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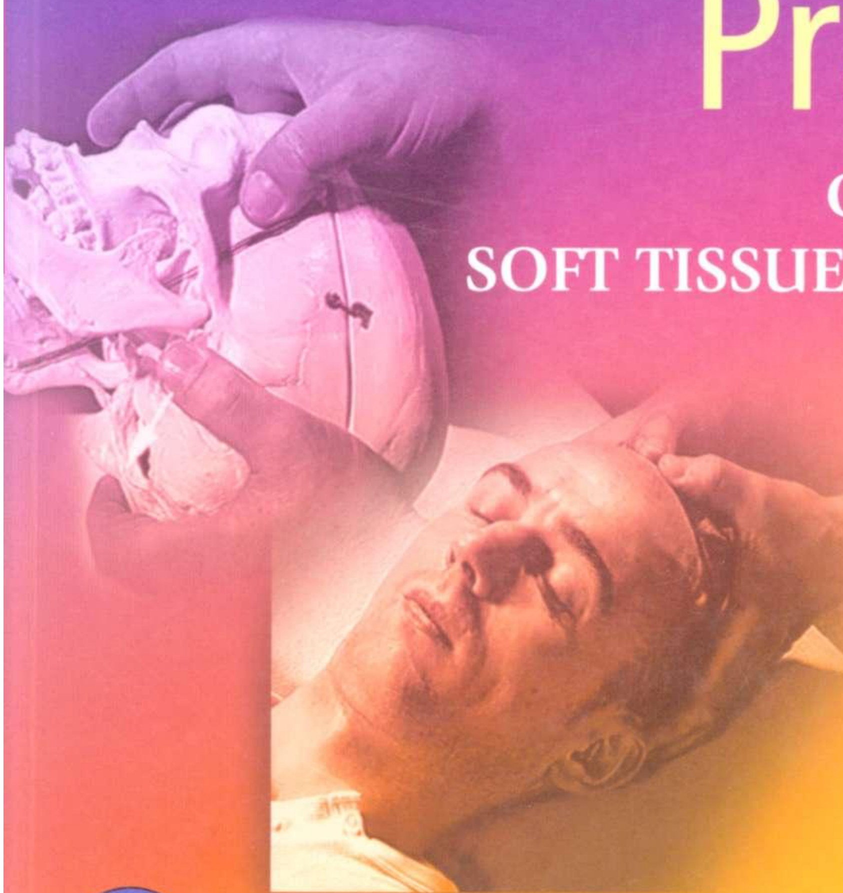
SECOND EDITION

Cranial Manipulation Theory and Practice

OSSEOUS AND SOFT TISSUE APPROACHES



Leon Chaitow

Foreword by
John E Upledger

With contributions by
Zachary Comeaux
John M McPartland
John D Laughlin III
with John D Laughlin IV
Frank O Pederick
Evelyn Skinner

INCLUDES CD-ROM

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OSSEOUS AND SOFT TISSUE APPROACHES

Cranial manipulation is a fast-growing area of manual therapy practice. In the new edition of *Cranial Manipulation Theory and Practice*, Leon Chaitow, together with six expert contributors, presents the latest thinking on the use of this valuable approach, and the most up-to-date research evidence to support its use.

Osteopathic biomechanical and biodynamic concepts are thoroughly examined, as are chiropractic and dental approaches involving cranial and cranio-facial manipulation. The supporting CD-ROM contains the entire text as well as video footage demonstrating exercises and techniques. Icons in the text indicate where there is a video clip on the CD-ROM to illustrate what is being described.

Written in the style of a clinical manual, and incorporating numerous palpation, assessment and treatment exercises, the text is easy to follow and links theory to the practical problems of the clinician. This book is unique in describing both soft tissue and osseous applications, and in providing the practitioner/therapist with guidance on which option to select in different clinical situations. The details of the techniques described are supported by high-quality illustrations, and practical exercises are included to help improve clinical skills.

Key features:

- Cranial osteopathic, cranio-sacral, sacro-occipital (chiropractic), cranio-facial and dental methods and perspectives are explained and compared
- Evidence based – highlighting the clinical relevance of the latest research findings
- Provides both osseous and soft tissue assessment and treatment options, and offers guidance on appropriate selection
- Includes numerous practical exercises to assist both students and practitioners in perfecting their skills
- Clear line drawings supplement the text
- Supporting CD-ROM with full text and video clips.

Cranial Manipulation Theory and Practice is aimed at all therapists interested or involved in using these valuable and evolving treatment approaches. It will be particularly useful to the practitioner or student who is new to this subject.

This product is appropriate for:

- **manual therapy**
- **massage therapy**
- **physiotherapy**
- **chiropractic**
- **osteopathy**

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Cranial Manipulation Theory and Practice

Osseous and soft tissue approaches

SECOND EDITION

With accompanying CD-ROM

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Contents

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Foreword

I was honored when Leon Chaitow requested that I write a foreword to this latest edition of his encyclopedic book on cranial (craniosacral) therapy. He would not give me any clue as to what he wanted so I shall simply indulge my creative instincts.

I was in osteopathic college in Kirksville, Missouri when I first heard about cranial osteopathy. What I heard was not necessarily good. In fact, the faculty members who talked about it expressed wishes that cranial osteopathy would evaporate in that it connected quackery to bona fide osteopathy. I was a student and I was working through a three-year fellowship in biochemistry concurrently. This made me very "scientific" and so I chose to believe the "quackery" rumblings about cranial osteopathy. I graduated in 1963 and subsequent to completing an internship at Detroit Osteopathic Hospital I opened a private practice on Clearwater Beach, Florida in October, 1964. I was a very "scientific" osteopathic physician and surgeon.

In 1972 I met the cerebrospinal rhythmical fluid wave first-hand. This introduction was to change my life. I was assisting Dr. James Tyler on a neurosurgical procedure wherein we were to surgically remove a calcified plaque from the posterior aspect of the external surface of the dura mater. The plaque was about the size of a dime and was located at the level of the 3rd and 4th cervical vertebrae. My job was to hold the dura mater very still with a pair of forceps while Dr. Tyler scraped the plaque off of the dural membrane without interrupting its integrity. I could not hold the membrane still. It continuously moved towards and away from me rhythmically. The patient was on a ventilation apparatus, the rhythm of which did *not* correlate with the movements of the dural membrane, nor did the monitored cardiac rhythm. This dural membrane rhythm was a different and independent rhythm. Dr. Tyler became rather irritated with my inability and I was feeling embarrassed and incompetent. Neither Dr. Tyler, the anesthesiologist, the intern nor the nurse had any explanations for that which was proving me incompetent. I stewed over this observation of the unknown for about a month and could find no acceptable answer for this renegade rhythm.

About a month after this surgical experience I noted an announcement in the *journal of the American Osteopathic Association* (JAOA) that there would be a five-day seminar given by the Cranial Academy in St. Louis. It dawned on me that perhaps I had viewed with my own eyes the cranial rhythmical impulse (CRI) so I attended the conference. The speakers presented all the anatomy and concepts that were needed for me to be able to manipulate skull bones when I returned to Clearwater Beach.

I shared with Dr. Tyler what I had learned and how it integrated with my inability to immobilize the dural membrane. His mind was open. He asked me to treat his office nurse's seven-year-old son who had three previous tympanotomies and was scheduled for a fourth in a week. I worked on his temporal bones, his ear drained via the eustachian tube and he did not have another tympanotomy over the next few years that I was in contact with his mother.

Next Dr. Tyler asked me to try my new approach on a World War II veteran who had forgotten his ear muffs in 1944 while standing aboard battleship next to a big cannon that was fired. Since that time he had severe non-stop headache and tinnitus. I mobilized his temporal bones and while I was doing this, his headache and tinnitus stopped, never to return.

These two clinical experiences silenced my previous scientific skepticism which was nurtured at the Kirksville College. Dr. Tyler suggested that I start scrubbing with him on craniotomies. I started doing this about twice a week. I observed, helped and learned during these surgeries. Dr. Tyler had me treat his craniotomy patients, most of whom were brain tumors. I knew what was going on inside the cranium because I was there during surgery. I treated these post-op patients daily beginning on day one after surgery. Dr. Tyler was very happy because he had much improved recovery rates, with almost no post-op complications and no surgically induced mortalities. This was enough to convince my "scientific" self that we were onto something. The word about what Dr. Tyler and I were doing and I was invited to join the faculty of the Biomechanics Research Department at Michigan State University. I did so in July, 1975. Here we investigated and proved the existence of the craniosacral system. We published a lot of our work, and I found myself frequently working with biophysicists who seemed to have very open minds.

While I was at Michigan State I was informed by professional researchers that it takes about 25 years for the conventional medical community to accept new concepts. Our contributions to the research and clinical outcomes at Michigan State University have largely been published in peer-reviewed journals and as craniosacral therapy is now coming into acceptance, the prediction seems qualitatively correct.

Leon Chaitow has created an encyclopedia of cranial and craniosacral therapy. Dr. Chaitow has thoroughly described the many pathways of investigation and treatment development that have led to the concepts and applications of cranial/craniosacral therapy. This is a book that every practitioner of this work will find of interest. It will be a very useful reference source and should be on the practitioner's bookshelf.

John E Upledger

Preface

My formal/informal training in the use of cranial methods took place over a seven- to eight-year period, starting in the late 1960s and ending around 1974. Over that period a group of approximately 20 colleagues, mainly UK-based osteopaths but also other health-care professionals, including French physiotherapists, met about once every 6 weeks for weekends of intensive training with the late, great, Denis Brookes DO.

Often those weekends took place in his home town of Shrewsbury, as well as in various locations scattered around England. They involved both social gatherings as well as workshops and study-group sessions in which we worked on each other as we learned to apply the methods that Denis taught. He was an old school DO, having worked in the USA with many of the pioneers of early osteopathic cranial development, and so the model of cranial methodology that this group taught was largely structurally oriented. It also included some methods (V-Spread for instance) that lacked coherent bio-mechanical explanations, which left a sense of slightly uncomfortable confusion as to just what was happening.

Over the decades, a greater understanding of just what may be happening when cranial methods are applied has emerged - as outlined in Chapters 1 to 4 in particular. These chapters provide back-ground details of the apparent schism between the mechanistic and the biodynamic models and methods. In truth, though, there are probably more similarities than differences in technique between biomechanical and biodynamic cranial work, although underlying explanations as to the physiological mechanisms involved are very different, as will become clear.

Taking a different model entirely may help to explain why these differences should not necessarily be seen as a negative.

When you palpate an area of tenderness and tension in someone's musculature, you might readily locate areas that demonstrate differences from surrounding tissue, involving perhaps altered tone, sensitivity and tissue texture. Applied pressure to such an area would have a number of predictable effects including: compression of mechanoreceptors - inducing modification of pain perception via the gate mechanism; the release of local analgesic endorphins and possibly brain enkephalins; creation of a local ischemic effect that would allow a flushing of fresh oxygenated blood on release of the pressure; and a mechanical stretching of the tissues under pressure. In other words, from a Western medical perspective, there would be neurological, endocrine, circulatory and mechanical effects deriving from applied pressure.

Now if virtually the same pressure was being applied by someone trained in traditional Chinese medicine methods, such as Shiatsu (acupressure), exactly the same influences would be taking place; however, the explanations arising from TCM would involve energy (chi) movement or obstruction. Which of these explanations is correct? Is it neurology, fluid movement, stretching, hormonal change or energy movement? Or is it all of these, and possibly unknown others as well?

Translate this to a cranial treatment setting and we can see that while the model, the story, the explanation, may differ, the effect of applied cranial treatment might be precisely the same, whether the practitioner's thoughts as to the underlying mechanisms involve fluid-electric/energy concepts or biomechanics and fascial release.

When cranial treatment is applied, almost all instruction asks for a sense of centeredness, stillness, focus, and applied intent. As will be seen (see Chapter 4 in particular on the topic of entrainment) a combination of a calm, unhurried, compassionate, physical contact from a caring practitioner/therapist almost certainly has a therapeutic benefit of its own.

On the other hand, at times, pure biomechanics enters the frame, as will be seen in the discussions of dental and facial influences.

Much cranial methodology has emerged from particular personal philosophies and beliefs, based on the work of individuals such as Upledger, Jealous and Dejarnette (see Chapter 5 for more on this theme). Today the expert, the authority, needs to base instruction and information on as much objective fact as possible; and in the absence of research evidence, clinical experience must of course inform opinion, but this carries less weight in modern health care than in the past.

As the healing professions move away from authority-based approaches toward evidence-based practice, a merging of what can be shown by research and clinical audit to be safe and effective should take place. What I have tried to do in this book is to explain the various philosophies and methods, to offer what explanations already exist, and so to begin the process that will eventually unite apparently disparate ideas and methods.

Leon Chaitow
Corfu, Greece 2005

Acknowledgments

It is traditional for authors to offer thanks to those closest to them for encouragement and for putting up with neglect. The reason for this tradition can only be understood by those who have been through the process, and it is one that I will not break. Alkmini, my wonderful wife of 33 years, has yet again endured the writing and editing process with unfailing humor and thoughtfulness. For this, my enduring thanks and gratitude.

My sincere thanks also goes to the contributors of the valuable new chapters to this second edition, Zachary Comeaux, John Laughlin III and John Laughlin IV, John McPartland, Frank Pederick, Evelyn Skinner, and to the author of the Foreword, John Upledger.

I wish also to express thanks to the dedicated editorial and production team at Elsevier Churchill Livingstone, Edinburgh, for their support and help.

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Chapter 1

A brief historical perspective

CHAPTER CONTENTS

Cranial manipulative (craniosacral) therapy is one of the fastest growing areas of manual medicine in terms of the numbers of practitioners and therapists learning and applying different versions of its methodology. An institute which teaches one of the main divisions of cranial manipulation, John Upledger's craniosacral therapy (Upledger 1996, Upledger & Vredevoogd 1983), claims to have instructed, between 1985 and 1995, some 25 000 individuals (mainly licensed massage therapists) in the USA alone. In the experience of the author, many of those who have acquired such training appear to utilize the methods as part of whatever else they do clinically, while only a small proportion devote their entire practice to craniosacral work.

With its modern roots in cranial osteopathy, as developed by Sutherland (Sutherland 1939) in the early years of the 20th century, and with parallel and sometimes derivative approaches including craniopathy (Cottam 1956) and sacro-occipital technique (SOT) (Dejarnette 1975/1978), cranial manipulation has become an area of debate, hypothesis and a significant degree of confusion regarding the theories which underpin the methods.

In this second edition chapters have been prepared by experts from different disciplines that specifically examine the perspectives of sacro-occipital technique (SOT), as well as different aspects of the osteopathic and dental variations of cranial manipulation (see Chs 3, 4, 5 and 11).

Many practitioners and therapists, often attracted by the dramatic and frequent successes claimed for these methods, remain unconvinced as to the 'science' of cranial manipulation and confused by the real and apparent discrepancies in the theories and explanations which surround it. It is hoped that these additions, together with the revisions throughout the original first edition text, will help to clarify and, where necessary, demystify the mechanisms involved.

This text will examine both proven and hypothetical aspects of cranial manipulation and will endeavor to guide the reader through the tangle of what is known, what is 'believed' and what is safe in the treatment of dysfunction affecting the soft and hard tissues of the cranium - and the myriad functions and systems that these appear to influence.

The format of the book, following a brief historical overview, will continue with an examination of the main theoretical concepts which underpin cranial manipulation and the research which supports (or fails to support) these theories. It is following this introduction that the new chapters have been placed, after which subsequent chapters offer: descriptions of what cranial motions occur at the various sutural articulations; a discussion of the possible clinical repercussions of cranial restrictions; an expanded illustrated segment offering guidance on assessment and palpation techniques as well as interpretation of findings resulting from these methods. Finally, safe therapeutic measures for the treatment of identifiable patterns of dysfunction involving the craniosacral mechanisms will be presented.

Note

No text can possibly replace taught and practiced manual techniques of assessment and treatment: the intention of this book is to provide information and supportive material which should be utilized in conjunction with reputable training in the methods described.

Not just one mechanism

- In discussing cranial mechanisms a number of overlapping processes need to be considered. We will find at times that we are speaking orthopedically - for example, about mechanical bony restrictions or ligamentous or fascial structural and functional anomalies.
- At other times discussion of abnormalities will involve more subtle factors, dysfunctional situations where interference with normal pulsatile activities or soft tissue properties seems to have occurred and which have no easy, 'gross', structural or orthopedic corollary.
- In other discussions it will be necessary to explore the possibility that bio-electromagnetic energy factors permeate all mechanical, functional and dysfunctional processes and that in some instances there seems to be no way of making sense of craniosacral treatment without hypothesizing energetic involvement.
- The skeptical perspective, which argues that cranial motion is a mirage and that the main benefit of cranial therapy results from the placebo effect, will also be discussed.
- Gross mechanical, subtle pulsatile or energy imbalances - which of these (if any) are we feeling and which are we using? The answers to these questions should become clearer as we explore the theories and practices which surround cranial manipulation.

HISTORICAL PERSPECTIVE

Greenman & McPartland (1995) succinctly summarize the origins of modern cranial manipulative study.

> *Craniosacral manipulation was first introduced into the osteopathic profession in the 1930s. Instruction in the field began in the 1940s. The pioneering work of William Garner Sutherland (described in Upledger & Vredevoogd 1983) included years of research into the anatomy of the skull, clinical observation of skull mobility in normal asymptomatic patients, and abnormal cranial mobility in patients with a variety of symptoms. Sutherland evaluated the response of application of restrictive and compressive forces to the skull [commonly his own]. He postulated the primary respiratory mechanism, consisting of*

five elements, as the essential components of the clinically palpable cranial rhythmic impulse (CRI).

The five key elements which Sutherland proposed were:

- inherent motility of the brain and spinal cord
- fluctuating cerebrospinal fluid
- motility of intracranial and spinal membranes (meninges, dura, etc.)
- mobility of the bones of the skull
- involuntary sacral motion between the ilia.

The validity of these concepts, which are fundamental to much of modern cranial manipulation as currently taught, need to be examined, evaluated and understood before palpation, assessment and treatment methods of this region can be usefully discussed and outlined.

The examination of these concepts which follows in the next and later chapters will address the following questions.

1. Is there palpable mobility at the cranial sutures and articulations and if so, what is the significance of such mobility in health terms?
2. What are the reciprocal tension membranes and is there a linking mechanism between cranial and sacral motion?
3. Does a cranial rhythmic impulse (CRI) exist and if so, what is it and, especially, what is its relationship with cerebrospinal fluid fluctuations and flow?
4. What are the forces moving cranial structures and so producing the CRI? Most importantly, are these forces primary or is movement the result of a combination of normal physiological functions such as respiration and cardiovascular rhythms?

In discussing these elements individually there is bound to be some overlap in the areas covered. For example, the concept of cranial sutures being mobile is meaningless without evidence of 'something' which can and does move them; also the view of there being a 'cranial rhythmic impulse' demands that the possible mechanism(s) driving such an impulse be investigated as well as the consensus, if any, as to what that rhythmic rate should normally be.

These cranial fundamentals need to be examined, both together and as independent phenomena, and as a result the research studies cited and discussed are likely to overlap.

Tables are provided to summarize aspects of the research and the reviews in order to give a sense of the variety of sources of research evidence (largely osteopathic but with some neurological, dental, biomechanical and anatomical research as well) along with a view of the chronology of these studies.

Is it really necessary to explore the theories that underpin much cranial therapy? Methods that have been widely used for over 60 years, based on beliefs many of which, as yet, lack verification, clearly require an attempt at clarification in the light of current research and knowledge.

There already exist variations of cranial manipulation that detach from the traditional beliefs deriving from Sutherland's work. There is, for example, the use of cranial manipulation, mainly by physiotherapists, working with craniofacial dysfunction. The authors of a key book describing the methods used state that while studying the literature, 'We quickly found that there was no standardization of manual cranial techniques, not to mention fundamental clinical proof. ... One of our basic objectives was to initiate the standardization of cranial manual techniques within manual therapy for various patient groups' (von Piekartz & Bryden 2001).

Aspects of this work will be referred to periodically throughout this text.

Note

It is necessary at the outset to say that, unless clearly stated to the contrary, all the discussions relating to cranial motion refer to adult humans. In some instances infant and animal studies will be referred to and this will be clearly stated.

Cranial structures and their mobility

There is little if any debate relating to the pliability, indeed the plasticity, of infant skulls and dysfunctional states affecting infants in general and neonates in particular will be discussed in a separate section of the book (see Appendix 2).

However, in order for cranial manipulation, as currently taught and practiced, to be taken seriously it is necessary to establish whether or not there is evidence of verifiable motion between the cranial bones during and throughout adult life.

Sutherland (described in Upledger & Vredevoogd 1983) observed mobile articulation between the cranial bones almost 100 years ago and researched the concept for the rest of his life. He also described the influence of the intracranial ligaments and fascia on cranial motion, which he suggested acted (at least in part, for they certainly have other functions) to balance motion within the skull.

He further suggested that there existed what he termed a 'primary respiratory mechanism' which was the motive force for cranial motion. This mechanism, he believed, was the result of the influence of a rhythmic action of the brain which led to repetitive dilatation and contraction of cerebral ventricles and which was thereby instrumental in the pumping of cerebrospinal fluid.

The reciprocal tension membranes (mainly the tentorium cerebelli and the falx cerebri) which are themselves extensions of the meninges, along with other contiguous and continuous dural structures, received detailed attention from Sutherland.

Sutherland described these soft tissues as taking part in a movement sequence which, because of their direct link (via the dura and the cord) between the occiput and the sacrum, produced a total craniosacral movement sequence in which, as cranial motion took place, force was transmitted via the dura to the sacrum, producing an involuntary motion in it.

These functions and the mechanisms that are claimed to drive them, as well as the arguments against their validity, will be discussed in depth in the following chapters and key aspects are summarized in appropriate tables.

The reciprocal tension membranes

If we examine the structure of the cranium we need to look beyond the obvious osseous structures and their articulations and come to an understanding of the soft tissues which relate intimately with it, most notably the dural/meningeal folds which are seen in cranial theory and practice to play a vital role (see Box 1.1 for a summary of the role and attachments of the dural folds which are known as the reciprocal tension membranes, and see Fig. 1.1).

Philip Greenman, Professor of Biomechanics at the College of Osteopathic Medicine, Michigan State University, describes the static and motion potentials of these membranous intracranial dural duplications, as follows (Greenman 1989).

> *[They are] continuously under dynamic tension, so that change in one requires adaptive change in another. In flexion movement [of the cranial mechanism] the tent descends and flattens and the falx cerebri shortens from before backwards. In extension movement just the reverse occurs.*

He goes on to explain that the motion of the craniosacral system results from a combination of articular mobility and alterations in the tensions of the reciprocal membranes and then makes clear what is becoming an increasingly controversial viewpoint when he says:

> *It is through this membranous attachment that the synchronous movement of the cranium and the sacrum occurs.... The tentorium cerebelli can be viewed as the diaphragm of the craniosacral mechanism. It descends and flattens during inhalation as does the thoracoabdominal diaphragm. The pelvic diaphragm is also observed to descend during inhalation.... One can then view the body from the perspective of three diaphragms ... in health these diaphragms should function in a synchronous manner. If dysfunction interferes with the capacity of any of the three, it is reasonable to assume that the other two will be altered as well. That is what is observed in clinical practice.*

Greenman points out that - via the continuation of the intracranial dural folds with the intraspinal membranes, attached as they are at the foramen magnum, the upper two or three cervical vertebrae and the sacrum itself - there exists a direct link between cranial and sacral motion (that is, what is known as the 'core-link'). The hypothesis that movement in the skull produces a traction via the dura which moves the sacrum rhythmically (see Fig. 1.2) is a current belief amongst many schools teaching craniosacral therapy. The validity of this view is seriously questioned and discussed in the next chapter (Ch. 2).

Box 1.1 Reciprocal tension membranes – attachments and functions (see Fig. 1.1)

The external layer of the dura is continuous with the periosteum of the skull. Its internal layer forms three duplications which surround the venous sinuses and create dividing barriers for segments of the brain.

Falx cerebri The anterior attachment is to that part of the ethmoid process known as the crista galli, the frontal bone, both parietals and the squama of the occiput, dividing the skull in two. It encloses the superior sagittal sinus.

Craniosacral hypothesis suggests that during cranial flexion ('inhalation' phase) the falx shortens from front to back and during the extension phase ('exhalation') of the cranial cycle, it lengthens from front to back (see Fig. 1.2).

Tentorium cerebelli The 'tent' separates the cerebellum from the cerebrum. Its attachments are to the occipital, parietal and temporal bones and to the anterior and posterior clinoid processes of the sphenoid.

The straight sinus is enclosed where the tentorium cerebelli meets the falx cerebri at the true 'reciprocal tension membrane'.

During cranial flexion ('inhalation') the tent is said to descend and flatten, returning to its neutral position during the cranial extension phase ('exhalation').

Falx cerebelli This duplication of the dura divides the two hemispheres of the cerebellum.

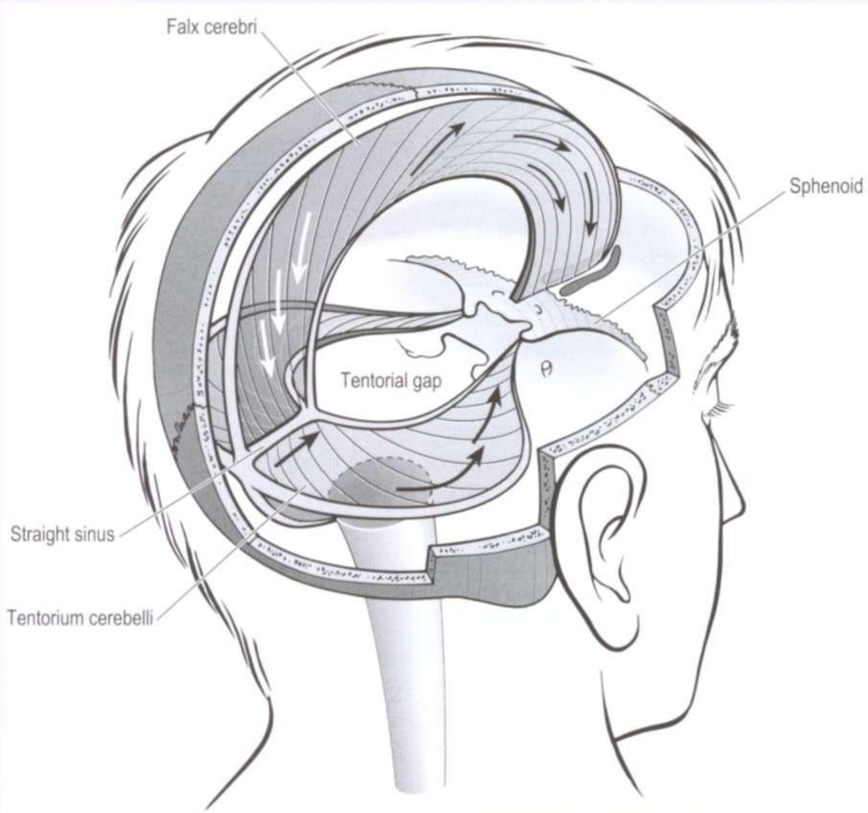

Figure 1.1 The reciprocal tension membranes of the cranium and proposed lines of force acting on them during the flexion phase of craniosacral motion.

Box continues

Box 1.1 Reciprocal tension membranes – attachments and functions (see Fig. 1.1)—*continued*

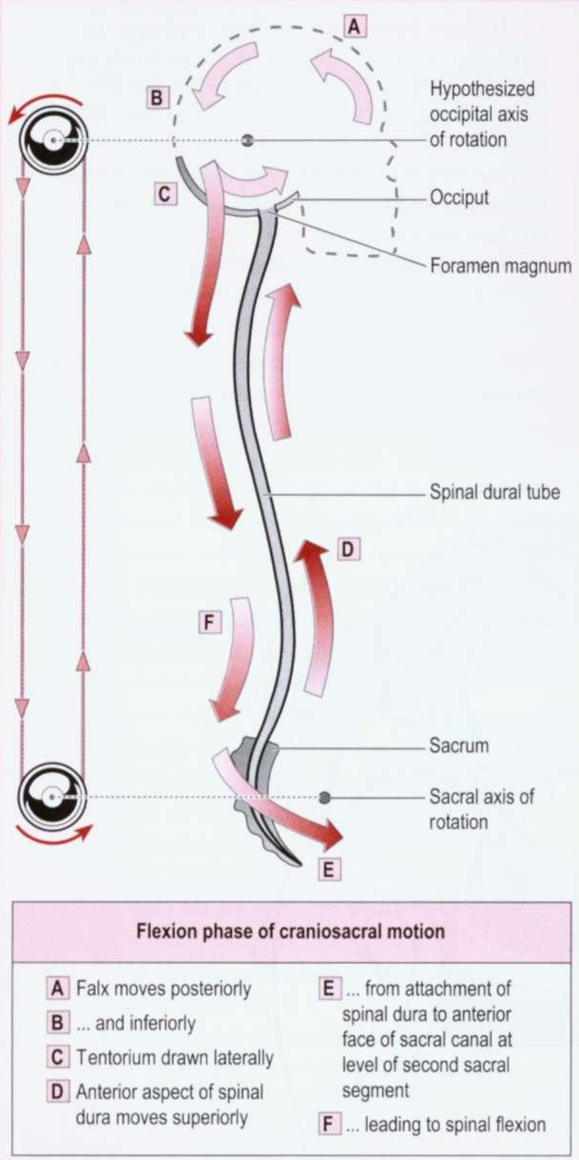

Figure 1.2 The hypothesized directions of movement during the flexion phase of craniosacral motion.

Diaphragma sellae This covers the sella turcica ('Turkish saddle') of the sphenoid, which houses the pituitary gland.

Note

1. Tension or restriction in any of these dural duplications influences all the others since they are continuous.
2. They directly influence, and are directly influenced by, all of their osseous attachments.
3. Distortions/restrictions of these soft tissues directly influence venous circulation/drainage.
4. The potential for interference with pituitary function exists via the influence of the diaphragma sellae.
5. There are constant modifications in the respective tensions of these membranes with cranial movement (and, for example, in relation to breathing, where the tentorium cerebelli acts in synchrony with the thoracic diaphragm).

There exists a model for explaining Greenman's statement that 'change in one requires adaptive change in another' when discussing the fascial reciprocal tension membranes inside the skull and their linkages to the diaphragms of the body. He offers the term 'dynamic tension'. An engineering definition would suggest that these tissues are all part of a tensegrity structure. See Box 1.2 and Figures 1.3 and 1.4 for a brief explanation of tensegrity.

Box 1.2 Tensegrity

Tensegrity is a word that derives from the work of architect Buckminster Fuller and his study of geodesic architecture. Fuller attempted to understand why a geodesic dome can carry a large load with a minimal amount of building materials. Fuller concluded that it is not what the structure is made of but rather how its elements distribute and balance mechanical stresses in three dimensions that determined stability. Fuller realized that the dome gains its omnidirectional stability from continuous tension that is resisted locally by a subset of its structural elements. Detailed research into the structure of cells shows that they use tensegrity to organize and mechanically stabilize their cytoskeleton network (Ingber 1993).

Much of the human body utilizes tensegrity to transfer and absorb the mechanical forces it generates and which are applied to it. The skull and its internal architecture can easily be seen to utilize tensegrity principles (see Figs 1.3 and 1.4).

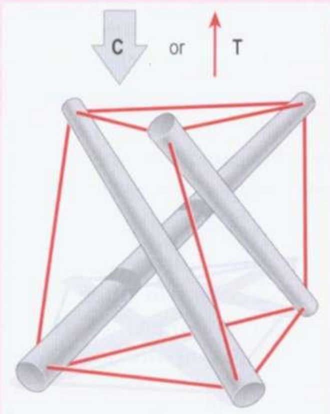

Figure 1.3 A simple model of a tensegrity structure in which internal tensions (T) and externally applied compression (C) forces are absorbed by the component solid and elastic structures by adaptation of form. (Reproduced with permission from Chen C, Ingber D 1999 Tensegrity and mechanoregulation: from skeleton to cytoskeleton. Osteoarthritis and Cartilage 7: 81–94.)

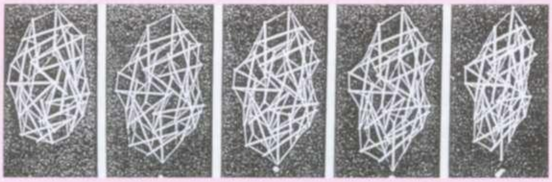

Figure 1.4 A tensegrity cell model under different mechanical loads. This model consisted of a geodesic spherical array of wood dowels and thin elastic threads. The model was suspended from above and loaded, from left to right, with 0, 20, 50, 100 or 200 grams weights on a single strut at its lower end, demonstrating that a local stress results in global structural rearrangements throughout the entire structure (Chen & Ingber 1999). Much of the human body utilizes tensegrity to transfer and absorb the mechanical forces it generates and which are applied to it. The skull and its internal architecture can easily be seen to utilize tensegrity principles. (Reprinted with permission from Wang N, Butler JP, Ingber DE 1993 Mechanotransduction across the cell surface and through the cytoskeleton. Science 260: 1124–1127. Copyright 1993 AAAS.)

Cranial rhythmic impulse (CRI)

It is a basic precept of all cranial teaching that there exists a palpable cranial rhythm, the cranial rhythmic impulse (CRI). This pulsation, while apparently related to other bodily rhythms (thoracic respiration, cardiac pulsations, etc.) is, in cranial theory, seen to be separate and independent of these.

The CRI (variously known as the 'primary respiratory impulse' (Brookes 1981, Upledger & Vredevoogd 1983), 'cranial rhythmic impulse' (Woods & Woods 1961) or 'Sutherland wave' (Magoun 1976)) is widely assessed and employed as a means of cranial evaluation - since the speed and rhythmicity, as well as the quality and/or amplitude, of this rhythmic function represent, it is widely believed, a direct means of assessing the status of the cranial mechanism.

Any increase or decrease in speed or amplitude, any indication of imbalance or an arrhythmic pattern implies the presence of a problem, often of a structural nature involving cranial and/or sacral restrictions, which can be addressed and possibly corrected by appropriate cranial technique.

There are numerous theories as to just what the rhythmic impulse is, many of which are discussed in the next chapter (Ch. 2). As well as a lack of an agreed explanation as to just what these impulses represent, there is also a variation in the stated rate of pulsation which is said to represent normality.

The most basic question relating to the CRI is quite simply, 'Is it a primary pulsation or does it represent a sensation deriving from a combination of recognizable physiological pulsations, such as heart rate, cardiac contractility, pulmonary blood flow, cerebral blood flow and movement of lymph and CSF?'.

What drives the cranial rhythm?

Sutherland (1939) had definite ideas as to what moves the cranial bones: the cerebrospinal fluid and a pulsating brain.

In 1971 Viola Frymann, herself a respected pioneer of cranial therapy in the osteopathic arena, offered a personal opinion based on over a quarter of a century of experience in this work.

> *The perpetual outpouring of impulses from the brain to maintain postural equilibrium, chemical homeostasis, and so on, conceivably may multiply the activity of individual cells into a rhythmic pattern of the whole brain, small enough to be invisible to the naked eye, but large enough to move the cerebrospinal fluid which in turn moves the delicate articulated cranial mechanism. (Frymann 1971)*

Was she right?

While recent research partially supports her view, most studies contradict it. These perspectives will be outlined and discussed in Chapter 2.

A host of theories have emerged to explain what seems to be an established fact, that there does exist a rhythmic impulse, which can be palpated at the head or almost anywhere on the body surface, which is apparently independent of the major physiological body rhythms (cardiovascular, respiratory, etc.). These theories will be evaluated in the next chapter (Ch. 2) as will the potential value of palpation as evidence of an individual's cranial rhythm.

What are the clinical implications of cranial dysfunction?

Let us assume, hypothetically speaking, that it is possible to establish that mobility exists between cranial bones in normal situations, as well as there being a direct connection between such motion and sacral motion and, further, that this motion has a rhythmicity which is palpable.

What would be the clinical significance of dysfunction in this mechanism - as evidenced perhaps by articular restrictions between specific cranial joints or alterations in the palpated rhythmic impulse or imbalances in the 'normal' cranial-sacral motions? What health repercussions might occur, according to cranial theory?

McPartland gives some indications:

> *Many of the cranial nerves exit the skull from between the sutures; if restricted they may cause many kinds of visceral mischief, such as dyspepsia. Misaligned temporal bones can give rise to temporomandibular joint (TMJ) dysfunction, headache, trigeminal neuralgia, dizziness and predispose children to otitis. (McPartland 1996)*

Upledger & Vredevoogd (Upledger 1996) offer a long list of possibilities, suggesting that the following conditions can often have craniosacral dysfunction involvement or that craniosacral treatment can substantially assist in treating them.

- Acute systemic infectious conditions (citing the antifebrile effect of what is known as CV-4 (compression of the fourth ventricle) technique - see Ch. 6).
- Localized infection (possibly treated using V-spread technique - a method employed to achieve gentle separation of sutural restrictions - see Ch. 6).
- Acute sprains and strains using a variety of techniques.
- Chronic pain problems (using techniques such as CV-4 as well as balancing tissue tension and dural membrane balancing).
- Visceral dysfunction (peptic ulcers, ulcerative bowels, tachycardia, asthma, etc. treated by means of normalizing restriction patterns in the craniosacral system).
- Autonomic nervous system problems such as Raynaud's syndrome (treated by using CV-4 daily).
- Rheumatoid arthritis (CV-4, often applied by a family member, daily).
- Emotional disorders - especially anxiety (using specialized techniques).

- Scoliosis, which is often seen to be a direct result of craniosacral distortions.
- Visual disturbances - especially strabismus which is said to be 'very amenable to the release of abnormal tension patterns in the tentorium cerebelli'.
- Auditory symptoms such as tinnitus and recurrent middle ear problems (via mobilization of the temporal bone).
- Cerebral ischemic episodes, which can be 'very favourably affected by weekly application of the parietal lift technique (see Ch. 6) after thoracic inlet and cranial base restrictions have been released. We have seen marked improvement in syncopal episodes, episodic paresthesias, memory loss and the like, after only three or four weekly treatments'.

While a great deal of the reporting of success of craniosacral therapy remains anecdotal, the sheer volume of these reports and the clinically proven value in treating children's problems utilizing craniosacral therapy (see discussion of research studies in later chapters) make this a compelling degree of evidence.

Box 1.3 Models which attempt to explain cranial therapeutics

In the preface to his excellent book *The heart of listening* (subtitled A visionary approach to craniosacral work), British-trained osteopath Hugh Milne discusses some of the variations currently available on the theme of cranial manipulation (Milne 1995).

> *What is now popularly known as 'craniosacral work', like any art, can be practiced many different ways. Some osteopaths practice 'cranial osteopathy' as a technical skill that focuses on treating symptoms in ten- to twenty-minute sessions. Many chiropractors practice 'craniology' with great mechanical and tactile aptitude in similarly brief visits. Both chiropractors and osteopaths tend to base their work upon the mechanical models of bone movement they were educated in. Gifted bodyworkers use craniosacral work as an adjunct to their hour-long sessions. They tend to interpret what they do in terms of balance, gravity, muscle tonus and fascial length. Massage therapists may employ a few craniosacral techniques at the end of each session. Exceptionally gifted with tactile sensitivity, they tend to let their hands tell them what to do. Christian healers touch the head while 'laying on hands'; they treat by praying. Psychics use craniosacral work as a way to access deep realms of the spirit during 'psychic healing'. Working through visionary perception, they see what is wrong with the head. In 'past life regression', therapists use craniosacral touch to help induct people into sensitive realms of experience. They work in altered states of consciousness, using their extraordinary sensitivity to the body's electrical field, or chi. My sessions encompass aspects of each approach mentioned above, appropriately used, each has its value and its contribution to healing.*

In an attempt to offer some clarity a few further attempts are made in this section to explain some of the different ways in which cranial therapy is used, and the outcomes anticipated.

1. Cranial osteopathy Based on the original research of William Garner Sutherland, this model originally held to the more mechanistic hypothesis of the motive force(s) driving cranial motion, including cerebrospinal fluid fluctuation and a 'primary' respiratory mechanism. The osteopathic therapeutic approach calls for osseous as well as reciprocal tension membrane and fluid factors being considered in treatment of identified dysfunction (Sutherland 1939).

Out of this particular tradition new concepts are appearing, notably as a result of the work of osteopaths such as John McPartland (McPartland & Mein 1997), who suggests that the therapeutic effects of much of cranial work relate directly to a process of entrainment in which the healthier influences of the therapist begin to encourage a normalization in the dysfunctional patterns of the patient. This is described in some detail in Chapter 2. Osteopathic thinking in regard to cranial therapy is explored in greater detail in Chapters 3 and 4. Additional elements relative to the cranial osteopathic approach include recognition of tensegrity features as described in Box 1.2.

2. Craniosacral therapy This is an evolution, by its developer John Upledger, of cranial osteopathy (Upledger 1995). Upledger says:

Box continues

Box 1.3 Models which attempt to explain cranial therapeutics—*continued*

The CranioSacral system is a core system in the human body. In my view it is the place where body, mind, and spirit reside independently and communally at the same time. ... It is quite fascinating to consider that all the very deep work is done within the confines of an anatomically defined physiological system. It suggests that the CranioSacral system and the techniques involved ... offer a bridge between objective science and spiritual healing. CranioSacral Therapy accesses the total human being's self-corrective and self-healing processes. Further the therapeutic approach attempts to maximise patient/client responsibility for their overall well-being.

As a summary these words should suffice to indicate the direction craniosacral therapy has taken, away from the mechanistic and towards ill-defined areas of the therapeutic relationship, which attracts many but is anathema to others. Upledger's training programs are far and away the most popular (worldwide) means of therapists acquiring basic (and safe if they follow the 'grams only' rules) cranial skills. A key feature of the work of Upledger (and McPartland and many others) is the demand that the practitioner/therapist be centered, relaxed and in a virtually meditative state for therapy to be successful.

3. The somatic model (somatic cranial work)

An approach to cranial work has evolved which calls for therapists to harmonize their biological systems (heart rate, breathing, cranial rhythms, etc.) with those of their patients to help in normalization of dysfunction (Norton 1991). Norton's concepts are discussed further in Chapter 4.

Shea (1997) proposes an evolution of this which he explains as follows.

The somatic model blends eastern and western traditions of introspection, interiority, mindfulness, archetypal psychology and cross cultural healing. Somatics involves contact, sensing, excitement, gestalt formation as essential variables in the palpatory sensitivity to not only CRI but also its potency and breath of life as proposed by Sutherland. To contact a fluid system that contains the primary intelligence of life requires authentic presence and the capacity to be still within one's self. These are essential disciplines if entrainment is going to happen. In somatics entrainment or perceptual transference is called matching. Matching has three parts 1/ awareness of shape, sensations, feeling or a movement in one's own body; 2/ an inner act of matching or aligning oneself with this; and 3/ allowing something to change. ... Then the therapist can match up with the client and feel into the client as an entrainment. (Shea 1997)

Somatic cranial work seems to utilize aspects of Sutherland's original concepts and to focus on fluid dynamics in particular, as well as the cranial bones and membranes as they relate to what is termed 'the breath of life', with particular emphasis on using these foci as means of dealing with the effects of shock and trauma on the nervous system.

4. Sacro-occipital technique (SOT) and applied kinesiology (AK)

SOT evolved out of the work of chiropractor Major Bertrand DeJarnette (DeJarnette 1975/1978), who based his methodology on Sutherland's original osteopathic research as well as on many of his own extremely complex ideas and methods. A further evolution through chiropractic was based on the work of George Goodheart, who modified both Sutherland's and DeJarnette's work (Walther 1988). Key points are monitored on the cranium (for example) while (apparently) associated muscles are tested for strength or weakness during particular phases of the breathing cycle, with specific guidelines as to the subsequent treatment protocol being based on the outcome of these tests. A common feature of both SOT and AK is the 'asking' of certain questions of the body (i.e. 'Is this muscle testing weak or strong, under these particular conditions, while this specific point is being pressed/touched?'). This somewhat formulaic approach, which provides protocols based on the 'answers' the body gives to the questions, is extremely popular, particularly in the USA. A detailed evaluation of SOT is to be found in Chapter 5.

5. Eclectic dental and craniofacial approaches

A range of applications of cranial manipulation have been developed, largely by physiotherapists, chiropractors and dentists, to deal with dysfunction and pain involving the facial bones as well as dentally related abnormalities of the facial structures. Dental considerations and approaches (many of which lean on cranial osteopathic, craniosacral and SOT methodologies) are discussed in detail in Chapter 11. Physiotherapy and orthopedic treatment of craniofacial and craniocervical problems have avoided particular immersion in the controversial areas discussed earlier in this chapter and have adopted an eclectic and pragmatic structural/functional approach to manual treatment of congenital and acquired (whiplash, etc.) dysfunctional patterns, involving the

Box 1.3 Models which attempt to explain cranial therapeutics—*continued*

bones and soft tissues of the head and neck (Vernon 2001, von Piekartz & Bryden 2002). Some of the methods used are discussed in later chapters.

Poly-vagal concept Two different oscillations in the cardiovascular system coexist; one is associated with blood pressure variations while the other seems to relate to respiratory sinus arrhythmia (RSA - heart rate variability in response to breathing cycles).

Sahar (2001) has proposed that RSA is controlled by sympathetic and vagal influences, and that it appear to represent the state of regulation of the autonomic nervous system.

Porges (2001) argues that these blood flow oscillations express the 'ventral' vagus complex. Unlike the 'dorsal vagus' (unmyelinated and phylogenetically earlier), the myelinated ventral vagus complex is a more recent mammalian development that can rapidly regulate cardiac output. The autonomic nervous system can also be influenced by the slower Traube–Hering–Mayer waves (Sahar 2001). Cranial therapy appears to strongly modify these influences. (Nelson et al, 2001). See Ch. 4 for more on this.

Conclusion There exists a purely mechanistic cranial model (incorporating, knowingly or unknowingly, the principles of tensegrity) , as well as various modifications which focus on the 'fluid/electric' aspects of the body which range from the partly mechanistic to the almost totally 'energetic' and spiritual. The focus of this book is to attempt to make sense of the theories underpinning these approaches as well as to encourage greater incorporation, into whichever model is being used, of some additional respect for the soft and hard tissue components and functions that – in health – make up the flexible cranium.

SUMMARY

As outlined at the start of this chapter, the five elements of the cranial hypothesis which Sutherland proposed were:

1. an inherent motility of the brain and spinal cord
2. fluctuating cerebrospinal fluid
3. motility of intracranial and spinal membranes
4. mobility of the bones of the skull
5. involuntary sacral motion between the ilia.

How do these propositions stand up to examination? The evidence which will be produced and argued in the next and subsequent chapters will indicate the following.

1. Inherent motility of the brain has been proven; however, the impact of this function on cranial bone mobility is possibly less than Sutherland imagined. Its motion probably contributes towards the composite of forces/pulses which it has been suggested produce the cranial rhythmic impulse (CRI).

2. The CSF fluctuates but its role remains unclear in terms of cranial motion. Whether it helps drive the observed motion of the brain or whether its motion is a byproduct of cranial (and brain) motion remains uncertain. This fluid pulsation seems likely to be at least one factor in the CRI phenomenon.

3. The intracranial membranous structures (falx cerebri, tentorium cerebelli, etc.) are clearly important since they attach strongly to the internal skull and give shape to the venous sinuses. Dysfunction involving the cranial bones has to influence the status of these soft tissue structures which strongly attach to them, and vice versa. To what degree they influence sacral motion is debatable. They will be seen in later sections of this book to be useful in assessment and treatment protocols.

4. The bones of the skull can undoubtedly move at their sutures. Whether this capacity is simply a plasticity which allows accommodation to intra- and extracranial forces or whether the constant rhythmical motion, the CRI, drives a distinct sequence of cranial motion is debatable. The clinical implications of restrictions of the cranial articulations seem to be proven, although dispute exists as to precise implications. The 'normal' CRI rate and the significance of this also remain very much in dispute.

5. There seems to be involuntary motion of the sacrum between the ilium but the means

whereby this occurs remains unclear (or at least unproven), as does the significance of this motion in terms of cranial mechanics. It is debatable as to whether there is indeed synchronicity between cranial and sacral motion (Moran & Gibbons 2001).

In the next chapter (Ch. 2) the most important issues surrounding cranial theory and practice will be reviewed in the light of research to date.

Questions will be asked which will cover the major conundrums surrounding cranial therapy beliefs - is there cranial motion between the bones and if so, what moves the bones?

What, if anything, is the 'CRI' and is there a 'normal' range of these pulsations?

Does cranial motion induce sacral motion and vice versa, and if so, what part do reciprocal tension membranes play?

The questions will be raised and, as far as current research allows, answered. While this investigation will reveal some firm answers, a degree of confusion will undoubtedly remain, since some of the research evidence is equivocal, with documentation emerging which both supports and contradicts some of the areas of debate.

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Chapter 2

Cranial fundamentals revisited

CHAPTER CONTENTS

The scene setting of the previous chapter should have allowed at least a partial familiarization with the basic tenets of the theories surrounding cranial therapies. It is to these theories, hypotheses and dogmas that our deliberate focus must now turn. The issues which are debated in this chapter are at the very heart of this rapidly growing discipline and deserve to receive our critical attention if we are to provide a solid basis for the further development of what is undoubtedly a very important evolution in manipulative medicine.

Failure to look critically at what is believed to be true by practitioners and therapists will lead to mainstream science rejecting what is valuable, along with what may currently represent at best conjecture and possibly erroneous interpretation of phenomena we do not yet fully understand.

The questions posed and, in part at least, answered in this chapter are based directly on the primary principles of cranial osteopathic and craniosacral therapy. The sources cited are derived from as wide a base as was available in literature searches in the USA and UK and through broad consultation with experts in the field. Many of these issues are discussed further, from particular perspectives, in Chapters 3, 4, 5 and 11.

The truth is that even after detailed assessment of current research, when set against cranial beliefs, we will find that some areas remain ambiguous. This should not be seen to negate cranially applied therapeutic interventions but to offer a series of challenges which need to be met so that what, at present, is vague and unacceptable can be validated.

QUESTIONS AND ANSWERS

Is there palpable mobility at the cranial sutures and articulations and, if so, what is the significance of such mobility in health terms?

Much recent research validates the concepts of cranial motion, originally described by Sutherland in his pioneering text on the subject, *The cranial bowl* (Sutherland 1939), as outlined in Chapter 1.

Examples of research which corroborates the presence in the adult human skull of a degree of palpable and significant cranial mobility include the following.

- In 1982 Libin, a dental physician, showed that changes of between 2 and 3 millimeters occurred across the maxillae, as measured at the second molars, following craniosacral therapy (Libin 1982).
- Another dentist, Baker, had already demonstrated in 1970 that a rhythmic alteration in the width of the maxillary arch (in a single individual) was measurable - showing a 1.5 millimeter average variance in width, approximately nine times per minute (Baker 1970).
- Viola Frymann utilized a mechanical measuring device in order to record circumferential alterations in the head (Frymann 1971). She noted that: The most significant discovery ... was that the cranial motions are much smaller than anticipated, in the range of from 0.0005 to 0.001 of an inch'.
- Animal studies were conducted in which the intracranial pressure of anaesthetized cats was modified in various ways, with strong evidence of sutural mobility being a major method whereby the skull accommodates even modest levels of altered internal pressure. Externally applied pressure was also shown to distract the sagittal suture, allowing parietal bone motion of an appreciable degree (Retzlaff et al 1976).
- Significantly, it is worth noting that in other research studies, involving squirrel monkey skulls, Retzlaff et al (Retzlaff & Mitchell 1987) demonstrated that there was a marked degree of independent motion, rather than a synchronous motion pattern, involving the parietal bones. This research supports the argument against the concept of a 'centrally driven' mechanism as a means of maintaining cranial rhythmic motion. More recent research in New York (Lewandoski et al 1996, Zanakis et al 1996b) supports the independent nature of cranial bone motion. This debate will be evaluated further later in this chapter when we consider cranial rhythmic motion.
- Retzlaff and Mitchell (Retzlaff et al 1975), who have been responsible for some of the most diligent research in the area of cranial motion, state: 'Whether cranial sutures in primates are ever obliterated by ossification remains unanswered. However histological studies suggest that there may be partial sutural fusion, but only at a relatively old age. Cranial sutures in the pigtail macaque are not fused by the 20th year and in humans by the 90th year'.
- This and other research (see below) has demonstrated that there is little chance of complete fusion occurring in adult human cranial sutures even into advanced age; this is summarized in Box 2.1.

Research evidence

In the early and middle 1990s new and important human research evidence emerged from the departments of biomechanics and bio-engineering, physiology and neuroscience of the New York College of Osteopathic Medicine (Lewandoski et al 1996, Zanakis et al 1996a, b, c, e). The following research methods were used.

1. To compare the dynamics of the proposed sutural motion of the parietal suture in particular, and cranial bone plasticity in general, infrared markers were attached to acupuncture needles which were placed firmly into specific bony locations relative to the sagittal and frontal sutures of living human volunteers. The motion of the bones was then

Box 2.1 Research showing cranial motion and CRI in adults and animals

- J and R Woods (Woods & Woods 1961)
  Manual palpation of 102 psychiatric patients indicated an average CRI rate of 6.7 cpm; 62 normal individuals averaged 12.47 cpm and patients having had frontal lobotomy averaged 4 cpm.
- W Wallace et al (Wallace et al 1966)
  Echo-encephalography (ultrasound) used to evaluate vascular anomalies shown as suitable CRI evaluation tool (see also Wallace et al 1975).
- E Baker (Baker 1970)
  Measurement was made of rhythmic alteration in width of maxillary arch in a single individual, showing a 1.5 mm average variance in width approximately nine times per minute.
- P Greenman (Greenman 1970)
  Relationship between sphenoid and basiocciput was evaluated by X-ray in 25 patients showing apparent structural/mechanical deviations described by Sutherland, including flexion, extension, sidebending, torsion, vertical and lateral strain patterns.
- V Frymann (Frymann 1971)
  A mechanical measuring device was constructed to record circumferential alterations in the head as well as cardiac and respiratory rhythms. A third rhythm, varying from 6 to 12 cpm, was demonstrated, independent of the two other rhythms recorded.
- W Wallace et al (Wallace et al 1975)
  A single case study (ultrasound) showed an apparently independent 9 cpm intercranial pulsation in brain and membrane tissues.
- M Tettambal (Tettambal et al 1978)
  Force transducers taped to frontal bones and mastoid processes of 30 individuals (age range 16–71) recorded respiratory and cardiac rhythms as well as a third rhythm (in all subjects) averaging 8 cpm, presumed to be the CRI.
- J Upledger (Upledger & Karni 1979)
  A cranially trained physician reported palpation (CRI) results which were compared with mechanoelectrical measurements performed on inactive patients. Distinct strain gauge, electrocardiography, electromyography and integrated electromyography patterns correspond with each of the palpated sensations ('smooth, regular, rhythmic, quick, jerky, irregular, etc.'), exceeding random probability.
- E Bunt (Lewer Allen & Bunt 1979)
  Tomographic studies of the ventricular system showed 2-dimensional display of lateral and third ventricles with a rhythmical dilatation and contraction in a normal adult woman at the rate of approximately 8 cpm. In a child with hydrocephalus the rate was irregular and approximately 4 cpm.
- B Libin (Libin 1982)
  Changes of 2–3 mm are reported in transverse dimension across maxillae as measured at second molars following craniosacral therapy.
- J Norton (Norton 1992)
  Twenty-four individuals were examined in the same manner by 12 skilled examiners. A total of 274 CRI cycles were reported with an average calculated rate per minute of 3.7 (see pp 25-26, for discussion and critique of this study).
- D Kostopoulos and G Keramides (Kostopoulos & Keramides 1992)
  Piezoelectric changes were used to measure lengthening of falx cerebri as anteriorly directed traction was applied to the frontal bone of a cadaver. Elastic response began at 140 grams and ended when viscous changes were noted at 642 grams traction on frontal bone. Falx cerebri lengthened by 1.097 mm with 642 grams traction.
- E Retzlaff, F Mitchell Jr, J Upledger et al (Retzlaff et al 1975, 1976; Retzlaff & Mitchell 1987)
  Histological studies of tissues of living patients aged 7–57 examined and found to show capability of motion within cranial sutures – with abundance of collagen, elastic fibers, vascular networks. No calcifications were noted in living subjects – this only appeared post mortem with the use of preservative chemicals. Numerous studies by these and associated researchers showed patent cranial sutures, with demonstrable motion capabilities into advanced old age.
- T Adams et al (Adams et al 1992)
  An instrument was attached to the medial sagittal suture of anaesthetized adult cats. Changes in intracranial pressure (forced hypercapnia), injection of artificial CSF and norepinephrine, as well as externally applied force, were assessed. A variety of different responses were recorded with a general conclusion that cranial compliance to force is defined at least in part by cranial suture mobility and that parietal motion was demonstrated.
- S Heisey and T Adams (Heisey & Adams 1993)
  Using a highly sensitive measuring device, small increments in intracranial volume were shown to

Box continues

Box 2.1 Research showing cranial motion and CRI in adults and animals—*continued*

cause parietal motion in cats, widening the sagittal suture. The cranial vault expands measurably.

- M Lewandoski, E Drasby and M Zanakis (Lewandoski et al 1996)
  Utilizing infrared markers and a kinematic system, demonstration of cranial bone movement at cranial sutures was possible. Range of motion was in the region of 250 µm and was not simply due to malleability.
- S Oleski, G Smith and W Crow (Oleski et al 2002)
  Twelve adult patients received cranial vault manipulation treatment with a pre- and post-treatment X-ray taken with the head in a fixed positioning device. This study concludes that cranial bone mobility can be documented and measured on X-ray.
- Y Moskalenko, T Kravchenko and B Gaidar (Moskalenko et al 1999)
  Serial X-rays and magnetic resonance tomograms of the human skull demonstrated changes in intracranial dimension of about 0.38 mm, which alternated between sagittal and frontal (AP) expansions.

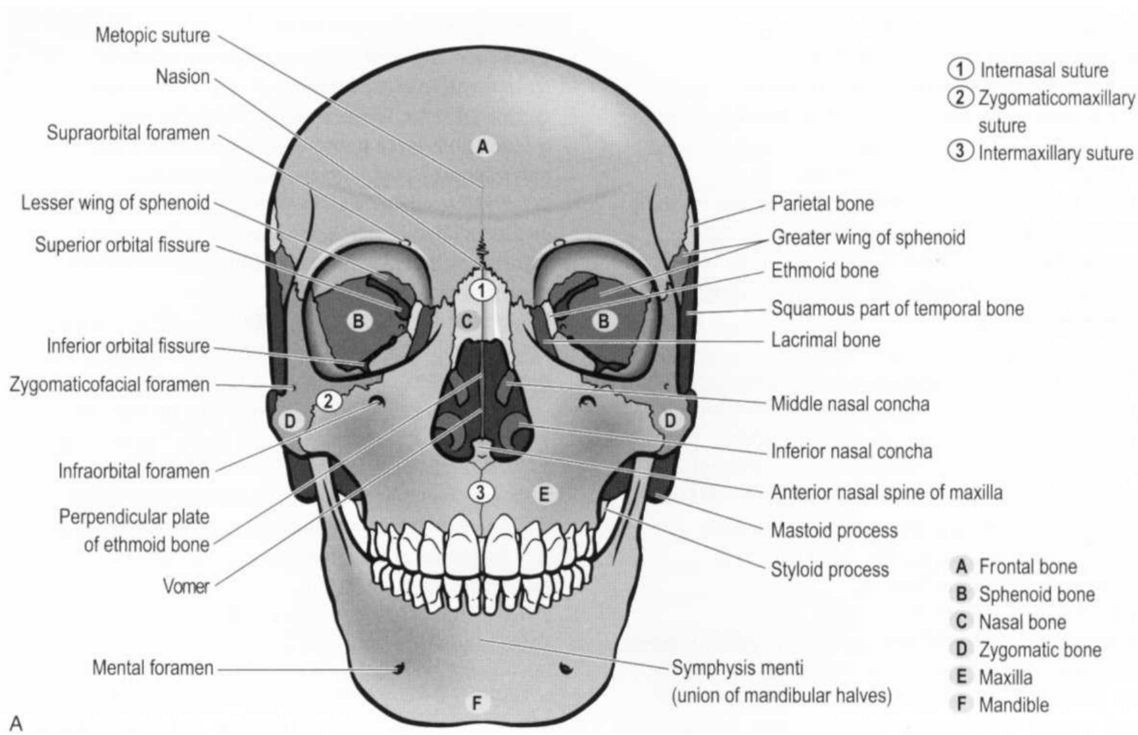

Figure 2.1 A Frontal view of cranium and its major landmarks and sutures.

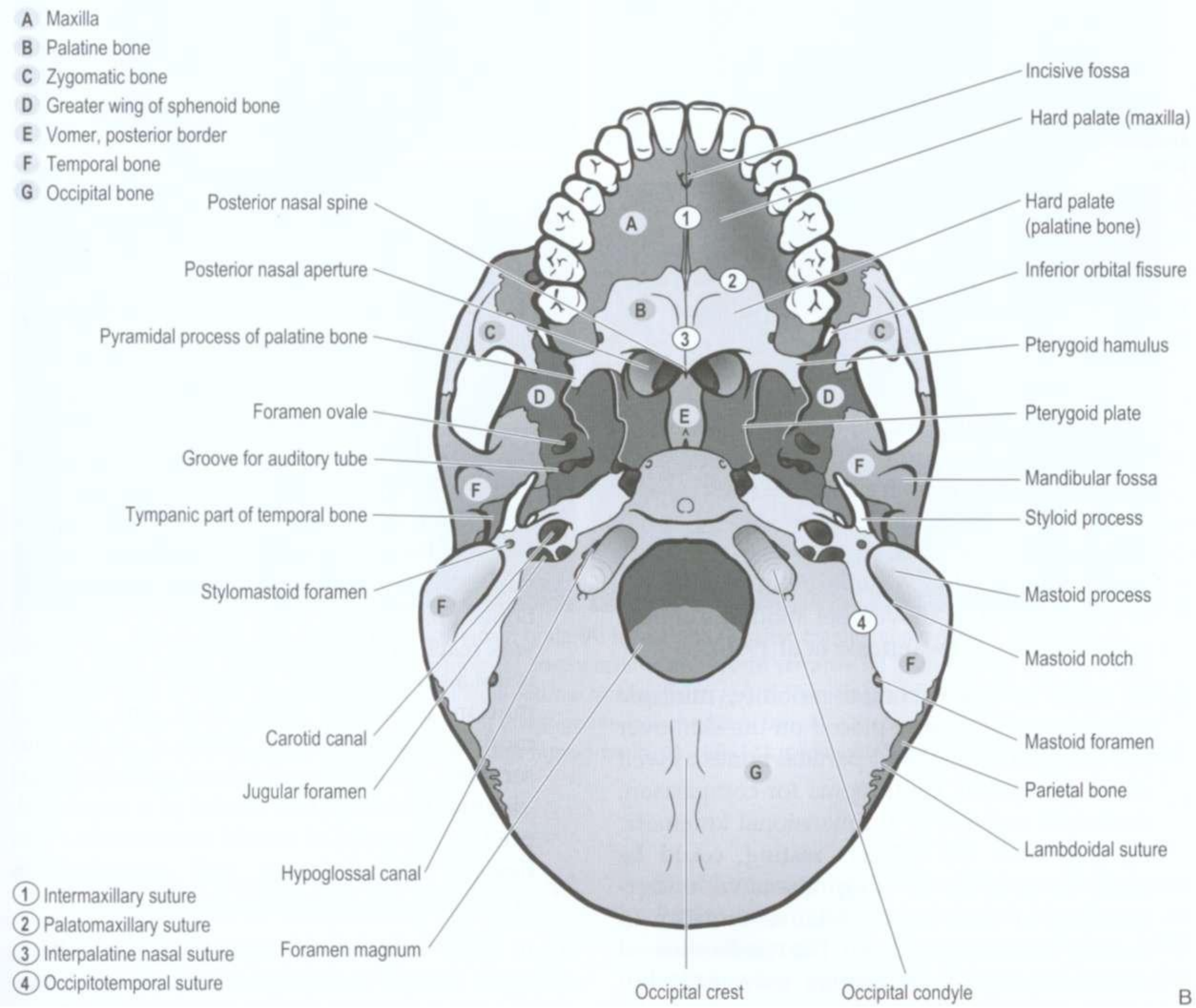

Figure 2.1 B Inferior view of cranium and its major landmarks and sutures.

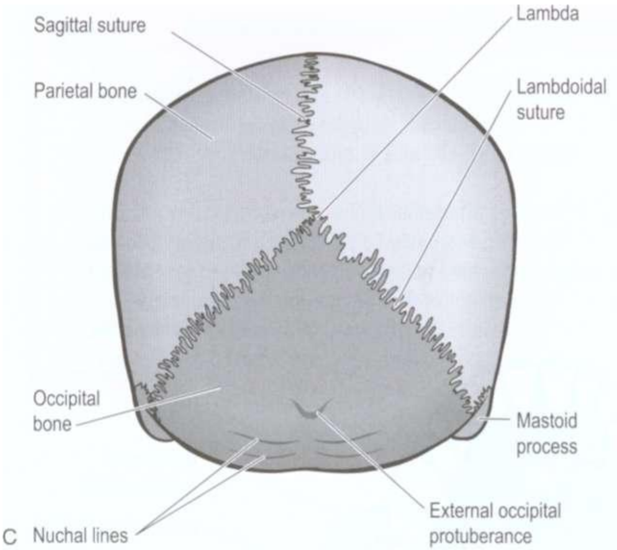

Figure 2.1 C Posterior view of cranium and its major landmarks and sutures.

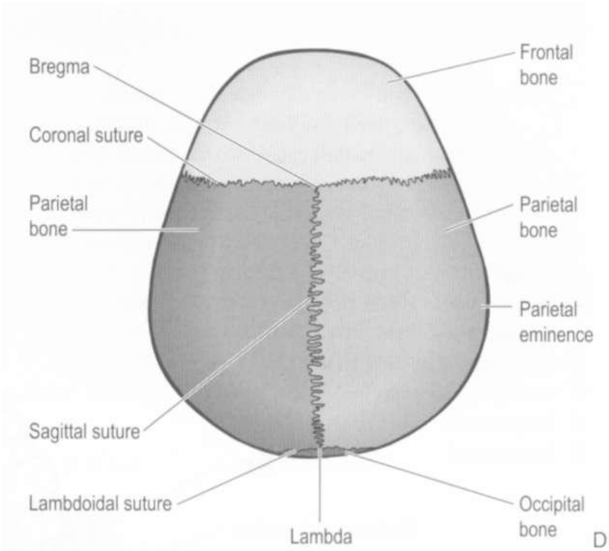

Figure 2.1 D Superior view of cranium and its major landmarks and sutures.

assessed by filming the markers for 30 seconds with the subject partially reclining. By comparing motion in the different markers, the dynamics of the parietal bones were assessed and the results showed that parietal bone motion was not due to malleability ('plasticity') of the bone but to 'movement about the cranial sutures alone' (Lewandoski et al 1996).

2. In order to study cranial mobility, multiple infrared markers were placed on the skin over the occipital, frontal and parietal bones as well as on the lambda and bregma for comparison, so that 60 seconds of 3-dimensional kinematic filming, with the subjects resting, could be used to provide a comprehensive understanding of each bone's relative mobility in healthy adults (aged 22-36). The results showed definite evidence of osseous movement but with considerable variation between the subjects tested.

3. In other similar studies, some of which are discussed later in this and subsequent chapters (Zanakis et al 1996a, c, d, e), the mean amplitude of motion of the parietal bones of adults was described as ranging between 245 um and 285 um (um = 1 micron or 1000th of a millimeter. These measurements of the range of cranial motion at the sutures in this study are therefore extremely small, representing a distance of approximately a quarter of a millimeter or around one hundredth (0.01) of an inch). Because of marked variations between the movement of frontal, parietal and occipital bones observed in these studies, a conclusion was reached that 'Motion of the cranial bones is not a simple "hinge" operation but a complex motion involving more than one axis of motion' (Zanakis et al 1996a, c, d, e). This seriously challenges aspects of current cranial 'dogma' that hold to a model of a sequential, predictable series of cranial movements - into flexion on inhalation and extension on exhalation - in the normal human skull.

4. In 1999 research was published, involving serial X-rays and magnetic resonance tomograms, that demonstrated changes in intracranial dimension of about 0.38 mm, which alternated between sagittal and frontal (AP) expansions, very much in line with the changes reported by countless practitioners when applying cranial palpation (Moskalenko et al 1999).

5. Also in 1999 a report was published by the British Columbia Office of Health Technology

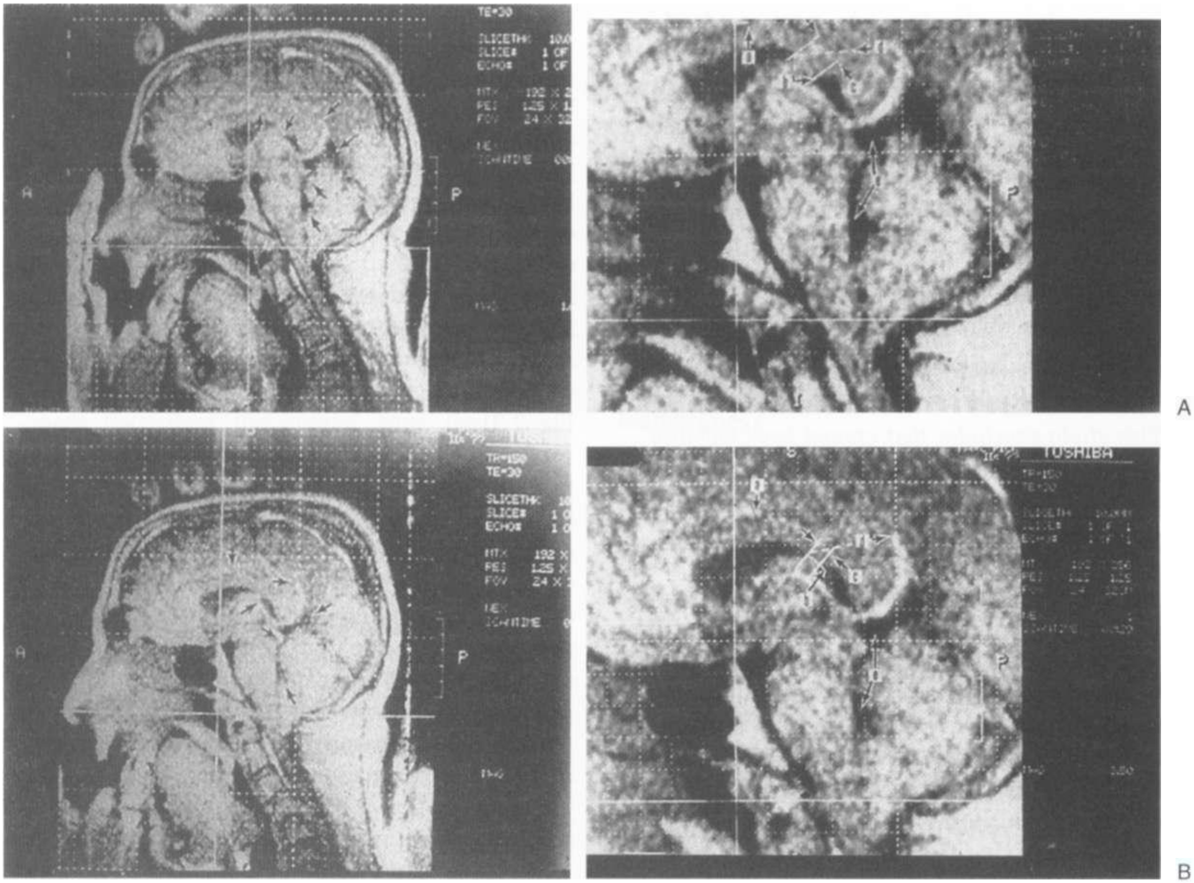

Figure 2.2 Mid-sagittal MRI scan of an adult human brain (A) before and (B) after cranial manipulation. Black arrows indicate where corpus callosum (a), lateral ventricle (b), fornix column and fourth ventricle (e) (picture B on the right side) show clear signs of tissue movement. (Reprinted from Journal of Manipulative and Physiological Therapeutics, 17, Pick M, A preliminary single case magnetic resonance imaging investigation into maxillary frontal-parietal manipulation and its short term effect upon the intracranial structures of an adult human brain, pp 168-173, copyright 1994, with permission from 'The National University of Health Sciences'.)

Assessment following systematic review and critical appraisal of the scientific evidence on craniosacral therapy. It concluded that:

The research evidence reviewed supports the theory that the adult cranium is not always solidly fused, and that minute movements between cranial bones may be possible. However, no research demonstrated that movement at cranial sutures can actually be achieved by manual manipulation (Green et al 1999).

6. This last statement is disputed, as is made clear by referral to the images in Figure 2.2. In 1994 chiropractor Marc Pick undertook a single case study to investigate the effect on the human brain and other intracranial structures of frontal-parietal maxillary manipulation. MRI scans were performed before and after the manipulation and show clearly that positional changes occurred in the corpus collosum and the lateral vesicle (Pick 1994).

7. Similar results have been demonstrated using X-rays before and after cranial osteopathic treatment (of an unspecified, individualized nature). The abstract from this study (Oleski et al 2002) includes the following assured statement.

Twelve adult patient charts were randomly selected to include patients who had received cranial vault manipulation treatment with a pre- and post-treatment X-ray taken with the head in a fixed positioning device. The degree of change in angle between various specified cranial landmarks, as visualized on X-ray, was measured. The mean angle of change measured at the atlas was 2.58 degrees, at the mastoid was 1.66 degrees, at the malar line was 1.25 degrees, at the sphenoid was 2.42 degrees, and at the temporal line was 1.75 degrees. 91.6% of patients exhibited differences in measurement at 3 or more sites. This study concludes that cranial bone mobility can be documented and measured on X-ray.

Contrary viewpoint discounted

In contrast to the evidence listed above, that cranial sutural motion is present throughout life, there are determined statements from detractors of the cranial perspective who state that an incremental process of rigidity occurs in the sutures of adults, as bony spicules (bridges) bind opposing surfaces together (although seldom completely). Quite simply, this viewpoint states that all cranial sutures eventually fuse (Cohen & MacLean 2000).

This viewpoint can, it is suggested, be discounted. It is contradicted both by the evidence summarized above, as well as by research such as that of Opperman et al (1993, 1995), which is not to say that in some circumstances and to some degree, over time, sutural motion potential between cranial bones may not be reduced or indeed lost. It is simply beyond questioning that a palpable degree of sutural pliability remains a feature, in most people, throughout life.

Verhulst & Onghena (1997) have found that there are periods of life when changes contributing to sutural closure become more active. They report evidence that sutural closure exhibits a definite periodicity, with the most extreme activity occurring between the ages of 26 and 30. Apparently further periods of activity take place in the fifties and the late seventies. Their research shows that in the eighth decade of human life there remains a potential for further closure of sutures, which underlines the fact that residual movement potential persists, even into advanced age.

What is found in the cranial sutures?

The studies on cranial motion by the major research teams have shown that ligamentous structures within the cranial sutures are formed in predictable and consistent patterns and that in these ligaments are found numerous free nerve endings (Retzlaff et al 1979). In the histological evaluation of the tissues found in human cranial sutures it seems notable that Sharpey's fibers have a wavy structure which suggests that they are subject to a degree of repetitive stretching. This supports the hypothesis of cranial motion (see Fig. 2.3).

Animal and human studies have shown that the greater the interdigitation of cranial sutures, the greater the bending strength and energy absorption capability of the total structure (Adams et al 1992). Adams and his colleagues explain that a variety of factors are involved in the complex hydrodynamic responses of the living cranium, including brain tissue, the volume and rates for production and reabsorption of CSF, the volume of blood and its rates of arterial supply and venous drainage, as well as the viscoelastic

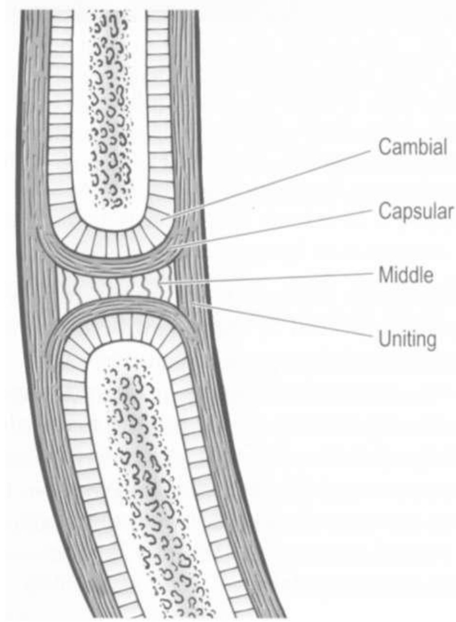

Figure 2.3 Cranial suture showing various layers including collagenous tissue bundles and nerve fibers in the middle layer.

properties of the connective tissues. All of these elements are involved in the static and dynamic intracranial pressure-volume relationships. They then point out that to accommodate to the changes inherent in life, the cranial sutures, with their collagen content and interdigitation (Kami et al 1983), have to play important roles in cranial compliance.

> *Cranial sutures in humans, for example, are more compliant than is cranial bone. ... How much a suture resists a bending force depends on the extent to which it is inter digitated, but all bend more than does the cranial bone itself ... compliance not only is a function of lateral movement of adjacent bony plates, but also depends on their rotation at the fulcrum of the suture. (Heisey & Adams 1993)*

Does palpable mobility at the cranial sutures and articulations exist and, if so, what is the significance of such mobility in health terms?

The first part of the question attracts an unequivocal 'Yes' answer.

The detailed research of Retzlaff and his various associates, as well as other studies cited in this chapter, indicate that there is little doubt that there remains, even into advanced age, a palpable and measurable degree of mobility at the cranial sutures. This mobility presumably offers some functional benefit to the individual.

Just what the benefits are should become clearer when the many conditions associated with restriction of cranial motion, often traumatically induced, are examined later in this text.

As Greenman & McPartland (1995) succinctly summarize the evidence: 'One may conclude ... that the sutures are present throughout life, and that their maintenance must require continuing motion between the related bones, with the suture as an articulation'.

Movement of cranial bones at the sutural articulations is seen to be a fact, indeed a necessity, with little left to debate apart from a need to know:

- what force(s) produces the movement?
- what are the potential functions of cranial motility?
- what happens when there is a restriction in cranial motion or a fault in the driving force which moves it?
- can we identify such restrictions via structural palpation/evaluation or by functional assessment, or both?

Before investigating these questions, other elements in this structural and functional maze need to be set in place - the intracranial soft tissue structures known as the reciprocal tension membranes.

What is the role of the reciprocal tension membranes?

The falx cerebri, falx cerebelli and tentorium cerebelli are all formed by creases of the cranial dura. Hence, they comprise double thicknesses. Plastic deformation of one of these transmits tension and deformity to the others (see Fig. 1.1, p. 5, and Box 1.1, p. 6).

The superior layer of the left side of the tentorium cerebelli is continuous with the left layer of the falx cerebri, for example, and the same relationship exists on the right side. Therefore if the falx cerebri elongates, it draws fibers in from the superior layer of the tentorium. This tends to rotate the petrous ridges of the temporal bones posteromedially (which in craniosacral parlance means 'external rotation' of these bones). This action requires some sliding of the dural lamina on each other. Cranial theory holds that distortion of the dural membranes may result from traumatic compression or plastic deformation of the osseous-articular cranium and that were this to occur, venous drainage and/or CSF movement from and in the brain could be seriously compromised (Kami et al 1983, Upledger & Vredevoogd 1983).

In evaluating and treating infant skulls it is well to remember that the occipito-atlantal joint is the only true cranial joint (discounting the temporomandibular joint, which is more a facial than a cranial structure). The rest of the cranium in the neonate has the feel of a soft-shelled egg or of a milk carton.

Andrew Ferguson, whose views on cranial mobility are described in more detail later in this chapter, discusses the membranous cranial structures as follows (Ferguson 1991).

The arrangement of the dural meninges to form the 'reciprocal tension membrane' makes more sense when one considers the cranium from birth, when the cranial vault is akin to a membranous bag with some plates or bone separated by fontanelles. A spherical structure inevitably needs a 3-dimensional internal support. As the main directions of motion allowed by the sutures appears to be a narrowing/lengthening (called 'extension') alternating with a shortening/ broadening (called 'flexion'). The membranes are oriented to limit the movement, the falx cerebri limits 'extension' and the tentorium cerebelli limits 'flexion' - and as they are joined together in the middle of the cranium they could reasonably be called a reciprocal tension membrane. (Ferguson 1991)

Noted British osteopath Helen Emelie Jackson has written of the importance of the reciprocal tension membranes and the dura as follows (Jackson 1957).

It must be remembered that the motivating force in the treatment of the skull is the patient's own breathing, and that the simple pressures and leverages applied to the cranium are designed merely to guide and direct these forces. The mechanical effects are probably obtained by changing the tensions of the dura mater.

Ettlinger & Gintis (1991) explain implications of restrictions and tensions in these membranes: 'Abnormal tensions in the dura may adversely affect neural function, either by causing direct pressure or inducing local circulatory changes'.

Upledger, one of the premier influences in modern craniosacral development, believes categorically that it is via the dura that cranial movement influences, and directs, spontaneous sacral motion (see also Fig. 1.2, p. 6): 'The occipital and sacral motions mimic each other. Unless abnormal restriction to mobility is present within the core-link (the dural membrane) the membrane transmits tensions imposed upon one of these bones directly to the other' (Upledger & Vredevoogd 1983).

This particular dogma is challenged by an increasing number of authorities who ask whether an identifiable linking mechanism between cranial and sacral motion exists or if it is possible to transmit force via the relatively slack dura from one to the other.

Following his somewhat grudging acknowledgment of the name ascribed to the dural folds (see above), Ferguson (1991) questions the proposed link between cranium and sacrum, at least insofar as the dura is concerned.

The movement of the sacrum between the iliac bones, is [also] irrelevant to cranial function (except via muscular tension patterns) as the dural membranous link between the sacrum and occiput must have considerable slack, otherwise we would not be able to move our spines at all. It could not transmit minute movements from one to the other.

As indicated, Upledger and his co-author Vredevoogd (1983) are certain that the intimate dural connection between occiput and sacrum does indeed allow minute transmission of forces. They describe the 'core-link' which they claim the dura forms between the foramen magnum and the sacrum which, while free to move within the spinal canal, allows tensions imposed upon either one of these bones (occiput or sacrum) to be transmitted onto the other.

This states their belief but does not actually answer the question as to 'how?'. How does the dural sleeve, a slack structure - something both Upledger and Ferguson agree upon - transmit a repetitive pull on the sacrum?

Recent American evidence supports doubts as to the ability of a core-link mechanism to allow transmission from occiput to sacrum, via the dura, of minute degrees of pull.

James Norton, of the Department of Physiology, University of New England College of Osteopathic Medicine, has conducted research into just this question (Norton 1996). Employing a dual examiner protocol in which two examiners, one at the cranium and one at the sacrum, could simultaneously and independently document motion, Norton was able to conclude that there was poor agreement as to lengths of cranial and sacral cycles of movement.

These data do not support the 'membrane pulley model' or 'spinal reciprocal tension membrane' hypothesis for craniosacral interaction, which would predict that movements or rhythms within the cranium would be causally or temporally related to movements at the sacrum, with respect to both mean frequency and the point of onset of the flexion phase.

Norton is categorical in his rejection of a purported linkage between sacral and cranial movement: 'There are no demonstrable temporal relationships between CRI rates of healthy human subjects measured simultaneously at the cranium and sacrum by two examiners, challenging the concept of cranio-sacral interaction through mechanical or functional linkages' (Norton 2002).

Evidence from the research into neural restriction mechanics by Australian physiotherapist David Butler (Butler 1991) makes it clear that the core-link hypothesis is probably seriously flawed: 'With the spinal canal being 5-9 cm longer in flexion than extension, the contained structures must adapt in order to function normally. Since the contents are composed of different tissues (compare neuraxis with dura mater), they will adapt differently'.

Butler highlights the presence of many powerful ligaments which tether the dura. In some areas (L4 for instance) so powerful is this tethering 'that they could not be displaced by a probe'. Butler also shows that it is necessary to place a patient into full flexion, with straight leg as well as full neck flexion ('slump' position) (see Figs 2.4A and B), in

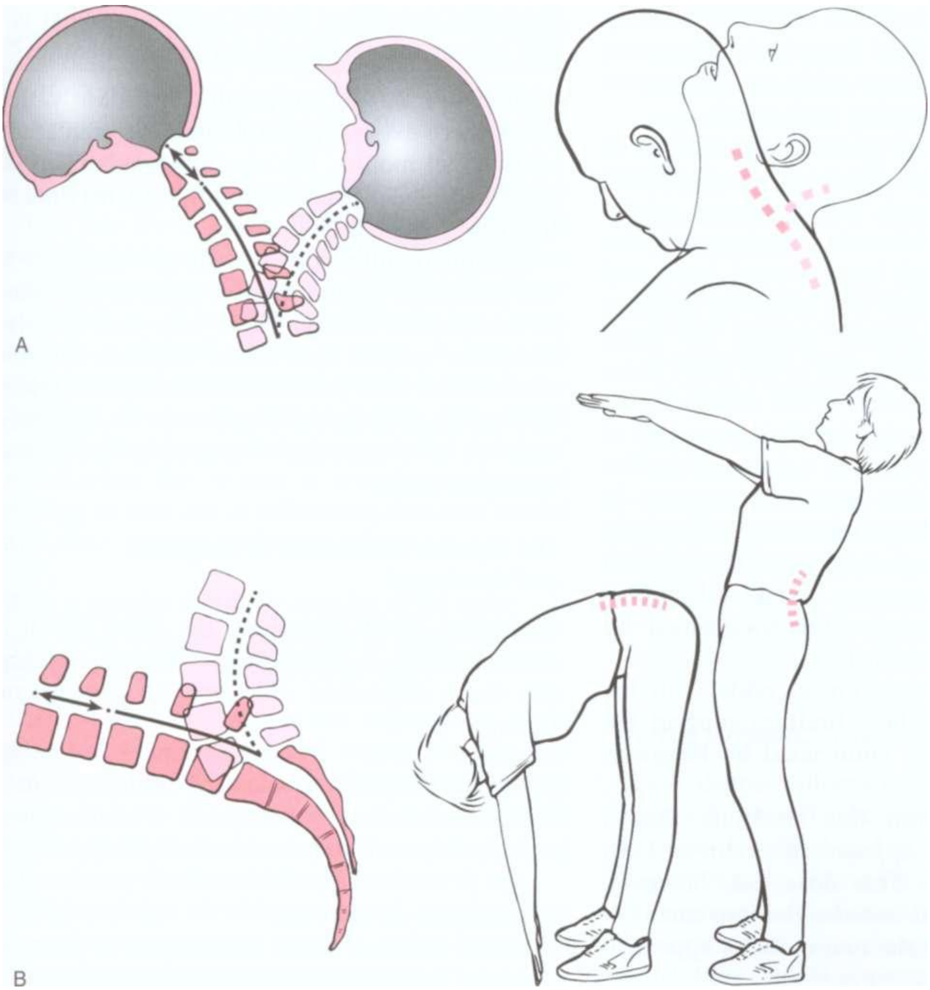

Figure 2.4
A Modification in length of spinal canal in cervical region during flexion and extension.
B Modification in length of spinal canal in lumbar region during flexion and extension.

order to produce sufficient tension to fully 'take out the slack' of the dura and other neural structures, in order to indicate abnormal mechanical restrictions.

And yet, despite evidence of this amazing ability to lengthen during flexion, and their own acknowledgment of this when they state 'the core link of dural membrane is relatively free to move within the spinal canal', Upledger & Vredevoogd ask us to believe that a movement of less than a hundredth of an inch can produce a pull from the occiput to the sacrum.

This would seem to stretch critical faculties far more than it stretches the dura.

Confusion

It might be supposed that this evidence, as well as Norton's testimony, described earlier, effectively demolishes the 'core-link' hypothesis. However, research, described below, adds to the current confusion by supporting just such a link.

A study conducted at the New York College of Osteopathic Medicine (Zanakis et al 1996b) involved the placement, on 18 normal adults (aged 18-42), of infrared surface markers onto the skin over each parietal bone, frontal bone and bregma. Cranial mobility was observed utilizing a 3-dimensional kinematic system for three 45-second periods. During part of the study there was simultaneous palpation of the sacrum by an experienced physician who signaled perception of the flexion phase by means of a foot switch. The findings showed a 92% degree of accuracy in agreement: 'These findings demonstrate objectively that flexion and extension cycles in the cranium can be palpated in the sacrum ... and lend support to the craniosacral relationship proclaimed by osteopathy in the cranial field'.

These results are therefore at odds with the evidence of Norton, whose findings support the skeptic's viewpoint, as enunciated by Ferguson and others.

What emerges from this study is that a synchronous motion appears to occur at both occiput and sacrum. This does not, however, prove that the occiput initiates the movement of the sacrum, only that the two motions appear to occur in tandem.

Other mechanisms?

What of the diaphragmatic hypothesis which Greenman suggests, in which motion of the respiratory diaphragm might act as a direct influence on the sacrum?

This suggestion also has problems. Since craniosacral motion continues when the breath is held, it cannot simply be respiratory force which moves the sacrum. Ettlinger & Gintis make this distinction clear: 'The sacrum rocks on a transverse axis through the articular pillar of the second sacral segment, posterior to the sacral canal. This motion must be differentiated from respiratory sacral motion, which is caused by spinal motion and contraction of the pelvic diaphragm'.

Tentative conclusion to the question, 'What is the role of the reciprocal tension membranes?'

Perhaps we should accept, albeit cautiously, that while there exists a probable link between sacral and cranial motion, the core-link mechanism, as described by Upledger & Vredevoogd, may not be the means whereby it operates.

Norton's evidence, and Ferguson's challenge to this particular dogma, seem to point to this being an unfounded theory. There may well be synchronous cranial and sacral motions but the answer as to what produces them remains unclear. The intracranial fascial membranes do, however, seem to have important therapeutic and assessment potentials.

The tension membranes in diagnosis and treatment

Greenman (1989) articulates the belief that it is normalization of membranous balance which is the most important objective in craniosacral therapy.

> *Simply, the goal of craniosacral treatment is to restore balanced membranous tension. The normal dynamic reciprocal tension of the falx and tent (tentorium) cannot occur in the presence of restriction or alteration in the relationship of cranial bones ... venous drainage cannot be enhanced if abnormal membranous tension persists.*

He continues by pointing out that the membranes are intimately attached to the periosteum on the internal surface of the skull bones and each exit foramen of the skull.

> *Tension in these regions could contribute to neural entrapment and negative neural function ... restoring maximum mobility to the osseous cranium allows homeostatic mechanisms to restore balanced membranous tension, enhance venous flow, reduce neural entrapment, and permit normal CRI rate, rhythm, and amplitude.*

As will be seen when techniques are presented in later chapters, one of the methods commonly utilized to reduce or normalize sutural restrictions involves what is called a 'V-spread', in which light compressive pressure (grams usually ounces at most) is applied diagonally across the cranium towards a sutural restriction which is straddled by two palpating fingers. The technique has variously been described as an 'energy transfer' approach or a 'fluid direction' method (since pulsation is commonly palpated by the two fingers when the suture 'releases').

Another, perhaps simpler explanation, and one which has fewer intellectual hurdles to jump, is that this form of sustained light compression offers the reciprocal tension membranes a degree of 'slack' - so allowing an opportunity for a spontaneous positional release to occur, in line with other manipulative approaches which introduce a 'position of ease' to stressed tissues. This might conceivably also explain many of the 'releases' noted when the sacrum is used in craniosacral therapy as a means of influencing distant - cranial and other - tissues and mechanisms.

Does a cranial rhythmic impulse (CRI) exist and, if so, what is it and does it relate to cerebrospinal fluctuations and flow?

There seem to be two major impressions as to precisely what the 'normal' cranial rhythm rate actually is (see Table 2.1, p. 27), with one group suggesting 6-12 cycles per minute, another holding that 10-14 is normal and some indicating a far slower rhythm of CRI pulsation.

There exists a wide range of disagreement amongst experts as to what is and what is not normal, regarding rates of pulsation.

For example a rhythm of six cycles per minute is suggested as 'normal' by authorities such as Upledger, Mitchell and Retzlaff, whereas British expert Denis Brookes (1981) states that 'a psychiatric personality is indicated by a rate of below nine impulses per minute'. Woods (Woods & Woods 1961) averaged the CRIs of 102 psychiatric patients and noted a rhythm of 6.7 cycles/min; Kami et al (1983) found comatose individuals to average 4.5 cycles/min (eight examined); and Greenman & McPartland (1995) examined 55 patients with traumatic brain injury (TBI), most as a result of automobile accidents, and reported the average CRI of these to be 7.2 cycles/min.

So what is normal?

There also appear to be more cranial rhythms than the one discussed above.

- Jealous (1997), for example, does not see the cycle he describes (2.5 cycles/min) as being the same as the CRI patterns described by others but as representing an underlying, 'deeper', pulsation which can be palpated when the practitioner is in a deep state of relaxation or 'defacilitation'.
- Rollin Becker (Becker 1977) describes an even deeper wave - 'the long tide' - which lasts for a considerable time, pulsating at a rate of 0.6 cycles per minute.
- As will be seen in discussion of 'what produces the CRI' later in this chapter, research from South Africa using tomography has produced further variations on the question of the rate of pulsations in the skull, ranging from 2.25 per minute to one pulsation every 3^ minutes, which are closer to Becker's suggested rate than anyone else's (Norton 1991).

Norton's research challenges previous findings

These 'deeper' alternative CRI patterns, however, are not apparently the same rhythmic pulsations as those described in 1992 by James Norton and associates at the University of New England College of Osteopathic Medicine (Norton et al 1992).

Norton and his colleagues set up a study in which they had 24 apparently healthy volunteers examined for their CRI rate by 12 medical students, teaching fellows, clinical faculty and cranial experts, ranging in cranial palpation experience from 2 to 15 years.

The various qualitative findings recorded alongside the quantitative CRI rate assessment included amplitude of the CRI as well as the length of what is known as the flexion phase and the extension phase of the cycle (see Box 2.3, p. 35, for an explanation of these terms).

The average number of cycles per minute for the 24 subjects was 3.7 while the length of cycles was 16.5 seconds, ranging from 11.7 to 22.8 seconds. Thus even the fastest rate recorded was lower than an average of six cycles per minute. Inter-examiner compliance was checked and it was found that while the average cycle length as determined by experienced examiners was longer and the CRI frequency lower than the corresponding findings of less experienced examiners, the differences were not statistically significant. Put simply, the more experienced the examiners, the closer was the degree of agreement:

> *Assuming the most experienced examiners to be the most proficient and accurate in identifying the CRI and its components, the low frequency [3.7 cycles/min] determined by this group and the good agreement among the examiners support the accuracy of the generally low CRI frequencies documented in this report. (Norton et al 1992)*

Norton's research and concepts are explored more deeply in Chapter 4.

What do other experts in the field make of these frankly revolutionary (for they contradict 60 years of dogma) findings? Upledger (1995) is on record as commenting on the findings of Norton and his colleagues as follows.

> *It is important to note that several spontaneous 'still points' occurred during the examination processes. The time for still points was included in the calculation of cycles per minute, which lowered the average rate significantly. It is also significant that the cycles per minute were consistently slower after the still point had occurred than it was before.*

The 'still point' phenomenon to which Upledger refers represents a temporary - sometimes sustained for minutes - cessation of the CRI pulsation and will be elaborated on later in the book (see Exercise 7.5 and Box 7.3 in Chapter 7).

Upledger's assertion regarding the frequency of still points is contradicted by Norton's paper which describes just one such incident, and indeed provides a copy of the experimental record of this event, showing that it lasted for no more than 20 seconds at most and that the rate of CRI cycles changed from 4.4 cycles per minute before the still point to 2.5 cycles per minute following its occurrence. The very short length of this single still point and the relatively slow rate prior to the incident (4.4 cycles/min) can hardly be seen to have influenced the overall statistical findings as presented by Norton.

Clearly there is a major area of disagreement between the findings of Norton and his colleagues and the majority of craniosacral practitioners. A simple but well-constructed study shows experienced osteopathic experts to have consistently evaluated rates of CRI in healthy volunteers wildly at variance with the commonly held rates as described for some 60 years of published literature on the subject.

What we see therefore is a deep and worrying underlying disagreement as to what the normal rate of the cranial rhythmic impulse is, with suggestions that there may be more than one (perhaps up to three) CRIs palpable. What is the practitioner/therapist to make of this disagreement?

New York evidence regarding the CRI rate (Zanakis et al 1996d, e)

A series of studies conducted at the New York College of Osteopathic Medicine cloud the evidence relative to CRI rates even further. These tests involved the placement of infrared markers on the skulls of both children and adults, thus allowing 3-dimensional kinematic filming of the skull's motion. The researchers reported that neither the positions in which the subjects were placed nor simultaneous palpation during these evaluations modified the rhythms observed, which were recorded as having mean rates of 7.9 cycles per minute for adults and 6.2 for children.

Whether or not palpation was simultaneously being carried out, variations in individual bone movement amplitude and quality of movement were observed relative to position (reclining at different angles), a finding in agreement with Greenman's statements on this subject described earlier in this chapter (p. 24). These variables (position and simultaneous palpation) did not seem to alter the objective CRI rates, as recorded on film.

Significance

As we will discover in the discussion on 'entrainment' (p. 39), there seems to be wide support for the suggestion that a major influence on the findings (CRI count) is actually dependent upon the status (relaxed or tense, calm or anxious, focused/'centered' or distracted, well or unwell, etc.) of the individual performing the palpation - and of their interaction with the subject being assessed.

It is difficult to equate this proposition with Norton's finding, which would suggest that all 12 examiners were able to slow down the CRI rates of the 24 examined volunteers to such a degree as to cause them to be so very different from normally reported rates.

The evidence from New York, of 'no effect at all' of palpation on the filmed CRI rates, adds to the confusion, unless it is assumed that perhaps the individuals performing the palpation were not sufficiently 'relaxed and centered' during the procedures to influence the subjects.

The answer to the first part of the question, 'Does a cranial rhythmic impulse (CRI) exist and, if so, what is it and does it relate to cerebrospinal fluctuations and flow?' is a definite 'yes'

There is a cranial rhythmic impulse but quite what it represents is not clear. The question of the validity and value of CRI rate evaluation requires research involving clinical feedback from experienced practitioners and therapists if it is to show itself to have the diagnostic value previously suggested.

The questions which need answers need not include enquiry as to whether a CRI exists or not, for clearly there is a palpable rhythmic impulse

Table 2.1 Some suggested 'normal' CRI rates

Authority	Rhythm (cpm)	Method
D Brookes	12 to 14	Palpation
P Greenman	10 to 14	Palpation
F Mitchell Jr	6 to 12	Palpation
E Retzlaff	6 to 12	Palpation, etc.
J Upledger	6 to 12	Palpation, etc.
H Ettlinger	8 to 12	Palpation
M Zanakis	7.9	Kinematic film
B Degenhardt	4.0	Doppler, etc.
J Norton	3.7	Palpation
J Jealous*	2.5	Palpation
H Podlas	2.25 to 0.25	Tomography
R Becker*	0.6	Palpation

noted when the skull (and other parts of the body) is palpated. We need to know:

- what is normal CRI rate?
- are there more CRIs than one?
- what is an abnormal CRI rate?

Table 2.1 shows some of the suggested 'normal' rates (although researchers Jealous and Becker, as asterisked* in the table, state that the rhythms they reported are different from CRI as reported elsewhere).

The answers to some of the questions posed should become clearer as we investigate further.

What are the primary forces moving cranial structures and so producing the CRI?

A variety of models have been proposed, including:

- intrinsic motion of the brain and nervous system
- movement of CSF ('pressurestat hypothesis')
- muscles as motive force
- lymphatic pump
- venomotion and/or vasomotion
- tissue pressure
- Traube-Hering-Mayer oscillations
- entrainment.

Each of these will be briefly described.

It should become apparent that all have some merit, though some more than others. In many of these there exists an overlap in which evidence used to validate one hypothesis is employed again for another, with a slightly different emphasis or interpretation.

Different technologies are involved in studies of cranial motion and account should be taken of those with the greatest likelihood of accuracy. Clearly tomography and kinematic filming of motion must carry more weight than subjective palpation reports, if indeed they are actually reporting the same phenomena. Judging from the wide range of rates reported, more than one rhythmic waveform phenomenon is probably being observed in different studies.

Intrinsic motion of the brain hypothesis

In 1987, Feinberg & Mark demonstrated human brain motion and CSF circulation, using magnetic resonance velocity imaging. They state in their paper (Feinberg & Mark 1987):

> *[We] describe what is believed to be the first observation and measurement of human brain motion, which occurs in extensive internal regions (particularly the diencephalon and brain stem) and is synchronous with cardiac systole. Twenty five healthy volunteers and five patients were studied. Observations of pulsatile brain motion, ejection of CSF out of the cerebral ventricles, and simultaneous reversal of CSF flow direction in the basal cisterns towards the spinal canal, taken together, suggest that a vascular-driven movement of the entire brain may be directly pumping the CSF circulation.*

A few years earlier scientists in Johannesburg had conducted computed tomography studies of the human brain (Podlas et al 1984). Their report mentions earlier South African research which demonstrated rates (apparently using ultrasound techniques) of 'slow sinusoidal pressure waves of frequency 2 to 9 per minute'. The tomography research, however, demonstrated a very much slower wave pattern than this or what is regarded as the 'normal' CRI rate.

> *The pulsating brain can be considered to act as a 'roller pump' energized by volumetric flux of blood and CSF circulating through the brain ... providing a driving force ... acting on the relatively static ventricular CSF to bring about caudally distributed peristaltic movements displacing CSF volumes into regions of greater compressibility.*

And what was the observed rate? 'Various periods of wave motion were identified, namely 24 seconds and 56 seconds (with a suggestion of a slower wave).' In later scans they observed much longer waves extending for up to 224 seconds, which they attempt to explain: 'Density differences between regions [of the brain] were associated with both phase and amplitude differences between the successive pairs of peaks of the faster waves, suggesting that a "roller" motion occurred to bring about a change of blood or CSF volume in each hemisphere'.

Once more we see a variety of rhythmic variations of the CRI (or something which mimics it), ranging from six per minute in the earlier South African research (Podlas et al 1984) to 2.5 per minute - with one wave recorded as lasting a full 3.5 minutes in the tomography studies.

It seems that what has been observed as movement of the brain is largely a response to expansion of arterial structures following systole, a force that moves brain tissue, causing CSF to be moved into the subarachnoid space, as well as enhancing venous sinus drainage (Greitz 1993, Greitz et al 1992, Maier et al 1994).

The brain's role in pumping CSF disputed

McPartland & Mein (1997) make it clear that while there has been validation of motion potential at cranial articulations, and a slight rhythmic motion of the brain has proved to be a reality, this latter phenomenon is an unlikely powerhouse for cranial motion, especially as its claimed rate of pulsation (12 per second, according to Sutherland) bears little relation to CRI rhythms.

Feinberg & Mark showed a rhythmic pulsation of the CSF at a rate synchronous with cardiac systole, which also fails to relate to any of the purported CRI rates listed in Table 2.1.

Upledger & Vredevoogd (1983) elaborate on why Sutherland's concept may be untenable, stating that they do not believe that there is sufficient tensile strength in brain tissue to act as a hydraulic pump. Secondly, they maintain that: 'Although the glial cells in vitro are seen to move rhythmically, their motion is perhaps one-tenth the rate that we observe in the craniosacral system'. They acknowledge that in vivo glial cell activity might be more rapid; however, they might also pulsate even more slowly and so this activity is discounted in their calculations.

We can deduce from the evidence thus far that while various intrinsic brain rhythms and CSF fluctuations do exist, these alone seem unable to account for palpated CRI pulsations.

Conclusion: The brain probably has, at most, a very minor intrinsic role in what is palpated as the CRI.

The pressurestat model: CSF as the driving force?

The 'pressurestat' model, partially proposed by Magoun (1976) and elaborated on by Upledger & Vredevoogd (1983), suggests that, rather than the brain's pulsating action driving the CSF, the production of CSF drives brain movement.

Is this a valid hypothesis? The evidence from researchers such as Feinberg (Feinberg & Mark 1987) suggests that too little CSF is produced per minute to allow this theory to be viable, at least in its entirety. However, Upledger & Vredevoogd include other mechanisms as supporting CSF fluctuations in their pressurestat hypothesis. They state their belief that:

> *One need only assume that cerebrospinal fluid production in the choroid plexus within the ventricular system of the brain is significantly more rapid than is the resorption of CSF back into the venous circulation by the arachnoid bodies. These arachnoid bodies are concentrated primarily in the intracranial venous sinus system. Probably the majority of resorption occurs in the sagittal venous sinus.*

Upledger & Vredevoogd (1983) suggest that if CSF production is twice as fast as resorption, there must be an upper threshold of pressure when homeostatic mechanisms determine that CSF production needs to be turned off temporarily. Resorption, however, continues after CSF production ceases, allowing pressure to drop, at which time a lower threshold would be reached causing the 'switching on' of CSF production once again.

This pump-like, rhythmic rise and fall of fluid pressure, operating in a semi-closed hydraulic system, could, they propose, cause rhythmic pressure to be exerted on the container enclosing it (based on the 'Monro-Kellie doctrine' [Ganong 1997]). They suggest several mechanisms which might be involved in this process, including the identified presence in the cranial sutures of collagen and elastic fibers as well as vascular and neural plexuses, which they hypothesize may also include a stretch reflex mechanism which could operate when the suture is gapped, something which seems to occur when intracranial pressure increases. (See the theories and explanations of Retzlaff, Adams and Heisy as summarized in Boxes 2.2 and 2.3; see also Adams et al 1992, Heisey & Adams 1993, Retzlaff et al 1975.)

Upledger and his colleagues search for a 'telegraph system' connecting the suture and the brain's ventricular system. They state: 'We have successfully traced single nerve axons in the monkey, from the sagittal suture centralward through the meningeal membranes to the wall of the third ventricle of the brain' (Upledger & Vredevoogd 1983).

A second mechanism is described by Upledger and his colleagues. They inform us of a description of the straight sinus found in the 38th British edition of *Gray's Anatomy*, in which an arachnoid granulation body is detailed which projects into the floor of the sinus, having a junction with the great cerebral vein. This arachnoid body contains a sinusoidal plexus of blood vessels which, it is suggested, becomes engorged and acts 'as a ball-valve mechanism' which may influence back-pressure and secretion of CSF by the choroid plexuses of the lateral ventricles: 'Drainage of these regions of the brain is from the internal cerebral vessels, which empty into the great cerebral vein'. (See Figs 2.5A and B.)

They further hypothesize that: 'It is this pressurestat mechanism which causes the ventricular system of the brain to dilate and contract rhythmically, rather than some intrinsic contractile power of the brain tissue itself.

Upledger describes South African research which demonstrated 'an approximate 50% area change during dilatation and contraction of the lateral ventricles of the brain at a rhythm of 6 cycles per minute in a normal patient'.

The Upledger & Vredevoogd pressurestat model remains one of the most widely accepted,

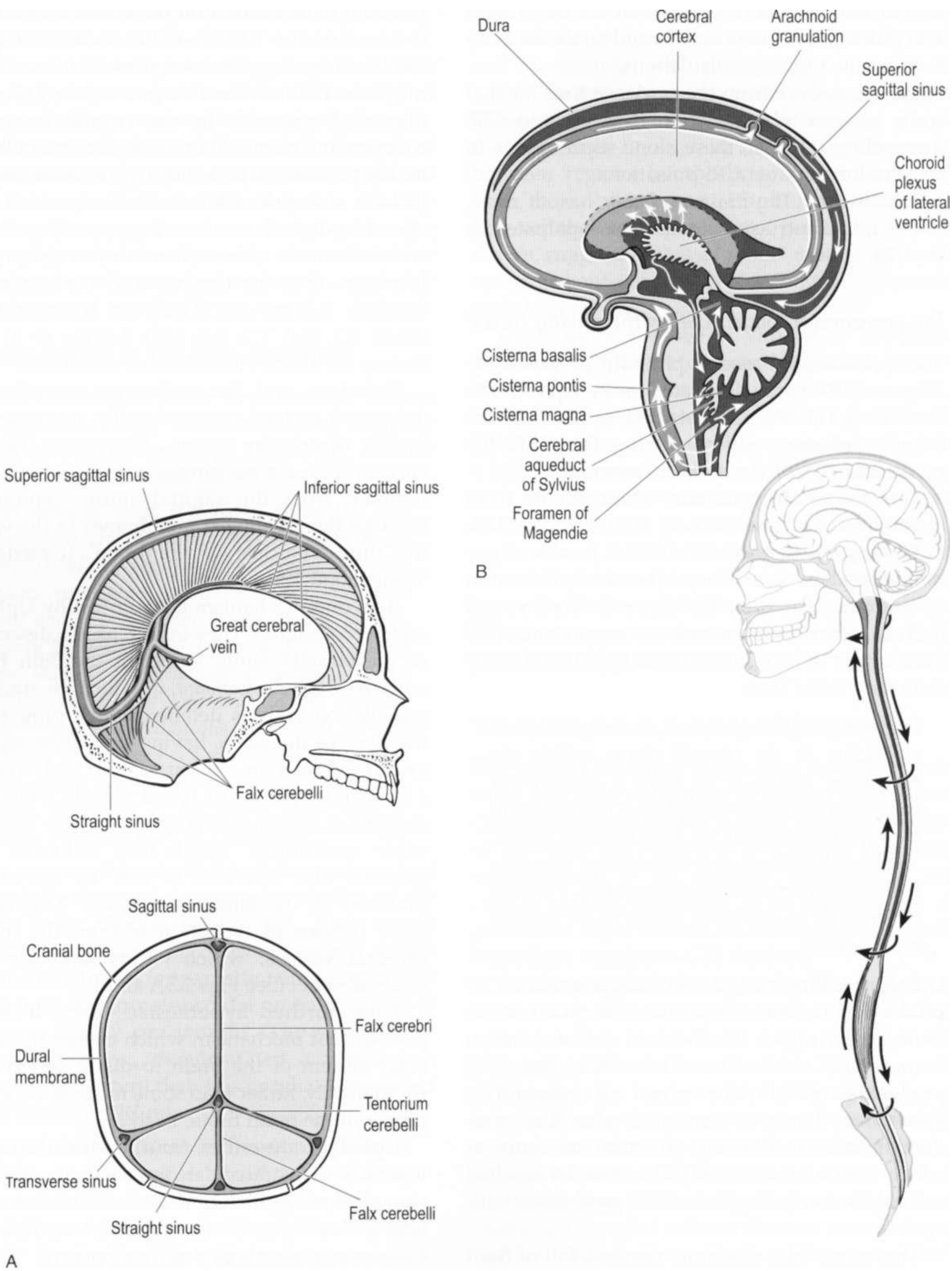

Figure 2.5 A Sagittal and coronal views of the venous sinuses as formed by folds and junction points of the reciprocal tension membranes. B CSF circulation and landmarks.

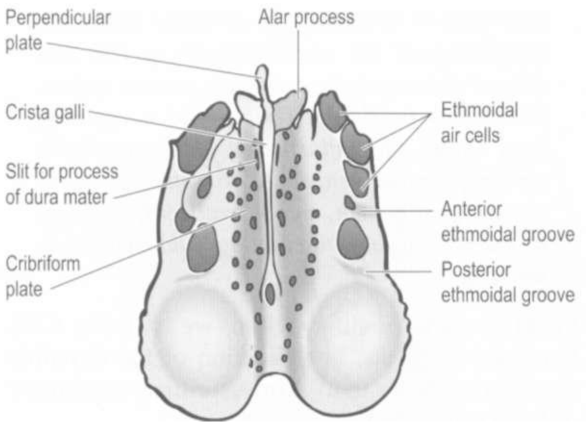

Figure 2.6 Cribriform plate of ethmoid bone.

albeit unproven, hypotheses to account for the motive force behind cranial motion and the CRI, but does it stand up to scrutiny?

Challenging the pressurestat hypothesis The pressurestat hypothesis hinges on the presence of a variable intracranial pressure 'pump'. The variation between the rate of CSF production and absorption seems, however, to be erroneous. Although the current view is that CSF is absorbed through the arachnoid villi into veins, at a rate slower than production, animal studies now suggest that much CSF actually moves into the cervical lymph nodes, by way of the olfactory nerve, and around or through the sieve-like cribriform plate (Fig. 2.6) to the nasal submucosa (Kida et al 1993, Leeds et al 1989).

Japanese research incorporated arterial features into the answer to the question 'What moves the CSF?'. Animal studies from the Department of Orthopedic Surgery, Jichi Medical School, Japan, suggest a harmonic wave as being the force which drives what they term the 'lumbar cerebrospinal fluid pulse wave' responsible for cerebrospinal fluid movement (Urayama 1994). Using dogs as subjects, the researchers were able to show conclusively that a combination of spinal arterial and venous pulsations, as well as intracranial motion, seem to interact (a 'harmonic wave' - see notes on entrainment later in this chapter).

More recent research suggests that it is only at relatively high intracranial pressure that routes such as the arachnoid villi are utilized to clear CSF and that the main drainage route is, as indicated by earlier studies, via the cribriform plate (lying immediately anterior to the anchorage point of the falx cerebri) (Mollanji et al 2001).

Conclusion: It seems likely that variations in intracranial pressure result largely from expansion of arterial structures in response to cardiac function (as discussed above) and it is this that 'drives' brain and CSF movement. The pressurestat hypothesis is therefore an unlikely contender as the source of CRI pulsations.

Muscles as the motor force?

A further suggestion, reported but also refuted by Upledger & Vredevoogd (1983), involves the work of Frederick Becker, of the Department of Biomechanics at Michigan State University, who hypothesized that craniosacral rhythmic motion might be the result of the efforts of extracranial muscles in their response to the forces of gravity, either via direct stimuli to the central nervous system (so producing CSF pressure fluctuations) or via straightforward fascial influences, since the fascia of the muscles might act directly on the fascia of the skull and spinal cord, causing a rhythmic rise and fall of pressure on the actual boundary wall of the cerebrospinal fluid hydraulic system (Becker 1977).

Upledger & Vredevoogd's arguments against these suggestions are that:

1. there are strong and apparently normal cranial rhythms in many quadriplegic patients
2. denervated muscle and connective tissue produces a rhythmic pulsation of 20-30 cycles per minute.

They argue that 'if craniosacral rhythmic motion were dependent upon skeletal muscle tonus, it does not seem possible that the elevated rate in the skeletal muscle could exist in the quadriplegic, without seemingly influencing the cranial rhythm'.

British osteopath Andrew Ferguson turns the argument around by suggesting that if denervated muscles produce a palpated CRI rhythm of around 20-30 cycles per minute, this indicates that it is the innervated muscles which are responsible for the 'normal' rhythms found in unaffected tissue of quadriplegics (Ferguson 1991).

He further argues that when the 'muscular hypothesis' is dismissed, for example because quadriplegics have normal CRI rates in their craniums, a major fact is ignored. This is that the most powerful cranial muscles, those involved in mastication, continue to be innervated by the trigeminal and facial nerves and that these would be unaffected by cervical cord lesions.

Ferguson (1991) summarizes a traditional cranial concept regarding the driving force for the CRI and suggests the following different hypothesis.

> *A pillar of the classical approach to cranial osteopathy has been the existence of a rhythmic movement of approximately ten cycles per minute. This is felt throughout the body and is independent of heart beat or breathing. This has been thought of as being caused by movement of the CSF and CNS [brain and glial cell motion] but this concept now has little credibility. Further the rhythm appears to occur throughout the body at the same time. There is no delay from head to toe as might be expected if it were caused by fluid pressure or fascial drag. Fascial or connective tissue transmission would be affected by the position of the body or limbs, which is not the case. The movement must be coordinated by the nervous system and involve muscles, as they are the only structures that cause any movement. Research evidence tends to support this view rather than the classical view.*

Ferguson identifies the constant neurological activity associated with simply being alive, never mind being active.

> *The body as a whole shows patterns of tension/relaxation, strength/weakness, bind/ease and integration/loss of awareness. These are individual, often complex and superimposed, and are reflected throughout the whole body including the cranium. It is also dynamic. There is constant movement or tone in innervated muscles, even when patterns feel fixed or repetitive. The patterns of tension also tend to shoiv different qualities at different depths; the more superficial muscles tend to respond to more transient tensions, the deeper ones to longer standing or deeper rooted postures and attitudes. ...It is also important to remember the complete functional integration of the neuromuscular system and visceral systems via the autonomic nervous system. Alterations in blood circulation at a capillary level under the influence of the sympathetic nervous system contribute to some effects of somatic dysfunction, and of treatment, and may be relevant to some fluctuating fluid changes in the body.*

What we are feeling when we palpate CRI, Ferguson suggests, is a function of the dynamic neuromuscular system - Korr's 'primary machinery of life' (Korr 1988).

Challenging the muscle hypothesis The patterns of alternating tone in muscles show little evidence of rhythmicity, apart from the effect of circulation to and through muscles. Whatever influence muscles have on cranial rhythms, it would not seem to be capable of producing a sustained, regular, palpable rhythm, apart, perhaps, from influences deriving from arterial circulation and/or the sympathetic nervous system (Grassi & Passatore 1988, Nakata et al 1998).

Conclusion: Muscles do not seem to be the source of cranial rhythmic impulses.

Lymphatic pump as motive force for CRI?

In 1996, Degenhardt & Kuchera, of the Kirksville (Missouri) College of Osteopathic Medicine, reviewed the current state of knowledge relating to the movement of lymphatic fluid (Degenhardt & Kuchera 1996) (see illustration of lymph nodes in Figs *2.7A* and B). They describe human and animal research which shows that a rhythmic spontaneous lymphatic contraction occurs in many species, including humans. For example, the thoracic duct in humans has been shown to contract once every 10-15 seconds (Kinmonth & Taylor 1956) - roughly four pulsations per minute, close to the CRI rate described by some experts such as Norton (see Table 2.1).

In 1963, photographs were taken of a relaxed and a contracted peripheral lymphatic vessel in someone undergoing lymphangiography (Szegvari et al 1963).

In 1979, rhythmic pulse waves were recorded from the lymphatic vessels of five healthy,

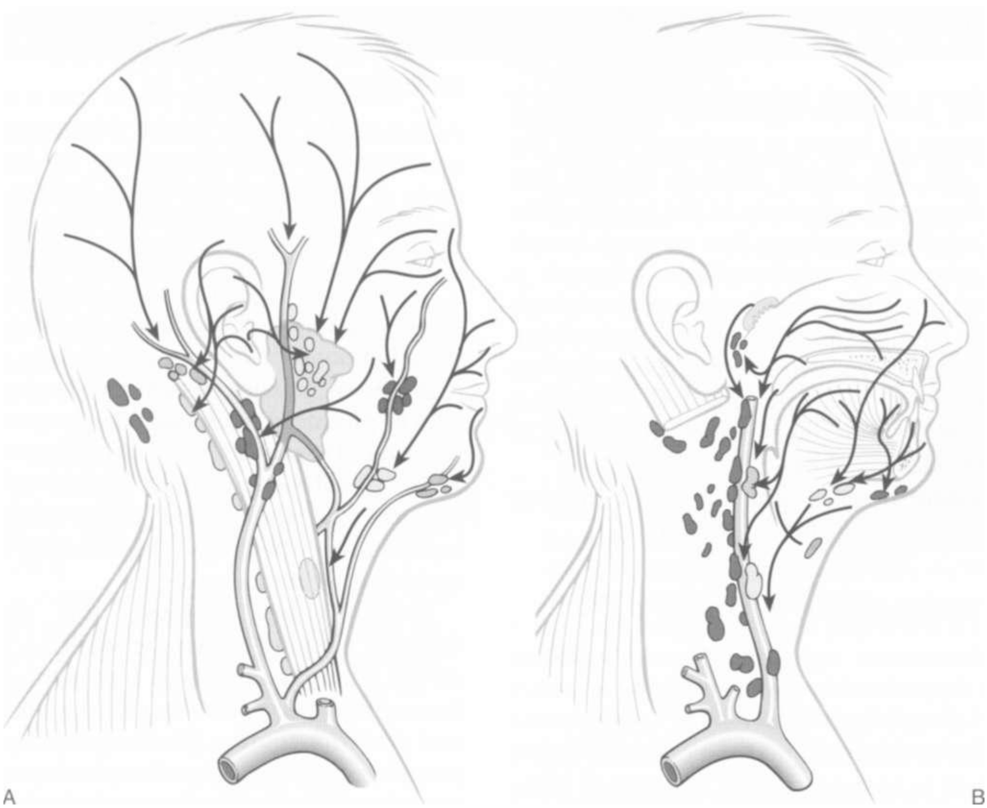

Figure 2.7 A, B Major lymph node sites and channels of the head and neck.

upright, motionless males at a rate of 8-10 per minute, asynchronous with respiration or leg movement (Oszewski & Engeset 1979).

Degenhardt & Kuchera describe the process as follows: 'The regulation of the intrinsic contractility of the lymphatic system is based on transmural distension of the vessel walls and neural and humoral mediators'. They comment further:

The physiology of the lymphatic system is quite complex. Research has only begun to demonstrate the many factors that influence lymphatic flow. The extrinsic compression of the myofascia on the lymphatics has been the focus of many manipulative techniques. ... Studies now consistently demonstrate contractility in the lymphatic vessels. This intrinsic pumping has been shown to be under autonomic control, modulated locally by soft tissue chemicals and systemically produced hormones. Currently it appears that intrinsic contractions have more influence on lymph flow than extrinsic forces.

And they raise a pertinent question:

Wliat is the relationship of lymphatic contractility to the cranial rhythmic impulse (CRI)? Could lymphatic contractility be causing the fascial impulse palpated throughout the body? Wliat implications does this have for osteopathic physicians in treating the chronically fatigued patient, as many of these patients have diminished CRI?

This 'lymphatic hypothesis', that the CRI is in fact nothing more than lymphatic vessels contracting, has the merit of simplicity compared with the elegant complexity of the McPartland & Mein suggestion which is discussed later in this chapter.

It has an apparent physiologically independent rhythmic pulsation (anywhere from 4 to 10 pulsations per minute in the examples cited) as well as a body-wide locality. Despite these advantages, in the quest to find an answer to the CRI conundrum, lymphatic contractile pulsations may prove to be just one more element in the allembracing harmonizing process which McPartland & Mein have suggested as producing the CRI.

Challenging the lymph hypothesis Only a very small amount of lymph is produced within the cranium and this drains through arterial and venous channels (particularly in the region of the ethmoid) before reaching the cervical lymph nodes. It is estimated that 70% of lymph is reabsorbed into the venous system at the lymph nodes. The absence of large lymph vessels within the cranium makes it extremely unlikely that the lymphatic system has anything but a marginal influence on the pulsations perceived as the CRI (Foldi 1996, Gashev & Zawieja 2001).

Conclusion: It seems unlikely that lymphatic pulsations are responsible for the CRI.

Vasomotion/venomotion influences

In the discussion regarding Norton's 'tissue pressure hypothesis' (below) we will cover Traube-Hering-Mayer waves (or oscillations) which relate to variations in blood pressure relative to variations in vasomotor tone. Alterations in the caliber of arteries and arterioles, governed by changes in smooth muscle tone, determine the rate of flow of blood through the vessels (vasomotion). It appears that there is slower vasomotion in larger caliber arterioles compared with smaller vessels, something further influenced by relative hypoxia (Colantuoni et al 1990). The caliber of arterioles fluctuates rhythmically, at approximately six cycles per minute (Hayoz et al 1993).

Venomotion describes the rate of flow of blood through veins. Farasyn (1999) has described an hypothesis in which this is seen to be a part of the motive force driving the cranial rhythmic impulse. This seems an unlikely candidate because of the relatively low levels of pressure in veins.

Vasomotion and, to a far lesser degree, venomotion would seem to be part of a larger collection of rhythmic pulsations that are discussed below in the segment evaluating Traube-Hering-Mayer waves as well as respiratory and cardiovascular pulsations, which have been shown in research studies to modify following cranial treatment.

Norton's tissue pressure hypothesis and its evolution, including Traube-Hering-Mayer oscillations

As indicated in Boxes 2.2 and 2.3, Norton has theories which are, at least partially, in agreement with those of Ferguson - that we need to look outside the head, away from CSF and brain motility, in order to understand the mechanisms behind CRI.

Norton (1991,1992) includes the cardiovascular and respiratory oscillations of both the subject and the practitioner in his model, which he attempted to evaluate utilizing a computerized simulation which produced patterns which, to an extent, resemble Frymann's CRI recordings (Frymann 1971). A subsequent study failed, however, to produce a correlation between the tissue pressure harmonic of patients and the perceived CRI when evaluated by cranial experts

Norton (1991) proposed that the cranial rhythmic impulse (CRI) is related to activation of slowly adapting cutaneous mechanoreceptors by tissue pressures *of both the subject and the examiner*, and that the sources of change in these tissue pressures are the combined respiratory and cardiovascular rhythms of both examiner and subject.

Norton explains:

> *A tissue pressure model was developed to provide a possible physiological basis for the manifestation of the Cranial Rhythmic Impulse, or CRI. The model assumes that the sensation described as the CRI is related to the activation of slowly adapting cutaneous mechanoreceptors, that the deforming forces stimulating these mechanoreceptors are the tissue pressures of both the examiner and the subject, and that the sources of changes in these tissue pressures are the combined respiratory and cardiovascular rhythms of both examiner and subject. This tissue pressure model utilizes well-documented relationships among vascular pressures, tissue pressures, and cardiovascular and respiratory rhythms. The model generates rhythmic impulses with frequencies and patterns similar to those reported for the CRI, and a significant correlation was found between frequencies calculated from the model and published values for CRI obtained using palpation. These comparisons suggest that the CRI may arise in soft tissues and represents a complex interaction of at least four different physiological rhythms.*

Box 2.2 Theories on proposed CRI and cranial motion mechanisms

- W Sutherland ('primary respiratory mechanism') (Sutherland 1939)
  Believed that involuntary brain motion generates pulse wave of CSF which causes movement of reciprocal tension membranes, dural meninges and thereby the cranial and sacral bones. Cranial motion itself is said to be dependent upon freedom of motion at the cranial articulations (sutures, etc.) and the patency of reciprocal tension membranes in the skull.
- C Lumsden (Lumsden 1951)
  Suggested that individual oligodendroglial cells pulsate, coil and uncoil, so influencing/propeling CSF. The rhythm and strength of these pulsations are, however, now thought to be too weak to initiate CRI mechanism.
- Y Moskalenko, E Cordoso et al, and D Feinberg (Moskalenko 1961, Cordoso et al 1983, Feinberg & Mark 1987)
  Various studies indicate rhythmic brain motility to be a normal physiological phenomenon, supporting the 'pressurestat' hypothesis. However, these pulsations are more rapid than CRI and seem to relate to the cardiac systolic pulse.
- H Magoun (Magoun 1976)
  Supported Sutherland's hypothesis. Proposed that direct electrical current or magnetic field was producing cyclical coiling/uncoiling of brain and neural structures. Believed that variations in production of CSF in choroid plexus can influence brain motility and therefore CRI.
- R Kappler (Kappler 1979)
  Suggested 'total body energy pattern' is being palpated rather than cranial rhythm only.
- J Upledger and J Vredevoogd (Upledger & Vredevoogd 1983)
  Adopted aspects of Magoun's CSF hypothesis and expanded it into a 'pressurestat' model in which CSF fluctuations are seen to be supported by both neurological and mechanical influences which together drive rhythmic brain motility, a reversal of roles described in Sutherland's hypothesis.
- A Ferguson (Ferguson 1991)
  Pointed out that CRI is palpable throughout body – simultaneously – and therefore was unlikely to relate to hydraulic 'pressurestat' mechanism in cranium; suggested muscular origin for palpable 'CRI' rhythm.
- J Norton (Norton et al 1992)
  Proposed that cutaneous tissue pressure factors determine the perceived CRI and that this pressure relates to cardiovascular and respiratory rhythms of both the subject and the examiner.
- A Degenhardt and M Kuchera (Degenhardt & Kuchera 1996)
  Proposed that intrinsic lymphatic contractility (distension of vessel walls, mediated neurally and humorally) could cause fascial impulse, palpated as CRI.
- J McPartland and E Mein (McPartland & Mein 1997)
  Suggested CRI is product of harmonic frequencies incorporating multiple biological rhythms, involving signals between subject and practitioner. Entrainment used therapeutically involves the 'rhythms' of the 'centered' practitioner dominating those of subject, harmonizing into composite 'new' CRI.

Box 2.3 Explanations – summary of arguments for and against the theories

- Central nervous system and brain have inherent motility which drives CSF/cranial mechanism.
  Rhythm of glial cell pulsations differs from CRI (McPartland & Mein 1997). Strength of contractions in brain too weak to drive CSF and rate not synchronous with CRI (Ferguson 1991, McPartland & Mein 1997). Too little CSF is produced per minute to have mechanical affect (Dove 1988, Ferguson 1991).
- Cranial bones allow motion throughout life.
  Suggested fusion of sphenobasilar synchondrosis by age 25 (*Gray's Anatomy* 1973) places doubt on validity of some aspects of cranial articular theory; however, there is no doubt of there being patent cranial motion at sutures throughout life (Kovich 1976, Retzlaff et al 1979, Retzlaff & Mitchell 1987). Inability of this synchondrosis to flex and extend – following fusion by age 25 – points to a need for an alternative motive force, externally driven, possibly by muscular involvement (Ferguson 1991).
- Reciprocal tension membranes (falx cerebri and tentorium cerebelli) formed from dural meninges connect with sacrum and involve this in cranial mechanism. The dural link to the sacrum requires 'considerable slack', otherwise spinal movement

Box continues

Box 2.3 Explanations – summary of arguments for and against the theories—*continued*

would be difficult or impossible, making this hypothesis an unlikely explanation (Ferguson 1991).

- Heart and respiratory rhythms drive CRI.
  Several studies now show poor correlation between CRI rhythm/rate and cardiovascular and respiratory activity (Norton 1992, Wirth-Patullo & Hayes 1994).
- Pressurestat model – hydraulic system driving cranial mechanism (Upledger & Vredevoogd 1983).
  Rhythmic brain motility is too fast to be linked to cranial rhythms of 6–12 per minute (McPartland & Mein 1997). Hydraulically driven mechanism unlikely explanation as CRIs can be palpated throughout body simultaneously (Ferguson 1991, McPartland & Mein 1997).
- Muscular (extracranial muscles) suggested as 'motor' for CRI (Ferguson 1991).
  Possibility is supported by various researchers – shown to be a likely candidate for (at least part of) driving force of CRI mechanisms (Becker 1977, Ferguson 1991, Kappler 1979, Norton et al 1992).
- Entrainment, involving harmonization of different biological oscillators (McPartland & Mein 1997).
  This possibility remains a strong contender for explanation of palpated CRI since it links both subject and operator characteristics.
- Lymph pump (Degenhardt & Kuchera 1996).
  Contractility of lymph vessels could produce CRI.

Norton's attempt to 'prove' his hypothesis using computerized simulation was unsuccessful, there being no strong correlation between the tissue pressure harmonic of patients and the perceived CRI when evaluated by cranial practitioners (Norton 1992).

Adding in the Traube-Hering-Mayer waves Norton's basic ideas have been adopted and adapted, notably by McPartland & Mein (1997), by including with Norton's model (involving the combined cardiovascular and respiratory rhythms, as well as palpatory pressures) additional features such as the Traube-Hering-Mayer oscillation (or wave). See further explanation of this evolution in the discussion of Entrainment, later in this chapter.

The Traube-Hering (TH) wave itself, which has a frequency of 6-10 cycles per minute, has been defined as: 'Slow oscillations in blood pressure usually extending over several respiratory cycles; related to variations in vasomotor tone; rhythmical variations in blood pressure' (Akselrod et al 1985).

Arterial blood pressure fluctuates rhythmically, with measurements showing two peaks, a high (15 cycles per minute) and a low (6 cpm). The high frequency is the Traube-Hering wave, which is associated with respiration and vagal parasympathetic activity, while the low frequency (Mayer wave) is linked to baroreceptors and chemoreceptors in the carotid sinus and aortic arch and to the sympathetic nervous system's control of the arterioles (Ganong 1997, Novak et al 1993, Turjanmaa et al 1990).

Recent confirmatory evidence of a link between THM and CRI It has recently been demonstrated that the CRI is palpably synchronous with the TH wave when measured by laser-Doppler flowmetry. On two separate occasions (using transonic laser-Doppler monitor BLF21 series), marked changes have been observed in the amplitude of the TH wave before and after cranial manipulative treatment (Sergueef et al 2001). These researchers, in a different publication relating to the same study, note:

> *Statistical comparisons demonstrated that the CRI is palpably concomitant with the low-frequency fluctuations of the THM oscillation.... This opens new potential explanations for the basic theoretical concepts of the physiologic mechanism of the CRI and cranial therapy. Comparison of the CRI with current understanding of the physiology of the THM oscillation is therefore warranted. Additionally, the recognition that these phenomena can be simultaneously monitored and recorded creates a new opportunity for further research into what is distinctive about the science and practice of osteopathic medicine. (Nelson et al 2001)*

The conclusion was that:

> *Cranial manipulation affects the blood-flow velocity oscillation in its low-frequency Traube-Hering-Mayer components. Because these low-frequency oscillations are mediated through parasympathetic and sympathetic activity, it is concluded that cranial manipulation affects the autonomic nervous system.*

Conclusion: The evidence for a link between 'tissue pressure', THM and CRI seems compelling, since it ties many loose ends together and does not raise major concerns. The multiple pulsations and harmonics of the body - both those of the patient and of the practitioner - may interact in a process described as entrainment. This is discussed further below.

What is clear, though, is that a model seems to be emerging in which the CRI, which has also been known (since Sutherland's time) as the primary respiratory mechanism, needs to be renamed as it is not a 'primary' mechanism, being more a secondary coalition of effects, with the motion palpated being less of a rhythmic 'impulse' and more of a rhythmic 'response'.

Prayer and THM oscillations Since respiration and sympathetic/parasympathetic balance are intimately bound up with the THM oscillations measured in these studies, it follows that they should be amenable to modification by measures that slow the breathing rate and reduce arousal/sympathetic activity.

A study that evaluated the effect of prayer and chanting concluded that this was an accurate supposition. Recent research has shown that the recitation of a rosary prayer ('Ave Maria' in Latin) or a yoga mantra results in a slowing of the breathing cycle to approximately six cycles per minute, along with synchronization of the Traube-Hering-Meyer oscillations. This influence on autonomic activity, represented by THM oscillations, may therefore be seen as having a profound influence on the CRI (Bernardi et al 2001). The cranial implications of breathing patterns are discussed in Box 2.4.

Box 2.4 Cranial implications of breathing pattern disorders

The research by Bernardi et al (2001) in relation to the link between THM waves and slower breathing patterns highlights some obvious, as well as a number of less obvious, potential connections between breathing patterns and cranial rhythms and function.

It is suggested that cranial practitioners pay renewed attention to breathing patterns and the demonstrable structural, functional and biochemical impact on cranial function and dysfunction deriving from habitual breathing pattern disorders (BPDs) – of which hyperventilation is an extreme (Chaitow et al 2002).

On a structural level an altered breathing pattern, such as upper chest breathing (as opposed to diaphragmatic respiration), inevitably alters accessory respiratory muscle (and fascial) function and structure (Garland 1994). A number of these implications are covered in Chapter 9 which examines treatment of key cranially associated muscles. Many of these muscles attach to the cranium, some capable of applying enormously powerful loads that cross sutures (sternomastoid, upper trapezius). How much this inhibits normal sutural flexibility remains to be established but it is clear that attempting to 'release' a sutural restriction that is affected by such muscular loads, without prior and appropriate attention to the muscular status, is likely to be relatively ineffective (Chaitow et al 2002).

Respiratory alkalinity effect on smooth muscle

The result of an increased ventilation rate (as occurs with BPDs, e.g. upper chest/non-diaphragmatic breathing), during which the rate of CO_2 exhalation exceeds the rate of its accumulation in the tissues, is respiratory alkalosis, characterized by a decrease in CO_2 (and therefore carbonic acid) and an increase in pH.

Lum (1987) notes that:

> *Cerebral vascular constriction, a primary response to hyperventilation, can reduce oxygen available to the brain by about* one-half. *Significant amounts of CO_2 can be lost in a few minutes of over-breathing, immediately causing respiratory alkalosis. Compensation, by excretion of bicarbonate, is relatively slow and may take hours or days.*

Box continues

Box 2.4 Cranial implications of breathing pattern disorders—*continued*

Goldstein (1996) concurs, stating that reduced cerebrovascular flow (rCBF) is the result of 'dysregulation of the vascular response to hyperventilation'.

Respiratory alkalosis induces vascular constriction, decreases blood flow and is commonly accompanied by reduced oxygen transfer from hemoglobin to tissue cells, due to the Bohr effect (Pryor & Prasad 2002). The Bohr effect states that an increase in alkalinity (decrease in CO_2) increases the affinity of hemoglobin for O_2.

Note: the lungs are more alkaline than the rest of the body, enhancing O_2 uptake. The hemoglobin carrier molecule is therefore less likely to release its oxygen in an alkaline environment such as prevails during respiratory alkalinity. Smooth muscle contraction reduces blood vessel caliber which directly influences vasomotion and therefore the rate of the THM waves and, by implication, the rate of the CRI (George 1961, Levitsky 1995).

Lum (1994) describes the resulting symptoms: 'cortical inhibition, emotional instability, generalized body tension and chronic inability to relax ... proneness to tetany (spasm) in muscles involved in 'attack posture' – they hunch their shoulders, thrust head and neck forward, scowl and clench their teeth.'

There are, however, potential cranial implications because of the presence, in fascia, of large numbers of smooth muscle cells.

Staubesand & Li (1996, 1997) studied fascia in humans with electron photomicroscopy and found smooth muscle cells widely embedded within the collagen fibers. They describe a rich intrafascial supply of capillaries, autonomic nerves and sensory nerve endings and concluded that these smooth muscle cells enable the autonomic nervous system to regulate a fascial pre-tension, independently of muscular tonus. There is also increasing interest in the possible effects SMC constriction may have in the many fascial/connective tissue structures – not excluding the reciprocal tension membranes within the skull and/or the dura - since the presence of smooth muscle cells with contractile abilities has now been identified in cartilage, ligaments and spinal disks (Ahluwalia 2001, Hastreite et al 2001, Murray & Spector 1999).

Additionally, an increase in pH (such as occurs during respiratory alkalinity) encourages fluid uptake by connective tissues, i.e. they swell, becoming denser and less pliable (Elden 1958, Jackson 1965).

The suggestion is that this new understanding of fascia, as an actively adapting organ, may have far-reaching clinical implications. Schleip (2003) notes that elevated pH, resulting from overbreathing, may produce smooth muscle contraction and even spasm in fascial tissues, so altering general fascial tone. The circulatory (and therefore cranial) implications of this are profound (Nakao et al 1997).

- The rate of arterial (and, to a much lesser degree, venous) motion on cranial rhythms has been discussed above, suggesting that the rate of vasomotion increases in smaller caliber vessels, as well as where systemic hypoxia is a feature (Bertuglia et al 1991). Since narrowing of blood vessel caliber (as a result of smooth muscle contraction), as well as relative hypoxia, occurs automatically and rapidly, as a sequel to a disordered breathing pattern, respiration should be evaluated and if possible rehabilitated, when dysfunctional, as a precursor to attempting to interpret or normalize cranial rhythms.
- The evidence that points to CSF drainage via the cribriform plate has been discussed above (Mollanji et al 2002, Silver et al 2002). The cribriform plate, lying as it does immediately anterior to an anchorage point for the falx cerebri, is clearly vulnerable to increases in local cranial fascial tension and behavior. Since fascia also forms the venous sinuses, via a folding of the dura, increase in fascial tension resulting from respiratory alkalosis is of potential significance. Can cranial treatment modify fascial structures such as the falx? Studies in 1992 by Kostopoulos & Keramides (1992) measured the forces required to lengthen the falx cerebri when anteriorly directed traction was applied to the frontal bone of an extremely fresh cadaver. Elastic response began at 140 grams and ended when viscous changes were noted at 642 grams traction on frontal bone. Falx cerebri lengthened by 1.097 mm with 642 grams traction. 140 grams – enough force to begin falx cerebri elongation – is equivalent to just over 4 ounces, an amount of pressure/effort commonly applied in cranial interventions.

How widespread are breathing pattern disorders?

Chronic hyperventilation can present with myriad respiratory, cardiac, neurological or GI symptoms, without any clinically apparent overbreathing by the patient. In the USA as many as 10% of patients in general internal medicine practices are reported to have hyperventilation syndrome as their primary diagnosis (Lum 1987, Newton 2001).

The number who are progressing toward that status is probably far higher, suggesting that features such as those described above are active in a large proportion of the general public, symptomatic or asymptomatic, with an unknown degree of influence on cranial function (Chaitow et al 2002).

A wider concept yet - McPartland ft *Mein's 'Entrainment' theory*

McPartland & Mein (1997) state:

> *We hypothesize that CRI is the perception of entrainment, a palpable harmonic frequency of multiple biological oscillators. These oscillators include cardiac pulse and heart rate variability, Traube-Hering modulation, diaphragmatic excursion, contractile lymphatic vessels, CSF production by the choroid plexus, pulsating glial cells, electrical fields generated by cortical neurons, cortical oxidative metabolism, and probably many other oscillators. Most of the oscillators, with the exception of the brain waves, can be easily transduced into tissue movement (i.e. palpable pulses in cardiac, smooth, and skeletal muscle, etc.) - the palpable CRI. ... If our hypothesis and findings from entrainment studies are true [see below], then the common denominator and underlying mechanism generating CRI is the balance between the sympathetic and parasympathetic nervous systems. If there is autonomic nervous system balance then the body's many rhythms harmonize into a strong, co-ordinated, sinusoidally fluctuating entrainment frequency, palpated by the practitioner as a strong healthy CRI. To wit, health as assessed by CRI becomes dependent on sympathovagal balance.*

All the rhythms of the body blend and merge to become one in this model, which takes elements from all other proposed mechanisms - Norton's tissue pressure, an oscillating brain and neural cells, CSF production, cardiovascular and respiratory influences along with muscular involvement - all resulting in CRI generation.

The principle underlying the evolution of this sequence of harmonizing events is 'entrainment', a concept which requires brief explanation.

Entrainment 'Entrainment is the integration or harmonization of oscillators', say McPartland & Mein (1997). They have equated the way in which different rhythms and pulsations pool to form the palpated CRI with a process observed in physics and in nature in which patterns or cycles tend to harmonize over time.

In physics they point to the example of pendulum clocks, in the same place, with the same length pendulum, starting to swing in synchrony with each other, a phenomenon described some 350 years ago by the developer of the pendulum clock, Christiaan Huygens (Strogatz & Stewart 1993).

Examples are given of something similar occurring in our bodies, such as the behavior of the cells in the pancreas which produce insulin or the rhythmicity of cardiac pacemaker cells (Llinas 1993). In nature, synchronization seems to take place between organisms which may involve a similar mechanism - crickets or cicadas producing their sounds in harmony or fireflies flashing synchronously.

The term used to describe the behavior of pendulums is 'entrainment'. The *Shorter Oxford English Dictionary* definition of 'entrain' is 'to drag away with, after oneself or 'the act of getting onto a train'. Either of these definitions gives a sense of what may be happening in the examples offered above, as one organism, function, cell or dominant activity begins to 'pull' or 'drag' others towards its mode of behavior and/or as the various disparate pulsating or moving patterns begin to harmonize they appear to 'get onto a train together'.

This, it is suggested, is what happens as the dozens, perhaps hundreds, of pulsating and oscillating impulses and signals emanating from the human body continuously throughout life integrate and blend to form the CRI, a personal, individual, probably variable harmonic end-point representing the individual's current health status. And clearly, if the palpated rhythm is an integrated harmonic involving both the palpating and the palpated individual, it will vary, making inter-rater agreement unlikely.

Therapeutic implications of entrainment If we are to make sense of the interaction of patient and practitioner in both the assessment and therapy stages of cranial (and many other) treatment settings, the understanding of a further implication of entrainment is suggested bv McPartland & Mein.

Huygens not only observed that pendulums eventually swung synchronously ('frequency-selective entrainment'); he also noted that there was a tendency for the heaviest pendulum to determine the frequency of the others ('frequency-pulling entrainment'). Even if it was unable to fully influence the other pendulums, the heaviest one would partially modify the others towards its own behavior pattern.

If a healthy, well-balanced practitioner/therapist, in a state which is calm, centered and focused (conditions implying a good degree of sympathetic/parasympathetic balance), applies cranial (or other) treatment with a therapeutic intent, this can be seen to be analagous to the 'heavy pendulum' and to offer the possibility of establishing a 'resonant bond', of an interaction which can influence, 'pull' or 'drag' the patient's dysfunctional state towards a more balanced and healthy state (Fig. 2.8).

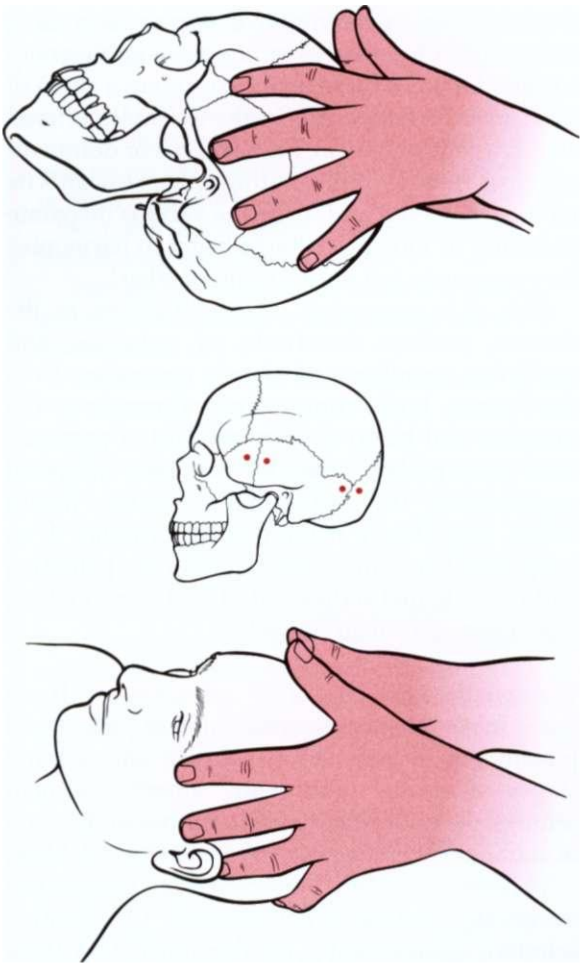

Figure 2.8 Vault hold for cranial palpation. Relative head and hand size may preclude precise replication of suggested sites for finger placement.

The fact that most cranial experts insist on the practitioner/therapist being calm, relaxed, centered, focused and with a clear intent, as they palpate CRI or apply craniosacral therapy, reinforces McPartland & Mein's suggestions. The need for the cranial practitioner/therapist to be in a calm and attentive state will be discussed further when therapeutic approaches are evaluated in later chapters and in 'energy' considerations elsewhere in this chapter (see Box 2.5).

Q. The question posed was: 'What are the primary forces moving cranial structures and so producing the CRI?'.

A. The many suggestions and answers offered by researchers and clinicians provide us with an opportunity to reflect on the complexity of the possibilities and to realize that at present we do not know, but that the harmonic entrainment concept embraces most of the individual suggestions that have been more or less discounted (motility of the brain, muscular influence, lymph, etc.).

Q. Is there a 'normal' CRI rate?

A. If the practitioner's influence on the CRI rate is as profound as is suggested by McPartland & Mein, then generalizations as to normality (or abnormality) are probably meaningless.

The evidence from numerous sources (Jealous, Norton, Becker, Podlas, etc.) seems to suggest that more than one CRI exists, with a slow, and very slow, pulsation underlying the more obvious (if subtle) CRI reported by the majority of researchers at a rate of approximately 6 cpm.

With so much disagreement, is there any point in palpating the CRI?

Doctors differ

The differing viewpoints as to what actually propels the craniosacral mechanism divide the leading exponents of these methods. We have seen that Upledger, one of the practitioners with the widest influence on craniosacral therapy via the training he offers through his Cranio-Sacral Institute, holds to the pressurestat model in which the CSF drives the brain's motion and thereby the whole craniosacral mechanism. Greenman, on the other hand, has the brain moving the CSF. And as noted above, there are many more possible explanations.

There seems little doubt that a cranial rhythmic impulse exists, although as yet it is not clear what this represents or what drives it. And if, as appears possible, there is no single intracranial driving force but instead a collection of interacting pulsations and rhythms, is palpating the CRI a pointless exercise?

Not necessarily, since whether we are palpating the result of a 'pressurestat' mechanism (Upledger & Vredevoogd) or a 'composite' of entrained rhythms (McPartland & Mein) or a combination of cardiovascular, diaphragmatic and glial cell pulsations combined with CSF fluctuation (Ettlinger & Gintis) or muscular influences at work (Ferguson) or Kuchera's lymphatic system pulsations, we are still palpating aspects of a subtle biological function (or a combination of functions) which may be useful as part of any qualitative clinical evaluation.

As British osteopath Andrew Ferguson puts it:

> *Palpating the CRI provides information as to the quality, ease, direction and vitality of muscular function. ... Assessment of this rhythm of interaction between patient and practitioner can provide qualitative information which may be reasonably consistent and useful ... but it is not in any way an objective rate that can be used for comparisons between practitioners.*

Each therapist/practitioner must evaluate for him/herself the relative value of the CRI. If useful cranial therapy application requires, as suggested by almost all cranial experts, an absolute requirement for stillness, centering and calm concentration, then the evaluation of the patient's CRI might offer just the meditative focus necessary to achieve this.

Important exercises

In the next section a number of cranial palpation exercises are presented in order to allow you to familiarize yourself with basic cranial palpation of the CRI in a number of settings, together with evaluation of the cranial sutures. Practicing these exercises will give a familiarity with the structures that are discussed in these early chapters.

These exercises were deliberately not placed in the bodies of Chapters 1 through 5, so that the flow of information, and the complex arguments and perspectives contained in them, is not interrupted. It is suggested that before going on to Chapter 3, anyone new to cranial methodology should practice these exercises (beginning on p. 51) to get a flavor of the degree of focus required to sense subtle motions in the cranium.

Energy

We have not so far included any discussion of energetic factors and in order to balance this omission, a brief review is called for - see Box 2.5.

Box 2.5 Energy considerations

These notes relating to research into energy potentials, in diagnostic and therapeutic settings, are to a large extent derived from the research of James Oschman, who has diligently explored this territory. It is difficult to do justice in summary form to the vast amount of information he has brought together and readers are strongly urged to revisit and review his original material (Oschman 1996/1997, 2000, 2003).

The following digest has to be both condensed and abbreviated due to space constraints, hence precluding detailed discussion of what are sometimes complicated and challenging revelations and concepts.

- Pre-1960s, the vast majority of research biologists and physicians regarded notions of energy medicine ('life force', etc.) as foolishness and undeserving of either attention or investigation, despite which a vast amount of early research and much anecdotal reporting had been accomplished (Oschman 1997b, 2000).
- In 1963, researchers at Syracuse University in New York announced the first measurement of the heart's magnetic field (Baule & McFee 1963).
- At about the same time, a number of scientists demonstrated that particles such as electrons could

Box continues

Box 2.5 Energy considerations—*continued*

behave as waves and pass through insulation materials, a phenomenon called tunneling (also known as the Josephson effect) (Josephson 1965). Thus, if a thin insulating barrier is placed between two superconductors, electrons will flow through the barrier. These observations form the basis for SQUID apparatus (Anderson & Rowell 1963) (see below).

- In the early 1970s, Zimmerman and colleagues developed an apparatus called a SQUID (superconducting quantum interference device) which could map biomagnetic fields around the body. Electromagnetic (biomagnetic) fields are produced whenever electricity flows through a conductor and these can be measured by SQUID devices (Figs 2.9, 2.10, 2.11).

  Electrical currents which occur in tissues and which pass along blood vessels, conducted by the high salt content of blood (which is why ECG readings are possible all over the body), therefore produce biomagnetic fields which may be measured in this way. These currents are initially produced by charged particles (ions of calcium, potassium, magnesium, sodium, chloride) (Zimmerman et al 1970).
- By 1974, earlier work by Burr (1957) had led to Friedenberg's definitive establishment that variations in ovulation could be determined by measurement of the electrical fields of the body (recorded between two fingers) (Friedenberg et al 1975).
- SQUID research has developed rapidly.

Measurement of biomagnetic fields of the heart and brain led to a veritable explosion of research into biomagnetics. It turned out that biomagnetic fields are often more indicative of events taking place within the body than are electrical measurement at the skin surface. For example biomagnetic fields produced by the brain pass undistorted through the cerebrospinal fluid (CSF), across the connective tissue covering of the brain (the dura), and through the skull bones and scalp. These tissues are virtually transparent to magnetic fields. In contrast, the electrical signals recorded with an EEG become distorted, smeared and decreased in strength by a factor of about 10 000 as they pass through the surrounding tissues. (Oschman 1997b)

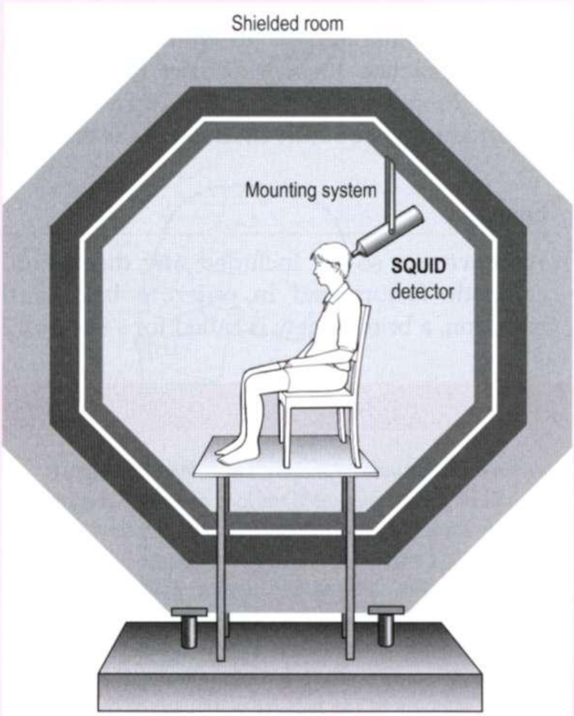

Figure 2.9 Method used to detect brain's magnetic field utilizing SQUID detector. (Redrawn from Fig. 4 in Oschman J 1997b What is healing energy? Part 2A Journal of Bodywork and Movement Therapies 1(2): 117–122.)

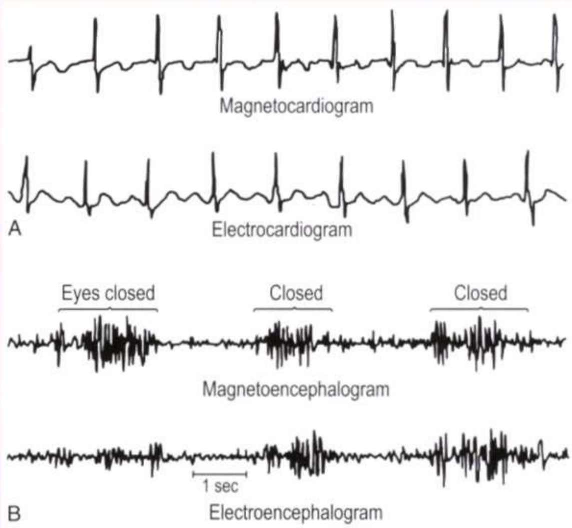

Figure 2.10 A Magnetocardiogram and electrocardiogram of the heart. B Brain's magnetic field and corresponding electrical field. (Redrawn from Figs 3 and 5 in Oschman J 1997b What is healing energy? Part 2A Journal of Bodywork and Movement Therapies 1(2): 117–122.)

Box 2.5 Energy considerations—*continued*

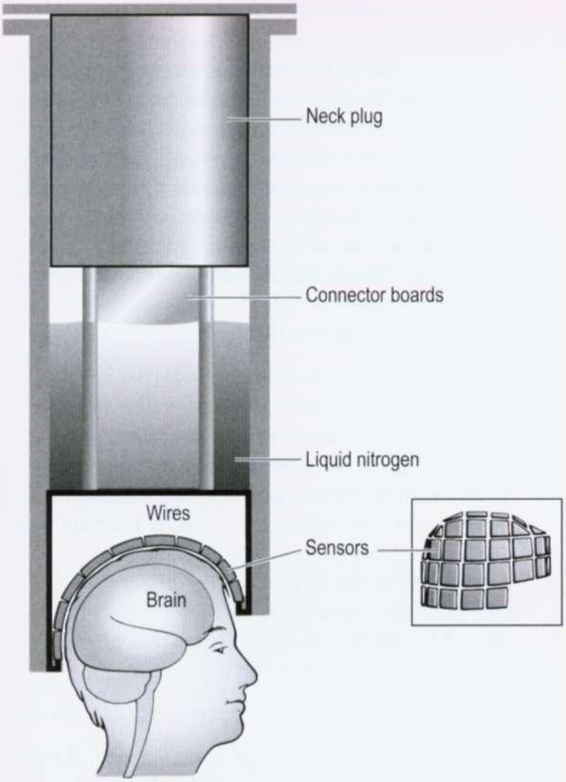

Figure 2.11 SQUID apparatus used to measure magnetic field of brain. (Redrawn from Fig. 6 in Oschman J 1997b What is healing energy? Part 2A Journal of Bodywork and Movement Therapies 1(2): 117–122.)

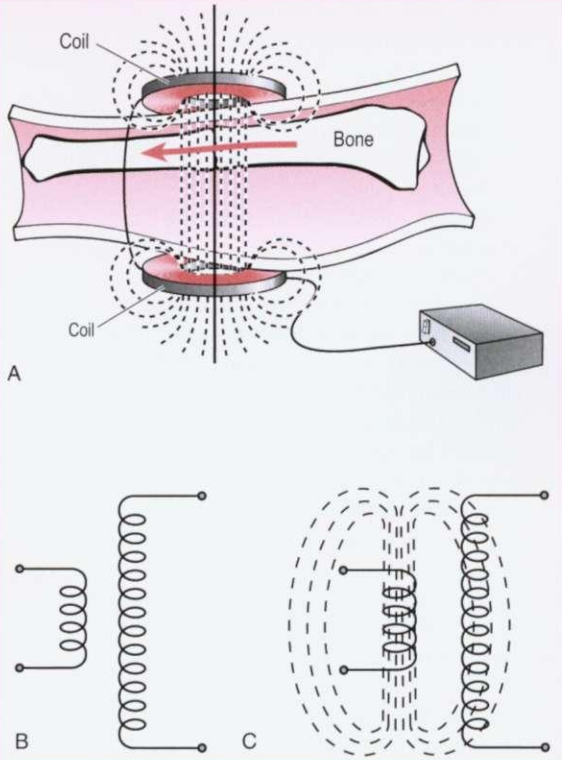

Figure 2.12 A Pulsed magnetic field therapy in treatment of bone fracture. B The flow of electricity through a coil (left) results in a magnetic field inducing the flow of current through the coil adjacent to it. (Parts A and B redrawn from Fig. 1 in Oschman J 1997b What is healing energy? Part 2B Journal of Bodywork and Movement Therapies 1(2): 123–128.)

- Research into brain activity of musicians who utilize fine hand movement (violinists, cellists, guitarists), using SQUID detectors, showed that brain wave patterns from specific areas of the brain were more intense and involved a greater surface area of the cortex in the musicians than in non-performers (Elbert et al 1995). Oschman, who reports on this study (Oschman 1997b), says:

  It would obviously be fascinating to know if repeatedly practicing 'hands-on' methods such as massage, Rolfing or structural integration, Trager, reflexology, acupuncture, shiatsu, QiGong, etc. enhances the biomagnetic output from corresponding areas of the brain, as it does for practicing musicians.

- In medicine, the use of pulsed electromagnetic field (PEMF) therapy has become commonplace in treatment, for example, of broken bones, as this process can 'jump start' the healing process (Bassett et al 1982) (see Fig. 2.12). Similar techniques are now being explored in treating soft tissues, with a review in 1995 indicating the following possible effects when extremely low frequency PEMF pulses were employed – precisely the fields recorded from the hands of 'healers', practitioners using therapeutic touch and related methods (Sisken & Walker 1995):

Box continues

Box 2.5 Energy considerations—*continued*

- Enhanced capillary formation
- Decreased necrosis
- Reduced swelling
- Pain reduction
- Improved recovery of function
- Skin wound reduction (in both depth and pain noted)
- Reduction in muscle loss following ligament surgery
- Improved tensile strength of ligaments
- Acceleration of nerve regeneration.

- Studies from the early 1980s onwards utilizing SQUID magnetometer technology examined the electromagnetic fields emanating from the hands of various healing professionals placed in a shielded chamber (to remove risk of contaminating fields). In a relaxed and meditative state, a therapeutic touch practitioner was recorded, demonstrating biomagnetic waves which pulsed from 0.3 Hz to 30 Hz, with most activity in the range of 7–8 Hz. In similar studies non-practitioners were unable to produce biomagnetic pulses (Zimmerman 1990).
- Japanese research has subsequently shown that biomagnetic fields in the region of 8–10 Hz regularly emanate from the hands of practitioners of various healing and martial arts, including yoga, QiGong, meditation, Zen, etc. These are the extremely low frequency (ELF) ranges utilized in assisting in the healing of soft tissues and bone, which suggests that the biomagnetic impulses produced by such therapists have a therapeutic potential (Seto et al 1992: Fig. 2.13).
- Further research from Israel shows that QiGong practitioners are capable of producing radiant (infrared) heat which increases cell growth DNA, protein synthesis and cell respiration (Muesham et al 1994).
- In trying to account for the means whereby healing can occur in hands-on settings, Oschman (1997a) explains the concept of entrainment:
  Physicists use this term [entrainment] to describe a situation in which two rhythms that have nearly the same frequency become coupled to each other, so that both have the same rhythm. Technically entrainment means the 'mutual phase-locking of two (or more) oscillators.'

  He continues by explaining:

  The question of whether living systems are sensitive to the earth's magnetic field has been bitterly controversial for more than a century. There are now a number of plausible and well-documented mechanisms for such interactions, and abundant evidence that they take place. ... Becker's (Becker 1991) research has shown how geomagnetic entrainment of the brain waves can affect the entire nervous system at a very high level of control, i.e. the perineural DC system that extends throughout the body and that has roles in regulating injury repair.

In our review of current concepts in craniosacral therapy we have noted that entrainment is one of the methods suggested to explain the influences of the practitioner/therapist on the patient and their CRI.

- There is now research evidence of the occurrence of entrainment of both the cardiac and brain rhythms of two individuals sitting quietly, facing each other, in

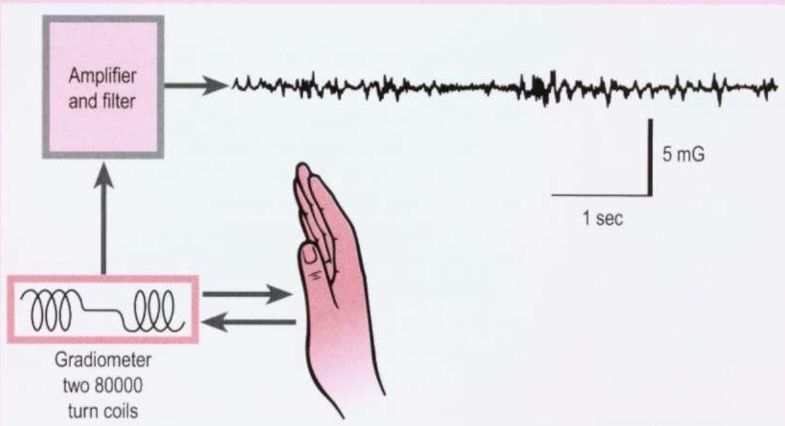

Figure 2.13 Biomagnetic measurement of an 'energy' (chi) emission from the hand of a Japanese female healer. (Redrawn from Fig. 4 in Oschman J 1997b What is healing energy? Part 2B Journal of Bodywork and Movement Therapies 1(2): 123–128.)

Box 2.5 Energy considerations—*continued*

the same room, with eyes closed and without touching; even more dramatically so when connection is enhanced by means of a wire being held in the left hand of one individual and the right hand of the other (Russek & Schwartz 1994).

- Oschman inquires:
  This approach opens the door to a variety of quantifiable studies of the healer–patient relationship in terms of energy coupling. If there is an entrainment of rhythms in two individuals who are not touching, what can we expect from commonly used therapeutic situations such as that used in cranial evaluation?

Solitons, tissue memory, soft tissue holography and quantum coherence In his most recent exploration of 'energy medicine', Oschman (2003) has brought together the remarkable earlier research of people such as:

- Davidov (1987): biological coherence and solitons (waves that carry large amounts of energy over distance, without loss) in biological systems
- Frohlich (1988): coherent emissions, such as light, as part of the regulatory process
- Brown (2000): microgenesis
- Hamerhoff (1988), Young (1975), Pribram (1969): tissue memory, holographic memory and many others – as well as the current thinking of pioneering researcher Mae-Wan Ho (1996).

The concept of biological communication systems emerge in which, in therapeutic terms, theories relating to energetic interchange and tissue memory are linked directly to the intuition, intent and the unconscious of the practitioner, irrespective of the technique being used (Ho 2003).

No attempt will be made here to summarize the information that Oschman has compiled. We hope that the individual reader's curiosity will lead to that exploration but one quote will allow a glimpse of the concepts and possibly where cranial methodology fits into it. Mae-Wan Ho explains the meaning of 'quantum coherence':

> *Organisms are made of strongly dipolar molecules packed tightly together in regular almost crystalline arrays. Large voltages are present. Electric and elastic forces cause the molecules in these arrays to vibrate. Because the structures are geometrically coherent, large collective modes or coherent excitations will develop. These are described as phonons [sound] or photons [light]. When the coherence builds to a certain level, a large-scale Frohlich wave is produced. In essence, the organism behaves as a single crystal. The anteroposterior axis is the optical axis for the whole organism. There is something very special about organic wholeness that is only describable in terms of quantum coherence.*

Conclusion The research data, summarized all too briefly above, touch the surface of the exploding interest in subtle energies. No definitive connection can be made between these research findings and what takes place during craniosacral therapy but much can be hypothesized. It is certain that 'energy' influences can no longer be discounted as nonsense when healing is being considered and that hands-on therapies in particular must take note of the potentials which exist for transmission of positive health-enhancing influences from therapist to patient.

It is relevant that in all examples of research into the production of biomagnetic healing, the therapist/practitioner/healer is in a calm, centered, meditative and focused state – just the state which the craniosacral operator is asked to achieve during evaluation of CRI and treatment of dysfunction. This evidence does not *prove* that energy factors are involved in craniosacral therapy but it certainly makes such a possibility more credible.

The next three chapters have been compiled by experts in the cranial field, evaluating a broad, emerging, integrated osteopathic perspective (Zachary Comeaux DO); a view of the more subtle osteopathic approaches (John McPartland DO); and cranial therapy examined from the chiropractic (SOT) point of view (Frank Pederick DC). In Ch. 11 the use of cranial methodologies in the context of dental practice is explained by John Laughlin DDS.

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Exercises: refining cranial palpation skills

CHAPTER CONTENTS

Exercise 1 To enhance awareness of palpated inherent tissue sensation

Time suggested 10 minutes

Frymann (1963) suggests that you sit at a table opposite a partner, one of whose arms rests on the table, flexor surface upwards. This arm should be totally relaxed. Place a hand onto that forearm with attention focused on what the palmar surfaces of the fingers are feeling. The other hand should lie on the firm table surface in order to provide a contrast reference as the living tissue is palpated, distinguishing a region in motion from one without motion. Your elbows should rest on the table so that no stress builds up in the arm or shoulders.

With eyes closed, concentration should then be projected into what the fingers are feeling, attuning to the arm surface. Gradually, focus should be brought to the deeper tissues under the skin as well, and finally to the underlying bone.

When structure has been well noted, the function of the tissues should be considered. Feel for pulsations and rhythms, periodically varying the pressure of the hand. At this stage Frymann urges you to: 'Pay no attention to the structure of skin or muscle or bone. Wait until you become aware of motion: observe and describe that motion, its nature, its direction, its

Exercise continues

Exercise 1 To enhance awareness of palpated inherent tissue sensation—*continued*

rhythm and amplitude, its consistency or its variation'.

This entire palpatory exercise should take not less than 5 minutes, ideally 10 minutes and should be repeated with the other hand to ensure that palpation skills are not one-sided.

Exercise 2 To enhance bilateral perception of palpated tissue sensation

Time suggested 5-10 minutes

When you have palpated an arm (or any other part of the body) to the point where you are clearly picking up sensations of motion and rhythmic pulsation, place your other hand on the other side of the same limb.

Is this hand picking up the same motions?

Are the sensations noted in each hand moving in the same direction, with the same rhythm and is there the same degree of amplitude to the motion?

In health they will be the same. When there is a difference it may represent the residual effects of trauma or some other form of dysfunction.

Exercise 3 To enhance perception of subtle sensations in neurally connected areas

Time suggested 5 minutes

Place one hand gently but fully on a spinal segment from which derives the neurological supply to an area which is simultaneously being palpated by the other hand.

By patiently focusing for some minutes - eyes closed - on what is being felt, Frymann states, 'a fluid wave will eventually be established between the two hands'.

Can you feel this or anything which approximates it?

Exercise 4 To discriminate between palpated sensations deriving from indirectly related areas

Time suggested 5-10 minutes

Frymann (1963) suggests that on another occasion (or at the same session) you palpate one limb with one hand (say the upper arm) and another limb (a thigh, for example) with the other and that you 'rest in stillness until you perceive the respective motions within'.

Ask yourself whether the rhythms you are feeling are synchronous and moving in the same direction. Are they consistent or do they undergo cyclical changes, periodically returning to the starting rhythmic pattern?

You may actually sense, she says, that the force being felt seems to carry your hands to a point beyond the confines of the body, pulling in one direction more than another, with little or no tendency to return to a balanced neutral position. This may represent a pattern established as a result of trauma which is still manifest in the tissues. Careful questioning might confirm the nature and direction of a blow or injury in the past.

Exercise 5 To discriminate between various sensations deriving from a palpated pulsation

suggests that palpation and assessment of obvious pulsating rhythms should be practiced, for example involving the cardiovascular pulses. He describes the first stages of this learning process thus:

> *With the subject lying comfortably supine, palpate the radial pulses. Feel the obvious peak of the pulsation. Tune in also to the rise and fall of the pressure gradient.*
>
> *How long is diastole?*
>
> *What is the quality of the rise of pulse pressure after diastole?*

Exercise 5 To discriminate between various sensations deriving from a palpated pulsation—*continued*

Is it sharp, gradual, smooth? How broad is the pressure peak?

Is the pressure descent rapid, gradual, smooth or stepped?

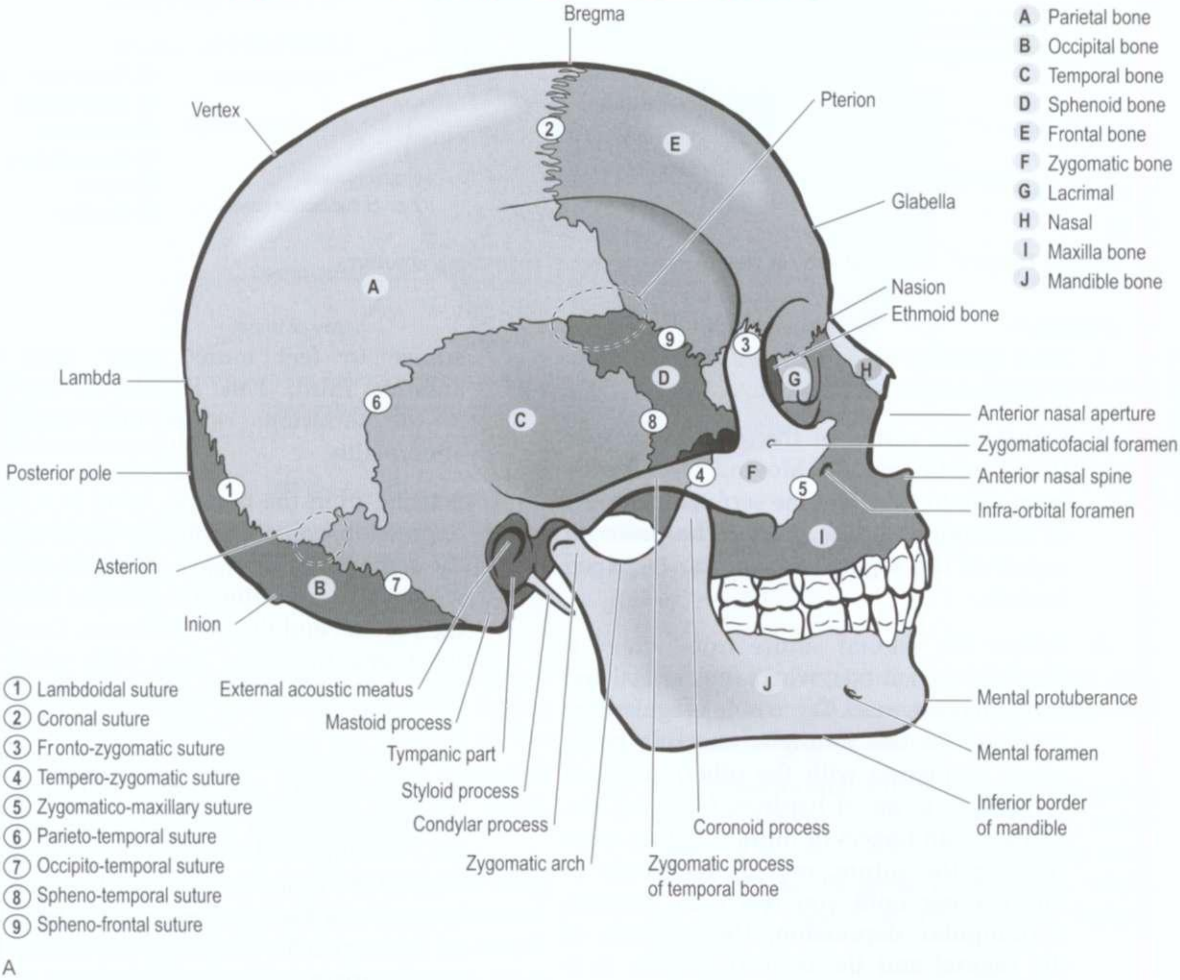
Memorize the feel of the subject's pulse so that you can reproduce it in your mind after you have broken actual physical contact with the subject's body. You should be able to mentally reproduce your palpatory perception of the pulse after you have broken contact.

Upledger then suggests you do the same thing with the carotid pulse and subsequently palpate both radial and carotid at the same time and compare them.

Exercise 6 Global suture palpation

Time suggested 10–15 minutes

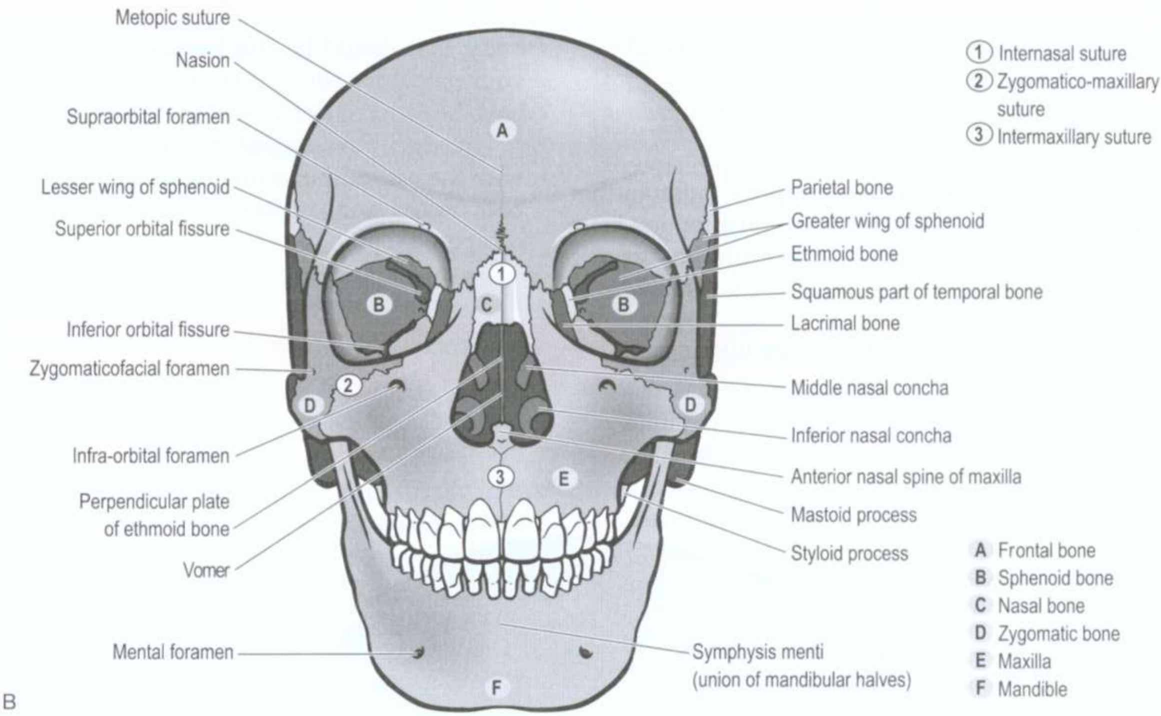
Greenman's cranial palpation exercise (supine) (see Exercise Figs 1A–E)



Exercise Figure 1 A Lateral view of the cranium and its major landmarks and sutures.

Exercise continues

Exercise 6 Global suture palpation—*continued*

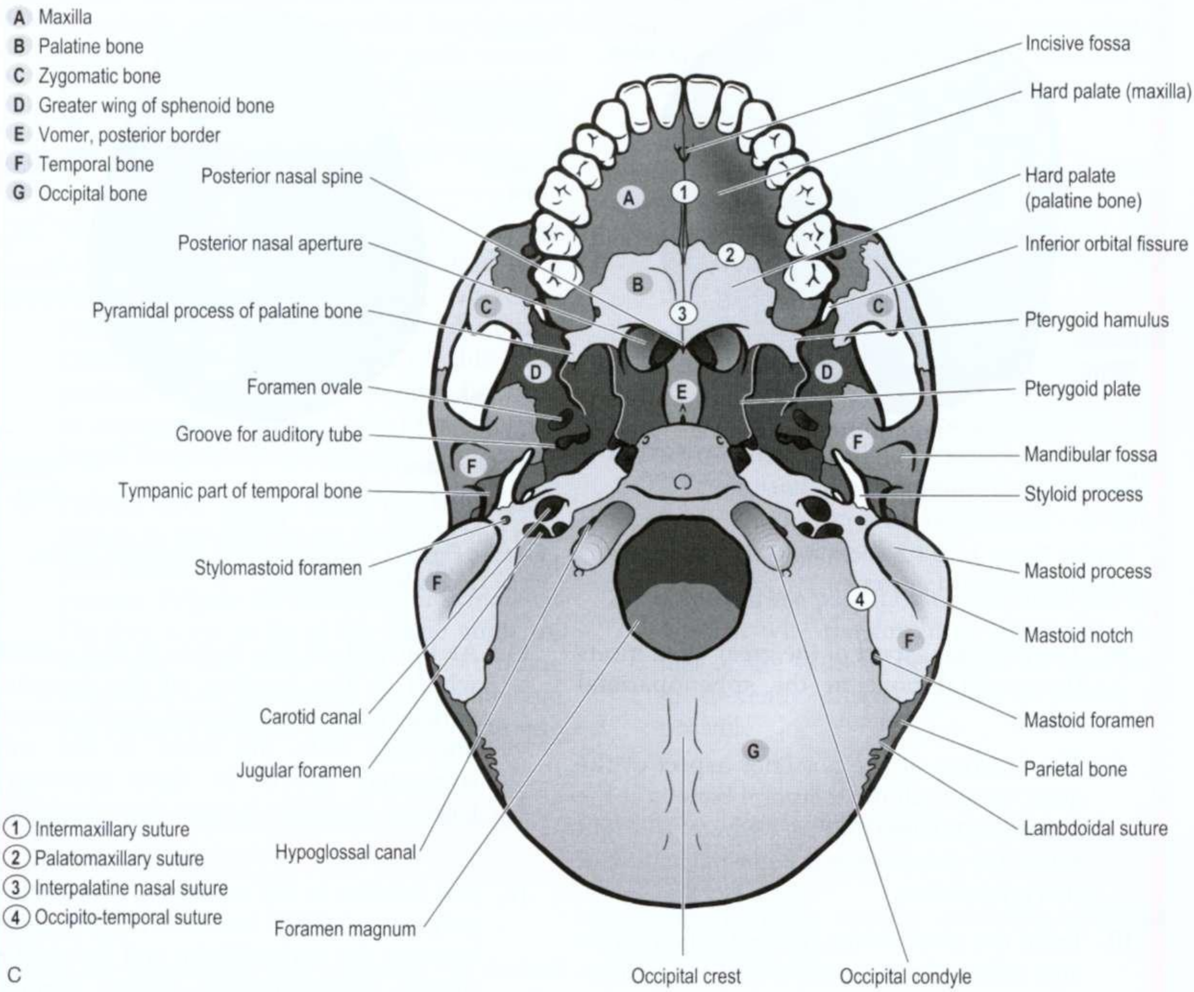


Exercise Figure 1 B Frontal view of cranium and its major landmarks and sutures.

1. Sit at the head of the table with your partner lying face upwards, no pillow.
2. Palpate the vertex of the skull with your thumb or fingerpads. Moving them gently from side to side, feel the serrated contours of the sagittal suture. Locate the posterior aspect of the sagittal suture, the L-shaped lambda.
3. Follow the sagittal suture from where it begins at the lambda, where the parietal and occipital bones meet. Try to note irregularities, asymmetries (for example, one side being raised compared with the other), areas of contrast in terms of hardness/softness, etc. Palpate with fingers or thumbs lightly criss-crossing the suture, moving anteriorly in this manner until you reach the bregma, a triangular depression, the junction of the sagittal and the coronal sutures. It is normal for the posterior third of the suture to feel more 'open' than the anterior third. This is due to the size of the serrations rather than being an abnormality.

Starting from the bregma, lying in a slight depression, palpate bilaterally (both ways at the same time) sideways along the coronal suture. You are feeling the junction between the parietal and the frontal bones. Compare what one fingerpad feels with what the other is sensing, trying to determine any indication of the frontal or the parietal bone being more prominent on one side compared with the other, assessing for irregularities, hard and soft areas, rigidity, etc., seeking evidence of any asymmetry. Pick (1999) describes the area between the bregma and the great wing as feeling 'like an open trench', as though the suture has 'spread apart'.

Exercise 6 Global suture palpation—*continued*



Exercise Figure 1 C Inferior view of cranium and its major landmarks and sutures.

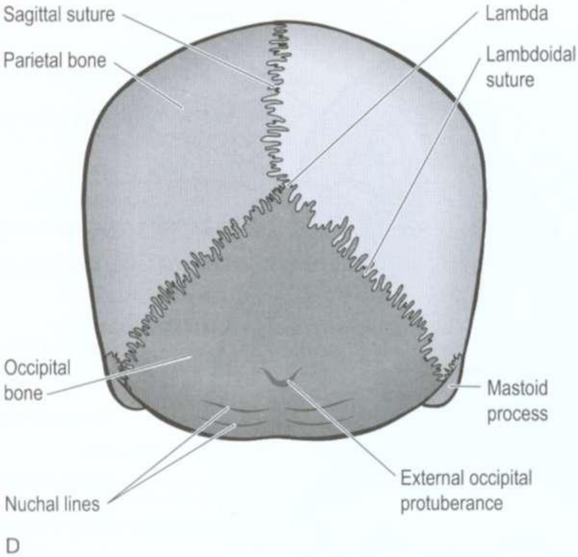
5. As you come to the end of the coronal suture you will feel a bony prominence and then a depression, the pterion, the junction of the sphenoid, frontal, parietal and temporal bones. Compare one side with the other, carefully, using a feather-light touch.

6. From the pterion move onto the great wing of the sphenoid and palpate its contours and sutures. This is a very important landmark in cranial methodology. Are the two sides of the sphenoid symmetrical; is one side higher or lower on the head? Is there any sense of one side being more 'rigid' than the other or more prominent?

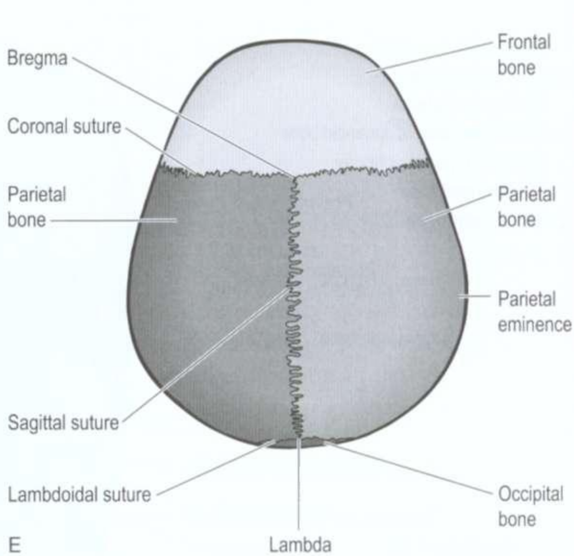
7. The sphenofrontal suture between the great wing of the sphenoid and the lower, outer aspect of the frontal bone is relatively easy to palpate as the great wing is flat, while the lateral aspect of frontal bone bulges laterally.

Exercise continues

Exercise 6 Global suture palpation—*continued*



Exercise Figure 1 D Posterior view of cranium and its major landmarks and sutures.



Exercise Figure 1 E Superior view of cranium and its major landmarks and sutures.

8. The superior aspect of the great wing meets the parietal bone at the sphenoparietal suture.
9. The junction of the posterior aspect of the great wing with the temporal bone is at the sphenosquamous suture, where a slight ridge-like prominence is a normal feature of this intersection.
10. From the great wings return to the pterion and follow the squamoparietal (or parieto-temporal) suture between the temporal squama and the parietal bone on each side. This travels backwards and curves over the ear. Use a light fingerpad contact on each side which gently, repetitively and thoughtfully travels superiorly and interiorly to cross and recross this border. Feel carefully (this is not an easy suture to locate) for the sense of greater fullness as the fingers move superiorly, where the parietal bone overlaps the temporal bone. Sense for irregularities on one side compared with the other, of a sense of rigidity or of soft tissue 'congestion', tension or fibrosis in the musculature.
11. At the end of this suture is the asterion, which is the junction of the temporal, parietal and occipital bones. Again compare one side with the other in the ways suggested above. Is there symmetry? Unusual rigidity? Is there any irregularity of feel?
12. Just anterior to the asterion it is possible to palpate a small amount of the suture between the parietal bone and the mastoid process (parietomastoid suture). Compare these for symmetry and irregularities and also for differences in the attachments of the sternomastoid muscles that apply such force at their attachment sites.
13. Moving back to the asterion, feel for the meeting place of the mastoid and the inferior edge of the occiput, the occipito-mastoid suture. This feels like a depression or furrow, running along the posteromedial border of the mastoid. Allow your fingers to follow the occipitomastoid suture until it is lost under the soft tissues inserting onto the cranium. Assess these soft tissues bilaterally for evenness of feel.

Exercise 6 Global suture palpation—*continued*

14. From the asterion move medially and superiorly along the serrated lambdoidal suture. Bilaterally using the same sutural evaluation method of crossing from side to side of the suture, evaluate for irregularities and asymmetries. It normally feels wide and open.
15. Your fingers will meet when you reach the L-shaped lambda, commonly sensed as a depression, lying on the midline, where the occipital bone meets the sagittal suture. Carefully evaluate the feel of this vital junction for evidence of crowding, distortion or asymmetry. This is close to where you began the palpation exercise.
16. Palpate back down, along the lambdoidal suture, to the asterion on each side and take your searching fingerpads onto the mastoid process. Palpate the mastoids for symmetry. Do they seem to lie at the same angle on each side? Are there signs of soft tissue imbalance (sternomastoid attachments here can produce marked differences of one side from the other)? Are they symmetrical in feel and do they have the same sense of ease when you lightly (half ounce maximum) ease them posteromedially or is one side more resistant?
17. Now move your hands to the face. Starting at the upper outer margin of the orbit, palpate laterally and interiorly until you feel the frontozygomatic suture, sensing for irregularities.
18. Follow the lateral aspect of the orbit until you find the zygomaticomaxillary suture.
19. Palpate medially along the inferior orbit and up the medial wall to feel the nasomaxillary junction and the frontomaxillary junction. Seek evidence of asymmetry and/or unusual tissue feel.
20. Repeat these palpation moves until you are familiar with the contours, landmarks and feel of the skull in people of all ages and in as many different states of health as possible.

Exercises 7a–7e Static (passive and kinetic) cranial suture palpation exercises – supine, seated and sidelying

Time suggested 20–25 minutes

There are suggestions that palpating the cranial sutures with the patient supine, as in the previous exercise, creates pressures that distort the accuracy of the findings, as well as making access to the posterior aspects of the cranium (lambdoidal suture, for example) more difficult. (Pick 1999). Pick notes: 'Gravity could conceivably initiate a compressive strain on the sutures touching the table ... and consequently cause a global articular fixation throughout the cranial vault'.

The sheer weight of the head, resting on the occipital bone, is seen as preventing normal sutural compliance during the palpation process. With the person seated and the practitioner standing at the front, back or side, access to the cranium is more readily available, without distorting pressures.

Exercise 7a Assessing gravity effect when palpating

Time suggested 2-3 minutes Before performing seated cranial palpation (Exercise 7b), Pick suggests that the supine position be adopted in order to appreciate the effect of weight/gravity on supine palpation.

1. The hands should be cupped to hold the supine patient's head. Does one side feel heavier than the other?
2. Rotate the head to face the side that feels lighter and sense the change in weight perceived by the supporting hands.

Exercise continues

Exercises 7a–7e Static (passive and kinetic) cranial suture palpation exercises – supine, seated and sidelying—*continued*

3. Return the head to the upright position and again note the change in perceived weight in the hands.
4. Gently elevate the head so that it is supported on your extended fingertips and note the degree of stress this causes over a short period as the effect of gravity acts on the mass of the cranium.

Exercise 7b Seated global suture palpation

Time suggested 5-7 minutes

1. Patient is seated and practitioner stands (or sits on a high stool) in front (slightly to one side) - see Exercise Figure 2A.
2. Palpation should start at the bregma and more or less follows the sequence described in Exercise 6, despite starting in a different place (i.e. at the bregma rather than the lambda).
3. The sutural palpation sequence should be: start at the bregma (see Exercise Fig. 2B) - palpate along the coronal suture to the pterion - then move onto the great wing of sphenoid and palpate its sutures with the frontal and parietal bones, as well as the sphenosquamous (aka sphenotemporal) suture - from the pterion palpate over the ear toward the asterion (finger movement should be superior-inferior-superior), following the squamoparietal suture (aka parietotemporal) - and from the asterion, move interiorly to the parietomastoid and occipitomastoid sutures, then back to the asterion and up the lambdoidal sutures to the lambda - then palpate along the parietal suture to return to the start, at the bregma. (For more detail of what to look for and what to expect, reread Exercise 6.)

The light to-and-fro, zig-zag motions of the palpating fingers or thumbs over the sutures and junctional unilateral (lambda, bregma) and bilateral landmarks (asterion, pterion, mastoids, etc.) should be constantly focused on key features such as asymmetry and altered sense of tone/tissue feel (hard/edematous, etc.). As with Exercise 6, the more people's heads that are palpated, of different ages, genders and states of health, the sooner awareness will be achieved as to what 'normal' feels like. This awareness becomes a foundational marker to be used for recognizing what feels abnormal, asymmetrical, unusual, questionable or frankly dysfunctional.

Exercise 7c Kinetic sutural palpation, left side (coronal and other sutures)

Time suggested 4-5 minutes Patient is sidelying on the right or supine, head on a cushion, with head turned to the right to examine the left side. The practitioner is on the patient's right, at head level.

The practitioner's cephalad (left) hand holds the head to support and stabilize it, with the fingerpads (usually index and/or middle) placed strategically to palpate whichever suture is being examined (see Exercise Fig. 2C).

For the coronal suture the left (palpation) hand rests so that the index and/or middle fingers lie on the left side of the coronal suture (see Exercise Fig. 2D), the thumb rests on the frontal bone.

The gloved right hand is placed so that the index and middle fingers (spread apart) are in contact with the crown surfaces of the posterior molars, allowing these contacts to be used to introduce rocking movements, from side to side or forward and backward, as motion at the suture is evaluated.

This is then compared with findings on the right side coronal (or other) suture being palpated, with all hand and patient positions reversed.

This same basic position can be used to palpate motion at the sphenofrontal, spheno-parietal, sphenosquamous, squamoparietal and even the parietomastoid sutures, by altering the palpating left hand contacts to rest on the appropriate suture, as the same rocking motion is introduced via the action of the right hand contacts on the maxillae.

Exercises 7a–7e Static (passive and kinetic) cranial suture palpation exercises – supine, seated and sidelying—*continued*

Exercise 7d Occipitomastoid suture

Time suggested 4–5 minutes Patient is sidelying on the right or supine, head on a cushion, with head turned to the right to examine the left occipitomastoid suture.

The practitioner is on the patient's right, at head level. The practitioner's cephalad (left) hand holds the occiput to support and stabilize it, with thumb placed strategically to palpate the left occipitomastoid suture (see Exercise Fig. 2E).

The gloved right hand is placed so that the index and middle fingers (spread apart) are in contact with the crown surfaces of the posterior molars, allowing these contacts to be used to introduce rocking movements, from side to side or forward and backward, as motion at the suture is evaluated.

The right suture is assessed with all patient and practitioner positions, as described above, reversed.

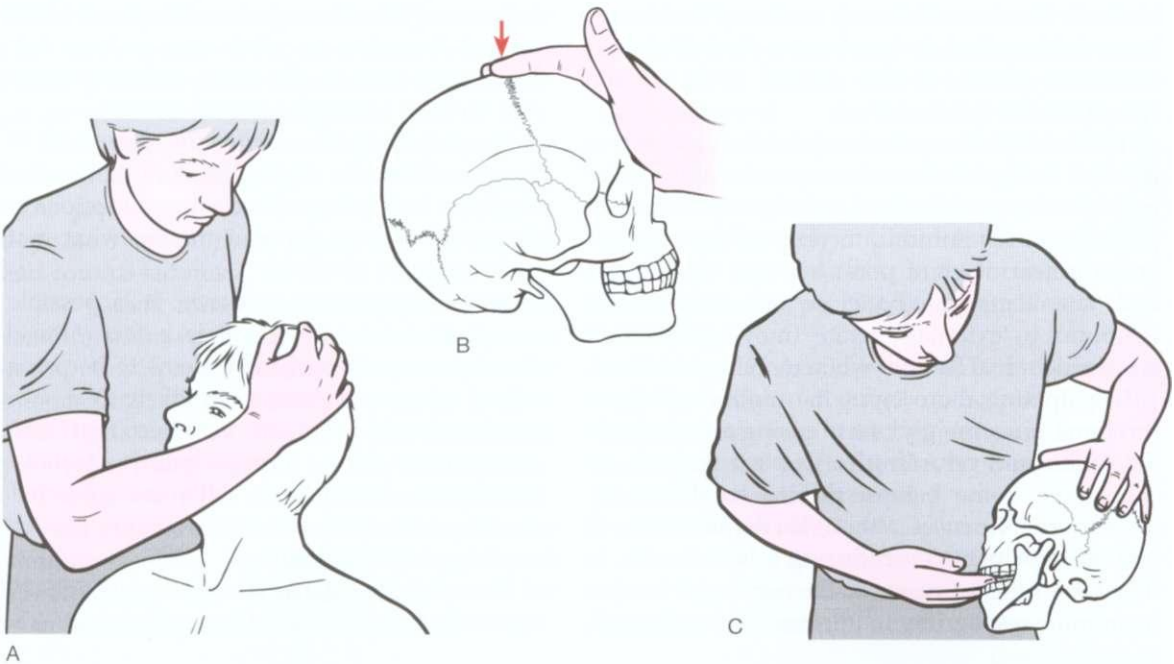
Exercise 7e Sagittal suture

Time suggested 4–5 minutes The patient is supine, head on a cushion. The practitioner is on the patient's right, at shoulder level.

The practitioner's cephalad (left) hand holds the head, thenar eminence resting on the patient's right temporal bone, with the index, middle and ring fingerpads placed strategically to palpate the anterior or posterior aspects of the sagittal suture (see Exercise Fig. 2F).

The gloved right hand is placed so that the index and middle fingers (spread apart) are in contact with the crown surfaces of the posterior molars, allowing these contacts to be used to introduce rocking movements, from side to side or forward and backward, as motion at the suture is evaluated.

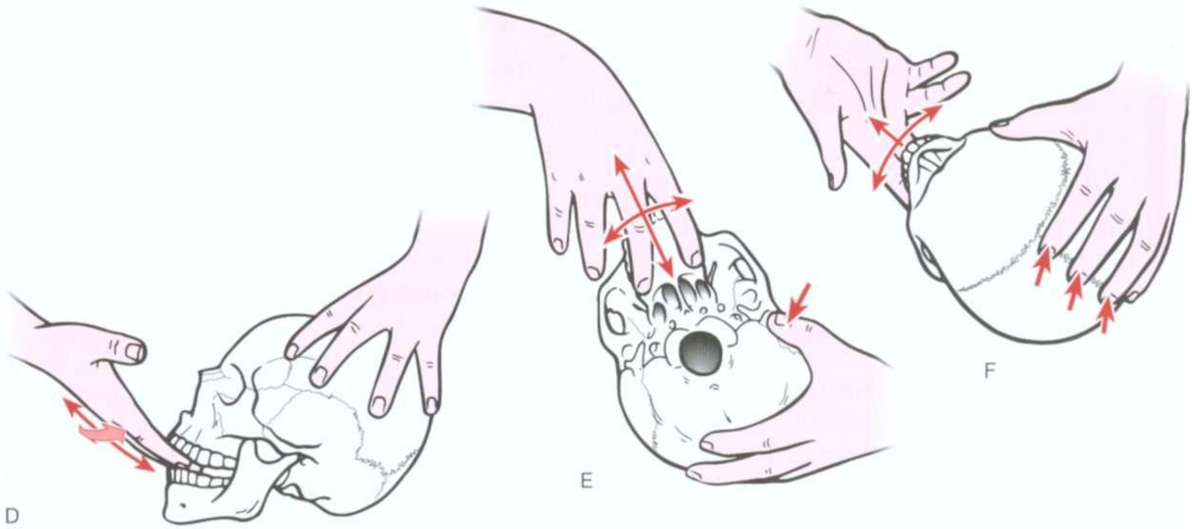
The anterior and posterior half, or any local feature, of the suture should be evaluated for a sense of motion as the maxillary contacts introduce rocking motions.



Exercise Figure 2 **A** Position for palpation of cranium with patient seated, practitioner standing. **B** Position of hand to help locate the bregma. **C** Examiner's position relative to patient for sidelying passive kinetic palpatory examination of the cranial vault. (Redrawn with permission from Pick M 1999 Cranial sutures: analysis, morphology and manipulative strategies. Eastland Press, Seattle.)

Exercise continues

Exercises 7a–7e Static (passive and kinetic) cranial suture palpation exercises – supine, seated and sidelying—*continued*



Exercise Figure 2 D Hand positions for passive kinetic palpatory examination of the coronal suture. E Hand positions for passive kinetic palpatory examination of the occipitomastoid suture. F Passive kinetic palpation of sagittal suture. (Redrawn with permission from Pick M 1999 Cranial sutures: analysis, morphology and manipulative strategies. Eastland Press, Seattle.)

Notes on cranial motion and palpatory accuracy

In classic craniosacral theory, motion of the cranial bones is described as involving a flexion and an extension phase of the cranial cycle at the sphenobasilar synchondrosis.

The concept of any flexion potential at all at this junction in the adult remains questionable. There is, however, an undoubted - if minute - degree of pliability at the sutural junctions of the cranium and a powerful pivot point between the occiput and the temporal bone, which allows the temporals to 'externally rotate' (moving into what is termed cranial flexion) when mobility is normal.

In palpating the occiput the motion noted, of this bone, is seemingly one of easing anteriorly on inhalation and returning to its start position on exhalation. Some believe this to be driven by respiratory influences, although a definite sense of motion is palpable even during a held breath. Is this due to the influence of the reciprocal tension membrane responding to intrinsic brain, glial cell, CSF and other pulsations/motions? Or is it a more direct response to muscular or circulatory/fluid influences? The discussions in Chapter 2 will have offered thoughts on what may or may not be happening and on the many different opinions and theories relating to cranial motion.

In palpating the bones of the skull it is suggested that the slight degree of motion that is available be felt for, with no preconceptions as to degree or rate or, for that matter, what motive force might be involved.

Based on research evidence, it is possible to accept that sutural motion is a fact. However, since a sense of movement seems to be palpable where osseous motion is unlikely (e.g. at the synchondrosis) we need to reflect that manual assessment skills remain poorly tested by researchers. When such skills are subjected to scrutiny both inter- and intraexaminer results are anything but encouraging.

For example, McPartland & Goodridge (1997) report that less than 30 interexaminer studies have been published involving palpatory diagnosis. Most of these studies evaluate 'traditional' palpatory tests (assessments performed at a single joint articulation as used by clinicians to determine the need for joint manipulation) using up to four criteria: joint tenderness; symmetry of position; range of motion (ROM); and tissue texture change. In examination of range of motion at C1-C2 segments, only a slight degree of agreement was noted amongst senior chiropractic students. Osteopathic students and professors fare no better in similar studies.

Where cranial palpation is concerned, Hartman & Norton (2002) report an almost non-existent degree of interexaminer agreement.

If it is possible to achieve only modest agreement amongst highly skilled practitioners (or even none) in assessing range of motion changes in mobile structures, should we not pause before accepting any sense of movement at all in structures where movement is measured in microns?

What is undeniable, based on the research discussed in Chapter 2, is that there is a degree of cranial motion available at the sutures. This falls into a range that is palpable. What significance sutural mobility has on health, when absent, is as yet unproven, despite the impressive results achieved by cranial practitioners and therapists for over half a century.

Where palpation of CRI (see below) is concerned, it is as well to recall the suggestion (see Ch. 2) that what is being palpated relates to an interaction between yourself and the patient, making interrater reliability unlikely. It is suggested that this does not discredit, nor should it preclude, such palpation.

Exercise 8 Cranial vault palpation for cranial motion

Time suggested not less than 10 minutes

The patient is supine and you are at the head of the table, thumbs resting on the bregma, finger-pads on the parietals, superior to the suture and carefully avoiding the temporal articulation with the parietals (see Exercise Fig. 3).

The hands will palpate, stabilize and monitor as well as allowing the thumbs to apply light pressure to the bregma, the triangular depression which is the junction of the sagittal and coronal sutures.

The patient inhales very deeply and, at the same time, moves the feet into dorsiflexion, as you apply palpatory pressure (grams only) to the bregma (this is achieved by pressing the heels of your hands together, which lifts the parietals and presses the thumbs gently against the bregma).

On exhalation the patient is asked to plantarflex the feet, as your hand contacts monitor the motions resulting from the fascial tug caused by inhalation and dorsiflexion, followed by exhalation and plantarflexion.

A wave-like sensation is being looked for in the cranial structures as these movements and functions produce their influences. If the falx cerebelli is restricted and there is a depressed cranial bowl, this wave-like motion will be less easily achieved.

Additional fascial maneuvers which amplify the effects can include clenching of fists on inhalation, tightening of abdominal muscles, using one foot only or alternating foot involvement in the process and/or introducing sucking (thumb/pacifier, etc.) coincidental with inhalation.

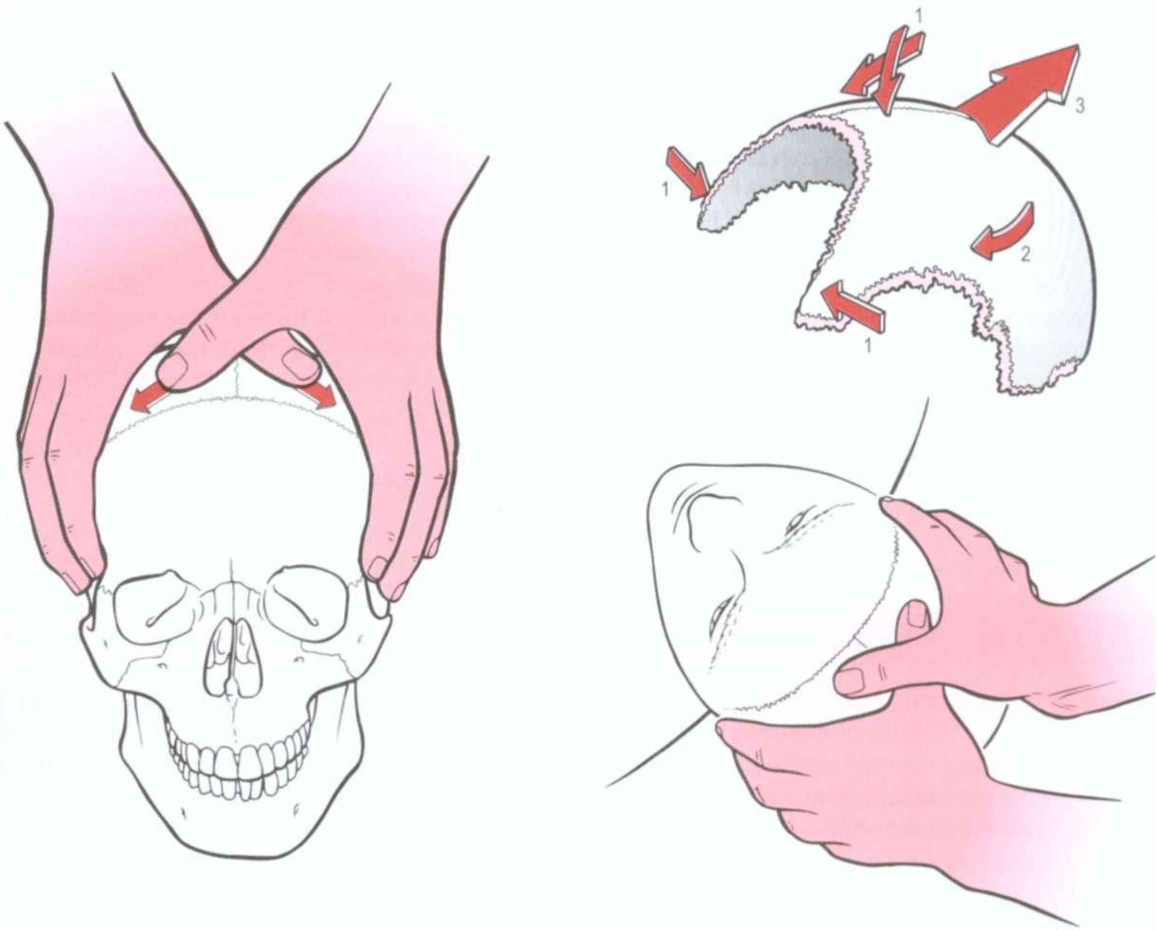
The motion should be felt at both the bregma and the occiput. As well as palpating at the bregma with your thumbs, you can alter your hand position to cradle the occiput while the thumbs rest on the bregma.

What do you feel?

How do you account for the movements you sense other than as a result of fascial and/or muscular influences?

Exercise continues

Exercise 8 Cranial vault palpation for cranial motion—*continued*



Exercise Figure 3 Fingers should be placed superior to the temporal suture with the parietals and the thumb either directly onto the bregma or, as a variation, crossed (as in the figure) and lying on the parietal bones close to the bregma.

Exercise 9 Cranial rhythmic impulse (CRI) palpation

Time suggested not less than 10 minutes

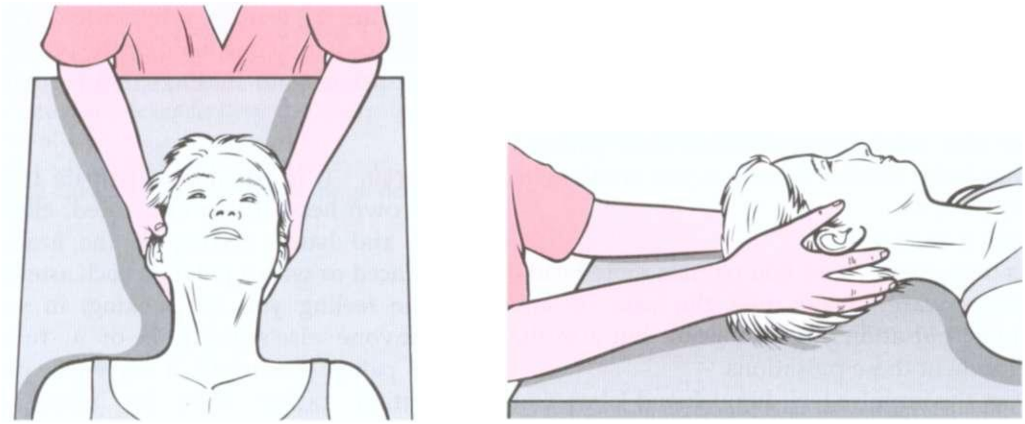
The 'normal' CRI rate remains a matter for debate (see Ch. 2) and it is suggested that you try to perform this exercise with no preconceptions as to what you might sense or feel.

To accomplish palpation of CRI you need to be relaxed, focused and centered.

The amount of contact pressure required to accomplish CRI palpation is around 5 grams.

CRI is said to best be felt at the parieto-temporal squama, using what is known as the vault hold 9 (see Exercise Fig. 4). This is achieved with the palms centered on the posterior surface of the parietal bones. The fingers are usually placed so that the small finger rests on the occipital bone, the ring and middle finger are resting one behind and one in front of the ear, with the index finger on the great wings of the sphenoid, thumbs crossed and supporting each other, but not in contact with the head. (Exercise Fig. 4 shows a variation on this hand position, thumbs resting on the great wing.)

Exercise 9 Cranial rhythmic impulse (CRI) palpation—*continued*



Exercise Figure 4 Hand placement for palpation of cranial rhythmic impulse. Note that the forearms are supported by the table to prevent undue fatigue.

It is important that your forearms are supported on the table, your feet flat on the floor, eyes closed, with all tension in the shoulders, arms and hands eliminated.

Spend the first 2-3 minutes noting the various pulsations and subtle motions under your hands, both cardiovascular and respiratory and possibly others.

After several minutes bring the focus of your attention to the motions of the head in relation to respiration only.

Have your patient/partner breathe normally as well as, at times, with increased emphasis on inhalation and/or exhalation.

Compare what you feel as the breathing pattern alters.

Have the person hold the breath for 10-15 seconds and again see whether you notice any difference in the motions under your hands.

Then for a minute or two screen out respiratory motion and try to pick up subtle cardiovascular pulsations.

Now screen out and temporarily ignore both cardiovascular and respiratory motions and see what else you can feel in the background.

Imagine that your hands are totally molded to the head, without more than a few grams of pressure and with this whole hand contact shift your focus to the proprioceptors in your wrists and lower arms. Sense what these, rather than the neural receptors in your hands, are feeling.

Magnify in this way the very small amount of actual cranial motion available for palpation and you might gradually begin to feel as though quite a considerable degree of motion is taking place, as though the entire head were expanding and contracting laterally to a very slow rhythm, unrelated to cardiovascular or respiratory function, anything from 4 to 10 times per minute (or more?). A faint, wave-like 'pushing' might be noted.

At this stage trust what you feel uncritically. Can you sense a rhythm?

Can you describe what you feel in words?

Is there a periodic 'prickling' or pressure sensation in the palms of the hand?

Does it feel like a 'tide' coming in and then receding?

What words would you use to describe what you feel?

Once you are sensing a rhythmic impulse start to time it by counting silently to yourself as each impulse begins ('one-hundred', 'two-hundred', etc. counts roughly a second at a time).

Remember what the count was as the sensation appeared and as it receded and later,

Exercise continues

Exercise 9 Cranial rhythmic impulse (CRI) palpation—*continued*

after the exercise, count at the same rate and check the number of seconds it takes from the start of one cranial impulse to the start of the next. Work out the rate per minute.

See also what happens when your patient/partner holds his/her breath as you continue to assess the CRI.

Does it change?

As time goes by and you palpate more heads, become aware of not just the rate of any rhythmic pulsation you may sense but also the amplitude of these pulsations.

Does the impulse feel sluggish and labored or energetic and brisk or something else?

And are the feelings symmetrical or is there a difference felt by one hand or the other?

Record all your findings in a journal or onto tape.

Variation It is possible to palpate the CRI on your own head if you are seated, elbows on a table and hands resting on the head, fingers interlaced or with a palm on each asterion.

The feeling you are seeking, in your own or anyone else's head, is of a 'fullness' in your palms, a warmth, a wave-like pushing, a sensation rather than an actual osseous movement.

Exercise 10 Cranial motion and CRI palpation

Time suggested not less than 10 minutes

Once you feel competent at sensing CRIs, of being able to count the rate and sense the amplitude - whatever the origin of the rhythm you are sensing - try a different approach. This time perform palpation of the head using a different hold.

The tips of the ring and little fingers should be placed on the occipital bone. The middle and index fingers rest on the mastoid bone and the thumbs are resting gently on the parietal bones.

Using your fingertip contacts to assess motion, ask yourself whether you sense a very slight dipping forward of the occiput at any stage of the cranial rhythmic pulsation - as lateral expansion occurs, producing a sense of increasing 'fullness' in the palms.

Does this 'fullness' slowly recede periodically, as the head 'narrows' again?

Can you, through the available contact of your middle and index fingers (resting on the mastoid bone and temporal bone respectively), sense what is happening to these during the various phases of the cranial cycle?

Do you have any sense of a change in the tissues under these very light but adherent contacts?

Describe this in your journal or onto tape.

And can you, through your thumb contact, sense what the parietal bones are doing during the cycles of rhythmic activity which your palms and (perhaps) other finger contacts are sensing?

Describe this as well.

What can you sense when the subject is breathing lightly, as well as when they are deliberately breathing deeply and when they hold their breath?

What do these finger contacts sense when you ask the subject to periodically dorsiflex and plantarflex the feet, at the same time or only on one side?

Can you sense osseous motion in response to the fascial pulls that these movements exert at any of the contacts or only at one or some?

Suggestion As you begin to explore these cranial palpation and assessment sensations, it is suggested that you keep a journal of your feelings and findings, as well as the answers to the queries posed in the exercise descriptions. By referring back to the words you use to describe your first tentative explorations you will note the progress you are making, as time passes and practice produces palpatory literacy.

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Chapter 3

Integration with medicine – the scope of cranial work

Zachary Comeaux

CHAPTER CONTENTS

INTRODUCTION

Historical perspective

As indicated in Chapter 1, the modern beginnings of cranial manipulation derive from the osteopathic tradition as interpreted by William Garner Sutherland. And so, in part, the scope of cranial work is embedded in that of osteopathic medicine. Yet many in the osteopathic profession in general have been slow to accept and implement this point of view. Despite osteopathy's ambivalence, a variety of manual practitioners have been attracted to and have developed aspects of cranial manipulation. Historically, then, many practitioners have practiced cranial technique outside their culture's definition of 'medicine'.

In a parallel development, those practitioners working in manual medicine, physical medicine and rehabilitation, sports medicine and American osteopathic medicine have to varying degrees integrated manual philosophy and techniques into orthopedic and disease model medical problem solving. This chapter deals with the sometimes controversial topic of osteopathic medical integration and its relevance in cranial work both in America and Europe. It also addresses the issue of how this integration affects the definition of treatment goals and the choice of techniques.

Historically, the scope of osteopathic work and thought has developed nearly independently on different continents and varied in its expression even within countries. Despite common inspirations, there has been variation in philosophical focus. In several quarters the search has concentrated on finding and treating the 'osteopathic lesion', which has been variously defined. The emphasis has often been on the articular components of the body, the joints. More recently, at least in American circles and in that sphere of influence, the goal of treatment has been to identify and treat somatic dysfunction, defined as an impairment of body function caused by structural distortion but possibly involving other body systems. These may be due to congenital conditions or may be acquired through trauma, strain or adaptation. This represents an approach that is broader than a biomechanical one.

In other settings, including among the students of J M Littlejohn DO, the British physician who worked with the founder of osteopathy, A T Still and who propagated osteopathy beyond America, there has been considerable focus on normalizing physiology and function. (Littlejohn's point of view will be discussed further below.) In this setting a general protocol is often used in which any variation from normal is corrected until the whole works more harmoniously. Currently there exists a muddle of methods and schools in the USA, Europe and Australia, competing for attention in defining what is and what is not an osteopathic treatment approach. The point being made is that priorities in intent of treatment have shifted with time, depending on how one defines the patient's problem - i.e. is it structural or functional?

As implied above, the scope of osteopathic practice has varied according to cultural and political setting. Early in its history in America, the osteopathic profession fought for, and received, legal recognition as a fully privileged profession on a par with medical doctors. Partly this occurred because of the strong contribution to health care given to communities in the rural mid-West where the profession arose. Through these events, osteopathic medicine has assimilated and contributed to many protocols in standard medical practice, since its practitioners were free to practice the full scope of medicine. Whether this development is viewed as an advance or as a corruption of pure osteopathy has been bitterly debated but it remains as a fact, influencing the health care of millions of people.

The progression toward legal recognition and licensure of osteopathy has been variable throughout the world and continues to evolve. These different national or regional expressions of osteopathic philosophy have fostered different opinions about the integration of medical concepts into osteopathic practice.

Additionally, in the USA, the separation of John Upledger DO from the greater osteopathic professional community, in teaching craniosacral therapy to the general professional and lay public, has served as a stimulus for the osteopathic profession to be more proactive in teaching cranial methods, while making treatment available to a broader population. With these events, however, has come a greater variation in medical competency or commitment to osteopathic principles among those treating under the name 'cranial'. Craniosacral therapists come from many backgrounds and apply craniosacral principles to complement other aspects of their work. Since they are not necessarily medically trained, their awareness of other aspects of the patient's medical condition will be highly variable.

Chiropractic is another practice tradition that has included the cranial area in its treatment protocol. Although many practitioners incorporate the methods taught as craniosacral therapy, a derived system of sacro-occipital technique (SOT) has evolved out of the work of Bertrand Dejarnette (Dejarnette 1934, 1935) who blended Sutherland's original research with his own systematic thought. Dejarnette's work then was incorporated into the system of applied kinesiology, as formulated by George Goodheart and adapted by others. The latter method varied from manual diagnosis by adding formulaic testing protocols, simultaneously with active muscle testing, in making diagnoses (Walther 1988) (see Ch. 5).

And so, it becomes apparent that cranial work in particular has been introduced into practice differently, at numerous locations and times. Hence, the flavor and particulars of application of the work vary according to the intent and bias of the introductory contact, teaching in new cultural contexts, as well as the practical needs and professional definition of the students. This leads to the certainty that there is no single authoritative voice for cranial practice. There is no 'right' or 'wrong' cranial approach, whether it is biomechanical in its focus and methodology or more 'energy' oriented. At present, despite heated debate, neither of these extremes has a clear evidence base and both seem equally effective in clinical practice, when appropriately applied.

Current focus

This chapter aims to clarify an appreciation of the development of cranial manipulation as it evolved in an osteopathic context and to provide an opportunity for the reader to reflect on the potential scope of application of cranial concepts in his/her own particular health-care practice. Of special relevance is the interface between osteopathic philosophy and contemporary medicine as it affects cranial practices. The particular issue of integrated osteopathic thought and how it affects perceptions, judgments and treatment strategies in applying cranial concepts will be addressed in a cultural and historic review.

- Does the head behave according to its own set of dynamics or is it part of the rest of the body?
- What are the clinical consequences of one (cranial) approach or another likely to be?
- Should the focus be on key symptoms and restrictions or should there be a more global approach to the patient?
- When is it appropriate to blend information, diagnosis and treatment deriving from manual medical or orthopedic contexts?

These questions are becoming more crucial as physicians of manual medicine around the world adopt osteopathic techniques.

The issue of scope of practice and manner of treatment depends on the way one defines the patient as a person. One intriguing area of exploration and redefinition is referred to as the biodynamic model of the patient. This area will be touched on here but addressed more extensively in Chapter 4.

The author, while practicing as an American osteopathic physician, with full medical privileges, will try to set aside bias and assume the position of a moderator, pointing out examples, advantages, disadvantages, benefits and limitations of implementing cranial concepts in a medically integrated approach to the patient.

DEFINING OSTEOPATHY IN THE CRANIAL FIELD

The dialectic: a drugless science

Osteopathy's founder, Andrew Taylor Still, described an approach to medical care minimizing the use of the harmful drugs of his day and also surgery. His intent was clear: to establish a complete system of health care based on discovering and assisting the natural functioning of body systems by optimizing structural integrity. His scope was universal, including the study of anatomy, physiology, spirituality, philosophy and theology as they applied to the patient. The pursuit of knowledge, of science, was paramount in diagnosing and treating (Still 1992, p. 6; 1902, p. 44; 1899, p. 16).

He gave his students a philosophy but not a handbook of techniques. Briefly this included the conviction that much of patient symptoms and illness depended on distortions of anatomic positions of bones or tension in fascia. This in turn led to congestion or edema, compression of nerves and interruption of free flow in blood vessels. His main strategy in treatment was to find these distortions and correct them in whatever fashion was necessary and to then allow the body to resume the natural function of healthy management.

In leaving this life he gave admonitions which provide the roots of division. He told his osteopathic progeny to 'keep it pure' (Truhlar 1950), meaning not to adulterate their practice with the use of drugs. But he also encouraged them to integrate current scientific knowledge into their understanding of their patient. Despite his disagreements with Drs Littlejohn and Smith (another Scottish physician) regarding the role of physiology in the curriculum, physiological principles are woven through Still's writings. When these two recommended teaching physiology, Still proclaimed that osteopathy was solely based on the understanding of anatomy. But he went on to include physiology as a subset of anatomy and in practice he observed, speculated and integrated physiological processes into his approach to designing interventions. More will be said in Box 3.1 regarding J M Littlejohn, the father of osteopathy in England.

Sowing and reaping: the varied growth of osteopathic ideas

A variety of historic events have contributed to the dispersal of Still's thought and its growth and cultivation. This has certainly affected osteopathy in the cranial field. Professionally this has generated disagreement and factions; politically it has evolved into nationally distinct circumstances of practice privilege, training and registration requirements within osteopathy. Additionally, the value of the concepts has been noted by many outside osteopathy, in physical therapy, kinesiotherapy and physical medicine, who have integrated aspects of osteopathic concepts into their practice methods. Physical therapy has incorporated strain/counterstrain and muscle energy techniques that have their origins with osteopathic practitioners and teachers. The use of direct articular manipulation or thrust techniques, as used in chiropractic, is argued as being linearly derived from Still's teaching (Trowbridge 1991). All these developments have been a background for the definition of cranial work today.

Similarly aspects of physical medicine, manual manipulation and movement therapies have been imported into osteopathic methodology. Muscle chains, incorporated from Godelieve Denys-Struyf and the meziarists (Denys-Struyf 1979), and effleurage and other soft tissue techniques from massage traditions are examples. The techniques of Jean Pierre Barral (1998), Vladimir Janda (Bullock-Saxton & Janda 1993) and Robert Maigne (1996) are other examples. It should be apparent from this discussion that ownership of an idea by one professional group is a moot point. Good ideas are freely traded and implemented by conscientious practitioners within the scope of their talent, experience and practice. Reverence for the particularities of the experience and context of application of the authors from which we learn ought to be presumed. But an appreciation of this history moves us off center into the broader arena of appropriate adaptation of ideas in treatment, within the context of an individual's knowledge, licensure and experience and the patient's need.

In this context, then, let us look at some of the threads of diversity which in the past have caused division but which influence how cranial concepts have been or may logically be used in osteopathic and other manual treatment.

General versus specific: where to start?

In classical philosophy there is an issue called the problem of the one and the many. Do we understand the world or any part of it by summing up an understanding of the particulars or do we approach the particular from a conceptual understanding of the whole? In the end it appears that both approaches have their advantages and limitations.

The same dilemma follows us in beginning our approach to the patient with a complaint, whether back pain, headache or sinus congestion. The same diversity of approaches exists. In cranial work, our practical and philosophical biases, or those of our teachers, translate into a preference for beginning with the general or specific features of the patient. Some consider the manipulation of the dynamics associated with the primary respiratory mechanism as adequate for management of all health problems. They then extend the principles first learned in the cranial field to other regions, even the body as a whole. Others proceed from the other direction, by applying articular approaches, learned in dealing with the body as a whole, to problems in the cranial area.

Still is sometimes quoted as saying that the cerebral spinal fluid is 'the highest known element' (Still 1902, p. 44). He had such a deep appreciation of the importance of the neural co-ordinative system, as well as the nutritive aspect of all body fluids. The primacy of the cranial dynamic is further underscored in the writings of William Sutherland (Sutherland 1990, p. 13). He was amazed at the degree of treatment success he was able to achieve on himself as an experimental subject and on others in clinical practice, through application of his personally discovered methods. As a result he somewhat specialized in difficult cases, with which he had success. Several of his students, including Viola Frymann, Beryl Arbuckle and Robert Fulford, extended this specialization in the particular application to problematic cases, using cranial methodology (Arbuckle 1977, Comeaux 2002, Fulford 1996, King 1998).

In extending the cranial approach - the principles of subtle motion, ligamentous-membranous connectivity and respiratory effects - to working with articular as well as soft tissue elsewhere in the body, some students of Sutherland reformulated their teacher's thoughts under the title ligamentous articular release (Speece & Crow 2001). Rollin Becker, another student, described a protocol for listening to the soft tissues of the body as 'taking them where they want to go'.

> *Using our palpatory skills to read this living body physiology, we're allowing this patient's body physiology to show its patterns of health. (Becker 1997, p. 219)*

Another student of Sutherland's, Robert Fulford, interpreted the subtle relationships of the body under the theme of energetic or bio-electric effects or influences (Comeaux 2002). In each of these approaches there is the recognized need to both accept the general orientation of cranial work, to work directly on the cranium as indicated but to also work with other osteopathic principles, in other parts of the body, as the need arose. In this context, the idea of integrating cranial techniques with other trains of thought is not new.

FORMATS FOR MEDICAL INTEGRATION

American osteopathic integration: the introduction of medical concepts

Still opened the American School of Osteopathy to convey his teaching in 1892. As with any new intellectual movement which has economic or political consequence, the early days of American osteopathy were steeped in struggle and intrigue. Politically there was an immediate awareness of the need to gain legal recognition and licensure in each of the United States. This was done in a manner that would preserve the philosophical distinctiveness of osteopathy. However, the smoldering tumult in Still's mind, over the scope and definition of osteopathic practice, ignited a conflagration among his early followers.

In starting his school, Still benefited from the interest and help of William Smith MD, a graduate of the University of Edinburgh, Scotland, who contributed greatly to the teaching of anatomy. Additionally, his program was enriched by the knowledge of physiology brought by J M Littlejohn, who had previous degrees in divinity and law and a Master of Arts from University of Glasgow (Berchtold 1975). Littlejohn, who, like many, came to Kirksville as a patient, stayed to learn the basics of osteopathy. A well-educated man, he saw the biological significance of Still's teaching and was hired both as the second dean of the school and to head the department of physiology, where he began animal research (Trowbridge 1991, p. 174).

As these and other recruited geniuses began to express their ideas, independent of their teacher, Arthur Hildreth, a family friend and initial student of Still, was charged with correcting the situation (Hildreth 1942). Smith was dismissed and Littlejohn relieved as dean. With his intent to leave, Littlejohn was moved to ask for recognition for his academic work and requested not a Doctor of Osteopathy degree, as was conventional, but a 'Doctor of Medicine, Osteopathic' degree. The conflict unresolved, he left and founded what remains today as the Chicago College of Osteopathy, before returning to England. Littlejohn's request was the earliest attempt at full medical privilege in the osteopathic tradition.

Another early controversy stemmed from the role of surgery in this fledgling medical profession. While remaining adamant about the non-scientific use of drugs, as such was the case in his day, Still allowed for surgery when necessary to save life. Surgery related to anatomy and anatomy was to remain the guiding principle of osteopathic practice. Physiology was recognized by Still as subsidiary to anatomy, that should be modified when necessary through structural manipulation. Surgery was, in a broader sense, an extension of manipulation.

The original ASO Hospital (1906), followed by the founding of the Laughlin Osteopathic Hospital by Still's son-in-law, George Laughlin, institutionalized this practice (Walter 1992, p. 59). This brought the profession further under the jurisdiction of governmental review, from the point of view of public safety. The standard by which these activities were judged were those of contemporary medical and surgical practice. Additionally, the Still-Hildreth Memorial Sanatorium was another institution in which the profession would undertake the integration of practices compatible with the medical standards of the day.

Medicine in general would be revolutionized in the 1930s and 1940s by the introduction of antibiotic medications. *The Journal of the American Osteopathic Association* in the 1940s demonstrated a significant assimilation or intrusion of popular medical culture. The issue of this author's birth month includes advertisements for neo-synephrine decongestant, ampicillin and even one representing a physician's recommendation to calm the nerves by smoking Camel cigarettes.

Furthermore, local tensions remained as osteopathic physicians attempted to gain practice privilege in allopathic hospitals in order to follow their patients. Additional pressure was applied for inclusion as medics in the armed forces, that finally came during the Korean War.

Through the 1970s and 1980s a sense of urgency for recognition of the professional practice privileges of general practitioners and the ascending specialty of family medicine, led to a general popular appreciation of the full scope of competency of osteopathic education and practice. Internal pressures within the profession led to the renaming of most degrees granted by osteopathic institutions, from Doctor of Osteopathy to Doctor of Osteopathic Medicine and the proper term of address of the graduates to osteopathic physicians rather than osteopaths (Gevitz 1982).

For those cherishing parity with MDs above all else, this has led to a diminution of manual diagnostic skill and application of traditional osteopathic principles in treatment. However, to those who value the contribution to health of complete diagnosis, including palpatory assessment and incorporating manual treatment and its benefits into medical care, there has been an advancement of the quality of medical care.

Although osteopathic medicine in the USA is heavily influenced by the scientific paradigm which advocates the biochemical and molecular approach to medicine, which supports pharmacotherapy, many in osteopathic medicine are beginning to revisit and test the concepts of traditional osteopathy, including osteopathy in the cranial field.

There is a trend in medicine emphasizing evidence-based practice. Independent research supports or finds feasible many of the teaching espoused by Sutherland (Hargans 1998, Moskalenko et al 2003). Additionally, osteopathic researchers are evaluating the physiological laws and phenomena that support osteopathic diagnosis and treatment (Comeaux 2003, Nelson et al 2002).

Still's basic premise that medicine should be scientific cannot be contested. The current emphasis on evidence-based medicine is quite compatible with this and should allow the inclusion of osteopathic medicine in standard medical care. With maturation of medical scientific understanding beyond the macroscopic world available to Still's contemporaries, osteopathic philosophy should support scientific technologies that enhance the harmony of natural processes.

The challenge to modern osteopathic thinkers is to follow this wave of maturation, respecting the vast ocean of scientific biological information while still valuing the hand, the mind and the heart as conductors of interpersonal experience, that are clinically usable to cultivate health in the patient. This transition of paradigms is confusing to all of us. However, the integration of osteopathic manual diagnosis and treatment into general medical practice, most importantly in primary care, brings a wealth of potential benefits that are often only partially appreciated. The case studies below will explore some of this richness.

Current cosmopolitan medical culture

Expanded physician interest

To complement the developments cited above, in the last several years the practice of manual medicine has become more popular among physicians. And so there has been the development of many national and now international

Box 3.1 European osteopathy and cranial concepts

Initial introduction of osteopathy Modern osteopathic practice in Europe, the United Kingdom and elsewhere has a different history and a different contemporary expression from that of the USA.

Osteopathy has been introduced to Europe in several successive waves. After being treated, matriculating, being academic dean and chair of the Department of Physiology at the American School of Osteopathy, Littlejohn returned to England for a visit in 1903, meeting with the first osteopaths to land, J J Horn and Dr Walker (Hall & Wernham 1974, p. 9). Returning to America and founding the Chicago College of Osteopathy, it was not until 1917 that he organized the British School of Osteopathy (BSO) in London. Like Still, Littlejohn was a thinker which made him cherish Still's insights but led to divisive disagreement.

From the following statements on the subject of physiology, one can see the divergence of views.

- 'Physiology is the gateway by which this immense field of osteopathy is to be entered.' (Hall & Wernham 1974, p. 9)
- 'A knowledge of anatomy with its application covers every inch of ground that is necessary to qualify you to become a skillful and successful osteopath ...' (Still 1899, p.16)
- 'Work in physiology at the present are compilations of many theories and a few facts.' (Still 1902, p. 29)

Still described physiology and other disciplines as parts of anatomy: 'I want to instill and impress it on your mind that this [physiology] is as much a part of anatomy as a wing is part of a chicken' (Still 1899, p.18).

Though initially semantic, their differences in interpretation of physiological function of the spine led to generations of divergent development in practice styles, as mentioned above. Littlejohn respected the complexities behind biomechanics and recognized the individual differences in function of each of the spinal vertebrae. His system also included dynamic patterns and relationships involving the spinal complex working as a whole. An individual vertebral segment had a role to play in a complex system of reversing arches, pivots and gravitational lines (Wernham 1956).

Littlejohn had a special interest in physiology, or body function, as a key to diagnosis and treatment. Largely through the popular theories evolved from the work of Harrison Fryette (1994), many of the systems of osteopathic work tended to be biomechanical and grossly articular. The emphasis was more on the key dysfunctional segment, rather than the function of the whole. And so for a long time the preoccupying issues were different in the USA and the UK.

Besides teaching osteopathic concepts, Littlejohn's initial worries included official recognition and political survival of the profession. Finally in 1935, having graduated 100 students, he approached Parliament for medical professional recognition and was rebuffed. From that time until the 1990s, osteopaths in the UK were limited in the scope of their practice and denied recognition of medical education and medical privileges.

Evaluation of the role of cranial osteopathy, as derived from the work of an American DO, William Sutherland (a graduate of Still's second class), and the field of cranial osteopathy or myofascial relationships was to wait until after Littlejohn's death in 1947. Littlejohn's system of curves and pivots stopped at the atlas (Wernham 1956, p. 29).

Cranial infiltration in the UK Sutherland had begun teaching individual physicians his cranial method at his office in Redwing, Minnesota in groups of four, for 2 weeks at a time. This activity began in the 1940s after he had made his thoughts public in 1939 in a small book called *The cranial bowl* (Sutherland 1939).

Denis Brookes, a DO trained in England, took cranial courses in America and began teaching cranial techniques at the BSO. His name appears as a new member of the General Council and Register of Osteopaths in January 1950 (*Osteopathic Quarterly* 1950). Clem Middleton, a younger colleague of Brookes, also British trained, taught cranial therapy at the BSO. He noted:

> *The idea of applying manipulative treatment to the skull seems at first to be rather absurd but the fact is that the skull can be manipulated with surprisingly beneficial results in a number of very serious ailments. (Middleton 1950)*

He goes on: 'As time goes on the scope of application of "Cranial Osteopathy" will steadily widen' (Wernham 1957).

Helen Emily Jackson, an American-born graduate of the Kirksville College of Osteopathic Medicine in 1935, moved to England through marriage in 1939. She later studied in the USA under Sutherland, in 1947 and under Beryl Arbuckle, a student of Sutherland, in 1956. Although not directly associated with a school, she was also influential in introducing the cranial concept to England (Jackson 2000).

Box continues

Box 3.1 European osteopathy and cranial concepts—*continued*

Second wave of cranial teaching in the UK

Colin Dove, principal of the BSO from 1968 to 1977 (Dove 1977), in the BSO Diamond Jubilee speech recalled hosting and delivering courses and lectures reciprocally with the Cranial Academy and Sutherland Cranial Teaching Foundation (SCTF), while concurrently running a week's course in cranial techniques for 36 students at the BSO. He recounted, in a later summary, the role of Greg Curry in inviting the SCTF to run a course in London using Frymann, Schooley, Harakal and Woods as teachers. Later he remarked on the positive contributions of Rollin Becker, Robert Fulford, Ann Wales, Herb Miller and James Jealous in sharing aspects of osteopathic work.

While many osteopaths accepted cranial teaching, many did not. Indeed, Dove's initial assignment was to infiltrate the SCTF course, in order to learn enough to be able to reliably and knowledgeably discredit the method. However, he was won over to the approach (*Cranial Letter* 1998). The same period saw the formation of the Society of Osteopathy Cranial Group, whose newsletters chronicle activities and interests of that time. This group was heavily involved with and supported by John Upledger DO, then a professor at the Michigan State College of Osteopathic Medicine. Upledger's research, theory and practice included applications of the use of cranial methods with schizophrenic and autistic children and comparisons with acupuncture technique. Involvement with the emotional components of disease is cited in this attempt to expand the osteopathic synthesis of methodologies.

One editorial from the Society of Osteopathy Cranial Group newsletter gives testimony to the impact of this contact on British osteopathic practice style.

> *Being educated in the Wernham GOT [general osteopathic technique] tradition, I am painfully learning the magic of the minimal dose, not just in homeopathic terms but also in the osteopathic approach. This seems to apply to Cranial technique, with what little experience I have so far ... my most complex cases are the ones which end up having cranial treatment and a little seems to go a long way.* (Society of Osteopathy Cranial Group Newsletter, *1964)*

This same issue announced an upcoming discussion between Upledger and Colin Dove, representing different points of view, while Dove, in another setting, called for understanding among British DOs who did and who did not buy into the cranial model. Intermixed with this contact with Upledger were members of the Sutherland Cranial Teaching Foundation, such as Robert Fulford and Rollin Becker (Bel 1999).

At the same time Brookes was training a group of approximately 30 British and French DOs in a series of weekend workshops that ran from 1969 to 1978. These practitioners formed the Cranial Osteopathic Association, that later became the International Cranial Association.

What becomes apparent is the collegial enthusiasm, shared across borders by those interested in this cranial model. However, the differences in scope of practice between UK- and US-trained DOs heavily influenced the variety of ways in which practitioners in the two countries could use this material. Under common law British DOs had no limitations as to what they could do clinically, only barriers to working within the state-funded health system. Since statutory regulation (in the 1990s), the osteopathic title is now protected and access to the National Health System is now open, with numerous DOs now employed in both GP and hospital settings, primarily in the management of musculoskeletal problems.

Examples in the USA provide the contrast. Upledger, for example, derived some of his pressurestat theory of cranial principles from participating in, or observing, intracranial surgery. American DOs such as Helen Emily Jackson or Beryl Arbuckle, her teacher, were trained and licensed to be involved in the full practice of pediatric medicine. American DOs working with neonatal osteopathy may actually have delivered these children as part of their obstetric practice. These differences would ensure that, although they had a common enthusiasm and language, the practice experience of American and British DOs varied greatly.

One gets the impression that during the 1980s the interest in cranial technique was swamped by resistance and interest in more biomechanical techniques. An example of the skepticism with which cranial technique was met in some quarters is encapsulated in the following quote from Alan Stoddard, DO MD, in his 1986 Littlejohn Memorial Lecture, reflecting on his 50 years of practice.

> *My fourth conclusion refers to palpation. Palpatory skill can be acquired and refined but there are limits to this method of examination – not merely limits of sensation but limits of interpretation. Imagination can so easily play a major role in palpatory diagnosis. I consider that I have acquired considerable skills in this direction yet I cannot detect the so-called cranial rhythm postulated by*

Box 3.1 European osteopathy and cranial concepts—*continued*

Sutherland and expounded here at the BSO. My old friend and expert in palpatory diagnosis, Audrey Smith, cannot feel it either. Is the rhythm of the cranium the same as the silk dresses of the King in the fairy tale? The silk is spun so finely that only the intellect can see it. No one would admit to being unintelligent except the little child who declared the King had no clothes on. Then everyone agreed with the child. ... Anyone who believes you can alter the flow of the cerebrospinal fluid by applying mechanical force to the cranium is gullible indeed. (Stoddard 1986)

A more robust parallel development in British cranial work, that has had a more linear connection to the present, is that of Thomas Dummer at the European School of Osteopathy (ESO) in Maidstone. Dummer's interest in osteopathy began with a background in Littlejohn-style techniques. However, his life was augmented by travels to Tibet and integration of bio-energetic and subtle physics into osteopathic theory and practice. In this setting, the ground was fertile for the planting of cranial thought.

Since the current ESO derived from the French School of Osteopathy, that history will be included below.

Introduction of cranial concepts to continental Europe As in the UK, cranial concepts came in through osteopathic teaching. An early introduction of osteopathic concepts in 1923 by Major Stirling, in France, was to a group of medical doctors. In 1957, Paul Geny, a French massotherapist, opened the first school of osteopathy in France, Ecole Européenne d'Osteopathie. Geny was also assisted greatly by Denis Brookes, the British-trained DO mentioned earlier (Barillon 2000).

Geny moved the school to London in 1964 to avoid political problems with medical doctors. Eventually the School was relocated to rural quarters near Maidstone, Kent. During this transition he was assisted by Francis Peyralade, Parnell Bradbury (an American-trained DC, practicing in Brighton), as well as Denis Brookes and Tom Dummer, mentioned above.

Prior to the move to the UK, Geny hosted a course in cranial technique taught by American students of Sutherland, Harold Magoun, Viola Frymann and Thomas Schooley. Many in this class were previously trained physicians. The course represented the first osteopathic cranial training in mainland Europe and its graduates joined the Cranial Academy.

A side note is that Dr Magoun was initially apprehensive about training non-physicians. In order to advance in the course, he gave the prospective students a proficiency test that amounted to a blindfolded challenge to identify and describe the form of individual cranial bones (Bel 1999).

A third introductory wave of cranial osteopathy occurred in Europe during the 1990s and 2000s, with the continued travels of Viola Frymann, now nearly the last living student of Sutherland.

The program at the ESO has continued to include courses and speakers incorporating cranial concepts in the expanded osteopathic model, as is reflected elsewhere in this book.

The third wave continues in Europe The osteopathic community in France has now regrouped to train under the Centre Internationale d'Osteopathie (CIDO), in Saint Etienne, with other schools emerging. More recently a generation of European osteopaths have been introduced to the field through the work of Viola Frymann who has contributed regularly to the curricula in schools in Germany, Canada and Russia. These students have received an orientation that cranial osteopathy is *the* focal concept or one of the founding concepts, of osteopathic practice.

This impetus and gradual continued training of foreign students in English osteopathic schools has led to a small but progressively growing group of osteopaths practicing, sometimes without official government recognition, in most European countries, including Spain, Italy and Portugal.

In Belgium the first osteopaths given training and degrees from the ESO opened offices but did not organize as the Belgian Society of Osteopathy and Research in Manual Therapy until 1976, later to reform as the Belgian Society of Osteopaths in 1986.

Osteopathy was exported to Russia in 1989 by Viola Frymann with a cranial emphasis. However, the Russian School of Osteopathy was also assisted by the ESO and BSO. Education largely follows the British model. Although many graduates have a prior medical degree, osteopathic training does not grant general medical privileges in Russia.

In Germany, since the 1990s the kinesiotherapy and medical models have competed as the prototype of osteopathic training and practice. This is also true in France, Sweden, Norway and Finland. In Canada, the largest training stream for osteopaths, the College

Box continues

Box 3.1 European osteopathy and cranial concepts—*continued*

d'Etudes Osteopathiques de Montreal, complies with the English model. Started by Phillippe Druelle DO (French trained) and Jean-Guy Sicotte MD, DO (Canadian medical graduate with American osteopathic training), this college has expanded to implement programs in Germany (Deutsche Osteopathiche Kolleg) and Switzerland (Swiss International College of Osteopathy). A small Canadian Osteopathic Association comprises mainly American-trained osteopathic physicians.

In Asia the introduction of osteopathic techniques has followed a different course. One key figure, Kunihiko Takagi MD, found his Western orthopedic training lacked correlations with Japanese traditional medicine, including acupuncture. Introduction to the concepts of Robert Fulford DO, a cranially trained DO who developed an interest in bio-energetic medicine, compatible with the Asiatic concept of qi (chi), aroused an interest in him for osteopathic concepts.

In this rapid review of developments it is apparent that there is no uniformity as to the teaching of osteopathic principle and the role of cranial therapy. It is also apparent that in many settings there is a mix of physicians and non-physicians using the ideas and techniques. While there is a struggle for dominance, regardless of bias, physicians are being trained in osteopathic methods, including cranial concepts and approaches.

associations of physicians involved in manual medicine. In the USA and in many other countries, the specialty of physiatry, or physical medicine and rehabilitation, provides a non-osteopathic approach to musculoskeletal disorders. Many in that field now value and seek training in osteopathic methods to integrate into their style of practice. Reportedly in Russia, manual medicine has been recognized as a separate specialty. However, the route of entry into this area is also through general medical education in the political jurisdiction of the practitioner. In many contexts this brings practitioners into the same topical arena as the osteopath but with a different, non-osteopathic orientation or philosophical training. Interested practitioners may then seek out osteopathic or craniosacral training

Recognizing this trend, organizations such as the Federation Internationale de Medicine Manuelle (FIMM) have evolved in an effort to develop standards of education and practice. The FIMM now hosts biannual international conferences for its membership associations from 26 countries. The FIMM was founded in 1958 through the initiative of Dr Christian Terrier (Switzerland) and representatives from Belgium, Great Britain, France, Scandinavia, Switzerland and West Germany. In this context, osteopaths, including those who practice cranial techniques and those coming from other training paths, meet and discuss ideas that have begun to influence individual practice styles.

As a consequence of such sharing, osteopathic practice, especially among those who have medical training, continues to evolve. Inevitably this will lead to further integration of medical and osteopathic concepts (Hutson 2003).

Physician/non-physician mix

In Europe there are continual efforts, by several groups, to develop international osteopathic consortia. American osteopathic organizations have made efforts to recognize the legitimacy of osteopathy in the international community. Embedded in these developments are discussions relative to qualifications required for recognition.

Recent efforts to develop formal international relationships have been made by the two major American osteopathic political organizations, the American Osteopathic Association (AOA) and the American Academy of Osteopathy (AAO). At the 2003 Convocation of the AAO, the committee on international relations facilitated the incorporation of the World Osteopathic Health Organization which is open to individual membership, regardless of practice style or training (www.woho.org). As this chapter is written, the AOA is continuing meetings toward forming an Osteopathic International Alliance which would consist of members with full medical licensure. Such developments will further influence the integration of osteopathic medicine with relevance to the practice of osteopathy in the cranial field.

INTEGRATED OSTEOPATHIC TREATMENT – INCLUDING CRANIAL

Current practice

Recognizing that the roots of osteopathic treatment were based in the intention to develop a complete approach to health and that medicine has evolved over the last 130 years, the following list of medical indications and contraindications to osteopathic manipulative treatment is proposed. This list will be followed by illustrative case scenarios. It is realized that in some circles the scenarios will appear as compromised standards of medical care, whereas to others they may appear as a corruption of osteopathic practice. Still himself, on several occasions, said there was not one way to treat (Still 1992).

The case examples will begin with several that integrate palpatory diagnosis and manual treatment into general medical management. Following this, some case examples will be presented which more directly involve cranial diagnostics and treatment as their focus.

The discussion below depends on an acceptance of the resolution attempted in the paragraphs on specific and general treatment above. It is the author's belief that there are interactive relationships within the body that integrate apparently separate systems, as well as structural interrelationships which affect systems. If a symptom is a reflection of a breakdown of body function, a failure of adaptation, the elements of the body that are locally, regionally or systemically most closely related to that area's normal function can be recruited to clarify the diagnosis and to expedite treatment. Clinical experience is the best teacher in selecting the local and non-local structures that will be most relevant to normalization of local function.

Whether or not the pharmaceutical industry is effective in achieving it, this is also the goal of modern pharmacology. While all therapy falls short of faithfully replicating natural body functions, it is the author's experience that it is often advantageous to use the complementary benefits of manipulation, pharmacology, herbal remedies, acupuncture, diet and other lifestyle or behavioral approaches in any attempt to restore normal function.

Indications and contraindications

Many of these are relative, depending on the diagnostic acumen of the practitioner, the physiological consequences of the therapeutic methods used and the current goals of treatment. To demonstrate this point several examples have been included, under both the indications and contraindications, in order to stimulate reflection and thought.

The suggested applications are derived from personal case experience, collegial consensus and the logical extension of physiological principles. Osteopathy has not advanced to full participation in the evidence-based medicine process because of lack of funds and patient numbers, as well as challenges in standardization of patient populations. Items marked with an asterisk (*) will be illustrated below, in the case scenarios.

These lists are in no way intended to be comprehensive. They are also not intended to suggest any application beyond the reader's professional competency or practice license.

Indications

Non-cephalic medical presentations benefiting from manipulation Most orthopedic complaints routinely referred to physical therapy, including:

- Extensor tendonitis
- Tennis elbow
- Biceps tendonitis
- Frozen shoulder
- Lumbar strain
- Plantar fasciitis*

Peripheral neuropathies

- Carpal tunnel syndrome
- Brachial plexus compression/thoracic outlet syndrome*
- Sciatica
- Vertebral disk prolapse

Systemic disease

- Edema including congestive heart failure
- Bronchitis, acute and chronic
- Hypertension
- Chest wall pain.

Non-cephalic medical presentations benefiting from cranial treatment

Structural or general medical

- Myofascial pain syndromes
- Cumulative chronic systemic disease
- Cancer, palliative phase of treatment

Psychological

- Anxiety, depression*
- Post-traumatic stress disorder*
- Panic disorder
- Anxiety associated with mitral valve prolapse

Developmental

- Growth retardation*
- Learning disabilities*
- Attention deficit disorder with hyperactivity
- Infant colic.

Cephalic-related complaints benefiting from cranial treatment

- Headache*
- Temporomandibular joint dysfunction*
- Whiplash-type cervical strain*
- Hemiparesis secondary to stroke
- Congenital non-synostotic plagiocephaly
- Postencephalopathic hemiplegia*
- Allergic rhinitis*
- Chronic otitis media
- Direct cranial trauma without fracture.

Con traindica Hons

Structurally or medically unstable conditions

- Stroke in evolution
- Suspicion of subarachnoid hemorrhage
- Suspicion of acute fracture, cranial or cervical
- Suspicion of cancer not yet diagnosed or staged
- Potential for metastasis when cure is still sought
- Acute encephalopathy or meningitis
- Vertebral disk prolapse
- Dizziness, loss of consciousness, blurred vision with cervical rotation/sidebending
- Local infection, cellulitis or abscess
- Untreated fracture.

All conditions beyond the practitioner's/therapist's training level.

Prescription: technique selection and dosing

All manipulation has health consequences and depends on knowledge, experience and judgment to appropriately select a method and to dose the intensity, duration and frequency of treatment. Many types of treatment, including cranial, allow an operator to be an artist, to work intuitively, modifying the technique for individual patient requirements.

The issue of individualization of treatments, according to patient need and therapist skill, reiterates what was mentioned regarding indications and contraindications.

These prescriptions are meant to serve as suggestive guidelines, with skill and sound judgment presumed. They are not intended as permission for the unqualified to apply a newly learned technique, nor for a patient to self-prescribe and then go looking for a practitioner. All medicine is, and should remain, serious business. Medically integrated manipulative practice is serious business and no part of this text should be construed as a substitute for trained medical judgment.

In no case is it intended to give anyone intellectual permission to practice outside the scope of their license or training.

CASE EXAMPLES

Explanation and disclaimer

A selection of case examples illustrating the integration of osteopathic manipulation, including cranial manipulation, in an otherwise medical context are detailed below. The author has attempted to describe routine situations, in which manipulation has been very useful, with unusual or heroic applications. These are presented to the reader as suggestions for further developing a practice repertoire within the scope of the currently held license and training. The descriptions are not meant to engender competency or increase practical skill.

Non-cephalic medical presentations benefiting from manipulation

Case 1: Plantar fasciitis

Complaint: JK is a 37-year-old female complaining of recent-onset left foot pain. She believed she injured it the previous weekend during a hike that involved unusual exertion.

Examination: Stocky individual, reasonable muscle tone, erect carriage with shoulders posterior to center of gravity and increased lumbar kyphosis. Posterior view demonstrated pelvic sideshift and declination of the sacral base to the left. Hip drop (Gillette) test was positive on the right. Standing flexion test was positive on the left. There was a left lumbar scoliosis pattern with thoracic compensation and the shoulders were level.

Seated examination revealed a similar scoliotic pattern, with positive seated flexion test on the left. Supine exam revealed tenderness in the medial aspect of the left heel, with an apparent short leg on the left. Cranial exam revealed a right sphenoid torsion pattern.

Assessment:

- Plantar fasciitis
- Restriction of motion/somatic dysfunction: lower extremity, pelvis, lumbar, thoracic and cranial.

Treatment sequence: Diagnoses were shared with the patient with an explanation of functional interrelationships between her pain and her pattern of postural and structural imbalance. Her condition was reinterpreted as a chronic condition, requiring more than acute care, with her symptom reflecting an acute exacerbation. Prognosis and the need for steady applied effort were described.

The patient was offered an integrated treatment approach that included osteopathic manipulative technique (including cranial), home exercise, use of an insert heel pad and anti-inflammatory medication. Although mentioned as a last resort, injectible corticosteroids for symptom relief were considered but dismissed.

The focus of osteopathic manipulation was threefold. To convince the patient of our care and knowledge, treatment began with a connective tissue stretch to the plantar aspect of the foot and the posterior compartment of the leg. The primary focus of the treatment approach was to restore symmetrical balanced function to the pelvis. This was accomplished using a combination of connective tissue releases, muscle energy and oscillatory techniques. By inference, through the core-link concept, this would imply optimal and symmetrical cranial function. A home exercise protocol was recommended and taught. This included a leg-over stretch, derived from a yoga spinal twist but with repetitive isometric contraction added. For the plantar fasciitis, a standing stretch of the posterior lower extremity was demonstrated.

Over a 3-week period, the patient used a cushioned heel insert and an anti-inflammatory medication and received three treatments involving manipulation. At each visit changes in cranial function and other somatic dysfunctional patterns were noted and treated as appropriate. Typically this would entail connective tissue stretch of the posterior compartment of the leg and muscle energy technique applied for the sacral and pelvic findings. The scoliosis improved with leveling of the sacral base. Cranial mobilization included gentle but direct stretch of the membranes and guidance of the cranial base into free motion.

Improvement of the heel pain was slow at first and the patient was frustrated. Coaching was critical to encourage her to persist with the heel cushion and home exercises to complement the office treatment. Each visit showed incremental improvement in her postural and cranial pattern of imbalance.

The early return of cranial symmetry suggested that the cranial findings represented a secondary or accommodative pattern. Cranial work, moving from direct manipulation to inductive balancing techniques, was continued in subsequent sessions, with the intention of monitoring diagnostic changes as well as treating subtle dysfunctions.

The patient was relieved when a decrease in the intensity of her pain was noted, particularly the absence of symptoms on rising. Progressively the frequency of visits was decreased and after

3 months she recognized that she had been symptom free for several weeks. She was encouraged to continue the stretching exercises.

Discussion: This case reflects the interrelatedness of the body in diagnosis and treatment. It also demonstrates the balance to be struck between attending to the patient's point of view, in their experience of symptoms and simultaneously attending to the issues of interrelatedness of the body as a functional unit and the issue of a primary cause of patterns of adaptation.

In this context structural and functional findings in the cranium may reflect a primary problem or an adaptive pattern to an underlying problem elsewhere. Classically the interconnectedness has been attributed to the distribution of dural attachments, resulting in forces being transmitted through the cerebrospinal fluid.

However, the 'core-link' hypothesis is not the only unifying concept through which explanations of interconnectedness can be produced. Several attempts to systematize the unifying function of the connective tissue system, notably the fascia, have been put forward which complement the implications in Sutherland (1990, p. 273) and Still. Rollin Becker describes the key role of a higher level potency which is responsible for the vital mobility underlying all of physiology (Becker 1997, p. 95).

Additionally, the work of Godelieve Denys-Struyf describes the functional interrelationship of muscles whose investing fascia create chains which direct the force and which are expressed in postural prototype (Fig. 3.1). The prototypes are also thought to correspond to emotional states, either endogenous as personality or acquired as attitude, deriving from thoughts or experience such as trauma. Her primary intervention is postural retraining, by means of which the person intentionally adjusts posture to a more desirable and consistent pattern (Denys-Struyf 1979).

Myers (2001), with his system of muscle trains, approaches treatment from a different point of view by conceptualizing the fascial interrelationship of a region as functional connections between nodes, the joints. Rather than seeing the limbs and trunk as a collection of separate bones and activating muscles, Myers expresses the structural interrelationship of parts as if they were elements of a continuum (a virtual tensegrity structure). The muscles and investing fascia are seen as railroad tracks, with the enthesis or attachment to bone as 'train stations' or important points for therapeutic intervention.

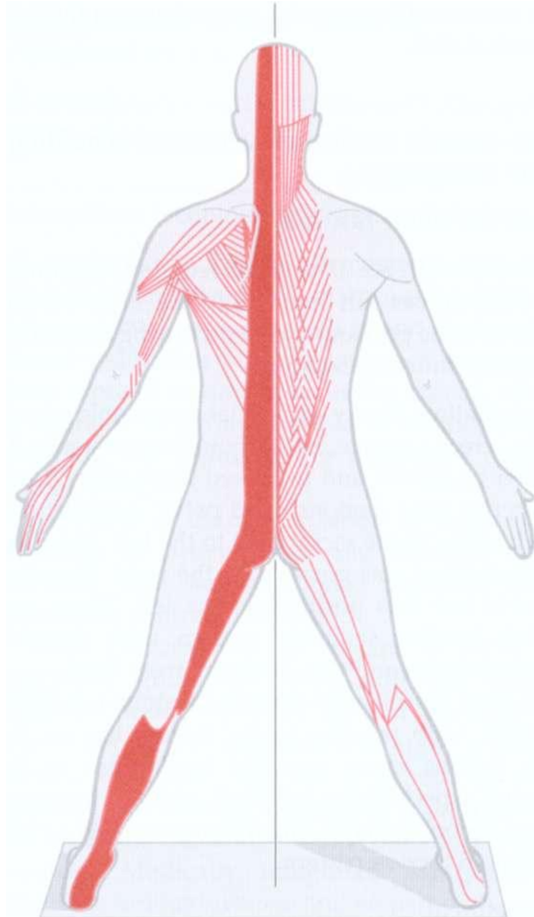

Figure 3.1 Diagram of muscle chain pattern PA, corresponding to attitude of confrontation. (Reproduced from Denys-Struyf 1997.)

Schultz (1996), in his book *The endless web,* expresses in a more basic way the extension of the fascia of the trunk and extremities which might express themselves in injury or pain patterns. However, the point is the same: the continuum of the fascial system is often underappreciated in bodywork. Classically, osteopathy, including that in the cranial field, has always created and promoted this idea, though admittedly not in a unified manner. This case shows a practical example of how these interrelationships are reflected in clinical practice.

The case draws us into the dilemma of attending to the patient's complaint of pain, their symptom, while simultaneously looking deeper into the chain of causation. Both postural and mechanical (articular) interrelationships, within the affected region and throughout the body, require consideration. The relationships may include vasculohumeral factors such as inflammation. They may include biomechanical consideration such as accommodation by regionally compensating joint surfaces. Additionally, they may be viewed from the neuromuscular or myofascial point of view. Whichever perspective is chosen, the person is a functional whole that can be affected from many points within a series of functional loops. On a more esoteric level, the chaos mathematical models can contribute to our appreciation of clinical syndromes, as discrete phase states organized around a particular attractor (Kelso 1995).

The integration of orthopedic, podiatric and pharmacological approaches to patient care, as illustrated in this case, represents a wide application of this paradigm. Each intervention, though sometimes redundant, can perturb the current unsatisfactory pattern and encourage normalcy, in a time frame satisfactory to the patient. This is important for maintenance of credibility with the patient, ensuring compliance with the critical aspects of care that involve their behavioral changes.

Non-cephalic medical presentations benefiting from cranial treatment

Case 2: Cognitive and constitutional delay and later onset of adolescent growth

Complaint: At the time of consultation CH was a 12-year-old boy, alert and active but small in build and behind his peers in reading skills. He had slight asthmatic bronchitis, allergic rhinitis and had taken allergy desensitization shots for 2 years. His mother brought him to a family practice initially for the weekly desensitization ***shots but*** on one occasion remarked about her dissatisfaction ***with his*** delayed growth and reading problems.

Out of school the child seemed developmentally normal. He had participated in the routine public health immunization schedule and had no serious perinatal conditions or illnesses. CH was the youngest of three siblings, delivery having been rapid after a medically normal but emotionally stressful pregnancy. APGAR scores were 9 and 9. (APGAR is a sum score determined by several physiologic parameters including color, cry and heart rate at 1 and 5 minutes after birth - ideal is 10 and 10.)

Examination: Physical examination showed a boy of slight build, pale but alert and oriented with good muscle tone. General musculoskeletal exam revealed no significant abnormalities or restrictions. Cranial exam revealed general symmetry with 4/5 strength of cranial rhythmic impulse, as noted on biparietal contact; no frank focal articular restrictions were apparent. If anything, there was stiffness and resistance to motion in the membranes.

Assessment:

- Dyslexia/learning disability
- Allergic rhinitis
- Small for age.

Treatment sequence: A general treatment protocol was initiated aimed at optimizing respiratory, cranial and bio-energetic function. Much of this included working from a posterosuperior supine vault hold but included application of cranial compatible principles elsewhere in the body. A percussion vibrator was also used, as will be described below.

The child was seen intermittently, if possible at the time of his allergy shots, averaging every other week. Over several months the mother noted a marked increase in reading skills and school grades improved. CH went into an adolescent growth spurt.

Discussion: Manipulative management integrated into this child's care reflects the complexity of influences. Continuation of the allergy desensitization injections may be seen to reflect a virtual 'schizophrenia' inherent **in *medically integrated*** osteopathic practice, that demands compliance with politically opposed paradigms of care.

Osteopathy is viewed by many as being an inherently drugless therapy while, in addition, many are concerned about the adverse effects of meddling with the body's immune system. Often such conflicting approaches occur due to the patient's acceptance of the utility of particular medical methods, such as desensitization injections. Building patient confidence regarding the quality of care is an important aspect of any treatment regimen.

The utility of cranial manipulation for an apparently behavioral problem is based on the concept that, as humans, our behavior is partly grounded in the physical substrate that is involved in co-ordinating the behavior - the brain. It is considered that deficiencies in childhood behavior and learning may be due to marginal dysfunction of intracranial processes caused by constitutional restriction of healthy inherent motion. Sutherland, Magoun, Arbuckle, Fulford and Frymann all attest to the importance of successful resolution of preterm and congenital strains in the later full functioning of the child. They all developed protocols for dealing with extreme cases of birth trauma, as well as injuries producing only minor immediate disturbance of function. Learning disability, in this context, reflects a slight, progressively disclosed inhibition of normal higher human function. Cranial manipulation is used to optimize function by normalizing subtle membranous, parenchymal and bony relationships, relative to the brain. There is often no evidence of a single glaring focal point of dysfunction, although sometimes there is one previously undiagnosed lesion.

The functional deficit may evidence itself in subtle ways. In general cranial work there is an appreciation of the complementarity of diaphragmatic respiratory function and cerebrospinal fluid fluctuation. Nelson & Gloneck suggest that these rhythmic phenomena help regulate the physiologically recognized Traube-Hering-Meyer oscillation (Nelson 2002). Based on his experience in subtle palpation, Robert Fulford explained the normal movement and function as an energetic component of the vital function of an individual. He termed the initiation of this vital process the 'first breath', which he described as qualitatively and quantitatively palpable to the trained individual. Stressful preterm or birth-related events could possibly limit the quality of the function. Arrests or suboptimal expressions of this first breath, the absence of a spirited cry, could be reflected in suboptimal function until corrected. In addition to his manual approach, he would use a percussion vibrator, variously applied, to normalize

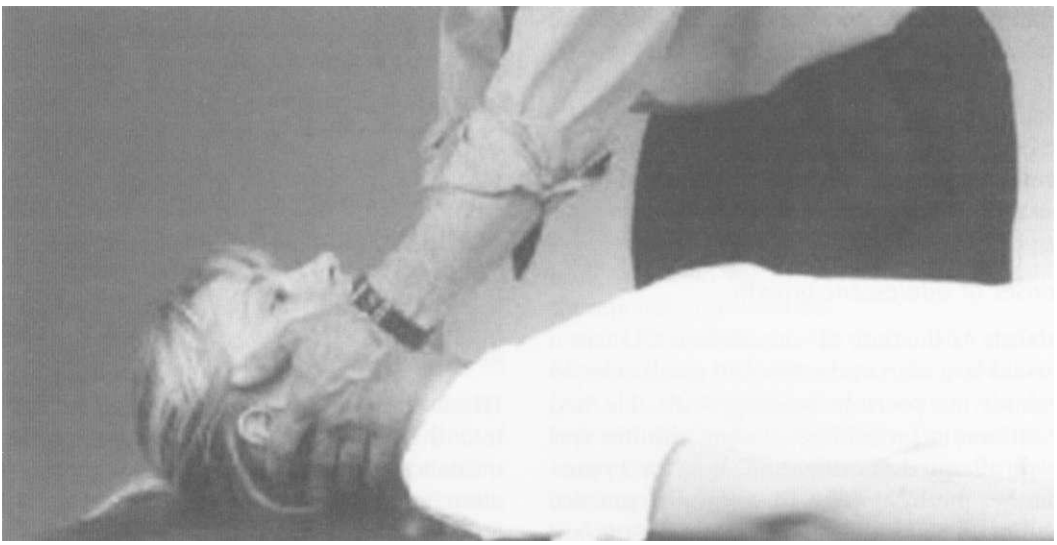

Figure 3.2 Palpation of the cranium with anterior approach, accommodating reciprocal complementary polarity, after protocol of Robert Fulford DO. (Reproduced with permission from Comeaux 2002.)

Figure 3.3 Percussion vibrator applied to treat pelvic dysfunction, after the protocol of Robert Fulford DO. (Reproduced with permission from Comeaux 2002.)

the electromagnetic relationships of cells and tissues involved in a dysfunction (Comeaux 2002).

In the percussion vibrator a motor drives a padded hand piece, by means of a flexible rotating shaft. The hand piece applies a short excursion force perpendicular to the surface of the skin. The frequency may be varied from 100 to 4000 strokes per minute and is generally used in the range of 40-100 Hz.

A formal protocol, with many considerations for modifying treatment, is described in Fulford (1996). The pad is applied over a bony prominence to disseminate oscillatory force through the target tissue. The vibratory force is intended to entrain the endogenous vibration of tissue that may have been reduced or dampened by trauma or other strain.

Cephalic-related complaints benefiting from cranial manipulation

Case *3: Headache with whiplash*

Complaint: BK, an 18-year-old, presented with headache and neck pain in a family practice setting 8 days after a motor vehicle accident. Emergency department evaluation included an incomplete cervical spine series which revealed cervical spine straightening; the patient had been dismissed from the emergency department after he insisted on staff response to his father's complaint of pain and an argument ensued. Both were injured when their vehicle was rear-ended by a vehicle impacting at high speed. The patient was a first-year college student and prior to the accident reported episodic neck stiffness for which he received some physical therapy.

Examination: After repeating a cervical spine series with odontoid view to demonstrate absence of fracture, the patient was further evaluated manually. As is typical of this type of injury, there were no discrete segmental vertebral restrictions but rather diffuse soft tissue tenderness, secondary to ligamentous and dural strain. The cranial base was found to be compressed with minimal mobility.

Assessment:

- Headache
- Cervical strain
- Sphenobasilar compression.

Treatment sequence: Treatment progressed and serial re-presentations of an evolving postural adaptive pattern were remolded over a 4-month period. Initially work was done to facilitate mobility during the healing phase. Minimal tissue texture changes in the occipito-atlantal and C1-C2 region were addressed by manual traction, focal inhibition, gentle connective tissue release and muscle energy technique, using oculocephalogyric reflex activation (Ward 2003). The full length of the dura was evaluated and focal restrictions were treated where appropriate. The cranial base compression was treated with a traction technique, separating the occiput and the sphenoid wings.

As healing progressed, there was localization of restriction in the thoracic inlet region and attention was paid to fascial and rib mobilization in this region. Eventually the patient resumed class work with progressively diminishing complaints.

Discussion: This case represents a rather straightforward case of head and cervical strain without more distant problems. However, both the strain pattern and the restrictions were viewed regionally, rather than as local articular dysfunctions.

The dura, the fascia and the cranial-spinal chain represent a continuum of structure and function. Cranial mobility and restriction should not be viewed in isolation from the structures with which they are continuous.

Objective findings become very valuable in the context of automobile accidents, in which litigation, narcotic seeking or other malingering are real possibilities.

Case 4: Allergic rhinitis

Complaint: CV, a 22-year-old woman, came to a family practice office complaining of recurrent sore throat and earache. She anticipated a positive streptococcal screen with a view to receiving an antibiotic. Her symptoms had worsened over the previous 3 days although she had noted no fever. She indicated recurrence of these symptoms over the last 4 months, despite using a course of cephalexin (antibiotic) 2 months previously. She had no shortness of breath but reported a cough at night.

Examination: The patient was a trim female, with slight 'allergic shiners' beneath her eyes. Examination of the ears, nose and throat showed the external auditory canals to be clear, the tympanic membranes to be slightly pink with retractions and no injection or significant fluid in the middle ear. The mucosa over the nasal turbinates were boggy and pale. The throat revealed pharyngeal erythema and hyperemia, with no erythema or exudates associated with the pharyngeal arches.

Supine cervical exam revealed adenopathy in the posterior triangle. No frank segmental rotations were noted but the right occipito-atlantal area revealed edema and tension in the rectus capitus posterior major. Cranial mobility was adequate and symmetric.

Assessment:

- Allergic rhinitis with secondary pharyngitis
- Serous otitis media.

Treatment sequence: It was necessary to begin where the patient was concerned, in order to convince her that the assessment of her condition was accurate. An explanation was offered as to a differential diagnosis suggesting irritative pharyngitis, secondary to the postnasal drip of allergic rhinitis. The acute and chronic aspects of this condition were then discussed. The futility of empiric antibiotics and complementary pharmaceutical methods of dealing with allergic rhinitis were also discussed. Although it is a stimulant, use of the appropriate dose of pseudephedrine was suggested to decrease congestive edema.

While discussing the pros and cons of various approaches the patient was asked to lie supine. Treatment involved a stroking or effleurage of the posterior fascia of the neck, as well as stretching to mobilize the fascia of the lower neck and the thoracic inlet (the doorway to the lymphatic ducts as it enters the subclavian vein).

Facial effleurage and a pumping of the mandible (called the Galbreath maneuver: see Fig. 3.4) were applied (Ward 2003).

Cranial manipulation followed the pattern and rationale as discussed below. In this case the patient agreed on a short course of an antihistamine, as well as over-the-counter pseudephedrine.

Discussion: A mundane but frequent complaint, nasopharyngitis can reflect a cranial problem. Though not threatening, the condition has a high prevalence and a significant amount of money is often spent on pharmacological and over-the-counter remedies, all aimed at masking symptoms.

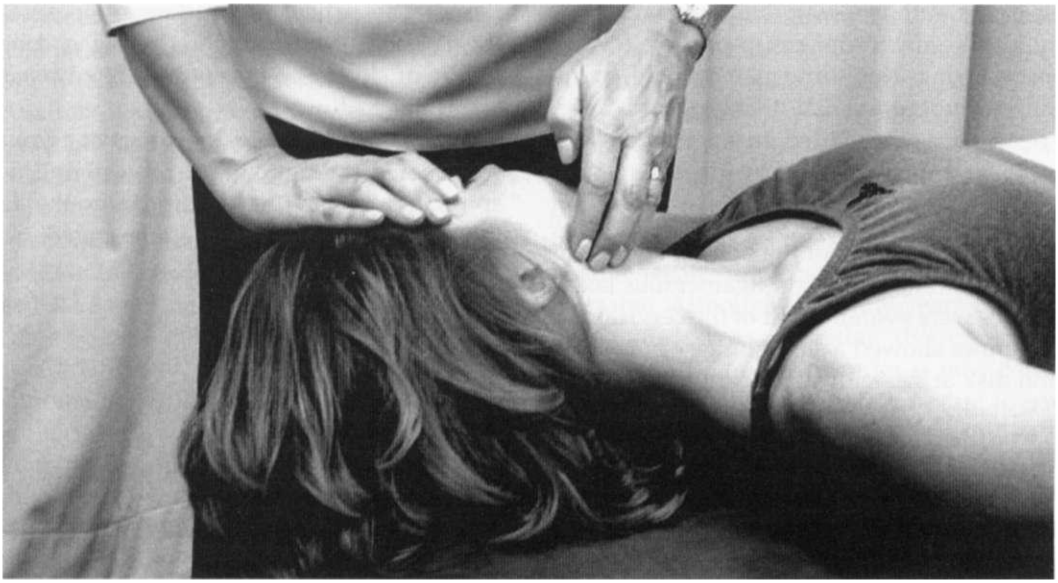

Figure 3.4 Galbreath maneuver to normalize Eustachian tube function and minimize serous otitis media. (Reproduced with permission from Steele ft Essig-Beatty 2004.)

Cranial manipulation can be very helpful. Although the patient was aware of the nasal and throat drainage, the majority of fluid which enters the head leaves posteriorly, through the jugular foramen. Treatment of the occipito-atlantal area by gentle stretching, mobilization of the occiput and spreading of the occipitomastoid suture is helpful in long-term management. Additionally a frontal lift, sphenoid flexion, as well as frontonasal traction and exaggerated flexion of the zygomata all contribute to opening the ostia of the sinuses and the venous and lymphatic channels which serve them.

Allergic rhinitis represents an enhanced immune response, the result of genetic, developmental and systemic factors. In the correct environment, the author has found homeopathic, as well as medical, desensitization to be of value.

Additionally there is a classic system involving use of neuroendocrine tender points (neurolymphatic or Chapman's points) (Ward 2003, p. 1051) which can be very helpful in upper respiratory complaints such as this. An energetic approach to these types of problems may reflect the work of Marcel Vogel, as passed on by Robert Fulford DO (Comeaux 2002).

Case 5: TMJ dysfunction, migraine trigeminal nucleus affected by the temporal bone

Complaint: MC was a 25-year-old female referred for osteopathic assessment and treatment by her family physician for recalcitrant jaw and neck pain plus headache. She reported that an automobile accident had caused the onset of symptoms 8 months previously. In the accident she, as the driver, collided with one car, looked over her right shoulder to care for her young daughter in the back seat and was struck by another car.

Initially after the accident she was unable to open her mouth and lost 18 pounds (~ 9 kg). Her current weight was 137.5 pounds (62.5 kg). Headaches continued intermittently and were debilitating; they were largely right frontal and temporal, associated with photophobia.

Prior to presentation the patient had been treated with physical therapy, with limited improvement and was using an orthodontic splint.

Current medications at the time of presentation included hydrocodone/acetaminophen, amitriptyline, sertraline, metaxolone and an oral contraceptive agent.

Prior to the author seeing the patient, she was seen by a colleague in the group practice for five sessions. During this time osteopathic manipulation, including cranial therapy, was used. Also, rizatriptan was added in an unsuccessful attempt to treat migraine-type headaches.

Previous studies: Plain radiographs of the cervical spine revealed flattening of the normal curvature; dynamic X-rays showed slight ligamentous laxity. No fractures were evident. MRI of the cervical and thoracic spines showed a slight bulge of the intervertebral disk at T2, with slight cord flattening.

Examination: The patient was a lean female with a tightly clenched jaw. There was paraspinal tension at multiple levels in the thoracic and lumbar regions, with excessive tension in bilateral masseter muscles. With the splint removed, the temporomandibular joint seemed regressed bilaterally. With the splint in place, there was a soft edematous feel, with restriction of motion bilaterally. There was no asymmetry.

Cranially, there was compression of the sacral base. She pointed to a knot at the back of her neck that represented the atlanto-occipital area, which was tender. C2 was rotated and sidebent right and flexed. The patient had a depression anterior to the lambda, presumably reflecting a congenital failure of closure of the sutures. She was anxious about this feature.

Tissue texture changes and articular asymmetries were noted throughout the cervical and thoracic spine and upper ribs. Additionally, the sacrum, though symmetrical, demonstrated limited respiratory flexion.

Assessment:

- Cranial dysfunction
- Dysfunction of cervical spine
- Headache
- Temporomandibular joint dysfunction.

Treatment sequence: Initially restrictions, beginning with the more remote elements of the sacrospinal-cranial complex, were evaluated and treated using a variety of osteopathic approaches. The temporomandibular joint was treated with traction and balanced ligamentous tension. Associated with this release were direct cranial mobilizations of the zygoma, maxilla and sphenoid.

The cranial base was progressively decompressed with traction technique. With greater

Figure 3.5 Temporomandibular decompression technique. (Reproduced with permission from Steele & Essig-Beatty 2004.)

mobility, restriction of the mandible, the sphenoid and zygoma on the right became more apparent. In addition to treating these restrictions, cervical manipulation was applied over several visits, using traction, ligamentous articular release and high-velocity thrust techniques.

When anticipated improvement was delayed, a cranial computed tomographic (CT) scan and repeat MRI of the cervical spine were ordered. The CT was read as normal; the MRI revealed diffuse mild, broad-based bulging from C3 to C7 and minor cord flattening.

Additionally, the implications of a chronic allergic rhinitis were evaluated with a course of an *antihistamine, loratidine. Trials of periods with* and without her mouth splint were tried.

Behavior issues, including overall tension and jaw clenching, were discussed and addressed, with a progressive relaxation method and a relaxation breathing protocol.

After 15 months of following and treating the evolving symptom complex and physical findings, the patient acknowledged she was well enough to withdraw from regular treatment. Seen in public, she looked happy, active and relaxed.

Discussion: This case represents a complex interaction between social, legal, psychological and biomechanical features. It involved a case of whiplash-type strain, with associated unresolved features. There was a distinct disadvantage in having to enter the case rather late.

Overall, the mandible is rarely addressed in classic cranial work. In some spheres of chiropractic and applied kinesiology there is recognition of what is called the somatognathic system (Walther 1983, p. 343; see also Ch. 5), indicating the relationship of jaw mechanics to other anterior body structures. In conventional whiplash strain, most attention is paid to the soft tissues of the cervical spine. However, as an appendage to the anterior skull, the mobile jaw, if abruptly altered in its inertial state, is capable of straining its suspensory muscles and ligaments. It is surmised that this was the case with this patient, especially considering the unusual bilateral quality of the tissues around the temporomandibular joint.

Additionally, no element of the biomechanical system is affected in isolation. The mandible is intimately associated with the temporal bone and also the occipito-atlantal (OA) area. Resumption of normal function and relief of pain depend on normalization of these elements.

Although articular restriction at the TMJ and OA joints and the cervical spine, plus tension in the associated soft tissues, can cause a tension-type headache, a further potential cause of headache in this patient might be atypical migraine. Although for many years migraine has been viewed as vascular dysregulation, the primary cause of this disorder is now considered to be trigeminal nerve irritation, due to irregularities at the ganglion (resting as it does on the *temporal bone) (Tepper 2003). In a cranial context,* one could legitimately surmise that temporal bone imbalance, restriction or dysfunction may underlie some cases of migraine. Cranial treatment in such a context can therefore have many goals and the potential for offering relief.

This case additionally highlights the regional relationships involving the cranium. While in the context of Sutherland and Upledger we cite the core-link concept of cranial and sacral interrelationship, the author finds it helpful to recall that the dura attaches at each of the spinal nerve roots and is therefore capable of affecting the motion of each of the spinal segments. This feature of the craniospinal complex requires assessment and normalization if dysfunctional.

Philosophically and consistent with this clinical observation, Charlotte Weaver (1938) conceptualized the embryonic development of the cranial base as paralleling the development of the vertebral segments, with separate ossification centers within the adult structure. This developmental similarity suggests that spine and cranium are part of a larger integrated system, with similar behavioral characteristics. Treating them as totally separate systems is inappropriate and ineffective.

The apparent disparate pattern of symptoms in this patient suggests these interrelationships. The clinical challenge is to work through these symptoms and findings as if one were untangling a ball of yarn.

Case 6: Postencephalopathic hemiparesis

Complaint: ES was a 37-year-old male who had been in a long-term convalescent nursing home for 3 years, after having an acute viral encephalopathy which left him with aphasia and paresis, affecting legs and arms bilaterally. A laborer with limited education, he had been abandoned by his wife who also took any financial assets he had. He was now a ward of the state, with limited prospects for a better life.

Having experienced a fatalistic approach to continued medical care, he was assigned to the author to care for his routine adjustment of antihypertension medications and other needs. Following an offer, he began to be transported to the author's office for monthly osteopathic treatment.

Examination: The patient arrived in a motorized wheelchair and was transferred with partial co-operation to the treatment table. He demonstrated about 20% normal strength in all extremities, with the ability to spontaneously move these. Passive mobility testing was complicated by limb spasticity. Involuntary movement spasticity of the extensor muscle groups predominated, preventing balance, essential to standing or walking. He struggled unsuccessfully to contribute to chair-to-table transfers.

Cranial evaluation revealed a large depression in the posterior occipital area as a result of exploratory surgery. CRI was initially very diminished without a clear rhythm. His stocky neck and spasticity made assessment of the cervical spine almost impossible. He had almost complete left arm and leg paresis with greater voluntary movement of the right limbs. Even passive range of motion testing was complicated by the spasticity. This was a most challenging patient.

Assessment:

- Postencephalopathic partial quadriparesis
- Cranial dysfunction
- Complications of surgery
- Depression.

Treatment sequence: Treatment was given intermittently, at monthly intervals, over 3 years. Monthly, when he was willing, he was transported by wheelchair from the nearby nursing home. On such occasions treatment was on a conventional treatment table. Sometimes he was treated with an anterior approach, in a chair, on monthly medication rounds at the nursing home.

No formal protocol was developed for treating this patient. Cranial treatment initially began using a CV-4 (see p. 189) or occipital compression technique, along with other inductive techniques, to enhance cranial mobility. An attempt was made to involve the scarred areas in the mobility pattern. Work ceased for a time when seizures resumed and the patient associated these with beginning the cranial work. He later returned to treatment.

A second approach involved experimentation with limb movement. Using the remaining power of his right arm, more controlled motion was introduced by recruiting and involving muscles other than the natural prime movers of the limb. In other words, to flex the arm, rather than contracting the biceps, he was encouraged to try to keep the biceps relaxed and to find a more circuitous route to get his arm to the desired level. He would then be able to use the lateral head of the triceps and the deltoid. This strategy worked with both arm and leg movements. Over several years he progressively resumed a fair range of his previous movement pattern. This probably had to do with a gradual reassignment of cortical areas of the brain to limb movement.

Significant effort was applied to reducing restriction of fascial and articular motion, utilizing passive stretch techniques. Stretches needed to be achieved in a way that avoided the spastic contractions.

As he made incremental gains and saw progress, he applied himself in heroic fashion to his efforts. In part he was relieved of his feelings of oppressive helplessness and began to set goals. He eventually applied for an assisted independent living arrangement.

Discussion: The osteopathic profession describes its commitment to working with the whole person. Here we had a patient who had experienced a major health crisis. Additionally he had been abandoned and legally deprived of his assets, so that he became a helpless ward of the state.

Through a bonding between patient and physician and the patience of all involved, he was able to achieve a more hopeful and self-reliant status. Most of the work involved being creative in the application of principles, being persistent and trusting instinct. Nothing done was technically complex.

Case 7: Post-traumatic stress

Complaint: BB was a 48-year-old female who presented in a family practice 4 weeks after suffering midback strain in a motor vehicle accident, from which she was not recovering. She attributed the location of her pain to the seatbelt restraint as she was hit by another vehicle obliquely from behind but had turned to the left in response to noise. Physical therapy was painful and her regular physician resorted to a pharmacological approach (pain medication) only. The patient was dissatisfied with this. She presented a litany of complaints of pain in her midback, arms and legs and initially exhibited near-hysterical responses to almost any contact.

She normally worked as an assistant head teller in a bank and felt harassed by her employer who wanted her to return to work. She also expressed anger that there must have been something deficient about her medical care thus far, since she had not sufficiently recovered. She expressed indignation about being involved in the accident at all. For emotional support she would most often come to treatment with another family member, usually a young daughter.

Examination: The patient had a straightforward pattern of left sidebending and rotation of her ribcage, with a primary spinal segmental dysfunction. The OA area was very tender and there were a series of tissue texture changes throughout the cervical spine. Cranial mobility, though symmetrical, was diminished.

On directly but gently attempting to treat these areas, the patient was disproportionately anxious, protesting about the pain.

Assessment:

- Cranial, cervical and thoracic strain
- Anxiety
- Post-traumatic stress.

Treatment sequence: Treatment began in the area of her primary thoracic complaint, with gentle articular and muscle energy approaches. Again the patient protested at every approach, however gentle. By the third visit, it became apparent that her anxiety was presenting an obstacle to comfortable treatment and also to her expectation of, and acknowledgment of, any improvement.

The patient expressed a need for relief from the pain that became worse with walking, even to the extent of making her nauseous to the point of vomiting.

Expanded physical examination showed a cervical strain pattern, consistent with her injury history. Cranial examination revealed the occipital condyles posterior, resisting anterior translation into cranial base flexion.

There was extreme muscle tension in the suboccipital area. Cranial monitoring revealed global limitation of mobility, consistent with cranial base compression. Even light cranial contact was reported as causing nausea, as well as pain in her midback. Associations with vagal nerve compression seemed probable. However, discovery of further tender areas sent the patient further into a panic over her prognosis.

The initial approach to her emotional state was to try to help her develop cognitive insight into the association between findings and symptoms. An attempt was then made to use relaxation breathing as a way to help her control her panic. Neither effort achieved credibility with the patient.

Pharmacological therapy was tried temporarily, using anxiolytics as well as several trials of anti-inflammatory and pain medication. Integrated into this approach were time-lines for tapering, or intermittent use, of the medication.

Despite protests, treatment continued on a weekly or biweekly basis, on her thoracic distortion pattern, using articular, muscle energy and connective tissue approaches. Reassurance was given to generate a more positive attitude toward progress. Additionally, each visit included cranial balancing, according to the findings of the day, integrated with gentle upper cervical manipulation. Special attention was paid to the disposition of CI and C2 and their relation to the muscles of the suboccipital triangle.

Two months after her first visit the patient requested release to resume her occupation.

Discussion: The role of cranial manipulation was twofold. One aim was to normalize structure and function of the tentorium which supports the diencephalon and the base of the brain. These structures support the tissues of the limbic system and the thalamic nuclei that relate to interpretation of experience and emotional response. It has been hypothesized that the experience of post-traumatic cervical strain, 'whiplash', may include neural reflexes involving this area, relating to vision (Levine 1997).

The symptoms of nausea associated with this patient's pain could be a centrally initiated vagal reaction to the pain experience. However, they could also represent symptoms of vagal crowding at the jugular foramen, at least partly in response to restriction of the occipitomastoid suture and the muscles of the suboccipital triangle, as mentioned above.

Additionally there were regional biomechanical relationships in her complex injury pattern, which involved the so-called 'core-link' (Magoun 1976, p. 337), the linear relationship of the dura below the cranial cavity. In conventional cranial work this is used to describe the relationship between the disposition of the sacrum and the cranial base. However, the responsible connecting structure is the dural tube, which also attaches at the lateral aspect of the spinal nerves, relative to their associated thoracic segmental vertebrae and ribs. These mechanisms become significantly more complex in the lower thoracic area, with the presence of the thoracoabdominal diaphragm. Robert Fulford has mentioned the involvement of this diaphragm in the 'shock of trauma'. In this case, the flexion-extension whiplash-type injury was compounded by the folding of the thoracic cage over the seatbelt restraint. Force was disseminated upward and downward with the focal area acting as a fulcrum.

CONCLUSION

This chapter has attempted to show the history of the development of cranial thought and work in the context of the osteopathic profession's attempt to define the scope of its practice, compared to conventional medicine. This development has varied around the world and is continuing to do so.

This discussion is not meant to imply that cranial work or osteopathy is being subsumed into medicine and will no longer be recognizable. Rather, it is the author's premise that there is natural compatibility between contemporary physiological knowledge and osteopathic principles, which can be the key to including the cranial approach comfortably - to great patient benefit - in regular medical practice. This chapter has used excerpts from osteopathy's long history to illustrate this point.

There are additional aspects of osteopathic principles and work that go beyond the defined scope of medicine. In the author's mind these represent a part of the future of cranial work, as well as of medicine, and need to complement the research hitherto performed to validate the cranial concept. The work of John Upledger with somato-emotional release, the thoughts of Robert Fulford DO and the bio-energetic approach to treatment, the expression of James Jealous DO regarding the significance of the 'long tide' as well as Hugh Milne's (1995) 'liquid electric' model all point to the horizon of our understanding and what has been summarized as the biodynamic model. Aspects of this dimension of cranial work will be addressed in Chapter 4.

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Chapter 4

The biodynamic model of osteopathy in the cranial field

John M McPartland and Evelyn Skinner

CHAPTER CONTENTS

The Tao thai can be completely explained is not the Tao itself.

Dao Dejing

INTRODUCTION

The aim of this chapter is to describe the biodynamic model of osteopathy in the cranial field (BOCF). To do this, we employ a dialectic, a weave of BOCF principles with BOCF science, presented within an historical context. Some of this material appears in Chapter 3 but within a different perspective. Note that certain words have an initial capital letter, indicating the use of a defined BOCF meaning, not a standard dictionary sense.

BOCF's legacy extends back to Hippocrates, as reflected in the Hippocratic Oath's axiom 'do no harm' and its concern for our triune (body-mind-spirit) integrity. Threads of Paracelsus-style empiricism and Avicennian experimentalism color the BOCF tapestry. The foundation of BOCF, however, is firmly grounded in the philosophy and practice of three osteopathic teacher-physicians, evolving from three lifetimes spent in general medical practice, working alongside the self-balancing, self-healing principles present in their patients.

The first of these teacher-physicians is Andrew Taylor Still (1828-1917), who 'unfurled the flag of osteopathy' in 1874. Dr Still sought 'the Health' in his patients, which was always present no matter how sick his patients presented. This concept was fundamental to Still's hands-on approach to care. 'I love my patients', he declared, 'I see God in their faces and their form' (Still 1908). The physician's task, Still always reminded his students, was to remove with gentleness all perceived mechanical obstructions to the free-flowing rivers of life (blood, lymph and cerebrospinal fluid). Nature would then do the rest. Still formulated innovative concepts regarding the cranium and the cranial nerves and he famously proclaimed, 'the cerebrospinal fluid [CSF] is the highest known element that is contained in the human body' (Still 1899). His treatment techniques included gentle pressure on cranial bones, for example in the treatment of pterygium (Still 1910).

The second of these teacher-physicians is William Garner Sutherland (1873-1954), who developed osteopathy in the cranial field (OCF). Dr Sutherland was a student of Still and became imbued with Still's thinking, methods and practice. Sutherland formulated his first cranial hypothesis as a student in 1899 while examining a temporal bone from a disarticulated skull. The thought struck him that its edges were bevelled like the gills of a fish, as if part of a respiratory system. Sutherland's 1899 revelation initiated a life-long evolution of thought, described in subsequent sections of this chapter.

The third teacher-physician is James S Jealous (1943-) whose biodynamic model of OCF (BOCF) has attracted great interest and controversy within the profession. For over 30 years Dr Jealous has compiled oral histories from Sutherland's students and he continues to research Sutherland's writings (both published and unpublished). This 'work with the elders' enabled Jealous to compile an authoritative chronology of Sutherland's journey. Thus BOCF dedicates itself to the perceptual odyssey where Sutherland left off at the end of his life.

METAPHOR AND ARCHETYPE: THE KEEPERS OF THE KEYS

Still (1902) wrote '... that life and matter can be united and that the union cannot continue with any hindrance to free and absolute motion'. Still's concepts, from the beginning, were already beyond the capabilities of double-blind trials. What Still saw and understood, and Sutherland came to refine in his later writings, was the universal principle that the natural world is constantly changing and what is fixed (or without motion) becomes out of balance with its environment. Still considered osteopathy a science but when Still's osteopathy extended beyond known science and rational explanation, he imparted his lessons by using metaphorical language. A metaphor uses familiar information to describe an unfamiliar idea. Metaphor provides a verbal bridge over the space between the speaker's intention and the listener's interpretation (Artaud 1938). This transformational space, metaphorically speaking, characterizes the learning space between teacher and student, the theatre space between actor and audience and the healing space between the practitioner and patient, where at a certain moment during an exchange something greater than the sum of the parts emerges.

Metaphors, despite being inherently non-rational, have long provided heuristic tools for approaching scientific problems (Chew & Laubichler 2003). Western culture, however, has difficulty grasping non-rational thought. The non-rational aspects of osteopathy (and other alternative medical systems) are the most difficult lessons to impart and the most difficult traditions to maintain. The man-as-triune truths that lay behind Still's osteopathy became the victims of medical reductionism, casualties of our Western way of emphasizing the intellectual and eschewing the intuitive and instinctual. Reductionism limits our view of reality and our faculty of awareness (sense of consciousness). Alternative forms of consciousness, as expressed through dreams, poetry, music, painting, or as found in cultures outside the West, such as meditation or trance states, have remained undeveloped in our society. Limiting our knowledge to what can be proven in a reductionist experiment has consistently succeeded in excluding the human spirit from the Western medical model.

This lack of spirit has been a concern of BOCF practitioners, who gained insight and inspiration from Laurens van der Post (1962).

> *Man's awareness since the Reformation has been so narrowed that it has become almost entirely a rational process, an intellectual process associated with the outside, the so-called physical, objective world. The invisible realities are no longer real. This narrowed awareness rejects all sorts of things that make up the totality of the human spirit: intuition, instincts and feelings, all the things to which natural man had access.*

van der Post's anthropological concepts have played an important role in our understanding of health and disease in society. BOCF practitioners have reclaimed the human spirit in their work, in part by use of poetic metaphor, e.g. 'From Hensen's node emerges the Primitive Streak, the landing strip of the Soul' (Turner 1994).

Still no doubt acquired the skill of communicating symbolically rich language from his father, a Methodist minister. Sutherland, like Still, was a practiced wordsmith, having worked as a newspaper editor before training as an osteopath (Sutherland 1962). Still's and Sutherland's language reflected the intimacy of their connection with the natural world. Still was part of a pioneer family, where nature was ever present and its impression was deeply embedded upon his psyche. He matured among the Shawnee and other Native American peoples - primal cultures, in anthropological terms. 'In indigenous, oral cultures, nature itself is articulate; it speaks.... There is no element of the landscape that is definitively void of expressive resonance and power ...' (Abram 1996). Abram quotes a Native American healer, whose words resonate with the writing of Dr Still:

> *In the act of perception, I enter into a sympathetic relation with the perceived, which is possible only because neither my body nor the sensible exists outside the flux of time and so each has its own dynamism, its own pulsation and style. Perception, in this sense, is an attunement or synchronization between my own rhythms and the rhythms of the things themselves, their own tones and textures.*

Still's landscape was peopled by individuals who saw things from a totally different cultural perspective. Highwater (1981) wrote: 'Though the dominant societies usually presume that their vision represents the sole truth about the world, each society (and often individuals within the same society) sees reality uniquely'. Still's and Sutherland's unique cultural perspectives have been revived by BOCF practitioners. BOCF initially evolved in New England, a land imbued with the spirit of Ralph Emerson and Henry Thoreau. These 19th-century New England philosophers believed that the study of Nature, or being out of doors in the natural world, offered a cleansing of the mind and spirit ('defacilitation' in BOCF terminology) and enhanced the journey of self-discovery.

When Sutherland first published his insights (1939), osteopathy was undergoing a period of reductionism. Most practitioners focused on the mechanistic aspects of osteopathic principles and practices. Sutherland's OCF represented a renaissance of Still's osteopathy but by the time of Sutherland's death in 1954, the OCF renaissance itself entered a reformational period, a reclaiming of the rational. Reformational OCF and its basic texts (Magoun 1976, Upledger & Vredevoogd 1983) have been embraced by many osteopaths as well as massage therapists, physical therapists and chiropractors. But Sutherland's original renaissance has carried on, under the aegis of his osteopathic students including Anne Wales, Ruby Day, Rollin Becker and Robert Fulford (Cardy 2004).

As OCF has led to BOCF, the use of metaphor has led to the use of archetype. Whereas a metaphor is a figure of speech used to suggest a resemblance, an archetype is a universal symbol that evokes deep and sometimes unconscious responses in a reader or listener. Archetypes symbolically embody basic human experiences and their meaning is instinctually and intuitively understood. Jealous's concept of 'the embryo' as *ever present in the living organism* is a key BOCF archetype. When studying the writings of the embryologist Blechschmidt (described below), Jealous was impressed by Blechschmidt's conclusion that embryonic function (fluid motion) creates form and precedes structure. Jealous (2001) intuited from Blechschmidt's reports that the embryologist must have witnessed the organizational forces of primary respiration at work, without the palpatory confirmation, given the reverence with which Blechschmidt & Gasser (1978) wrote:

> *The originality of embryonic human beings is discernible in many ways; for example, the early human conceptus is master of the whole geometry that it applies to itself. It is never mistaken about any angular sum and it is never deceived in any surface to volume ratio. It never sets an intersecting point on the wrong site and is master of every physical as well as chemical reaction.*

The embryo, as an archetype of perfect form, serves as a blueprint for our body's ability to heal itself. The formative, resorptive and regenerative fluid forces that organize embryological development are present throughout our lifespan, ready for our co-operation in harnessing their therapeutic potency. In other words, the forces of *embryogenesis* become the forces of *healing* after birth. It is to this state of originality and omnipotentiality that our Fluid Body is constantly returning, a process of 'morphic resonance' (Sheldrake 1981).

Among BOCF practitioners, every event within the therapeutic arena has a name. Nothing is referred to vaguely in terms of 'energy'. The importance of naming is shared by primal cultures worldwide, notably the Bushmen of the Kalahari (van der Post 1961). According to the Bushman, an individual's separation from that part of themselves that is connected to 'everything else' leads to fear and a sense of aloneness and this facilitates the disease process. Because treatment using the BOCF connects the patient to nature, the patient receives an immediate experience of 'not-aloneness' or 'belonging' in a deep way. Patients gain a physical sense of 'community', possibly for the first time in their life. As Wendell Berry (1996) emphasized, 'The community is the smallest unit of health'.

In the next three sections of this chapter, we review OCF's and BOCF's evolution of thought, evolution of perceptual skills and evolution of treatment approaches - from the *Bones* to the *Dura* to the *CSF* to the *Fluid Body.* See Box 4.1 for a summary.

EVOLUTION OF THOUGHT

Bones

From his student days until the late 1920s, Sutherland concentrated on cranial bones, their sutures and foramina. Sutherland proposed that cranial sutures remain mobile throughout a person's life. His hands-on insights predicted what is now known through histological studies - that most cranial sutures never completely ossify (Retzlaff & Mitchell 1987). Living sutures contain connective tissue, blood vessels and nerves. They maintain articular function and serve as crossroads of metabolic motion and somatic information. Sutherland's deductive observations were confirmed by research completed by his osteopathic contemporary, Charlotte Weaver. She conducted experiments that led her to regard the bones of the cranium as modified vertebrae (Weaver 1936a). Fetal dissections supported her theory that the spinal column and the cranium are embryologically homologous (Weaver 1936b). Weaver characterized the sphenobasilar symphysis as a modified disk between occiput and sphenoid - plastic and capable of motion (Weaver 1938).

Box 4.1 A chronology of OCF and BOCF evolution

1910s–1920s Sutherland studies the cranial bones and their sutures and foramina

1930s, early Sutherland begins experimenting with the dura and its infoldings (falx, tentorium)

1930s, late Sutherland shifts his focus to the fluctuation of cerebrospinal fluid and elucidates the Primary Respiratory Mechanism

1943 Sutherland describes the Breath of Life

1948 Sutherland begins working with Tidal Potency

1951 Sutherland stops motion testing, all fulcra occur in still points

1960s Sutherland's writings are published, after editing by Ada Sutherland and Anne Wales

1970s Sutherland's students Rollin Becker and Robert Fulford expand his post-1943 work

1980s Bar Harbor: at a meeting of osteopaths from England and New England, James Jealous links Sutherland's insights to the works of Blechschmidt and van der Post

Dura

In the early 1930s Sutherland shifted his emphasis to the dura and its bilaminar infoldings that form the falx and the tentorium, collectively known as the reciprocal tension membrane, which balances motion within the skull. Sutherland accessed the dura by gently gripping the cranium. The external periosteum is contiguous with the internal dura. Sutherland visualized one continuous web of connective tissue, from the cranium down to the sacrum - which he characterized as the tadpole-shaped 'core-link'.

CSF

In the middle 1930s Sutherland shifted his focus to the fluctuation of CSF, driven by what he termed the Primary Respiratory Mechanism (PRM). He postulated that the PRM consists of five phenomena (Magoun 1976).

- The inherent motility of the brain and the spinal cord
- Fluctuation of the CSF
- Motility of the intracranial and intraspinal membranes
- Articular mobility of the bones of the cranium
- Involuntary mobility of the sacrum between the ilia.

Sutherland described CSF circulating down and around the spinal cord in a rhythmically pulsatile and spiral fashion. Science has again caught up with his hands-on insights, thanks to advances in radionuclide magnetic resonance imaging (Greitz et al 1997). Magoun (1976) named this CSF pulsation the Sutherland Wave, after its discoverer. Many practitioners refer to the pulsation as the cranial rhythmic impulse (CRI), a term coined by Rachel and John Woods (1961). Clinical studies report a palpable CRI rate of 6-12 cycles/min, independent of cardiac or diaphragmatic rhythms (Magoun 1976).

The CRI phenomenon is poorly understood and its origin remains unknown (acupuncturists face a similar situation when asked to describe *qi).* Sutherland (1939) proposed that pulsations arise from rhythmical motions of the brain, causing dilatation and contraction of cerebral ventricles, generating a pulse wave of CSF. Magoun (1976) elaborated on this proposal and also posed an alternative hypothesis - that the choroid plexus produces CSF in rhythmic cycles and this oscillation generates brain motility. Upledger & Vredevoogd (1983) refined the choroid plexus hypothesis, calling it the 'pressurestat model'. McPartland & Mein (1997) called the CRI a palpable *harmonic frequency,* a summation of several pulsations such as CSF oscillations, the cardiac pulse, diaphragmatic respiration, Traube-Hering modulations, rhythmically contractile lymphatic vessels, pulsating glial cells and other polyrhythms. This 'entrainment hypothesis' has been put forward independently (e.g. Milne 1998) and recently supported by experimental data (Nelson et al 2001). Many of these biological oscillators are lesioned by imbalanced autonomic tone (Schleip 2002), making the CRI variable and ephemeral. Indeed, in the face of severe dysfunction, the body's rhythms may not co-ordinate into harmonics, resulting in an undetectable CRI. Thus from a BOCF perspective the CRI is a lesion phenomenon.

Fluid Body

Many osteopaths today work within the CRI models proposed by Magoun or Upledger but Sutherland moved on. In the final 10 years of his life, Sutherland described the PRM being generated by *external* forces. He sensed his patients being moved by an external ubiquitous force, which he called the Breath of Life (BoL). Sutherland perceived the BoL to be an incarnate process, passing through the patient's body and the practitioner's hands, undiminished. With the BoL concept Sutherland's reverence for a self-correcting system had fully flowered.

> *Sutherland arrived at a conceptual transition, leaving those who followed with a bridge to the depth of osteopathic research and practice that places us upon a new and deeply challenging renewal of the ultimate truths of our profession, (jealous 1997)*

Sutherland's bridge linked his students to Still's earlier insights, such as 'Life is the highest known force in the universe' and 'We are the children of a greater mind' (Still 1902).

In the final years of his life, Sutherland's perceptual language drew upon the natural world around his home in Pacific Grove, California. He spoke of his patients as if they were part of a sea, with *waves* that rhythmically move through the water and a tide that moves deeper, through both water *and* waves (Sutherland et al 1967). Sutherland was describing a polyrhythmic system (see Table 4.1). As the BoL transubstantiates into the PRM, it generates various harmonic rhythms in the body, such as the 'Long Tide,' the '2 to 3 cycle' and the CRI. Becker (1965) described the Long Tide as the basal rhythm, its rate directly correlating with that of the BoL, oscillating at a frequency of six cycles every 10 minutes. Around 1988 Jealous described the '2 to 3' (aka the 21 CPM cycle) with a mean frequency of 2.5 cycles/min (Jealous 1997). The *l*\ CPM is a harmonic of the Long Tide. It is not modulated by the central or autonomic nervous systems, making it a stable rhythm. Polyrhythms may explain the poor agreement seen in some OCF interexaminer reliability studies. For example, the interexaminer study by Norton (1996) reported low reliability between OCF practitioners. This study was flawed because one practitioner recorded the CRI rate while the other practitioner recorded the 7\ CPM cycle (Jealous, personal communication, 1997).

Sutherland (Sutherland & Wales 1990) compared the BoL to the cyclic, sweeping beam of light emitted from a lighthouse, 'lighting up the ocean but not touching it'. The BoL sweeps through the patient, enlightening the healing forces already present in the patient. This allows the 'Fluid Body' to emerge, where the whole body behaves as if it were a single unit of living substance. The Fluid Body represents the BOCF equivalent of a Bose-Einstein condensate, where individual molecules lose their identity and form a cloud that behaves as a single entity (Cornell & Wieman 2002).

Table 4.1 Polyrhythmic cycles described in OCF and BOCF

Cycle name	Cycle rate	Cycle source
Cranial rhythmic impulse	6–12 cycles/min	Unknown. Possibly autonomics or pre-Neutral CNS activity
2½ CPM cycle	2.5 cycles/min	Primary Respiration
Long Tide	0.6 cycles/minute	Breath of Life

EVOLUTION OF PERCEPTUAL SKILLS

Bones

Sutherland's initial osseous approach to OCF requires a sound palpatory comprehension of all surface landmarks of the cranium, at all stages of human development. This includes the contours of the 22 cranial bones, their interlocking articulations and many fissures and foramina. Normal and abnormal levels of tonus in extracranial muscles must also be appreciated, as well as tissue texture changes in cutaneous tissues.

Dura

The dural model of OCF, like the osseous approach, requires a comprehensive grasp of anatomy. Perceptually, sensing the dura and the reciprocal tension mechanism requires the practitioner to palpate tissues beyond his or her fingertips. This seemingly esoteric skill is familiar to anyone who has driven an automobile on wet roads - feeling a slippery road surface through the steering wheel, sensing the road surface indirectly, through a series of linkages from the road through the tires through the wheel axles to the steering wheel.

CSF

For practitioners working with the CSF and fluid fluctuations, anatomical knowledge is not sufficient. Rollin Becker admonished, 'Studying the cadaver is like studying a telephone pole to find out how a tree works' (Speece et al 2001). The requisite education comes from a study of living tissues in one's patients. The practitioner visualizes 'a state of rapport in the fluid continuity between the physician and the patient' (Magoun 1976) by 'melding the hands with the head' (Upledger & Vredevoogd 1983). With training and practice the practitioner feels a subtle motion, much like the respiratory excursion of the chest, sensed as a broadening and narrowing of the head between the hands. This type of palpation represents a harmonic signal of several senses, including temperature receptors, mechanoreceptors and proprioceptors (McPartland & Mein 1997). Other yet unelucidated sensors may detect piezoelectricity or electrical fields as described by yogic practitioners (Green 1983). Milne (1998) achieved 'visionary craniosacral perception' by entraining his diaphragmatic breath, empathy and intent with those of his patient.

Fluid Body

Detecting polyrhythms and the Fluid Body requires practitioners to augment their 'afferent' activity and reduce their 'efferent' activity. In other words, practitioners must emphasize reception rather than transmission - the difference between listening to a radio and conversing on a cell phone. Even 'melding the hands with the head' may be too efferent. Conveying efferent forces into a patient creates a jumbled sense of 'I-thou'. To detect the Long Tide and the l\ CPM cycle requires defacilitation of the practitioner's central nervous system (Jealous 2001). Our consciousness, like our spinal cord, can become facilitated and noisy. According to Jealous, a quiet mind requires the cranial, thoracic and pelvic diaphragms to function without inhibition. This is accomplished by allowing the breath to become slow and regular and by softening the muscles above the pubic bone. These actions reportedly serve to 'synchronize the practitioner's attention'. As attention synchronizes and has room to breathe, the practitioner senses deeper rhythms and the signal shifts from the CRI rate to the 2j CPM cycle. With deeper defacilitation, perception of the 25 CPM cycle disappears into the Long Tide (Jealous 2001).

With enhanced perceptual skills, the practitioner eventually perceives a sense of *Neutral,* which is experienced as a homogenization of tissue, fluid and potency - the Fluid Body, where nothing under the fingertips can be discerned as a separate entity. This lysergic entity lies at the perceptual center of BOCF. The Neutral cannot be conceptualized, it can only be experienced. It is here that 'holism' becomes more than a philosophical concept; it can be appreciated as an actual sensory perception.

References to the Long Tide and the BoL appear in the first edition of Magoun (1951), possibly due to the influence of Paul Kimberly (Jealous, personal communication, 2001). But references to the BoL were expunged from later editions. 'Osteopathy has shamefully hidden its greatest mystery and resources' (Jealous 2001). A summary of some of the differences between OCF and BOCF is presented in Table 4.2.

EVOLUTION OF TREATMENT APPROACHES

Bones

Directly adjusting sutures and foramina affects the function of cranial nerves and vessels that traverse these apertures, as well as the function of muscles that originate or insert upon cranial bones. Some of Sutherland's students continue to focus on bones and sutures, such as the American chiropractor Dejarnette, who founded sacral-occipital technique (Hesse 1991). Treatment of suboccipital muscles directly impacts the dura and may be helpful in patients with dural headaches and chronic pain syndromes (McPartland et al 1997).

Dura

Treating the reciprocal tension membrane with balanced membranous tension (BMT) is an indirect technique, performed by gently exaggerating the membrane's strain patterns, balancing the tension in strained fibers with the tension present in normal fibers, effecting a release of the strain (Sutherland & Wales 1990). Many osteopaths work with this dural model and get good results. Lawrence Jones used his counterstrain technique to mold the falx and the tentorium. Beryl Arbuckle was an extraordinarily gifted practitioner of BMT.

CSF

Sutherland initially used direct hydraulic force, such as the CV-4 technique for compressing CSF in the fourth ventricle (Magoun 1976, Upledger & Vredevoogd 1983). The CV-4 induces therapeutic

Table 4.2 A brief comparison of biomechanical and biodynamic models of OCF

Biomechanical	Biodynamic
Techniques led by practitioner's forces, directly or indirectly	Techniques follow movement within the system. Transmutative ability of the Tide is acknowledged. Tidal forces directly interface with pattern of disease. Practitioner follows closely
Axial motion in bones	Transmutational, translational motion
'Mechanism' used as a non-distinct collective term	'Mechanism' defined through specific elements (i.e Breath of Life, Fluid Drive, Tidal Forces, different rates, etc.). Words have sensory foundations that are clearly stated
CRI is a primary expression of the BoL	CRI is not an expression of the BoL, nor is it a therapeutic force.
CRI 8–14 cycles per minute. Slower rates not identified	Basic rate is 2–3 cycles per minute; slower rates are specifically identified as primary to the system
Perception is automatic. Skills not delineated	Perception is a conscious, skillful act, requiring training and moment-to-moment adjustment, not automatic
Lesions are somatic and articular in nature	Lesions may occur at any level in the system. A lesion is seen as a unit of dysfunction in the Whole person
SBS is a primary site of orientation for lesion activity. Lesions are diagnosed and reduced by conceptual sequences beginning at SBS	Primary site is variable. Lesions are not automatically corrected, sequences are not conceptual. Priorities are established by the Tide

changes around the body, possibly via peri-aqueductal gray (PAG) tissue, which surrounds the fourth ventricle. The PAG is lined with neuro-receptors (opioid and cannabinoid receptors) and it responds to stimuli (such as hydraulic pressure) by activating these neuroreceptors, by releasing endorphins and endocannabinoids and by propagating pain-inhibitory signals to the dorsal horn. The PAG is homuncular, like the somato-sensory cortex, so the topography of the PAG corresponds to different parts of the body (J Giodarno, personal communication, 2002).

Most practitioners who work with the rhythmic fluctuation of CSF focus upon the CRI rate, as exampled by Magoun's and Upledger's models. The CRI rate is also the focus of the Sutherland Cranial Teaching Foundation (SCTF), although the SCTF now incorporates the *2j* CPM cycle and the Long Tide into its curriculum (A Norrie, personal communication, 2002).

CRI-oriented practitioners may bring about therapeutic changes by inducing entrainment (McPartland & Mein 1997). Entrainment was first described in 1665 by Christiaan Huygens (Strogatz & Stewart 1993). He noted that collections of pendulum clocks began swinging in synchrony with each other. This coupling phenomenon also arises within organisms (e.g. cardiac pacemaker cells) and between organisms (e.g. simultaneously flashing fireflies, harmoniously chirping crickets and women whose menstrual phases cycle together). Huygens noted that the 'strongest' clocks (those with the heaviest pendulums) established the eventual, overall rhythm. McPartland & Mein (1997) proposed that practitioners transferred their 'strong clock' rhythms onto their patients and enhanced this transfer by assuming a meditative state before treating patients. Meditative, centered states are known to produce strong entrainment (Tiller et al 1996). Centering to harness entrainment may be a widespread therapeutic technique, albeit unrecognized by practitioners of Feldenkrais, network chiropractic, polarity therapy, reiki, therapeutic touch and Tragering. Chinese practitioners center on *tan tien,* the 'one point', about 5 cm above the pubic bone, whereas Tibetan practitioners meditate on an image of the Medicine Buddha centered at *sahar chakra,* the crown of the head (McPartland 1989). The new 'Freeze-Frame' technique focuses on the heart to achieve entrainment (Tiller et al 1996). All these techniques center attention on parts of the body rich in biological oscillators (intestines, brain and heart).

Tiller et al (1996) stated that feelings of empathy and love lead to strong entrainment. Jahn (1996) described the *resonant bond* between practitioner and patient as a form of love, transmitting 'beneficial information'. Wirkus (1992) emphasized that the healer '... must feel and be the heart chakra.... It is not thinking the word "love", it is the real sensation of pure love which brings warmth, delicate vibrations in your heart area'. Fulford (1988) was precise: 'You the [practitioner] stand neutral, acting as a conduit for the flow of divine love. As you learn to use love properly in healing work, your body vibrations increase and it becomes easier to handle the potency of the love energy'.

Entrainment has its limitations. It can only be employed by practitioners who work with the CRI. Practitioners working with slower rhythms avoid efferent activity, so no entrainment may be possible or desired. We limit our therapeutic potential when we focus solely on the CNS - whether we work with the CSF or the cellular vibrations of entrainment. We may also cause side effects and iatrogenesis (Greenman & McPartland 1995, McPartland 1996).

Fluid Body

According to a precis by Jealous (personal communication, 2004), 'Cranial osteopathy is not about the cranium. It is about Primary Respiration'. Sutherland's move from the CSF to the Fluid Body began with a technique he called 'automatic shifting'. Paulsen (1953) described Sutherland's sensation of a 'motor' starting in the CSF and then carrying on of its own accord, generating a healing force that treated several lesions around the body. 'The core of this work is perceptual', wrote Jealous (2001). 'We learn to sense the Whole. When one meets a patient, one sees the Whole - a very rare event in our modern world.' When a patient achieves a Neutral as described previously, the CNS becomes quiet (the person often falls asleep). With the CNS 'out of the way', the whole person - the CNS, CSF, all other fluids and all other tissues - merges into the Fluid Body. Within the protoplasmic Fluid Body, motion is purely metabolic, responding freely to the outside presence of the natural world and the BoL.

To harness the potency present in the BoL as expressed in the Tide requires ever more subtle techniques. In the final years of his career, Sutherland stopped all motion testing of the head and applied no forces to osteopathic lesions. He worked with fulcrums in still points and stated, 'treat not with techniques but gentle contact' (Sutherland & Wales 1990). Working with the Health is a BOCF imperative, echoing Still (1899): 'To find health should be the object of the doctor. Anyone can find disease'. Jealous (1997) described therapeutic changes requiring an 'aboriginal and instinctual consciousness' on the part of the practitioner, not intellectual or even intuitive: 'The moment is filled with the effort to be present with the Health in the patient and the story as it unfolds into its own answer'.

BOCF SCIENCE: QUANTUM CONSCIOUSNESS

Osteopaths base their science in *physics*, whereas Western medical practitioners practice *chemistry* - their pharmacodynamic tools treat chemical moieties known as genes and gene products. Osteopaths recognize the A-T-C-G chemistry of genes but focus on the physics of the midline within the double helix itself. To wit, osteopaths focus on the double helix's fourth dimension: time. DNA converts time into space. Surprisingly, this transmutation can be explained within the mechanistic model of Newtonian physics (Pourquie 2003). Many new ideas proposed by New Age healers operate within a Newtonian paradigm. Pert (2000) hypothesized that energy therapists heal their patients by inducing a vibrational tone that shifts neuroreceptors into their constitutively active state or the vibrations trigger the release of endorphins that activate the neuroreceptors. Oschman (2000) described crystalline materials within biological structures (e.g. phospholipids within cell membranes, collagen in connective tissues) that generate electric fields when compressed or stretched (piezoelectricity). These energy fields may be the source of hands-on healing, a radical proposition but safe within a mechanistic paradigm.

Newtonian physics has undergone a paradigm shift to quantum physics, thanks to relativistic studies addressing subatomic phenomena and consciousness. Still's writings suggest he had undergone a quantum paradigm shift. He knew instinctively that the healing events in his patients happened at the subatomic level but he did not have the words or the concepts of quantum physics to draw upon, to express the transformation he was experiencing in his treatments. Instead, he ascribed the return to health to God or Divine Nature at work.

Sutherland's BoL exhibits characteristics that can only be explained by quantum theory (e.g. the theory of implicate order by Bohm 1980). The BoL transubstantiates into Primary Respiration, a field force that generates a spatial orientation, so it shares characteristics with the 'morphogenetic fields' described by Sheldrake (1981). Sheldrake's concepts are very quantum: morphogenetic fields carry information only (no energy) and are available throughout time and space without any loss of intensity after they have been created. These non-physical 'blueprints' guide the formation of physical forms through three-dimensional patterns of vibration he called *morphic resonance.* The morphic resonance that generates form in the embryo is the same process that generates healing in the adult.

The role of consciousness in quantum theory is a radical departure from classic physics. The outcome of any experiment depends upon the consciousness of the observer. Indeed, the term *observer* should be replaced by the term *participator.* We cannot observe the universe, we are participants in it. Our individual consciousness is a small hologram of the universal consciousness shared by all living things. Capra (1996) named consciousness ('the process of knowing') as a key feature of life, including life forms such as plants and protozoans that lack a central nervous system. The protoplasmic Fluid Body shares this consciousness, which explains its 'sensitive' and 'decision-making' attributes (Jealous 2001).

From a BOCF perspective, Jealous (2001) acknowledged that the practitioner's consciousness has a primary role in the depth of therapeutic changes arising in the patient. Jealous discovered that his therapeutic results improved in proportion to the extent to which he could free himself from conscious rationalization. He discovered, as did Sutherland, that the practitioner's effort'... is to let the Breath of Life move us, allow us vision.... One's effort must be from a "sense of the possibilities'" (Jealous 2001). The following sections of this chapter review new research 'around the edges' of BOCF science.

Blechschmidt's embryology vis a vis the BoL

Jealous (2001) characterized traditional osteopathy as a science based on anatomy, whereas BOCF is a science based on embryology. BoL practitioners have followed the work of Erich Blechschmidt (1902-1992), an unabashedly holistic embryologist. Blechschmidt (1977) maintained that the embryo is not only alive, it is *fully functional* at every stage of its development. According to Blechschmidt, each part of the embryo develops in motion and each motion impacts the development of each subsequent development. Early embryological development is largely *epigenetic,* guided by fluid dynamics. Blechschmidt's concepts agree with BOCF practitioners, who postulate that the BoL, the external force described by Sutherland, generates a spatial orientation in the embryo. The spatial orientation becomes expressed in the material plane by fluid forces, perhaps by electromagnetic water hydrogen bonds (a concept that resonates with the 'water imprint' theory of homeopathy), generating a matrix that governs the embryo's development. This conceptual agreement between Blechschmidt and BOCF places them on one side of a great debate. For the past 50 years scientists have argued over two theories regarding embryonic development: is it *passive* and *'external'*, driven by fluid dynamics, or *active* and *'internal'*, driven by the molecular activity of genes?

Neural crest cells (NCCs) are a focus of this debate. Migratory NCCs appear in the fourth week of human embryogenesis. As the lateral edges of the neural plate fold up and fuse at the midline to form the neural tube, NCCs surf the crest of the wave generated by this zipper-like action. They follow highly replicated, stereotypical pathways. In our age of molecular medicine, advocates of *active* cell migration uphold the dominant paradigm. According to this view, migrating NCCs are directed by genes that express cell membrane receptors. NCC receptors sense molecular gradients in the extracellular fluid. Thus NCC migration has been described as *chemotaxic,* guided by molecules such as integrins, cadherins and connexins (Maschhoff & Baldwin 2000). This molecular view is challenged, however, by phylogenetic inconsistencies - NCCs only appear in vertebrate embryos. Invertebrate embryos have no NCCs yet they express genes linked with NCC migration, such as *BMP2/4, Pax3/7*, *Msx, Dll* and *Snail* (Holland & Holland 2001). Vice versa, genes associated with vertebrate cell migration, such as *CNR1* (Song & Zhong 2000), are absent in invertebrates (McPartland & Glass 2001, McPartland et al 2001). Plants, which are devoid of a CNS, also express integrin receptors (Lynch et al 1998), which aid plant cells in the perception of gravity (a very subtle force in non-ferrous materials). Perhaps integrin receptors are not chemotaxic guides but in fact respond to subtle electromagnetic forces such as the BoL.

Blechschmidt argued that fluid dynamics permit migrating cells to overcome the inertial, thixotropic (viscous) behavior of embryonic extracellular fluid. The tensile quality of the fluid matrix provides a scaffold for the migration and movement of NCCs. BOCF practitioners correlate this concept with Sutherland's description of the Tide acting as a fluid-within-a-fluid, expressing a tensile quality, with the ability to direct force. Blechschmidt's theory has been verified by researchers around the world (see a dozen citations in Jesuthasan 1997) who injected latex beads into living embryos. Latex beads are inert objects incapable of molecular chemotaxis and lacking inherent motility. They nevertheless follow the migratory pathways of NCCs. The tensile fluid forces required for this kind of movement were demonstrated by Schwenk (1996), who used micropipettes to inject streams of fluids into water. Boundary surfaces arising between the moving fluid and the still water vortexed into organic forms (see Fig. 4.1). Experimental changes in fluid density or injection speed created different forms. In some experiments, the tensile quality of the fluid matrix created shapes that resembled the migratory path of neural crest cells. In other experiments the spatial orientations of fluid-in-a-fluid suggested CNS formation in the embryo, complete with dura and pia, cerebral hemispheres and a corpus callosum connecting the hemispheres (see Fig. 4.2). Schwenk's experiments with fluid mechanics suggested that the geometric configuration of the embryo is present *before* the structure develops.

Genetic contributions

After the fluids lay down a matrix or blueprint, genetic expression subsequently organizes the cells and cell migration does indeed become active. For example, the initial wave of NCCs stops migrating and establishes a reticular lattice. This lattice provides a scaffold for the active chemotaxic growth of neurons, presaging the mature organization of the autonomic nervous system (Conner et al 2003).

Similar phenomena govern the growth of neurons, via a sensory and motor apparatus in their tip termed the growth cone. Growth cone pathfinding is partially guided by fluid forces, a passive process again demonstrated by the translocation of inert latex beads (Newman et al 1985). But genes also contribute to growth cone pathfinding, by expressing cell membrane receptors that are activated by extracellular 'attractant' or 'repellent' compounds. For example, *UNC-40* and *Eph* receptors are activated by netrins and ephrins, proteins secreted into extracellular fluid. Activated *UNC-40* and *Eph* receptors begin a molecular cascade that directs the cell's actin cytoskeleton, thereby regulating growth cone motility (Dickson 2002). A veritable molecular soup guides neurons to their destinations. This complexity can be appreciated by the daunting task faced by commissural axons, which must grow towards the midline, cross it and then continue on their path without turning back.

Nevertheless, Blechschmidt emphasized that genes do not *act*; they *react* to external forces. The reaction of genes to hydrostatic pressure during

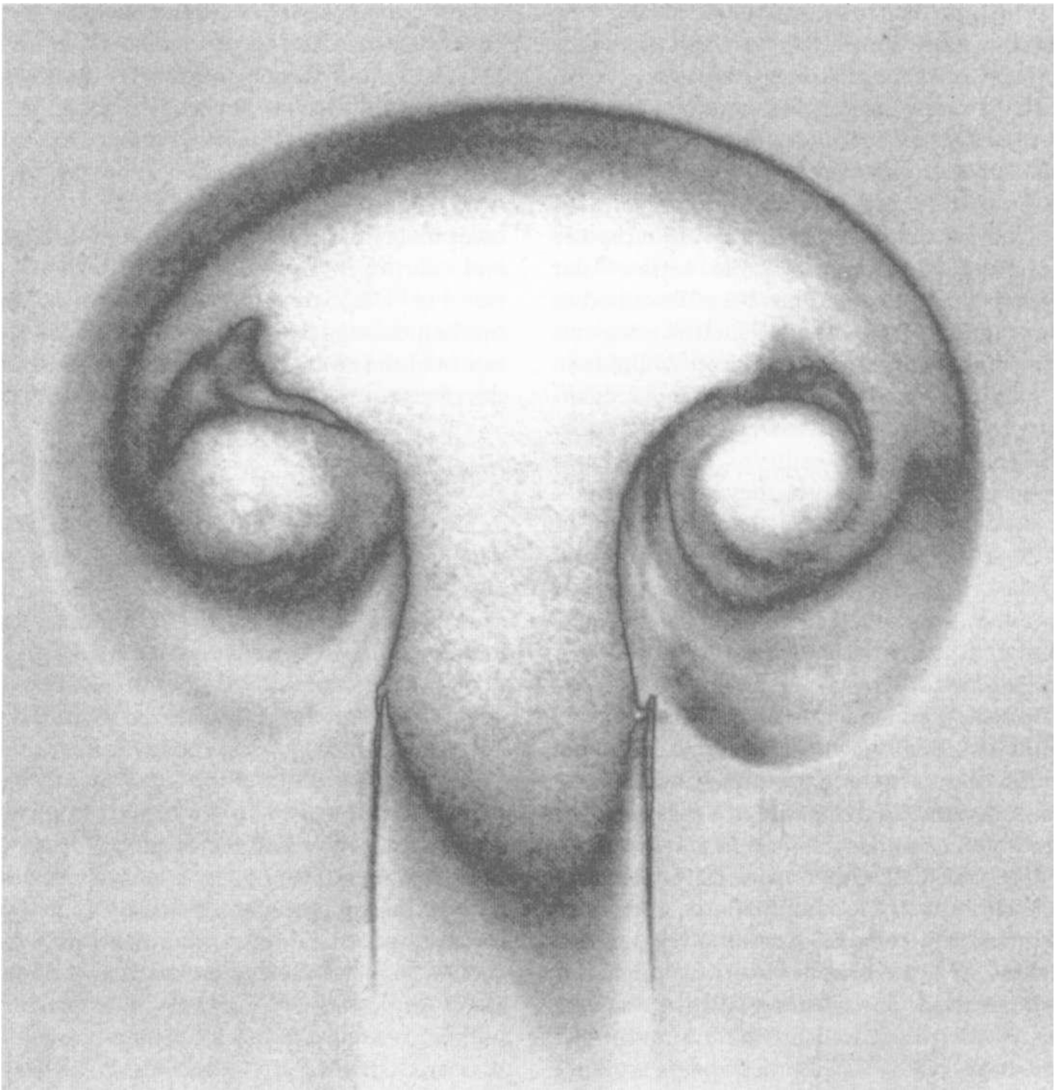

Figure 4.1 Photomicrograph of micropipette injecting a stream of fluid into water, forming a vortex. The boundary surface between the moving fluid and the still water creates organic forms. (Illustration by Gerald Moonen, redrawn from Schwenk 1996, with permission.)

embryogenesis has recently been termed 'the morphogenetic mechanism' (van Essen 1997). van der Wal (1997) likened genes to the clay that forms a piece of pottery. Clay by itself cannot form into shape, it requires the hands of the artist. And the hands of the artist cannot act without the mind of the artist. From a BOCF perspective, clay represents the genes, the hands represent the fluid forces and the artist's mind represents the BoL - the 'deific plan' or the 'master mechanic' often alluded to by Still. Anecdotally, we (JM and ES) attended a BOCF workshop the week that Venter et al (2001) published the human genome sequence. While scientists around the world pondered the paradox that an organism of our complexity could operate on only 30 000 genes (Claverie 2001), our workshop of BOCF practitioners confirmed the obvious necessity for epigenetic forces to make 'decisions' that shape embryogenesis.

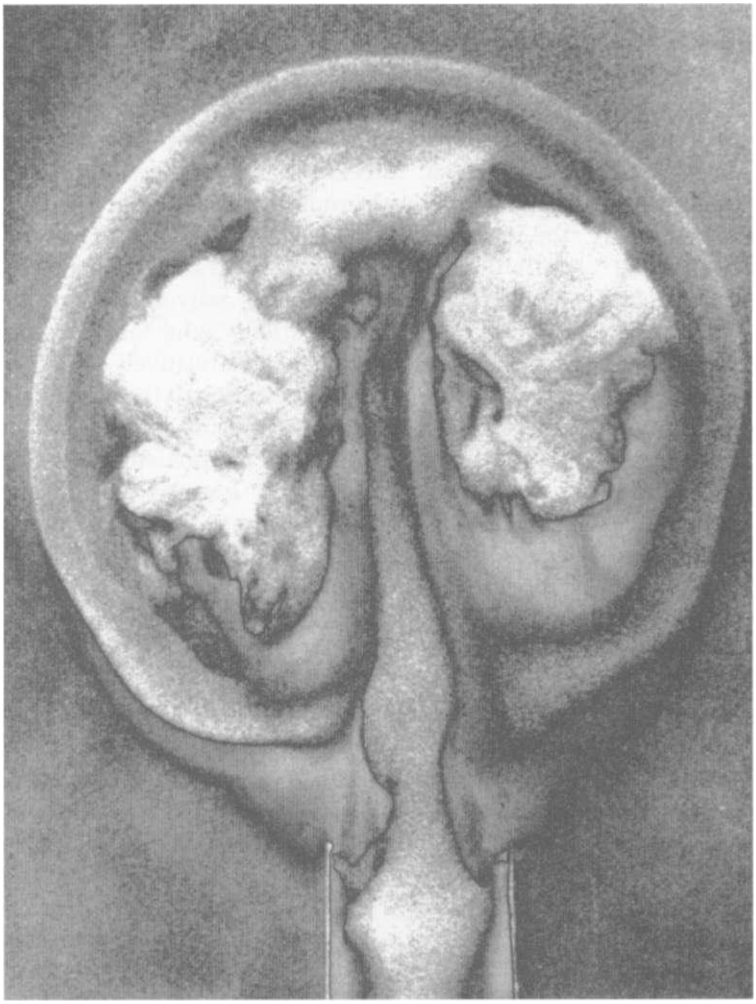

Figure 4.2 Photomicrograph of micropipette injecting a stream of fluid into water, an experimental variation from Figure 4.1, changing the density of the fluid. The spatial orientation of boundary surfaces suggests that of embryonic CNS formation. (Illustration by Gerald Moonen, redrawn from Schwenk 1996, with permission.)

Metabolic motion

Blechschmidt (1977) elaborated six different mechanisms by which fluids 'behave internally', creating function out of which emerges structure: contusion, distusion, dilatation, retension, detraction and densation. Later he added corrosion, loosening and suction mechanisms (Blechschmidt & Gasser 1978). These mechanisms are driven by the metabolism of cellular tissues. Cell metabolism potentizes or depletes various fluids, which Blechschmidt termed 'metabolic fields'. For example, the earliest bending of the embryonic disk - flexing into a 'C shape - is due to a decrease in pressure from the collapse of the yolk sac (Drews 1995). Cellular metabolism depletes nutrients in extracellular fluids and causes a build-up of metabolic wastes. Sheets of cells adjacent to depleted fluids slow their growth and become the concavity of tissue curvatures. Concentration gradients of nutrients and wastes create fluid movements between sources and sinks. When these fluid movements canalize tissues they become embryonic blood vessels.

Sheets of cells, tissues and organs grow at different rates. The epithelial linings of these assemblages become restraining structures, generating form. The embryonic face, for example, arises as folds and furrows between an expanding brain and a beating heart (Blechschmidt & Gasser 1978). Growth differentials within the embryonic cranium create fluid patterns that later condense into mechanical tension zones or mesenchymal restraining bands known as the dural girdles. They guide the position, shape and inner structure of the brain: The resistances are not crude mechanical forces but delicate living developmental resistances' (Blechschmidt 1961). The midline dural girdle between the cerebral hemispheres serves as a strong restrainer against the pull of the descending viscera and the eccentric growth of the cerebrum. This midline dural girdle is retained into adulthood as the falx cerebri. It initially cleaves the frontal bone, which is why the frontal bone, a single midline structure in most adults, functionally behaves like a paired bone. In some individuals this midline function is retained as structure, the metopic suture (Magoun 1976). Several paired dural girdles arise in the embryo and one of them is retained into adulthood as the tentorium cerebelli.

Functional midline

Another aspect of embryology that informs BOCF is the concept of a *functional midline,* around which our bodies and health must organize. The midline is the earliest expression of function within the embryo. A series of structures arises from the midline - first the primitive streak appears in the ectoderm, beginning at the caudal pole of the embryonic disk. Subsequently, the notocord develops within the endoderm, again growing from caudad to craniad. Days later, the neural groove forms along the midline, arising tail to head. During the fourth week of development, the neural tube closes at its two ends and the movement of fluid is no longer a *circulation* but a *fluctuation.* The amniotic fluid becomes the CSF. The lamina terminalis marks the closure of the cephalgic end of the tube. This midline structure persists in the adult, at the roof of the third ventricle. It is the pivot point for all neural movement. During the inhalation phase of the PRM, the entire central nervous system spirally converges upon the lamina terminalis. During the exhalation phase, all tissues move away from the lamina terminalis.

Jealous (1997) described the midline arising from the Stillness, generated by the BoL. The functional midline remains present throughout our life and our structure and physiological motion remain oriented to the midline. The BoL comes into the body at the coccyx and ascends along the midline, radiating 'like a fountain spray of life' (Sills 1999). The conveyance of a midline bio-energetic force from tail to head has been described by numerous workers, perhaps first by the medical polymath Wilhelm Reich. Reich and his students independently described the PRM: '... confirmation of brain movement can be obtained from individuals who are free of armoring ... this movement is relatively slow and unrelated to arterial pulsations' (Konia 1980). Interestingly, genetic mechanisms tend to work in the opposite direction, in a cephalad to caudad progression. This is best exemplified by the activation of a dozen *Hox* transcription factor genes (the '*Hox* clock') that direct the formation of embryonic somites from head to tail. The sequence of *Hox* gene expression is co-linear with their gene order on the chromosome (Kmita & Duboule 2003).

The movement of the Tide can be palpated throughout the body, termed 'Zone A' by BOCF practitioners (Jealous 2001). Asian practitioners conceptualize this energy moving in channels, such as Chinese *qi* and Ayurvedic *vata* and its subdosha *prana* (McPartland & Foster 2002). The movement of the Tide can also be palpated outside the body, in the 'auric field' of various Eastern and Western energy workers, termed Zone B in the BOCF lexicon. Osteopaths such as Randolph Stone and Robert Fulford primarily worked in Zone B. Rollin Becker worked in Zone C, a field diffusing from the midline to the edges of the room (personal communication, J Jealous, 1999). Jealous (2001) emphasized that all these zones exist simultaneously, as do other domains, such as Zone D which extends from the patient's midline to the horizon. The zones are useful diagnostic tools, augmenting the practitioner's perceptual fields.

Embryology learns from BOCF

BOCF has learned from embryology but the relationship is reciprocal - BOCF has informed the science of embryology. Take the anterior dural girdle (ADG) for an example. The ADG arises

Figure 4.3 The anterior dural girdle forming in an 8-week-old embryo, drawn as a thin double line between anterior and lateral telencephalic vesicles. (Illustration by McPartland, redrawn with permission from Blechschmidt ft Gasser 1978.)

around the eighth week of pregnancy, as a condensate of strain patterns between the evaginating telencephalic vesicles (Fig. 4.3). According to most embryologists, the ADG regresses before birth. However, one of Jealous's colleagues alerted him to a cranial strain pattern that he detected in several of his adult patients. They started calling it 'the hoop', describing its sensory feel. They organized perinatal dissections with Frank Willard PhD and discovered that the anterior dural girdle does not always involute before birth but sometimes remains as an anterior transverse septum (Fig. 4.4). In other cases the girdle regresses, although a strain pattern may remain in the fluids.

BOCF palpation also presaged the discovery of a dural bridge in the suboccipital region (Jealous, personal communication, 1999) and this structure is now known to persist in adults (McPartland & Brodeur 1999). The dural bridge attaches the dura to the posterior atlanto-occipital membrane (PAOM), a ligament that spans the OA joint.

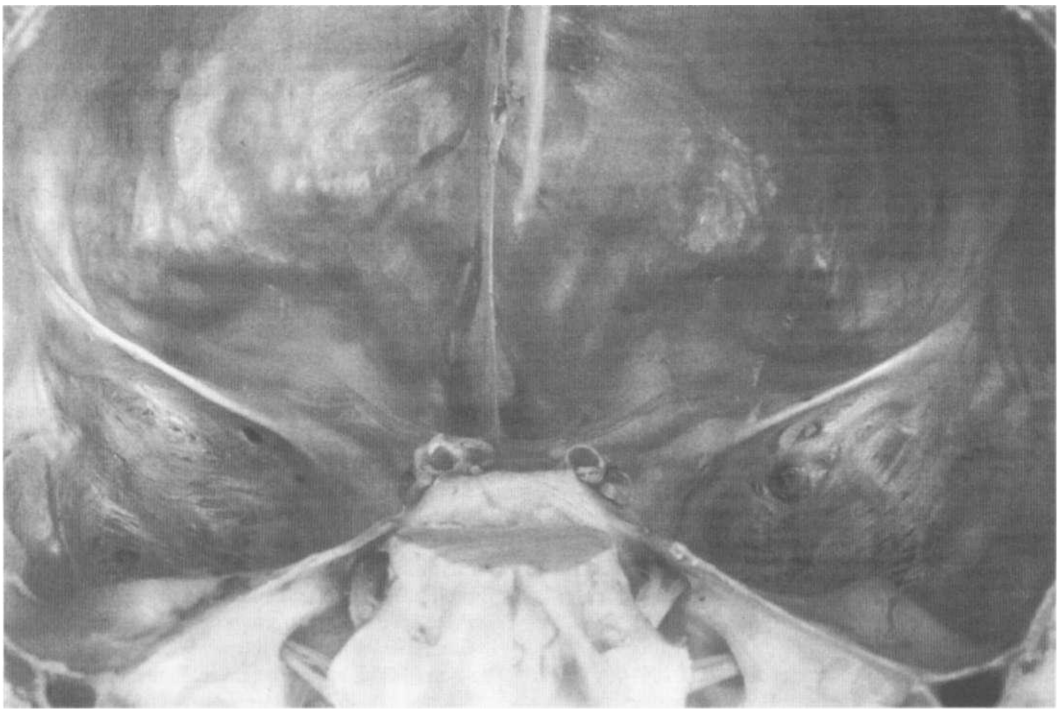

Figure 4.4 Neonate dissection of the anterior cranial fossa, looking from posterior to anterior, with the pons sliced and brain removed. Bilateral anterior transverse septae angle between the dissected midline falx and paired tentoria. (Photograph courtesy of the F.O.R.T. Foundation, www.BioDO.com.)

CARE AND ENHANCEMENT OF THE ATTENTION FACULTY

BOCF is taught within a clinically based program, where each step is designed as a journey to reawaken the intuitive and instinctual aspects of the practitioner's mind. Our intuitive and instinctual faculties were called 'primary perceptions' by Pearce (1977), who described them as 'part of nature's built-in system for communication and rapport with the earth'. These abilities tend to disappear, like muscle atrophy, if they go unused. Thus intuition and instinct are present at birth but wither due to lack of use given today's societal and educational burdens. Our intuition, instinct and perceptual vitality are also dulled by the stress of urban living and the pressures of our professional life.

Great care is taken in the choice of where practitioners receive BOCF training. The natural world is a necessary participant and instructor. Through his own experiences in the wildernesses of New England and Canada, Jealous learned how the deeper self, the human spirit, emerges upon encountering the natural world. Nature's 'spell of the sensuous' quiets a person's CNS, allowing boundaries to fall away between the individual and the whole. John Muir, a 19th-century American naturalist, spoke like an osteopath: 'In nature, when we try to pick out anything by itself, we find it hitched to everything else in the universe' (Muir 1911). The BOCF practitioner transports this natural-world phenomenon to the urban treatment room, incorporating an indigenous state of consciousness into everyday clinical practice.

It is important to recognize that what is observed during the course of treatment is not the result of mesmerism, colored by a vaguely vitalistic theory, but evidence of a precisely organized natural system which requires discipline and dedication in order to develop the practitioner's perceptual faculty. Practitioners are currently in a unique position. Given our training in medical science and hands-on manipulative techniques, combined with the principles of Still and Sutherland, we can consult with the blueprint for health, namely embryological growth and development recapitulated as the forces of healing. But there is a caveat: without the proper preparation, this approach can be dangerous for the patient and an abuse of the practitioner's commitment to the Hippocratic Oath. This model does not work with 'energy' but with the consciousness of the natural world.

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For more about BOCF, see:

Jealous J 2001 (with annual updates) The biodynamics of osteopathy (interactive audio CD series): www.bioDO.com

Chapter 5

Chiropractic in the cranial field

Frank O Pederick

CHAPTER CONTENTS

Do not seek to follow in the footsteps of the men of old: seek what they sought. (Basho, in Schiller 1994, p. 107)

We are like dwarfs on the shoulders of giants, so that we can see more than they, and things at a greater distance, not by virtue of any sharpness of sight on our part, or any physical distinction, but because we are carried high and raised up by their giant size. (Bernard of Chartres (d.c.1130) in Palmer BJ 1981)

The shell must be cracked apart if what is in it is to come out, for if you want the kernel you must break the shell. And therefore, if you want to discover nature's nakedness, you must destroy its symbols and the further you get in the nearer you come to its essence.... (Meister Johannes Eckhart (1260-c.1328) in Schiller 1994, p. 32)

INTRODUCTION

These three quotations encapsulate some of the author's experience as a chiropractor in the cranial field. When first undertaking studies in this area, instruction seemed doctrinaire with little explanation offered of the mechanisms involved. As Pick (1999) has noted (in the preface to Howat 1999, p. xiv), recent graduates, with a better understanding of the underlying physiological mechanisms, now demand fuller explanations.

In every field of human endeavor there are major revolutionary breakthroughs by 'giants' which change thinking profoundly. But most subsequent advance relies on the 'dwarfs' for the slow accretion of knowledge, based on what has gone before or made possible by advances in other fields. The work of some of the major chiropractic 'giants' who have influenced chiropractic cranial methodology is outlined in this chapter.

In order to assess chiropractic work in the cranial field a standardized method of evaluation, devised by Kaminski et al (1987), has been applied. This and other assessment issues are discussed in Box 5.1.

A BRIEF HISTORY OF THE CHIROPRACTIC CONTRIBUTION TO THE CRANIAL FIELD

There are records of manipulation in most cultures and folk medicine forms of cranial manipulation probably exist. However, Calvin Cottam (Cottam & MacGillivray Smith 1981) quotes Ligeros (1937) who had researched the history of spinal manipulation in Europe back to 1250 BC and had found no indication that cranial manipulation was practiced. If cranial methods were used, little has filtered through to the present. For example, some therapists offer a form of Indian head massage and Shiatsu uses pre-determined application of pressure and spreading of sutures, in a set way, for general symptoms.

Modern forms of chiropractic cranial manipulation stem from the work of Nephi Cottam and W G Sutherland (as discussed in Ch. 1). Harrington's review (1992) offers a good starting point for an investigation of chiropractic's contribution to this area of manipulative therapy.

Nephi Cottam: craniopathy

Cottam's technique is the earliest (1928) verifiable chiropractic cranial approach. He produced the first text, *The story of craniopathy,* in 1936. The modern revised version, *Craniopathy for you* (Cottam & Rasmussen 1975a), and *Craniopathy for others* (Cottam & Rasmussen 1975b) were produced by Nephi's son Calvin. Cottam's procedures are presented as a series of 10 lessons, for both self-manipulation and by a practitioner, and cover extremities and viscera, as well as the cranium. The material is self-printed, on roneoed sheets. Calvin Cottam (1988) has more recently produced a revised 22-lesson version for professionals.

Although Nephi Cottam was aware that motion of the cranial bones is palpable, his procedures relied on observation of cranial landmarks, asymmetries and symptoms to provide indications for the need to manipulate particular cranial bones. In Cottam's approach, firm direct manual pressure is applied, although he also recommended

Box 5.1 Evaluation of techniques

There are difficulties in evaluating techniques. A formal consensus approach has been undertaken in the USA by the Association of Chiropractic Colleges Technique Consortium (Cooperstein 1997) to assess the efficacy and appropriateness of various techniques for instructional purposes. Research is a necessary background for any such valid appraisal. Blum (2001) has commented on the fraught relationship between those involved in research and those concerned with technique development.

> *All research findings are essentially 'good' and studies that do not 'prove' the legitimacy of a specific chiropractic technique can still be of value by illustrating:*
>
> 1. *Problems in study design;*
> 2. *Problems with the tester or testee;*
> 3. *Alternate interpretations and definitions of the research;*
> 4. *That a reason for a specific chiropractic result my be due to an entirely different mode of action;*
> 5. *That the positive outcome to therapy may be due to another indirect aspect of the care, and*
> 6. *That a diagnostic or treatment protocol of a chiropractic technique may be ineffective.*

As Bergmann (1993) pointed out to the chiropractic profession over 10 years ago, 'It has not been established that any adjective or evaluative procedure is more or less effective than any other, for any condition. Studies comparing the effectiveness and efficiency of technique systems are long overdue'.

Box 5.1 Evaluation of techniques—*continued*

Hestoek (Hestoek & Leboeuf-Yde 2000) has more recently concluded:

> *The detection of the manipulative lesion in the lumbo-pelvic spine depends on valid and reliable tests. Because such tests have not been established, the presence of the manipulative lesion remains hypothetical. Great effort is needed to develop, establish and enforce valid and reliable test procedures.*

Gatterman et al (2001), using a consensus method, concluded:

> *The ratings for the effectiveness of chiropractic technique procedures for the treatment of common low back conditions are not equal. Those procedures rated highest are supported by the highest quality of literature. Much more evidence is necessary for chiropractors to understand which procedures maximally benefit patients for which conditions.*

No such studies can be found specifically for chiropractic cranial procedures.

Gleberzon (2002), who examined the literature on 'named techniques' of chiropractic, concluded that research into these methods was still in its infancy. He considered that intra- and interrater reliability of major diagnostic procedures needed to be established, as well as their clinical applicability and relevance.

Most technique systems rely on the subjective assessments performed by practitioners and are influenced by their interactions with patients. Realistically, in defence of the chiropractic profession, they are not the only ones in the healing professions with this problem and it may be difficult to establish parameters for efficacy, efficiency and appropriateness and to measure these consistently. Two books to be released in the near future, by Ebrall (2004) and by Cooperstein & Gleberzon (2004), promise to address these issues more thoroughly. Another problem arises because, in the author's experience, very few chiropractors practice techniques by precisely following the procedures developed by the originator or as taught. In the cranial field there is a paucity of well-documented studies on the effects of particular procedures, let alone comparative studies, so that nobody can realistically show that one method is better than another.

There has been a considerable focus on experimentation and clinical research involving the spine, undertaken by different professions, over many decades and yet Leach (1994) notes:

> *Evaluation of the chiropractic lesion(s) remains perhaps the greatest frustration and challenge facing researchers and S/Ps [scientist/practitioners] alike. Quantification and qualitative definition of the phases of the VSC [vertebral subluxation complex], SDF [segmental dysfunction] and RDF [regional dysfunction], are needed and no operational definition of even the most generic 'manipulable lesion' is available at this time.*

Although major advances have been made in the description of cranial restrictions, for example by Pick (1999), the nature of cranial faults or subluxations remains more complex and less explored than those involving the spine. For some authorities (Ferre 1991, Fiepel et al 2003, Hartman & Norton 2002, Herniou 1998, 1999), the basic concepts that support the use of cranial manipulation are seen to be invalid. It is of course possible that these writers have not considered all the available information and evidence. Although many practitioners believe that they can detect differences and changes in cranial motion, resulting in positive responses by patients when motion is improved, the difficulty of proving the cranial hypotheses remains.

Consequently, statements regarding the cranial field frequently represent subjective opinion on the relevance of scientific data, colored by personal experience. Such observation of course also applies to the writings of this author.

Kaminski analysis of chiropractic in the cranial field The analysis of chiropractic technique systems, devised by Kaminski et al (1987), involves several investigative steps, with decision steps between them (see Fig. 5.1). It is not clear whether this procedure has been applied to any major chiropractic technique system. Most chiropractic techniques have been developed over a period of time with patient welfare, rather than evaluation of the procedures, in the forefront of the mind of the innovating practitioners. The only known application of Kaminski's approach in the peer-reviewed literature was made by the author (Pederick 1997) for cranial procedures based on traditional osteopathic methods, including Upledger's (1983), modified by procedures from SOT and Kotheimer's writings, other chiropractic techniques and some original thoughts of the author.

Aspects of Kaminski analysis will be applied to the evidence available relating to SOT, AK and Kotheimer's work and will be summarized later in the chapter.

Box continues

Box 5.1 Evaluation of techniques—*continued*

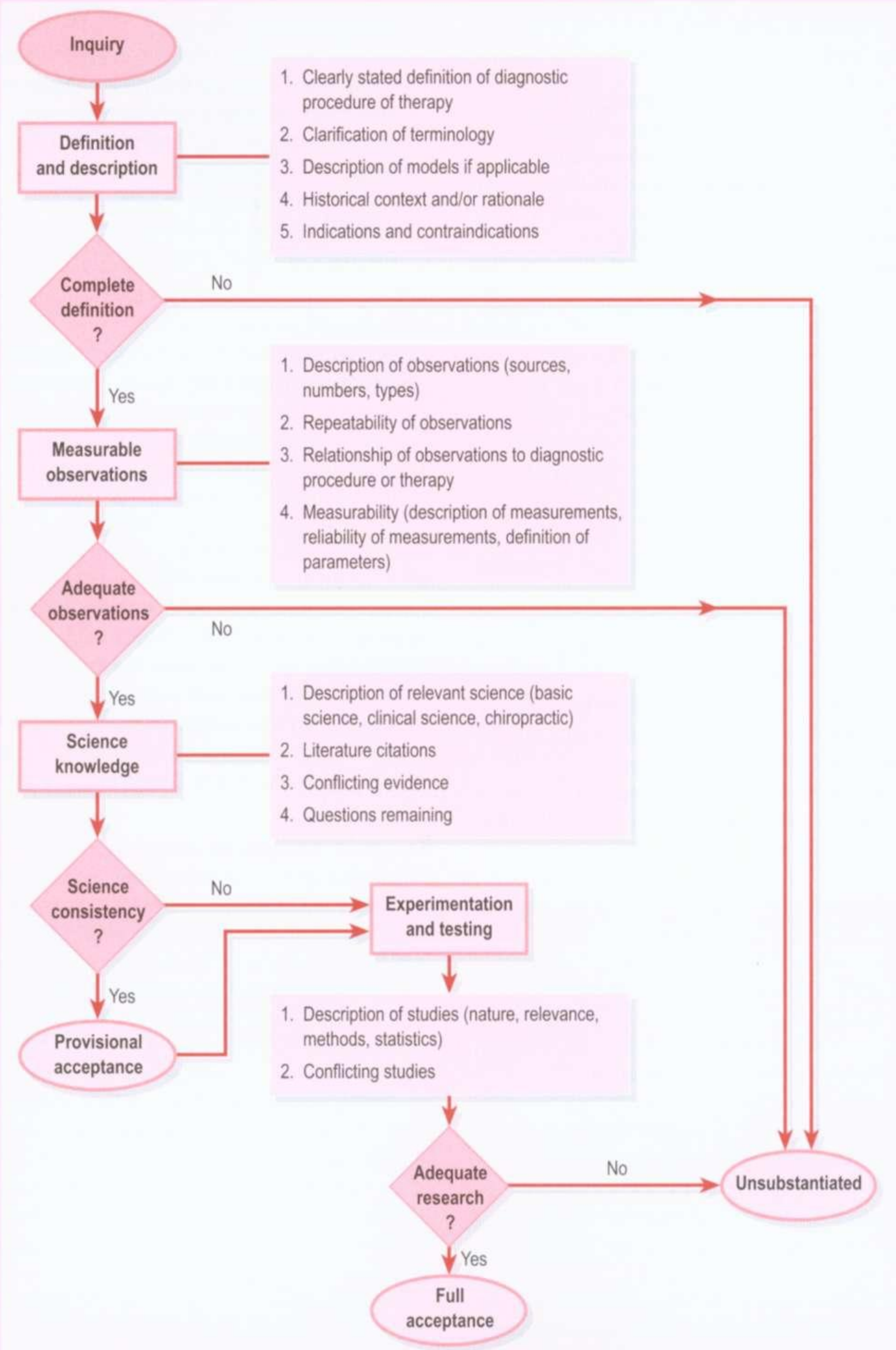

Figure 5.1 Algorithm for technique evaluation. Ovals represent inputs and outputs, rectangles indicate data entry steps (with key issues), diamonds involve a decision based upon previously gathered information and arrows delineate the flow of thought. (Reproduced from Kaminski et al 1987, with permission from Elsevier.)

a 'flipping' action of the hands and vibration, as part of the maneuver. Cottam's methods appear to lack a coherent rationale or to have a basis in research into anatomy, neurology or physiology. However, his procedures were highly regarded by his contemporaries and are still in use by some practitioners.

Calvin Cottam was keenly interested in proving his father's claim to be the first in the modern era to manipulate the cranium. He has outlined the history of his father's work in two papers (Cottam 1988, Cottam & MacGillivray Smith 1981) and in pamphlets. A number of techniques promoted by individual chiropractors, which Calvin Cottam perceived to be derivative of his father's work, are mentioned in his 1981 paper but these do not appear in the current chiropractic literature.

The principal chiropractic techniques today, which incorporate cranial procedures, are sacro- occipital technique (SOT), as developed by Dejarnette, and applied kinesiology (AK), as developed by Goodheart. In the work of both these innovators there is a direct link back to Sutherland's methods. Other cranial procedures used by chiropractors, stemming from SOT or AK, have evolved from the work of Sutherland, via other osteopaths, for example Magoun (1976) and most recently Upledger (Upledger & Vredevoogd 1983).

Upledger has been a major influence because he has made his writings and seminars readily available to virtually all comers, whereas there have, in the past, been attempts by some osteopaths to maintain an exclusive use of the methods, by restricting access to training. SOT and AK methodologies offer complex approaches to a wide variety of conditions, whereas craniosacral therapy (Upledger's approach) offers a relatively simple addition to methods already employed by many chiropractors.

The next phase of this examination of chiropractic influence on cranial treatment methodology will look at the work of Dejarnette, Goodheart and Kotheimer. In the discussions of their work, assessment will be offered, using methods devised by Kaminski et al (1987) (see Box 5.1).

M B DeJarnette: sacro-occipital technique (SOT)

Dejarnette's history has been summarized by Heese (1991) and Rosen & Blum (2003).

Following a severe work-related injury, Dejarnette discovered osteopathy and later enrolled in the Dearborn College of Osteopathy, Elgin, Illinois. While there he met and became friendly with W G Sutherland (see Ch. 1). After graduation in 1922 he returned to his home state, Nebraska, where he was influenced by the head of the Nebraska College of Chiropractic to receive chiropractic care and to enroll in the college, from which he graduated in 1924, aged 25.

Other significant influences on Dejarnette include:

- receiving a jail term in 1929 for practicing medicine in Nebraska without a license (Heese 1991)
- meeting with and studying the work of then chiropractic college heads, Drain, Carver and B J Palmer
- recognizing inadequacies in his own methods and those generally used by chiropractors at the time
- discovery of vasomotor effects, through a clinical experience, which led him to consider the effects of neural stimulation and inhibition. This led to his development of a vasomotor control technique by 1930
- clinical experience with and an extensive study of the reflex interactions between occipital fibers and the sacrum
- use of occipital fibers to control pain and a plumb line to monitor spinal muscular distortions, which led him to privately publish *Reflex pain* in 1935 and *Spinal diagnosis* in 1936. SOT ultimately developed from this work.

During the period 1930-1945, Dejarnette treated only patients who had not been helped by other chiropractic methods and who were prepared to take part in his research.

His professional development continued via collaboration with Sutherland in the cranial arena and Stone and his methods of 'bloodless surgery'. The work with Stone evolved into the chiropractic manipulative reflex technique (CMRT) part of SOT (see Box 5.2). There was also assistance from study groups of chiropractors who reported on the clinical usefulness of Dejarnette's ideas.

Dejarnette was on the staff of the Brown Osteopathic Hospital, Nebraska City, and this

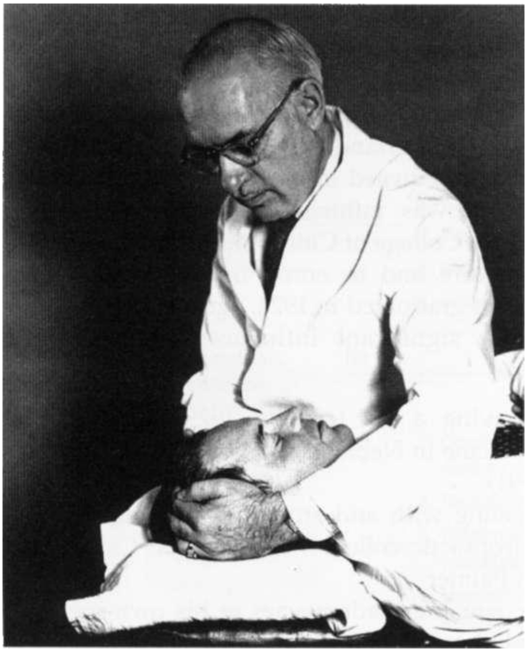

Figure 5.2 Photograph of Major B Dejarnette. (Copied with permission from Richard C Gerardo, DC, 178 Victory Blvd. #105, Burbank, California, USA.)

gave him access to observe surgery and autopsies and to specialists associated with the hospital. SOT was first mentioned in the title of his self-published book (1940) *Sacro-occipital technic of spinal therapy*.

Not until 1952, when he produced *Sacro-occipital technic of chiropractic*, was cranial work introduced into his writings. Harrington (1992) links this with the 1951 publication of Magoun's text *Osteopathy in the cranial field*. She also says that Dejarnette made the apparently spurious comment to Calvin Cottam that he had been using cranial technique since 1921. This was when Dejarnette was at osteopathic college and predates Sutherland's first experimentation, in about 1924.

The introduction of pelvic wedges (blocks) in 1964 was a major advance (Heese 1991). Heese says that during his osteopathic training Dejarnette observed 'a demonstration by a Dr Taplin ... on the use of leverage for pelvic manipulation ...'. Apparently he worked on the idea over many years and devised the pelvic blocks to enable gentle repositioning of the pelvis (see Box 5.3).

Box 5.2 Chiropractic Manipulative Reflex Technique (CMRT)

Howat (1999, p. 325) reports that DeJarnette developed CMRT as a soft tissue technique. Newer additions to CMRT involve a visceral component. Howat (1999, p. 52) says that muscle fibers, inserting into the occipital area, as well as trapezius and gluteal muscle fibers, 'act as indicators, showing the level of visceral and vertebral involvement. Each set of fibers, which total seven in number on either side of the spine, are specific for each category'.

Rasmussen's charts (Rasmussen et al 1992) indicate that occipital fibers are associated with Category 1; trapezius (primarily) and occipital fibers with Category 2; and gluteal fibers with Category 3. (See Box 5.4 for explanation of SOT categories.)

Occipital fibers 'The occipital fiber system consists of a muscular evaluation of the trapezius and sternocleidomastoid muscles, at their attachment across the base of the occiput' (Bathie 1996b, pp. iv-1). Detection of swelling and/or tenderness of a fiber '... indicates the functional aspects of a particular spinal segment have been affected with respect to the craniosacral respiratory mechanism', according to Bathie. She goes on to say that this affects spinal motion and the amount of CSF to the same nerve root. This is claimed to compromise nerve transmission that leads to effects in the associated organ system. Associated reflex arcs are said to disturb muscle tone in distant areas, while local arcs change the function of the spinal motor unit at that level.

Tender nodules may occur on three nuchal lines, in seven areas on each side of the centerline (area 7 being medial and area 1 lateral) (Howat 1999, p. 53). Each area is said to relate to particular spinal levels. For example, area 3 relates to cervical 3, dorsal 4.5 and lumbar 1 (Bathie 1996b, pp iv–3).

Nuchal line 1, the most superior, is said to relate to CSF–meningeal dysfunction, line 2 to vertebral–visceral and line 3 to persistent structural–vertebral problems.

Combined, the line and area of the nodule are claimed to determine specific vertebral levels between the occiput and sacrum nominated for testing and adjustment, depending on findings (Bathie 1996b, pp iv–9).

Trapezius fibers These fibers are palpated in a line extending bilaterally from alongside the spinous process of T1 (area 7) and 'the "V" between the acromial process and the spine of the scapula' (area 1). Bathie (1996b, pp iv-11–4) notes that the trapezius is innervated by the spinal accessory nerve. She says detection of a painful nodule is indicative of a specific spinal subluxation, affecting associated striated muscles. The area of the nodule determines the location of the affected segment,

Box 5.2 Chiropractic Manipulative Reflex Technique (CMRT)—*continued*

which may be at nominated levels of the cervical, thoracic or lumbar areas of the spine. The segment to be adjusted is determined by pain findings after contacting the nominated vertebrae. Adjustment is made to the vertebra with the major pain finding, which should relieve the pain. This adjustment is completed before blocking procedures are attempted.

Gluteal fibers The gluteal fibers of gluteus medius are palpated on the iliac crests (Bathie1996b, pp III–17). The L5 vertebral level is said to relate to the most medial part of the crest and T11 to the most lateral, with L4 to T12 levels distributed in between. When category 3 techniques fail to control pain, goading of the taut gluteal fibers is recommended.

Comparisons with Sutter's spondylogenic reflex syndrome (SRS) The SRS is discussed in Dvorak & Dvorak (1984). It is based on work outlined by Sutter (1975) who discovered, apparently independently, three occipital fiber lines, trapezius and gluteal fiber lines. Sutter also produced SRS charts for the major muscles attached to the shoulder girdle, the pelvis and the axial skeleton. Sutter relates a spinal fixation to reflex changes in associated muscles but makes no attempt to relate this to the viscera.

Sutter's occipital lines (Dvorak & Dvorak 1984, pp 86–87) relate to the insertions of the semispinalis capitis muscle, rather than trapezius and SCM, as in DeJarnette's method of analysis. Sutter's analysis of the trapezius (Dvorak & Dvorak 1984, pp 114–115) takes account of the descending, horizontal and ascending fibers, while DeJarnette's method evaluates only descending fibers and some horizontal. There appears to be no correlation between the two systems, except that the findings for gluteus medius are similar. Sutter has also defined SRSs for other pelvic muscles.

Box 5.3 DeJarnette blocks or pelvic wedges

The wedges used for blocking are made from a 10 × 10 × 20 cm wooden block, cut diagonally across the long dimension to form two wedges. The sloping surface is padded and the whole is covered with leather or vinyl. Handles of the same material are fixed to the flat end and rows of upholstery tacks secure the covering to the base of the wedge. These provide resistance to motion when the wedges are placed under the patient on a padded tableboard (see p. 116), on which the patient lies prone or supine, depending on category findings.

The author has noted that wedges made from high-density foam rubber seem to be just as effective and enhance patient comfort.

He usually blocks with the patient in the prone position. The supine position is used if clinically indicated, e.g. pregnancy. Sometimes the blocks need to be repositioned when an underlying condition is revealed.

Bathie (1996b) reports the following, relative to Category 1 blocking:

> *The short leg block is angled at 45° upward [i.e. toward the head], through the acetabulum, with the centre of the block being under the hip joint. The long leg block is angled at 45° downward [i.e. toward the feet] at the level of the PSIS, with the centre of the block under the ilium. The blocks are angled to face each other while in position and, if the positions are correct, the pelvis is balanced from side to side and from inferior to superior.'*
>
> *After three full respiratory cycles the short leg should appear to be approaching the length of the long leg . If not the blocks are removed and the patient is reassessed.*
>
> *With the blocking determined to be correct: The blocks remain in position for 5 to 6 minutes to allow for adaptation and a response from the muscular system. The correct position is enhanced by the patient breathing deeply, inhaling fully, holding as long as possible then exhaling deeply as long as possible ...*
>
> *During this time [the practitioner] will check for dollar signs [neurological indicator] and crest signs [myological indicator] to ensure there is no decrease in muscle tone. This would indicate that the patient cannot tolerate the correction. The dollar sign is affected by all direct and indirect cord level failures, since it monitors all neurological indicators. A positive sign consists of resistance or tension but may be overridden by pain. These areas must be correctly balanced in order to maintain the pelvic positions that the blocks have established.*

The 'dollar sign' is so named because it occupies an area about the size of a US silver dollar, bilaterally at the crossover point of the piriformis and gluteal muscles and is checked for tension and pain findings. The 'crest sign' relates to the erector spinae muscles, about 7.5 cm lateral from the L4 spinous process. Altered proprioceptive reaction due to changes caused by body imbalances, primarily muscular, is said to result in strengthening on one side of the erector spinae and weakening on the other. The crest is tested for pain and tension findings.

In a 1985 interview with Heese (1991), Dejarnette said,'… the tableboard finally provided the foundation for the blocks, so that when the patient breathes this energy can be transmitted to motion for correction of the subluxation'.

The next important SOT evolution was the establishment of the category system of assessment and treatment (see Box 5.4) in the 1970s.

Dejarnette's definitive works are considered to be the 1984 *Sacro-occipital technique manual* and the 1979-80 *Cranial technique manual.* The cranial component of SOT is intimately connected with category findings and the general objective follows that of Sutherland, in that he saw the need for resolution of dysfunctional patterns such as interacting reflexes relating to the spine, axial

Box 5.4 SOT categories

In the SORSI SOT Manual, Bathie (1996b, pp i–1) states:

> *The sacrum is the basis of the corrective procedures in SOT. Problems develop in the sacrum due to stress and as the foundation of the spine begins to shift all systems have to compensate. As dural system torques, cord level dysfunction develops and vertebrae shift to regain and maintain postural balance. These changes cause foraminal alterations. The shifting sacrum in relation to the innominates is responsible for the production of one of three distinct disease/trauma categories which displaces normal function. These systems are interrelated and yet separate, each being treated in a certain manner.*

Category 1 (Fig. 5.3) Bathie (1996b, pp i–13) describes Category 1 as:

> *… a system which involves the craniosacral mechanism. This comprises the structures of the axial skeleton and their involvement in the mechanism which pumps the cerebrospinal fluid throughout the central nervous system. The Category 1 system is comprised of the respiratory portion of the sacroiliac (SI) joint (the boot) as well as the respiratory system of the vertebral and cranial bones. Also involved is the entire meningeal system which requires a balanced tension in the pelvis. Distortion of the SI boot results in an altered relationship between the sacral and iliac surfaces within the articulation. Irritation of the meninges at the intervertebral foramen is considered to be a primary cause of nerve irritation at the nerve root level. The central nervous system is disturbed through more complex distortions.*

Howat (1999, pp 31–37) illustrates these effects and indicates that the major muscle groups involved are erector spinae, semispinalis and quadratus lumborum. He also gives a description of the evolution of a Category 1 lesion and the observable clinical effects and findings.

The 'sacral boot ' or 'sacroiliac auricular boot' is DeJarnette's name for the part of the SI joint which is described as boot shaped on the iliac side and ear shaped on the other. Howat (1999, p. 38) shows this diagrammatically and says: 'there are two parts to the sacro-iliac joint. The moveable moist synovial auricular section which is the Category 1 part of the sacro-iliac joint and the dry hyaline weight-bearing Category 2 part of the sacro-iliac articulation'. Howat describes how an uncorrected Category 1 lesion may develop into a Category 2, weight-bearing, SI joint lesion.

Category 2 (Fig. 5.4) Bathie (1996b, pp i–17) says Category 2 '… is represented by the weight-bearing, gravitational articulations of the body'. She makes a similar statement to that made by Howat, above, regarding the SI joint in a Category 2 lesion but adds that it '… also involves the articulations of the entire skeleton'. She notes that with this lesion:

> *Lateral stability is important to dural tensions. Category 2 involves the temporomandibular joint and the extremities, plus all mechanical vertebral conditions. The musculoskeletal and fascial planes of the body have distorted planes of movement, horizontally (fascial primarily) and vertically (muscles primarily). The proprioceptive mechanism of the pelvis affects all other proprioceptive responses of the body. The sutural system of the cranium is also a Category 2 component.*

Howat (1999, p. 40) indicates that the muscle dystonias associated with this category affect temporalis, SCM, trapezius, latissimus dorsi, sartorius, gracilis, the iliotibial tract and 'separation of the interosseous ligaments' at the SI joint. He also describes (1999, p. 43) the observable clinical findings associated with Category 2.

Box 5.4 SOT categories—*continued*

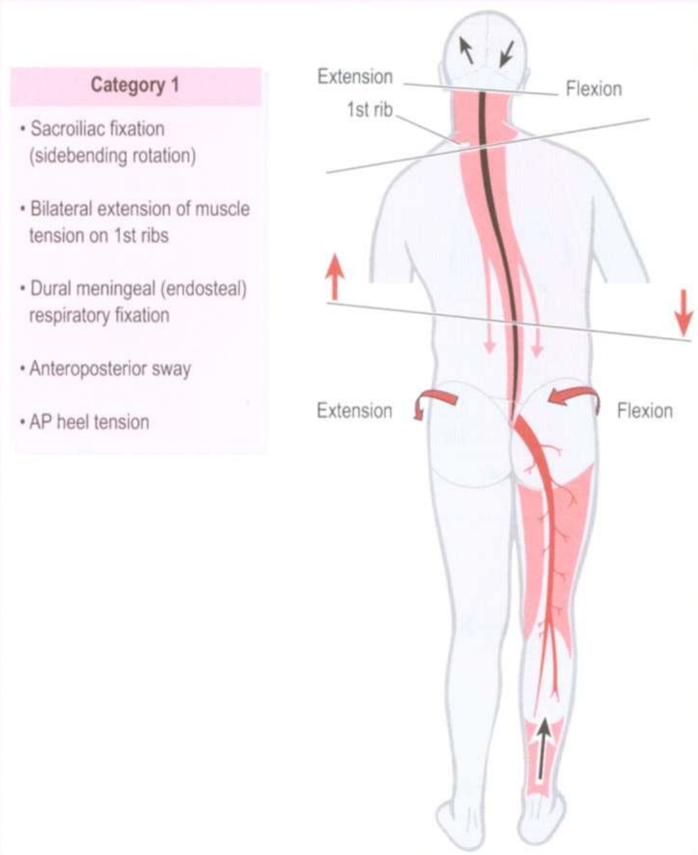

Figure 5.3 Effects of a Category 1 lesion. (Redrawn with permission from Howat 1999.)

Category 3 (Fig. 5.5) According to Bathie (1996b, pp i–21):

> *Category 3 involves the cartilaginous joints of the entire skeleton, in particular the intervertebral discs and the facet joints. Often, this situation results from a long standing Category 1 or 2 situation. When the normal pelvic mechanics are disturbed, the lumbar spine will become hypermobile to compensate for the motion decrease. The ligamentous and cartilaginous structures are not designed for a continual movement adaptation such as this and the breakdown of the tissues is inevitable. The supportive structures have sacrificed tension strength to allow movement. The neurological structures are involved through compression and/or traction forces.*

Both Bathie and Howat (1999, pp 47–50) describe the observable features and clinical findings of Category 3 lesions . Howat provides illustrations of these and details the effects of discogenic degeneration associated with this category.

All three categories have autonomic nervous system effects and cranial effects. Bathie (1996b, pp i–1) mentions that 'Mixed categories can exist and it is your duty to determine the prevalent situation for correction. The proper application of each system's techniques will not provoke an insult reaction ... the goal is to promote healing, not to uncover an underlying condition'. She also mentions the need to check the indications at each visit to ensure a new major complaint will not take precedence over procedures used during previous visits.

She stresses the need to follow the flow charts (Rasmussen et al 1992) when applying procedures. These

Box continues

Box 5.4 SOT categories–*continued*

Category 2

- Sacroiliac subluxation (torsion and sidebending rotation)
- Unilateral body drop
- Dural sutural (periosteal) subluxation
- Temporomandibular maxillary subluxation
- Lateral sway
- Medial and lateral knee tension
- Medial and lateral heel tension

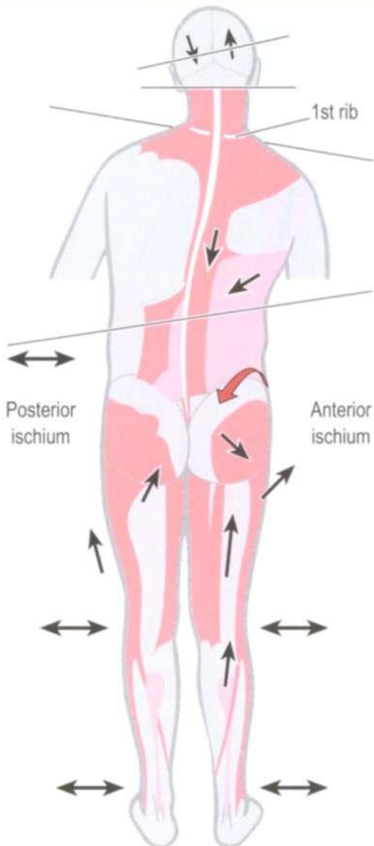

Figure 5.4 Effects of a Category 2 lesion. (Redrawn with permission from Howat 1999.)

flow charts show six checks to establish the category and 18 checks or action steps, to complete an uncomplicated Category 1 treatment with 12 more steps in a situation where dural tension is involved which may lead to cranial adjusting.

Category 2 requires up to seven preliminary checks to establish the category, with 13 more steps in an uncomplicated case or up to eight more checks or action steps, if complicated.

Cases assessed as 'healing Category 2' require eight more action steps. Cranial adjustments are included in the Category 2 procedure.

Category 3 requires a minimum of 11 checks or action steps and, depending on findings, may require 16 checks or action steps. Cranial adjusting is included as a pain control procedure (Bathie 1996a, pp iii–8).

Howat (1999, pp 37,42, 51) illustrates the cranial areas affected in each category.

Bathie (1996a, pp ii–27) lists the types of cranial procedures for each category. There are five types of procedures used with Category 1, six with Category 2 and one with Category 3. 'Certain procedures are used only with a specific category situation and are contraindicated in other categories.'

Without making an exhaustive study of the procedures, the detailed approach to the neuromusculoskeletal system is obvious. However, it is difficult for a student to readily comprehend.

Box 5.4 SOT categories—*continued*

Getzoff (1996) has developed a simplified approach to the SOT methods of cranial adjusting. He states: '... the cranial techniques illustrated in this book can be used with other chiropractic techniques, provided other structural problems are addressed prior to adjusting the cranium'.

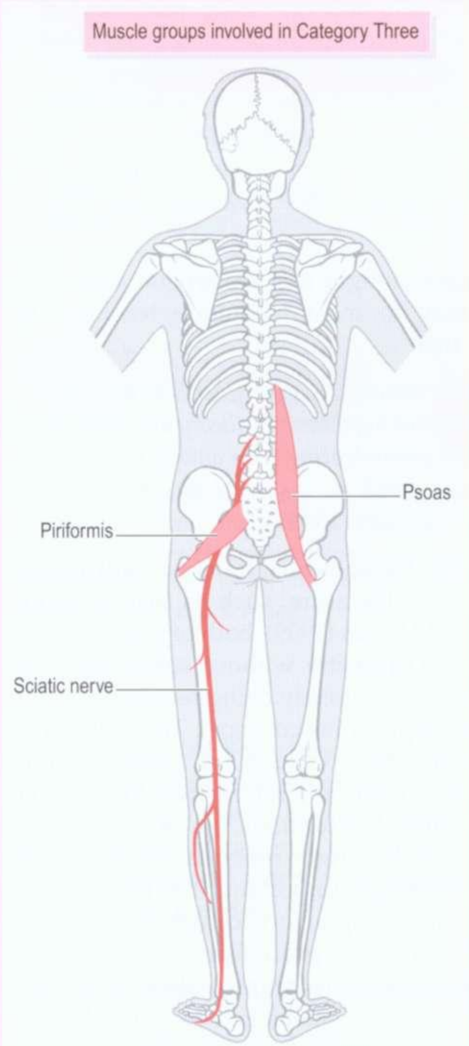

Figure 5.5 Muscle groups involved in Category 3 lesion. (Redrawn with permission from Howat 1999.)

skeleton, extremities, soft tissues and cranium, before commencing specific cranial procedures.

During his lifetime Dejarnette investigated many reflex phenomena. He authored over 125 publications and produced a monthly newsletter between 1933 and 1991. By today's standards these self-published works may appear crude, with many naive, hand-drawn illustrations. Nevertheless, they contain a wealth of observation and information, obtained from patient care, experimentation and correlation with other sources, over a period of 60 years, much of which had not, and still has not, been investigated elsewhere.

Dejarnette was not without contemporary critics. Regarding his 'constructive criticism' of the National Chiropractic Association's research policies, in the Sacro-Occipital Research Bulletin (August 1944), Weiant (research director of the

NCA's National Council on Public Health) observed:

> *One can hardly help expressing amazement at the lack of appreciation of the nature and spirit of scientific enquiry and the advocacy - in place of a program of research - of indoctrinating chiropractors with a long series of unproved and, for the most part, highly debatable propositions, simply because Dejarnette says they are true.*

While Weiant thought that Dejarnette acted in a superior way to most technique teachers, he suggested that:

> *... when the itinerant teacher teaches as fact what is in reality but hypothesis or theory and when he succeeds in promulgating error among us, a situation exists which is ... a cause for professional concern ... (Weiant 1944)*

Unfortunately, Weiant's final statement still applies to much recent literature, such as that of Bathie (1996a, b) and Howat (1999), both of whom restate the work of Dejarnette without subjecting it to critical analysis or directly citing references to the literature to support his concepts. The author has sympathy for the position of these authors because while many of Dejarnette's ideas make sense in clinical situations, in a climate of increasing scientific rigor research validation has become increasingly important. It is the author's belief that if chiropractors continue to act as technicians, following procedures some of which lack validated underpinnings, they may find themselves severely challenged by other healthcare providers.

Dejarnette may not have realized the full import of some of his findings. One example is postural sway, which he observed in the early 1930s using a plumb line and incorporated into his procedures. It is not suggested that his plumb line research was the immediate precursor of the methods used in postural analysis today but it confirms the significance of this practical clinical observation. Today international seminars (Duysens et al 2001) are held to present papers relating to posture and gait and their relationship to many of the reflexes that Dejarnette observed and reported on many decades ago (see Ge 2001, Sjostrom et al 2003, Tucker et al 2001, Wollacott 2001).

Dejarnette apparently used independent researchers, on contract, to investigate some of his findings but no record of this work is in the public domain. Harrington (1992) has noted the lack of formal attribution of much of the information in his writings, possibly including such independent research.

On Dejarnette's death in 1992, his teachings were continued by those chiropractors, worldwide, who were members of the Sacro-Occipital Research Society International (SORSI), formed by Dejarnette in 1957. Lavitan (2003) says that, for internal political reasons, the Sacro Occipital Technique Organization (SOTO) USA split from SORSI. Both organizations have similar stated aims and both have websites and conduct courses promoting Dejarnette's teachings. Both appear to retain the core of Dejarnette's procedures but seem prepared to refine the original writings and remain open to information from other sources in the cranial field. This is clear from the documentation on the respective websites and from lists of speakers at seminars.

Analysis of definition and description of SOT

Dejarnette (1967) provided this overall definition of the diagnostic aims of his procedures.

> *The philosophy, art and science of Sacro Occipital Technique seeks to search for and find the reasons for neurological changes which affect muscles and the effect of muscle changes upon human mechanics, especially the mechanics of the vertebral spinal system of man.*

Specifically relating to the cranium, he said (1977):

> *This book is dedicated to an understanding of a co-ordinated movement of cranial sutural systems in such a manner as to maintain a normal for the brain systems and to provide those brain systems with nourishment through motion.*

More recent publications (Bathie 1996a, b, Howat 1999, Pick 1999, Saxon et al 1990) have refined Dejarnette's writings and give clearer indications of diagnostic procedures.

This involves:

- visual observations of surface landmarks
- lateral X-ray analysis
- static palpation of the whole skull, with sutural palpation (i.e. detecting sutural anomalies) and noting pain responses to light pressure
- detecting cranial motion using applied external pressure, using breathing to assist cranial motion and palpating the cranial rhythmic impulse
- detection and correction of dysfunction in body parts remote from the head
- consideration of patient history and symptoms to restore intrinsic cranial motion associated with the primary respiratory mechanism (PRM).

The SOT interpretation of the correlation of cranial findings to the condition of the rest of the body (as defined by the SOT categories) is discussed by Saxon et al (1990), with recommendations and cautions relating to the procedures to be used.

Howat (1999) has provided a beautifully illustrated interpretation of the effects of the three categories (see Box 5.4) on the cranium and spinal dura. The SORSI publications by Saxon et al (1990) and Bathie (1996a, b), referred to above, are clearly written and define SOT terms and procedures adequately.

There is no overall model of the procedures of SOT. However, the SORSI has developed logic trains (Rasmussen et al 1992) for the procedural sequences relative to each category. These and methods of undertaking procedures are adequately illustrated in Bathie's (1996a, b) work to act as an *aide memoire* for participants at seminars. Howat's (1999) illustrations also provide a valuable aid to instruction.

The historical background of SOT and the rationale for treatment have been discussed. The SOT indications, contraindications and cautions for treatment are mostly defined within the confines of the technique.

The main difference between SOT and other procedures is the method of diagnosis and determination of the sequence of application of adjustments. Most of SOT's cranial manipulation procedures are similar to those used in osteopathy. Although there is no overall diagrammatic model defining the SOT approach to cranial procedures, it is clear that SOT co-ordinates cranial manipulation with whole-body procedures, using specific vertebral adjustments, blocking procedures, soft tissue techniques and a range of reflex techniques, in an attempt to address and influence neural, fluid dynamic and mechanical aspects of cranial structure and function.

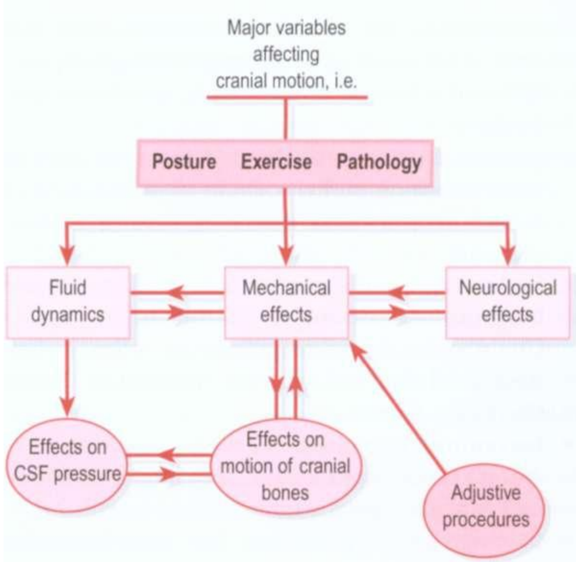

Figure 5.6 This figure summarizes the interacting factors influencing cranial motion. Body position, exercise and pathology may have major mechanical, neurological and fluid dynamic effects which influence cranial bone motion. (Adapted from Pederick 1994.)

George Goodheart: applied kinesiology (AK)

Goodheart, the son of a chiropractor, graduated from the National College of Chiropractic (Chicago) in 1939 and went into practice with his father. In 1941 he began military flying training, eventually becoming involved in air operations research. He resumed his chiropractic career in 1946.

Many of the influences on Goodheart are described in his book *You'll be better: the story of applied kinesiology* (undated, early 1980s). They derive from his clinical experience, leading to the development of AK, and include:

- observing the excellence of his father's work and realizing that his own clinical and diagnostic skills needed further development

- recognizing the value of nutrition. Later this area of his work was expanded using temporo-sphenoidal-vertebral reflexes, as developed by Rees
- gaining an understanding of the principles of muscle testing and the value of stimulation of muscle origins and insertions, using manual pressure
- finding that some conditions could be affected by lymphatic drainage, leading to the use of Chapman's, or neurolymphatic, reflexes, first described by osteopathic physician Frank Chapman (Owen 1963)
- becoming aware of cases where application of cranial procedures, as developed by Sutherland and Magoun, produced beneficial results
- finding an application for neurovascular reflexes, developed in the 1930s by Bennett (a chiropractor) leading to the evolution of the neurovascular component of AK
- studying acupuncture in the early 1960s, leading to the detection of a relationship between viscera and muscles, resulting in procedures which were subsequently incorporated into AK
- adopting the use of Dejarnette's blocks and category system, for treating pelvic dysfunction.

Goodheart (1980s) says:

> *Applied Kinesiology is based upon the fact that body language never lies. The opportunity of understanding body language is enhanced by the ability to use muscles as indicators of body language. The original method for testing muscles and determining function, by the methods first advocated by Kendall and Kendall (4th edn. 1993), is a prime diagnostic device. Once muscle weakness has been ascertained, a variety of therapeutic actions are available.*

Some aspects of AK have been taken over by other health-care providers, such as massage therapists and naturopaths, some of whom may not have the diagnostic skills and breadth of knowledge of the neuromusculoskeletal system expected of a chiropractor. Such therapists often base their approach on the work of Thie, as described in his book *Touch for health* (1973), who originally collaborated with Goodheart.

The primary reference book describing AK is the work of Walther (1988), a monumental, heavily referenced text of 572 pages.

Within the chiropractic profession there are a number of techniques which seem to be offshoots of AK or that appear to use similar approaches, e.g.:

- Touch for health (Thie 1973)
- SOTAK (Denton 1979)
- Neural organization technique (NOT) (Ferreri 2003)
- Neuro emotional technique (NET) (Walker 2003)
- Total body modification (Frank 1995)
- Nambudripad's allergy elimination technique (NAET) (Nambudripad 2002)
- Chiropractic ecology (Peacock 1999).

Analysis of definition and description of AK

One of AK's basic concepts, held in common with other health-care fields, is that the body is self-correcting and self-regulating (Goodheart 1980s). A complete standard diagnostic work-up is strongly advocated, to which AK adds a functional element.

Many standard diagnostic procedures may fail to detect significant changes of function until they are two standard deviations from the norm. That is, when the normal negative feedback control mechanisms of homeostasis have failed. AK aims to detect what could be termed 'noise in the system', which detracts from system performance, so providing a functional diagnosis.

AK techniques including use of the stomatognathic system

Widely used approaches within AK include:

- adjustment of spinal and extremity joints
- observation of and actions to normalize posture and gait
- soft tissue techniques
- neural receptor treatment
- meridian balancing
- balancing the craniosacral primary respiratory system
- nutritional therapy.

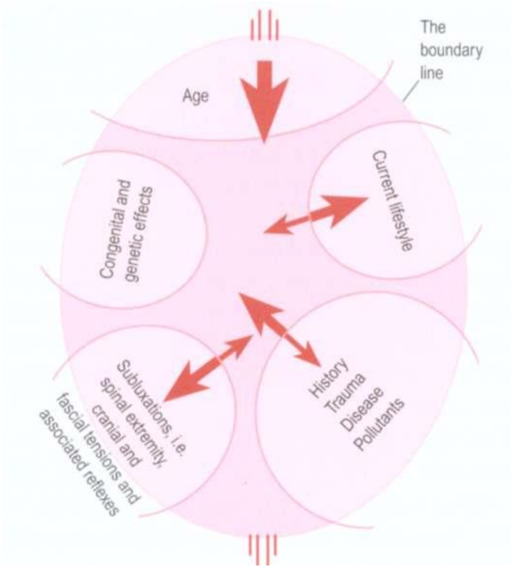

Figure 5.7 Outline of a theory of dysfunction. Australian Rules football is played on an oval ground. The shaded area represents the homeostatic range available to the body's feedback mechanisms. In youth and perfect health, the human body is extremely adaptable: the shaded area occupies most of the ground. The shaded area is reduced in size by factors such as age, lifestyle, congenital and genetic factors, traumatic insults from physical injury, disease processes, environmental factors and subluxations which may be vertebral, paravertebral, extremity or cranial, allied with muscle or fascial dystonias and associated reflexes. The effect of these factors is to generate noise or aberrant signals into sensory nerves, leading to interference with homeostatic and other control processes. Arrows indicate the potential for reversing these factors. Lifestyle and traumatic factors may be reversed slowly but reducing subluxations is the quickest way to increase the available shaded area, i.e. the range of homeostatic and other control processes. The concepts in this diagram may indicate a basis for AK and other techniques testing procedures. (Adapted from Pederick 1994.)

AK practitioners consider cranial procedures to be part of their comprehensive approach to the body and particularly to the stomatognathic system (referring to the mouth and jaw).

The stomatognathic system involves the complex interaction between structures and functions of the head and neck (Walther 1988, p. 344). Shore (1976) has listed the components of this system as including 'the bones of the skull, the mandible, the hyoid, the clavicle and the sternum; the muscles and ligaments; the dento-alveolar and the temporo-mandibular joints; the vascular, the lymphatic and the nerve supply systems; and the soft tissues of the head and teeth'. In addition Walther includes within the stomatognathic system the dural connection to the sacrum and coccyx and, by extension, the innominate bones.

The stomatognathic system is therefore considered during the initial history taking and examination. In AK, dysfunction of the endocrine system, indications of sympathetic/parasympathetic imbalance, proprioception relative to visual righting, labyrinthine and head-on-neck reflexes are some of the features examined which might suggest the need for cranial treatment.

The cranial bones are assumed to be capable of being restricted in either extension or flexion positions (see Chs 1 and 2) and such dysfunctional patterns are tested during the inhalation and exhalation phases of respiration.

Rebound challenge

Cranial restrictions are detected by what has been termed the *rebound challenge* method. The cranial bone being assessed is subjected to a vector of force, in order to exaggerate the putative lesion (a method described by Magoun 1976, p. 100) and is then released. Following the challenge, temporary inhibition of the strength of a previously tested muscle is regarded as confirmation of a cranial restriction.

Treatment is completed by 'applying pressure in the direction of optimal challenge, on the phase of respiration that correlates with the cranial fault' (Walther 1988, p. 353; see also Cuthbert 2003). (This is a positional release approach; see notes relating to 'strain/counterstrain' in Appendix 1.) Gentle continuous pressure is applied, possibly repeated several times, until improved motion of the bone is detected.

Cuthbert (2003) says:

> *The correction procedure is sustained through several respiratory cycles (using the same vector as found by the optimal challenge) allowing the reciprocal tension membranes (dura, arachnoid and pia mater surrounding the brain and spinal cord) to accumulate enough energy or tension, to free itself and spring back or 'rebound' into the correct relationship.*

Reapplication of the same rebound challenge should then result in a negative finding.

Walther (1988) has taken pains in his text to clearly define the terms he is using. He also uses a number of diagrams to illustrate aspects of cranial motion, notably the closed chains of kinematic gears and levers (p. 349) which simulate the mechanical relationships of cranial bones and the closed kinematic chain of the stomatognathic system (p. 375).

There is no representation of the whole-body interaction with the cranium, although in the text mention is made that: 'the stomatognathic system integrates with function of the pelvis and spine and those three divisions integrate with the rest of the body's actions' (p. 375). AK procedures include a comprehensive range of treatments for these areas and the bony and soft tissue components of the stomatognathic system.

The history of AK has been discussed, as have the indications for cranial manipulation. Specific contraindications and cautions for cranial treatment have not been defined but the detailed initial examination that Walther advocates should detect any such cases.

The main differences between AK cranial methods and those procedures more closely aligned to traditional osteopathy are the methods of diagnosis and the determination as to which bones require manipulation, as well as the range of methods of treatment.

Although there is no comprehensive model defining the AK approach to cranial procedures, it is clear that AK attempts to co-ordinate cranial manipulation with whole-body procedures, using specific vertebral adjustments, blocking procedures, muscle receptor and other soft tissue techniques, plus a range of reflex techniques based on meridian patterns, in order to address and influence the neural, fluid dynamic and mechanical aspects thought to be affecting cranial structures.

W J Kotheimer: applied chiropractic in distortion analysis

Kotheimer's work (1976) is not as well known as that of either Dejarnette or Goodheart. However, he has made a significant contribution to the field. Kotheimer was an instructor at the SORSI annual seminars for 3 years and president of the SORS of Ohio. He also lectured for state SOT study groups. He was fully aware of Goodheart's work and keenly interested in motion palpation, having maintained correspondence with Dr Henri Gillet on the subject. Gillet, a Belgian physician, is regarded as the modern developer of motion palpation as a diagnostic procedure for manual therapy. Kotheimer (1976, pp 3-4) was especially interested in patterns of fixation, as noted by Gillet, particularly those between the altanto-occipital joints and the pelvis.

Discussing the impetus for his work, Kotheimer (1976, p. 4) says: 'I reasoned that if Dr Gillet's and Dr Dejarnettte's teachings were valid, then there should be a definite correlation between the two'.

Kotheimer defined a whole-body distortion pattern, including cranial distortion, similar to patterns noted by others, e.g. Bergmann (1993), Cooperstein (2003a), Defeo & Hicks (1993), Hammer (1993a, b), Masse et al (2000), Siclare (1993) and Wiegand (1996). He also developed a challenge method (1976, pp 9-12), a modified Malcolm Test (see Box 5.5) for assessing spinal and cranial distortions. This test relies on observation of changes in leg length when a subluxated spinal segment or cranial bone has pressure applied in a specific direction. The test developed by Malcolm (1972) was originally used for evaluating food intolerances.

Kotheimer (1976, p. 132) determined the most desirable direction of cranial adjustment by using the challenge test. The optimal direction for the manipulation is considered to be opposite to the positive challenge direction. He also used 'a light flipping action in the prescribed direction', which, as noted previously, was originally advocated by Dr Nephi Cottam.

Kotheimer used multiple repetitions of his adjustment, up to approximately 50, in the course of one treatment.

Kotheimer's procedures: definition and analysis

Kotheimer (1976, p. 2), noted that his research was based on the proposition that:

Box 5.5 Kotheimer's modified Malcolm Test

Kotheimer's modified Malcolm Test involves placing the patient prone and symmetrically on an adjusting table with a split headpiece. The patient is made comfortable with the knees bent to about 10° with the ankles supported on a footrest. The pelvic portion of the table is raised about 2.5 cm to place the weight of the lower trunk and pelvis at the acetabular level. If the patient has a pendulous abdomen, the abdominal section of the table should be dropped to take the weight off this part.

Using a ruler and marker, a line is made across both calves, about 8 cm above the ankle, at right angles to the centerline of the patient.

The challenge is made to any vertebra or cranial bone which may be considered to be restricted, by exaggerating the putative distortion using firm finger pressure.

The practitioner then moves to the patient's feet and gently raises the ankles to bend the knees to 15–20° and observes any change in leg length, as determined by the position of the marks on the calves. A positive finding is clearly obvious as the change is usually 7 mm or more.

The effect lasts for about 25–30 seconds and can be reversed by the practitioner flexing and unflexing the patient's knees a few times.

The author has considerable experience with this test and, after ruling lines for long enough to establish confidence in the method, now relies on comparison of change of leg length at the medial malleoli. If the major structural corrections have been made to the body, the legs will usually appear to be of equal length.

The practitioner needs to be observing the malleoli from directly above, with the hands supporting the ankles and the vertical flexed second fingers against the medial inferior aspects of the malleoli. The change for a positive finding is usually great enough (often a finger's width) to be readily seen.

The effect may also be observed when testing cranial bones with the patient supine. The examination of the change in leg length is made, again viewed from directly above the malleoli with the patient's ankles supported on the footrest of the table with the thumbs placed firmly up against the medial inferior malleolar surfaces.

> *Man has a tendency to develop specific structural distortions which may involve the cranial and facial features, the atlas rotations, the pelvis and the physiological leg length. And each of several of these distortions that are prevalent is characterized by specific patterns of fixation, also involving the cranium, the atlas and the pelvis.*

Kotheimer (1976, p. 4) detailed the general characteristics of the cranial fixation patterns for the temporal, occipital and frontal bones, with atlas rotation, leg length differences, innominate and sacral distortion. He inferred cranial extension restrictions on the side of the long leg and flexion on the short (see Box 5.5). He also associated the long leg with a flexion fixation of the innominate and extension of the sacrum. He associated the short leg with innominate extension and sacral flexion.

Along with use of the modified Malcolm Test, Kotheimer inferred the type of sacroiliac restriction from the atlas position, combined information on leg length differences and atlas position, to indicate likely cranial distortion patterns. The spontaneous release of the atlas fixation was used to assess the effectiveness of cranial or pelvic manipulations.

A further understanding of the neurological mechanisms involved in the modified Malcolm Test may be found in the research of Denslow et al (1947). They studied facilitation of motor neuron pools by assessing the reflex threshold at several spinal levels, by determining the lowest pressure on a spinous process that elicited spike potentials, detected in electrodes imbedded at the same level. Among other things, they found:

> *... low threshold segments are those in which a relatively large portion of the motoneurons are maintained in a state of facilitation, due to chronic bombardment from some unknown source. Presumptive evidence indicates that the facilitating impulses arise from segmentally related structures.*

Kotheimer considered that application of pressure to a vertebra, in a low threshold segment, should induce a leg length difference. However, extrapolation of this process to cranial bones requires further investigation.

Having used the modified Malcolm Test for approximately 20 years, this author supports the value of Kotheimer's work. The experience has been one of consistently positive patient outcomes following treatment, when the dysfunctional, restricted structure retests negative after an initial positive finding. The author has also observed that, in some instances of severe spinal injury, such as are incurred during a motor vehicle accident, a spinal segment may never retest as negative. He has also used this test to check for restrictions in non-palpable structures, for example in the centerline of the skull. A positive finding is commonly negated by careful application of procedures designed to restore motion in the area under test.

Kotheimer also used the modified Malcolm Test to check the patient's nutritional status.

Although Kotheimer clearly described his procedures and provided tables, drawings and photographs to illustrate details of these, he does not appear to have developed a comprehensive model. His writing is based mainly on his clinical experiences and provides few references or explanations as to the physiological mechanisms that may be operating.

Kotheimer does not provide any contraindications or cautions for cranial manipulation but makes a careful preliminary examination. He considers the main indications for cranial manipulation to involve facial and cranial asymmetry, tender points on the temporosphenoidal sutures, occipital fiber nodularity and recurrence of these indicators following four or five treatments (possibly involving spinal and extremity adjustments, soft tissue treatment and nutritional supplementation). The modified Malcolm Test is used to locate cranial faults in specific bones/sutures.

Kotheimer's approach, compared with SOT and AK, places more weight on observation of bodily distortion patterns and uses motion palpation and the modified Malcolm Test to determine the level and direction of standard manipulative procedures for the spine. The cranial manipulation methods are based on those developed by Cottam and involve applying light force in directions determined by the modified Malcolm Test (see Box 5.5).

Although there is no overall model defining his approach to cranial procedures, it is clear that Kotheimer co-ordinates cranial manipulation with whole-body procedures. He advocated use of specific vertebral adjustments, soft tissue techniques (principally Nimmo trigger point therapy) and reflex techniques (principally Dejarnette's occipital fiber-line techniques), in order to address and influence the neural, fluid dynamic and mechanical aspects influencing cranial structures.

Assessment of the evidence for SOT, AK and Kotheimer's methods

The next phase of this examination of chiropractic influences on cranial treatment methodology will be to assess them for measurable evidence using the methods devised by Kaminski et al (1987) (see Box 5.1).

There are no measurable observation studies that relate specifically to the three chiropractic approaches under discussion. However, there are numerous studies relative to the broader cranial field of study that do support the validity of these procedures. For further evidence see Chapters 1 and 2, as well as the works of British Society of Osteopaths (BSO 2003), Drangler & King (1998), Farvis (2003), Moran & Gibbons (2001), Oleski et al (2002), Pederick (1997, 2000), Sergueef et al (2001) and SOT USA (2003).

Research papers that appear to challenge cranial concepts include those by Ferre et al (1990), Fiepel et al (2003), Hartman & Norton (2002) and Herniou (1998,1999).

Feipel's study on 11 formaldehyde-fixed whole-body anatomical specimens (mean age: 82 years) fails to support the contention that cervical spinal motion induces strain, measured by linear transducers in the dura mater of the skull.

However, a report by Upledger (2000), associated with dissection of the fresh unembalmed cadaver of an 80 year old, found that gentle traction on the dural tube, at various points between the occciput and sacrococcygeal complex, could be palpated in the falx and tentorium and vice versa.

These are not directly comparable experiments but suggest that Fiepel could be incorrect and that the preservation process may have affected the findings. It might be worthwhile repeating

Upledger's experiment with induced cervical spinal motion. (See also Ch. 6 regarding Kostopoulos & Keramides (1992) who demonstrated that 4 ounces of traction force could encourage elongation of the falx cerebri.)

Ferre, Herniou and Hartman & Norton challenge many of the basic cranial concepts. Herniou states that his experimentation showed that changes in CSF pressure could not account for cranial bone motion and that the primary respiratory motion (PRM) was a myth. Hartman & Norton examined all of the elements of the PRM and placed special emphasis on interrater unreliability of CRI measurements. A detailed review of this work is beyond the scope of this chapter and the reader is referred to the first two chapters of this book (see particularly Norton's (1996) discussion of these issues in Ch. 2).

In response to negative observations it is worth noting that: 'The combination of the human brain/hand, with training plus experience, is an extremely sensitive and accurate detection system, not readily replicated or modeled. The ability to more readily palpate movement of "other" rather than "self" has been documented' (Vines 1999). As with all forms of detection, palpation is imperfect and subject to interpretation. From the author's personal observations of performance at seminars and in classes, it appears that at least 10% of participants have initial difficulty in palpating the CRI.

The histological and physiological basis of cranial manipulation has been examined within the limits of the ethics of experimentation on humans and equipment accuracy, with sufficient detail to enable replication, in experiments noted earlier (Chaitow 1999, Pederick 1997, 2000).

Niculescu (1999) has suggested that brain imaging studies, using functional MRI or PET scans, correlated with detection of biochemical changes in neurons, could be used to detect changes in brain function. The use of SQUID (superconducting quantum interference device) detectors to note such changes has been reported in earlier chapters (see full discussion of SQUID in Ch. 2).

Surface detectors, as used by the Brain Sciences Institute (2004) at Swinburne University of Technology in Melbourne, could also provide low-cost applications to map changes in brain function. However, cranial research is unlikely to readily attract the funding needed to undertake this type of work on an ongoing basis. See the observations of Professors Ernst and Korr later in this chapter on this topic (p. 132). On a clinical level greater use could be made of paper-based comprehension and intelligence tests, as a relatively low-cost means of evaluating changes induced by cranial manipulation. Upledger's research (1977,1978) appears to offer validation of such changes.

Although not directly related to the diagnostic procedures used in the three chiropractic approaches being examined, the experimental observations discussed in preceding paragraphs provide a basis for a rationale for cranial procedures. Despite dissenting voices, there is a broad consensus in the literature, supported by measurement, for at least two key elements of the cranial concept: the detectable motion of cranial bones and the existence and detection of the CRI. This consensus applies to the techniques under discussion (see Chs 1 and 2).

Scientific knowledge

The data input in this step of the Kaminski evaluation is detailed in Box 5.1. Much of the basic science information relating to the techniques under examination has been discussed above. Papers cited and those on chiropractic clinical science form an expanding body of evidence and, in the case of SOT and AK, can be examined in detail in references listed previously, including related websites.

The SOTO USA site shows a growing list of papers, most of them peer reviewed, relating to cranial issues. These contain a large number of case reports but there is a dearth of research into clinical aspects. Case reports offer a useful way to relatively inexpensively direct research effort in the future.

Testing SOT procedures

SOT diagnostic methods have been subjected to examination.

- Leboeuf, who authored four papers on this subject between 1988 and 1991 (Leboeuf 1990, 1991, Leboeuf & Patrick 1987, Leboeuf et al 1988), concluded in a more recent paper (Hestoek & Leboeuf-Yde 2000), based on a literature review: 'For the sacro-occipital technique, some evidence favors the validity of the arm-fossa test but the rest of the test regimen remains poorly documented'.
- Gatterman et al (2001), using a consensus approach, concluded that: 'The ratings for the effectiveness of chiropractic technique procedures for the treatment of common low back conditions are not equal. Those procedures rated highest are supported by the highest quality of literature'. Techniques described as 'non-thrust reflex/low force', which could include SOT, were rated amongst techniques considered least effective, for four low back conditions.
- Gleberzon (2000a) examined 111 papers on 'named techniques', of which 11 dealt with SOT. He found that: 'The literature suggested that prone leg length testing and some X-ray mensurations may have acceptable inter- and intrarater reliability'.
- The reader is referred to the comments on Walker & Buchbinder's paper (1997), later in this chapter.
- Muscle testing by Unger (1998), which he conducted before and after SOT Category 2 blocking procedures on 16 patients, found a statistically significant increase in muscle strength in 15 of 16 muscles tested. Unger concludes that this demonstrated the effect of blocking. However, Unger's procedure is not part of SOT diagnostic procedures.
- None of the papers listed above relates directly to the cranial aspects of SOT and they do not provide validation of the procedures.

Testing AK procedures

Most AK procedures are based on muscle testing. The essential hypothesized link is that dysfunction of the neuromusculoskeletal system (including cranial components), together with influences involving the autonomic nervous system, vascular, lymphatic and visceral dysfunction, also produces aberrant input into the nervous system which, if sustained, becomes evident in neuronal pools at spinal cord level and in the brain. The aberrant input degrades system performance, including muscle strength (see Fig. 5.7).

AK posits that a range of conditions may be detected by appropriate muscle testing. However, the method does not appear to tolerate independent examination.

Information from the ICAK USA website (2003) indicates that those trained in the methods conduct manual muscle testing at a more refined level and designates their tests as AK MMT ('applied kinesiology manual muscle testing'). This seems to be a rational basis for diagnosis on a theoretical level.

Most AK MMT studies have involved one of three types: comparisons of AK MMT to objective measures of muscle strength or neurological function; interexaminer reliability of AK MMT; and changes in AK MMT findings.

- Klinkoski & Leboeuf (1990) found none of the ICAK papers between 1981 and 1987 met all of their requirements for research papers and none contained statistical information which would enable conclusions to be drawn on the researcher's findings.
- The results of peer-reviewed papers by Hass et al (1994), Jacobs (1984), Peterson (1996) and Triano (1982) also failed to provide support for AK MMT as an accurate diagnostic procedure. See also comments later in this chapter on Walker & Buchbinder's paper (1997).
- McDaniel (1999), critically analyzing four papers said by ICAK representatives to support AK MMT procedures (Lawson 1997, Leisman 1989, 1995, Perot 1991), concludes: '... in the preceding four studies, manual muscle testing was found to have an interesting, reproducible but unexplainable, neurologic component. The conclusion drawn can only be that humans have strong and weak muscles and that this difference can be detected by machines and other trained humans. No pathologies were identified. No link was established between manual muscle testing and any diagnosis.

None of the standard challenges that in AK theory could change muscles from weak to strong and therefore indicate a pathology, were tested (i.e. neurolymphatic points, nutritionals, etc.). No pre- or post-treatment component was examined

- Caso (2003) has tried to refute these criticisms by pointing out that parts of the papers can be interpreted to support aspects of AK propositions. He maintains that, as with deep tendon reflexes (DTRs), the results of AK MMT are a snapshot of the neurological condition of the patient and can only be interpreted in the context of all work-up information available to the practitioner, such as history, biochemical tests and other examination results.
- ICAK USA, in a status statement (2003), has pointed out the wide range of potential causes of facilitation or inhibition of a muscle, a range of modifying factors, plus several precautions that need to be observed if testing using AK MMT is to be reliably reproducible.
- Motyka & Yanuck (1999) have written a detailed examination of the implications of such testing.
- There is no experimental evidence of changes due to AK cranial procedures, previously described (Cuthbert 2003, Walther 1988).

It is this author's personal observation that the AK methods of diagnosis and treatment often result in patient benefits not readily achieved by other means. There would seem to be a need for devising different ways of evaluating AK performance.

Testing Kotheimer's procedures

No peer-reviewed papers on Kotheimer's technique appear in the literature. However, he wrote an article for the *Digest of Chiropractic Economics* (1993) in which he described his method as: '...a relatively simple approach to cranial analysis, which requires no cranial motion palpation, muscle testing or other vague signs, such as the cough test'. (The 'cough' test was devised by Dejarnette to detect dural adhesions in the spine by observing the motion of the thumb placed on the L5 spinous process when the prone patient coughs.) There are no studies to substantiate Kotheimer's findings. He has reputedly been able to have assistants accurately replicate some of his testing procedures.

The author has found, on the basis of extensive clinical application, that Kotheimer's methods, particularly his modified Malcolm Test, appear to offer accurate and reliable indications of subluxation. However, I have not conducted any tests to prove this. Again, many of the problems involved in testing procedures, mentioned earlier, arise, such as defining the 'gold standard' method of detecting a subluxation to enable testing to take place.

Conclusions so far

The analysis of these techniques so far suggests that one could infer that while there are an increasing number of case studies, as well as anecdotal evidence extending over many decades, to support the use of chiropractic cranial technique, adequate proof remains absent.

- There are no studies that link diagnostic procedures used to particular conditions.
- There is no evidence that one technique is superior to another and this would also seem to apply to cranial techniques used by other health-care professionals.
- The same observations seem to be true of cranial manipulation relying on palpation of the cranial bones.

The evidence is not consistent, based on the processes defined by Kaminski et al (1987). The techniques described can at best be rated as attracting 'provisional acceptance', subject to further experimentation and testing.

Experimentation and testing

The Kaminski process for experimentation and testing is detailed in Box 5.1.

In the case of the three types of chiropractic cranial methodology discussed above, there are no studies in the peer-reviewed literature which assess the efficacy and efficiency of these cranial procedures for any condition and none to provide a comparison of or between these methods.

There is little independently tested evidence to support the diagnostic procedures used in SOT and AK and none for Kotheimer's. Yet practitioners and patients continue to report favorable outcomes for a variety of conditions. In some instances outcomes have been published in peer-reviewed journals as case reports. For example, the SOTO USA website (2003) contains a growing list of papers relating to the cranial field and there are an increasing number of case studies being reported. These could, in the future, lead to a means of overcoming the experimentation and testing impasse.

Korr, a renowned researcher in the osteopathic field, suggested a different approach to experimentally testing manipulative procedures. His talk to the 1956 annual convention of the American Osteopathic Association and his 'Andrew Taylor Still memorial lecture: research and practice - a century later' (1974) provide the background to his thinking on this topic. Korr (1956) stressed the need for independently trained researchers to direct research and for the development of research skills in interested practitioners.

Korr (1956, 1974) pointed out that osteopathic (and, by implication, chiropractic) patient-practitioner interactions involve much more than manipulative input to the spine, soft tissues or cranium. There appears to be an interaction taking place at several levels simultaneously and this is especially true with cranial work.

If research analysis interferes with this process, the results are unlikely to be the best attainable. Korr advocates treating the process as a 'black box' (not Korr's term), where experimenters do not concern themselves with the process but only with measuring objective findings relating to the patient's condition, before and after the therapeutic input, as well as assessing the patient's subjective impression of their condition, before and after the process.

Some of the difficulties inherent in research, including the 'black box' approach, have been pointed out (Blum 2001, Korr 1956,1974). Looking at individual tests or parts of a procedure in isolation can be likened to tearing off a butterfly's wings in order to find out what makes it fly.

Ernst, in a *BMJ* article (2000) and in an editorial paper in a recent *Medical Journal of Australia* (2003), outlines the financial, methodological and ethical obstacles to research in complementary and alternative medicine. He points out that the shortage of funds prevents projects being started, limits the development of a research infrastructure comparable to medicine and keeps well-trained scientists out of the field. Ernst appears to agree with Korr that it is possible to: 'conduct an RCT [randomized control trial] comparing a complex, individualized, 'holistic', treatment package to the standard care for that condition'. He says that, while this may involve adaptation of standard research methods, in principle it is feasible.

Discussing the chiropractic field generally, Wenban (2003) raises the 'massive theory-research-practice gap'. He continues: 'this gap is being made increasingly obvious by events unfolding within the broader health-care environment, where there is a strong drive from many sources to act only in the presence of appropriate evidence'. He says this equates to a need for randomized controlled trials (RCT). Wenban raises the dangers of medical disease models driving chiropractic research and quotes Korr (1991) who suggests a change of research focus, directing it toward the causes of health as a phenomenon.

APPLICATION OF CRANIAL TECHNIQUES

Some years ago a pioneer in the cranial field, Paul Kimberley DO (1987), wrote:

> *Forty-five years after gaining the attention of a few osteopathic physicians and 85 years after its inception, the idea that the skull is mobile and influences health is less frequently rejected and is attracting a steadily growing following among all groups of health providers. Unfortunately, many of the areas in which application of the cranial concept might be of great benefit are controlled by specialists who are not yet aware of this very potent and vital tool which is applicable in both diagnostic and treatment procedures. Some such specialities include pediatrics, obstetrics, psychiatry and general medicine.*

A reading of the current literature suggests that not much has changed.

Keen (2000) and a multidisciplinary team in Sydney have included craniosacral methods in work involving the integration of retained primitive reflexes.

Davies (2000) in Melbourne, working in pediatrics, has produced encouraging evidence of the value of cranial treatment. Nevertheless, he has commented: 'The pediatricians I work with are very willing to accept the spinal and extremity work we do but see the cranial work as a sort of aberration on my part' (Davies 2003).

One area where there is a fair degree of interprofessional understanding and co-operation exists between orthodontists and chiropractors using cranial procedures, described by Ancell (2000), Chinappi & Getzoff (1994,1995,1996) and Bob Walker (2000).

An example of what may be achieved for some patients with complex problems, when cranial manipulation is included in multidisciplinary specialist environments, is contained in a recent case report by Elliott et al (2003). Elliott discusses the treatment, including cranial manipulation, of a patient with complex neurological sequelae of a blunt head injury, incurred in a motor vehicle accident.

Trends

An increasing trend in the use of cranial and cranially related procedures has been recorded by the USA's National Board of Chiropractic Examiners survey of US chiropractors (Christensen 2000). Methods involving cranial treatment are rated 8th, 9th and 11th among the 17 techniques listed as being regularly employed.

Adjustive technique	% of DCs using technique 1991	1998	% of patients receiving technique 1998
SOT	41.3	49.0	16.5
Applied kinesiology	37.2	43.2	14.5
Cranial	27.2	37.3	11.2

For comparison, diversified technique, a full spine manual technique, was reported as being used by 95.6% of chiropractors in 1998, who applied it to 73.5% of their patients.

These statistics appear to be supported by research in Australia by Leboeuf & Patrick (1987), who stated: 'Applied Kinesiology, Sacro-Occipital technique and Nimmo were most commonly reported as minor core techniques'.

Walker & Buchbinder (1997) conducted an assessment of frequency of use of methods employed to detect spinal subluxations, as well as the reliability of the methods, amongst 85% of chiropractors in the state of Victoria, using a self-administered questionnaire. Frequency of use and estimated reliability of each method was rated on a seven-point scale, a score of 1 indicating never used or very unreliable and a score of 7 indicating always used and very reliable. The percentage of respondents with an opinion on a particular method was also recorded.

Method	Freq. of use	Rated reliability	Respondents %
Static palp.	6.6+/-1.1	5.7+/-1.2	99
Motion palp.	5.8+/-1.6	5.9+/-1.2	96
AK MMT	3.7+/-2.2	4.3+/-1.9	80
SOT diag. tests	2.9+/-2.3	3.9+/-2.1	68
Visual postural	5.5+/-1.8	4.7+/-1.5	97

These figures give an indication, at that time, of the opinions of chiropractors practicing in the state of Victoria as to the value and reliability of these methods. They are, however, not necessarily an indication of the opinion of those who regularly employed the less commonly used methods, such as AK and SOT. This may be reflected in the higher standard deviations noted for these methods. The results do not necessarily relate to cranial dysfunction but similar diagnostic tests, as used in both SOT and AK, are commonly used as part of cranial assessment.

More recently, Gleberzon (2000b) reported that Canadian chiropractic students have shown a preference for the continued exclusion of SOT, AK and craniosacral techniques from the core of elective subjects available to them.

In the 7 years between the USA's NBCE surveys, the major increase has been in the category of 'cranial'. In correspondence with the author in 2003, the NBCE indicated that the 'cranial' figures should be considered to represent forms of cranial training other than the cranial components of SOT and AK.

Chaitow (1999) has pointed out that between 1985 and 1995 the Upledger Foundation claims to have trained 25 000 people worldwide in his methods. Although most of these are members of other professions (many being massage therapists), a large number were undoubtedly chiropractors. This may be reflected in the survey results.

The NBCE survey also shows that the utilization of cranial techniques appears to be low.

Use of cranial techniques amongst US osteopathic physicians would seem to be even lower than amongst chiropractors. A recent survey by Johnson & Kurtz (2003) indicated that cranial techniques are the least used of 11 osteopathic manipulative treatment (OMT) techniques amongst US osteopaths surveyed. These authors also note that indirect techniques (such as cranial) were predominantly the province of female and older male osteopathic practitioners. The author's observations suggest that within chiropractic, as with osteopathy, females and older males are the principal providers of cranial techniques.

CONCLUSION: POSSIBLE FUTURE TRENDS IN THE CHIROPRACTIC CRANIAL FIELD

SOT and AK may need to simplify methods if they are to retain numbers of chiropractors using their cranial techniques. As has been mentioned, there have been several evolutions from AK. Getzoff (1996) has developed a simpler version of SOT's cranial procedures which can be used alongside other chiropractic technique systems.

Other apparently simpler techniques, such as Kotheimer's or those based on palpation and standard manipulative techniques, can be used to treat spinal mobility and balance problems, as well as to release fascial and muscular dystonia.

Conventional osteopathic techniques can also be incorporated into chiropractic practice. Chiropractors may need to evaluate the types of cranial procedures being used and debate the physiological underpinning of these. Ideally, procedures need to be developed to establish which methods consistently yield the best results for patients.

Some ideas from the pioneers live on in procedures used today. Cooperstein (2003b) summarizes the situation:

> *Contemporary technique-system practitioners might best show their respect for the founders by taking an honest look at the creation myths and non-reproducible research typically present at their historical core. The founders would expect and demand nothing less. I know people (friends) who have assigned themselves the impossible and totally unnecessary task of validating just about everything the legendary founder ... said and did. What a pity; what a waste of time! Chiropractic techniques deserve a healthy admixture of constructive and destructive criticism; that is how they might best be supported. Although it is proper to show respect - even reverence - for early attempts at research and for the techniques that developed from it and [which] have withstood the test of time, it would be a terrible mistake to accept conclusions without the same scrutiny we would maintain for modern research. No double standard for old and for new research is warranted.*

Chiropractors will probably continue to use cranial techniques that appear to them to offer benefit for patients. Unless they also take the trouble to record their work and report on it in the open literature, there is little likelihood of establishing best practice for cranial procedures.

A recent article (Kelly 2003, discussing a possible candidate for sainthood, Father Mychal Judge, who died tending others during the terrorist attack on the World Trade Center) included the remark:'... we find a man whose life teaches us that holiness is not about being perfect but about being real'. There is a parallel with the chiropractic technique systems discussed above. They do not fully meet the standards of acceptability set by Kaminski but they are real. In part they are based on proven physiological phenomena, many of the clinically observed effects are capable of rational explanation and they do commonly lead to benefits for patients. The immediate challenge is to note the words of Korr (1956,1974, 1991) and Ernst (2000, 2003) and to verify clinical efficacy first and later investigate efficient means of achieving and explaining those results.

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Chapter 6

Cranial movement: mechanical and subtle

CHAPTER CONTENTS

In this chapter discussion will be confined largely to features relating to adult skulls and not those of infants. It is necessary to make this separation/distinction in the investigation of cranial features for a number of reasons, primarily because, in the infant skull, pliability and plasticity are far greater and the disputes which exist, for example over motion potentials at the sphenobasilar synchondrosis (see later in this chapter, p. 156), are not an issue. As will become clear, treatment approaches also differ when dealing with similar restriction patterns assessed in an adult and an infant skull (see also Appendix 2 and Appendix Fig. 2.1 that shows the growth and development of the skull).

Note

As the discussions in Chapters 3, 4 and 5 have indicated, it is important that we include in any attempt to understand and assist in normalizing any apparent or suspected cranial dysfunction those aspects which are:

1. mechanical ('orthopedic') and which relate to restricted or lost motion of and between the cranial bones (however infinitesimal)
2. subtle influences, such as the cranial rhythms (CRI) which seem to be so intimately linked to these physical osseous motions but which many interpret as relating to other (circulatory, energy or 'fluid/electric') factors, some of which demand for their acceptance a different

mindset and belief system to that currently operating in Western medicine.

This statement is not meant to be dismissive of such concepts but only to insist that there are more ways than one to interpret phenomena, all or some of which may contain valid elements. As far as possible this text is working from a pragmatic viewpoint as to what is happening, interpreting wherever possible in the simplest and least complicated manner what the hands may be feeling.

In examining some of the controversial hypotheses which are contained in current cranial teaching, it is important for the reader to have had exposure to both the basic 'cranial osteopathic' as well as 'other' concepts, in so far as adequate interpretation can be offered (see also Chs 3, 4 and 5). In this chapter an attempt will be made to inquire further into some of the controversial issues surrounding cranial manipulation (see also summary in Box 1.2 in Ch. 1).

SMITH'S SAILING BOAT

The following 'energy' analogy is taken from the work of Fritz Smith, whose contribution to our understanding is discussed later in this chapter (p. 170).

A sailing boat has a physical structure - mast and sails, for example. When the wind blows, the sails fill and move the boat. It is possible to objectively measure, test and assess the structural, physical and mechanical characteristics and efficiency potential of the boat - of its mast, sails and the plethora of ropes and attachments involved in their activities. We can also assess the nature and power and direction of the wind which moves the boat along and some of the influences of the fluid in which it is carried.

A boat that is moving erratically could be being influenced by:

- an erratic wind (gusting strong and then weak, etc.)
- problems in the machinery and structure of the boat's sails/mast, etc.
- other factors such as the conditions prevailing in the sea itself.

Some practitioners and therapists spend a great amount of time and effort trying to modify the energy factors (the wind). Others focus on mechanical restrictions (sails, mast, etc.) and yet others try to evaluate and deal with the mind/body complex, environment, diet, etc. (environment of the boat, the sea, weather conditions and so on).

Some of course try to deal with all aspects - the whole person - and it is suggested that this should be the ideal, so that we focus on the individual, her environment (internal and external), her functional capacity and 'energy', as well as on her structural integrity.

All of these elements might be usefully modified under specific conditions - and all of them should receive appropriate attention without any suggestion that one or other approach is too 'mechanistic' or too 'subtle' or too 'non-specific'. All aspects of function and structure interrelate so completely that a focus on one aspect alone cannot be described as truly holistic and comprehensive.

Many of the exercises and treatment methods suggested in this book are clearly attempts to modify structural components of the complex, perhaps restricted sutures or the soft tissues (muscles or reciprocal tension membranes) to which they are attached, while others have a more non-specific, possibly energy-related objective. Yet others (such as V-spread techniques or CV-4 technique) are suggested because they are tried and tested but have no generally agreed modus operandi, i.e. they seem to 'work' and they are safe but they cannot easily or 'scientifically' be explained (although attempts have been made and some will be presented).

LEARNING TOOLS

In order to effectively apply cranial manipulative techniques, subtle or orthopedic, it is essential that the anatomy of the skull, the 22 individual bones, their sutures and other articulations, as well as surface landmarks be intimately studied. This knowledge can best be achieved by obtaining and becoming familiar with an intact human skull. Most plastic models offer accurate representations of the shape and articular characteristics of the skull, with many showing quite adequate detail as to attachments and surface markings. Plastic is, however, a poor substitute for the feel of real bone, even dead bone, but because of expense and the lack of availability of human skulls, plastic may have to suffice. A real specimen skull, superior though it undoubtedly is to a plastic version, will still fail to provide the degree of pliability present in the living skull.

As Magoun (1966) explains:

> *Osteopathic findings are based on living tissues, not cadaveric anatomy. They are concerned with the dynamic rather than the static. The tree that is alive and full of sap sways in the wind but the telephone pole does not. There is [just] as much difference between the normal physiological state of living bone and the dry, defatted condition of laboratory specimens from which anatomic descriptions for the average text are derived.*

A further important learning aid is a disarticulated skull, which for preference should also be real, although plastic is cheaper (but not inexpensive) and more readily available. A good-quality atlas of human anatomy (Churchill Livingstone's *Gray's Anatomy* is highly recommended) is another absolute requirement.

In addition, as many living heads as possible, of all ages, including your own, should be palpated as frequently as possible, so that your hands can familiarize themselves with the numerous landmarks and patterns of movement which you need to be able to 'read', long before therapeutic application of these methods can commence.

Magoun (1966) once again has found the words which summarize palpation (and treatment) requirements, especially of the cranium: 'To employ other than a skilful and delicate sense perception is to lose the shades of physiological reaction so necessary for success. Living cells prefer persuasion to force, consideration to trauma, intelligence to ill-expended energy. One must work with the tissues not against them'.

This text will not attempt a complete description of all that it is necessary to know in terms of cranial anatomy and physiology in order to safely perform cranial therapy; it will, however, summarize what that knowledge should include, using lists, brief discussion and illustrations (see Figs 6.1A-E and Fig. 6.2).

Additional texts, suitable for further study, will also be indicated, with Pick's *Cranial Sutures* (1999) in particular being a highly recommended source of information. Exercises will be suggested, involving the previously mentioned whole and disarticulated skulls as well as living heads, in order to facilitate achievement of the degree of palpatory literacy necessary to allow intelligent assessments to be made of functional and structural patterns, well before beginning to safely apply cranial therapy in an effective manner.

Note: It is necessary to restate the widespread belief (including the author's) that the skills required for safe and effective cranial therapy application cannot be acquired from books alone, without accompanying hands-on demonstration and lengthy practice, supervised by a skilled tutor.

The trainee cranial therapist needs to have available:

- a disarticulated skull (authentic if possible)
- a whole skull (authentic if possible)
- a high-quality illustrated anatomy text (*Gray's Anatomy* is recommended - Churchill Livingstone edition).
- time to practice on numerous volunteers (friends, family) who can loan their heads for up to an hour regularly, ideally daily.

Palpation pressure considerations

How much pressure should be used when palpating and when treating cranial structures? There are various answers to this question, some simple, some complex.

In the discussion, later in this chapter, of the proposed flexibility into adult life of the junction between the occipital bone and the sphenoid (the sphenobasilar synchondrosis), there is mention of the extremely light degrees of force/pressure suggested by different experts. These include 5-10 grams (Milne 1995, Upledger 1996) and 'half an ounce' (14 grams) (Ettlinger & Gintis 1991). Kostopoulos & Keramides (1992) demonstrated in their study on a recently deceased cadaver a need for 4 ounces (140 g) of traction force to begin the process of elongating the falx cerebri.

Pick (1999) has suggestions regarding pressure in cranial assessment and treatment that he describes as:

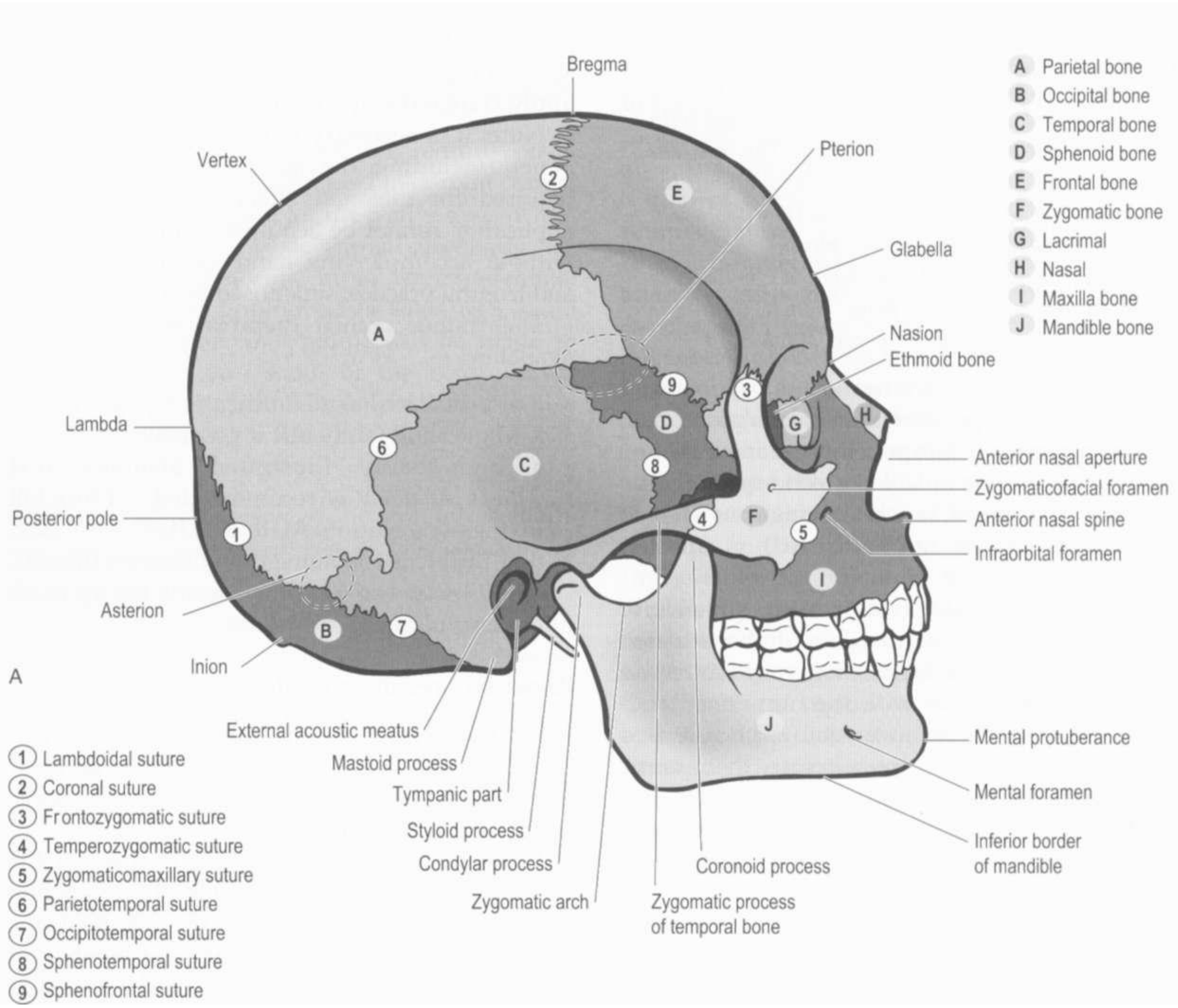


Figure 6.1 A Lateral view of cranium and its major landmarks and sutures.

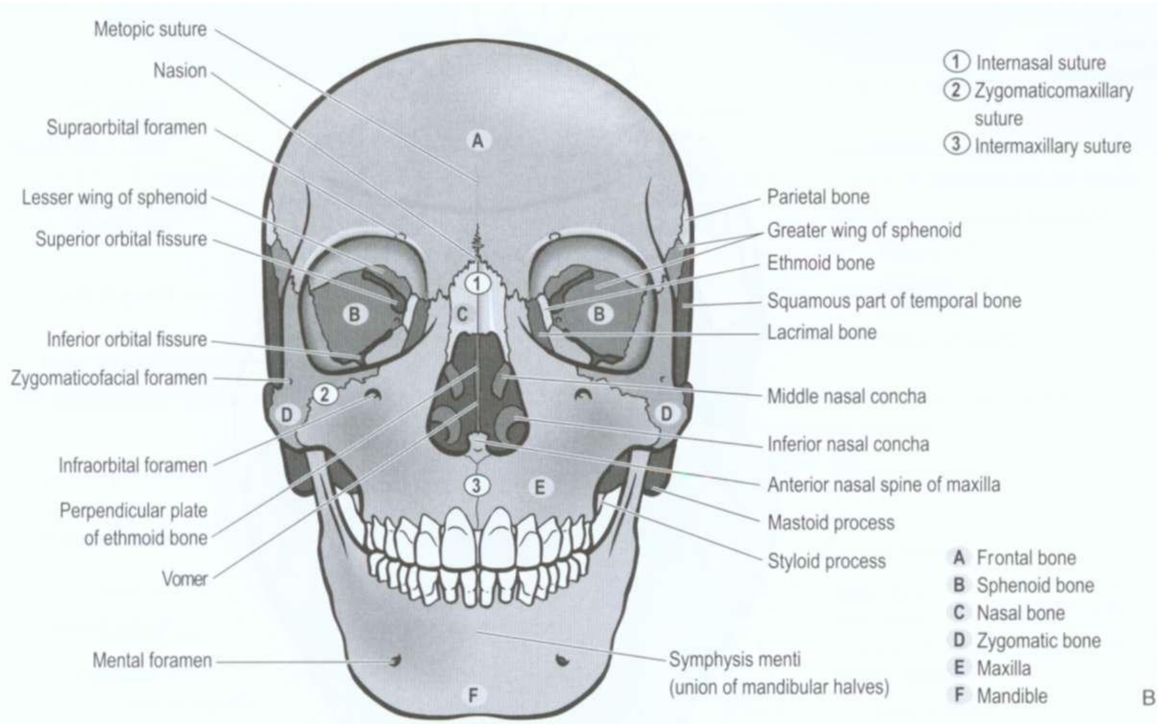


Figure 6.1 B Frontal view of cranium and its major landmarks and sutures.

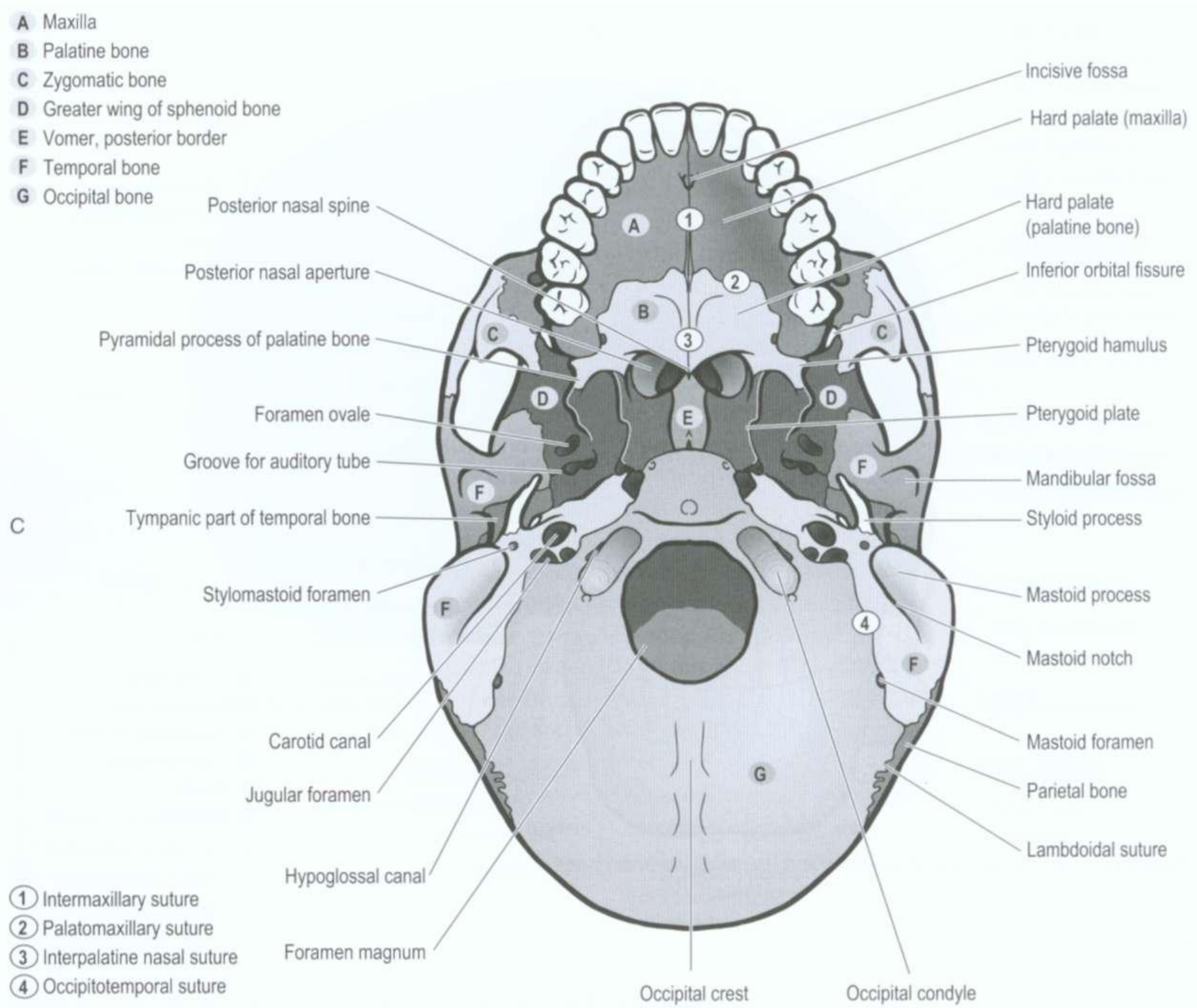


Figure 6.1 C Inferior view of cranium and its major landmarks and sutures.

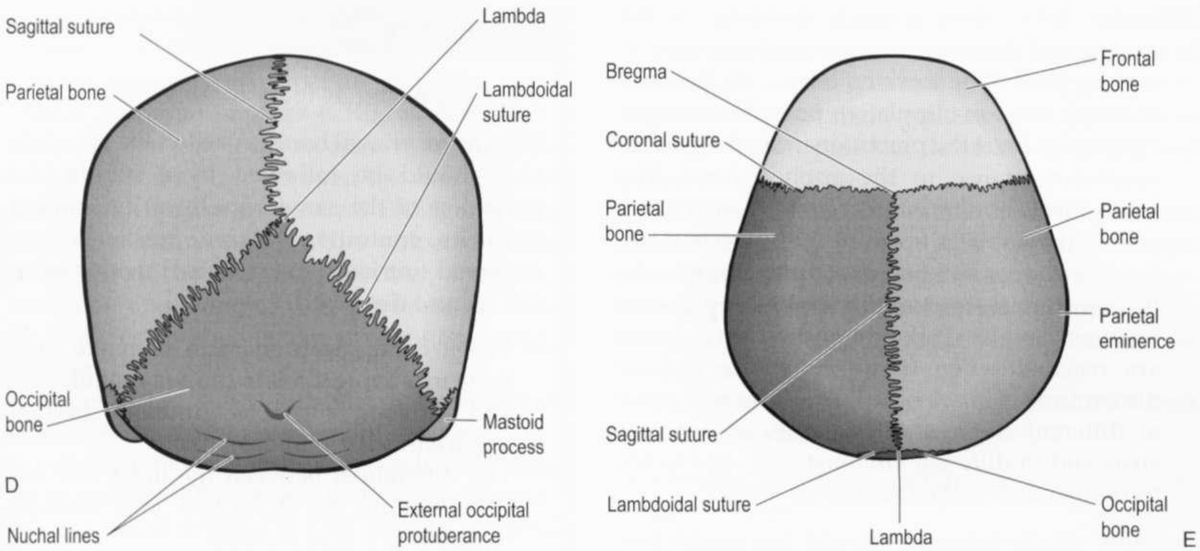


Figure 6.1 D Posterior view of cranium and its major landmarks and sutures. E Superior view of cranium and its major landmarks and sutures.

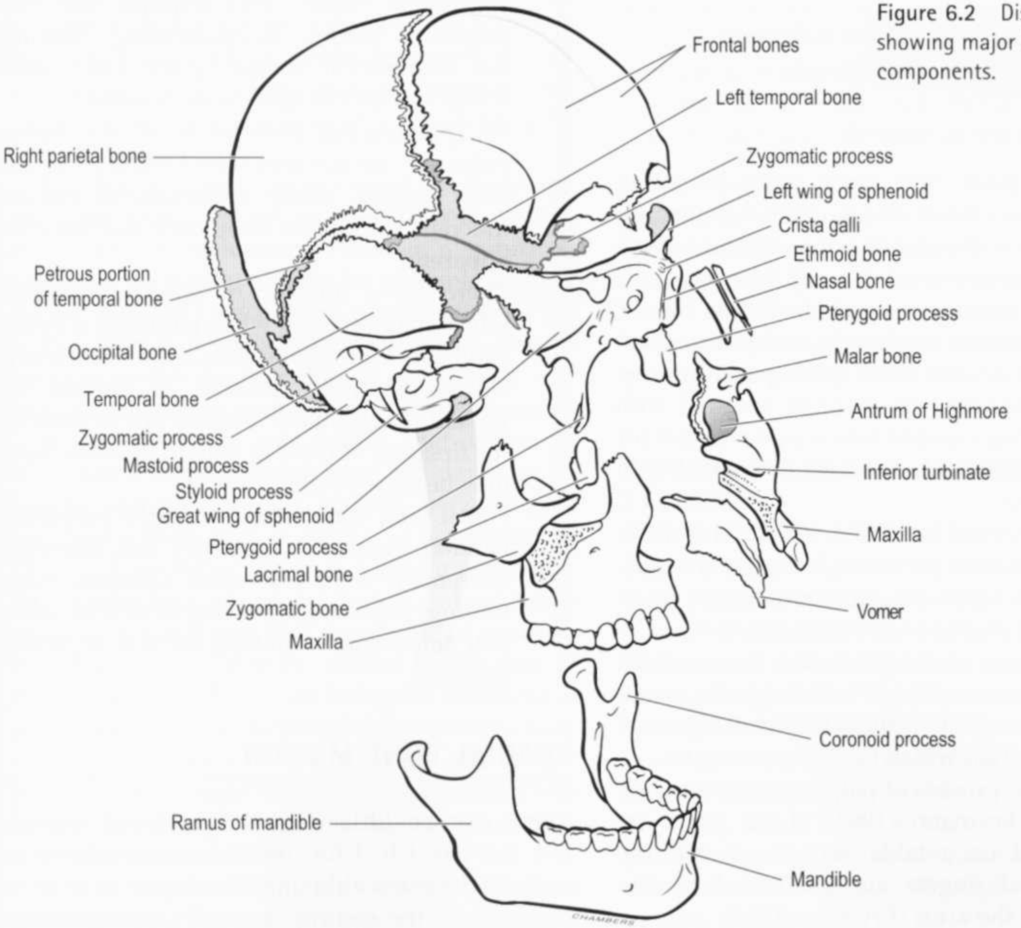


Figure 6.2 Disarticulated skull showing major bony components.

- *surface* level: first contact, molding to the contours of the structure, no actual pressure
- *working* level: 'The working level.... Is the level at which most manipulative procedures begin. Within this level the practitioner can feel pliable counter-resistance to the applied force. The contact feels noninvasive ... and is usually well within the comfort zone of the subjects. Here the practitioner will find maximum control over the intracranial structures' (Pick 1999, pp xx-xxi)
- *rejection* levels: Pick suggests these levels are reached when tissue resistance and/or discomfort/pain are noted. Rejection will occur at different degrees of pressure, in different areas and in different circumstances and is not recommended in the therapeutic setting.

So how much pressure should be used? Not enough to hurt and yet enough to be effective.

Exercise 6.1a Cranial bone palpation exercise (use both hands)

Time suggested 5 minutes

- Sit with your eyes closed while palpating one of the cranial bones, real or plastic (in time each of the cranial bones should receive this palpation attention many times).
- Articular structures should be felt for bevels, interdigitations, landmarks and features and described in some detail (perhaps with someone else handing the bone to you and with your findings spoken into a tape recorder for re-evaluation when the bone is studied with eyes open).
- The bone should be named, sided and as many as possible of its particular features discussed.
- Reflect on what the difference might be in the feel of plastic as opposed to bone.
- Bone, albeit no longer living, has a slight compressive resilience which plastic never has, nor can plastic achieve the detail of sutural interdigitation which bone demonstrates.
- The whole process of palpating is enhanced, suggests Frymann (1963), if the arms are supported on a table surface, so that the hands and fingers are unaffected by the weight of the arms (Frymann 1963).

Exercise 6.1b

Time suggested at least 5 minutes

Whichever cranial bone is used in Exercise 6.1a, this should be followed by a blindfolded palpation of the same bone in a live subject, with its contours, sutures, resilience and observed (intrinsic, not initiated) motion being felt for and described.

- When comparison is made with the same bone in a living skull in this way, similarities and differences should gradually become apparent.
- The differences between the dead and live bone should be described and defined, ideally into a tape recorder.
- Clearly the living bone cannot be palpated directly but must be palpated through superficial tissue. This requires that the palpation become discriminating, filtering out information offered by the soft tissues which overlie the bone being assessed.
- By applying full attention to what is being palpated (for not less than 5 minutes in the early stages), subtle awareness of motion inherent in the live bone may also become apparent.
- There are a number of possible rhythms which may be noted when palpating a living skull - including pulsation, respiration and a slower rhythmic motion. It should be possible to gradually focus on one or other of the first two of these at will. In time the third may become evident.
- For at least some of the time the palpating hand(s) should be absolutely still, allowing movement to be evaluated. Compare your findings regarding the living bone with what you noted when handling the real or plastic version.

CRANIAL BONE MOTION

There can be little doubt that cranial motion is a fact (see Ch. 1 for discussion of evidence as well as citations) although the degree of motion potential in the sutures is small (approximately

250 pm - around 1 /100th of an inch) at the sagittal suture.

It is necessary to separate palpation of the cranial rhythmic impulse (CRI), as described in Chapters 1 and 2, from assessment of the movements that take place between the various articulations which make up the skull. Ettlinger & Gintis (1991) are clear on this: 'The palpated motion (CRI) should be evaluated for rate, strength of excursion and symmetry. These findings should be firmly established before any motion testing is initiated'.

Issues surrounding the cranial rhythmic impulse (CRI) remain controversial, with disagreement as to what the 'normal' rate is and what is actually being palpated. This means that the significance of what is noted in terms of CRI rate and amplitude is also open to interpretation.

These observations and reservations do not nullify the potential value of CRI evaluation since it offers a chance for the subjective gathering of qualitative data which could be useful in any given case. Such information is, however, not likely to be reproducible or consistent from patient to patient.

The degree of mobility of cranial structures, on the other hand, should be open to comparative interexaminer evaluation. Whether a suture is restricted or mobile should be palpable by any skilled therapist/practitioner who has refined his or her palpation skills sufficiently to be able to read the minute degrees of yield or plasticity - or lack of it in cases of restriction - in living bone.

In one study it was found that when 19 craniosacral characteristics were evaluated, in 25 healthy and symptomatic patients, between four examiners, there was a degree of agreement of 71%, with no rating variance. Using a computer-driven simulator of parietal flexion and extension motions, it was found that the degree of accuracy of palpation was directly related to the rate of cranial motion (0.5 mm/sec being the threshold of perception) and that decisional delay was inversely related to accuracy. In other words, the longer practitioners thought about whether motion was or was not being noted, the less accurate they were (Roppel et al 1978).

It is as well to recall the words of Magoun (1968) in respect of just how much (or rather, how little) motion is being assessed: 'This so-called movement is not motion as found in other joints of the body. It is merely a resiliency composed of... a combination of slight yielding or suppleness in the articulation plus the flexibility of living and pliant bone'.

Magoun (1968) continues: 'It is emphasized that this motion is minimal, that it reflects the type of movement which occurs during the developmental period and that, persisting throughout life, makes up an accommodative mechanism of considerable magnitude'.

Palpation exercises should be performed which aim at achieving the ability to:

- identify and name cranial bones, landmarks and sutures
- effectively assess the cranial rhythmic impulse
- effectively assess free motion potential at sutural articulations
- recognize structural asymmetries and their implications
- begin to evaluate 'energy' imbalances in living tissue in general and cranial structures in particular (see exercises later in this chapter).

It is essential that the prospective cranial practitioner/therapist becomes familiar with the terms used in cranial therapy, if confusion is to be avoided. See Box 6.1 for a summary of sutural names and Box 6.2 for a summary of terminology which describes these movements, as used in cranial therapy.

CRANIAL PALPATION AND OBSERVATION EXERCISES

Before commencing these exercises, ensure that you have acquired at least a passing understanding of cranial mechanics, the names and suggested directions of movement of the bones taking place during the phases of the respiratory cycle.

Magoun (1966) reminds us that cranial motion is a 'slight yielding of the intra-articular tissue, not the movement of bone on bone. It is the flexibility of living bone, with a very small amount of permitted motion in the articulations, qualified by the restraint imposed through the reciprocal tension membranes'.

Box 6.1 Cranial bone groupings and sutural links (Feeley 1988, Gehin 1985, Retzlaff 1987, Upledger 1986)

Bones

Vault bones Two parietal bones

Occipital squama

Those portions of the temporal bone which develop from membrane

Cranial base Body of sphenoid

Petrous and mastoid portions of temporal bones

Basilar and condylar portions of the occiput (formed from cartilage)

Facial bones

Malar
Lacrimal
Palatine
Nasal
Turbinate
Ethmoid
Maxillae
Mandible
Frontal
Vomer

Bones of the ear

Incus
Stapes
Malleus

Unpaired (midline) bones

Occiput
Sphenoid
Ethmoid
Vomer
Mandible

Paired bones

Parietals
Temporals
Frontals
Zygomae
Maxillae
Palatine
Lacrimals
Inferior conchae
Nasal
Incus
Stapes
Malleus

Sutures

Sagittal suture Junction of parietal bones

Anterior junction with coronal suture is bregma

Posterior junction with lambdoidal suture is lambda

Coronal suture Meeting of anterior parietals and frontal bones (they meet centrally at the bregma)

Inferior aspect of coronal suture is the pterion where frontal meets the great wing of sphenoid, temporal squama and parietal bones

Squamous suture Junction of parietal and temporal squama

Posterior depression on squamous suture is asterion which is junction of temporal, parietal and occipital bones

Lambdoidal suture Junction of occipital and parietal bones

Meet centrally at lambda, junction with sagittal suture

Occipital mastoid suture Junction of occipital bone and mastoid portion of temporal bone

Frontozygomatic suture Where zygomatic process meets frontal bone

Zygomaticomaxillary suture Where zygomatic process meets maxilla

Maxillae–nasal junction Where nasal bones and maxillae meet

Metopic suture Midline of frontal bone (a true suture in approximately 20% of population) (Gorbis 1996)

Box 6.2 Cranial terminology and associated motion patterns based on traditional osteopathic methodology

Cranial flexion (inhalation phase) During cranial flexion (also known as inhalation phase) the paired bones of the skull (see Box 6.1) rotate externally. This part of the cranial cycle is associated with the following.

- The occipital base is said to move anteriorly/superiorly.
- The sacral base moves posteriorly/superiorly ('sacral flexion').
- The midline bones of the skull 'flex'.
- The paired bones of the skull externally rotate.
- The effect of these movements is to flatten and widen the skull (transverse diameter increases while anteroposterior diameter decreases, vertex becomes flattened).
- The tentorium cerebelli flattens and falx cerebri shortens from front to back.
- The spinal column straightens as a whole.
- The ventricles fill.

Cranial extension (exhalation phase) During cranial extension (also known as exhalation phase) the paired bones of the skull rotate internally as they return to their neutral starting position.

- All cranial motions in this phase involve a return to neutral.
- The occipital base is said to move posteriorly/inferiorly.
- The sacral base moves anteriorly/inferiorly (sacral 'extension').
- The midline bones 'extend' to their starting positions.
- The paired bones internally rotate to their starting positions.
- The effect of this is for the skull to become longer and narrower (transverse diameter decreases while anteroposterior diameter increases, vertex becomes more elevated).
- The tentorium cerebelli domes and the falx cerebri is restored to its normal position.
- The spinal curves are restored to normal.
- The ventricles empty.

Look also at the summary of some observable cranial changes in Table 6.1.

Exercise 6.2a Cranial observation (Magoun 1966)

Time suggested 5–7 minutes

Observe a subject's face and head for symmetry (see Fig. 6.3). Look for clues (these are not diagnostic, merely indicative) such as the following.

- Supranasal vertical fold which may have moved to the side on which the frontal bone has moved posteriorly and into internal rotation (extension).
- The superomedial-inferolateral orbital diameter is greater on the side of the high great wing of the sphenoid, making that eye more prominent.
- The nasolabial crease is deeper on the side of an externally rotated maxilla because the cheek is carried anterolaterally.
- The frontal eminence is more prominent when the frontal bone is in internal rotation (extension).
- The slope of the forehead is more acute when the frontal bone is in external rotation (flexion).
- When there is sphenoidal torsion or side-bending rotation, one side of the frontal bone may be prominent (on the extension/low great wing side) and the other (on the flexion/high great wing side) more sloping.
- Wide or narrow nares or deviation of the bridge and septum suggest maxillary involvement.
- The contours of the hard palate give information as to distortion and asymmetry of the sphenoid.
- Upper jaw status indicates position of the maxillae. External rotation (flexion) causes upper incisors to move posteriorly while other upper teeth slope laterally.

Exercise continues

Table 6.1 Dysfunction patterns and observable cranial changes*

Sphenobasilar dysfunction patterns	Head	Forehead	Eyes	Paired bones	Ears
Locked in flexion phase – extension is restricted	Increased width	Wide/sloping	Prominent	Rotated externally	Protrude
Locked in extension phase – flexion is restricted	Narrow vertically	Slopes	Recede internally	Rotated	Flat to head
Torsion strain dysfunction patterns	**Orbit**	**Eye menti**	**Symphysis**	**Mastoid tip**	**Ears**
Side of high sphenoid wing	Wide	Prominent	To side of high wing	Posteromedial	Protrude
Side of low sphenoid wing	Narrow	Receding	Away from low wing side	Anterolateral	Flat to head
Sidebending rotation dysfunction patterns	**Orbit**	**Eye menti**	**Symphysis**	**Mastoid tip**	**Ears**
Convex side	Narrow	Receding	To side of convexity	Posteromedial	Protrude
Concave side	Wide	Prominent	Away from concave side	Anterolateral	Flat to head

*In the adult cranium the probability is that strains such as these are fixed, resulting from the ossification of the synchondrosis whilst in a dysfunctionally strained position. The influence of such a strain can be observed in the shape of the head as well as in key features such as the position of the mastoid, degree of eye and ear prominence, etc. Strains will also be apparent in both the reciprocal tension membranes and the sutures, which will have adapted to the pattern of strain. These should receive primary attention as the likelihood of modifying the strain pattern at the synchondrosis in an adult skull is slight. In a non-adult skull correction remains possible.

Exercise 6.2a Cranial observation (Magoun 1966)—*continued*

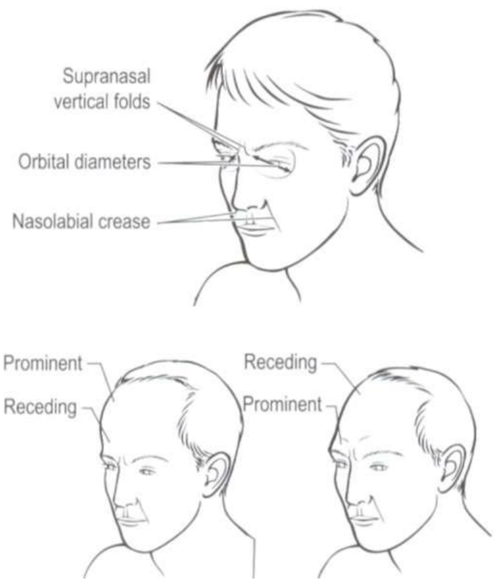


Figure 6.3 Examples of modifications of shape resulting from variations in cranial features. The supranasal vertical folds and nasolabial creases as well as the orbital diameters alter in direction and size according to frontal, sphenoidal and maxilla positions. The relative prominence or otherwise of the frontal bone and the angle of forehead slope are modified by rotational variations so that in external rotation (flexion phase of hypothesized cranial motion) the lateral angle of the frontal bone moves anteriorly, leading to an increased slope of the forehead.

Exercise 6.2a Cranial observation (Magoun 1966)—*continued*

- Lower jaw status indicates position of temporals. Retrusion is caused by bilateral external rotation (flexion). Bilateral internal rotation (extension) causes protrusion. When there is torsion, asymmetry of jaw and teeth results.
- The top of the head may show that the front and back are altered in their vertical relationships due to shift or strain at the sphenobasilar symphysis.
- Look for convexity of sidebending rotation. Compare ear levels and flare. External rotation of one temporal is indicated by the lower, protruding ear and a posteromedial mastoid tip on that side.
- If both ears are flared there is bilateral external rotation of the temporals.
- If the ears are flat to the head there is bilateral internal rotation of the temporals (or plastic surgery has been performed?).
- Note the contour of the back of the head and observe position of the ears. Rotation of the occiput into torsion is suggested by the tilt of the head on the atlas as well as inclination of the occiput from side to side.

Exercise 6.2b Cranial observation (and contour/symmetry palpation)

Time suggested 10–15 minutes

Magoun suggests the following exercise in both palpation and observation.

Feel for - and look at - the features you are assessing, seeking anomalies, imbalances, asymmetries. Use a contact which is 'as light as the touch of a silk handkerchief (Magoun 1966).

- Seated at the head of the table, evaluate the cranial contours and structures of your supine partner/patient, including a general evaluation of symmetry.
- Does the nose slope off to one side?
- Is the chin central or deviated to one side?
- Are the ears symmetrically placed and/or level and/or flat to the head or prominent?
- Is the overall shape of the face/head distorted ('banana head')?
- Is there sutural disturbance? Perform light palpation (Greenman's suture palpation, p. 53).
- Is there any palpable reduction of bone resilience? (Use grams of pressure only to assess at the sutures.)
- Frontal contours - are they abrupt? Sloping? Palpate and observe.
- Metopic suture - is it ridged? Grooved? Palpate and observe.
- Frontal eminence - is this prominent? Palpate and observe.
- Zygomae - are they prominent? Not prominent? Palpate and observe.
- Orbits - is one wider or narrower than the other? Palpate and observe.
- Eyeballs - is one/both prominent or depressed?
- Palate - is this high? Low? Symmetrical? (Use cotted or gloved finger(s).)
- Pterygoid process - do either or both seem to be prominent and/or is one or the other too medial? Lateral? (Use cotted or gloved finger(s) and extremely light contact pressure.)
- Temporals - are either of the mastoid tips anterolateral or posteromedial compared with 'normal' and each other? Palpate and observe.
- Mandible - are the TMJs normal? Palpate and observe with subject still and while opening and closing mouth.
- Occiput - is the subocciput superior? Inferior? Palpate and observe.
- Cervical tension - is this greater on the left or the right? Palpate.
- Vault - is the lambdoidal suture prominent? Flattened? Palpate and observe.
- Sagittal suture - is this grooved? Ridged? Palpate and observe.
- Parietal eminence - is this flat? Prominent? Palpate and observe.
- Sphenoid great wings - is one superior or inferior compared with the other? Palpate and observe.
- Temporal fossa - is this shallow? Deep? On one side or the other? Palpate and observe.
- Record your findings and repeat many, many times.

Palpation hint

It is recommended that in this, as in all early exercises in which cranial structures, motion or cranial rhythms are being assessed, you should think in terms of a slight 'surging' sensation, sometimes described as feeling 'as though the tide is coming in' or a feeling of 'fullness' under the palpating hand, rather than expecting to feel movement of a grosser nature. After a few seconds this 'surge' may be felt to recede, 'as the tide goes out again'. This is a subtle but unmistakable sensation, once experienced.

When feeling for active motion of a bone or at a suture (as in the next exercise), you should anticipate no more than a feeling of pliability, yielding, accommodation, 'give'. In contrast, there is a restricted, hard, wooden, unyielding sensation noted when motion potential at a suture has been lost.

Exercise 6.3 Zygomatic self-palpation

Time suggested 5–7 minutes

Exercise 6.3a Place the thumbs of each hand on the frontal process of your own maxillae - so that there is a contact (no pressure) just medial to the inner corner of each. With your tongue, push laterally against the upper front teeth on one side and then the other.

Can you **feel** the slight movement **of** the bones with your contact thumbs **as** the pressure **of** the tongue increases **on** one side and then the other ?

Is the sensation **of** maxillary motion the same **on** each side?

Exercise 6.3b Now gently (using grams only!) compress both your zygomae towards the nose for a few seconds while taking a deep breath.

Do you feel the restriction this light pressure creates in your ability to inhale normally?

Exercise 6.3c Now hold the zygomae gently apart (again, grams only) and breathe again - do you feel the difference?

Exercise 6.3a illustrates the sense of movement of the maxillae engendered by tongue pressure on the teeth. Exercises 6.3b&c illustrate the impact on function (inhalation through the nose) of extremely light pressures on a facial bone.

Exercise 6.4 DiGiovanna's temporal suture 'spring' tests (DiGiovanna 1991)

Time suggested 5–7 minutes

Four sites are involved in the temporal 'spring' tests.

1. **Occipitomastoid suture.** One hand cups the occiput with fingerpads palpating the occipitomastoid suture on the side to be tested. The thumb and index finger of the other hand rest anteriorly and posteriorly on the mastoid process on the tested side and are used to lightly 'spring' the temporal bone externally (thumb eases mastoid posteromedially) and internally (finger or thenar eminence eases mastoid process anterolaterally). An immediate sense of movement should be felt at the sutural palpation site. If springing motion is absent, then restriction exists.
2. **Parietotemporal suture.** The asterion is palpated as the posterior corner of the parietal bone is 'sprung' gently medially. Motion should be felt at the palpation site. If not, a restriction exists (Fig. 6.4).
3. **Sphenotemporal suture.** One hand palpates the pterion while the other takes the mastoid on the same side posteromedially (into internal rotation/extension). This

Figure 6.4 Assessment of freedom of movement (pliability) between temporal and parietal bones (parietotemporal suture) with palpation (left thumb) on the asterion.

Exercise 6.4 DiGiovanna's temporal suture 'spring' tests (DiGiovanna 1991)—*continued*

should produce a 'gapping' sensation at the pterion. Failure of this is said to indicate a possible temporosphenoidal or sphenobasilar restriction (Fig. 6.5).

4. **Temporobasilar suture.** One hand is cradling the occiput (as in 1 above) while the other lightly grips the temporal bone, which is eased anteromedially at the same time that the occipital bone is eased posterolaterally. These directions are then reversed. A sense of movement should be felt as the petrous portion of the temporal bone glides on the basilar aspect of the occiput. Palpate also for tenderness on the sutures.

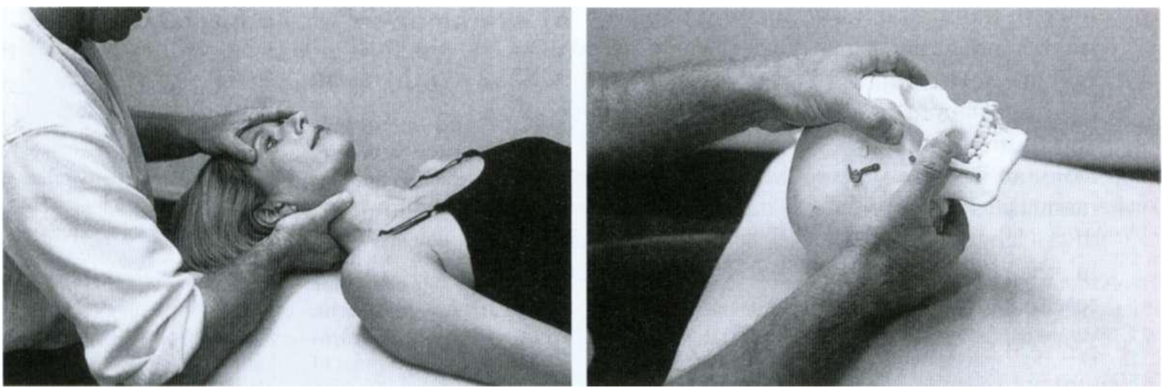
Figure 6.5 Assessment of freedom of movement (pliability) between temporal and sphenoidal bones (sphenotemporal suture) with palpation (left thumb) on the pterion.

Exercise 6.5 Palpating passive cranial motion (von Piekartz & Bryden 2001)

Exercise 6.5a Fronto-occipital compression and decompression
Time suggested 2–3 minutes

Compression

- With the patient/model supine you should sit to the right of the head, with your right hand on the treatment table, supporting the occiput, fingertips resting on the left lateral aspect of the occiput (see Fig. 6.6).
  Your left hand should cover the frontal bone.



A B

Figure 6.6 A Hand position for general compression method of occipitofrontal region. B General compression method of occipitofrontal region performed on skull. (Reproduced from von Piekartz Et Bryden (2001) with permission from Elsevier.)

Exercise continues

Exercise 6.5 Palpating passive cranial motion (von Piekartz & Bryden 2001)—*continued*

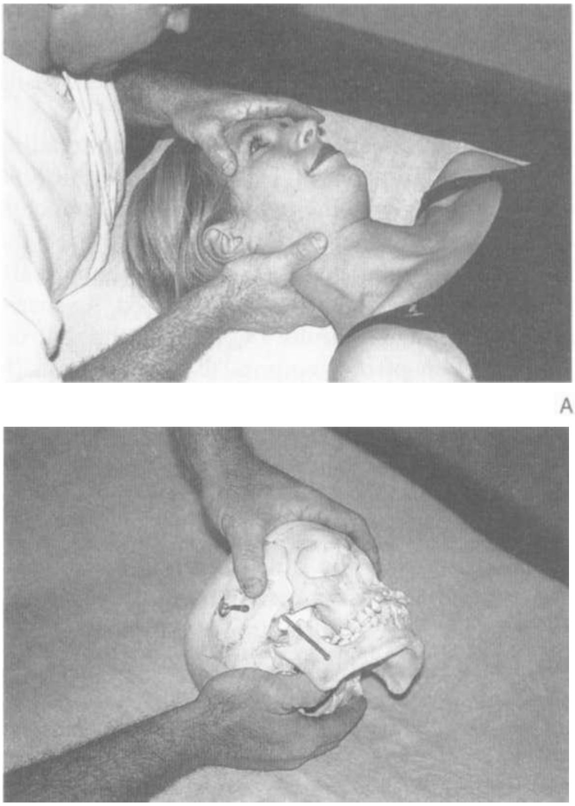
- The left hand builds up posteriorly directed pressure, as your right hand simultaneously commences an anteriorly directed pressure.
- Try to judge what degree of compression is required to remove all slack, without causing distress.
- Experiment by altering the compression to introduce an angulation of the forces, on a diagonal, for example by directing the posteriorly focused force from the front left toward the back right and the anteriorly directed force from back right toward the front left.
- Once slack has been removed and compression created, maintain the hold for 30-90 seconds before a slow release is introduced.
- It is useful to ask for feedback from the model/ patient as to sensations, altering of symptoms (headache, neck pain, etc.).
- Von Piekartz & Bryden (2001) suggest that this maneuver 'influences many cranial tissues between the occipital and frontal bones'.
- It may be speculated that positional release mechanisms may operate during compression, to allow subsequent changes in function of, for example, the reciprocal tension membranes (see positional release discussion in Appendix 1).

Decompression

- To decompress the fronto-occipital structures adopt the same hold and use the left hand to traction the frontal bone anteriorly, while the right hand introduces a posteriorly directed pull on the occiput.
- It is important to avoid squeezing with fingers and thumbs during these holds.
- Do you sense a degree of release as you maintain decompression? This process introduces lengthening of the falx cerebri, as noted in the Kostopoulos & Keramides (1992) research.

Exercise 6.5b Occipitosphenoidal translation (shunt)
Time suggested 2–3 minutes

- The patient/model lies supine.



A

B

Figure 6.7 A Hand position for translation of sphenoid on the occiput. B Translation of sphenoid on the occiput performed on skull. (Reproduced from von Piekartz & Bryden (2001) with permission from Elsevier.)

- You sit or stand at the head, cupping the occipital bone in the right hand.
- Your left hand spans the frontal bone so that the thumb and index finger rest (not pressing into the tissues) on the two great wings of the sphenoid (see Fig. 6.7).
- Keeping the hands relaxed, avoiding squeezing with finger and thumb toward each other, brace your arms against the trunk if possible and using body motion rather than arm movement, introduce a transversely directed, to-and-fro movement of the sphenoid.
- Judge whether you can sense a symmetrical degree of 'shunt' of the sphenoid towards the left and the right or whether this seems limited in one or both directions.

Exercise 6.5 Palpating passive cranial motion (von Piekartz & Bryden 2001)—*continued*

- The possibility of motion at this synchondrosis in adult life is discussed later in this chapter.
- It seems that even if motion as such is lost, some degree of plasticity remains. This is, however, an area of major disagreement and debate in the cranial field.
- Von Piekartz & Bryden (2001) suggest that the sphenoid and its foramina have a predisposition to neuropathies and that many symptoms may relate to dysfunction in these structures.

Exercise 6.5c Maxillary rotation on sagittal axis
Time suggested 2–3 minutes

- The patient/model lies supine and you stand at head level, on the patient/model's right.
- Your left hand should span the frontal bone, with a finger and thumb stabilizing the two great wings of the sphenoid (to examine maxillosphenoid articulation) or in touch with the lateral borders of the frontal bone (to examine the maxillofrontal articulation).
- Wearing a glove, the right index finger and thumb should be placed so that they lie intrabuccally, on the maxillae, superior to the teeth and inferior to the zygomatic processes.
- Take care to avoid increasing finger or thumb pressure as you use body leverage to flex your trunk over the patient, so introducing a rotational force to the intraoral hand, while stabilizing the head with the other hand (see Fig. 6.8).
- Reverse the rotation by returning to the upright from a flexed position. In this way it is body movement that induces the rotation rather than force delivered by your hands.
- Von Piekartz & Bryden (2001) report that this approach is useful in assessing for dysfunction related to 'asymmetry of the cranium, malocclusions, temporomandibular joint dysfunctions, neuropathic pain from the maxillary nerve and maxillary sinusitis'.

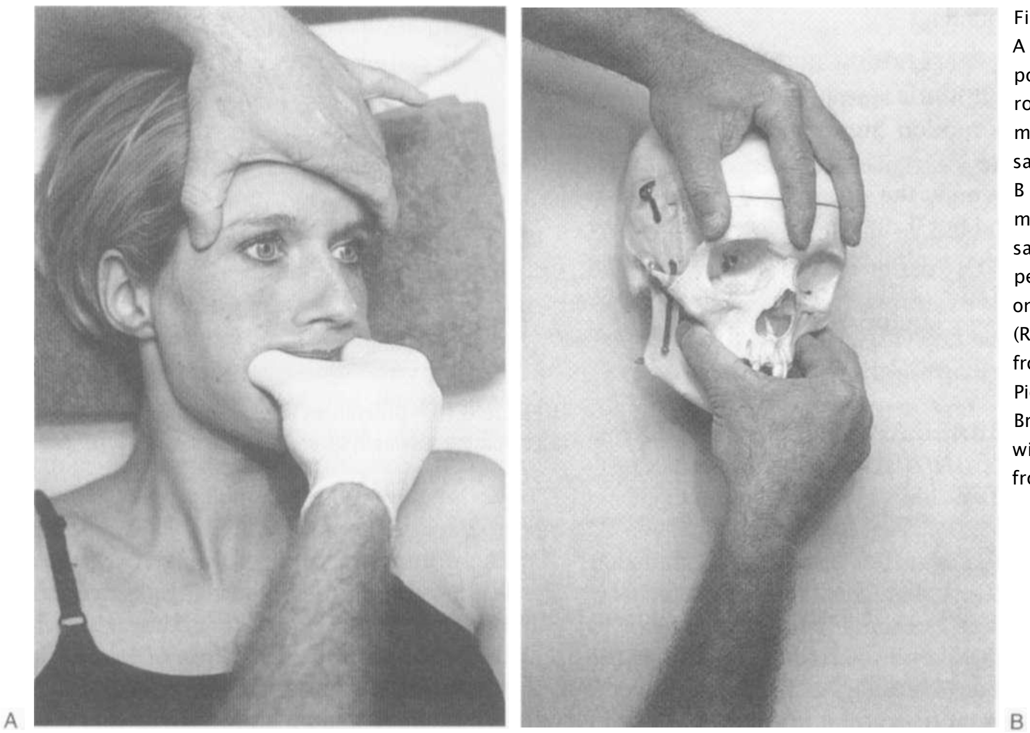


Figure 6.8 A Hand position for rotation of maxilla on sagittal axis. B Rotation of maxilla on sagittal axis performed on skull. (Reproduced from von Piekartz Ft Bryden (2001) with permission from Elsevier.)

New York research

Do the cranial bones move in a sequence? Do they follow the sort of pattern which traditional craniosacral teaching has suggested, of a centrally driven motion series of movements commencing at the sphenobasilar synchondrosis (see below,) and then proceeding in an ordered manner, with external rotation of the temporals, the parietals and so on?

A study performed at the New York College of Osteopathic Medicine (Zanakis et al 1996) produced the following information.

- Surface infrared markers were placed on the skin overlying each parietal, frontal and occipital bone as well as over the lambda and the bregma.
- These served as precise reference points while cranial motion was determined for 60 seconds by means of a 3-dimensional kinematic system.
- It was found that there was considerable 'variation between subjects.
- In some individuals the markers on one parietal moved differently from the other side in both anterior and posterior motions, while in these same subjects the frontal bones also moved disproportionately.

The conclusion overall was that: 'motion of the cranial bones is not a simple "hinge" operation but a complex motion involving more than one axis of movement'.

There is motion at the sutures and it does seem to be rhythmical but it does not necessarily follow any particular sequential pattern. But within these apparently variable patterns of motion, does the sphenobasilar synchondrosis flex?

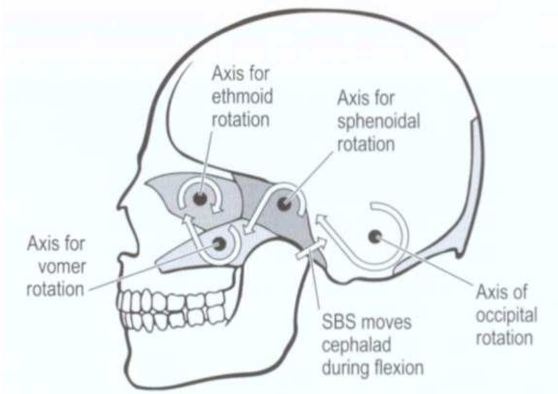


Figure 6.9 Schematic representation of cranial motion showing directions of hypothesized motion during the flexion (external rotation, inhalation) phase of the cycle. Extension (internal rotation, exhalation phase) is thought to result in a return to neutral.

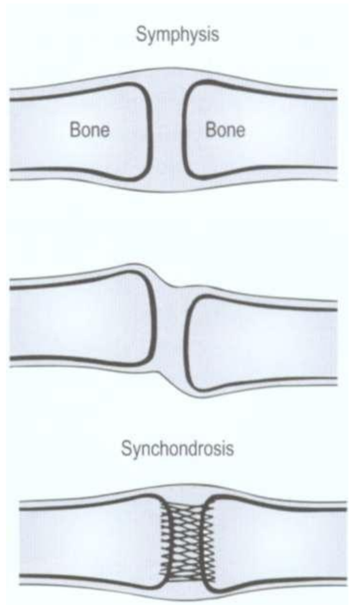


Figure 6.10 Differences in movement potentials comparing a symphysis and a synchondrosis junction.

THE SPHENOBASILAR SYNCHONDROSIS – CAN IT MOVE IN ADULT LIFE? (see Figs 6.9–6.11)

Since Gray's *Anatomy* (1973) is quite clear that ossification of the sphenobasilar synchondrosis is usually complete by age 25, it is reasonable to assume that childhood and adolescence are the only times when even slight degrees of flexion and extension motion may be present.

The primary motions of the bones of the skull, which, according to craniosacral dogma, result in all the bones moving in sequence, are described in most cranial texts as arising from what happens at the sphenobasilar junction. For example, Greenman (1989) portrays this phenomenon as follows.

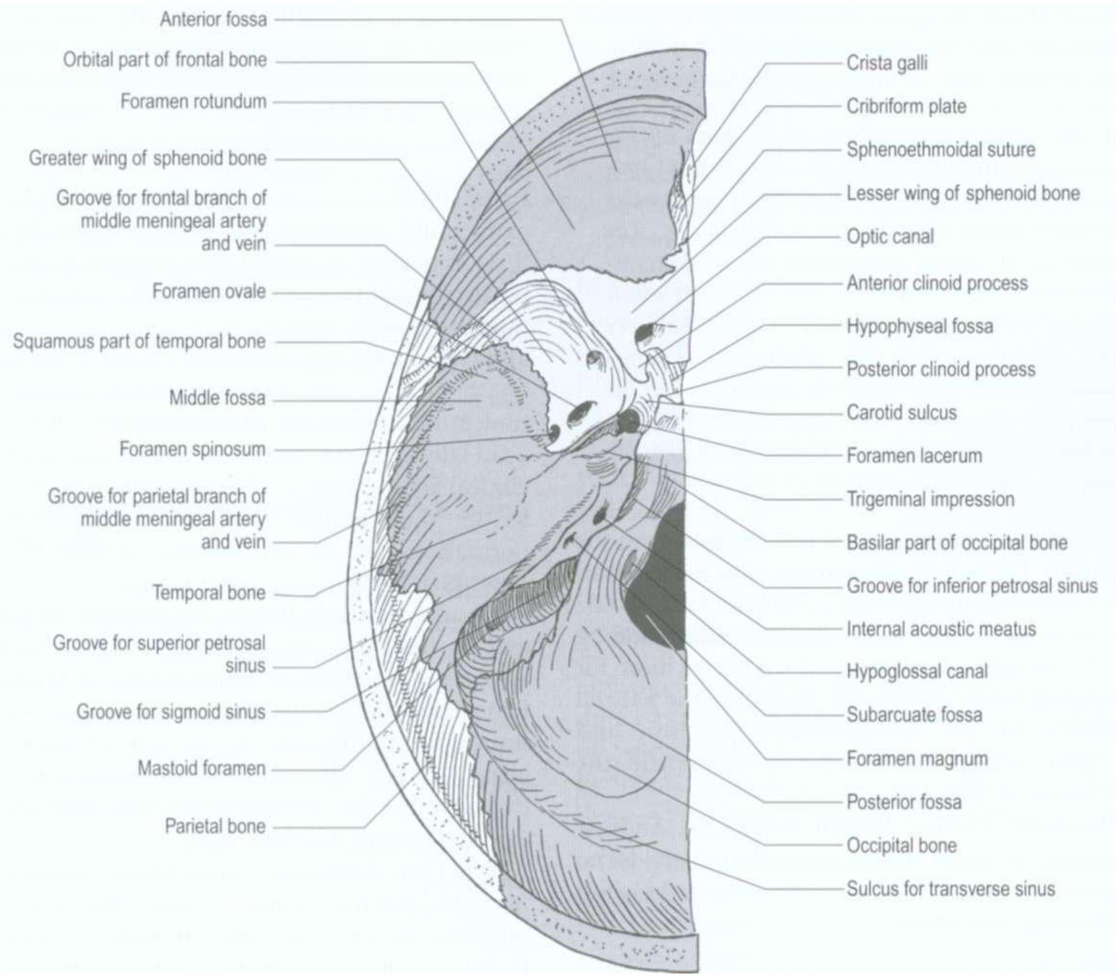


Figure 6.11 Sphenobasilar synchondrosis – internal skull view. (Reproduced from Gray's Anatomy (1995) with permission from Elsevier.)

Flexion-extension movement occurs at the sphenobasilar junctions, a synchondrosis. During this movement the sphenoid and the occiput rotate in opposite directions. During sphenobasilar flexion, the sphenoid rotates anteriorly with the basisphenoid being elevated and the pterygoid process moving inferiorly and the occiput rotating posteriorly with the basiocciput being elevated and the squama and condylar parts being depressed (caudad). During sphenobasilar flexion, the ethmoid rotates in the opposite direction to the sphenoid and in the same direction as the occiput. During sphenobasilar flexion, the vomer is carried caudad as the anterior portion of the sphenoid moves in that direction. During spheno-basilar extension all of the motions are reversed.

A number of pertinent questions need to be asked.

1. What if, in adult life, this synchondrosis cannot flex, cannot allow the described motions to occur?
2. What happens to cranial concepts if this primary occipitosphenoidal motion is denied in an adult skull because the junction ossifies?
3. Does there actually need to be any movement at all at the synchondrosis in order for there to be resilient and plastic compliance of other skull articulations, in response to intra- and extracranial pressure changes and other stresses and forces (Heisey & Adams 1993)?

Jackson (1957) suggests that there is no general agreement as to whether or not there is motion at the synchondrosis, as suggested by Sutherland.

> *In the original presentation of his work on the cranium Sutherland made the hypothetical proposition that a pivot action at the sphenobasilar junction exists after the age of twenty five. The majority of cranial technicians are in disagreement with this contention and we must await further proof on this point. If we agree however that the bones of the head are capable of movement and that they move rhythmically with the breathing apparatus, there does appear to be an ordered sequence in these movements which are palpable and demonstrable.*

How does Jackson explain this movement and the apparent 'lesions' or distortions which are found in the relationship between occiput and sphenoid? In a footnote which acknowledges ossification by age 25, she adds a comment which leaves room for supposing some movement: 'Probably the natural pliability of the sphenobasilar junction and the great wings [of the sphenoid] explain the movement in later life'.

However, another British osteopath, Andrew Ferguson, is clear in his view that there is no motion potential at the synchondrosis, in the adult skull (Ferguson 1991).

> *Sutherland and his followers placed great emphasis on motion at the sphenobasilar synchondrosis although this fuses by about the age of 25. Examination of any adult skull shows that it fuses quite strongly, thus any study of the articular mechanics of an adult skull must assume that the sphenoid-occiput is one strong fused unit forming the base of the cranium. This means that a fundamental change in perspective is necessary from the classical view - that of an 'internally driven system where spheno-occipital motion moves the other bones - to an externally driven system where muscles attached to the cranium move the other bones relative to a solid spheno-occipital cranial base. This cranial base is itself mobile and held in a position of dynamic balance on top of the cervical spine by the many muscles and tissues of the neck. Prior to fusion limited movement between sphenoid and occiput remains a possibility; functionally there is a distinction between muscles attached to the occiput, which are surrounded by the prevertebral fascia and those attached to the sphenoid, amongst which is the pretracheal fascia.*

Latey (1984) comments on just how powerful some extracranial structures attaching to it actually are: 'It is important to realise how extreme forces can be distributed through the skull. The clenched jaw may easily support twice the person's own weight and crack some nuts that won't break if you jump on them ... gross musculoskeletal stresses are transmitted across the parietotemporal joint'.

In later sections, emphasis will be placed on the clinical importance of the muscular attachments to the skull and of the need for these to be normalized, as far as possible, as part of any attempt at assisting cranial function.

Cranial experts in Britain, for example Ferguson, and in the USA, for example Sherman Gorbis, Associate Professor of Biomechanics at Michigan State University, subscribe to the importance of muscular influences in cranial dysfunction, although not all seem to be forthcoming in denying that the occipitosphenoidal junction can flex and extend (Gorbis 1996).

Whether Ferguson's hypothesis relating to 'muscles driving cranial motion' (see Ch. 2) is accurate in total or only in part or whether Jackson's suggestion that 'During inspiration the upward convexity of the sphenobasilar junction appears to increase' is correct, it seems that a definite problem exists in accepting the traditional occipitosphenoidal movement hypothesis.

Ettlinger & Gintis (1991) acknowledge the ossification process and maintain that despite this, the bony junction 'bends':

> *The sphenoids articulate with the basilar portion of the occiput (the sphenobasilar joint), a synchondrosis that is cartilaginous until they are 20 to 25 years, then converts to cancellous bone. It exhibits flexibility, not articular mobility.*

Since we are asked by Jackson and Ettlinger & Gintis to accept that this bony junction remains flexible but not mobile, it seems reasonable to question the likelihood of extremely light pressure (grams usually, ounces sometimes) being capable of moving this osseous junction. These light degrees of pressure, as suggested by Upledger (1996) and Milne (1995) who seldom ask for more than 10 grams of force to be applied or Ettlinger & Gintis (1991) who suggest 'half an ounce at most' (14 grams), seem unlikely forces to produce such an effect.

As we will see when we examine the work of Fritz Smith later in this chapter, other interpretations are available as to what happens when a solid structure is 'bent' using extremely light pressures - where subtle energy factors might be involved rather than orthopedic, mechanical ones.

Why should the synchondrosis ossify if it offers functionality?

A further question relates to why, if motion in the synchondrosis is physiologically necessary and important (and we are repeatedly told in cranial textbooks that this is the key 'joint' in the skull), ossification commonly takes place in the early 20s, when other cranial articulations/sutures seldom ossify, even into advanced age (Jaslow 1990)?

The British Columbia Office of Health Technology Assessment report on craniosacral therapy states: 'The research evidence reviewed supports the theory that the adult cranium is not always solidly fused and that minute movements between cranial bones may be possible' (Green et al 1999).

If actual movement is a requirement for normal function, ossification of the synchondrosis would not occur, except in abnormal conditions. However, fuse it does and usually before 30 years of age (Gray's *Anatomy* 1973).

Although there have been tentative attempts to address this fundamental issue, an impression exists of a more or less blind acceptance by many cranial therapists of dogma - that the synchondrosis continues to bend in adult life - and this creates an 'emperor without clothes' impression and does no service to the development and evolution of cranial manipulation.

Upledger & Vredevoogd (1983) acknowledge this debate and in offering their own explanations, seem somewhat equivocal over the degree of possible motion at the synchondrosis.

> *Some doubt has been cast upon the possibility of motion at the sphenobasilar joint in the adult human. However, motion at this joint is an essential part of Sutherland's functioning model. Early in embryonic life the sphenobasilar joint is a synchondrosis.... This thin band of cartilaginous material probably retains some degree of flexibility throughout life.*

In this statement the 'joint' is said to 'probably' allow motion; however, several paragraphs further on (p. 10), they state with more certainty that 'It [the synchondrosis] does maintain some degree of flexibility throughout life.

As will be noted below, Pick (1999) agrees that pliability remains even after ossification but this is a long way from being sutural, the sort of accommodation that is noted in all other osseous junctions in the cranium.

Further doubts raised

Upledger & Vredevoogd themselves also express doubt as to the likelihood of the existence of some of Sutherland's descriptions of lesion' patterns between the occiput and the sphenoid, notably those which have a translatory or shearing form.

> *Torsions, sidebending and flexion-extension motions can conceivably occur if some flexibility is retained between the sphenoid and occiput. The shearing relationship between the sphenoid and occiput, which Sutherland called a vertical or lateral strain is, however, somewhat more difficult to conceptualize as inherent in a joint which is not, in fact, a symphysis.*

They also include in their analysis of what might take place at the junction of the sphenoid and the occiput the results of external, usually soft tissue forces, including muscles: 'We believe that motion distortion of the cranial base is usually caused by abnormal soft tissue or dural membrane tensions which are transmitted to their osseous anchorings. Another significant cause may be suture immobility'.

The acknowledgment that structural distortion of the synchondrosis is unlikely and that motion restrictions of it are commonly the result of soft tissue and/or sutural causes is interesting in that it is at variance with the opinions of Greenman and Ettlinger & Gintis. However, it still presumes motion at the synchondrosis, since the restrictions in question - albeit resulting from soft tissue tensions and/or sutural immobility - are said to result in 'distortions of normal motion'.

The assertion by Upledger & Vredevoogd that vertical strains probably cannot occur at this junction is contradicted in a remarkable video which successfully makes 'the basic physics and biochemistry that underlie these processes [craniosacral manipulation] more understandable'. In this video, Carlisle Holland (1991) shows photographic evidence (MRI scans) of a vertical strain in an infant skull. It is possible to state with virtual certainty that such a distortion would remain in its warped state into adult life, were treatment not initiated in infancy, since without such treatment it is impossible to conceive of a spontaneous normalization taking place.

How flexible?

Childhood flexibility of the sphenobasilar junction is not in question; it is the degree of 'flexibility' existing after age 25 which remains an issue. The concern is whether this remnant of childhood flexibility can possibly bow, bend or move in an adult skull sufficiently to allow the possibility of flexion and extension to be produced, whether via intrinsic (fluid? brain? glial cells?) or extrinsic (muscles, manipulation, etc.) forces.

We are asked by Greenman, Jackson, Ettlinger & Gintis and, more reservedly, by Upledger & Vredevoogd to accept that sufficient movement occurs (the latter speak variously of movement being 'conceivable', 'possible' and 'probable') to allow a mechanical chain of events to take place in which all other cranial structures subsequently move in response.

The intrinsic forces (brain pulsation, glial cells coiling and uncoiling, etc.) have individually already been ruled by many experts as inadequate to the task of moving CSF (see Box 2.3, p. 35). How much less likely is it that these forces could bend a virtually rigid bony junction?

Muscles?

It may be hypothesized (as by Ferguson and others) that vastly more powerful muscular forces attached directly to the cranial bones, which move rhythmically, for example in relation to respiration or intermittently (in chewing), are perfectly capable of exerting sufficient pull and pressure on the skull to demand a compliant degree of resilience, flexibility and palpable motion at the sutures, which appear to exist largely for just this purpose.

It is just about conceivable that muscular or fascial pulls, if sufficiently powerful, could produce extremely slight resilience at the ossified adult sphenobasilar junction. With strong muscular attachments at the base of the occiput, as well as on the external surface of the great wings of the sphenoid (see Ch. 9), such a hypothetical motion (a minute degree of 'yielding') may be possible. The words 'diving', 'bowing' and 'bending' are, however, unlikely descriptors for this minute degree of activity. (Many muscular influences on the skull will be discussed more fully in Chs 8 and 9.)

Accommodation rather than movement?

As was noted in Chapter 2, Adams and colleagues (Heisey & Adams 1993) have demonstrated the complex hydrodynamic responses of the living cranium. These involve brain tissue factors, the volume of CSF production and reabsorption rates, intracranial blood volume as well as rates of arterial supply and venous drainage, plus the viscoelastic properties of the connective tissues of the region. All these features and factors are involved in influencing intracranial pressure and volume relationships, which demand an ability for adaptation of the container in which they find themselves. Adaptation potentials, accommodation, compliance to meet these many variables has to be offered by the presence of flexibility at the cranial sutures.

It seems likely that cranial motion at the sutures is a response, or a series of responses, to dynamic circulatory pressure fluctuations and requirements (probably associated with fascial and muscular demands), so that there is no need to hypothesize a central, pivotal flexion and extension of what, in adult life, is a semi-solid joint, in order to account for motion at the sutures. The simpler answer may well be the most accurate.

Whatever happens in adult life, there is little dispute that a degree of mobility exists between the occipital bone and the sphenoid at the synchondrosis until the late teens or early 20s. During this early period of life numerous possibilities exist for strain or trauma to the skull, most notably in the womb, during childbirth and in early infancy (Miller & Clarren 2001).

Any synchondrosis distortion patterns acquired prior to ossification (for example, as a result of birth injury through forceps delivery or difficult labor, trauma, etc.) would become permanently established by the time ossification is complete. The stresses and strains imposed on the reciprocal tension membranes and other osseous components of the cranium, as a result of any such fixed sphenobasilar deviation, warping, twisting or torsion, may produce symptoms and should therefore become the focus of assessment and treatment in the adult skull.

Pick (1999, p. 422) is categorical regarding the progressive ossification of the junction between the occiput and the sphenoid.

> *This articulation is primarily a synchondrosis-based symphysis until the middle of the second decade of life. After the 25th year, cancellous bone infiltration obliterates the symphysis junction and fuses the occiput with the sphenoid. Consequently the practitioner is concerned with the articulation's realignment prior to its obliteration. After its ossification, the practitioner's focus shifts toward addressing release of tension in the trabeculae of the symphysis.*

Pick (p. 424) nevertheless encourages the viewpoint of sustained pliability, even after ossification.

> *The practitioner must keep in mind that this structure is not a suture and that it becomes ossified after the twenty fifth year of life. However the anterior two-thirds of the sphenoid's body is a sinus cavity, while the posterior third as well as the occiput's basilar portion is composed of spongy bone. This means that the junction has a certain degree of pliability and is capable of reacting to outside forces through its sinus-trabecular association.*

Upledger & Vredevoogd (1983) see distortions at this junction as resulting, in part at least, from dural tensions and warping.

> *Abnormal sphenobasilar relationships are probably not maintained by inherent primary distortion of the anatomical relationship between the sphenoid and the occiput. The dura mater is firmly attached to the bones of the cranial vault and base as periosteum and endosteum. Abnormal tensions placed upon the dural membranes are therefore transmitted to the various bones to which these membranes attach. This circumstance produces abnormal functional motion of these bones.*

They highlight the importance of muscular influences on this region when they speak of contracture of the trapezius and splenius capitis muscles as 'causing pronounced distortion of cranial base motion via the occiput and temporal bones'.

This reinforces the need for attention to be paid to structures and soft tissues associated with and attaching to the cranium, as well as the cranium itself, a necessity which will be developed in later chapters.

Whether distortions between the occiput and the sphenoid at the synchondrosis are merely ossified distortion patterns acquired in youth or the result of imposed soft tissue stresses, observable and/or palpable cranial asymmetries would almost certainly be noted on examination.

There would probably also be palpable areas of dysfunction (widening, narrowing, 'tension', tenderness, etc.) noted at some aspects of the sutural articulations, where physiological patency of motion is normally maintained throughout life.

There could also be profound interference with normal circulatory function into and out of and within the skull.

The exercises in observation and palpation (above, pp 146-155) will have demonstrated some of the 'fixed' distortion patterns possibly involving the sphenobasilar synchondrosis. A summary of indications as to what may be observed cranially when such sphenobasilar distortions are in place is given in Table 6.1 (p. 150).

Why and how do distortions involving the occiput occur?

In Appendix 2 there is discussion of cranial distortions (plagiocephaly) in infancy and the implications of such conditions. If uncorrected,

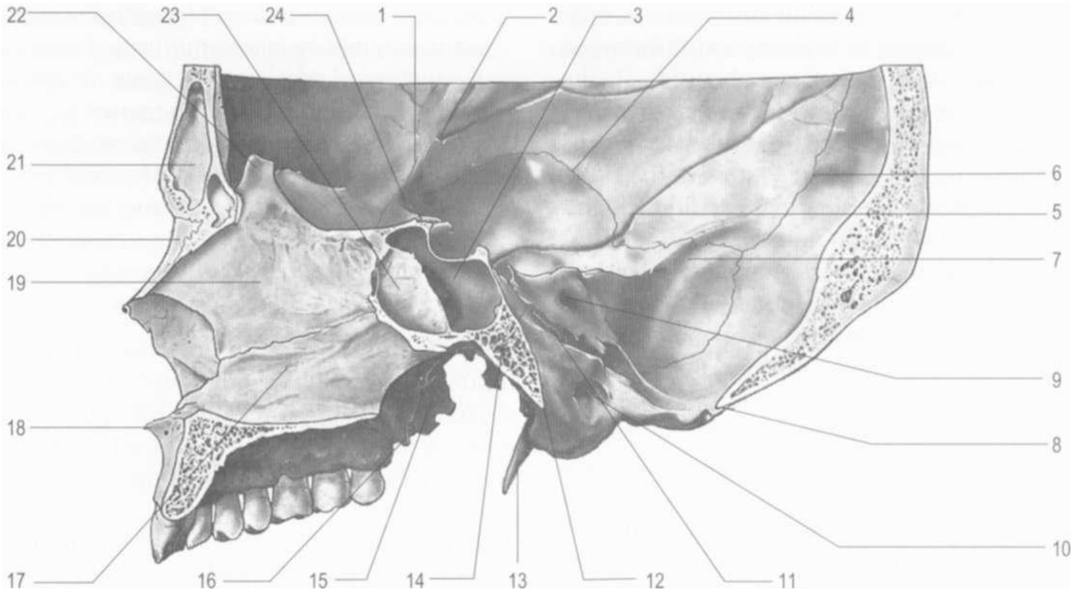


Figure 6.12 Cross section of skull showing cranial base junction. 1. Frontosphenoidal suture. 2. Bony canal for middle meningeal vessels, frontal branches, upper orifice. 3. Right sphenoidal sinus. 4. Squamosal suture. 5. Groove for parietal branches of middle meningeal vessels. 6. Lambdoid suture. 7. Groove for transverse sinus. 8. Posterior margin of foramen magnum. 9. Internal acoustic meatus. 10. Hypoglossal canal. 11. Petro-occipital suture in floor of groove for inferior petrosal sinus. 12. Anterior margin of foramen magnum. 13. Styloid process. 14. Line of occipitosphenoidal junction. 15. Lateral pterygoid plate. 16. Pterygoid hamulus. 17. Vomer. 18. Anterior nasal spine. 19. Perpendicular plate of ethmoid. 20. Nasal bone. 21. Frontal sinus. 22. Crista galli. 23. Left sphenoidal sinus. 24. Bony canal for frontal divisions of middle meningeal vessels, lower orifice. (Reproduced from Gray's Anatomy (1995) with permission from Elsevier.)

these deformities are likely to be present throughout life. Causes are thought to include :

- abnormalities in brain shape and subsequent aberrant directions in brain growth
- premature fusion of a single coronal or lambdoidal suture
- prenatal or postnatal external constraint (Miller & Clarren 2001)
- enforced supine sleeping position to reduce incidence of SIDS (Argenta et al 1996).

Synchondrosis distortion effects on intracranial circulation

A distorted osseous occipitosphenoidal junction can be assumed to produce negative influences resulting from 'abnormal tensions' affecting the reciprocal tension membranes, which would have been obliged to adapt to any positional, structural osseous modifications.

Any such warping of the reciprocal tension membranes would directly affect internal circulatory dynamics relative to both the CSF and venous drainage of the skull cavity (see Box 6.3, p. 168).

Because the cranial venous sinuses are enclosed by dural folds and are not supported by elastic or muscular structures, as are all other veins in the body, efficient drainage is to a large degree dependent on the relative integrity and normality of these fascial folds. The major veins of the nervous system are epidural.

Both the large diploic veins which can be seen when the bony cap is removed from the brain and the venous sinuses of the skull lie exterior to the dura mater. The valveless vertebral venous plexus is also epidural but its adventitial supportive connective tissues are loosely integrated with the dura.

Also integral with the dura is the periosteum of the internal table of the skull. The significance of the anatomy of the veins and venous sinuses in relationship to the dura is that dural tension influences the size of these conduits and hence their ability to transport their fluid contents.

Note also that since the cervical fascia is continuous with the dural folds, this allows cervical dysfunction to directly influence the status of the dural tension membranes and therefore the enclosed sinuses.

Thanks to recent research a further very important influence is now known to exist as a result of a direct connective tissue link between the suboccipital muscle, rectus capitis posterior minor and the dura (described in greater detail in Ch. 10).

Exercises 6.6 and 6.7 Palpation of resilience/movement at sphenobasilar synchondrosis

Time suggested not less than 10 minutes for each exercise

Note: Make a point of performing this exercise on people well under 25 years of age as well as people well over that age and compare differences in motion potentials, plasticity, etc. as you perform the exercises.

This exercise is performed using two different holds.

Exercise 6.6 Vault hold (see Fig. 6.13) The patient is supine, you are seated at the head with forearms resting on the table. Your fingers are placed in a relaxed manner so that the:

- small finger is on the squamous portion of occiput
- ring finger rests behind the ear near the asterion so that the distal portion of the finger is just on the mastoid
- middle finger is anterior to the ear, to rest on the pterion with the tip touching the zygomatic process
- index finger rests on the great wing of sphenoid
- thumbs rest, touching each other (see Fig. 6.13) or crossed, without touching the head if possible, allowing pressure between them to form a base for the flexor muscles of the hand to operate.

Sit quietly for at least 2 minutes or until cranial motion is noted (a sense of intermittent 'fullness' in the palms of the hands may be all that is felt initially). As the flexion phase (also known as the inhalation phase/external rotation) of the cranial cycle commences (manifested by a sense of fullness, slight tingling, minute pressure in palms of hands or in wrists/forearms - by proprioceptors), the following might be noted:

- your ring and middle fingers seem to be carried caudally and laterally
- your index fingers seem to be carried anteriorly and caudally.

These motions are all passive with no effort on your part.

As sphenobasilar extension commences (exhalation/internal rotation phase) you might sense the palpated bones returning towards their start positions (i.e. your index finger moves cephalad and posteriorly, while your ring and middle fingers move cephalad and medially).

Can you feel any of these movements? Retest and if necessary retest again. If you do feel the movements, try to formulate an image of what cranial bone movements might be taking place.

Were there any differences in palpated movement when the patient/model was under 25 and over 25?

Exercise 6.7 Fronto-occipital hold (see Fig. 6.14) The patient is supine and you sit or stand to the right or left, near the head of the table.

Your caudal (closest to the feet) hand rests on the table cradling the occipital area so that the occipital squama closest to you rests on your hypothenar eminence, while the tips of your fingers support the opposite occipital angle.

Your cephalad hand (closest to the head) rests over the frontal bone so that the thumb lies on one great wing and the tips of the fingers on the other great wing, with as little contact as possible on the frontal bone (Fig. 6.14).

Exercise continues

Exercises 6.6 and 6.7 Palpation of resilience/movement at sphenobasilar synchondrosis—*continued*

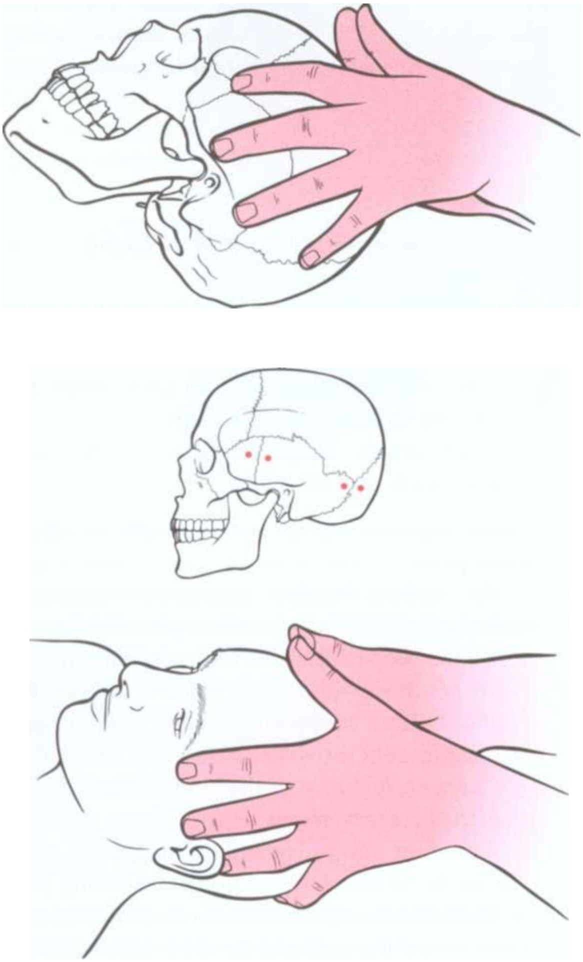


Figure 6.13 Vault hold for cranial palpation. Relative head and hand size may preclude precise replication of suggested sites for finger placement.

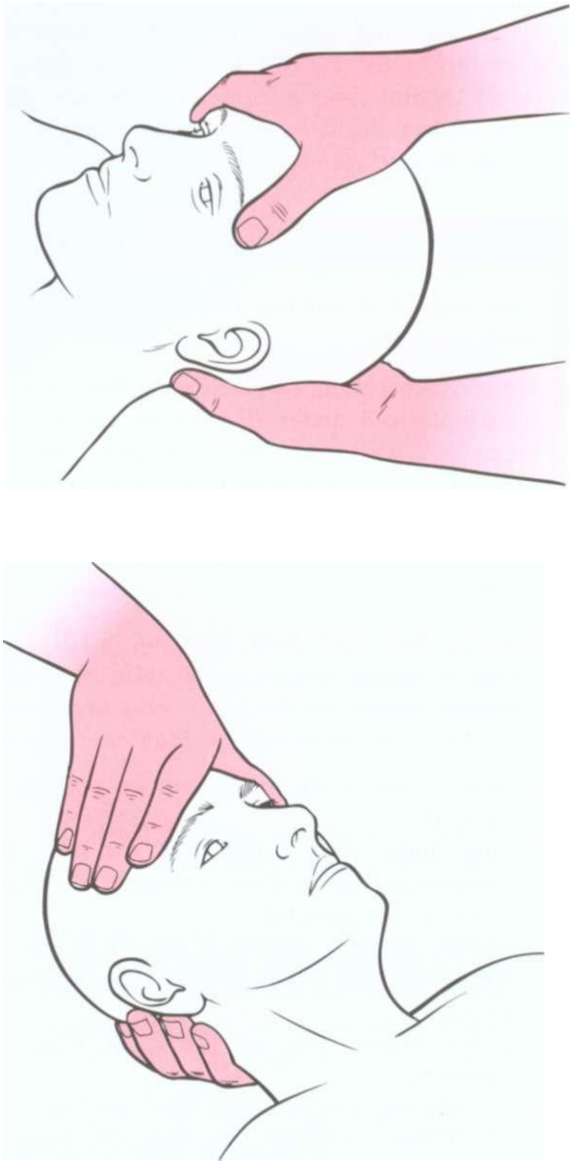


Figure 6.14 Fronto-occipital hold for cranial palpation.

If your hand is small, make your contacts on the lateral angles of the frontal bone.

Sit for some minutes until cranial motion is noted. As sphenobasilar flexion (inhalation/external rotation phase) commences (sensation in the hands of fullness, tingling, etc.) you might feel:

- occipital movement which is caudad and anterior, while simultaneously
- the great wings seem to rotate anteriorly and caudally around their transverse axis.

If you sense these motions you may encourage them in order to assess any restriction by using very light pressure in the appropriate directions to impede the movement described.

During the hypothesized sphenobasilar extension (exhalation/internal rotation phase) you might feel a return to neutral as the lower

Exercises 6.6 and 6.7 Palpation of resilience/movement at sphenobasilar synchondrosis—*continued*

hand goes cephalad and the upper hand goes cephalad and posteriorly.

Do you sense these motions? Test again **and** retest.

These two palpation exercises offer you a first opportunity to assess the disputed midline motion functions, flexion and extension, of the cranial mechanism - that of the sphenobasilar synchondrosis - and all that flows from it.

- Can you sense these motions **of** the occiput **and/or** the sphenoid?
- **If you can feel movement, what structures do you believe are actually moving?**
- **Does the movement continue when the patient holds her breath?**
- **Is the movement accentuated by deep inhalation and/or exhalation?**
- **Were there any differences in palpated movement when the patient/model was under 25 and over 25?**
- **Repeat these exercises many times.**

Consider

There are no definitive answers to the questions raised above as to what is actually happening when you sense a motion taking place at the synchondrosis (as most cranial therapists believe they do at times).

Did you notice a difference in feel when palpating young heads as opposed to older ones?

Consider also the concepts of Fritz Smith (discussed later in this chapter), which might offer a subtle energy answer, since an orthopedic one is far from acceptable to many as, in all probability, the junction between these bones prevents any 'real' movement.

It is open to debate whether the palpable resilience and plasticity noted to exist between the cranial bones, mainly at their sutures, have any function apart from the provision of a degree of shock-absorption potential and the ability to accommodate to moderate alterations in intracranial pressure. The action of chewing and biting imposes enormous pressures on cranial structures via the muscular attachments and some degree of accommodation to these forces would seem to be a practical necessity for the skull. Certainly, being able to 'give' or bend, even just a little, when blows, sustained compression or leverage (dental work?) forces are applied to the head must have life-preserving and brain-protective potential.

The wide range of dysfunctional patterns which have been clinically linked to cranial bone/sutural restrictions is partial evidence of the importance of the maintenance of cranial bone/suture motion potential.

Whether or not (and 'not' seems the likeliest) during adult life there is the possibility of actual movement (flexion/extension) rather than a residual pliability at the sphenobasilar synchondrosis, there is certainly 'actual' movement between many of the other articulations of the skull, as shown in earlier chapters (particularly 1 and 2).

SACRAL INVOLVEMENT?

According to craniosacral theory sacral dysfunction is likely to result from any cranial distortion or imbalance, although this concept is challenged by some authorities (see Chs 1 and 2 for discussion of the issues).

It is suggested that you now perform the exercises described below in order to evaluate your own findings regarding the claims and statements relative to synchronous cranial and sacral motion. Among the questions you might be asking yourself are:

- Can I sense sacral motion?
- Can I sense cranial and sacral motion synchronously?
- How does sacral function/motion relate to the individual's respiratory cycle?
- Does sacral motion seem to be independent of respiratory function?

Exercise 6.8 Palpation of sacral motion

Time suggested not less than 10 minutes

Your model/patient may be supine, prone or sidelying (see Figs 6.15 and 6.16A-C). If supine, slide your dominant hand beneath the sacrum so that the fingertips rest at the base of the sacrum, spreading from one sacroiliac articulation to the other.

The coccyx should be gently cradled in the heel of the hand with the forearm and elbow resting comfortably on the surface of the treatment table.

Kneel or sit so that you are as comfortable as possible during the 10 minutes or so of this exercise. The free hand may be placed across the anterior pelvis so that the forearm rests on one ASIS and the hand on the other. This increases awareness of pelvic motion.

Figure 6.15 Sacral palpation, ideal hand position.

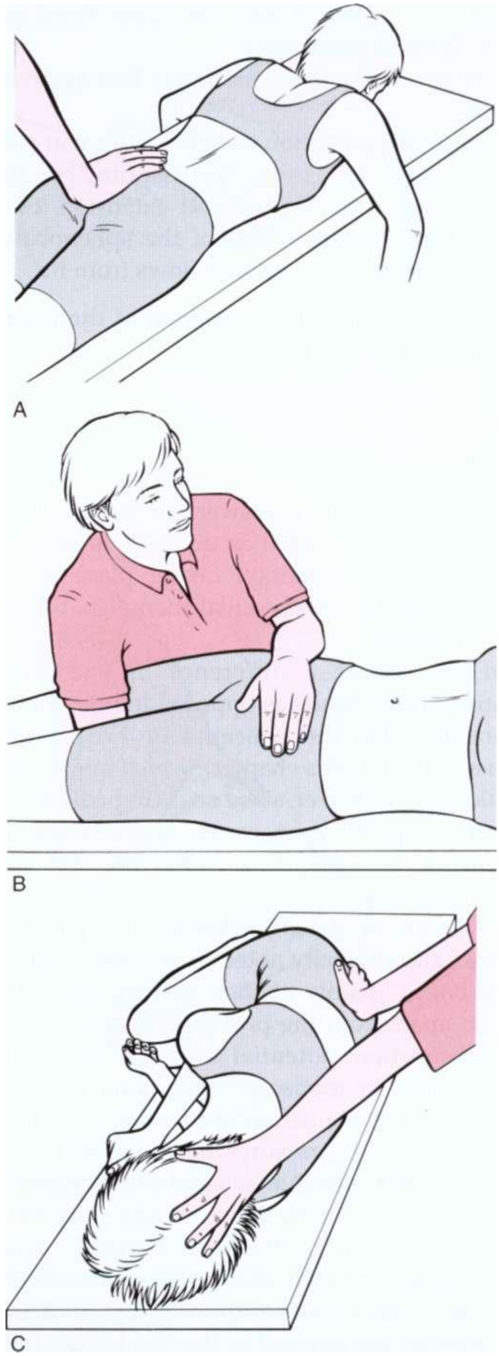


Figure 6.16 A,B Variations in patient and operator positions for sacral palpation and treatment. C Palpation of synchrony between occipital and sacral motion/pulsation.

Exercise 6.8 Palpation of sacral motion—*continued*

With eyes closed, focus attention to all sensations reaching the palpating hand on the sacrum.

Can you sense a rhythm synchronous with normal respiration? During the flexion (inhalation) phase of sacral and cranial motion the sacral apex is said to move anteriorly as the base moves posteriorly. These structures move back to their starting position during the exhalation (extension) phase.

If you sense these subtle movements ask the patient to hold her breath and observe what happens to the sacral motion at this time.

Is there still a subtle motion palpable as the breath is held?

As respiration resumes, try to sense whether or not this subtle motion alters again. Many craniosacral experts maintain that it is possible to learn to distinguish the motion related to breathing from a more subtle 'cranial respiratory' rhythm.

Record your findings after each performance of this and similar exercises.

If the subject is sidelying, the palpating hand is placed on the sacrum by taking it between the legs, as you sit in front facing the individual. In the prone position the hand is placed over the sacrum, fingers pointing cephalad.

Upledger & Vredevoogd (1983) make the following comments relative to numbness of hands when they are under the supine individual's sacrum: 'Pressure paraesthesia does not reduce proprioception; as a matter of fact, it enhances proprioceptive sensitivity somewhat by removing tactile noise. When the sacrum of the subject is supine on your hand, lean heavily upon your elbow, close your eyes and let your hand meld with the sacrum'.

Using a downward pressure on the elbow to enhance palpation sensitivity when the hand is under the palpating surface was a method devised by Rollin Becker (Becker 1963,1964,1965).

Exercise 6.9 Palpation for synchrony between occipital and sacral motion

Time suggested 7–9 minutes

Philip Greenman (1989) suggests that your partner/model/patient lies on her side, pillow under the head in order to avoid any side-bending of the neck during this palpation. You should be seated behind and place one hand on the occiput (fingers going over the crown) and the other on the sacrum, fingers towards the coccyx (see Fig. 6.16C).

Upledger & Vredevoogd (1983), on the other hand, suggest palpating the motion in these bones simultaneously as the patient lies supine. If a normal synchronous motion is palpated they advocate slightly inhibiting the motion of either the occiput or the sacrum with one hand and noting the effect on the motion being perceived by the other hand. If, in the assessment, dural drag is presumed, due to a 'lag' between the occipital and sacral motions, they ask you to see whether you can tell whether this 'drag' is coming from one end or the other or from somewhere in between.

- Simultaneously palpate the motions of the occiput and the sacrum.
- Are they synchronous with each other and/or with respiratory function?
- What happens when the breath **is** held?

If peforming the palpation with your partner sidelying, once you have satisfied yourself of the answers to these questions (5 minutes should be ample), have your partner remove the pillow, so that the neck is sidebent.

Repalpate and compare the results.

- Can you feel the synchronous motions under your hands between occiput and sacrum?
- Are movements different from when the head was supported?
- If not, what changes occur when the neck **is** not supported on the cushion?

After performing this palpation several times, ask yourself whether or not you agree with Norton's statement (2002):

Exercise continues

Exercise 6.9 Palpation for synchrony between occipital and sacral motion—*continued*

There are no demonstrable temporal relationships between CRI rates of healthy human subjects measured simultaneously at the cranium and sacrum by two examiners, challenging the concept of craniosacral interaction through mechanical or functional linkages.

RECIPROCAL TENSION MEMBRANES AND THE VENOUS SINUSES

The importance given to the relative balance and functional integrity of the reciprocal tension membranes is all too apparent in the literature. Moskalenko et al (1999) have demonstrated that the falx cerebri, the falx cerebelli and the tentorium cerebelli are in a state of constant reciprocal tension and that the cranium tends to alternately expand laterally or in an AP or sagittal direction.

Greenman (1989) explains the importance to cranial circulation of this balanced tension, as follows.

> *Simply, the goal of craniosacral treatment is to restore balanced membranous tension. The normal dynamic reciprocal tension of the falx and tent cannot occur in the presence of restriction or alteration in the relationship of cranial bones. Because of the relationship of the membranes to the venous sinuses within the skull [see Box 6.3], venous drainage cannot be enhanced if abnormal membranous tension persists.... Restoring maximum mobility to the osseous cranium allows the homeostatic mechanisms to restore balanced membranous tension, enhance venous flow, reduce neural entrapment and permit normal CRI rate, rhythm and amplitude.*

See Figure 2.5A (p. 30) for an illustration of the relationship between the venous sinuses and the reciprocal tension membranes, falx cerebri and tentorium cerebelli and also Figure 6.17. See Box 6.3 for details of the venous sinuses.

Box 6.3 The venous sinuses: relationships and drainage patterns (Ettlinger & Gintis 1991)

The relationships between the reciprocal tension membranes and the sinuses are as follows.

- Superior and inferior sagittal sinuses are enclosed within the falx cerebri.
- Transverse, sigmoid, superior and inferior petrosal sinuses are enclosed within the tentorium cerebelli.
- The straight sinus lies at the junction of the falx and the tentorium.
- The cavernous sinus and the basilar plexus are found anterior and inferior to the tentorium.

The **venous sinuses** drain as follows.

- The superior sinus drains into the right transverse sinus and thence to the sigmoid and finally the internal jugular vein.
- The inferior sagittal sinus drains into the great vein of Galen, thence to the straight sinus, the left transverse sinus, the sigmoid sinus and the internal jugular vein.
- The occipital sinus drains into the transverse sinus on the same side and thence to the sigmoid sinus and the internal jugular vein.
- The cavernous sinus drains into the superior and inferior petrosal sinuses and thence to the sigmoid sinus and the internal jugular vein.

Neurological and other associations with the sinuses include:

- the third and fourth as well as the ophthalmic division of the fifth and sixth cranial nerves which run through the cavernous sinus
- the internal carotid artery also runs through the cavernous sinus.

Exercise 6.10 Venous sinus drainage exercise (Greenman 1989)

Time suggested **10–15** minutes

This exercise describes a method commonly applied to enhance venous sinus drainage (see Fig. 6.17). Prior to its application the ducts and channels through which drainage is anticipated, including the thoracic outlet as well as the occipitoatlantal and cervical regions, are treated to prepare them for the cranial drainage.

Exercise 6.10 Venous sinus drainage exercise (Greenman 1989)—*continued*

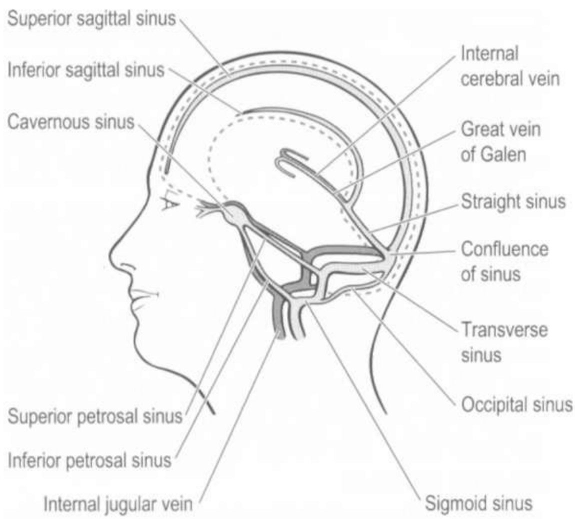


Figure 6.17 Venous sinuses of the cranium.

Muscular insertions into the region should all receive attention, notably sternomastoid, rectus capitis and upper trapezius (details of suggested approaches to cranial muscular attachments are given in Ch. 9).

The patient is supine. The head rests on two, three or four fingers of one hand placed so that they are vertical to the table, pointing towards the ceiling in contact with the superior nuchal line close to the external occipital protuberances.

The weight of the head resting on the finger-pads is all the pressure required so that no additional force is applied by the hands or fingers. This position is maintained until a sense of warmth or 'softening' is noted in the tissues resting on the fingerpads.

It is recommended that this softening sensation should be felt as bilateral and equal before moving to the next position. The transverse sinus drains in response to this part of the sequence.

The fingers are now moved towards the foramen magnum where an identical position of the fingers is maintained until the softening response occurs to release the cerebellar sinus.

At this point the first position is readopted, with fingerpads on the external occipital protuberances on the superior nuchal line but this time with one finger on the inion, until once again a 'softening' is noted. This is thought to release the confluence of the sinuses.

Two fingers are now placed on either side of the inion applying gentle separation force (ounces) on the occipital squama, while two fingers of the other hand apply a similarly mild pressure from a point contralaterally distant on the cranium, directed towards the fingers on each side of the inion. This contralateral point might be on the metopic suture of the frontal bone.

This process is called a V-spread and possibly has a disengaging effect on the reciprocal tension membranes associated with the areas being treated (or energy factors may be at play - see Ch. 2 and consider Smith's opinion, below). When a softening or 'fluid wave sensation' is noted this is considered to have influenced drainage from the sagittal sinus.

The head is now cradled in the palms of the hands with the thumbs placed one on each side of the sagittal suture, starting from a point just anterior to the lambda. The thumbs are moved progressively anterior after each softening sensation is noted until they reach the bregma at the coronal suture in order to influence the straight sinus.

The metopic suture of the frontal bone is treated by placing four fingers on either side of this suture, applying a mild separating pressure across the suture and waiting for softening to occur.

The metopic suture is said to remain patent in approximately one in five individuals.

FRITZ SMITH'S ENERGY CONCEPTS

Fritz Smith has outlined a model which, if valid, allows us to effectively begin to palpate and manipulate energy imbalances related to structural dysfunction. In his teaching of 'zero balancing' and in his book (Smith 1986), he offers explanations which may allow us to put the 'energy' concepts, as discussed in Chapter 2, to practical use, making them clinically applicable in both assessment and treatment. Smith offers clarifications which marry the orthopedic with the subtle energy information which Oschman has so eloquently outlined (summarized in Ch. 2, p. 41).

Smith suggests that there exists an energy field which penetrates the whole body and which extends some distance beyond the physical limits of the body. He further proposes that the currents of these energy fields form layers: a deep one which invests the skeletal system, a middle layer which involves the soft tissues - and which relates directly to the qi meridians described in traditional Chinese medicine (TCM) - as well as a superficial layer which lies just below the skin.

Smith maintains that these arrangements of energy are capable of disruption if the physical medium through which they pass (bone, muscle, skin, etc.) is traumatized or stressed. He further hypothesizes (and Upledger concurs) that historical patterns of distress (toxic, emotional, physical) can be imprinted in these non-differentiated energy fields which are capable of being assessed and treated.

Smith is an orthodox medical physician and an osteopath, who has also studied TCM; his approach is of considerable value to those practitioners who struggle to align the apparent contradictions faced when comparing the variables in theory and methodology which exist between Western and Eastern medicine. Of particular interest in our cranial exploration are what Smith describes as 'the foundations for the energetic bridge', what he calls 'foundation joints'. These, he says, are the:

- cranial bones of the skull
- sacroiliac articulations
- intercarpal articulations of the hand
- pubic symphysis
- intertarsal articulations of the foot.

These foundation joints, he maintains, transmit and balance the energetic forces of the body, rather than being merely involved in movement and locomotion. What they have in common is extremely small ranges of motion and little or no voluntary movement potential. In all cases movement in them occurs in response to forces acting upon the area, rather than being initiated by the part itself.

Thus, if there is an imbalance or altered function in any of these joints, the body is obliged to compensate for the problem rather than being able to resolve the situation through internal, local adaptation. Such compensation can be widespread and will often involve other associated structures, commonly producing a situation which becomes 'locked into' the body, limiting its ability to function normally.

Smith believes that these foundation joints have a close relationship with the subtle body so that any limitation in them can be seen as a direct readout of the energetic component of the body. He reminds us of a basic law of physics which tells us that the effect of stress on any mechanism will spread until it is absorbed or until the mechanism breaks down. What Smith is pointing to is the fact that stresses will spread into these 'foundation areas' and that, because they have no power of voluntary motion, they absorb strains until they become locked. Resolution requires externally applied forces.

Smith describes a variety of assessment methods capable of identifying reductions in the normal energy flow in tissues associated with distressed foundation joints and describes methods which he uses to restore normal function when reduced energy flow is perceived. These concepts and the exercises associated with them (below) are useful in preparing for cranial assessment and treatment methods.

Smith's 'essential touch' palpation

Smith's work seems to be a bridge between the gross methods of Western physiological systems (orthopedic/structural/mechanical assessment and treatment) and the more intangible concepts of subtle 'energy' medicine. He explains the way he makes contact with the patient, which involves an instinctive, intuitive, yet conscious action on the part of the aware therapist. What should we feel when this is achieved? He describes it thus.

> *There are a number of sensations, mostly involving the feeling of movement or aliveness, which let us know we are engaging an energy field. We may perceive a fine vibration in the other person's body or in the aura, a feeling we are making contact with a low voltage current. This may be described as tingling, buzzing, a chill sensation, 'goose bumps', as well as a subtle sensation that some people describe as 'vibration'. We may also perceive a grosser feeling of movement as though the person's body or our own, were expanding or contracting, even though we see no physical change.*

Smith uses the concept of a fulcrum in order to establish his contact. A fulcrum is defined, says Smith, as a balance point, a position, element or agency through, around or by means of which forces are exercised: the simplest fulcrum is created by the direct pressure of one or more fingers into the body, to form a firm support, around which the body can orient. The fulcrum needs to be 'deep' enough into the body so that the physical slack of the tissue is taken up; this is the point at which any further pressure meets with resistance in the tissue beneath the fingers.

Getting 'in touch' with the person's energy field is thus achieved by taking up slack from tissues, so that any additional movement on the part of the operator will be translated directly into the person's experience. At any fulcrum or balance point one is in solid contact with the material, the mass orients around the finger and any further pressure will affect the energy. Additional ways of creating a fulcrum, apart from direct pressure with finger or hand, can involve stretching, twisting, bending or sliding contacts.

Note: Smith insists that there should be frequent breaks (he calls these 'disconnects') from the patient when energy exercises (or therapy) are being performed. A loss of sensitivity - which he calls 'accommodation' - takes place, as well as a draining of the therapist's vital reserves.

Exercise 6.11 Rubber band exercise

Time suggested 10–15 minutes

Smith suggests that, before beginning palpation of a person, you should take a rubber band and stretch it, just taking out the slack. At that point he likens what you have done to 'making contact' in the patient situation. Any further movement or stretch will involve the elastic itself.

With this experience in mind, make contact with a patient or model by placing a hand anywhere on their soft tissues - back, thigh, abdomen, for example - and lightly pull the hand towards yourself and slightly 'lift' it from the tissues, without losing contact.

Smith describes this as a 'half-moon' vector, since it combines both lifting and pulling motions which translate into a curved pull. This is the key to what he seeks.

Once you have taken out the physical slack and have established an interface (fulcrum) with the tissues, any additional movement on your part will be noticed by the patient and any movement in the person's body will be noticed by you.

At this point you are in touch at the energy level. Can you feel it?

Stay with the contact for some time and assess what you feel.

Record your description of the sensations you are feeling.

Fine-tuning

It is with such a contact, Smith states, that you should sense vibrations and/or currents and by adding more movement yourself, you can judge how the tissue (or the patient as a whole) responds. To fine-tune the fulcrum contact, he asks himself 'How does this feel to the patient?' or 'How would this feel if it were done to me?'.

The response helps him decide whether to pull harder or more gently, to twist more or less. He also asks the patient how it feels, suggesting that with a straight pressure fulcrum a 'nice hurt' is what is desirable.

He suggests the following 'exercises' to help in assessment of energy aspects of bony structures.

Exercise 6.12 'Bending' arm bones

Time suggested 7–10 minutes

Take hold of your patient/model's forearm above the wrist and below the elbow and, after taking out the slack (by 'pulling' your hands apart until the point is reached where you have created a fulcrum), gently put a bend or 'bow' into the arm (Fig. 6.18). After taking up the slack of the physical body and soft tissues by pulling your hands apart, the resistance of the arm bones will be encountered.

Any movement from this interface position will be felt by both the patient and yourself. Make a 'bowing' motion in one direction just as far as the tissues will allow and then gently release the tension; then make a bowing motion in the opposite direction.

Try this several times, once with the eyes open and once with the eyes closed. Repeat the exercise on the person's other forearm and compare and record the findings.

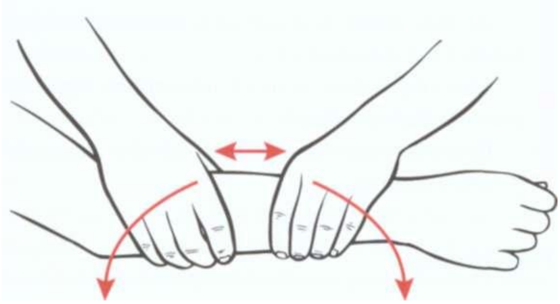


Figure 6.18 Fritz Smith's palpation exercise for interface between biomechanical and 'energetic' structures of the forearm.

Interpretation

Smith states that if the arm is normal, not injured, it may 'bow' more easily in one direction than the other; a bow in one direction may feel obstructed or it may suggest a twisting motion or have the feel of a steel bar or be more rubbery Great variations exist and it is for each of us to establish what 'normal' feels like, to become aware of what is acceptable and what needs working on.

Smith then suggests a similar study/exercise involving the long bones of the lower leg. These are probably a better testing ground for practice than the forearm, which has a natural rotational tendency anyway and so can confuse assessment.

Exercise 6.13 'Bending' leg bones

Time suggested 2–4 minutes

Place one hand just above the ankle and the other below the knee of one leg. Take up slack in the soft tissue (pull hands apart) and gently twist in one direction (hands going in opposite directions), feeling the bony resistance and introducing a twisting motion, as if gently wringing a sweater.

Repeat in the other direction.

What do you feel?

Smith says: 'Because the bones are denser in the leg than the forearm and because the muscles are heavier, it takes a moment longer to perceive the energy currents interacting in the twisting motion. It is an exaggeration to say that energy on this level moves with the speed of molasses but the principle is true'.

Note: This is not an exercise in judging whether things are good or bad but is designed to help you to become sensitive to motions and energies not previously registered.

Repetition and comparison

As with most exercises, these should be performed on several people within a short space of time, making comparisons easier. By sharing experiences with others it is possible to validate the subtle perceptions derived from these palpation experiences.

If it is possible to palpate limbs which have previously been fractured and which have healed, energy current variations become very instructive: 'Energy fields across a fracture may feel heavy and dense, have low vitality or be disorganized and chaotic. These qualities relate to the process of reconnecting or bridging the energy fields across the damaged bone' (Smith 1986).

Can the palpated patterns be altered?

Yes, says Smith. For example, he takes a forearm which has an old fracture, grasping it as in Exercise 6.12 above. He takes out the slack by stretching apart his hands: *'Holding this, I might add a further stretching force and then, in addition, a bowing or twisting force. I hold this configuration, being sensitive to the resilience of the bone, for a brief period, possibly 15 to 20 seconds and then gently release'.*

On re-evaluation he would expect a lessening of the asymmetry of the original force fields, a greater freedom of energetic movement through the long bone.

He says that he allows three such attempts in order to create the greatest degree of 'shift' at any one session.

Suggestions regarding force application

It is suggested that, when working on cranial structures rather than arms or legs, the word 'force' be taken very cautiously.

- Imagine the very smallest amount of effort which would be required to rotate an empty cup standing on a saucer and you will have an idea of how much force is needed in many aspects of cranial manipulation. Even this degree of effort should not be created by the hands but should be transmitted from the arms through the hands, which are molded to the part being treated.
- In this situation it is as well to consider the hands as the contact only, with the motive force coming from the shoulders or arms.
- Rather than using direct force, it should be understood that leverage is being applied by subtle use of arm muscles to guide the hand, rather than allowing direct hand strength to operate.
- Smith suggests that palpating/contact hands be neutral, allowing the patient's body to organize itself around these contacts, which become 'organizational fulcrums'.

See also the notes on degree of 'Palpation pressure considerations' earlier in this chapter (p. 141).

Exercise 6.14 Palpating energy via the legs

Time suggested 5–7 minutes

Introduce traction from the ankles of the supine model/patient until all slack has been removed (Fig. 6.19).

Sense the connection with the energy field of the patient.

Does it elongate and eventually try to contract?

If so, slowly release it, like an elastic band.

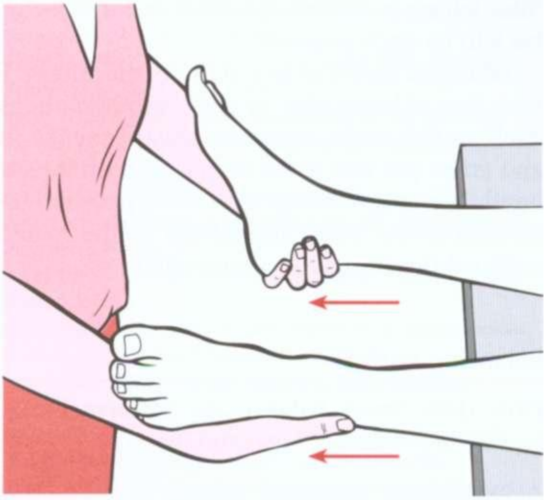


Figure 6.19 Smith's energy palpation using the legs and feet.

Explanation - manipulation of energy?

Once a fulcrum has been established (as in this last exercise), Smith explains that a number of sensations are possible. As the barrier is held, a sense that the patient's energy body is elongating, 'stretching' or 'flowing' into the hands may occur - a sensation/process which at some point will stop.

If at that time there is not a feeling of contraction as though the energy body was returning to its previous state but rather of a stillness, a resting in the 'elongated' state, Smith would gradually release the traction and rest the patient's legs on the table. The patient then remains in a very deep relaxed state for some moments before returning to normal (Smith watches eye movements, patient's color and breathing pattern to assess states of consciousness).

However, if for therapeutic reasons Smith wishes to anchor the energy field as it tries to contract again, he can do so by maintaining traction. This would be very similar to the idea of creating and holding a 'still point' as the body tried to normalize ('organize' or 'unwind') itself around that fulcrum, in craniosacral methodology - something we will be discussing in later chapters.

If, however, he were to decide to go with the retraction rather than anchoring it, this would be 'like letting a stretched rubber band slowly go back to its slack position'.

Were you aware of any of these sensations? The very fact of being able to sense subtle motions is itself, at this stage, adequate reward for the time and effort put into these exercises. If on the other hand these sensations are not apparent, then repetition and quiet application of the methods outlined thus far are recommended.

Balancing energy

How does Smith balance any abnormal energy waves he perceives? He could, he says:

- override an abnormal pattern with a stronger, clearer energy field, or
- introduce a force field which matches the aberrant pattern and, by holding it, allow the original field to diminish and vanish, or
- make an 'essential connection' with the aberrant pattern and anchor this as the body tries to pull away.

Whichever he chooses, immediate re-evaluation will often show that the aberration is still present. However, reassessment some days or even weeks later may show that it has normalized.

Example

Smith illustrates his ideas with clinical examples. In one instance he examined a patient who had been in pain since an automobile accident over a year before, in which no significant injury had occurred apart from bruising. Smith was unable to find any cause for the pain until he noted a strong twisting force in the energy field from the right side of the chest to the left abdomen. This represented the twisting force exerted at the time of the accident.

He used traction on the legs to 'engage' this force field and exerted a slightly stronger force field through his body, noting 'a sensation of a rebounding effect along the energy imprint itself. By anchoring the new field I allowed the rebound to subside'. A gradual release of first the energy body and then the physical body and a subsequent resting of the legs on the table left the patient with a sense of well-being and quietness. On examination 2 days later he was free of pain and there were no twisting currents to be found.

Implications of Smith's work in cranial therapy

By keeping these 'energy' interpretations in mind when palpating and treating cranial structures, it may become possible to straddle the divide between orthopedic and subtle energy approaches.

When working on easily tangible structure we can, by using Smith's guidelines ('take out the slack'), learn to palpate energy patterns and are shown ways of altering these. Also, in application of the V-spread technique approach (as used as part of Exercise 6.10, p. 169) a direct correlation with Smith's methods can be seen.

What is actually happening in such situations? Is the practitioner 'transferring energy' as Upledger and many cranial therapists suggest? Or is there some other explanation; for example, when cranial sutures are involved could the light compressive forces involved be allowing a spontaneous release of fascial or other soft tissue distortion? See Chapter 10 for further thoughts on this possibility.

Interpretations will vary and definitive answers are not yet available. What is clear is that for almost a century precisely these methods have yielded remarkable therapeutic results and current knowledge about energy potentials allows for a greater range of possible explanations. Fritz Smith's contribution has been to make some of these concepts more tangible and solid.

Having read Smith's ideas, it is suggested that you revisit the palpation exercises in this chapter, in particular those relating to evaluation of flexion and extension at the sphenobasilar synchondrosis

(Exercises 6.6 and 6.7). See to what extent you are 'taking out the slack' as you apply the suggested hand hold positions and just how much of what you are feeling relates to energy rather than mechanical /orthopedic/structural factors.

In subsequent chapters the influences of muscles on cranial function will be examined, as well as a detailed bone-by-bone review of the cranial osseous structures and their complex relationships.

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Chapter 7

Cranial bones: assessment and manipulation

CHAPTER CONTENTS

Dysfunctional patterns that are assessed and treated in bodywork settings in general and cranial manipulation contexts in particular, can be the result of single traumatic insults or a series of microtraumas which may represent compensation (defensive adaptation) responses to behavioral, structural, functional or emotional factors.

Selye (1956) called stress the non-specific element in disease production, describing an initial alarm reaction, after which a resistance (adaptation) phase develops followed by an exhaustion phase, when adaptation finally fails. Such processes can affect the whole body or a specific stressed area of the body. Selye emphasized the importance of connective tissue in these processes and demonstrated that stress results in a pattern of adaptation, individual to each organism.

Researchers have shown that the type of stress involved can be entirely physical (Wall & Melzack 1989) (e.g. a single injury or repetitive postural strain) or purely psychic in nature (Latey 1983) (e.g. chronically repressed anger).

Commonly a combination of emotional and physical stresses will so alter neuromusculoskeletal structures as to create a series of identifiable physical changes, which will themselves generate further stress, such as pain, fascial and muscular changes, joint restriction, general discomfort and fatigue. Predictable chain reactions of compensating changes will evolve in the soft tissues in most instances of chronic adaptation to biomechanical and psychogenic stress (Lewit 1992). Such adaptation will almost always be at the expense of optimum function as well as also being an ongoing source of further physiological embarrassment. These issues are examined further in Chapter 8.

In contrast, when traumatic insults are absorbed by the body, the force which is 'soaked up' and which alters the connective tissues in a distorting and dysfunctional manner requires far less therapeutic effort.

We see here the suggestion that precisely the same dysfunctional pattern, arrived at via different forms of physiological abuse, might require quite different therapeutic approaches to achieve normalization. The form of the injury, its slow chronicity or sudden violent onset are key determining factors.

Smith (1990) uses a metaphor.

> *In ancient China, a distinction was made between a 'horse kick injury' and a 'camel kick injury'. The horse kick (hard hoof) produced an acute local trauma whereas the camel kick (soft hoof) produced a dispersed aftermath which affected the tissues in a more widespread manner, in a way which 'melds into the recipient's body, smoulders without stimulating the body's defence mechanism and disperses through the energy systems'.*

When palpating or working on cranial structures it is as well to have such thoughts in mind, to realize that what is being evaluated or treated might be the result of years of compensation (say postural or occupational misuse), perhaps involving chronic changes to the muscles of the shoulder and neck region, as well as whatever local cranial restrictions might be discovered.

In such cases there should be active stretching and releasing of shortened fascial and muscular structures before addressing any cranial restriction directly. Such an approach would be in line with the concept of dealing with a 'camel kick'.

A history of direct trauma to the head, however, might call for direct cranial treatment of an extremely light nature, appropriate for an area which had absorbed 'traumatic energy' - in the form of a 'horse kick', perhaps?

A review of hypothesized cranial motion at the sphenobasilar junction is given in Chapter 6. Descriptions of the motions at the various sutures and articulations will be found in this chapter, as will details of muscular influences.

Palpation and treatment methods (exercises) will be described to allow evaluation of the particular aspects of cranial structure or function under discussion.

The explanations of patterns of cranial bone movement will include evaluation of evidence relative to a major area of disagreement - the proposed amount (if any) of motion said to occur in the adult skull between the occiput and the sphenoid, at the synchondrosis. It is vital that these disputed issues be discussed so that what follows in the assessment, diagnosis and treatment sections is based, as far as current knowledge allows, on fact and not fantasy.

It is strongly suggested that, before treating apparent cranial dysfunction, attention should be paid to soft tissue changes, muscle and fascia, which could be impacting upon cranial suture mobility. In this chapter key features relating to the major bones of the cranium will be outlined. These descriptions will use the following format.

- Named bone
- Bones with which it articulates and named junctions (sutures)
- Reciprocal tension membrane relationships with named bone
- Muscular attachments
- Range and direction of motion (using traditional cranial osteopathic terminology) to be anticipated if normal
- Other associations and influences
- Dysfunctional patterns and consequences
- Palpation and treatment exercises.

As indicated, a number of palpation and treatment exercises will be outlined as part of the discussion of each named bone. These derive from classic cranial osteopathic tradition as taught to the author by Denis Brookes DO between 1969 and 1978 (see Brookes 1981) as well as from methods subsequently acquired by the author in clinical practice.

Additionally some of the methods described are taken from the teachings of acknowledged cranial experts to whom credit is offered in the text. The information contained in this chapter therefore derives from a variety of sources (including *Gray's Anatomy 1995).*

In order to appreciate the many variables in approach which will be included in the palpation and treatment exercises, it is suggested that you make yourself familiar with the details and methods summarized in this chapter in Boxes 7.1, 7.2 and 7.3, as well as the exercises between Chapters 2 and 3 (pp 51-64) See also Figures 7.1 A-D.

In many of the following exercises the phrases 'wait for release' or 'when you sense a release' will be found. What do these words mean? See Box 7.1 for a discussion.

THE CRANIAL BONES

The bones discussed in detail in this chapter will include first the single, central, cranial bones followed by the paired bones (see also Box 6.1, p. 148).

- Occiput
- Sphenoid
- Ethmoid
- Vomer
- Mandible

Box 7.1 The meaning of 'release'

Holding tissues, sutures or joints in a position of relative comfort or ease or applying techniques such as fourth ventricular compression (see Exercise 7.5) leads to a normalization or 'release' of the dysfunctional pattern, either completely or partially. How is the practitioner/ therapist to recognize when this occurs? When has there been enough holding?

There are certain guidelines based on the clinical experience of many experts which can indicate a local tissue release.

- A sense of steady and strong pulsation or greater warmth enters the area.
- A very definite change (reduction) in palpated tone is noted.
- The tissues which are being held seem to 'lengthen' or 'free up'.
- On a wider, whole-body level such phenomena may also involve deeper emotional release, sometimes called 'emotional discharge'.

This may be accompanied by all or any of the following.

- The patient becomes flushed and a change in skin color is observed, from pale to ruddy perhaps.
- A light perspiration appears on the patient's upper lip or brow.
- The breathing pattern may alter. It may become slow and deep or in contrast may quicken and be accompanied by rapid eye movement and restlessness.
- Observation of the diaphragm region may indicate that such a change is imminent or current.
- Fasciculation may be observed – trembling and twitching intermittently or constantly.
- The patient may express a wish to vomit or cry or may simply begin crying or laughing.

How should such changes be handled? If a local release is noted, this can be held and gently released with nothing more done to the area at that session apart perhaps from some soothing massage strokes.

Alternatively, the holding pattern can continue at the new 'barrier' as the tissues are offered the opportunity to continue to release, perhaps in the form of an unwinding process. The skills appropriate for the application of such techniques need to be learned in suitably detailed instruction forums.

In regard to deeper emotional discharges, appropriate skills in counselling or psychotherapy are the ideal accompaniment to bodywork skills. If these are unavailable then a suitable referral should be made.

At the time of such emotional release the patient needs appropriate support – physical, verbal and emotional – so that whatever has provoked the release can be slowed down. Deep, slow anti-arousal breathing, incorporating a lengthy exhalation, should be encouraged.

For many patients the development of protective armoring offers a way of handling their emotional baggage. Because treatment of such hypertonic protection patterns may provoke discharge/release episodes, all bodywork practitioners and therapists need ideally to acquire appropriate psychological knowledge. They should learn skills which will allow them to manage the often complex return into consciousness of emotions which have been somatized, perhaps for decades, and which the patient may be quite unable to understand or handle.

Box 7.2 Cranial manipulation approaches

Direct techniques An attempt is made to reduce movement restrictions by moving a part of the structure in the direction of the barrier. In cranial work a 'leaning' against the restriction barrier, rather than any attempt to force motion through it, is utilized. This is clearly more appropriate in a region where motion is extremely small in range. Various 'assists' can be employed to encourage this process (see Box 7.3).

Direct methods are more commonly used in addressing the soft, pliable cranial tissues of infants and young people, rather than adult restrictions, although in some instances these are employed (see Exercises 7.4 and 7.15 as examples).

Indirect techniques These are the favored methods in adult cranial manipulation and can either involve an exaggeration of whatever distortion, pattern or restriction is present or, rather than trying to overcome a barrier, the soft tissues (reciprocal tension membranes, muscles, etc.) and bones are moved towards the direction of their greatest ease (called dynamic neutral) and held there until a spontaneous release occurs.

Commonly both methods will achieve the same position in which to hold the tissues. Various forms of assistance can encourage this process and these will be outlined in Box 7.3 (see also Ch. 10).

Separation or disengagement techniques A restricted articulation is gapped using mild force (ounces at most, grams usually) often with additional assistance as listed below (Box 7.3). The objective is restoration of free motion at the suture or articulation (commonly a pivot point).

Molding This approach applies to the treatment of tissues which are still soft and plastic, as in the infant skull. Distorted structures are held in a manner which molds their contours towards a more normal status, in either form or resiliency.

Box 7.3 Assisting or activating forces

Inherent motion As discussed in Chapter 1, there exist a number of rhythmic, pulsating forces which seem together to form a 'cranial pulse' (CRI). In craniosacral therapy this is used to assist the freeing of restricted sutures by what is called 'fluid direction' or V-spread. Other interpretations of what is achieved when this method is applied include the possibility that the reciprocal tension membranes are being offered a degree of 'ease', resulting in a beneficial therapeutic response.

Respiratory assistance There seems to be a strong influence on all cranial structures from respiratory function (see Ch. 1). By utilizing a forced inhalation (which encourages flexion/external rotation of the cranium) or exhalation (which encourages extension/internal rotation of the cranial bones) or by holding the breath in one or other phase of the cycle, specific effects can be achieved to activate or assist cranial manipulation. In some techniques a strong sucking action on a pacifier/dummy or thumb achieves a similar enhancement of the flexion phase of the cranial cycle.

Fascial influences The fascia of the body is continuous, which suggests that the reciprocal tension membranes can be influenced by introduction of fascial stretching or motion elsewhere in the body. Active or passive dorsiflexion of the feet or clenching of the fists during inhalation/flexion (external rotation) are examples of this. A long diagonal is commonly used so that, for example, left foot dorsiflexion is employed to assist right side cranial treatment.

Still point application Intrinsic cranial motions are stopped by gentle application of compressive or restrictive pressure, which induces a period of rest followed (usually) by a slower pulsating rhythmic rate, involving greater amplitude of motion. See details of 4-VC (Exercises 7.5a–d) as an example.

Sacral influence on cranium As indicated in Chapters 1 and 2, it is widely (but not universally) held that cranial and sacral motion are directly linked, possibly via the dural sheath, and that cranial treatment can therefore be assisted via the sacrum.

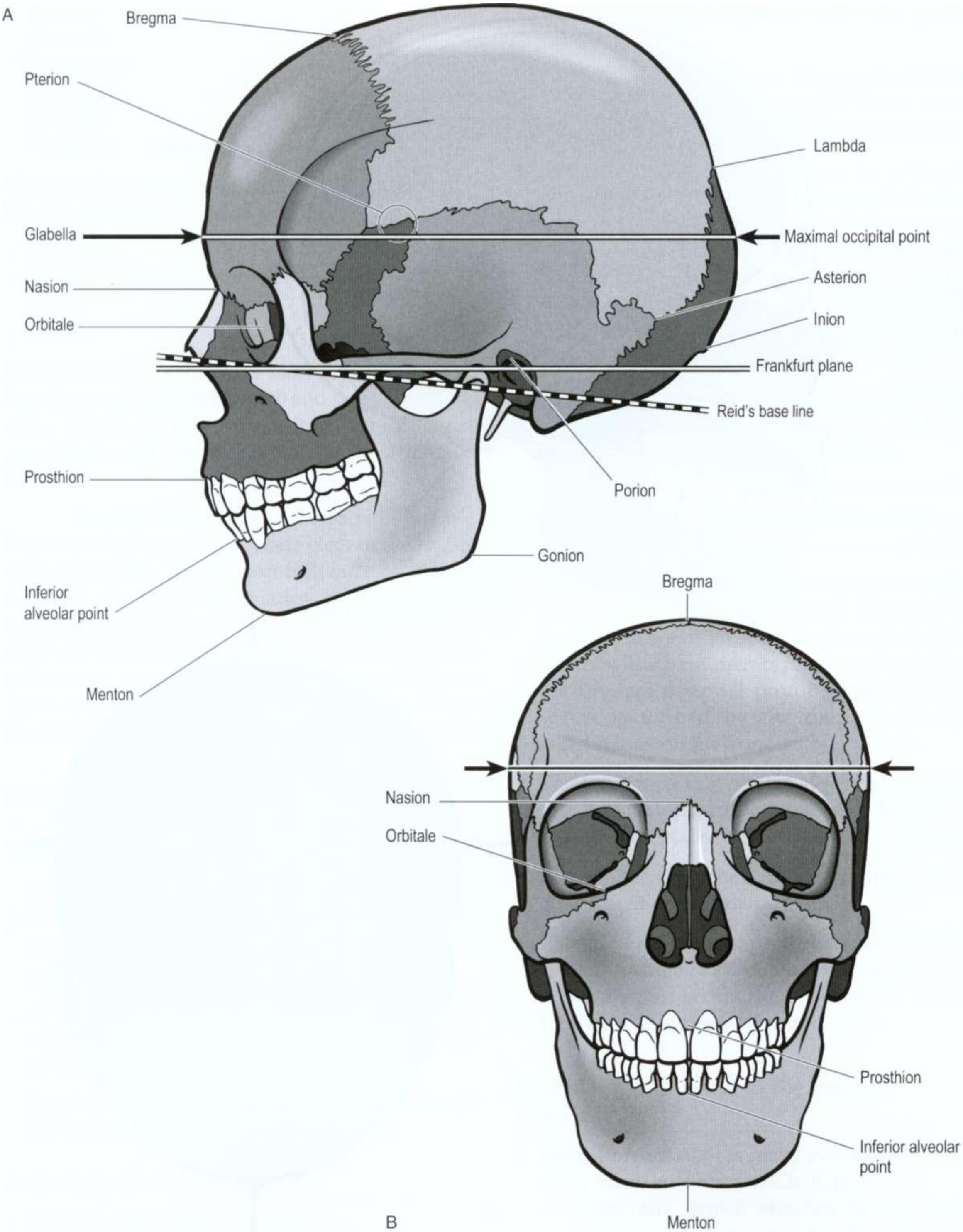


Figure 7.1 A-D Lateral (A), frontal (B), median section (C) and superior (vertical) (D) views of skull showing cranial points used in making linear and angular measurements in anthropometry. C and D overleaf.

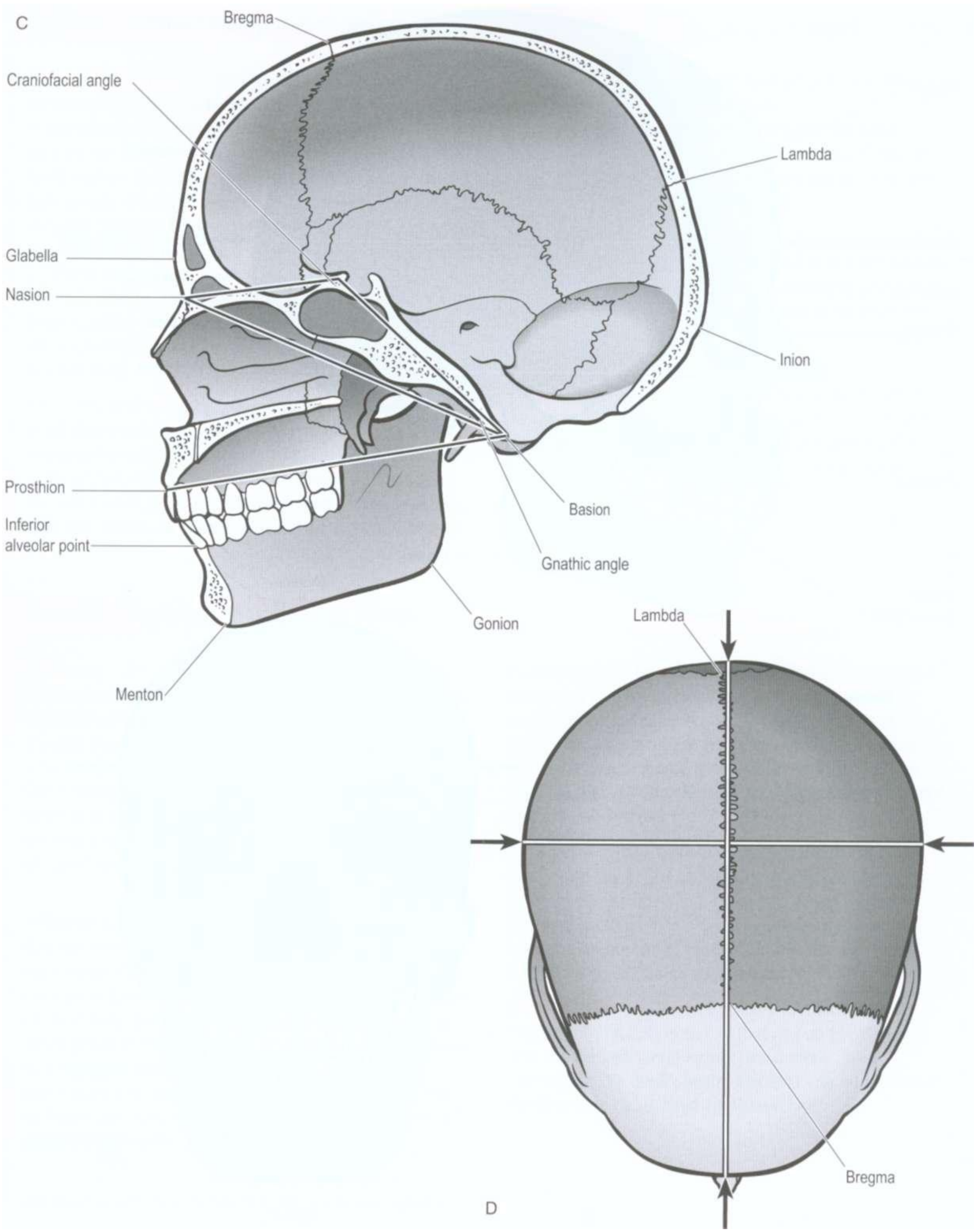

C
Bregma
Craniofacial angle
Lambda
Glabella
Nasion
Inion
Prosthion
Basion
Inferior
alveolar point
Gnathic angle
Gonion
Menton
Lambda
Bregma
D

Figure 7.1 C,D

- Frontal
- Parietals
- Temporals
- Zygomae
- Maxillae
- Palatines.

Mentioned in association with those listed above but not discussed in detail will be the following.

- Lacrimals
- Inferior conchae
- Nasal
- Sacral.

Refer to Box 6.1 (sutures, p. 148), Table 6.1 (cranial base distortion patterns, p. 150) and Box 6.3 (venous sinus details, p. 168) for additional information associated with the individual bones discussed below.

Note Detailed discussion of the sacrum has not been included for reasons made clear in the text of earlier chapters. The indirect influence on cranial function of sacral mechanics is not denied; however, to comprehensively evaluate and describe these as well as all the influences of muscular imbalances on the sacrum itself would have detracted from the intended focus on direct muscular and other influences on cranial function.

OCCIPITAL BONE

This comprises:

- Squama - the main body of the bone which forms the posterior border of the foramen magnum
- Basiocciput - which forms the anterior border of the foramen magnum and which possesses a rostrum joining it to the sphenoid at the synchondrosis
- Condyles - which form the lateral borders of the foramen magnum (see Fig. 7.2A,B).

Articulations with the occiput

- With the atlas at the condyles.
- With the sphenoid at the synchondrosis (this is potentially mobile up to age 25 or so).
- At the lambdoidal suture with the parietal bones.
- With the temporal bones. The jugular notch of the occiput and the jugular fossa of the temporal bone meet to form an articulation.
- Posterior to this notch there is a beveled articulation which is partially internally (anterior aspect of articulation) and partially externally (posterior aspect of articulation) beveled, with a point of transition known as the condylo-squamomastoid pivot which allows an easily achieved rocking potential in clinical evaluation and treatment.
- Anterior to the notch the basiocciput has a tongue-and-groove articulation with the petrous portion of the temporal bone.

Reciprocal tension membrane relationships with occiput

- Both the falx cerebri and tentorium cerebelli attach to the occiput. The inner surface of the bone carries evidence of the powerful attachments with these membranes, most notably at the internal occipital protuberance (episthion) which is formed by the drag of the dural attachments on the bone.
- The bifurcated falx cerebri attachment is above the internal protruberance and houses the superior sagittal sinus.
- Below the internal protruberance is the attachment of the falx cerebri.
- Lateral to the internal protruberance are double ridges formed by the bifurcated tentorium attachments, with the transverse sinuses located within the bifurcations.

Muscular attachments to the occiput (see Fig. 7.2B)

- **Occipitofrontalis** - is really two muscles which cross many sutures (see Ch. 9, p. 272):
  - **occipitalis,** which attaches to the occiput and temporal bones (via tendinous fibers to the mastoid), crossing the suture on the lateral aspects of the superior nuchal line

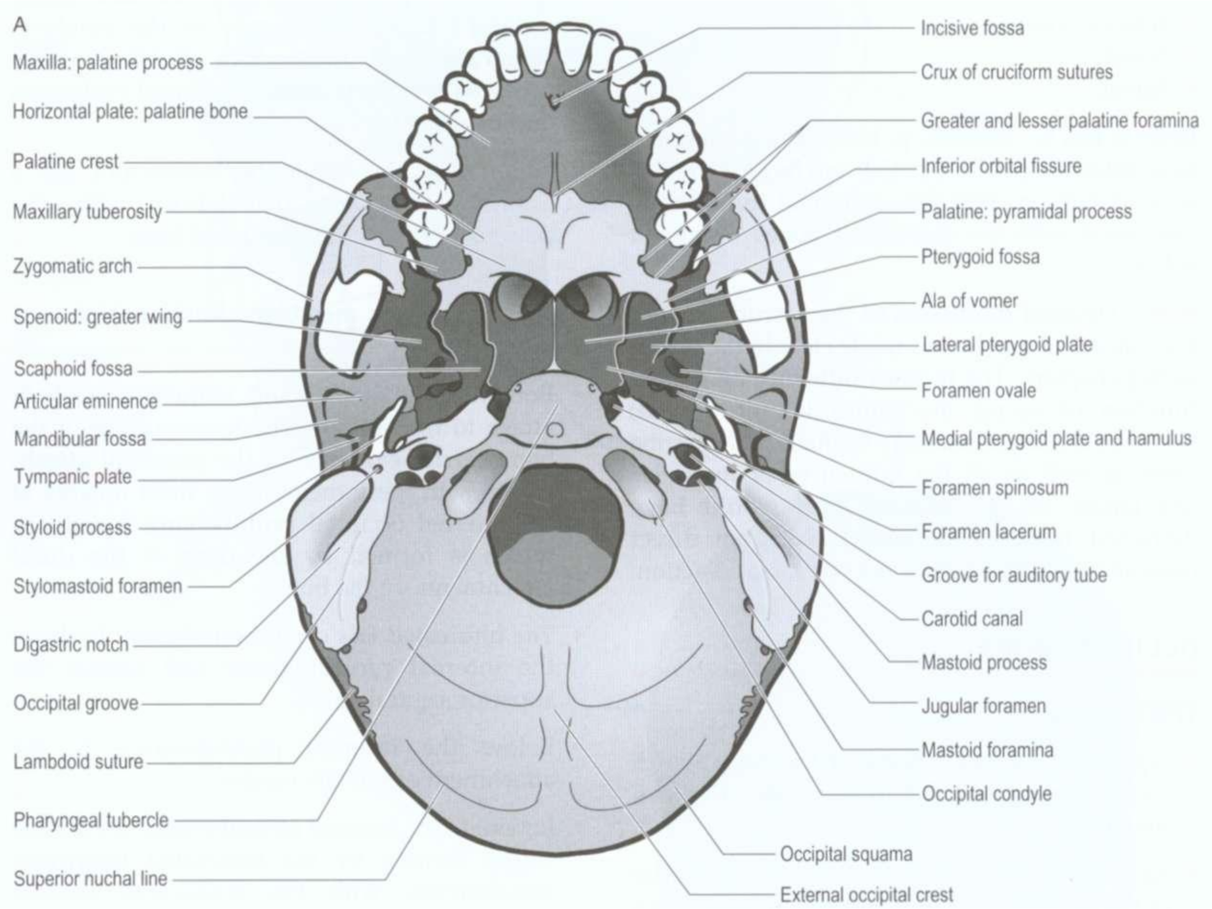


Figure 7.2 A Inferior view of skull without mandible showing major landmarks.

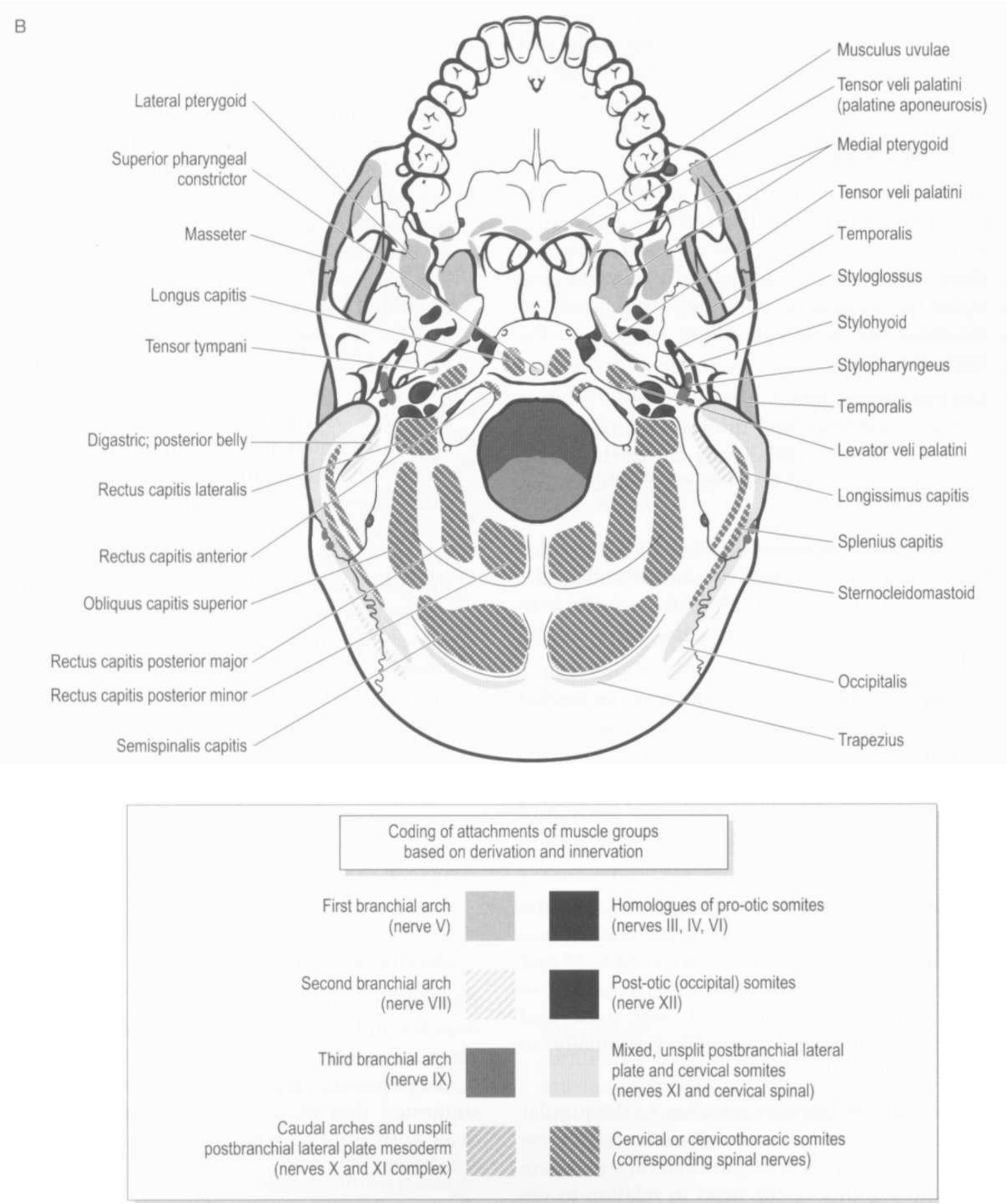


Figure 7.2 B Inferior view of skull without mandible showing muscular attachment sites.

- **frontalis,** which has no bony attachments but merges with the superficial fascia of the eyebrow area, with some fibers continuous with fibers of corrugator supercilii and orbicularis oculi attaching to the zygomatic process of the frontal bone and further linkage to the epicranial aponeurosis anterior to the coronal suture.

- **Trapezius** (upper) attaches to the superior nuchal line and external occipital protruberance as well as the ligamentum nuchae, acting via these insertions to unilaterally elevate and rotate the scapula or, with the scapula fixed, to sidebend the neck with slight rotation to the opposite side.
- **Longus capitis** attaches to the inferior surface of the basiocciput (and transverse processes of C3 to C6), acting to bilaterally flex the head and neck and unilaterally sidebend the head and neck.
- **Rectus capitis anterior** attaches to the inferior basiocciput anterior to the condyle and to the transverse process of CI (atlas), acting to bilaterally flex the head and unilaterally sidebend it.
- **Splenius capitis** attaches to the superior nuchal line and mastoid process, crossing the suture and the spinous processes of C7 to T3 and the lower part of the ligamentum nuchae, acting to bilaterally extend the head and neck and unilaterally sidebend and rotate the head and neck to the same side.
- **Semispinalis capitis** and **spinalis capitis** attach to the superior and inferior nuchal lines and the transverse processes of C7, Tl to T7 and the articular processes of C4 to C6, acting to bilaterally extend the head and neck and unilaterally sidebend and rotate (minimally) to the opposite side.
- **Rectus capitis lateralis** attaches to the jugular process of the occiput as well as the transverse process of the atlas, acting to bilaterally maintain postural stability of the head in relation to the neck and unilaterally to sidebend it.
- **Rectus capitis posterior major** is one of the suboccipital muscles which lie deep; it attaches to the lateral aspect of the inferior nuchal line as well as to the spinous process of the axis, acting to bilaterally extend the head and maintain postural integrity and unilaterally to rotate and slightly sidebend the head to the same side.
- **Rectus capitis posterior minor** is one of the suboccipital muscles which lie deep; it attaches to the medial aspect of the nuchal line and to the posterior arch of the atlas, possibly bilaterally extending the head and maintaining its postural integrity. This unusual muscle (an attachment of which has been only recently identified - see Ch. 9, p. 308) has been shown to attach to the posterior atlanto-occipital membrane via dense connective tissue and to be fused to the dura by numerous connective tissue elements. According to research these two structures function as a membranous unit - the 'posterior arch of the atlas membrane spinal dura complex'. Contraction of this revealed movement of and tension on the spinal dura which was transmitted to the cranial dura of the posterior cranial fossa. This shows a direct connection between suboccipital muscles and the spinal dura as well as the dura mater capable of influencing cerebrospinal fluid systems, which has major implications in cranial work (Hack et al 1995, McPartland et al 1997).
- **Obliquus capitis superior** is one of the suboccipital muscles which lie deep; it attaches between the inferior and superior nuchal lines as well as to the transverse process of the atlas, acting to bilaterally extend the head and to maintain postural integrity and unilaterally to slightly sidebend it.

Restrictions and hypertonicity in any of these muscles, uni- or bilaterally, will strongly influence occipital motion. Refer to Chapter 9 for methods of assessment, palpation and treatment. It is suggested that muscular dysfunction should be dealt with prior to addressing apparent occipital restrictions.

Range and direction of motion

In classic craniosacral theory, occipital motion during the flexion phase of the cranial cycle is described as 'swinging about its transverse axis. The basilar process moves anterior and superior; the foramen magnum moves anterior and slightly superior; the superior angle moves inferior and slightly posterior' (Brookes 1981).

The concept of any flexion potential at all at the adult occipitosphenoidal junction remains questionable, even without imagining an actual 'swing'. There is, however, an undoubted degree of pliability at the occiput's sutural junctions with the parietals and, as noted above, there exists a powerful pivot point between the occiput and the temporal bone which allows the temporals to 'externally rotate' when mobility is normal. This will be further described when temporal bone motions are outlined.

In palpating the occiput, the motion of this bone, easing anteriorly on inhalation and returning to its start position on exhalation, might be assumed to be largely driven by respiratory influences, although a definite sense of motion is commonly noted even during a held breath. Is this due to the influence of the reciprocal tension membrane responding to intrinsic brain, glial cell, CSF and other pulsations/motions? Or is it a more direct response to muscular or circulatory/fluid influences?

In palpating the bone it is suggested that the slight degree of available motion be felt for, with no preconceptions as to degree, rate or what may be driving it.

Other associations and influences

These include the following.

- The inion is a landmark on the external surface of the occiput formed by the attachment of the ligamentum nuchae.
- The hypoglossal nerve (12th cranial nerve) passes through condyles via the hypoglossal canal.
- The jugular foramen, which has both an occipital and a temporal border, allows passage of the ninth (glossopharyngeal), 10th (vagal) and 11th (spinal accessory) cranial nerves as well as the posterior meningeal artery, the sigmoid sinus and petrosal sinus.

Dysfunctional patterns

- Any injury affecting the atlanto-occipital joint is likely to negatively influence occipital motion. (See also notes on muscular influences on the occiput in Ch. 9.)
- Blows to the occiput from behind can cause a crowding or distortion pattern of the occipital base with the sphenoid, prior to ossification. A number of palpation exercises which can assist in identifying such patterns are described below. These palpation exercises may be more usefully performed once details of the sphenoid bone's characteristics (p. 192) have been reviewed.
- Observation (see also Table 6.1) offers a means of identifying possible distortions at the sphenobasilar junction.
- Any injuries or strains affecting the temporal or parietal bones will influence the occiput. Sutural restrictions relating to parietal or temporal articulations may evolve and palpation exercises to assess motion will be described when these bones are individually discussed later in this chapter. See also the exercises in Chapters 2 and 3.
- Muscular dysfunction in the suboccipital region can directly influence dural status and thereby cerebrospinal fluid fluctuations (see notes on rectus capitis posterior minor above, p. 186 and in Ch. 9, p. 308).
- Internal drainage of the cranium can be directly influenced by changes affecting the reciprocal tension membranes which attach to the occiput and which house both the superior sagittal and the lateral sinuses.

Palpation and treatment exercises for the occiput

Exercise 7.1 Basic sutural palpation

Go back to the exercises between Chapters 2 and 3 and repeat Exercise 6 (Exercise Figures 1A-E) (pp 53-57).

Exercise 7.2 Additional sutural palpation

Repeat Exercises 7a-e (Exercise Figures 2A-F) from the exercises between Chapters 2 and 3 (pp 57-60).

Exercise 7.3 Cranial base release

Time suggested 5-7 minutes

This technique (see Fig. 7.3) releases the soft tissues where they attach to the cranial base and which, if hypertonic, may restrict occipital motion as well as that of the temporal bones.

The patient is supine and the operator should be seated at the head of the table with arms resting on and supported by the table.

The dorsum of the operator's hand rests on the table with fingertips pointing towards the ceiling, acting as a fulcrum on which the patient rests the occiput so that the back of the skull is resting on the palm. The fingertips touch the occiput and the patient allows the head to lie heavily so that the pressure induces tissue release against the fingertips.

As relaxation proceeds and the fingerpads sink deeper into the tissues, the arch of the atlas may be palpated and it may be encouraged to disengage from the occiput by application of mild traction cephalad (applied by the middle fingers). This would probably not be for some minutes after commencement of the exercise.

The effect is to relax the attachments in the area being treated with benefit to the whole muscle. This 'release' of deep structures of the upper neck enhances drainage from the head and circulation to it, reducing intercranial congestion.

Figure 7.3 Hand positions for cranial base release.

Exercise 7.4 Occipital condyle decompression

Time suggested 5-7 minutes

The objective of the decompression technique is to separate the occiput from the articular surfaces of the atlas, if they are not freely able to do so.

Upledger & Vredevoogd (1983) report that condylar compression may accompany cranial base and/or lumbosacral compression and may be related to hyperkinesis in children and headache in adults. The method for achieving decompression is identical with the method for assessing whether or not it is necessary to do so - in other words, assessment and treatment are the same.

Exercise continues

Exercise 7.4 Occipital condyle decompression—*continued*

The cranial base release (Exercise 7.3 above) should be performed first and any muscular influences which might be impeding free motion should be dealt with using appropriate soft tissue methods (as outlined in Ch. 9).

The patient is supine and you sit at the head of the table with your arms supported on the table and placed so that the elbows are a little apart. The patient's head rests on your palms.

The middle (and perhaps index) fingerpads are placed close to the midline and as near the foramen magnum as can comfortably be achieved, without force.

The distal interphalangeal joints of the middle fingers are flexed so that the tips apply a gentle sustained pressure to the occiput which is directed posteriorly and cephalad (Fig. 7.4).

If the occiput is normal you will sense the occiput being able to move freely. If it is restricted, there will be a resistance to the gentle traction applied by the fingerpads to the occipital base, in which case this traction should be sustained as described until a sense of free motion is achieved. (Upledger & Vredevoogd call it a 'glide'.)

At this time your elbows are slowly brought towards each other, the hands pivoting on the hypothenar eminences, so introducing both supination of your hands and a simultaneous separation force at the contact fingers, creating a posterolateral traction on the occiput from these fingers.

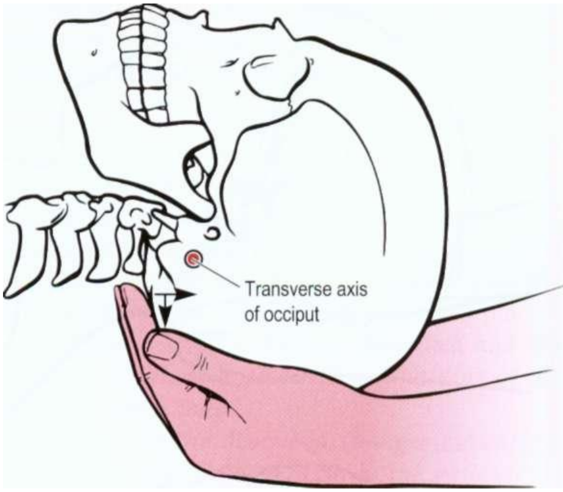


Figure 7.4 Hand and finger placement for occipital condyle decompression.

The forces being applied should be minimal and sustained until a sense of 'softening' or warmth is noted, ideally on each side of the foramen magnum.

Were you able to achieve these contacts?

Was the occiput free or restricted in relation to the atlas?

Did you sense the softening as you stayed in contact and waited?

Exercises 7.5a–d Fourth ventricular compression (4-VC) variations

Time suggested 5-7 minutes each

This is a profoundly relaxing method which, it is claimed, enhances cranial rhythmic function and is believed to improve lymphatic flow throughout the body (Greenman 1989, Upledger & Vredevoogd 1983).

According to Greenman (1989): 'This ... seems to enhance the movement of fluid, changes the rhythm of the diaphragms and increases the temperature in the suboccipital region'.

Ettlinger & Gintis (1991) state:

> *This is one of the most useful of all cranial techniques ... it has been used successfully to relieve headaches, reduce fever, assist in difficult labour, relieve congested sinuses and lungs and reduce edema. It can also be used to reduce [the effects of] trauma, such as whiplash injury.*

Upledger & Vredevoogd (1983) believe:

> *CV-4 affects diaphragm activity and autonomic control of respiration and seems to relax the sympathetic nervous system tonus to a significant degree.... Autonomic functional improvement is*

Exercise continues

Exercises 7.5a–d Fourth ventricular compression (4-VC) variations—*continued*

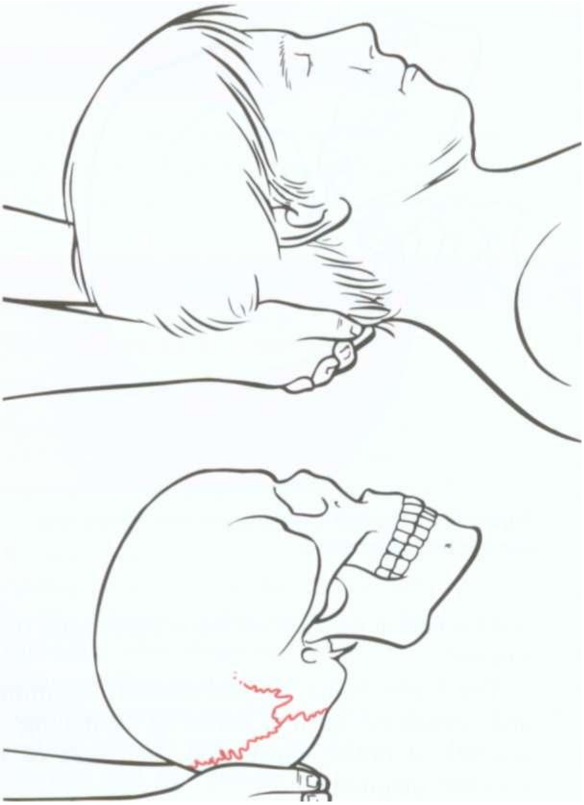


Figure 7.5 Hand positions for fourth ventricular compression (4-VC). Note that contacts are away from sutures.

always expected *as a result of still point induction.*

Exercise 7.5a The patient is supine. You sit at the head of the table, arms resting on it, fingers interlocked to form a bowl into which the patient lays his head so that the thenar eminences are lateral to the external occipital protuberances but medial to the lateral angles of the occipital squama. This positioning of the hands is important to the success of the method (Fig. 7.5).

Sit for a while and wait until you have 'tuned in' to the patient's cranial motion rhythm.

During the extension phase (i.e. internal rotation or exhalation phase), as the head appears to narrow, begin to apply *very slight* but persistent pressure medially, so exaggerating the normal cranial motion of that phase. *This pressure should not be generated by hand action but by contraction of the deep flexor muscles of the forearm.*

Upledger & Vredevoogd (1983) say: 'As the subject's occiput attempts to widen during the flexion phase ... you resist this widening. *Your hands become immovable. You do not squeeze'.*

The slight compressive pressure is maintained, gently retarding or resisting the flexion phase of the cycle, until eventually the cranial rhythm appears to stop.

This might be accompanied by the patient sweating, sighing or noticeably altering his breathing pattern and you will note a sensation of warmth and softening under your hands. This is what is known as a still point.

Greenman describes it more simply: 'One holds this [still point] for approximately five cycles and waits for the fluctuations to return and push the hands away'. Or, in the words of Upledger & Vredevoogd: 'When you feel a concerted strong motion bilaterally, stop your resistance. Follow this broadening and evaluate for amplitude and symmetry of craniosacral motion'.

A slow release of the compressive force is then allowed.

Exercise 7.5b Exactly the same contacts are made but this time, instead of maintaining the exhalation (extension, etc.) phase, it is released as the patient goes into the inhalation (flexion, etc.) phase, with a repetition of the holding/ exaggeration each time the extension phase occurs (using deep flexor muscle contraction and not 'squeezing' with the hands).

This repetitive action continues until a 'warmth' sensation, as described above, occurs. (This could take up to 10 minutes but is more usual within 3 minutes or so.)

Exercise 7.5c An alternative to the hand position described in Exercise 7.5a is to cup one

Exercises 7.5a–d Fourth ventricular compression (4-VC) variations—*continued*

hand in the other so that the thumbs make a 'V and, with the apex of this 'V resting at the level of the second and third cervical vertebrae, allow the base of the skull to rest so that the thenar eminences are on the occipital squama, medial to and avoiding the sutures.

Pressure is exerted medially to coincide with the exhalation/extension phase and this pressure is maintained in an unyielding manner as subsequent phases of the cycle repeat themselves.

No squeezing is applied, merely a fixed holding of the mechanism to prevent easy motion.

Cranial rhythms eventually cease for a time. This is the 'still point' which should be allowed to continue for minutes until you release it when the feelings of warmth develop or obvious changes occur in the patient's breathing or sweating, as described above.

The still point can be induced in any cranial structure by holding it in its exhalation phase until rhythmical activity ceases for a time.

Exercise 7.5d Brookes (1981) enhances the induction of the process by having the patient inhale and exhale deeply several times, holding the exhalation as long as possible, as the process described in Exercise 7.5a is introduced.

This breathing assistance continues until the still point 'release' described above takes place.

Did you sense the rhythms described and the cessation of these with sustained holding of the occiput in this way?

Did any of the described changes (sweating, respiratory rate change) occur in the patient?

Did you feel the attempt of the cranial mechanism to start again, after the still point?

What do you feel was happening throughout this procedure?

Exercise 7.6 Learning to use the V-spread

Time suggested 5-7 minutes

A V-spread can be employed directly across the cranium to encourage release of any restricted suture.

Two fingers offer a V-shaped contact astride or lying on each side of any restricted suture, while a single- or two-finger pressure (grams only) is directed towards it from the furthest diagonal on the cranium, until a sense of warmth, a strong pulsation or softening is noted.

One recommended sequence is as follows.

- Place a single fingerpad onto the restricted suture, pointing across the head at its greatest diameter from that point.
- Place one or two fingers of the other hand to palpate the tissue overlying the area being pointed to by the first finger (Fig. 7.6A,B).
- When a pulsation is noted at this place, a finger of the palpating hand is placed at the very center of the pulsation, pointing back towards the suture in question.
- The one-finger contact at the suture should now be changed to a two-finger V-spread, with either the two fingers laid on either side of the suture or two fingerpads placed across it with a light separation force.
- When warmth, strong pulsation or softening is noted by these two fingers, the treatment is complete.

It is hypothesized that the compressive force, albeit very light, induces some degree of slack on the internally attached fascial reciprocal tension membranes, allowing positional release mechanisms to operate. (See Ch. 10 and Appendix 1 for discussion of positional release.)

The example illustrated (Fig. 7.6) shows a V-spread applied to the coronal suture. However, precisely the same method would be used on an occipitally related suture (such as the lambda, the suture between the parietal and occipital bones or to release aspects of the sagittal suture - see Exercise 7.27) and it is suggested that, following location via palpation

Exercise continues

Exercise 7.6 Learning to use the V-spread—*continued*

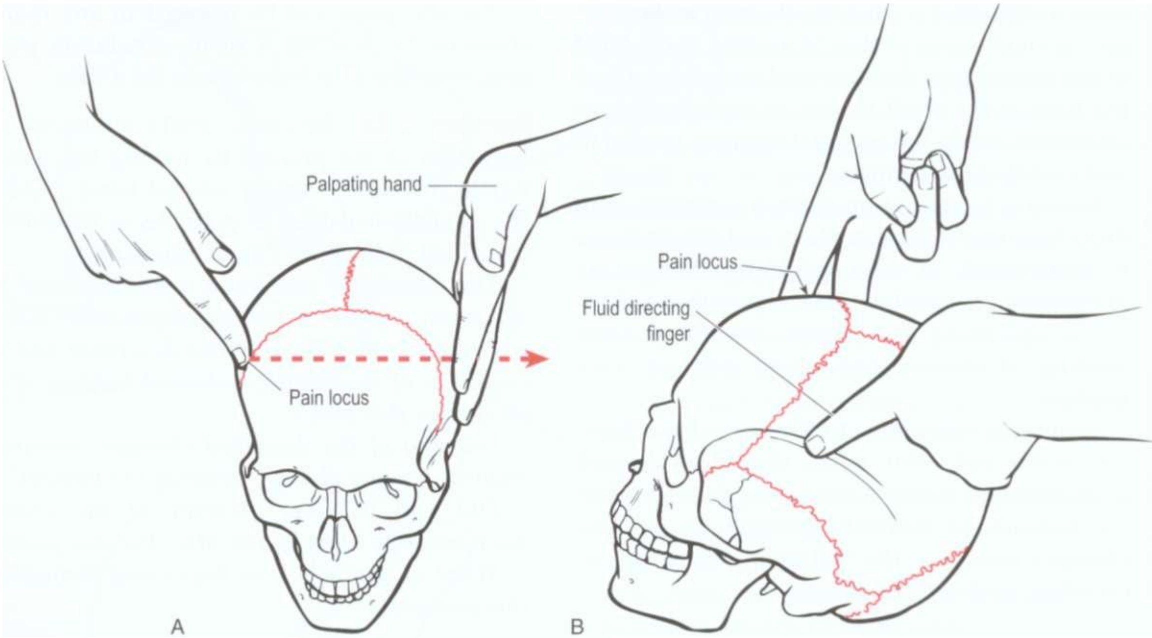


Figure 7.6 A,B Sutural release utilizing V-spread. Anterior view of first stage where single finger contact is placed over restricted or painful suture (A) and superior view (B) of second stage where a two-finger 'spread' is placed over this point as 'fluid'/pressure is directed/applied towards this.

of an area of sensitivity or restriction on the lambda, a V-spread release is performed as an exercise.

Note The discussion and exercises relating to the maxillae in the exercise section between chapters 2 and 3 (pp 59,60) (p. 234) will highlight the potential for using intraoral contacts on the crown surfaces of the posterior molars to mobilize numerous sutures directly and indirectly connected with the maxillae, including the lambdoidal sutures.

SPHENOID

This comprises:

- The body, sited at the center of the cranium - a hollow structure enclosing an air sinus (see Fig. 7.7A,B)
- Two great wings, the lateral surfaces of which form the only aspect palpable from outside the head, the temples and the anterior surfaces of which form part of the eye socket
- Two lesser wings, the anterior surfaces of which form part of the eye socket

Two pterygoid processes which hang down from the great wings and which are palpable intraorally posteromedial to the eighth upper tooth

The pterygoid plates which form part of the pterygoid processes and are important muscular attachment sites

The sella turcica ('Turkish saddle') which houses the pituitary gland

The sphenobasilar junction with the occiput, a synchondrosis which fuses in adult life.

Articulations

- With the occiput at the synchondrosis.
- With the temporal bones at the petrous portion and posterolaterally with the squama.
- With the parietal bones at the pterion.
- Anteriorly with the ethmoid.
- Inferiorly with the palatine bones.
- Anteriorly both greater and lesser wings articulate with the frontal bone bilaterally.
- Inferiorly with the vomer.
- Anterolaterally with the zygomae.

Reciprocal tension membrane relationships with sphenoid

Both the falx cerebri and the tentorium cerebelli attach to the sphenoid.

Muscular attachments

- The **temporalis** muscle attaches to the great wing and the frontal, parietal and temporal bones, crossing important sutures such as the coronal, squamous and the frontosphenoidal. Specifically, the attachments of temporalis are to the temporal bone, zygomatic arch, mandible and the lateral and medial pterygoid plates of the sphenoid.
- Attaching to the internal pterygoid plate is the **buccinator** as well as a number of small, palate-related muscles.
- **Medial pterygoid** attaches to the lateral pterygoid plate and palatine bones running to the medial ramus and angle of the mandible.
- **Lateral pterygoid** attaches to the great wing of the sphenoid, the lateral pterygoid plate and the anterior neck of the mandible.
- Various extremely small muscles relating to movement of the eye, as well as **levator palpebrae** which helps raise the eyebrows, attach to that part of the great wings of the sphenoid which form part of the eye socket.

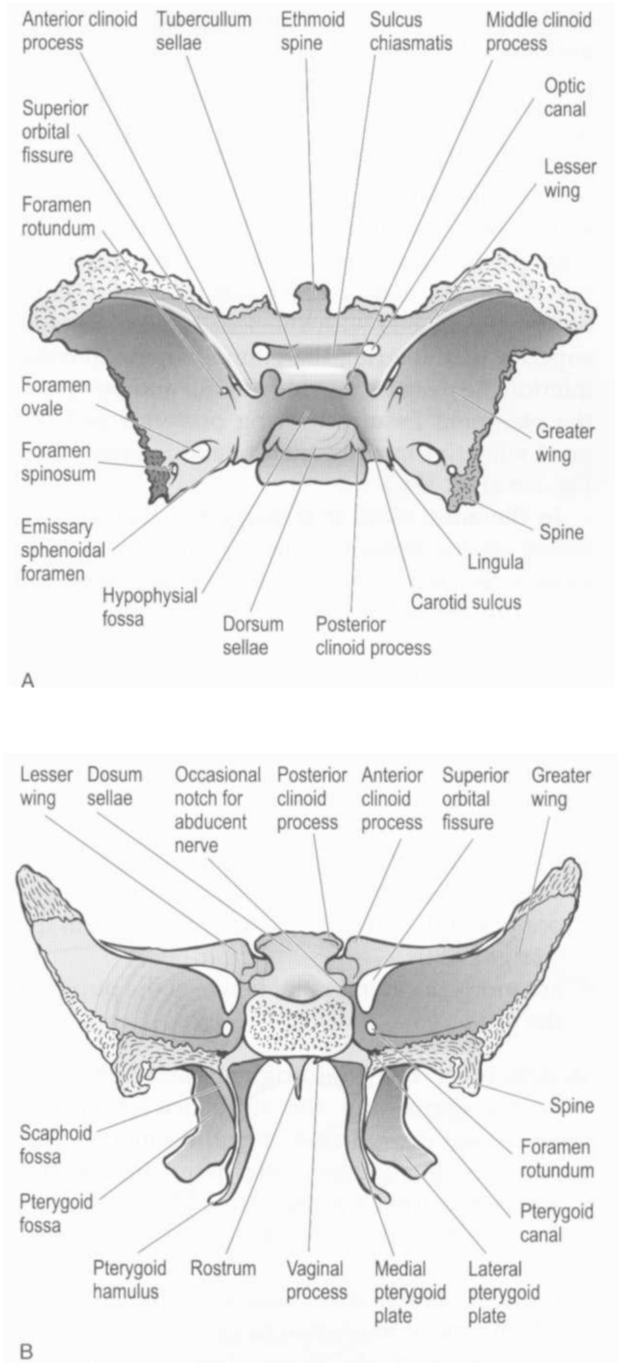


Figure 7.7 Superior (A) and posterior (B) aspects of the sphenoid bone and its major features.

Range and direction of motion to be anticipated if normal

It is in discussion of sphenoid motion that the debate as to cranial motion intensifies. In traditional osteopathic thinking the sphenoid rotates anteriorly on flexion and returns to a neutral position during the extension phase of the cranial respiratory cycle. Brookes (1981) describes movement as follows: 'The sphenoid rotates about its transverse axis with the sella turcica moving superior and anterior, the ethmoid spine moving inferior, the rostrum moving inferior and posterior, the pterygoid fissures moving posterior and the great wing tips moving anterior and inferior'. (See Fig. 6.9 on p. 156.)

In the adult skull it is suggested that, due to fusion of the sphenobasilar synchondrosis, this motion is impossible; it nevertheless remains central to the belief system of most craniosacral therapists.

The axis of rotation through the center of the sphenoid body, known as Sutherland's fulcrum, runs along the straight sinus where the tentorium cerebelli and falx cerebri meet. The landmarks which characterize this are:

- posteriorly: the internal occipital protuberance which is formed by the drag on the internal occiput of the dura, the folds of which form the straight sinus
- anteriorly: a central point between the pupils of the eyes.

Models other than the original osteopathic one exist for explaining the influence of cranial function and dysfunction, including models that hypothesize that cranial bones move in response to forces imparted by circulatory fluctuations as well as the rhythmic pulls imparted by the spinal dura and a variety of muscular influences.

In the 'liquid-electric' model the cranial bones 'float' and move in relation to a central focal point at the center of the brain. There are, in this concept, no fixed axes or pivot points, with all movement responding to tissue changes elsewhere. Milne (1995) explains: 'Neurocranial bones float, as if they had neutral buoyancy and were suspended in water and are pushed or pulled by tidal electrical, muscular and osseous forces'.

The model, for all its need to take leaps of faith as to what is happening, envisions a mechanism which is open to multiple forces and avoids the physiological denial inherent in the 'bending joint' of the classic osteopathic model (refer back also to Box 1.2, p. 7, which outlines some of the key models of cranial theory).

The sometimes confusing concepts as to what is being palpated need to be kept in mind when particular palpation and treatment exercises are practiced, since they relate inevitably to the belief systems which they reflect.

Other associations and influences

These include the following.

- The first six cranial nerves have direct associations with the sphenoid. The second (optic), third (part of oculomotor), fourth (trochlear), fifth (nasociliary, frontal, lacrimal, mandibular and maxillary branches of trigeminus) and sixth (abducens) cranial nerves all pass through the bone into the eye socket (the first, the olfactory nerve, runs superior to the lesser wings).
- The sphenoid has direct articulations with almost all other cranial structures as well as the major reciprocal tension membranes and half the cranial nerves, indicating its importance in terms of potential influence on function and, via dysfunction, on the region and throughout the body.
- The intimate relationship with the pituitary gland suggests that endocrine function might be influenced via any dysfunction of the sphenoid which creates circulatory or other stresses on the gland.
- The muscular links with the mandible create a connection between temporomandibular dysfunction and sphenoidal dysfunction, with influences being possible from either direction.

Dysfunctional patterns

- Symptoms of sphenoid dysfunction can be local or bodywide, ranging from headaches to emotional disturbances.

- Observation (see also Table 6.1) offers a means of identifying possible distortions at the sphenobasilar junction.
- Because of the intimate linkage with neural structures, sphenoid dysfunction can be directly associated with optical, trigeminal and acoustic disturbances.
- Because of its proximity to the pituitary gland, endocrine disturbances may be an outcome of sphenoidal dysfunction.
- According to the structural/mechanical model, a range of possible 'lesion' patterns may exist between the sphenoid and any of its articulating neighbors, deriving from trauma (possibly including forceps delivery or stressful birth trauma), which can be evaluated and treated by a process of testing (see palpation exercises below).
- If the 'energetic' or 'fluid' model is accepted, a different, more intuitive, unstructured approach to palpation is suggested, as discussed in the exercises section below.

Palpation and treatment exercises for the sphenoid

Exercise 7.7a General sphenoidal release (including 'sphenoid lift')

Time suggested 7-10 minutes

The mechanical/structural model of cranial therapy states that six possible dysfunction patterns can exist at the sphenobasilar junction. These should be tested and treated while the occiput and sphenoid are lightly palpated.

The patient's head is cradled in the hands so that the fingers enfold the occiput and the thumbs rest lightly on the great wings of the sphenoid (see Fig. 7.8).

By lightly (ounces at most) drawing the thumbs towards the hands, the sphenoid is 'crowded' towards the occiput. This crowding is held for several seconds, at which time the thumbs alter their direction of activity and are lightly drawn directly towards the ceiling, so (theoretically) decompressing the sphenobasilar junction and applying traction to the tentorium cerebelli as the weight of the cranium drags onto your palms and fingers. This is the 'sphenoid lift' technique which represents a treatment in its own right, as do the various assessment methods listed below.

Figure 7.8 Palpation and treatment contact for great wing of sphenoid.

Exercise 7.7b Testing for directions of ease between sphenoid and occiput

Time suggested 4-5 minutes

Using the fronto-occipital hold illustrated in Chapter 6 (see Fig. 6.14, p. 164), very lightly assess the ease of movement of the individual great wings, as you encourage movement of the sphenoid on the occiput to:

- flexion and then extension: evaluate whether movement into extension is easier than into flexion or vice versa
- sidebending one way and then the other: evaluate whether sideflexion of the sphenoid is easier to one side than the other
- torsional movement one way and then the other: consider whether one great wing moves more easily cephalad than the other
- translation by introducing a 'shift' of the sphenoid superiorly and then inferiorly on the occiput, to evaluate greater resistance to superiorly or inferiorly directed translation
- translation by introducing a 'shift' of the sphenoid on the occiput laterally one way and then the other, to evaluate greater resistance to translation to the right or left
- compression of the sphenoid towards the occiput and distraction from it (dysfunction is indicated by greater resistance as one or other movement is attempted).

In each test you are asking the question, 'Do you want to go this way?' and as you ask it, you compare the movement with the precisely opposite movement.

If there is an obvious sense of ease in one direction and bind in the other, you have identified a 'lesion' or dysfunctional pattern. (Note that the degree of movement perceived in any direction during these evaluations is not the main feature; rather, it is the ease with which movement towards any given direction is sensed that indicates dysfunction, when compared with the resistance noted in the opposite direction.)

To correct a restriction, you can guide the tissues towards the ease position/direction and hold this until you sense the tissues wishing to move, of a pull or push against your hands. Follow this tendency and allow the movement to progress under its own direction as you support the tissues without actively guiding them.

Note As a general rule, try to avoid moving tissues towards the directions of bind or resistance in an adult skull. Rather, attempt to move towards the direction of ease. See Chapter 10 and Appendix 1 for discussion of positional release concepts.

If movement ('unwinding') commences and then ceases, lighten your contact and allow the tissues to remain dormant during what is considered to be a 'still point'. After a while a sense of movement will recommence and this should be supported and followed.

Reassess the various movement potentials as described above.

Author's comment As I have stated that torsional, flexion or sidebending strains at the sphenobasilar synchondrosis are most unlikely, the reader is justified in questioning the need for assessments, such as those described above.

One argument for such evaluation is that the orthopedic-structural-mechanical model, in which actual osseous restriction is at the heart of the problem, may not be the mechanism involved and some other mechanism entirely may be operating, perhaps associated with the fluid/electric or the energy models outlined in Box 1.2 and elaborated on in the discussion of Fritz Smith's work in Chapter 6.

Another argument is that dysfunctional patterns of distortion may have become locked into the junction between the sphenoid and the occiput during the period of relative pliability of the structure (perhaps since birth) and that the palpation exercise described above can evaluate this and the soft tissue stresses which flow from it. This possibility is reinforced by research evidence such as that offered by Biedermann (2001) who describes a major source of cranial distortion in what he terms 'KISS' children (an acronym for kinematic imbalances due to suboccipital strain). Among the many symptoms reported by Biedermann in KISS children are torticollis, reduced range of motion of the head/neck, cervical hypersensitivity, opisthotonos, restlessness, inability to control head movement and one upper limb underused (based on statistical records of 263 babies treated in one calendar year up to June 1995). Biedermann believes that infant sleeping position can be a major etiological feature in development of such distortions.

Miller & Clarren (2001) on the other hand suggest that deformational plagiocephaly (cranial distortion or 'crooked head shape') can result from different etiologic processes, including:

- abnormalities in brain shape and subsequent aberrant directions in brain growth
- premature fusion of a single coronal or lambdoidal suture
- prenatal or postnatal pressures or constraints.

For further discussion of this see Appendix 2.

Another possibility is that the whole exercise of palpation of the cranial base relates to soft tissue evaluation (reciprocal tension membranes, dural folds, etc.) and not to the osseous junction at all, so that the assessment of torsions and stresses in these structures is erroneously being interpreted as an osseous dysfunction.

The final argument for use of such evaluation is that it has proven extremely valuable clinically to tens of thousands of practitioners and therapists for the best part of a century and not knowing how or why it 'works' is insufficient reason for avoiding a method which is safe and effective. The precise explanation for the mechanisms involved has therefore to await further research and knowledge.

Exercise 7.8 Coronal shear method for sphenoid mobilization

Time suggested 5-7 minutes

The patient is supine and you sit to one side facing the head. In this description it is assumed that you are seated to the right of the head and facing it.

Your left hand holds the occiput on the palm so that your forearm, resting on the table, is lined up with the spinal column.

Your right hand spans the frontal bone and holds the great wings of the sphenoid, between thumb and index finger.

An option is to insert the small finger into the mouth so that it rests cephalad to the buccal surface of the alveolar ridge of the maxilla, on the left (see Fig. 7.9).

With this hold it is possible to initiate assessment efforts in which various directions of motion of the sphenoid can be introduced, testing for freedom of motion, particularly shear assessments (translations), as well as sidebending and torsions.

The added advantage of the intraoral contact is that very precise directions of motion can be introduced towards the side on which you are seated.

Compare this approach to evaluation with that employed in the previous and subsequent exercises.

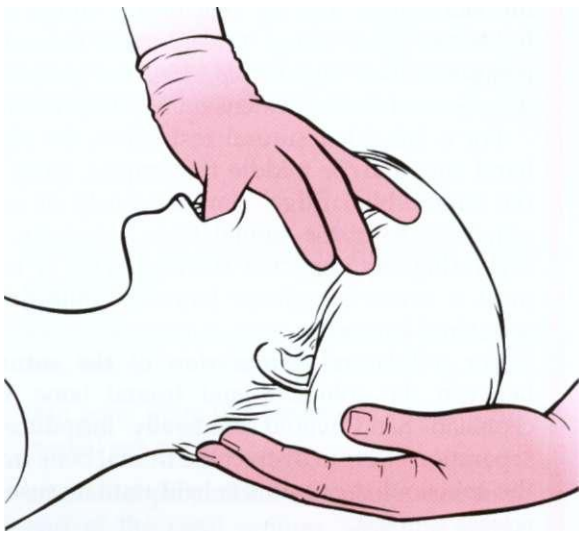


Figure 7.9 Hand and (gloved) finger placement for coronal shear assessment.

Exercise 7.9a,b Cant hook release methods for the sphenoid

Time suggested 5-7 minutes each

To assess and potentially modify restrictions existing between the frontal, zygomatic, mandible or maxillary and sphenoid bones, the following methods are suggested. They all employ a leverage approach known as the 'cant hook'.

Exercise 7.9a Sphenoid - frontal restrictions, especially if traumatically induced You should be seated facing the side of the supine patient's head opposite that to be treated. For a left-sided articulation restriction of the greater or lesser wing at the sphenofrontal suture, you would be seated on the right.

Place your right thumb (caudad hand) on the great wing closest to you and your caudad ring and middle fingertips on the great wing on the opposite side (see Fig. 7.10).

Your cephalad index finger rests on the left side frontal bone close to the supraorbital ridge.

It is possible to gently separate the compressed sutural borders by using the caudad hand contacts to ease the sphenoid towards its extension position.

The thumb and index finger of the right hand move in an anticlockwise direction, applying light pressure which takes the available slack out of the skin/fascia and by this means drags and holds the great wings toward their extension positions. (See Fig. 6.9, p. 156, for proposed directions of flexion/extension of the sphenoid.)

For a left-sided sutural restriction, the right hand ring and/or middle fingertip(s), lying on the supraorbital ridge, simultaneously or subsequently lever the frontal bone anteriorly, so separating the impacted surfaces. This is held until a sense of release (warmth/pulsation/softening) is noted.

For a bilateral compaction of the sutures between the sphenoid and frontal bone, the cephalad hand would bilaterally introduce a separation effort to distract the frontal bone from the sphenoid. Again this is held until a sense of release is noted.

An alternative to these direct approaches would be to introduce an indirect approach

Figure 7.10 Hand and thumb placements for cant hook technique application.

where the already crowded sutural compression at the site of restriction is accentuated and held until a sense of release is noted (see Ch. 10 for details of positional release methodology).

Exercise 7.9b Sphenoid and zygomae, mandibular or maxillae restrictions Standing or sitting on the side opposite that being treated, contact the great wings with the thumb and index/middle fingertips of your cephalad hand (see Fig. 7.11). With the caudad hand make a contact on the appropriate other bone (zygomae, mandible or maxillae).

The thumbs act to secure a stable leverage point via which the restricted bone can be separated (using grams of force only) from the sphenoid and gently held in a distracted state until a sense of release is noted.

These processes are helped if the contact thumbs and fingers act as stable points which are moved by means of alterations in wrist flexion and extension, rather than attempting to utilize finger or hand actions to initiate motion.

An alternative is to add to the crowding/approximation at the suspected dysfunctional suture and to hold this until a sense of release is noted.

Exercise 7.9a,b Cant hook release methods for the sphenoid—*continued*

Using these gentle methods, attempt to evaluate freedom of movement at the sutures between the bones approximating the great and lesser wings of the sphenoid.

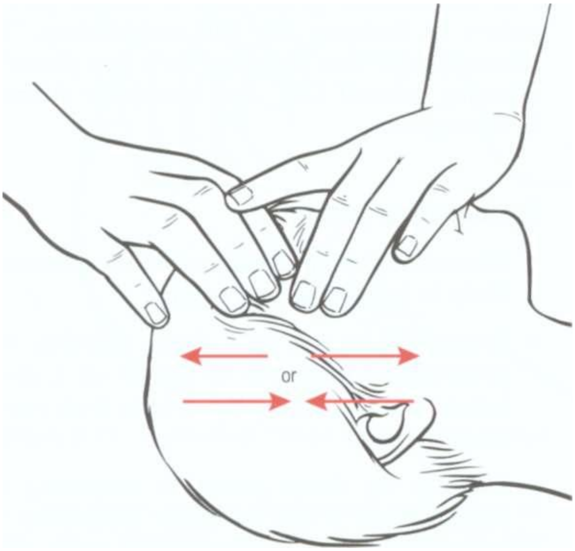


Figure 7.11 Hand and finger placements for cant hook technique application.

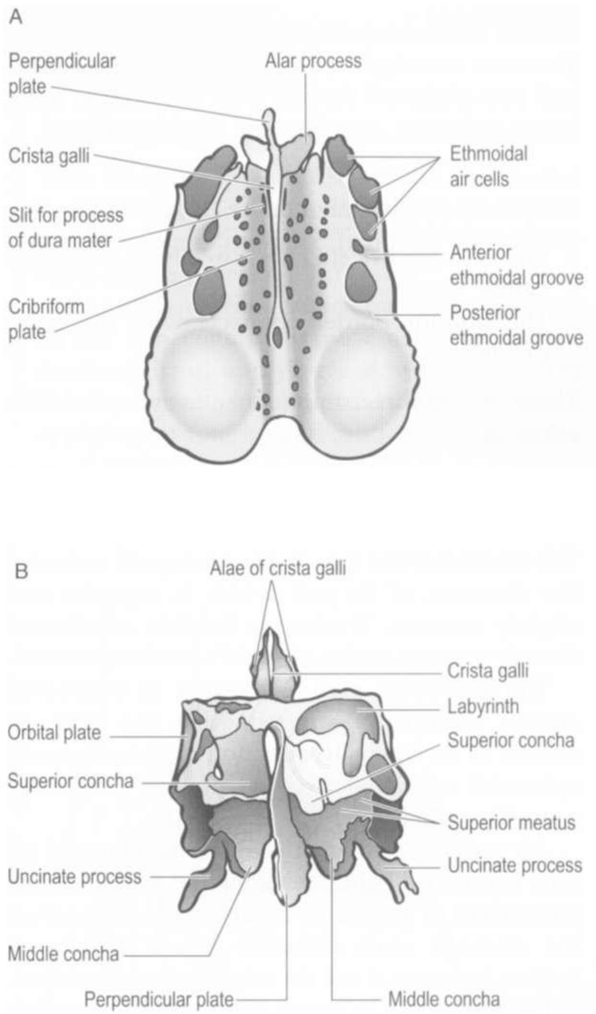


Figure 7.12 Superior (A) and posterior (B) aspects of ethmoid bone showing major features.

Note The discussion and exercises relating to the maxillae in the exercise section between Chapters 2 and 3 (pp 59, 60) (p. 234) will highlight the potential for using intraoral contacts on the crown surfaces of the posterior molars to mobilize numerous sutures, directly and indirectly connected with the maxillae, including a number of sphenoid-related sutures.

ETHMOID

The ethmoid is a tissue paper-thin construction comprising a central horizontal plate (cribriform) which contains tiny openings for the passage of neural structures, surrounded by:

- shell-shaped air sinuses forming a honeycomb framework to each side of the plate which is crowned by
- a thin crest (crista galli) formed by the dragging attachment of the falx cerebri (see Fig. 7.12A,B)
- thin bony plate-like structures which form the medial eye socket
- additional projections and plates, one forming part of the nasal septum, with the perpendicular plate being a virtual continuation of the vomer (see below).

Articulations

There are interdigitated sutures with the sphenoid and non-digitated sutures with the vomer, nasal bones, palatines, maxillae and the frontal bone.

Reciprocal tension membrane relationships

- The falx cerebri attaches directly to the crista galli.
- The inferior border connects with the nasal cartilage.

There are no direct muscular attachments to the ethmoid.

Range and direction of motion

The traction of the falx on the crista galli indicates the direction of its pull which is superior and slightly anterior. Tension at the falx attachment directly impacts on the ethmoid's motion potential.

The presumed axis of rotation in traditional cranial osteopathy suggests that the ethmoid rotates in an opposite direction to the supposed sphenoid rotational axis, as though they were geared together (see Fig. 6.9, p. 156).

Air passing through the shell-like ethmoid air cells is warmed before reaching the lungs and the alternation of pressures as air enters and leaves the ethmoid must influence minor degrees of motion between it and its neighboring structures.

Because in life its tissue paper-like delicacy has a sponge-like consistency it must be presumed that the structure acts as a local shock absorber.

Other associations and influences

The first cranial (olfactory) nerve lies superior to the cribriform plate and from this derive numerous neural penetrations of it which innervate mucous membranes which provide us with olfactory sense.

Animal research has shown that CSF flows into the cervical lymph nodes of dogs, by way of the olfactory nerve and around the cribriform plate (Leeds et al 1989). Rat studies have shown that there is direct drainage of CSF through the sieve-like cribriform plate, to connect with nasal lymphatics (Kida et al 1993).

In sheep and rats, at least 50% of CSF is cleared via the lymphatic system. It has been demonstrated that obstruction of drainage of CSF through the cribriform plate to the nasal mucosa leads to reduced CSF clearance and an increase in intracranial pressure (Mollanji et al 2002, Silver et al 2002).

Although a virtual certainty, studies that will conclusively prove that a similar process occurs in humans are still outstanding. The ethmoid bone may therefore be a key player in allowing normal CSF and lymphatic function in the region.

Dysfunctional patterns

- When sinus inflammation exists, the ethmoid is likely to be swollen and painful.
- Because of its role as a shock absorber, it is potentially vulnerable to blows of a direct nature and to soaking up stresses from any of its neighbors.
- There is no direct access to contacting the ethmoid, but it can be easily influenced via contacts on the frontal bone or the vomer.

Palpation and treatment exercises for the ethmoid

Exercise 7.10 Ethmoid–nasomaxillary release technique A

Time suggested 5-7 minutes

The patient's forehead (frontal bone) is gently cupped by your caudad hand as you stand to the side and facing the supine patient (standing on the left in this example).

Your cephalad (right) hand is crossed over the caudad (left) hand so that the index finger and thumb can gently grasp the superior aspects of the maxillae, inferior to the fronto-maxillary suture.

The unused fingers of this (right) hand should be folded and resting on the dorsum of the left hand (see Fig. 7.13).

Exercise 7.10 Ethmoid–nasomaxillary release technique A—*continued*

Figure 7.13 Treatment of ethmoid utilizing pincer contact.

Introduce a slow rhythmical separation of the two contacts so that the hand on the forehead is applying gentle pressure towards the floor - so pushing the falx away from the ethmoid and dragging on it - at the same time as the finger and thumb are easing the maxillae anterocaudally.

The 'pumping' (repetitive separation and release applications) should continue for at least a minute to achieve a local drainage effect, enhanced flow of air and blood (and presumably CSF - see above) through the ethmoid and release of restricted sutures.

This method is thought to be more effective if you can co-ordinate this pumping action with what you perceive to be the flexion stage of the cranial cycle.

Alternatively the separation hold can be maintained until a sense of release is noted.

The separation action (pulsed or constant) eases sutural impaction which may exist between the ethmoid as it is taken away from the frontal, nasal and maxillary bones into its presumed external rotation position (flexion phase of the cycle - see Box 6.2, p. 149).

Exercise 7.11 Ethmoid–nasomaxillary release technique B

Time suggested 5-7 minutes

With the same forehead hold with the caudad hand as in technique A above, apply a broad thumb contact (cephalad hand) to the midline nasal suture (see Fig. 7.14).

The slow rhythmical separation and release of the two contacts is now achieved by the forehead hand applying a downward (to the floor) pressure, synchronized with the thumb applying an anterior and caudal pressure to the nasal contact.

The mechanical effects are as described in technique A above.

Figure 7.14 Treatment of ethmoid utilizing thumb contact.

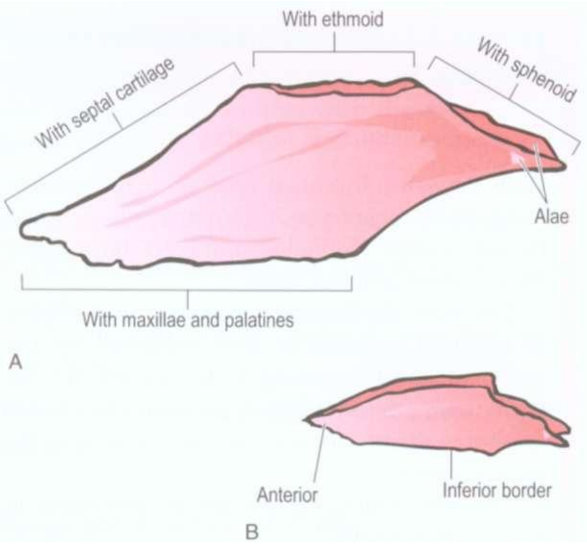


Figure 7.15 A Left lateral view of vomer and its articulations. B Vomer at birth.

VOMER

The vomer is a plough-shaped sandwich of thin bony tissue which houses a cartilaginous membrane, which forms the nasal cartilage (see Fig. 7.15A,B). It forms a junction point between the ethmoid and the maxillae and the maxillae and the sphenoid.

Articulations

- Superiorly the vomer articulates with the sphenoid at a tongue-and-groove joint of spectacular beauty, as the vomer forms two wing-shaped expansions which dovetail with the receptacle offered by the inferior aspect of the center of the sphenoid.
- On the inferior aspect of the sphenoid, the vomer also has minor articulation contacts with the palatine bones at the rostrum.
- There is a direct, plain (not interdigitated) suture with the ethmoid at its anterosuperior aspect. The vomer is a virtual continuation of the ethmoid's perpendicular plate.
- The inferior aspect of the vomer articulates with the maxillae and the palatines.
- There is a cartilaginous articulation with the nasal septum.

There are no direct associations of the vomer with the reciprocal tension membranes and there are no direct muscular attachments to it.

Range and direction of motion

The vomer's range of motion in traditional osteopathic thinking is identical to that of the ethmoid and opposite to that of the sphenoid.

Other associations and influences

- As with the ethmoid, this is a pliable shock-absorbing structure which conforms and deforms dependent upon the demands made on it by surrounding structures.
- The mucous membrane covering the vomer assists in warming air in nasal breathing.

Dysfunctional patterns

- In rare cases the vomer can penetrate the palatine suture, producing an enlargement/swelling of the central portion of the roof of the hard palate, a condition known as torus palatinus.
- As with the ethmoid, inflammation of the vomer is probable in association with sinusitis.
- Direct trauma can cause deviation of the vomer and so interfere with normal nasal breathing.

Palpation and treatment exercises for the vomer

Exercise 7.12 Vomer release A

Time suggested 5-7 minutes

Cup the supine patient's occiput with one hand.

Place the (gloved) thumb of the other hand into the mouth so that the pad rests on the hard palate just behind the upper incisors (see Fig. 7.16).

The index and middle fingers of that hand should be placed either side of the nose so that they rest on the superior aspects of the maxillae, inferior to the suture.

It is possible to utilize these strong contacts to gently separate the vomer in an anteroinferior direction during the flexion phase of the cycle as the hand holding the head offers simultaneous gentle encouragement of occipital flexion.

It is also possible to increase a degree of compaction of the vomer by holding it towards the ethmoid and sphenoid until a sense of unwinding or release becomes apparent.

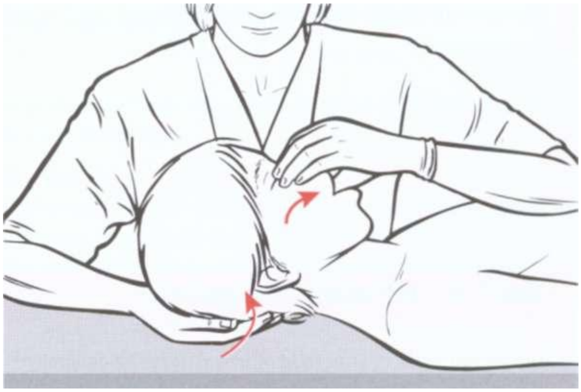


Figure 7.16 Intraoral thumb approach to treatment of vomer.

Exercise 7.13 Vomer release B

Time suggested 5-7 minutes

The patient is supine and you stand to one side with the cephalad hand cupping the frontal bone (without any pressure), with the thumb and middle fingers holding the greater wings of the sphenoid. The (gloved) index finger of the other hand is placed into the mouth just anterior to the transverse palatine suture (see Fig. 7.17A,B).

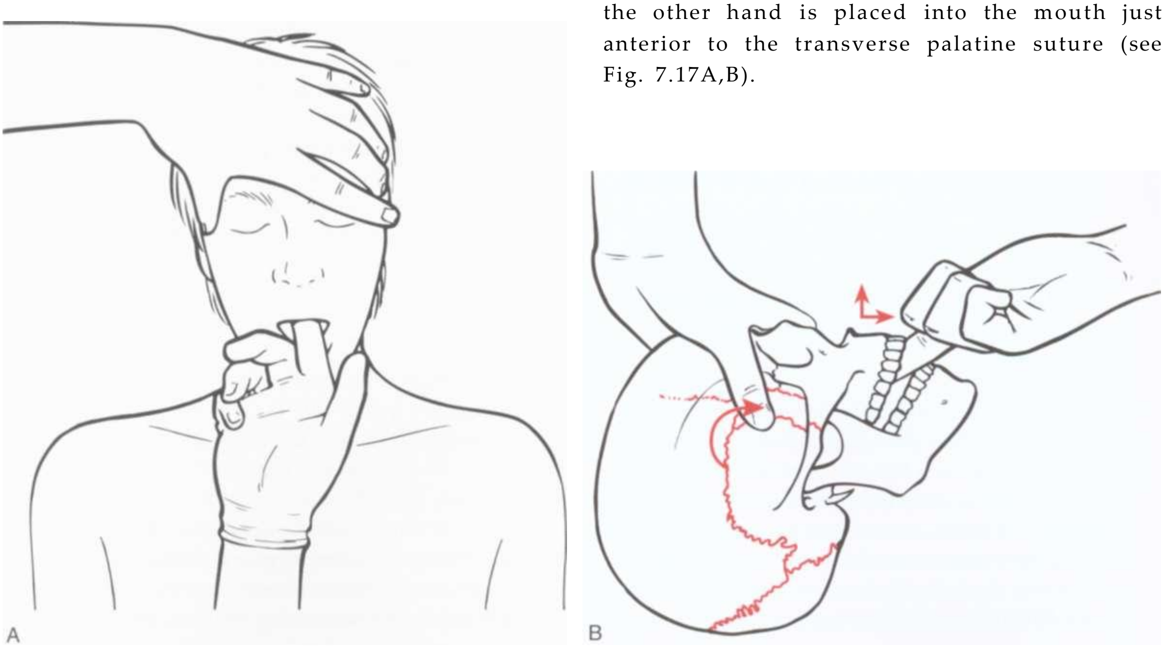


Figure 7.17 Superior (A) and lateral (B) views of intraoral finger approach in treatment of vomer.

Exercise continues

Exercise 7.13 Vomer release B—*continued*

During the flexion phase of the cycle the finger contacts on the great wings can encourage flexion while the gloved finger contact provides gentle traction of the palatine bones anteriorly and inferiorly to encourage external rotation/flexion of these, encouraging ethmoid and vomer movement.

The degree of pressure applied inside the mouth should be minute (a few grams at most).

It should be possible to sense the motion of the vomer against the contact finger in the mouth and to attempt to encourage a freedom of movement by balancing the motions of the two bones being contacted.

Box 7.4 Intranasal manipulation

Intranasal work is a method which is sometimes applied during the 10-session series of structural integration processing developed by Dr Ida Rolf (Rolf 1976). Rolfing has an objective of 'whole-body' structural integration and would not focus specifically on a region (such as the nasal/sinus structures), but would commonly include such structures in its overall approach.

Other schools, including some neuromuscular therapy (NMT) training organizations, are developing this work, according to Rolfer Tom Myers (2001). Myers writes:

> *Dr Rolf died in 1979 and the history of how intranasal work came to be included in the Rolfing series is not clear. Dr Rolf herself acknowledged yoga and osteopathy as the two main taproots for her work. Yoga, as she practiced it earlier in her life, included 'kriyas' or cleansing practices, one of which reportedly involved passing a cloth through the nasal passages. More likely the source of the nasal work was seminars that Ida Rolf took with William Sutherland DO, the founder of cranial osteopathy.*

Myers suggests that employing intranasal techniques should ideally involve prior preparation of the client's connective tissues and that the technique may be contraindicated in cases of current acute sinus or other pharyngeal infection, recent facial trauma, the use of anticoagulant drugs, hemophilia or patients on the extreme end of psychophysiological sensitivity, as well as anyone habitually using ('snorting') cocaine.

CAUTION

Neither the intransal nor the nasal specific ('balloon' method), described briefly below, should be attempted without a thorough training in their usage, as well as a full understanding of the risks involved and a signed informed consent form from the patient.

Additionally anyone employing any technique which enters any body orifice needs to confirm their legal scope of practice in the state/country in which they work. For example, it is illegal for some therapists, in some areas of the United States, to enter any body orifice of the patient, with or without consent.

Description of these methods should not be seen as a recommendation for their use without specific training.

The structural integration method Myers (2001) reports:

> *In structural integration [i.e. Rolfing] practice, intranasal work is done with the little finger, gloved and lubricated, with great sensitivity and concentration, with ultimate slowness and client communication and only after the entire rest of the body has been prepared for this work by detailed myofascial processing. The direct purpose in introducing a finger into the nose is to widen, open and loosen the soft tissues surrounding the nasal cavity.*

Box 7.4 Intranasal manipulation—*continued*

Myers states:

> *Once into the vestibule, the finger encounters the 'gate' around the nasal passage, formed by the maxillary bones laterally and inferiorly and the nasal septum medially. When the vestibular gate has 'melted' open (forcing is neither called for nor advisable), the fingertip emerges into the wider chamber of the nasal cavity. In the deeper part of the nasal passage, the vomer bone, rather than the cartilaginous nasal septum, forms the medial wall and the palatine bone forms the floor behind the maxilla. Superior to this are the nasal conchae as well as the nasal and lacrimal bones. None of these bones are touched directly. It is the contention of structural integration and the rationale for this part of its technique library, that the tendency is for these turbinates to migrate medially, thus reducing such contact and rendering the inner passages, between the turbinates and the septum, less open. This compels more reliance on the outermost passage, between the first turbinate and the maxilla, though this passage may also be reduced in the general narrowing of the facial structure. Thus the idea in the intranasal work is to move the turbinates laterally away from the septum. The turbinates are located not only one above the other but one behind the other, so that they would be encountered sequentially by the practitioner's finger.*

An additional focus of the method is evaluation of the position of the turbinates, 'the doors to the facial sinuses'. The (anecdotally) reported efficacy of enhanced sinus drainage by means of intranasal work is a principal justification for its application.

Myers also reports that he:

> *... has found many deviated septa to be responsive to treatment, with the results of increased opening being very gratefully received by clients. The cartilage, we must admit, occasionally crackles disconcertingly when directed toward the midline, but we have had no reports of post-session pain or disturbance related to these sounds. Intraosseous strain within the vomer caused by cranial torque or shear forces can also be eased by sustained attention in this direction.*

Particular caution also applies to such treatment methods when they involve the extremes of very young or elderly nasal structures, where immature or degraded cartilage may make such an approach unwise or even dangerous.

> **CAUTION**
>
> Habitual use of cocaine and other recreational drugs, which can break down the cartilage of the septum, is a contraindication for this type of manipulation.

The balloon method ('nasal specific technique') A method involving the inflation of small balloons (finger cots) within the nose was developed in the 1930s as a means of altering intranasal deviations or obstructions.

This method employs a minimum of two finger cots (one inside the other), which are inserted into the nasal cavity with the outer one lubricated. The first is secured to the nipple on the bulb of a blood pressure cuff, which is used to inflate them. The inflated cots follow the path of least resistance posteriorly into the nasopharynx. Dr Douglas Lewis, past head of the Department of Physical Medicine at Bastyr University in Seattle, USA, describes the effect as equivalent to 'a high-velocity, low-amplitude thrust' commonly employed in osteopathic or chiropractic manipulation. Lewis has used this method for a variety of problems, including sinusitis as well as opening the nasal passages to enhance breathing. This treatment is 'not pleasant at the moment of inflation', according to Lewis, but due to its efficacy, patients frequently request, however reluctantly, for him to repeat it (reported in Myers 2001).

According to Folweiler & Lynch (1995):

> *It is common for the patient to hear 'cracking' or 'popping' sounds within the skull during the technique. Occasionally, they can be perceived by the practitioner. Tenderness following the treatment along the median palatine suture and other facial sutures is common, persisting for a few days after treatment. Epistaxis (nose bleed) can occur, but is not commonly long in duration nor large in volume.*

The 'balloon' treatment is primarily employed for chronic sinusitis and other nasal complaints. 'The nasal specific technique, when used in conjunction with other therapies, may be useful in treating chronic sinus inflammation and pain,' speculate Folweiler & Lynch.

Box continues

Box 7.4 Intranasal manipulation—*continued*

They go on to hypothesize as to the mechanism of such relief:

> *Numerous theories could be used to explain the benefits of the nasal specific technique for chronic sinusitis. One such explanation may be the direct elimination of mucus from the nasal passages by the force of the inflated cot, thus reducing pressure and pain and allowing increased sinus and nasal drainage. It is also possible that pressure against the thin, slightly pliable bones surrounding the sinuses allows equalization of pressure in the sinus to that of the atmosphere. It is also possible that a neural reflex exists by which the nasal specific technique causes mucous thinning and/or altered discharge. Manually compressing edematous tissues may result in a vascular response that leads to normalization of function.*

THE MANDIBLE

The mandible comprises:

- A body, which is the horizontal portion which meets with the body of the other side at the symphysis menti, to form the central jaw protruberance (see Fig. 7.18)
- The rami, the vertical portions of the mandible, attached to the posterior aspect of the bodies.

Each ramus forms two projections, the posterior of which becomes the articular condyle, via a slender neck, for its articulation with the temporal bone, while the anterior forms the coronoid process to which the temporals attach.

Articulations

The only osseous articulation of the mandible is with the temporal bone at the temporomandibular

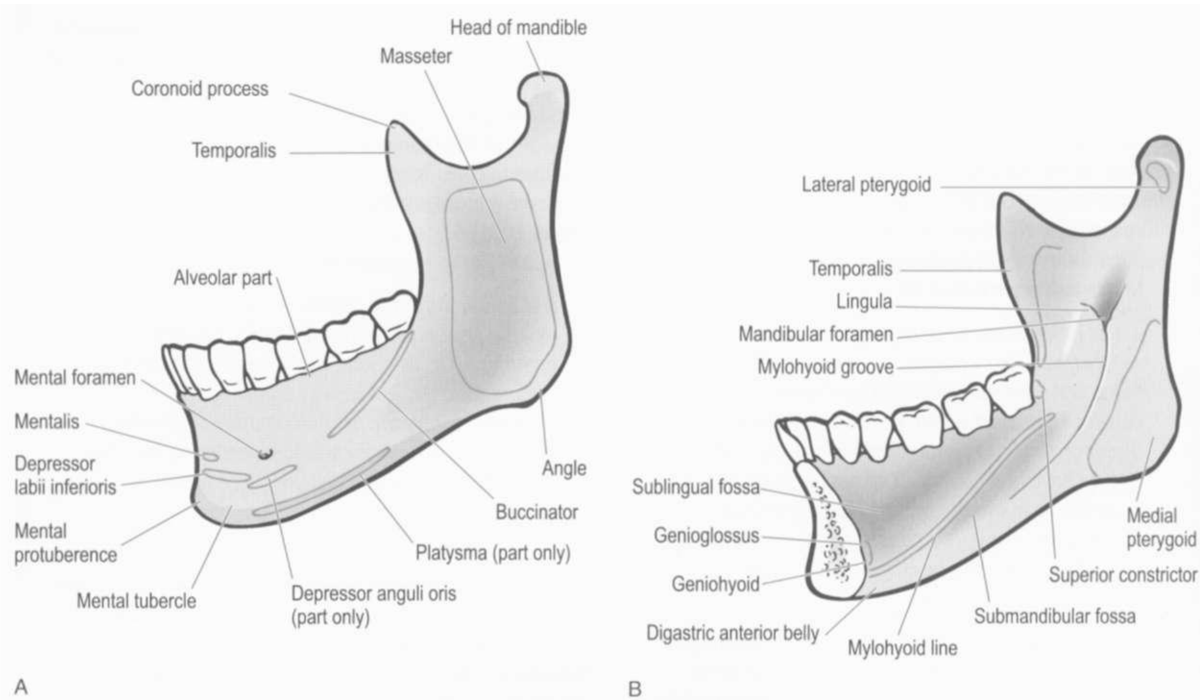


Figure 7.18 A Lateral (external) aspect of left mandible with muscular attachment sites. B Medial (internal) aspect of right mandible with muscular attachment sites.

joint. It also articulates with its teeth, which articulate (occlude) with the upper teeth set in the maxillae.

There are no reciprocal tension membrane connections.

Major muscular attachments (see Fig. 7.18A.B for attachment sites)

- **Temporalis** attaches to the temporal fossae, converging medial to the zygomatic arch, with an insertion on the coronoid process and the ramus of the mandible. The anterior/superior fibers occlude the teeth as the mandible is elevated, while the posterior fibers assist in retraction of the jaw as well as lateral chewing movements.
- **Masseter** attaches via its superficial fibers to the zygomatic process and arch while the deeper fibers arise from the deeper surface of the zygomatic arch. Superficially it inserts into the lateral ramus, while the deeper fibers attach to the upper ramus and to the coronoid process. Its functions are to occlude the jaw during chewing and, by means of fibers running in different directions, to alternately retrude and protrude the mandible during chewing. This is considered to be the most powerful muscle in the body.
- **Lateral pterygoid** attaches to the greater wing of the sphenoid as well as to the lateral pterygoid plate, both heads inserting via a tendon to the anterior aspect of the neck of the mandible and the articular disk of the temporomandibular joint. The various actions in which the muscle is involved include depression and protrusion of the mandible as well as offering stability to the temporomandibular joint when the mandible is closing.
- **Medial pterygoid** arises superficially from the tuberosity of the maxilla as well as from the palatine bone. A deeper origin is from the medial pterygoid plate and the palatine bone. Superficial and deeper fibers merge to attach to the medial ramus of the mandible close to the angle. The functions of the muscle are to elevate and protrude the mandible (acting with the lateral pterygoid and the masseter).
- **Digastric** arises from two sites - the posterior belly from the mastoid notch of the temporal bone and the anterior belly from the anterior aspect of the mandible. The two parts of the muscle link via a tendon which is attached to the hyoid bone by a fibrous connection. The action is to depress the mandible while lifting the hyoid bone.
- **Platysma** - the anterior fibers interlace with the contralateral muscle, across the midline, below and behind the symphysis menti. Intermediate fibers attach to the lower border of the mandibular body while the posterior fibers cross the mandible and the anterolateral part of the masseter and attach to subcutaneous tissue and skin of the lower face. The actions of the platysma involve reducing the concavity between the jaw and the side of the neck. Anteriorly it may assist in depressing the mandible.
- **Mylohyoid** arises from the inner surface of the mandible and attaches to the hyoid bone. Its function is to depress the mandible and to elevate the hyoid during swallowing.
- **Geniohyoid** attaches at the symphysis menti and runs to the anterior surface of the hyoid bone, acting in much the same manner as mylohyoid.

Minor muscular attachments (not described)

- Buccinator
- Depressor angularis oris
- Orbicularis oris
- Depressor labii inferioris
- Hyoglossus
- Mentalis
- Superior pharyngeal constrictor
- Genioglossus.

Range and direction of motion

Involuntary motion of the mandible cranially relates to motion of the temporal bones with which it articulates. This will be modified by the degree of muscular contraction at this junction. Brookes (1981) describes the process as follows: 'The mandible follows the temporals with the symphysis receding and the alveolar arch widening at the posterior area'.

There is some disagreement as to the 'normal' active range of motion of the mandible which in various texts is considered to be between 42 mm and 52 mm (Rocobado 1985, Tally et al 1990). As Skaggs (1997) reports:

> *Rocobado (1985) states maximum mandibular opening to be 50 mm, thereby taking the periarticular connective tissue to 100% stretch. He qualifies that the stretch of the periarticular connective tissue should not exceed 70-80%, thus making functional mandibular range of motion approximately 40 mm. Okeson's recent guidelines (Okeson 1996) cite normal minimum interincisal distance and active ranges of motion to be 36 to 44 mm and less in women.*

There is more to the range of motion of the mandible than mechanics, as Milne (1995) points out.

> *The mandible is more open to psychological input than any other bone in the head ... unexpressed aggression, determination or fear of speaking out, cause changes in mandibular motion that range from subtle to dramatic. For instance, in states of rage the mandible is so muscularly tense that almost all movement is lost.*

Latey (1996) amplifies some of these influences.

> *The temporalis and pterygoids ... can completely jam the jaw in extremis (trismus). They also carry out an agitated mastication movement in some restless states of mind (bruxism) and a much slower gentle ruminative wandering when the mind is in more of a state of reverie. ...In early life the orofacial muscles are associated with real and imagined breastfeeding movements and will commonly come into conflict with the urge to bite.*

Muscular influences on the mandible include:

- protrusion: medial and lateral pterygoid
- retraction: temporalis (posterior fibers), masseter (middle and deep fibers), digastric, geniohyoid
- elevation: temporalis, masseter, medial pterygoid, lateral pterygoid
- depression: lateral pterygoids, digastric, geniohyoid, mylohyoid, gravity
- lateral translation: medial and lateral pterygoid
- maintaining position of rest: temporalis.

Dysfunctional patterns

Both physical and emotional injuries and stresses can result in dysfunctional temporomandibular joint behavior. The effects are demonstrated in pain, clicking and variations on the theme of restriction and abnormal opening and closing patterns. In almost all instances of TMJ dysfunction soft tissue considerations should be primary and these are to a large extent explained in Chapter 9 under the headings of the particular muscles in question, notably relating to masseter, the pterygoids and the temporalis.

Dental and particularly orthodontic treatment can be responsible for TMJ problems (see Ch. 11). Extractions, bridges, dentures, braces and plates can all play a part in the mechanical disturbances and imbalances leading to (or helping to maintain or aggravate) TMJ dysfunction. Associated symptoms (apart from TMJ pain, restriction, clicking, etc.) might include headache, neck pain, sinus and/or ear problems, as well as symptoms occurring at a distance, due to the altered posture of the jaw, head, neck, etc.

It is suggested that involved soft tissues should receive appropriate attention before joint corrections are attempted and that home exercise strategies for rehabilitation are started early in the treatment schedule, as well as paying appropriate attention to underlying features, including habits such as bruxism, gum chewing, etc., emotional turmoil or poor stress coping abilities.

Posture and TMJ problems

Forward head posture often accompanies TMJ pain and this should be an early focus in rehabilitation of TMJ dysfunction.

Examining for forward head posture (anterior head position) is noted by Simons et al (1999) to be 'the single most useful postural parameter' regarding head and neck pain (see notes on 'crossed syndromes' in Ch. 8). Simons et al (1999) note that a forward head position:

Box 7.5 The temporomandibular joint and its disks

The articular disk of the TM joint, composed of dense non-vascular fibrous tissue (Simons et al 1999), is bound tightly to the condyle, its inferior concave surface fitting the condyle like a cap while its concavoconvex upper surface corresponds to the mandibular fossa and glides against the articular tubercle. The joint surfaces as well as the interposed disk are designed to remodel in response to stress, changing shape to accommodate forces imposed.

The disk is firmly attached at the medial and lateral condylar poles by strong bands and is attached anteriorly to the joint capsule, as well as to fibers of the upper head of lateral pterygoid. The upper head of lateral pterygoid also attaches to the condyle and pulls the disk and condyle forward as a unit during opening of the mouth (Cailliet 1992, Simons et al 1999). Posteriorly is the fibrovascular bilaminar zone where the thick fibers separate into two layers, the inferior one made of non-elastic fibrous tissue attaching to the back of condyle, while the upper fibroelastic layer attaches to the posterior margin of the fossa. The area between the two layers is loose connective tissue that is highly vascularized and richly supplied with nerve endings.

The interposed disk is a deformable pad which is thicker anteriorly (pes) and posteriorly (pars posterior) and thinner in the center (pars gracilis). Increasing its load thickens its annulus (*Gray's Anatomy* 1995). Its job is to allow considerable movement of roll, spin and glide of the condylar head while reducing the possibility of trauma.

As the condyle hinges into place, in preparation for translation against the articular tubercle, it engages the central (thinner) portion of the disk, 'thereby "squeezing out" material to form a thickened zone, the annulus of Osborn, which surrounds the thin area – a recess for the mandibular condyle' (*Gray's Anatomy* 1995). The lateral pterygoid engages the disk and the condyle to slide down the articular tubercle until the posterior fibroelastic elements are stretched to their limit. The condylar head may further hinge and glide against the inferior surface of the disk to articulate with its most anterior parts. During closure movements, the condylar head is seated in the central recess as it glides back up the incline and rests in the mandibular fossa.

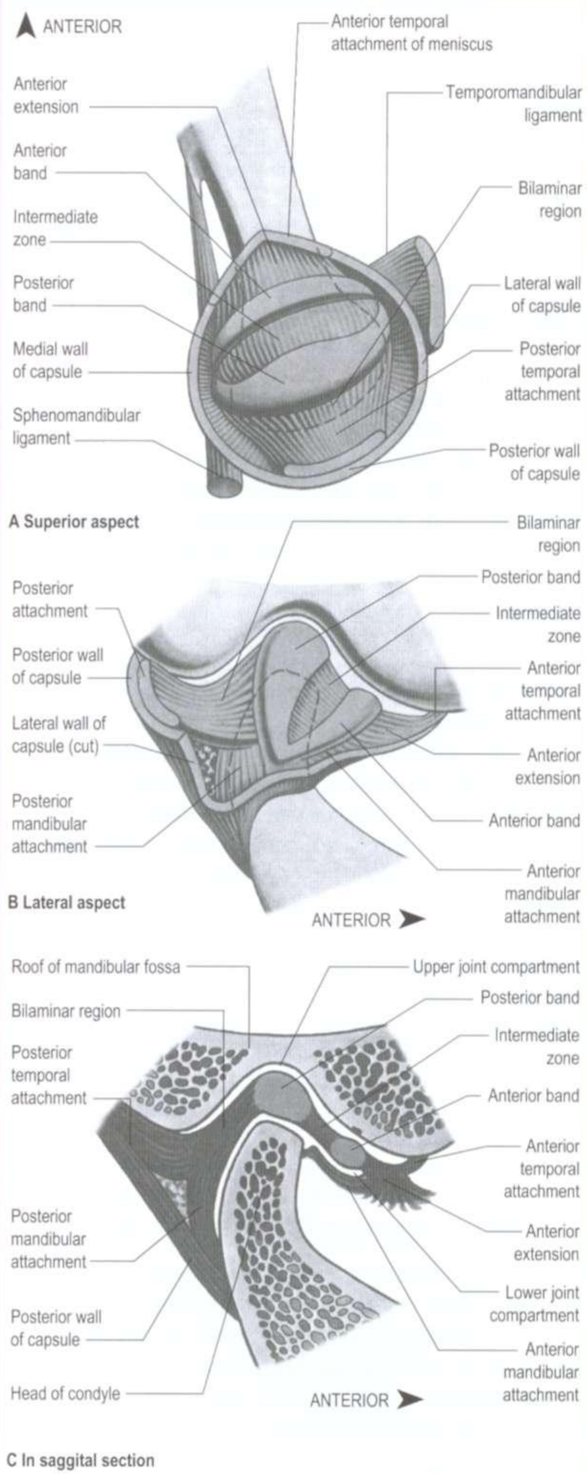


Figure 7.19 The temporomandibular intraarticular disc. (Reproduced from Gray's Anatomy (1995) with permission from Elsevier.)

Box continues

Box 7.5 The temporomandibular joint and its disks—*continued*

The causes and effects of temporomandibular joint dysfunctions may be the result of structural, habitual, postural, nutritional, hormonal or emotional stresses rather than localized TM joint syndromes.

A diagnosis of TM joint dysfunction (TMD) might include one or more of the following internal derangements of the disk. These may be due to gross trauma, such as that incurred in acceleration-deceleration injuries, or to strain imposed on the joint by faulty muscles, occlusal interferences, damaging oral habits or postural positioning.

Anterior displacement with reduction The disk may be torn from the underlying condyle which may allow the lateral pterygoid fibers to dislocate it anteriorly (Cailliet 1992). When this occurs, the condylar head will need to overcome the thick posterior rim, producing a 'click' as it seats itself onto the disk (often with pain). If a reduction has occurred (condylar position recaptured), the condyle may translate and the jaw will open. When the disk is not reducible, the range of motion will abruptly end as the condylar head encounters the posterior aspect of the anteriorly displaced disk. Range of motion is usually significantly lessened with a non-reducible anterior displacement.

Cailliet (1992) comments: 'In the presence of a click, indicating the possibility of a disk impingement syndrome, there are factors that influence the prognosis and even the preferred treatment. Pain or no pain with the click is a prognostic factor with the presence of pain being more ominous'.

Cailliet states that the response to conservative treatment is more favorable if the history of clicking is brief, if the click occurs early in the opening phase of jaw motion and if the click is reduced by repositioning the mandible (with orthosis), especially when little distance is required. The prognosis is less favorable if more than 3–5 mm of repositioning is needed to abolish the click.

The click (as well as crepitation) produced during translation of the mandible may well be the first indication of a progressive TM joint problem. Often the patient expresses no complaint until pain is experienced.

When the disk is anteriorly displaced, the posterior bilaminar zone (if still attached) is stretched and positioned to lie directly above the condylar head. Damage to the fibers, irritation to the neurovascular tissues and resultant excitation of the overlying muscles are some of the perils which may result the moment the disk displaces. Recapture of the disk (if possible) by orthotic intervention may reduce pressure on the elastic fibers by repositioning the condylar head forward and onto the disk in ideal position. By reducing pressure on the neurovascular tissues by both removal of the condylar head's presence as well as reduction of muscular tension and its often resultant intrajoint pressure, a quieting of the musculature may result, due to the effects of Hilton's law.

Anterior displacement without reduction A closed lock is a more serious condition. The process is similar to a displaced disk with reduction, except the disk is unable to reposition over the condyle and instead, impacts the condyle against the posterior aspect of the disk and is unable to translate further. This condition results in limitation of opening, often to 25 mm or less. This condition is a locked displacement without reduction and is a difficult one to correct with conservative measures.

Cailliet (1992) comments:

> *When there have been repeated dislocations with or without reduction, the cartilage of the glenoid and the condyle undergo damage and degeneration with resultant degenerative arthritis. In the presence of degenerative arthritic changes, there is a persistent crepitation, pain, joint range-of-motion limitation and concurrent spasm of the muscles of mastication. In systemic inflammatory arthritis (rheumatoid, psoriatic, ankylosing, gouty, etc.), the TMJ frequently becomes involved. In these etiological conditions there is painful crepitation, limited opening, protrusion and lateral and rotatory jaw movement and concurrent masticatory muscle spasm with muscle pain and tenderness.*

- occurs with rounded shoulders
- results in suboccipital, posterior cervical, upper trapezius and splenius capitis shortening to allow the eyes to gaze forward
- most often presents with a loss of cervical lordosis (flattening of cervical curve)
- overloads SCM and splenius cervicis
- places extra strain on the occipitoatlantal joint (places it in extension)
- increases the change of compression pathologies
- places the supra- and infrahyoids on stretch and places downward tension on the mandible, hyoid bone and tongue
- induces reflexive contraction of the mandibular elevators to counteract downward traction of the mandible (which then) results in increased intra-articular pressure in the TM joints which could give rise to the development of clicking, especially in a posteriorly thinned disk (see Box 7.5).

Palpation and treatment exercises for the mandible

Exercise 7.14 Review of TMJ-associated musculature

Time suggested 20 minutes

Review the particular muscles associated with the mandible and the TMJ, as described in Chapter 9, as well as their treatment options when dysfunctional and then palpate temporalis, masseter, the pterygoids and suprahyoid - bilaterally.

During mastication compressional forces are created by the muscles which cross the TMJ. The process of mastication involves a complex, co-ordinated interaction of numerous muscles and is dependent upon the integrity of the TMJ and health of the associated myofascial tissues. Trigger points within these tissues, intrajoint dysfunctions or dental factors which inhibit normal occlusion of the teeth (such as the inability to chew on a particular side which, in turn, overloads the contralateral side) are a few of the many conditions which interrupt and affect the synchronized action of eating.

The suprahyoid muscles form the floor of the mouth and are involved in opening the mouth and deviating the mandible laterally. The muscles which directly cross the TM joint include temporalis, masseter, lateral pterygoid and medial pterygoid. These muscles move the mandible powerfully while others influence its quality of movement directly (e.g. digastric) or indirectly (e.g. those which position the head).

In assessing the muscles associated with primary movement of the mandible, both external palpation and intraoral contact with the muscles can be used. External palpation of temporalis is primary rather than secondary, since it lies almost entirely exterior to the oral cavity. Only its tendon attachment to the coronoid process is palpable from inside the mouth. These muscles are discussed and addressed in Chapter 9.

Exercise 7.15 TMJ compression and decompression

Time suggested 5-7 minutes

The patient is supine and you are seated at the head.

Place the palms of your hands onto the side of the patient's face so that they follow the contours, thenar eminence over the TMJ and fingers curving around the jaw. No lubricant is used at this stage.

Gently bring the hands superiorly, so that traction is applied to the skin and fascia of the cheeks, until all the soft tissue slack has been removed. In this way the temporomandibular joint will be over-approximated/crowded. Hold this crowding for not less than a minute (longer if it is not uncomfortable for the patient).

Exercise continues

Exercise 7.15 TMJ compression and decompression—*continued*

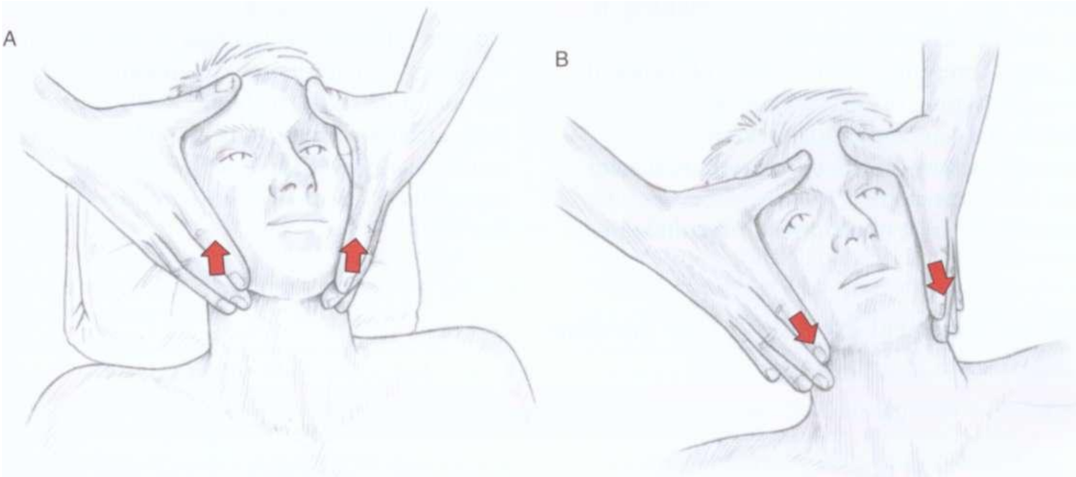


Figure 7.20 A Crowding/compression stage of temporomandibular joint treatment. B Distraction/decompression stage of temporomandibular joint treatment.

Now reverse the direction of the hands so that a distraction occurs, as the skin and fascia are taken to their pain-free elastic limits and the underlying structures are eased away from the TM joint. Hold this for at least one and ideally several minutes.

A sense of unwinding may be noted as the tissues release, in which case follow the motion without superimposing any direction to the movement.

Exercise 7.16 MET method for restricted jaw opening (1)

Time suggested 3-4 minutes

If the mandible cannot open fully or adequately, reciprocal inhibition may be usefully tried.

The patient is asked to open the mouth (gently) against resistance applied by the operator's (Fig. 7.21A) or the patient's own hand (Fig. 7.21B).

The patient places an elbow on a table, chin in hand and attempts to open the mouth against resistance for 10 seconds or so, thus inhibiting the muscles which act to close the mouth.

The jaw would have been opened to its comfortable limit before attempting this and after the attempt it would be taken to its new barrier, before repeating.

This MET method would have a relaxing effect on those muscles which are shortened or tight and which are acting to restrict opening of the mandible.

Exercise continues

Exercise 7.16 MET method for restricted jaw opening (1)—*continued*

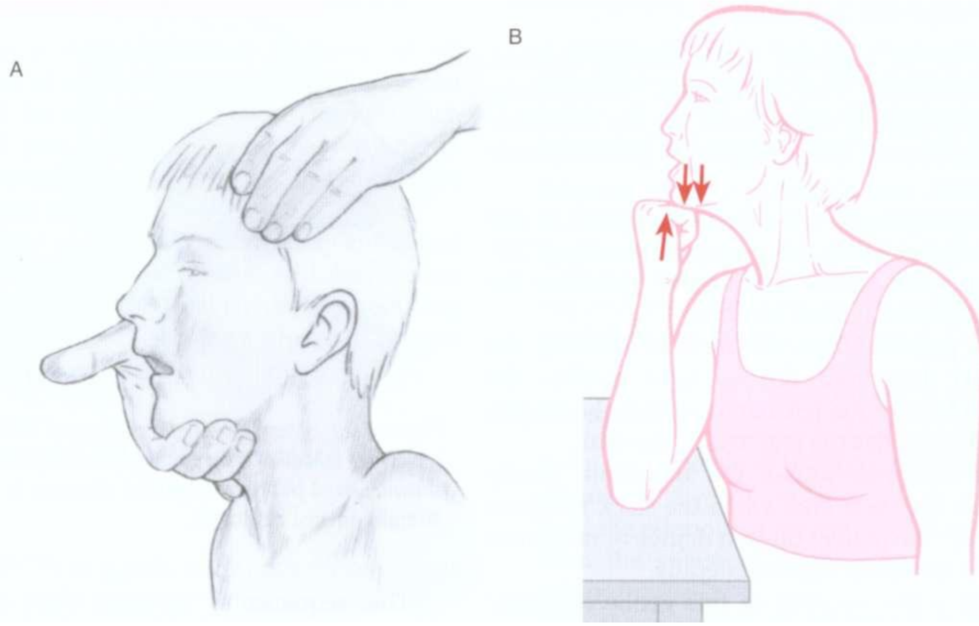


Figure 7.21 A Muscle energy technique for treatment of TMJ restriction showing isometric contraction phase of the sequence as the patient opens the mouth (lightly) against resistance. B Self-applied muscle energy technique for treatment of TMJ restriction showing isometric contraction phase of the sequence as the patient opens the mouth (lightly) against resistance.

Exercise 7.17 MET method for restricted jaw opening (2)

Time suggested 3-4 minutes

This is an alternative to the previous exercise, used also to relax the short, tight muscles which prevent the mandible from opening adequately. This method uses postisometric relaxation, therefore counterpressure would be required in order to prevent the open jaw from closing (using minimal force).

The thumbs (suitably protected) are placed along the superior surface of the lower back teeth, while an isometric contraction is performed by the patient, attempting to close the mouth against resistance (see Fig. 7.22).

In this exercise the operator is directing force towards the restriction barrier (operator direct method) rather than the patient doing so (patient direct, as in Exercise 7.16B).

Figure 7.22 Muscle energy technique of TMJ restriction showing isometric contraction phase of sequence as patient attempts to close the mouth against resistance.

Exercise 7.18 MET method for restricted jaw opening (3)

Time suggested 3-4 minutes

Lewit (1992) suggests the following method of addressing TMJ problems, maintaining that laterolateral movements of the mandible are important, encouraged by postisometric relaxation.

The patient sits with the head turned to one side (say the left in this example) (see Fig. 7.23). The operator stands behind and stabilizes the patient's head against his chest.

The patient opens the mouth, allowing the chin to drop and the operator cradles the mandible with his left hand, so that the fingers are curled under the jaw, away from him.

The operator draws the mandible gently towards his chest and, when the slack has been taken up, the patient offers a degree of resistance to its being taken further, laterally.

After a few seconds of this gentle isometric contraction, the operator and patient relax simultaneously and the jaw will usually have an increased lateral excursion.

Figure 7.23 Muscle energy technique of TMJ restriction (involving tendency to lateral deviation of jaw on opening) showing hand positions as patient attempts to deviate jaw laterally against resistance.

This sequence is repeated three times and should be performed so that the lateral pull is away from the side to which the jaw deviates on opening.

Exercise 7.19 Positional release method – cradling the mandible

Time suggested 3-4 minutes

The patient is supine and you stand to one side, at chest level, facing the patient's head.

Place both (gloved) thumbs into the relaxed but open mouth so that they rest on the superior surface of the lower back teeth.

Place the index fingers on the cheek along the inferior aspect of the zygomatic arches.

The ends of your middle and ring fingers should be able to reach behind the ramus of the mandible, with the small finger lying anterior to the angle of the jaw.

From this position it is possible to gently crowd the mandible towards the temporal bone (moving it superiorly) and to distract from it (moving it inferiorly), assessing which direction offers the greatest sense of ease or resistance.

It is also possible to crowd one side and distract the other (one side moves inferiorly and the other superiorly), again selecting whichever seems to offer the least resistance.

Holding the mandible towards the direction of ease revealed by this test, you can then assess the mandible's 'willingness' to translate laterally one way and then the other, holding it towards that direction.

With the mandible now held in a double 'comfort' or 'ease' position (compression or distraction unilaterally or bilaterally, together with translation laterally one way or the other) you can gently attempt to assess posterior and anterior translation efforts: does the mandible wish to protrude, to come forwards or to retract?

Hold the mandible in this further combined position of ease and attempt a gentle rotational movement in which a sidebending is introduced from the combined position of ease achieved so far.

Exercise continues

Exercise 7.19 Positional release method – cradling the mandible—*continued*

Once a final combined stacking of all positions of ease has been achieved, this should be held for at least 60 seconds, during which time, if you sense the mandible wishing to move towards a new position, this should be supported and allowed.

Possible unwinding patterns may emerge or a simple positional release will have been achieved, enhancing local circulation, reducing hypertonicity and restoring a degree of balance in previously stressed musculature.

Exercise 7.20 TMJ self-treatment (1)

Time suggested 3 minutes

Gelb (1977) suggests a retrusive exercise as follows.

The patient curls the tongue upwards, placing the tip as far back on the roof of the mouth as possible. Whilst this is maintained in position, the patient is asked to slowly open and close the mouth (gently), to reactivate the suprahyoid, posterior temporalis and posterior digastric muscles (the retrusive group).

Exercise 7.21 TMJ self-treatment (2)

Time suggested 3 minutes

The patient places an elbow on a table, jaw resting on the clenched fist.

The tongue should rest on the palate just posterior to the middle upper incisors throughout the exercise, to ensure that the mandible remains centered.

The fist should offer some, but not total, resistance to the slow opening of the mouth, which should be performed five times with hand pressure and then five times without, ensuring that the lower jaw does not come forward.

The lower teeth should always remain behind the upper teeth on closing.

A total of 25 such movements should be performed, morning and evening.

FRONTAL BONE

This comprises:

- A central metopic suture which is usually fused but sometimes (rarely) interdigitated, on the inside of which lie the attachments for the bifurcated falx cerebri (see Fig. 7.24A,B)
- Bilateral concave domed bosses which house the frontal lobes of the brain as well as air sinuses at the inferior medial corner
- Superciliary arches, a nasal spine and the medial aspects of the eye socket.

Articulations

- With the parietals at the interdigitated coronal suture.
- With the ethmoid at the ethmoidal notch.
- With the sphenoid at the greater and lesser wings.
- With the zygomae via the interdigitated zygomatic process at the dentate suture.
- With the maxillae via the frontal process.
- With the temporals (not always).
- With the lacrimal bones and the nasal bones.

Reciprocal tension membrane relationships

The falx cerebri attaches strongly to the inner aspect of the midline of the frontal bone at a double crest formed by its bifurcated attachments, which creates a space which becomes the superior sagittal sinus.

Muscular attachments

- **Temporalis** arises from the temporal fossa and its fibers converge to attach on the coronoid process and ramus of the mandible, medial to the zygomatic arch. The origin of temporalis crosses the coronal suture between the frontal and parietal bones as well as that between the temporal and parietal bones.
- **Occipitofrontalis** covers the entire dome of the skull from the superior nuchal line to the eyebrows, completely enveloping the parietal suture. The muscle also spans the lambdoidal

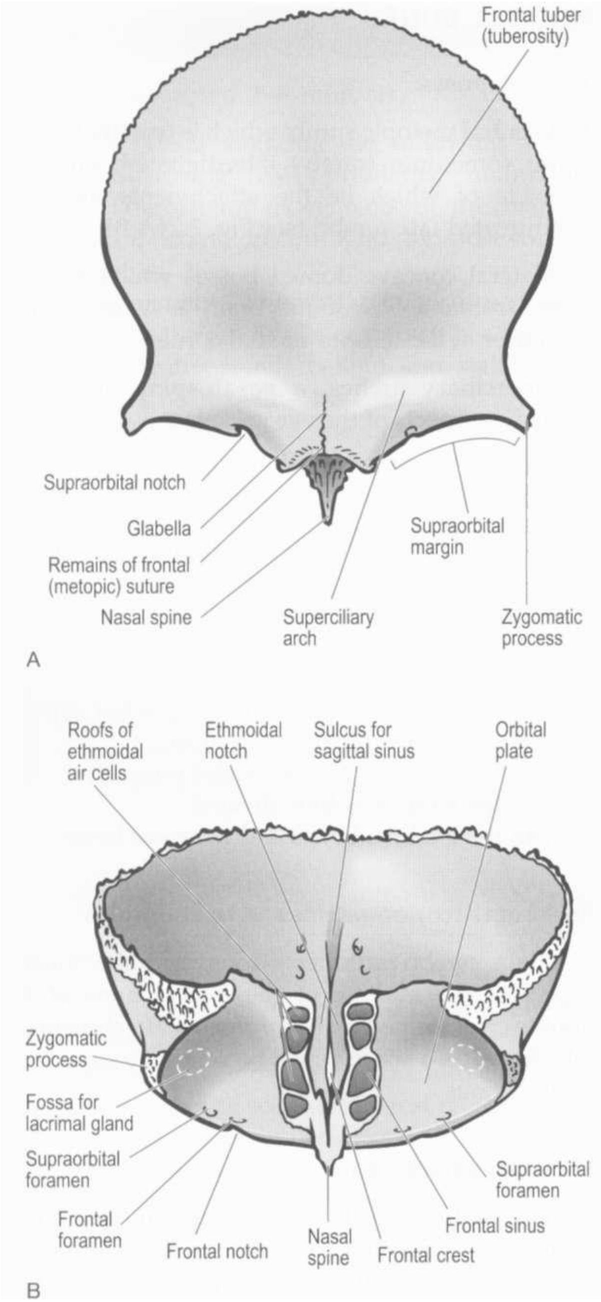


Figure 7.24 Frontal (A) and inferior (B) aspects of frontal bone with major features.

and coronal sutures, attaching via direct or indirect linkages with the frontal, temporal, parietal and occipital bones.

- **Frontalis** merges with the superficial fascia of the eyebrow area while some fibers are continuous with fibers of corrugator supercilii and orbicularis oculi attaching to the zygomatic process of the frontal bone, with further linkage to the epicranial aponeurosis anterior to the coronal suture. The action of the muscles is to produce wrinkling of the forehead (frowning), so assisting in facial expressiveness.
- **Corrugator supercilii** lies medial to the eyebrow and comprises a small pyramid-shaped structure lying deeper than occipitofrontalis and orbicularis oculi. Its action is to draw the eyebrow medially and down.
- **Orbicularis oculi** is a broad flat muscle which forms part of the eyelids, surrounds the eye and runs into the cheeks and temporal region. Parts are continuous with occipitofrontalis. It is the sphincter muscle of the eyelids, causing blinking and in full contraction drawing the skin of the forehead, temple and cheek towards the medial corner of the eye.
- **Procerus** is a slip of nasal muscle which is continuous with the medial side of the frontal part of occipitofrontalis. It acts to draw the medial eyebrow downwards.

Range and direction of motion

In classic cranial osteopathy, during flexion the frontal bone is said to be:

> *... carried by the sphenoid wings and, held by the falx cerebri, so rotates about an oblique axis through the squama, so that the glabella moves posterior, the ethmoid notch widens, the orbital plate's posterior border moves slightly inferior and lateral, the zygomatic processes move anterior and lateral and the squama 'bend' and recede at the midline. (Brookes 1981)*

It is the combined effect of sphenoidal flexion and the backwards pull of the falx, during the flexion phase of the cycle, that is thought to produce the midline frontal bone flexion, which would be conceivable if a true suture were present but clearly could not occur if the bones had fused, as is most commonly the case.

Other associations and influences

Associations with problems of the eyes and sinuses are clear from the geography of the region alone and congestion and discomfort in this area can at times be related to frontal bone compression or lack of freedom of motion. The connection with the falx cerebri offers other possible linkages, in particular to cranial circulation and drainage.

Dysfunctional patterns

Apart from direct blows to the forehead, few problems seem to arise as a direct result of frontal dysfunction. However, as with the parietals (see below), problems may arise as a result of the accommodation of the bone to influences on it, whether from the temporal, parietal, sphenoidal or the facial bones.

Palpation and treatment exercises for the frontal bone(s)

Exercise 7.22 Hypothenar eminence application for frontal lift

Time suggested 3-5 minutes

The patient is supine and you sit at the head of the table, elbows fully supported and fingers interlaced, so that the hypothenar eminences rest on the lateral angles of the frontal bones, with your fingers covering the metopic suture.

As the patient exhales the interlaced hands exert light compressive force to take out slack (grams only) via the hypothenar eminences (bringing them towards each other), utilizing a contraction of the extensor muscles of the lower arm (see Fig. 7.25).

At the same time a slight upwards (slightly cephalad and anteriorly directed) lift is introduced either uni- or bilaterally, to release the frontal bone from its articulations with the parietals, sphenoid, ethmoid, maxillae and zygomae.

This lift is held during several cycles of inhalation and exhalation after which, during the inhalation phase of breathing (the flexion phase of the cranial cycle), a slight exaggeration of this movement of the frontal is introduced, taking it slightly caudad and posterior (see Figs 1.2 and 6.9).

On the next exhalation (extension phase of the cranial cycle) cephalad and anterior motion is encouraged.

Maintaining the bilateral decompression all the while, the repetitive attempted enhancement of normal motion is continued until a sense of freer motion is noted and warmth or softness is felt.

At this time the frontal bone is allowed to settle back into its unassisted range of motion.

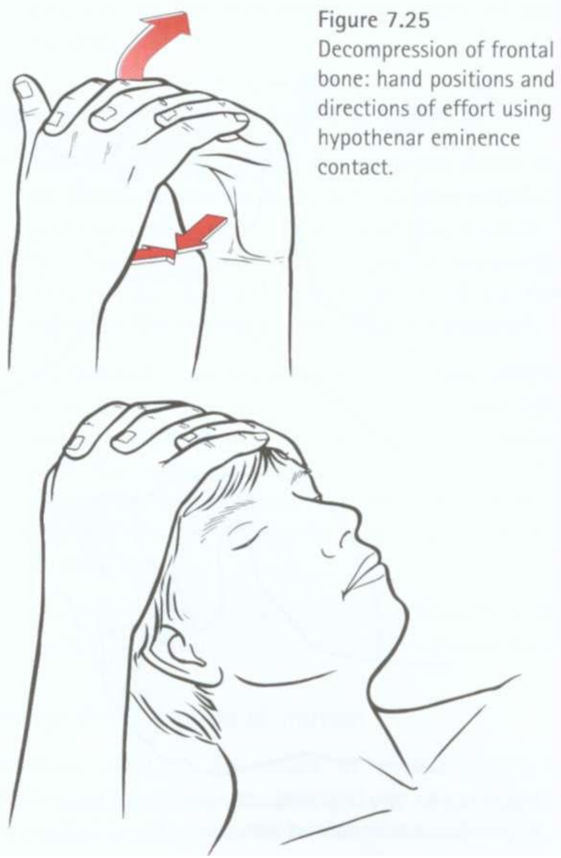


Figure 7.25
Decompression of frontal bone: hand positions and directions of effort using hypothenar eminence contact.

Exercise 7.23 Thumb application for frontal lift

Time suggested 3-5 minutes

The patient is supine and you sit at the head, with fingers facing each other under the occiput and with thumb pads placed carefully on the posterior aspect of the superior temporal line (Fig. 7.26).

Using light sustained compression and an anterior-medial pressure, the slack in the skin overlying the contact is removed so that the frontal bone is eased in an anterior direction, with the cranium offering a counterweight, applying traction at the thumb contacts.

This is maintained for several minutes, until a sense of release is noted.

This method should have the effect of increasing the length of the falx cerebri (see research evidence from Kostopoulos & Keramides (1992) as reported in Chapter 6).

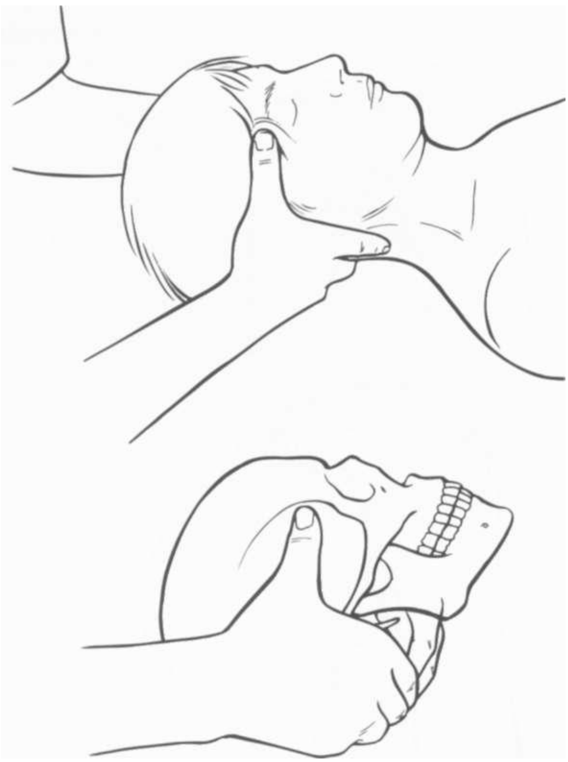


Figure 7.26 Decompression of frontal bone: hand positions and directions of effort using thumb contact.

Exercise 7.24 Falx cerebri release using V-spread

Time suggested 5-7 minutes

The patient is supine, neck supported on a cushion, external occipital protruberance (and inion) unsupported and accessible. You stand or sit at the head.

Two fingers (ring and middle) are placed facing nasally, astride the midline of the frontal bone (metopic suture), so that the heel of the hand lies close to the coronal suture (see Fig. 7.27).

One or two fingers of the other hand are placed onto the inion, applying very light pressure (ounces only) pointing directly towards the metopic suture, which lies between the V-spread contact.

These contacts should be maintained until a sense of release is noted.

The light sustained compression across the head may have a positional release influence on the falx cerebri.

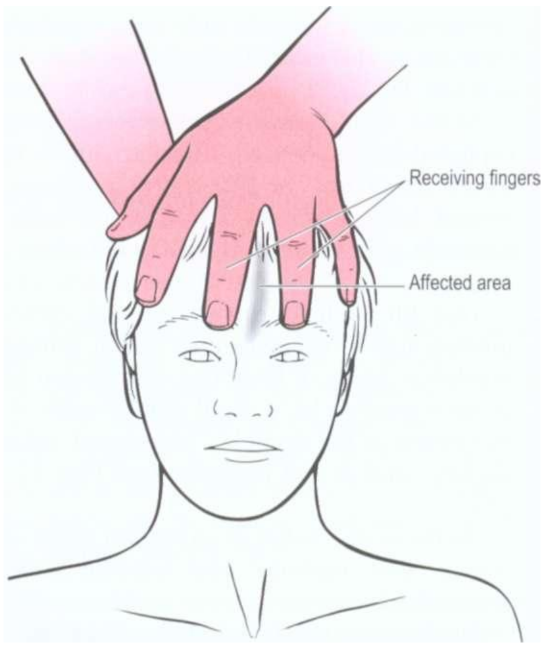


Figure 7.27 Anterior hand position alongside metopic suture in falx cerebri V-spread release.

PARIETALS

These are the simplest of cranial structures: two four-sided, curved, half-domes (Fig. 7.28A,B).

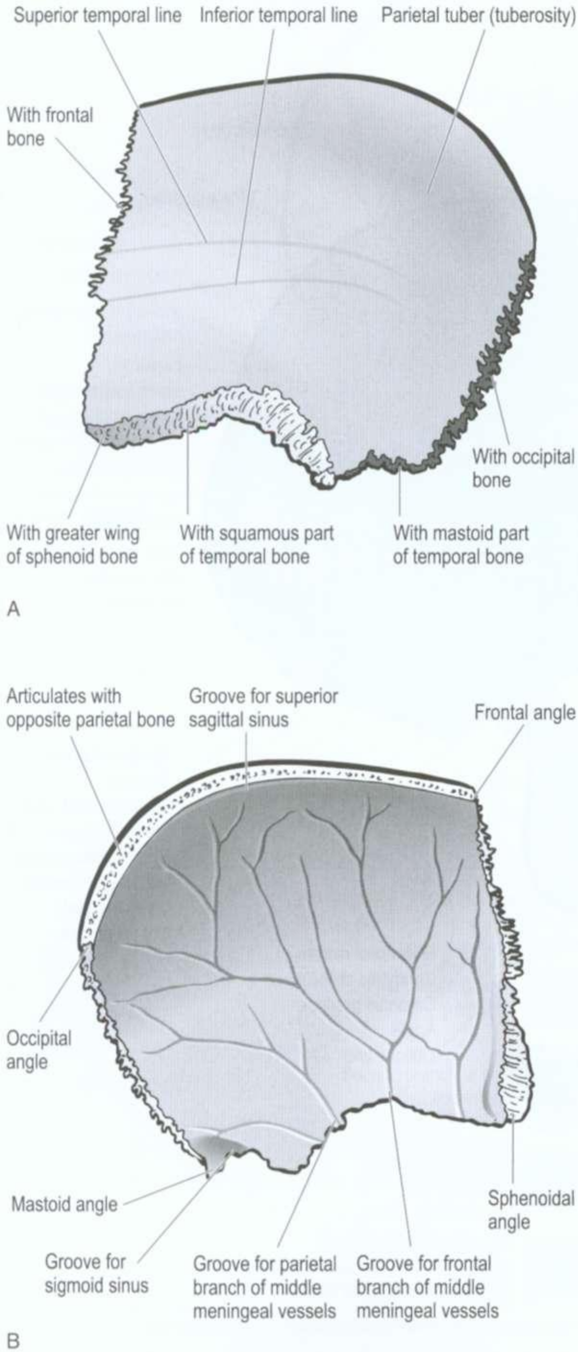


Figure 7.28 External (A) and internal (B) surfaces of left parietal bone showing articulation information.

Articulations

Each parietal articulates:

- with the occiput at the interdigitated lambdoidal suture
- with the sphenoid at the great wing
- with the temporal at the asterion and, in a remarkable junction of its externally beveled margin, at the squamous suture and at the parietal notch
- with the frontal bone at the coronal suture
- with the intensely interdigitated opposite parietal, at the sagittal suture.

Reciprocal tension membrane relationships

- The falx cerebri attaches strongly into a groove on each side of the sagittal suture, forming a space which is the superior sagittal sinus, meaning that any sutural deviation or restriction must influence drainage from this.
- In some individuals the tentorium cerebelli attaches to the posteroinferior angle of each parietal.

Muscular attachments (see Fig. 7.29A.B)

- **Temporalis** arises from the temporal fossa and its fibers converge to attach on the coronoid process and ramus of the mandible, medial to the zygomatic arch. The origin of temporalis crosses the coronal suture as well as that between the temporal bone and the parietal.
- **Auricularis superior** is a thin, fan-shaped muscle which arises from the epicranial aponeurosis, converging to insert by a flat tendon into the upper surface of the auricle. This allows for some degree of direct traction to be applied to the parietals utilizing 'ear-pull' techniques.
- **Occipitofrontalis** does not attach directly to the parietals although its aponeurosis covers them.

Range and direction of motion

Human studies, discussed in earlier chapters, indicate that approximately 250 urn of movement is available at the sagittal suture (Lewandoski et al

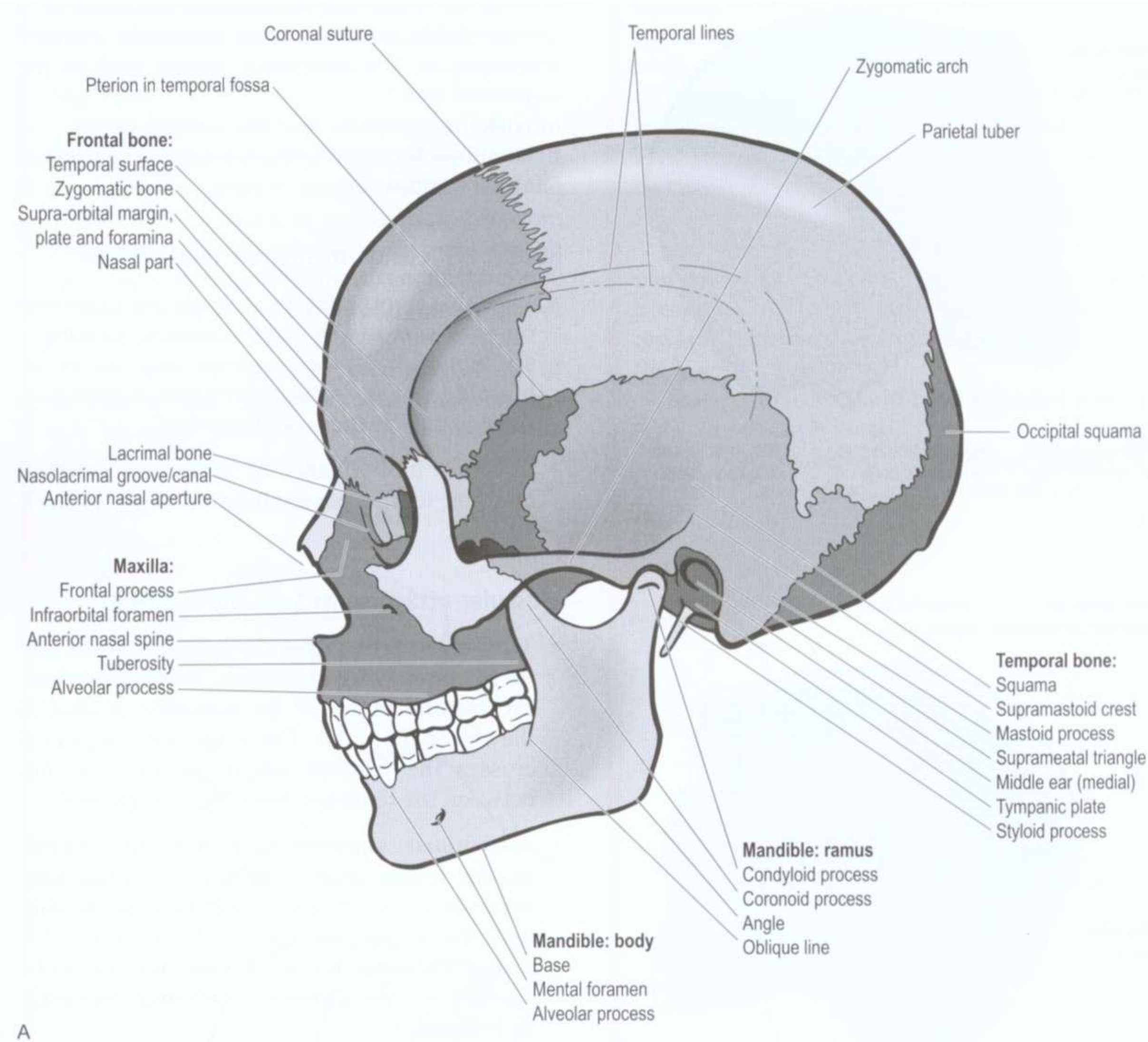


Figure 7.29 A Lateral aspect of skull with sutures and other major features

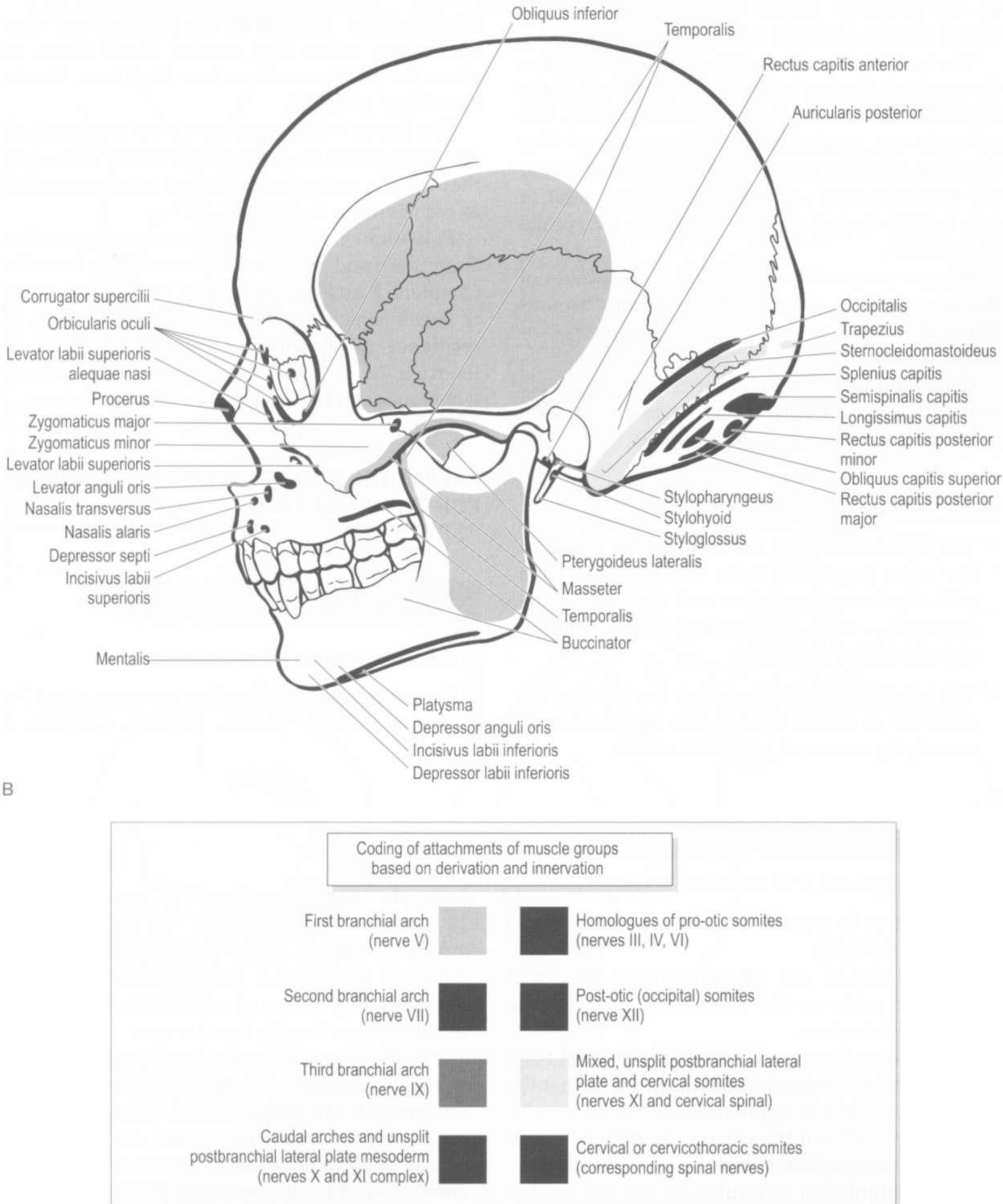


Figure 7.29 B Lateral aspect of skull showing muscular attachments.

1996). There is a greater degree of interdigitation on the posterior aspect of the sagittal suture, where motion potential is therefore greatest.

The traditional osteopathic cranial concept has the parietals flexing inferiorly ('flattening') at the sagittal suture. According to Brookes (1981), 'the parietals are carried by the temporals so that the inferior border moves lateral and anterior and the posteromedial angle moves slightly inferior and lateral, during the flexion phase of cranial movement'.

A more pragmatic view is that the pliability of the suture is a means of absorbing stresses imposed on the structure via either internal or external forces.

Other models (liquid/electric, energetic, etc.) offer different interpretations as to the motion potentials of these bones (Milne 1995).

Other associations and influences

- The connection with the falx cerebri is one of the most important links the parietals have with the inner circulation and drainage of the cranium - with the sagittal sinus running directly below the suture.
- The temporal bone articulation is a key area for evidence of cranial dysfunction and treatment, usually by means of temporal contact.

Dysfunctional patterns

Dysfunctional patterns in the parietals are rare, apart from when they receive direct blows or when the resilient sutures lose their free, 'shock-absorbing' potential.

The bones which articulate with the parietals are more likely to produce problems and when they do, the parietals are obliged to accommodate to the resulting stresses.

Palpation of the sagittal suture (as suggested in Exercises 6 and 7e in the Exercise section between Chapters 2 and 3) allows you to become aware of areas which are tense or 'hard', lacking in resilience or a sense of motion (particularly Exercise 7e, p. 59). Where appropriate, release techniques can be employed as outlined below.

PALPATION AND TREATMENT EXERCISES FOR THE PARIETALS

Exercise 7.25

Time suggested 20 minutes

Repeat the suture palpation exercises 6 and 7e, in the Exercise section, between Chapters 2 and 3.

Exercise 7.26 Parietal lift technique

Time suggested 4-5 minutes

The patient is supine and you are seated at the head of the table.

Your fingers are placed so that the small fingertip rests on the asterion, anterior to the lambdoidal suture.

The other fingerpads rest on the parietal bone just above the temporoparietal suture so that the middle fingers are approximately a finger width above the helix of the ear, on the parietal bones (*not* on the temporal bones).

The thumbs act as a fulcrum, bracing against each other or crossed above the sagittal suture without any direct contact (at this stage; see below) (Fig. 7.30A-D).

Apply gentle pressure - approximately 10 grams - medially with the fingerpads to crowd the sagittal suture and to disengage their temporal articulation. This pressure should be introduced by means of contraction of the wrist flexors, rather than by hand action.

The thumbs stabilize the hands as the pressure is maintained and a light but persistent lifting of the parietals, directly cephalad, is introduced by the fingerpads (while the medial compression is maintained) for between 2 and 5 minutes, during which time a sensation of the parietals 'spreading' and lifting superiorly might be noted.

During this procedure the other restricting influence, apart from the temporal suture

Exercise continues

Exercise 7.26 Parietal lift technique—*continued*

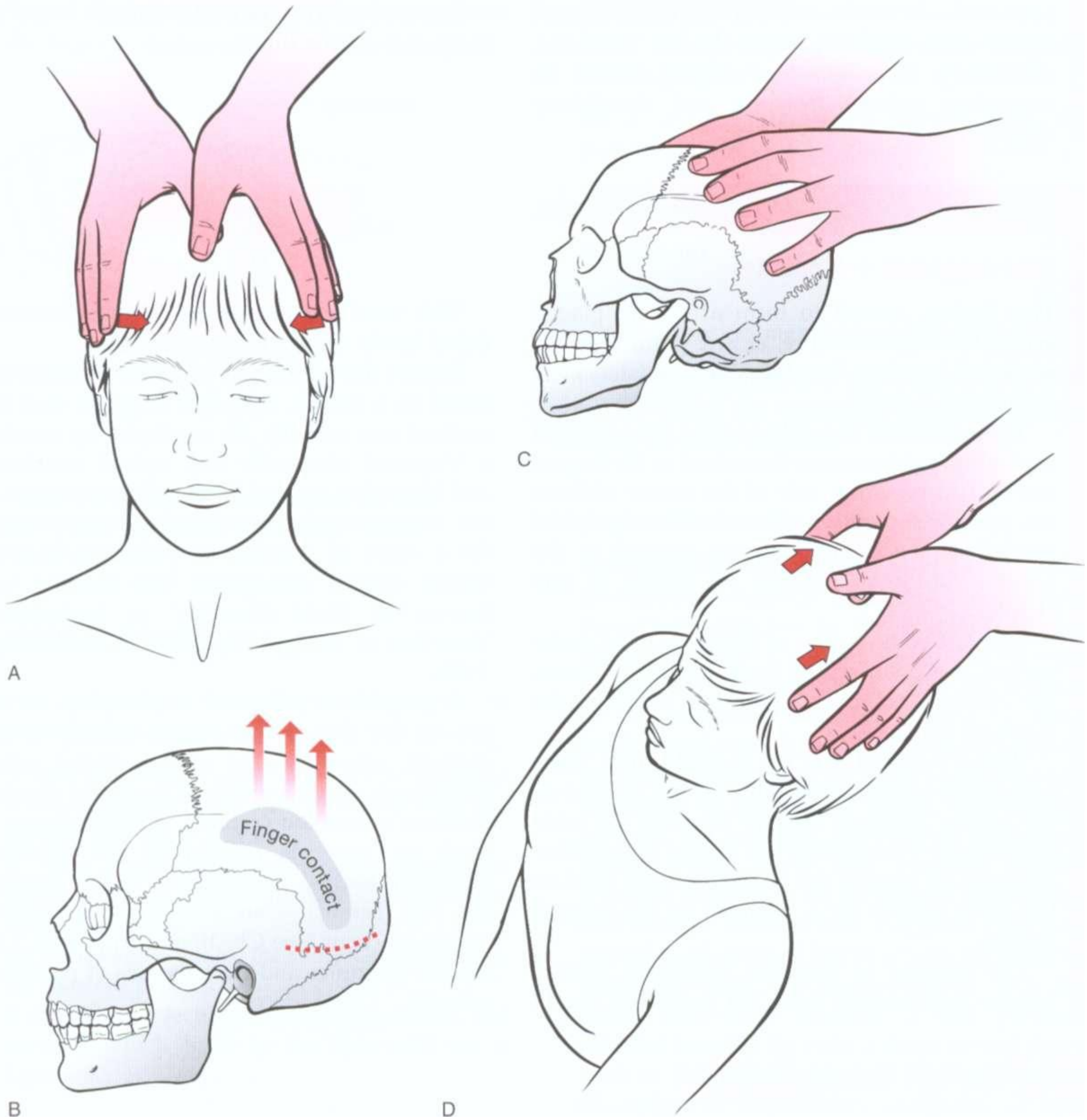


Figure 7.30 A Anterior aspect showing hand positions for parietal lift technique. B Finger contact sites and direction of parietal lift. C Lateral aspect showing fingers in position avoiding sutures. D Hand position and direction of effort during parietal lift technique application.

contact, is that offered by the falx cerebri and sensitivity should be maintained to any resistance it is offering.

Successful application of this parietal lift should enhance drainage via the superior sagittal sinus, formed by the falx cerebri's attachments to the parietals.

This process can be enhanced towards the end of the procedure, if you have noted a sense of softening and warmth in the tissues, by placing

Exercise continues

Exercise 7.26 Parietal lift technique—*continued*

your crossed thumbs on either side of the sagittal suture and applying light lateral pressure, alternately, in a gentle pumping action to encourage sutural freedom and circulatory efficiency.

Remember to avoid any contact with the temporals during this procedure.

Exercise 7.27 V-spread for the sagittal suture

Time suggested 4-5 minutes

Two fingers, spread to form a 'V, are placed across the sagittal suture, at any point where a sense of tension, 'hardness' or resistance to movement is noted.

These contacts can either apply light (grams) separation pressure over the suture or the fingers can be laid on either side of the suture without any specific separation effort (see description of precise sequence, although not applied to the sagittal suture, in Exercise 7.6 earlier in this chapter).

One or two fingertips of the other hand make contact at a point on the head diagonally across the cranium from, and pointing towards, the V-spread contact.

With a V-spread over the sagittal suture, place a fingertip contact intraorally, on the midline of the palate, pointing directly towards the mid-point of the V created by the fingers of the other hand (or, an area on the occiput may be used as the other contact for a V-spread on the sagittal suture).

The amount of pressure employed should involve an extremely light, but persistent, touch.

Wait until a strong sensation of pulsation is noted by the fingers forming the 'V.

Repeat this technique wherever restriction is noted in a suture. Upledger suggests that this method can usefully be employed by creating a V-spread alongside any spinal restriction and 'directing energy' from a finger contact on the cranium pointing towards it and waiting for a sense of warmth or pulsation. In traditional cranial osteopathy this method was known as 'fluid direction' or (sometimes) 'direction of energy' (Upledger & Vredovoogd 1983).

A possible 'mechanical' explanation for the proven (by clinical experience) efficacy of this method, when used to release cranial suture restrictions, could be that in applying counter-pressure across the cranium, a slight degree of slack or 'ease' is offered to the attaching reciprocal tension membrane - in this example the falx cerebri - so allowing a positional release to occur (see Ch. 10 and Appendix 1 for further examples and explanations of positional release).

Exercise 7.28 'Hair tug' method

The methods for releasing occipitofrontalis, especially the positional release and the 'hair-tug' approaches, as described in Chapter 9 (Exercise 9.3, p. 275), will help to release parietal suture restrictions resulting from adherence of the aponeurosis.

Exercise 7.29 Venous sinus drainage

Repeat Exercise 6.10 (p. 168), venous sinus drainage.

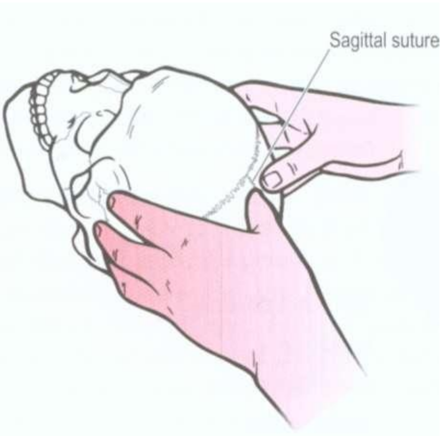


Figure 7.31 Separation forces applied alongside sagittal suture as part of venous sinus drainage sequence.

TEMPORAL BONES

These comprise a complex arrangement of different bone formats:

- A slim, fan-shaped upper portion (the squama) with an internal bevel for articulation with the parietal (see Fig. 7.32A,B)
- A long projecting column (the zygomatic process) which reaches forwards to articulate with the zygoma
- An anchorage point for the sternocleidomastoid, the mastoid process
- A rock-like projection, the petrous portion, the apex of which links to the sphenoid via a ligament.

Articulations

Each temporal articulates:

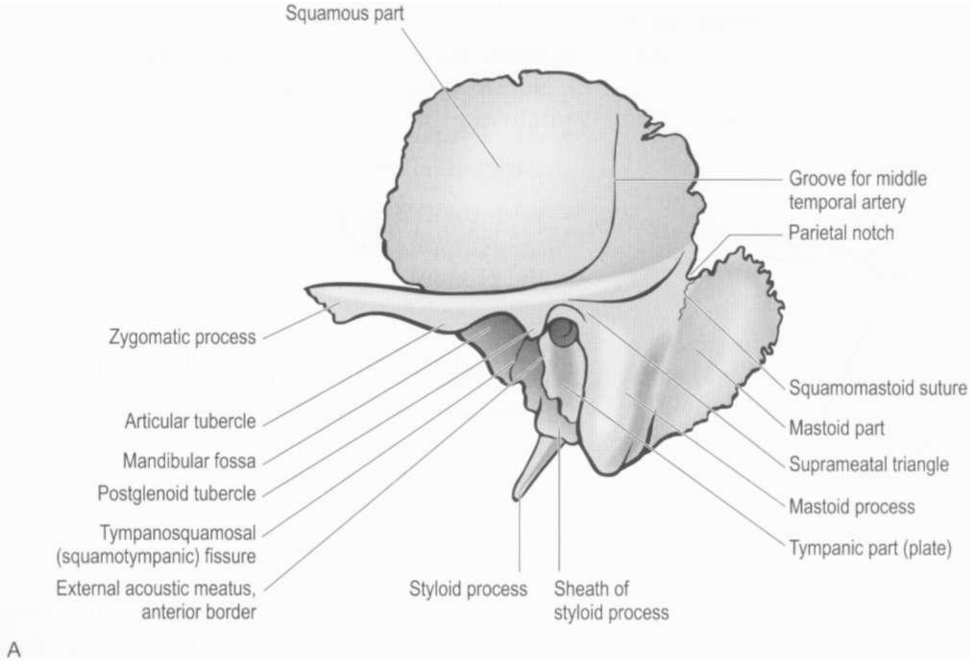
- With the zygoma at the zygomaticotemporal suture, a small pivot junction
- At the interdigitated mastoid suture which articulates with the occiput (the junction of the temporal with the occiput and parietal is the asterion). The jugular notch of the occiput and the jugular fossa of the temporal bone meet to form an articulation
- With the sphenoid at the sphenotemporal suture, deep in the cranium
- At a uniquely bevelled suture with the parietals, allowing for a gliding articulation
- With the frontal at the pterion (the junction of the temporal, sphenoid, parietal and frontal is the pterion).

Reciprocal tension membrane relationships

On the petrous portion of the bone, a groove is apparent where the tentorium cerebelli attaches, forming the petrosal sinus.

Muscular attachments

- **Sternocleidomastoid** arises from heads on the manubrium sternum and the clavicle and powerfully attaches to the mastoid process (clavicular fibers), as well as to the superior nuchal line (sternal fibers). The importance of this muscular influence cannot be overemphasized, since it allows enormous forces to be exerted onto one of the most vulnerable and important of the cranial bones. The linkage between, for example, postural or respiratory habits which stress this postural muscle (possibly leading to its permanent shortening) and cranial dysfunction suggests that any cranial work applied before efforts are made to normalize both the sternomastoid and the habits that have stressed it will produce minimal benefits for only a short period. Refer back to Box 5.2 on page 116, where there is discussion of Dejarnette's categories of dysfunction, which features sternocleidomastoid in its methodology.
- **Temporalis** arises from the temporal fossae. The posterior aspect of the origin of the muscle lies on the temporal bone. The inferior attachment is to the ramus of the mandible.
- **Longissimus capitis** arises from the transverse processes of T1 to T5 and the articular processes



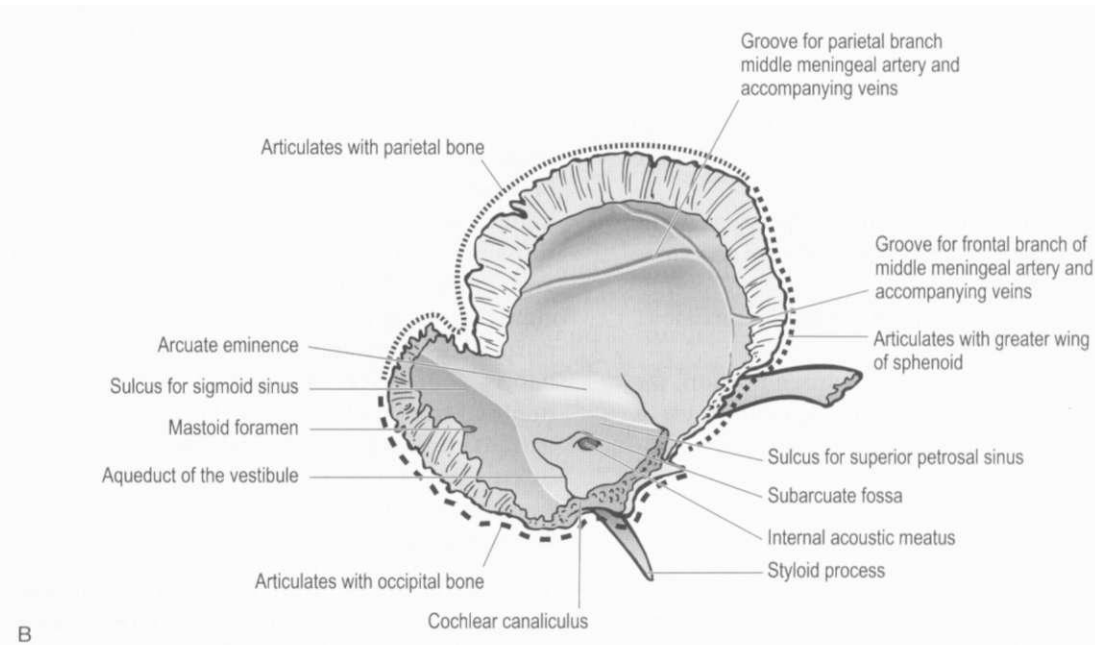


Figure 7.32 A Left temporal bone and major features, external aspect. B Left temporal bone and major features, internal aspect.

of C4 to C7, attaching to the mastoid process. Again this is a powerful postural muscle which will shorten under prolonged mechanical/ postural stress and therefore is capable of producing sustained, virtually permanent drag on the mastoid in an inferior/posterior direction. If such traction were combined with a similar drag anteroinferiorly by sternomastoid, the temporal bone's ability to move freely would be severely compromised.

- **Splenius capitis** arises from the spinous processes of C7 to T3 as well as the lower half of the ligamentum nuchae and attaches to the mastoid process and the lateral aspect of the superior nuchal line. Any sustained traction from this would crowd the suture between the occiput and the temporal bone, reducing its potential for free motion.

Range and direction of motion

At its simplest, the motion during flexion can be visualized as a flaring outwards of the squama (as it pivots at its beveled junction with the parietal) while the mastoid tip moves posteromedially. These all return to neutral during the extension (internal rotation) phase of the cycle.

A more complex description is offered by Denis Brookes (1981):

> *When the temporal bone moves into flexion (external rotation) the superior border of the petrous portion moves anterior and lateral, while the petrous apex rolls away from the rising basilar process; the squamous superior border rolls anterior and lateral; the zygomatic process moves anterior; the mastoid process moves medial and posterior and the mastoid portion moves superior to lateral.*

Other associations and influences

- The auditory canal passes through the temporal bone, while the internal auditory meatus carries the seventh and eighth cranial nerves.
- The trigeminal ganglion is in direct contact with the petrous portion.
- The jugular vein passes through the jugular foramen, part of which is formed by the temporal bone's inferior surface.
- The stylomastoid foramen allows passage of the seventh cranial (facial) nerve.
- The mandibular fossa forms part of the temporomandibular joint.

This is arguably the most complex bone in the cranium (possibly excluding the sphenoid), which is subject to a variety of influences, including thoracic and cervical stresses via sternocleido-mastoid and longus capitis, as well as dental influences via the temporomandibular joint and the temporalis muscle.

The potential for direct negative influences on temporal mechanics, emerging from emotionally induced habits such as bruxism or upper chest breathing patterns, is obvious.

Because of its direct linkage with the tentorium cerebelli, any dysfunctional pattern of a temporal bone automatically influences the other bones with which the tentorium is connected and the other temporal bone, as well as the occiput and the sphenoid.

Dysfunctional patterns

A wide range of symptoms may be associated with temporal dysfunction, often following trauma such as whiplash or a blow to the head. Amongst the commonest reported in osteopathic literature are the following.

- Loss of balance, vertigo
- Nausea
- Chronic headaches
- Hearing difficulties and recurrent ear infections in children
- Tinnitus
- Optical difficulties
- Personality and emotional fluctuations (mood swings)
- Bell's palsy
- Trigeminal neuralgia.

Palpation and treatment exercises for the temporal bones

Exercise 7.30 Assessment of temporal motion

Time suggested 3-5 minutes

The patient is supine and you are seated at the head.

Insert your middle fingers into each external auditory meatus and place your ring fingers onto the mastoid processes (see Fig. 7.33).

Sit quietly in this position and sense for motion at either or both finger contacts, as the mastoid eases posteromedially during the flexion phase and returns to neutral during extension.

During flexion a very slight clockwise (anteroinferior) rotation of the external auditory meatus may be noted by the middle fingers.

Compare what is being palpated on one side with the other. Are the movements noted symmetrical?

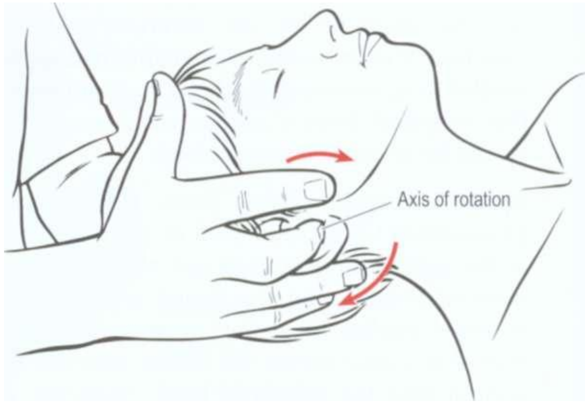


Figure 7.33 Assessment of temporal motion showing axis of rotation into flexion (external rotation/ inhalation).

Exercise 7.31 Temporal springing

Repeat DiGiovanna's temporal spring exercise (Exercise 6.4, p. 152).

Exercise 7.32 Bitemporal rolling

Time suggested 5-7 minutes

Sit at the head of your supine patient.

Interlock your fingers (or have the hands cupped, with one in the other) so that the head is cradled, your thumbs are parallel on the anterior surfaces of the mastoid processes, while the thenar eminences support the mastoid portion of the bone.

Your index fingers should cross each other and be in direct contact (see Fig. 7.34A,B).

- Create an alternating rocking motion (one side going into flexion as the other goes into extension) at the thumb contact, by pivoting the middle joints of your index fingers against each other in rhythm with cranial flexion and extension.
- The amount of pressure introduced at the mastoid should be grams only and should initially maintain and enhance the current rhythm of cranial motion.
- When you become expert at applying this method it is possible to gradually speed up (stimulate) or slow down the cranial rhythm (to inhibit and relax the individual and, it is suggested, lower blood pressure).
- Following bitemporal rolling, synchronous rolling should be performed (next exercise).

Important note Always try to complete contact with the temporals during the neutral phase, between the extremes of motion.

Exercise 7.32 Bitemporal rolling—*continued*

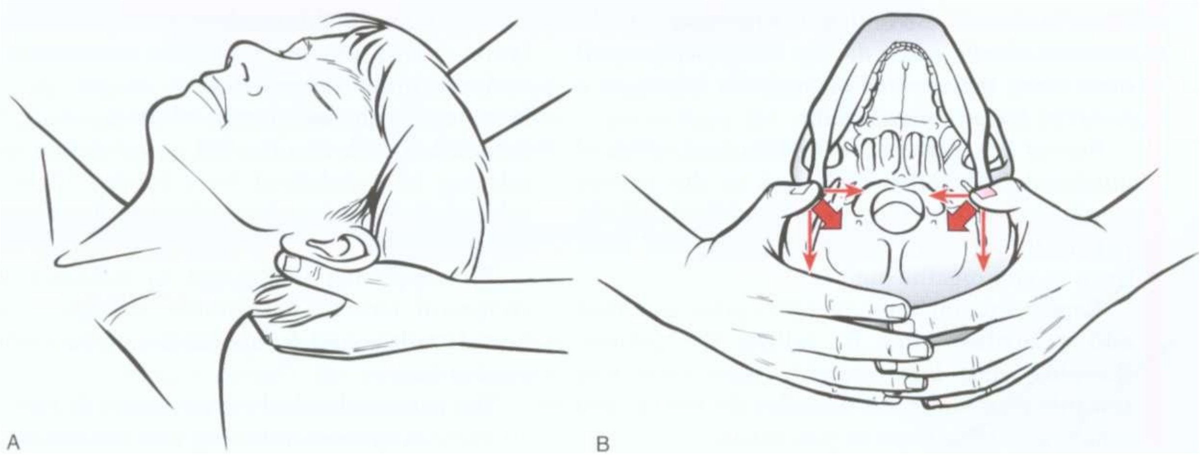


Figure 7.34 Bitemporal roll hand position (A) and position of thumbs (B) on mastoid processes and directions of effort to encourage temporal flexion (external rotation, inhalation) motion.

Exercise 7.33 Synchronous temporal rolling

Time suggested 5-7 minutes

The hand hold and general positioning are as in Exercise 7.32 (see Fig. 7.34), above.

The deep forearm flexors are employed to exert gentle pressure, via the thumbs, onto the mastoid processes during the inhalation (external rotation, flexion) phase of the cycle. This takes the mastoids posterior and medial and encourages normal flexion motion of the temporal bones.

As exhalation (internal rotation, extension) occurs, the forearm muscles are released to allow a return to neutral.

As this return to neutral occurs, a very slight (grams only) pressure can be introduced via the thenar eminences, resting on the mastoid portions of the temporal bones, taking these slightly medial and posterior, encouraging a slight exaggeration of the extension phase.

By repeating these motions, the amplitude of both phases of the cycle of cranial motion will be increased.

A gradual acceleration of the rate is possible, which is thought to encourage greater cerebrospinal fluid fluctuation. A slowing down of the rate is also possible, producing a relaxing effect.

This synchronous rolling should always be used to complete the treatment if alternate rolling has been used (see previous exercise).

Important note Always try to complete contact with the temporals during the neutral phase, between the extremes of motion.

Exercise 7.34 Multiple release method

Time suggested 5-7 minutes

The patient is supine and you are seated at the head, with your arms supported on the table, elbows together, fingers interlaced, thenar eminences on the mastoid portions and thumbs lying on the anterior surfaces of the mastoid processes.

The patient inhales deeply and you simultaneously spread your elbows apart, which emphasizes the external rotation (flexion) of the mastoid processes/temporal bones.

On exhalation, return your elbows to your sides.

Exercise continues

Exercise 7.34 Multiple release method—*continued*

Important note ***No direct squeezing of the mastoid should occur during this procedure, all force being transmitted through the hands, as a result of the arm movement.***

Repeat this pattern for three or four cycles of inhalation/exhalation and then as the pattern continues, synchronous with inhalation, ask the patient to 'Strongly clench your fists and relax them as you breathe out'.

Repeat this for three or four cycles and then add a further force by telling the patient: 'Keeping your legs straight, draw your toes towards your knees (i.e. dorsiflex the feet) as you inhale, and relax them as you exhale'.

Continue with this combined series of motions (your elbows moving externally on inhalation and returning on exhalation, as the patient breathes deeply and slowly, while clenching the fists and dorsiflexing the feet on inhalation, and relaxing on exhalation) for a further 10 or so cycles before ceasing these efforts, at the end of a complete cycle.

This approach is thought to influence the reciprocal tension membranes strongly - via fascial pulls - and to benefit the entire cranial mechanism.

The patient should be encouraged to rest for 10 minutes or more following this procedure.

Exercise 7.35 Ear-pull method for temporal release

Time suggested 5-7 minutes

You sit at the head of the supine patient.

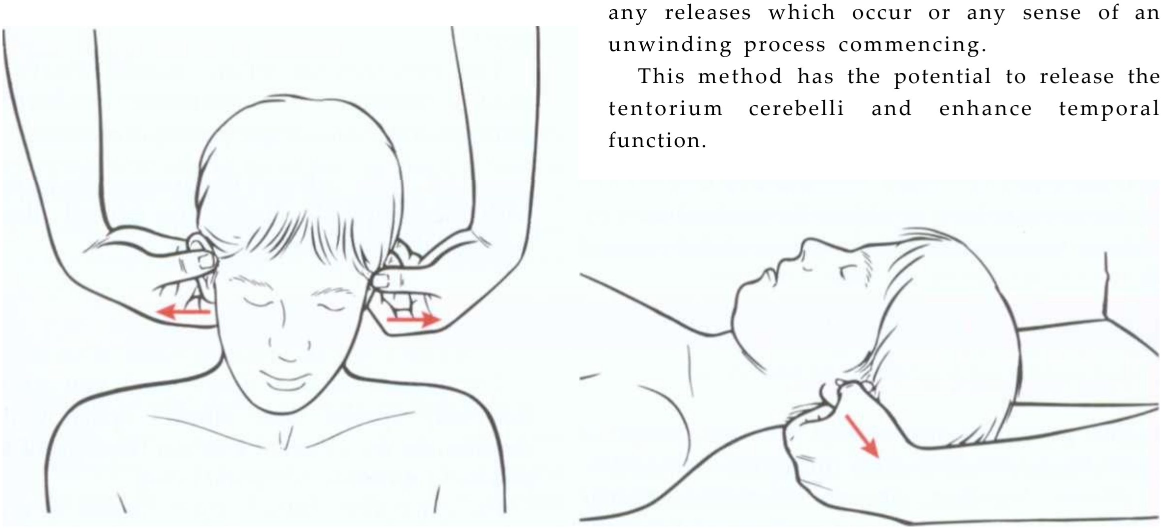
With your arms parallel to each other and with the sides of the patient's head and with your wrists markedly flexed, place each thumb pad into an ear at the antihelix, with your index and middle fingers in opposition to the thumbs on the posterior surfaces of the external ear (see Fig. 7.35A,B).

Using no more than 2 ounces of force, less usually, take out the slack and ease the ears away from their anchorage on the temporal bones, at an angle of around 45° posterolateral^, by increasing your wrist flexion slightly, *not by pulling on the ears.*

This action distracts the petrous portions of the temporals from their sphenoidal articulations at the clivus.

Hold this traction for several minutes, sensing any releases which occur or any sense of an unwinding process commencing.

This method has the potential to release the tentorium cerebelli and enhance temporal function.



A B

Figure 7.35 A,B Different views of temporal release utilizing 'ear pull'.

Exercise 7.35 Ear-pull method for temporal release—*continued*

Release the traction very slowly on completion.

In regard to this approach, Upledger says: 'Place gentle traction posterolaterally on both external ears. Directions will become self-determining by the inherent patterns of the tissues which will be in a state of constant dynamic change as the temporal bones decompress from the sphenobasilar region' (Upledger & Vredevoogd 1983).

Exercise 7.36 Unilateral gapping of the squamous suture

Time suggested 5-7 minutes

To treat the possible effects of unilateral temporal trauma (possibly dental), the patient is supine, with the head turned away from the side to be treated (to the right in this example).

You are seated at the head with your left thenar eminence resting on the posterior aspect of the left temporal squama, your thumb resting just superior to the auricle with fingers on the side of the neck (see Fig. 7.36).

Your right thenar eminence is placed onto the parietal bone, so that your right thumb rests parallel with and just superior to the left thumb, fingers draped over the left mandible.

Your thenar eminences are now on either side of the squamous suture.

As you sense the start of the flexion phase of the cranial cycle, follow the temporal motion with your left hand, taking it in a caudad direction, while at the same time easing the right hand cephalad to 'lift' the parietal on that side - in effect gapping the suture between parietal and temporal bones unilaterally.

Figure 7.36 Squamous suture release hand positions.

Hold this distraction for a number of cycles until you sense a release/warmth/pulsation, at which time ensure that the temporal is released at a neutral point in the cycle, not while in extension or flexion.

ZYGOMAE

These comprise:

- A central broad, curved malar surface (see Fig. 7.37A-C)
- A concave 'corner' which makes up most of the lateral and half of the inferior border of the orbit
- An anteroinferior border which articulates with the maxilla
- A superior jutting frontal process which articulates superiorly via interdigitations with the temporal portion of the frontal bone and posteriorly with the greater wing of the sphenoid
- A posteromedial border which articulates via interdigitations with the greater wing above and the orbital surface of the maxilla below.

Articulations

- With the temporals via the zygomatic bone where it meets the zygomatic process at the zygomaticotemporal suture.

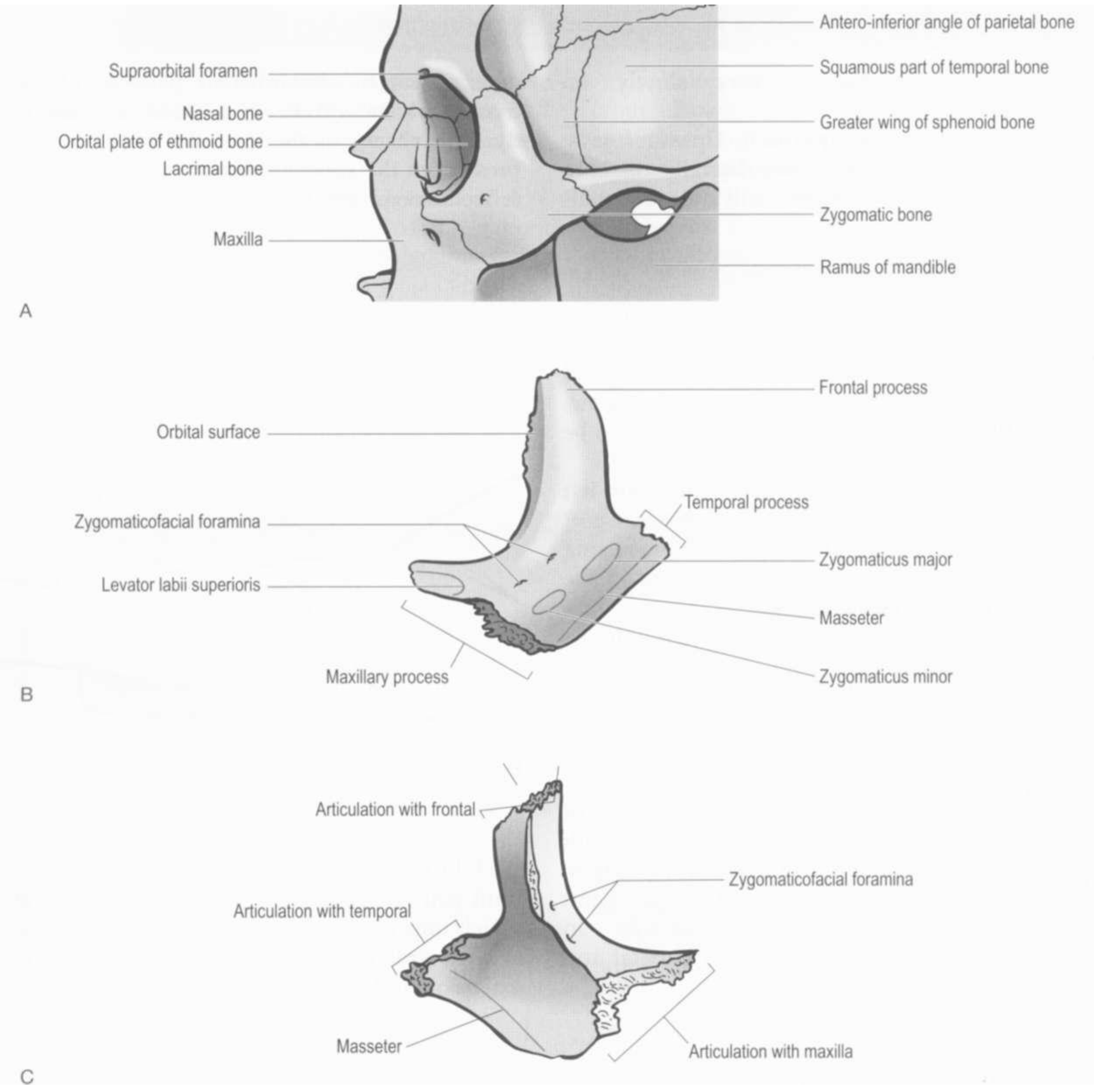


Figure 7.37 The left zygomatic bone in situ with associated structures (A); the lateral aspect of the left zygomatic bone showing muscular attachments and articulations (B) and the medial aspect of the zygomatic bone showing muscular attachment and articulations (C).

- With the frontal bone at the frontozygomatic suture.
- With the maxillae at the zygomaticomaxillary suture.
- With the sphenoid at the zygomatic margin.

There are no direct reciprocal tension membrane relationships.

Muscular attachments

- The **masseter** attaches from the zygomatic arch, both superficially and deep, running superficially to the lower lateral ramus of the mandible and deep to the coronoid process and upper ramus of the mandible.

- **Zygomaticus minor and major** extend from the zygomatic bone to the upper lip and the angle of the mouth - involved in raising the upper lip and laughing.
- **Orbicularis oculi** is a broad flat muscle which forms part of the eyelids, surrounds the eye and runs into the cheeks and temporal region. Parts are continuous with occipitofrontalis. It is the sphincter muscle of the eyelids, causing blinking and in full contraction drawing the skin of the forehead, temple and cheek towards the medial corner of the eye.
- **Levator labii superioris** arises from the frontal portion of the maxilla and runs obliquely laterally and inferior to insert partly in the greater alar cartilage and partly into the upper lip. Its actions are to raise and evert the upper lip and dilate the nostrils.

Range and direction of motion

The orbital border is said to 'roll anterolaterally and the tuberosity rolls inferior' in the classic osteopathic description of flexion motion (Brookes 1981).

Other associations and influences

The zygomae offer protection to the temporal region and the eye and, along with the ethmoid and vomer, shock absorbers which spread the shock of blows to the face.

Milne (1995) suggests that 'they act as speed reducers between the markedly eccentric movements of the temporals and the relative inertia of the maxillae'.

The zygomaticofacial and zygomaticotemporal foramina offer passage to branches of the fifth cranial nerve (maxillary branch of trigeminal).

Dysfunctional patterns

Sinus problems can often benefit from increased freedom of the zygoma. They should always receive attention after dental trauma, especially upper tooth extractions, as well as trauma to the face of any sort, as they are likely to have absorbed the effects of the forces involved.

Habits such as supporting the face/cheekbone on a hand when writing, for example, should be discouraged as the persistent pressure modifies the movement not just of the maxillae but all associated bones and structures. They should be assessed and treated in relation to problems involving the temporals, maxillae and sphenoid.

Palpation and treatment exercises for the zygomae

Exercise 7.37 Zygomae release – various approaches

Time suggested 5-7 minutes

The patient is supine and you are seated at the head.

Rest the tips of the middle, index and ring fingers just below the inferior surface of the anteroinferior border, with the thumbs resting on the forehead, facing each other above the eyebrows (Fig. 7.38A). Make absolutely sure that your contacts are anterior to the zygomaticotemporal suture and gently (grams only) encourage flexion and extension of the bones, during the appropriate phases of the cranial cycle.

Decompression can be introduced in any direction from this contact, bilaterally or unilaterally, as appropriate.

In order to produce greater purchase for lateral decompression, the thumbs can be brought from their forehead resting place to active involvement on the anterosuperior surface of the zygoma, close to the infraorbital foramen (see Fig. 7.38B).

With this hand position it is possible not only to engage barriers, but also to test for directions of ease, using light movements of the maxillae, individually, into lateral, anterior, inferior or superior directions, stacking one position of ease onto another and holding. (See Ch. 10 on positional release and Appendix 1 on treatment methods, for a greater understanding of this approach.)

Exercise continues

Exercise 7.37 Zygomae release – various approaches—*continued*

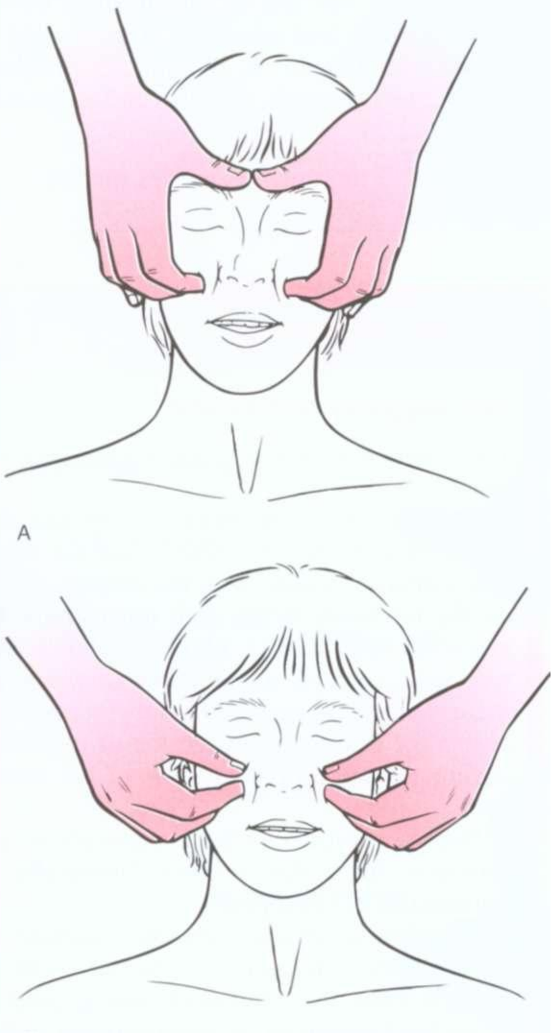


Figure 7.38 A Palpation of the zygoma utilizing three fingers. B Testing for directions of freedom of zygomatic motion utilizing fingers and thumb.

MAXILLA

This extremely complex bone is made up of:

- The body, which houses an air sinus (see Fig. 7.39)
- A superior concave orbital surface which forms part of the floor of the eye socket
- An infraorbital foramen and canal which offer passage to part of the fifth cranial (trigeminal) nerve and the infraorbital artery
- An anterior spine to which the nasal septum attaches
- An aperture (maxillary hiatus) on the medial wall of the air sinus which is largely covered by the palatines posteriorly and the inferior conchae anteriorly
- A jutting superior projection which articulates by interdigitation with the frontal bone
- A notch (ethmoid notch) on the medial surface of this projection which articulates with the middle conchae
- A lateral zygomatic process which articulates with the zygoma at the dentate suture
- An inferiorly situated palatine process which forms most of the hard palate (anterior portion)
- An inferiorly situated central suture for articulation with its pair, the intermaxillary suture
- A suture which runs transversely across the palate where the maxillary palate and the palatine bone articulate (maxillopalatine suture)
- A central (incisive) canal, placed inferiorly and anteriorly, for passage of the nasopalatine nerve
- The alveolar ridge, an anterior/inferior construction for housing the teeth.

Articulations

As described above, the maxillae articulate at numerous complex sutures with each other and with the teeth they house, as well as with the ethmoid and vomer, the palatines and the zygoma, the inferior conchae and the nasal bones, the frontal bone and the mandible (by tooth contact) and sometimes with the sphenoid.

There are no direct reciprocal tension membrane relationships.

Muscular attachments (see Fig. 7.40)

- The **medial pterygoid** runs from the palatine bones and the medial surface of the lateral

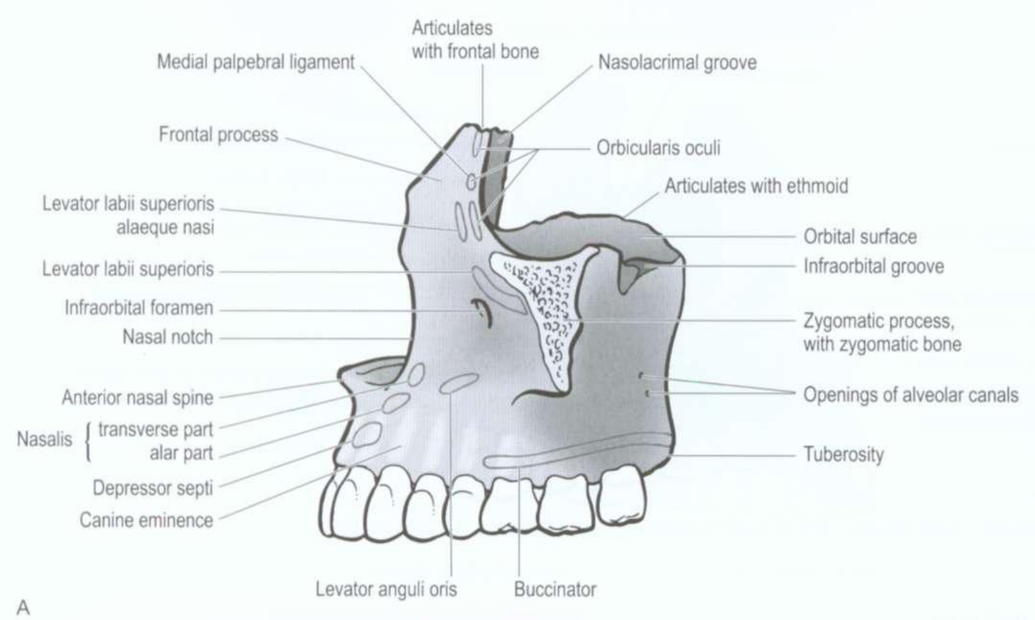


Figure 7.39 Left maxilla, lateral aspect showing major features, articulations and muscular attachment sites.

pterygoid plate of the sphenoid and the tuberosity of the maxilla to the ramus and angle of the mandible, to which it attaches via a tendon. The action is to close the jaw, elevating the mandible. Hypertonic states will interfere with sphenoid function, with the maxilla and with normal motion of the palatines. It is commonly involved in temporomandibular problems.

- The **masseter** attaches from the zygomatic arch both superficially and deep, running superficially to the lower lateral ramus of the mandible and deep to the coronoid process and upper ramus of the mandible.
- **Buccinator** is a thin, four-sided muscle which forms part of the cheek, occupying the space between the maxilla and the mandible. It attaches to the alveolar processes of the maxilla and the mandible, opposite the three molar teeth. Its fibers converge towards the angle of the mouth and the lips. Its action is to compress the cheeks against the teeth during chewing and it is involved in the act of blowing (buccinator means trumpeter).
- Of lesser importance, but also attaching to the maxillae, are other muscles, many of which have to do with facial expression as well as mouth movement in eating. These include orbicularis oris, depressor anguli oris, levator labii superiosis, levator labii superiosis alaeque nasi, levator anguli oris, nasalis, depressor septi nasi, risorius.
- There are also strong influences from the muscles of the tongue, although these do not directly attach to the maxillae.

Range and direction of motion

These follow the palatines (which follow the pterygoid processes of the sphenoid) so that, during the flexion phase of the cranial cycle, 'the nasal crest moves inferior and posterior, the tuberosity moves lateral and slightly posterior, the frontal process posterior border moves lateral and the alveolar arch widens posteriorly' (Brookes 1981).

Other associations and influences

Because of the involvement of both the teeth and the air sinuses, the cause of pain in this region is not easy to diagnose. These connections (teeth and sinuses) as well as the neural structures which pass through the bone, plus its multiple associations with other bones and its vulnerability to trauma, make the maxilla one of the key areas for cranial therapeutic attention.

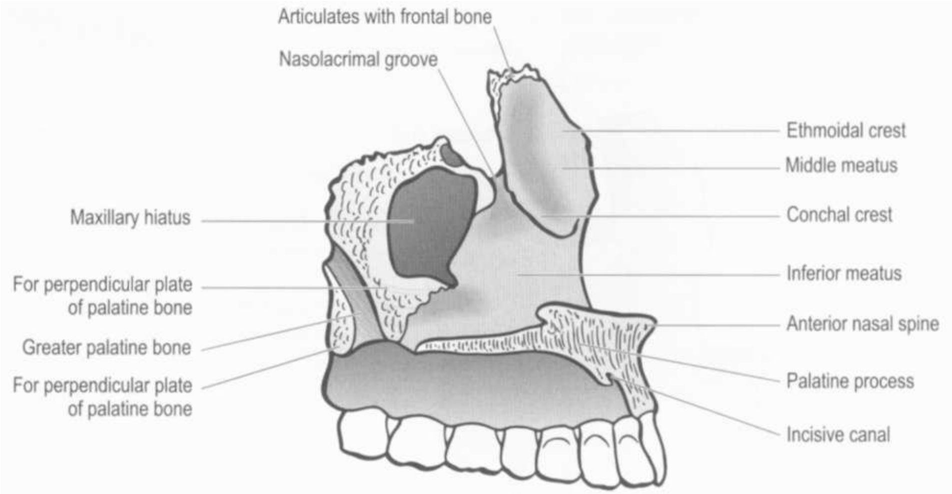


Figure 7.40 Left maxilla, medial aspect showing major features and articulations.

Dysfunctional patterns

Headaches, facial pain and sinus problems plus a host of mouth and throat connections with emotions (especially 'unspoken' ones) mean that purely structural and largely mind-body problems meet here, just as they do in dysfunctional breathing patterns.

Palpation and treatment exercises for the maxillae

Exercise 7.38 Direct inferior maxillary decompression – method 1

Time suggested 3-4 minutes

You are seated at or stand to one side of the head of the supine patient.

Use absorbent paper to dry saliva from the upper incisors. Wearing surgical gloves, grasp the upper incisors between fingers (index is best) and thumbs.

Using *very light* traction, introduce a pull caudally to distract the maxillae from their superior attachments and to also initiate a caudad movement of the vomer, ethmoid and, ultimately, the falx cerebri.

Hold the distracting pull for several minutes to ensure a complete release of these structures, before slowly relaxing your hold.

Exercise 7.39 Direct anterior maxillary decompression – method 2

Time suggested 3-4 minutes

You stand to one side of the patient's supine head.

With your cephalad hand, engage the great wings of the sphenoid between middle finger and thumb.

Your caudad hand is taken, palmar side cephalad, to the open mouth of the patient and the (gloved) index and middle fingers (separated widely) are placed into the mouth and hooked behind the last or last but one upper teeth.

An anteriorly directed decompression force (ounces at most) is slowly introduced, which brings the maxillae away from their posterior attachments with the palatines, the zygoma, the conchae and the ethmoid (and possibly the pterygoid processes if impaction has occurred).

Hold the distracting pull for several minutes to ensure a complete release, before slowly relaxing your hold.

PALATINES

This complex, extremely thin, hook-shaped structure includes:

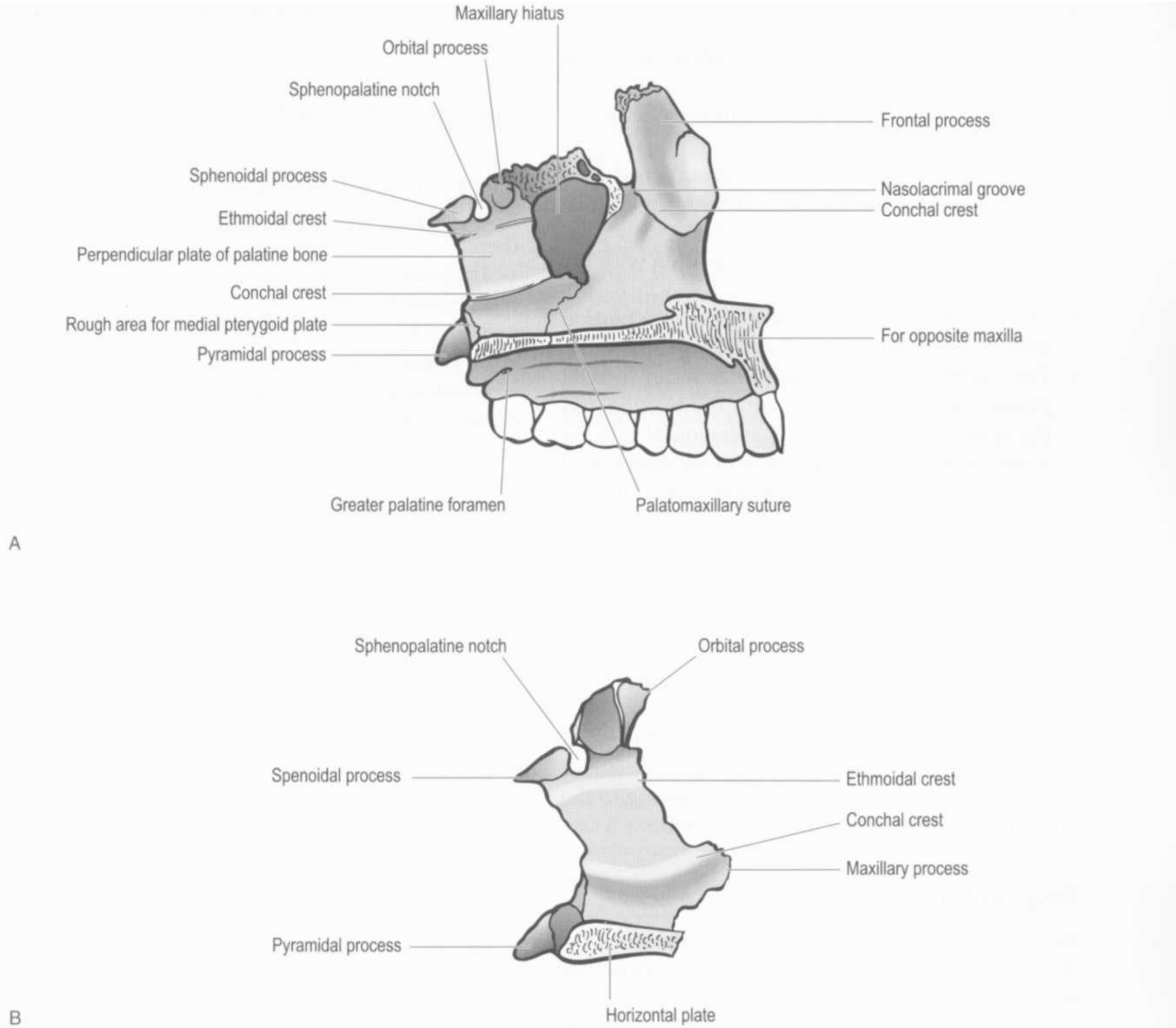


Figure 7.41 A Medial aspect of left palatine bone articulating with the maxilla. B Enlarged left aspect of palatine bone and major features.

- A perpendicular plate which forms part of the wall for the maxillary sinus (see Fig. 7.41A,B)
- A horizontal plate which makes up the posterior aspect of the hard palate as well as the floor of the nose
- A pterygoid process which articulates with the sphenoid
- An ethmoidal crest which articulates with the middle conchae of the ethmoid
- A ridge which articulates with the inferior conchae
- An orbital process which articulates with the maxilla, ethmoid and sphenoid
- A sphenoid process which articulates with the vomer and the inferior aspect of the sphenoid
- A nasal crest which is a continuation of the suture which links the two palatines (median palatine suture)
- A sulcus which houses the greater palatine nerve and the descending palatine artery.

Articulations

- The conchal crest for articulation with the inferior nasal concha.
- The ethmoidal crest for articulation with the middle nasal concha.
- The maxillary surface has a roughened and irregular surface for articulation with the maxillae.
- The anterior border has an articulation with the inferior nasal concha.
- The posterior border is serrated for articulation with the medial pterygoid plate of the sphenoid.
- The superior border has an anterior orbital process which articulates with the maxilla and the sphenoid concha and a sphenoidal process posteriorly which articulates with the sphenoidal concha and the medial pterygoid plate, as well as the vomer.
- The median palatine suture joins the two palatines.

There are no direct reciprocal tension attachments.

Muscular attachments

The medial pterygoid is the only important muscular attachment. It attaches to the lateral pterygoid plate and palatine bones, running to the medial ramus and angle of the mandible.

Range and direction of motion

According to traditional osteopathic descriptions, the palatines move during flexion to follow the pterygoid processes of the sphenoid. The nasal crest moves inferiorly and slightly posteriorly, with the perpendicular part moving laterally and posteriorly.

Other associations and influences

These delicate shock-absorbing structures, with their multiple sutural articulations, disperse strain in many directions when any force is exerted on them.

They are capable of deformation and stress transmission and their imbalances and deformities usually reflect what has happened to the structures with which they are articulating.

Great care needs to be exercised in any direct contact with the palatines (especially cephalad-directed pressure) because of their extreme fragility and proximity to the sphenoid, in particular, and the nerves and blood vessels which pass through them.

Note ***No palatine exercises are described in this text as individual tuition and great skill are required in order to treat them safely.***

CAUTION

In a report on iatrogenic effects from inappropriately applied cranial treatment, McPartland (1996) presented nine illustrative cases, of which two involved intraoral treatment. All cases seemed to involve excessive force being used and these cases highlight the need for care and gentleness in all cranially applied treatment, especially when working inside the mouth.

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Chapter 8

Cranial implications of muscular and fascial distress

CHAPTER CONTENTS

Much of the research discussed in previous chapters strongly suggests that resilient, pliable articulations exist at the cranial sutures.

This plastic function offers a flexibility which accommodates both internally arising pressure variations and externally applied forces, including demands deriving from those muscles which link the skull to the trunk, such as upper trapezius and sternocleidomastoid, as well as some enormously powerful muscles situated entirely on the cranium, such as temporalis.

It has been hypothesized, by Ferguson (1991) and others, that powerful muscles attaching directly to the cranial bones which move rhythmically, for example in relation to respiration, or intermittently (as in chewing) are perfectly capable of exerting sufficient pull and pressure on the skull to demand the compliant degree of resilience, flexibility and palpable motion at the sutures which appear to exist, at least in part, for just this purpose.

While sutural compliance with movement demands is intellectually and scientifically acceptable as a concept, this author finds it almost impossible to imagine muscular or fascial drag of sufficient strength to produce significant movement at the ossified adult sphenobasilar synchondrosis.

With powerful muscular attachments to the base of the occiput, as well as the external surface of the great wings of the sphenoid, a minute degree of 'yielding' pliability at this junction is not inconceivable but it is challenging to conceptualize this as actual motion. Words such as 'diving', 'bowing' and 'bending', as employed in some depictions of sphenobasilar motion (Brookes 1984, Upledger & Vredevoogd 1983), therefore seem a most unlikely set of descriptors.

CHAIN REACTIONS

Just as it is unwise to try accurately to determine pelvic joint status, unless note is also taken of the condition of those dynamic muscles which attach to the bones of the pelvis (such as the hamstrings, piriformis, quadratus lumborum and/or psoas), so should evaluation and treatment of cranial dysfunction require referral to those muscles and their forces (amongst the most powerful in the body), which are anchored to the bones of the skull.

In the same way that a unilaterally chronically shortened hamstring will confuse any meaningful assessment of iliosacral function, for example during the standing flexion test, so would a shortened or hypertonic sternocleidomastoid or upper trapezius confound any meaningful diagnosis/assessment of occipital or temporal status.

It seems self-evident that any attempt to 'normalize' cranial mobility in one or other of these structures, employing minute degrees of pressure (10 grams maximum according to Upledger) would be futile, unless prior and adequate normalization of such muscular influences had been carried out.

Although this chapter will discuss direct muscle influences on cranial function, it is as well to be reminded of wider influences, such as those Janda has discussed in his discourse of whole-body postural influences on facial and jaw pain (Janda 1986).

Janda's premise is that TMJ problems in particular and facial pain in general, can be analyzed in relation to the patient's posture. He has hypothesized that the muscular patterns associated with TMJ problems may be considered as locally involving hyperactivity and tension in the temporal and masseter muscles while, because of this hypertonicity, reciprocal inhibition occurs in the suprahyoid, digastric and mylohyoid muscles. The external pterygoid in particular, in this scenario, is likely to often be in spasm.

This imbalance between jaw adductors and jaw openers alters the ideal position of the condyle and leads to a consequent redistribution of stress on the joint, potentially leading to degenerative changes.

Janda describes the typical pattern of muscular dysfunction of an individual with a TMJ problem as involving upper trapezius, levator scapulae, scaleni, sternocleidomastoid, suprahyoid, lateral and medial pterygoid, masseter and temporal muscles; all show a tendency to tighten and develop spasm.

He further notes that, while the scalenes are unpredictable because commonly they become atrophied and weak under overload conditions, they may also develop spasm, tenderness and trigger points.

The wider postural pattern in a patient with temporomandibular joint problems or chronic facial pain, might, he suggests, also involve:

- hyperextension of the knee joints
- increased anterior tilt of the pelvis
- pronounced flexion of the hip joints
- hyperlordosis of the lumbar spine
- rounded shoulders and winged (rotated and abducted) scapulae
- cervical hyperlordosis
- compensatory overactivity of upper trapezius and levator scapulae
- forward thrust of the head, resulting in opening of the mouth and retraction of the mandible.

This series of changes provokes increased activity of the jaw adductor and protractor muscles, creating a vicious cycle of dysfunctional activity. Intervertebral joint stress in the cervical spine inevitably follows.

It is evident from this 'chain reaction' that it would be useful to identify such patterns of dysfunction and assess the roles these changes might be playing in the patient's pain and restriction conditions. Certainly it is necessary to identify dysfunctional soft tissues before these can be successfully and appropriately treated.

POSSIBLE FACTORS THAT DISTURB CRANIAL MUSCULATURE

The following factors are capable of altering muscular balance sufficiently to produce stresses that affect jaw (TMJ), facial or cranial suture function. Key imbalances often involve shortness and tightness of the cervical extensor muscles, accompanied by inhibition and weakness, as well as diminished endurance, of the deep neck flexors (longus coli, infra- and suprahyoid) (von Piekartz & Bryden 2000). All too commonly, more than one factor will be associated with symptom production and not infrequently all will be involved.

- **Forward head posture** - alters the biomechanics of the head-neck relationship, as well as TMJ function (see above) (Janda 1986). With an anterior head position the suboccipital musculature shortens and the anterior neck muscles lengthen. This creates increased tension at the thoracic attachments of the anterior cervical muscles and a dragging (inferior/posterior) tug on the mandible (see Fig. 8.1). This places major

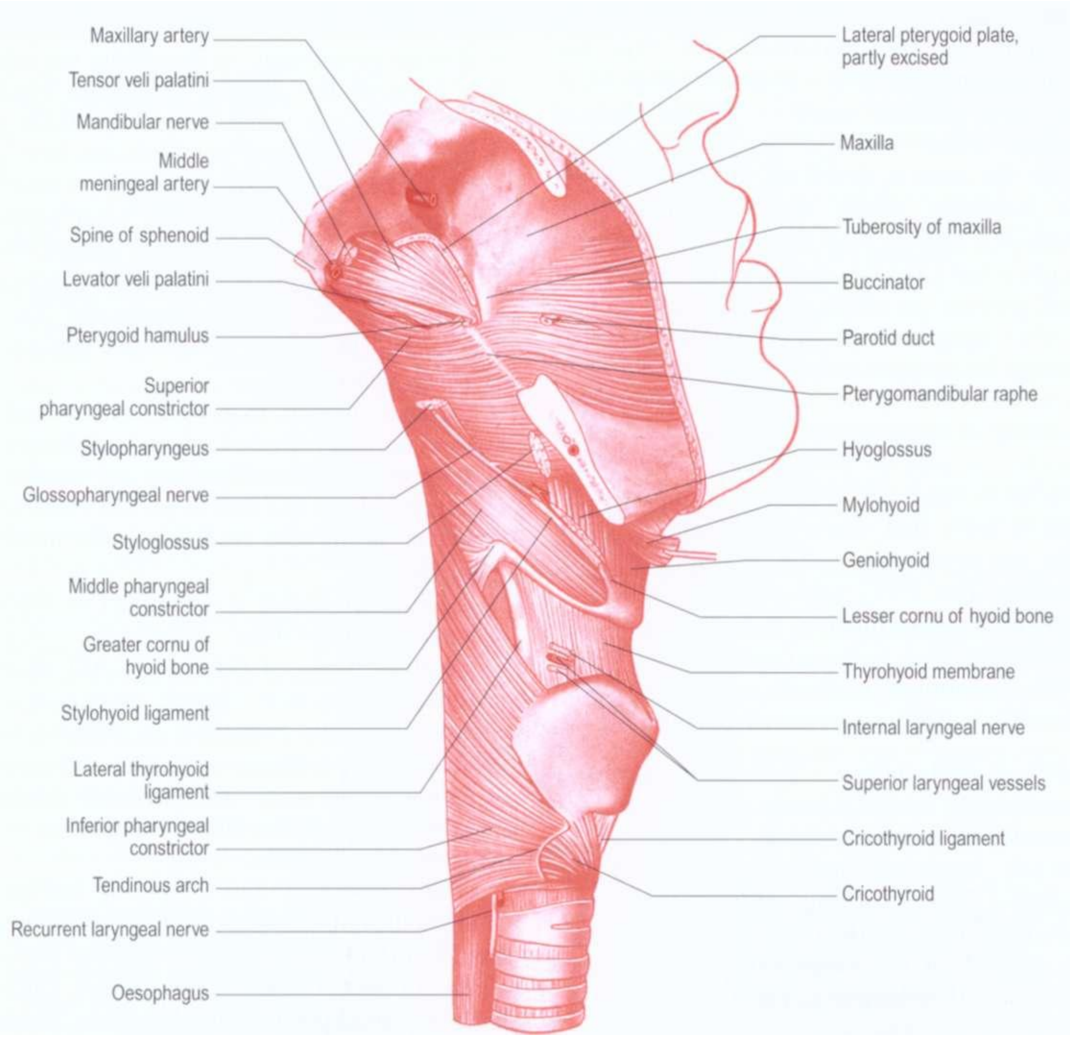

Figure 8.1 Buccinator and the muscles of the pharynx. The zygomatic arch, masseter, the ramus of the mandible, temporalis and a large part of the lateral pterygoid plate and the pterygoids have all been removed. In addition, the upper parts of stylopharyngeus and styloglossus have been excised, together with the posteroinferior part of hyoglossus and all the infrahyoid muscles. (Reproduced from Gray's Anatomy (1995) with permission from Elsevier.)

stress on the facial structures as a whole and the TMJ in particular (Lee 1995, Rocabado 1981). The hyoid bone appears to play a key role in TMJ function, with alterations in its position 'co-ordinated with changes in both mandibular and cranio-cervical posture' (Bryden & Fitzgerald 2000, Tallgren & Solow 1987). Clearly an anterior head position places stress on the upper cervical spine (extension at C0-C1) with compensating adaptation transferred interiorly into the rest of the cervical and thoracic spinal structures (Cailliet 1992).

- **Malocclusion** - involves an altered resting position for the mandible and this has been shown to be both a potential result of, as well as a possible cause of, altered cervical posture (von Piekartz & Bryden 2000). When the head is flexed on the neck (C0-C1) the mandible moves superiorly/anteriorly, decreasing interocclusal distance. The opposite occurs when C0-C1 is extended (as in forward head posture) at which time the intraocclusal distance (gap between lower border of upper incisors and upper border of lower incisors) increases (Urbanowicz 1991). The 'ideal' gap, resulting in the least stress for the masticatory muscles, is said to be between 2 and 5 mm (Bryden & Fitzgerald 2000). It is a fundamental clinical truth that correction of malocclusion does not necessarily result in improved TMJ behavior (Just 1991), until correction of associated cervical dysfunction, including muscular imbalances, has been accomplished (Skaggs 1997). (Treatment methods for correction of muscular imbalances are detailed in Ch. 9.)

- **Cervical dysfunction** - commonly involving extension at CO and C1 levels; a reduction in the normal mid-cervical lordotic pattern, upper thoracic kyphosis and protraction of the scapulae. There is strong evidence that extension of the head on the cervical spine increases the activity of the masticatory muscles (and vice versa) (Forsberg et al 1985).

- **Breathing pattern disorders** - are discussed more fully below but are primarily associated with overuse and consequent shortening of the accessory respiratory muscles (including the upper fixators of the shoulder, such as upper trapezius, sternocleidomastoid, scalenes), as well as a tendency to mouth breathing and an altered resting tongue position.

- **Pelvic and/or spinal dysfunction** - can create compensation patterns that translate adaptive forces into the cervical and cranial structures. See discussion of crossed syndrome patterns later in this chapter.

Postural (muscle) considerations

Selye (1956) called stress the non-specific element in disease production. In describing the relationship between the general adaptation syndrome (GAS) (i.e. alarm reaction and resistance phase (adaptation), followed by the exhaustion phase when adaptation finally fails), which affects the organism as a whole and the local adaptation syndrome (LAS), which affects a specific stressed area of the body, Selye emphasized the importance of connective tissue. He demonstrated that stress results in a pattern of adaptation individual to each organism.

He also showed that when an individual is acutely alarmed, stressed or aroused, homeostatic (self-normalizing) mechanisms are activated as part of the alarm reaction of the GAS and LAS. In muscular terms this response leads initially to hypertonia.

If the alarm status is prolonged or repetitive, defensive adaptation processes commence (adaptation phase of GAS and LAS) ultimately resulting in long-term, chronic changes involving relative ischemia, reduction in efficient venous drainage, fibrous changes, trigger point evolution, imbalances between agonist and antagonist musculature and, in time, changes in tendon structure and function.

When assessing and palpating the patient, these neuromusculoskeletal changes represent a record of the body's attempts to adapt and adjust to the imposed stresses, as time passes. The results of the repeated postural and traumatic insults of a lifetime, combined with tensions of emotional and psychological origin, will often present a confusing pattern of tense, contracted, bunched, fatigued and ultimately fibrous tissue (Chaitow 1989).

Research has shown that the type of stress involved can be entirely physical in nature (Wall & Melzack 1989), e.g. a single injury or repetitive postural strain, or purely psychic in nature (e.g. chronically repressed anger) (Latey 1983). More often than not, though, a combination of emotional and physical stresses will so alter neuromusculoskeletal structures as to create a series of identifiable physical changes, which will themselves generate further stress, such as pain, joint restriction, general discomfort and fatigue. Predictable chain reactions of compensating changes will evolve in the soft tissues in most instances of chronic adaptation to biomechanical and psychogenic (psychosocial) stress (Lewit 1992). Such adaptation is almost always at the expense of optimal function, as well as being an ongoing source of further physiological embarrassment (see Boxes 8.1 and 8.2).

Box 8.1 Soft tissue stress response sequence (Basmajian 1974, Dvorak & Dvorak 1984, Janda 1982, 1983, Korr 1978, Lewit 1992, Travell & Simon 1983, 1991)

When the musculoskeletal system is 'stressed', 'something' (see Box 8.2) occurs which leads to increased muscular tone.

- Increased tone, if anything but short term, leads to retention of metabolic wastes.
- Increased tone simultaneously causes a degree of localized oxygen lack (relative to the efforts being demanded of the tissues), resulting in ischemia.
- Sustained increased tone might also lead to a degree of edema.
- These factors result in discomfort/pain.
- Discomfort/pain leads to increased or sustained hypertonicity.
- Inflammation, or at least chronic irritation, may be a result.
- Neurological reporting stations in hypertonic tissues will bombard the CNS with information regarding their status, leading to a degree of sensitization of neural structures and the evolution of facilitation – hyperreactivity.
- Macrophages are activated as is increased vascularity and fibroblastic activity.
- Connective tissue production increases, with cross-linkage leading to shortened fascia.
- Since all fascia/connective tissue is continuous throughout the body, any distortions which develop in one region can potentially create distortions elsewhere, so negatively influencing structures which are supported or attached to the fascia, including nerves, muscles, tendons and associated bony structures, lymph structures and blood vessels.
- Changes occur in the elastic (muscle) tissues leading to chronic hypertonicity and potentially to fibrotic changes.
- Hypertonicity in a muscle will produce inhibition of its antagonist muscles.
- Chain reactions evolve in which some muscles shorten (postural – Type I) while others weaken (phasic – Type II) (these muscle types are described and listed on pp 248–249).
- Because of sustained increased muscle tension, ischemia in tendinous structures occurs, as it does in localized areas of muscles. In time, periosteal pain areas develop.
- Malco-ordination of movement occurs, with antagonist muscle groups being hypertonic (e.g. erector spinae) or weak (e.g. weak rectus abdominis group).
- Joint restrictions and/or imbalances as well as fascial shortenings develop.
- Postural adaptation patterns emerge (see 'crossed syndrome' concept, on pp 249–250).
- Localized areas of hyperreactivity of neural structures evolve (facilitated areas) in paraspinal regions or within muscles (trigger points).
- Energy wastage due to unnecessarily maintained hypertonicity leads to fatigue.
- Widespread functional changes develop (for example, affecting respiratory function) with repercussions on the total economy of the body (see pp 246–247).
- Heightened arousal results and there will be an inability to relax adequately with consequent increase in hypertonicity.
- Biologically unsustainable functional patterns emerge, involving chronic musculoskeletal problems and pain.

At this stage restoration of normal function requires therapeutic input which addresses the multiple changes which have occurred and re-educates the individual as to how to use the body less stressfully - how to breathe, carry and use the body more efficiently.

The chronic adaptive changes which develop may cause future acute exacerbations as the increasingly less supple structures attempt to cope with new stress factors arising from the normal demands of modern living.

Box 8.2 Causes of soft tissue dysfunction

The 'something' which can contribute to the sequence described in Box 8.1 includes:

- congenital factors (short/long leg, small hemipelvis, short upper extremity, fascial, cranial and other distortions)
- overuse, misuse, abuse and disuse factors (such as injury or inappropriate patterns of use involved in work, sport or regular activities)
- postural stresses
- reflexive factors (trigger points, facilitated spinal regions)
- chronic negative emotional states (anxiety, repressed anger, etc.)
- nutritional deficits
- toxic accumulations
- infection
- endocrine (hormonal) imbalances.

As a result of the processes described in Boxes 8.1 and 8.2, which affect each and every one of us to some degree, acute and painful problems overlaid on chronic soft tissue changes become the norm.

Baldry (1993) describes the progression of normal muscle to one in painful chronic distress as commonly involving initial or repetitive trauma (strain or excessive use) resulting in the release of chemical substances such as bradykinin, prostaglandins, histamine, serotonin and potassium ions. Sensitization of A-delta and C (Group IV) sensory nerve fibers may follow with involvement of the brain (limbic system and the frontal lobe).

Trigger points, which evolve from such a progression, become the source of new problems in their own locality as well as at distant sites, as their sarcoplasmic reticulum is damaged and free calcium ions are released, leading to the formation of localized taut bands of tissue (involving the actin-myosin contractile mechanisms in the muscle sarcomeres). If free calcium and energy-producing ATP are present this becomes a self-perpetuating feature compounded by the relative (to surrounding tissues) ischemia which has been identified as a common feature of chronically contracted tissues (Simons et al 1999).

Where pain has been produced by repetitive habits, postural and otherwise, with emotional and psychological overtones, the task of the practitioner/therapist is complex, since release or relaxation of hypertonicity cannot be achieved without resolution of the underlying pattern of use which, in any case, may represent a defensive, protective process that should not be haphazardly removed until primary causes have been dealt with. If repeated recurrences of painful episodes are to be minimized, a state of relative equilibrium of body structure and function is required and this calls for both treatment of structural restrictions (where appropriate) and re-education of posture and use patterns.

Dysfunctional breathing

Amongst the 'abuse, misuse' factors that load the musculoskeletal system with adaptation demands, inappropriate breathing patterns represent a major potential contributor to the evolution of dysfunction. Chronic breathing pattern disorders (overbreathing, upper chest breathing, etc.) are extremely common, affecting approximately 10% of the population (Lum 1984, 1987, 1994), often associated with anxiety, chronic fatigue and persistent muscle pain and creating long-term adaptive changes in key muscles that attach to the cranium, such as sternocleidomastoid and upper trapezius.

A sequence can be described for many such people which includes some or all of the factors highlighted below (Timmons 1994).

- A person (often in childhood) responds habitually to what they perceive as a stressful situation by breathing shallowly, using the upper chest more than the diaphragm.
- This breathing pattern becomes a habit, so that it continues even when whatever they see as stress is not present (often even when sleeping) although it tends to be much more obvious when they are stressed (Lum 1994).
- With such a pattern of breathing the accessory breathing muscles (the upper fixators of the shoulder girdle, including scalenes, sternocleidomastoid, levator scapulae and upper trapezius)

become overactive and tense, often developing painful local areas, and because these are postural muscles, over time they shorten chronically.

- Headaches, possibly accompanied by light-headedness and dizziness, can develop, resulting from irritation of local neural structures in these distressed muscles and/or interference with circulation to and drainage from the head.
- Marked traction at the attachment sites on the cranium will occur, specifically in these examples from sternocleidomastoid (on both the temporal and occipital bones - spanning sutures) and upper trapezius (on the occipital bone and also crossing sutures).
- The overbreathing pattern leads to excess carbon dioxide being exhaled, causing carbonic acid levels in the blood to be lowered, so the bloodstream becomes too alkaline for normal physiological functioning.
- Alkalization (respiratory alkalosis) leads automatically to a feeling of apprehension/anxiety, causing the abnormal breathing pattern to be accentuated. Panic attacks and even phobic behavior are not uncommon following this.
- Alkalization also leads to neural receptors, including nociceptors, becoming increasingly sensitive, so that the individual is more likely to report pain when previously only discomfort would have been reported (Mogyoros et al 1997).
- Alkalization also results in vasoconstriction of the blood vessels, including those supplying the cranium, further reducing oxygenation of the region.
- Along with heightened arousal/anxiety and cerebral oxygen lack, during respiratory alkalosis there is a tendency for oxygen in the bloodstream to become more tightly bound to its hemoglobin carrier molecule, leading to decreased oxygenation of tissues and easier fatiguability (known as the Bohr effect) (Levitsky 1995, Pryor & Prasad 2002).
- Inadequate oxygenation results, along with retention of acid wastes in overused muscles, which become even more painful and stiff.
- The muscles being overused in the inappropriate breathing pattern are mainly postural stabilizing muscles (scalenes, SCS, upper trapezius, pectoral, levator scapulae) which, with the repetitive stress involved in the over-breathing, will become short, tight and painful and will develop trigger points.
- The increased tension in these muscles adds to feelings of fatigue since the muscles are constantly using energy in a non-productive way, even during sleep.
- The poor breathing pattern leads to a restriction of the spinal joints that attach to the ribs which, because they are not moving adequately due to shallow breathing, are deprived of regular rhythmic movement, leading to stiffness and discomfort, eventually making 'normal' breathing almost impossible.
- The rib attachments to the sternum also become restricted, leading to pain.
- The intercostal muscles become tense and tight with the likelihood of chest pain and a feeling of an inability to take a full and deep breath.

End result of chronic overbreathing?

The outcome of such a breathing pattern is that the individual develops a stiff and painful neck and chest region, with associated sensitive and painful areas in the chest (back and front), headaches, dizziness, light-headedness Cbrain-fog'), fatigue, a sense of anxiety, possible indigestion and poor circulation, along with a possible tendency to panic attacks and phobic behavior. Since this breathing pattern continues with sleep, this too is likely to be disturbed. Chronic muscle pain is a likely outcome.

The shortened, hypertonic muscles attaching to the cranium induce profound tension at the attachment sites, modifying the potential for normal sutural pliability.

Resulting sutural distress

Pick (1999), in his landmark text on cranial sutures, inexplicably fails to mention the profound potential impact of muscular attachments that frequently overlie and traverse sutures. He does, however, describe different patterns of sutural dysfunction (he calls these variously 'deformities' or 'displacements') that clearly implicate the attaching musculature. For example, he discusses (p. 4) what he terms 'fibrous adhesion deformities', in which he describes a 'wire-like formation traversing a suture's articular seam'. He also describes what he perceives as the same phenomenon, at an earlier stage of development, as 'pliable nodular adhesions' that have 'infiltrated the periostium'. These and other evolutionary changes appear to be adaptive responses to the persistent drag applied by attaching musculature, such as occur elsewhere in the body and which have been dubbed by Lewit (1999) as 'periosteal pain points'. Such changes may be seen to represent evidence of adaptive changes to almost certain hypertonicity of the attaching musculature. Why do some muscles become hypertonic (e.g. suboccipital muscles) while others (e.g. deep neck flexors) weaken and lengthen?

Different responses in postural and phasic muscles (Engel et al 1986, Woo et al 1987)

Muscles have a mixture of fiber types, although in most there is a predominance of one or the other. There are those which contract slowly ('slow-twitch' fibers or 'slow red' fibers) which are classified as Type I. These have very low stores of energy-supplying glycogen but carry high concentrations of myoglobulin and mitochondria. These fibers fatigue slowly and are mainly involved in postural and stabilizing tasks.

There are also several phasic/active Type II fiber forms, notably:

- Type IIa fibers ('fast-twitch' or 'fast white' fibers), which contract more speedily than Type I and are moderately resistant to fatigue with relatively high concentrations of mitochondria and myoglobulin
- Type IIb fibers ('fast-twitch/glycolytic' fibers or 'fast white' fibers), which are less fatigue resistant and depend more on glycolytic sources of energy, with low levels of mitochondria and myoglobulin
- Type IIm ('superfast' fibers) found mainly in the jaw muscles which depend upon a unique myosin structure which, along with a high glycogen content, differentiates them from the other Type II fibers (Rowlerson 1981).

The implications of the effects of prolonged stress (overuse, abuse, misuse, etc.) on these different muscle types cannot be too strongly emphasized, since long-term stress involving Type I muscle fibers causes them to shorten whereas Type II fibers undergoing similar stress will weaken without shortening over their whole length; indeed, they may actually lengthen (although they may develop shortened areas within the muscle).

It is important to emphasize that shortness/tightness of a postural muscle does not imply strength. Such muscles may test as strong or weak. However, a weak phasic muscle will not shorten overall and will always test as weak (Lewit 1999).

Fiber types

Fiber type is not totally fixed. Evidence exists as to the potential for adaptability of muscles, so that committed muscle fibers can be transformed from slow twitch to fast twitch and vice versa, depending upon the patterns of use to which they are put (Lin 1994).

An example of this potential, which is of profound clinical significance, involves the scalene muscles which Lewit (1999) confirms can be classified as either postural or phasic muscle. If the largely phasic (dedicated to movement) scalene muscles have postural functions thrust upon them, as in an asthmatic or hyperventilation condition in which they attempt to maintain the upper ribs in elevation to enhance lung capacity, and if, due to the labored breathing of such an individual, they are thoroughly and regularly stressed, their fiber type will alter and they will shorten, becoming postural muscles.

Postural muscles (see Fig. 8.2)

Postural muscles which shorten in response to dysfunction include:

- trapezius (upper), sternocleidomastoid, levator scapulae and upper aspects of pectoralis major, in the upper trunk; and the flexors of the arms
- quadratus lumborum, erector spinae, oblique abdominals and iliopsoas, in the lower trunk

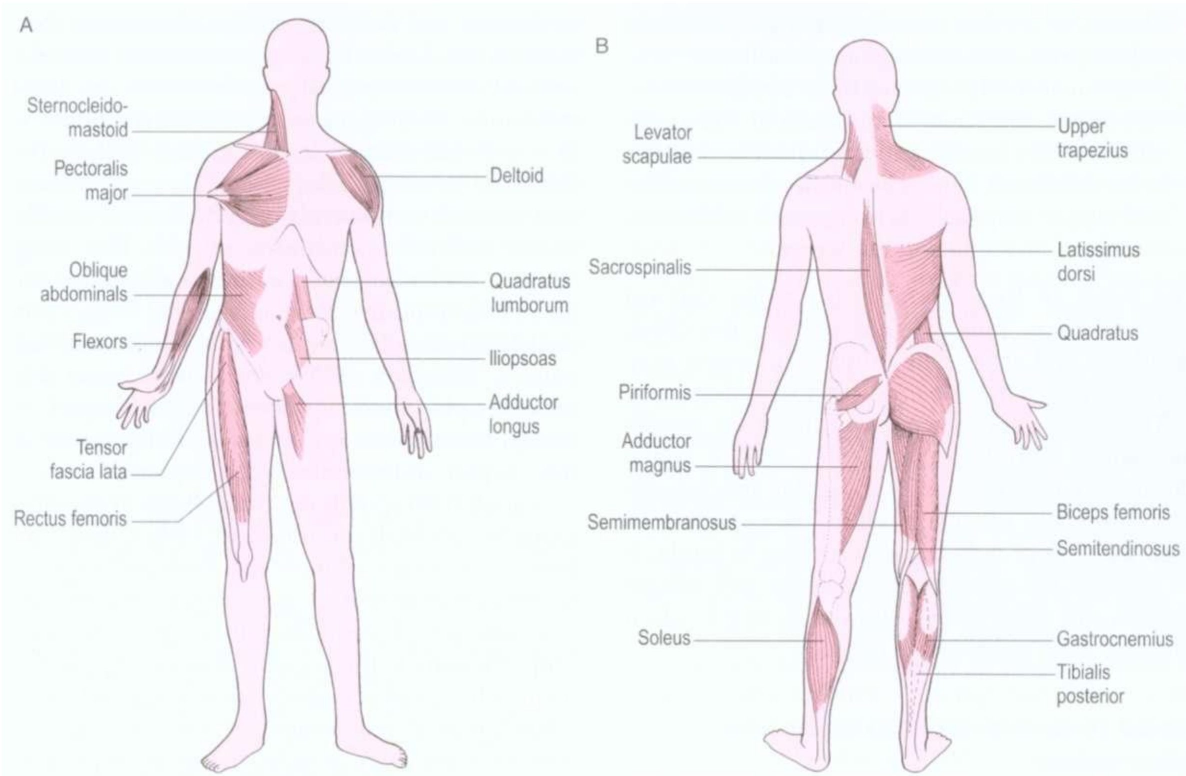

Figure 8.2 Major postural muscles of (A) the anterior aspect and (B) posterior aspect of the body.

- tensor fascia lata, rectus femoris, biceps femoris, adductors (longus brevis and magnus), piriformis, hamstrings, semitendinosus, in the pelvic and lower extremity region.

Phasic muscles

These weaken in response to dysfunction (i.e. are inhibited) and include the paravertebral muscles (not erector spinae) and scaleni (which can become postural through stress), the extensors of the upper extremity, the abdominal aspects of pectoralis major, middle and inferior aspects of trapezius, the rhomboids, serratus anterior, rectus abdominis, the internal and external obliques, gluteals, the peroneal muscles and the extensors of the arms.

PATTERNS OF DYSFUNCTION – 'CROSSED SYNDROMES'

When a chain reaction evolves in which some muscles shorten and others weaken, predictable patterns involving imbalances develop. Czech researcher Vladimir Janda has described the so-called upper crossed syndrome, as follows.

Upper crossed syndrome (Fig. 8.3)

This involves the following basic imbalance.

- Pectoralis major and minor
- Upper trapezius
- Levator scapulae
- Sternomastoid

all tighten and shorten, while:

- Lower and middle trapezius
- Serratus anterior and rhomboids

all weaken.

As these changes take place they alter the relative positions of the head, neck and shoulders as follows.

- The occiput and C1-2 will hyperextend, with the head being pushed forward.

- The lower cervical to fourth thoracic vertebrae will be posturally stressed as a result.
- Rotation and abduction of the scapulae occur.
- An altered direction of the glenoid fossa axis will develop, resulting in the humerus needing to be stabilized by additional levator scapulae and upper trapezius activity, with additional activity from supraspinatus as well.

The result of these changes is greater cervical segment strain plus referred pain to the chest, shoulders and arms. Pain mimicking angina may be noted plus a decline in respiratory efficiency.

The implications of such changes on cranial mechanics will become clearer as we move through an examination of muscular attachments and influences on the cranium. The solution to such patterns of imbalance, according to Janda, is to identify the shortened structures and release (stretch and relax) them, followed by re-education towards more appropriate function.

Fascial stress responses and therapeutic opportunities

Adaptive changes in connective tissue can result from passive congestion, which leads to fibrous infiltration and a more 'sol'-like consistency than is the norm. Under healthy conditions a 'gel'-like ground substance follows the laws of fluid mechanics. Clearly, the more resistive drag there is in a colloidal substance, the greater will be the difficulty in normalizing this. There is evidence that connective tissue absorbs fluid more readily under different conditions of pH. The more alkaline the individual or the local region, the greater the fluid uptake (Jackson et al 1965, Yahia et al 1993). This has implications when breathing pattern disorders (BPD) are a feature, as this increases pH (alkalinity). Breathing influences on cranial function were discussed briefly earlier in this chapter and more fully in Chapter 2.

Scariati (1991) points out that colloids (connective tissue is colloidal) are not rigid; rather, they conform to the shape of their container and respond to pressure, even though they are not compressible. The amount of resistance they offer increases proportionally to the velocity of motion applied to them, which makes a gentle, slowly applied touch a fundamental requirement if viscous drag and resistance are to be avoided when attempting to produce a lengthening or a release.

Cantu & Grodin (1992) describe what they see as the 'unique' feature of connective tissue as its 'deformation characteristics'. This refers to a combined viscous (permanent - viscoplastic) deformation characteristic, as well as an elastic (temporary - viscoelastic) deformation characteristic. This leads to the clinically important way in which connective tissue responds to applied mechanical force by first changing in length, followed by some of this change being lost. The implications of this phenomenon can be seen in the application of stretching techniques to such tissues, as well as in the way they respond to postural and other repetitive insults (Neuberger et al 1953).

Cantu & Grodin (1992), in their evaluation of the myofascial complex, conclude that therapeutic approaches which sequence their treatment protocols to involve the superficial tissues (involving autonomic responses) as well as deeper tissues (influencing the mechanical components of the musculoskeletal system) and which also address the factor of mobility (movement) are in tune with the requirements of the body, when dysfunctional.

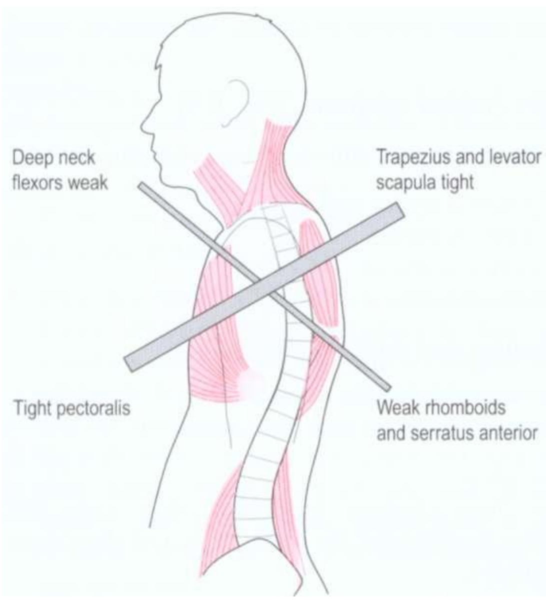

Figure 8.3 The upper crossed syndrome, as described by Janda.

Cathie (1974) maintains that the contractile phase of fascial activity supersedes all of its other qualities. The attachments of fascia, he states, have a tendency to shorten after periods of marked activity which are followed by periods of inactivity and the ligaments become tighter and thicker with advancing age. These observations now make a great deal more sense because of the discovery of contractile smooth muscle cells embedded throughout connective tissue structures (see below for further discussion of this emerging evidence) (Murray & Spector 1999, Yahia et al 1993).

The properties of fascia (connective tissue) that Cathie regards as being important to therapeutic consideration are listed as follows.

1. It is richly endowed with nerve endings.
2. It has the ability to contract and to stretch elastically.
3. It gives extensive muscular attachment.
4. It supports and stabilizes, thus enhancing the postural balance of the body.
5. It is vitally involved in all aspects of motion.
6. It aids in circulatory economy, especially of venous and lymphatic fluids.
7. Fascial change will precede many chronic degenerative diseases.
8. Fascial changes predispose towards chronic tissue congestion.
9. Such chronic passive congestion precedes the formation of fibrous tissue which then increases hydrogen ion concentration of articular and periarticular structures.
10. Fascial specializations produce definite stress bands.
11. Sudden stress (trauma) on fascial tissue will often result in a burning type of pain.
12. Fascia is a major arena of inflammatory processes.
13. Fluids and infectious processes often travel along fascial planes.
14. The CNS is surrounded by fascial tissue (dura mater) which in the skull attaches to bone so that dysfunction in these tissues can have profound and widespread effects.

Greenman (1989) describes how fascia responds to loads and stress in both a plastic and an elastic manner, the tissue response depending upon the type, duration and amount of the load. The response to either acute injury or repetitive microtrauma (short leg imbalance, for example) is, according to Greenman, likely to follow a sequence of inflammation which subsequently leads to absorption into the superficial fascia of inflammatory fluids as well as into tight compartmentalized areas in the deep fascia - with this latter event being both palpable and detrimental.

Cathie (1974) points out that many myofascial trigger points are situated where nerves pierce fascial investments. Fascial derangement may therefore be seen to result from faulty muscular activity, alteration in bony relationships, visceral positional change (e.g. visceroptosis) and/or the adoption of unnatural positions and habits (dysfunctional breathing, for example). All these can be sustained, repetitive causes or single, violently induced events (see Alexander and Smith's concepts on this topic in Ch. 6, p. 140).

Modern techniques of electron and phase microscopy have been used to study myofascial biochemistry activity, showing that much of the fascia and connective tissue is built of tubular structures. Erlinghauser (1959) has shown that lymph and cerebrospinal fluid spread throughout the body via these channels. The implications of this knowledge have not yet been fully realized or investigated by physiologists but it plays an increasing part in the theories (and practice) of cranial and craniosacral therapists.

Electron microscopy has also identified smooth muscle cells in connective tissue (Staubesand & Li 1996). These authors describe a rich intrafascial supply of capillaries, autonomic and sensory nerve endings and concluded that these intrafascial smooth muscle cells (SMC) enable the autonomic nervous system to regulate a fascial pre-tension, independently of muscular tonus.

There is increasing interest in the possible effects that active SMC contractility may have in the many fascial/connective tissue sites in which their presence has now been identified, including the cruciate (and other) ligaments, spinal disks and, as suggested by Yahia et al's research, in the lumbodorsal fascia (Ahluwalia 2001, Hastreite et al 2001, Murray & Spector 1999, Yahia et al 1993). It remains for research to show the presence of contractile SMC in reciprocal tension membranes inside the skull or the dura.

Creep, etc.

When stressful forces (undesirable or therapeutic) are applied to fascia, firstly a degree of slack is taken up, followed by what is colloquially referred to as 'creep' - a variable degree of resistance (depending upon the state of the tissues). 'Creep' is an honest term that accurately describes the slow, delayed yet continuous stretch which occurs in response to a continuously applied load as long as this is gentle enough not to provoke the resistance of colloidal 'drag'.

Since the fascia comprises a single continuous structure, the implications for body-wide repercussions of distortions in that structure are clear (Myers 2000). An example of one possible negative influence of this sort is to be found in the fascial divisions within the cranium, the tentorium cerebelli and falx cerebri, which are commonly warped during birthing difficulties (too long or too short a time in the birth canal, forceps delivery, etc.) and which are noted in craniosacral therapy as affecting total body mechanics via their influence on fascia (and therefore the musculature) throughout the body (Brookes 1984).

Use of sustained but light traction in the cranial area is a feature of many of the techniques outlined as exercises in Chapter 7 and which might well be achieving their beneficial effects via the 'creep' phenomenon mentioned above.

Muscle dysfunction as primary target

A basic understanding of muscular and fascial influences leads to the conclusion that the status of soft tissues which attach directly to the skull (and to a certain extent those which attach to the cervical spine, to the spine as a whole and to the sacrum or possibly any part of the pelvis) can, to a greater or lesser degree, influence cranial function.

Three clear messages

1. If local cranial treatment is applied without attention to the larger postural picture, results are likely to be poor.
2. If attempts are made to normalize apparent cranial sutural or other restrictions without appropriate prior attention to the powerful local muscular and fascial influences, which may be acting directly on the sutures and therefore on the motion potentials of the skull, treatment results are likely to be disappointing at best and useless at worst.
3. The causes of such muscular imbalance should of course also be considered and, where possible and appropriate, modified or removed. In some instances trauma is likely to be causative whereas in others, wider postural, habitual (e.g. breathing patterns) or emotional influences might be paramount as predisposing factors. Without attention to these elements, only short-term benefits can be anticipated.

Notes

- Although sacral and cranial functions seem to be intimately connected (despite how they influence each other remaining open to debate), no detailed consideration will be given here to muscular influences on sacral function, as this would detract from the focus which has been selected - direct muscular (and fascial) influences on cranial function.
- Nor will attention be offered for assessment and treatment of wider postural influences on cranial function (as highlighted in Janda's example, given earlier in this chapter) since to do so would be to encompass practically all the muscles in the body. It seems sufficient in a text that is examining local (cranial) influences to emphasize the need for such factors to be taken into account.
- This does not mean that these wider (postural, sacral) influences are not considered important but rather that direct soft tissue influences on cranial dysfunction are the major focus of this text.

In the next chapter most of the important muscles which might require attention in terms of their direct cranial influences will be discussed, along with a variety of palpation and treatment options.

The list of muscles discussed will not be exhaustive, as several exist which are not readily accessible to manual methods of treatment.

A selection of manual approaches which can contribute towards the normalization of muscular changes associated with cranial dysfunction will be detailed. Readers unfamiliar with the methodology of the techniques presented should study the introduction in Appendix 1. Other treatment methods exist for treatment of soft tissue dysfunction but those outlined in the text represent effective approaches.

Methods which might be employed in dealing with soft tissue dysfunction include those listed below (not all of these will be discussed in detail in Appendix 1).

TECHNIQUES FOR ADDRESSING SOFT TISSUE DYSFUNCTION (see Appendix 1)

Muscle energy techniques

- Reciprocal inhibition (use of antagonist before stretching)
- Postisometric relaxation (use of agonist before stretching)
- Active and passive stretching after isometric contractions
- Eccentric isotonic stretching approaches.

Positional release techniques

- Strain/counterstrain (using 'tender points')
- Functional technique (holding tissues at 'ease')
- Indirect myofascial release (following tissue into 'ease').

Direct manual approaches

- Manipulation of associated joints
- Neuromuscular techniques - trigger point elimination
- Soft tissue manipulation (e.g. 'C and 'S' bends)
- Massage, friction, cross-fiber friction
- Forms of myofascial release
- Integrated neuromuscular inhibition (sequence of inhibitory pressure, positional release and muscle energy technique to eliminate trigger point activity)
- Integrated neuromuscular release (combinations of any of the methods listed above, plus breath work, active and passive movements), 'working in 3D'.

Specific cranial techniques

- Sequential sutural releases via direct pressure to enhance venous drainage
- V-spread at sutures (release of reciprocal tension membranes)
- Indirect methods (exaggeration of apparent distortions)
- Compression/decompression methods
- Fourth ventricular compression
- Direct approaches (for example, to temporal bone restrictions)
- Rocking, rhythmic, mobilization methods.

NOTE: See Box A1.1 pp 383-387 for NMT approaches to mimetic, palatine and tongue muscles.

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Chapter 9

Assessment and treatment of key cranially associated muscles

CHAPTER CONTENTS

INTRODUCTION

As has been emphasized in previous chapters, preliminary assessment and, where appropriate, treatment of hypertonic muscles attaching to the cranial and facial structures are essential prior to any attempt at treating the osseous structures themselves.

The discussion in this chapter of assessment and treatment of muscles potentially associated with cranial dysfunction is not exhaustive but it includes those muscles which appear to have the greatest influence on cranial mechanics and function. Some of the major postural muscles attached to the cranium that have a tendency to shorten, such as sternocleidomastoid (SCM) and upper trapezius, receive full attention. Other smaller muscles, such as those connected to the hyoid, are also given due attention as is the important new information regarding the function of rectus capitis posterior minor (RCPM).

We will also discuss the RCPM and its set of attachment sites, described in detail for the first time in 1995 by researchers from the University of Maryland at Baltimore (Hack et al 1995a). The two RCPM muscles have now been shown to have direct fascial attachments ('bridges') to the dura, as it exits the foramen magnum. It appears that when RCPM contracts (on anterior translation of the head at CO), a specific effect occurs in the immediate area of the cisterna magna, a major cerebrospinal fluid reservoir. Hack et al (1995a) hypothesize that, 'One possible function of the RCPM muscle may be to modulate dural folding, thus assisting in the maintenance of the normal circulation pattern of CSF. Trauma [to RCPM] resulting in atrophic changes ... may interfere with this suggested mechanism'. Subsequent to the Hack et al revelation, a further dural attachment has been discovered in this region, via a fascial bridge attaching to the ligamentum nuchae (Mitchell et al 1998).

These important observations emphasize the profound and as yet incompletely understood influences of soft tissue attachments to the cranium, the importance of some of which, in cranial therapy terms, this chapter will highlight.

A number of possible therapeutic measures will be suggested for each muscle (or group of muscles) discussed and recommended as assessment and/ or treatment exercises. Obviously, not all methods can be applied to all patients or models and readers are strongly urged to experiment with the methods and, over time, to decide which approach(es) best suits their work or gives the best results.

The first two muscles under review are major postural muscles (see previous chapter for definition of postural muscle) that can dramatically influence cervical and cranial function when dysfunctional and short - upper trapezius and sternocleidomastoid (see Fig. 9.1).

UPPER TRAPEZIUS (UT)

- The upper, middle and lower parts of the muscle often function independently.
- In relation to direct cranial associations, upper trapezius is the most important, although trigger point activity from both upper and lower trapezius can refer into the head, thus creating local dysfunctional patterns in these target areas.
- Travell & Simons (1983) report that a trigger point lying approximately in the center of this part of the muscle is 'the most commonly observed of all myofascial TPs [myofascial trigger points] in the body'.
- TPs in trapezius are frequently overlooked causes of temporal headaches affecting the side of the head, the temple, back of the eye and commonly the jaw and sometimes the occiput.
- Attachment is to the medial third of the superior nuchal line, the external occipital protuberance and the ligamentum nuchae as well as the spinous processes and their supra-spinous ligaments from C7 to T12 (see Box 9.1).
- Additional attachments are to the lateral third of the clavicle, the medial acromial margin and the superior aspect of the crest of the scapular spine.
- In some people there is a merging of trapezius fibers with sternocleidomastoid.
- The actions of trapezius include stabilizing the scapula during arm movement (along with other muscles).
- Together with levator scapulae, it elevates the scapula and the shoulder, while acting together with serratus anterior, it rotates the scapula and braces the posterior shoulder.
- When the shoulder is fixed trapezius extends and sidebends the head and neck.

Consider the consequences of shortening of this postural muscle.

- As such shortening involves a drawing together of origin and insertion, the occiput will be pulled inferolaterally via enormously powerful fibers.

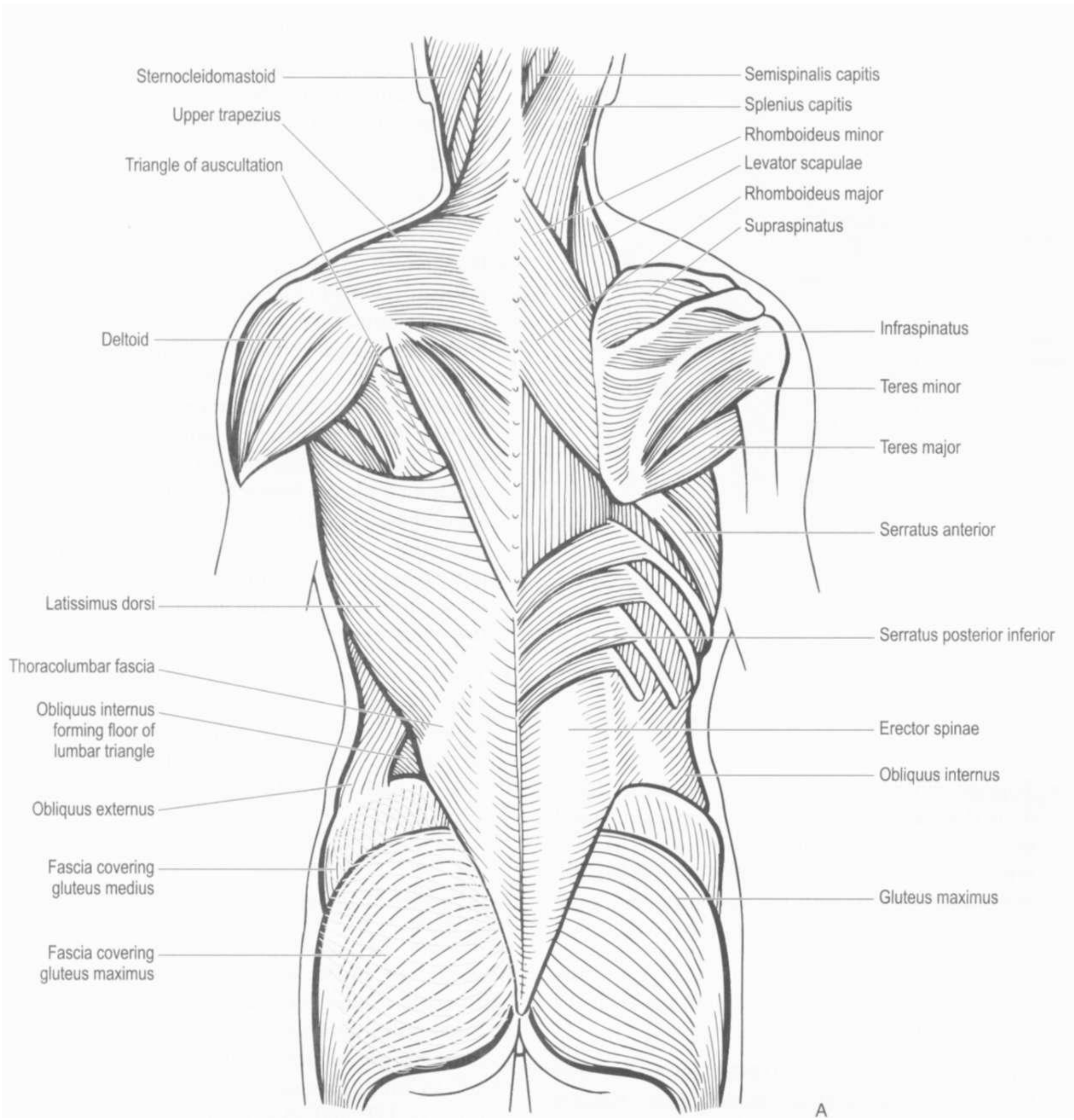


Figure 9.1 A Superficial muscles of the back. On the left side skin, superficial and deep fascia (apart from gluteofemoral) have been removed. Right side sternocleidomastoid, trapezius, latissimus dorsi, deltoid and externus abdominis have been removed.

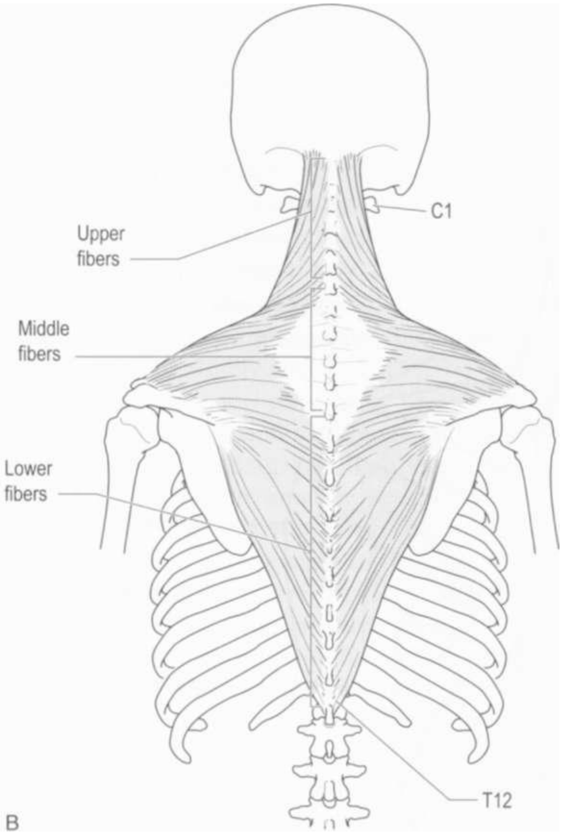


Figure 9.1 B Posterior view of all aspects of trapezius muscle.

- Trigger point activity will produce local disturbance and probably some additional general or local shortening in target tissues, which will almost certainly include the temporalis muscle with its vast influence over the sutures which lie beneath it.
- The potential negative influence of trapezius dysfunction is directly to occipital, parietal and temporal function (see p. 261, Box 9.1).
- Upledger & Vredevoogd (1983) point out that trapezius dysfunction immobilizes flexion function of the occiput and normotensive status of the muscle needs to be achieved before cranial base treatment can be effective. This supposes that flexion as described in craniosacral literature actually occurs, which is a questionable assumption, as discussed in previous chapters. Irrespective of this, the influence on sutural mobility of a restricted, shortened trapezius would be profound and sutural mobility is beyond question a physiological occurrence.
- Via its other attachments, trapezius influences and is influenced by the scapulae and clavicles, with possible respiratory implications.
- In some people its fibers merge with sternocleidomastoid, offering other possible areas of influence when dysfunctional.
- It is worth noting that motor innervation of trapezius is from the spinal portion of the XI cranial (spinal accessory) nerve. Originating within the spinal canal from ventral roots of the first five cervical segments (usually), it rises through the foramen magnum and exits via the jugular foramen where it supplies and sometimes penetrates sternocleidomastoid, before reaching a plexus below trapezius. Upledger & Vredevoogd (1983) point out that hypertonus of trapezius can produce dysfunction at the jugular foramen with implications for accessory nerve function, so increasing and perpetuating trapezius hypertonicity.
- The intimate and potentially hazardous relationship between SCM and trapezius (if the penetrated region of SCM is contracted) should be kept in mind when palpating the attachments, which are themselves closely linked structurally.

Assessment of upper trapezius for shortness (Fig- 9-2)

It should be possible to recognize the postural features that suggest upper trapezius overactivity and resulting shortness: forward head posture, rounding of shoulders, possibly overdevelopment of UT ('Gothic shoulders'). Assessment of overactivity of UT and evaluation of the degree of shortness is then necessary, before initiating treatment to normalize the muscle. See Figure 9.2A.

Method A

The patient is seated and the practitioner stands behind, one hand resting on the shoulder of the

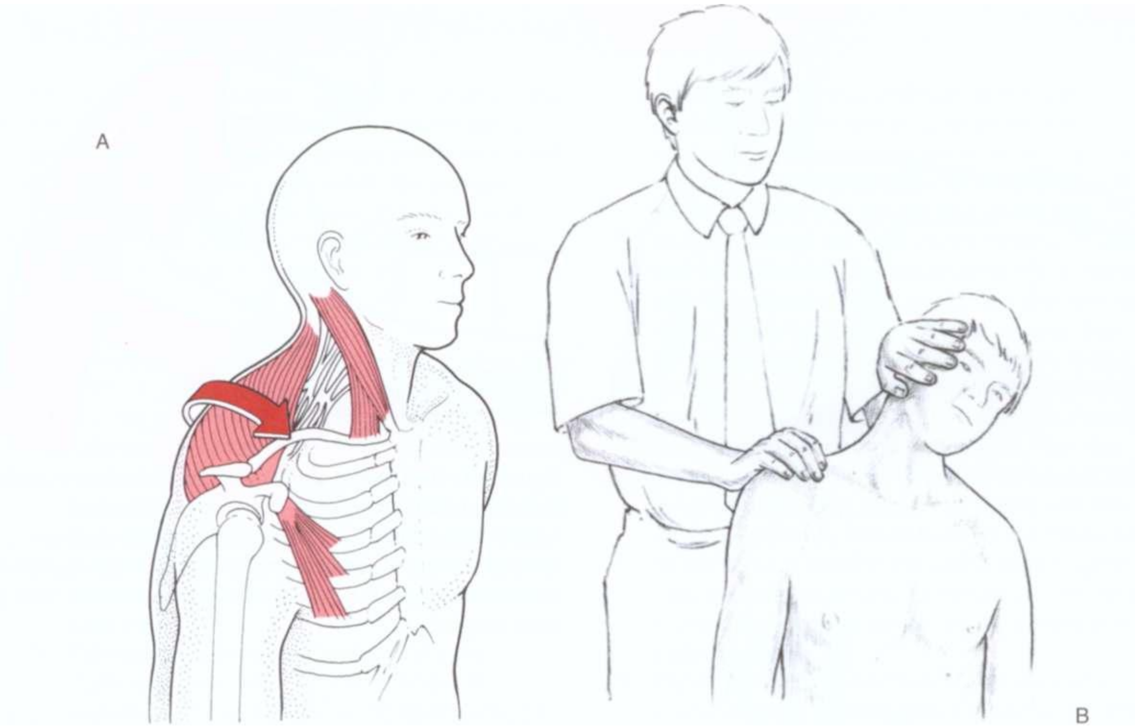


Figure 9.2 A Progressive postural and biomechanical adaptation. B Assessment of relative shortness of right side upper trapezius using unforced motion to the end of range.

side to be tested. The other hand is placed on the side of the head being tested and the head/neck is taken into sidebending away from that side, without force, whilst the shoulder is stabilized.

The same procedure is performed on the other side with the opposite shoulder stabilized.

A comparison is made as to which sidebending maneuver produced the greater range and whether the neck can easily reach a 45° angle from the vertical, which it should. If neither side can achieve this degree of sidebend then both trapezius muscles may be short. The relative shortness of one compared with the other is evaluated.

Method B

The patient is seated and the practitioner stands behind with a hand resting over the muscle on the side to be assessed. The patient is asked to extend the shoulder, bringing the flexed arm/elbow backwards. If the upper trapezius is stressed on that side it will inappropriately activate during this arm movement. Its shortness can then be assumed.

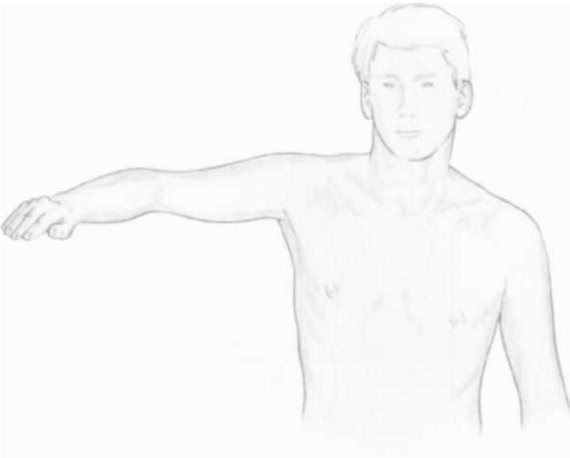
Method C: functional evaluation (Jull Et Janda 1987, scapulohumeral rhythm test)

The patient is seated or standing, upper arm at the side, elbow flexed so that the forearm points forwards. The patient is asked to raise the arm sideways, so that the elbow reaches shoulder level (Fig. 9.3A).

If, during elevation of the arm, 'bunching' of UT is noted or winging of the scapulae occurs before the arm reaches 60° of abduction, this suggests levator scapula and/or upper trapezius are short/tight and the lower and middle trapezius weak (Fig. 9.3B).

Method D: tests for shortened levator scapula and upper trapezius

The patient is supine. To test for shortness in levator scapula the neck should be fully flexed



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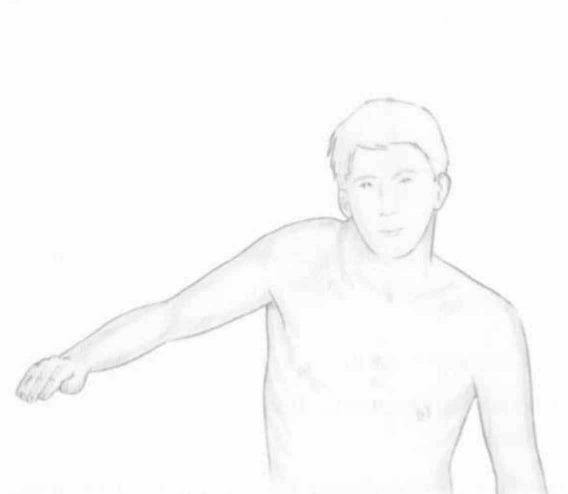


B

Figure 9.3 A Scapulohumeral rhythm test showing normal upper trapezius/levator scapula response on elevation of the arm. B Abnormal response with 'bunching' indicating relative weakness of lower stabilizers of the scapula and overactivity of upper fixators of the shoulder, implying relative shortness of upper trapezius and levator scapulae.

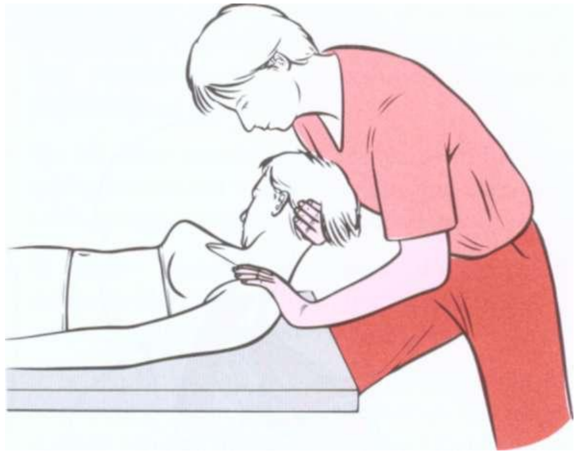


Figure 9.4 Test and treatment position for levator scapula. Patient is held with neck in flexion, sidebending and rotation and the relative ease of 'springing' the shoulder towards the feet is noted. In this same position an isometric contraction introduced prior to stretching allows the muscle to be lengthened.

and rotated away from the side to be tested. The neck is then fully (but not forcefully) rotated and sidebent away from the side being assessed. At this point the practitioner, standing at the head of the table, uses a contact on the shoulder (tested side) to assess the ease with which it can be depressed (moved distally) (see Fig. 9.4).

To assess the various fibers of upper trapezius for shortness, a similar method is used but there is no flexion of the neck. The head should be fully sideflexed and rotated away from the side to be tested in order to assess the posterior fibers of upper trapezius. With the head half-turned *away* it is the middle fibers and with the head turned slightly *toward* the side being tested, it is the anterior fibers that are being assessed (see Fig. 9.5 - treatment positions that are identical to assessment positions).

There should be an easy springing sensation as the shoulder is pushed towards the feet, with a soft end-feel to the movement. If depression of the shoulder is difficult or if there is a harsh, sudden end-point, upper trapezius on that side is short.

MET treatment of shortened upper trapezius

Method A

The patient lies supine, head/neck flexed and sidebent away from the side to be treated, up to or short of the restriction barrier (at the barrier if acute or short of the barrier if chronic, as appropriate) with the practitioner stabilizing the shoulder with one hand and cupping the ear/mastoid area on the same side with the other.

In order to bring into play all the various fibers of the muscle, this stretch needs to be applied with

Box 9.1 Fascial continuities and the cranium

Myers (2001), has described a number of clinically useful sets of myofascial chains. The connections between different structures ('long functional continuities') which these describe help draw attention to (for example) dysfunctional patterns in the lower limb which impact directly (via these chains) on structures in the upper body, commonly affecting the cranium.

The five major fascial chains:

1. **The superficial back line** involves a chain which starts with the plantar fascia, linking the plantar surface of the toes to the calcaneus; gastrocnemius, linking calcaneus to the femoral condyles; hamstrings, linking the femoral condyles to the ischial tuberosities; subcutaneous ligament, linking the ischial tuberosities to sacrum; lumbosacral fascia, erector spinae and nuchal ligament, linking the sacrum to the **occiput, and the scalp fascia, linking the occiput to the brow ridge.**
2. **The superficial front line** involves a chain which starts with the anterior compartment and the periostium of the tibia, linking the dorsal surface of the toes to the tibial tuberosity; rectus femoris, linking the tibial tuberosity to the anterior inferior iliac spine and pubic tubercle; rectus abdominis as well as pectoralis and sternalis fascia, linking the pubic tubercle and the anterior inferior iliac spine with the manubrium; sternocleidomastoid, linking the manubrium with the **mastoid process of the temporal bone.**
3. **The lateral line** involves a chain which starts with the peroneal muscles, linking the 1st and 5th metatarsal bases with the fibular head; iliotibial tract, tensor fascia latae and gluteus maximus, linking the fibular head with the iliac crest; external obliques, internal obliques and (deeper) quadratus lumborum, linking the iliac crest with the lower ribs; external intercostals and internal intercostals, linking the lower ribs with the remaining ribs; splenius cervicis, iliocostalis cervicis, sternocleidomastoid and (deeper) scalenes, linking the ribs with the **mastoid process of the temporal bone.**
4. **The spiral line** involves a chain which starts with; splenius capitis, which wraps across from one side to the other, linking the **occipital ridge** (say, on the right) with the spinous processes of the lower cervical and upper thoracic spine on the left; continuing in this direction, the rhomboids (on the left) link via the medial border of the scapula with serratus anterior and the ribs (still on the left), wrapping around the trunk via the external obliques and the abdominal aponeurosis on the left, to connect with the internal obliques on the right and then to a strong anchor point on the anterior superior iliac spine (right side); from the ASIS, the tensor fascia latae and the iliotibial tract link to the lateral tibial condyle; tibialis anterior links the lateral tibial condyle with the 1st metatarsal and cuneiform; from this apparent endpoint of the chain (1st metatarsal and cuneiform), peroneus longus rises to link with the fibular head; biceps femoris connects the fibular head to the ischial tuberosity; the sacrotuberous ligament links the ischial tuberosity to the sacrum; the sacral fascia and the erector spinae link the sacrum to the **occipital ridge**.
5. **The deep front line** describes several alternative chains involving the structures anterior to the spine (internally, for example). The anterior longitudinal ligament, diaphragm, pericardium, mediastinum, parietal pleura, fascia prevertebralis and the scalene fascia, which connect the lumbar spine (bodies and transverse processes) to the cervical transverse processes and via longus capitis to the basilar portion of the **occiput**:
   - other links in this chain might involve a connection between the posterior manubrium and the hyoid bone via the subhyoid muscles and
   - the fascia pretrachealis between the hyoid and the cranium/mandible, involving suprahyoid muscles
   - the muscles of the jaw linking the mandible to the face and cranium.

Additional smaller chains involving the limbs include the **Back of the arm line** in which trapezius links the occipital ridge and the cervical spinous processes to the spine of the scapula and the clavicle; the deltoid, together with the lateral intermuscular septum, connects the scapula and clavicle with the lateral epicondyle, while the lateral epicondyle is joined to the hand and fingers by the common extensor tendon.

the neck in three different positions of rotation, coupled with the sidebending, as described:

- With the neck flexed, sidebent and fully rotated the posterior fibers of upper trapezius are involved in any contraction (as are levator scapulae fibers).
- With the neck flexed, fully sidebent and half rotated the middle fibers are accessed.
- With the neck flexed, fully sidebent and not rotated at all - or slightly turned towards the side from which it is rotated - the anterior fibers are being treated (see Fig. 9.5).

This maneuver may be performed with the practitioner's arms crossed, hands stabilizing the mastoid area and shoulder, or not, as comfort dictates and with practitioner standing at the head or the side, also as comfort dictates.

The patient introduces a resisted effort to take the stabilized shoulder towards the ear (a shrug movement) and the ear towards the shoulder. The double movement (or effort towards movement) is important in order to introduce a contraction of the muscle from both ends. The degree of effort should be mild and no pain should be felt.

After the 7-10 seconds of contraction, followed by complete relaxation of effort, the practitioner gently eases the head/neck into an increased degree of sidebending (back to the barrier if this has been reduced before the contraction in a chronic setting or to the new barrier if it was an acute problem being treated from the resistance barrier) (see Appendix 1 on MET, p. 388). Then, while stabilizing the head/neck, stretch the shoulder away from the ear to the new barrier in an acute problem and through that barrier if chronic, as appropriate. No stretch is introduced from the head end of the muscle as this could stress the neck unduly.

Method B

Lewit (1992) suggests the use of eye movements to facilitate initiation of postisometric relaxation before stretching, an ideal method for acute problems in this region.

The patient is supine, while the practitioner fixes the shoulder and the sidebent (away from the treated side) head and neck at the restriction barrier and asks the patient to look, with the eyes only (i.e. not to turn the head), towards the side away from which the neck is bent. This eye movement is maintained with a held breath, while the practitioner resists the slight isometric contraction that these two factors (eye movement and breath) will have created.

On exhalation and complete relaxation, the eyes adopt a neutral gaze (not to one side or the other) while the head/neck is taken to a new barrier and the process repeated.

If the shoulder is brought into the equation, this is firmly held as it attempts to lightly push into a shrug.

Figure 9.5 Treatment position for application of MET to shortened upper trapezius. Different degrees of rotation of the neck induce focused contraction (and subsequent stretching) of all fibers of upper trapezius.

After a 7-10 second push, the muscle will have released somewhat and slack can again be taken out as the head is repositioned, before a repetition of the procedure commences, stretching upper trapezius.

Direct manual (NMT) assessment/treatment of upper trapezius

The supine patient lies with head (on pillow) tilted slightly towards the side to be assessed. Using a pincer grip, evaluate the entire available length of muscle, from shoulder to neck.

Lift the muscle away from supraspinatus and sequentially squeeze and roll tissues, seeking localized areas of contraction/induration, as well as taut bands which house myofascial trigger points.

Maintain compression for several seconds when these are identified to evaluate the referral pattern, if any.

Treatment of active triggers is suggested, utilizing INIT (compression, followed by positional release followed by isometric contraction followed by stretching of the entire muscle and/or local stretching of region housing trigger point) (see description of INIT in Appendix 1, p. 395).

Travell & Simons (1983) report that trigger points in upper trapezius:

> *Consistently refer pain unilaterally upwards along posterolateral aspect of neck to the mastoid process and are a major source of 'tension neck ache'. The referred pain, when intense, extends to the side of the head centering in the temple and back of the orbit and also may include the angle of the jaw. Occasionally the pain may extend to the occiput and rarely ...to the lower molar teeth.*

Trigger points are likely to develop in the target areas and these should also be assessed (Fig. 9.6).

It is clear that cranial mechanics are likely to be altered if upper trapezius is shortened, since it anchors to the occipital bone and thus modifies any potential it has for normal motion.

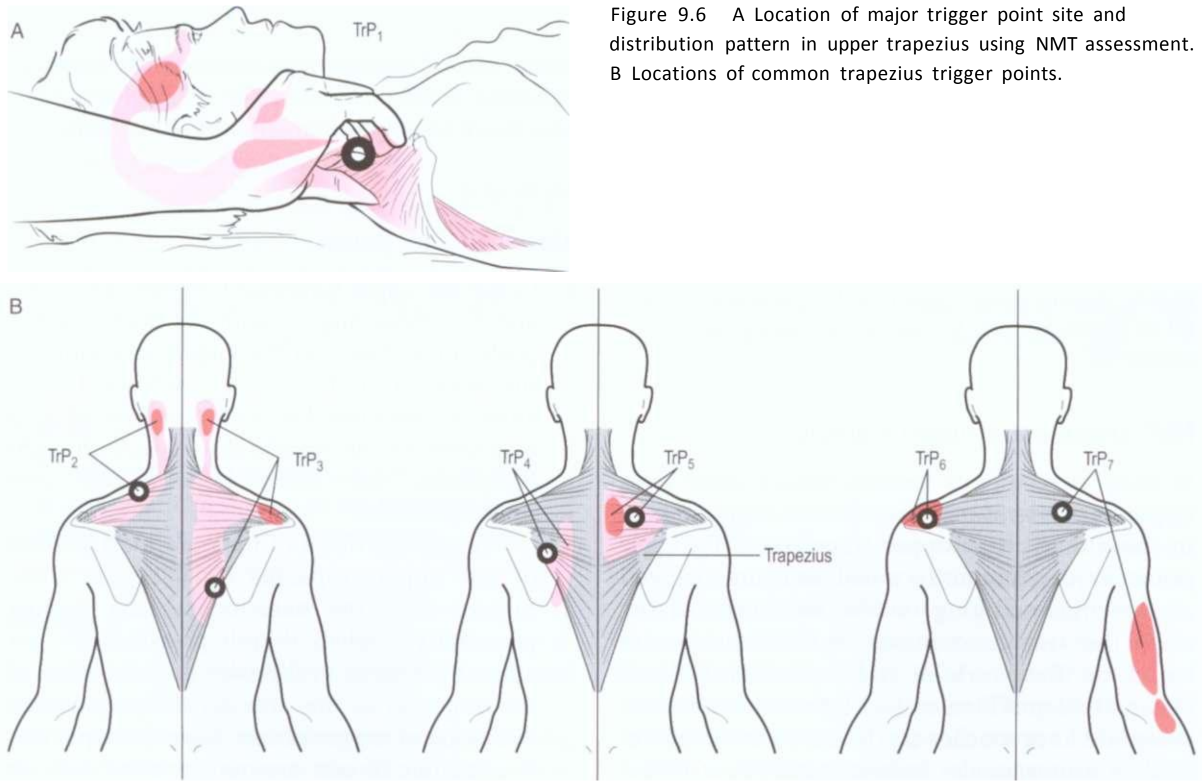
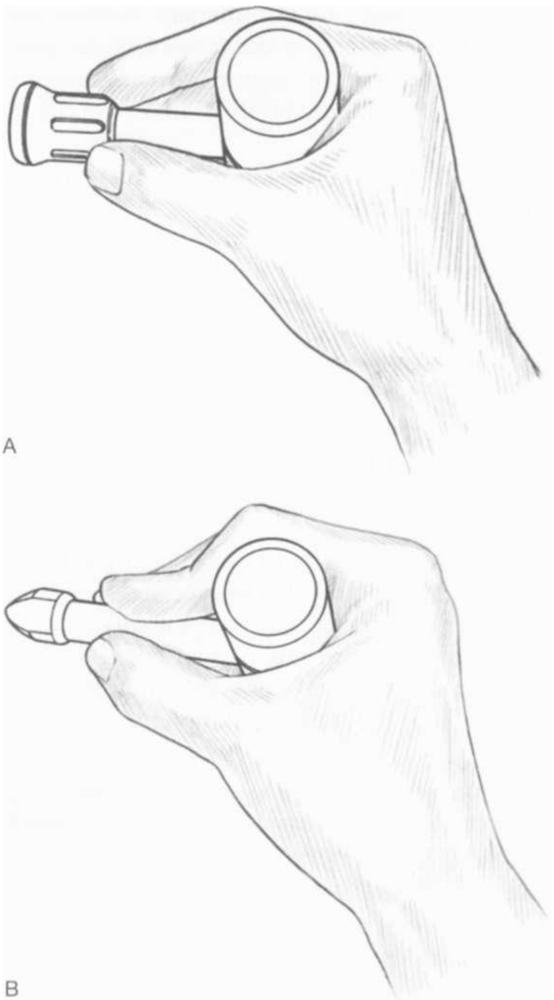


Figure 9.6 A Location of major trigger point site and distribution pattern in upper trapezius using NMT assessment. B Locations of common trapezius trigger points.



A

B

Figure 9.7 Wooden rubber-tipped T-bars utilized for trigger point treatment to relieve stress on practitioner's thumbs, showing broad-tipped T-bar (A) and beveled T-bar (B) for intercostal work, for example, and paraspinal application.

NMT treatment of upper trapezius

In these descriptions various tissues other than upper trapezius are addressed, since trigger points in these may affect upper trapezius. UT trigger points in turn refer into cranial structures, as well as directly impinging on the mechanics of the area. The two descriptions of NMT below are based on the work of Judith Walker DeLany (Method A) and Stanley Lief (Method B). Both of these NMT approaches are described more fully in *Modern neuromuscular techniques* (Chaitow 1996a) and in *Clinical applications of neuromuscular technique* (Chaitow & DeLany 2000,2002). See Figure 9.7 and also Box 9.1 for information on pressure bars.

Box 9.1 Pressure bars (Walker DeLany 1996)

Pressure bars may be used as tools for treatment and are constructed of light wood. They comprise a 1 inch dowel horizontal crossbar and a G inch vertical shaft and have either a H inch flat rubber tip or a G inch beveled rubber tip at the end of the vertical shaft (Fig. 9.7A,B).

The large flat tip is used to press into large muscle bellies, such as the gluteals, or to glide on flat bellies, such as the anterior tibialis. The small beveled tip is used in the laminar groove, under the spine of the scapula, and to friction certain tendons which are difficult to reach with the thumb. The beveled end of a flat typewriter eraser can also be used. The pressure bars are never used on extremely tender tissues, at vulnerable nerve areas such as the clavicle or to 'dig' into tissues.

Contracted tissues, fibrosis and bony surfaces may be 'felt' through the bars just as a grain of sand or a crack in the table under writing paper may be felt through a pencil when writing. The tips of the tools should be cleaned with cold sterilization after each use.

Method A

The patient lies prone.

1. Grasp the upper trapezius between the thumb and first three fingers, with the thumb on the posterior surface and the fingers wrapping all the way around and up underneath the anterior fibers (see Fig. 9.8). This 'pincer' grip is suitable for this muscle as well as, with slight variations, the sternocleidomastoid and scalene muscles.

   'Uncoil' the fibers of the outermost portion of the upper trapezius by dragging three fingers over the anterior surface against posteriorly applied thumb pressure. Do not allow the fingers to flip over the very edge of the trapezius as this area can be very tender, with violent trigger points. Keep the wrist low to angle the fingers around the most anterior fibers. Thoroughly examine the toothpick-sized strands of the outermost portion which often contain trigger points with painful referrals into the face and eyes.

2. Place the prone patient's arm onto the table at his side. Elevate the humeral head 3-6 inches (use a rolled-up towel, wedge, etc.) to shorten the middle and lower trapezius. To define the middle trapezius, draw two lines from the two ends of the scapular spine directly at right angles towards the spine. The middle trapezius lies between these two lines.

   Grasp the middle trapezius with both hands and manipulate the belly of the middle portion (Fig. 9.9). Repeat the grasping manipulation to the outer (diagonal) edge of the lower trapezius. This manipulation is similar to skin-rolling techniques but includes more than the skin, lifting and evaluating/stretching the fibers of the muscle itself. If trigger points are found, static pincer-like compression or INIT is used to treat them.

3. Place the small pressure bar in the laminar groove at a 45° angle against the lateral surface of the spinous processes at the level of C7. Apply friction cephalad to caudad at tip-width intervals all the way down to LI to treat the trapped attachments on the spinous processes as well as deeper attachments.

4. The beveled pressure bar (see Box 9.1) may be used on the scapular and acromial attachments of the trapezius. Gliding strokes with the thumb may be used on the clavicular attachments where the pressure bar is not used.

CAUTION

It is suggested that the pressure bar not be used on clavicular attachments of the trapezius due to the proximity of the brachial plexus.

Method B

In Lief's NMT the skin over the area to be treated would be lightly oiled.

The practitioner begins by standing half-facing the head of the couch on the left of the patient

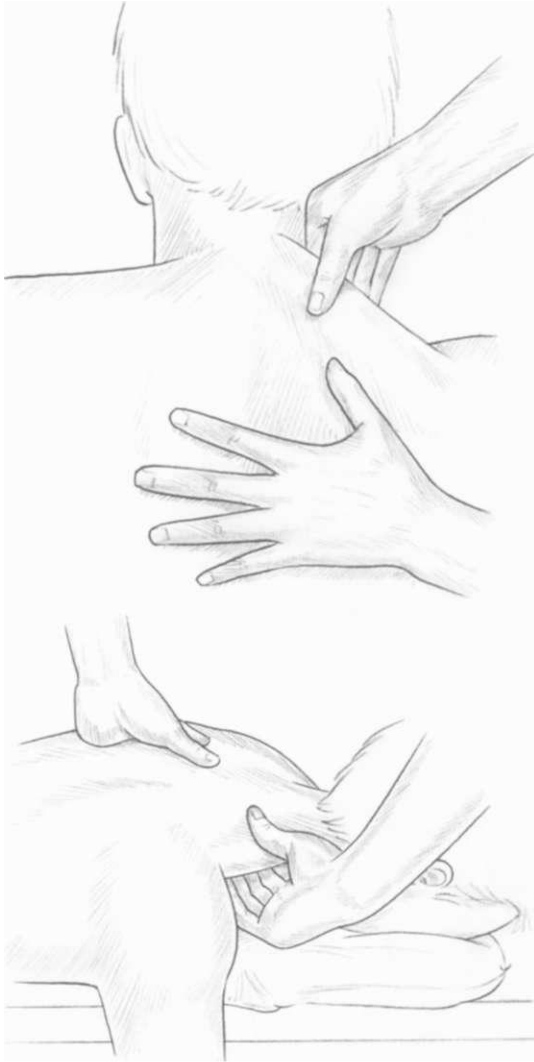


Figure 9.8 Different views of neuromuscular therapy (NMT) application to myofascial trigger point in upper trapezius.

with his hips level with the midthoracic area (see also Fig. 9.10). The first contact to the left side of the patient's head is a gliding, light-pressured movement of the medial tip of the right thumb, from the mastoid process along the nuchal line to the external occipital protuberance. This is then repeated with deeper pressure. The practitioner's left hand rests on the upper thoracic or shoulder area as a stabilizing contact.

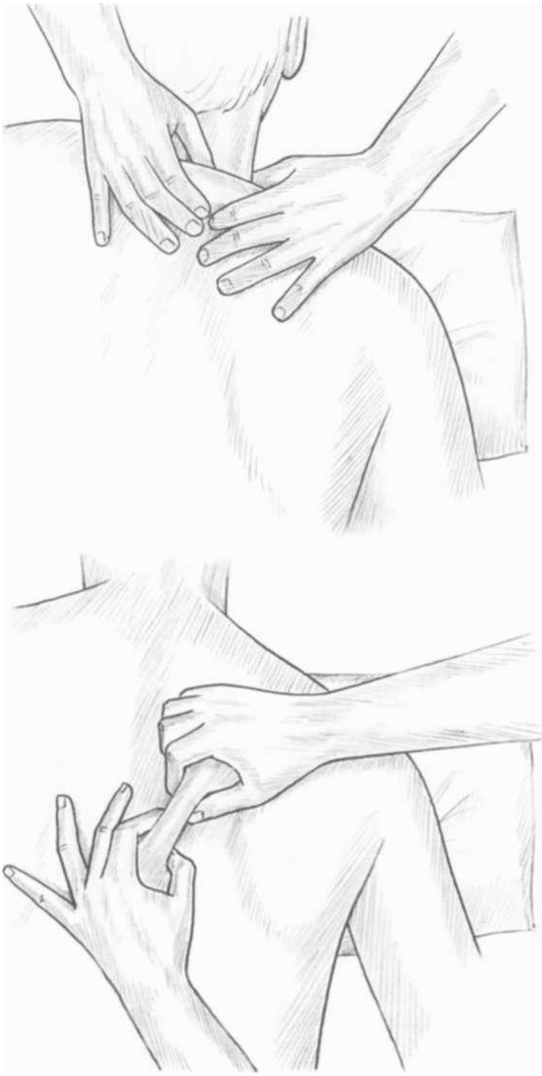


Figure 9.9 Various hand and finger positions during neuromuscular therapy (NMT, American version) applications to middle and lower trapezius showing support under head of humerus which slackens fibers for easier access to myofascial trigger points.

The treating/assessing hand should be relaxed, molding itself to the tissue contours. The fingertips stabilize the hand.

After the first two strokes of the right thumb - one shallow and diagnostic, the second deeper, imparting therapeutic effort - the next stroke is half a thumb width caudal to the first. A degree of overlap occurs as these strokes, starting on the belly of the sternocleidomastoid, glide across and through the trapezius, splenius capitis and posterior cervical muscles. A progressive series of strokes is applied in this way until the level of the cervicodorsal junction is reached. Unless serious underlying dysfunction is found, it is seldom necessary to repeat the two superimposed strokes at each level of the cervical region. If underlying fibrotic tissue appears unyielding, a third or fourth slow deep glide may be necessary.

The practitioner stands at the head of the table (Fig. 9.11). The left thumb is placed on the right lateral aspect of the first dorsal vertebra and a series of strokes is performed caudad and laterally as well as diagonally towards the scapula.

A series of thumb strokes, shallow and then deep, is applied caudad from Dl to about D4 or 5 and laterally towards the scapula and along and across all the upper trapezius fibers and the rhomboids. The left hand treats the right side and vice versa, with the non-operative hand stabilizing the neck or head.

By slightly moving to one side, it is possible more easily to apply a series of sensitively searching contacts into the area of the thoracic outlet. Thumb strokes which start in this triangular depression move towards the trapezius fibers and through them towards the upper margins of the scapula.

Several strokes should also be applied directly over the spinous processes, caudad, towards the mid-dorsal area. Triggers sometimes lie on the attachments to the spinous processes or between them and if identified, should be treated using INIT methodology (Appendix 1, p. 395).

Myofascial release of upper trapezius

The patient is seated erect, feet separated to shoulder width and flat on the floor below the knees, arms hanging freely. The practitioner stands to the side and behind the patient with the proximal aspect of the forearm closest to the patient resting on the lateral aspect of the muscle to be treated. The forearm is allowed to glide slowly medially towards the scapula/base of the neck, all the while maintaining a firm but acceptable pressure towards the floor.

By the time the treating contact arm is close to the medial aspect of the superior border of the

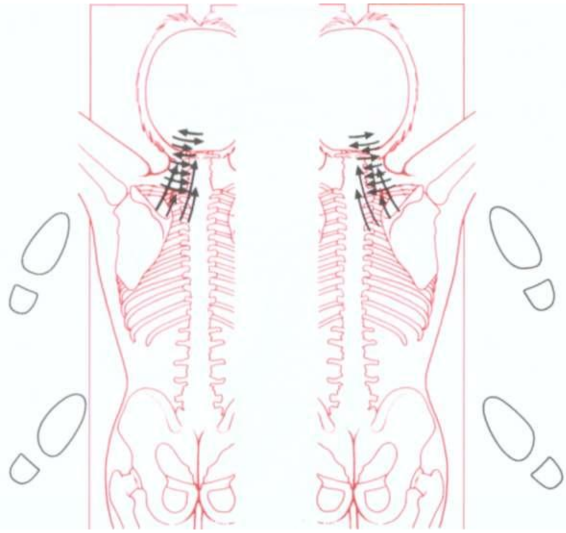


Figure 9.10 Map showing first two positions for application of assessment and treatment in European (i.e. Lief's) neuromuscular technique (NMT).

scapula, the practitioner's contact will be with the elbow itself.

As this slow glide is taking place, the patient should equally deliberately be turning the head away from the side being treated, having been made aware of the need to maintain an erect sitting posture. The pressure being applied should be transferred through the upright spine, to the ischial tuberosities and ultimately the feet. No slump should be allowed to occur.

If areas of extreme tension are encountered by the moving arm it is useful to maintain firm pressure to the restricted area, during which time the patient should be asked to slowly return the head to the neutral position and to then make several slow rotations of the neck away from the treated side, altering the degree of neck flexion, as appropriate, to ensure maximal tolerable stretching of the compressed tissues. Separately or concurrently, the patient should be asked to stretch the fingertips of the open hand, on the side being treated, towards the floor, so adding to the fascial 'drag' which ultimately achieves a degree of lengthening and release.

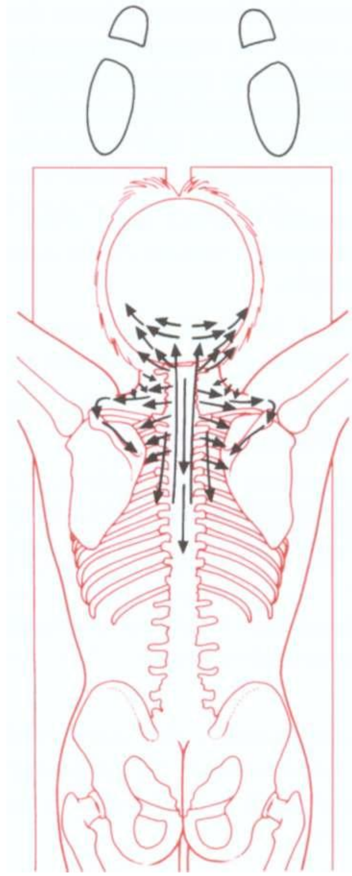


Figure 9.11 Map showing third position for application of assessment and treatment in European (i.e. Lief's) neuromuscular technique (NMT).

Exercise 9.1 Assessment and treatment of upper trapezius

Time suggested 7-10 minutes

Palpate and treat upper trapezius as described above, using MET and myofascial release, as well as NMT methods A and/or B.

STERNOCLEIDOMASTOID (see Fig. 9.12)

- Insertion superiorly is via a strong tendon into the lateral surface of the mastoid, as well as by an aponeurosis to the lateral surface of the nuchal line.

- The clavicular fibers attach to the mastoid process, while the sternal fibers extend to the occiput where the attachment crosses several sutures between the occiput and the parietals, as well as between the temporals and the occiput and parietals.
- The clavicular (lateral) head arises vertically from the superior surface of the lateral border of the clavicle.
- The sternal (medial) head arises from the anterior surface of the manubrium sterni.
- As they ascend, the clavicular fibers spiral behind the sternal head.
- The deep surface of the muscle is related to the sternoclavicular joint as well as to the sternohyoid, omohyoid and sternothyroid muscles.
- The posterior part is related to splenius, levator scapulae and the scalenes.

Actions

- Acting individually, the sternocleidomastoid tilts the head towards the ipsilateral shoulder while rotating the head and the face to the opposite side.
- When acting together from below, the action is to draw the head forward, assisting longus colli to flex the cervical spine.
- From a supine position both sternocleidomastoid muscles will lift and flex the head.
- When the head is fixed the combined action is to assist in elevation of the thorax in forced inhalation.
- EMG evidence suggests that the sternal fibers are most involved in contralateral rotation.

Sternocleidomastoid is thus involved in both extension and flexion of the neck. Most important from a cranial perspective is the fact that its attachments cross the sutures between the occiput, the parietal and the temporal bones.

Sternocleidomastoid's potential for causing cranial mischief is, according to Upledger & Vredevoogd (1983), greater than that of trapezius because of this sutural influence which can 'jam' motion, producing widespread symptoms.

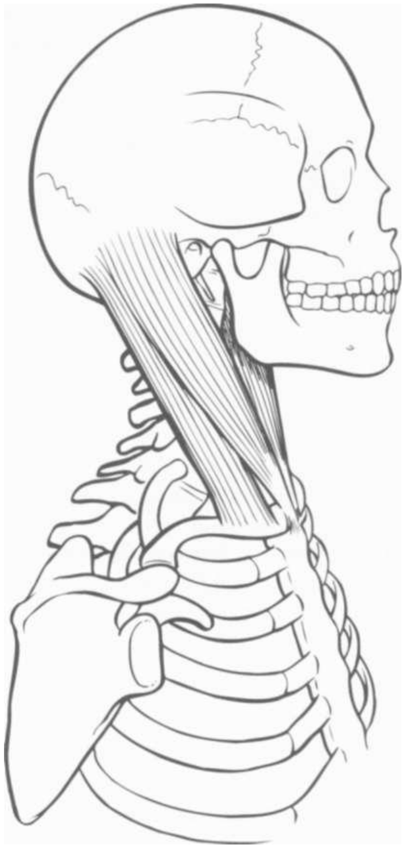


Figure 9.12 Anatomy of sternocleidomastoid (SCM).

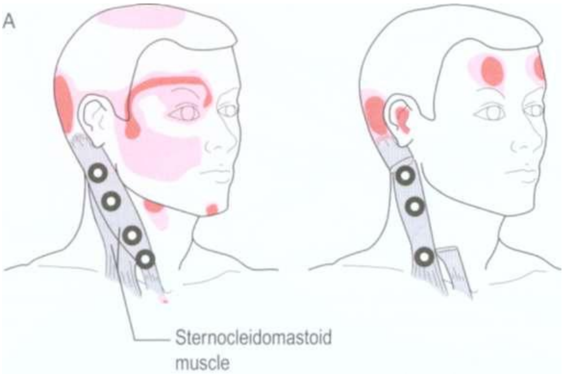
The anchoring of the muscle onto the mastoid process allows it to severely impinge on temporal function and via this to negatively influence tentorium cerebelli and thus cranial circulation and drainage.

Upledger & Vredevoogd remind us that innervation of the muscle is via the 11th cranial nerve (accessory) as well as branches of the second and third cervical nerves, which allows self-perpetuation of dysfunctional patterns via the effect on the jugular foramen (see trapezius discussion of the same phenomenon).

Trigger points (Travell El Simons 1983) Trigger points are extremely frequent in both divisions of the muscle but present quite different pictures in both pain and autonomic symptomatology.

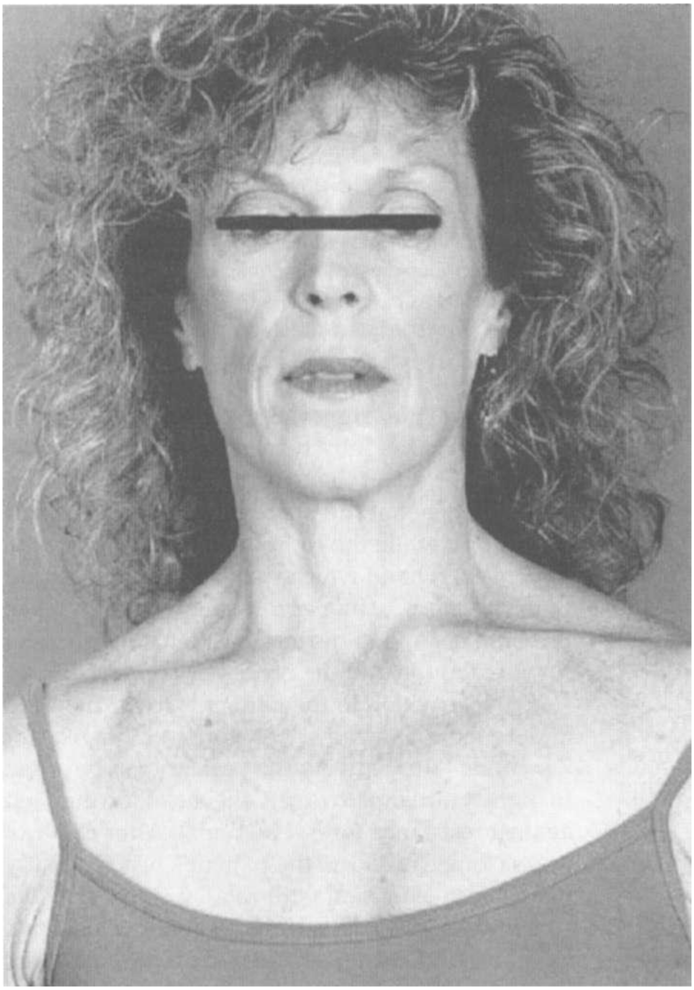
- Sternal fiber trigger points may refer pain to the vertex, occiput, cheek, over the eye to the throat

A



or sternum with autonomic symptoms involving sinus and eye problems.

- Clavicular fiber trigger points refer to the frontal area (headache) and to the ear with autonomic symptoms possibly involving proprioceptive dizziness, as well as forehead and ear problems (see also Fig. 9.13).



B

Figure 9.13 A Location of trigger point site and distribution pattern in sternocleidomastoid. B Typical appearance of hypertonic sternocleidomastoid, frequently associated with upper chest breathing pattern. (Reproduced with permission from Maria Perri DC)

Assessment of SCM dysfunction

Janda (1996) states that 'evaluation of sternocleidomastoid is not reliable because it crosses too many segments'. Palpation may offer a more accurate method of assessment. There is no absolute test for shortness but observation of posture (hyperextended neck, chin poked forward) and palpation of the degree of induration, fibrosis and trigger point activity can all suggest probable shortness of sternocleidomastoid.

SCM is an accessory breathing muscle and, like the scalenes, will be shortened by inappropriate breathing patterns which have become habitual.

Observation is an accurate assessment tool. Since SCM is only just observable when normal, if the clavicular insertion is easily visible or any part of the muscle is prominent, this can be taken as a clear sign of tightness of the muscle and therefore of traction on the mastoid process of the temporal bone (see Fig. 9.13B).

If the patient's posture involves the head being held forward of the body, often accompanied by cervical lordosis and dorsal kyphosis, weakness of the deep neck flexors and tightness of SCM should be suspected (Janda 1983).

An accurate functional test for extreme shortness of SCM involves asking the supine patient to very slowly 'raise your head and touch your chin to your chest'. The practitioner stands to the side with his head at the same level as the patient. As the patient lifts the head from the table, if SCM is short the chin lifts first, allowing it to jut forwards, rather than the forehead leading the arc-like progression of the movement (see Fig. 9.14A,B). In marked shortness of SCM the chin pokes forward in a jerk as the head is lifted. If the reading of this sign is unclear then Janda (1983) suggests that a slight resistance pressure be applied to the forehead as the patient makes the 'chin to chest' attempt. If SCM is short this will ensure the jutting of the chin at the outset of the movement.

Treatment of shortened SCM using MET

The patient is supine, head supported in a neutral position by one of the practitioner's hands while the shoulders rest on a cushion (see Fig. 9.15), so that when the head is rested on the table the neck will be in slight extension.

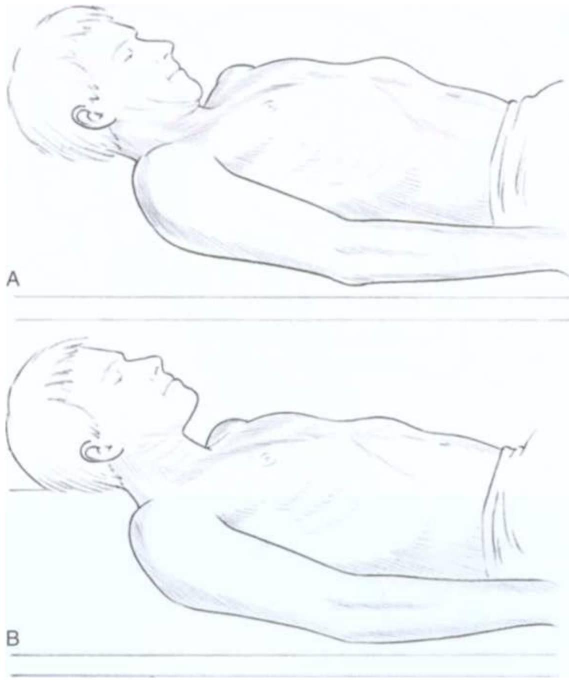


Figure 9.14 A Neck flexion test performed normally with forehead leading as patient responds to the instruction 'take your chin to your chest'. B Abnormal response in which 'chin poking' occurs as patient follows this instruction, indicating relative shortness of sternocleidomastoid.

To treat the right sternocleidomastoid the patient's head is fully turned to face the left. The practitioner's left hand supports the head in neutral (i.e. not at this stage allowing it to fall into extension), while the right hand lies on top of the patient's left hand which rests on the upper aspect of the sternum, acting as a 'cushion', so that when pressure is applied during the stretching phase of the method (below) the process is comfortable.

The instruction to the patient is to lift the head and to hold it against the force of gravity for 7 seconds (alternatively the patient may be asked to lightly attempt to turn the head further left against resistance for 5-7 seconds). After either of these isometric efforts the patient's head is gently placed into extension (still rotated fully) with the practitioner's left hand covering the patient's right mastoid area, to stabilize the head, while the right hand, covering the patient's left hand, applies oblique pressure towards the feet, as the patient breathes out.

Figure 9.15 Treatment of SCM utilizing muscle energy technique (MET).

The degree of extension of the neck should be slight, 10-15° at most.

The stretch should be maintained for approximately 30 seconds to achieve release/stretch of hypertonic and fibrotic structures. Repeat as necessary.

Treatment of shortened SCM using NMT (Walker DeLany 1996)

The patient should be supine.

1. Do not lubricate the tissues but grasp the tendon of the SCM lightly between the thumb and first two fingers, as close to the mastoid process as possible. Turn the head toward the side being treated to rotate it away from the carotid artery. Tilt (sidebend) the head toward the side being treated to more easily grasp the SCM and so lift it away from the deeper tissues. Be sure to grasp both heads of the SCM. A paper tissue may help the grasp if the area is oily.

> **CAUTION**
>
> If a pulse from the carotid artery is felt while compressing the SCM, release the muscle immediately and reposition the fingers to ensure the artery is not compressed.

2. Compress the SCM for 8-12 seconds, at 1-inch (2.5 cm) intervals from the mastoid process to the sternal and clavicular attachments (Fig. 9.16A). Each sternal head should be treated separately. Medial to lateral friction may be used on the sternal and clavicular attachments (Fig. 9.16B).
3. Support the head in 45° of flexion and rotate it away from the side being treated. Glide interiorly on the upper 1 inch (2.5 cm) of the mastoid attachment of the SCM, while being careful to avoid the styloid process located anterior to it.
4. Place the thumb posterior to the SCM tendon, at the mastoid process and displace the tendon anteriorly while simultaneously pressing onto the mastoid attachment of the longissimus capitis (erector spinae) and the splenius capitis (Fig. 9.16C). Use static pressure or combination friction to treat these areas.

Treatment of shortened SCM using myofascial release methods

The patient is supine, facing ahead. The practitioner's treating hand is formed into a loose fist resting against the SCM, so that the dorsum of the hand faces back and the knuckles face forwards. In this example the practitioner's left hand may be imagined to be treating the patient's left SCM.

Light force is applied against the muscles by the knuckles, as the left hand is slid towards the right transverse processes, while at the same time the patient slowly and deliberately turns the head towards right.

This spiral motion of the muscle as it turns the neck/head to the right, during the simultaneous application of pressure from the knuckles, offers an opportunity for both fascial and elastic muscle fibers to lengthen. This rotational maneuver should be repeated, very slowly, at least three times.

> **Exercise 9.2 Assessment and treatment of SCM**
>
> Time suggested 7-10 minutes
>
> Palpate and treat SCM utilizing MET, myofascial release and NMT approaches as described above.

Figure 9.16 Showing various contact positions in treatment utilizing NMT (American version) in treatment of SCM: on belly (A), inferior attachment (B) and superior attachment (C).

MUSCLES OF THE HEAD AND FACE (Fig. 9.17)

Unlike SCM and upper trapezius, many of the cranial and facial muscles have both their attachments on the skull and facial bones and as such their influence is local. This does not minimize their potential for producing dysfunction at the sutures, however, but maximizes it.

Muscles such as masseter are amongst the most powerful in the body and dysfunction of the muscle can have an enormous impact on cranial suture mobility, especially when it is hypertonic, as it so often is.

OCCIPITOFRONTALIS

- This broad, thin, musculofibrous layer covers the entire dome of the skull from the superior nuchal line to the eyebrows, completely enveloping the parietal suture.
- It additionally spans the lambdoidal and coronal sutures, attaching via direct or indirect linkages with the frontal, temporal, parietal and occipital bones, with the potential to significantly influence mobility and function of the region.
- Occipitalis attachments are on the occiput and temporal bones (via tendinous fibers to the mastoid), crossing the suture on the lateral aspects of the superior nuchal line.
- Frontalis has no bony attachments but merges with the superficial fascia of the eyebrow area while some fibers are continuous with fibers of corrugator supercilii and orbicularis oculi, attaching to the zygomatic process of the frontal bone, with further linkage to the epicranial aponeurosis anterior to the coronal suture.
- The posterior attachments bridge the lambdoidal suture between the occipital and temporal bones.
- The action of the muscles is to produce wrinkling of the forehead (frowning), so assisting in facial expressiveness.

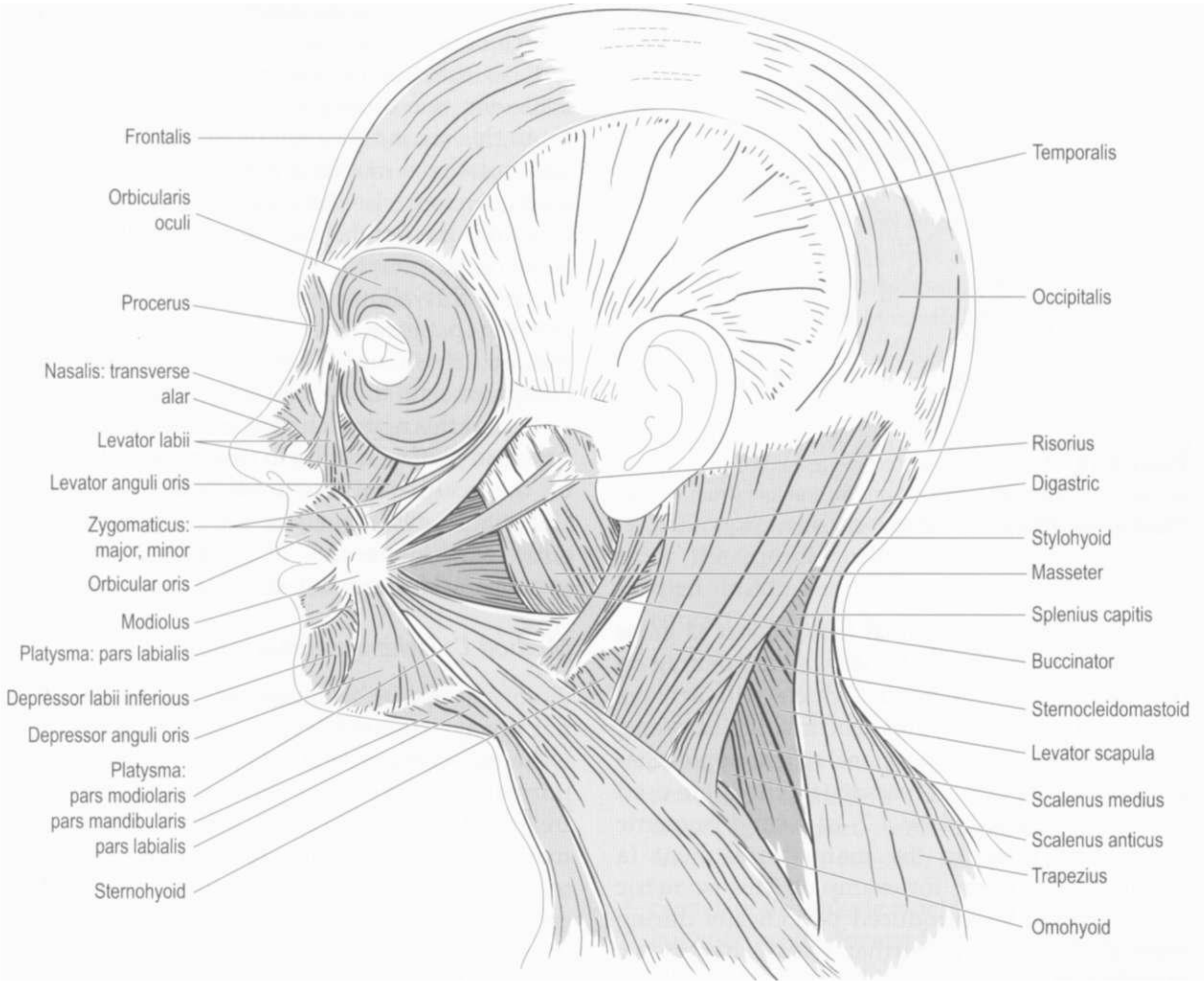


Figure 9.17 Superficial lateral view of muscles of the head and neck. Pain may be referred into the orbit from occipitalis trigger points.

- Restrictions and tension in either the frontalis or occipitalis muscles will produce a 'tightening' of the scalp, which can be diagnostic.
- Lewit (1996) states that the 'scalp should move easily in all directions in relation to the skull. Examination of scalp mobility is warranted for patients with headache and/or vertigo'.
- Tension in the occipitofrontalis or the epicranial aponeurosis can also potentially interfere with mobility potentials between the occipital, parietal and frontal bones.
- Trigger points from the frontalis belly of this structure refer to the forehead while trigger points in the occipital fibers refer to the back of the head, the cranium and the area behind the eyes (Fig. 9.18).
- Localization of the triggers calls for flat palpation:
  - above the medial end of the eyebrow and
  - in a small hollow superior to the nuchal line some 4 cm lateral to the midline.

Manual treatment of occipitofrontalis

Method A: direct approaches

Direct manual release of the fascial restrictions in this structure is recommended. Tension in the

Figure 9.18 Neuromuscular technique applied to occipitalis muscle attachments on the cranium (from which triggers may refer to the eye region).

scalp interferes with cranial motion, just as gross restriction in the thoracolumbar fascia can drag on the sacrum. The methods which will achieve release of such structures can involve massage, myofascial release and positional release approaches (see below). If NMT or massage methods are used these will be assisted by a 7-10 second isometric contraction prior to the manual treatment (a strongly held frown, for example). This isometric assistance can be introduced periodically during manual treatment to further release hypertonic muscle activity.

Method B: functional positional release

With the pads of two or three fingers, apply light compression, less than half an ounce, onto the skin overlying those parts of the muscle which appear most tightly compacted to the skull, identified by light to-and-fro gliding assessments of skin and underlying fascia.

Consider the point of initial contact as 'point neutral' and from it assess the relative freedom of movement in two opposite directions, say moving laterally one way, then back to neutral and then in the opposite direction. Decide which direction of movement is 'easiest' and glide the skin on fascia towards that direction.

Next, from this first point of 'ease', assess the relative freedom of glide in another pair of directions, say moving anteriorly and posteriorly. Which of these offers least resistance?

Ease the tissues towards that direction, so achieving two directions of ease in combination. From this second position of ease assess whether light rotational motion is easiest in a clockwise or a counterclockwise direction and take the tissues towards this and hold it there for at least 30 seconds.

After this allow the tissues to return to the starting position and re-evaluate freedom of motion; it should have improved markedly compared with the commencing assessment.

Repeat this approach wherever there appears to be a degree of restriction in free motion of the skin of the scalp over the underlying fascia. (See Chapter 10 and Appendix 1 for a fuller explanation of the concepts of positional release in general and functional technique in particular.)

Method C: ischemic compression

Simons et al (1999) suggest that this muscle does not always respond well to stretching and that ischemic compression may be called for to normalize it when hypertonic and that self-treatment is recommended. Brisk frictional scalp massage encourages the external connective tissue to soften. Any tender areas found during this process may be treated with combination friction or static pressure. Special attention should be given to cranial suture lines, which may be more sensitive than other local areas, indicating a need for further cranial attention, as described in earlier chapters (for example, see V-spread approach in Ch. 7).

Advice should be given to avoid frowning and wrinkling of the forehead. Trigger points and hypertonicity in sternocleidomastoid and the muscles of the cervical spine can contribute to maintenance of occipitofrontalis dysfunction and pain.

Method D: hair traction

The practitioner is seated cephalad to the supine patient. Light to moderate hair traction may be applied over the entire cranium, one handful at a time, if the hair is long enough to be grasped. The hair is gently lifted away from the scalp by the non-treating hand, as the fingers of the treating hand slide into place, close to the scalp, with segments of hair lying between the fingers.

As these fingers close into flexion, they also wrap around the hair shafts so that they grasp the hair close to the scalp. The non-treating hand now stabilizes the cranium while the treating hand gently pulls the hair away from the cranium, until slack is taken out and tension produced. The hair traction is sustained for 30 seconds to 2 minutes. If brisk friction has been applied immediately before hair traction, the fascial tissues will usually quickly loosen and soften. When friction is not applied first, the release of the tissues is delayed. The entire procedure may be repeated, although single applications are often adequate.

Self-treatment can be taught. The individual would be seated, elbows on a table, one hand applying traction while the other stabilizes the head.

Exercise 9.3 Treating occipitofrontalis

Time suggested 7-10 minutes

Palpate and treat occipitofrontalis as described above.

MASSETER

- This very thick muscle has a superficial part which commences as a tendon attached to the zygomatic process of the maxilla as well as from the posterior aspect of the zygomatic arch, inserting into the inferior aspect of the lateral ramus of the mandible (refer back to Fig. 9.17).
- The deeper part of the muscle is not as large and arises from the medial surface of the zygomatic arch and inserts into the superior half of the mandibular ramus and the coronal process.
- Its geographical position suggests that dysfunction in masseter can result in disturbance of the temporal bone as well as TMT involvement.
- Emotional problems that lead to excessive jaw clenching can cause major problems in the muscle, which may also be involved in malocclusion.
- Marked restriction in the jaw's ability to open is often associated with trigger points in the muscle. Deep triggers here can also cause tinnitus (see Fig. 9.19). Examination for these is best achieved with the mouth propped slightly open using either a light/flat palpation (or 'drag'), by compressing the muscle onto the bony tissue beneath it or by a pincer action with one digit inside the mouth (see Fig. 9.20). During this palpation, take care to avoid lateral pressure onto the mandible, which could produce deviation and discomfort.
- Direct pressure on trigger points in the middle of the muscle calls for working with one digit inside the mouth to achieve a pincer contact. In other instances pressure onto the ramus of the jaw or the zygomatic process allows triggers to be located and ischemic compression initiated.
- Advice should be given regarding irritating activities, including mouth breathing, gum chewing, bruxism, clenching and grinding the teeth, as well as possible dental involvement.
- Stretch of the muscle is achieved by a sustained, but not forceful, forwards and downwards pull, taking out all available slack and then holding to allow a 'creeping' release to evolve.

MET treatment of masseter

Method A

If reciprocal inhibition is the objective, the patient is asked to open the mouth against resistance applied by the practitioner's or the patient's own hand. (Patient places elbow on table, chin in hand and attempts to open mouth against resistance for 10 seconds or so.) The jaw should have been opened to its comfortable limit before attempting this and after the attempt, it would be taken to its new barrier (by the patient's own effort) before repeating. This MET method would have a relaxing effect on various muscles, including masseter, if they are shortened or tight (see Fig. 9.21A).

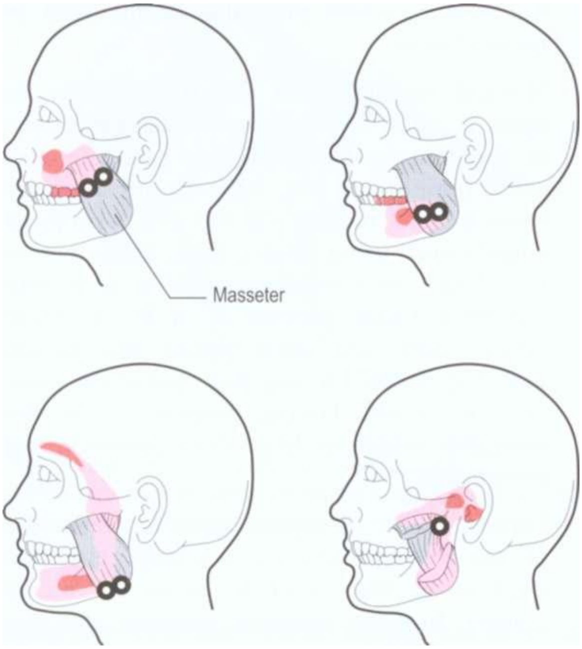


Figure 9.19 Location of major trigger point sites and distribution patterns in masseter and other masticatory muscles.

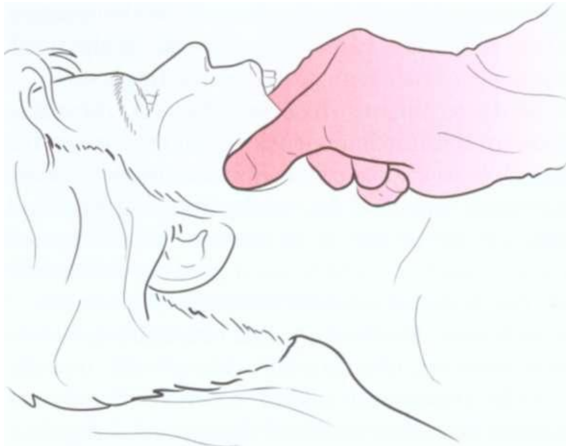


Figure 9.20 Palpation and treatment approach to belly of masseter.

Method B

To relax the tight muscle using postisometric relaxation, counterpressure would be required in order to prevent the open jaw from closing (using minimal force). This would require the thumbs (suitably protected) to be placed along the superior surface of the lower back teeth, whilst an isometric contraction was performed by the patient. In this exercise the practitioner is directing force through the barrier (practitioner direct method) rather than the patient (patient direct) as in Method A above (see Fig. 9.21B).

Massage/myofascial stretch treatment of masseter

Method A

A very gentle myofascial release approach is achieved by sitting at the head of the supine patient and placing the pads of the three middle fingers onto the tissues just inferior to and attached to, the zygomatic process. The contact should be 'skin on skin' with no perceptible pressure. The amount of force applied in an inferior/posterior direction should be minimal, barely half an ounce (14 grams). This is held for a period of up to 3 minutes, during which a sense of release or 'unwinding' may be noted.

Method B

Immediately following this, the thenar eminences are placed onto the tissues overlying the masseters with the fingers resting on the face, following its contours. A slightly increased degree of pressure should be applied (up to 4 ounces or 112 grams), as the wrists gently move into and out of extension so that a slow, repetitive stroking/ kneading effect, in an inferior/posterior direction along the long axis of the muscle, is achieved. A light lubricant may be used.

Method C

Following this, gently palpate the muscle for its most tense or congested local areas, using finger-pads or thumbs. Identify the most tense point on each side and apply direct thumb-tip pressure to this, sufficiently firmly to remove all slack from the tissues but not to cause distress. Maintain this bilateral pressure, thumb-tips facing each other, until a release is sensed (see Box 7.1, p. 179, for discussion of the term 'release').

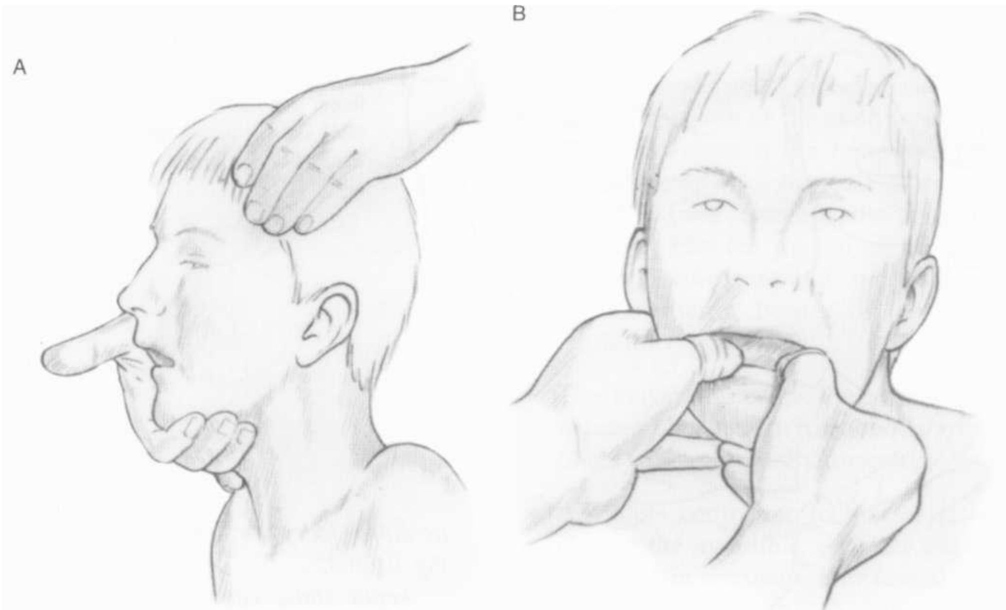


Figure 9.21 A Muscle energy technique of TMJ restriction showing isometric contraction phase of the sequence as the patient opens the mouth (lightly) against resistance. B Muscle energy technique of TMJ restriction showing isometric contraction phase of sequence as patient attempts to close the mouth against resistance.

Method D

Judith Walker DeLany (1997) describes a neuromuscular therapy approach as follows, firstly for external application (see Fig. 9.22A-D).

Support the non-treated side when applying pressure to the mandible and work with one side at a time. Do not proceed if there is evidence of inflammation or infection in the parotid (salivary) gland or teeth or if heat, redness, edema or extreme tenderness is present.

Lubricate the masseter muscle and glide inferiorly eight to ten times from the zygomatic arch to its insertion on the ramus of the mandible (Fig. 9.22A). Place the index finger onto the inferior surface of the zygomatic arch and press into the masseter attachment. Apply static pressure and medial-lateral friction at finger-width intervals until the mandibular condyle is reached. Do not put friction on the condyle (see Fig. 9.22B).

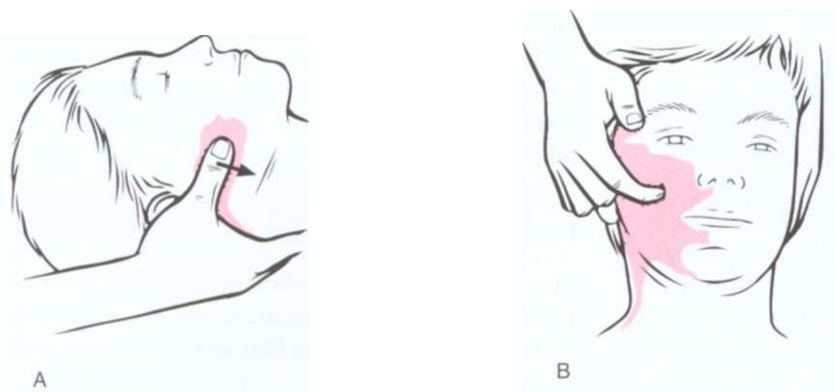
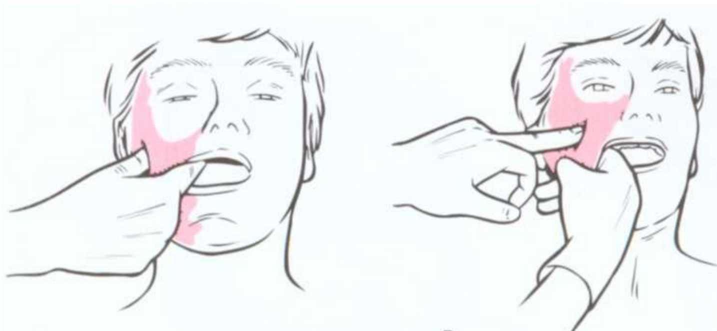
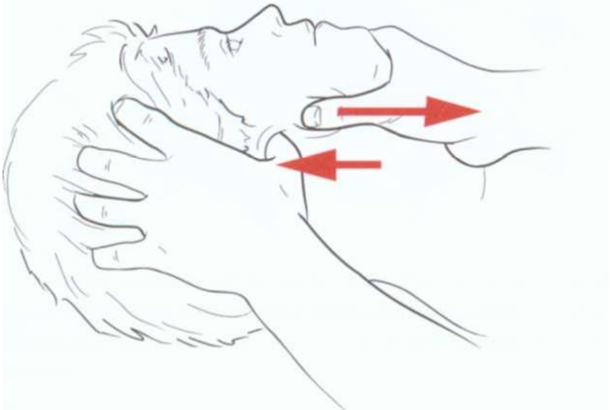
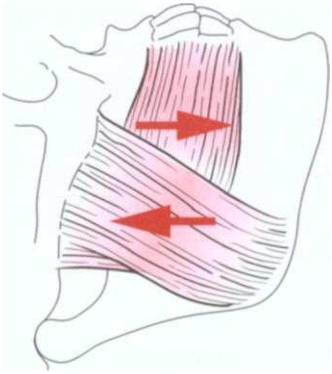


Figure 9.22 A NMT gliding technique on masseter. B NMT friction applied to zygomatic attachment of masseter.



C D





E

Figure 9.22 C Compression of masseter between finger and thumb of same hand as part of NMT. D Compression of masseter between finger and thumb of different hands as part of NMT. E 'S' bend myofascial release of masseter muscle.

For intraoral treatment of masseter, place the gloved index finger of the right hand inside the patient's mouth and just inferior to the zygomatic arch, with the pad of the finger facing towards the right cheek. With the finger still in place but clear of the teeth, ask the patient to clench the teeth to contract the masseter. After locating it, ask the patient to relax the mandible until the therapy is completed. It may be necessary to have the patient shift the mandible toward the side being treated to allow room for the treatment finger (see Fig. 9.22C).

Apply static compression at finger-width intervals for the entire length of the masseter, especially the deep, thicker portion. Pressure may be applied between the thumb and finger of the same hand in a pincer-like compression or against an external finger of the opposite hand. Apply static compression at finger-width intervals along the entire inferior surface of the zygomatic arch.

Method E

A further, externally applied approach might usefully be added to the sequence described above. Goodheart (Walther 1988) recommends application of a 'scissor-like' maneuver across the muscle by the thumbs - forming an 'S' bend - with one thumb pushing anteriorly across the fibers while the other pushes posteriorly. The fibers between the thumbs are thereby effectively stretched and held for some 15-30 seconds. A series of such stretches, starting close to the ramus of the jaw and finishing at the pterygoid, can be applied. The buccinator muscle will also be effectively treated at the same time (see Fig. 9.22E).

Positional release of masseter (Chaitow 1996b)

The masseter tender point lies on the anterior border of the ascending ramus of the mandible and may be involved in TMJ dysfunction as well as mandibular neuritis.

Figure 9.23 Positional release treatment of right side masseter dysfunction.

The patient should be supine, with the jaw slack and the mouth open approximately 1 cm (approximately half an inch).

The practitioner is seated, or stands, on the non-affected side (left in this example). The heel of the caudad hand (left in this example) rests on the point of the chin, applying very light pressure towards the right (the affected side), as the left index finger monitors the tender point (see Fig. 9.23).

The right hand lies on the right side of the patient's head (in the parietal/temporal area) offering counterforce via the heel of hand, to stabilize the head. The right fingers, above the zygoma, lightly draw that area towards the practitioner's chest, against which the head is braced. When sensitivity in the tender point has been reduced by 70% the position of ease should be held for 60-90 seconds (see Ch. 10 and Appendix 1 for full explanation of this strain/counterstrain method).

Exercise 9.4 Treating the masseter

Time suggested 7-10 minutes

Palpate and treat masseter as described and decide which approach(es) best suit your work or offer best results.

TEMPORALIS

- This fan-shaped muscle covers a large part of the side of the skull (see Figs 9.17 and 9.24). Its origin is the temporal fossa and its fibers merge and descend to form a tendon which passes beneath the zygomatic arch, inserting into the medial surface, the anterior border of the coronoid and its apex, as well as the anterior border of the ramus of the mandible.

- The major portion of the muscle involves the anterior fibers which run obliquely; the posterior fibers run horizontally forwards.

- All fibers contribute to the major function of closing the mandible, with the posterior fibers involved in retrusion and lateral deviation of the mandible towards the same side while the anterior fibers are largely involved in elevation (closure) and positioning of the anterior middle incisors.

- The attachments of the two temporalis muscles mean that they are directly connected to the temporal bones (fossa and squama), the parietals (squama), the great wings of the sphenoid and the posterior-lateral aspects of the frontal bones, crossing the coronal sutures, the spheno-squamous sutures and the temporoparietal sutures.

- It is hard to imagine muscles with greater direct mechanical influence on cranial function than these thick and powerful structures.

- Upledger & Vredevoogd (1983) point out that when the teeth are tightly clenched, contraction of the temporalis draws the parietal bone down. Because of the architecture of the squamous suture between the temporal bone (internal bevel) and the parietal bone (external bevel), a degree of slide/glide is possible between them.

- Prolonged crowding of this suture (possibly resulting from dental malocclusion, anger, tension, trauma, etc.) can lead to ischemic changes and trigger point evolution, as well as pain locally and at a distance.

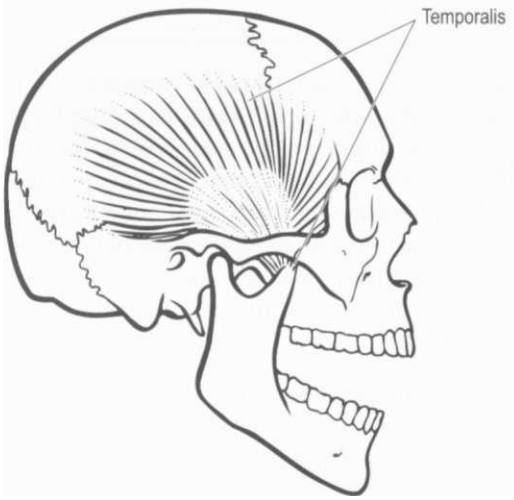


Figure 9.24 Anatomy of temporalis muscle.

- Subsequent influences might involve the sagittal sinus and possibly CSF resorption. Upledger & Vredevoogd (1983) report that such a scenario can lead to mild to moderate cerebral ischemia which may be reversible.
- Trigger points from the temporalis muscle refer to the side and front of the head, eyebrows and upper teeth, as well as the TMJ (Fig. 9.25).
- A differential diagnosis with polymyalgia rheumatica (PR) is necessary if widespread pain is a feature (PR usually occurs in those aged over 50 and its pain distribution is usually more widespread than trigger point influences on the face/head. A blood test confirms PR).
- To examine the muscle, the jaw needs to be propped open slightly. Single finger palpation above the zygomatic arch is utilized to locate firm, tender bands and points. In addition, examine above the ear and on the inner surface of the coronoid process from inside the mouth. Pressure in this instance is directed outwards towards the coronoid rather than inwards, as would be the case for the lateral pterygoid.

Manual treatment of temporalis

Direct manual techniques include both cross-fiber and longitudinal stretching maneuvers.

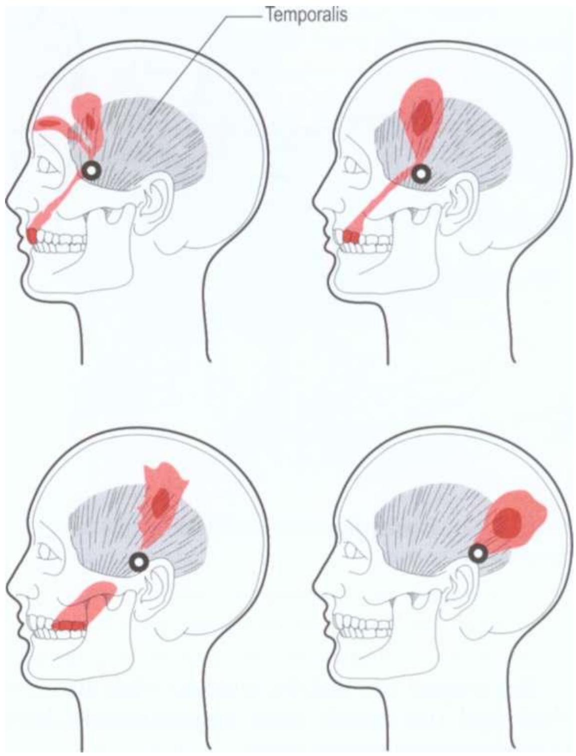


Figure 9.25 Major trigger point sites in temporalis muscle, with distribution patterns.

Method A: for the posterior fibers

Sit at the head of the supine patient and place your middle three fingertips on the head, on a line running from the superior tip of one ear to that of the other. Have the patient clench and unclench the teeth to ensure that your fingertips lie on the posterior fibers.

Apply gentle compression - an ounce (28 grams) at most - to take out the slack and then, without sliding the fingertips, draw the pressure superiorly and slightly anteriorly across the fibers, stretching them. Hold this traction for 60 seconds or so. You can also apply similar cross-fiber stretching more anteriorly, if appropriate.

Method B: longitudinal stretch

Another approach to treating tense temporalis muscle is to address the posterior fibers, along their axis of action. Adopt the same start position as in Method A above and slowly, gently but firmly stroke with the fingertips in an anterior/inferior direction, as though 'draining' the muscle. Slowly work all the fibers from their superior attachments towards their inferior ones, in line with their fan-like fiber directions. Try to use 20 or more repetitive strokes to effectively work these fibers.

Method C

Judith Walker DeLany (1997) describes her NMT approach as follows.

> *Use transverse friction on the entire temporal fossa at 2.5-cm intervals to examine the temporalis muscles in strips. Apply static pressure for 8-10 seconds on any tender areas or trigger points found. Be sure to examine the portion of the temporalis that lies posterior to the ear. With the patient's mouth closed, examine the temporalis tendon directly above the zygomatic arch with transverse friction. Repeat with the mouth open to stretch the tendon slightly. Less pressure is needed when the tendon is stretched (see Figs 9.26 and 9.27).*
>
> *With the mouth still open, use light friction to examine the temporalis attachment on the coronoid process of the mandible. The mouth must be open fully to reach the tendon attachment on the coronoid process since the zygomatic arch would otherwise cover it from palpation (see Fig. 9.28). The treating finger should be anterior to the masseter muscle. This attachment is often tender and light pressure should be used.*

Intraoral treatment of the temporalis tendon is as follows. With the patient's mouth open as far as

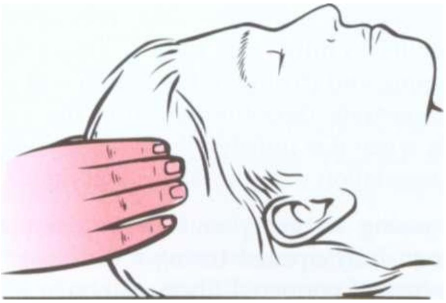


Figure 9.26 NMT transverse friction application to temporalis muscle.

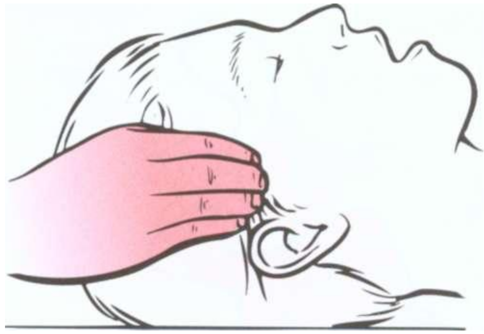


Figure 9.27 NMT treatment of temporalis tendon above zygomatic process (mouth open).

Figure 9.28 NMT treatment of temporalis tendon at coronoid process (mouth open).

possible, without inducing pain, ask the patient to shift the mandible towards the side being treated to allow more room to work. With the pad of the gloved index finger of the right hand touching the inside cheek surface, glide the finger posteriorly very gently until it runs into a bony surface embedded in the cheek. This is the coronoid process. Place the index finger on the inside surface of the coronoid process and use gentle static pressure to examine the coronoid process where the temporalis tendon attaches. The tendon is very hard and will feel like a continuation of the coronoid process. Friction may be used if the tendon is not too tender. Care should be taken during all intra-oral work to avoid pressing on the salivary duct (see Fig. 9.29).

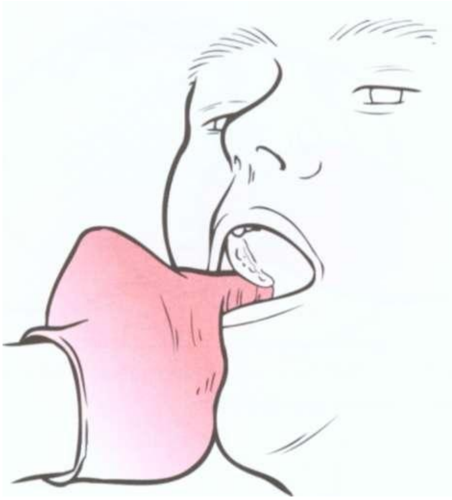


Figure 9.29 NMT treatment of temporalis attachment on coronoid process utilizing intraoral contact.

Method D: for spindle cell manipulation

Goodheart (Walther 1988) recommends a spindle cell manipulation in which, once identified, the tissues overlying dysfunctional areas ('sensitive and/or fibrous') are held in approximation, i.e 'pushed together' to reduce tone in the muscle (see Fig. 9.30).

The general guidelines for this method state that the contact thumb or fingertips be applied approximately 2 inches (5 cm) apart (but obviously less on a small muscle such as the temporalis), over the belly of a muscle.

Firm pressure along the axis of the muscle fibers towards the center of the muscle will temporarily weaken (reduce tone) while pressure applied away from the center will strengthen (increase tone). Repeat several times before using other methods to lengthen the muscle fibers (such as Methods A or B above).

The masseter self-stretch exercise, as described earlier, may also usefully be applied, as this will produce some stretch of temporalis (Exercise 7.16, p. 212).

Exercise 9.5 Treating temporalis manually

Time suggested 7-10 minutes

Palpate and treat temporalis in one or more of the ways described.

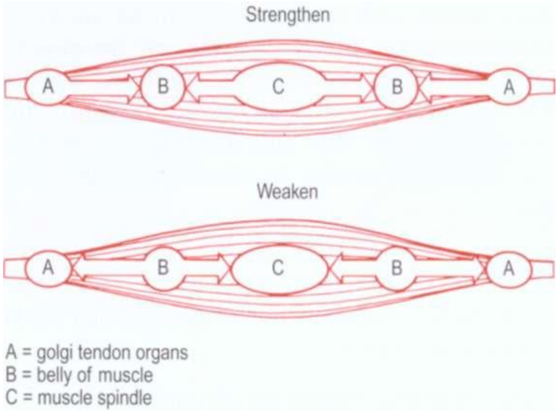


Figure 9.30 Schematic representation of methods for proprioceptive manipulation of muscles.

MEDIAL (INTERNAL) PTERYGOID (see Fig. 9.31A.B)

- The medial pterygoid attaches to the palatine bones, the medial surface of the lateral pterygoid plate of the sphenoid and the tuberosity of the maxilla and runs to the ramus and angle of the mandible, to which it attaches via a tendon.
- Its position, medial to the mandible, mirrors the position of masseter which lies lateral to it.
- The action is to close the jaw, elevating the mandible.
- Hypertonic states will interfere with sphenoid function, with the maxilla itself and with normal motion of the palatines.
- Medial pterygoid is commonly involved in temporomandibular problems.
- Trigger points in medial pterygoid may produce swallowing difficulty and restriction and inability to fully open the jaw. Observation of opening and closing of the mouth will usually demonstrate deviation towards the opposite side when it is unilaterally hypertonic (usually in association with the lateral pterygoid).
- Assessing trigger points: with the patient's mouth fully opened (using a cardboard tube) the medial pterygoid fibers will be in a degree of tension. By tilting the head backwards into extension slightly, one finger can be placed on

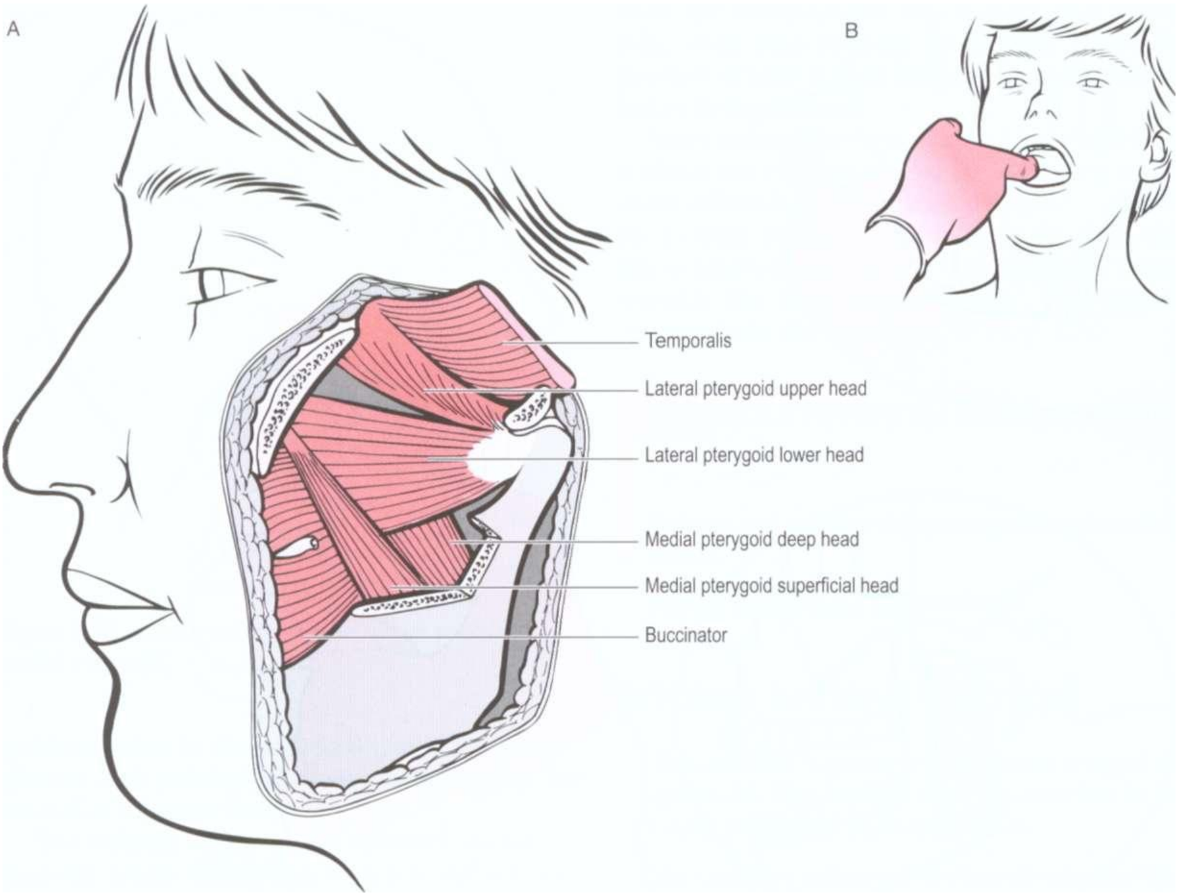


Figure 9.31 A Left pterygoid muscles: the zygomatic arch and part of the ramus of the mandible have been removed. B NMT treatment of medial pterygoid utilizing pressure and gliding on belly of muscle intraorally.

the medial surface of the mandible to press upwards where a tense mass can be sensed, the mandibular end of the muscle.

- Intraoral palpation is needed for the mid-belly. A finger (fingerpad facing outwards) is slid along the medial aspect of the upper molars until it reaches the bony ridge of the ramus. Pressure should be applied to this as the patient exhales or inhales fully and holds the breath, in order to avoid the gag reflex. This can further be inhibited by the patient forcing the tip of their tongue lateral and posterior - away from the palpated side - as strongly as possible during the palpation. The vertical muscle mass which the practitioner's finger contacts just posterior to the bony edge of the ramus is the medial pterygoid. Extreme tenderness is likely if there is an active trigger in the muscle.

Manual treatment of medial pterygoid

Method A: transverse friction

Judith Walker DeLany's (1997) approach is as follows (see Fig. 9.32A,B).

> *With the patient's mouth closed, place two fingers on to the (external) medial aspect of the lower angle of the mandible, where the medial pterygoid muscle attaches. Rotate the head toward the side being treated to allow more room for the fingers. Use transverse friction or static pressure, while being careful not to press the mandible cranially into the fossa or to apply pressure against the styloid process.*

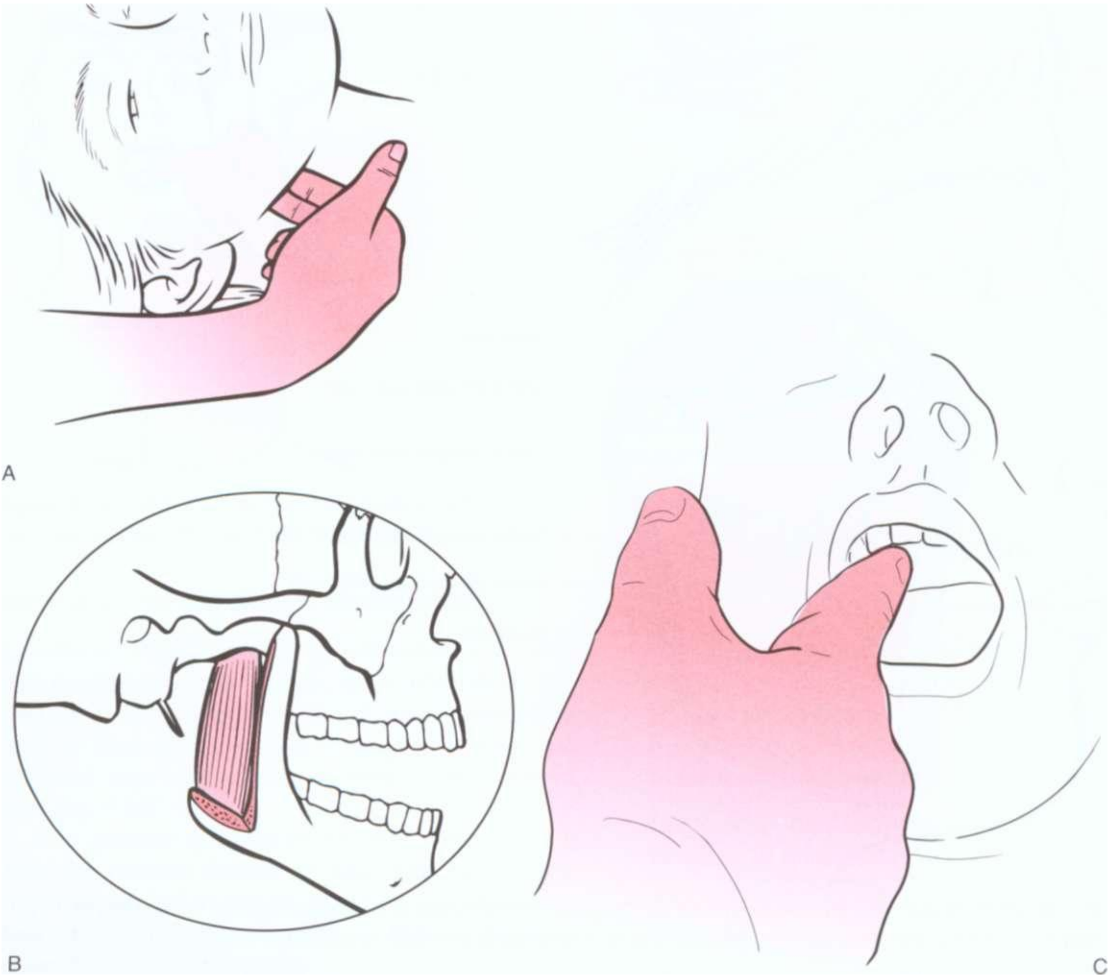


Figure 9.32 A NMT treatment of medial pterygoid with contacts on the medial surface of the ramus and angle of the mandible. B Anatomy of medial pterygoid muscle. C Placement of finger to palpate/treat lateral pterygoid is lateral to teeth and to palpate/treat medial pterygoid is medial to teeth.

Method B

The patient is supine with the mouth open. The practitioner's index finger of the treating hand (right hand for right side problem) is placed between the upper and lower molars and moved posteriorly until it contacts the most anterior edge of the medial pterygoid muscle, which is posterior and medial to the last molar.

Static pressure or short gliding strokes may be applied onto the belly of the medial pterygoid (Fig. 9.32C). Extreme tenderness is likely if there is an active trigger in the muscle so pressure should be mild until tenderness is assessed (Fig. 9.32D).

The finger may be carefully slid up to the medial pterygoid's attachment on the medial pterygoid plate and the palatine bone as long as the hamulus is avoided due to its sharp tip and the overlying delicate tissues. Pressure on the

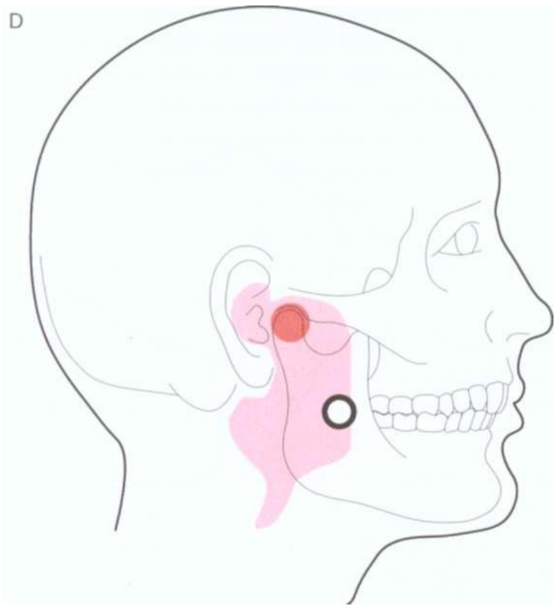


Figure 9.32 D Location of mid-belly trigger point in medial pterygoid.

palatine bones is also to be avoided. The palato-glossus and palatopharyngeus muscles may be treated at the same time.

The treating finger glides caudally as far as possible while attempting to reach the inferior attachment on the inside surface of the ramus of the mandible. If gliding down the medial pterygoid causes too much discomfort or a gag reflex is provoked, the lower angle may be reached by gliding the index finger along the inside surface of the mandible until the internal surface of the lower angle is reached. Static pressure or gentle friction may be applied if appropriate.

Positional release of internal/medial pterygoid muscle

A sensitive (tender) point will be found on the medial aspect of the ascending ramus of the jaw, associated with internal pterygoid dysfunction (Jones & Kusunose 1995). This tender point is palpated and the patient is asked to ascribe a value of '10' to the pain being created. The ramus itself is then gently crowded medially until the pain eases by at least 70% (or the open jaw is eased from the contralateral side toward the painful side, until pain reduces by at least 70%). The position of ease is then held for up to 90 seconds before being released.

Jones states: 'The best success I have had is via a lateral force on the side of the ascending ramus on the affected side which would seem to ... shorten the internal pterygoid without any rotation. Also this is relieved with the jaw wide open and forced towards the sore pterygoid side'. (See strain/counterstrain discussion in Ch. 10, p. 325.)

Exercise 9.6 Treating the medial pterygoids

Time suggested 2-3 minutes

Palpate and treat medial pterygoids as described above.

NOTE: See Box A1.1, pp 383-387.

EXTERNAL (LATERAL) PTERYGOID

- This attaches superiorly to the great wing of the sphenoid. The inferior division attaches to the lateral pterygoid plate (Fig. 9.33).
- The complex actions of the two divisions of this muscle, which are separated by fascia, assist in opening the jaw as well as helping to protrude and move the jaw laterally. The superior head is active in jaw closing, where it guides the TMJ disk to its optimal position. In normal function the superior and inferior parts of the external pterygoid act reciprocally whereas during dysfunction there may be simultaneous contraction (Walther 1988).
- TMJ dysfunction often involves problems of lateral pterygoid which, due to its attachment sites, may also influence more widespread cranial dysfunction, most notably of the sphenoid.
- Travell & Simons (1983) state: 'The external (lateral) pterygoid muscle is frequently the key to understanding and managing TMJ dysfunction syndrome and related craniomandibular disorders'.

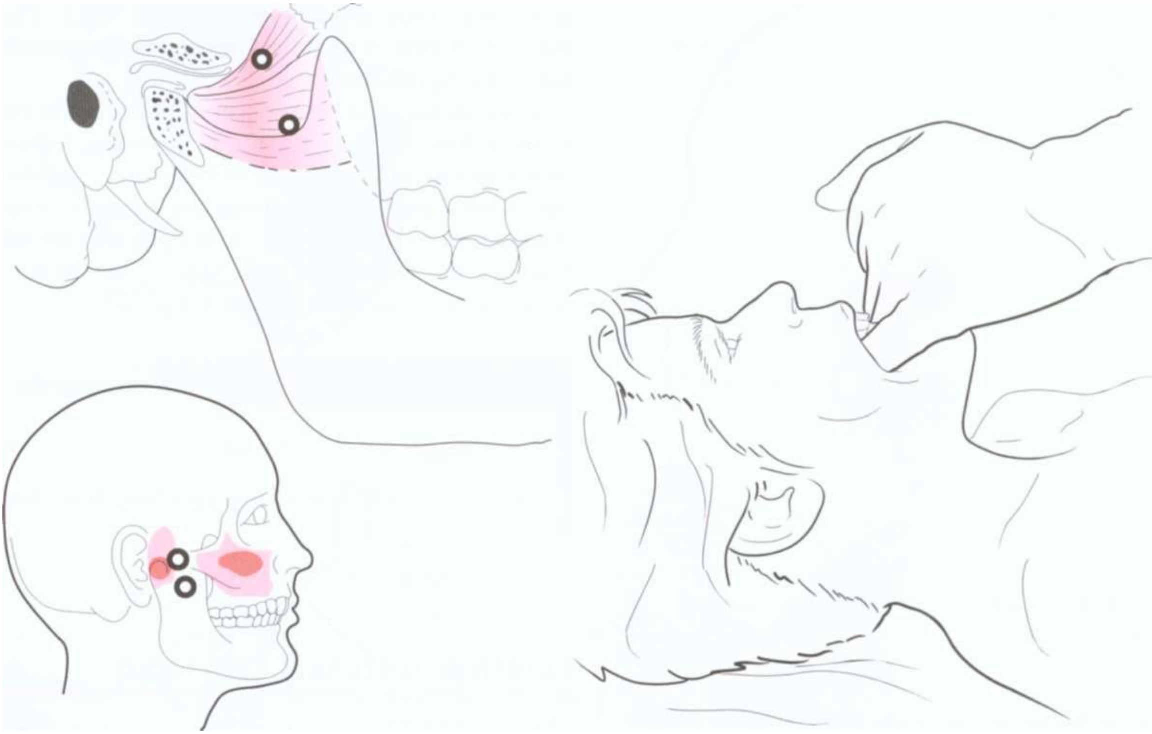


Figure 9.33 Location and palpation of trigger point in lateral pterygoid using small finger (mandible is shifted ipsilaterally to make this easier).

- Referred trigger point pains from this muscle focus into the TMJ area and the maxilla.
- Upledger & Vredevoogd (1983) report that 'it is a frequent cause of recurrent craniosacral and temporomandibular joint problems'.
- Along with other key muscles of the region, assessment and, if necessary, therapeutic attention to the lateral pterygoid are absolute prerequisites of craniosacral therapy.

Trigger point assessment

Because dysfunction of the lateral pterygoid (superior division) directly impinges upon TMJ disk status (leading to clicking and possible condylar displacement), problems of this sort can be associated with trigger points in this area.

With the jaw propped open it is usually possible to palpate for trigger points externally, through the masseter fibers as well as in the area between the mandibular notch and the zygomatic arch.

Intraoral palpation requires great sensitivity. The mouth is opened slightly and the jaw deviated towards the side being evaluated. A gloved finger is slid between the maxilla and the coronoid process, reaching as high as possible. Pressure is applied medially (towards the lateral pterygoid plate) or laterally (towards the medial aspect of the coronoid process) to identify sensitivity/trigger points (see Fig. 9.33).

Manual treatment of lateral pterygoid

Method A: muscle energy technique (MET) variations

With the mouth closed but relaxed, apply gentle but firm pressure to retrude the mandible against its ligamentous barrier and hold this for 10 seconds or so. A small degree of increased range may be obtained in this way.

Evjenth & Hamberg (1984) describe the treatment as follows.

Patient is seated. Stand facing patient's left side. Therapist's right forearm and hand grip patient's head from behind, fingers against forehead. Therapist stabilizes head between right hand, arm and chest. Left hand enfolds chin. Using this grip therapist gradually and maximally pushes dorsally against patient's mandible to produce dorsal glide of the head of the mandible at the TMJ. During the procedure the mandible should be completely relaxed.

During this procedure a sequential variety of muscular efforts can be attempted while retrusion pressures are applied to induce postisometric relaxation:

- The patient can be asked to 'push your chin forwards' and then, after 5-7 seconds, during which time the effort is resisted and after complete relaxation, the retrusion effort can be reintroduced for a further 5-7 seconds.
- The patient can be asked to 'push your chin to the right (or left)' and then after 5-7 seconds, during which time the effort is resisted and after complete relaxation, the retrusion effort can be reintroduced for a further 5-7 seconds. This should be done to both right and left at least once.
- The patient can be asked to 'open the mouth' and then after 5-7 seconds, during which time the effort is resisted and after complete relaxation, the retrusion effort can be reintroduced for a further 5-7 seconds.
- The patient can be asked to 'close the mouth' and then after 5-7 seconds, during which time the effort is resisted and after complete relaxation, the retrusion effort can be reintroduced for a further 5-7 seconds.

Method B: MET plus rocking

The patient is supine, the practitioner sits at shoulder level facing cephalad (Fig. 9.34). The patient's mouth is relaxed and very slightly open. The practitioner passively retrudes the mandible (i.e. eases it posteriorly) while gently rocking it from side to side. This will be enhanced if periodically the patient pushes the mandible against the restraining practitioner's hand for 5-7 seconds, so inducing postisometric relaxation.

Figure 9.34 Muscle energy technique application in treatment of lateral pterygoid.

Method C: compression-induced myofascial release

The practitioner sits at the head of the supine patient with palms of hands over the area immediately anterior to the TMJ. The index and middle fingers should be touching and applying slight pressure to the TM joints. The patient is asked to slowly and gently open and close the mouth while this pressure is maintained. Feel for the gradual freeing of the motion involved as the condyles glide forwards to their most anterior position when the mouth is fully opened.

Method D: continuation of compression-induced myofascial release

Immediately following application of Method C the patient is asked to maintain the fully opened position of the mouth as the practitioner places the index and middle fingers just anterior to the prominent masses of the condyles, where slight pressure is applied (avoiding strong pain). This addresses the pterygoid and its tendons by pressure through masseter muscle fibers. Several minutes of slow application of pressure, accompanied by slight stretching motions, should further release tension and enhance function.

Method E: retrusion mobilization

One of Milne's approaches (Milne 1995) involves a stretch involving what he calls a 'jaw cradle'. The patient is supine with the practitioner at chest level, at the side of the table. The patient's head is turned towards the practitioner. The practitioner places one (bandaged/gloved) thumb at a time inside the mouth, with palmar aspects on the upper surface of the lower molars, as far posterior as possible, close to the ascending ramus.

The index fingers are then placed external to the mouth, pointing to the top of the ears, which allows index finger contact with the masseters. The middle and ring fingers are then hooked posterior to the ramus of the jaw with the small fingers placed just anterior to the angle of the jaw. The jaw is now stable and controllable. Any pinching of the angles of the mouth should be avoided.

Retrusion of the mandible is then introduced as the practitioner 'feels' for hypertonic locations and vectors. The retrusion stretches the long axis of the muscle fibers. By simultaneously introducing rotation to a 'bind' barrier, it is possible to stretch one side at a time or to focus on particular hypertonic areas. The procedure continues for some minutes until a freedom of motion is sensed.

Milne reports that this may also release upper cervical joints.

Method F: lateral pterygoid NMT compression method (Fig. 9.35)

Judith Walker DeLany (1997) describes her neuromuscular therapy approach for lateral pterygoid as follows.

> *With the patient's mouth open as far as possible, without inducing pain, locate the coronoid process. Place the index finger just posterior to the coronoid process while remaining a finger-width anterior to the mandibular condyle. This will be approximately two finger-widths in front of the external auditory meatus. Have the patient close the mouth halfway. An indentation will be felt directly over the lateral pterygoid when the mouth is half open.*

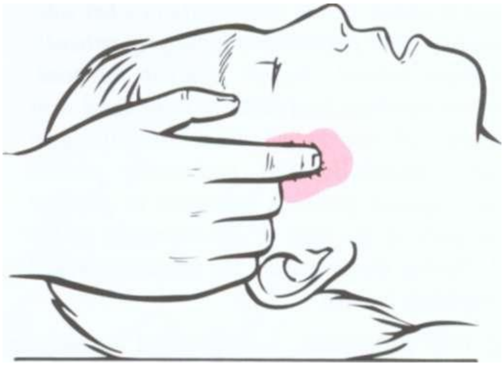


Figure 9.35 NMT treatment of lateral pterygoid with mouth half open.

> Press *the index finger into the indentation, through the masseter muscle and towards the lateral pterygoid muscle belly. Apply static pressure to one side at a time while stabilizing the mandible on the opposite side of the face.*

Method G: lateral pterygoid intraoral (Fig. 9.36A.B)

This method is best accomplished from the contralateral side. Shifting the mandible towards the side being treated may allow better access.

For right side lateral pterygoid treatment, place the index finger of the left hand just above the lateral aspect of the upper molars. Glide the finger very gently posteriorly and superiorly, as far back and up as it will reach, applying no pressure until the finger is in place. The fingerpad will be posterior to the upper molars.

Press the pad of the finger toward the midline and into the belly of the lateral pterygoid. Press (gently) superiorly and posteriorly at the same time. Use static pressure while being careful not to press too deeply (Fig. 9.36B).

Move the finger caudally one tip-width and press again toward the midline. Continue the tip-width pressures until all the palpable portions of the lateral pterygoid have been treated.

Positional release of the external pterygoid muscle

The patient is supine with the practitioner standing at the side of and facing the head.

Figure 9.36 NMT treatment of lateral pterygoid intraorally, sliding finger gently into place (A) and pressing towards midline into the muscle (B).

Digital pressure is applied intraorally to the most sensitive part of the lateral pterygoid (index finger contact) and the patient is asked to ascribe a value of '10' to the pain.

With the other hand, the head/neck is passively taken into flexion until pain reduces markedly (patient can indicate 'score' by use of fingers).

Once pain is reduced by flexion, fine tuning is performed in which the head, still in flexion, is taken into sidebending and rotation - usually towards the side of pain - until the score is reduced to 3 or less, at which time a strong inhalation is asked for and held for as long as is comfortable.

Additional 'ease' may be obtained by light (200 grams or so) application of pressure through the long axis of the neck, from the crown of the head.

The position is then held for 20-30 seconds before slowly restoring the head and neck to neutral and removing the finger from the mouth.

Exercise 9.7 Treating the lateral pterygoids

Time suggested 10-12 minutes

Palpate and treat the lateral pterygoid in the various ways described.

DIGASTRIC (see Figs 9.37 and 9.39)

- This important muscle has two bellies connected by a tendon.
- The posterior belly attaches at the mastoid notch of the temporal bone, while the anterior belly attaches to the mandible close to the midline. The meeting of the two bellies is via a tendon which attaches to the hyoid bone having perforated the stylohyoid.
- Digastric is active in swallowing and chewing and its action is to depress the mandible, acting synergistically with the lateral pterygoids in this function.
- Trigger points in the posterior belly of digastric can refer pain to the upper part of the sternocleidomastoid muscle, as well as producing neck and head pain.
- Trigger points in the anterior belly refer to the lower incisors.

Manual assessment and treatment of digastric

When digastric is hypertonic it places a load onto the contralateral temporalis and masseter, which attempt to balance any potential deviation that a taut digastric might create.

If a trigger point in digastric is referring into the lower incisors then a rapid tensing by the patient of the anterior neck muscles ('pull the corners of your mouth down vigorously') will activate the trigger and reproduce the pain.

The posterior belly of digastric is palpated between the angle of the mandible and the neck, with the patient supine, neck extended by placing a small cushion under the shoulders. A finger is

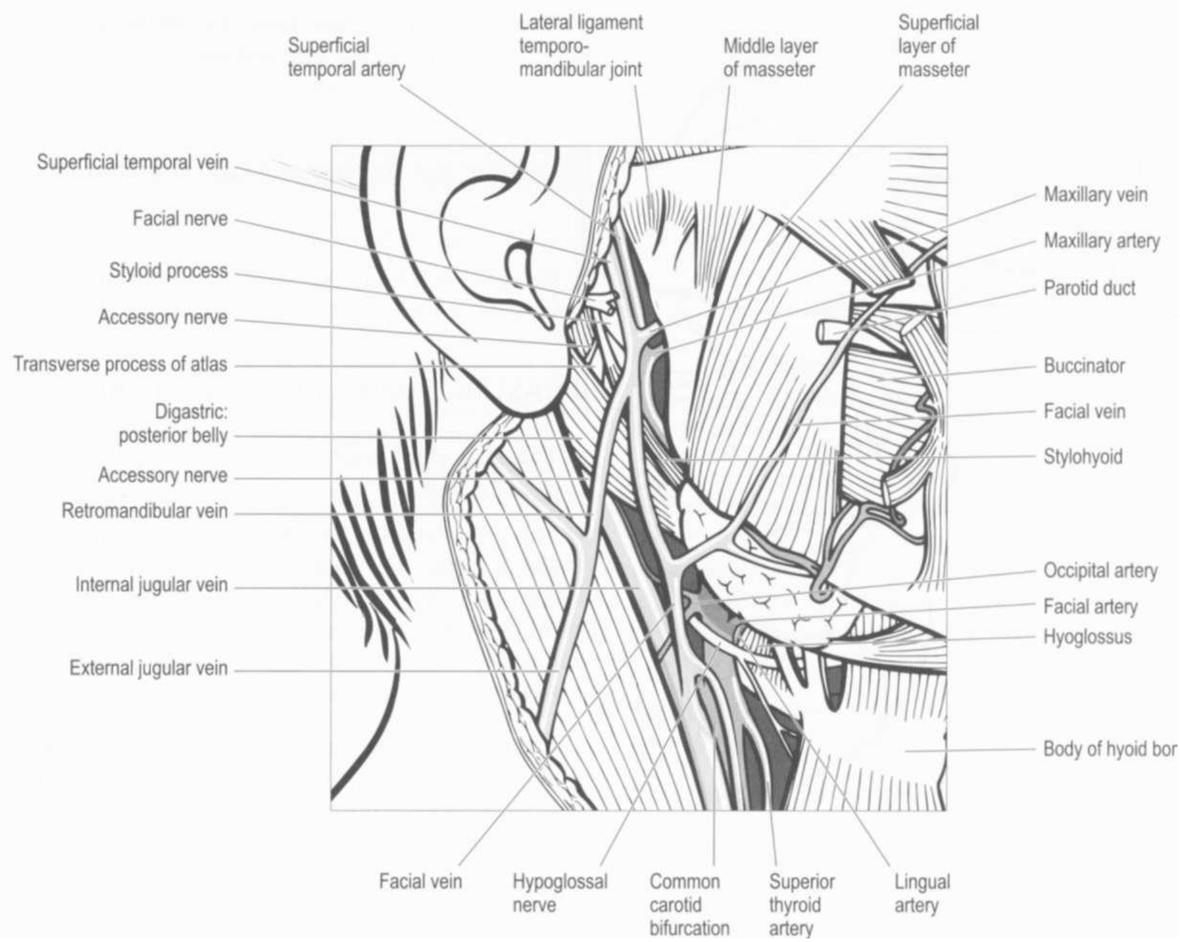


Figure 9.37 Posterior belly of digastric muscle and its relationships revealed by removal of skin, fascia, parotid gland and cutaneous branches of the cervical plexus.

rubbed firmly but gently across the fibers as well as along their length behind the angle of the mandible, upwards to the ear lobe and along the anterior border of the SCM.

In the same head position the anterior belly is found beneath the point of the chin in the soft tissues either side of the midline.

Stretching the posterior belly of the muscle involves the seated patient taking the head/neck into extension against the practitioner's chest with the teeth touching but relaxed. To stretch the right digastric the head is turned towards the right, in light extension. The practitioner simultaneously presses the hyoid bone downwards and to the left.

To stretch the anterior belly, the same head position is adopted and the patient protrudes the mandible, jaw closed.

A general stretch involving digastric may be achieved by means of a method described under the heading Longus capitis later in this chapter (p. 298).

Travell & Simons (1983) suggest vapocoolant spray during these procedures and/or ischemic compression which is directed for the posterior belly to the muscle deep to the angle of the mandible and for the anterior belly to the area just under the tip of the jaw.

THE MUSCLES OF THE ANTERIOR NECK

These are considered as having a largely subordinate influence on cranial functions when dysfunctional, with some exceptions which will be highlighted (see Figs 9.38A,B and 9.39A,B).

STYLOHYOID

Arises via a tendon from the posterior surface of the styloid process inserting onto the hyoid, having been perforated by the tendon which joins the two bellies of the digastric muscle.

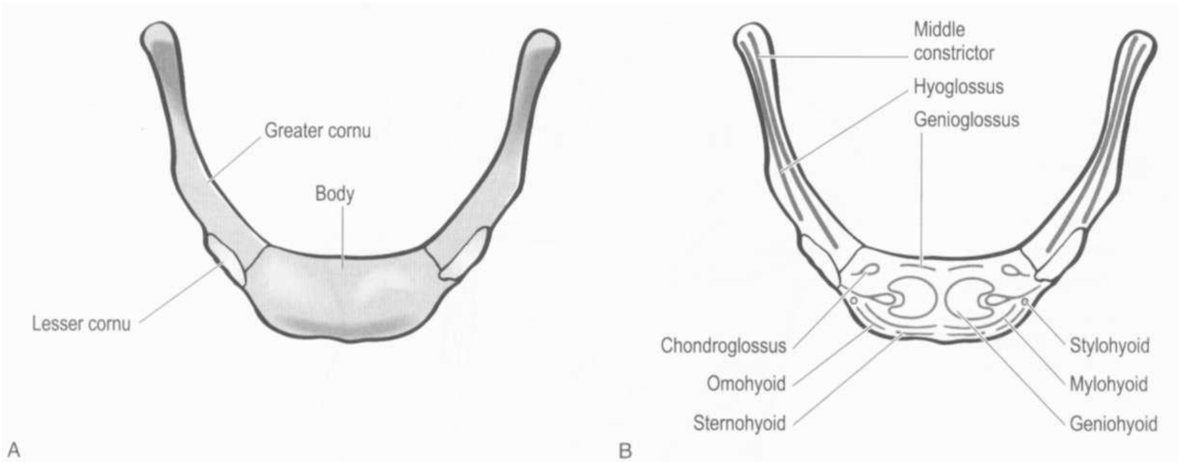


Figure 9.38 A Anterior aspect of hyoid bone. B Superior view of left side of hyoid bone showing muscular attachments.

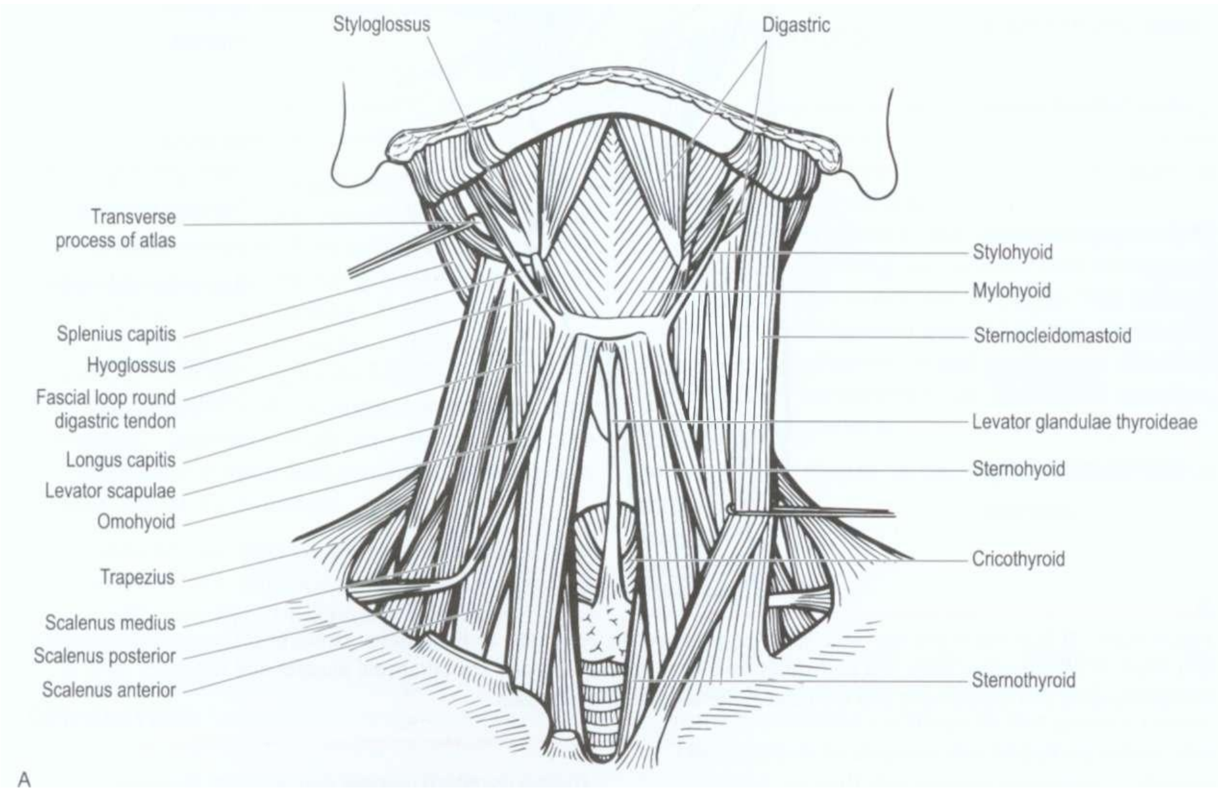


Figure 9.39 A Muscles of the anterior neck. Sternocleidomastoid has been removed on the right side.

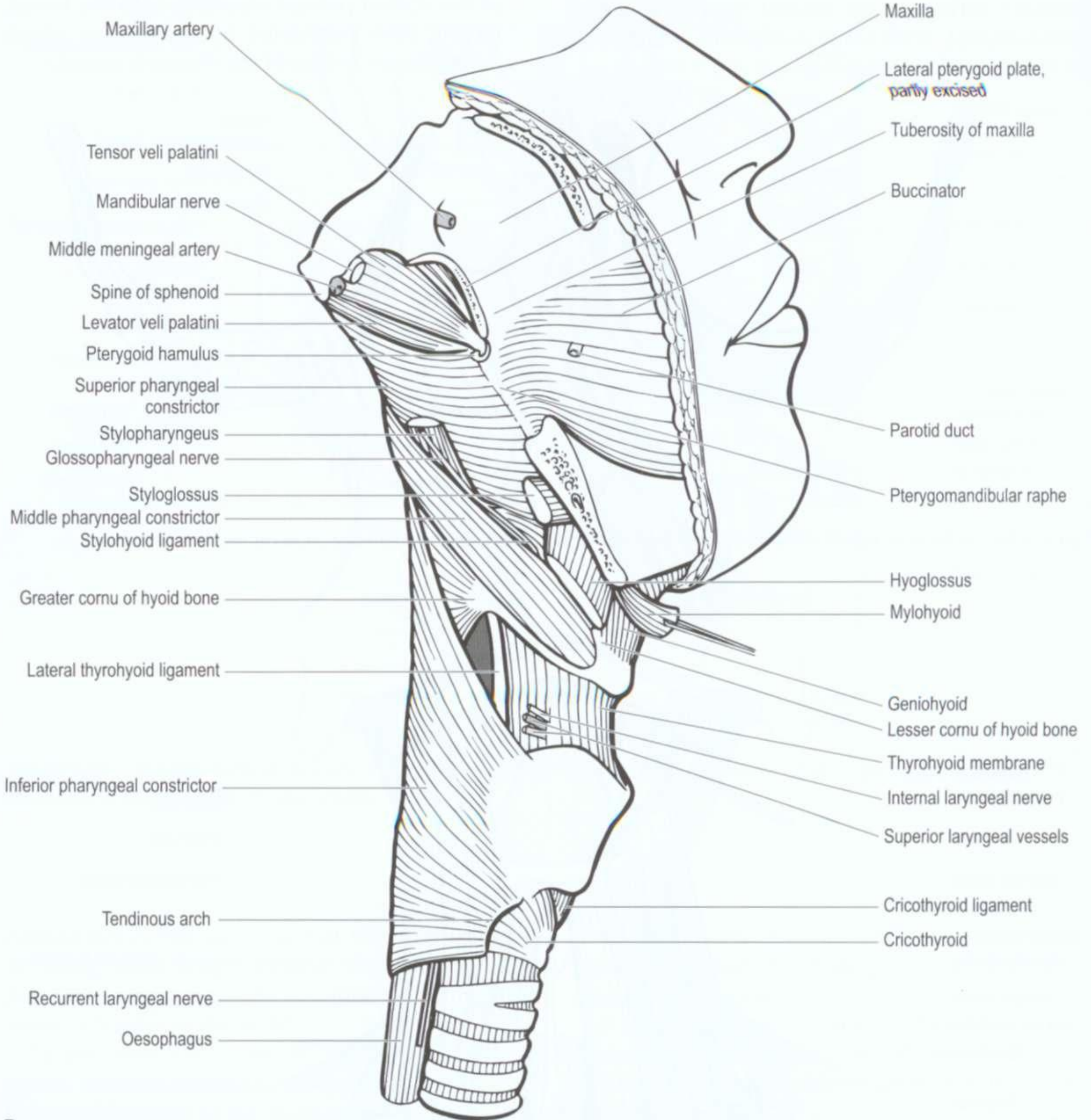


Figure 9.39 B Buccinator and the muscles of the pharynx. The zygomatic arch, masseter, ramus of the mandible, temporalis and much of the pterygoid plate and pterygoids have been removed as have the infrahyoid muscles and the upper parts of stylopharyngeus and styloglossus and the posteroinferior part of hyoglossus.

- The action is to elevate the hyoid bone, drawing it backwards and elongating the floor of the mouth, with roles in speech, chewing and swallowing.
- Because trigger points lying in the posterior belly of the digastric (Travell says it is hard to tell digastric fibers from stylohyoid fibers) refer into it, the expression 'pseudo-sternocleidomastoid pain' is used by some practitioners.
- Anterior belly trigger points refer into the four lower incisors.
- Treatment: as for digastric and anterior neck muscles (pp 289 and 300), plus hyoid balancing treatment below (p. 300).

MYLOHYOID

- The two mylohyoid muscles form a floor to the oral cavity, lying superior to digastric along the length of the mandible and the symphysis menti. The lower attachments are to the front of the hyoid bone.

  The action is to raise the floor of the mouth during swallowing and possibly to elevate the hyoid and depress the mandible.
- Upledger & Vredevoogd (1983) point out that the mylohyoid can interfere with cranial mechanics because of its action of opening the mouth when the hyoid is stabilized by the infrahyoid - an action which would be counteracted by muscles attaching to the maxillae and the zygomatic bones. The complex of stabilization and counterpressures can, they suggest, 'interfere with the function of the craniosacral system and contribute to temporomandibular dysfunction'.
- Treatment: as for digastric and stretching procedures for anterior neck muscles (pp 289 and 300) and hyoid balancing treatment below (p. 300).

GENIOHYOID

- This narrow muscle lies above the mylohyoid, attaching at the hyoid and the symphysis menti, with an action of elevating the hyoid bone, drawing it forwards, acting as an antagonist to the stylohyoid.
- Treatment: hyoid balancing treatment below (p. 300) and stretching procedures for anterior neck muscles (p. 300).

STERNOHYOID

- A narrow muscle arising from the posterior surface of the medial clavicle, the manubrium sternum and the sternoclavicular ligament and running upwards to attach to the inferior border of the hyoid bone, having merged with the contralateral sternohyoid.
- Its action is to depress the hyoid bone during swallowing.
- Treatment: hyoid balancing treatment below (p. 300) and stretching procedures for anterior neck muscles (p. 300).

STERNOTHYROID

- Lies deeper and medial to sternohyoid, arising from the posterior surface of the manubrium sternum and from the first rib cartilage. It attaches to the thyroid cartilage.

  Its action draws the larynx downwards during swallowing and speech and during the singing of low notes, for example. The linkage between the sternum and the hyoid allows this muscle to influence cranial mechanics, albeit by secondary involvement of associated muscles, when dysfunctional.
- Treatment: hyoid balancing treatment below (p. 300).

THYROHYOID

- This small muscle can be regarded as an upwards extension of sternothyroid, running from the thyroid cartilage to the greater cornu. The action is to depress the hyoid or, when this is stable, to pull the larynx upwards - during high sung notes, for example.

- As with sternothyroid, its influence on cranial mechanics is indirect.
- Treatment: hyoid balancing treatment below (p. 300) and stretching procedures for anterior neck muscles (p. 300).

OMOHYOID

- The two bellies of this muscle are linked by an intermediate tendon. The inferior belly arises from the upper border of the scapula near the scapular notch, running forwards and upwards across the lower neck, passing behind sternocleidomastoid, where it joins the intermediate tendon. The superior belly commences at the tendon and passes vertically towards the lateral border of the hyoid bone.
- Gray's *Anatomy* (1995) tells us that: 'The angulated course of the muscle is maintained by a band of deep cervical fascia, attached below to the clavicle and the first rib, which ensheathes the tendon'.
- The action is to depress the hyoid after it has been elevated. A connection with prolonged inhalation is suggested by *Gray's Anatomy,* via the deep cervical fascia.
- The extraordinary connection of this muscle, linking as it does the scapula, clavicle and hyoid bone which has, via other attachments, links directly to the mandible, gives some idea of the potential for cranial problems arising from numerous influences on these structures, not least from respiratory and postural dysfunction.
- Treatment: hyoid balancing treatment below (p. 300) and stretching procedures for anterior neck muscles as outlined in respect of both scalene stretch, general stretching and those applicable to individual muscles discussed below.

Manual release of anterior neck muscles

A general release of many of the anterior neck muscles - if shortened - is achieved during MET treatment of the scalenes as described below (p. 297).

Scalene shortness can be assumed if there is any indication of upper chest breathing and this translates as including shortness of, at least, omohyoid.

Scalene assessment A

The patient is seated and the practitioner stands behind, hands resting over upper trapezius so that fingertips rest on the superior aspect of the clavicles. On moderate inhalation, any sign of the shoulders or clavicles rising indicates scalene overactivity and probable shortness.

Scalene assessment B

The patient places a flat hand on the upper chest and a flat hand just above the umbilicus and inhales moderately deeply. If the upper hand moves first and furthest, especially if there is observable movement *towards* the chin, upper chest breathing can be assumed and by implication a degree of shortness in the scalenes can be assumed.

Direct palpation for myofascial changes should also be carried out with the patient supine.

Treatment of short scalenes by MET (Fig. 9.41 A-C)

The patient lies supine with shoulders under the upper thoracic area so that, if not supported by the practitioner, the head would lie in an extended position. The head is turned away from the side to be treated.

As with treatment of upper trapezius described earlier, there are three positions of rotation required:

- a full rotation producing involvement of the more posterior fibers of the scalenes on the side from which the turn is being made
- a half turn involves the middle fibers
- a position of only slight turn, or upright, involves the more anterior fibers.

The practitioner's free hand is placed on the patient's contralateral (to the side being treated) hand, which lies palm down just below the lateral end of the clavicle of the affected side.

The patient is instructed, with appropriate breathing co-operation, to lift the forehead a

A

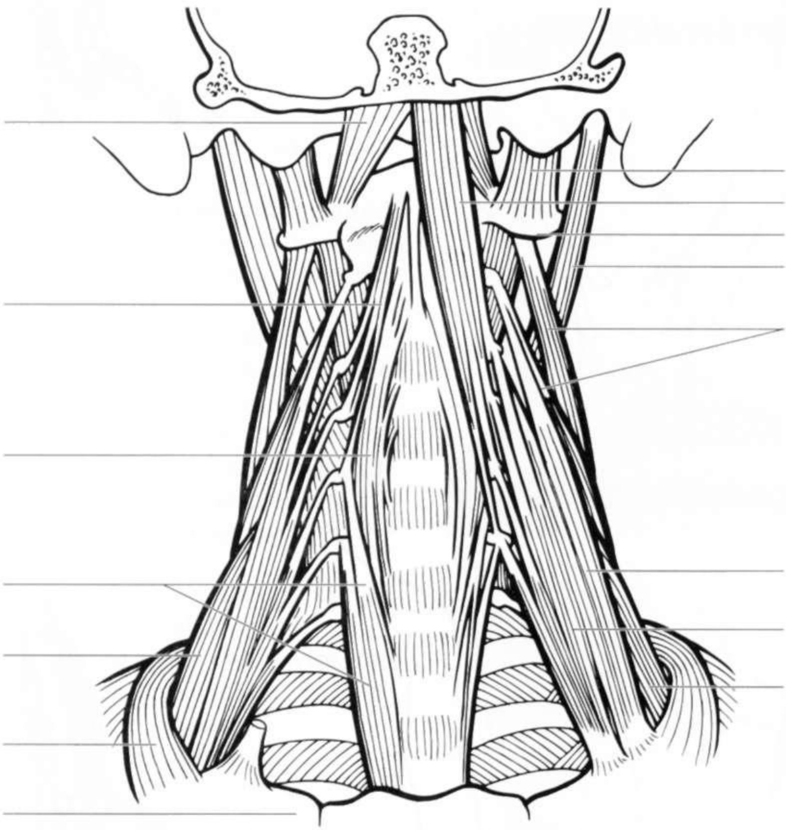
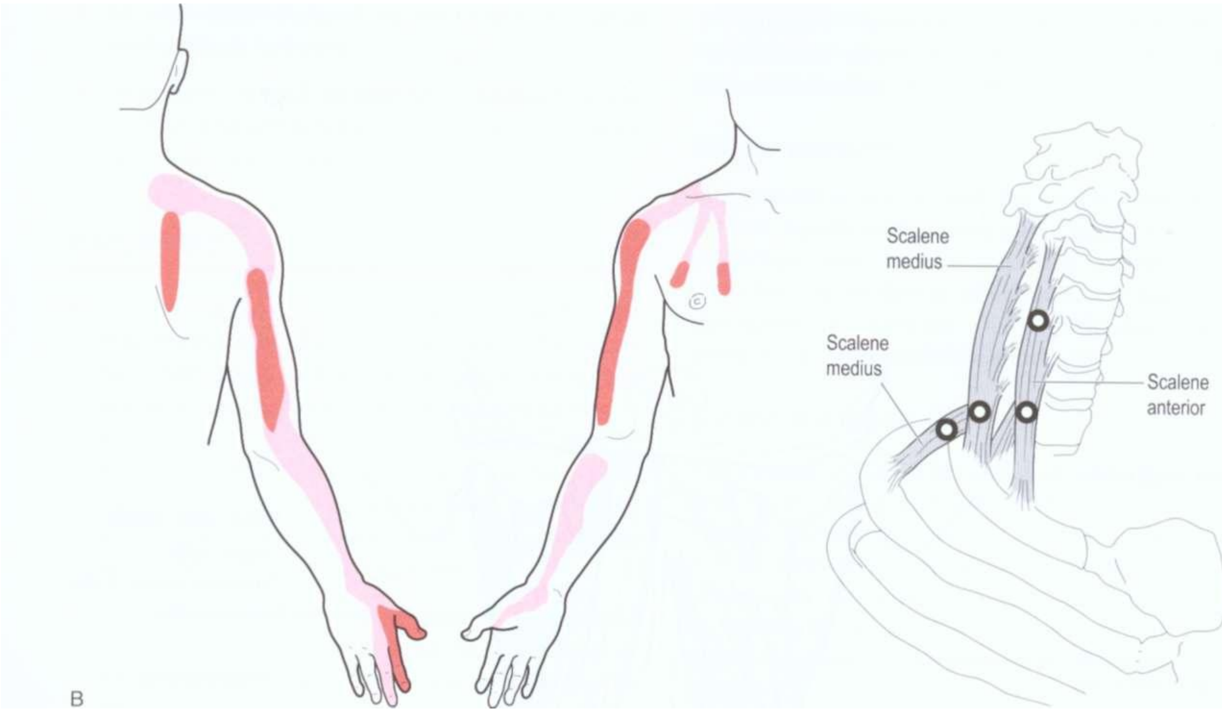


Figure 9.40 A Anterior and lateral vertebral muscles. Scalenus anterior and longus capitis have been removed on the right.



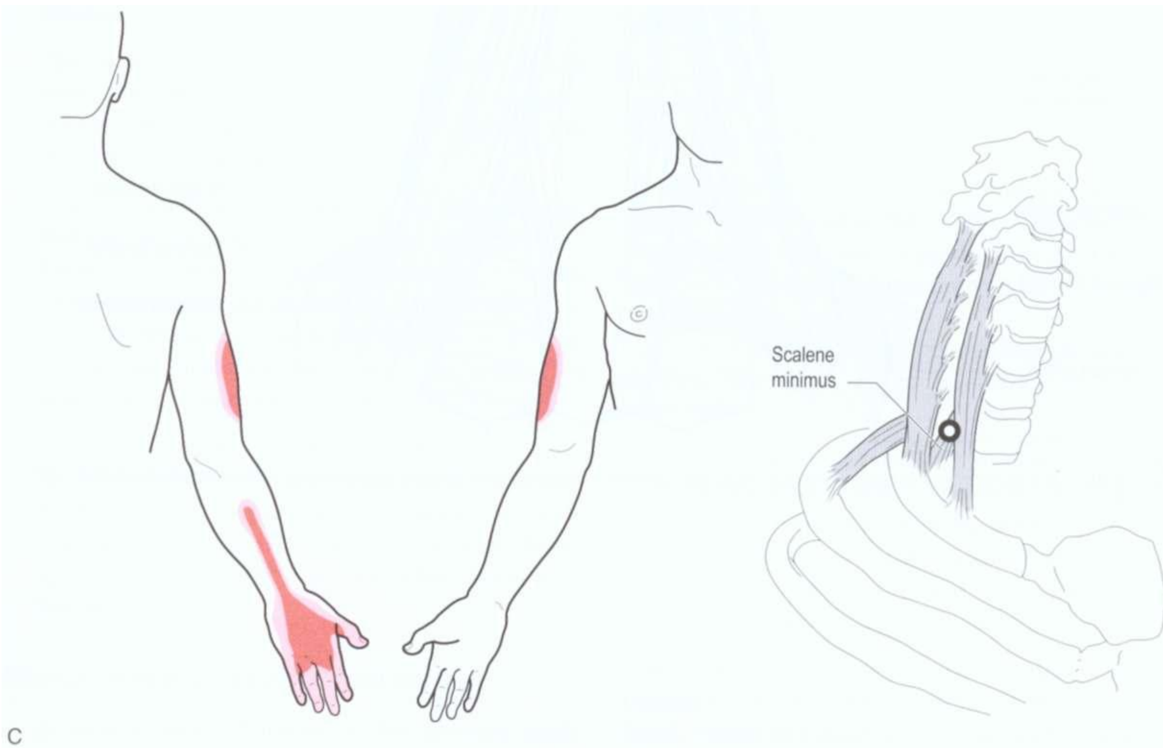


Figure 9.40 B Trigger points and distribution patterns in medial and anterior scalenes. C Trigger point and distribution pattern for scalene minimus.

fraction and to attempt to turn the head towards the affected side, whilst resistance is applied preventing both movements ('lift and turn').

The effort and therefore the counterpressure should be modest and painless at all times.

After the 7-10 second contraction, the head is allowed to ease into extension, stabilized and, as the patient exhales slowly, the contact hand resting on the patient's hand (which lies on the second rib and/or upper sternum) follows the upper ribs into their exhalation position, with pressure obliquely away towards the foot on that same side, so stretching the attached musculature and fascia.

This stretch is held in the position of full exhalation, for at least 30 seconds after each isometric contraction.

The head/neck should be returned to a neutral position between stretches, for subsequent isometric contractions and returned to extension when stretching is performed.

With the head half turned away from the affected side, the hand contact which applies the stretch into the middle fibers of the scalenes is just inferior to the middle aspect of the clavicle (practitioner's hand on patient's hand as cushion).

When the head is in the upright position, for anterior scalene stretch, the hand contact is on the upper sternum itself.

In all other ways the methodology is as described for the first position above.

Each stretch should be performed twice, for each aspect of the scalenes, on each side.

CAUTION

It is important not to allow heroic degrees of neck extension during any phase of this treatment. There should be some, but it should be appropriate to the age and condition of the individual.

A degree of eye movement can assist scalene treatment. If the patient looks downwards (towards the feet) and towards the affected side during the isometric contraction, he will increase the degree of contraction in the muscles. If during the resting phase, when stretch is being introduced, he looks

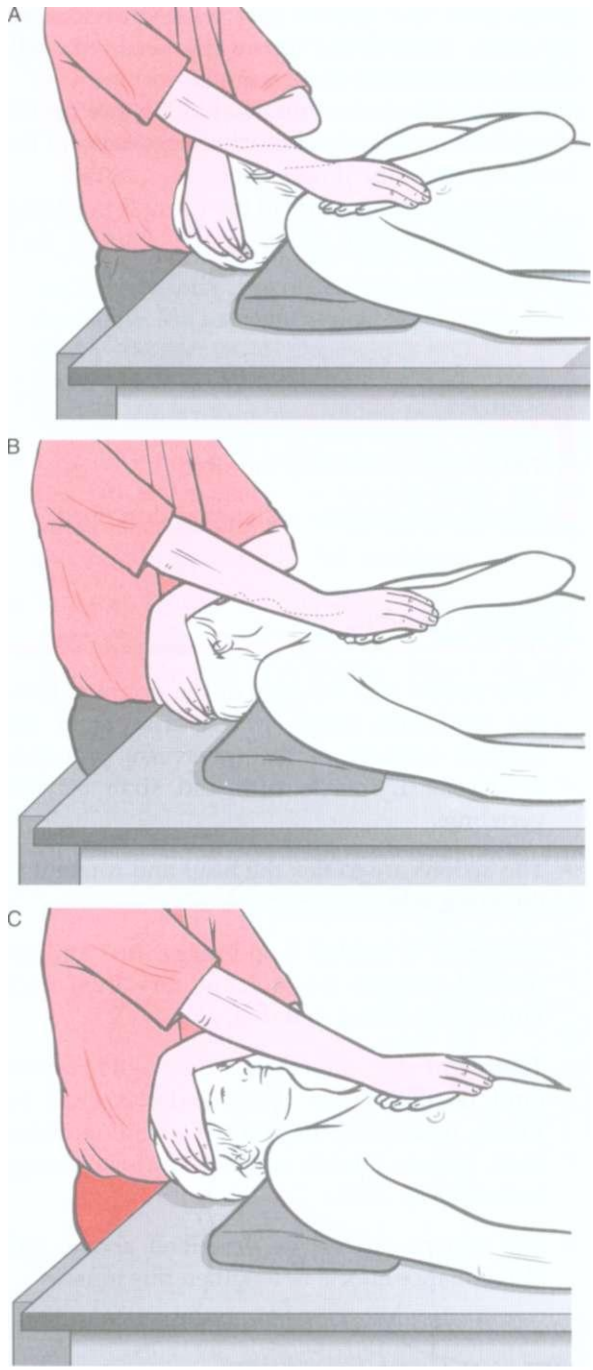


Figure 9.41 A MET of scalenus posticus. Note head position and practitioner's and patient's hand positions. B MET of scalenus medius. Note head position and practitioner's and patient's hand positions. C MET of scalenus anterior. Note head position and practitioner's and patient's hand positions.

away from the treated side with eyes focused upwards, towards the top of the head, this will enhance the stretch of the muscle.

This whole procedure should be performed several times, in each of the three positions of the head, for each side if necessary.

Scalene stretches, with all the variable positions, clearly also involve many of the anterior neck structures.

Exercise 9.8 Muscle energy release of scalenes

Time suggested 7-10 minutes

Palpate and treat the scalenes as described.

LONGUS CAPITIS

- This inserts into the base of the occipital bone via tendinous strips which arise from the anterior surfaces of the transverse processes of the third, fourth, fifth and sixth cervical vertebrae.
- The actions are to flex the head and rotate it to the same side.
- Treatment is needed if an exaggerated lordotic cervical posture exists (chin forwards, neck kinked, shoulders rounded, etc.).
- Treatment for shortness of longus capitis (and most anterior throat muscles) will be found under the heading, General anterior neck muscle stretch utilizing muscle energy technique (p. 300).
- The scalene stretch, as described above, will also enhance efforts to lengthen this muscle.

MET stretch of longus capitis

Stretching of the neck, with the head in extension, is not recommended. To achieve relative stretch of longus capitis, a procedure is used which incorporates all the stretching elements required, apart from extension.

To treat left side longus capitis

The patient is supine and the practitioner stands facing the right side of the head. The practitioner's left hand grasps the left side of the patient's occiput, stabilizing the head against the practitioner's trunk. The right forearm and hand lie across the patient's chest with the hand on the left shoulder, holding this to the table.

Using this hold, the practitioner applies gentle traction to take out slack and then introduces flexion, sideflexion and rotation to the right (so stretching left side longus capitis) by means of the firm occipital hold and body movement.

When slack has been taken out, the patient is asked to gently attempt to sidebend and turn the head back to the left, against resistance, for 5-7 seconds.

Following this the traction, flexion, sideflexion and rotation are increased slightly and held for 20-30 seconds.

This stretch effectively includes most of the anterior throat musculature, including the various hyoid-related structures and platysma, as well as rectus capitis anterior.

No force should be used and no pain produced by the procedure.

Repeat on opposite side as appropriate.

Exercise 9.9 Muscle energy release of longus capitis

Time suggested 3-4 minutes

Palpate and treat longus capitis as described above.

RECTUS CAPITIS ANTERIOR

- This muscle connects the anterior surface of the lateral mass of the atlas with the inferior surface of the basiocciput, just anterior to the occipital condyle.
- Its action is to flex the head at the atlanto-occipital joint.
- According to Upledger & Vredevoogd (1983), bilateral hypertonicity of either longus capitis

or rectus capitis anterior inhibits occipital flexion and unilateral hypertonicity would be likely to produce torsional forces at the cranial base.

- The possibility of such a torsion occurring in an adult skull would seem remote once ossification had taken place and the almost universal hypertonicity in these muscles in Western adults would appear to make efforts to normalize this state, and the causes of it, a priority in preparation for cranial manipulative treatment.

Self-treatment for shortness in rectus capitis anterior

The patient lies supine with shoulders resting on a thin cushion or folded towel, sufficiently thick to produce a very small degree of neck extension (15° maximum).

The patient is asked to flex the neck by lifting the head slightly from the table and then to tuck the chin towards the chest and to hold this position for 5-7 seconds.

Following this, the head is returned to the table, without any rotation, allowing the slightly extended position to induce stretch on the muscles anterior to the neck (including scalenes, SCM, rectus capitis anterior and platysma).

After 30 seconds in extension the procedure is repeated.

Treat both sides in the same manner or utilize any of the general stretches for the anterior neck region (p. 300).

Exercise 9.10 Stretching rectus capitis anterior

Time suggested 4-5 minutes

Treat rectus capitis anterior as described.

PLATYSMA

- Attachments of the various parts of this broad sheet of muscle are:
  - Anterior: fibers interlace with the contralateral muscle, across the midline, below and behind the symphysis menti
  - Intermediate: fibers attach to the lower border of the mandibular body
  - Posterior: fibers cross the mandible and the anterolateral part of the masseter and attach to subcutaneous tissue and skin of the lower face.
- The actions of platysma involve reducing the concavity between the jaw and the side of the neck. Anteriorly it may assist in depressing the mandible. Via its labial attachments it can draw down the corners of the mouth and the lips. EMG studies indicate contraction during violent effort related to sudden inspiration.
- Cranial influences could conceivably arise via the effects of platysma hypertonicity on its antagonists, which are responsible for closing the mouth, resulting in TMJ problems.
- Trigger points in platysma often overlie sternocleidomastoid muscle and can result in facial symptoms ('prickling pain') on the mandible (see Fig. 9.42).

Figure 9.42 Trigger point and referral pattern in platysma.

Self-treatment for shortness in platysma

Method A

The patient lies supine with shoulders resting on a thin cushion or folded towel, sufficient to produce a very small degree of neck extension (15° maximum).

To treat left side platysma the patient is asked to turn the head to the right and to then lift the head slightly from the table and to hold this position for 5-7 seconds.

Following this, the head is returned to the table, still in rotation, allowing the slightly extended position to induce stretch on the muscles anterior to the left side of the neck (including scalenes and SCM). (See also the stretch treatment for longus capitis (p. 298) and the general anterior neck stretches, described below.)

After 20-30 seconds in extension the procedure is repeated.

Treat both sides in the same manner.

Method B

Skin rolling and careful digital work of the anterolateral aspects of the neck, especially close to the sternum, can reveal taut and fibrotic structures which respond to lateral as well as lengthwise stretching or to compression (pincer like, not directly into the tissues).

General balancing methods affecting all muscles relating to the hyoid

The following four methods are adapted from the work of Clayton Skaggs DC (Skaggs 1997).

1. To facilitate the depressors of jaw. The patient is supine, jaw relaxed. The practitioner is facing caudad at the patient's head. The practitioner's thumbs are used to depress the mandible from above in a down-and-back trajectory that emphasizes rotation of the condyle-disk complex in a mid-opening position. The patient is asked to hold the mandible in this position while the practitioner applies mild closing force against resistance. Various directions of challenge are subsequently attempted against resistance, to tone the muscles.
2. The patient is seated. The practitioner's or patient's hand contact is on the hyoid or just superior to it, feeling for its position. The patient is asked to raise the hyoid and /or contract muscles just superior to the hyoid. The mouth should be one quarter open. This process loads the condyle-disk complex in rotation. Once this procedure is learned the patient can proceed to the same action with partial and full opening of the mouth, while holding the hyoid (see Fig. 9.43A-C).
3. The patient places the tongue in the roof of the mouth as if to make the 'N' sound. Without losing contact with the roof of the mouth, the patient performs slow repetitive mandibular opening and closing.
4. General positional release of hyoid and its attachment muscles. Sequentially ease the hyoid bone into all its various directions of possible motion, superiorly, interiorly, laterally left and right, depressed posteriorly and lightly drawn anteriorly. Assess which the preferred directions of motion are and hold the hyoid in that position, stacking one position of 'ease' onto another. After holding the bone in this way for not less than 30 seconds, release and reassess. A more balanced feel should be achieved with hypertonicity reduced in previously tense muscles supporting the bone (see Fig. 9.44).

Exercise 9.11 Balancing hyoid and its related muscular attachments

Time suggested 7-10 minutes

Palpate and treat hyoid and its related muscles as described.

General anterior neck muscle stretch utilizing muscle energy technique (MET)

For involvement of rectus capitis anterior, suprahyoid, infrahyoid, platysma, suprathyroids and infrathyroids, the two procedures described immediately below are performed with the mouth closed. For involvement of longus colli and longus capitis, the mouth is held slightly opened.

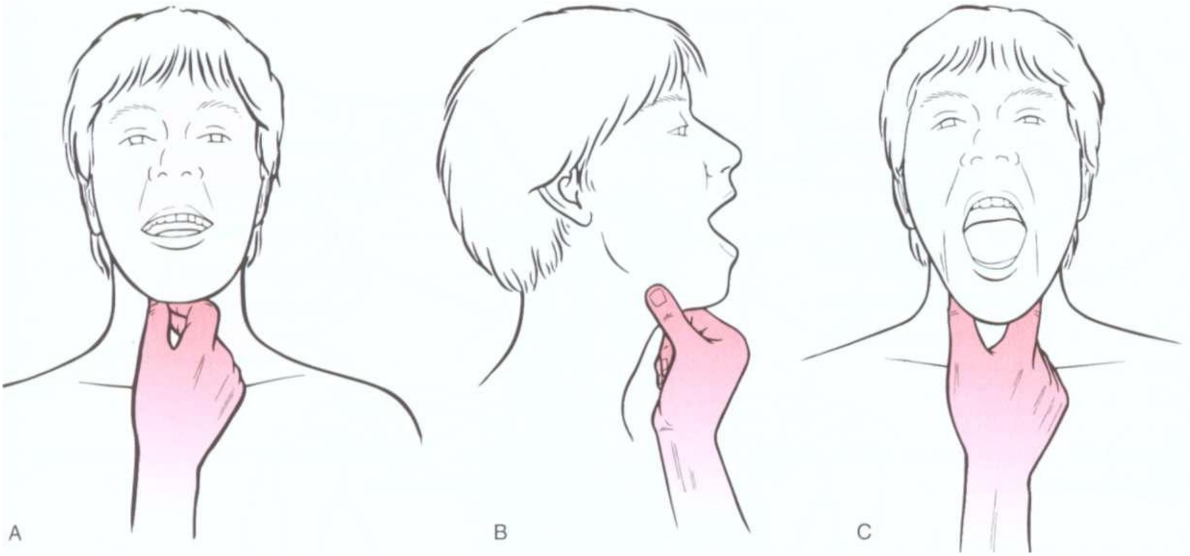


Figure 9.43 A Loaded mandibular depression. Hand contact is on hyoid or superior to it. B,C Loaded mandibular depression. Patient 'raises' hyoid or contracts muscles superior to it with mouth a quarter open, loading condyle-disk complex into rotation. Subsequently patient can do this with mouth fully opened.

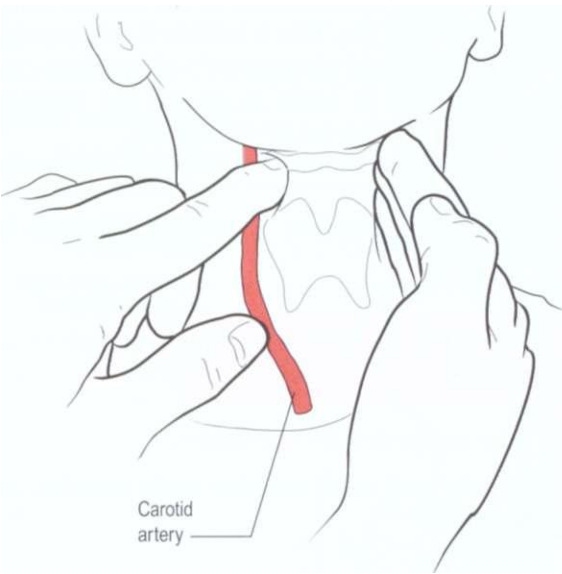


Figure 9.44 Examination and/or treatment of infrahyoid group using extremely gentle pressure.

Note Sternocleidomastoid and scalene stretches, as described earlier, will automatically produce stretching of many of these anterior neck muscles.

Variation 1

A general stretch involving most of the deep and shallow muscles attaching to the anterior cervical spine, the skull and hyoid, is as follows. The patient is seated and the practitioner stands at the side facing (in this example) the left side of the head.

The practitioner's left hand wraps around the right side of the patient's head, palm of hand cupping the ear and mastoid, stabilizing the head firmly against the practitioner's chest.

The practitioner's left small finger is at the level of the patient's axis. The practitioner's right hand stabilizes the posterior aspect of the neck and supports this at and below the level of C3. (Longus colli originates at the level of C3 and so to stretch it there is a need for stabilization at and below this level.)

Traction is gently initiated as a slow movement is made into pure extension of about 10° at most. The patient is asked to gently (20% of strength) take the head and neck forwards against resistance.

This effort is held for 7-10 seconds after which, with traction still being maintained, a further 5° of extension is initiated and held for not less than 10 seconds.

Figure 9.45 General cervical stretch (seated) following isometric contraction.

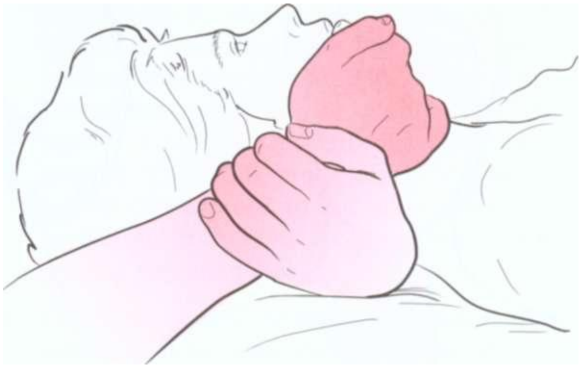


Figure 9.46 General cervical stretch (supine) following isometric contraction.

To introduce stretch into the muscles attaching more distal than C3, the contact hand on the back of the neck can be lowered, one segment at a time, for subsequent isometric contractions and stretches. However, a slight movement (5°) towards the upright should be produced before each contraction.

Abort the stretching if any dizziness is reported.

To produce greater emphasis on stretching of one side a moderate degree of sidebend (about 20°) away from that side should be introduced prior to extension.

Remember that to involve rectus capitis anterior, suprahyoid, infrahyoid, platysma, suprathyroids and infrathyroids, these procedures should be performed with the mouth closed. To involve longus colli and longus capitis, the mouth is held slightly opened (see Fig. 9.45).

Variation 2

Perform this sequence with the patient supine, without a pillow.

The practitioner is seated at the head of the table with a forearm (left in this example) in a position which allows the midcervical spine to rest on it, with the right hand cupping the patient's jaw (which should be relaxed throughout the procedure, whether open for longus colli and longus capitis or closed for other anterior hyoid-related muscles).

The practitioner grasps his own right forearm with the left hand, so forming a stable contact.

By leaning backwards a degree of mild traction can be introduced (see Fig. 9.46).

The patient is asked to lightly lift the head into flexion against the resistance of the contact hand on the (relaxed) jaw. This is held for 7-10 seconds.

After this a mild amount (10°) of extension can be introduced, in order to stretch the anterior muscles of the neck for 20-30 seconds.

The traction should be released extremely slowly.

Abort the procedure if pain or dizziness is reported.

Exercise 9.12 Stretching hyoid-related muscles

Time suggested 7-10 minutes

Palpate and treat anterior neck muscles as described.

Muscles of the back of the neck

Muscles arising in the posterior neck and attaching to the cranium are often directly involved in cranial suture crowding and/or temporal bone dysfunction, with profound general influences on other aspects of cranial function (see Fig. 9.47). Before considering these muscles individually and possible treatment approaches, a

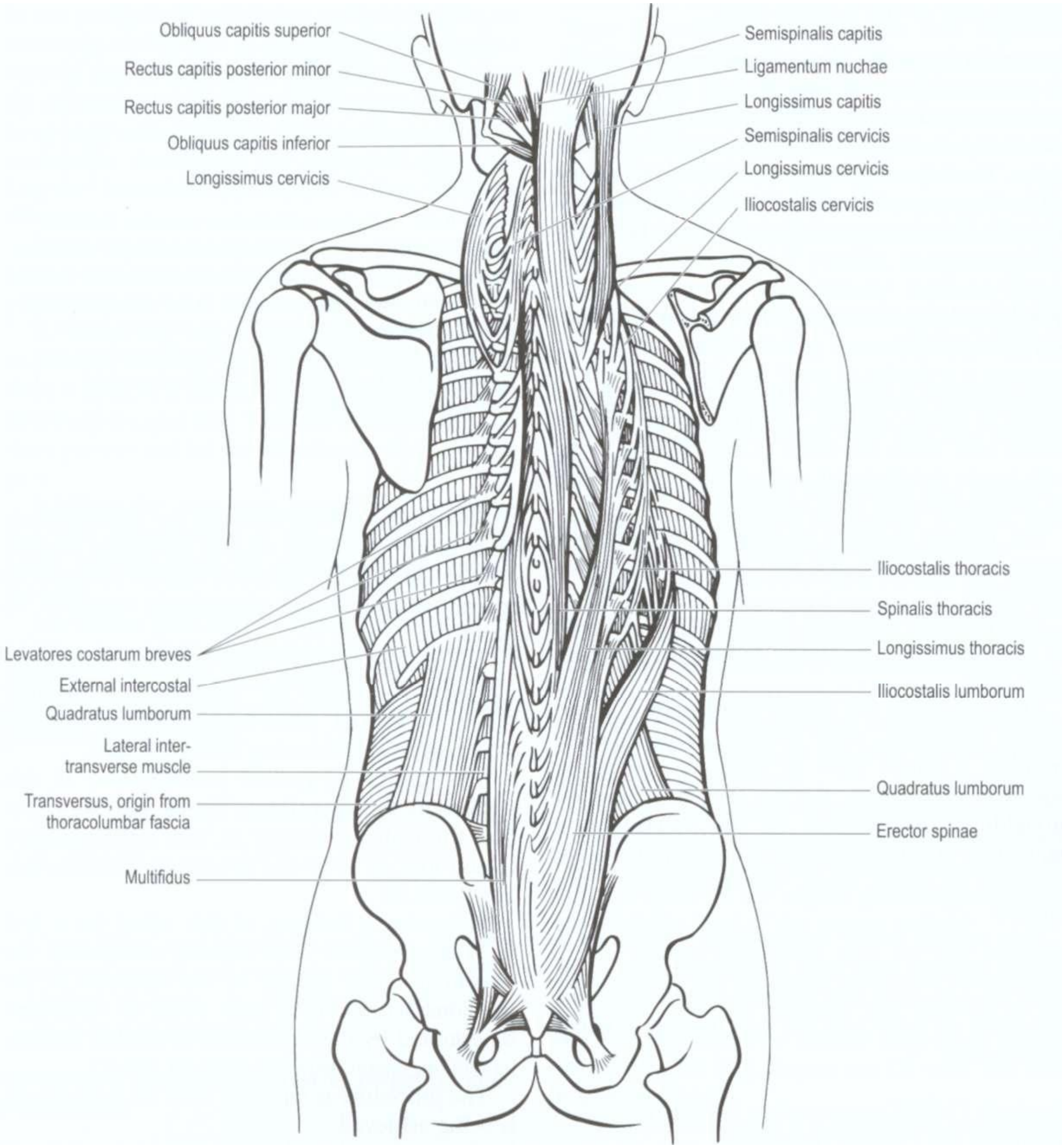


Figure 9.47 Deep muscles of the back on the left side. Erector spinae and upward continuations (apart from longissimus cervicis which has been translated laterally) as well as semispinalis capitis have been removed.

brief overview of safe mobilization of the cervical spine is necessary.

Mobilization of the cervical spine

General, non-specific cervical mobilization as well as precise segmental releases, as appropriate, considerably enhance cranial function by reducing undue myofascial and mechanical stress in the region. The following methods, based on the work of Drs Greenman, Harakal and Stiles, incorporate safe, non-invasive approaches which can be easily learned.

Stiles' (1984) general procedure using MET for cervical restriction

Stiles suggests a general maneuver, in which the patient is sitting upright. The practitioner stands behind and holds the head in the midline, with both hands stabilizing it and possibly employing his chest to prevent neck extension.

The patient is asked to (gently) flex, extend, rotate and sidebend the neck, in all directions, alternately.

No particular sequence is necessary, as long as all directions are engaged, painlessly, at least twice each.

After engaging the barrier of resistance in the chosen direction, each muscle group should undergo a slight (20% of available strength) isometric contraction for 5-7 seconds, against unyielding force offered by the practitioner's hands (the effort can involve an attempt to move towards, or away from, the direction of the barrier).

This relaxes (even traumatized) tissues in a general manner. After each contraction the patient eases the area to its new position/barrier without stretching or force and the next isometric effort commences.

HarakaTs (1975) co-operative isometric technique for cervical restriction

When there is a specific or general restriction in a spinal articulation, the area should be placed in neutral (patient seated usually). The pain-free range of motion should be determined by noting the patient's resistance to further motion.

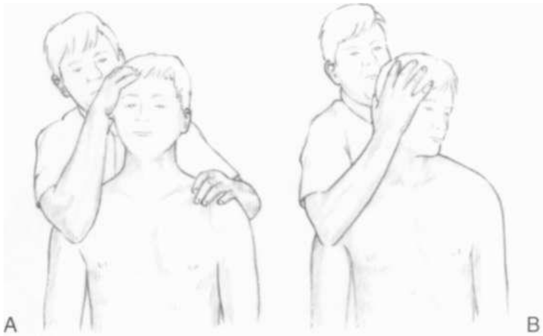


Figure 9.48 A Patient with limited excursion potential into left cervical rotation is held just short of the restriction barrier as they initiate a light isometric contraction against resistance by painlessly attempting to turn the head to the right. B Following this contraction an increased degree of rotation to the left should be possible without force, to a new restriction barrier at which a further isometric contraction may be initiated.

The patient should be rested for some seconds at a point just short of the resistance barrier, termed the 'point of balanced tension', in order to 'permit anatomic and physiologic response' to occur.

The patient is asked to reverse the movement towards the barrier by 'turning back towards where we started' (thus contracting any muscles which may be influencing the restriction).

The degree of patient participation at this stage can be at various levels, ranging from 'just think about turning' to 'turn as hard as you would like' or by giving specific instructions (see Fig. 9.48A,B).

Following a holding of this effort for a few (5-7) seconds and then relaxing completely, the patient is taken further in the direction of the previous barrier, to a new point of restriction determined by their resistance to further motion, as well as tissue response (feel for 'bind').

The procedure is repeated until no further gain is being achieved.

It would also of course be appropriate to use the opposite direction of rotation against practitioner resistance, for example asking the patient to 'turn further towards the direction you are moving', so utilizing the antagonists to the muscles which may be restricting free movement.

What to do if movement to the new barrier hurts

Evjenth & Hamberg (1984) have a practical solution to the problem of pain being produced when an isometric contraction is employed. They suggest that the degree of effort be markedly reduced and the duration of the contraction increased, from 10 to up to 30 seconds. If this fails to allow a painless contraction then use of the antagonist muscle(s) for the isometric contraction offers another alternative.

Following the contraction, if a joint is being moved to a new resistance barrier and this produces pain, what variations are possible?

If, following an isometric contraction and movement towards the direction of restriction, there is pain, or if the patient fears pain, Evjenth & Hamberg suggest that 'then the therapist may be more passive and let the patient actively move the joint'.

Additionally, any pain experienced may be lessened considerably if the therapist applies gentle traction while the patient actively moves the joint.

Sometimes pain may be further reduced if, in addition to applying gentle traction, the therapist simultaneously either aids the patient's movement of the joint or provides gentle resistance while the patient moves the joint.

Exercise 9.13 MET mobilization of cervical spine

Time suggested 7-10 minutes

Using Stiles' and Harakal's methods, treat the cervical region and evaluate relative benefits. Utilize Evjenth & Hamberg's additional assistance to evaluate their results.

Greenman's approach to cervical palpation and mobilization

The following sequence is based on the work of Philip Greenman (1989) and is suggested as an excellent way of becoming familiar with both the mechanics of the neck joints and the safe and effective MET applications to whatever is found to be restricted.

In performing this exercise it is important to be aware that normal physiology of the cervical spine from C2 downwards dictates that side-flexion and rotation in the cervical area follow a 'Type 2' pattern, which means that segments which are sideflexing will automatically rotate towards the same side, i.e. a sideflexion to the right means that rotation will also automatically take place to the right. This pattern is determined by the angles of the facet joints.

Most cervical restrictions are compensations and will involve several segments, all of which will adopt this 'Type 2' pattern. Exceptions occur if a segment is traumatically induced into a different format of dysfunction, in which case there may be sidebending to one side and rotation to the other (termed Type 1), which is a common physiological pattern for the rest of the spine and for C1-C2 (i.e. sideflexing one way and rotation the other).

To easily palpate for sideflexion and rotation, a side-to-side translation movement is used, with the neck in slight flexion or slight extension.

When the neck is absolutely neutral (no flexion or extension - an unusual state in the neck) true side-to-side translation is possible. As a segment is translated to one side it is therefore automatically sideflexing to the opposite side and because of the anatomical and physiological rules governing it, it will also be rotating to the side towards which sideflexion is occurring.

In order to evaluate cervical function using this knowledge, Greenman suggests that the practitioner places the fingers as follows, on each side of the cervical spine of the supine patient (practitioner seated at the head of the supine patient).

The index fingerpads rest on the articular pillars of C6, just above the transverse processes of C7 (which can be palpated just anterior to the upper trapezius). The middle fingerpads should be on C6, the ring fingers on C5 with the little fingerpads on C3.

With these contacts it is possible to examine for sensitivity, fibrosis and hypertonicity as well as being able to apply lateral translation to cervical segments with the head in flexion or extension (see Fig. 9.49A).

In order to do this effectively it is necessary to stabilize the superior segment to the one about to be examined. The heel of the hand controls movement of the head.

With the head/neck in relative neutral (no obvious flexion or extension), translation to the right and then left is introduced (any segment) to assess freedom of movement (sidebending and rotation) in each direction (see Fig. 9.49B).

Say C5 is being stabilized with the fingerpads, as translation to the left is introduced; the ability of C5 to freely sideflex and rotate on C6 is being evaluated, with the neck in neutral. If the joint is normal this translation will cause a gapping of the left facet and a 'closing' of the right facet, as left translation is performed and vice versa and there will be a soft end-feel to the movement, without harsh or sudden braking.

If, say, translation of the segment towards the right produces a sense of resistance or bind, then the segment is restricted in its ability to sidebend left and (by implication) to rotate left. If such a restriction is noted, the translation should be repeated, but this time with the head in extension rather than in neutral. This is achieved by lifting the contact fingers on C5 (in this example) slightly towards the ceiling before reassessing the translation to the right.

After assessing the range and quality of translation with the segment in extension, the head and neck should be taken into flexion and translation to the right should again be assessed.

The objective is to ascertain which neck position - neutral, flexion or extension - produces the greatest degree of bind, as translation is introduced and the barrier engaged.

You are effectively asking - is the segment more restricted in translation right (rotation and sideflexion left) when it is in neutral, extension or flexion?

If this restriction is greater with the head extended, the diagnosis is of a joint locked in flexion, sidebent right and rotated right (meaning that there is difficulty in the joint extending and sidebending and rotating to the left).

If this (C5 on C6 translation left to right) restriction is greater with the head flexed, then the joint is locked in extension and sidebent right and rotated right (meaning there is difficulty in the joint flexing, sidebending and rotating to the left).

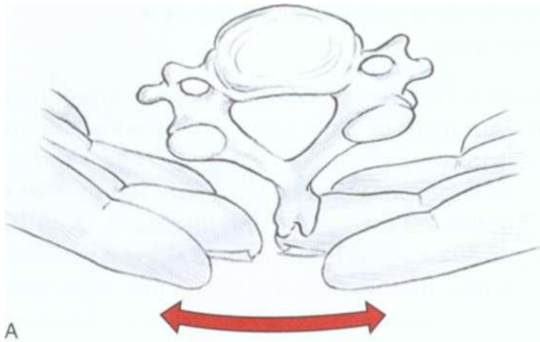


Figure 9.49 A Fingerpads rest as close to articular pillars as possible in order to be able to palpate and guide vertebral translation. B The practitioner sequentially translates individual segments in order to assess relative ease and freedom of motion. MET or positional release opportunities can follow such assessment by holding segments towards relative restriction and introducing gentle isometric contractions or by taking segments in the directions of ease and holding them there for appropriate periods.

MET treatment of this dysfunctional pattern

This description uses the same example (C5 on C6 as above, translation to the right is restricted with the greatest degree of restriction noted in extension).

One hand palpates both of the articular pillars of the inferior segment of the pair which is dysfunctional. In this instance this hand will stabilize the C6 articular pillars, holding the inferior vertebra so that the superior segment can be moved on it.

The other hand will introduce movement to and control the head and neck above the restricted vertebra.

The articular pillars of C6 are held and lifted towards the ceiling, introducing extension, while the other hand introduces sidebending and rotation toward the right, until the restriction barrier is sensed.

A slight isometric contraction is introduced by the patient on the instruction of the practitioner who asks for an effort to introduce gentle sidebending, rotation or flexion (or all of these).

The patient may be asked to try to lightly turn the head to the left and to sideflex to the left, while flexing the neck, or any one of these movements may be asked for individually. The patient's efforts should be light and sustained for approximately 7 seconds and should be firmly resisted.

After 5-7 seconds the patient relaxes and extension, sideflexion and rotation left are increased to the new resistance barrier, with no force at all.

Repeat two or three times in total.

Alternatively Instead of the full motions (rotation, etc.), a resistance to translation could be introduced.

By taking the segment into its testing translation, where resistance was first noted, the patient could be asked to lightly contract the muscles which would reverse that movement and to hold for 7-10 seconds, after which increased range of translation (and of the gross sidebending and rotation motions) should be available.

Alternatively Eye movement can be used instead of muscular effort in cases of pain being produced by any effort. Looking upwards will encourage isometric contraction of the extensors and vice versa and looking towards a direction encourages contraction of the muscles on that side.

Alternatively Instead of assessing the direction of most resistance in translation, the opposite selection could be made, by evaluating the direction of greatest ease during translation, involving neutral, flexion and extension (if there is 'bind' in one direction the opposite direction should offer relative 'ease'). Once this has been established, the position of maximum ease could be engaged and held for 30-90 seconds to await a spontaneous release of tension in the tissues.

This type of 'functional' (positional release) approach is more fully explained in Appendix 1.

Exercise 9.14 Greenman's cervical translation methods

Time suggested 7-10 minutes

Using Greenman's methods as described above, treat the cervical region and attempt to evaluate the relative benefits of the various MET and functional positional release approaches.

POSTERIOR CERVICAL MUSCLES AND THE CRANIUM

SPLENIUS CAPITIS (see Figs 9.1 and 9.17)

- The cranial insertions of splenius capitis are into the occipital bone below the nuchal line and the mastoid process. It runs upwards and laterally from the lower part of the ligamentum nuchae, the seventh cervical and the upper three thoracic vertebral spines and their supraspinous ligaments. Splenius cervicis and capitis are superficial to semispinalis capitis and deep to trapezius (Fig. 9.50).
- The action of this muscle (together with splenius cervicis, which is not described in this text as it does not attach to the skull - details of this and other associated muscles should be studied from other texts) is to draw the head directly posteriorly. On its own it acts synergistically with the contralateral

sternocleidomastoid, to sidebend and rotate the head ipsilaterally.

- The cranial attachment crosses the suture between the temporal and the occipital bones, just posterior to the mastoid.
- As Upledger & Vredevoogd (1983) point out, contraction of splenius capitis causes the squamous portion of the temporal bone to rotate posteriorly while internally rotating the petrous portion. Crowding of the occipitomastoid suture can contribute, according to Upledger & Vredevoogd, to a wide range of symptoms including head pain, dyslexia, gastrointestinal symptoms and personality problems.
- Head and neck pain, as well as blurred vision, can result from trigger point activity in splenius capitis.
- Use of the general cranial base release method described below (p. 313) as well as NMT to the area should effectively release hypertonicity.

SEMISPINALIS CAPITIS

- The cranial insertion is towards the medial aspect of the area between the superior and inferior nuchal lines, on the occipital bone, having arisen via a series of tendons from the tips of the transverse processes of the upper six or seven thoracic and the lower four cervical vertebrae. The various vertebral attachments merge towards their insertion on the skull (Fig. 9.47).
- The action is to extend the head, turning it slightly towards the opposite side (Gray's *Anatomy* 1995, p. 812) or towards the same side (Travell & Simons 1983, p. 309).
- Trigger point activity refers to the occipital region and/or to the neck itself and to temporal area (see Fig. 9.51).
- Use of the general cranial base release method (p. 313) as well as the MET and NMT approaches (pp 313-316) should effectively release hypertonicity.

RECTUS CAPITIS POSTERIOR MAJOR

- The insertion is into lateral aspect of the inferior nuchal line on the occipital bone, having arisen from a tendon on the spine of the axis. The action is to extend the head, together with rotation towards the same side as the muscle.
- Together with the inferior and superior obliqui (see below, p. 311) this muscle forms part of the occipital triangle which encloses the exposed loop of the vertebral artery.
- Anyone regularly working with the neck in flexion would stress these 'check' muscles, encouraging the evolution of hypertonicity and trigger point activity.
- Referred pain from trigger points has poor definition, radiating anywhere from the occiput to the eye. See Figure 9.51.
- As with rectus capitis, Upledger & Vredevoogd (1983) believe that bilateral hypertonicity of rectus capitis posterior major and minor can retard occipital flexion, while unilateral hypertonicity is said to be capable of producing torsion at the cranial base (see Figs 9.47, 9.50 and 9.51).
- As stated previously, the possibility of such a torsion occurring in an adult skull is unlikely once ossification has taken place.
- Use the general cranial base release method described below (p. 313), as well as NMT and/or MET methods for the area, to release hypertonicity.

RECTUS CAPITIS POSTERIOR MINOR

A remarkable discovery, which resulted a dissection using a sagittal rather than a coronal incision, revealed that this tiny muscle has a unique connection to the dura, at the atlanto-occipital junction. Subsequent research has shown it to have a major potential for symptom production when damaged or severely stressed (Hack et al 1995b).

The superior insertion of the muscle is into the medial part of the inferior nuchal line and

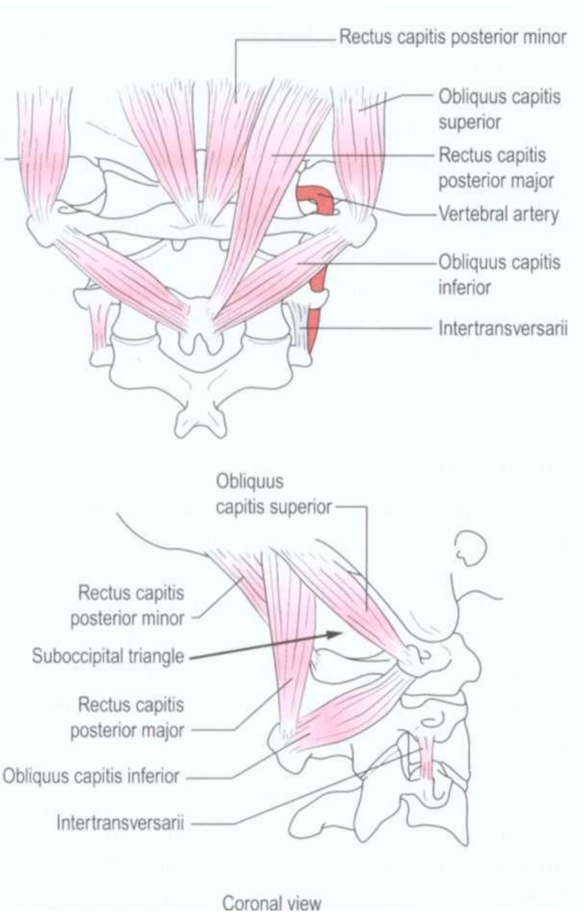


Figure 9.50 The suboccipital muscles, including rectus capitis posterior minor, which are often described as a group but have individual roles and functions.

the occipital bone, between the nuchal line and the foramen magnum. RCPMinor arises from a tendon on the atlas.

The research referred to above demonstrated that a connective tissue extension ('bridge') links this muscle to the dura mater, which provides it with potentials for influencing the reciprocal tension membranes directly, with particular implications relating to cerebrospinal fluid fluctuation, because of its site close to the posterior cranial fossa and the cisterna magna. RCPMinor may also influence the functioning of the vertebral artery and the suboccipital nerve which could further aggravate any hypertonus of the region.

The researchers at the University of Maryland, Baltimore, state:

> *In reviewing the literature, the subject of functional relations between voluntary muscles and dural membranes has been addressed by Becker (Becker 1983) who suggests that the voluntary muscles might act upon the dural membranes via fascial continuity, changing the tension placed upon them, thus possibly influencing CSF pressure. Our observation that simulated contraction of the RCPM muscle flexed the PAO membrane-spinal dura complex and produced CSF movement supports Becker's hypothesis.... During head extension the spinal dura is subject to folding, with the greatest amount occurring in the atlanto-occipital joint (Cailliet 1991). One possible function of the RCPM muscle may be to modulate dural folding, thus assisting in the maintenance of the normal*

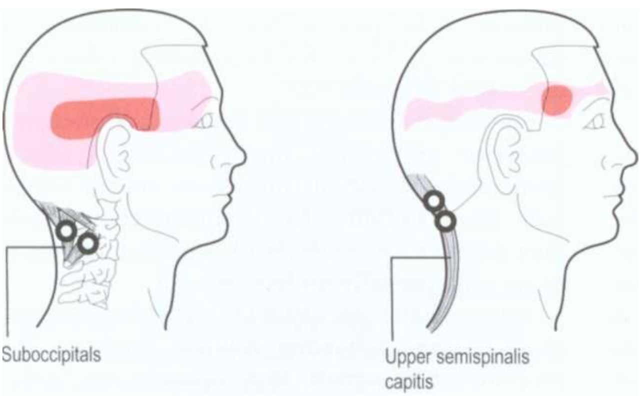


Figure 9.51 Locations and referral patterns of trigger points in suboccipitals and semispinalis capitis.

circulation of the CSF. Trauma resulting in atrophic changes to the RCPM muscle may interfere with this suggested mechanism (Hallgren et al 1993). The observed transmission of tension created in the spinal dura to the cranial dura of the posterior cranial fossa is consistent with the described discontinuity between the spinal and intracranial parts of the dura mater (Penfield & McNaughton 1940). Not only has the dura lining the posterior cranial fossa been described as being innervated by nerves that subserve pain (Kimmel 1961) but also it has been demonstrated that pressure applied to the dura of the posterior cranial fossa in neurosurgical patients induces pain in the region of the posterior base of the skull (Northfield 1938). Therefore one may postulate that the dura of the posterior cranial fossa can be perturbed and become symptomatic if stressed to an unaccustomed extent by the RCPM muscle acting on the dura mater.

The orientation of the muscular 'bridge' is described as being perpendicular to the dura, an arrangement which 'appears to resist movement of the dura towards the spinal cord'.

Additional research at the Department of Osteopathic Medicine, Michigan State University College of Osteopathic Medicine, utilizing magnetic resonance imaging of rectus capitus posterior major and minor, was performed on six patients with chronic head and neck pain, as well as on five control subjects and produced remarkable findings (Hallgren et al 1994). In the subjects with chronic pain, the muscles were shown to have developed fatty degeneration, in which muscle tissue had been replaced by fatty deposits. This was not seen in the control subjects. The researchers suggest that the reduction in proprioceptive afferent activity in these damaged muscles may cause increased facilitation of neural activity that is perceived as pain (McPartland et al 1997).

Greenman, a major researcher in both the studies reported above, utilizing EMG testing, has found that RCPMinor is not an extensor of the head as is suggested by most physiology texts. When tested, the muscle does not fire during extension but rather does so when the head is translated forwards, in a 'chin-poking' manner, as would be the case if bilateral sternocleidomastoid shortening existed (Greenman 1997, personal communication).

Greenman (1997) further suggests that denervation of the muscle may lead to the reported fatty degeneration, following severe trauma such as whiplash. In some instances, he has also observed that the muscle hypertrophies and is then involved in severe headache problems.

It seems probable that excessive demands upon the stabilizing function of the muscle would induce just such hypertrophy.

The fibromyalgia connection

A study involving over 100 patients with traumatic neck injury as well as approximately 60 patients with leg trauma evaluated the presence of severe pain (fibromyalgia syndrome) an average of 12 months post trauma (Buskilia et al 1997). The findings were that 'almost all symptoms were significantly more prevalent or severe in the patients with neck injury... The fibromyalgia prevalence rate in the neck injury group was 13 times greater than the leg fracture group'.

Pain threshold levels were significantly lower and trigger point counts were higher in the neck injury patients compared with leg injury subjects. Fully 21% of the patients with neck injury developed fibromyalgia within 3.2 months of injury as against only 1.7% of the leg fracture patients (a percentage not significantly different from the general population).

The connection between the findings in this whiplash study and the findings of Greenman and his colleagues regarding fatty degeneration of rectus capitis posterior minor following trauma remains to be proven, but the likelihood of a connection is clear. This hypothetical scenario is illustrated in Figure 9.52.

The direct structural link between rectus capitis posterior minor and the dura makes this a particularly important muscle in cranial terms, with the possibility that its dysfunctional state may account for widespread negative influences as yet only partially understood.

Vernon (2001) speculates that fatty degeneration of RCPMinor, following trauma, removes 'the proprioceptive signals, thus opening the "gate" that normally blocks nociceptor transmission to higher centers'.

Hu & Vernon (1995) report that other major pain-inducing influences from RCPMinor include transmission of radiating pain sensations to the neck (such as trapezius) and jaw muscles that mimic the pattern initiated by irritation of the meningeal/dural vasculature in the upper cervical regions.

The general cranial base release technique described below (p. 313) acts directly on this muscle, as would general stretching and release of the posterior cervical muscles, as in MET treatment of levator scapulae, for example.

Ligamentum nuchae research shows dural connection

Research at the Anglo-European College of Chiropractic has demonstrated that the ligamentum nuchae also has direct connective tissue bridges to the dura ('cervical posterior spinal dura') at the levels of CI and C2. These connections therefore complement those already described linking the dura to RCPM (which lies lateral to the ligamentum nuchae).

The researchers (Mitchell et al 1998) suggest that the dural bridge acts in much the same manner as that suggested for the bridge from RCPM, 'to prevent dural puckering'. They observe that the dura, at this level of the cervical spine (CI to C3), is far thicker posteriorly than anteriorly, suggesting it is designed to resist force impinging on it: 'If the ligamentum nuchae, with its cervical dural attachments, is injured in any way during whiplash injuries it is conceivable that some of the chronic signs and symptoms ... may originate from such injury to the ligamentum nuchae-dural interface'.

The implications of this discovery are clear. Attention to the suboccipital musculature, including ligamentum nuchae, is re-emphasized and the techniques described for general and specific release of soft tissues in this region can be seen to be of primary importance, *prior to direct attention to the cranial structures.*

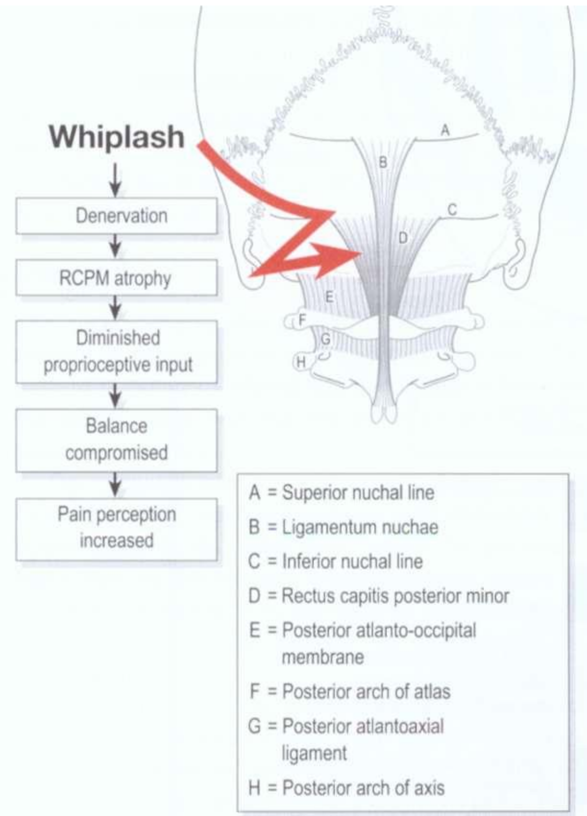


Figure 9.52 Schematic representation of hypothesized sequence leading from whiplash to denervation of RCPMinor and chronic pain/fibromyalgia.

OBLIQUUS CAPITIS (OC) INFERIOR AND SUPERIOR

- Attachment is to the spine and the lamina of the axis (OC inferior), while OC superior attaches to the occipital bone, lateral to semispinalis capitis, overlapping the insertion of rectus capitis (see Fig. 9.53).
- The action of OC inferior is to rotate the face to the same side, while OC superior takes the head backwards and to the same side. *Gray's Anatomy* suggests that these obliques are probably postural rather than phasic muscles, which has implications regarding their response to 'stress' in that they are likely to shorten over time (Lewit 1992).
- Use of the general cranial base release method described below (p. 313), as well as NMT applied to the area, should effectively release hypertonicity.

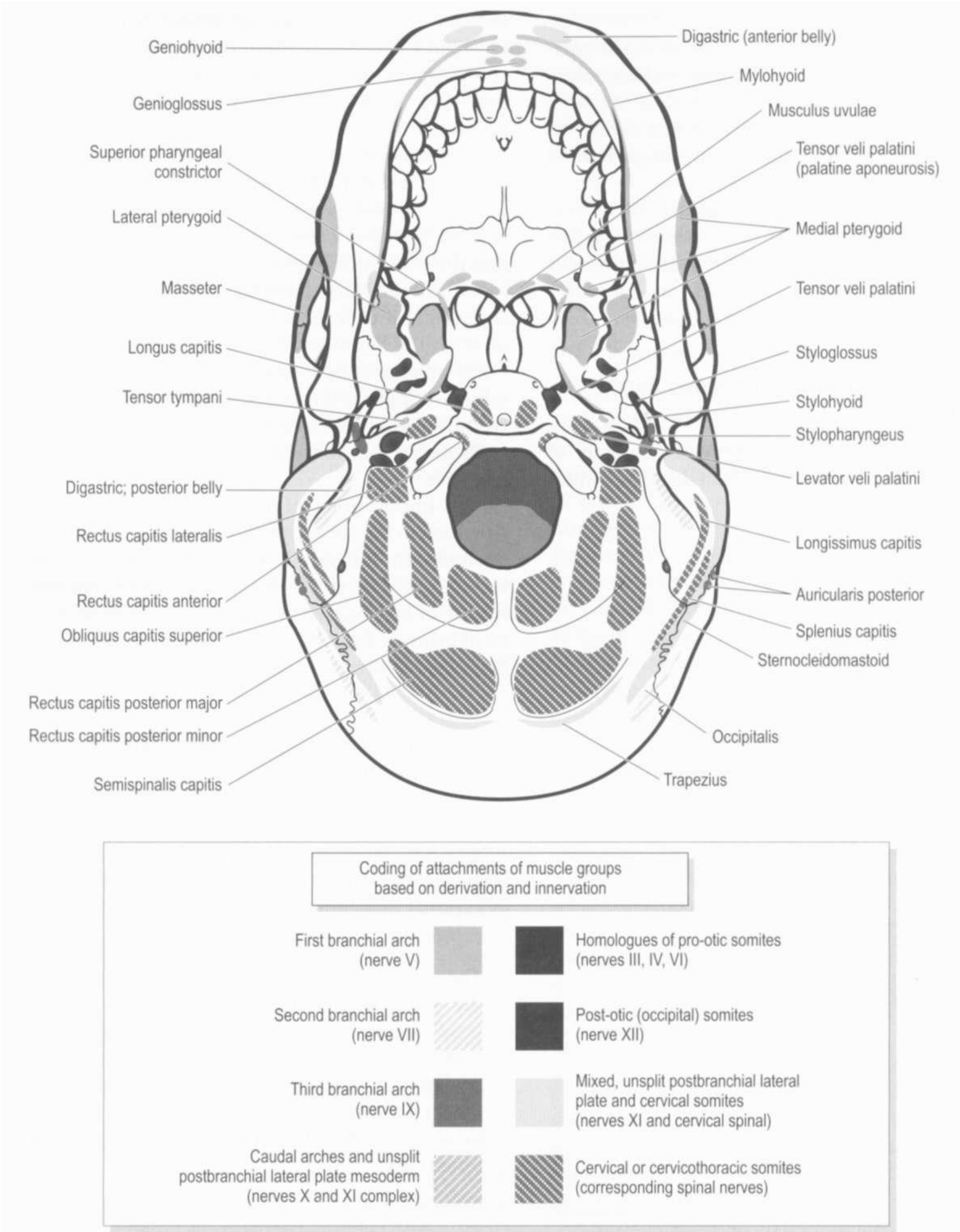


Figure 9.53 Muscular attachments of the skull viewed from an inferior position.

GENERAL (MET-ENHANCED) STRETCHES FOR POSTERIOR CERVICAL MUSCLES

Method A

The patient is supine, head and neck just beyond the end of the couch supported by the practitioner's right (in this example) hand, with the crown of the head just touching and lightly supported by the practitioner's abdomen.

The practitioner's left hand cups the chin (avoid larynx) and introduces mild traction.

By movement of the practitioner's body, it is possible to introduce controlled flexion to its full extent, without force.

A light (10% of strength) attempt may be made by the patient to extend the neck against resistance from the practitioner's hands (or the patient may merely look upwards as far as possible to initiate light contraction of the extensors of the neck).

After 7-10 seconds of this, an increase in flexion is introduced to its fullest extent, pain free and unforced. At the same time the practitioner introduces slight downwards (to the floor) pressure on the patient's forehead to increase a stretching flexion of the muscles at the atlanto-occipital junction. This is held for 10 seconds before a slow return to neutral.

Method B

The neck of the supine patient is flexed to its easy barrier of resistance or just short of this and the patient is asked to extend the neck (take it back to the table) using minimal effort on an inhalation, against resistance.

The practitioner's hands are placed, arms crossed, so that one hand rests on each shoulder or upper anterior shoulder area, while the patient's head rests on the crossed forearms.

After the contraction the neck is flexed further to, or through, the barrier of resistance, as appropriate.

A further aid during the contraction phase is to have the practitioner contact the top of the head with his abdomen and to use this contact to prevent the patient tilting the head upwards. This allows for an additional isometric contraction and subsequent stretch which involves the short extensor muscles at the base of the skull.

Repetitions of the stretch should be performed until no further gain is possible or until the chin easily touches the chest on flexion.

CAUTION

No force should be used or pain produced during this procedure.

Exercise 9.15 Stretching methods for upper cervical muscles

Time suggested 7-10 minutes

Treat posterior neck muscles as described.

General cranial base release

This technique releases the soft tissues where they attach to the cranial base and which, if hypertonic, may restrict occipital motion as well as that of the temporals. It is fully described in Chapter 7 as Exercise 7.3 of the occipital palpation exercises. See Figure 9.54.

NMT for posterior cervicals (Walker DeLany 1996)

Compare these methods for the cranial base area with those of Lief's approach described below.

The patient is prone. Carefully examine the attachments on the transverse process of CI of the

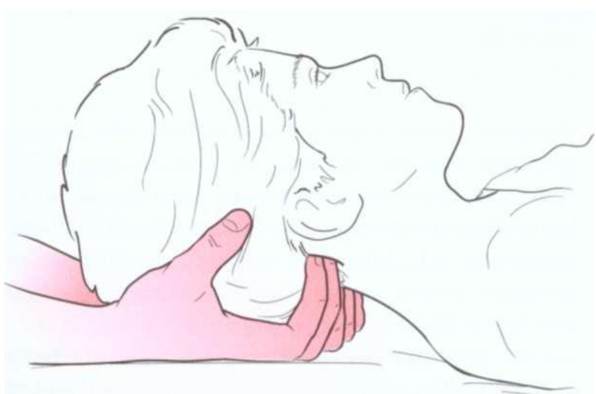


Figure 9.54 Hand positions for cranial base release.

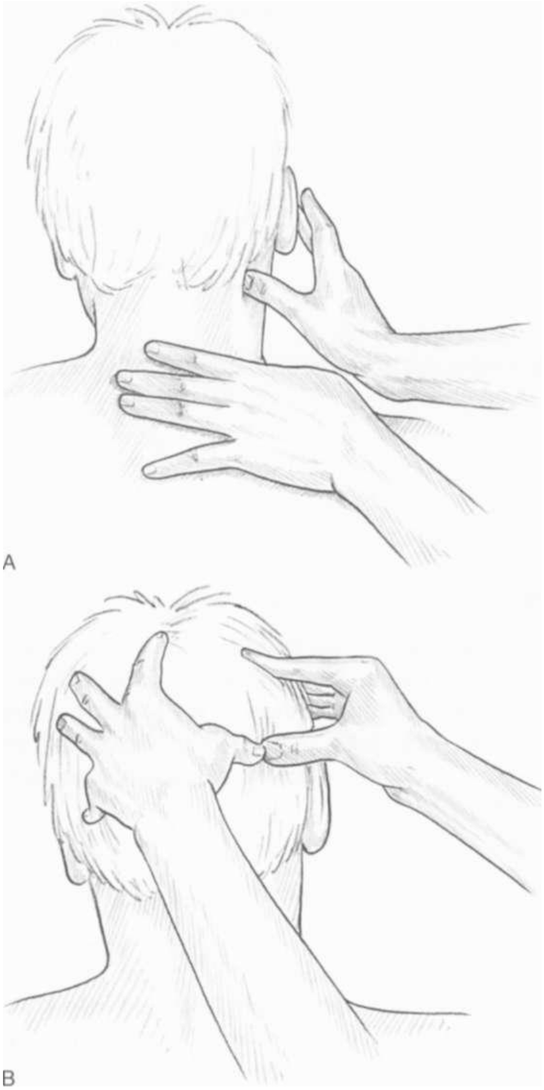


Figure 9.55 NMT treatment of attachments of muscles at the transverse process of the atlas (A) and on the occipitalis muscle (B).

obliquus capitis superior and inferior, the levator scapulae and the splenius cervicis muscles. The SCM may need to be displaced laterally in order to palpate the muscles attaching to the transverse process of CI. Take care to avoid application of pressure which could affect the vertebral artery (see Fig. 9.55A,B).

Use combination friction to examine the belly of the thin flat occipitalis muscle which is located about 1.5-2 inches lateral to the occipital protuberance. This muscle may be palpable on some individuals when the eyebrows are raised repeatedly, since it merges with the cranial aponeurosis and connects with the frontalis muscle.

Trigger points in this muscle may refer strongly into the eye and into the frontal sinus area

Cervical lamina - patient supine (Fig. 9.56A-C)

Lubricate the laminar groove from the occiput to Tl. The left hand lifts and supports the head. The right-hand fingers lie across the back of the neck at the occipital ridge with the thumb placed next to the lateral surface of the spinous process of CI.

Glide from CI to Tl while simultaneously pressing toward the ceiling. Repeat the gliding movements five or six times. The therapist's elbow should remain low and the arm should remain in the same plane as the spine. Observe the chin moving into extension as the gliding movements of the thumb restore flexibility to the posterior cervical muscles.

Rotate the head away from the side being treated and move the right thumb laterally one thumb's width (about 1 inch) and repeat the gliding movements five or six times. The chin will not move while gliding on the lateral strips.

CAUTION

Extreme head rotation is not recommended for the elderly as it may induce stress to the vertebral artery which lies within the transverse processes.

Continue a series of caudad glides with the thumb, moving laterally in strips until the entire laminar groove has been treated. Stay posterior to the transverse processes. The muscles being treated are the trapezius, semispinalis capitis, semispinalis cervicis, splenius capitis, splenius cervicis and levator scapulae.

CAUTION

It is necessary to ensure that the glides remain posterior to the transverse processes.

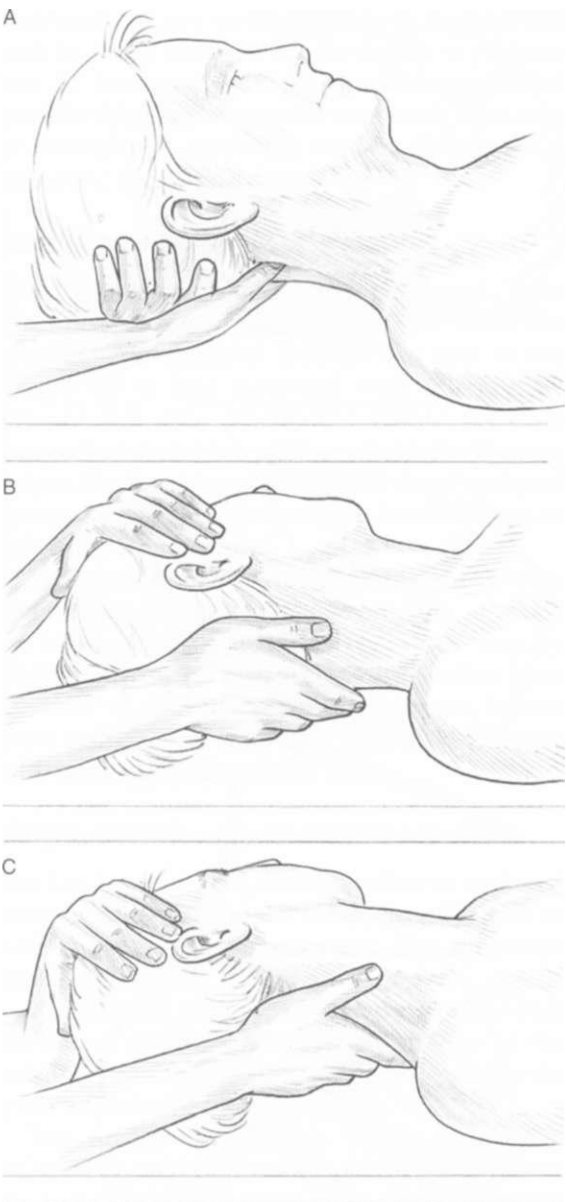


Figure 9.56 A-C NMT applied to the cervical lamina from the occiput to the upper thorax as far laterally as the transverse processes.

Direct pressure onto the tips of the spinous processes is not suggested as this may traumatize tissues lying between the bony prominence and the contact thumb.

Return to any ischemic bands or trigger points found and treat with static compression.

S pi en ii tendons ('corkscrew technique')

CAUTION

Use no pressure until the thumb is securely in place as described below.

To treat the right side splenius capitis, the patient is supine and the practitioner's right-hand fingers cup across the back of the neck like a shirt collar. Place the right thumb anterior to the trapezius and posterior to the transverse processes, while pointing the thumb toward the patient's feet. Use the left hand to rotate the head toward the side being treated.

The right hand should rotate with the neck as if molded to the back of the neck (see Fig. 9.57A-C). This rotation will open a 'pocket' anterior to the trapezius, allowing the thumb to be angled toward the nipple of the opposite breast, pressing lightly against the lateral surface of the spinous processes. The thumb pad should now be facing toward the ceiling.

Slide the right thumb into the 'pocket' formed by the trapezius. If the pocket does not allow penetration of the thumb due to excessive tension, or if pressure of the thumb produces more than moderate discomfort, press lightly at the 'mouth' of the pocket until the tissues relax enough to slide in further.

Apply pressure towards the lateral surface of the spinous processes and simultaneously toward the ceiling for 8-12 seconds. The thumb will be pressing into the tendons of the splenius capitis and splenius cervicis, as well as the deeper muscles of the rotatores and multifidi.

After the initial application of pressure, rest for a few seconds and then press the thumb into the pocket a little deeper and repeat the maneuver. When the tissues prevent the thumb's caudad movements, mild to moderate static pressure may produce more opening of the pocket and allow the therapist to go a little further down the spinal column.

If tender, repeat the entire process three or four times during a session. This step will help restore cervical rotation as well as reduce tilting pull on the transverse processes of C1-C3. Trigger points in the splenii tendons can refer strongly into the eye, causing eye pressure-like discomfort. Practitioners should rule out glaucoma or other serious eye conditions as a cause of such discomfort, in addition to treating these tissues.

Lief's NMT for the cranial base area

(See Fig. 9.58 and also Figs 9.10 and 9.11 for 'maps' of suggested thumb/finger strokes.)

The patient is prone with a medium-thickness pillow under the abdomen to support the lumbar spine, forehead supported in a split headpiece or facehole.

The practitioner should begin by standing half-facing the head of the couch, on the left of the patient, with his hips level with the midthoracic area. In order to facilitate the intermittent application of pressure and the transfer of weight via the arm to the exploring and treating thumb, the practitioner should stand with the left foot forward of the right by 12-18 inches (30-45 cm), weight evenly distributed between them, knees slightly flexed.

The first contact to the left side of the patient's head is a gliding, light-pressured movement of the medial tip of the right thumb, from the mastoid process along the nuchal line to the external occipital protuberance. This same stroke, or glide, is then repeated with deeper pressure, assessing for dysfunctional soft tissues.

The non-treating hand's role

The practitioner's left hand should at this time rest on the upper thoracic or shoulder area to act as a stabilizing contact. Whichever hand is operating at any given time, the other hand can give assistance by means of gently rocking or stretching tissues to complement the efforts of the treating hand or it can be useful in distracting tissues which are 'mounding' as the treating hand works on them.

What the treating thumb feels

The movement of the right thumb through the tissue is slow, not uniformly slow, but deliberately seeking and feeling for 'contraction' and 'congestions' (to use two words which will be

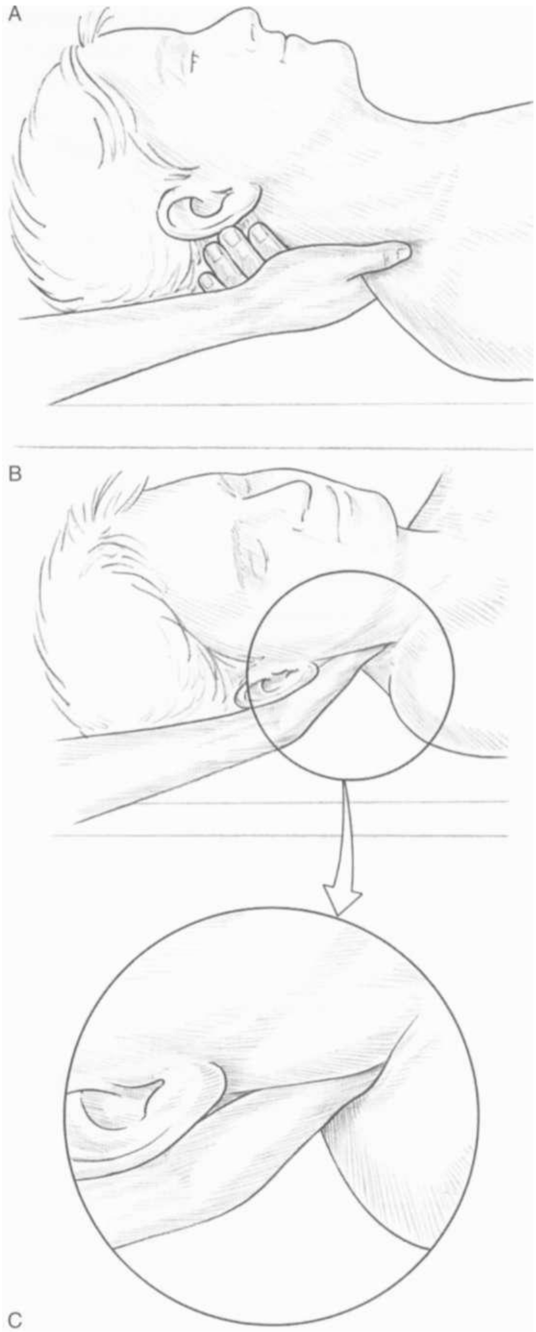


Figure 9.57 A-C 'Corkscrew technique' is a NMT method developed by Raymond Nimmo nc to effectively treat the splenii tendons from C7 to T4.

meaningful to any manual therapist). If and when such localized areas are felt, the degree of pressure can be increased and, in a variably applied manner, this pressure carries the thumb tip across or through the restricting tissues, decongesting, stretching and easing them.

Practitioner's posture

The treating arm should not be flexed, since the optimal transmission of weight from the practitioner's shoulder through the arm to the thumb tip is best achieved with a relatively straight arm. The practitioner should therefore ensure that the table height is suitable for his own height. He should not be forced to stand on tiptoe to treat the patient, nor should he have to adopt an unhealthy bent posture.

The practitioner's weight should be evenly spread between the separated feet, both of which are forward facing at this stage. In this way, by slightly altering his own weight distribution from the front to the back foot and vice versa, he can exert an accurate, controlled degree of pressure with minimum arm or hand effort.

Weight transfer - key to economy of effort

The hand itself should not be rigid but in a relaxed state, molding itself to the contours of the neck or back tissues. To some extent the fingertips stabilize the hand.

The thumb's glide is controlled by this so that the actual stroke is achieved by the tip of the extended thumb being brought slowly across the palm towards the fingertips.

The fingers during this phase of cervical treatment would be placed on the opposite side of the neck to that being treated. The fingers maintain their position as the thumb performs its diagnostic/therapeutic glide.

The first two strokes of the right thumb having been completed - one shallow and almost totally diagnostic and the second deeper, imparting therapeutic effort - the next stroke is half a thumb width caudal to the first. Thus a degree of overlap occurs as these strokes, starting on the belly of the sternocleidomastoid, glide across and through the trapezius, splenius capitis and posterior cervical muscles. A progressive series of strokes is applied in this way until the level of the cervicodorsal junction is reached. Unless serious underlying dysfunction is found it is seldom necessary to repeat the two superimposed strokes at each level of the cervical region.

Figure 9.58 In application of NMT, its developer Stanley Lief suggested that the practitioner's posture should be such as to ensure economy of effort, allowing easy transmission of body weight through the straight arm when pressure was required. In addition, leg and body positions as well as height of treatment table should all be considered as factors which can influence energy expenditure and comfort, positively or negatively.

Variable pressure - the key to painless treatment

If underlying fibrotic tissue appears unyielding, a third or fourth slow deep glide may be necessary. Should trigger points be located, as indicated by the reproduction in a target area of an existing pain pattern, then a number of treatment choices exist.

- The point can be marked and noted (on a chart and if necessary on the body with a skin pencil).
- Sustained pressure or 'make and break' pressure can be used.
- Application of a positional release approach (strain/counterstrain) will reduce activity in the hyperreactive tissue, as outlined in Chapter 10 and Appendix 1.
- Initiation of an isometric contraction followed by stretch could be used.
- A combination of pressure, positional release and MET (INIT) can be introduced (see Appendix 1).
- Acupuncture or a procaine-type injection might be used, if appropriate.

Note Whichever approach is used, a trigger point will only be permanently deactivated if the muscle in which it lies is restored to its normal resting length and MET can assist in achieving this (Travell & Simons 1983).

Sustained pressure, if applied, should be slightly variable, i.e. deep pressure for 5-7 seconds followed by a slight easing for a further few seconds and so on, repeated until the reference pain diminishes or until the maximum time (2 minutes) has elapsed. No more than this amount of manual pressure should be applied to a trigger point at any one session.

Treatment continues

Once the right thumb has completed its series of transverse strokes across the long axis of the cervical musculature, the left hand, which has been resting on the patient's left shoulder, comes into play. A series of strokes is applied by the left thumb, upward from the left of the upper dorsal area towards the base of the skull.

The fingers of the left hand rest (and act as a fulcrum) on the front of the shoulder area at the level of the medial aspect of the clavicle. As it glides cephalad, the thumb tip should be angled to allow direct pressure to be exerted against the left lateral aspects of the upper dorsal and the lower cervical spinous processes. Many of the muscles attaching to the cranium have attachments at these sites.

The subsequent strokes of the thumb should be in the same direction but slightly more laterally placed. The fingers should then be placed on the patient's head at about the temporo-occipital articulation. The left thumb then deals in the same way with the mid and upper cervical soft tissues, finishing with a lateral stroke or two across the insertions on the occiput itself.

In travelling from the nuchal line to the level of the cervicodorsal junction and back again in a series of overlapping gliding movements, common sites of possible trigger points will have been evaluated (see Fig. 9.59A-E).

- The midpoint of the sternocleidomastoid, at the level of the posterior angle of the jaw, can be an intensely painful trigger point which refers its influence from the area above the temple in the ear region to below the angle of the jaw.
- Similar triggers exist in the splenius capitis, upper trapezius, posterior cervical and other muscles of the area, all with different targets.

Following treatment of the left side of the cervical area, the same procedures are repeated on the right. A tall practitioner can probably adapt to treat both sides of the area from one standing position but a move to the opposite side allows a more controlled delivery of the appropriate strokes.

Origins and insertions

During NMT treatment special attention should be given to the origins and insertions of the muscles of the area. Where these bony landmarks are palpable by the thumb tip, they should be treated by the slow, variably applied pressure technique. Indeed, all bony surfaces within reach of the probing digit should be searched for undue sensitivity and dysfunction of their attachments which are amongst the most common sites of trigger points, according to Travell & Simons (1983).

How long?

Treatment of the left cervical area should take no more than 2 minutes and, in the absence of dysfunction, can be comfortably and successfully dealt with in no more than 90 seconds.

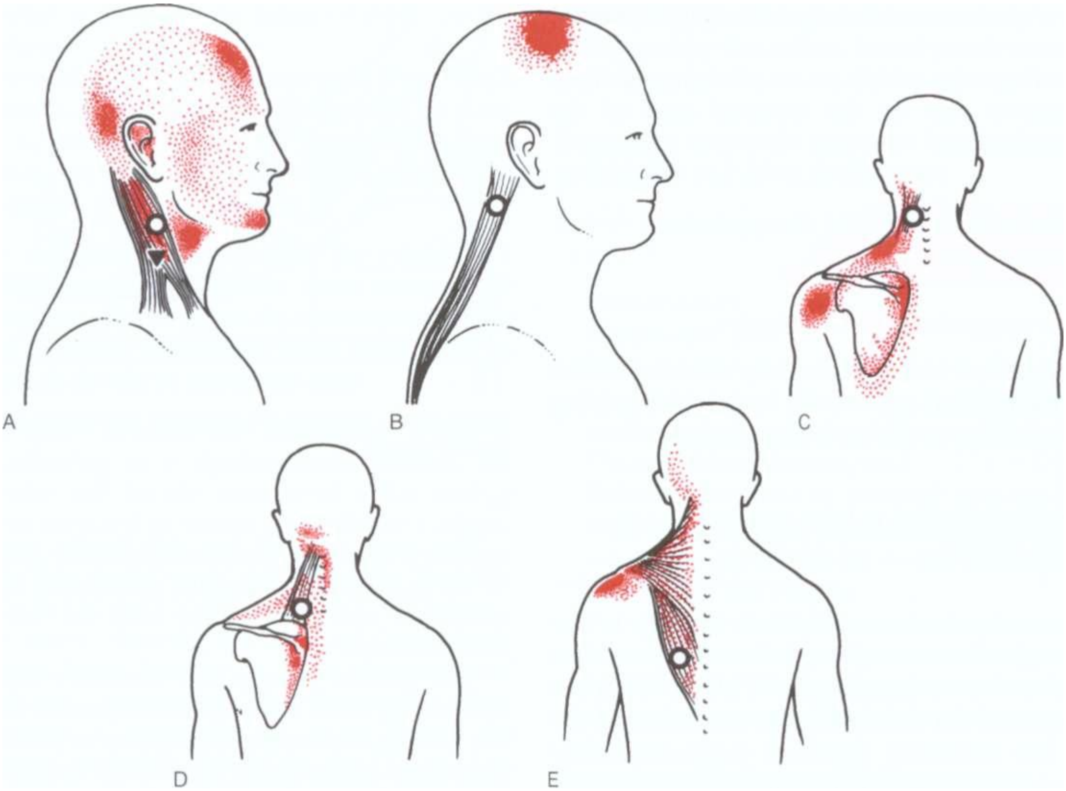


Figure 9.59 A Location of major trigger point site and distribution pattern in sternocleidomastoid. B Location of major trigger point site and distribution pattern in splenius capitis. C Location of major trigger point site and distribution pattern in levator scapulae. D Location of major trigger point site and distribution pattern in posterior cervicals. E Location of major trigger point site and distribution pattern in lower trapezius.

Adopting a new position (see Fig. 9.11)

Once both left and right cervical areas have been treated, the practitioner moves to the head of the table.

Resting the fingertips on the lower, lateral aspect of the neck, the thumb tips are placed just lateral to the first dorsal spinal process.

A degree of downward (towards the floor) pressure is applied via the thumbs which are then drawn cephalad alongside the lateral margins of the cervical spinous processes.

This bilateral stroke culminates at the occiput where a lateral stretch or pull is introduced across the bunched fibers of the muscles inserting into the base of the skull.

The upward stroke should contain an element of pressure medially towards the spinous process so that the thumb pad is pressing downward (towards the floor) whilst the lateral thumb tip is directed towards the center, attempting to contact the bony contours of the spine, all the time being drawn slowly cephalad to end at the occiput.

This combination stroke is repeated two or three times.

The fingertips which have been resting on the sternocleidomastoid may also be employed at this stage to lift and stretch it posteriorly and laterally.

During this bilateral stretch across the cranial base area the thumb tips dig deep into the medial fibers of the paraoccipital bundle as an outward stretch is instituted, using the leverage of the arms, as though attempting to 'open out' the occiput.

The thumbs are then drawn laterally across the fibers of muscular insertion into the skull, in a series of strokes culminating at the occipitoparietal junction.

The fingertips which act as a fulcrum to these movements rest on the mastoid area of the temporal bone.

Exercise 9.16 NMT for the posterior cervical area

Time suggested 10-12 minutes

Palpate and treat the cranially related muscles of the cervical and cranial base regions, using one or other of the NMT approaches.

LEVATOR SCAPULA INFLUENCES AND TREATMENT

Levator scapula does not attach directly to the cranium but because of its profound influence on the cervical spine (attaching to TPs CI to C4) it has the potential for disrupting the mechanics of the area. The stretching approach suggested below will additionally influence many of the smaller posterior neck muscles discussed previously in this chapter, which do attach to the cranium.

Treatment

Use MET for levator scapulae to enhance stretching of the extensor muscles attaching to the occiput and upper cervical spine (see Fig. 9.60).

The position described is used for treatment at the limit of the easily reached range of motion. The degree of effort in an isometric contraction should involve no more than 15-30% of available strength, with the duration of each contraction being 7-10 seconds.

The patient lies supine with the arm of the side to be tested stretched out, with the hand and lower arm tucked under the buttocks, palm upwards, to help restrain movement of the shoulder/scapula.

The practitioner's arm is passed across and under the neck, to rest on the shoulder of the side to be treated, with the forearm supporting the neck. The practitioner's other hand supports the head.

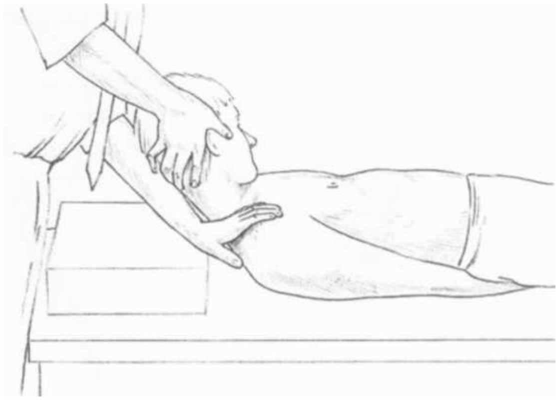


Figure 9.60 MET test and treatment position for right side levator scapula.

The neck is lifted into full flexion with the forearm (aided by the other hand) and is fully sideflexed and rotated away from the side to be tested/treated.

The patient shrugs the shoulder into the restraining hand of the practitioner and extends the neck against resistance, in order to produce an isometric contraction. After 7-10 seconds the effort ceases and a light stretch is introduced by taking the head/neck into greater flexion, side-flexion and rotation. This position is held for not less than 30 seconds.

Exercise 9.17 MET release of levator scapula

Time suggested 4-5 minutes

Palpate and treat levator scapula as described.

PROTOCOLS AND CHOICES

With the range of possible approaches to soft tissue and joint dysfunction outlined above, the choices can seem so varied as to offer confusion instead of clarity.

Which should be chosen and why?

It is suggested that the choice of technique should be based on what is appropriate to the patient and their current status (sensitive, fragile, robust, etc.)

and what is available (in terms of skills) to the practitioner.

A re-reading of the subtle concepts (Fritz Smith in particular) in Chapter 2 is suggested, as these insights into the degree of appropriate force required, in a given setting, are well worth review. In summary, these suggest that:

- the more traumatic (violent) the origin of a dysfunctional pattern, the more energy will have been absorbed into the system, suggesting that the initial therapeutic effort that should be applied should be extremely light
- the more gradual the adaptation which is manifesting as a dysfunctional pattern, the greater will be the amount of effort/energy input required to restore normality or a degree of functional improvement, although this effort does not need to be provided all at once
- the more chronic, fibrotic and 'organized' tissues have become in their dysfunctional pattern(s), the greater the therapeutic effort required. Conversely, the more recent the trauma, the less the treatment input needs to be to begin the normalization/recovery process
- the more sensitive the patient, the less invasive and more indirect the therapeutic method should be, involving perhaps positional release and/or Lief's NMT methods (see Ch. 10 and Appendix 1)
- the more robust the individual, the more direct the approach might appropriately be, possibly involving MET, myofascial release and/or ischemic compression methods, for example.

If cervical restriction is associated with the dysfunctional pattern, one or other of the methods discussed, such as those of Stiles, Harakal or Greenman, might prove adequate. However, where structural modifications of joint structures have occurred in the spine, including the cervical region, high-velocity thrust or mobilization methods may be appropriate and necessary.

In the author's experience, many such spinal joint restrictions can be satisfactorily normalized utilizing positional release and MET approaches, accompanied by additional soft tissue methods (myofascial release and/or NMT, for example). In terms of sequence, the following approach is advocated by the author, based purely on clinical experience.

Suggested approach sequence for treatment of soft tissue and joint dysfunction

Before treatment, the following assessments are necessary.

- Postural status
- Respiratory pattern
- Joint restrictions, especially in the cervical region, assessed by motion palpation (using methods such as those of Greenman)
- Cranial status (sutures, etc.)
- Relative shortness of postural muscles in this region, particularly of SCM, trapezius, scalenes, which are identifiable by means of the methods outlined in this chapter
- Presence of associated trigger points in any of the muscles of the region, involving one or other form of NMT assessment as a method for the early mapping of local dysfunctional patterns.

Example: rehabilitation of background stressors, such as breathing pattern disorders

If there is evidence of a disturbed breathing pattern, as described in Chapter 8, p. 246, it is important to start rehabilitation of this before trying to correct the results of such an ongoing pattern (the same applies to a postural pattern that may be creating repetitive adaptive demands on already distressed tissues and structures - including cranial ones).

The following outline of a protocol for breathing pattern rehabilitation is based on clinical experience (for further detail see Chaitow et al 2002).

Treatment involving breathing pattern retraining commonly calls for not less than 12 weekly sessions, followed by treatment sessions every 2-3 weeks, to approximately 6 months. Initially two sessions weekly may be appropriate. It is important to include an educational component at each session.

First 2 weeks (ideally four sessions)

- Attention to release and stretch, as needed, upper fixators/accessory breathing muscle (upper trapezius, levator, scalenes, strenocleido-mastoid, pectorals, latissimus dorsi) plus attention to active trigger points.

- Focus on diaphragm area to release and/or stretch anterior intercostal muscles, abdominal attachments to the costal margin, quadratus lumborum and psoas, plus attention to active trigger points.
- Breathing retraining: pursed-lip breathing method, together with instruction as to how to reduce tendency for shoulder rise on inhalation.

Weeks 3 and 4

- As above, plus mobilization of thoracic spine and rib articulations (and possible use of osteopathic lymphatic pump methods).
- Addressing fascial and osseous links (cranial, pelvic, lower extremity).
- Retraining: antiarousal breathing pattern instruction, plus specific relaxation methods (autogenics, visualization, meditation, etc.), stress management.

Weeks 5-12

- As above, plus particular focus on other influences (ergonomics, posture).
- Retraining: additional breathng, stretching, toning and/or balance exercises, as appropriate.

Weeks 13-26

- Review and treat residual dysfunctional patterns/tissues plus, as indicated: nutritional issues, counselling, stress management.
- Focus on adjunctive methods for home application: hydrotherapy, tai chi, yoga, Pilates, massage, acupuncture, etc.

Soft tissue dysfunction treatment choices relative to cranial treatment

If any of the major postural muscles attaching to the cranium are identified as shortened, these should be released and lengthened by use of MET, as described. Alternative stretching methods, perhaps involving myofascial release approaches, are also appropriate.

Trigger points should be deactivated/eliminated sequentially, based on criteria derived from the collective experience of many practitioners which suggests that when multiple sites of local or referred pain exist, these be dealt with as follows.

- Treat no more than five painful areas or trigger points in any one session because of the adaptation demands which such attention places on the homeostatic mechanisms of the body. It is very easy to overwhelm the adaptive capacity of the body and to cause major 'reactions' if too much is attempted at once, even in otherwise healthy and dynamic individuals. In less robust patients fewer than five painful areas or trigger points should be treated at any session.
- This suggestion of a maximum number of pain points for treatment at any one session applies irrespective of the methods being used, since positional release approaches, although gentle in application, demand the same degree of adaptive response from the body as do direct ischemic compression and stretching methods.
- It is suggested that the most painful, the most medial and the most proximal relevant points be treated first, i.e. those closest to the center of the body, those closest to the head and those most involved in the pattern of dysfunction being treated.

Local dysfunctional structures such as those within the oral cavity should be treated with the same degree of selectivity as is suggested for trigger points, i.e. at most, two such areas being addressed at any one time. Thus attention to medial pterygoid should be regarded in the same light as treatment of a myofascial trigger point when counting the number of points receiving attention.

Once soft tissues have received appropriate attention, any relevant joint restrictions that remain may be considered for manipulative attention.

Cranial and facial structures should then be addressed as required.

Example

A patient receiving treatment (ischemic compression or INIT) of two or three trigger points which refer into the neck, face or head could at the same time also receive direct treatment to address shortening in the sternocleidomastoid, masseter or pterygoid muscle, involving NMT, MET or other methods.

Apart from these specific interventions, all other treatment at that session should be of a general nature, perhaps involving global postural considerations, attention to the breathing pattern and gentle cervical mobilization (as described) as appropriate.

General cervical mobilization and stretching (MET or other) involving the scalenes, as described, can be a useful precursor to more specific muscle attention on the anterior neck.

Similarly, general cervical mobilization (positional release, for example), followed by cranial base release and/or MET release of the upper trapezius (if required), may offer a useful precursor to deeper attention to soft tissue structures in this region or to cranial work, at the same or a subsequent session.

By mixing and matching techniques, it is possible to utilize direct and indirect, gentle and more forceful methods in order to progressively eliminate myofascial trigger points, shortness of postural muscles and local areas of dysfunction, in order to achieve a degree of normality in dysfunctional tissues associated with cranial dysfunction.

At the same time it is appropriate to evaluate sutural tenderness and restriction (a sense of 'rigidity' is a major clue) and to apply appropriate light release methods (V-spread, etc.) to these.

However, before any direct cranial approaches, such as V-spread, are utilized, a simple freeing of the skin/fascia should be attempted by means of the positional release approach suggested for the treatment of restrictions in occipitofrontalis muscle (p. 272). Such methods, simple as they are, can appreciably release contracted, adherent superficial structures which can themselves act to restrict underlying mobility.

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Chapter 10

Positional release and cranial pain and dysfunction

CHAPTER CONTENTS

When distressed tissues are moved toward their preferred directions of motion, into 'ease' and away from 'bind', an attempt is being made to achieve a position of 'dynamic neutral'. This describes positional release, a clinical approach in which, rather than engaging the restriction barrier, this is retreated from, allowing neurological and/or circulatory modification to assist in normalization of dysfunctional tissues (Jacobson et al 1989, Korr 1975, Rathbun & Macnab 1970).

Charles Bowles (1969) has discussed the 'position of ease' as follows.

> *Dynamic neutral is a state in which tissues find themselves when the motion of the structure they serve is free, unrestricted and within the range of normal physiological limits. Dynamic neutral is not a static condition ... it is a continuing state of normal, during living motion, during living activity ... it is the state and condition to be restored to a dysfunctional area.*

The impetus towards the use of this most basic and non-invasive of treatment methods in a coherent rather than a hit-and-miss manner lies in the work of Laurence Jones, who developed an approach to somatic dysfunction which he termed 'strain and counterstrain' (SCS) (Jones 1981). Walther (1988) describes the moment of discovery in these words.

> *Jones's initial observation of the efficacy of counterstrain was with a patient who was*

> *unresponsive to treatment. The patient had been unable to sleep because of pain. Jones attempted to find a comfortable position for the patient to aid him in sleeping. After twenty minutes of trial and error, a position was finally achieved in which the patient's pain was relieved. Leaving the patient in this position for a short time, Jones was astonished when the patient came out of the position and was able to stand comfortably erect. The relief of pain was lasting and the patient made an uneventful recovery.*

The position of 'ease' which Jones found for this patient was an exaggeration of the position in which spasm was holding him, which provided Jones with an insight into the mechanisms involved.

Over the years since Jones first made his valuable observation that a position that temporarily and painlessly exaggerated a patient's distortion could provide the opportunity for a release of spasm and hypertonicity, many variations on this basic theme have emerged, some building logically on that first insight and others moving in new directions.

When, during treatment, tissues are disengaged from a restriction barrier, the method is described as 'indirect' as opposed to methods which overtly attempt to overcome the restriction barrier which are known as 'direct' approaches.

COMMON BASIS

The commonality of such approaches is that they move the patient, or the affected tissues, away from any resistance barriers and towards positions of comfort/ease/neutral, whether employing the holding of a painful point which acts as a monitor or guide to the position of ease (as its pain alters during the positioning process) or whether a palpated sense of 'ease' is employed (functional technique).

The shorthand terms used for the two extremes - the barrier and the position of comfort - are 'bind' and 'ease', terms which anyone who has handled the human body will recognize as being extremely apt.

The need to understand the many variations should be obvious. Different clinical settings, as well as the host of different ways in which tissues can become dysfunctional, require that a variety of therapeutic choices be available.

UPLEDGER'S CRANIAL POSITIONAL RELEASE CONCEPTS

Upledger & Vredevoogd (1983) give a practical explanation of indirect methods of treatment, especially as related to cranial therapy. The idea of moving a restricted area in the direction of ease is, they say, 'a sort of "unlatching" principle. Often in order to open a latch we must first exaggerate its closure'. They suggest that in order for cranial structures to be satisfactorily and safely treated, indirect approaches are best.

By following any restricted structure to its easy unforced limit, in the direction towards which it moves most easily ('the direction towards which it exhibits the greatest range of inherent motion'), a sense may be perceived of the tissues attempting to 'push back' from that position, at which time the operator is advised by Upledger to become 'immovable', not forcing the tissues against the resistance barrier or trying to urge it towards greater ease but simply refusing to allow movement. Upledger explains that 'it is the inherent motion of the structure as it attempts to return to neutral, that pushes against you'.

Upledger explains what may happen next.

> *When the structure stops pushing against you it will travel farther in the direction of the ease of motion, often called 'the direction of ease'. As this movement away from you occurs, follow it, take up the slack but without pushing. At the end of a cycle the motion will again move against you. Once more you become immovable. Repeat this procedure through several more cycles of inherent craniosacral motion (CRI). Ultimately a tissue softening or release will occur. This is the therapeutic effect for which you have been waiting. The tissue has 'unlatched' itself. Follow a few cycles and re-evaluate for ease of motion and symmetry.*

Upledger's energy cyst release

Upledger has also described similar 'positional release' processes used in normalization of what he terms 'energy cysts', relating to long-held emotional or physical forces. Energy cyst release is a therapeutic process in which the therapist is able, by sensitive manual assessment, to locate an area in a patient's body wherein its inherent rhythmical activities are disrupted. Quite often this area of chaotic energetic activity represents the retention of energy resulting from a traumatic event. When discovered, the area may be released by assisting the patient's body to return to the position it was in at the time of injury. The patient's tissues seem to retain a virtual memory of this position. When the appropriate position is achieved, a spontaneous release of the inappropriate tension in the tissues occurs.

In order to achieve the release of the 'energy cyst', the therapist uses his/her own effort to counterbalance gravity, while assisting the dysfunctional area to achieve agonist-antagonist balances. When the balanced position is achieved, the normal rhythmical activity of the craniosacral system usually stops and the spontaneous release commonly takes place. The patient may simultaneously re-experience emotions that were present at the time of the trauma. During the release, skin temperature elevates at the site of the trauma and a reduction takes place of total body electrical potential. These phenomena have been measured by Upledger & Kami (1978a, b). The position of release is held until the craniosacral rhythm resumes, the emotion passes and the skin temperature returns to normal.

JONES'S CRANIAL METHODS

The developer of 'strain/counterstrain', Laurence Jones, has also focused attention on cranial dysfunction and suggests specific corrective methods for pain ('tender points') or restrictions (Jones 1981). Appendix 1 offers further explanations of positional release concepts.

Locating tender points (see Fig. 10.1)

Finding the tender points listed below (based on Jones's extensive research and clinical experience) is a matter of gentle fingertip palpation. Despite there being a very shallow layer of muscle in most of the locations described, there can be trigger points in these sites and care is needed as to how much pressure is applied. The suggestion is that the palpating digit should produce just enough discomfort for the patient to register the sensitivity and to be able to report on the easing of discomfort as positional release is attempted.

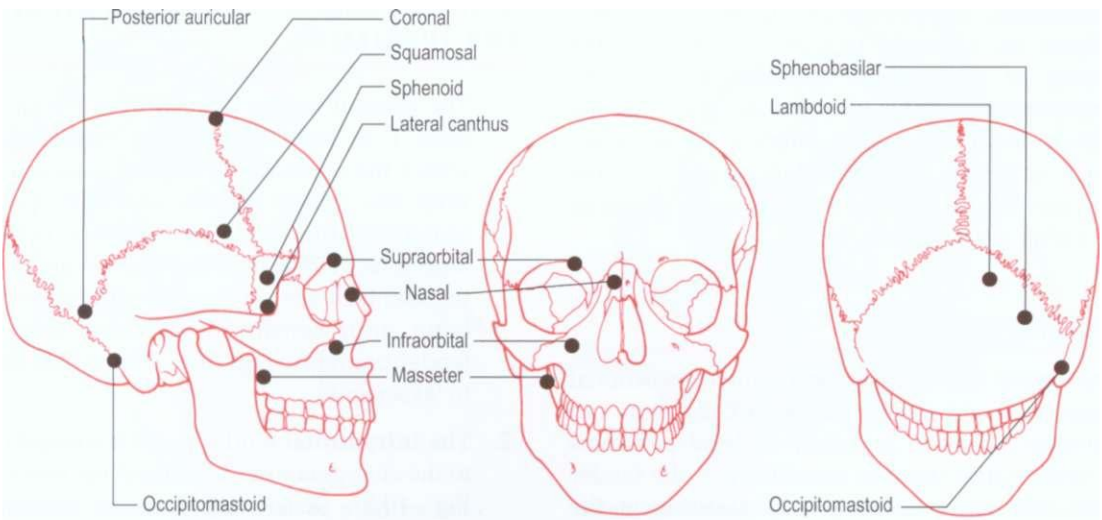

Figure 10.1 Jones's cranial tender point locations.

How much force?

The amount of effort required to produce 'ease' should be minimal and should not exceed ounces/grams, despite some of Jones's suggested pressure levels, which are often much higher.

Varying but light forces are used in order to ease the palpated pain/sensitivity. Once this has been achieved, an instruction in the text to 'hold the position for up to 90 seconds' will be seen.

It is worth keeping the words of Upledger in mind regarding 'sensing' the tissues 'pushing back', at which time it is suggested the structure be held in the direction of the position of ease. This approach is valid, although there is a difference between the underlying approaches of Upledger and Jones. While Upledger relates his guidelines to craniosacral therapy, Jones is clear that he does not.

> *By the time 1 had begun to adapt my method to treat cranial disorders, 1 had acquired an abiding faith in the reliability of the tender points to report the efficacy of treatment. I claim no mechanical understanding of the skull, but I am able to relieve most cranial problems simply by relying on feedback from the tender points. The method probably is not comparable to the cranial studies developed by Dr. W. G. Sutherland, but it is much easier to learn and it does an excellent job. On these terms I am -willing to forego mechanical understanding.*

As indicated, the poundage suggested by Jones confirms his admitted lack of awareness of the delicacy of the cranial structure and so the recommended degree of pressure given in the methods described below offers a scaled-down version of Jones's recommendations and is in line with craniosacral levels of force (ounces/grams or less, rather than pounds/kilos).

The cranial tender points

Jones reports that suitable treatment, by positional release, of the tender points described below can positively influence a variety of local problems and sensitivities (pain or sensitivity in the tender points, for example) as well as assisting in the resolution of a number of common complaints.

Note The connections between named conditions (below) and the tender point locations are those described by Jones.

- Infraorbital tender point
  - Periorbital headaches
  - Maxillary sinus problems
- Lateral canthus tender point
  - Upper dental neuritis
- Masseter tender point
  - Earache
  - Lower dental neuritis
- Nasal tender point
  - Periorbital headaches
  - Nasal congestion
- Occipitomastoid tender point
  - Frontal and periorbital headaches
  - Earache
  - Vertigo
  - Dysphagia
- Posterior auricular tender point
  - Tinnitus
- Sphenoid tender point
  - Upper dental neuritis
- Squamosal tender point
  - Periorbital headaches
  - Upper dental neuritis
- Zygomatic tender point
  - Tinnitus
  - Earache.

JONES'S CRANIAL POINTS: LOCATION AND TREATMENT

1. The **coronal** tender point lies on the parietal bone 1 cm from the anterior medial corner where the coronal and sagittal sutures meet. With the patient supine and the operator seated at the head, the tender point is monitored while light pressure is applied to the identical site on the non-affected parietal bone until sensitivity vanishes from the tender point (see Fig. 10.2). This is held for up to 90 seconds.
2. The **infraorbital** tender point is located close to the emergence of the infraorbital nerve (see Fig. 10.3). Sensitivity here is commonly associated with sinus headache symptoms.

Figure 10.2 Coronal tender points, palpation and treatment contacts and hand positions.

The patient is supine with the operator seated at the head of the table. The interlocked hands of the operator are placed over the patient's face so that the middles of the palms rest over the cheekbones. Pressure (light) is applied obliquely medially and posteriorly with both hands, as though the heels of the hands are being brought together. Mild discomfort is often noted even with light pressure (ounces only, not the 8 lb suggested by Jones!). This compressive effort needs to be sustained until a marked feeling of decongestion is reported, along with relief of any sense of pressure previously felt behind the nose.

3. The **lambdoidal** dysfunction tender point lies on the occipital bone, just medial to the lambdoidal suture, approximately 2.5 cm below the level of the lambda, obliquely above and slightly lateral to the inion. Positional release treatment is applied via light compression of precisely the same contralateral site on the occipital bone, until discomfort vanishes from the palpated tender point (see Fig. 10.4). The direction in which pressure is applied can vary from an anterior direction to a medial one, easing the treatment point towards the tender point site, whichever produces greatest relief of the tenderness. The patient should be seated or prone for easy access to the points (tender point and treatment point).
4. The **lateral canthus** tender point lies in the temporal fossa, approximately 2 cm lateral to the end of the lateral canthus. The operator is on the ipsilateral side and treatment of the supine patient involves the operator's cephalad hand spanning the frontal bone, so that the thumb can rest on the tender point as a monitor (see Fig. 10.5). The other hand, using the thenar eminence as a contact, applies upward pressure towards the palpating thumb, via a contact on the zygomatic bone

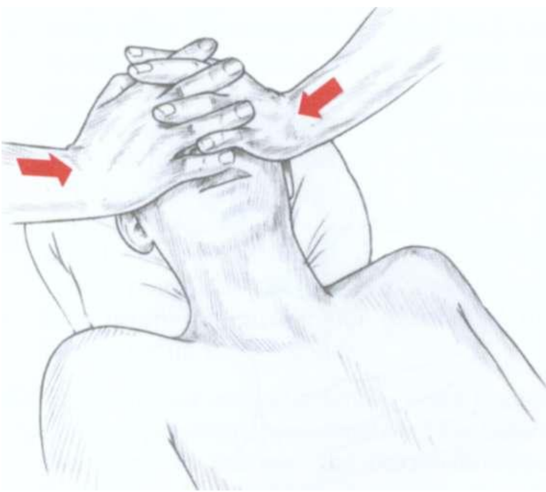

Figure 10.3 Infraorbital tender points, palpation and treatment contacts (only ounces of pressure at most).

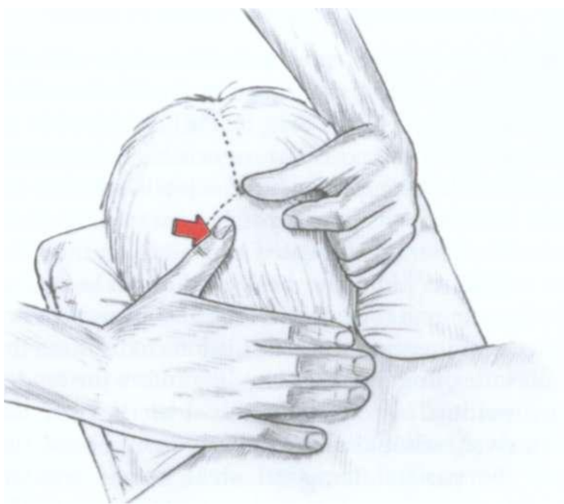

Figure 10.4 Lambdoidal dysfunction palpation and treatment contacts and hand positions.

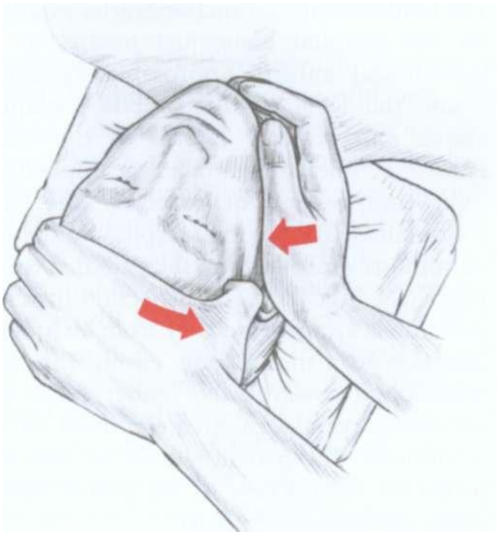

Figure 10.5 Lateral canthus (right side) dysfunction/tender point palpation and treatment contacts and hand positions.

Figure 10.6 Masseter (right side) dysfunction/tender point palpation and treatment contacts and hand positions.

and the zygomatic process of the maxilla. The palpating cephalad hand exerts light pressure on the frontal bone towards the zygoma, crowding the tissues and articulations in the area. Varying directions of application of these forces should be attempted until sensitivity in the palpated point eases markedly. The position of ease is maintained for up to 90 seconds; however, Upledger's guidelines outlined earlier in this chapter should be borne in mind.

5. The **masseter** tender point lies on the anterior border of the ascending ramus of the mandible and may be involved in TMJ dysfunction as well as mandibular neuritis. The patient should be supine, with the jaw slack and the mouth open approximately 1 cm (see Fig. 10.6). The operator is seated or stands on the non-affected side, the heel of the caudad hand resting on the point of the chin, applying very light pressure towards the affected side as the index finger of that hand monitors the tender point. The other hand, which lies on the dysfunctional side of the patient's head (on the parietal/temporal area), offers counter-force to the palpating hand's pressure via the heel of hand which is stabilizing the head against the operator, while the fingers, which are just above the zygoma, lightly draw it towards the operator's chest.

6. The **nasal** dysfunction tender point is located on the side of the bridge of the nose and as this is palpated, tenderness is relieved by application of light pressure towards it from the same point on the contralateral side of the nose (see Fig. 10.7).

Figure 10.7 Nasal (right side) dysfunction/tender point palpation and treatment contacts and hand positions.

Figure 10.8 Occipitomastoid dysfunction/tender point palpation and treatment contacts and hand positions.

Figure 10.9 Posterior auricular (right side) dysfunction/ tender point palpation and treatment contacts and hand positions.

7. The **occipitomastoid** tender point lies in a vertical depression just medial to the mastoid process, approximately 3 cm superior to its tip. The patient lies supine and the operator holds the head in both hands, with one ring finger on the tender point (see Fig. 10.8). The heels of the hands contact the parietal bones, making absolutely certain that they are superior to the suture line between it and the temporal bones. A very slight (ounces at most) effort is introduced by each hand, one 'torsioning' its contact clockwise and the other anticlockwise, until sensitivity vanishes from the tender point. The particular mechanics involved in the dysfunction will determine which side of the head, the ipsilateral or contralateral, requires a clockwise or an anticlockwise rotational effort. Once the tender point palpates as much less sensitive than before the introduction of rotation, this is held for up to 90 seconds.

8. The **posterior auricular** tender point lies in a slight depression approximately 4 cm behind the pinna of the ear, just below its upper border (see Fig. 10.9). Treatment requires the patient to be sidelying, with the affected side uppermost, resting on a small cushion which supports both the ear and zygoma of the contralateral side. Light pressure is applied to the parietal bone, as though to 'bend' the skull 'sideward and over an anteroposterior axis' (Jones's words). This should remove the pain from the tender point and should be held for up to 90 seconds. Jones reports that tinnitus and dizziness often respond well to easing of tenderness in this point.

9. The **sphenobasilar** tender point lies 2 cm medial to the lambdoidal suture, above the level of the inion. Treatment (see Fig. 10.10) involves the operator cupping the occipital bone (patient supine, operator seated at head of table) in one hand and the frontal in the other, while applying gentle counterclockwise rotation to the frontal and clockwise to the occipital (rotation directions are described as seen from the front of the patient looking at the operator's hands). This introduces torsion through an anteroposterior axis and relieves tenderness which can be monitored by one of the fingers of the inferior hand cupping the occiput. The amount of force introduced in these contacts should be minimal, involving ounces only.

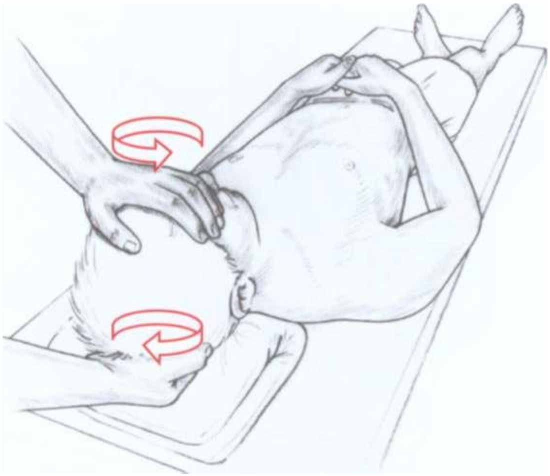

Figure 10.10 Sphenobasilar dysfunction/tender point palpation and treatment contacts and hand positions (use ounces of pressure at most).

Figure 10.11 Sphenoid (right side) dysfunction/tender point palpation and treatment contacts and hand positions (use very light pressure only). Compare this with Jones Method (Fig. 10.6).

10. The **sphenoid** tender point lies on the great wing of the sphenoid. Jones notes that the temple on the affected side will normally palpate as more prominent than its pair and that the tenderness may relate to tension in the temporalis muscle, as well as to the eccentric stress on the sphenoid. Positional release is achieved by the application of pressure (light, ounces only) with the heel of one hand, from the contralateral great wing towards the monitoring index finger contact on the affected side (see Fig. 10.11). At the same time the heel of the hand that is monitoring the tender point applies counter-pressure towards the ipsilateral side via its contact on the frontal bone.

11. The tender point on the **squamosal suture** lies on the superior border of the temporal bone and is best palpated from above (see Fig. 10.12). The patient should be sidelying with a pillow under the head and the affected side uppermost. Positional release is achieved by placement of three fingers above and parallel to the temporoparietal articulation, distracting the parietal bone away from the temporal bone. Light pressure only is required (grams or ounces at most). The angle of 'pull' should be varied until the pain noted from pressure on the tender point is reduced markedly or vanishes completely. This is held for anything up to 90 seconds or until a 'softening' warmth is noted. If the tender point is more anterior, closer to the squamosal border, then the contact fingers would be placed on the frontal bone which would then be distracted obliquely away from the temporal bone in an anterosuperior direction, until pain is reduced or vanishes. Jones reports that upper dental neuritis is often relieved by treating this point.

12. The **zygomatic** tender point: lies just above the zygomatic arch of the temporal bone, about 3 cm anterior to the external auditory meatus. Treatment is identical to that applied to the lateral canthus point (see Fig. 10.5) except that the 'crowding' forces are applied approximately 4 cm more posteriorly.

POSITIONAL RELEASE METHODS FOR TMJ PROBLEMS

DiGiovanna (Scariati 1991) describes a counterstrain method for treating tenderness in the masseter

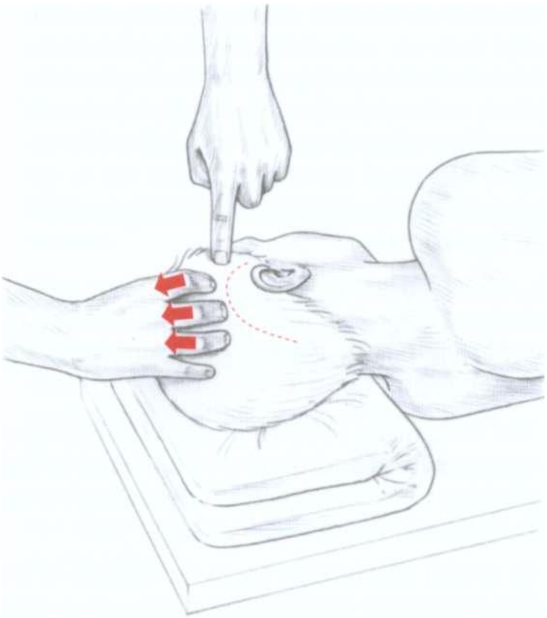

Figure 10.12 Squamosal (right side) dysfunction/tender point palpation and treatment contacts and hand positions.

Figure 10.13 Masseter muscle (right side) dysfunction/tender point palpation and treatment contacts and hand positions.

muscle (Fig. 10.13). The patient is supine and the operator sits at the head of the table. One finger monitors the tender point in the masseter muscle, below the zygomatic process. The patient is asked to relax the jaw and with the free hand the operator eases the jaw towards the affected side until the tender point is no longer painful. This is held for 90 seconds before a return is allowed to neutral and the point repalpated.

Upledger (Upledger & Vredevoogd 1983) uses a positional release via 'decompression' on the TMJ, as a preliminary to application of a gentle traction on the joint in order to disengage overapproximation. The TMJ can be treated by a simple approach involving 'crowding' or compression, followed by traction or decompression. The contact (no squeezing, just a non-sliding contact) is on the skin. The palms and fingertips are placed onto the skin of the cheeks of the supine patient, as the operator sits at the head. Light traction on the skin pulls on connective tissue that is attached to bone. The skin is taken to a point of resistance as the hands are drawn cephalad (taking out the slack). This is held until any sense of the structures moving or repositioning themselves ceases, which could take a minute or more. After this, skin traction is introduced in a caudal direction and held at its easy resistance barrier, in traction, until all restriction has released, which can take some minutes.

According to Upledger this approach can produce multiple profound releases throughout the cranial mechanism, including the reciprocal tension membranes and sutures (see Fig. 7.20A,B on p. 212).

Goodheart's coccygeal lift technique (Goodheart 1985)

Different uses of what appear to be SCS mechanisms have been evolved by clinicians such as George Goodheart (see Ch. 4). Goodheart has described a method that seems to rely on the crowding or slackening of spinal, dural tissues, with the coccyx being used as the means of achieving this. Startling results in terms of improved function and release of hypertonicity in areas some distance from the point of application are claimed (Goodheart 1985). Goodheart terms this a 'filum terminale cephalad lift' (which it is proposed be shortened to 'coccygeal lift', at least in this text).

This method focuses on normalizing flexion/extension dysfunction between the spinal column and the spinal cord, despite the spiral nature of the manner in which the spine copes with forced flexion (Illi 1951). Goodheart and Walther report that there is frequently a dramatic lengthening of the spinal column after application of the coccygeal lift procedure, with Goodheart mentioning specifically that in good health there should be a difference of no more than about half an inch in the measured length of the spinal column sitting, standing and lying, using a tapeless measure which is rolled along the length of the spine.

Goodheart quotes from the work of Upledger and Breig in order to substantiate physiological and pathological observations which he makes relating to the dura, as to its normal freedom of movement and its potential for causing problems when restricted (Breig 1978, Upledger & Vredevoogd 1983).

Breig states that using radiography, microscopic examination and mechanoelastic models, it has been shown that there are deforming forces, which relate to normal movements of the spine, impinging on the spinal cord and meninges, from the brain stem to the conus medullaris and the spinal nerves.

Upledger, in discussion of the physiological motion of the central nervous system, recalls that when assisting in neurosurgery in 1971, in which extradural calcification was being removed from the posterior aspect of the dural tube in the midcervical region, his task was to hold the dura with two pairs of forceps during the procedure. However, he states: 'The membrane would not hold still, the fully anaesthetised patient was in a sitting position ... and it became apparent the movement of the dural membrane was rhythmical, independent of the patient's cardiac or respiratory rhythms' (see Foreword).

Goodheart states:

> *Tension can be exerted where the foramen magnum is attached to the dura and also at the 1st, 2nd and 3rd cervicals, which if they are in a state of fixation can limit motion. The dural tube is completely free of any dural attachment all the way down to the 2nd anterior sacral segment where finally the filum terminate attaches to the posterior portion of the 1st coccygeal segment.*
>
> *The release which comes from the coccygeal lift cannot be just linear longitudinal tension problem. The body is intricately simple and simply intricate and once we understand the closed kinematic chain and the concept of the finite length of the dura, we can see how spinal adjustments can sometimes allow compensations to take place.*

Rationale and method for the coccygeal lift (see Fig. 10.14)

The anatomy of what is happening and the process of utilizing this procedure are briefly explained as follows (Sutherland 1939, Williams & Warwick 1980).

- The dura mater attaches firmly to the foramen magnum, axis and third cervical vertebra and possibly to the atlas, with a direct effect on the meninges.
- Its caudal attachments are to the dorsum of the first coccygeal segment by means of a long filament, the filum terminale.
- Flexion of the spine alters the length of the intervertebral canal while the cord and the dura have a finite length (the dura being approximately 2.5 inches longer than the cord, allowing some degree of slack when the individual sits) which Goodheart reasons requires some form of 'arrangement' between the caudal and the cephalad attachments of the dura, a 'take-up' mechanism to allow for maintenance of proper tension on the cord.
- Measurement of the distance from the external occipital protuberance to the tip of the coccyx shows very little variation from the standing to the sitting and lying positions. However, if all the contours between these points are measured in the different positions, a wide variation is found and the greater the degree of difference, the more likely there is to be spinal dysfunction and, Goodheart postulates, dural restriction and possible meningeal tension.
- Tender areas of the neck flexors or extensors are used to monitor the lift of the coccyx which is to follow; as the palpated pain and/or hypertonicity eases so is the ideal degree of lift being approached.
- With the patient prone and the operator standing at waist level and having palpated

and identified the area of greatest discomfort and/or hypertonicity in the cervical spinal musculature with the cephalad hand, the index finger of the caudad hand is placed so that the tip of the index or middle finger is on the very tip of the coccyx, while the hand and fingers follow precisely the contours of the coccyx and sacrum.

- This contact slowly and gently takes out the available slack as it 'lifts' the coccyx (cephalad) along its entire length, including the tip, directly towards the painful contact on the neck, using anything up to 15 lbs of force.
- If the painful monitoring point does not ease markedly, the direction of lift is altered (by a few degrees only) slightly towards one shoulder or the other.
- Once the pain has been removed from the neck point and without inducing additional pain in the coccyx, this position should be maintained for up to 1 minute.
- Additional ease to the restricted or possibly torsioned dural sleeve can be achieved by using the hand which is palpating the cervical structures to impart a gentle caudal traction by holding the occipital area in such a way as to lightly compress it while easing it towards the sacrum (so moving the upper three cervical segments inferiorly) as the patient exhales. This hold is maintained for four or five cycles of breathing.
- Goodheart and others report dramatic changes in function, as well as lengthening of the spine so that it measures equally when sitting, lying and standing, along with reduction in cervical dysfunction, removal of chronic headaches and release of tension in psoas and piriformis.

Author's note

The author has found the following variations commonly make application of the coccygeal lift, as described above, far less difficult to achieve.

1. Once identified, the patient can apply the compression force to the tender cervical area which is being used as a monitor until ease is achieved. This frees the operator so that positioning and application of the coccygeal lift are less physically stressful. The position described above, as advised by Goodheart and Walther, can be awkward if the operator is slight and the patient tall.
2. A sidelying position of the patient can allow for an even less uncomfortable (for the operator and the patient) application of the procedure. In this instance the patient monitors the painful point in the cervical area once the operator has identified it and the operator, standing at upper thigh level behind the side-lying patient, uses the ulnar aspect of the cephalad hand to make contact along the whole length of the coccyx, with that elbow braced against the hip/abdomen area. The force required to achieve the lift is then applied by the operator leaning into the hand contact,

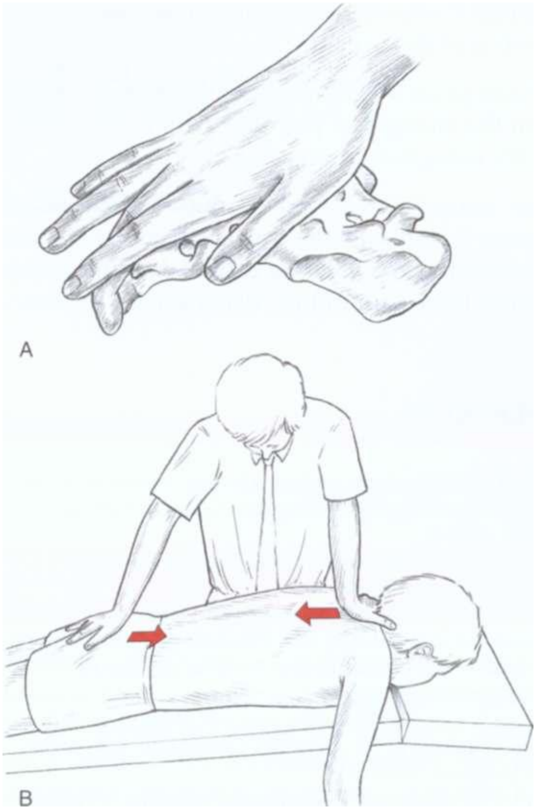

Figure 10.14 A,B Goodheart's coccygeal lift technique.

while the caudad hand stabilizes the anterior pelvis of the patient.

3. As in Jones's SCS methods, the patient reports on the changes in palpated pain levels until a 70% reduction is achieved.

These examples, as well as those described in Chapter 9, indicate the versatility of positional release methods in treating cranial dysfunction by utilizing local pain points, dealing with dysfunctional soft tissues attaching to or associated with cranial function, or in attempting to modify the entire dural fascial network by means of Goodheart's unusual but effective approach.

Acknowledgment

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Chapter 11

Cranial therapy and dentistry

John D Laughlin III with John D Laughlin IV

CHAPTER CONTENTS

DENTISTRY AND CRANIAL THERAPY: THE LINKS

Dentists, along with most doctors, are taught to analyze body systems and body parts separately. We are taught to change one area at a time, but such approaches frequently ignore the inter-connectedness of the systems in the human body. If it is accepted that normal cranial motion and structure are necessary for the optimal functioning of the individual (Page 2003, Stockton 1998, Zeines 2000), it should be possible to acknowledge that dental procedures can potentially have debilitating, possibly long-term effects on a person's health, when those procedures interfere with the optimal functioning of the cranial complex (Fischer 1940, Hodgson & Hansen 2000, Morgan et al 1982, Simon 2001).

Similarly, cranial treatment may be less effective if inappropriate dental procedures produce changes that interfere with normal function (Frymann 1998).

In contrast, it is suggested that dental therapy that considers the whole body can result in major benefits, especially when integrated with suitable cranial therapies.

BACKGROUND

The cranium is a compact container with many structurally and functionally interrelating parts and tissues. Dysfunction of a single part can affect the entire interrelated system (Upledger 1997). Because of this, an integrated 'whole-body' dental approach needs to take into account more than just the achievement of 'straight' teeth (Gelb 1971, 1977, Upledger 1987).

Dental education, for the most part, fails to take into consideration areas of the body beyond dentition, the status of the maxillae and mandible and their occlusion (Breiner 1999, Zeines 2000). Similarly, many practitioners who treat temporomandibular dysfunction symptoms (TMJ dysfunction or TMD) do not look beyond the interrelationships of the maxillae, mandible and TMJ (Hruby 1985, Page 2003). Issues surrounding hard tissue correction seem to be given more weight than other cranial interrelationship issues (Simon 2001). It is not surprising therefore that much of the discussion that follows is neither understood, nor accepted, by mainstream dentistry (Breiner 1999, Carter 1993, Zeines 2000).

In this chapter we define the goal of *whole-person dentistry* as:

- healthy tooth structure
- optimal occlusion
- mandibular/maxillary relationship, with correct structural relationship between the maxilla, the sphenoid and all other cranial bones (Breiner 1999, Gelb 1971).

DENTAL TREATMENT CAN ENHANCE OR INHIBIT CRANIAL TREATMENT

FUNCTIONAL JAW ORTHOPEDIC ORTHODONTICS (also known as functional jaw orthopedics or FJO)

Functional jaw orthopedic orthodontics: 'The use of orthopedic orthodontic appliances to influence the teeth and bone in such a way as to stimulate remodeling or alteration of growth patterns of the jawbones and associated neuromuscular tissues' (Zeines 2000). A longer definition would be:

> *The use of tooth and tissue anchored appliances, designed to create change during function, toward the eventual goal of cranial symmetry through orthopedic movement and soft tissue balance, while at the same time emphasizing correct TMJ mechanics, cranial suture, cranial bone and sacral motion. (Hockel 1983, Hruby 1985, Wiebrecht 1966,1969)*

FJO can have positive effects in transforming a person's life. The author has regularly in clinical practice, observed marked positive physical, mental and emotional changes, as the face, skull and body are reorganized following appropriate dental care (Magoun 1979, Page 2003, Stack 2004, Stockton 1999).

Depending on the individual's belief system, these beneficial changes might be ascribed as deriving from changes in CSF movement, cranial sutural mobility and/or membranous and facial stress reduction (Gelb 1977).

Some clinically documented examples of these transformations include: increased self-esteem, marked improvements in school grades, enhanced ease of learning, reduced ADD or ADHD symptoms, improved social skills, ease of breathing, bedwetting elimination, desire to change abusive relationships and increased energy.

FJO can make cranial treatment more efficient and effective and have longer lasting benefits by encouraging the correction of underlying structural problems (Hockel 1983).

FJO analysis and treatment from a dental relationship point of view

Class I Dental relationships

This refers to a fairly normal relationship of upper to lower teeth. However, this classification does not address the health of the TMJ nor the possible malposition of the maxillae relative to the cranial base.

For example, a patient may present having had several teeth extracted, a severe TMJ dysfunction, as well as cranial and esthetic disturbances and despite these problems may still have a classification of a Class I occlusion, merely because the teeth fit together well.

Figure 11.1 A represents a post-treatment case with a normal face form and Figure 11.1B demonstrates an intraoral view of a normal overbite (vertical overlap) and overjet (horizontal overlap of the upper jaw compared to the lower jaw). In this Class I case the TMJ, tooth alignment and jaw relationship are ideal.

Box 11.1 Understanding what another health professional may be saying: different classifications (systems) for the same problem

In order to be able to establish good communication with a dentist it is vital that there is an understanding of the background of his/her diagnosis. There are five main types of classifications used to describe the interrelationship of the teeth, jaws and skull (Bowbeer 2003, Gelb 1977).

I Dental
II Functional
III Esthetic
IV Radiographic
V Cranial.

Each can be used to describe the same case in a different way, which means that to communicate it is necessary to establish a common language. A broad overview of these classifications follows.

Dental relationships Classes I–III relate to how the upper and lower teeth fit together. This classification utilizes the first molars and the cuspids (eye teeth) as reference points to describe and diagnose a case. This classification is also known as describing occlusion or the interdigitation of the upper and lower teeth. It does not however describe or diagnose the health or function of the TMJ (Enlow 1975, Spahl & Witzig 1991).

Functional relationships The health of the TMJ and neuromuscular system can be identified by grading the degree of joint degeneration from 1 to 4. Neuromuscular dysfunction can be graded according to the degree of over- or undercontraction through the use of electromyography.

Esthetic relationships This classification is a diagnosis of how the face appears from the front and side.

The facial balance involves one-third upper, one-third middle and one-third lower face dimensions. This classification can overlap with the dental classification in that how the teeth fit together can also be related to how the face appears from the profile view. For example:

- Class I demonstrates a normal/ideal profile
- Class II Division I: the lower jaw is recessive (posteriorly positioned)
- Class II Division II: has a bite in which the dentition of the maxilla hangs too far over the dentition of the lower – an overclosed vertical or deep bite
- Class III: the lower jaw is too far forward and generally the upper jaw is deficient anteriorly (Celic & Jerolimov 2002, Enlow 1975).

Radiographic relationships The most commonly used radiographic analysis involves the use of cephalometric X-rays (lateral head and neck), transcranial X-rays of the TMJ, CT or MRI of the TMJ/skull and panographic X-ray of the lower half of the skull.

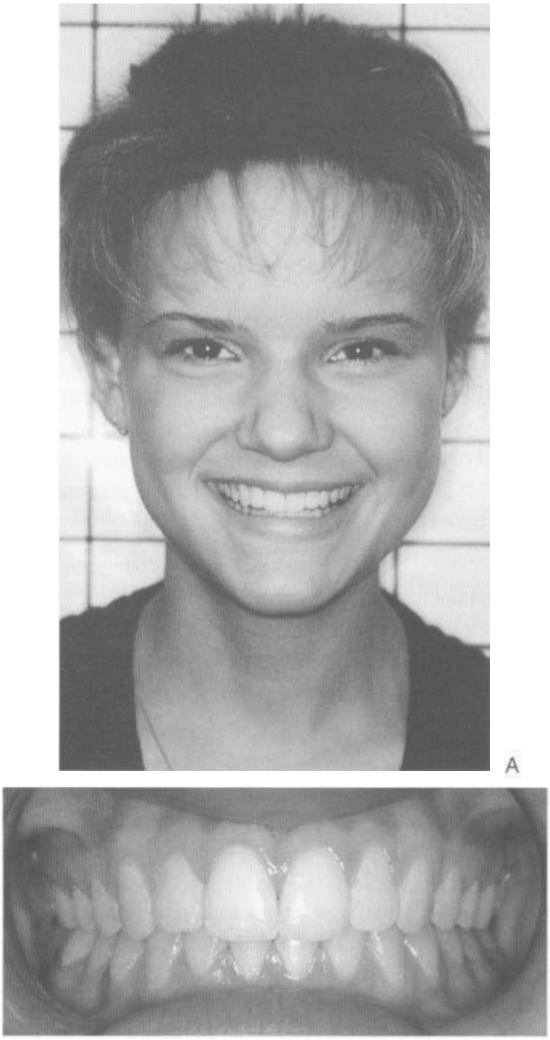
Cranial relationships There are a number of classifications which seek to explain malformations and/or malalignments of the cranial structure. A professional's ability to classify such characteristics would depend on training and background, for example in cranial osteopathy or craniosacral therapy, Howell's neurocranial restructuring, orthobionomy, sacro-occipital technique (SOT) and chirodontics. Each area of study has its own classification methods and philosophy, sometimes making it difficult to hold a meaningful cross-educational-background discussion.

Class II Division I dental relationships

Division I refers to the occasions when the upper teeth are abnormally in front of the lower teeth, commonly known as 'buck teeth'. This condition involves having a recessive lower jaw, with or without crowded teeth. This is often related to headaches, ear problems (otitis media), TMJ clicking and a narrow cranial structure (extension pattern) (Morgan et al 1982, Price 1945).

Figure 11.2A represents the facial profile of a classic Class II Division I malocclusion. Figure 11.2B shows the same malocclusion from an intra-oral view. Note the horizontal protrusion of the upper teeth (overjet). The reality is that the lower jaw is extremely retruded (recessive). In cases such as this it would be a mistake for a dentist/orthodontist to extract upper bicuspids in order to move the upper teeth backward to match the lower jaw (Carlson 2004).

Appropriate dental treatment of this problem involves widening the upper jaw with a flexible appliance, such as the Advanced Lightwire



A

B

Figure 11.1 A A post-treatment case with a normal face form. B An intraoral view of a normal overbite (vertical overlap) and overjet (horizontal overlap of the upper jaw compared to the lower jaw). In this Class I case the TMJ, tooth alignment and jaw relationship are ideal.

Functional appliance (ALF - Fig. 11.3), combined with cranial treatment to balance the mechanism. Both methods, dental and cranial, can be utilized to encourage forward repositioning of the mandible. A twin block, or Bionator, is used to further advance

A

B

Figure 11.2 A The facial profile of a classic Class II Division I malocclusion. B The same malocclusion from an intraoral view. Note the horizontal protrusion of the upper teeth (overjet). The reality is that the lower jaw is extremely retruded (recessive). In cases such as this it would be a mistake for a dentist/orthodontist to extract upper bicuspids in order to move the upper teeth backward to match the lower jaw.

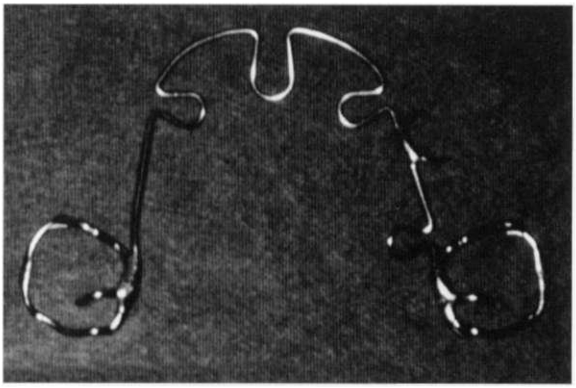


Figure 11.3 Advanced Lightwire Functional appliance.

the lower jaw and decompress the TMJ. Treatment completion may possibly involve use of fixed orthodontic appliances to bring the back teeth together, providing the TMJ with better support through proper occlusion (Nordstrom 2003, Spahl & Witzig 1991).

Class II Division II Dental relationships

This is the diagnosis that represents a deep bite where the upper teeth are both forward of the lower and severely overlap them vertically. The result is an outward facial appearance of a large lower lip that in turn causes a cleft between the lip and chin.

This condition is classified by Jecman (1998) and others as a sphenobasilar symphysis (SBS) lesion, in which the SBS junction is in a 'hyper-flexed' position (invaginated superiorly). This position tips the posterior aspect of the maxillae up and posteriorly, causing the anterior maxillae (the premaxilla) to rotate interiorly so that the tips of the front teeth incline posteriorly (see Fig. 11.4A,B). The result of this condition is that the mandible is trapped in a posterior position, with the temporal bones in external rotation (Magoun 1976).

Box 11.2 Controlled arch development and non-surgical mandibular advancement

Cranial orthopedics is a term that helps to explain how the lower jaw is able to move forward in a patient who has a posteriorly displaced mandible. The mandible cannot make drastic changes in position without involving simultaneous changes in the position, function and mobility of the temporal and other cranial bones (Baker 1971, Jecmen 1995, Magoun 1979, Morgan et al 1982).

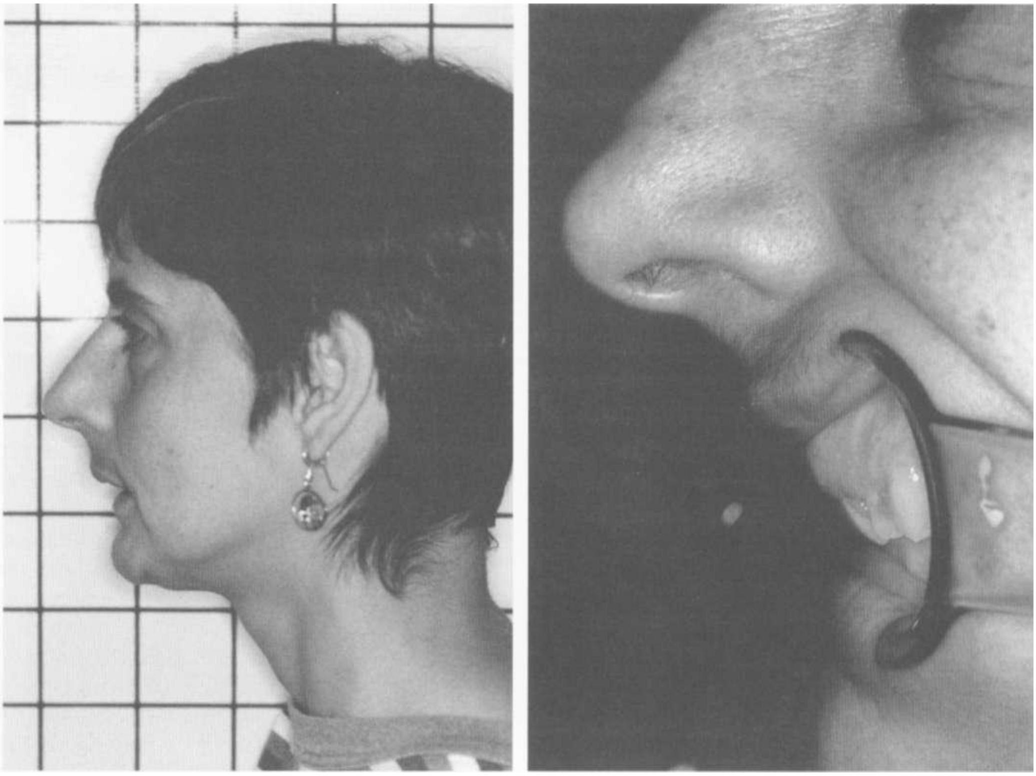
A wide variety of appliance designs have been used for many years to advance the mandible. These include the Andresson activator, Frankel Witzig orthopedic corrector, Mew orthotropics, Sved, Katsev's K-Flex, Clark's Twinblock, Nordstrom's ALF and others. All these appliances are dependent on affecting major cranial changes to accomplish their goals of mandibular advancement. Most dentists using these appliances do not fully realize the dental–cranial connection and therefore do not understand the positive impact a cranial therapist can have on assisting their progress (Zeines 2000). For example, in not adequately preparing for maxillary development, both anteriorly and laterally, the forward mandibular movement will be considerably impeded, because the maxilla is the matrix for mandibular position (Gelb 1994). If birth, general trauma or improper nutrition has restricted the normal maxillary growth and position, then the temporals, and thus the mandible, will be negatively affected (Gelb 1977, Nordstrom 2003, Price 1945).

The advantages of this form of treatment are the achievement of better face form, wider maxillae and zygomatic processes (allowing the cranial mechanism greater freedom of movement) and better forward positioning of the lower jaw (Diamond 1979a). Mechanically, this treatment also provides improved TMJ function, enhanced drainage of the sinuses and Eustachian tubes, as well as improved inner ear function, cranial motion and amplitude (Hockel 1983).

Dental treatment First, the premaxilla must be released into a more anterior position. The teeth are tilted so that the tips are not retroinclined. In other words, a type of buck tooth position is created (with the upper front teeth ahead of the lower front teeth) before the mandible and temporal bones can change position. Appliances such as the Twinblock, ALF twin block, Bionator, etc. are then used to further correct the mandibular position (Gelb 1977,1994).

Results obtained

- Correction of the SBS restriction
- Improved position of the externally rotated temporals



A B

Figure 11.4 A,B The anterior maxillae (the premaxilla) are rotated interiorly so that the tips of the front teeth incline posteriorly.

- Reduced overbite and overjet, improving face length and esthetics
- Lessened stress of the TMJ complex
- Positive changes in positioning of the neck, back and neuromuscular system (Jecmen 1998).

Any technique which mobilizes the craniosacral mechanism can assist this transformation (Smith 2000b).

Class III Dental relationships

In this diagnosis the lower jaw is seen to be in front of the upper jaw (commonly known as an underbite) - see Figures 11.5A and C. A cranial description might include a maxilla that is positioned posteriorly (recessive/pushed back), laterally constricted and anteriorly underdeveloped. Internal rotation of the temporal bones is also often seen in a Class III diagnosis (Magoun 1976).

The author provided dental treatment utilizing upper and lower ALF appliances with elastics hooked from the upper posterior to the lower anterior teeth. The elastics can encourage anterior development of the maxillae and provide a general widening effect of the upper arch (Nordstrom 2003). As shown in Figures 11.5B and 5D, the results obtained by such therapies can be excellent.

Low tongue posture (almost always present) should be addressed with special tongue retraining (myofunctional therapy) (Gelb 1977, 1994). The treatment generally includes stimulating the maxillae to become wider and positioned anteriorly. This creates more room for the tongue in the roof of the mouth.

The temporals can be further balanced with cranial therapy and improved vertical development (this adds to TMJ support) which is encouraged with the use of elastics (Spahl & Witzig 1991).

Improved TMJ function and improved esthetics of facial features can be achieved, usually without surgical intervention. When treatment is started before age 15-16 (the younger the better; 4-6 years

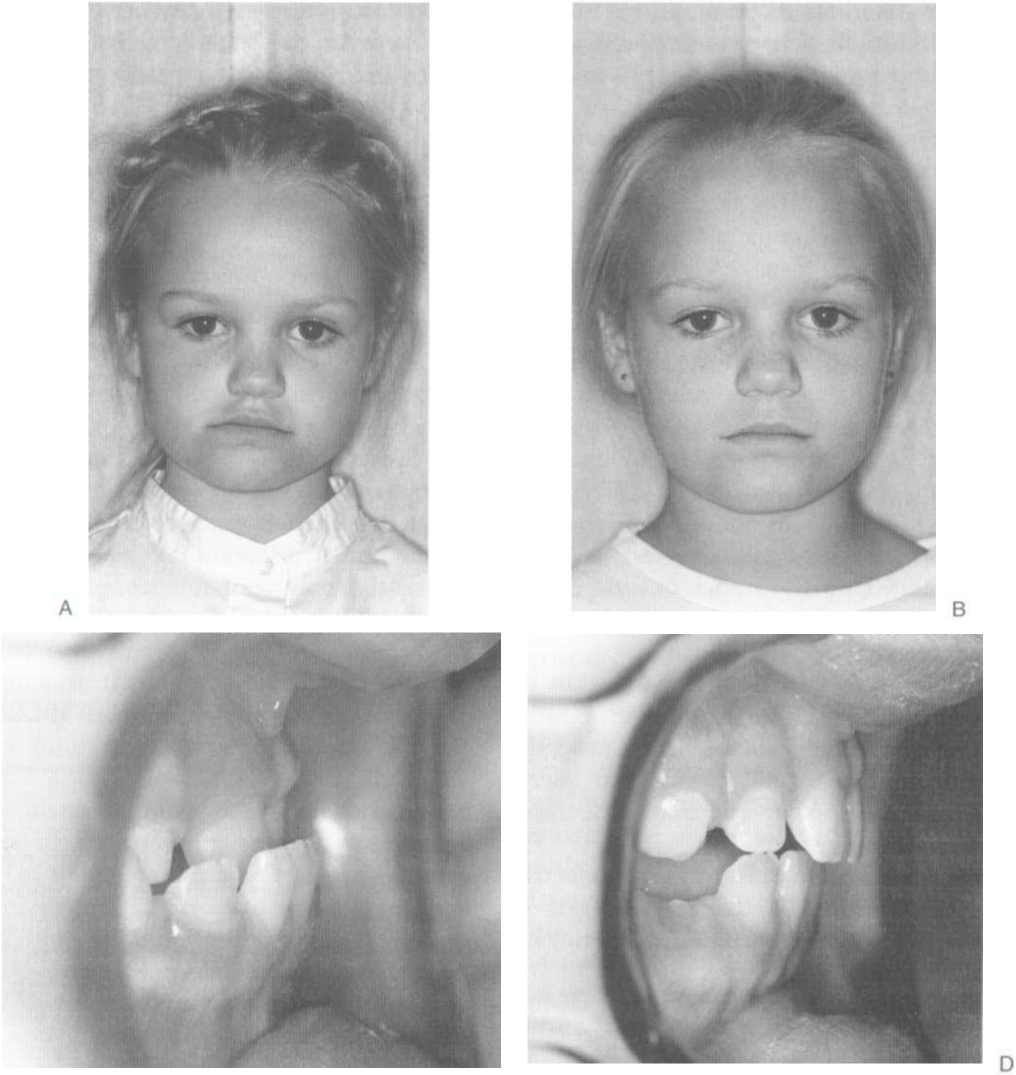


Figure 11.5 A-D Class III dental relationship. The lower jaw is in front of the upper jaw (commonly known as an underbite).

is best) the possibility of resorting to surgical or extraction therapy is greatly reduced (Page 2003, Simon 2001).

Functional jaw orthopedic FJO analysis and treatment from a cranial relationship point of view

Many varied cranial conditions are described in the literature, including sideflexions, lateral strains, vertical strains and torsions. Such dysfunctional patterns are commonly present in combinations (Nordstrom 2003). In order to demonstrate how dental orthopedics can assist in the correction of these patterns, a sidebend/vertical strain combination has been chosen.

A sidebend (sideflexion) dysfunction pattern is a cranial classification of an imbalanced cranial form. In this classification the face, when viewed from the front, appears to have one side which is wider and compressed vertically (involving external rotation of the temporal bone) with the other side appearing narrower and longer (internal rotation of the temporal bone).

Figures 11.5A and 5C show an example of this dysfunction; the right side of this patient can be seen to be compressed and the lower jaw shifted to the right.

It has been reported by numerous experts that ear problems can often be found on the internally rotated side (Frymann 1998, Fushima et al 1999, Magoun 1976). Headaches (sometimes severe) are commonly also seen in these cases, as is unilateral chewing on the internal temporal side, which creates further cranial imbalance. Tinnitis is possible in later life and its symptoms are generally located on the side of the internally rotated temporal (Magoun 1976).

Dental treatment

The upper and lower ALF appliance is used, with elastics positioned on the upper outside of the externally rotated (wide) side, down to the lower inside on the same side.

This action helps to hold the wide side by 'putting the brakes on' the maxilla, with elastics on the ALF or Crozat appliance. This causes the opposite side of the maxilla to receive lateral stimulation from the expanding appliance transfixed to it.

The internally rotated side therefore balances out and the mandible is then encouraged to correct its position by moving and rotating toward the internally rotated side (Jecmen 1995).

Cranial therapy helps to facilitate the change through mobilization of the internally rotated side, as well as normalizing functional behavior of the sphenoid, occiput and temporals (Smith 1992, Upledger 1987).

The author suggests that when changes are only made dentally (as described above), without accompanying cranial support, the rest of the craniosacral system can be left in a state of subclinical or clinical distress.

In the case of the patient seen in Figure 11.5, an immediate vertical dimension restoration was accomplished by building up the vertical support over the lower back teeth. Use of an ALF appliance widened the maxilla and elastics helped develop the maxilla anteriorly. A K-wire was anchored to the upper cuspids (eyeteeth) to further encourage widening of the maxillary arch (Katsev 2003).

By using functional jaw orthopedics to correct this type of cranial lesion, combinations of the following benefits have been reported (Diamond 1979a, Page 2003).

- Restoration of normal facial symmetry (Fig. 11.5B,D)
- Bilateral chewing
- Normalized cranial motion and CSF flow
- Improved TMJ function
- Improvement or elimination of a variety of other symptoms (physical, mental, emotional).

Examples of a sidebend pattern of dysfunction may be present in a Class I, II or III malocclusion. All lesion and strain patterns may be present in combinations, often overlaying one another. It is for this reason that cookbook, analytical and reductionist methods of diagnosis, although necessary, may lead to incomplete and limited success (Cathie 1952, Zeines 2000).

STRUCTURAL/FUNCTIONAL ASPECTS OF THE CRANIAL SYSTEM

Implications of vertical dimension

Within dentistry, vertical dimension refers to the distance between the alveolar process of the mandible and the maxilla; in other words the height of the bones and teeth from the nose to the chin. If a person has all their teeth removed, with no dentures in place, their nose would nearly touch their chin. Missing one or more back teeth or wearing dentures with inadequate vertical dimension will to a lesser degree have the effect of reducing vertical support, but less dramatically (see Fig. 11.6A).

Unless dental orthopedics, fixed or removable dentures, crowns or bridges are included in the treatment plan, reduced vertical dimension can cause disruption of neuromusculoskeletal balance. This will often result in dysfunctions that are resistant to cranial therapy.

Symptoms of vertical dimension inadequacy

Symptoms that are seen in such cases may include inner ear problems involving hearing loss, tinnitus and infections; trigeminal neuralgia; bone/tooth pain; sleep apnea; severe headaches and sinus infection (which may lead to tooth death and bone infections) (Fischer 1940, Morgan et al 1982).

It has been suggested (Morgan et al 1982, SOTO 2001) that when there is inadequate support for the TMJ, patients may exhibit irresolvable, unresponsive, structurally related TMJ pain, jugular foramen impingement with vagal nerve compression, equilibrium problems (Meniere's syndrome, Costen's syndrome), temporal artery compression and compression of occipitomastoid suture and nerves.

Results of a restored vertical dimension

When a patient's vertical dimension is restored (either temporarily with appliances or more permanently with prosthetics or by means of FJO) the TMJ is restored to proper form and function, thus reducing TMJ-related pain and condylar and/or disk displacement (Gelb 1994).

Restoration of the vertical dimension can also alleviate many underlying problems that would otherwise inhibit the effectiveness of cranial treatment.

Take as an example yawning, which involves translation of the mandibular condyles to the eminence of the glenoid fossae and a maximum opening of at least 42 mm. Structural corrections allow for this motion of yawning (as well as chewing) to improve (Jecmen 1998, Magoun 1976).

Once TMJ form and function are restored, the muscles and ligaments of the area (such as stylomandibular, stylohyoid, stylomastoid, internal pterygoid, tensor veli palatini, tensor tympani) are likely to assume normal length and tension. This reduces impingement on the vessels (lymphatic, blood and cerebrospinal), muscles and nerves in the region. An example is the vagus glossopharyngeal, its accessory nerves and internal jugular vein as they pass near and through the jugular foramen, just medial and posterior to the TMJ complex (Feeley 1988, Magoun 1976).

Once vertical dimension is restored and the condyle-fossa relationship is balanced, the temporal bones appear to experience greater freedom to resume normal internal and external rotation. Equilibrium difficulties such as Meniere's and Costen's syndromes have been reported to be related to an excessive internal rotation of the temporal bone (Magoun 1976). Restoring the tensions of the medial TMJ region, the tensor veli palatini and the tensor tympani, accompanied by relaxation of the Eustachian tube, can contribute to greater ease in the manipulation of the temporo-occipital region, as well as to greater stability once correction is achieved (Magoun 1976, 1978, Morgan et al 1982).

Figure 11.6A demonstrates a loss of vertical support due to bone resorption under the dentures. The patient's dentures were 25 years old and needed temporary relining, followed by new upper and lower dentures. Once treatment was completed the patient's facial profile was improved (see Fig. 11.6B). Headaches were eliminated for this patient following the change, in conjunction with chiropractic care and cranial therapy.

Implications of sinus function as it relates to vertical dimension

Neuromuscular imbalance, brought about by the many structural effects of an inadequate vertical dimension, results in reduced fluid flow through the sinus cavities. The resultant congestion in the sinus cavities can inhibit the beneficial effects of cranial treatment. Restoration of improved vertical dimension to the mouth, restoring proper neuromuscular balance and function to the muscles of mastication, improves the flow of fluids through the sinus cavity and allows increased freedom of sutural motion, thus increasing the effectiveness of cranial therapy.

Inappropriate (shortened) muscle length, caused by an inadequate vertical dimension, reduces the effectiveness of the masticating muscles. Proper function of those muscles appears to be largely responsible for powering the action and drainage of the sinuses (SOTO 2001).

A suggested sequence might involve the following.

Proper function

- Correct occlusion in combination with efficient mastication causes external rotation of the maxillae during chewing and swallowing.
- This creates a pumping motion that aids fluid flow in the sinus cavities.

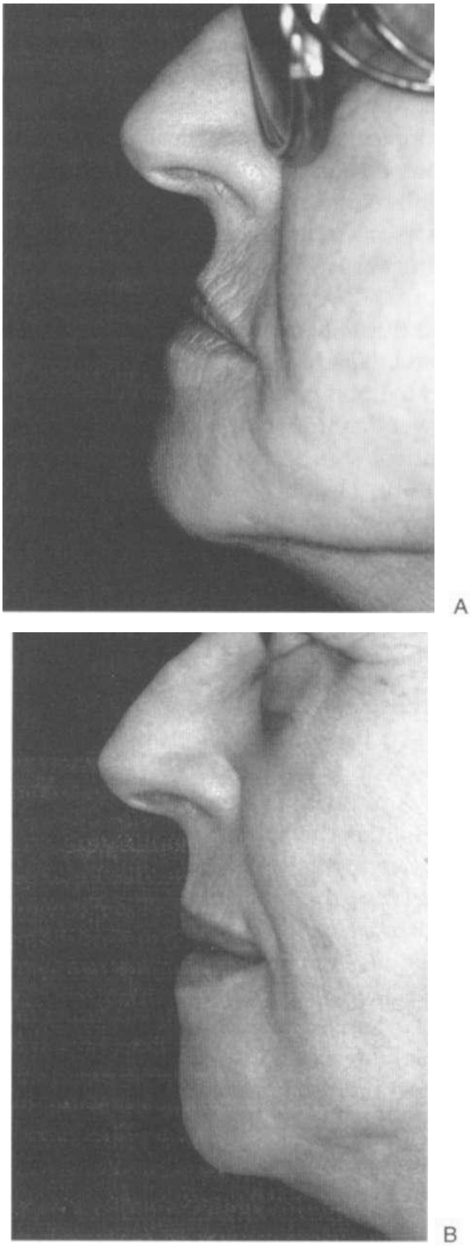


Figure 11.6 A Loss of vertical support due to bone resorption under the dentures. B The patient's facial profile was improved by the treatment.

- Decreased efficiency of these muscles results in diminished fluid flow through the sinuses.
- This reduced fluid flow may lead to increased pressures which inhibit the freedom of sutural movement, possibly limiting the effectiveness of cranial treatment.

Reduced motion of the maxillary/mandibular complex may produce a domino effect, resulting in the disruption of neuromuscular balance which in turn impacts on sinus function.

Improper function

- The resultant reduction in external rotation of the maxillae reduces function of the maxillary division of the trigeminal nerve.
- It also reduces stimuli to the cilia, resulting in less ciliary motion (Gelb 1977, Lundberg & Weitzberg 1999).
- Diminished ciliary motion moves the fluids through the sinuses less efficiently.

Normalization of bilateral chewing improves function of the maxillary sinuses, as well as other sinuses such as the nasal, frontal and sphenoidal (Fonder 1977, Gelb 1994, Page 2003, Upledger 1987).

When correction of function is accomplished in a growing patient, reduced pressures allow the maxillary tuberosity to achieve greater growth, allowing for a larger, more efficient sinus cavity (Enlow 1975, Gelb 1994).

The importance of correct airway function

Normal nasopharyngeal airway function is essential to appropriate cranial growth, TMJ health and correct mandibular positioning. Restriction of the airway, anywhere between the nose and the alveoli of the lungs, can create a number of signs and symptoms (Fig. 11.7). Long-term dysfunction of the nasopharyngeal airway can, in some cases, result in postural changes, which can further inhibit correct cranial function (Gelb 1977,1994).

A discussion of proper airway function, its effects and its presentation is not only appropriate when considering vertical support (as discussed above), but also in relation to a person's overall health. Poor dietary control (consuming foods that trigger allergic reactions), other allergies, cavitation-induced sinus infections (see later in this chapter), chronic or acute immune system disturbances (from any source) and many other causative factors can induce acute - possibly leading to chronic - nasopharyngeal airway

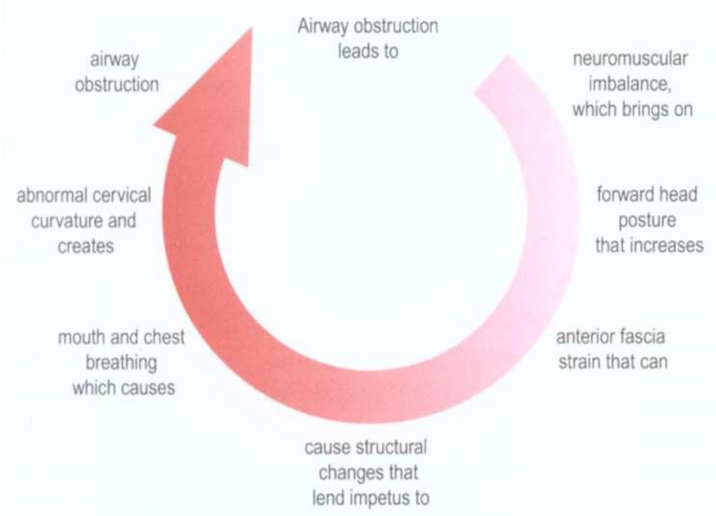


Figure 11.7 The acute/chronic nasopharyngeal airway dysfunction-postural correction-body adaptation cycle of change.

dysfunction. This dysfunction, as discussed below, can lead to serious inhibitions of cranial function (Page 2003, Rubin 2003, Stockton 1999).

Acute signs and symptoms of a dysfunctional nasopharyngeal airway (Diamond 1979b, Fonder 1990, Stockton 1999)

- Sore throat with infections
- Shoulder pain
- Middle and low back pain
- Sleep disorders
- Moodiness
- Allergies (both as cause and effect)
- Swallowing difficulties
- Ear problems
- Vertigo
- Reduced fluid flow to and from the head.

Chronic signs and symptoms of a dysfunctional nasopharyngeal airway (Char 1980, Gelb 1994, Hockel 1983, Rubin 2003)

- Increased decay of teeth and bone
- Adverse cervical curvature
- Facial deformity
- TMJ dysfunction
- ADD
- ADHD
- Bedwetting
- Crowded teeth.

Effects of functional nasal breathing

Nasal breathing may contribute to the ionization of cerebrospinal fluid through the olfactory bulb and the cribriform plate of the frontal bone (Chia & Chia 1993).

A side benefit to nasal breathing involves the relatively automatic superior and anterior positioning of the tongue. It has been suggested that this assists the flexion and extension of the sphenoid and occiput at the SBS. This may occur by way of lateral pressures at the maxillae, affecting the temporals (Gelb 1977).

Normal nasal breathing also stimulates nitric oxide (NO) production which is believed to play a vital role in regulation of blood flow (through endothelial relaxing factor - ERF), platelet function, immunity and neurotransmission. Nitric oxide seems to be produced in the paranasal sinuses, suggesting that the natural production of NO may be enhanced by improved functioning of the cranial/sinus system. If this hypothesis is correct it may explain why patients feel better when the maxillae are widened/developed and nasal breathing becomes easier (Lundberg & Weitzberg 1999).

TWO CAUSES OF DENTAL RELATED DISTRESS AND DISEASE

Cavitations: an underrated source of distress and disease in the human body

Definitions according to Dorland's illustrated medical dictionary (24th edn)

- Cavitations: the formation of caries.
- Caries: the molecular decay or death of a bone, in which it becomes softened, discolored and porous. This decay produces chronic inflammation and forms a cold abscess filled with a cheesy, fetid, pus-like liquid, which generally burrows through the soft parts until it opens externally by a sinus or fistula.
- Fistula: an abnormal passage. In effect, these definitions mean that we have necrotic material that is hidden away from sight, mainly walled off, but eventually leaking its gangrenous materials into the rest of the body (Neville et al 2002, Newman 1996).

Clinical results have demonstrated a consistent link between the existence of cavitations and the presence of many treatment-resistant diseases (Herzberg & Weyer 1998, Mattila 1993, Newman 1996, Nord & Heimdahl 1990) (see Fig. 11.8A).

Diagnosing cavitations

The presence of cavitations may be linked to a range of symptoms and the presence of recurrent and unremitting health problems suggests the possibility of cavitations. Dental assessment, including use of radiographs, electrodermal screening, applied kinesiology, CT and most accurately (and most recently) the Cavitat ultrasonograph three-dimensional imaging device, can diagnose the presence of cavitations. Treatment of these cavitations can often result in the alleviation of substantial and seemingly unrelated pain and suffering (Stockton 1998).

Symptoms which have been associated with cavitations include the following (Cutler 1999, Fischer 1940, Huggins & Levy 1999, Stockton 1998).

- Amyelotrophic lateral sclerosis (ALS)
- Angina
- Migraine
- Multiple sclerosis
- Nephritis
- Arthritis
- Asthma
- Bacterial endocarditis
- Bronchitis
- Eczema
- Epilepsy
- Gangrene
- Gout
- Herpes
- Iritis
- Neuritis
- Pain with or without referral
- Parotiditis
- Pneumonia
- Sinusitis
- Sore throat
- Trigeminal neuralgia
- Tonsillitis
- Ulcer

Diagnosis of cavitational lesions should be performed by a qualified dentist/dental surgeon using methods including the following.

- Radiographs. In this medium a cavitation is very difficult to discern. Most dentists have been trained to misdiagnose areas which we now know to be cavitations (by way of other diagnostic methods) as normal bone formation. Mainly this confusion is due to the fact that in most cases where actual cavitations are present, the cortical plate has not been compromised. Doctors seeing such X-rays only 'see' the healthy cortical plate which leads them to report an incomplete or faulty analysis of the condition. Unless the practitioner is adequately trained in this identification process the cortical plate is likely to conceal the presence of the vast majority of cavitational lesions. Figure 11.8B shows the highlighted presence of a cavitation that was identified using a combination of X-ray and Cavitat analysis.

- Electrodermal screening. Originally known as EAV (Electro-Acupuncture according to Voll), developed in the early 1950s, this technique measures electromagnetic field disturbances in the body. In the hands of a well-trained technician this type of screening can provide specific analysis of the body's health. An experienced and knowledgable practitioner can use this device to uncover the possibility of cavitations and their location, often to the accuracy of a quadrant or tooth site (Fetzer 1989, Voll 1978).

- Applied kinesiology. This method of 'asking' the body to diagnose itself was originally developed by Goodheart (Walther 1988). Despite a paucity of research validation, practitioners

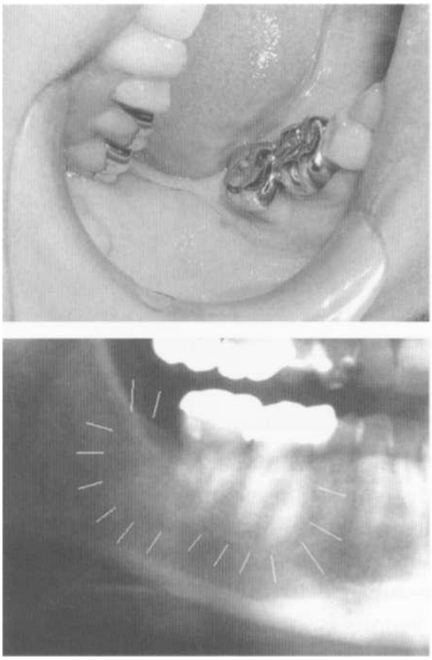


Figure 11.8 The first image (A) gives the appearance of a healthy jaw condition and X-ray analysis on its own could leave one with an inconclusive or incorrect diagnosis (B). Once diagnosed and surgical treatment is begun, the presence of cavitations becomes obvious.

who are familiar with AK claim clinical success in identifying the effects of cavitations and may use that knowledge to more accurately assess the body's responses (Gelb 1977; see Ch. 5).

- Computed tomography (CT). This X-ray based diagnostic tool provides computerized axial tomography of the skull. The higher resolution and ability to see cross-sections inside the bone make it very precise in its diagnostic abilities.
- Cavitat ultrasonograph three-dimensional imaging device. This device can provide an accurate three-dimensional image representing density changes within the alveolar process (jawbone). These density changes have been determined to accurately represent the health of the bone (Stockton 2002, Walker 2000, Zeines 2000).

Cavitations, when diagnosed with the Cavitat, may be graded on a scale of 0-4, with a 0 rating indicating normal healthy bone. A rating of 1 is the diagnosis for bone that has reduced blood/fluid flow in the examined area. 2 indicates that there is an ischemic area of bone present, which means that while the bone is probably still technically 'living' the lack of blood flow to the area is endangering its health and viability. 3 and 4 are indicative of the presence of necrotic material and the necessity for surgical intervention (Fischer 1940, Stockton 1998).

When the health of a section of bone begins to degrade and degenerate (rating of 2-3) the body identifies a growing source of toxicity and begins to defend itself by creating a hard bony layer around the toxic area. This walling off of the cavitation is what makes it difficult to identify cavitations through X-ray examination. While the toxic cavity is walled off the patient can go for extended periods of time without any indication that there is poisonous, gangrenous material in their jawbone. The growing cavitation will eventually begin leaking necrotic material into the rest of the body with potentially serious consequences (Cohen & Burns 2002, Herzberg & Weyer 1998, Neville et al 2002, Newman 1996, Price 1945).

Development of cavitations

Cavitations generally develop as a result of trauma, bacterial infection, reduced vascular activity or toxicity (Stockton 1998).

Cavitations are usually the result of one of the following (Shankland et al 2001, Stockton 1998):

- an infection the body has walled off to protect itself
- reduced blood flow resulting in dead or dying bone
- physical trauma, when the jaw is unable to heal itself.

Disease-related results of cavitations in the body

Dorland's illustrated medical dictionary (24th edn) provides a basis for a discussion of the implication of cavitations in the body.

- Metastasis. The transfer of disease from one organ or part to another not directly connected with it. It may be due either to the transfer of pathogenic micro-organisms or to transfer of cells, as in malignant tumors.

Box 11.3 Types of trauma that can lead to cavitations

Physical trauma	Bacterial trauma	Toxic trauma
Tooth extractions	Avital (dead) teeth	Root canal toxins
Root canal procedures	Infected wisdom teeth	Bacterial toxins
Dental injections	Root canal bacteria	Anesthetic vasoconstrictors
Periodontal surgery	Abscesses	Dental materials
Grinding and clenching	Cysts	Chemical toxins
Electrical trauma from dissimilar metallic restorations	Improper removal of periodontal ligament after tooth extraction	Anesthetic by-products
Heat from high speed drilling	Periodontal disease	Other toxins

- Metastases. A growth of pathogenic microorganisms or of abnormal cells distant from the site primarily involved by the morbid process.
- Metastasize. To form new foci of disease in a distant part by metastasis.

The ideas behind focal infection have been with modern medicine since 1877 with Carl Weigert's observations of a 'dissemination of "tuberculosis poison"' (Fischer 1940). Since then there have been many studies analyzing distant effects of focal infections as it has been shown that oral pathogens can infect other parts of the body (Herzberg & Weyer 1998, JADA 2002, Mattila 1993, Neville et al 2002, Newman 1996, Nord & Heimdahl 1990, Shankland et al 2001).

Treatment of cavitations

Treatment of cavitations can be accomplished by surgical removal of the cavitation lesion or non-surgical therapies designed to help the body heal itself. Though the non-surgical avenues of treatment are generally only appropriate when the lesion has not yet reached the 'necrotic' stage and is more ischemic in nature, those types of treatment can often be incorporated with surgical intervention to increase the chances of success.

Figure 11.8A gives the appearance of a healthy jaw condition and X-ray analysis on its own could leave one with an inconclusive or incorrect diagnosis (Fig. 11.8B). Once diagnosed and surgical treatment is begun, the presence of cavitations becomes obvious.

Figure 11.8C shows a first molar extraction and the beginnings of exposure of a deep cavitation at the previous third molar extraction site. Once the oral surgeon began cleaning out the cavitation it became apparent how extensive the necrosis was (Fig. 11.8D).

Non-surgical treatment of less serious cavitational lesions is an area with less documentation, less consistent results and many differing avenues of treatment (Hodgson & Hansen 2000, Tuner & Hode 1999). Some success has been achieved with treatment protocols that involve infrared pads, low-level lasers and nutritional guidelines (including enzyme therapy). The internet is a good resource for identifying alternatives in this area.

Cranial effects of cavitations

In the author's clinical experience, cavitational lesions cause reduction in the amplitude of cerebrospinal fluid fluctuation and in the overall vitality of the individual. Elimination of the cavitations should theoretically have a positive effect on neuromuscular balance and on the effectiveness of cranial therapy.

Cranial implications of intraoral metals

Evidence suggests that the presence of mercury (silver amalgam) fillings and other metals in the mouth interferes with the proper function of the nervous system (Carpi 1998, EPA 1997). Additional electromagnetic fields, produced by the presence of different metals, may lead to irritation of the nervous system. Both these factors are reported to inhibit the effectiveness of cranial therapy (Huggins & Levy 1999, Walker 2000).

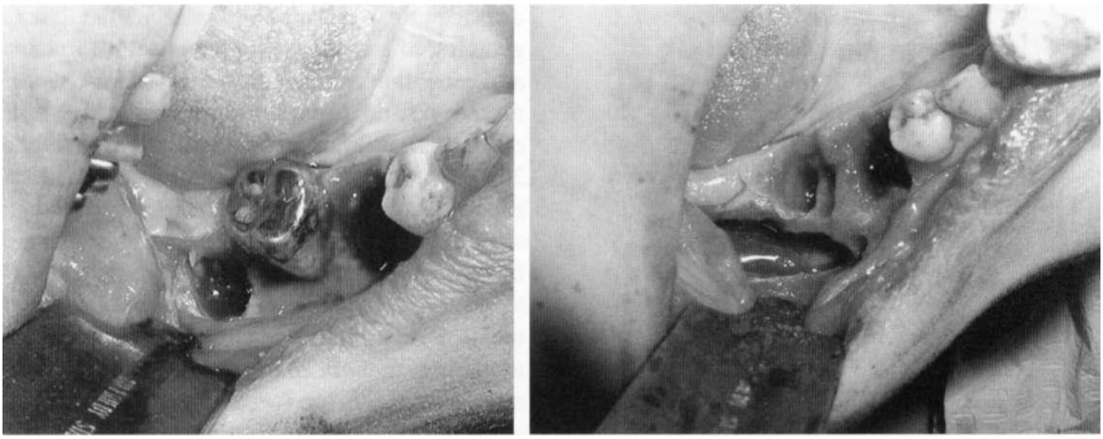


Figure 11.8 C shows a first molar extraction and the beginnings of exposure of a deep cavitation at the previous third molar extraction site. Once the oral surgeon began cleaning out the cavitation it became apparent how extensive the necrosis was (D).

Summary

Mercury is a powerful neurotoxin (EPA 1997, Simon 2001, WHO 1991).

- Mercury vapor constantly leaks from amalgam fillings, even after having been in the mouth for 20 years (Leistevuo 2001, Sellars & Sellars 1996, Zeines 2000).
- Research shows that there are three definitive genome types which determine how the body will handle the assimilation of mercury. This may explain why some people react strongly to small amounts of mercury (Cutler 1999, Ziff & Ziff 2001).
- Two or more dissimilar metals, in contact, cause a current, for example in the mouth of the patient featured in Figure 11.9A-C.
- In the mouth, restorations of differing metals (or even silver amalgam fillings done at different times) such as non-precious metal crowns, gold, stainless steel, etc., combined with saliva (an electrolyte), creates electrical currents that are far greater than those involved in normal neurological activity (Cutler 1999, Stortebecker 1985, Vimy 1999, Walker 2000, Ziff & Ziff 2001). These currents can negatively affect neurological function (Marino & Ray 1986, Neutra 2001, Thomas et al 1987).

Clinical example

The patient featured in Figure 11.9A was experiencing severe memory loss. The author's electrical tests showed very high readings between teeth, crowns, fillings and root areas. Figures 11.9B and 9C view the various metals present which, with the saliva acting as an electrolyte, were creating a flow of electrons similar to a battery (Becker & Selden 1985, Raue 1980, Stortebecker 1985). Improvement of her mnemonic abilities followed shortly after removal of the amalgam fillings and metallic crowns.

INAPPROPRIATE ORAL SURGICAL PROCEDURES

Alteration of the jaw form, structure and position without proper consideration given to the cranial mechanism can cause harmful long-term effects.

Bicuspid extraction

It is not uncommon for a dentist or orthodontist to diagnose a patient as having a tooth/jaw discrepancy (generally meaning that the jaw is not sufficiently large to accommodate the teeth that are present or erupting) (Simon 2001). Some

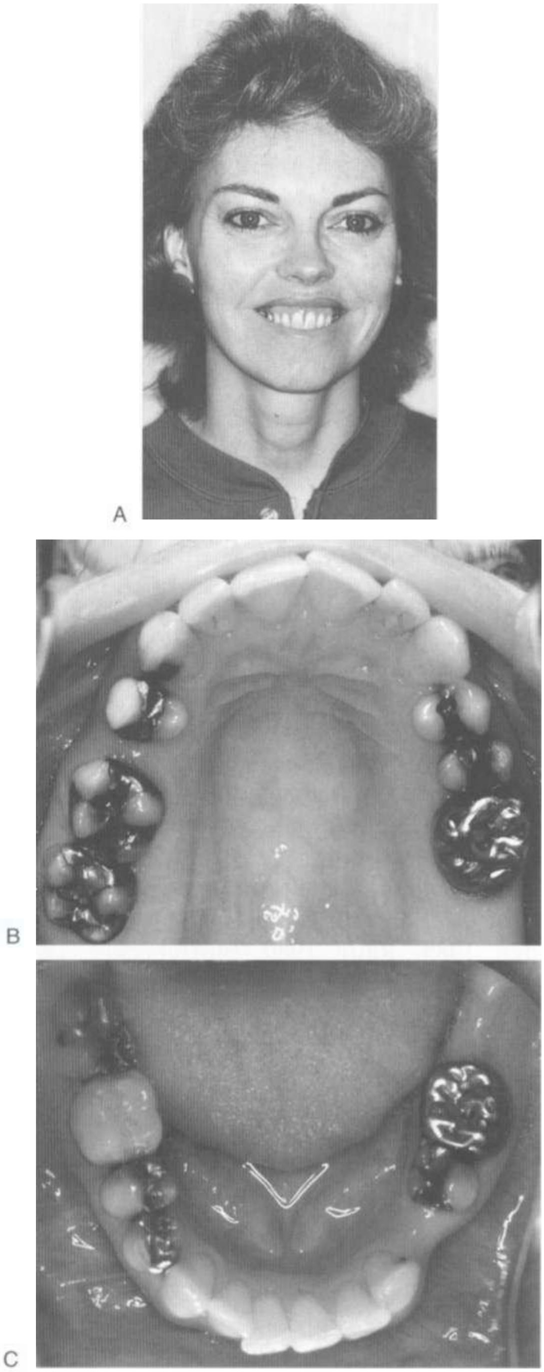


Figure 11.9 A-C Patient who experienced severe memory loss. The author's electrical tests showed very high readings between teeth, crowns, fillings and root areas. Figures 11.9B and 11.9C show the various metals present which, with the saliva acting as an electrolyte, were creating a flow of electrons similar to a battery.

orthodontic philosophies believe that jaws stop growing at a certain age, usually 11-15 years old, and after that age the only way to make room for the teeth, and to 'straighten' them, is to remove other teeth (Mahoney et al 2003, Mew 1999, Zeines 2000). In such cases referral may be made to an oral surgeon for bicuspid teeth to be removed.

Such removal leads to elimination of the normal forces on the jaw to continue its natural growth (Enlow 1975). This process often leads to the creation of more space than is actually necessary to 'straighten' the patient's teeth. Tight muscles and fascia whose forces may originally have contributed to the underdevelopment of the jaw continue to exert their force (Enlow 1975).

With no opposition, these forces may, through their constant constrictive action, force the arch to shrink to a size more appropriate for the remaining teeth (see Fig. 11.10A) (Gelb 1994, Mahoney et al 2003, Mew 1999).

This pressure is commonly increased with the orthodontic practitioner's use of braces and headgear, resulting in a posterior movement of the lower half of the face (see Fig. 11.10B) (Mew 1986, Page 2003, Spahl & Witzig 1991).

This posterior movement or 'distilization' of the maxilla (and as a result, the mandible as well) creates compression of various structures (nerves, vessels, dura, muscles, bones and fascia) between the upper front teeth and the occiput (Baker 1971, Jecmen 1998). It has been suggested that the effects of this procedure can lead to:

- depression (Hockel 1983)
- snoring (Katsev 2003)
- sleep apnea (Frymann 1998, Katsev 2003)
- vision problems (Page 2003)
- hearing difficulties (Gelb 1977)
- vocal cord nodules (Solberg & Clark 1980)
- swallowing problems (Jecmen 1995)
- TMJ dysfunction (Jecmen 1998)
- mid and low back pain (Page 2003)
- headaches (Solberg & Clark 1980)
- reduced self-esteem (Frymann 1998)
- birth/conception difficulties (Ziff & Ziff 1987)
- endocrine/growth disturbances.

The patient in Figure 11.10 is a good example of the conditions described in this section. Many of the symptoms listed here are issues she has faced.

Figure 11.10A shows the retarded growth of the upper and lower jaws, which has basically made the lower half to one-third of the face set back 8-10 mm. Functionally this has also resulted in an airway problem; esthetically the patient appears very nearly chinless.

Figure 11.10B shows a picture of two upper ALF appliances. The small one is that of the patient in Figure 11.10A, the large one belongs to her 8-year-old son. In both appliances, the 'cribs' (circles of metal that fit over the same teeth - first permanent molars in both mother and son) show an astonishing size difference. Consider the pressures that having the maxilla and mandible placed in such a posterior position must bring to bear on the rest of the cranial mechanism (Jecmen 1998). It also follows that the more teeth that are removed, the less support the TMJ receives, as vertical support is reduced.

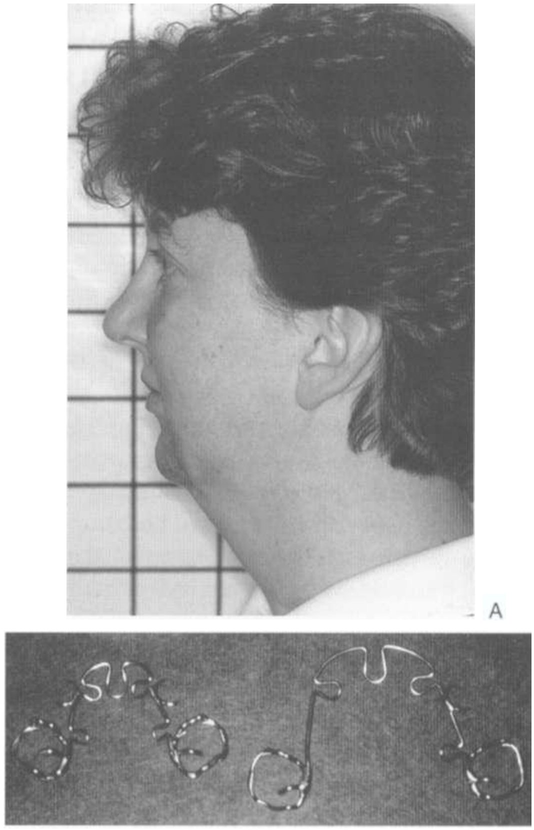


Figure 11.10 A This shows the retarded upper and lower jaws, which have in effect made the lower half to one-third of the face set back 8-10 mm. Functionally this has also resulted in an airway problem and esthetically the patient appears very nearly chinless. B Two upper ALF appliances. The small one is that of the patient in Figure 11.1 OA, the large one belongs to her 8-year-old son. In both appliances the 'cribs' (circles of metal that fit over the teeth - lower part of the appliance) fit onto the first molars. The size difference is astonishing. Consider the pressures that having the maxilla and mandible placed in such a posterior position must bring to bear on the rest of the cranial mechanism (Jecmen 1998). It also follows that the more teeth that are removed, the less support the TMJ receives, as vertical support is reduced.

Muscular imbalance

Loss of tooth mass produces neuromuscular imbalance (Page 2003, Smith 1986). Normal muscle length will now be inappropriate since the vertical distance from the upper skull (and jaw joint) to the lower jaw will have been reduced by the loss of teeth. The muscles and fascia anterior to the upper cervical spine would be altered, with potential changes in the neck curvature and occipital position. Vagal nerve compression and distress to the areas innervated by the vagus nerve can result (Gelb 1994).

Compressive effects

Some oral surgical procedures such as maxillary resection and bicuspid extraction can have compressive effects oh the maxillary sinuses as well. As mentioned previously, tooth extraction often has the negative effect of reducing jaw growth. The resultant smaller skull size manifests in compressed vertical face height (Frymann 1998, Mahoney et al 2003, Mew 1999, Upledger 1987) which, when combined with scar tissue formation, creates compromised sinus size and function (Burr Saxton 1972, Voll 1978).

Though there is no research that the author is aware of substantiating reduced nasal function as a direct result of bicuspid extraction, it has been noted in clinical practice that one frequently accompanies the other. Possibly the reduced nasal capacity precedes the bicuspid extraction and contributes to the condition that eventually is diagnosed as requiring extractions. On the other hand, it could be the extractions that result in, or contribute to, the reduced nasal function (Hockel 1983, Page 2003).

There are some instances where removal of teeth is indicated; however, appropriate FJO and cranial treatment can reduce subsequent dysfunction to a minimum.

Dental Surgery

There are a variety of situations in which surgery may be appropriately or inappropriately suggested. For example, where there is upper to lower jaw size discrepancy, incorrect positioning of jaw or jaws, improper face form, clicking of the TMJ, acute trauma, severe joint degeneration, chronic infection or reconstruction following cancer or repair of congenital anomalies (Morgan et al 1982, Neville et al 2002, Solberg & Clark 1980).

Some of these conditions may be better served by a more conservative, non-surgical technique. Each case should be evaluated individually.

The specific surgical procedure proposed by the oral surgeon depends on the diagnosis and philosophy of the surgeon. When cranial/jaw surgery takes place, the new muscle orientation is resisted by those muscles which seek to return to their previous state. This reorientation places stress on the neuromuscular system and on the cranial mechanism. A relapse rate of 40-70% has been reported in the literature (Morgan et al 1982).

Oral surgery is seldom accompanied by follow-up treatment to help adjust the cranial mechanism (Smith 1986). Appropriate or inappropriate as the surgery may be, to not relieve the stresses created by such surgery on the neuromuscular system may cause undiagnosed effects to the structure and function of the cranium and its sutures.

Jaw surgery, though sometimes indicated, can also affect the somatognathic system by creating neuromuscular disturbances, often without improving the underlying cause of the dysfunction, which may very well have been neuromuscular or craniosacral in origin. An example of this situation can be seen in Figure 11.11 (Huggins & Levy 1999). It is imperative that cranial and other neuromuscular therapy accompanies surgery of the jaw (Frymann 1998).

Figure 11.11 shows a panographic X-ray of a surgical procedure to close an anterior open bite secondary to TMJ treatment. Note the metallic parts relative to surgical realignment. The patient in this case experienced no relief from TMJ symptoms after the surgical procedure. In fact, her overall level of health declined considerably following the procedure. Her symptoms included: severe lymphatic congestion; suicidal thoughts with need for psychiatric care and antidepressants; reduced cognitive and speech abilities; partial loss of

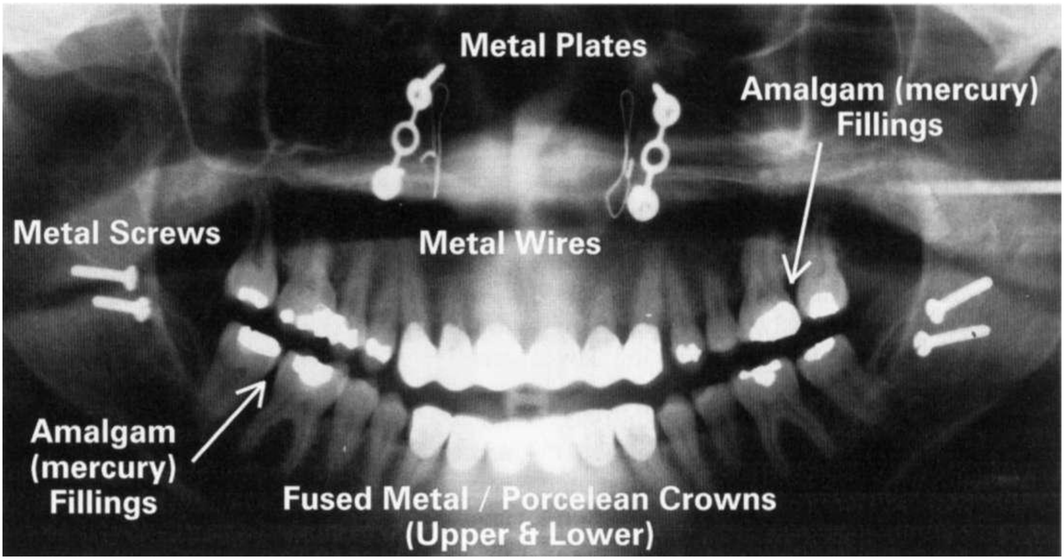


Figure 11.11 Jaw surgery can also affect the somatognathic system by creating neuromuscular disturbances, often without improving the underlying cause of the dysfunction, which may well have been neuromuscular or craniosacral in origin.

memory; and inability to smile. All symptoms and general condition improved following appropriate dental rehabilitation. Within 3 weeks this patient was off all antidepressant medication with the approval and recommendation of her psychiatrist.

Braces, bridges, dentures and other dental therapies

These can all have negative side-effects on cranial function when constrictive treatment modalities cross (fix) sutures in the maxillae or mandible. Though the number of functional sutures in the jaw bones is debated, the existence of four is generally acknowledged.

The three sutures found in the maxilla are the maxillary/midsagittal suture (the midline suture found between the two front teeth) and two premaxillary sutures (just medial to the cuspids - eye teeth).

In the mandibular area, the most widely recognized suture is the symphysis menti (also located between the two front teeth at the midline) (Gehin 1985, Magoun 1976, Simon 2001).

Though fixation, eliminating the freedom of movement, at any of these sites can have negative effects, it is most vital that the maxillary/ midsagittal suture retains freedom of motion. Fixation of this suture can lock the front of the head and reduce overall cranial motion. In some patients this may not noticeably impact on the individual's daily life but in others the effects can be serious (Smith 2000a, Laughlin 2002a, b).

If cranial motion is reduced by mechanical means, the cranial therapist may be unable to influence the resulting symptoms. Release of the fixation will, in nearly every case, instantly improve cranial function and provide the patient with instant relief of seemingly unrelated symptoms (Laughlin 2002a, b).

Bridges, braces, dentures, some appliances (e.g. rapid palatal expander) and other therapies (e.g. headgear) can all have this 'fixating' effect to some extent. While all of these therapies are esthetically and functionally important, their use in some cases can be harmful (Frymann 1998, Huggins & Levy 1999).

In the author's clinical experience the most disturbing of all these therapies is the placement of a bridge that crosses the midline maxillary suture. Some of the symptoms that this can contribute to are:

- depression (sometimes clinically)
- headaches
- feelings of claustrophobia
- irritability
- impaired reaction time
- sternocleidomastoid dysfunction
- sinusitis.

Inappropriate suture constriction caused by fixed bridges

Fixed bridges are prosthetic devices which are bonded onto two teeth in order to replace one or more teeth in between. Teeth are normally independent units, not bonded or fused together (see Fig. 11.12A,B). When a bridge is constructed and cemented in place it essentially fuses or locks a span of teeth together. This is especially restrictive when done in the front part of the mouth (crossing the midline) and inhibiting the action between the right and left maxillae.

In cases where the bridge has already been cemented and is found to be restrictive, the author's clinical experience has shown that cutting the bridge between the two front teeth provides immediate relief to the patient in the majority of cases.

In Figures 11.12A and B we see the crowns all splinted solidly together in one unit in both the maxillary anterior and the mandibular anterior, similar to what would be seen in a bridge.

Figure 11.12B also shows where the cuts in the splinted crowns were planned. These planned cuts correspond to the maxillary/midsagittal suture and two premaxillary sutures (it does not show where the cut was made for the mandibular/ symphysis menti).

Figure 11.12C shows an exterior view of the splinted crowns after the three cuts were made at the locations of the sutures. A thin diamond disk was utilized to sever these sections. The patient noticed immediate relief of cranial tension and smiled more easily. She also soon experienced a 50-70% reduction in the swelling of her hands and feet. She was referred because she had been on medical leave from her forklift job, due to an

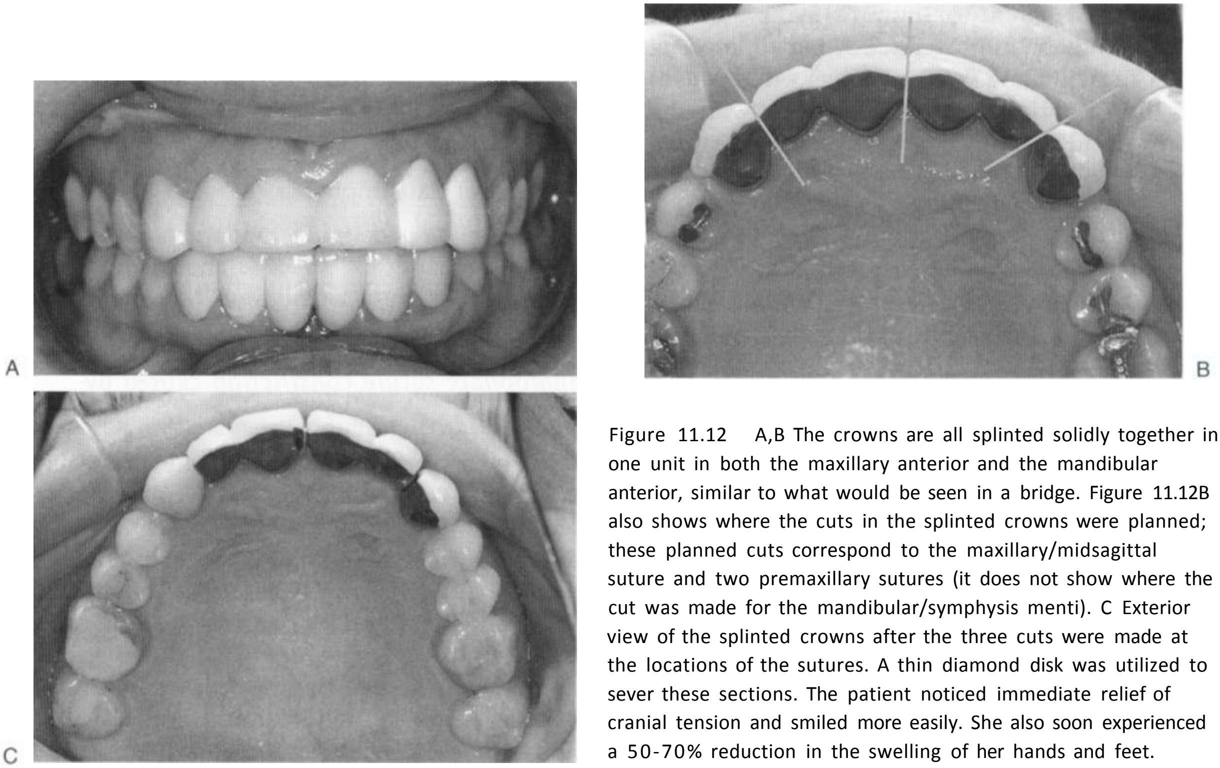


Figure 11.12 A,B The crowns are all splinted solidly together in one unit in both the maxillary anterior and the mandibular anterior, similar to what would be seen in a bridge. Figure 11.12B also shows where the cuts in the splinted crowns were planned; these planned cuts correspond to the maxillary/midsagittal suture and two premaxillary sutures (it does not show where the cut was made for the mandibular/symphysis menti). C Exterior view of the splinted crowns after the three cuts were made at the locations of the sutures. A thin diamond disk was utilized to sever these sections. The patient noticed immediate relief of cranial tension and smiled more easily. She also soon experienced a 50-70% reduction in the swelling of her hands and feet.

inability to close her hands due to the extreme swelling.

It is important to note that cutting the bridge in the mouth is like severing a bridge that crosses a river. When cut, the structural integrity of that bridge is compromised. Because of the probable benefits to the health of compromised patients, the author, in his clinical experience, will provide an option that the bridge be cut even though it could compromise the stability of the prosthesis.

Future options for the patient include the following.

- Replace the missing tooth with a removable non-metallic partial.
- Leave the 'cut' bridge in place (recementing if it dislodges).
- Insert a new (ideally non-metallic) bridge with a 'stress break' that allows sutural movement. A special attachment (called a CMA) has been developed that can be incorporated by the dental lab into the fixed bridge construction, allowing the sagittal suture of the maxilla to retain its freedom of motion (Smith 1986,2000a). This is one alternative that may solve the problem of cranial restriction for the patient.

Sutural restriction caused by fixed orthontic braces

Fixed orthodontic braces can also restrict critical sutural motion by essentially creating a complete fixation of all upper and/or lower teeth (Frymann 1998, Magoun 1976, SOTO 2001). In some patients this will not impact their daily lives but in others, the effects can be debilitating. Young adults who are faced with this problem will commonly have trouble putting words to their difficulties. For this reason it is important to evaluate the overall well-being of the patient when use of this therapy is incorporated into a treatment plan.

The greater the arch-wire thickness used for braces, the greater the restriction of motion. Because braces are sometimes necessary, if the patient is experiencing difficulty with their use, one option would be to ask the orthodontist to consider the cranial sutures in his/her treatment and to possibly reduce the period of time braces are used. Because of differences in training and philosophy, many orthodontic practitioners may be unconvinced regarding this concern. Using the ALF appliance before and during use of braces can also help to reduce the time braces are necessary and reduce the cranial restrictions.

Restricted motion of the maxilla, temporals and sphenoid can also occur with overly tight partials or dentures (Upledger 1987). Splint therapy using a rigid upper appliance (e.g. rapid palatal expander) can have similar negative effects due to its restrictive nature. In cases where these therapies could be the cause of health-compromising symptoms, it is suggested that the offending prosthetic devices be replaced with ones more conducive to sutural movement.

THE POTENTIAL BENEFICIAL INFLUENCES OF CRANIAL THERAPY

The information contained in this section is based on years of clinical practice in the field of whole-person dentistry. The author and his peers in the fields of functional orthopedics/orthodontics, biological dentistry and holistic dentistry have shared clinical experience with one another and come to the conclusions represented in this chapter. Distinct advantages can be gained when incorporating cranial techniques, such as the occipital, pterygoid and SBS release, into therapeutic dental programs.

Practically speaking, the author has accomplished orthodontic techniques with and without the benefit of cranial therapy.

The advantages of using (or referring) for cranial therapy may include improved:

- pain reduction following appliance adjustments
- amplitude and symmetry of cranial motion
- overall attitude of the patient and improved co-operation with the treatment.

Adult patients, following an orthodontic, TMJ or general dental appointment, commonly express gratitude after receipt of bilateral medial pterygoid, SBS and suboccipital release (see below), which the author performs and believes to assist in rebalancing chronic TMJ/cranial issues and some acute (iatrogenic) dental trauma following their appointment.

OCCIPITAL RELEASE

Freedom of motion and relaxation of the sub-occipital triangle appears to have broad-ranging effects. Throughout the author's 28-year career in whole-person dentistry, it has been frequently demonstrated that relaxation in this region greatly enhances the positive cranial changes which occur during the use of dental cranial orthopedics/TMJ therapy (Frymann 1998, SOTO 2001).

Clinical experience shows that the cranial release which occurs with treatment of the occiput, C1, C2 region facilitates the patient's recovery following dental appointments. Venous drainage is positively affected by this release (Frymann 1998). The author has had subjective responses from his patients reporting clearance of nasal and maxillary sinuses, ease of breathing and drainage into the throat with these procedures (Hammer 2003). It is theorized that all sinuses are positively affected, including the superior sagittal and straight sinuses. In the author's clinical practice, the person who experiences the stress of chronic TMJ/TMD, long dental appointments or dental orthopedic treatment can benefit greatly from these therapies (see Exercises 7.3 and 7.29, Ch. 7).

LATERAL AND MEDIAL PTERYGOID RELEASE

The author not only uses the internal pterygoid release following almost 90% of all dental procedures, but will often perform it before procedures are begun. The effects are marked. In this clinical setting two measurement criteria are used to determine the effectiveness of the therapy. The first is the maximum distance the mouth can open. Using this criterion, the release routinely demonstrates an average increase in jaw opening of 3-6 mm. The second criterion used to measure effectiveness is responsiveness to commands.

While in the dental chair it is common to see delays in the patient's ability to process information in the form of commands and their response to the command. Responses after the internal pterygoid release are faster and more accurate.

The lateral and medial pterygoid muscles are extremely important in TMJ and cranial dysfunction. The lateral pterygoid muscle is important in its relationship to the mandibular positioning as well as the temporal mandibular disk or meniscus positioning (Chaitow 1999, Chaitow & DeLany 2000, McCatty 1988).

The medial or internal pterygoid has its origin at the pterygoid process of the sphenoid bone and can directly affect not only the sphenoid but also the temporal, the occiput and the maxillae (Magoun 1976). The wide range of influences this muscle has on the patient's health and well-being requires it to be in a relaxed state when it is not in use. In clinical practice, the author has never found a patient with TMJ dysfunction that did not have problems with neuromuscular imbalance of either or both the pterygoid muscles. In the author's opinion it is essential that normal tone is restored to these muscles before any progress can be made in treating the orthopedic orthodontic, or TMJ, needs of patients (Laughlin 2002a, b). (See pp 282-283 for treatment methods for the pterygoids.)

In the author's opinion cranial therapists could benefit all dental patients if they were seen soon after dental treatment. This is especially true following a long operative (dental restorative) or surgical procedure(s), when the patient's musculature has been subjected to strain. Home therapy to release internal pterygoid tension prior to dental appointments is also possible.

SPHENOBASILAR SYNCHONDROSIS (SBS)

The author's clinical experience strongly supports the importance of 'balanced membranous tension' throughout the cranial structure. Marked clinical changes have been noted following techniques which are directed toward membranous/energetic/osseous mobility of the SBS. Enhanced responses to dental therapy and functional jaw orthopedics have frequently been observed following appropriate SBS treatment (Frymann 1998, Gelb 1977, SOTO 2001). The author believes that compression of this region of the cranium may relate to dental fixation between the right and left maxillae (caused by bridges, braces, etc.). It is hypothesized that releasing those fixations changes the mobilization at the SBS (Jecmen 1998).

ADDRESSING CRANIAL ORTHOPEDICS EARLY IN LIFE

Early attention brought to dysfunctional tendencies can eliminate their development later (see Fig. 11.13) (Zeines 2000).

PREVENTATIVE TREATMENT SAVES PATIENTS PAIN AND SUFFERING

A variety of symptoms and problems can be avoided later in life with early treatment consideration, including the following.

TMJ dysfunction: what it is and how it may be avoided

Some of the symptoms associated with TMJ problems in adult life (i.e. late adolescent and through adulthood) include earache, clicking/pain of the jaw, headaches, unbalanced face form, tonsillitis, pain while chewing, sinusitis, tinnitis, crooked teeth and swallowing difficulty resulting in face, neck and/or lip contortions during swallowing (Gelb 1977). It is suggested that had the patient shown in Figure 11.13 continued to develop uncorrected, she would probably have exhibited many of these signs and symptoms (Page 1949, Simon 2001).

The development of such symptoms in adult/late adolescent life can be avoided if the tendency is diagnosed and treated early. Early treatment of such tendencies, such as arch widening, jaw repositioning (through orthopedic orthodontic appliances) and/or cranial therapy, can provide positive results. The most beneficial treatment may usefully involve a combination of neuromuscular, cranial and dental orthopedic therapies. In normal clinical practice, dental orthopedics will not usually be initiated prior to the age of 4-6 though when future tendencies toward malformation are seen, 4-6 is an ideal age to begin treatment (Page 1949).

Improper growth (which can lead to considerable difficulties as an adult) is often responsive to orthopedic orthodontic techniques, especially if addressed early in life (Page 1949).

Although surgery may be unavoidable, in the author's opinion it should not be the first option considered as it may cause permanence of the skull/cranio/cervical malrelationship with the rest of the body. Scar tissue is a secondary adverse effect of surgery that may cause disruption of the functioning of the neuromuscular system (Becker & Selden 1985).

Early treatment with functional jaw orthopedics as well as identifying and eliminating the causes of the abnormal growth is paramount to the prevention of the malformation (Fig. 11.13). It is significantly more advisable to develop the jaw size at 4 years of age rather than have baby teeth extracted. There are some instances when surgery is not only important but necessary but it should be the last, not the first option explored. Seeking the alternative becomes an uphill battle where insurance reimbursement is concerned (Carter 1993). This may be another reason why dental practitioners are slow to make the shift to incorporating alternative therapies into their practices.

The five images in Figure 11.13 tell a complete story of dysfunctions corrected by FJO. No braces (fixed orthodontics) were used in this case.

Growth disturbances had been developing since birth in this case. The author began treatment very soon after the patient's first visit at the age of 7. A combination of direct bite build-ups (using composite resin, non-metallic filling material to build up the vertical of her teeth) and ALF appliances with elastics was used to produce these results by the time she was 8 years old.

Cranial therapy was used to great benefit and, in the author's opinion, enabled the results to be obtained in a shorter period of time. This patient is a prime example of a child whose situation, speaking from clinical experience, would have probably led to TMJ problems as well as many other symptoms without the treatment as described.

Posture and airway obstruction

What follows is a scenario that has been seen regularly in the author's clinical experience.

- Poor posture contributes to forward head positioning during eating, sitting, studying, working or sleeping.
- This in turn leads to airway obstruction which causes mouth breathing and resultant low tongue posture.
- If the tongue is in a Tow posture' position, it is not properly positioned up against the roof of the mouth, unable to stimulate forward and lateral growth of the maxillae.
- This lack of stimulation inevitably leads to insufficient growth and development.
- The resultant poor growth and development of the jaws will result in crowding of the teeth.
- At this point, very often the parents will be advised to remedy the situation with four bicuspid extractions and fixed orthodontics.
- This only exacerbates the underlying problems and in the end can lead to body-wide hormonal changes and neuromusculoskeletal problems (Jecmen 1998).

Treatment from a dental orthopedic viewpoint involves proper maxillary, nasal, sinus and airway development. Such cranial development assists proper tongue and head position which then translates into correct head, neck, jaw and thorax relationship (Gelb 1977). When these regions are in balance and nasal breathing is habitual, then the tongue is in correct location in the mouth (up with the tip behind the front teeth) to provide positive encouragement toward stimulation and then stabilization of the arch form (Gelb 1994). This broad maxillary form then provides a sound base for the lower jaw to function within a healthy downward and forward direction (Mew 1986). The TMJ complex appreciates this posture and mandibular position - less compression, improved circulation and less crowding of the cranial system (Gelb 1994).

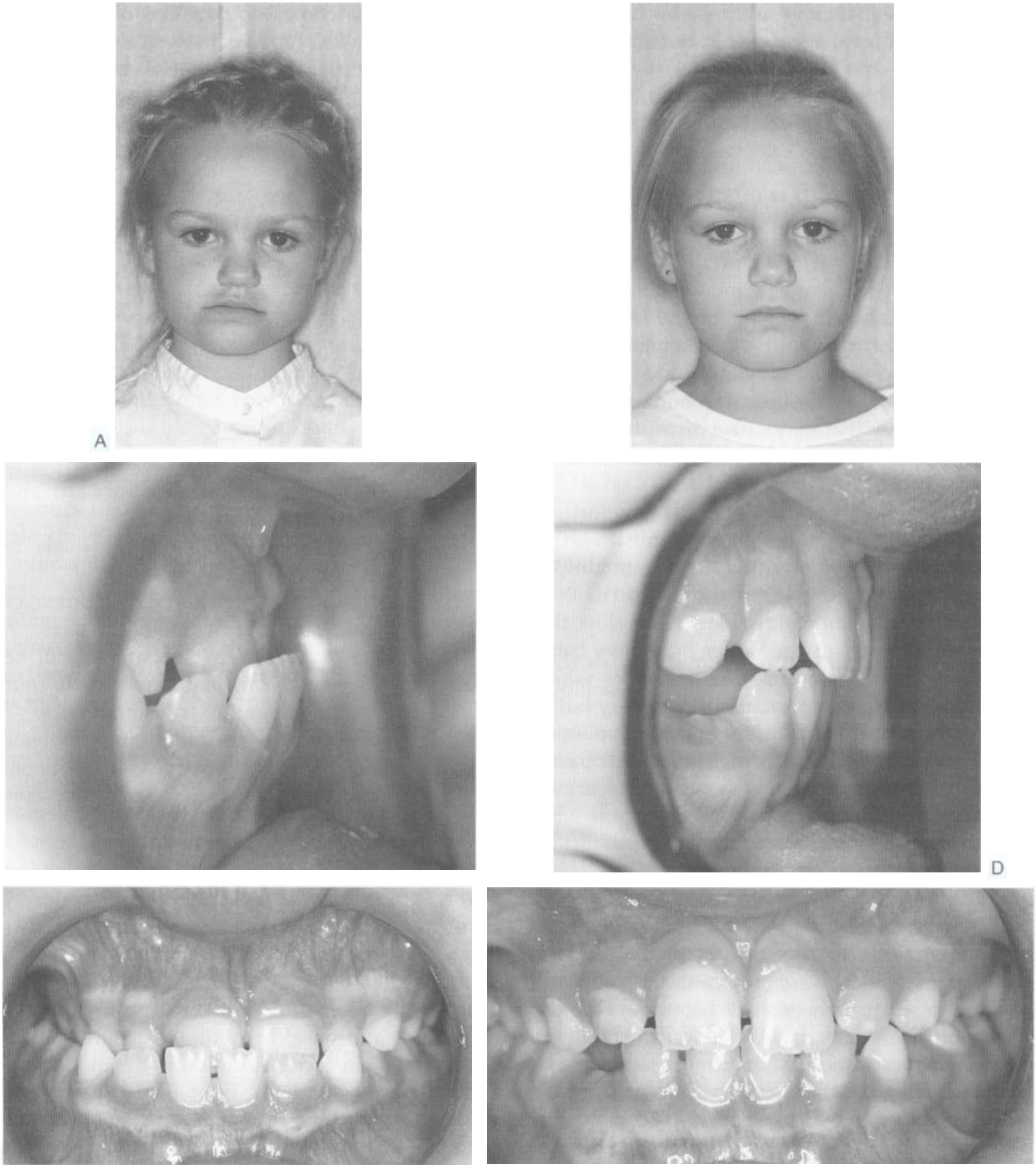


Figure 11.13A-E These images tell a complete story of dysfunctions corrected by functional jaw orthopedics. No braces (fixed orthodontics) were used in this case. Growth disturbances had been developing since birth in this case. The author began treatment very soon after the patient's first visit at the age of 7. A combination of direct bite build-ups (using composite resin, non-metallic filling material to build up the vertical of her teeth) and ALF appliances with elastics was used to produce these results by the time she was 8 years old. Cranial therapy was used to great benefit and in the author's opinion enabled the results to be obtained in a shorter period of time.

CORRECTING CRANIAL DYSFUNCTION DENTALLY

There are numerous classifications of cranial lesions which relate to the reciprocal tension membranes, motion of the cranial bones, flow of the CSF and lymph, as well as energetic blockages (Frymann 1998, Gelb 1977, Jecmen 1998).

Symptoms which are caused by cranial lesions may include headaches, ear problems (vertigo, tinnitis, otitis media), nasal congestion, sinusitis, maxillary and mandibular growth disturbance, endocrine disturbance, eye problems, swallowing problems and neck problems (Feeley 1988, Frymann 1998, Phillips 2001, Stockton 1999).

Methods of intervention using dental orthopedic techniques include: improved upper and lower jaw development; proper positioning of the maxillae and mandible relative to the sphenoid, occipital and other cranial bones as well as to each other (Jecmen 1998); establishment of proper reciprocal membrane tension within the TMJ/ cranial complex (Jecmen 1998). In the author's opinion, these objectives are best accomplished through the combined therapy of functional jaw orthopedics and cranial therapy.

Example: ear problems

Correct TMJ support and correct length of the lateral pterygoid and temporal muscles are critical to free functioning and normal drainage of the Eustachian tube (Gelb 1977, Morgan et al 1982, Simon 2001).

Children may present with a variety of signs and symptoms which alert to potential ear-related problems. These include: runny nose; frequent colds; head congestion (indicative of thickened fluids and probably allergies); mouth breathing; dry lips; mandible shifting to one side, too far forward or too far backward; or a strong habit of thumb, finger or pacifier sucking. Once these issues have been identified a multidisciplinary analysis can determine the possible consequences and an ideal treatment plan (Morgan et al 1982).

Fonder (1977, 1990) accomplished some of the research in the 1960s and 1970s regarding ear problems and vertical support. He would build up the back teeth with filling material to relieve otitis media and hearing loss. The author has found that releasing the internal pterygoid and improving vertical support are two of the most important techniques to employ. Figures 11.14A and B display a mouth-breathing patient with a developing cranial, cervical scoliosis. When treatment began she presented with extremely underdeveloped maxillary and mandibular arches. The resultant treatment brought about marked changes in posture, jaw form and jaw position (Figs 11.14C,D). Note the profile change and the ease with which the lips are able to close (facilitation of nasal breathing). Whereas before, the patient often experienced earaches and other ear problems, after the completion of treatment these problems were greatly diminished or eliminated.

EARLY OBSERVATION AND CROSS-REFERRAL

Early childhood observation and treatment, when appropriate, can eliminate or alleviate long-term symptoms and problems (Page 2003). Parental and professional attention to the criteria outlined below is critical to a timely identification and proper treatment, in order to avoid the possible development of malformations and their associated dysfunctions (Gelb 1994, Mahoney et al 2003, Mew 1999).

A list of what is required from a cranial therapist, in terms of observation, is provided below, with the suggestion that when problems are identified it may be time to consult a cranially educated dentist for further diagnosis.

Prenatal history

- Evaluate the nutrition and health of the parents. A healthy sperm and egg are the first steps toward a healthy fetus (Price 1945).
- Neuromuscular balance for the mother will help to lead to a normally functioning pelvis and birth canal (Phillips 2001).
- Magnesium consumption should ideally increase for pregnant and nursing mothers (Huggins 1981, Pierce 1994).

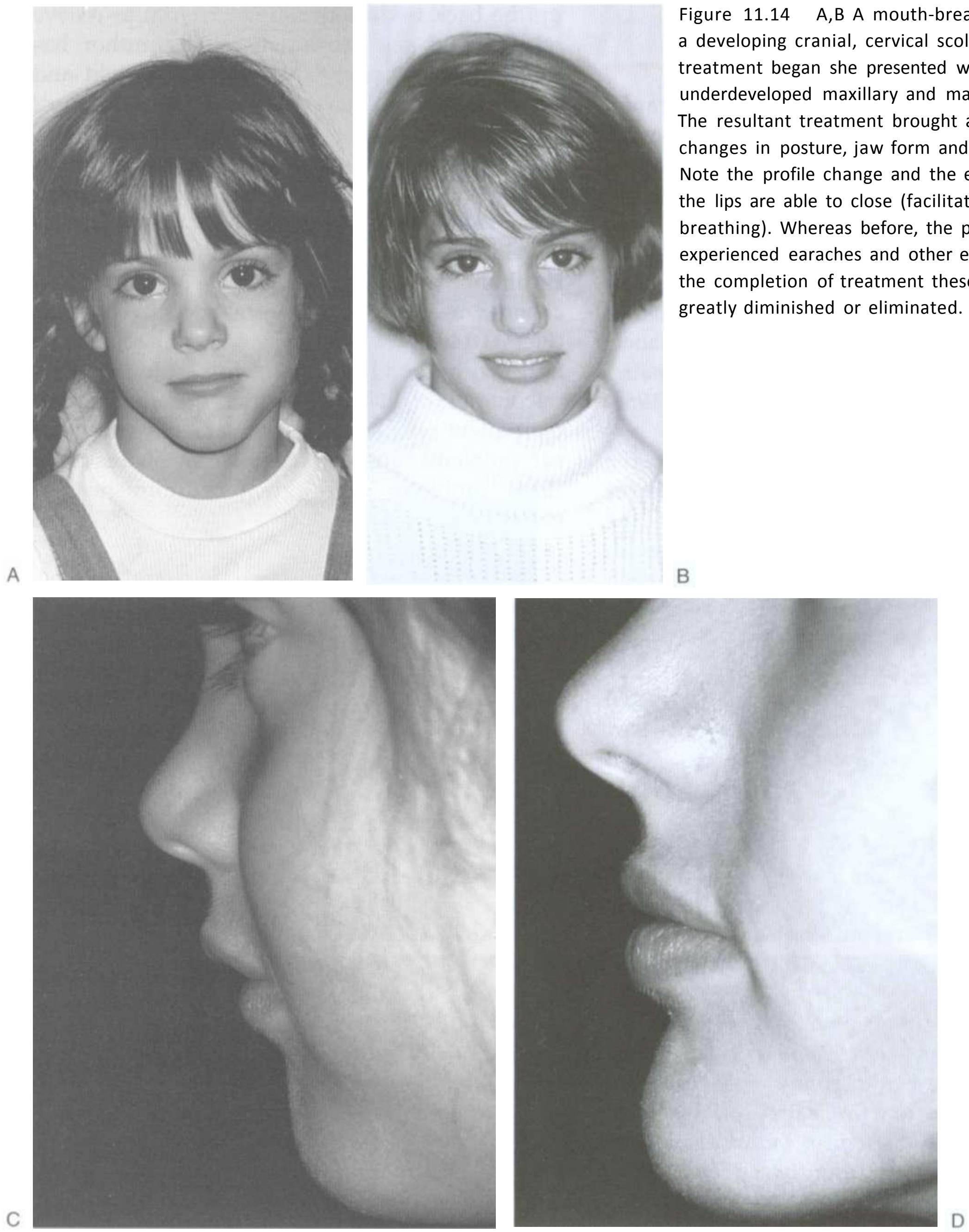


Figure 11.14 A,B A mouth-breathing patient with a developing cranial, cervical scoliosis. When treatment began she presented with extremely underdeveloped maxillary and mandibular arches. The resultant treatment brought about marked changes in posture, jaw form and jaw position C,D. Note the profile change and the ease with which the lips are able to close (facilitation of nasal breathing). Whereas before, the patient often experienced earaches and other ear problems, after the completion of treatment these problems were greatly diminished or eliminated.

Birth

- Birthing posture. Encourage ideal birth posture for the mother, avoiding being supine with stirrups, unless surgery is necessary (Northrup 1998, Phillips 2001).
- Note specifics of birth: ease, trauma (mechanical assists such as suction or forceps), length of labor, force of delivery, surgery, Apgar score (reflection of trauma) (Arbuckle 1954, Frymann 1976,1998).

- Skull shape and form at birth (often reflective of trauma) if undiagnosed, unnoticed and untreated can have developmental repercussions in the future. These repercussions can affect the esthetic and functional presentation of the mouth (Arbuckle 1948, Frymann 1976).
- For example, consider a forceps extraction delivery of the newborn. The temporal bones, as well as the maxillae, can be driven into an internal rotation. Left untreated, this would probably lead to mouth breathing, a high palate and a recessive mandible. Early cranial treatment can reduce or eliminate the future manifestation of these conditions (Arbuckle 1948, Frymann 1976, Phillips 2001).

Age 0-4

Observe (Page 2003):

- mouth versus nasal breathing
- inability to latch on/nurse easily
- irritability and pain from gas (colic)
- inability or uneasy yawning
- earaches
- swallowing difficulty
- chewing problems.

Tongue freedom There may be a need for a frenectomy for a newborn or as soon as the restricted tongue movement is diagnosed. The 'tongue tied' condition is best addressed soon after birth but in any case, the sooner the better. If the tongue is 'tied' or 'tethered' too tightly to the floor of the mouth, low tongue posture will ensue (Gelb 1977). Low tongue posture inhibits maxillary growth both laterally and anteriorly, which reduces maxillary and cranial sinus size. This can also limit development of the nasal airway and pharyngeal airway which can sequentially lead to mouth breathing; more low tongue posture; excessive lower jaw growth; TMJ compression; and TMJ dysfunction (Hockel 1983). The use of the tongue then goes between the back teeth to act as a cushion (splint) to help take pressure off the TMJ and assist neuromuscular balance to the jaws, as well as the rest of the cranial mechanism (Hockel 1983).

This illustrates a cycle that has begun and will continue until corrective measures are taken (Gelb 1977). A simple frenectomy procedure can correct the 'tongue tied' condition and reduce future difficulties (Gelb 1994). This is best accomplished by a laser technique which reduces scar tissue formation and is nearly bloodless. The healing is further enhanced by the use of a low-level laser following the surgery (Tuner & Hode 1999). The author recommends 2x/day for 7-10 days for further healing and scar reduction.

Age 2-5

An examination by a cranially astute dentist trained in functional jaw orthopedics should be scheduled to evaluate posture, nasal breathing, arch form and jaw position (Gelb 1994).

Permanent teeth begin erupting between 5 and 6 years old so if the jaws are too small, the teeth will not have room to straighten. When small jaws are present it is not unusual to see one permanent tooth, in the lower front part of the mouth, displace two baby teeth as it forces its way into the jaw (Page 2003). The ideal arrangement in the 3-5 year old is to have 1-2 mm of space between all the front baby teeth because the permanent teeth are larger so they need more room than the baby teeth.

Age 5-12

Observing overall facial structure can provide a therapist with important clues as to historical growth patterns and possible undiagnosed dysfunctions (Zeines 2000).

- A 'long' face is one that seems too long and narrow, almost stretched out. This appearance may have been caused by allergies, mouth breathing, birth trauma, flaccid muscles of mastication, trauma or incorrect height of restorative treatments which have increased the vertical dimension by too great a degree (Enlow 1975, Gelb 1994, Mahoney et al 2003, Mew 1999).
- A 'short' face is noticed by an overall appearance of compressed facial features. This can be caused by clenching or grinding of the teeth secondary to trauma or emotional/ psychological stress. Sacroiliac joint instability can also cause a TMJ clenching reflex to occur in an effort to stabilize the sacroiliac joint

(Enlow 1975, Feeley 1988, Frymann 1998, Gelb 1977).

IMPORTANCE OF MULTIDISCIPLINARY APPROACH

Multidisciplinary care can enhance the quality, efficiency, speed and effectiveness of cranial/TMJ/TMD treatment (Gelb 1971). Though more time and effort are required, the patient, therapist and doctor all benefit from the communication and joint treatment plans which result. In the words of Gelb (1977), a foremost author and proponent of these approaches, 'There is no place for intellectual isolationism in the holistic approach to the diagnosis and treatment of this clinical entity (TMJ dysfunction)'.

CONCLUSION

The strength of the cranial/dental connection cannot be overstressed. Without one or the other, the best planned treatment can fail. It is this author's opinion that cranial therapy can have immediate positive effects on the general health and well-being of any individual. This especially includes those who are medically compromised. The author believes that cranial therapy is beneficial for all dental patients and should be included in most - if not all - dental regimens. That being said, he also believes that dentistry has a powerful effect (positive and negative) on the cranial mechanism and thus, can enhance or thwart the best efforts of the cranial therapist. The body needs to be viewed as an entire structure and the dental professional (dentist, orthodontist or oral surgeon) must be encouraged to understand and consider this interrelatedness. Only in that way can he or she truly appreciate the long-term impact their choice of treatment will have on their patient's overall health and welfare. It is this author's hope that through increased education and awareness, the health professions will make a concerted effort to utilize the information in this book.

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Chapter 12

Clinical applications of cranial manipulation

CHAPTER CONTENTS

In a review of the first edition of this book Frank Pederick (2001) said, 'Chaitow has given excellent detailed information on specific cranial adjustments, but has not provided an integrated process of implementation'.

Pederick's observation was accurate, largely because there was never any intent to provide a comprehensive or integrated model for implementation of cranial methodology. The original objective of the book was to investigate the underpinnings of cranial manipulation, to evaluate the various theories and models, as well as offering a range of practical examples of cranial manipulation methods. The hope was that the reader would take from the text those aspects of the cranial concept that resonated with his/her current beliefs and would then perform any necessary integration, either by carefully practicing some or all of the methods described or by pursuing further training.

It is all too clear that individual therapists and practitioners arrive at the point of showing interest in cranial methodology from disparate backgrounds and with widely varying manual skill levels, as well as holding very diverse perspectives on issues relating to health maintenance and the treatment of ill health and dysfunction.

A PRESCRIBED MODEL OF CARE?

It is not the role of this text to attempt to impose a model of care and therefore any attempt at integration needs to come from the reader, the therapist, the individual attempting to bring cranial manipulation methods into his/her therapeutic armamentarium, alongside or in place of whatever methods are currently in use.

A reading of Chapters 3, 4, 5 and 11, in particular, will have offered a flavor of some of the beliefs and methods associated with different models of cranial therapy. Cranial approaches can be seen to range from a pragmatic integration with modern American osteopathic/medical care (Ch. 3) to extremely subtle forms of application (Ch. 4); the highly structured, virtually formulaic models of modern chiropractic cranial work (Ch. 5), as well as the elegant, functional combination of cranial methodology as it interacts with modern dentistry (Ch. 11).

Alongside these variations have been other examples, including Upledger's craniosacral therapy, von Piekartz & Bryden's (2001) practical manual therapy methods and Jones's osteopathic positional release techniques, all adding further strands to the tapestry of cranial therapeutic possibilities.

As will by now be clear to the reader who has worked through the exercises in the book, most particularly in Chapters 6 , 7 and 10, some cranial therapy involves a structural, biomechanical approach while other applications appear to operate with a degree of intuitive subtlety that is sometimes hard to rationalize, although with the recent linkage of the CRI to the Traube-Hering-Mayer oscillations, as well as the study of extremely low electromagnetic energy influences described by Oschman (2000, 2003) and characterized by the SQUID research (both discussed in Ch. 2, Box 2.5 in particular), rationalization becomes somewhat easier! Additionally, in Chapters 8 and 9 numerous examples have been described of adjunctive approaches, involving treatment of the soft tissues attaching to the cranium as well as the facial structures, as integral aspects of cranial methodology.

Examples have been given of the vast differences in belief and application of cranial

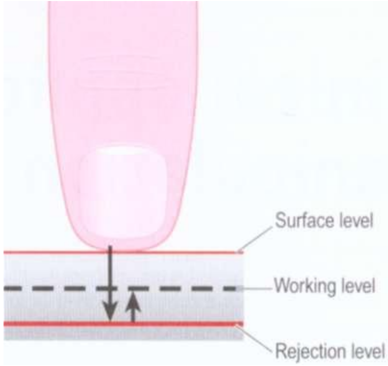

Figure 12.1 The concept of a 'working level'. Surface level involves touch without any pressure at all. Rejection level is where pressure meets a sense of the tissues 'pushing back' defensively. By reducing pressure slightly from the rejection level, the contact arrives at the working level, where perception of tissue change should be keenest, as well as there being an ability to distinguish normal from abnormal tissue (hypertonic, fibrotic, edematous, etc). (After Dr Marc Pick DC 1999)

treatment. Upledger & Vredevoogd (1983) call for 5 grams of pressure at times, while D'Ambrogio & Roth (1997) state: 'The amount of force is in the range of 1 to 2 kg (2 to 5 lbs)'.

Pick (1999), on the other hand, calls for a careful matching of manual force with the response of the tissues, in order to achieve contact at what he terms the 'working level' (much as Lief suggested in his 'meet and match the tissue tension' injunction in use of neuromuscular technique (see Fig. 12.1 and pp 141 & 380).

Under different circumstances it is certainly possible that all these recommendations may be appropriate.

A CLINICAL FORMULA

Pederick's (2001) expressed desire that an attempt be made to offer an integrated model is therefore unlikely to be met. The menu is too broad and variations in patient presentation and practitioner skill level too diverse.

Nevertheless, it should be possible (and an attempt will be made below) to offer broad suggestions as to how integration of cranial concepts and methods with other approaches might be contemplated. When challenged to describe what is aimed for in cranial (and in fact all other) forms of therapeutic intervention, the author falls back on a formula (explained in Ch. 8 and abbreviated below) that can be summarized as 'reducing the adaptive burden while attempting to improve the body's innate ability to adapt', with the objective of allowing self-regulation to operate more efficiently.

ADAPTATION AND MALADAPTATION

Conceptually it is not difficult to accept a model in which health problems emerge from a background of failure of adaptation (see notes on adaptation in Ch. 8, p. 244).

The evolution of adaptive distress is easy to conceive when slow changes emerge as a result of functional stressors having to be handled, often over a lengthy period. Postural adaptation and, as we have seen in Chapter 8, adaptation to the changes demanded by breathing pattern disorders are clear and obvious examples. Over time predictable changes occur as we move from pliable, balanced, well-toned functionality to restricted, unbalanced hyper- or hypotonic dysfunctionality, with non-compliant, trigger point-riddled muscles, manifesting fibrotic and other adaptive changes including restricted joints (see tensegrity notes in Ch. 1).

Trauma also requires adaptation. How well or poorly tissues absorb sudden blows, strains and assaults of a physical nature is just as varied as the way different individuals cope with (i.e. adapt to) emotional stress. See the notes on Fritz Smith's (1986) perception of the way the body handles trauma in Chapters 6 and 7, as well as discussion of Selye's (1956) general and local adaptation syndromes (GAS and LAS) in Chapter 8. It is suggested that particular attention be given to the notes in Boxes 8.1 and 8.2 (pp 245 and 246).

Adaptation to similar stressors - physical or psychic - will vary in rate, degree and type of compensation in different individuals, dependent on genetic features and past events. There is therefore a large element of individuality associated with how we handle biochemical, biomechanical and psychosocial stress.

The end result of adaptation, based on Selye's research (1956), involves an eventual breakdown of the ability to compensate, as the stage of collapse emerges. At this point there is just no more available elasticity, no more ability to absorb the stress demands, no further compensation potential so dysfunction, decompensation and/or frank disease or disability result.

And all this is just as true in cranial tissues as it is of tissues anywhere else in the body.

Three people with identical symptoms - say, head pain - will almost certainly have quite different histories and might also demonstrate on assessment quite different patterns of adaptive change.

- One of these individuals might be shown to have cervical and cranial restrictions and changes that are the end result of influences reaching the area from a distant site, for example a short leg problem that has resulted in adaptive modifications and stresses, telegraphed via kinetic chains to the upper body and exacerbated by particular work or leisure activities and habits of use.

- Someone else with similar symptoms might reveal adaptive changes in the neck and head region, resulting from a visual (or conceivably dental) imbalance that has produced a particular habitual head position or pattern of use, possibly exacerbated by an upper chest breathing pattern that further adds adaptive stress into the soft and articular structures of the region.

- A third individual, with very similar head and neck pain, might have been symptom free until a blow or a whiplash injury some months prior to presentation.

It is not difficult to imagine numerous other scenarios, all leading to 'head pain'.

Neither the etiological features nor the actual soft tissue or articular changes involving restrictions, shortening, etc. would necessarily be the same, or even similar, in any of these three individuals - although they might.

How then could one single prescription of care be responsibly offered for treatment of these same head symptoms, when causes and clinical features are so disparate?

The conclusion this leads to is that each person's pattern of adaptation needs to be evaluated individually and that a particular symptom cannot provide a prescription for a particular therapeutic intervention. The best that can be suggested involves guidelines, indications and contraindications, since in each and every patient therapeutic needs will differ, requiring the eliciting from the evidence of clues as to what may best assist recovery and rehabilitation.

IS THE PROBLEM FIXABLE?

Hope of recovery needs to be tempered with a strong dose of reality. Not every one, or every condition, can be restored to functional, pain-free normality. Many (probably most) conditions are self-limiting, with therapeutic input at best offering assistance or easing symptoms, as this process evolves naturally.

Some conditions are unlikely to resolve fully, even with expert attention, with a realistic expectation sometimes being of a variable degree of improvement at best.

And some conditions are almost certainly not going to improve and are more than likely to deteriorate, with the therapeutic objective being to make life as tolerable as possible during this process.

These variations can be described as conditions that are fixable, maintainable and containable. How can we know in advance which category to assign to individual patients? Much has to do with the general state of health of the person involved. Attributes such as vitality and the individual's residual potential to respond to therapeutic input need to be assessed. Often this is achieved by an almost intuitive awareness of the relative degree of vulnerability or robustness of the patient. Such 'enlightened guesswork' can, however, be extremely subjective and is not necessarily a reliable guide to the likelihood of clinical progress.

ADAPTATION EXHAUSTION

After analyzing many thousands of well and unwell individuals, Zink & Lawson (1979) identified a bias of the fascias of the body along its length, from the ground up. They termed this a common compensatory pattern (CCP). This manifested in the majority of healthy individuals (80% or so) as follows.

- With respect to the feet, the pelvic girdle is found to be rotated to the right.
- The lower thoracic outlet (diaphragm) to the left.
- The upper thoracic outlet (roughly cervico-thoracic junction level) to the right.
- The craniocervical junction to the left.

Reading down the body, therefore, Zink & Lawson claimed that 80% of healthy people had body patterns of L/R/L/R rotational preference. The other 20% of healthy individuals displayed the opposite, R/L/R/L pattern.

But what of unhealthy people, a category many of our patients would occupy? Zink & Lawson found that where decompensation had progressed to a point where no further adaptation was readily available, patterns of rotation or compensation were commonly directed in one way only (see Fig. 12.2).

Such individuals would have minimal adaptive capacity on a biomechanical level and might be expected to react negatively to major modifications (heel lift, spinal or pelvic manipulation), since compensation for changes introduced would have little chance of being achieved, increasing the likelihood of the evolution of strong reactions and new symptoms emerging.

Such patients usually require slow and gentle mobilization, tailored to their reduced adaptive capacity.

Exercise 12.1 Zink test exercise – assessment of tissue preference

Time suggested 5-7 minutes

Occipitoatlantal area The patient is supine. You stand at the head and cradle the occiput.

The head/neck is fully flexed to lock segments below C2 and the head is then carefully rotated left and right to assess the range of free, unforced motion. Register the direction of preferred motion.

Exercise 12.1 Zink test exercise – assessment of tissue preference—*continued*

In most individuals there will be a preference to rotate left.

Cervicothoracic area The patient is supine and you kneel or crouch at the head. The hands are slid under the patient's upper back, so that a scapula rests on each hand.

Using minimal leverage (by pushing down with the elbow, so raising the hand), the area can be tested to see whether its preference is to rotate left or right. The likeliest preference will be to rotate right.

Thoracolumbar area The patient is supine, you are at waist level facing cephalad with hands spread over the lower thoracic structures, fingers facing laterally along the lower rib shafts.

Treating the structure being palpated as a cylinder, the hands test the preference; this has to rotate around its central axis, one way and then the other.

The likelihood is to prefer to rotate left.

Lumbosacral area The patient is supine and you stand below waist level facing cephalad with hands on the anterior pelvic structures. Using the ilia as a 'steering wheel', evaluate tissue preference as the pelvis is rotated around its central axis.

The likeliest preference will be to rotate right.

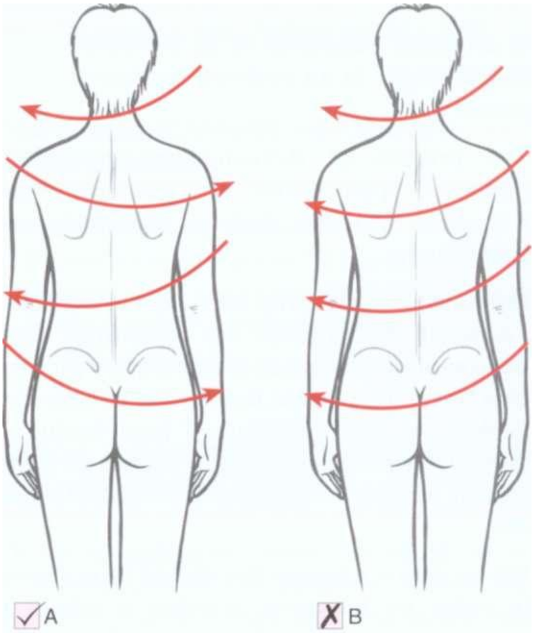

Figure 12.2 Zink's compensation patterns. (A) Appropriate/minimal adaptive compensation - alternating directions of rotational preference at key junctions indicating system to be capable of absorbing additional stresses and change. (B) Poorly compensated pattern, reduced adaptive capacity, unlikely to easily accept additional load and change.

If the Zink test proves negative, i.e. alternating rotational preferences are identified, the suggestion is that a positive outcome to appropriate treatment is far more likely, compared with someone who tests positive to the Zink test, where rotational preferences are not found to alternate.

A MODEL FOR THERAPEUTIC INTERVENTION

A logical model of care emerges from a background in which the compensation/decompensation model, as outlined above, is operating. Any form of therapeutic intervention that intends to engage the self-regulating mechanisms of the body (rather than attempting to impose solutions on these) is left with the following choices/objectives.

- To attempt to reduce or remove the adaptive demands being imposed on the individual (for example, by changing habits of use, whether functional, postural, respiratory, nutritional or other).
- To try to enhance the ability of the individual, or the local region, to handle biomechanical, biochemical and/or psychosocial adaptive demands.
- To treat symptoms.

It can be argued that *there are no other potentially beneficial therapeutic choices* and that selection of appropriate treatment methods (i.e. tailored to meet the needs and ability of the individual to respond) that have the potential to 'lighten the load' or to 'enhance adaptive capability' are the fundamentals of all successful therapeutic interventions.

How are these objectives to be achieved? Essential stages in an evolving treatment approach

- The process of devising an appropriate treatment plan calls for gathering and recording evidence, derived objectively and subjectively.
- Dysfunctional patterns need to be identified, i.e. what mechanisms are operating? Does the condition involve an inflammatory process? Infection? Neurological factors? Reflex activities? Global and local imbalances? Joint (including sutural) restrictions? Dental features? Other cranial features? Muscular or fascial changes? etc.
- Where pain is a feature this should be evaluated in order to determine whether it relates to central sensitization, reflex patterns (e.g. trigger point or facilitated segmental activity) or local factors/processes such as neural impingement, or a combination of all or any of these.
- The clinical reasoning should have as an objective the answer to the question: 'What might be producing, aggravating and/or maintaining these symptoms?'.
- The patient's own thinking regarding these questions should also be recorded.
- Part of what is being evaluated will also relate to the general background health status of the patient, including a judgment as to where the individual is in the adaptation spectrum (see notes on Zink above).
- Other factors that may be modulating or aggravating the symptoms should be considered (including biochemical - endocrine, nutritional, toxic, inflammatory, etc. - and psychological elements).
- An hypothesis as to cause(s) should emerge, along with an initial prognosis and from this a treatment/management and/or referral plan should evolve.
- The diagnosis, prognosis and treatment plan should be discussed and agreed with the patient, particularly as co-operative elements of self-care are often called for, which are more likely to be complied with if the patient gains a reasonable understanding of the mechanisms and processes involved.
- The treatment plan should be regularly reviewed (and revised if necessary), based on progress or lack of it.

BUTLER'S THOUGHTS ON CLINICAL REASONING - EMERGING FROM THE 'GRAY ZONE'

Butler (2000) has described with perception the gray area in which most manual therapy operates, despite the pressure for evidence-based approaches and what has been termed the 'outcomes movement' (Epstein 1990).

> *Most clinicians work in a world of syndromal diagnosis where the underlying pathoanatomy and pathophysiology of the syndrome is not known and neither are the risk/benefit ratios of treatment. This is common in psychiatry (e.g. major depression), in neurology (e.g. migraine headache) and very frequently in musculoskeletal medicine (e.g. thoracic outlet syndrome, myofascial syndrome, fibromyalgia). Most of us work in what has been termed 'gray zones of practice' (Naylor 1995) where all is obviously not black and white. Contrast non-specific low back pain, sitting right in the middle of the gray zone with rheumatoid arthritis for example, where the pathophysiology is reasonably well understood.*

He continues: 'At this stage, best practice clinical reasoning must be applied to traverse the gray zones; reasoning which includes, integrates and contributes to relevant evidence based work as it comes about'.

Butler has identified categories that relate to each other and which together build the reasoning process. This approach is as essential in application of cranial therapy as in any other area of manual medicine.

Clinical reasoning

- **Pathobiology:** relates to the pathobiological mechanisms (such as neurological, endocrine and central processing) that may be operating in any given syndrome or condition. Put simplistically, there are input, processing and output mechanisms in most conditions.
- **Dysfunction and sources:** refers to general, specific and psychological aspects of function and dysfunction and the sources of these such as nerve root, joint and soft tissues.
- **Contributing factors:** trauma, habits of use, psychosocial issues, etc.
- **Precautions:** red flags and contraindications.
- **Prognosis:** the identified elements suggest a positive or negative prognosis.
- **Management:** treatment protocol, emerging from what has been identified from the history, assessment, special tests and investigations.

Essential biomechanical components in this process

On the biomechanical level necessary assessment elements include the following.

- Evaluating and recording the individual's history, including past treatment interventions.
- Analyzing patterns of function and dysfunction, involving consideration of posture, balance, gait, habits of use (including respiratory function), as well as neurological and functional soft tissue features (muscle strength, length, *stamina,, firing* .sequences and *functionality,,* presence of myofascial trigger points, joint ranges of motion, etc.).
- Particular attention should be directed to the status of soft tissues attaching to, or situated on, the cranium.
- Evaluation is required of those cranial elements that can be assessed manually, via palpation and testing, including particularly sutural status and the mobility of cranial structures, as well as, for those convinced of its importance, the CRI.
- Investigation involving scans, X-rays, ultrasound, etc. may be called for.
- Identification of red flags and contraindications.

Treatment protocols and choices were outlined at the end of Chapter 9. An abbreviated form of these notes is listed below. For fuller explanations re-read the notes in that chapter (pp 321-322).

CONTRAINDICATIONS TO CRANIAL MANIPULATION

- Space-occupying lesions
- Recent major trauma to the head, particularly if there was any loss of consciousness at the time
- Stroke (cerebrovascular accident)
- History of seizures.

WHICH TREATMENT METHODS SHOULD BE CHOSEN AND WHY?

Choice of technique should be based on what is appropriate to the patient's current status (sensitive, fragile, robust, etc.) and on the clinical methods and skills the therapist/practitioner has acquired.

- The more traumatic (violent) the origin of a dysfunction, the lighter the initial therapeutic effort that should be applied.
- The more gradual the adaptation being manifested symptomatically, the greater the effort/energy input required.
- The more chronic the dysfunctional tissues have become in their adaptation, the greater the therapeutic effort required. However, this may need to be applied gradually, over considerable time. (See Box 12.1 below which contains an outline of the sort of time frame and combination of treatment and rehabilitation methods suggested (by the author) in treatment of breathing pattern disorders.)
- The more sensitive the patient, the less invasive and more indirect the treatment should be.
- The more robust the individual, the more direct the approach might appropriately be.

Thoughts on cranial treatment choices

Let us say that the patient's presenting symptoms suggest possible cranial involvement.

Box 12.1 Rehabilitation of background stressors, such as breathing pattern disorders (Chaitow et al 2002)

Note: These recommendations are based on the clinical experience of the author and have not necessarily been validated by research trials, although Lum (1984) reported that more than 1000 anxious and phobic patients were treated using breathing retraining, physical therapy and relaxation. Symptoms were usually abolished in 1–6 months with some younger patients requiring only a few weeks. At 12 months 75% were free of all symptoms, 20% had only mild symptoms and about one patient in 20 had intractable symptoms.

If there is evidence of a disturbed breathing pattern (see Ch. 8) it is important to commence rehabilitation before attempting cranial correction (the same is true of postural patterns that may be creating repetitive adaptive demands on already distressed tissues and structures, including cranial).

Treatment involving breathing pattern retraining calls for not less than 12 weekly sessions, followed by treatment every 2–3 weeks, for approximately 6 months. Initially two sessions weekly may be appropriate. It is important for an educational component to be included at each session.

First 2 weeks (ideally four sessions)

- Release and stretch upper fixators/accessory breathing muscles and give attention to active trigger points.
- Focus on diaphragm area to normalize anterior intercostal muscles, abdominal attachments to the costal margin, quadratus lumborum and psoas, plus attention to active trigger points in these.
- Breathing retraining: pursed-lip breathing method, together with methods to reduce tendency for shoulder rise on inhalation.

Weeks 3 and 4

- As above, plus mobilization of thoracic spine and rib articulations.
- Address fascial and osseous links (cranial, pelvic, lower extremity).
- Retraining: antiarousal breathing pattern; specific relaxation methods (autogenics, visualization, meditation, etc.), stress management.

Weeks 5–12

- As above, plus focus on other influences (ergonomics, posture).
- Retraining: additional breathing, stretching, toning and/or balance exercises, as appropriate.

Weeks 13–26

- Review and treat residual dysfunctional patterns/tissues, plus nutritional status, psychosocial issues.
- Focus on adjunctive home application methods: hydrotherapy, tai chi, yoga, Pilates, massage, etc.

Symptoms might point to this clearly, for example obvious cranial and/or facial pain or dysfunction (problems of head, facial or jaw pain and/or dysfunction and/or oral, ocular, vestibular, nasal or some other obviously cranially associated structure or function).

Or subtle symptoms might suggest the possibility of cranial involvement (such as a condition linked to disturbed autonomic nervous system function, potentially involving almost any functional musculoskeletal and/or visceral disturbance) (Ferguson 1991).

Whatever leads to the investigation of cranial involvement, assessment requires at least the following, summarized by the acronym ARTT. Following observation (see Exercises 6a and 6b in Ch. 6), sutural palpation should be performed, seeking evidence of:

- some degree of asymmetry (A)
- and/or an altered motion potential (R, for range of motion)
- and/or abnormal tissue texture (T)
- and/or sensitivity to light pressure (T, for tenderness). See Pick's 'working level pressure', mentioned earlier in this chapter (and in Ch. 6), regarding the degree of lightness of touch required on cranial palpation.

In addition, the following should be undertaken.

- Palpation of the cranial rhythmic impulse (CRI). Whether or not this is perceived as a primary 'motor' or as a by-product of pulsating fluid activity possibly associated with cranial motion, it represents a feature that can be monitored, the rate of which seems to be linked to autonomic nervous system behavior

(Bernardi et al 2001, McPartland & Mein 1997, Nelson et al 2001). See Chapter 2 for discussion of CRI and the Traube-Hering-Mayer (THM) oscillations, as well as the exercises between Chapters 2 and 3 - Exercises 8, 9 and 10 - describing CRI palpation.

- Careful testing for freedom of movement at the sutures and between given bones, using any of the numerous examples described in the exercises in earlier chapters, for example the kinetic sutural palpations described in the Exercise section between Chapters 2 and 3 (Exercises 7a-e); the 'spring tests' (Ch. 6, Exercise 6.4); the various compression and decompression tests (Ch. 6, Exercise 6.5a); shunt tests (Ch. 6, Exercise 6.5b); rotation tests (Ch. 6, Exercise 6.5c); and/ or motion at the sphenobasilar synchondrosis (Ch. 6, Exercises 6.6 and 6.7). A great many other examples have been given of specific test (and treatment) options, relative to the individual bones of the skull, as described and illustrated in Chapter 7.

Upledger's cranial assessment

Upledger (2000) describes a craniosacral evaluation as follows:

> *This is a physical examination designed to assess the degree of restriction to motion present in each of 19 motion patterns associated with the cranio-sacral system and, in particular, related to the occiput, temporal bones, sphenoid, basilar joint and sacrum. Range of motion, bilateral equality and ease or restriction to motion, as initiated by the examiner, are evaluated.*
>
> *Additionally, the cranial rhythmical impulse, an involuntary physiologic and rhythmic pulse of the craniosacral system, is measured.* (Upledger 1977,1978)

Choices Once it has been established that a palpable cranial 'restriction' or area of dysfunction exists, treatment choices are numerous.

- Associated soft tissues should be normalized as far as possible (releasing and relaxing muscles attaching to the cranium).
- Patterns of use that add stress to these tissues should be reduced, whether this involves attention to postural and/or respiratory features, fascial chains, auditory or visual imbalances that might be causing altered head positioning and/or psychosocial issues (chronic anxiety, for example) that might relate to modification of neurological or circulatory functions, etc.
- Pelvic and spinal imbalances and restrictions should be treated. Whether or not the implied connection between cranium and sacrum is accepted in its 'cranial' sense, there are obvious adaptations to pelvic dysfunction that affect the spine as a whole and the cranium that sits on top of it. In the author's experience, many (most) spinal and pelvic restrictions can be satisfactorily normalized using positional release (PRT) and muscle energy (MET) approaches, together with other soft tissue methods (Chaitow & DeLany 2000, 2002).
- Direct or indirect methods can be used to modify sutural restrictions (reduced motion of identified cranial bones), for example using the V-spread (Exercise 7.6) or positional release approaches described in Chapter 10 or any of the numerous specific methods to assist release of restrictions of the bones of the cranium, jaw and face, as described particularly in Chapters 7 and 8.
- For general circulatory (venous sinus) enhance-ment, methods such as are described in Exercise 6.10, as well as fourth ventricular compression (4VC) approaches (Ch. 7, Exercise 7.5a-d).
- It is also possible to assist lymphatic drainage from the cranium and if this is an objective, a variety of methods have been outlined, for example in Exercises 7.10 and 7.11 dealing with treatment of the ethmoid. General lymph flow enhancement is thought to result from 4VC treatment (see above).
- As discussed in Chapter 2, there appears to be a process of entrainment ('the integration or harmonization of oscillators') that takes place when a quiet, focused practitioner engages the cranium appropriately, for any length of time, resulting in a tendency towards normalization of CRI rhythms and autonomic function (McPartland & Mein 1997).

- This brief list of examples is not meant to be exhaustive but merely to offer a sense of the wide range of choices that exist and the ways in which they might be selected, as part of a comprehensive approach, rather than in isolation.

It is important to hold on to the one absolute in all therapeutic endeavor: the realization that self-regulation operates constantly and that reduction in load (see notes on adaptation earlier in this chapter), as well as enhanced functionality (allowing for better handling of load), will *automatically* create an environment in which self-regulation can operate more effectively.

The corollary to this thought is that it is all too easy to overload the adaptive mechanisms and functions. The more fragile, the more vulnerable, the more unwell an individual, the less that should be done at any one treatment session, in order to avoid overloading the adaptive potentials that remain.

If a sense of confusion emerges from the plethora of choices, a simple, non-invasive model of cranial treatment can be considered. Tissues can be gently eased toward the direction of greatest ease (see Pick's 'working level' notes earlier in this and in Chapter 6 for a sense of how much pressure to use). No specific 'diagnosis' is necessary, simply a sensing of an asymmetrical difference in freedom (ease) of movement between cranial bones. Holding tissues in their ease direction(s) eventually creates a 'still point' (see the discussions associated with Exercise 7.5, Ch. 7). On release of the tissues held in this way, an improvement of range/freedom of movement should be readily noticed.

SOFT TISSUE DYSFUNCTION CHOICES RELATIVE TO CRANIAL TREATMENT

Over a period of weeks or months:

- any shortened postural muscles attaching to the cranium should be released and lengthened using NMT, MET or myofascial release
- trigger points should be deactivated/eliminated sequentially (see notes at end of Ch. 9 for more detail)
- local dysfunctional structures, e.g. within the oral cavity, should be treated sensitively
- global patterns of fascial involvement should be addressed (lower extremity, pelvis, etc.)
- after soft tissues have received appropriate attention, any relevant joint restrictions (e.g. cervical) should be treated
- cranial and facial structures should then be addressed as required, using methods outlined in the various exercises throughout the text
- symptomatic relief for cranial pain can commonly be offered using positional release methods, as outlined in Chapter 10.

CONCLUSION

The body is unequivocally a combination of integrated systems and mechanisms. The fascial structures of the cranium (reciprocal tension membranes) are linked directly to the fascial structures of the feet and to all fascia and therefore all other soft tissues and bones that lie between the head and the feet.

In earlier chapters the cranial mechanisms have been described, as have numerous assessment and treatment methods capable of addressing associated dysfunctional cranial features. A clear message emerges: that the cranium should be considered alongside overall musculoskeletal evaluation of patterns of dysfunction, even when symptoms are not obviously linked to it.

It makes little sense to assess, and to treat as appropriate, everything between the feet and the atlas and to ignore the potential for therapeutic benefit offered by incorporating the cranium into a comprehensive assessment (and if necessary, treatment) protocol.

It makes even less sense to focus therapeutic attention solely on the cranium!

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Appendix 1

Soft tissue manipulation fundamentals

APPENDIX CONTENTS

NEUROMUSCULAR TECHNIQUE (NMT) (Chaitow 2003) (with example of NMT treatment of the mimetic, palatine and tongue muscles: see Box A1.1)

- NMT aims to produce modifications in dysfunctional tissue, encouraging a restoration of normality, with the primary focus of deactivating focal points of reflexogenic activity such as myofascial trigger points.
- An alternative aim of NMT is to normalize imbalances in hypertonic and/or fibrotic tissues, either as an end in itself or as a precursor to rehabilitation.
- NMT relies on physiological responses involving neurological mechanoreceptors, Golgi tendon organs, muscle spindles and other proprioceptors, in order to achieve the desired responses.
- Insofar as they integrate with NMT, other means of influencing such neural reporting stations form a natural set of allied approaches, including positional release (SCS - strain/counterstrain) and muscle energy methods (MET - indeed, many European practitioners speak of MET as 'NMT' (Dvorak & Dvorak 1984).
- Traditional massage methods which encourage a reduction in the retention of metabolic wastes, and which enhance circulation to dysfunctional

tissues, are included in this category of allied approaches (Rich 2002).

- NMT can usefully be integrated in treatment aimed at postural reintegration, tension release, pain relief, improvement of joint mobility, reflex stimulation/modulation or sedation. There are many variations of the basic technique as developed by Stanley Lief and his cousin Boris Chaitow, the choice of which will depend upon particular presenting factors or personal preference. Similarities between some aspects of NMT and other manual systems should be anticipated since techniques have been 'borrowed' from other systems where appropriate (Chaitow 1992).
- NMT can be applied generally or locally and in a variety of positions (sitting, lying, etc.). The order in which body areas are dealt with is not regarded as critical in general treatment but is of some consequence in postural reintegration.

The methods described are in essence those of Stanley Lief and Boris Chaitow, both of whom achieved an unsurpassed degree of skill in the application of NMT. Boris Chaitow (personal communication, 1983) has written:

> *The important thing to remember is that this unique manipulative formula is applicable to any part of the body for any physical and physiological dysfunction and for both articular and soft tissue lesions.*
>
> *To apply NMT successfully it is necessary to develop the art of palpation and sensitivity of fingers by constantly feeling the appropriate areas and assessing any abnormality in tissue structure for tensions, contractions, adhesions, spasms.*
>
> *It is important to acquire with practice an appreciation of the 'feel' of normal tissue so that one is better able to recognize abnormal tissue. Once some level of diagnostic sensitivity with fingers has been achieved, subsequent application of the technique will be much easier to develop. The whole secret is to be able to recognize the 'abnormalities' in the feel of tissue structures. Having become accustomed to understanding the texture and character of 'normal' tissue, the pressure applied by the thumb in general, especially in the spinal structures, should always be firm, but never hurtful or bruising. To this end the pressure should be applied with a 'variable' pressure, i.e. with an appreciation of the texture and character of the tissue structures and according to the feel that sensitive fingers should have developed. The level of the pressure applied should not be consistent because the character and texture of tissue is always variable. These variations can be detected by one's educated 'feel'. The pressure should, therefore, be so applied that the thumb is moved along its path of direction in a way which corresponds to the feel of the tissues.*
>
> *This variable factor in finger pressure constitutes probably the most important quality a practitioner of NMT can learn, enabling him to maintain more effective control of pressure, develop a greater sense of diagnostic feel, and be far less likely to bruise the tissue.*

Compare this description involving 'variable' pressure with that of Pick in Chapter 12, where he describes the 'working level' used in cranial therapy - see Figure 12.1.

NMT thumb technique

- Thumb technique as employed in NMT in either assessment or treatment modes enables a wide variety of therapeutic effects to be produced. The tip of the thumb can deliver varying degrees of pressure via any of four facets: the very tip may be employed or the medial or lateral aspect of the tip can be used to make contact with angled surfaces. For more general (less localized and less specific) contact, of a diagnostic or therapeutic type, the broad surface of the distal phalange of the thumb is often used.
- It is usual for a light, non-oily lubricant to be used to facilitate easy, non-dragging, passage of the palpating digit.
- For balance and control the hand should be spread, tips of fingers providing a fulcrum or 'bridge' in which the palm is arched in order to allow free passage of the thumb towards one of the fingertips as the thumb moves away from the practitioner's body.

- During a single stroke, which covers between 2 and 3 inches (5-8 cm), the fingertips act as a point of balance while the chief force is imparted to the thumb tip via controlled application through the long axis of the extended arm of body weight. The thumb therefore never leads the hand but always trails behind the stable fingers, the tips of which rest just beyond the end of the stroke.
- Unlike many bodywork/massage strokes, the hand and arm remain still as the thumb, applying variable pressure, moves through its pathway of tissue. The extreme versatility of the thumb enables it to modify the direction of imparted force in accordance with the indications of the tissue being tested/treated.
- As the thumb glides across and through those tissues it becomes an extension of the practitioner's brain. In fact, for the clearest assessment of what is being palpated the practitioner should have the eyes closed so that every minute change in the tissue can be felt and reacted to.
- The thumb and hand seldom impart their own muscular force except in dealing with small localized contractures or fibrotic 'nodules'. In order that pressure/force be transmitted directly to its target, the weight being imparted should travel in as straight a line as possible, which is why the arm should seldom be flexed at the elbow or the wrist by more than a few degrees.
- The positioning of the practitioner's body in relation to the area being treated is also of the utmost importance in order to facilitate economy of effort and comfort. The optimum height vis-a-vis the couch and the most effective angle of approach to the body areas being addressed must be considered and the descriptions and illustrations will help to make this clearer.
- The degree of pressure imparted will depend upon the nature of the tissue being treated, with a great variety of changes in pressure being possible during strokes across and through the tissues.
- When being treated, the patient should not feel strong pain but a general degree of discomfort is usually acceptable as the seldom stationary thumb varies its penetration of dysfunctional tissues.
- A stroke or glide of 2-3 inches (5-8 cm) will usually take 3-5 seconds, seldom more unless a particularly obstructive indurated area is being dealt with. If reflex pressure techniques or ischemic compression are being employed, a much longer stay on a point will be needed but in normal diagnostic and therapeutic use the thumb continues to move as it probes, decongests and generally treats the tissues.
- It is not possible to indicate the exact pressures necessary in NMT application because of the very nature of the objective which, in assessment mode, attempts precisely to meet and match the tissue resistance, to vary the pressure constantly in response to what is felt. (Compare this description with that of Pick in Chapter 12, where he describes the 'working level' used in cranial therapy - see Fig. 12.1.)

In subsequent or synchronous (with assessment) treatment of whatever is uncovered during evaluation, a greater degree of pressure is used and this will vary depending upon the objective - whether this is to inhibit, to produce localized stretching, to decongest and so on. Obviously on areas with relatively thin muscular covering the applied pressure would be lighter than in tense or thick, well-covered areas such as the buttocks.

- Attention should also be paid to the relative sensitivity of different areas and different patients. The thumb should not just mechanically stroke across or through tissue but should become an intelligent extension of the practitioner's diagnostic sensitivities so that the contact feels to the patient as though it is sequentially assessing every important nook and cranny of the soft tissues. Pain should be transient and no bruising should result if the above advice is followed.
- The treating arm and thumb should be relatively straight since a 'hooked' thumb, in which all the work is done by the distal

phalange, will become extremely tired and will not achieve the degree of penetration possible via a fairly rigid thumb.

NMT finger technique

- In certain localities the thumb's width prevents the degree of tissue penetration suitable for successful assessment and/or treatment and the middle or index finger can usually be suitably employed in such regions.
- The most usual area for use of finger rather than thumb contact is in the intercostal musculature and in attempting to penetrate beneath the scapula borders in tense fibrotic conditions.
- The middle or index finger should be slightly flexed and, depending upon the direction of the stroke and density of the tissues, supported by one of its adjacent members. As the treating finger strokes with a firm contact and usually a minimum of lubricant, a tensile strain is created between its tip and the tissue underlying it. This is stretched and lifted by the passage of the finger which, like the thumb, should continue moving unless or until dense, indurated tissue prevents its easy passage. These strokes can be repeated once or twice as tissue changes dictate.
- The ideal angle of pressure to the skin surface is between 40° and 50°.
- The fingertip should never lead the stroke but should always follow the wrist, the palmar surface of which should lead as the hand is drawn towards the practitioner.
- It is possible to impart a great degree of pull on underlying tissues and the patient's reactions must be taken into account in deciding on the degree of force to be used. Transient pain or mild discomfort is to be expected but no more than that. All sensitive areas are indicative of some degree of dysfunction, local or reflex, and are thus important and their presence should be recorded. The patient should be told what to expect so that a co-operative unworried attitude evolves.
- Unlike the thumb technique, in which force is largely directed away from the practitioner's body, in finger treatment the motive force is usually towards the practitioner. The arm position therefore alters and a degree of flexion is necessary to ensure that the pull or drag of the finger across the lightly lubricated tissues is smooth.
- Unlike the thumb, which makes a sweep towards the fingertips whilst the rest of the hand remains relatively stationary, the whole hand will move as finger pressure is applied. Certainly some variation in the degree of angle between fingertip and skin is allowable during a stroke and some slight variation in the degree of 'hooking' of the finger is sometimes also necessary. However, the main motive force is applied by pulling the slightly flexed middle or index finger towards the practitioner with the possibility of some lateral emphasis if needed. The treating finger should always be supported by one of its neighboring digits.

Application of NMT

- It should be clear to the practitioner that underlying tissues being treated should be visualized and, depending upon the presenting symptoms and the area involved, any of a number of procedures may be undertaken as the contact digit(s) moves from one site to another. There may be superficial stroking in the direction of lymphatic flow, direct pressure along the line of axis of stress fibers, deeper alternating 'make and break' stretching and pressure, traction on fascial tissue or sustained compression, as in trigger point treatment (see INIT description later in the chapter, and also Box A1.1).
- As variable assessment pressure is being applied the practitioner needs to be constantly aware of diagnostic information being received via the contact digits, as this is what determines the variations in pressure, and the direction of force, to be applied therapeutically.
- Ideally any changes in direction or degree of applied pressure should take place without any

Box A1.1 Soft tissue treatment of mimetic, palatine and tongue muscles

The notes that follow have been adapted from Chapter 12, *Clinical applications of neuromuscular technique* (Chaitow & DeLany 2000).

Assessment and treatment of the majority of cranial and facial muscles will be found in Chapter 9. Examples are given below of neuromuscular treatment of some of the muscles of expression, the mimetic muscles and those associated with the soft palate and tongue.

The muscles of expression (see Fig. 9.17)

Facial expression largely depends on mimetic muscles that attach skin to skin, skin to underlying fascia or skin to bone.

Mimetic muscles can be divided into four regions that work to produce often unconscious muscular movements that represent the wide variety of emotions experienced in life (*Gray's Anatomy* 1999, Platzer 1992):

- scalp (epicranial)
- eyelids (circumorbital and palpebral)
- nasal
- mouth (buccolabial).

Those mimetic muscles most involved in head and facial pain are discussed below. Orthodontic and cranial influences of the muscles of expression have yet to be fully established. Latey (1996) has observed that he has seldom seen anyone suffering from migraine headaches who has a normal range of facial expression.

Mimetic muscles of the epicranium

The scalp is composed of five layers. The first three (skin, subcutaneous tissue and epicranius, with its aponeurosis) are considered a single layer since they remain connected when torn or surgically reflected.

The deeper subaponeurotic areolar tissue allows the scalp to glide on the deepest layer, the pericranium. The epicranial muscles express surprise, astonishment, attention and fright and are used when glancing upwards. When pulling from below, the frontalis can draw the scalp forward, as in worry, grief or sadness, often in combination with other brow muscles.

NMT of the muscles of the epicranium The practitioner sits at the head of the supine patient. A pillow may be placed under the head. Rotation of the head will be necessary to reach the posterior aspect.

Transverse friction and small, circular massage techniques may be applied to the entire cranial surface to soften the superficial fascia. Tender areas may be treated with combination friction or static pressure. Special attention should be applied to cranial suture lines, where undue tenderness may indicate a need for further cranial attention.

Direct manual release of fascial restrictions in occipitofrontalis is suggested (see Ch. 9 for descriptions). Methods to release such restrictions can include NMT, massage methods, myofascial release and positional release approaches. NMT can be assisted by an isometric contraction of the muscle. A 7–10 second, strongly held frown will reduce hypertonicity and allow easier manual treatment of the soft tissues.

Mimetic muscles of the circumorbital and palpebral region

Orbicularis oculi and corrugator supercilii comprise the mimetic muscles of the eye region (palpebral fissure). These are important for facial expression and also ocular reflexes. As with all mimetic muscles, they are innervated by the facial nerve.

Orbicularis oculi is divided into three parts.

- The orbital portion of orbicularis oculi encircles the eye and lies on the body orbit.
- The palpebral portion lies directly on the upper and lower eyelids.
- The short, small fibers of the lacrimal portion cross the lacrimal sac and attach to lacrimal crest.

Orbicularis oculi is responsible for closing the eye voluntarily or reflexively, as in blinking. It also aids in reducing the amount of light entering the eye and hence is involved with squinting. Levator palpebrae superioris antagonizes eye closure by elevating the upper eyelid.

Corrugator supercilii blends with the frontalis muscle and the orbicularis oculi and radiates into the skin of the eyebrows, drawing the brows toward the midline.

These two muscles create vertical furrows between the brows that, over time, can become deeply entrenched. Orbicularis oculi also produces radiating lateral lines - 'crow's feet' - and expresses worry or concern, while corrugator supercilii produces expressions associated with thinking hard.

Box continues

Box A1.1 Soft tissue treatment of mimetic, palatine and tongue muscles—*continued*

NMT for the palpebral region The eye region contains delicate tissues and should be treated gently. Care should be exercised to avoid stretching the skin of the eye region.

Flat palpation is used to press fingertip portions of the orbicularis oculi against the underlying bony orbit. Gentle static pressure or gentle transverse movement may help assess the underlying muscle.

The corrugator supercilii is easily picked up near the midline between the brows and compressed between the thumb and side of the index finger (see Fig. A1.1). It can also be rolled gently between the palpating digits. This compression and rolling technique is applied at thumb-width intervals across the width of the brow and may also include fibers of the procerus, frontalis and orbicularis oculi, as well as corrugator supercilii.

Mimetic muscles of the nasal region

- Procerus arises from the facial aponeurosis over the lower nasal bone and nasal cartilage and attaches into the skin of the forehead, between the eyebrows. It reduces glare and produces transverse wrinkles at the bridge of the nose. Expressions associated with procerus include menacing looks, frowns and deep concentration.
- Nasalis consists of a transverse (compressor naris) portion, that attaches the maxilla to the bridge of the nose, and an alar (dilator naris) portion, that attaches the maxilla to the skin on the nasal wing. The transverse portion compresses the nasal aperture while the alar portion widens it, reducing the size of the nostril and producing a 'desiring' look.
- Depressor septi attaches the mobile portion of the nasal septum to the maxilla above the central incisor tooth. It depresses the septum during constriction and movement of the nostrils.
- Levator labii superioris alaeque nasi attaches the skin of the upper lip and nasal wing to the infraorbital margin. When it contracts, it enlarges the nostrils and elevates the nasal wing, producing transverse folds in the skin on each side of the nose and a look of displeasure, such as when sniffing an unpleasant odor.

NMT for nasal region Procerus can be grasped between the fingers and thumb at the bridge of the nose.

Flat palpation and light friction may be used along the sides of the nose and spreading slightly laterally onto the cheeks to treat the remaining nasal muscles. The two index fingers, very lightly placed, provide precise myofascial release. The facial tissues are very delicate and anything other than light pressure is contraindicated.

Mimetic muscles of the buccolabial region

Movements of the lips derive from a complex system that postures the lips and controls the shape of the orifice. *Gray's Anatomy* (1999) details the following muscles of this area.

Figure A1.1 Compression and precise myofascial release may soften deep vertical furrows between the brows.

Box A1.1 Soft tissue treatment of mimetic, palatine and tongue muscles—*continued*

- Elevators, retractors and evertors of the upper lip: levator labii superioris alaeque nasi, levator labii superioris, zygomaticus major and minor, levator anguli oris and risorius
- Depressors, retractors and evertors of the lower lip: depressor labii inferioris, depressor anguli oris and mentalis
- Compound sphincter: orbicularis oris, incisivus superior and inferior
- Buccinator.

The buccolabial muscles are involved in eating, drinking and speech, as well as emotional expressions such as reserve, laughing, crying, satisfaction, pleasure, self-confidence, sadness, perseverance, seriousness, doubt, indecision, disdain, irony, etc. (*Gray's Anatomy* 1999, Platzer 1992).

A number of these muscles converge into the modiolus just lateral to the buccal angle of the mouth. This can be palpated in an intraoral examination and is usually felt as a dense, mobile fibromuscular mass which may or may not be tender. This fan-shaped radiation of muscular fibers helps integrate facial activities of the lips and oral fissure, cheeks and jaws, such as chewing, drinking, sucking, swallowing and modulations of various vocal tones.

NMT for buccolabial region An intraoral examination including the labial area will address the muscles in this region. The practitioner should wear protective gloves. Precautions relating to latex allergy should be adopted (NIOSH 1997).

The gloved index finger is placed inside the mouth and the thumb is placed on the outside (facial) surface. The tissue is compressed between the two digits as the internal finger is slid against the external thumb while manipulating the tissue held between them. The treating digits progress at thumb-width intervals around the mouth until all the tissues have been examined. Tender spots or trigger points may be treated with static pressure (Simons et al 1998).

Musculature of the soft palate

The soft palate is a mobile muscular flap that hangs down from the hard palate with its posterior border free and, when elevated, closes the passageway between the nasopharynx and the oropharynx. The uvula hangs from the posterior border and, when relaxed, rests on the root of the tongue. The elevated uvula aids the tensor and levator veli palatini muscles in sealing off the nasopharynx. Adjacent are the palatine tonsils and the sharp hamulus, around which the tensor veli palatini turns to radiate horizontally into the palatine aponeurosis (see Fig. A1.2).

The palatine musculature includes levator and tensor veli palatini, palatoglossus, palatopharyngeus and musculus uvula. Innervation to the soft palate musculature is controversial (*Gray's Anatomy* 1999), possibly including the vagus, trigeminal, mandibular, glossopharyngeal and facial nerves. These muscles are involved in swallowing and speech.

Levator veli palatini is a cylindrical muscle which courses from the petrous portion of the temporal bone, the carotid sheath and the inferior aspect of the cartilaginous part of the auditory tube to blend into the soft palate and palatine aponeurosis. This muscle pulls the soft palate upward and backward. It has little effect on the pharyngotympanic tube (*Gray's Anatomy* 1999).

Tensor veli palatini is a thin, triangular muscle attaching to the root of the pterygoid process, the spine of the sphenoid bone and the membranous wall of the pharyngotympanic (auditory) tube. It wraps around the hamulus before attaching to the palatine aponeurosis, which it elevates during swallowing. Its primary role is to open the entrance to the auditory tube, to equalize air pressure during swallowing (Clemente 1987).

Ear infections in young children and their relationship with tensor veli palatini hypertonicity deserve clinical research. Such infections occur most frequently in young children during the chronic sucking stage (thumbs, fingers, pacifiers, toys, nipple of the bottle or breast).

The paired uvulae muscles attach the uvula to the hard palate and soft palate. They radiate into the uvular mucosa, elevating and retracting to seal off the nasopharynx. The uvula may contain trigger points which induce hiccups (Simons et al 1998, Travell 1977).

NMT for soft palate The patient tilts the head into extension and breathes through the mouth slowly or holds the breath to inhibit the gag reflex. A confident but not aggressive finger pressure is used to avoid a tickling sensation which might cause gagging.

The gloved index finger is placed just lateral to the midline of the hard palate and glides posteriorly on the hard palate until it reaches the soft palate. No pressure should be placed on the palatine bones or the vomer.

The finger is hooked into a 'C' shape as it sinks into the soft palate posterior to the palatine bone and sweeps

Box continues

Box A1.1 Soft tissue treatment of mimetic, palatine and tongue muscles—*continued*

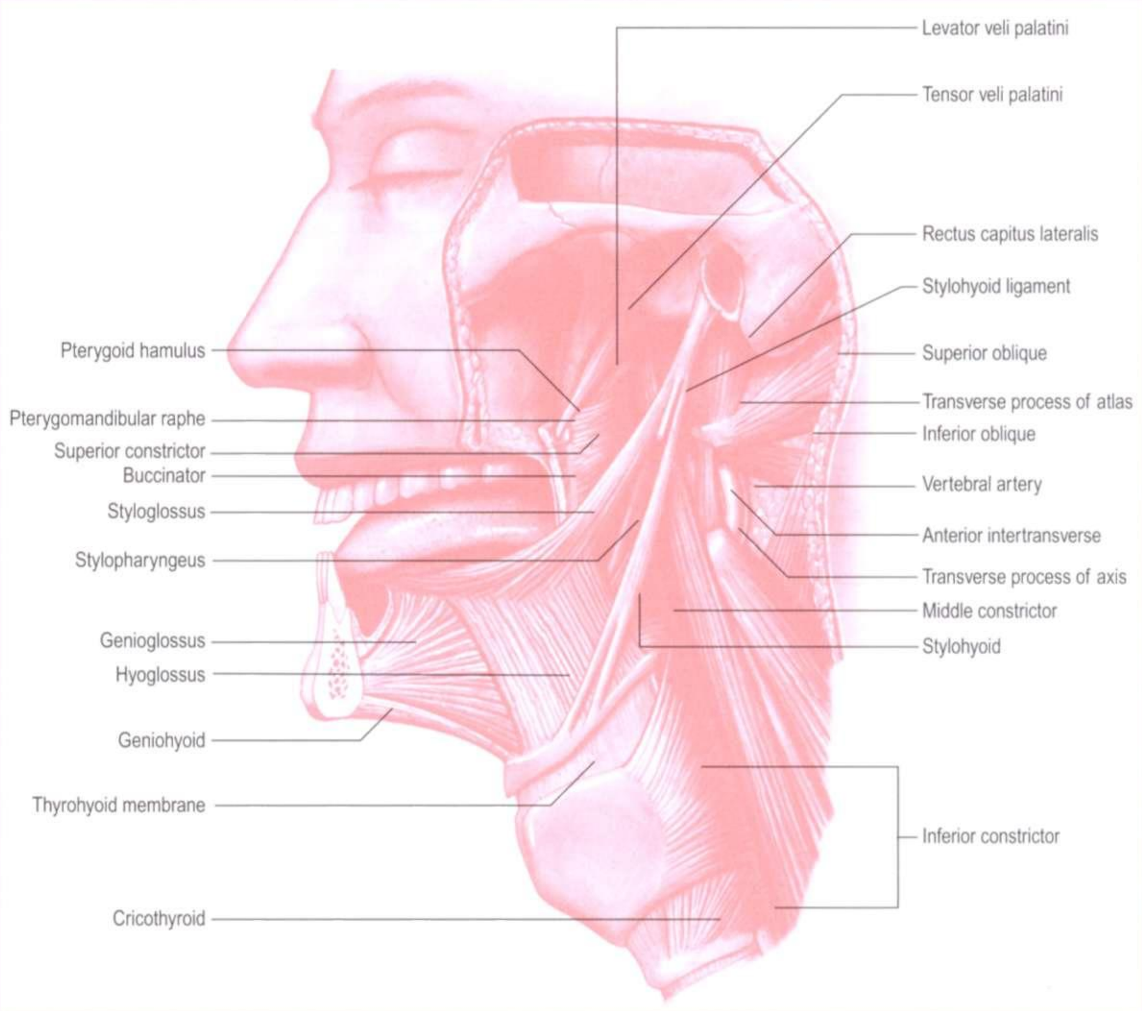

Figure A1.2 Muscles of the tongue, soft palate and styloid process (from *Gray's Anatomy* 1995, with permission).

out to the lateral one-third of the soft palate. A back and forth medial/lateral movement of the finger, or static pressure, is applied into the lateral third of the soft palate, while pressing through the superficial tissues of the soft palate and onto the palatini muscles.

Muscles of the tongue (see Fig. A1.2)

Extrinsic tongue muscles arise from outside the tongue to act upon it, while intrinsic muscles arise wholly within it and have the primary task of changing the shape of the main body of the tongue (Leonhardt 1986).

The tongue muscles are innervated by the hypoglossal nerve (cranial nerve XII).

Extrinsic muscles of the tongue include the following.

- Hyoglossus, attaches the side of the tongue to the hyoid bone below, by vertical fibers which serve to depress the tongue.
- Genioglossus, runs from the geniotubercle (cephalad from geniohyoid) fanning posteriorly and upwardly to

Box A1.1 Soft tissue treatment of mimetic, palatine and tongue muscles—*continued*

attach to the hyoid bone, blending with the middle pharyngeal constrictor, attaching to the hyoglossal membrane and the whole length of the ventral surface of the tongue, from root to apex, intermingling with the intrinsic lingual muscles. It pulls the tongue forward to protrude its tip from the mouth.

- Styloglossus, anchors the tongue to the styloid process, near its tip, and to the styloid end of the stylomandibular ligament. Its fibers divide into a longitudinal portion, which merges with the inferior longitudinal muscle, and an oblique portion, which overlaps and crosses hyoglossus to decussate with it. It draws the tongue posteriorly and upwardly.
- Chondroglossus, ascends from the hyoid bone to merge with the intrinsic musculature between the hyoglossus and genioglossus, assisting the hyoglossus in depressing the tongue.
- Palatoglossus, extends from the soft palate to the side of the tongue and the dorsal surface and merges with the transverse lingual muscle. It elevates the root of the tongue while approximating the palatoglossal arch, so closing the oral cavity from the oropharynx.

Intrinsic muscles of the tongue include the following.

- Superior longitudinal, bilaterally extends from submucous tissue near the epiglottis, and from the median lingual septum, to the lingual margins and apex of the tongue. It shortens the tongue and turns the tip and sides upward to make the dorsum concave.
- Inferior longitudinal, extends from the lingual root and the hyoid bone to the tip of the tongue, blending with styloglossus. It shortens the tongue and turns the tip and sides downward to make the dorsum convex.
- Transverse lingual, extends from the median fibrous septum to the submucous fibrous tissue at the tongue's lingual margin. It narrows and elongates the tongue.
- Vertical lingual extends from the dorsal to the ventral aspects in the borders of the anterior tongue. It makes the tongue flatter and wider.

The tongue muscles can act alone or in pairs, and in endless combination. They provide the tongue with precise movements and tremendous mobility, which impacts not only the acts of chewing and swallowing but also speech.

Myofascial tissues are known to produce trigger points and trigger points are known to produce patterns of referral as well as to encourage dysfunction of co-ordinated movement of the muscles in which they are housed (Simons et al 1998). The tongue muscles might also contain trigger points that produce pain in surrounding tissues, as well as being involved in dysfunctional responses which interfere with swallowing or normal speech patterns. The tongue should be examined and, if necessary, treated in these conditions as well as in those involving voice dysfunction, elevated hyoid bone or sore throat.

NMT for muscles of the tongue The tongue muscles are most easily addressed by reaching across the body to the opposite side of the tongue. The practitioner's gloved index finger is placed on the lateral surface, as far posteriorly as possible. The finger curls into a 'C' shape as it is slid forward the full length of the tongue. The curling action of the finger sinks it into the side of the tongue and penetrates the musculature more effectively than attempting to slide a straight finger.

The gliding, curling movement is repeated a number of times. The finger is moved caudally at fingertip widths and the process repeated as far caudally as possible. Special attention should be given to the most caudal, most posterolateral aspect of the tongue, where the long gliding strokes, previously applied, may become shorter and more precisely applied or static pressure may be used.

The tongue may also be gently tractioned forward and the muscles stretched by grasping it firmly through a clean cloth. This stretch can be held for 30–60 seconds and the direction of tension changed by pulling the tongue to one side or the other.

sudden release, or application, of force, that might potentially irritate the tissues and produce pain or provoke a defensive response.

- Lief's basic spinal treatment followed a set pattern, part of which is set out in Figures 9.10 and 9.11 (p. 267). The fact that the same pattern is recommended to be followed at each treatment does not mean that the treatment is necessarily the same - far from it. The pattern provides a framework, a useful starting and ending point, but the degree of pressure (and time) applied to the various areas of dysfunction revealed varies, based always on what information the palpating contacts are picking up and the objectives required by the situation. This is what makes each treatment different, despite a similar grid being used to comb the tissues in each case.

- The areas of dysfunction should be recorded on a case card together with all relevant information including diagnostic findings relating to myofascial tissue changes, trigger points and reference zones, areas of sensitivity, restricted motion and so on.

What is working when the thumb applies NMT?

Consider which parts of the practitioner's body/arm/hand will be involved with the various aspects of the glide/stroke as delivered by the thumb (finger strokes involve completely different mechanics).

- The transverse movement of the thumb is a hand or forearm effort.
- The relative straightness or rigidity of the last two thumb segments is also a local muscular responsibility.
- The vast majority of the energy imparted via the thumb results from transmission of body weight through the straight arm into the thumb.
- Any increase in pressure can be speedily achieved by simple weight transfer, from back towards front foot, together with a slight 'lean' onto the thumb from the shoulders.
- A lessening of imparted pressure is achieved by reversing this body movement.

(See Chapter 9, Lief's NMT application to the cranial base area, p. 316, for a detailed description of individual strokes by the thumb through these tissues. See Figure 9.59A-E.)

MUSCLE ENERGY TECHNIQUE: SUMMARY OF VARIATIONS

(DiGiovanna 1991, Greenman 1989, Janda 1989, Lewit 1986, Liebenson 1990, Mitchell 1967, Travell & Simons 1992)

1. Isometric contraction – using reciprocal inhibition (RI)

Indications
- — Relaxing muscular spasm or contraction
- — Mobilizing restricted joints
- — Preparing joint for manipulation.

Contraction starting point For acute muscle or any joint problem, commence just short of, or at, the 'easy' restriction barrier.

Modus operandi An isometric contraction is introduced involving the antagonists to affected muscle(s), so obliging shortened muscles to relax via reciprocal inhibition. The patient is attempting to push through the barrier of restriction against the practitioner's precisely matched counterforce.

Forces The practitioner's and patient's forces are matched. Initial effort involves approximately 20% of the patient's strength with an increase to no more than 30-40% on subsequent contractions. Increasing the duration of the contraction (up to 15 seconds) may be more effective than any increase in force.

Duration of contraction Initially 7-10 seconds, increasing to up to 15 seconds in subsequent contractions, if greater effect required.

Action following contraction Area (muscle/joint) is taken to its new restriction barrier without stretch after ensuring complete relaxation. Perform movement to new barrier on an exhalation.

Repetitions Repeat two to three times or until no further gain in range of motion is possible. No stretching is introduced where tissues are acutely sensitive or have been recently traumatized (3 weeks or so).

2. Isometric contraction – using postisometric (PIR) relaxation (without stretching)

Note: This approach is ideal for acute settings, involving recent trauma or severe pain.

Indications
— Relaxing muscular spasm or contraction
— Mobilizing restricted joints
— Preparing joint for manipulation.

Contraction starting point At or just short of resistance barrier.

Modus operandi The affected muscles (agonists) are used in the isometric contraction, therefore the shortened muscles subsequently relax via post-isometric relaxation. The practitioner is attempting to push through the barrier of restriction against the patient's precisely matched countereffort.

Forces The practitioner's and patient's forces are matched. Initial effort involves approximately 15-20% of the patient's strength, increasing to no more than 30-40% on subsequent contractions. Increase of the duration of the contraction (up to 15 seconds) may be more effective than any increase in force.

Duration of contraction Initially 7-10 seconds, increasing to up to 15 seconds in subsequent contractions, if greater effect required.

Action following contraction Area (muscle/joint) is taken to its new restriction barrier without stretch after ensuring that the patient has completely relaxed. Perform movement to new barrier on an exhalation.

Repetitions Repeat three to five times or until no further gain in range of motion is possible. Hold stretches for not less than 30 seconds.

3. Isometric contraction – using postisometric relaxation (with stretching, also known as postfacilitation stretching)

Note: This approach is ideal for chronic settings.

Indications Stretching restricted, fibrotic, contracted, soft tissues (fascia, muscle).

Contraction starting point Short of resistance barrier, in mid-range.

Modus operandi Affected muscles (agonists) are used in the isometric contraction, therefore the shortened muscles subsequently relax via post-isometric relaxation (PIR), allowing an easier stretch to be performed. The practitioner is attempting to push through the barrier of restriction against the patient's precisely matched countereffort.

Forces The practitioner's and patient's forces are matched. Initial effort involves approximately 30% of the patient's strength; an increase to no more than 40-50% on subsequent contractions is appropriate. Increase of the duration of the contraction - up to 15 seconds - may be more effective than any increase in force.

Duration of contraction Initially 7-10 seconds, increasing to up to 20 seconds in subsequent contractions, if greater effect required.

Action following contraction Rest period of 5-10 seconds to ensure complete relaxation before stretch is useful. On an exhalation, the area (muscle) is taken to its new restriction barrier and a small degree beyond, painlessly, and held in this position for at least 10 seconds. The patient should, if possible, help to move to and through the barrier, effectively further inhibiting the structure being stretched and retarding the likelihood of a myotatic stretch reflex occurring.

Repetitions Repeat three to five times or until no further gain in range of motion is possible. Hold stretches for not less than 30 seconds.

4. Isotonic concentric contraction

Indications Toning weakened musculature.

Contraction starting point In a mid-range easy position.

Modus operandi The contracting muscle is allowed to do so, with some (constant) resistance from the practitioner.

Forces The patient's effort overcomes that of the practitioner, since the patient's force is greater than practitioner resistance. The patient uses maximal effort available but force is built slowly not via sudden effort. The practitioner maintains a constant degree of resistance.

Duration 3-4 seconds.

Repetitions Repeat five to seven times or more if appropriate.

5. Rapid isotonic eccentric contraction (isolytic)

Indications Stretching tight fibrotic musculature.

Contraction starting point A little short of restriction barrier.

Modus operandi The muscle to be stretched is contracted and is prevented from doing so by superior practitioner effort, so that the contraction is overcome and reversed and the contracting muscle is stretched. Origin and insertion do not approximate. Muscle is stretched to, or as close as possible to, full physiological resting length.

Forces The practitioner's force is greater than the patient's. Less than maximal patient's force is employed at first. Subsequent contractions build towards this, if discomfort is not excessive.

Duration of contraction 2-4 seconds.

Repetitions Repeat two to three times if discomfort is not excessive.

> **CAUTION**
>
> Avoid using isolytic contractions on head/neck muscles or at all if patient is frail, very pain sensitive or osteoporotic. Isolytic contractions of this sort (rapid isotonic eccentric stretch) create microtrauma and will result in soreness for several days.

6. Slow eccentric isotonic contraction (SEIC)

Indications Toning inhibited antagonists while preparing agonists for subsequent stretching

Contraction starting point At restriction barrier.

Modus operandi The muscle to be stretched at the end of the procedure is taken to its comfortable end of range and actively held there by the patient's effort. The practitioner uses superior effort to *slowly* overcome this attempt to remain at the barrier and returns the structure (e.g. arm, leg, etc.) to its neutral position. This effectively tones the muscles that are being slowly stretched, while inhibiting their short/tight antagonists. The short/tight structures can then be stretched as in the example of RI and PIR given above (methods 2 and 3).

Forces The practitioner's force is greater than the patient's. Less than maximal patient's force is employed at first. Subsequent contractions build towards this, if discomfort is not excessive, and if the practitioner can overcome the resistance in a controlled manner (i.e. no jerking or undue effort on either part).

Duration of contraction 5-10 seconds.

Repetitions Repeat two to three times for best results. Hold stretches for not less than 30 seconds.

7. Isokinetic (combined isotonic and isometric contractions)

Indications
- Toning weakened musculature
- Building strength in all muscles involved in particular joint function
- Training and balancing effect on muscle fibers.

Starting point of contraction Easy mid-range position.

Modus operandi The patient resists with moderate and variable effort at first, progressing to maximal effort subsequently, as the practitioner puts joint rapidly through as full a range of movements as possible. This approach differs from a simple isotonic exercise as whole ranges of motion rather than single motions are involved and because resistance varies, progressively increasing as the procedure progresses.

Forces The practitioner's force overcomes the patient's effort to prevent movement. First movements (taking an ankle, say, into all its directions of motion) involve moderate force, progressing to full force subsequently. An alternative is to have the practitioner (or machine) resist the patient's effort to make all the movements.

Duration of contraction Up to 4 seconds.

Repetitions Repeat two to four times.

Important notes on assessments and use of MET

1. When the term 'restriction barrier' is used in relation to soft tissue structures it is meant to indicate the first signs of resistance (as palpated by sense of 'bind' or sense of effort required to move the area or by visual or other palpable evidence), not the greatest possible range of movement available.

2. The shorthand reference of 'acute' and 'chronic' is commonly used to alert the reader to the variations in methodology which these variants call for, especially in terms of the starting position for contractions (acute - and all MET joint treatment - starts at the barrier, chronic short of the barrier) and the need to take the area to (acute) or through (chronic) the resistance barrier subsequent to the contraction.

3. Assistance from the patient is valuable as movement is made to or through a barrier, providing the patient can be educated to gentle co-operation and not to use excessive effort.

4. In most MET treatment guidelines the method described involves isometric contraction of the agonist(s), the muscle(s) which require stretching. There also exists the possibility of using the antagonists to achieve reciprocal inhibition (RI) before initiating stretch or movement to a new barrier, an approach suggested if there is pain on use of agonist or if prior trauma to the agonist has occurred.

5. There should be no pain experienced during application of MET although mild discomfort (stretching) is acceptable.

6. The methods recommended provide a sound basis for the application of MET to specific muscles and areas. By developing the skills with which to apply the methods, as described, a repertoire of techniques can be acquired offering a wide base of choices appropriate in numerous clinical settings.

7. Breathing cooperation can and should be used as part of the methodology of MET. Basically, if appropriate (the patient is co-operative and capable of following instructions), the patient should inhale as they slowly build up an isometric contraction, hold the breath for the 7-10 second contraction and release the breath on slowly ceasing the contraction; they should be asked to inhale and exhale fully once more following cessation of all effort as they are instructed to 'let go completely'. During this last exhalation the new barrier is engaged or the barrier is passed as the muscle is stretched. A note to 'use appropriate breathing', or some variation on it, will be found in the text describing various MET applications.

8. Various eye movements are sometimes advocated during contractions and stretches.

9. There are times when 'co-contraction' is useful, involving contraction of both the agonist and the antagonist. Studies have shown that this approach is particularly useful in treatment of the hamstrings, when both these and the quadriceps are isometrically contracted prior to stretch (Moore et al 1980).

POSITIONAL RELEASE TECHNIQUES (PRT) (INCLUDING STRAIN/COUNTERSTRAIN) (Chaitow 2002)

There are many different methods involving the positioning of an area, or the whole body, in such a way as to evoke a physiological response which helps to resolve musculoskeletal dysfunction. The means whereby the beneficial changes occur seem to involve a combination of neurological and circulatory changes which occur when a distressed area is placed in its most comfortable, its most 'easy', most pain-free position. The impetus towards the use of this most basic of treatment methods in a coherent rather than a hit-and-miss manner lies in the work of Laurence Jones, who developed an approach to somatic dysfunction which he termed 'strain and counterstrain' (SCS) (Jones 1981). Walther (1988) describes the moment of discovery in these words.

> *Jones's initial observation of the efficacy of counterstrain was with a patient who was unresponsive to treatment. The patient had been unable to sleep because of pain. Jones attempted*

to find a comfortable position for the patient to aid him in sleeping. After twenty minutes of trial and error, a position was finally achieved in which the patient's pain was relieved. Leaving the patient in this position for a short time, Jones was astonished when the patient came out of the position and was able to stand comfortably erect. The relief of pain was lasting and the patient made an uneventful recovery.

The position of 'ease' which Jones found for this patient was an exaggeration of the position in which spasm was holding him, which provided Jones with an insight into the mechanisms involved. Since Jones first made his valuable observation that a position which exaggerated a patient's distortion could allow a release of spasm and hypertonicity, many variations on this basic theme have emerged, some building logically on that first insight with others moving in new directions.

Common basis

The commonality of all of these approaches is that they move the patient or the affected tissues away from any resistance barriers and towards positions of comfort. The shorthand terms used for these two extremes are 'bind' and 'ease', terms which anyone who has handled the human body will recognize as being extremely apt.

The need for the many variations to be understood should be obvious. Different clinical settings require that a variety of therapeutic approaches be available. Jones's approach requires verbal feedback from the patient as to the degree of discomfort in a 'tender' point being used as a monitor by the practitioner who is palpating/compressing it, as an attempt is made to find a position of ease.

One can imagine a situation in which the use of Jones's 'tender points as a monitor' method would be inappropriate (loss of the ability to communicate verbally or someone too young to report levels of discomfort). In such cases there is a need for a method that allows achievement of the same ends, without verbal communication. This is possible using either 'functional' approaches or 'facilitated positional release' methods, involving finding a position of maximum ease by means of palpation alone, assessing for a state of 'ease' in the tissues.

As we examine a number of the variations on the theme of PRT, release by placing the patient, or area, into 'ease', the variety of clinical and therapeutic potentials for the use of this approach will become clearer.

It is important to note that if positional release methods are being applied to chronically fibrosed tissues, a reduction in hypertonicity may result, but a reduction in fibrosis is not possible. Pain relief or improved mobility might therefore be only temporary in such cases.

1. **Exaggeration of distortion (an element of SCS methodology)** Consider the example of an individual bent forward in psoas spasm/ 'lumbago'. The patient is in considerable discomfort or pain, posturally distorted into flexion together with rotation and sidebending.

   Any attempt to straighten towards a more physiologically normal posture would be met by increased pain. Engaging the barrier of resistance would therefore not be an ideal first option.

   However, moving the area away from the restriction barrier would not usually be a problem for such an individual. The position required to find 'ease' for someone in this state normally involves painlessly increasing the degree of distortion displayed, placing the person (in the case of the example given) into some variation based on forward bending, until pain is found to reduce or resolve. After 60-90 seconds in this *position of ease,* a slow return to neutral would be carried out and commonly, in practice, the patient will be somewhat, or completely, relieved of pain and spasm.

2. **Replication of position of strain (an element of SCS methodology)** Take the example of someone who is bending to lift a load when an emergency stabilization is required and strain results (the person slips or the load shifts, perhaps). The patient could be locked into the same position of lumbago-like' distortion as in example 1, above.

   If, as SCS suggests, the position of ease equals the position of strain, then the patient needs to be taken back into flexion, in slow motion, until tenderness vanishes from the monitored tender point and/or a sense of 'ease' is perceived in the previously hypertonic, shortened tissues. Adding small 'fine-tuning' positioning to the initial position of ease, achieved by flexion, usually results in a maximum reduction in pain. This position is held for 60-90 seconds before a slow return to neutral is allowed, at which time, as in example 1, a partial or total resolution of hypertonicity, spasm and pain should be experienced. The position in which the strain took place is likely to be similar to the position of exaggeration of distortion, as in example 1.

These two elements of SCS are of limited clinical value and are described as examples only, since it is not every patient who can describe precisely in which way their symptoms developed. Nor is obvious spasm, such as torticollis or acute anteflexion spasm ('lumbago'), the norm. Ways other than 'exaggeration of distortion' or 'replication of position of strain' are therefore needed in order to be able to identify probable positions of ease.

3. **Using Jones's tender points as monitors (D'Ambrogio a Roth 1997, Jones 1981)** Over many years of clinical experience Jones compiled lists of specific tender point areas, relating to every imaginable strain, of most of the joints and muscles of the body. These are his 'proven' (by clinical experience) points. Tender points are usually found in tissues which were in a shortened state at the time of strain, rather than those which were stretched. Tender points, other than those identified by Jones and his colleagues, are periodically reported on in the osteopathic literature - for example, sacral foramen points relating to sacroiliac strains (Ramirez et al 1989).

Jones and his followers provided strict guidelines for achieving ease in any tender points which are being palpated. The position of ease usually involving a 'folding' or crowding of the tissues in which the tender point lies. This method involves maintaining pressure on the monitored tender point, or periodically probing it, as a position is achieved in which:

- there is no additional pain in whatever area is symptomatic
- pain in the monitored point has reduced by at least 75%.

The position of ease is held for an appropriate length of time (90 seconds according to Jones; however, there are variations suggested for the length of time required in the position of ease, as will be explained).

In the example of the person with acute low back pain who is locked in flexion, the tender point will be located on the anterior surface of the abdomen, in the muscle structures which were shortened at the time of strain (when the patient was in flexion). The position that removes tenderness from this point will usually require flexion and probably some fine-tuning involving rotation and/or sidebending.

If there is a problem with Jones's formulaic approach it is that, while he is frequently correct as to the position of ease recommended for particular points, the mechanics of the particular strain with which the practitioner is confronted may not coincide with Jones's guidelines. Any practitioner who relies solely on Jones's 'menus', or formulae, could find it difficult to handle a situation in which the prescription failed to produce the desired results. Reliance on Jones's menu of points and positions can therefore lead to the practitioner becoming dependent on them and it is suggested that development of palpation skills, and other variations of Jones's original observations, offers a more rounded approach for dealing with strain and pain.

Fortunately Goodheart (and others) has offered less rigid frameworks for using positional release.

4. **Goodheart's approach (Goodheart 1984, Walther 1988)** George Goodheart (the developer of 'applied kinesiology' - see Chapter 5) has described an almost universally applicable formula which relies more on the individual features displayed by the patient and less on rigid formulae, as used in Jones's approach.

Goodheart suggests that a suitable tender point be sought in the tissues opposite those 'working' (active) when pain or restriction is noted. If pain/restriction is reported/apparent on any given movement, muscles antagonistic to those operating at the time pain is noted will be those housing the tender point(s). Thus, for example, pain (wherever it is felt) which occurs when the neck is being turned to the left will indicate a tender point located in the muscles that turn the head to the right.

In examples 1 and 2, of a person locked in forward bending with acute pain and spasm, if Goodheart's approach is applied, pain and restriction would be experienced as the person straightened up (moved into extension) from their position of enforced flexion.

This action (straightening up) would usually cause pain in the back but, irrespective of where the pain is noted, a tender point would be sought (and subsequently treated by being taken to a state of ease as in the Strain/counterstrain described above) in the muscles antagonistic to those working when pain was experienced - i.e. it would lie in the flexor muscles (possibly psoas) in this example.

Note It is important to emphasize this factor, that tender points which are intended to be used as 'monitors' during the positioning phase are not sought in the muscles antagonistic to those where pain is noted, but in the muscles that antagonize those which are actively moving the patient, or area, when pain or restriction is noted.

5. **Functional technique (Bowles 1981, Hoover 1969)** Osteopathic functional technique relies on a reduction in palpated tone in stressed (hypertonic/spasm) tissues as the body (or part) is being positioned, or fine-tuned, in relation to all available directions of movement, in a given region. One hand palpates the affected tissues (molded to them, without invasive pressure). This is described as the 'listening' hand, since it assesses changes in tone as the practitioner's other hand guides the patient, or part, through a sequence of positions which are aimed at enhancing 'ease' and reducing 'bind'.

   A sequence is carried out involving different directions of movement (e.g. flexion/extension, rotation right and left, sidebending right and left, etc.) with each movement starting at the point of maximum ease, as revealed by the previous evaluation, or combined point of ease following a number of previous evaluations. In this way one position of ease is 'stacked' on another, until all movements have been assessed for ease.

   Were the same fictional patient with the low back problem, as previously discussed, being treated using functional technique, the tense tissues in the low back would be the ones being palpated. Following a sequence involving flexion/extension, sidebending and rotating in each direction, translation right and left, translation anterior and posterior and compression/distraction - so involving all available directions of movement of the area - a position of maximum ease would be achieved after which (if the position were held for 30-90 seconds) a release of hypertonicity and reduction in pain should result.

   The precise sequence in which the various directions of movement are evaluated seems to be irrelevant, as long as all possibilities are included.

   Theoretically (and often in practice) the position of palpated maximum ease (reduced tone) in the distressed tissues should correspond with the position which would have been found were pain being used as a guide, as in either Jones's or Goodheart's approach, or using the more basic 'exaggeration of distortion' or 'replication of position of strain' formulae.

6. **Any painful point as a starting place for SCS (McPartland & Zigler 1993)** All areas which palpate as painful are responding to, or are associated with, some degree of imbalance, dysfunction, sensitization or reflexive activity, which may involve acute or chronic strain. Jones identified the probable positions of tender points relating to particular strain positions. It makes just as much sense to work the other way around, by identifying the strain pattern associated with any identified pain point. It is useful to consider that any painful point/area located during soft tissue evaluation can be treated by positional release, whether the strain that produced the dysfunction is known or not and whether the problem is acute or chronic.

This approach, of being able to treat any painful tissue using positional release, is valid whether the pain is being monitored via verbal feedback from the patient (using reducing levels of pain in the palpated point as a guide) or a functional approach is adopted, assessing for maximal reduction in tone in the tissues. The recommended time for holding the position of maximum ease is 60-90 seconds.

Experience, and simple logic, suggest that the response to positional release of a chronically fibrosed area will be less dramatic than from tissues held in simple spasm or hypertonicity. Nevertheless, even in chronic settings, a degree of 'release' can be anticipated, allowing for easier access to the deeper fibrosis.

7. **Integrated neuromuscular inhibition technique (INIT) (Chaitow 1994)** INIT involves using the position of ease as part of a sequence which commences with the location of a tender/pain/trigger point, followed by application of ischemic compression (optional - avoided if pain is too intense or the patient too sensitive) followed by the introduction of positional release. After an appropriate length of time, during which the tissues are held in 'ease', the patient introduces an isometric contraction into the affected tissues for 7-10 seconds, after which these are stretched to attempt to restore normal resting length to the tissues.

Method A trigger point should initially be treated by direct inhibitory ('ischemic') pressure (sustained or intermittent) until a change in perceived pain is reported.

Pressure is continued as the tissues in which the trigger point lies are positioned in such a way as to reduce the pain (entirely or at least by approximately 70%). When this has been achieved the most (dis)stressed fibers surrounding the trigger point will have been placed into a position of ease.

Following a period of 20-30 seconds of this position of ease and inhibitory pressure (constant or intermittent), the patient should be asked to introduce an isometric contraction into these tissues and to hold this for 7-10 seconds, involving the precise fibers which had been repositioned to obtain the positional release.

The effect of this would be to produce (following the contraction) a reduction in tone in these tissues. The hypertonic or fibrotic tissues should then be gently stretched, as in any muscle energy procedure, so that the specifically targeted fibers are lengthened.

SCS rules of treatment

The following 'rules' are based on clinical experience and should be borne in mind when using positional release methods (SCS, etc.) in treating pain and dysfunction, especially where the patient is fatigued, sensitive and/or distressed (McPartland & Zigler 1993).

- Never treat more than five 'tender' points at any one session and treat fewer than this in sensitive individuals.
- Forewarn patients that, just as in any other form of bodywork which produces altered function, a period of physiological adaptation is inevitable and that there will therefore be a 'reaction' on the day(s) following even this extremely light form of treatment. Soreness and stiffness are therefore to be anticipated.
- If there are multiple tender points - as is inevitable in fibromyalgia - select those most proximal and most medial for primary attention; that is, those closest to the head and the center of the body rather than distal and lateral pain points.
- Of these tender points, select those that are most painful for initial attention/treatment.
- If self-treatment of painful and restricted areas is advised - and it should be if at all possible - apprise the patient of these rules (i.e. only a few pain points on any day to be given attention, to expect a 'reaction', to select the most painful points and those closest to the head and the center of the body).

The guidelines which should therefore be remembered and applied are:

- locate and palpate the appropriate tender point or area of hypertonicity
- use minimal force

- use minimal monitoring pressure
- achieve maximum ease/comfort/relaxation of tissues
- produce no additional pain anywhere else.

These elements need to be kept in mind as positional release/SCS methods are learned and are major points of emphasis in programs which teach it (Jones 1981). The general guidelines which Jones gives for relief of the dysfunction with which such tender points are related involve directing the movement of these tissues towards ease, which commonly involves the following elements.

- For tender points on the anterior surface of the body, flexion, sidebending and rotation should be towards the palpated point, followed by fine-tuning to reduce sensitivity by at least 70%.
- For tender points on the posterior surface of the body, extension, sidebending and rotation should be away from the palpated point, followed by fine-tuning to reduce sensitivity by 70%.
- The closer the tender point is to the midline, the less sidebending and rotation should be required and the further from the midline, the more sidebending and rotation should be required, in order to effect ease and comfort in the tender point (without any additional pain or discomfort being produced anywhere else).
- Sidebending when trying to find a position of ease often needs to be away from the side of the palpated pain point, especially in relation to tender points found on the posterior aspect of the body.

PRT: the cranial dimension

- The treatment of tender points on the cranium has been described in Chapter 10.
- Many cranial methods involve functional technique concepts (e.g. exaggeration of distortion).
- All PRT methods can be safely used on soft tissues attaching to the cranium, even in acute settings.
- Upledger's release of 'energy cysts', as described in Chapter 10 (p. 326), incorporates positional release methods.
- Apparently 'direct' approaches such as the V-spread (see Exercise 7.6, Ch. 7) might actually involve PRT mechanisms, by virtue of a slackening of internal fascial structures (e.g. tentorium cerebelli, falx cerebri) via the sustained light pressure involved.

MYOFASCIAL RELEASE (MFR) TECHNIQUES (Barnes 1996, Shea 1993)

John Barnes writes: 'Studies suggest that fascia, an embryological tissue, reorganizes along the lines of tension imposed on the body, adding support to misalignment and contracting to protect tissues from further trauma' (Twomey & Taylor 1982). Having evaluated where a restriction area exists, MFR technique calls for a sustained pressure (gentle usually) that engages the elastic component of the elastico-collagenous complex, stretching this until it ceases releasing. This barrier is held until release recommences as a result of what is known as the 'viscous flow phenomenon' in which a slowly applied load (pressure) causes the viscous medium to flow to a greater extent than would be allowed by rapidly applied pressure. As fascial tissues distort in response to pressure, the process is known by the short-hand term 'creep'. Hysteresis is the process of heat and energy loss by the tissues as they deform (*Darlands medical directory* 1985).

Mark Barnes (1997) describes the simplest MFR treatment process as follows.

> *Myofascial release is a hands-on soft tissue technique that facilitates a stretch into the restricted fascia. A sustained pressure is applied into the tissue barrier; after 90 to 120 seconds the tissue will undergo histological length changes alloiving the first release to be felt. The therapist follows the release into a new tissue barrier and holds. After a few releases the tissues will become softer and more pliable.*

Shea (1993) explains this phenomenon.

> *The components of connective tissue (fascia) are long thin flexible filaments of collagen surrounded by ground substance. The ground substance is composed of 30%-40% glycoaminoglycans (GAG) and 60%-70% water. Together GAG and*

water form a gel ... which functions as a lubricant as well as to maintain space (critical fiber distance) between collagen fibers. Any dehydration of the ground substance will decrease the free gliding of the collagen fibers. Applying pressure to any crystalline lattice increases its electrical potential, attracting water molecules, thus hydrating the area. This is the piezoelectric effect of manual connective tissue therapy.

By applying direct pressure of the appropriate degree, at the correct angle (angle and force need to be suitable for the particular release required), a slow lengthening of restricted tissue occurs.

A number of different approaches are used in achieving this (note that it bears a strong resemblance, in parts, to the methodology of Lief's NMT as described above).

- A pressure is applied to restricted myofascia using a 'curved' contact and direction of pressure in an attempt to glide, or slide, against the restriction barrier.
- The patient may be asked to assist by means of breathing tactics or moving the area in a way which enhances the release, based on practitioner instructions.
- As softening occurs the direction of pressure is reassessed and gradually applied to move towards a new restriction barrier.
- In using patient assistance single directions and small, slowly applied degrees of effort are called for initially until you are sure of what it is you want of the patient.

MFR technique is used to improve movement potentials, reduce restrictions, release spasm, ease pain and to restore normal function to previously dysfunctional tissues.

CONCLUSION

The range of soft tissue methods available to treat soft tissue dysfunction associated with the cranium is no less varied than for other parts of the body. This chapter has attempted to provide a basic introduction to some of the most widely used methods and their rationale. There are other soft tissue approaches, as well as numerous other variations deriving from NMT, MET, PRT and MFR, that have not been described. What is of the most importance is that skills be acquired that lie outside basic cranial manipulation methodology, to enable the practitioner to encourage normalization of the soft tissues that attach to the cranium, as part of an integrated and comprehensive approach to treatment.

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Appendix 2

Cranial treatment and the infant

APPENDIX CONTENTS

This text has deliberately concentrated attention on the adult skull. The skull of the infant, and more so in the neonate by necessity, is immensely malleable, with the pliability of a milk carton. As a mainly cartilaginous structure at birth, the infant skull is ultraresponsive to direct molding pressures.

The evolution of the neurocranium, through different growth centers, as well as the main sutural features of the skull and face are shown in Figure A2.1.

The cranial bones are unconnected by sutures at birth and some of the cranial bones, known as composite bones (e.g. occiput, sphenoid, temporal) comprise several parts, allowing scope for the rapid growth of the brain (Carreiro 2003). The neonatal cranium is remarkably soft and unstructured, to allow folding of the cranium as it passes through the birth canal, where it is particularly vulnerable to deformation during the birth process (see Figs A2.2 and A2.3).

Cranial distortion can be created by prebirth influences, via trauma (seat-belt compression during an automobile accident, for example) or if the womb is crowded (perhaps by a twin) or if chemical influences distort development (drugs, toxins and/or nutritional deficits). Far more likely to produce damage, however, are the influences of the powerful forces acting upon the supple skull during the birth process.

Among the factors which can produce cranial damage during birth are (Biedermann 1992, 2001):

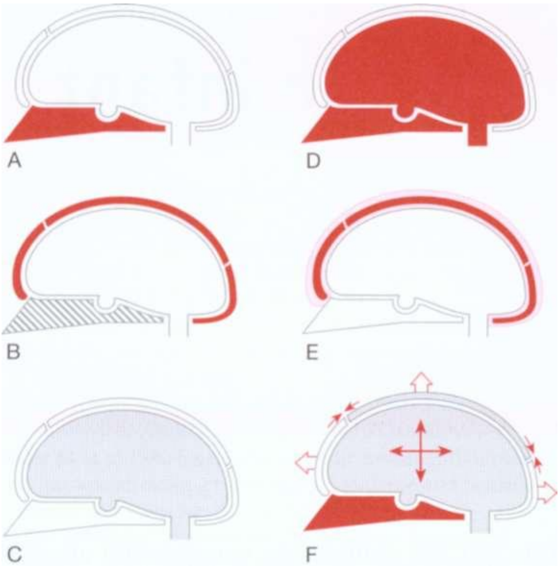

Figure A2.1 The neurocranium increases through various growth centers: (A) the synchondroses in the skull base; (B) the sutures in the cranium. The growing brain (C) is a mechanical entity with a stable skull base. (D) The sutures in the cranium allow movement of the dura mater (E). (F) The brain growth is buffered by the skull base and makes the cranium reform at the sutures. (Redrawn from von Piekartz ft Bryden (2001) with permission from Elsevier.)

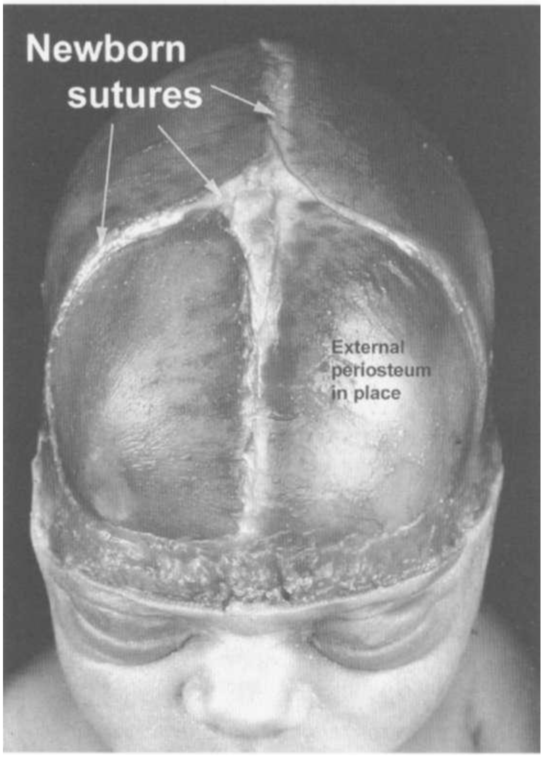

Figure A2.2 Anteroposterior view of the neonatal cranium. The periosteum has been removed from the right frontal bone but is still in place on the left. The sutures can be seen to comprise thickened connective tissue. (Reproduced with permission from the Willard ft Carreiro Collection.)

- too rapid a transit through the birth canal which precludes the opportunities for 'normal' molding to occur
- too extended a period in the birth canal with excessive compression forces operating on the delicate membranes, sometimes for many hours (Magoun 1976)
- anomalous prenatal positioning and/or crowding (as in twins or triplets)
- the application of mechanical force to extract the infant via inappropriate use of forceps or the stress of vacuum suction delivery (Noret 1993).

As Milne (1995) explains:

> *A newborn baby has no sutural interlocking or interdigitation between adjacent cranial bones. The bony plates of the cranial vault are free to float like icebergs in an elastic sea of membranous dura. The mechanism of the fontanells, pliant cartilage, tender membrane, open sutures, cerebrospinal fluid and falx and tentorium has evolved so that what is, evolutionarily, a huge head can pass through a small birth canal intact. This is achieved by progressive and controlled cranial implosion.*

The cranioeervieal link

Biedermann (2001) suggests that the common denominator in all of these negative influences is undue mechanical stress impinging on vulnerable cerebral tissues and the craniocervical area. The result may include asymmetrical posture, morphology or movement patterns, as well as inappropriate responses to external stimuli.

Under normal conditions any minor distortions imposed during birth will resolve as a result of the influences of the reciprocal tension membranes within a matter of days, greatly assisted by the forces involved in suckling and crying (Frymann

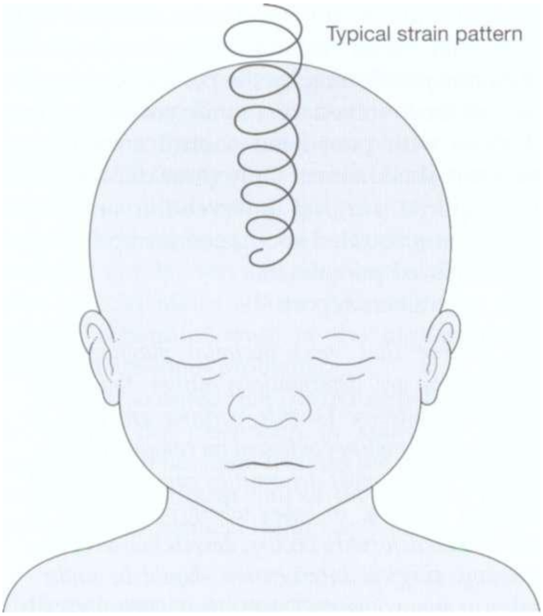

Figure A2.3 Schematic diagram depicting the typical cone-shaped, rotational strain seen at the sight of vacuum placement. The depth of extension into deeper tissues appears to be dependent upon the duration and intensity of application of the device. (Reproduced with permission from Carreiro 2003.)

1966). In many instances, however, such a recovery is not achieved due to the degree of distortion created, with sometimes disastrous consequences in health terms (Arbuckle 1948, Frymann 1976).

Distortions and deformities are often easily noted and may be the reason the parent(s) seek assistance. Behavioral problems such as incessant crying, feeding difficulties, 'head banging' or frank illness might cause parents to attempt to find appropriate professional help. Clearly if the health-care provider consulted is ignorant of the influence of cranial function on health, whatever is offered will be less than satisfactory.

After birth the pliability of the infant cranium continues to allow damage to occur more easily than once ossification has taken place. Falls and blows are obvious possibilities, and indeed probabilities, during the early years of life. If severe enough, these may produce problems similar to those which can occur during childbirth.

Biedermann (2001) describes what he terms 'KISS' children in whom the main clinical feature is torticollis, often combined with an asymmetrical cranium, postural asymmetry and a range of dysfunctional symptoms (see Fig. A2.4). KISS is an acronym for kinematic imbalances due to suboccipital strain. Biedermann notes: '(KISS imbalances) can be regarded as one of the main reasons for asymmetry in posture and consequently asymmetry of the osseous structures of the cranium and the spine'.

Among the many symptoms reported by Biedermann in KISS children are torticollis, reduced range of head/neck motion, cervical hypersensitivity, opisthotonos, restlessness, inability to control head movement and one upper limb underused (based on statistical records of 263 babies treated in one calendar year up to June 1995).

Biedermann (2001) is convinced that the most effective treatment for such infants is removal of suboccipital strain by manual treatment and not direct treatment of cranial asymmetry, as this is considered to be a symptom of the underlying problem (most commonly suboccipital strain). Following appropriate treatment to re-establish full range of upper cervical motion, functional improvement is reported to be common within 2-3 weeks, although normalization of cranial asymmetry takes many months.

How much treatment is required? According to Biedermann, of the 263 babies treated, 213 required only one treatment, 41 were treated twice and the remainder more often, with just two requiring 4-5 treatment sessions.

Sleeping position and cranial deformity

One of the reasons for KISS-like problems seems to relate to infant sleeping position. A research study by plastic and reconstructive surgeons has concluded that the almost universal acceptance of positioning neonates on their backs to avoid SIDS may well increase the incidence of abnormalities of the occipital cranial sutures, causing significant posterior cranial asymmetry, malposition of the ears, distortion of the cranial base, deformation of the forehead and facial structures (Argenta et al 1996).

The study reported that there had been a dramatic increase in the incidence of deformation of the occipital structures, although the patient

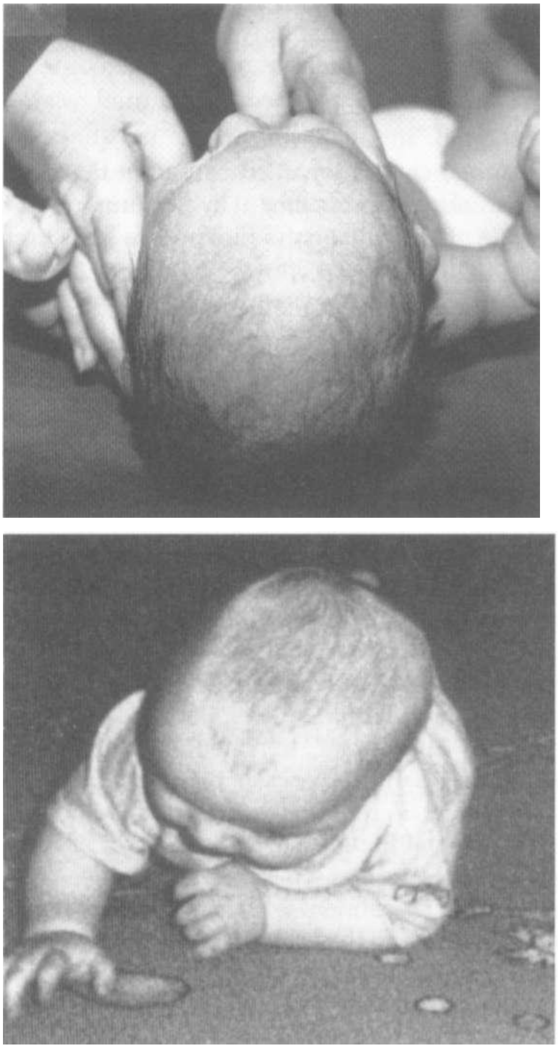

Figure A2.4 Two KISS babies with their cranial asymmetries. Both pictures were taken by the parents and are reproduced here with their kind permission. They show in both cases a right-convex KISS situation with the accompanying cranial scoliosis, microsomy of the left side of the face, flattening of the right occipital region and a seemingly asymmetrical positioning of the ears. All these morphological asymmetries need many months to subside. The important sign at the control 3 weeks after the initial treatment is the free movement of the cervical spine. (Reproduced from von Piekartz & Bryden (2001) with permission from Elsevier.)

referral base has not changed appreciably. Argenta et al note that the timing of this increase correlates closely with the acceptance of recommended changes in sleeping position to supine or side positioning for infants because of the fear of sudden infant death syndrome (SIDS). They report that older infants were treated with continuous positioning by the parent, keeping the infant off the involved side, while younger infants and those with poor head control were treated with a soft-shell helmet. Only three of 51 patients have required surgical intervention and other patients demonstrated spontaneous improvement of all measured parameters.

The researchers report:

> *We believe that most occipital plagiocephaly deformities are deformations rather than true cranio-synostoses. Despite varying amounts of suture abnormality evidenced on computed tomographic scans, most deformities can be corrected without surgery. In cases where progression of the cranial deformity occurs, despite conservative therapy, surgical intervention should be undertaken at approximately I year of age. (Argenta et al 1996)*

Other reasons for serious cranial distortion in infants, according to medical authorities

It is reported (Miller & Clarren 2001) that deformational plagiocephaly (cranial distortion or 'crooked head shape') can result from three different etiologic processes.

- Abnormalities in brain shape and subsequent aberrant directions in brain growth
- Premature fusion of a single coronal or lambdoidal suture
- Prenatal or postnatal external constraint.

What are the long-term effects of deformational plagiocephaly?

A study was conducted to determine whether there was an increased rate of later developmental delay in school-aged children who presented as infants with deformational plagiocephaly, without obvious signs of delay at the time of initial evaluation (Miller & Clarren 2001).

A total of 181 families from the medical record review were notified about the study and 63 families agreed to participate in a telephone interview. The sample of participants for the telephone interview was random to, and representative of, the group as a whole. The families reported that 25 of the 63 children (39.7%) with persistent deformational plagiocephaly had required special help in primary school including special education assistance, physical therapy, occupational therapy and speech therapy, generally through an Individual Education Plan. Only seven of 91 siblings (7.7%), serving as controls, required similar services. One useful finding was that affected males whose deformity was due to uterine constraint were at the highest risk for subsequent school problems.

It was also noted that the use of helmet therapy to correct the distortion (a standard medical approach) did not seem to affect the rate of developmental delay, almost half of the delayed patients having worn helmets (Miller & Clarren 2001).

Different cranial approaches

This text is not an appropriate place in which to offer precise details of infant cranial care, as the methods needed for application on such delicate structures need to be learned in closely supervised clinical and classroom settings. Suffice it to say that the method of application of cranial manipulation in infants is usually direct rather than indirect, i.e. the barriers of resistance are engaged and molding is applied to normalize distortions, utilizing very gentle and sensitive holding patterns.

Biedermann (a physiotherapist, whose work on KISS children is reported earlier in this appendix) applies a direct approach in cervical treatment of KISS children, using what is described as 'minimal impulse manipulation', commonly in a lateral direction but with a rotational component in some cases.

> *We measured the force used in treatment of babies and adults [and found] the force used for treating babies is 15-20% of that used in adults. In most cases the direction of the impulse is determined by radiological findings (85%).... The manipulation itself consists of a short thrust with minimal force of the proximal phalanx of the medial edge of the second finger.*

The amount of force involved, tested with a calibrated pressure gauge, required no more effort than would be needed to 'push a bell-button energetically'.

Clinical researchers and authors such as Viola Frymann (1976) and John Upledger (Upledger & Vredevoogd 1983) record many instances of success in treating dysfunctional children, some with severe learning and behavioral problems as well as a host of physical complaints, utilizing cranial techniques (Upledger 1978). Some research has been undertaken, notably by these two pioneers but also by others such as Californian osteopathic physician Carlisle Holland (1991), whose video evidence of the benefits of cranial manipulation is well worth study.

Holland discusses mainstream methods which attempt to address infant cranial distortion (largely from a cosmetic perspective). Some of the methods currently employed by orthopedic surgeons to 'correct' cranial distortions involve surgical removal of plates of bone from the skull, fusion of sutures and the imposition of irreversible damage to the cranial mechanism. An alternative is to inflict growing infants with the wearing, for years, day and night, of a 'helmet' which forcibly molds deviant skulls into cosmetically acceptable shapes, with no regard for functional integrity (and with an enormous degree of discomfort).

Visual evidence is available via videos (such as those produced by physicians such as Carlisle Holland) of the possibility of returning the growing skull to a degree of normality, structurally, with benefits aplenty in terms of symptom relief, from associated wry neck, visual and acoustic problems, as well as behavioral and learning difficulties. The younger a baby's head is treated the better as, once ossification commences, normalization becomes more difficult.

Should cranial distortion occur in infancy and childhood, when plasticity allows for a degree of movement not available in the adult skull, in particular in relation to the sphenobasilar synchondrosis (see especially Chs 1 and 2), the resulting distortion patterns, with their associated soft tissue imbalances of the reciprocal tension membranes in particular, will become 'set' and will be largely impervious to 'corrective' treatment in adult life. Some modification of the associated stress patterns can still be initiated via cranial and other therapeutic measures, even in adult life, but restoration of structural 'normality' and symmetry becomes a virtual impossibility after childhood.

Moving away from cranial distortion to far more common patterns of ill health affecting infants leads inevitably to the topic of chronic ear infection.

Ear disease and cranial care

Spermon-Marijnen & Spermon (2001) have treated many children with chronic middle ear disease, using cranial techniques. They report that: '60 children [with otitis media with effusion] were inspected and treated with passive movements of the craniofacial region over the past 6 years; 49 children were treated successfully and 11 showed no change'.

These children had been referred by general physicians because standard treatments such as insertion of grommets, paracentesis, surgery and/or antibiotic usage had failed. Spermon-Marijnen & Spermon (2001) suggest that 'passive movement of the cranium can restore the circulation and motion by which drainage of the middle ear is stimulated'.

It is worth reflecting that this model of care represents one of the therapeutic choices, discussed in Chapter 12, in which the objective is enhancing function so that the adaptation load (inflammation, congestion, etc.) can be better handled via enhanced drainage and circulation, with homeostatic/self-regulating mechanisms effecting the recovery.

As discussed in Chapter 12, these clinicians commence the process of treatment by observation, palpation and motion palpation.

> *Look at symmetry or deformity, paying special attention to asymmetry, the orbital line, the level of ears related to the level of eyes, and the mastoids. Palpate the vault and position of the sutures, noting swelling, overlap and mobility. Test the condylar parts of the occiput and examine the occipito-atlantal mobility.*

As has been repeated throughout this book, palpation and motion palpation merge readily into treatment: 'The techniques of passive motion testing are, in our opinion, also effective as therapeutic movements, with the application of additional or sustained pressure'.

In earlier chapters it has been suggested that treatment of the adult cranium frequently involves indirect methods ('exaggerate distortion'), although direct methods can also be useful (springing methods, decompression, V-spread, etc.). In contrast, when treating infants, direct approaches are most commonly utilized, reflecting the far more pliable nature of the tissues involved.

The following list is a summary of the methods described by Spermon-Marijnen & Spermon (2001) as relevant techniques used for children with chronic ear conditions. Some of these methods, as well as similar but not identical approaches, have been outlined in previous chapters, most notably in Chapters 6 and 7.

1. Transverse **movement of the** sphenoid. Sitting at the head of the supine patient, one index finger and middle finger on the sphenoid and the other index and middle finger on the contralateral zygoma and frontal bone, pressure is used to gently shunt the sphenoid into a translation. Hand positions then reverse and translation to the other side is introduced. In this same opposition rotation of the sphenoid is also achievable. Note: this is similar to the method described in Exercises 6.5a and b and 7.8. See also method 10 in Chapter 10, describing Jones's method for treatment of the sphenoid tender point.

2. Longitudinal movements **of the** nasofrontal region. Standing to the side of the supine patient, one hand over the crown of the head, the index finger contacts and stabilizes the supraorbital region on one side, while the other hand uses a pincer contact on the superior aspect of the nose to introduce a distraction force. This may be sustained or can rhythmically 'pump' the area. One side is treated and then the other to 'influence the frontal and maxillary sinuses'. While not identical, the methods described in Exercises 7.10 and 7.11 will achieve similar results.

3. Transverse movement **of the** zygomatemporal **and** zygomamaxilla region. The patient is supine and the practitioner is seated at the


Figure A2.5 Movement of the zygomatemporal region. (Reproduced from von Piekartz & Bryden (2001) with permission from Elsevier.)

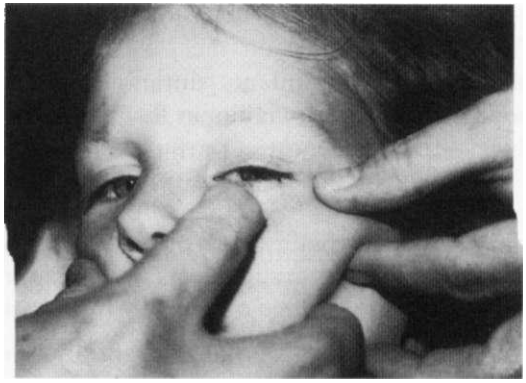
Figure A2.6 Movement of the zygomamaxilla region. (Reproduced from von Piekartz & Bryden (2001) with permission from Elsevier.)

head. One side is treated at a time, (a) Using finger and thumb contacts of each hand, one contact closer to the zygomamaxilla junction and the other closer to the zygomatemporal junction, a gentle distraction/separation is introduced as the patient's head is rotated contralaterally. (b) Thumb and index finger of one hand is placed on the zygoma and the same contacts of the other hand are placed on the maxilla, allowing distraction that eases the zygoma laterally and cephalad and the maxilla medially and caudad. The distraction is applied and released synchronous with the breathing of the patient several times. Spermon-Marijnen & Spermon suggest that these methods influence the maxillary and frontal sinuses. See Exercises 6.5c and 7.37 for variations on these approaches. See Figures A2.5 and A2.6.

4. **Longitudinal movement of the petrous bone (mastoid lift).** The patient is supine and the practitioner is seated at the head. With finger contact on the petrous portion of the mastoid bone, rhythmic repetitive longitudinal traction is applied cephalad, synchronous with breathing. This decompression approach is thought to influence the craniocervical region. See also Exercises 7.32 and 7.34 for rhythmic approaches utilizing leverage of the mastoid processes.

5. **Rotation of the forehead on hindhead.** The forehead is held with one hand, while the other cradles the occipital region, to act as a stabilizing force. The frontal bone is gently rotated clockwise then anticlockwise several times to influence sinus drainage. See also method 9 in Chapter 10, describing Jones's treatment of the sphenobasilar tender point, which uses similar mechanics (see Fig. 10.10).

6. Distractions of relevant sutures. A gapping pressure is applied at right angles across sutures. See Exercise 7.6 for a description of the V-spread technique, as well as method 11 in Chapter 10 describing Jones's treatment of the squamosal tender point, which distracts the parietal bone from the temporal, gapping the suture between them (see Fig. 10.10).

7. Opening external auditory meatus. The patient is sidelying, head on a firm pillow. The practitioner places two fingers of one hand on the mastoid process and two fingers of the other hand anterior and superior to the external auditory meatus. A rhythmic separation stretch is introduced, with the patient being asked to either swallow after each stretch, swallow during the stretch or perform a Valsalva maneuver during the stretch (i.e. inhale, hold the nose and attempt to exhale through the nose, creating increased pressure in the nasopharynx, in an attempt to open the Eustachian tubes).

CONCLUSION

Cranial treatment of infants differs from the methodology applied to adults in that it usually involves direct approaches. Pressures used are even lighter for infants than the gentle methods suggested for adults. Whether problems are developmental or distortional or treatment is aimed at improving drainage (as in otitis or sinusitis), there are a range of effective treatment methods, examples of which have been described in this chapter.

> **CAUTION**
>
> It is essential that appropriate training is undertaken before infants are treated using cranial methods.

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Abbreviations used: AK, applied kinesiology; BOCF, biodynamic model of osteopathy in the cranial field; CRI, cranial rhythmic impulse; CSF, cerebrospinal fluid; FJO, functional jaw orthopedics orthodontics; MET, muscle energy technique; MFR, myofascial release; NMT, neuromuscular technique; PRT, positional release; SOT, sacro-occipital technique; TMJ, temporomandibular joint

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