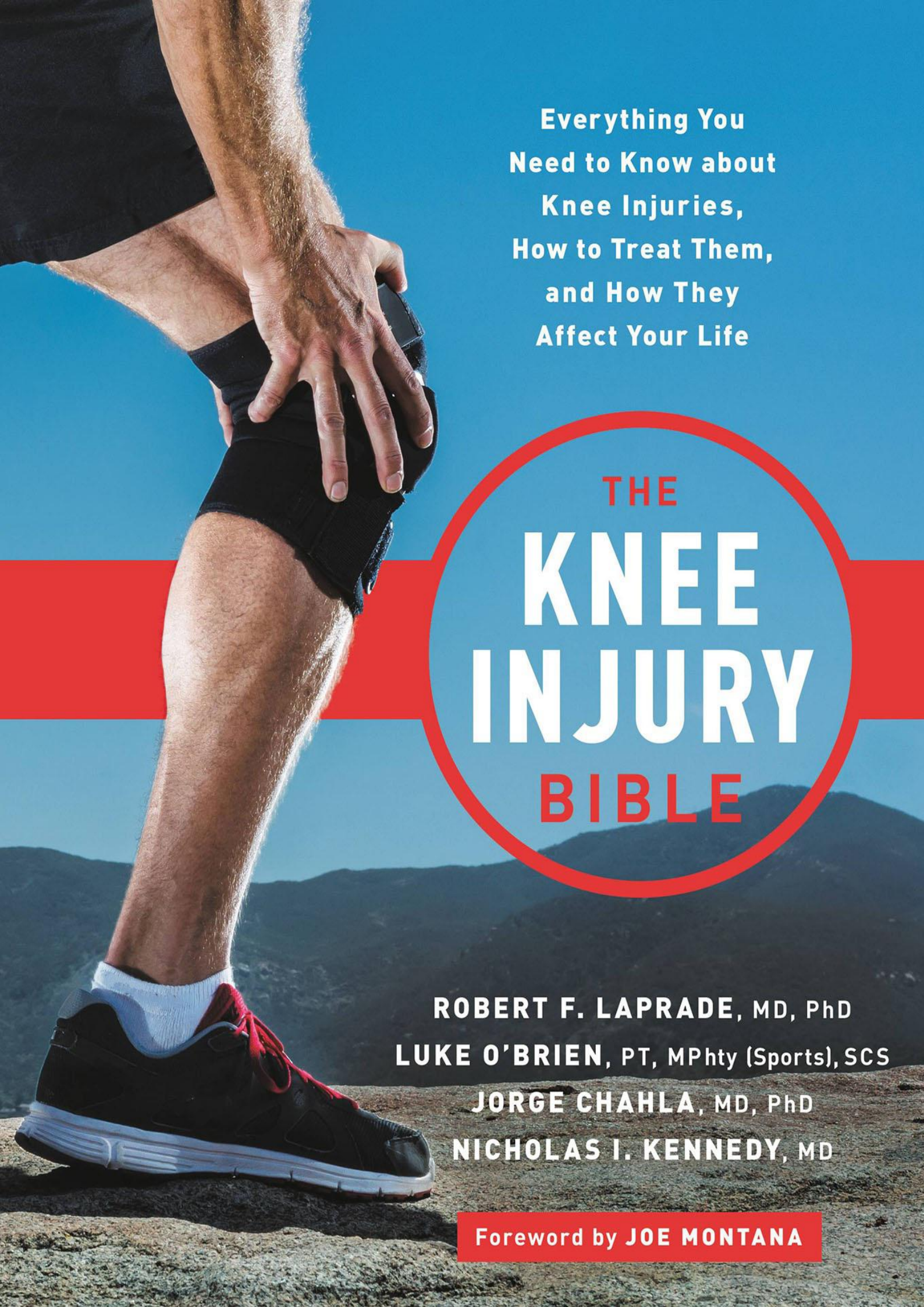
Everything You Need to Know about Knee Injuries, How to Treat Them, and How They Affect Your Life
THE KNEE INJURY BIBLE
ROBERT F. LAPRADE, MD, PhD
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Foreword by JOE MONTANA

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This book is dedicated to our patients as well as the many patients who will read this book in the future. We hope the information in this book will help them in their healing process and even enrich their lives.

FOREWORD

by Joe Montana

The sport of football has brought more into my life than I could have ever imagined. A brotherhood of lifetime bonds, a strong work ethic, a chance to see the world, and the opportunity to spend a career loving what I did. In my seventeen-season NFL career, I played in hundreds of games, threw thousands of passes, and was fortunate enough to compete on some of football's biggest stages.

But playing the sport I love for so many years came with a price. The mileage I put in on the field was mileage that was taken from my post-football body. When I stepped off the field for the last time, I did so thinking that while my NFL career lay behind me, I had an entire active life ahead of me. My body had other reckonings for me.

The time I thought I was getting back became time I spent in doctors' offices: consultations, x-rays, surgeries, physical therapy. I've had elbow surgery, three neck fusions, and half a dozen knee surgeries. I also have arthritis in my elbows, hands, and knees. I've been in and out of a doctor's office enough times to have an honorary degree. Yet although I was fortunate to have access to the world's greatest in medicine, advanced tools, and surgery methods, I still faced a fear of the unknown with each visit.

Hindsight being 20/20, knowledge is power. Early in my career, there was so much I didn't know—and still so much I don't know. What allowed me to be my best on field was the work I put in off-field: countless hours studying tendencies, learning the intricacies of my craft, educating myself on strengths and weaknesses of my opponents. Every big play, every single drive, every

pass thrown was rooted in months or years of preparation and education. The more you know, the better primed you are to achieve your goals and succeed.

The same can be said for your knee: the more you know about it and its relationship to the rest of the body, the better prepared you can be to recover, and to stay healthy, strong, and without injury.

In *The Knee Injury Bible*, Dr. LaPrade, Dr. Chahla, Luke O'Brien, and Dr. Kennedy have put together a book with that exact goal in mind: to educate and empower the patient. From their combined fifty-plus years of experience in sports medicine, they have written this book for you, beginning with injury and ending with recovery and covering everything in between. Having also been a knee patient himself, Dr. Kennedy offers further insight through the eyes of someone who has been there.

A resource like this would have been incredibly helpful for me during my own experiences with injury, and is a must-have for anyone with a knee injury, whether fresh or a years-old disability.

INTRODUCTION

by Dr. Nicholas Kennedy

Autumn mornings in Vail, Colorado, have a certain feeling to them. There's fresh dew on the ground, a crisp chill in the air, and a medley of yellow aspens dotting the valley. The year is 2012, and I'm taking advantage of the cool weather, playing some flag football with a few friends from my work at a sports medicine clinic, most of whom happen to be doctors or medical students. The league may be amateur, but for this group of former competitive athletes, winning is definitely still a top priority.

This competitive, take-no-prisoners attitude has earned my team a spot at the championship game—which we are currently losing. Badly—down 21 to 6 already and only in the second quarter. *Frustrated* doesn't even begin to describe my mental state. To make matters worse, I have a pulled groin on my left side, easily one of the worst I have ever experienced, and it's causing some annoying—and I admit, embarrassing—limping.

"Hey Max," I shout at one of my teammates, "play safety. I'm gonna rush the QB from now on!" With levelheaded thinking having gone by the wayside hours ago and the championship title on the line, this flag-football game has morphed into NFL Game Day.

After the next snap, I take off after the quarterback with a desperate fervor, sprinting at a completely unimpressive speed. Just as I reach the opposing quarterback, who I might add is thirty years my elder, he sidesteps to my right but takes off to the left, an incredibly effective juke. When I attempt to recover from his tricky change of direction by cutting from my right leg, which is already bearing most of my weight thanks to the groin pull on the

left, my right foot inconveniently finds a pothole in the grass. As my awkward cut turns into a rather dramatic plunge to the ground, I hear a *crack* like a firework on the Fourth of July.

The knee pain that follows is as nausea-inducing as it is excruciating. Rolling on the ground, I'm utilizing a full arsenal of vocabulary to describe my pain. But if you are going to hurt yourself playing flag football, might as well do it with a team full of orthopedic residents and medical school students on site to diagnose you.

And the diagnoses start flying.

"I think it's his ACL [anterior cruciate ligament]," one declares, after he's finished his spur-of-the-moment evaluation.

"His ACL feels fine to me, but I think maybe his FCL [fibular collateral ligament] is loose," proclaims another.

The battle between diagnoses continues, but one thing is for sure: whatever is torn or broken, my knee hurts like the dickens. As I rise to take my first step to get off the field, my right leg does a sideways curtsy, and it becomes abundantly clear that some things that should be working are definitely not.

The morning after that fateful flag-football championship game, my boss (now friend and mentor) Dr. Robert LaPrade, an orthopedic surgeon, performs a thorough exam on me, including several maneuvers to assess the status of the different ligaments of my knee. From the look on his face, I can tell I have done a number on it.

He shakes his head. "Your FCL is torn for sure. ACL too, probably. You need an MRI [magnetic resonance imaging] and stress x-rays."

Later that day, the MRI confirms his suspicions. I have torn my ACL and my FCL, and also have a small tear of my meniscus, which is the knee's cushion. Surgery is in my near future.

Still, pain aside, none of this seems to faze me; why should it? I'm twenty-three years young, and figure it'll heal fast. With a quick surgery and rehab, I'm sure I'll be back to reliving my glory days in the local basketball, flag-football, and softball leagues in no time. I even say to Dr. LaPrade confidently, "I'll be back in time for Hoopfest, no problem," a three-on-three basketball tournament in my home state of Washington the following June.

I was fortunate enough to have some background in the field of

orthopedics, which deals with bone, muscle, and ligament injuries. At the time of my injury, I was completing a year of sports medicine research in Vail. While I was still very green, I knew what my knee ligaments were, and I had a basic understanding of what surgery and physical therapy encompassed. I had also grown up around surgery and sports medicine—my father is a sports orthopedic surgeon in Yakima, Washington. I was often on the sidelines at semiprofessional games or touring hospitals on weekend rounds with my dad. Additionally, over the years I'd seen my younger sister, my wife, and my sister-in-law all tear their ACLs and undergo reconstructive surgery. It had been easy for them, right?

So I was more than confident this process would be smooth. I was going to have my surgery done at Steadman, arguably the best place to have ACL reconstructive surgery. Names like Kobe Bryant, Ed Reed, Alex Rodriguez, Ricky Rubio, and a whole host of other professional athletes have had their surgeries done here. On top of that, I was going to be treated at Howard Head Physical Therapy, a mecca for sports rehabilitation. I wasn't just in good hands; I was in the most capable hands you could ask for. This was going to be a breeze!

How's that Montgomery Gentry song go again? "Lord, I'm learning so much more than back when I knew it all." Or said in another way, ignorance is bliss. I came to find out that injuring your knee is no joke. Surgery is not the walk in the park that I had made it out to be in my head, nor is physical therapy the leisurely bike ride you might want to take around the park. My ten-thousand-foot view of watching others go through the journey of knee recovery would be nothing like actually experiencing it.

During my recovery, I remembered words I had spoken to my sister once during her ACL rehab: "Just do your exercises, Julia. Physical therapy is easy." Those words would be the purest form of karma during my weeks of struggling to regain my normal motion and strength. Let it be known that I was definitely not playing full-contact basketball at eight months post-injury, as I had so arrogantly proclaimed. It would be months, and honestly years, until I was back to doing the things I love to do: everything from playing basketball and football to hiking and fishing.

THE PURPOSE OF THIS BOOK

If you have suffered a knee injury, this book is meant to be your road map to recovery: understanding why your knee injury happened, your treatment

options, and how to regain function and return to your favorite activities as quickly as possible with least risk of reinjury. When I got injured, I was fortunate enough to be immersed in the world of orthopedics, surrounded by the best care one can receive—yet despite this I still, at times, felt completely lost. I'd had unrealistic expectations when it came to my treatment and my recovery, and it was these fairy-tale ideas that led to my long and admittedly complicated rehab journey. A journey that included development of significant knee stiffness that required additional surgery, a fall in the bathroom the night of my second surgery leading to another knee ligamentous injury, hours of continuous passive motion device usage (see here), and more than fifty physical therapy visits, before eventually regaining full function.

I like to tell my patients the knee is an incredibly logical joint—its logical quality is one of the reasons why we authors of this book are such fans of it and have a passion for treating injuries of the knee. By "logical" I mean that its function is very easy to understand. The knee mainly does two things: flexes and extends. It does not want to move in and out (abduct or adduct), nor does it want to rotate internally or externally like the hip and shoulder; it is a very stable joint. But because it only wants to do two things, there are a lot of movements that can cause injury, and furthermore its location along our biomechanical axis exposes it to *a lot* of force with every step. This is a good explanation for why the knee is the most common joint injured by adolescent athletes, responsible for approximately 2.5 million emergency department visits per year.

And all the force the knee joint is exposed to day in and day out, combined with the high prevalence of acute injuries, helps explain why the knee is also the most common joint to be affected by arthritis. Nearly one in five adults over age forty-five have knee osteoarthritis. This is a fairly staggering statistic, even more so when one considers our current aging population and the number of people in the United States in that age group, approximately 120 million people.

Even though knee injuries are highly prevalent, they can be challenging to manage. Why is this? We think it boils down to three major factors: lack of adequate information, lack of patient comprehension, and lack of access to proper care and implementation of necessary rehabilitation steps.

All three of these factors are intricately related. Some of you are probably familiar with the saying "too much of anything is bad." That saying definitely holds true for medical information. In today's culture, where Google searches make answers available at the click of a button, everyone can feel like an

expert. The problem is that a good deal of the information presented as fact is not vetted and is actually far from fact. A wealth of resources sometimes actually makes it more difficult to get the knowledge you need, and this is particularly evident in medicine.

The lack of good information and abundance of misinformation then help lead to the second problem, which is lack of comprehension. Patients read something they believe to be true, or hear a doctor on TV, and assume it applies to them, which can lead to a poor understanding of their problem. This then directly leads to not receiving proper care or taking the timely, necessary steps for recovery. In our practices, we've found that often patients do not fully grasp the importance of their knee injury—not just the current impact but the impact on the long-term health of their knee and whole body.

We want to help people learn from our mistakes, and also make decisions in as informed a way as possible. It is our goal to give you the power, knowledge, and encouragement to succeed, and to not only help you understand what your knee injury is and how to treat it but give you a more holistic and educated view of your injury and the journey that lies ahead. We will cover what to do, where to go, who to see, and what it all means. We will help provide a good estimate of what one can expect with surgery in regard to pain, medications, rehabilitation, diet and its effects, the new advancements of what is called "stem cell therapy" and beyond, and how and when you can expect to get back to doing the things you love.

This book is for the seventeen-year-old senior in high school who has just torn their ACL in the middle of their last year of high school sports. It's also for the seventy-five-year-old mother and grandmother with daily knee pain that is beginning to make it tough for her to enjoy her hobbies or keep up with her grandkids. This book is for the forty-five-year-old office worker who has seen the number on the bathroom scale continue to climb but is experiencing too much knee pain to stop the climb. It is even for the parents of the teenager who is trying to decide if knee surgery is the right decision. Is it too invasive, aggressive, or maybe just plain unnecessary for their child to undergo?

In short, this book is for you—the patient, the patient's parent, family member, or loved one—to provide you with an arsenal of information so that this whole process feels less overwhelming. We don't expect you to emerge from reading this book with a medical degree, but we do hope you come away with an improved understanding of your injury and what can be done for it.

ABOUT THE AUTHORS

So who are your Mr. Miyagis to teach you the wax on and wax off of the knee joint? There are four of us. The veteran of the group is Robert LaPrade, MD, PhD. He is a sports-certified orthopedic surgeon who practices at Twin Cities Orthopedics in Edina, Minnesota. He has more than twenty-five years of experience in the field and has helped thousands of patients (including scores of professional athletes) address their injuries and eventually return to the life and activities they love.

Dr. LaPrade also has a passion for research and has published more than four hundred seventy-five peer-reviewed papers, which serve not only to help shape his practice but also to help advance the field of orthopedics as a whole. He has traveled around the globe to present his work and educate others in the field. Among his numerous awards for his research is the Kappa Delta Award, which is the highest career honor for orthopedic research. Time and time again he likes to say, “There is nothing like your health.” He knows how important your knee health is for your overall health, and he aims to help patients understand and treat their injuries.

Luke O’Brien is an Australian-born physical therapist and head of the Howard Head Sports Medicine Center in Vail, Colorado. Luke is a well-respected physical therapist in the field of sports medicine and has led the way in several areas, including developing return-to-sport criteria. He has worked with all-pro NFL players, all-star NBA players, soccer players in the top European leagues, NHL stars, and of course, a moderately athletic and overconfident medical student whom he then agreed to write a book with years later.

In his practice, Luke has developed rehab plans for people from all walks of life, from the casual outdoor enthusiast to the professional athlete. He has a wealth of knowledge on the physiology and biomechanics of the human body, and he also has widely published his research work and been invited to give presentations all over the world.

A native of Argentina, Jorge Chahla, MD, PhD, is an orthopedic surgeon and researcher who now works at Rush University Medical Center in Chicago. He is someone who could not get enough education. Not only did he complete the usual five years of medical residency, but he also has completed two years of research fellowship and two years of clinical fellowship in the field of sports medicine at two of the top ten programs in the country, at the Steadman Clinic in Vail, Kerlan Jobe in Los Angeles, and Rush University in Chicago. He too has done extensive research, publishing in more than two

hundred peer-reviewed publications, and he has a particular interest in biologics in orthopedics—things like stem cell, platelet-rich plasma, and other biologic healing modulators, and how they affect your knee, and whether or not they actually work. (We'll discuss these in-depth in Chapter 11.)

Dr. Nicholas Kennedy is currently in his third year of orthopedic resident training at the Mayo Clinic. He completed medical school at Oregon Health & Science University and spent about two years in Vail working on research with their world-renowned staff. He has more than fifty peer-reviewed publications focusing on biomechanics, reconstruction, and rehabilitation of knee ligamentous injuries. At the age of twenty-three he won the Excellence in Research award, given to the best research paper at the American Orthopaedic Society for Sports Medicine annual meeting in 2014. Having had a serious knee injury himself, he also knows firsthand what it's like to be on the other side of the operating table as an orthopedics patient.

Together, we have a combined fifty-plus years of experience with all aspects of treating knee injuries. Here we've shared our expertise to give you the most up-to-date and comprehensive view possible.

YOUR ROAD MAP: HOW TO USE THIS BOOK

Many of you reading this book are probably already overwhelmed regarding your injury, what it means for your life, and what to do going forward. This book is meant to help ease the burden—it should be a tool that should act to reduce stress, not a homework assignment that adds stress. With that in mind, here's how to best utilize this book as your resource.

We have written the book in the order of how most patients address their injury. First you get hurt, and you find yourself asking, *Why and how did this happen?* That is the focus of Part 1, and why we start the first chapter with an explanation of what the knee joint is, how it gets hurt, why some people hurt it easier than others, and what traits you may personally possess that lead to an injury. We also give you some brief anatomy—not so much that you will feel like Billy Madison in biology class, but enough so that it gives you a foundation for understanding later chapters. Next, in Chapter 2, we address the question of what to do. Whom do you see? What tests are performed? How are they performed? When can you wait to see a doctor versus when is it urgent? We'll look at the steps leading to a diagnosis.

Chapter 3 gives you a closer look at the top twenty-five knee injuries. We'll talk about your diagnosis, explain some more regarding the anatomy

and biomechanics (aka the “what” and “how” of the injury), and then give you treatment options. These include surgical and nonsurgical options.

In Part 2 of this book, Chapters 4, 5, and 6 are all things that involve surgery. What things happen leading up to surgery, what your day of surgery and recovery in the hospital or at home look like, and what common mistakes and misconceptions are regarding the entire surgical process. Our attempt in these chapters is to *minimize surprise*! We hope to give you as much information regarding the process as possible so that you can be more prepared. The authors of this book are firm believers in educating our patients and not sugar-coating. If we tell you, “After surgery, you won’t hurt at all,” or “Rehabilitation will be easy” and the medications have “no side effects,” it may convince you to have the surgery, but it does nothing to establish good rapport, and in actuality leads to worse outcomes and loss of trust between patients and doctor. These chapters should help educate you on the process as much as we can on paper. Chapter 7 is your guide to the medications you may be prescribed for a knee injury.

Part 3 is all about how to maximize your recovery to get your knee function back. In Chapter 8, we’ll talk about how to avoid complications postsurgery and what’s important to do—and *not* to do—in those early days and weeks. Chapter 9 discusses the rehab and physical therapy part of treatment, both for those undergoing surgery and for those opting to go the nonsurgical route. This part of the book has a significantly increased photo-to-word ratio with photos demonstrating how to do each of the exercises we suggest. Here, Luke also lays out some specific rehab exercise plans with set and repetition ranges to give some guidance for each phase of recovery.

Chapter 10 covers some nutrition and diet basics. The topic of how diet affects systemic health, and our musculoskeletal health, is a constantly evolving topic. We’ll look at the importance of protein and how the food you eat may improve healing and ease inflammation. Many types of diets may be effective for health and weight loss, from Mediterranean to vegan to paleo, and dozens of books are available. With that in mind, here we are giving some basic recommendations based on the best of our knowledge and the best scientific evidence available.

Chapter 11 addresses some of the nonsurgical treatment options, such as cortisone injections, which we find many of our patients have questions about. We also talk about more cutting-edge treatments you may have heard about in the media, or in professional athlete circles, such as stem cell therapy and platelet-rich plasma. Our goal in this chapter is not only to explain the

options but also to explain the evidence. A lot of treatments being pushed on the public actually have very little evidence to suggest they have a measurable effect, and while they are relatively safe and sometimes worth the old college try, you as consumers should know as much as possible about the product you are about to pay (sometimes a hefty ransom) for.

Finally, Chapter 12 covers prevention—or how not to be living Bill Murray's life in *Groundhog Day* when it comes to your injury. We discuss some ways to help maintain your knee strength and avoid reinjury.

As the book is organized chronologically, should you want to go through the journey of injury from start to finish, you can easily do so. But let's say you have already had surgery, and you are just looking for some information on recovery and return to sport—simply jump to Chapter 8 and beyond. Or if you just want information on your diagnosis, skip to the subtopic in Chapter 3—or even just the "Rundown" box that follows each entry for the short version. If at any point you decide you want more information about the anatomy of your injury or why it happened, then you could backtrack to opening chapters.

The point is that you can use this book in any way you see fit. This book is a tool—you do not need to conform to the book; it should conform to you!

Lastly, although yes, this book is written by medical professionals, and yes, it is based in scientific evidence and combined decades of experience, please note that it should not *replace* seeing and receiving direct care from medical professionals. That is to say, please do not consult this book instead of going to see a doctor. Please don't think to yourself, *Well, I know what my diagnosis is based on the book, so I do not need to see anyone*. The book is meant to supplement your care with your physician, physical therapist, dietician, and treatment team. It should work in concert to empower you, so that you can have informed discussions with them, but please follow your own physician's and medical team's advice. And be sure to talk with them before starting any exercise program.

YOU CAN DO IT

One thing we want you to remember throughout this book is that the process of bouncing back from a knee injury won't always be easy. It won't always be fun. But you *can* do it—and it's worth it! Surgery, rehab, the long hours involved, the medications you take, the pain and soreness, they are all a part of the process. You can and you will improve if you stick with it.

My journey from a torn FCL, ACL, and meniscus involved multiple surgeries. At one point in time I was a twenty-three-year-old who suddenly couldn’t bend his knee further than 60 degrees (remember 90 degrees is a right angle; you need about 100 degrees just to sit in a stadium or movie theater seat) or go up and down stairs normally. It took me a year to walk without a limp, and eighteen months to jog again. As I recovered, I managed to reinjure my knee twice. But eventually I got there. In time you will, too.

Thanks to the amazing care I received, the hours of rehab, eating right, and pushing myself to regain my knee functionality, the local community flag-football leagues are still graced with my mediocre quarterbacking skills, and open gym basketball courts still get to see my attempts to take shots that don’t quite find the bottom of the net. Seven years after my injury, I’m able to work out, bike, and hike. I’m on my feet all day in a bustling hospital, and my knee manages to keep up. And I’m happy to say I can now do these things with minimal pain. All this is to say: if I can do it, so can you. *The Knee Injury Bible* is your guide to getting the best possible outcome for your knee.

PART 1

HELP! MY KNEE IS NOT WORKING!

HOW DID THIS HAPPEN?

Factors That Lead to Knee Injury and Chronic Knee Pain

Unfortunately, if you are reading this book, you or a friend or loved one has experienced a knee injury. You didn't sign up for that pain and inconvenience, right? You're not alone. In medicine, it seems no matter what the diagnosis, whether it's an ACL tear or meniscus injury—or pneumonia or cancer, for that matter—a shared question most everyone has is: *Why me?*

For thousands of years the answer for almost all conditions was also very similar: *because*. Or in other words, tough cookies—it happened. Thankfully, medicine has come a long way from Hippocrates's day to the modern era of medical meccas like Mass General and the Mayo Clinic. As medicine has advanced, experts have been able to pinpoint with greater clarity why certain ailments affect certain people. The goal of this chapter is to give you a basic understanding of how your knee works and what factors may have led to the injury.

With this knowledge we hope to educate and empower you to feel more confident in understanding your injury. A large amount of the fear and anxiety that comes with an injury is due to the unknown that comes with it. We want to try to answer as many questions as possible to make more of the unknown known, and thereby make you more comfortable in your recovery process.

A LOOK INSIDE YOUR KNEE

The knee joint is one of the strongest and most important joints in the human body. It can withstand your body weight not only for simple activities such as walking and climbing stairs, but also during pivoting activities when it must

bear significant loads. Although a complex structure, the knee is actually relatively simple in terms of its main function. It basically wants to flex and extend in a straightforward, stable, harmonious way, allowing the lower leg to move relative to the thigh.

There are two main bones, and four total bones, involved in the knee joint. There is the shinbone (tibia) and the thighbone (femur), which are the main attractions. The opening acts, if you will, are the fibula (smaller bone in lower leg) and your kneecap (patella). These bones, and the soft tissues involved as well, must all interact in such a way as to maintain balance and alignment of the knee.

Let's take a deeper look at some of the key structures inside your knee. (See Figure 1.1.)

The Bones and Joints

OK, we know we just called it a joint, but in reality the knee is composed of *three* joints: (1) the *tibiofemoral joint*, which is formed between three bones: the thighbone (femur), the shinbone (tibia), and the kneecap (patella); (2) the *tibiofibular joint* between the shinbone (tibia) and the fibula; and (3) the *patellofemoral joint*, which is the kneecap with the end of the thighbone. All three of these joints work in harmony to encompass the knee.

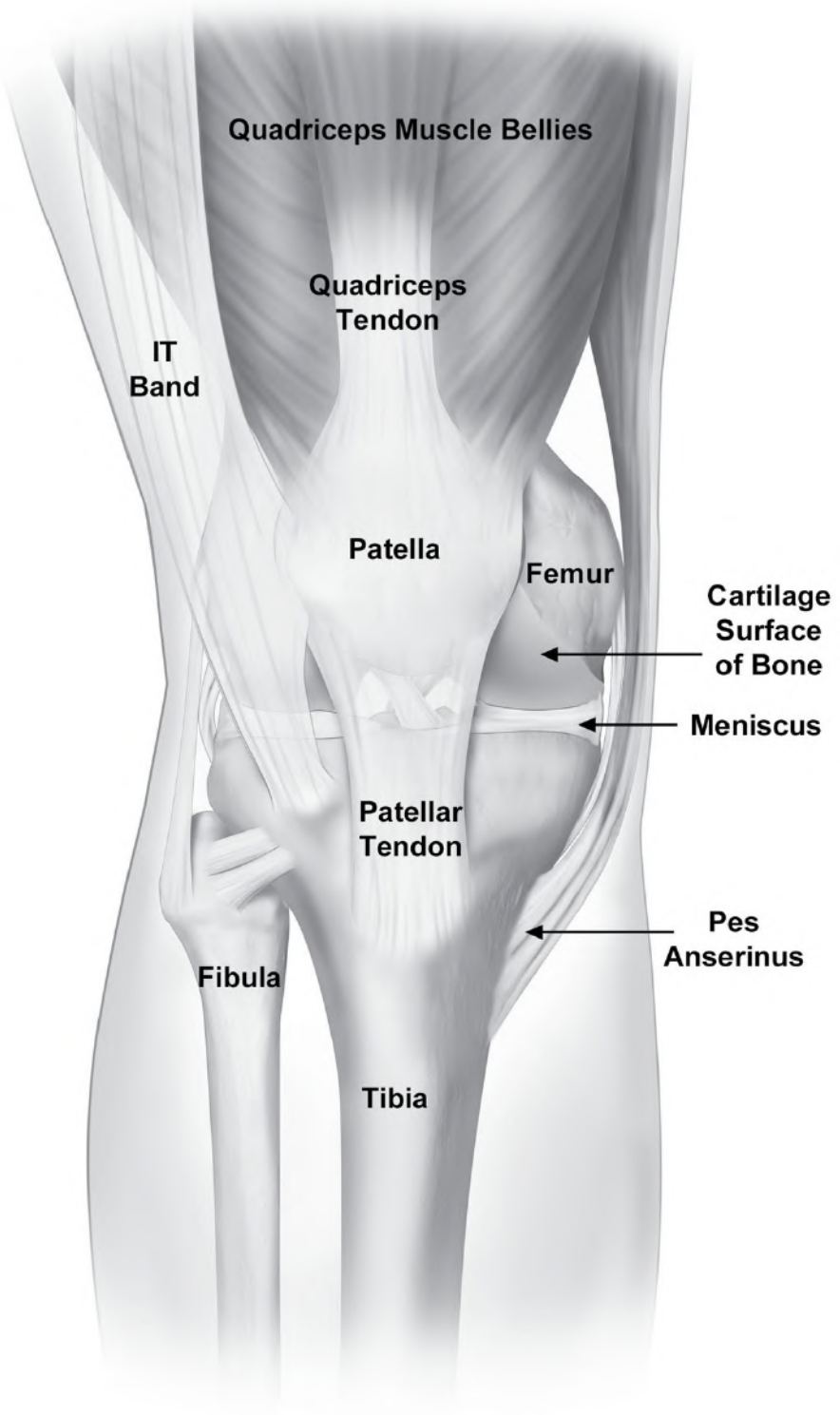


FIGURE 1.1.

Anatomy of Anterior (Front) of Knee

The patellofemoral joint, in particular, is an extremely complex joint that is frequently a source of pain for many patients. The kneecap is vital to extend and bend the knee. It allows for greater strength and mobility of the knee joint. The kneecap is flat on the front and has a V shape on the back. That V

interacts with a groove that the femur has on its end, which is called the *trochlea*; the V slides up and down in that groove. The *quadriceps tendon* (which comes from the quadriceps muscle, a large muscle that runs down the front of your thigh) attaches into the upper border of the kneecap and is one of the main contributors to your knee's range of motion. The pain generated from this joint commonly comes from the grinding of the back of the patella on the V area of the femur it slides within. This can happen from overuse with time, or from malalignment where the V of the patella doesn't sit quite perfectly in the groove and instead rubs on the edges of the groove.

The tibiofemoral joint is composed of two rounded structures from the femur (known as the femoral condyles), which interact with two roughly flat structures from the tibia (the tibial plateaus). Everything on the knee will be referred to from now on as *medial*—inside of the knee—or *lateral*—outside of the knee. For example: medial and lateral femoral condyles—inside and outside, respectively—and medial and lateral tibial plateaus—inside and outside, respectively.

The surfaces of every bone that participate in forming a joint are covered with a layer of gristle (cartilage) that gives them an extremely smooth surface so they can move without friction and protect the underlying bone from damage. As the bone does not have a smooth surface, if the cartilage is gone—for example, in patients with advanced osteoarthritis—there is grinding of the joint. The joint is also filled with a small amount of fluid that allows for improved and frictionless motion, therefore reducing wear on the cartilage. This fluid is created by the joint lining or capsule—imagine a small, thick bag that encompasses the whole joint.

The Cushions: Pregnancy Donut for Your Knee

Between the femur and tibia are two structures that act as a cushion for the knee joint: the medial and lateral *meniscus*. These structures are tough and rubbery, which allows them to function as a "shock absorber" inside the knee to prevent the direct contact of the leg bones, diminishing the load that the tibia receives with every step or even more during landing (when jumping or running) or when lifting weights. These structures have a C shape and are referred to by three zones: a front part (anterior horn), a middle part (body), and a portion on the back (posterior horn). Furthermore, they are strongly attached to the tibia so they are not displaced during knee motion, through the meniscal roots. These root attachments are really important because if they are injured, the meniscus stops working, letting all the load that comes from the femur go directly to the tibia.

In addition to the main knee structures, there are also several structures around the knee that help cushion and protect the joint from friction and outside forces. Small pockets that contain fluid, which are called *bursae*, are distributed in several parts of the knee to reduce the friction from movement of tendons across the surface of the joint. They are important to further reduce the friction between bones by allowing for better sliding of the surfaces. (An adult knee normally has between three and five milliliters of joint fluid.) In addition, fat deposits around the knee, known as *articular fat pads*, help with knee motion and to cushion the knee from external stress. One of the most important is located below and behind the kneecap, the *infrapatellar fat pad*, which absorbs from the front of the knee (like an airbag) and cushions the patellar tendon as it moves when the knee flexes and extends.

Ligaments for Stability

But wait, there's more! In order to keep the overall knee stable, there are several ligaments (think: cords) around the joint capsule of the knee to reinforce its structure and hold its bones in the proper alignment.

On the front, the patella is held in place by the *patellar tendon* or ligament, which attaches to the tibia.

On the inner side of the knee, the *medial collateral ligament (MCL)* connects the medial (inside) side of the thighbone to the tibia and prevents forces applied to the lateral (outside) side of the knee from moving the knee medially. (See Figure 1.2.)

Likewise, the *lateral (fibular) collateral ligament (LCL)* binds the lateral side of the femur to the fibula and prevents forces applied to the medial side of the knee from moving the knee laterally. The LCL is also called the FCL because it attaches to the fibula, which is the skinny bone on the outside of your knee. (See Figure 1.3.)

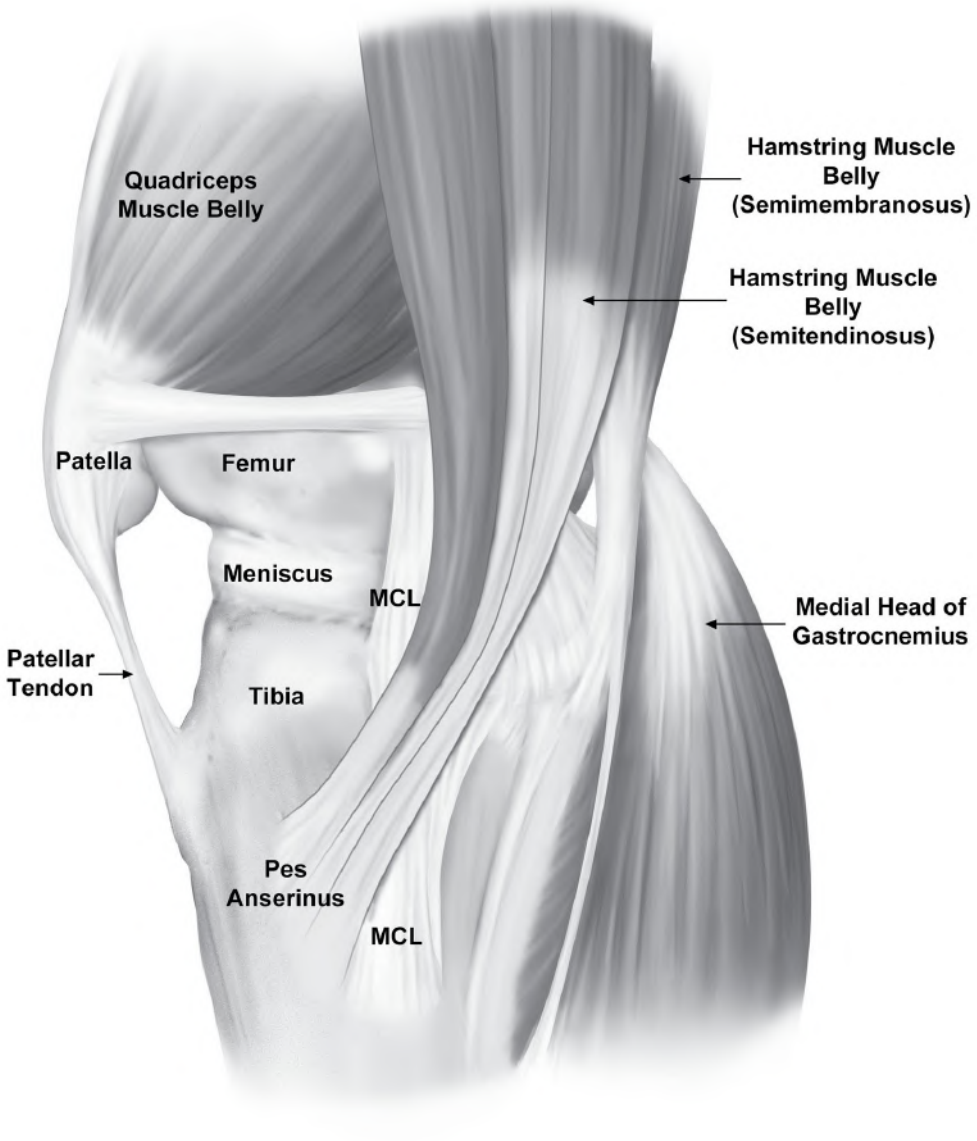


FIGURE 1.2.

Anatomy of Medial (Inside) of Knee

On the inner and outer sides of the knee, toward the back of the knee, there are more complex structures called the *posteromedial and posterolateral corners of the knee*, respectively, that can prevent knee instability when it is in extension. Injury of these structures makes any injury much more severe.

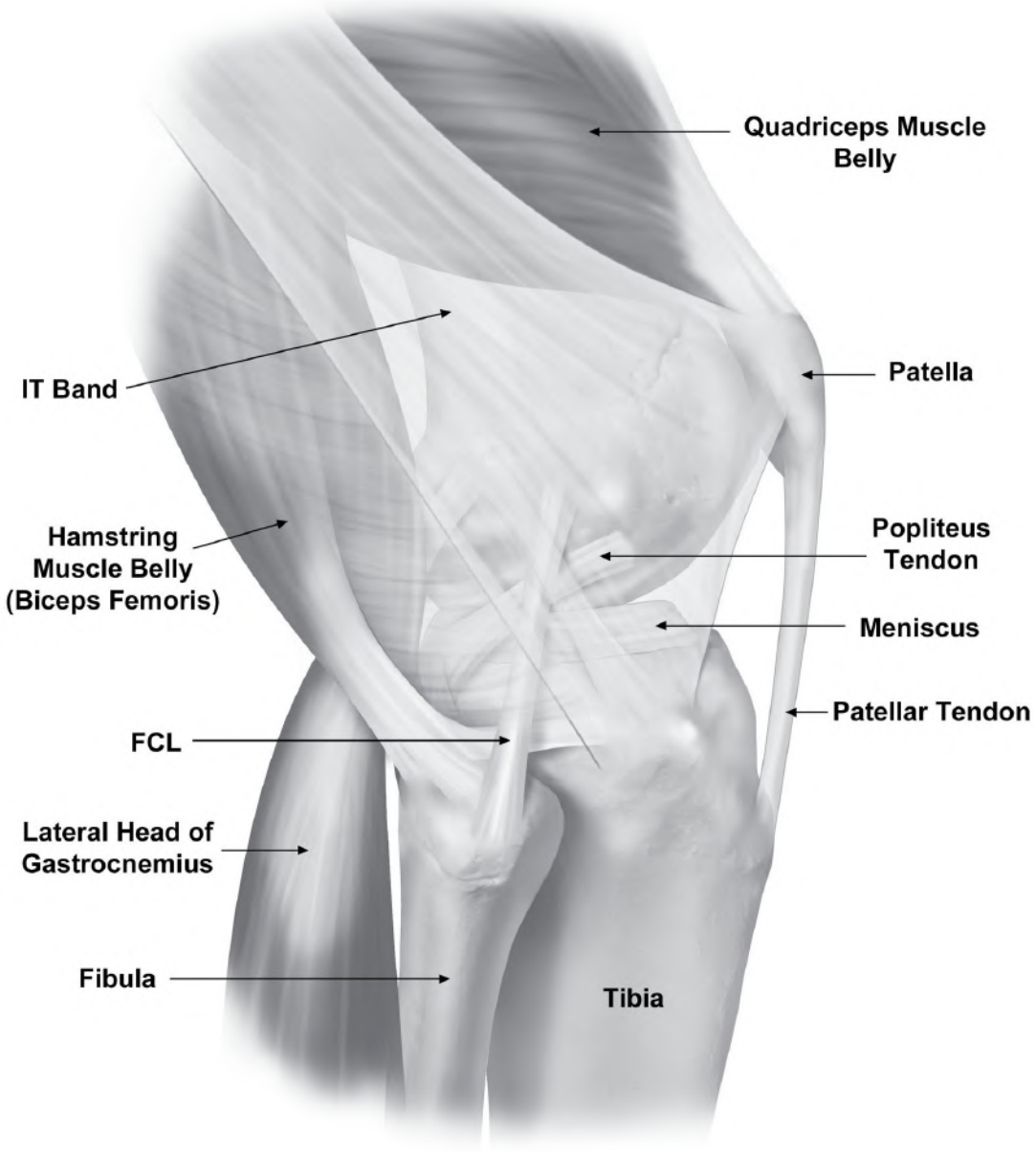


FIGURE 1.3.

Anatomy of Lateral (Outside) of Knee

On the back of the knee, the *oblique popliteal ligament* prevents the tibia from moving in the opposite direction (forward) with respect to the femur.

Last but not least, there are two important internal ligaments in the knee —*the anterior and posterior cruciate ligaments (ACL and PCL)*—which are major contributors to knee stability. They are named “cruciates” because they run from the front to the back and from the center of the knee to the outer side and inner side of the knee and cross each other. The ACL is important to make sure the knee does not slip forward, or more specifically, to make sure the tibia does not slip forward relative to or in front of the femur. The femur and the tibia should be basically aligned, and the ACL and PCL help with

that. The ACL also limits how much the tibia internally rotates, or turns inward relative to the femur. The PCL does the opposite, preventing the knee from slipping backward, especially when it is bent.

IS YOUR KNEE BLOWN OUT OR WORN OUT?

There are two basic groups of knee injuries: (1) *acute* (think: traumatic and sudden) and (2) *chronic* (think: gradual wear). A good example would be the difference between blowing a tire on a car after running over a nail versus wearing down the tread of the tire over time. Of course, these causes of injury can overlap: a chronic condition can cause an abrupt, acute worsening and vice versa—an acute injury can cause changes in knee function, leading to an ongoing problem. For example, chronic tendonitis of the patellar tendon (otherwise known as "the tissue that connects your patella to the tibia is angry and inflamed") can eventually lead to an acute rupture of that tendon, whereas an acute meniscal tear (tearing the shock absorbers in your knee) can lead to chronic joint pain and osteoarthritis down the road.

Direct, or contact, injuries are those caused by an external blow or force—a collision with another person, for example, during a tackle in rugby or football or being struck with an object like a hockey stick. Indirect, or noncontact, injuries result from internal forces built up by the actions of the performer, such as over-stretching, poor technique, fatigue, and lack of fitness. Direct injuries cannot be prevented because one cannot predict these events, but indirect injuries can be prevented by appropriate exercise and training programs.

RISK FACTORS FOR KNEE INJURY

Both acute and chronic knee injuries share a similar list of risk factors that can lead to injury. In general, these risk factors can fall into two common general patterns: nature-based and nurture-based. "Nature" you can think of as your anatomy and your genes—the body you were born with. Many people are born with genetic mutations in their cells that may make them more susceptible to certain health conditions, such as some types of diabetes. "Nurture," on the other hand, would include your lifestyle habits and whether they may lead to detrimental effects. It's well known, for example, that a smoking habit can lead to chronic lung disease. What makes this slightly more complicated is most health conditions fall into an in-between zone,

where both nature and nurture play their respective parts. For example, high cholesterol and heart disease can be affected by food choices like a poor diet; however, numerous people also inherit traits that make them more susceptible to heart disease.

Musculoskeletal injuries especially fall smack dab into that gray area where both anatomy and lifestyle play a role. In this chapter, we are going to cover the aspects that put you at risk, and throughout this guide we discuss to what extent you can control them.

Nature-Based Risk Factors

1. Your Shape. The contour, or curve, of the shinbone and thighbone can be very different from person to person. In fact, some people have unique slopes, curves, and angles of their bones that make them predisposed to injury. If you think about it, this is logical. Think about how changing the angle at which you perform an exercise at the gym affects the difficulty and how much energy you need to complete the exercise. Doing a crunch is hard enough, but doing it on an incline bench is considerably harder. The same can be said for your knee anatomy. There is a natural orientation that should exist between the bones and the ligaments of your knee.

When these angles are changed compared to "normal," this significantly alters the force that the structures of the knee are subjected to and can lead to injury.

MAY THE FORCE BE WITH YOU

What do we mean by "force" on your knee? You'll hear us mention this a lot, and no, it is not the same Force Yoda speaks of. Who remembers high school physics? (Show of hands.) Force is, simply put, mass times acceleration. Your mass determines your weight (mass × gravity = weight). OK, we promise we're done with physics equations. However, now that we have those, we can understand some key principles.

In broad strokes, the more force is applied to an object, the more an object will respond. In regard to your knee, the more force you apply to the structures involved—meniscus, ligaments, cartilage—the more likely you are to injure those structures and to wear them down. This is especially true over time, and it is a great explanation for why we do not develop arthritis in one day. Rather, it is the accumulated effect of excess force being applied through the knee over the years.

2. Your Knee Alignment. Your knee joint has two sides, if you will: the

inside, or medial, and the outside, or lateral. Their balance creates a knee that is aligned and moves freely. Think of a teeter-totter that has a child of equal size on both sides.

If your knee is not aligned properly, the normal motion of the knee is affected, leading to increased forces in different areas of your knee.

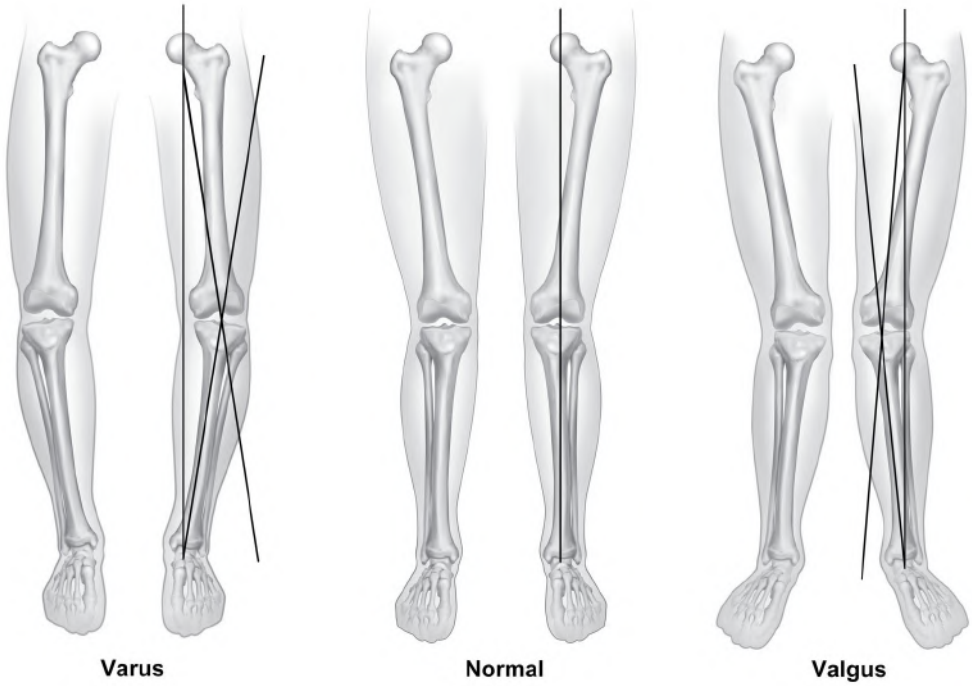


FIGURE 1.4.

Types of Alignment of the Knee

What does a misaligned knee look like? you may ask. Often it looks similar to a knee in good alignment from a ten-thousand-foot view, and it would take advanced imaging to notice the problem. But for more obvious examples, think of people who are knock-kneed (knees bend inward) or bowlegged (knees bend outward). (See Figure 1.4.)

Knock-kneed and bowlegged are examples of a very imbalanced teeter-totter. These conditions are caused by deformities of the bones, namely the tibia and femur. If one side of the bone (the outside or the inside) grows at a different rate than the other, you can end up with one side longer than the other. This leads to an imbalance in the axis of your knee.

The knee's axis is where the force of your body weight is transmitted. In a well-balanced knee, that axis is dead center. However, when you have misalignment, the force is displaced to one side or the other, and this can cause premature wear and breakdown of your meniscus and cartilage (the same shiny surface you see on the ends of the chicken wings you love so

much, which help bones to slide and move with less friction in joints). In other words, it can cause faster onset of osteoarthritis and chronic pain.

But this misalignment does not just affect cartilage. It also affects other soft tissues in your knee, such as ligaments and tendons. You have two major ligaments on either side of the knee, your MCL and your LCL. These ligaments help to prevent your knee from gapping open, or having more space between the femur and the tibia on their respective sides. Think of the ligaments as elastic bands—capable of tightening down, but also at risk of stretching out. With that in mind, you can imagine a knee that is misaligned would cause one side of the knee's ligaments to be very loose, while the other side becomes more taut. This can put the knee at risk for traumatic injuries in the near term, as well as chronic problems down the road.

3. Your Limb Length. Another anatomic issue you can have is limb length abnormalities. Said differently: one leg is longer or shorter than the other. It is more common than you would think. While people often live many years without noticing it, even a slight difference in limb length can change the way you walk. Over time, this slight alteration in your walking form can lead to chronic conditions like pain, muscular atrophy (wasting) or hypertrophy (increased size) depending on the muscle, and potentially osteoarthritis.

As mentioned, some issues of misalignment are less easy to spot. There are subtle differences that would take some sort of imaging, such as an x-ray, to reveal. One example is how much slant there is on the top of your tibia from front to back (tibial slope). A higher degree of slope is correlated with an increased risk of tearing your ACL. That is a very specific academic fact you do not need to memorize; there will not be a test! However, it just goes to show there are numerous variants when it comes to alignment and anatomy that can lead to injury.

4. Your Bone Strength. Turns out not all bones were created equal. As some of you know, there are soft bones and hard bones, tough bones and brittle bones. Bone strength is one factor that falls into both nature and nurture. People are born with inherently different bone density and strengths and therefore have a theoretically maximum strength or size that can be achieved. On the other hand, some good habits can help maximize your bone strength potential. Consuming a diet rich in calcium and vitamin D, staying as active as possible, and not smoking are all habits that can support your bone health and strength.

5. You're Super Flexible. Are you one of those folks who bend more like Gumby than a human being? If you can put your hands flat on the floor, touch

your thumb to your forearm, bend your whole wrist nearly back on itself, and extend your elbow so far that it's bending the opposite way, you may be a phenomenal gymnast or butterfly swimmer, and you definitely have a cool party trick. However, you are also at a greater risk for knee injury. Yes, we know you've been taught it's good to be flexible, and it is; however, when you are that flexible, it can also be a problem. The ability to bend that far is known as hypermobility. And if you meet enough criteria and receive a high Beighton hypermobility score (because of those same X-Men–like bending abilities we just mentioned), you are even given that as a medical diagnosis. This means the tissue that composes your ligaments and tendons, called collagen, is a little bit stretchier than it should be. This also means your joints move way farther than they should in multiple directions, which leads to more force on your ligaments and therefore an increased risk of injury.

6. Muscle Imbalance. If you haven't noticed a trend yet, we want to call attention to it right now: for proper function of your knee, and your body as a whole, you need balance. You have probably heard the saying "everything in moderation." This is true when it comes to what we eat, how we live, and also, the muscles that move your body.

Remember, the knee's main movements are simple: flexion and extension. The two main muscle groups that control these movements are your quadriceps on the front of your thigh (knee extension) and your hamstrings at the back of your knee (knee flexion).

The strength of these muscles should be, you guessed it, balanced. Too much strength in one group or the other can lead to increased forces across your knee. For example, if your quadriceps are much stronger than your hamstrings, this leads to an increased risk of an ACL tear. Your hamstrings help pull your tibia backward, while the quadriceps help pull the tibia forward. ACL tears happen when your tibia moves too far to the front relative to its normal alignment with the femur, while it is rotated toward the outside, creating a huge stress on the ligament.

7. Being Female. Unfortunately, knee injuries are not as modern as American society and have not gotten on board with equal opportunity for the sexes. Being female does convey a significantly greater risk for knee injury, specifically for an ACL injury.

So what does the knee have against women? That answer can be found in the aforementioned anatomical risk factors. Almost all are more common in women. Women are far more likely to be hypermobile, far more likely to have more fragile bones, more likely to have quadriceps that are stronger than their

hamstrings, and also more likely to have some of the bony alignment abnormalities noted, such as an increased posterior tibial slope.

On top of all of this, in general, women tend to have smaller ligaments, tendons, and bones, which can withstand less force and are therefore at an increased risk for injury. One other risk factor involved specifically in ACL injuries in women is their landing biomechanics—how they land after a jump. Women tend to land with their knees more extended, or straight, and also more in a valgus (knock-kneed) position. Both of these positions tend to put more strain on the ACL and therefore are associated with an increased risk of injury.

Pregnancy is a unique situation in which nature (being a female) and nurture (having higher weight) coincide. Obviously, it is expected and encouraged to gain weight during pregnancy. One of the things that make it challenging is the body aches and soreness that comes with gaining twenty-five to thirty pounds or even more in nine months. One of the areas of the body that feels that increased strain is the knees. This is common but fortunately does not have to be lasting. While you're pregnant, working to stay active and mobile as much as is recommended (depending on your health status) can help, both with minimizing excess weight gain but also with staying limber and flexible. Some of the increased pain is unavoidable while pregnant, but following delivery and loss of the extra weight postpartum, that pain should subside. This is also a good reason to work on regaining your activity in the months following pregnancy (again, should your overall health allow it), to work toward maintaining a healthy weight going forward. In Chapter 10, we will discuss why excess weight and obesity are such detrimental issues for knee health.

Nurture-Based Risk Factors

With most of the nature aspects covered, let's talk lifestyle factors. These include your athletic activities, whether you have gained weight, and whether you have previously felt knee pain or incurred knee injuries.

1. You're an Athlete. In general, the young video game maven—the extreme *Call of Duty* general or *FIFA* master, say—does not hurt their knee. Objects at rest tend to stay at rest, and if you are at rest, it's hard to cause acute trauma to your knee. However, those of you regularly blazing black diamonds, hiking Kilimanjaro (or just your local trails), tearing up the basketball court, and kicking Beckham-bending shots into the corner of the soccer goal are the ones who get injured.

High-energy, high-intensity sports especially tend to put a lot of load and force on the knee. The risk comes down to a few things: how you play and how you train.

Often the skills that make you a good athlete—those jukes, that power, that speed—are all things that put you at risk for an injury. Whenever we explain this to patients, we are reminded of scenes from the film *Friday Night Lights*. In the movie, Boobie Miles is the star running back of a high school football team in Texas. The kid is incredibly agile and can stop and change direction on a dime. One of his quotes is "You wanna win, put Boobie in, I'm about to spin." When Boobie tears his ACL, the doctor explains to him why he can't play: his ACL is largely what allows Boobie to decelerate and change directions so quickly. Those movements that make him so good are constantly putting strain and force on his knee.

THE BIGGEST SPORTS CULPRITS

Are there certain sports and activities that are more likely to lead to knee injuries? The simple answer is yes. Playing any sport in which your knee is susceptible to high-energy impact; that asks you to stop abruptly, change direction abruptly, or land awkwardly; or that puts disproportional amounts of force on the knee can lead to injury. Here is a list of the most common offenders, in no particular order:

- **Downhill skiing**, which can send you down a hill at forty or more miles per hour, has an inherently high risk of knee injury. Combine that with your ski boots, which means that you basically wear rigid casts around your ankles so they are supported but therefore make another part of you extra susceptible—the knee.
- **Basketball** is pretty much defined by starting, stopping, and landing awkwardly. Nowadays, basketball shoes almost stick to the floor—but that can mean your foot stops while your knee and leg do not.
- **Soccer** is a common cause of ACL tears for women especially. Again, there's a risk similar to that of playing basketball: plant that cleat in the ground, and you'll get great traction, which allows your foot to stop, but the knee doesn't get the memo.
- **Football** tops the list for ligament injuries in men and also tops the list of popular team sports for complex multi-ligament (more than one ligament) injuries. This makes sense considering the aggressive and fast-paced nature of the game. Also, as the sport moves away from high hits to the head, to reduce the risk of concussions and their effects (as it should), players will start to hit lower and lower. This makes the knees a good target for a tackler and therefore a big risk for injury.
- **Distance running**, while good for you in terms of cardiovascular health and maintaining a healthy weight, is one of the more damaging activities for your knee long term. The reason? Running is much more high-impact when compared to other cardio activities such as elliptical workouts or biking. That is not to say that running is bad or not a worthwhile endeavor, but it puts your knee at a higher risk for chronic

damage and wear. You can help minimize this by running on softer surfaces. Trail running or running on grass is much preferred to long runs on concrete or asphalt.

That said, playing any sport or doing activities where you make these types of movements can make you more prone to knee injuries. Others include gymnastics, tennis, hockey, and baseball.

This is where what is good for your knee physically, and what is good for success on the field, take two very opposite directions. Here is a list of common sports moves that put you at risk for knee injury, and an example of what a safer movement would be.

Risky Move: Full Speed Cut

Think of an NFL running back hitting a hole and getting to that second level of defenders, the linebacker. Right as he is about to get tackled, he makes a 90-degree change of direction, eludes the tackle, and takes it to the house. This movement is commonly done at full speed, planting your foot in the ground and then pushing off with the planted foot, allowing the direction change. The combination of speed and energy that goes into a cut like this leaves your knee very vulnerable to injury, and it is a common cause of noncontact (no contact with another individual) injuries. All of the power you have built up is being channeled through that one foot, which is kind of out in no-man's-land and not squarely beneath you or aligned with your center of gravity.

Safer Move: Break Down and Change

The recommended replacement to such a move would be the "break down and change." Instead of changing direction while maintaining full speed, you would instead stutter step and slow your speed, then change direction. This also allows you to keep your feet closer to your body and your center of gravity, which in turn allows for better balance and, more importantly, control. For a pro-athlete example, think of someone like NFL running back Marshawn Lynch. He is the master of carefully and meticulously breaking down and changing direction at slower speeds. He also has mastered the jump cut, which is a cutting movement made off of two feet simultaneously rather than one. (While some of you may think this move is less effective, let us remind you that Lynch has managed quite a few thousand-yard NFL seasons *and* won a Super Bowl. They don't call him Beast Mode because he is *in*effective!)

Risky Move: One-Legged, Off-Balance Jump and Landing

A movement made off-balance on one leg. This move commonly happens in basketball: driving to the basket, trying to get around your defender, and going up on one leg at full speed, then subsequently coming down on one leg awkwardly. It also often happens when flying in for a rebound: because you are jumping *out* almost as much as *up*, you come down awkwardly on one leg.

Safer Move: Taking Off and Landing on Two Feet

Some instances are unavoidable, but making a conscious effort to take off and land on two feet can help avoid excess risk to your knee. Think of getting to a good spot on the floor, boxing out, and going up with two feet. For a pro to look up to on this, there's Rebekkah Brunson of the Minnesota Lynx, the all-time WNBA rebounding leader. She is excellent at getting good position and going up strong with two feet, securing the rebound, and landing with a good center of gravity.

Risky Move: Abrupt Deceleration

This is somewhat similar to the full speed cut. Think of someone on a fast break in basketball, running at full speed and then coming to a complete stop, for example in a jump stop. Movements like this confer a lot of force on the knee because your knee and the rest of your body are moving in one direction at a high speed when suddenly your feet come to a stop. The tendency is for your knee to continue in the forward direction it was traveling.

Safer Move: Controlled Stop

Again, for preventative measures, think of staying under control: coming to a controlled jump stop with *two feet* before your step through and shoot or before your pull-up jumper. For a great example of this watch any one of the numerous all-stars to have come through Geno Auriemma's women's basketball program at the University of Connecticut. Those players all have superb fundamentals including the vital skill of the jump stop and step through.

Another aspect of risk for athletes lies in how you train. This topic will largely be covered in Chapter 12 on prevention, but we do want to hit a few of the important points here. Sports moves that tend to put your knee at risk all have the common factor of being performed out of control and off-balance. You may be asking, *So then, Mr. Miyagi, how exactly do I work on this control and balance?* Maintaining good control and balance when you

compete is like an intricate dance. It requires core strength, good proprioception (your or your body's understanding of where you are in space), and, specifically for the knee, great strength and size of surrounding musculature. Your hamstrings and your quadriceps especially play an important role in protecting your knee from injury.

Whenever we watch an NBA basketball game, some of the awkward falls, trips, and tumbles those guys take have us cringing, thinking, *If that were me, I would need to be carried off the court.* We are constantly amazed how often the players land awkwardly yet can get up and get right back to the play. Use that handy-dandy TiVo app, or look on YouTube, and rewind and slow motion a play the next time you see a basketball player go down. Look at their thigh muscles just above the knee. As the player lands, watch how those muscles engage, acting as a scaffold and protective shield for the knee, which would otherwise end up awkwardly bent. If you are looking for a specific player to watch, we suggest LeBron James. The guy seems to take three to five awkward spills per game, but his incredible conditioning and lower body strength allow him to protect his knee.

Again, Chapter 9 on rehab and Chapter 12 on prevention will give you some of the tools you need to help be proactive in preventing these injuries.

2. Weight Gain = Knee Pain. Another common risk factor for knee injury, especially chronic knee pain, is weight gain. We know what you're thinking: *Here we go again—another MD telling me not to be overweight, and to eat better and to make healthy life choices. Jeez, get off your soapbox!* OK, it's true that there are more weight-control books out there than there are Kardashian selfies. However, not only does carrying extra weight increase the daily toll on your knees, but it also creates greater risk for suffering an acute knee injury. That extra weight can manifest as extra force during dangerous movements. Also, carrying extra weight tends to disrupt your balance and coordination.

Here is an extreme orthopedic example to drive home the point. If you have the heart to watch former football player Marcus Lattimore's infamous knee injury on YouTube, what you'll see is a knee dislocation: the whole knee joint disrupted and grossly unstable. Or in lay terms, he done messed his knee up. These injuries generally occur in high-force situations, like a football tackle, a car accident, heli-skiing, and so forth. These are all what we call high-velocity injuries.

There is also a group of injuries called low-velocity knee dislocations, such as when someone walking falls and subsequently dislocates their knee.

These injuries are much likelier in individuals who are extremely overweight (obese). People of normal to slightly-above-normal body mass index (BMI) rarely experience such severe injury in that situation. But process this for a second: adding one hundred pounds of weight to your frame makes walking almost as dangerous as getting tackled below the knee by a linebacker! Yes, we are exaggerating, but only slightly. The point is that carrying excess weight is very bad for your joints, especially your knees.

Now this is just information; it is *not* to body shame you. We'll explain more in Chapter 10 on why carrying extra weight can be detrimental for your musculoskeletal health. Later in the book we'll also provide some dietary as well as physical therapy recommendations to help you heal, which can help with your weight and thereby help your knees!

3. You've Felt Knee Pain Before. We always ask patients, "Have you previously felt this pain?" or "Have you ever had a knee injury?" One of the main causes of arthritis is previous trauma to the knee. Cartilage injury is largely irreversible and progressive—unfortunately, once you have damaged your cartilage, it will continue to worsen, and it is just a matter of at what rate we try to slow it down.

How this happens is a somewhat complex process that involves a lot of big words that even bore doctors, but we will summarize it briefly here. We have already talked about the bones, ligaments, and meniscus involved in the function of your knee joint. The bones provide the alignment and some stability, the ligaments similarly provide stability, the meniscus cushions the bones from rubbing against one another as well as providing some stability, and the cartilage helps things to move smoothly. What happens with injury is one of these things gets "broken" or "torn" and loses its function. This causes a cascade effect that changes the function of the other involved components.

For example, a torn ACL makes your tibia move differently compared to your femur. This change in the biomechanics (movement of your knee) puts extra strain on your other ligaments as well as your meniscus. This causes your meniscus to wear out sooner, which eventually causes breakdown of your cartilage, and you feel arthritis pain. Or let's go in another direction. You experience a tibial plateau fracture (more information to come in Chapter 3), which causes your joint alignment to be off. Even a couple of millimeters of misalignment could completely change the force on different parts of your knee, which also changes how you move and thereby leads to wear on your meniscus and your cartilage leading to… you guessed it, arthritis.

The key point is that sometimes even if you can't feel it early on, the

effects of an injury can be long-lasting and progressive. With that in mind, once you have had a significant knee injury, your aim should be to address the injury and try to minimize other factors that can worsen the health of your knee.

We hope this chapter has helped answer the age-old question of why you hurt your knee and helped you to understand a little bit of how to avoid injuries or prevent worsening of these injuries in the future. Knee injuries come in numerous flavors, many of which will be discussed in Chapter 3. Another key point to remember is that an injury to an important structure of your knee upsets its balance and alignment, which then leads to increased force. Yes, to use a *Star Wars* analogy again, knee injuries then are essentially dark Siths of the knee galaxy looking to upset the force. So treatment should be aimed at restoring the balance and trying to minimize further disruption.

As you will learn, some injuries are very treatable and have phenomenal outcomes, while others are more difficult to handle. Focusing on what you can do for your specific injury is important. Avoiding high-energy, high-risk situations and activities can be helpful, as well as maintaining a healthy weight to help decrease excess knee force.

Now let’s look at the immediate steps of what to do and what your treatment options are after a knee injury has occurred.

WHAT TO DO FOLLOWING A KNEE INJURY

Next Steps in Your Care: Where to Start, Whom to See, and Why

Along with the inevitable "Why me?," the big question after an injury is usually "Now what?" What the heck should you do? Many times, we don't know what to do when we take a spill or what's the best course to take after a knee injury. Is it better to stay at home and ice it for a couple of days, or should you go straight to the hospital emergency room? Should you visit your primary care physician, or should you wait to see a specialist? *Is this serious? Will I be able to go back to being myself Should I pick the doc that I saw on TV, or should I go to the one my friend went to?* Indeed, it is a challenging moment when you have to make several complex decisions in a short period of time, and when at the same time you cannot think clearly because of the pain, fear, and stress.

This chapter will describe everything you need to know about getting initial treatment for the knee injury. We'll look at what to do during and immediately after an injury, how you get diagnosed, and which imaging tests you might get. (We'll answer questions like, "Are all the methods pretty much the same? Or are some better suited than others?") Finally, we'll look at how to choose a specialist, the questions to ask, and how to proceed with your decision making.

IT HAPPENED TO ME: RICKY RUBIO, UTAH JAZZ POINT GUARD

Ricky Rubio was a young budding superstar from Spain in his rookie season in the NBA. He had already had the makings of a stellar career overseas and was in the midst of a phenomenal NBA season, one that garnered him first team all-rookie honors. He was guarding one of the greatest to ever lace them up, Kobe Bryant, when he went down with a serious knee injury.

Ricky's initial thought was one that is commonly shared by our athlete patients: "What if I can never play again?" He says, "It was scary, and I didn't know what to expect. I was very optimistic, but you never know with those types of injuries."

Ricky sought numerous opinions before determining where and when to have surgery. Once he did, that was just the beginning of his long and onerous recovery process. However, nine months later, he returned to play at the NBA level, and he continues to excel in the league today as a point guard for the Utah Jazz.

His advice for others with knee injuries: "Be patient. It's a long road, and there are a lot of up and downs, but you just have to stay focused and set little goals. Don't think ahead too much. Set goals by week or two weeks. Some weeks you won't see any progress, but don't give up; it's part of the process. It's very important to have a good feeling with your PT [physical therapist] and have fun during the recovery. A positive attitude really helps."

FIRST THINGS FIRST

So you felt a pop, and you're on the ground. What do you do now?

It is really important to stay calm and don't freak out. Try to stand up with the help of somebody (or something if no one is around) and put progressive weight into your leg. If this is feasible without significant pain, you can try to walk. Unless there was a significant trauma (car accident, high-energy trauma, high-velocity twisting), most injuries won't get aggravated by an attempt at weight bearing. If you can walk, and the pain rapidly disappears, there is no need to immediately go to the doctor in the majority of cases. A pop can be caused by multiple things, and it is highly unspecific (meaning that it can be produced by any structure in the knee). Some causes are very benign, such as an abnormal sliding of the kneecap over your femur, and others can be more serious—for example, a ligament tear.

On the other hand, if the pain persists and you can't put any weight on it, don't force it, and try to go the emergency department or an urgent care center for a more accurate diagnosis. Some hints that something might be going on are: rapid development of swelling, severe pain, limited range of motion, and continued popping or catching. Remember that in the vast majority of cases

these are not life-threatening events and thus there is no real urgency. One or two days of rest won't change the prognosis of your injury.

A note for athletes: If you are injured during a game, first try to sit up. If the game did not stop, and you are lying on your face or back, you could sustain far worse injury if someone else falls on you; therefore seated is the safest position. It is important to immediately alert the athletic trainer or team doctor that you cannot keep playing and that you should be extracted from the game.

RICE (Rest, Ice, Compress, and Elevate) Your Knee

The first thing to do after a potential injury is to avoid significantly loading your knee (avoid putting all of your weight on it) and start icing it as soon as possible to diminish the swelling until you get a diagnosis. As a general rule, while waiting to see your doctor, you should try to minimize the swelling in your knee. The most effective way to ice your knee is to place an ice pack on it in an intermittent fashion (on and off). Common protocols are twenty minutes on and twenty minutes off or ten minutes on and off. Heat is not helpful; inflammation is best treated with cold.

Next, **compress/protect, elevate, and continue to rest your knee.** Wrap the injured knee with an elastic bandage (such as an Ace wrap)—compression will help decrease inflammation. Be sure to only apply gentle pressure; if the wrap is too tight, it can disrupt the normal blood flow and cause more swelling below the knee. Try to keep your knee at or above the level of your heart whenever possible to help reduce the swelling. Finally, reduce the stress on your knee when you walk by using a cane or a crutch if you can't walk without a limp, in the hand opposite your injured knee.

It's important to note that all these measures are extremely important regardless of the specifics of the knee injury or future treatment needed. Reducing swelling and inflammation is always the first step. Even if you don't wind up needing surgery, the first step for a successful outcome is to diminish the inflammation and swelling so that you can better work on knee motion. If a surgery turns out to be required, having your knee with less inflammation and with an acceptable range of motion (full extension to 90 degrees of flexion) will not only make your surgery feasible but also improve your postoperative outcomes.

HOW BAD IS IT? DO I NEED TO GO TO THE ER?

There are four red flags you need to look for after a knee injury:

1. Pain: Most of the injuries will have pain only when loading the joint. When you experience a lot of pain at rest or with normal range of motion, you should be checked out sooner rather than later. If pain is out of control, going to the ER for pain management and diagnosis is the right thing to do. If the pain is tolerable, waiting for a doctor's consultation is appropriate.

2. Swelling: This can be the result of a torn ligament that induced bleeding inside the joint or a defense mechanism from your body to try to maintain a smooth range of motion when the coating for the bone is damaged. Specifically, for cases when there is a significant amount of swelling in your knee (mostly ligament injuries), the knee capsule (the bag that contains the joint) can be filled with blood and extremely distended. The capsule has nerve receptors that tell the brain that the maximum capacity has been reached (it is not like a balloon that can keep growing), which could translate to significant pain. In this case, going to the ER is mandatory, as an arthrocentesis (taking the blood out with a syringe) will relieve the symptoms immediately. (See Figure 2.1.)

FIGURE 2.1.
Swollen Knee

3. Instability: If after an injury you feel that your knee gives way with certain motions, this should be definitely evaluated by a doctor at some point. However, if your knee is completely unstable, meaning that just standing causes the knee to give way in different directions, go to the ER because this

might be a knee dislocation. Injuries such as dislocations (femur loses contact with the tibia or with the patella) constitute an emergency and should be treated immediately. (See Figure 2.2.)

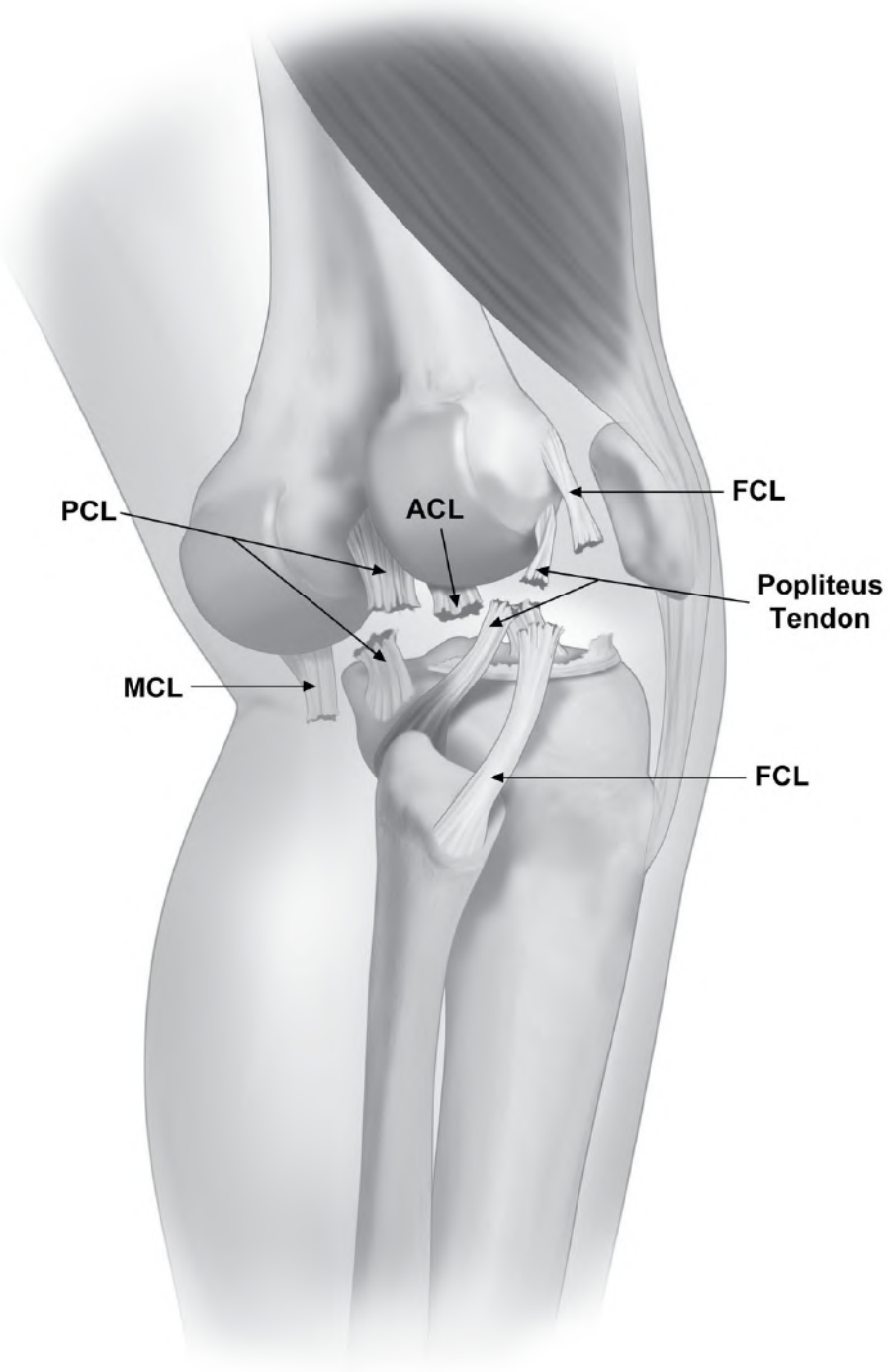


FIGURE 2.2.

Knee Dislocation

Usually other injuries should be ruled out with imaging studies such as radiographs (to rule out fractures) if they are suspected. (See Figure 2.3.)

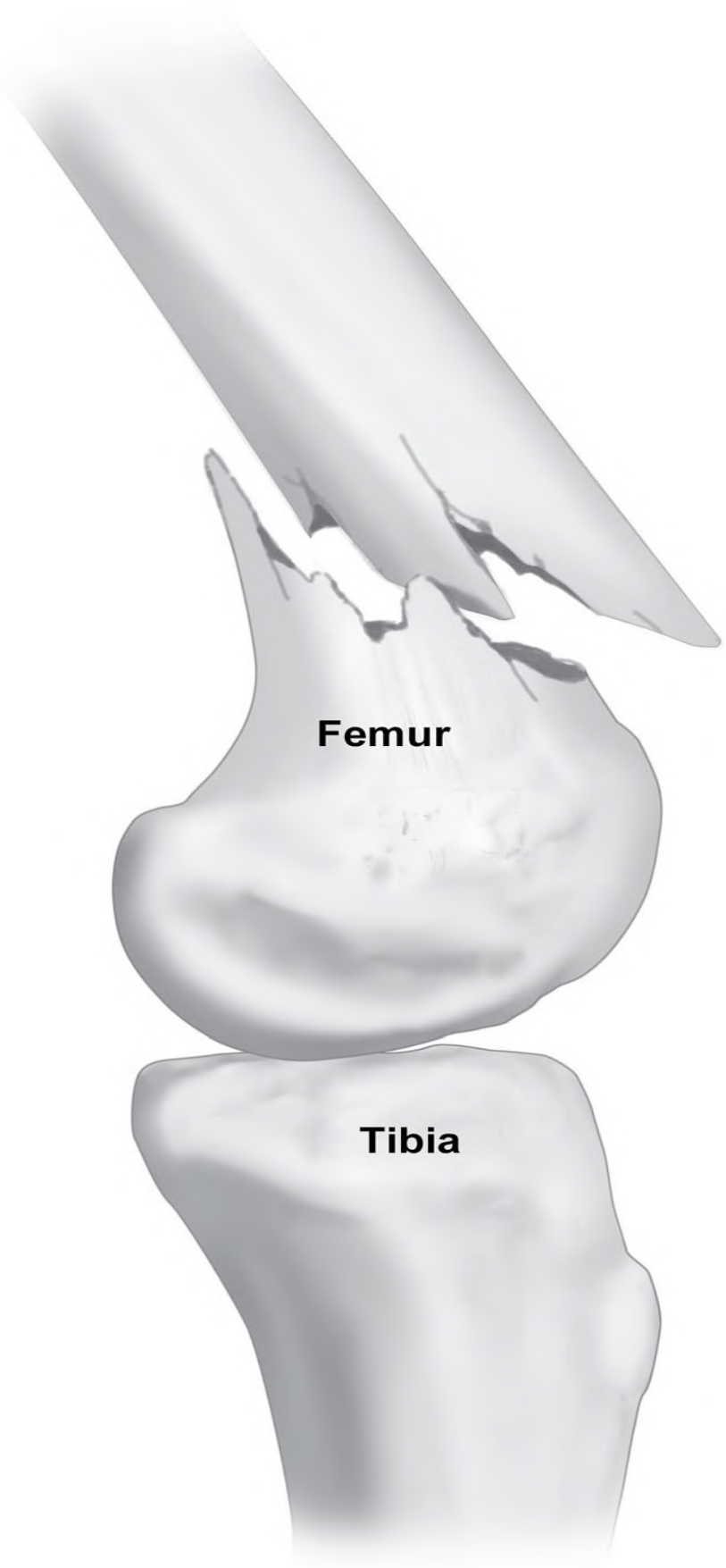

Femur
Tibia

FIGURE 2.3.

Distal Femur Fracture

4. Wound: If there is a hole in the skin, or if you notice a wound at all, you need to go to an emergency department immediately so a physician can determine if you have an open fracture. Open fractures mean the outside world and all its bacteria can access your fracture and your bone, or your "inside world." This puts you at a high risk of infection, which is BAD BAD BAD. You need to be evaluated, and if the fracture is deemed open, you will be given antibiotics and taken to the operating room to have your wound washed out.

Now, distinguishing a mild injury from a severe injury based only on your symptoms is sometimes hard to do. We recommend that if you are not sure, go to the doctor. This will help clarify your diagnosis and give you some reassurance if it turns out it's only a matter of time to get it healed.

EMERGENT VERSUS URGENT VERSUS ELECTIVE

What's the difference? In an **emergency** there is immediate threat to life or health; whereas in **urgency**, there is no immediate danger or threat to life or health, but if not taken care of in a given period of time, then the situation may turn into an emergency situation. **Elective** means that one can choose the timing of surgery because there is no immediate urgency. (See Figures 2.4 and 2.5.)

FIGURE 2.4

FIGURE 2.5

WHAT TO DO?

WAIT AND SEE

Soreness, Swelling, Bruising

ELECTIVE

Stable fracture, One ligament or tendon injury, Muscle sprain/strain, Arthritis with no new acute injury

URGENT

Nonimmobilized fracture, Significant instability

EMERGENT

Injury of veins and arteries, Fracture of bone through skin, Compartment syndrome, Dislocated joint

Listen to Your Body

It might seem intuitive, but when injuries happen, they should be treated with respect so as not to produce more damage. Do *not* follow the gym mantra "no pain, no gain." If your pain is significant, do not keep trying to put weight on your leg; if you feel that your knee is unstable, falling is a real risk.

If it's been a few days and the symptoms (pain, swelling, popping) are not

improving, go to the doctor. Delaying treatment for too long might have consequences. Avoid lifting heavy objects, and when you turn to face a different direction, make sure you turn your entire body and avoid twisting your knee. It is important to listen to your body. If you feel that the pain is tolerable and lets you function, but at the end of the day the swelling is significant, do not just keep going, as your knee is trying to tell you that something is just not right.

The "six-week rule" is a good one to follow for bumps, bruises, strains, and sprains. Most benign injuries will improve by six weeks. If not, it is something that warrants a visit to the doctor's office.

MAKING THE DIAGNOSIS

Depending on your symptoms, you'll be either in the ER or in the doctor's office for a consultation. Initially, x-rays are obtained to rule out a bony injury before the doctor sees you and also to determine the severity of your injury. If there is a dislocation or a fracture, your case might be more urgent, and therefore it is important to have this information readily available.

Then you'll have a physical examination. Here's how a typical knee exam goes:

First, the doctor will see if you can **walk** and will look at how you walk if you are able to do so.

Then, the doctor will perform a **bilateral knee joint examination** to see if there are any differences in your injured knee compared to your uninjured knee and to evaluate for any skin injuries, sensation, and pulses.

The doctor will assess **temperature**—if your injured knee is warmer than the other knee, they will suspect inflammation or infection.

Next, the doctor will assess for **fluid inside the joint**. For this, the doctor will push all the fluid from the top of your joint down and see if your kneecap moves down and hits the thighbone, just like an ice cube would do in a cup of water. If there is no liquid inside your joint, your kneecap should be against the femur, and therefore there should be no motion at all.

Then, the doctor will assess active **range of motion** (how much you can move your knee on your own). This will give hints on how much they can mobilize your knee afterward.

Next, the doctor will **palpate** all the potential injury zones of your knee—

meniscus, cartilage, outer ligaments, and bones—to see if there is any specific tenderness.

Finally, **specific tests** for assessing if your knee is unstable will be performed to see which ligaments are involved if there is significant instability.

After this, the doctor will give you a potential diagnosis and let you know which other studies or imaging is needed to confirm it. At this point, the key questions to ask are:

1. What is the severity of the injury?
2. What can I expect if I have or don't have the suspected diagnosis?
3. What is the time frame to get the study done? Should this be done today? Can I do this later?
4. Where should I do these studies? Do you have a preferred provider? (Sometimes doctors know which facilities are better in regard to the quality of the images. There are sometimes special views that are needed to fully diagnose a particular condition.)
5. When should I come back to see you?
6. Are you going to call me with the results?
7. What should I do in the meantime? Should I use a brace, anti-inflammatories, ice, and so forth?
8. Can I do my regular activities? (Try to write down as much as you can, take notes on your cell phone, or ask for written information, as you probably won't remember some things. This is not the best time to test your memory.)

DO I NEED X-RAYS, AN MRI, AND/OR A CT SCAN?

X-Rays

Many times, patients ask if they really need to get an x-ray. It is usually the first step because it is one of the most useful tests and helps provide vital information for one's diagnosis. It is an important tool to confirm or rule out fractures and the possible presence of tumors. Sometimes patients ask if instead of an x-ray they should get an MRI. In many cases an x-ray is actually

much more useful than an MRI because doing an MRI alone won't allow a doctor to get a complete understanding of most knee injuries. It's less costly and less time-consuming, too. Many knee injuries are better diagnosed by x-ray, and information such as knee alignment, bone quality (an x-ray can detect osteopenia, or thinning of the bone), and the extent of osteoarthritis (joint space narrowing, bone spurs) is better assessed this way.

Getting an x-ray is relatively simple. It takes three to four minutes depending on the number of x-rays your doctor requested. They will take you to a room where the machine is located. Technicians there may ask you to change into a hospital gown for the study. They may also ask you to remove metallic items or jewelry from your body. Once you're fully prepared, the technician will tell you how to position your knee to create clear images. They may ask you to lie, sit, or stand in several positions during the test. They may take images while you stand in front of a specialized plate that contains x-ray film or sensors. It's important to stay still while the images are being taken. This will provide the clearest images possible.

Special x-rays, called stress x-rays, can determine how your ligaments are working in a dynamic fashion. The knee ligaments are tested by the surgeon stressing your knee toward the inside or outside (valgus or varus) to see if the ligaments are working properly. For example, if the ligament on the inside of the knee (MCL) is torn, there will be a significant gapping of that side of the knee in comparison to the noninjured knee. This information is vital, and sometimes a stress x-ray is the only way to see these functional deficiencies. An MRI might not be able to detect them in chronic cases, for example.

Magnetic Resonance Imaging (MRI)

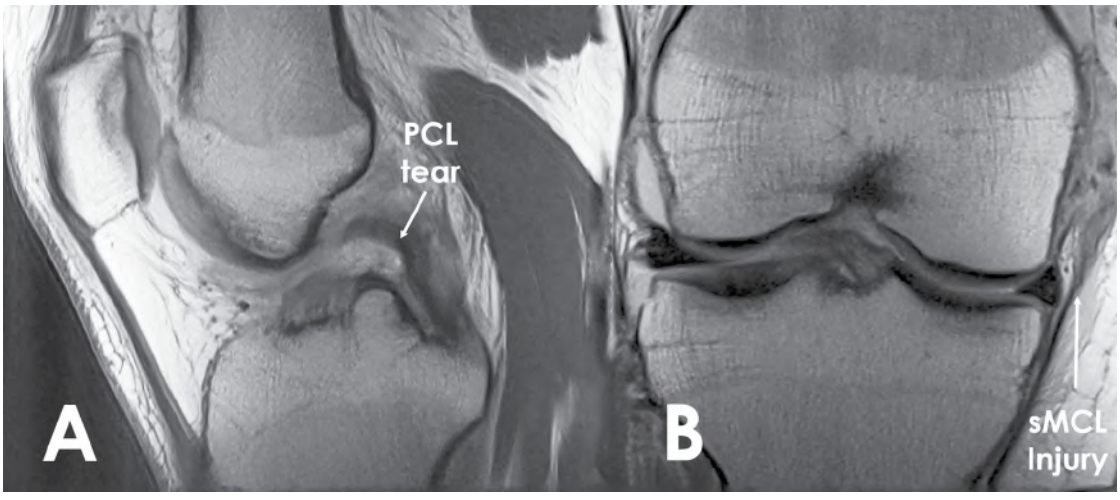


FIGURE 2.6.

Example of What Knee Magnetic Resonance Imaging (MRI) Looks

An MRI is useful when a doctor suspects that there is a soft tissue (ligaments, tendons, meniscus, cartilage) injury. This machine uses a magnetic field with radio waves and a computer to create a detailed picture of your knee in every dimension. An MRI lets the doctor see not only bone but also cartilage, tendons, ligaments, and even blood vessels (see Figure 2.6).

MRI machines are classified according to their power in Teslas (0.5, 1, 1.5, and 3 Teslas). Usually, a 3 Tesla machine will be a newer and better machine; if you can, ask to have your study in one.

A typical MRI machine looks like a large, hollow tube with a rigid bed in the middle, which moves backward and forward. It contains a powerful magnet, so no metal is allowed inside the room when performing the study. After explaining the procedure, the technician will have you lie on the table. For a knee MRI, you'll go in feet first, and only your lower body will be in the tube. Stay as quiet and as still as possible to avoid having a bad image (just the way you would expect a picture to be blurry if you move). Expect to hold still for around thirty to forty-five minutes, while the machine makes images of your knee. During the exam, you're usually alone in the room. Technicians running the machine will be outside and are able to communicate with you via a two-way intercom.

Some patients are anxious about the MRI machine and ask if they can use an open machine instead of a closed one. Instead of a closed tube, the open MRI uses a magnet on the top and the bottom and is open on all four sides. This makes it better for patients that experience claustrophobia or panic attacks and allows bigger patients to be able to make use of an MRI to accurately diagnose their problems. Nonetheless, the images are of lesser quality because open machines aren't as strong. If you can tolerate the closed MRI machine, this will always be a better option. If you are unsure if you will be able to withstand this study, ask the medical staff for a sedative or anti-anxiety drug to take during the test and use earplugs (MRI machines tend to be very noisy).

An MRI is usually not necessary immediately after a minor injury and can be deferred. If your doctor feels that your physical examination is completely normal, and your x-rays do not show any injury, further studies can be delayed until it's clear the symptoms have not improved. MRIs are expensive and can take thirty to forty-five minutes. If there is no suspicion of further soft tissue injury unable to be diagnosed by x-rays and a physical exam, then they can be avoided.

Computed Tomography (CT) Scan

A CT scan is like having a hundred x-rays at once. A CT scan is usually ordered when a doctor wants to see bone-related issues, such as the configuration of a fracture if a fracture has healed or tunnel position and tunnel enlargement from previous ligamentous reconstruction surgeries.

Because scans have become quicker, x-ray exposure has decreased, providing better images at lower doses of radiation. The average CT scan of a knee today exposes patients to less radiation than what airline passengers receive on long flights. That said, if your doctor is considering ordering a CT scan, ask them about the risks from radiation exposure versus the benefits of early diagnosis.

WHICH DOCTOR SHOULD I CHOOSE TO TREAT MY INJURY? HOW DO I PICK THE RIGHT ONE?

Choose a doctor who is qualified to handle your specific knee injury. Make sure to research providers carefully. Primary care physicians, sports medicine physicians, and orthopedic surgeons can guide you in the right direction. Clinics with large volumes of knee-injury patients are usually more efficient and experienced than those that seldom see these injuries. Consider the type of injury you have, and take some time to investigate which physicians are relevant and experienced in treating your condition. Seek referrals and opinions from others in the medical field. Keep in mind that even if a friend of yours raves about their doctor, that person may not necessarily be the best doctor for you, depending on what their specialty is.

If you play a sport and continuing to play is important to you, you might look for a sport-specific doctor. Doctors who see a lot of runners, baseball players, or basketball players can have more experience in the specific injuries associated with each sport.

You can also look for a physician who has published in academic journals (search on pubmed.gov by the name of the injury and last name of the doctor, or ask a doctor who is a friend of yours or your family to do this for you) and presented about the type of injury you have. Look for authored publications, chapters, and books. Usually people who publish on a specific condition have more experience and know the pathology better. Again, do enough research until you have a clear idea on who can best help you.

Then make sure you have an understanding of your chosen physician’s practice, including what type of surgery they do and how often. Most

orthopedic surgeons and doctors who specialize in sports injuries can do an ACL or meniscus trimming surgery; however, more complicated injuries like a knee dislocation are not common in everybody's practice. Also consider how many of that type of surgery they perform. Specifically, for the more complex injuries, you do not want to go to a doctor who does only a couple a year. High-volume surgeons usually have more experience, and their team is better prepared than low-volume surgeons. Doing fifty complex surgeries every year is very different from doing one or two.

Of course, a doctor who is local to you may be more convenient. That said, if your injury is serious and travel is feasible for you, do not hesitate to travel to see an expert in the field. It might be a hassle in the beginning, but it is well worth it at the end. Take into account that your body is going to be with you as long as you live, so you want the best results.

Above all, get a doctor you feel comfortable with. Listen to what they have to say, and make sure they are knowledgeable on the topic. You want a care provider you are confident about professionally and you feel understands you and your care goals, and who will work to give you the best possible outcome.

It is also worth mentioning that pesky aspect of medicine that for many people is a four-letter word: insurance. Seeking out a specific surgeon is all well and good, but unfortunately not all doctors are in your insurance carrier's network. Insurance policies' networks range from extensive to limited. Navigating the system of in-network, out-of-network, and not-covered physician listings can be complicated, but it is important to know the differences because of the costs involved. Seeing in-network physicians may have minimal costs, while seeing out-of-network physicians may require considerable out-of-pocket costs. This is the sad reality of medicine today, and it can make a difference in your postsurgery outcome if the physicians who are covered in your network do not treat your particular problem or if they have little experience in treating it.

Usually the physician you are seeing will have someone in their front office who can help you with navigating insurance coverage and give you a good understanding of just exactly what and how much insurance will cover. Some physicians, especially those who are specialists, may not be covered or will only be minimally covered. When you are faced with that decision, it is important to understand how complicated your surgery may be and what the risks may be. Having your surgery performed by somebody with no or little experience in your particular injury may not be best for your ultimate

outcome. But you also may face significant costs if you see a specialist who is not covered by your network. Advising you on these types of decisions is outside the scope of this book, but we encourage you to discuss your options with your family and your physician if you need to obtain an out-of-network referral covered by your insurance plan.

MORE QUESTIONS TO ASK YOUR SPECIALIST

Once you have a diagnosis, ask the specialist all the questions you want. If you don't understand an explanation, don't be afraid to ask again. Complications can occur, and it is important that you are aware of them (so you can be prepared) and also that your expectations are accurate for each individual procedure.

Before the Treatment

1. What are the first steps of treatment?
2. How common is my injury?
3. Should I try to regain my knee's range of motion before the surgery?

Treatment

1. Is there a surgery involved in my treatment? What are the pros and cons of having surgery versus nonsurgical approaches? If I need surgery, when should I do it?
2. What's the surgery like? How long does it take?
3. What happens if you find something we did not see in the MRI? Will you address that, too? How can that change my options?
4. Can you explain all the complications to me? How often do they occur? Is there anything I can do to prevent them? If they happen, what should I do?

Post-Treatment

1. How tough is the recovery?
2. Will I need any special equipment, like crutches? Any special machines?

3. What are the steps I need to accomplish throughout therapy? Should I go to therapy before surgery?
4. How can I accelerate recovery?
5. Is a stem cell treatment right for me?
6. How long until I go back to school/work/sports?
7. What are the chances I won't go back at the same level?
8. What are my long-term chances of having any kind of disability?

PAGING DOCTOR GOOGLE

Once you have a diagnosis, it's natural to want to do your own research about it on the Internet. Certainly, you should read up on your condition—but trust your doctor, too. Some information online is not scientific, not updated, or not accurate. Doctors usually go to academic meetings of their fields (where all the experts go to discuss the latest evidence and technology), and therefore they have the best source of information. So the purpose of educating yourself should be to be able to ask good questions. Try to write down your questions in advance, or record them in your cell phone notes—that way you won't forget them during your appointment.

For more on specific conditions and what to expect with your diagnosis, see Chapter 3, The Top Twenty-Five Knee Problems.

GETTING A SECOND OPINION

Getting a second or even a third opinion on your diagnosis and treatment plan can also be a good way to help you determine the best course of action. Feeling comfortable and trusting your doctor and their team is vital. Confidence is a key factor in the success of every treatment, so you want to feel sure that your doctor is the best for what you need.

While the popular phrase "trust but verify" may have first been used in reference to foreign relations, it can perfectly be applied to your medical care. If you are in agreement on the recommendation by your chosen physician, and you feel 100 percent confident in it, then great—you are set. However, if you are unsure, or have lingering questions, it is always appropriate to seek a second opinion. You probably wouldn't buy a car or a house, get married, or go through with almost any important life decision without seeking multiple

opinions or options. The same should go for your health care. This is especially true when you are not confident that you have received the correct diagnosis for the injury, or you have been told that there is nothing to worry about, yet you still feel there is a problem. We always feel that a patient should go by the adage that the patient is always right. If you think something is wrong, indeed, something is probably going on. In this circumstance, obtaining a second opinion about your knee problem is a good idea. Remember, doctors are human and can make mistakes. Trust your gut, and be proactive in researching and seeking out your care options.

WHERE SHOULD I GO FOR REHABILITATION?

A good rehabilitation program is the key for success in any procedure. Moreover, a surgery's outcome is probably 50 percent dependent on the work done in the operating room and 50 percent dependent on what you do with your rehab. Most physicians work closely with certain physical therapists (licensed health care professionals who specialize in rehabilitation and regaining of function), depending on the pathology. This is not a random selection: they know who can do a better job. Certainly, there are lots of good physical therapists out there, but making sure that the one you work with knows your physician's protocol is essential. Sometimes, surgeons will ask you to start physical therapy in their facilities, and later you continue it in a location more convenient for you. Be sure you understand the steps you need to accomplish throughout therapy and how long the recovery is expected to take. Again, ask! We'll talk more rehabilitation in Chapter 9.

In conclusion, knowing your first steps is key to be able to start the healing process and to get to the right doctor in a timely fashion. Asking the right questions, setting your expectations with your doctor, and researching and understanding your options are crucial. Finally, working hard in your rehabilitation to get back to your activity level constitutes the other important factor for a successful recovery.

THE TOP TWENTY-FIVE KNEE PROBLEMS

Whom They Affect, How They Happen, and What to Do About Them

ANTERIOR CRUCIATE LIGAMENT (ACL) TEAR

When you think “knee injury,” chances are you may think “torn ACL.” The ACL is one of the most common knee ligaments that gets torn and therefore the one that receives the most public attention. The ACL is located in the center of the knee and has a slightly angled attachment. It has an important role in preventing your knee from sliding forward and from rotating when you twist, turn, or pivot. Most ACL tears occur during athletic activity. In those cases, about three-quarters of the time, an ACL tear does not happen during a contact injury; rather it occurs when you’re in an open field or open court situation. You’re twisting or turning, and the knee may bend inward or buckle, resulting in an ACL tear (Figure 3.1). (Classic example: YouTube Klay Thompson injury NBA finals 2019.) When you do try to get up and walk, the knee often can feel unstable, as if it is going to buckle.

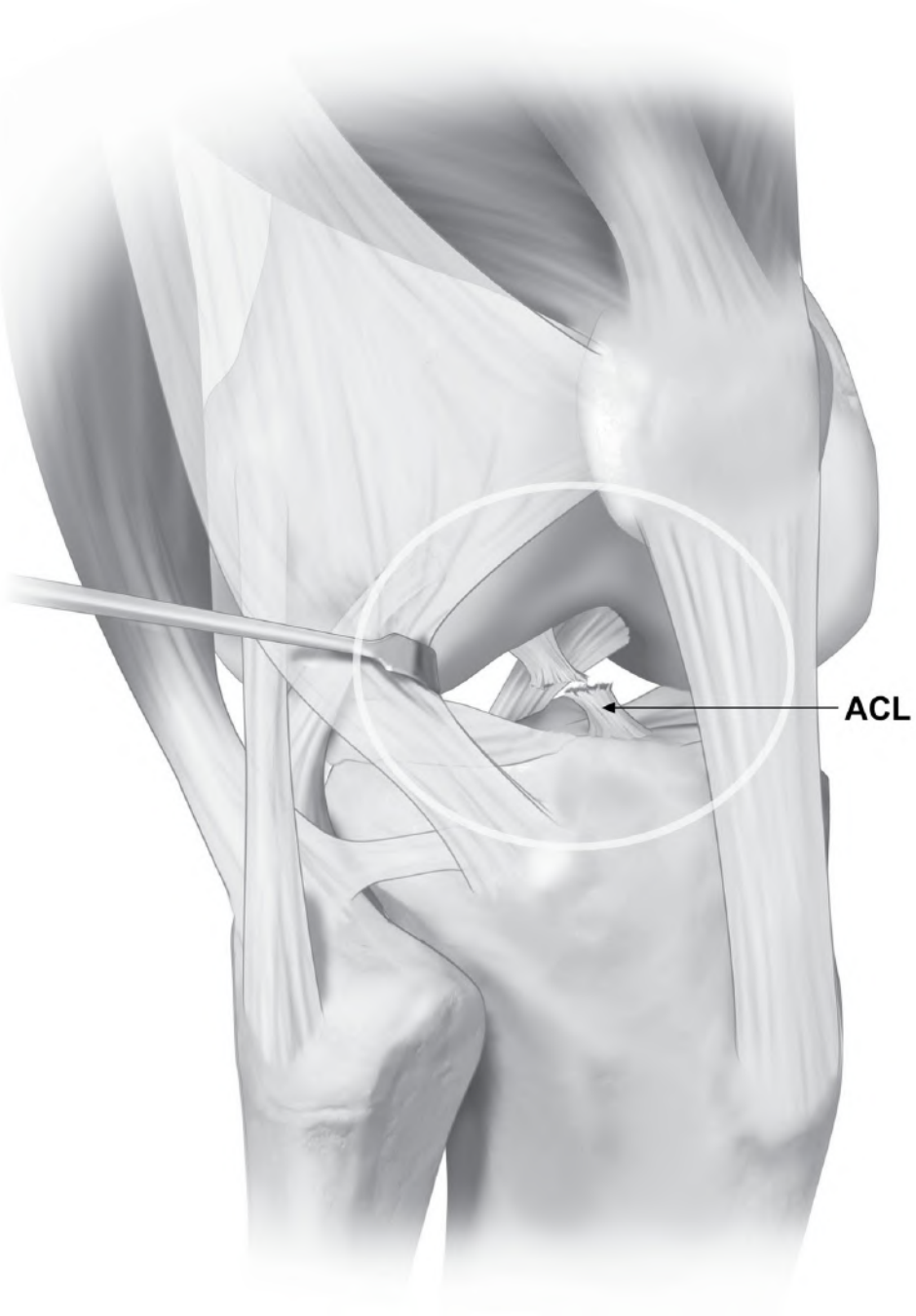


FIGURE 3.1.
ACL Tear

Often, you'll feel a pop when the ACL tears. This is due to a bone bruise, which can be considered a prefracture, with enough force to bruise but not break the bone, as a result of the joint slipping on itself and the bones banging against each other. This most commonly occurs on the outside of the knee, where the back of the tibia bangs against the front of the femur. About 75 percent of people who have an ACL tear will have bone bruises on the outside of their knee, and the presence of these bone bruises can be a sign that the ACL is not working, even if the MRI scan is unclear.

The ACL is supplied by the middle genicular artery. For this reason, it is common within the first twenty-four hours after an ACL tear to end up with a very swollen knee as a result of bleeding. It's important to immediately ice it to try to minimize this bleeding because blood in the joint is not good for it. Blood and increased inflammation are nightmares for cartilage health. This inflammation can further damage cartilage and also lead to an environment prone to developing scar tissue, which leads to stiffness and long-term complications. If there is so much pain that you can't concentrate or sleep for two to three days after an ACL tear, it could be because blood is building pressure inside your joint. For these cases, your doctor can take some of the fluid out, which will give you immediate relief.

Studies have shown that about 50 percent of people who have suffered an ACL tear will get post-traumatic osteoarthritis (PTOA) within twenty years. The two most determining factors are a delay in treatment and your age at the time of your ACL tear. The older you are, the more likely you will get osteoarthritis after an ACL tear.

Obviously, you cannot control your age, but you can determine the timing of the treatment. Therefore, a "wait and see" approach to see if one does have problems with an ACL tear could backfire and ultimately lead to your knee getting arthritis. If you do have signs that your knee is unstable, which your doctor can determine in the office, and reconstruction surgery is your best option, then proceeding with an ACL reconstruction sooner rather than later is in your best interest.

Now the question of what is the right treatment for you after an ACL tear arises. The course of ACL treatment used to be a fairly clear-cut distinction based on patient age: the recommendation for younger patients was reconstruction, and for older patients (over fifty) conservative management. However, as the population ages, and people are staying more active, this distinction is becoming less clear. As with all injuries, treatment goals should be discussed case by case and be individualized to each patient.

Generally, we feel that people who have problems with twisting, turning, and pivoting activities and who wish to continue to participate in sports like basketball, soccer, football, skiing, and other activities should have an ACL reconstruction. This is to protect their knee from having slippage, which can lead to further cartilage and meniscus tears; moreover, studies have shown that the longer you wait to have an ACL tear reconstructed, the more likely you will get arthritis over time. This means if you have a patient who is a "young sixty-something" like a Pierce Brosnan or a Christie Brinkley—

someone who still skis or runs or plays pickup sports—it is entirely reasonable to consider undergoing ACL surgery. Other factors also play into the decision, such as:

1. *Other injuries in combination.* While we may be able to treat the ACL conservatively, a meniscal tear or other ligament injury may push the needle toward operative treatment. Or in the case of multiple knee injuries, the injury that is the most complicated or the worst drives the overall treatment.
2. *Presence or absence of osteoarthritis.* Patients with significant arthritis already present are usually not good candidates for arthroscopic procedures such as ACL reconstruction. This is similar to factor 1: osteoarthritis is worse and therefore drives treatment.
3. *Overall patient health.* Because this is elective surgery, one's overall health must be taken into consideration.

So what are your options? The conservative approach consists of nonsurgical treatment: mainly rest, ice, Tylenol (acetaminophen), physical therapy, and often the use of a brace. Sometimes certain injections can be tried, such as platelet-rich plasma (PRP) or bone marrow aspirate concentrate (BMAC), or other healing stimulants. These options will be discussed at length in Chapter 11; the science behind them is still not definitive. Physical therapy will focus on your regaining good functional range of motion, preventing long-term stiffness, and improving muscular strength, specifically hamstring strength.

THE RUNDOWN: ACL TEARS

How common: Approximately three hundred thousand ACL injuries in the United States each year.

Common causes: Any force that causes the shinbone (tibia) to go too far forward in relation to thighbone (femur). In sports, these include quick stopping, change of direction, jump stop, and jump cut.

Average patient: An otherwise healthy sixteen-year-old female soccer player. That is the sport and age group most at risk; however, any athlete who participates in sports that require quick changes of direction or of speed is at risk.

What to do: If you hear a *pop* and have significant pain and swelling, schedule an appointment with a doctor. If you are unable to bear any weight, have numbness and

tingling in your leg, or have pain that is uncontrollable with over-the-counter medications, then go to the nearest urgent care or emergency department, as these can all be signs and symptoms of more troubling injuries.

Severity of injury: ACL tears are graded 1 to 3 in severity, based on clinical and advanced imaging findings. Grade 3 tears are associated with complete rupture of the ACL, while grades 1 and 2 are partial tears of increasing damage.

Treatment options: The main two options are conservative (nonoperative) therapy and reconstructive surgery. Conservative therapy is usually the treatment for partial tears, or complete tears in patients who are less active or do not require the function that the ACL affords. Surgery is usually recommended for complete tears in athletes and patients who wish to remain active, and in patients who continue to have instability after nonoperative treatment.

Expected results: ACL reconstructive techniques have come a long way in the last twenty years. In general, you can expect to return to your pre-injury level of activity at a similar level of performance. Long-term studies do suggest that ACL injuries, even those treated with surgery, are associated with increased risk of osteoarthritis, but we do not yet have ten-, fifteen-, and twenty-year follow-up on the more recent surgical techniques being implemented. It stands to reason that as techniques improve, this association should decrease.

Return-to-activity timeline: Patients can usually begin walking or bearing weight as tolerated on day one. A full return to competitive sports usually takes six to twelve months. This is an area of debate; even five years ago many doctors were allowing return to play at six months. Recent data, however, has shown that the ligament is still undergoing healing and would be better served by an additional three to six months of healing for the best results.

Surgical options vary depending on the surgeon. However, except in a few specific circumstances, a surgeon does not repair the ACL—that is, fix your native ACL. They reconstruct it with a new tissue source, which requires choosing a graft type, drilling bone tunnels (tibial and femoral), and fixing the graft into the tunnels with some sort of fixation device such as screws. The two broad categories of graft types are autograft (tissue from your own body) and allograft (tissue from a donor). The most common grafts are from the hamstring, patellar tendon, and quadriceps tendon. Autograft tissue has been shown to result in better healing ability and better long-term outcomes in most peer-reviewed studies; however, complications at your harvest site (where you take the tissue from) are not uncommon. Stiffness and pain are somewhat common at the site of harvest.

Furthermore, if you are an older patient undergoing reconstruction, many

of your own tendons that would be targets for harvest have wear and tear (tendonitis) from age and therefore may not always be the best graft choice. In general, the recommended upper age for when to use your own tissues keeps creeping up as more studies come in, and using your own tissues up to the age of sixty is becoming more common. Because of these factors, it is important to have a conversation with your surgeon regarding their thoughts on which they prefer and why. Again, surgeon preference combined with your age, sex, and treatment goals all play into the decision, so have an open and honest conversation with your surgeon about which is best for you.

ARTHRITIS

Any damage to a cartilage surface is effectively arthritis (see Figure 3.2). (If you've been diagnosed with *chondromalacia*, or cartilage damage [see here], that's a kind term for early arthritis.) The cartilage on the end of your bones is a unique organ. It is very efficient at absorbing shock and allowing us to participate in activities. But once the cartilage is damaged or starts to wear out, more stress is placed across the joint, the bone can become deformed, and your knee alignment can change. This can lead to an acceleration of the arthritis process over time.

FIGURE 3.2.

Arthritis

The cartilage has four main layers. The surface layer is the strongest. Once the surface layer is broken, the remaining deeper layers start to wear out more rapidly. Therefore, it is important to ensure that the surface layer does not break, or if there is some cartilage wear, that you adapt your activity levels so the rest of the cartilage does not wear out faster.

Arthritis can present in many different ways. Sometimes you will notice crunching inside your knee, called *crepitation*, or there may be pain or swelling with activities. Minor swelling can cause a feeling of joint stiffness, which indicates to surgeons that there is some underlying arthritis present. In addition, the swelling in the front of the knee can leak out the back of the knee between two tendons, which is called a Baker's cyst. (It is rare that a Baker's cyst must be treated surgically. Most of the time, doctors treat the problem in the front of the knee by decreasing the swelling, and the Baker's cyst will usually diminish over time.)

It is important to try to determine why the arthritis developed. In particular, if it is due to excessive activities, such as squatting and lunging, or jumping and high-impact activities, the body is telling you that you have done too much, things are starting to wear out, and you need to change what you're doing. Unfortunately, it is not reasonable to think that you can have the cartilage surface trimmed out and smoothed down and then expect to be able to return to those same activities. Because you have already broken down the strongest surface cartilage, continuing those activities will invariably lead to further wear and bigger problems down the line.

Whether the arthritis is due to injury or simply genetic, try to develop a plan to ensure that it does not progress further. Surface cartilage changes may be able to be treated with activity modification and exercises such that you do not cause any further problems. This could include strengthening your quadriceps muscles so that one has the best absorption and avoiding any significant impact or running activities after one has the a nonrepairable meniscus tear trimmed out. Deeper cartilage problems are more problematic because we do not have cures for arthritis even with today's technology.

So what do you do if your arthritis is advanced? End-stage arthritis leads to significant pain and debility. Given that osteoarthritis is irreversible, there really are only two basic treatment paths: (1) *nonoperative*, which involves physical therapy and often injections (steroids to decrease pain and inflammation or hyaluronic acid to increase lubrication, diminish inflammation, and potentially decrease pain), or (2) *operative*, which usually entails a partial or a total knee replacement, depending on how much of the knee is affected.

A partial knee replacement aims at only surgically addressing the part of the knee that is diseased. This could be the medial (Figure 3.3), the lateral (Figure 3.4), or the patellofemoral compartment (Figure 3.5). There are many stipulations to when this procedure should be done. The arthritis should be

mostly isolated to one compartment and should not be widespread or all over the joint. The patient should *not* have any inflammatory arthritis, with the joint lining secreting enzymes that break the cartilage down; significant knee stiffness (cannot move the knee throughout the whole range of motion); significant malalignment (having knocked knees or being bowlegged); or ligament damage. All of these conditions are predictors of failure for partial knee replacements. Instead the patient is a candidate for total knee replacement, which is for those with widespread arthritis or those who have other factors that make them poor candidates for partial.

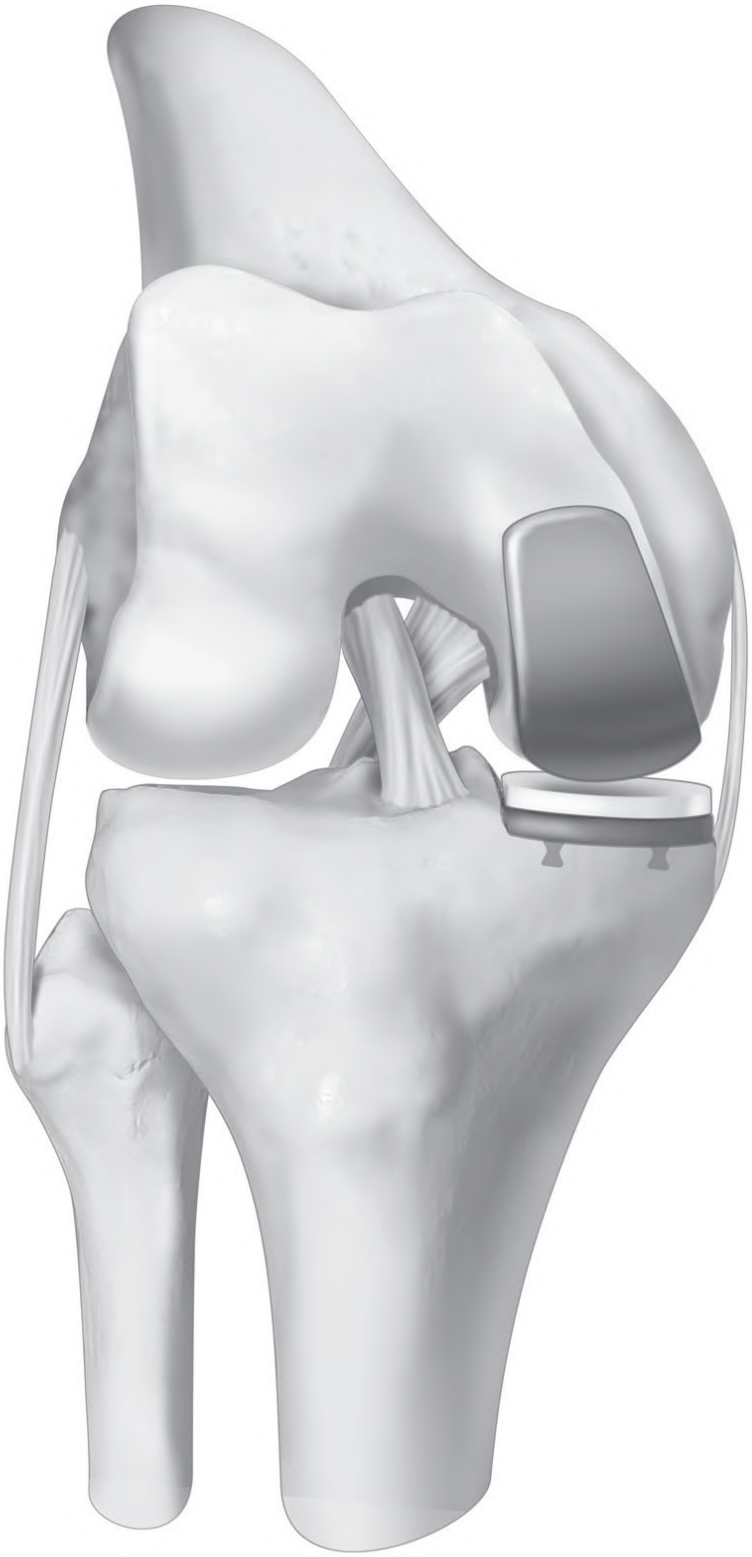


FIGURE 3.3.

Medial Knee Replacement

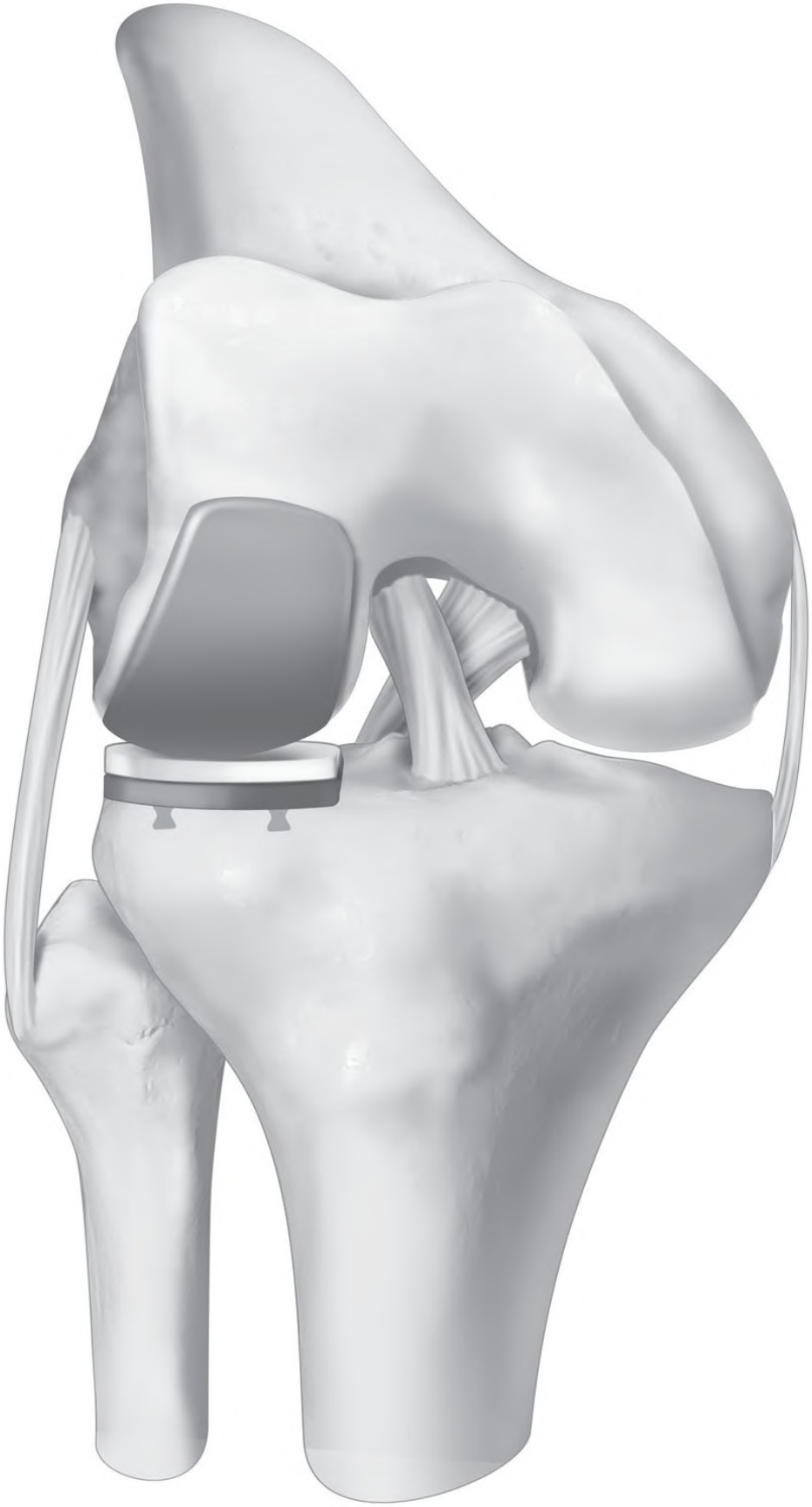


FIGURE 3.4.

Lateral Knee Replacement

FIGURE 3.5.

Patellofemoral Knee Replacement

Knee Replacement

A knee replacement (Figure 3.6) is a procedure in which your native knee is replaced by a combination of metal and plastic. In fact the whole knee is not replaced; it's a bone resurfacing procedure, in which the cartilage that was worn out is removed and replaced by metal and plastic surfaces. By removing this part of the femur and tibia, the surgeon removes the arthritis that is causing the pain, thereby essentially curing your pain. The metal or plastic replacement components are usually then cemented onto bone at the level the cuts were made after some more extensive and intricate cutting and drilling. What you are left with is a new knee, which should alleviate or cure the previous pain and should allow for good and full range of motion in most cases. This is a highly successful procedure that allows people to return to daily activities and recreational sports in some cases.

FIGURE 3.6.

Total Knee Replacement

These are the basic steps your surgeon will undertake for a knee replacement:

- **Prepare the bone.** The damaged cartilage surfaces at the ends of the femur and tibia are removed along with a small amount of underlying bone to have a healthy bone surface where the new prosthesis is going to be cemented in place.
- **Position the metal implants.** The removed cartilage and bone are replaced with metal and sometimes plastic components that recreate the surface of the joint. (What material the components are made of depends on the brand of implant; for example, all-poly tibial inserts have no metal on the tibia.) These parts may be cemented or press-fit into the bone.
- **Resurface the patella.** The undersurface of the patella (kneecap) is cut and resurfaced with a plastic button. Some surgeons do not resurface the patella, depending upon the case.
- **Insert a spacer.** A medical-grade plastic spacer is inserted between the metal components to create a smooth gliding surface.

Over the years, knee replacement techniques and instrumentation have undergone countless improvements. “Robotically implanted” is an example of how technology is transforming the way joint replacement surgeries are being performed. When you hear “robotic-arm assisted technology,” it’s important to understand that the robotic arm doesn’t actually perform the surgery. It is performed by an orthopedic surgeon, who uses special software to preplan your surgery. Your orthopedic surgeon will guide the robotic arm to remove diseased bone and cartilage. The potential advantage of this procedure is greater accuracy in the placement of the metal parts, and therefore the durability of the prosthesis can potentially increase.

There are many companies that make knee replacement systems, and if you ask fifty surgeons you may get fifty opinions on which companies are best. You may want to do your own research regarding companies and products just so you have a basic understanding. That being said, most of these products are of similar quality, and what may be more important is the familiarity your surgeon has with the product.

Aside from the usual concerns and complications regarding surgery

(which will be discussed in-depth later), a total knee replacement has a shelf life. Its metal and plastic components do not last forever, and therefore this is not a procedure we like to perform in younger patients unless absolutely necessary. Often fifteen to twenty years is the expected survival of the components, although there are reports of them lasting thirty years or more. While the surgery can be redone, it becomes more complicated, and the outcomes, while still pretty good, are not as good as the first time around. With all this in mind, we try to maximize nonsurgical treatment and postpone the need for replacement as long as possible in our younger patients.

One additional thing to note is infection risk. In almost all surgeries there is a risk of infection, and elective knee surgery is no exception to the rule. Usually knee surgery is a fairly clean, or uncontaminated, procedure, especially when compared to dirtier, or contaminated, areas of the body like the colon. Nevertheless, every time you make an incision, you risk allowing the nonsterile or dirty outside world into the clean knee, and thereby there is always a risk of infection.

This infection risk is mildly elevated in cases in which more nonbiologic materials—that is, metal and plastic—are being implanted into your body. This is because bacteria are much better at growing on nonbiologic material than our own native tissue. Total joint replacement is a surgery that, while very clean, does involve the replacement of a significant amount of native tissue with nonbiologic inserts. Therefore even with all our advances in sterility, antibiotics, and prevention, the risk of infection is still approximately 1 percent.

While that means that ninety-nine out of one hundred people will likely not get infected, on average one out of a hundred people will. Infection turns a routine procedure—an elective total knee replacement—into a prolonged, complicated process that usually involves two additional procedures: one to remove all the implants and leave antibiotics in your knee (discussed in more detail in the subsection on septic arthritis) and a secondary procedure to put new implants in. This process usually takes a minimum of three months and requires the patient to be limited in weight bearing or bear no weight on that leg for some if not all of that time.

This is not to dissuade you. Every decision in life has risks and rewards, and it is up to you to choose what is worth it to you. Ninety-nine out of a hundred people do not end up with an infection, and a majority of people are pleased with their decision. In order for you to be an informed consumer, you should understand both the rewards and the risks of surgery.

Be sure to discuss risks and rewards with your surgical team; this will usually come in the context of filling out an informed consent document, which will be described in more detail later.

THE RUNDOWN: ARTHRITIS

How common: Very: 13 percent of women over sixty and 10 percent of men over sixty have symptomatic knee arthritis.

Common causes: Osteoarthritis is caused by both genetic factors or an injury, like taking out a torn meniscus. The latter is called post-traumatic osteoarthritis (PTOA). About 15 percent of osteoarthritis is post-traumatic; this type usually occurs in younger patients. It can be due to the initial injury causing a cartilage crack or fissure, or it can develop after a meniscus is taken out.

Average patient: A sixty-year-old who had some type of knee injury (like an ACL or meniscus tear) at some point earlier in their life.

What to do: This is not urgent and should be seen in an orthopedic surgeon's clinic, not the emergency room, as the emergency department most likely will not be able to offer you any treatment that will help significantly. In clinic, physicians can assess the severity of the osteoarthritis and determine the best treatment given the state of your knee.

Severity of injury: The amount of arthritis depends on the depth of the cartilage lesion (chondromalacia). Mild, superficial cartilage lesions that have softening but no real loss of cartilage are considered grade 1 chondromalacia. Grade 2 chondromalacia is a defect down into approximately half of the thickness of the cartilage. Grade 3 chondromalacia is close to bone, whereas a full-thickness cartilage lesion down to bare bone is Grade 4 chondromalacia.

Treatment options: Treatment depends upon the symptoms a patient has, associated injuries, and the depth of the cartilage lesion. For small, partial-thickness cartilage lesions, a trimming, called a chondroplasty, may be indicated. For full-thickness cartilage lesions, a complete workup can determine the cause and whether other associated surgeries may be the next step. For people with end-stage osteoarthritis, treatment options are largely temporizing, such as therapy, weight loss, and injections, or definitive, as in full or partial knee replacement procedures. However, a knee replacement will not last forever (usually about fifteen to twenty years).

Expected result: The expected result depends on the overall activity level that one plans to return to as well as the treatment undertaken. If one can avoid high-impact activities and can also take other measures to offload the knee such as weight loss and muscle strengthening, then often patients can do quite well, at least for some time. Chondroplasty

and clean-out procedures (see here) often provide short-term relief but aren't a long-term solution. Knee replacement (arthroplasty) procedures allow for a return to most low-impact activities, like golf, walking, sometimes light jogging, some tennis, and day-to-day activities. High-impact activities such as team sports, heavy weight lifting, and jumping are not recommended; however, these are usually not in high demand in older patients. These restrictions are important: even though total knee replacement is a successful operation, we don't rush to do this in a younger patient who is still high-demand because the prosthesis is at risk of wearing out faster; revision knee replacements generally don't function as well as the first time around.

Return-to-activity timeline: This is largely dependent on chosen treatment. For those choosing to try the more conservative route via wearing a brace, losing weight, and getting knee injections, usually you are allowed to be as active as your pain allows, so very minimal restrictions. The day of your injection, depending on the type you receive (see here), you are usually allowed to maintain a normal activity level, if not slightly decreased, in order to determine how well the injection is working. Most injections take a few days to a few weeks to take full effect, but no hospital stay, period of immobilization, or period of protected weight bearing is necessary. With surgery, after a total knee replacement, you will usually spend anywhere from zero to two days in the hospital; however, you are allowed to be up and walking the day of surgery. From that point on, your activity is largely as tolerated, unless there was another additional aspect of your care. Some people take it easy for a few days to a couple of weeks before feeling up to really getting around much; others are known to be out walking around the block within a couple of days.

MUSCLE STRAIN

A muscle is composed of muscle fibers and a tendon at the end of the muscle, which allows it to pull on a bone and exert its force. When your activity exceeds the strength of the muscle fibers, the fibers can tear. Voilà: a muscle strain.

There are different types of muscle strains. A minor strain with minimal muscle injury, which is basically just some soreness, would be considered a grade 1 strain. A muscle strain in which the muscle is definitely torn but not completely, and the patient has significant disability, would be a grade 2 strain. A complete muscle tear, either in the muscle or where the tendon tears off the bone, is a grade 3 strain.

The vast majority of muscle strains are grade 1 tears. These are the type where you may overdo it at the gym and your muscle feels sore for a few

days. You should usually treat this with icing to minimize bleeding, as well as a stretching program, mild compression, and avoiding the activity that caused the pain in the first place until the soreness resolves. If you are participating in sports and cannot avoid that activity, make sure that you ice the muscle down after activities to minimize swelling and bleeding, and then place heat over the area to allow the blood supply to resume flowing into the injured area prior to activity. Most grade 1 muscle strains can be treated based on their symptoms and may only limit you to avoiding activities or sports for a few days.

Grade 2 muscle strains are more severe. They involve a partial tear of the muscle. The most common grade 2 muscle strains are in the hamstrings. Because these muscles are important for running and lifting up your leg, grade 2 hamstring muscle strains need to be treated with icing and rest, as well as stretching, until the muscle quiets down. This may take up to three or four weeks.

Complete grade 3 muscle strains are a more serious matter. Where the muscle may be completely torn off the bone and retracted, surgery may be indicated. This is most common for hamstring tears off the pelvis. These are usually accompanied by a large amount of bleeding, in which the thigh may completely fill up with blood, and result in significant disability. Patients with hamstring tears off the pelvis usually have difficulty going up stairs or up hills because the hamstrings are important for this activity. Patients may need to be on crutches for several days to avoid limping when they have a complete muscle tear like this. Other sites around the knee where the muscles can tear off include the hamstrings tearing off the tibia. While this is less common, it can happen to high-level athletes and has been known to occur almost every season in the NFL. In this circumstance, letting the muscle tear quiet down and then slowly resuming activities is usually indicated. It is rare that one would need to surgically reattach one of the smaller hamstring muscles back to the tibia.

THE RUNDOWN: MUSCLE STRAIN

How common: Very common. It's activity- and sport-dependent, but reports indicate that 8 to 25 percent of athletes in various competitive sports sustain a hamstring strain. These numbers don't include strains affecting the quadriceps, calf muscles (gastrocnemius and soleus), and other lower leg muscles.

Common causes: Sudden stops, full-speed running from a static position, eccentric

contractures (the muscle is firing against a muscle that is attempting to lengthen), or sudden loads to joint.

Average patient: An eighteen-year-old male soccer player.

What to do: Most often you can employ a "wait and see" strategy. Without a big *pop*, or other concerning symptoms (which are not anticipated), muscle strains can be treated with rest, Tylenol (acetaminophen), and an ice/heat combination. However, if pain and debility persist for more than six weeks, an appointment with your primary care provider is in order.

Severity of injury: Muscle strains are graded according to the amount of injury to the muscle fibers. A grade 1 strain is soreness, but no obvious muscle tear. A grade 2 strain is a partial muscle tear, whereas a grade 3 strain is a complete disruption of the muscle.

Treatment options: Most muscle strains can be treated with the RICE principles (see here) and a program of physical therapy. When the muscle is completely torn off of bone, surgery may be required to reattach it.

Expected results: Most patients can get back to higher levels of activity over time. If there is a lot of scar tissue that forms within the muscle, patients are at an increased risk of a repeat muscle strain injury.

Return-to-activity timeline: Grade 1 muscle strains usually require two to fourteen days of activity modification, grade 2 muscle strains may take up to six weeks, and a complete grade 3 strain may require two to three months of rest and physical therapy.

Some of the newer treatments for muscle strains and tears include the injection of biologics. This could include the injection of PRP or different forms of plasma itself without any significant platelets or white cells. Unfortunately, there is not a lot of solid scientific data about the effectiveness of these injections. There is some thought that injection of plasma (see here) may get athletes back to competition sooner, but more research is needed in this area.

For those who do need a repair of a grade 3 strain, or muscle tear off of bone, the usual treatment is to repair it with suture anchors and then have the patient on crutches for up to six weeks to allow it to heal. If there is a good solid and secure repair, early partial weight bearing may be possible. It is important to recognize that it takes at least six weeks for the muscle to heal and adequately adhere to the bone to be able to take any stress, so being on crutches for six weeks and then working on strengthening for a good three or four months would be beneficial prior to returning to higher-level activities.

ILIOTIBIAL (IT) BAND FRICTION SYNDROME

The iliotibial (IT) band is a thick fascial band that runs along the outside of the knee. It attaches at the hip and then courses down to a bump of bone on the shinbone called Gerdy's tubercle. It also attaches to the outside of the patella (kneecap). The IT band is important for stabilizing the outer part of the knee. (See Figure 3.7.)

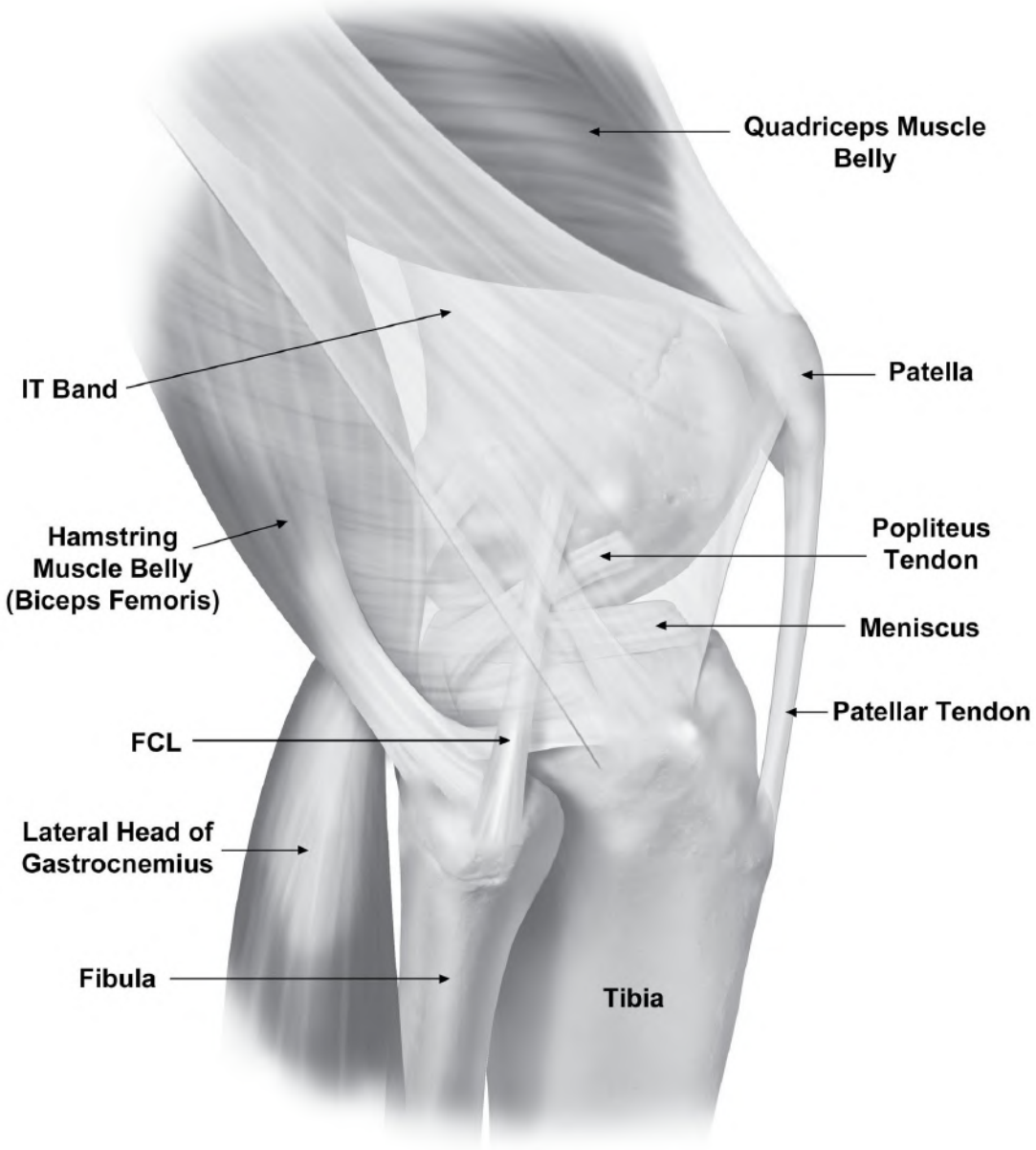


FIGURE 3.7.

Anatomy of Lateral (Outside) of Knee

In some athletes who participate in regular repetitive activities, such as cycling, hiking, or long-distance running, the IT band can rub against a bump of bone called the lateral epicondyle on the outside of the knee. Over time,

this can cause significant irritation and possible thickening of the IT band at this location. The condition is usually diagnosed by having pain when you push on the lateral epicondyle and bend your knee back and forth. For athletes who develop IT band friction syndrome, it typically starts about two miles into a run. That's when the IT band will start to get further irritated, causing the tissue to get quite sore.

Treatment is almost always an IT band stretching program (see below), combined with a low-impact lower-extremity strengthening program. Almost all cases of IT band friction syndrome can be treated without surgery. That said, in patients who may have long-standing IT band friction syndrome, or where the IT band becomes quite thickened and there is no chance that it will become thinner over time, a surgery to resect a diamond-shaped portion of the IT band may be indicated if a nonoperative treatment regimen hasn't worked. In general, this surgery is successful about 75 percent of the time.

HOW TO STRETCH THE ILIOTIBIAL BAND

1. Lie on your side with your affected knee on top.
2. Bend your top knee and grab your ankle. You should feel a tightness in your quadriceps muscle with this.
3. Pull back a bit, and then place your bottom foot on the top side of your top knee.
4. Gently pull the foot on your knee down toward the floor, elongating the outside part of your top thigh.
5. You should feel a stretch in the side of your knee where the IT band crosses the knee.
6. Hold the stretch for fifteen to twenty seconds, and then release. Repeat 3 to 5 times.

THE RUNDOWN: IT BAND FRICTION SYNDROME

How common: Up to 25 percent of active individuals will experience IT band friction syndrome; it is very common in runners and cyclists.

Common causes: Running long distances while having bowlegged alignment.

Average patient: A thirty-five-year-old long-distance runner.

What to do: This is a wait-and-see situation. Treat it with good old-fashioned RICE (here), combined with some activity modification for six weeks. If this fails to improve the symptoms, then it is time to schedule an appointment.

Severity of injury: Severity depends on the amount of swelling over the lateral

epicondyle and the outside of the knee, and also the thickness of the IT band as a result of the irritation. If you have a new onset of the syndrome with no significant lateral swelling, you usually can return to activities within two to six weeks. If you have long-standing IT band friction syndrome with an MRI that shows five millimeters or more of thickening of the IT band, you may require surgery.

Treatment options: The vast majority of patients who have IT band friction syndrome can be treated with a program of therapy and stretching. Surgery is generally reserved for very recalcitrant cases with thickening of the IT band where it crosses the lateral epicondyle.

Expected result: Most patients can return to full activities with a proper stretching and rehabilitation program. However, recurrences (symptoms coming back after treatment) are common.

Return-to-activity timeline: Patients with mild cases can usually return to activities two to six weeks after their program of stretching and rehabilitation. If you do require surgery, you will usually need four to six months of physical therapy to be able to return to activities.

ANTERIOR KNEE PAIN

Anterior knee pain is a catch-all term for many different problems that can cause pain in the front of the knee. These include arthritis, the kneecap not sliding in the correct position through the thighbone groove (trochlea), or overuse issues, which can present as bursitis. If you've been diagnosed with anterior knee pain, it's important to know the underlying cause, since the treatment for each of these individual causes can be quite different. A frequent condition is patellofemoral pain syndrome. This is a broad term used to describe pain in the front of the knee and around the patella, or kneecap. It is common in athletes but can happen in nonathletic people as well.

Anterior knee pain can be caused by some mild or advanced arthritis within the kneecap joint. This is called *chondromalacia patellae* or *chondromalacia of the patella or trochlea*. This is in effect a type of arthritis. Chondromalacia of the kneecap joint may respond to activity modification, steroid or hyaluronic acid injections, bracing, taping, or a good quadriceps strengthening program. An exercise program is the first and most important means to try to address any kneecap arthritis issues. However, if one has any significant cartilage pieces catching or locking in the joint, and causing disability because of the catching, it is probably advised to proceed with an arthroscopy to trim down these cartilage pieces (see here) prior to trying an exercise program.

Other causes of anterior knee pain can be overuse of the tendons around the knee. The patellar tendon attachment on the kneecap can get overused and lead to *patellar tendinitis* or *patellar endinopathy*. In addition, the attachment site of the tibial tubercle on the tibia may become irritated, especially in patients who are growing, and when the growth plate is still open, it may pull on the growing bone portion, called an apophysis, which can lead to fragmentation of the apophysis and anterior knee pain. This is called Osgood-Schlatter disease. Bursitis, or irritation of the gliding space where tendons cross each other or a ligament, also occurs at the knee. The bursa, a sac filled with lubricating fluid and located between tissues, decreases rubbing, friction, and irritation; a bursa is present in several places around the knee. All of these bursal sites can become irritated if the hamstring tendons are particularly tight. The hamstring tendons can be particularly tight in patients who are growing fast, have Osgood-Schlatter disease, or have problems in their knee that are causing some reflex spasm of the hamstring attachments to try to protect the knee from fully straightening out.

THE RUNDOWN: ANTERIOR KNEE PAIN

How common: 12 to 25 percent of people in the United States experience anterior knee pain. Young women are one of the most common groups to experience it.

Common causes: Growth spurts, knee overuse in sports leading to strain at tendinous attachments and damage at cartilaginous surfaces, and direct trauma.

Average patient: A fifteen-year-old girl who plays volleyball fourteen to twenty hours per week, or a thirty-five-year-old female marathon runner.

What to do: This is a wait-and-see injury. RICE (rest, ice, compression, elevation; see here) therapy is the mainstay, with rest being the key. The pain can usually get better with rest; however, follow the six-week rule (see here), and if it doesn't improve, then schedule an appointment.

Severity of injury: Depends on the cause. For patients who have anterior knee pain with no underlying arthritis, a program of rehabilitation is usually sufficient to improve or resolve the symptoms. For patients who have cartilage problems causing their anterior knee pain, they may need an arthroscopy (see here) or other further surgeries.

Treatment options: By far, the vast majority of treatment options for patients with anterior knee pain involve physical therapy. This includes working on quadriceps strengthening, pelvic strengthening, and ensuring that their hamstrings are not tight. Low-impact exercises are generally preferred over higher-impact activities until the knee quiets down.

Expected result: Most patients recover from episodes of anterior knee pain with activity modification or physical therapy or both.

Return-to-activity timeline: Most treatments for anterior knee pain are nonoperative. Therefore, you may need to modify your activities that caused the pain to develop in the first place, as well as undertake a strengthening program to return to full activities. Even if you are consistent with physical therapy, it may take up to six weeks for you to notice an improvement.

PATELLAR TENDINOPATHY OR JUMPER'S KNEE

The kneecap absorbs some of the highest forces in the knee, especially when you're squatting, landing after a jump, or lunging. To compensate for this, the shock-absorber cartilage on the kneecap is the thickest in the body. However, it is not just the kneecap that sees stress during squatting and lunging activities. The tendons that hold the kneecap in place, the quadriceps tendon (above the kneecap) and the patellar tendon (below the kneecap), also undergo a lot of stress. (See Figure 3.8.)

The patellar tendon connects the kneecap, or patella, to the front of the shinbone, an area called the tibial tubercle. Jumping and running, especially during sports like basketball or volleyball, often can cause the attachment of the patellar tendon to the kneecap to become overloaded. The most common term for this is patellar tendinitis (inflammation around the tendon). If this overloading is caught soon enough and you start treatment via activity modification, bracing, and physical therapy, the patellar tendon can often recover without any consequences.

However, if you continue to overload the patellar tendon and it breaks down to the point where it cannot heal, the tendon can often become degenerative and may actually partially separate from the kneecap over time. This is patellar tendinopathy (tendon breakdown at its attachment site).

Almost always, patellar tendinopathy is caused by an overuse injury—that is, doing more than your body can compensate for within that particular activity. Realize that treating the tendon or having surgery on it will not mean that you can continue to overload it. Often you'll have to adjust your activity level and sports participation to ensure that your body does not become overloaded again. If the overloading is relatively new, treatments tend to be more effective because the tendon can get back to its normal anatomy. But if this has been happening for several months or years, the tendon changes its structure and becomes more difficult to treat.

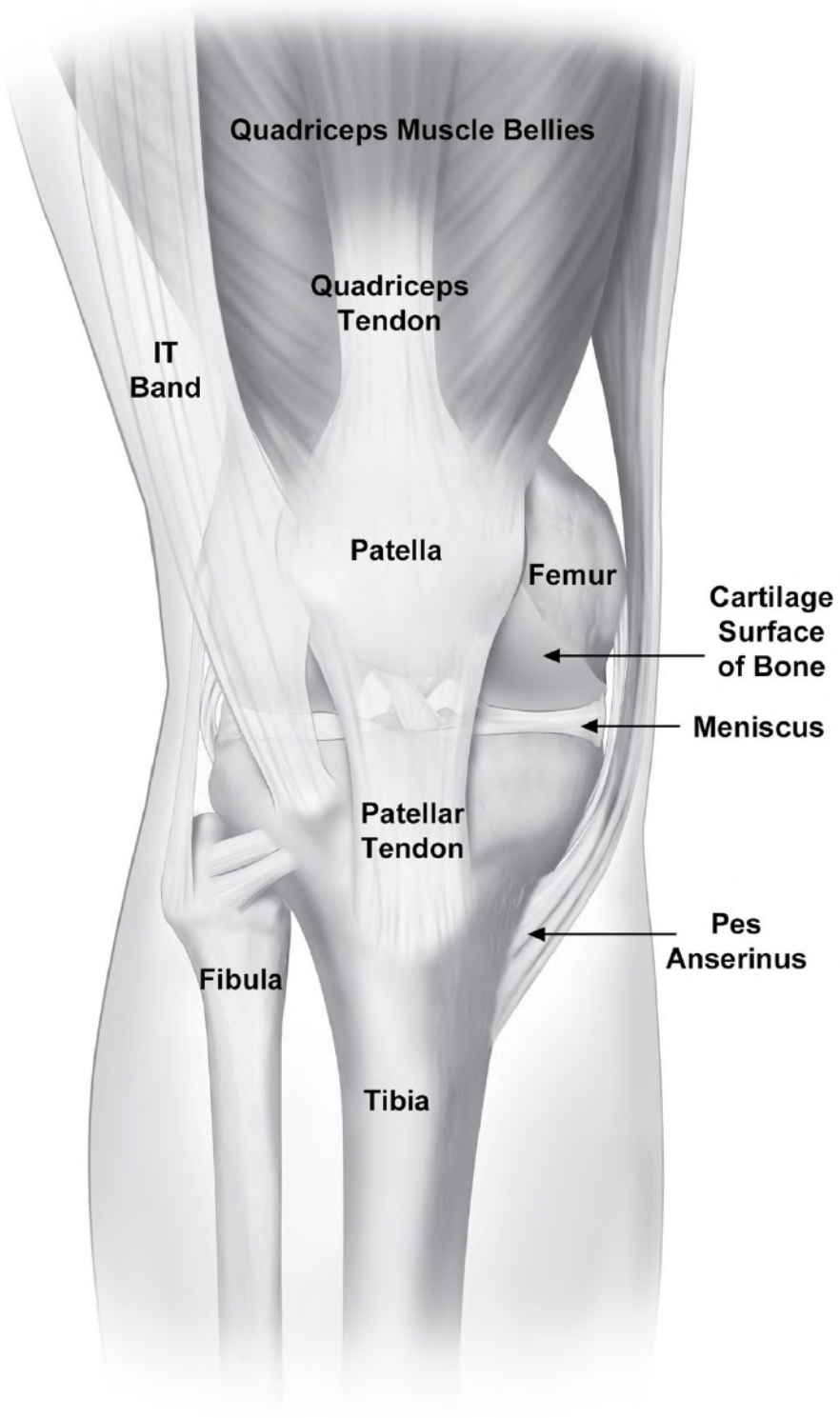


FIGURE 3.8.

Anatomy of Anterior (Front) of Knee

The main treatment for patellar tendinopathy is physical therapy and activity modification. Avoiding deep squats or lunges is important to ensure that the tendon can heal. Physical therapy exercises focusing on quadriceps

strengthening are also very effective, as well as balance and agility exercises. The use of a patellar tendon strap, which can help distribute the forces away from the patellar tendon attachment on the kneecap, have also been found to be effective and should be a form of treatment for athletes who need to continue in their sport while they still have symptoms.

Taking anti-inflammatory medications, such as ibuprofen or Naprosyn, can also help to decrease some of the symptoms, but they are not going to treat the underlying problem. Therefore, we often encourage these medications in low doses to allow a patient to participate in sports, but we make sure the patient doesn't use them to excess and have side effects, such as bleeding in the stomach or ulcers.

In the past, it was thought that a steroid injection into the site of the degenerative tendon would help it heal. In fact, this often prevented the tendon from healing, and while athletes may have been able to get a few weeks of improved performance, it often led to further breakdown and bigger problems over the long term. The American Academy of Orthopaedic Surgeons currently recommends that steroid injections not be used to treat patellar tendinopathy.

One of the newest hot topics is whether one should have PRP (platelet-rich plasma) injections to treat patellar tendinopathy. The theory behind this is that a PRP injection, usually with extra white blood cells in the PRP, may kick-start the healing process. The most effective studies for using PRP in this circumstance have used ultrasound to make sure that the white cell–rich PRP is injected into the correct spot and the patients also participated in a well-guided physical therapy regimen. The problem is that studies still have not definitively shown if it makes a difference, and insurance companies do not pay for it, so it can be very expensive to treat this problem and often up to $2,000 for each PRP injection. What we can say about it is that the specialist should probably look at the extent of your patellar tendon breakdown at its attachment on the kneecap on an MRI scan. If there is a significant amount of breakdown, it is probably impossible for the PRP injection to work. In cases in which the patellar tendon "lights up" because it is irritated, but there is not any separation of the patellar tendon, it is possible that a PRP injection could be beneficial. However, the jury is out on whether it truly works over time.

Cases that require surgery usually involve patients who have had a significant partial detachment of the patellar tendon and cannot lunge, squat, or participate in daily activities without any significant pain at that area. We have found that taking out the bad portion of the tendon and reattaching the

remaining tendon, or even reconstructing the patellar tendon with the patient's own hamstring tendon, can often be beneficial to treat these more severe cases of patellar tendinopathy. However, the recovery period can be long: the patient has to be on crutches for six weeks, followed by a program of rehabilitation for several months. This type of surgical treatment should be reserved for those who have failed activity modification and who cannot function at the level they want.

THE RUNDOWN: PATELLAR TENDINOPATHY

How common: Very common in jumping sports; some reports suggest as high as 25 percent of volleyball players and 30 percent of basketball players.

Common causes: Frequent lunging or jumping activities, such as basketball, figure skating, and volleyball.

Average patient: A college basketball player who does a lot of jumping.

What to do: This can become a chronic issue, so if the symptoms persist for longer than four to six weeks to begin with, a visit to your primary care physician for an exam to determine the extent of the injury is indicated. If necessary, you can then be referred to the most appropriate provider: a sports medicine specialist, a physical therapist, or an orthopedic surgeon.

Severity of injury: The severity of the injury is primarily based on both the clinical exam and the MRI findings: a mild case is indicated by some swelling of the patellar tendon attachment with no significant degeneration of the tendon, a moderate case by a small partial detachment with more swelling, and severe patellar tendinopathy by a portion of the patellar tendon being detached from the inferior pole of the patella.

Treatment options: First, avoiding the activity that caused the irritation, at least until the symptoms diminish, is recommended. The use of a patellar tendon strap may also take some of the force off the patellar tendon and allow the knee to quiet down. While steroid injections are discouraged, PRP injections with high white cell counts may be beneficial to jump start the healing process, although it can be painful in the beginning. Surgical options are usually reserved for cases in which the patellar tendon has partially detached.

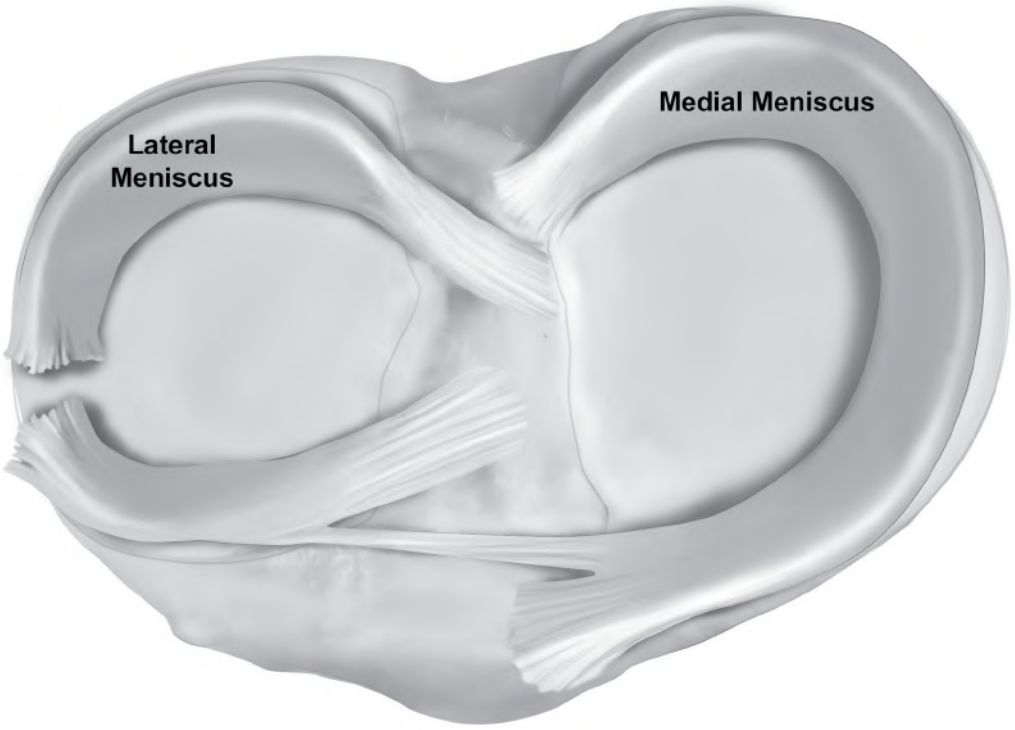
Expected result: Most patients can return to full activities after being treated for patellar tendinopathy. For most athletes who have to resume the same type of activities, the prognosis can be more guarded because it was an overuse injury to start with. Recurrences are very common for this pathology.

Return-to-activity timeline: For patients who are treated without surgery, a time frame of one to three weeks of limited activities to allow the area to quiet down and then a slow

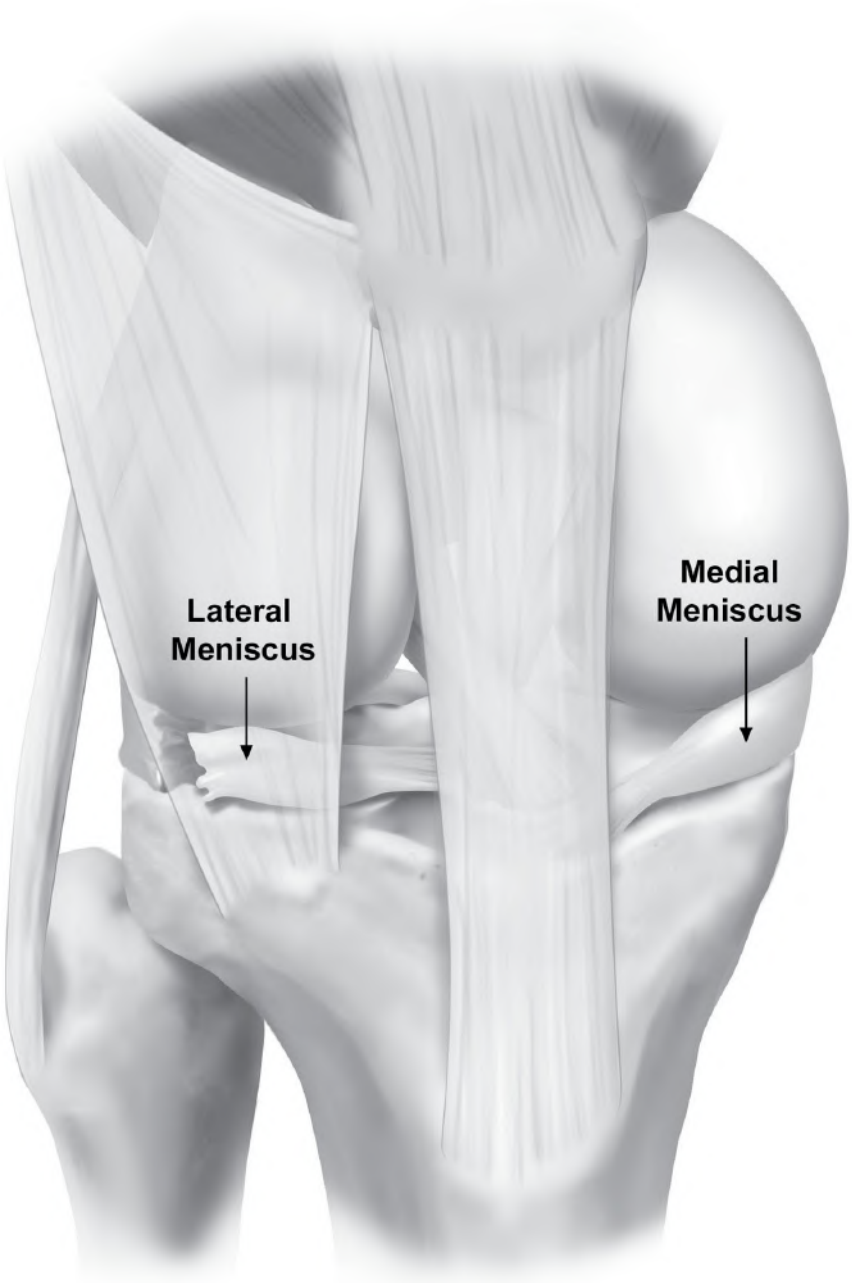
return to activity may be recommended. After surgical treatment, patients are restricted to minimal or no weight bearing on crutches for six weeks, and need from five to seven months to recover.

MENISCUS TEAR

Meniscus tears are some of the most common injuries that are treated by orthopedic surgeons worldwide. The meniscus is a C-shaped cushion that sits on both the inside (medial) and the outside (lateral) part of the knee. (See Figures 3.9 and 3.10.) The menisci are essential shock absorbers to the knee. A torn meniscus is commonly treated by surgically trimming the meniscus. Nonetheless, when you lose your menisci, it usually leads to the development of osteoarthritis. It is thought that one of the main reasons why the incidence of knee replacements is increasing dramatically is because more people are having their menisci trimmed out. So it can be a serious decision for you to have a meniscus trimmed, rather than repaired, especially when you are young. Additionally, new evidence suggests that meniscal deficiency can produce knee instability (a “giving way” sensation) and therefore aggravate symptoms.



FIGURES 3.9 AND 3.10. Meniscus Tear


Lateral
Meniscus
Medial
Meniscus

Meniscus Trimming

There are many different types of meniscus tears. A number of them are degenerative tears that can cause pain when they catch in the joint or when you squat down, twist, turn, or pivot. In these types of tears, if they are located closer to the middle of the knee, there may not be enough meniscus tissue present to have the opportunity for a repair. In these circumstances, you should have the meniscus trimmed, or when the torn portion of meniscus is removed. The reason most meniscal tears are trimmed and taken out is because the meniscus itself does not have an abundant blood supply, especially on the inner parts of the meniscus. So with a meniscus tear, you have to be cautious in your rehabilitation.

Whatever meniscus volume remains after trimming is essential to slow down any rate of arthritis. Therefore, if it's possible, you should have a nonrepairable meniscus trimmed in a technique called saucerization. In this technique, the edges of the meniscus are trimmed where necessary, while the portion of the meniscus that probably will not tear further and could still act as a cushion is retained.

A special type of meniscus tear is meniscal root tears: the meniscus gets detached from the bone and floats around the knee. This is equivalent to not having a meniscus, so it's crucial to repair this type of tear.

Meniscus Repair

If you have a reparable meniscus tear, and you are young or have very little arthritis, it's best to have the meniscus repaired if at all possible. Research hasn't yet determined what the upper age is for a meniscus repair, which is probably more dependent on the state of your cartilage and underlying arthritis than on your age. If you are still active and willing to have the repair and then undergo rehabilitation, you should strongly consider it.

There are many different types of meniscus repairs. The more common one is the all-inside technique: the surgeon sutures the meniscus without having to make incisions. This is the most frequently used technique because many physicians do not have assistants to help them with more complex repairs; moreover, this technique is preferred over taking out a meniscus. The downside is that the surgeon cannot put in as many sutures as with other techniques, and the all-inside meniscus insertion device makes relatively large holes in the meniscus; the meniscus may tear later at these insertion holes.

The inside-out technique places meniscus sutures from inside the joint to outside the joint and catches the needles through an incision on the medial or lateral aspect of the joint. This technique is considered the gold standard because many more sutures can be used, it can treat complex tears, and it has a higher success rate for complex tears. Its downside is that it does require incisions (which is a small price to pay to be able to save one's meniscus), and the surgeon must have knowledgeable assistants to be able to catch the needles and tie the sutures.

The other less common technique is to make a small incision in the front of the knee and place sutures from outside the knee to inside the knee. This technique is called the outside-in technique. This is a bit more challenging, and many surgeons do not use this technique. Nevertheless, it is effective for repairing tears in the front of the meniscus where an inside-out or all-inside meniscus repair technique cannot be used. Internationally this technique is used more commonly because it can be less expensive than all-inside or inside-out meniscal sutures.

Isolated meniscus repairs, where there is not an ACL reconstruction concurrent with it, commonly require patients to be non–weight-bearing for up to six weeks and to avoid for several months any significant stress on the knee like squatting, lifting, or sitting cross-legged. This is to give the meniscus the best opportunity to heal after it has been sutured in place. When you do have a meniscus tear with an ACL reconstruction, the drilling of the tunnels of the reconstruction releases many of your body's healing growth factors and stem cells, and often you can start bearing weight right away. The exception would be complex meniscus tears, such as a meniscus root repair or a meniscus radial repair. In these circumstances, the meniscus repair is still quite fragile, and one needs to be non–weight-bearing for up to six weeks.

THE RUNDOWN: MENISCUS TEAR

How common: Sixty-one out of one hundred thousand (0.061 percent) people per year in the United States. The highly active are at much greater risk.

Common causes: Meniscus tears are often caused by twisting, turning, or pivoting-type activities. They can also occur as a result of hyperflexion activities, such as during a deep squat and lifting.

Average patient: The average patient with a repairable meniscus tear is usually in their teens or twenties during a sports activity. The average patient for a meniscus root tear is usually in their fifties or sixties, and they have the meniscus tear while cleaning floors or

gardening.

What to do: These injuries, when occurring in isolation, are often not urgent. But if you have intractable pain, locking (your knee cannot be straightened), or any other concerning signs and symptoms (numbness, tingling, gross instability, or inability to walk), you should schedule an appointment with your primary care provider or go to the emergency department.

Severity of injury: Meniscus tear severity is usually graded according to its appearance on an MRI scan. Grade 1 and 2 intrasubstance meniscus tears are only within the body of the meniscus on MRI scans and cannot be seen at the surface during an arthroscopy. Usually these types of tears can be treated without surgery. Complete meniscus tears extend to the surface and are called grade 3 tears.

Treatment options: Meniscus tears that are nondisplaced or causing minimal pain in older patients may be treated with a program of physical therapy and observation. Bucket handle meniscus tears, meniscal root tears, and radial tears of the meniscus, especially in younger patients, usually need surgery sooner rather than later. In general, if the meniscus tear is repairable, and the patient is younger, surgery is recommended to try to preserve the meniscus function. For those tears that are not repairable, a trial of physical therapy can be attempted. But if the meniscus is locking or catching, proceeding to an arthroscopy and removal of the offending torn portion of the meniscus would be indicated sooner rather than later.

Expected result: Patients who have a meniscus repair may take longer to recover but often can get back to full activities with a better long-term prognosis. Patients who have a meniscus resected often return to activities much quicker but then will start to develop arthritis and have to decrease their activities over time. The takeaway on all this is that while it is easy to have your meniscus taken out, you'll pay the consequences over the long term. Look at having a meniscus repair over having a meniscus taken out, if possible. Saving your meniscus can make a huge difference in your knee function over the long term.

Return-to-activity timeline: Patients who have a meniscectomy usually are on crutches for two to seven days and can start driving during the end of this time frame. They can typically resume full activities in four to six weeks. Patients who have a meniscus repair and need to be non–weight-bearing for up to six weeks often need to be on crutches for the first six weeks and then can wean off of crutches when they can walk without a limp. They may start driving at approximately seven to eight weeks postoperatively. People with meniscus tears (who are not also having ligament reconstructions) usually can return to full activities at five to seven months postoperatively.

MEDIAL COLLATERAL LIGAMENT (MCL) TEAR

The medial collateral ligament is located on the medial side (inside or closer to the middle of the body) of your knee. It prevents the knee from gapping when one tries to twist to the inside. Overall, MCL tears are two to three times more common than ACL tears (see here). MCL tears can occur when you're twisting to the outside and your knee gives out, or when you get hit on the outside of the knee, such as a clipping injury while playing football, basketball, or soccer. (See Figure 3.11.)

When you have an MCL tear by itself, it commonly can heal without surgery. However, there are two situations in which it often does not heal on its own. First, if the knee gaps to the outside when the knee is out straight, which we call *valgus gapping in extension*, the chance of the MCL healing without surgery is very low. Second, when the MCL tears at its attachment on the shinbone (tibia), it retracts toward the knee, which we call a *meniscotibial MCL tear*. These types of tears also usually don't heal on their own. This is because the MCL can get trapped above the hamstring tendons and there is virtually no way for it to heal back down to the shinbone. In both of these types of injuries, the knee will feel very unstable to outward pressure, and a physician should assess this instability. A clinical exam or stress x-rays, coupled with an MRI scan, can determine if one does have this type of MCL tear. Most surgeons who treat complex knee injuries will obtain stress x-rays to objectively confirm that a patient has a complete MCL tear. Fortunately, these types of MCL tears are not that common.

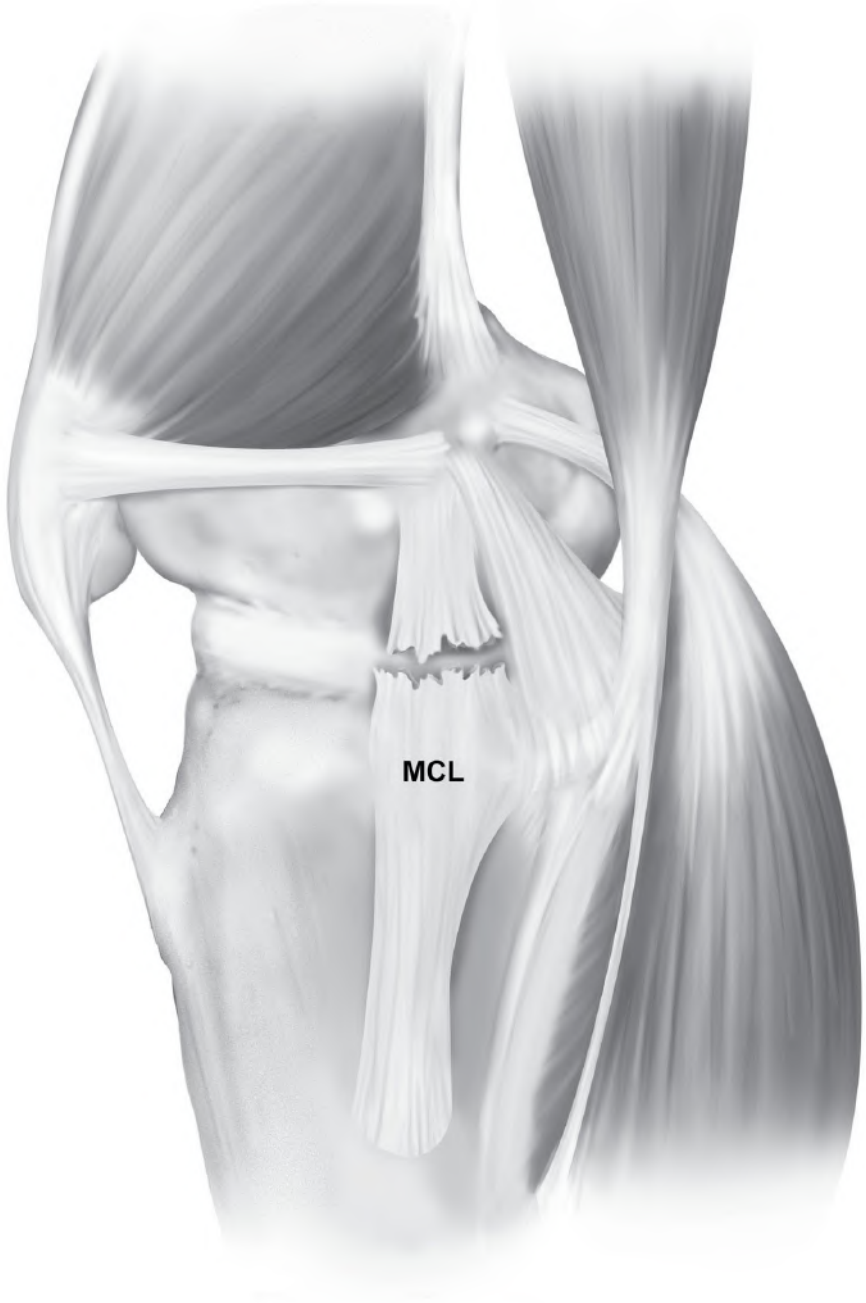


FIGURE 3.11.
MCL Tear

Most types of MCL tears are partial or tear off the femur, and the knee does not gap open when it is out straight. In most of these circumstances, surgery will not be needed; this ligament has a great capacity for self-healing. Participating in a well-designed physical therapy program—one that works on restoring motion and restoring strength to the quadriceps mechanism, incorporates exercise on a stationary bike, and considers the use of a hinged knee brace—also gives you an excellent chance of returning to activities sooner.

When an MCL tear is associated with another ligament tear in the knee, surgery may be needed. For partial MCL tears or for tears that are only torn off the femur, without the knee swinging open on extension, and that occur along with an ACL tear, you can undergo a physical therapy regimen first to try to get the MCL to heal and then proceed with the ACL reconstruction one to two months later. If the MCL is found not to have healed after that therapy program, then you should be considered for a combined ACL and MCL reconstruction.

When the MCL tear is associated with a complex knee injury to multiple other structures such as the posterolateral corner, the MCL should be reconstructed at the same time as the other ligaments to ensure the best outcome. These types of injuries should be treated sooner rather than later after injury to make sure that the knee can be put back together in its normal position without having some underlying looseness.

THE RUNDOWN: MCL TEAR

How common: Approximately seven hundred fifty thousand per year in the United States. It's twice as common in men as in women.

Common causes: Twisting, causing the knee to buckle and gap in valgus (see Figure 1.4 for a demonstration of valgus), or a contact injury, like a blow to the outside (lateral) side of the knee, causing valgus gapping.

Average patient: A teenage soccer or football player, although skiers and active people in general are at risk.

What to do: This injury is more benign and less concerning for warning signs when in isolation. If you experience an injury and have some pain on the inside (medial) of your knee with instability, you should schedule an appointment with your doctor. If you have numbness, tingling, gross instability, or an inability to walk, then proceed to the emergency department.

Severity of injury: The severity of MCL tears is graded 1 to 3, with grade 3 corresponding to a complete tear. Of note, the grade will not tell you where the tear has occurred (in the middle of the ligament, off the femur, or off the tibia). The location can guide treatment.

Treatment options: The main two options are conservative therapy and surgery. Conservative therapy is generally the course of action for the majority of isolated tears and tears that are mid-substance or off the femur. Tears that are in combination with other injuries, are associated with gross instability (gapping in extension), or have failed

conservative therapy should undergo surgery.

Expected result: Most MCL tears heal with limited functional loss over time.

Return-to-activity timeline: Some MCL tears can do quite well healing without surgery, thanks to the inherent bony stability of the medial side of the knee and the good blood flow to the area. Patients can often be back to participating in sports within six weeks and competing at a high level. Those who undergo surgery have a completely different and much longer timeline: six weeks of non–weight-bearing activity, followed by a gradual increase in activity, and a return to full activities around nine to twelve months after injury.

Nonsurgical treatment of MCL tears usually depends on the severity of the MCL injury. An MCL tear that hurts but does not gap open, called a grade 1 tear, usually heals within two weeks after injury. A partial MCL tear, grade 2, where there is just a mild amount of gapping and pain, can typically be treated and rehabilitated; an athlete can get back to competition within three to four weeks. A complete MCL tear that does not need surgery, called a grade 3 MCL tear, usually takes five to six weeks, or sometimes a little longer, before an athlete can go back to full competition. It is important during this time to try to work on a stationary bike as much as possible to help the healing MCL fibers to better align themselves and heal in place.

For those who undergo surgery, it is similar in principle to other ligament injuries discussed in this book that involve using a graft (see here). MCL injuries vary slightly in that instead of using two tunnels (holes drilled in bone), a suture anchor can be used to tack the ligament down to the tibia (shinbone). Instead of putting the ligament in the tunnel and securing it, the surgeon nails it down to the bone with an anchor. On the femur, a tunnel is usually used. Another aspect that differs slightly from ACL and PCL surgeries is that MCL tears are more commonly repaired with a graft to support the repair, as opposed to ACL and PCL tears, which are almost always reconstructed. The grafts used include hamstring tendons (the most common) or a tibialis anterior allograft (tendon from muscle at the front of your shin).

CARTILAGE INJURY

Articular cartilage is an amazing organ. It is so complex that no scientist has yet been able to come close to duplicating its function. The cartilage on the end of your bones (think of the gristle that you see on the end of a chicken bone) is very important for smooth motion of your knee, shock absorption, and allowing one to participate in normal activities. When it becomes damaged, one cannot participate in normal impact-type activities, and this is

called arthritis (for more on arthritis, see here). John Hunter, a famous eighteenth-century English surgeon, reported in 1743 that once cartilage was injured, it never heals again. Unfortunately, that fact is still true today, and the holy grail of knee surgery is to figure out a way to truly repair cartilage as it was composed prior to the injury. (See Figure 3.12.)

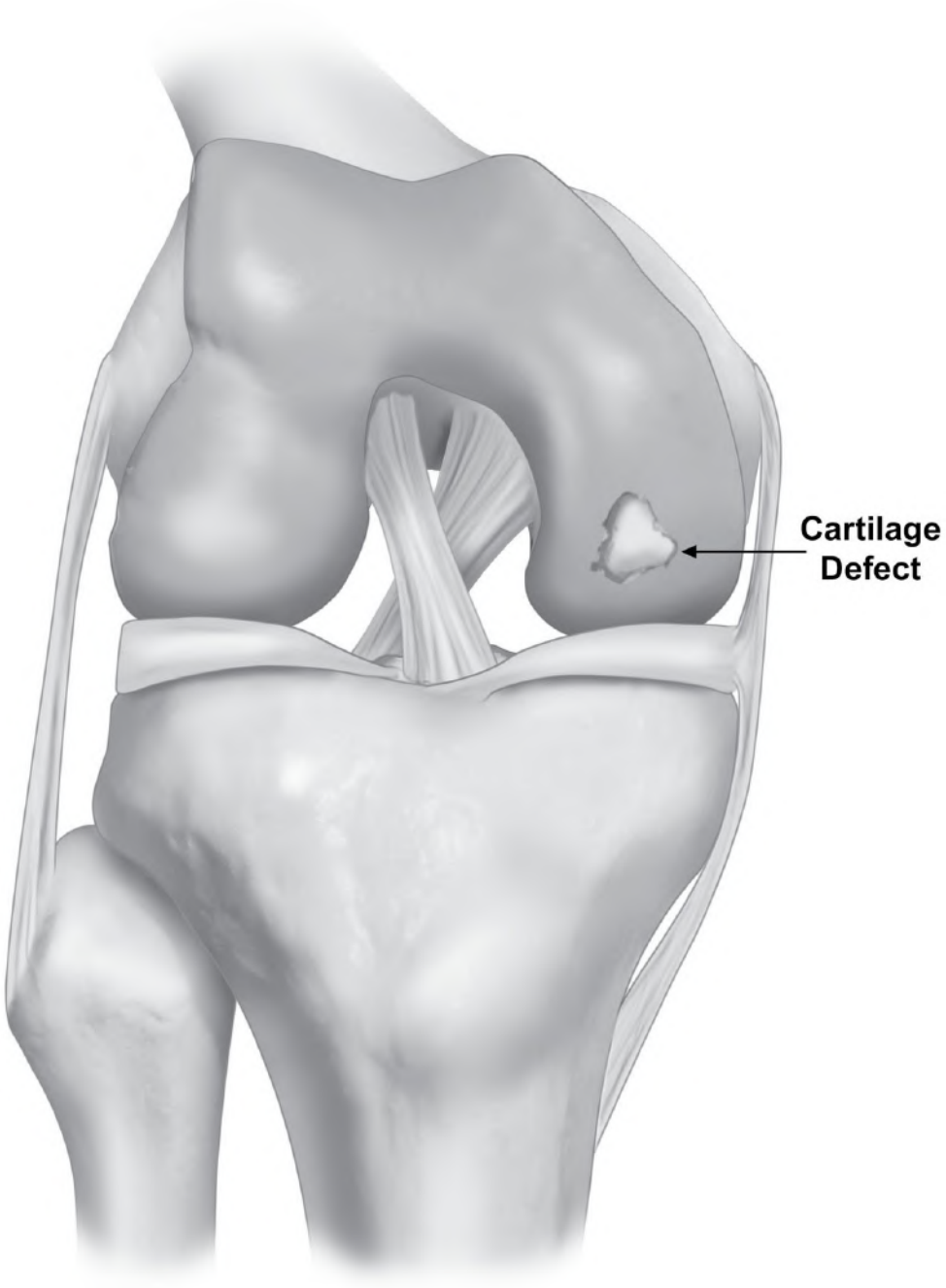


FIGURE 3.12.

Cartilage Injury

Early cartilage wear is called chondromalacia and is the beginning stages of arthritis. Sometimes with chondromalacia some pieces of the cartilage flip

back (delamination) and can limit your function. If this is only in the top portion of the cartilage, and not all the way down, an arthroscopic procedure to trim out the damaged cartilage can be useful in improving your function.

Returning to high-impact activities and activities that load that particular portion of the joint, however, will probably make it wear out again. As there is no cure for arthritis, modifying your activities can allow your knee to function better over the long term, rather than paying the price with advancing amounts of arthritis. (Keep in mind that you may or may not feel pain with these injuries, as inflammation plays a huge role in this disease. And sometimes a trial of physical therapy can help improve your symptoms with muscular strengthening.) What happens if you keep doing high-impact activities anyway? Over time, the cartilage defect will worsen, and you will have more symptoms, such as pain and swelling with activities and an overall stiff joint. A full-thickness cartilage defect is similar to a pothole in a highway: when the cars drive over it, they slowly break down the edges, and the pothole keeps getting bigger and bigger.

Surgical Treatments

Smaller potholes are also easier to treat. With the cartilage restoration techniques we have today, surgery for a smaller lesion is more effective and has a better chance of success than treating a larger lesion. Also, when fewer lesions are present, better outcomes can be expected.

One of the main ways to treat cartilage lesions is called a chondroplasty. This involves taking a shaver and smoothing off the edges of the torn cartilage. In this circumstance, only the damaged edges of the cartilage that are catching are removed because if the deeper portions or edges of the cartilage are removed, it can never be restored. Chondroplasty can be effective in treating symptoms and is a mainstay of cartilage treatment for many patients who may have surface changes or larger flaps causing symptoms.

A slightly higher-level technique to treat cartilage lesions is called a microfracture. In the microfracture technique, a small pick or drill is used to break through the bony layer that supports the cartilage. The theory behind this is that the stem cells (see here) deep within the bone will form a clot and ultimately lead to a sturdier fibrocartilage layer. The patient needs to be on crutches for a minimum of six weeks to not stress the clot and make it fall off, and so the trabecular bone can heal. Because the tissue has to grow and mature to be able to absorb some shock, most patients are not allowed to go

back to any type of impact activities or any stressful activities for a minimum of six to nine months after a microfracture procedure.

Another technique used to treat localized cartilage defects is taking a plug of bone and cartilage from one area of the knee and transferring it into the "pothole." This is called an autogenous cartilage transfer procedure. Once again, this technique works better when the cartilage defect is smaller. The advantage is that it is a one-stage procedure and your own tissue is used. However, it's robbing Peter to pay Paul, and there can be some problems with the area of the knee where the cartilage was taken from to treat the recipient site. In addition, there has to be time to let the bone heal around the edges of the transferred cartilage, and also for a fibrocartilage-like layer to grow over the donor site. Therefore, you also need to wait several months after a cartilage plug transfer to heal.

When you have a cartilage defect that is more than about two centimeters in size, the microfracture or autogenous transfer procedures have a much lower chance of working. In these circumstances, treatment can involve taking a plug of bone and cartilage from a young donor, called an osteochondral allograft transfer, or having a biopsy of one's cells and having them grow in the lab and be transferred back in place, called an autologous chondrocyte transfer procedure. These procedures are more involved and require a longer recovery time on crutches. For both of these procedures, a minimum of a year prior to returning to impact activities is usually recommended.

All in all, the best treatment for cartilage lesions is to avoid them at all costs. Preserving your meniscus tissue and avoiding any significant overloading of the knee joint is the best way to ensure that you keep your cartilage healthy. Remember, once cartilage is injured, it never heals with the same tissue, and all the treatments available still do not restore it to its normal state.

THE RUNDOWN: CARTILAGE INJURY

How common: It's difficult to know the exact number of cartilage injuries because many are not diagnosed. Every year 0.15 cartilage repair/restoration procedures are performed per 1,000 people, or approximately 50,000 cartilage repair/restoration procedures in a year in the United States.

Common causes: Cartilage injury is damage to the gristle on the end of the bone. It can be caused by direct trauma or by wear and tear over time because of a genetic

predisposition or the lack of a meniscus.

Average patient: The average patient is a high school student who tears their ACL and has a significant instability episode in which they knock a piece of cartilage off the end of the bone.

What to do: An MRI will almost always be an integral part of the diagnostic process for cartilage injuries. Plain x-rays can show this type of injury but are nowhere near as informative as an MRI.

Severity of injury: The severity of injury is graded according to the depth of the cartilage defect. This is usually called chondromalacia. Grade 1 chondromalacia is some surface damage, grade 2 chondromalacia is cartilage damage into about half the depth of the lesion, grade 3 chondromalacia is cartilage damage down almost to bare bone, and grade 4 chondromalacia is a complete hole in the cartilage and the cartilage worn down to bare bone.

Treatment options: Treatment options for a cartilage injury can include therapy, bracing, injections, or surgery. Surgery can include trimming of unstable cartilage pieces or a cartilage resurfacing procedure.

Expected result: Unfortunately, there is no cure for arthritis. Therefore, the best way to treat cartilage injuries is to figure out why they happened in the first place and to avoid those activities going forward. Cartilage replacement surgery is best served by a donor graft, but the main goal of the surgery is primarily to restore you to the point at which you don't have a lot of pain and swelling. It is not necessarily performed to allow you to return to high-level activities without the risk of the cartilage graft wearing out.

Return-to-activity timeline: An arthroscopic chondroplasty debridement requires patients to be on crutches for two to seven days, and they can usually return to full activities within six to eight weeks. A microfracture procedure requires patients to be on crutches with no weight bearing for six to eight weeks and may take seven to nine months to return to activities. An osteochondral transfer from another area of the knee requires six weeks of minimal weight bearing to no weight bearing and four to six months of recovery. A fresh osteochondral allograft requires patients to be non–weight-bearing for up to eight weeks with partial weight bearing for an additional month, and they should avoid any impact activities until the bone sufficiently heals. This can take up to a year. When the right leg is affected, patients can usually drive at about the nine- to ten-week point after surgery.

PATELLA (KNEECAP) FRACTURE

As mentioned previously, the kneecap (patella) receives the most force of any joint in the body. Patella fractures can occur from direct contact, such as

falling on a flexed knee, a motor vehicle accident, or falling from a height when you land on your knee and have a sudden strong quadriceps muscle contraction. (See Figure 3.13.) If you have a patellar fracture that is minimally displaced and stable (you should be able to do a straight leg raise), where the cartilage surfaces are still in relatively good position, you can often be treated without surgery. Sometimes this injury may require a cast, especially for a young person, or an immobilizer for a period of time to allow the fracture to heal. Usually this requires patients to be on crutches for up to six weeks; most fractures take six weeks to heal.

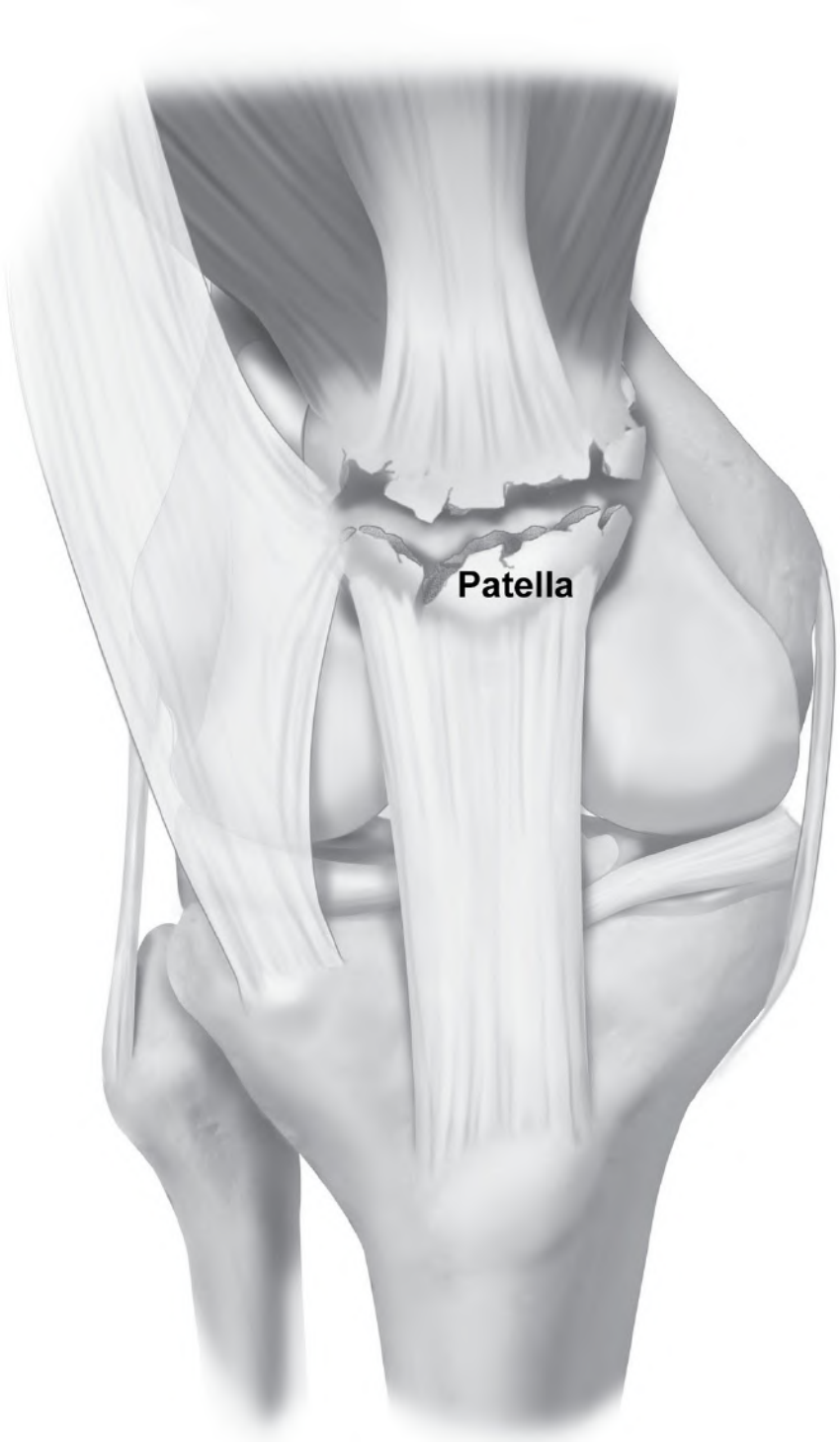


FIGURE 3.13.
Patella Fracture

For those fractures that are displaced, or where the kneecap is completely separated and has a gap between the ends of the fracture, surgery is indicated. This is because the cartilage surfaces should be restored as much as possible, since this joint sees so much stress. Once you have a fracture through the kneecap, traumatic arthritis is a factor, so you have to be careful about overly

stressing the kneecap going forward. Usually fractures that are transverse (perpendicular to the axis of the body) are more likely to need a surgical repair because the upper and bottom parts of the patella are pulled in opposite directions by the quadriceps tendon and the patellar tendon, respectively.

THE RUNDOWN: PATELLA (KNEECAP) FRACTURE

How common: 0.131 per 1,000 per year, or approximately 45,000 per year in the United States.

Common causes: Being hit by an object or falling directly onto one's kneecap.

Average patient: A fifty-five-year-old female who slips on a patch of ice and falls on her knee.

What to do: Seek medical advice. If you land on your kneecap but are still able to straighten your leg and walk, and your main issue is pain, then schedule an appointment with your physician. But if your ability to straighten your knee or walk has been compromised, then make an urgent acute visit with your primary care provider or local emergency department.

Severity of injury: The severity of injury depends on the stability of the patella and the amount of displacement of the fracture. For a fracture that is not displaced, with the joint surface still relatively smooth, a trial of nonoperative treatment and limited weight bearing may be indicated. For a displaced fracture, an open reduction internal fixation is usually indicated.

Treatment options: Treatment options include rest and limited weight bearing for nondisplaced fractures and surgery for displaced patellar fractures.

Expected result: The expected result depends on the amount of cartilage damage. For patients who have a nondisplaced fracture with no cartilage damage, most can expect to return to full activities. Patients with displaced patellar fractures with cartilage damage may have difficulty performing lunges and squats in the future.

Return-to-activity timeline: Patients who undergo surgery are limited to no weight bearing for six weeks. They can usually return to driving in about seven to eight weeks postoperatively. Complete healing of the fracture usually occurs by three months, and strength returns between five and seven months.

The usual surgical technique for restoring a patellar fracture is to make an incision over the front of the knee, clean out the end of the patella fracture, and put the pieces back together as closely as possible. In some patellar fractures, this is almost like assembling a jigsaw puzzle. Then, the surgeon can place pins across the patella fracture and view either arthroscopically or

on x-rays in surgery to judge if the cartilage surfaces should be restored. This may mean that the bone surfaces do not look perfect, but the whole goal of the patella fracture surgery is to make sure that the cartilage surfaces are restored as much as possible. Most of the time, screws are placed across the kneecap, and then wires are placed through the screw in a tension-band-type technique to hold the kneecap together.

In summary, when you have a displaced patella fracture, your surgeon should strive to have the cartilage surfaces match up as much as possible. The rehabilitation afterward almost always involves restriction to non–weight-bearing activity and using crutches for six weeks, but if you have a good restoration of the cartilage surfaces, you can perform knee motion early in your recovery to minimize the risk of getting stiff.

TIBIAL PLATEAU FRACTURE

The part of the shinbone that supports the thighbone is called the tibial plateau. In the middle of it is where the cruciate ligaments attach. The plateau has two sides; the medial tibial plateau (on the inside of the tibia) is larger, flatter, and a bit concave. The lateral tibial plateau (on the outside) is slightly convex in shape and smaller. Combined, they help to evenly distribute the forces from the thighbone on the shin.

Fractures of the tibial plateau can be quite serious because they involve the cartilage surfaces. (See Figure 3.14.) These fractures come in all shapes and sizes. In a Humpty Dumpty fracture, in which the pieces are small and fragmented, it can be difficult to put them together, and you can rapidly develop traumatic arthritis. Your doctor will need to assess the amount of displacement of the fracture (often part of the floor of the tibia will have a depression where the joint surface is offset, causing problems with cartilage erosion) and how extensive the fracture is to determine if you need surgery, or if you can go without surgery and use crutches for a period of time to let the fracture heal.

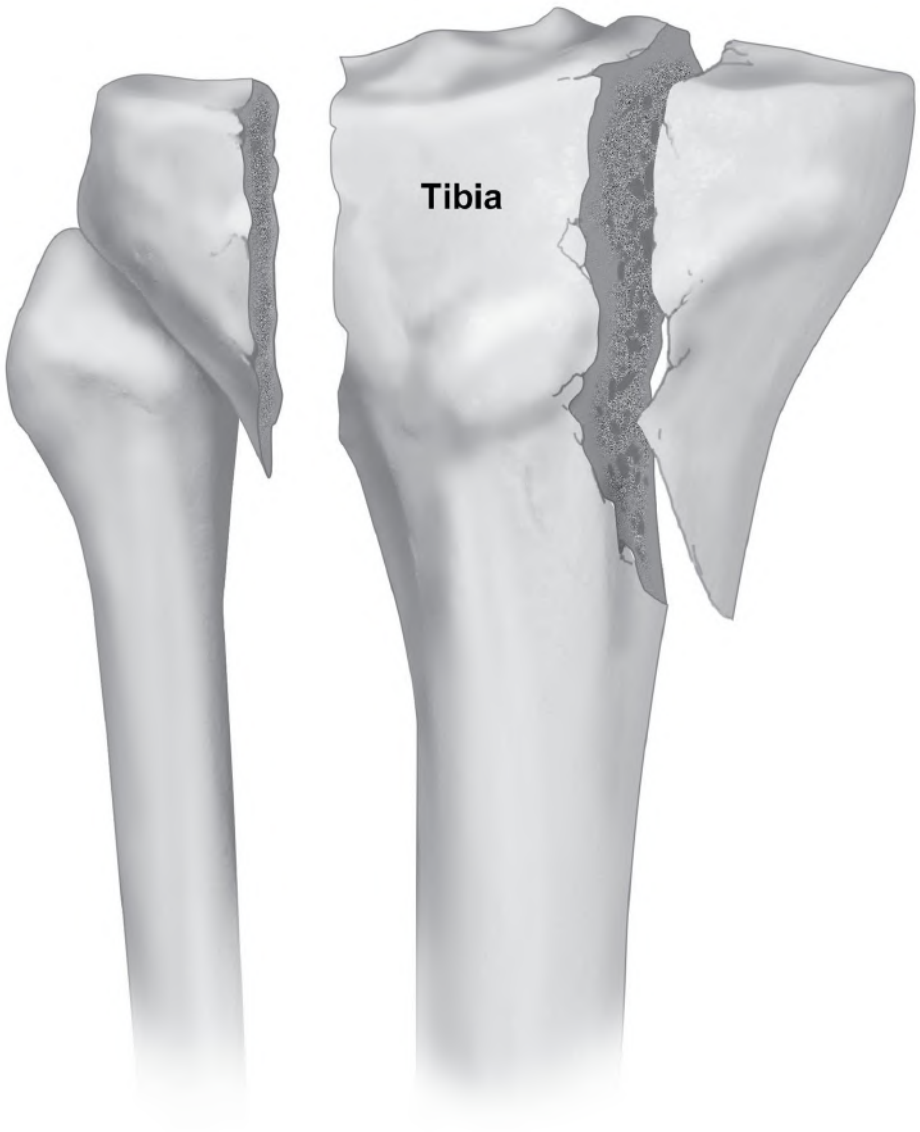


FIGURE 3.14.

Tibial Plateau Fracture

In addition to regular x-rays, patients often need a CT scan to determine exactly where the fracture fragments may be offset. In some instances, your physician may obtain an MRI scan to see the status of the menisci and their root attachments, as well as the cruciate ligaments and other ligaments around the knee.

Nondisplaced tibial plateau fractures can almost always be treated with a period of immobilization or non–weight-bearing activity until they heal. These fractures usually have no or minimal offset of the cartilage surface at the fracture site, and if they heal correctly, there is typically little consequence in the short term. Over the long term, arthritis may still form. The best way to ensure that arthritis does not develop is to make sure that you exercise

correctly and do not have a stiff knee.

For displaced fractures, surgery is almost always a next step. In these circumstances, some type of fixation hardware is required to hold the fracture in place so that it heals in the correct position. When these fractures involve one surface with little fragmentation, the joint surface can usually be successfully restored. In cases of significant fragmentation, it may be almost impossible to get the joint surface back to normal, and the long-term prognosis can be grim. This is because the area is likely to develop arthritis; often the even normal-looking cartilage surfaces get so damaged that the cartilage cells themselves die over time, and this area also becomes arthritic.

Probably the best way to treat a severe tibial plateau fracture is to be your own advocate. If possible, find a surgeon who has successfully performed these types of fracture repairs. If the joint surface is not restored at the time of the first surgery, it may be almost impossible for a later surgery to fix the problem and prevent arthritis.

After surgery, you will need to be on crutches for six weeks or longer with no weight bearing. Motion is often allowed and encouraged. It is important to make sure that the joint does not become stiff after this type of fracture, even if there are other injuries involved. Undergoing appropriate physical therapy can ensure that the swelling goes down, muscle strength gets restored, and knee motion is restored—this is vital for the best possible outcome after this severe injury.

THE RUNDOWN: TIBIAL PLATEAU FRACTURE

How common: 0.10 per 1,000 people per year, or approximately 35,000 affected people per year in the United States.

Common causes: Motor vehicle accidents, skiing injuries, or a fall from heights.

Average patient: A fifty-year-old female who falls while skiing.

What to do: These injuries fall into the high-energy category. Urgent and emergency tibial plateau fractures need to be seen by a physician as soon as possible; x-rays will determine if there is a step-off (depression) at the joint line resulting from the fracture. If the x-ray isn't clear, a CT scan can show how much bony offset is present. If there is no displacement, surgery may not be necessary. If the joint line is displaced, surgery may be indicated.

Also, of even more importance, severe plateau fractures are associated with injuries to important nerves, veins, and arteries and also with compartment syndrome, when fluid

(usually blood from an injury) builds up in a compartment and overwhelms your body's ability to remove the fluid from that area. The fluid can then compress your muscles and even shut off their blood supply, which can lead to muscle death. These injuries need to be evaluated in an emergency department or acute care center immediately. The number one symptom of compartment syndrome is worsening and excruciating pain.

Severity of injury: A complex classification system takes into account the amount of displacement of the tibial plateau fracture, whether it is both an inside and an outside plateau fracture (medial and lateral), and if it extends down into the shinbone. The classification system can be useful to determine the surgical approach and the expected outcome.

Treatment options: Nondisplaced tibial plateau fractures can usually be treated with a period of using crutches and possibly immobilization. Fractures displaced at the joint line are best treated with surgery.

Expected result: Usually the lesser the fracture, the better the outcome. Patients with more complicated, cornflake-like, or Humpty Dumpty fractures often cannot get back to full activities and are at a much higher risk for an early total knee replacement (see here).

Return-to-activity timeline: Most tibial plateau fractures, whether treated with or without surgery, require no weight bearing or limited weight bearing for the first six weeks after injury. Progression from there depends on the severity of the fracture and if bone grafting was necessary.

PROXIMAL TIBIA FRACTURE

Fractures of the upper third of the shinbone, or tibia, are relatively common. (See Figure 3.15.) Open fractures (see here) are more common in this type of fracture than others. If there is a wound or hole in the skin caused by the fracture, this puts you at great risk of infection; go to an emergency department immediately.

The main thing that differentiates these injuries from a tibial plateau fracture (here) is whether they enter the joint surfaces. If they do not enter the joint surface, then they are generally easier to treat and have a better long-term outcome than fractures that do, which can lead to arthritis over time.

Many proximal tibial fractures are actually avulsions of the attachment of the patellar tendon to the shinbone, also called the tibial tubercle. Tibial tubercle avulsion fractures can be either displaced or not displaced (lined up straight).

Most tibial tubercle avulsion fractures occur in younger patients, often in

those who are close to having their growth plates close. Among these patients, the fracture can be more complicated and require a closer amount of watching for healing to be sure the leg will heal straight. Other proximal tibial fractures can occur from high-energy, direct forces such as car crashes or motorcycle collisions.

FIGURE 3.15.

Proximal Tibia Fracture

The proximal tibia is a location where numerous different muscles attach

(hamstrings, patellar tendon, gastrocnemius or calf), so these muscles pull on that area of the bone. When the bone is intact, these muscles move your tibia and do not cause any deformities because the rest of the tibia keeps in line and balances the forces of those muscles. With a fracture in that area or just below those attachments, the muscles pull the higher pieces of the fracture up, forward, and medial. This causes the fracture to heal in an incorrect location, unless addressed with surgery.

Fractures that are minimally displaced—that is, still lined up—can be treated with casting and be immobilized for four to six weeks with minimal to no weight bearing. During this recovery period you should be on a blood thinner such as aspirin to minimize the risk of developing a blood clot, which could go to your lungs and interfere with breathing.

If the fracture is displaced, then surgery is vital to ensure that you have a normally aligned tibia and also to maximize healing potential. Surgery can involve an external fixator, a plate and screws, or a nail down the middle of the bone.

THE RUNDOWN: PROXIMAL TIBIA FRACTURE

How common: 0.23 tibial shaft fractures per 1,000 people, or 75,000 tibial shaft fractures per year; 5 to 11 percent of these are located proximally, so approximately 7,500 proximal tibia fractures per year in the United States.

Common causes: A sudden force to a young patient with open growth plates may cause a tibial tubercle avulsion fracture. Proximal tibial fractures in adults are usually high-energy, caused by ATV, motorcycle, or car collisions.

Average patient: A fourteen-year-old boy during his growth spurt who has a sudden stop while playing basketball. Or a forty-five-year-old man who crashes while riding an ATV.

What to do: These injuries need to be examined by a doctor right away and sometimes may warrant a hospital admission for observation. These injuries are associated with compartment syndrome, in which bleeding around the muscles cuts off the blood supply and leads to muscle death, which can be a dire emergency. Open fractures also are susceptible to infection.

Severity of injury: The severity of injury depends on the amount of displacement of the tibial tubercle fracture. Mild displacement may not need surgery, whereas a complete displacement would need surgery to restore the function of the kneecap mechanism.

Treatment options: Treatment options include nonoperative and operative treatment. Operative treatment in tubercle avulsion fractures is usually reserved for severely

angulated fractures or fractures that are completely pulled off the shinbone. Proximal tibial fractures in adults almost always require surgery unless they are nondisplaced (lined up normally) or only minimally displaced.

Expected result: Most patients are able to get back to full activities after the fracture heals.

Return-to-activity timeline: Recovery from these fractures usually requires up to six weeks of no weight bearing or partial weight bearing, depending on whether surgery was performed or not. Once the fracture heals, a slow progression to activities is generally allowed. Patients with proximal tibia fractures treated with a nail are allowed to bear weight the same day as surgery. The more patients walk and stay active, the fewer complications they experience. Patients who are inactive are at much higher risk of blood clots, pneumonia, and many other complications.

DISTAL FEMORAL FRACTURE

A fracture of the end of the thighbone (the distal femur) can be simple, or it can be very problematic. (See Figure 3.16.) In younger patients, the fracture can often be treated with a cast and may not need surgery. In older patients, the amount of bone present is minimal, and the fracture can be difficult to fix and get to heal.

In general, fractures of the distal femur that are displaced—meaning the fracture is causing the bone to be misaligned—need surgery. These procedures are often complicated and require precision to restore the overall alignment of both the femur and the joint surfaces.

If it is a displaced fracture, then fracture fixation, like inserting a rod up the end of the femur to hold it in place or plates and screws on the side of the femur, may be indicated. For a fracture that enters the joint space, if there is any significant disruption of the cartilage surface (which may be more than one to two millimeters), surgery to restore the normal congruity of the joint surface may be needed. A Hoffa fracture, which only involves one of the femoral condyles, can be difficult to treat because the fracture can be entirely through the cartilage surface, and the screws and other devices required to fix the fracture have to go into the cartilage to hold it in place. It may need to be fixed in position and then a surgery scheduled soon afterward, once the fracture heals, to remove the screws before they damage the cartilage surface.

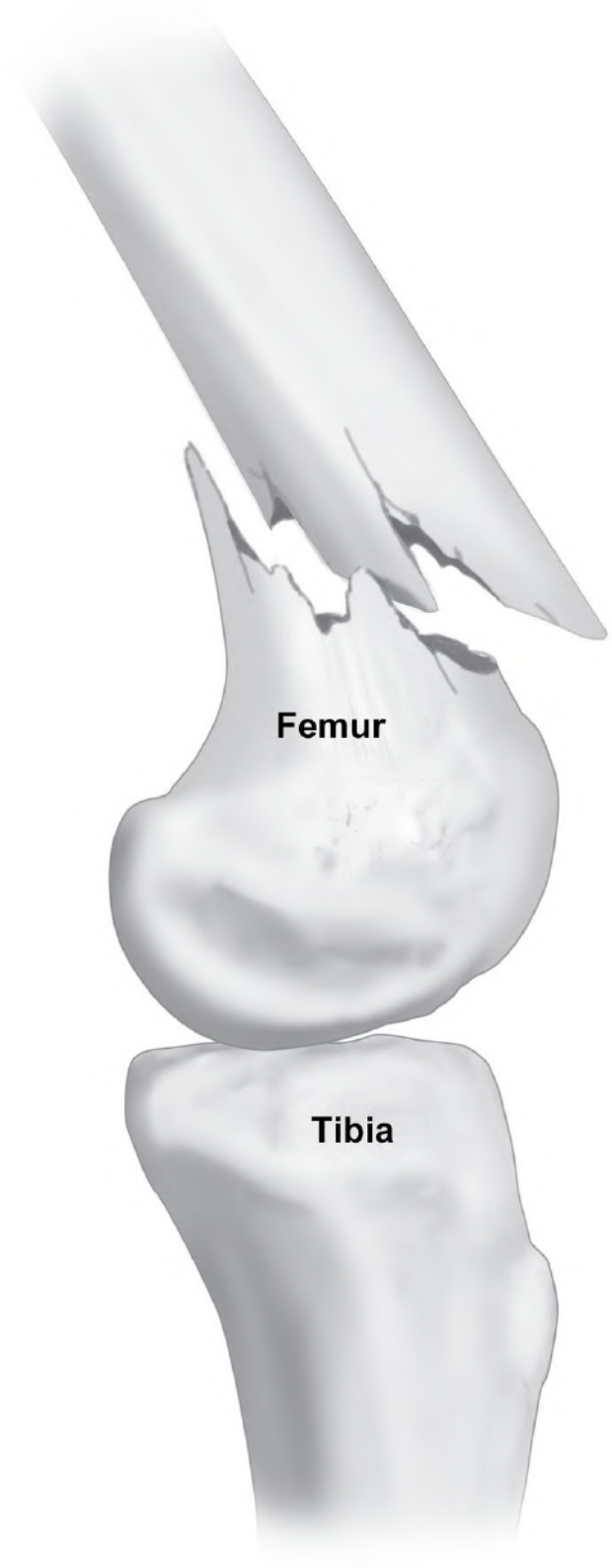


FIGURE 3.16.
Distal Femoral Fracture

THE RUNDOWN: DISTAL FEMORAL FRACTURE

How common: Femoral shaft fractures have an occurrence of 0.37 per 1,000 people, or about 58,600 per year in the United States. Distal femur fractures are on the rise, largely because of the increasing number of people who have total joint replacements, which create stress points around prosthetic components.

Common causes: Direct impact, such as sporting injuries, or a motor vehicle accident.

Average patient: A young adolescent with open growth plates or an older patient who previously had a total knee replacement.

What to do: These injuries require a visit to the local emergency department to determine the severity and the associated treatment. These injuries can be significantly displaced, meaning the fracture is causing the bone to be misaligned and possibly shortened, in which case it may urgently need to be reduced back into its normal position.

Severity of injury: It depends on the amount of displacement of the fracture. Nondisplaced fractures may be less serious, while a displaced fracture is more severe and difficult to treat.

Treatment options: Likewise, treatment options depend on the amount of displacement. Minimally or nondisplaced fractures may be able to be treated in a cast, whereas displaced fractures often need surgery—either a closed reduction or an open reduction and internal fixation of the ends of the fracture.

Expected result: Most patients will be able to eventually return to full activities. In older patients where the bone is very soft or where the fracture is in multiple pieces, it may be difficult to get back to full activities because the healing potential is significantly reduced.

Return-to-activity timeline: Most patients need to be on crutches with no to minimal weight bearing for the first six weeks. Depending on the severity of the fracture and the number of plates and screws required, you can usually start bearing weight at about the six-week point. Driving usually is allowed at about week seven or eight, whereas recovery to the point where you can participate fully in activities may take four to six months or longer.

After surgery, it's essential to participate in a rehab program that emphasizes early motion. If the knee cannot be moved because the fracture is fragile, then there may be a risk of having the knee joint become stiff afterward. This is because the quadriceps muscles can be stuck down on the top of the femur; it can be difficult to work through this with physical therapy. This condition may require secondary surgeries to release the scar tissue to allow your knee to bend.

POSTERIOR CRUCIATE LIGAMENT (PCL) TEAR

The PCL is the biggest and strongest ligament in the knee. Since it sits in the center of the knee, if it is injured, the knee must be held in position to keep it from slipping backward. Given the PCL's size and strength, it does take quite a bit of trauma to tear it; most PCL tears occur combined with other ligament injuries. When a knee contact injury happens to either the outside or the inside of the knee, it commonly results in tears of the collateral ligaments on the affected side as well as the PCL and the ACL. A PCL tear by itself, called an isolated PCL tear, happens only 10 to 20 percent of the time. Most isolated PCL tears occur as a result of an injury to the front of the knee when it is bent. Falling on a flexed knee while playing sports, slipping on ice, or hitting a dashboard during a traffic accident are some common ways that the PCL is torn. (See Figure 3.17.)

Having an isolated versus a combined PCL tear affects whether you need surgery and the timing of surgery. Some isolated PCL tears may heal with a dynamic PCL brace or a cast, while combined PCL tears rarely heal and should be surgically reconstructed relatively soon to obtain the best outcomes and to reduce your risk of developing osteoarthritis.

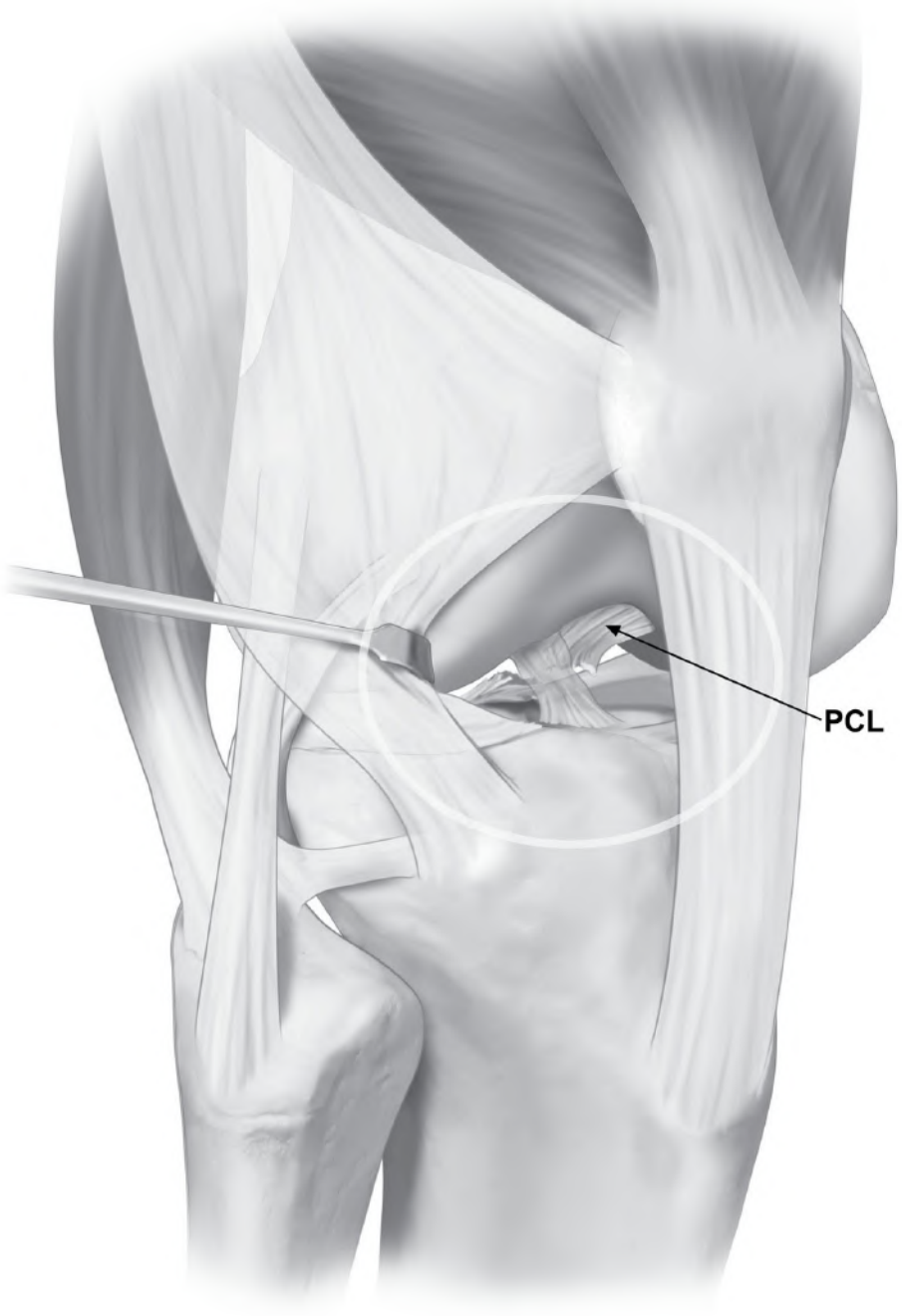


FIGURE 3.17.
PCL Tear

With an isolated PCL tear, it is common to have a little bit of soreness and a slight amount of swelling within the knee. PCL tears do not bleed as much as ACL tears do. The knee may feel unstable, especially when going down inclines, decelerating, or going down stairs, but sometimes you may be limping or being careful with that knee after injury and not notice these symptoms right away. Sometimes patients don’t perceive an isolated PCL tear until several weeks after injury. Still, you should see your doctor relatively

quickly because if it turns out you've injured the PCL, a dynamic PCL brace, which holds the knee forward against the forces of gravity, may be able to let your PCL heal without surgery. This is especially true for patients who have partial PCL tears.

For patients who have PCL tears with other ligament injuries, there may have been a knee dislocation, which is a surgical emergency. When your knee feels grossly unstable or shifts with weight bearing and is painful, you should be carefully evaluated soon after injury at either a physician's office or in the emergency room to check pulses, nerve function, and the overall stability of the knee. This is especially important for a knee dislocation, where a missed artery injury, especially more than eight hours after the injury, could result in your leg needing to be amputated. (See the YouTube video mentioned in Chapter 1, here). If you or a parent, coach, or friend sees your knee do that, you should get to an emergency department as soon as possible. X-rays should be obtained as well to make sure that you do not have a fracture associated with this type of injury pattern.

Until the past decade, we did not understand how to successfully reconstruct PCLs. The rehabilitation programs did not take gravity into consideration, which often meant the grafts would stretch out and the braces that protect a PCL graft when you bend your knee, called a dynamic PCL brace, were not yet developed. Many physicians who were trained how to do PCL reconstruction ten to fifteen years ago often felt that their PCL reconstructions were not much better than how the patient presented to them initially. Therefore, physicians in the past abandoned reconstructions because they were not working well in their hands at that point in time.

A lot of work has gone into understanding PCL tears over the last ten years. This includes detailed anatomy and biomechanical studies and the development of new surgical techniques to reconstruct the PCL. In addition, the use of a special PCL brace to protect the PCL graft against gravity has allowed knees to be moved in physical therapy one day after a PCL reconstruction surgery. If you need a reconstruction, see a surgeon who is trained in newer PCL reconstruction techniques, rehabilitation techniques, and use of dynamic PCL bracing because the results of PCL reconstructions with this newer surgical program have now been shown to equal those of ACL reconstructions.

If you have an isolated PCL injury, you have two basic options: conservative or surgical. The conservative approach involves rest, ice, Tylenol (acetaminophen), physical therapy, and a brace. Physical therapy for a PCL

injury is somewhat more restrictive than for an ACL injury. The braces available are usually much bigger and, unfortunately, more uncomfortable, and range of motion restrictions are typically a little more conservative at first because the PCL is under more stress at higher ranges of knee flexion. Also, whereas in ACL rehab a specific emphasis is put on hamstring strength, in PCL rehab there's an emphasis on the quadriceps muscles to protect the PCL graft.

In regard to surgical management, PCL surgery is similar to ACL surgery in that it involves drilling tunnels into your bones (tibia and femur) and fixing a graft into those tunnels. Achilles tendon allografts and hamstring tendon auto- and allografts are most often used. One slight difference is the number of grafts used. The ACL surgery is typically done with a single graft. The PCL on the other hand is a much bigger ligament, and thus it should be reconstructed with a two-graft (double bundle) technique. Substantial evidence suggests that the double bundle technique is superior in terms of knee function and stability, but the technique is more difficult. With this in mind, be sure to have a conversation with your surgeon regarding their preference and rationale.

THE RUNDOWN: PCL TEAR

How common: 0.02 per 1,000 people per year, or approximately 6,500 PCL injuries per year in the United States.

Common causes: A blunt trauma to the front of the shin (tibia), driving it backward. This could be from a contact injury during high-energy sports, like a football tackle; your knee hitting the car dashboard in an accident; or falling on a flexed knee.

Average patient: A passenger in a car wreck or a football player who takes a tackle below the knee.

What to do: Be aware of the signs of an emergency. Gross instability, numbness and tingling, gross malalignment (leg pointing in the wrong direction), and inability to bear weight are all signs that you should go to the emergency department right away for an evaluation.

Severity of injury: PCL tears are similar to ACLs: they are graded 1 to 3 based on the amount of damage, with grade 3 being a complete tear.

Treatment options: The main two options are conservative (nonoperative) therapy and surgical. Conservative therapy is reserved for isolated tears, usually partial tears, and tears in patients who are less active or will not be exposed to significant force to their

knee. Surgery is reserved for those with complete tears, athletes who require good knee stability, those who have failed conservative treatment, or those who have unacceptable residual instability.

Expected result: PCLs can heal well on their own in the right patient; however, complete tears often heal loose. Think of a rubber band that has been stretched and subsequently cannot return to its previous tautness. Surgery is therefore often recommended. Outcomes for surgery are variable depending on technique and surgeon. For PCL tears, given their relative rarity, you should find a surgeon who is well versed in these injuries in order to optimize your chance at success because it is not an easy or common procedure.

Return-to-activity timeline: Patients usually are back to walking within six weeks, with nine to twelve months being the usual time required for the ligament to be healed enough to return to sports. You can usually return to driving two to three weeks after you're able to walk.

FIBULAR (LATERAL) COLLATERAL LIGAMENT (FCL/LCL) AND POSTEROLATERAL CORNER (PLC) INJURY

For many years, the structures on the outside of the knee were not fully understood. Many surgeons called this part of the knee "the dark side of the knee" because they did not understand the anatomy, these injuries caused a lot of disability, and surgical outcomes were not very good. More recent detailed anatomy studies, laboratory studies, and the development of new surgical techniques that reconstruct the torn ligaments in their normal location has resulted in greatly improved surgical outcomes for this part of the knee.

One of the first things to understand about the outside of the knee, called the posterolateral corner (PLC), is that the bony shape is different from the inside of the knee. While MCL injuries have a good chance of healing (see here), most of the time injuries to the PLC do not heal on their own. The tibia and the femur, on the outside or lateral side of the knee where they interact (lateral femoral condyle of the femur and lateral tibial plateau of the tibia), are both convex in shape, making them inherently unstable. Therefore, these injuries should be seen and treated quickly to get the best outcomes. There is also an important nerve that crosses just below the top of the fibula, called the common peroneal nerve, which can be injured or stretched when there is a PLC injury and can cause you to have a foot drop (gait abnormality) or nerve pain in the top of your foot and side of your leg.

PLC injuries can occur in various scenarios: from a contact or noncontact hyperextension injury, in which the knee bends backward; from a blow to the

inside of your leg while playing sports; or as part of significant trauma such as during a motor vehicle accident. PLC injuries commonly result in the knee gapping to the inside (varus gapping), as well as the tibia rotating to the outside of the femur (external rotation of the knee). This constitutes a highly debilitating injury that needs to be assessed as soon as possible by an experienced surgeon.

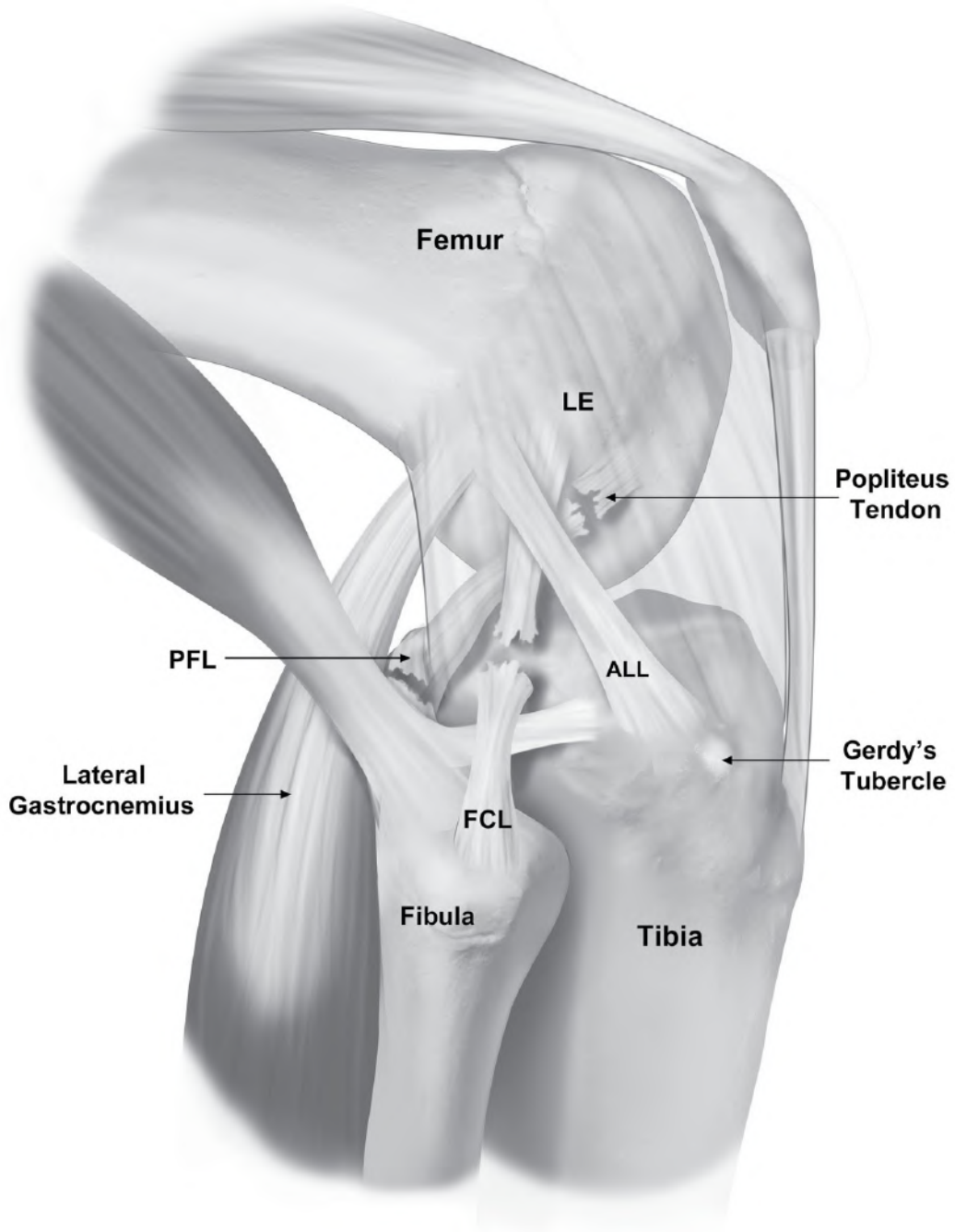


FIGURE 3.18.

FCL Injury

Almost always with a complete PLC injury, some other knee ligament injury accompanies it. Several different structures on the outside of the knee

are key to your knee's stability. The most important is the fibular collateral ligament (FCL), also called the lateral collateral ligament (LCL), which keeps your knee from swerving side to side. When you have a tear of the FCL, you may not have a lot of pain and swelling, but you may have difficulty in turning and pivoting to the same side as that injury. The other main structures on the outside of the knee are the popliteus tendon and the popliteofibular ligament. These ligaments make sure that the tibia does not rotate externally on the femur. (See Figure 3.18.)

Because FCL tears and posterolateral corner injuries rarely heal on their own, timely diagnosis and treatment are essential. If you wait six weeks or longer to be treated and you are bowlegged (most men are a bit bowlegged), an osteotomy, or a surgical correction of the bowleggedness, is usually needed before proceeding with the ligament reconstruction, to make sure that the surgical reconstruction does not stretch out. Obviously, breaking the bone, resetting it, and then waiting six to nine months for the second-stage surgery is not ideal, so getting this particular injury treated quickly is a key to recovery.

For a complete tear of the FCL or all the structures in the posterolateral corner of the knee, surgery should usually take place within the first two weeks after injury. This is the best time to repair the structures, before enzymes break the tissues down, because weakened tissues do not hold sutures well. The knee can also be put in a more normal position and better fixed during that time frame, rather than when it is starting to heal in a looser position. More recent reconstructions of the FCL and posterolateral corner have allowed many patients to get back to high-level activities. This was not true in the past, when a posterolateral corner injury would typically doom you to giving up sports or even limit participation in normal activities because of ongoing knee instability.

Treating Foot Drop

As mentioned, some patients with PLC injuries end up with a nerve injury as a result of the knee stretching when it twists to the inside. Unfortunately, about 50 percent of the time these patients do not recover fully. Symptoms include having numbness on the outside and top of the foot or having foot or ankle weakness. Muscle weakness involves the muscles on the top and outside of the shinbone and fibula, making it difficult to bend the ankle up, pull your toes toward yourself, pull the ankle outward, or pull your big toe toward yourself.

The usual treatment for foot drop is a heel cord stretching exercise regimen that involves using a towel around the foot to pull up the ankle when the leg is out straight and doing this several times a day. That way, if the nerve function does come back, you don't end up with a foot that doesn't move properly. Another treatment is to place the foot and ankle into a splint, called an ankle foot orthosis. When you cannot pull up your ankle, the foot will sit down toward the floor and it may get stuck in that position because your Achilles tendon becomes contracted over time.

If you do have a foot drop for a period of time, you may need to see an orthopedic foot and ankle surgeon for a tendon transfer. Transferring a tendon from the inside of the ankle to the top of the foot can be effective to get out of your splint, although you won't gain normal function. It's best to have foot drop seen and treated as soon as possible.

THE RUNDOWN: FCL/LCL AND PLC INJURY

How common: A rare injury; fewer than five thousand per year in the United States.

Common causes: Contact sports and motor vehicle accidents, usually in association with other knee injuries. Noncontact causes include hyperextension. In addition, if you sustain a blow to the inside part of the knee, it will commonly place stress on the posterolateral knee structures and lead to injury.

Average patient: A college football player or someone who injures themselves skiing.

What to do: This injury is commonly associated with a lot of force (whether contact or noncontact) and often a great deal of instability. Gross instability, numbness and tingling, gross malalignment (the leg pointing in the wrong direction), and inability to bear weight are all signs that you need evaluation in an emergency department.

Severity of injury: FCL/LCL tears and posterolateral corner injuries are graded 1 to 3 based on severity. Severity is based on both the clinical exam and stress x-rays.

Treatment options: Grade 1 and 2 tears can usually be treated nonoperatively with physical therapy. Grade 3 tears are almost always treated with surgery.

Expected result: Complete FCL/LCL or complete posterolateral corner injuries, when treated acutely (within the first two to three weeks after injury) with a ligament reconstruction surgery, almost always do better than those that are treated chronically. Patients who don't have any associated arthritis or cartilage problems can often return to close to full activities. Those with grade 3 injuries that need to be treated chronically (longer than six weeks after injury) usually do not have a complete return to normal activities.

Return-to-activity timeline: Patients must not bear weight for the first six weeks after injury. They then initiate a partially protected weight-bearing program (with crutches) at the six-week point and may wean off of crutches when they can walk without a limp. Driving on the operative knee is usually allowed at about seven to eight weeks postoperatively. Because the majority of these injuries occur along with other knee ligament injuries, a complete return to normal activities usually takes nine to twelve months.

QUADRICEPS TENDON TEAR

The quadriceps tendon attaches the quadriceps muscles (on your thigh) to the kneecap. It is one of the thicker tendons in the body, and it is thick because it transmits a lot of force from the quadriceps muscles to the kneecap.

If you sustain a high force to your kneecap when you're not ready for it, such as landing from a height when skiing on a flat leg, or misstepping on a stair and having to catch your knee, the quadriceps tendon may tear off the kneecap. (See Figure 3.19.) This most commonly happens in people over forty or people who are immunocompromised, such as those with diabetes or kidney problems or who have taken fluoroquinolone antibiotics (such as Cipro). Quadriceps tendon tears are a major injury because when the tendon is torn, you cannot straighten your leg. If at all possible, you should have surgery to repair the tendon.

FIGURE 3.19.

Quadriceps Tendon Tear

Most quadriceps tendon tears are hard to ignore because you can’t walk on that leg, so they tend to be diagnosed and treated quickly. The surgery involves an incision over the front of the knee, cleaning out and freshening up the end of the tendon such that it has a good margin, and then reattaching it to the kneecap. The reattachment is commonly done using suture anchors, which are placed into the kneecap or through tunnels made through the kneecap, and then the sutures are tied into the tendon. The surgeon has to make sure that there are enough suture anchors to hold the tendon long enough for it to heal, and also to ensure that the repair does not slowly slip over time and result in

the quadriceps tendon being looser than it was originally. After having the surgery, you need to avoid bearing weight for up to six weeks to make sure you don't put too much stress on the healing tissue, which could cause it to rerupture or partially rupture and stretch out.

What if you don't have surgery right away? If a quadriceps tendon tear has not been treated for a period of time and it becomes chronic, it is a big problem. The kneecap can slide farther down toward the shinbone and become stuck there, and it can be very difficult to restore the overall length of the quadriceps mechanism. The quadriceps may be shortened, which can make it difficult to restore the quads tendon back to the kneecap. In these circumstances, often a ligament graft is needed to supplement the tendon repair, to give it enough tissue to maximize healing. However, even in the best of circumstances, the reconstruction may not get the kneecap to its original location, and full strength may not be restored.

Recognizing a quads tendon injury as soon as possible and having it treated surgically gives you the best chance at a full recovery. It will require rest and a period of time on crutches, and you shouldn't try to "push through" during this time frame. Some patients who return to activities too soon have the tendon partially separated and the kneecap fail to be restored to a normal position. After the tendon heals, it can take several months to get your quadriceps strength back to the point where you can participate in your desired level of activities.

THE RUNDOWN: QUADRICEPS TENDON TEAR

How common: 0.014 per 1,000, or approximately 5,000 per year in the United States.

Common causes: Patients in their forties and fifties landing suddenly with their knee out, straight on their knee with a high-impact force.

Average patient: A forty-five-year-old man who slips and falls going downstairs after missing a step.

What to do: If you experience symptoms like a popping sensation above your kneecap, an inability to straighten your leg, and severe pain, it is important to be seen urgently. This injury can affect your ability to walk, so you should see your primary care physician or a local emergency department.

Severity of injury: The severity of the injury is classified according to the amount of tearing. If there is just some minor soreness with no obvious tendon tearing, it would be a mild tear. A moderate tear would be a partial tear of the quadriceps tendon, but where the

patient can still perform a straight-leg raise. A complete tear is a severe tear in which the quadriceps tendon attachment on the superior pole of the patella is disrupted.

Treatment options: Treatment depends on the severity of the tear. Mild and partial tears may be able to be treated with activity modification and physical therapy. Complete tears are usually recommended to undergo surgical repairs.

Expected result: Patients may have some continued pain at the site of their tear but usually are able to have the majority of their quadriceps strength restored.

Return-to-activity timeline: After surgery, patients are advised to bear minimal to no weight for six weeks. During this time, they should use crutches. If the injury involves the right knee, they can usually start driving when they have sufficient quadriceps strength, usually at seven to eight weeks after a quadriceps tendon repair. A return to normal activities usually requires a significant return of strength, which can take about four to six months after surgery.

PATELLAR TENDON RUPTURE

The patellar tendon stretches between the kneecap and the front part of the tibia (shin). This tendon sees a lot of stress even on a normal day. If you land from a height or come down suddenly on your knee, the patellar tendon can tear off its attachment on the kneecap. (See Figure 3.20.) This is a serious injury that for elite athletes can be career-threatening if not treated right away. Other people who tear their patellar tendon include those with diabetes and kidney problems and those who take fluoroquinolone antibiotics such as Cipro (because they cause tendon breakdown).

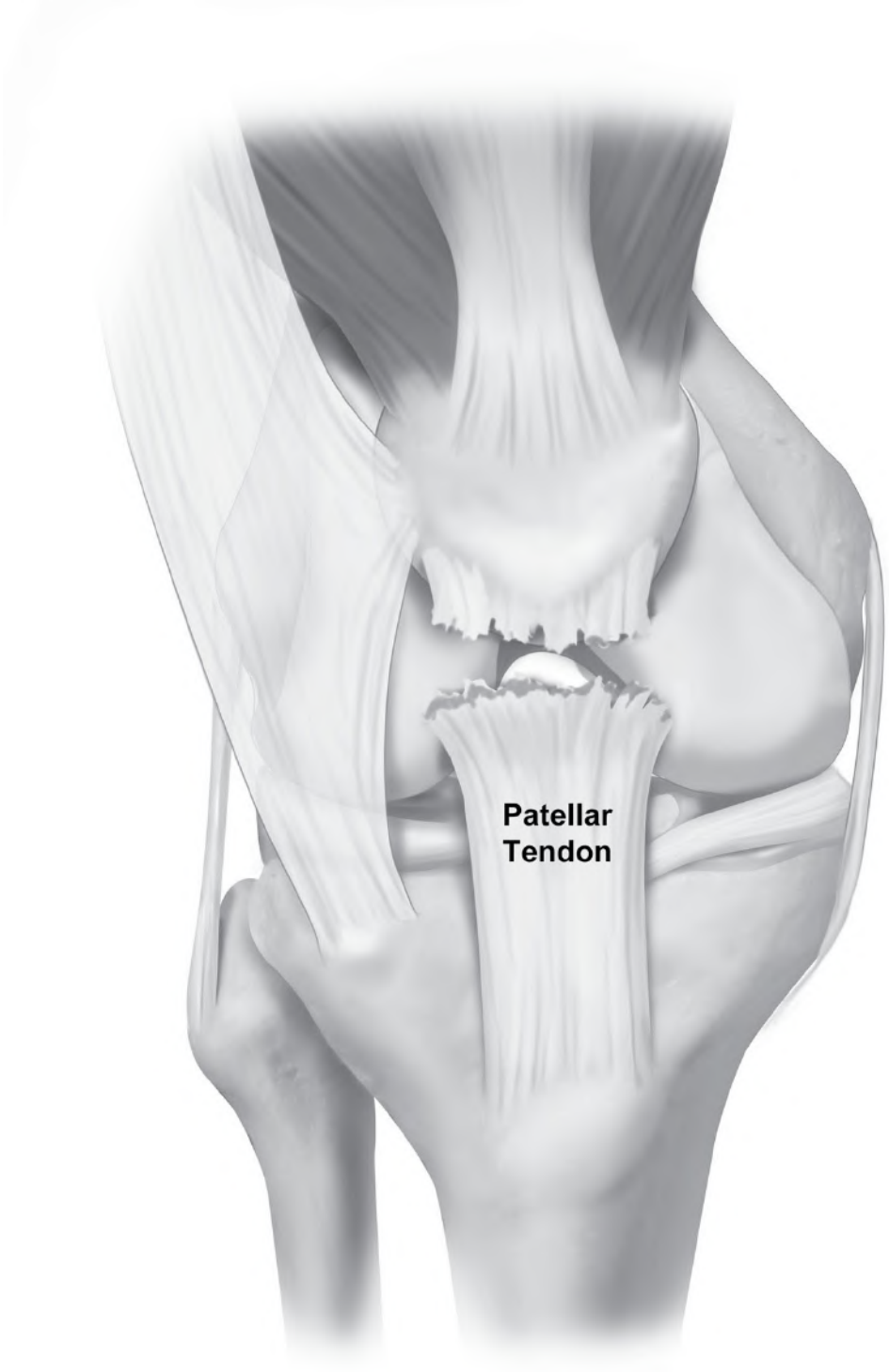


FIGURE 3.20.
Patellar Tendon Rupture

The treatment for a complete patellar tendon tear is almost always surgery, unless your medical condition is too poor to undergo surgery. It involves taking the end of the torn tendon and reattaching it to the kneecap. Using strong sutures and tying them into the tendon through two bone tunnels in the kneecap, and then tying them with the kneecap flexed, can get a good repair

of the patellar tendon. In some circumstances, the surgeon may need to put extra sutures through the shinbone and kneecap, in a rectangular fashion around the patellar tendon repair, to give the best chance of healing of the patellar tendon.

In our practice, we have seen some shredded patellar tendons that are almost impossible to repair. In these circumstances, a more extensive surgery that involves using a hamstring tendon graft through tunnels in the tibial tubercle and kneecap may be necessary, especially to get athletes back to high-level activities.

THE RUNDOWN: PATELLAR TENDON RUPTURE

How common: Fewer than five thousand per year in the United States.

Common causes: Landing suddenly from a height, such as while playing basketball.

Average patient: A thirty-year-old male recreational basketball player.

What to do: Similar to a quadriceps tendon rupture, this type of injury can be classified as an urgent (though usually not an emergency) injury. Feeling severe pain, a popping sensation just below the kneecap, or an inability to extend your knee warrants a visit with your primary care physician in short order, or an emergency department visit.

Severity of injury: Patellar tendon ruptures can be mild, moderate, or severe.

Treatment options: Mild to moderate tears involve minor disruptions of the patellar tendon and may be able to be treated without surgery. Complete tears typically need a surgical repair. The usual surgical treatment is to repair the patellar tendon back to the patella with sutures drilled across it. For severe tears with significant damage, a hamstring tendon reconstruction graft to reconstitute the tendon may be necessary.

Expected result: Most athletes get back to about 85 to 90 percent of their normal strength on the same side.

Return-to-activity timeline: Patellar tendon repairs can be fragile. Therefore, patients need to be on crutches for six weeks. They can usually start driving at about seven to eight weeks after surgery. A complete return to normal activities is usually anticipated between five and seven months postoperatively.

KNEE DISLOCATION

A knee dislocation is a serious injury. While the ligament damage is concerning, the damage to the blood vessels makes this injury potentially life-

and limb-threatening, and therefore an emergency.

A knee dislocation involves an injury to several ligaments around the knee that results in the knee being slipped out of place, with the thighbone no longer centered on the shinbone. (See Figure 3.21.) If this happens to an athlete during a sporting event, it's essential to perform a reduction (putting the ends of the bones back in alignment) of the dislocation and a close assessment to ensure that the artery and nerves to this extremity are intact. A knee dislocation after a high-velocity impact, such as a motor vehicle accident or a fall from a significant height, is a more serious injury because the skin and other soft tissues such as the muscles, tendons, nerves, and blood vessels can be severely damaged. Studies have shown that if an artery injury is present and it is not treated within the first eight hours, the risk of amputation of the leg is almost 90 percent. With a possible knee dislocation, you should go to the emergency room immediately so that you can get a close and thorough assessment of pulses and the overall status of the popliteal artery. If there is any concern about an artery injury, your doctor will request a CT angiogram, where dye is injected into the artery to assess for injury.

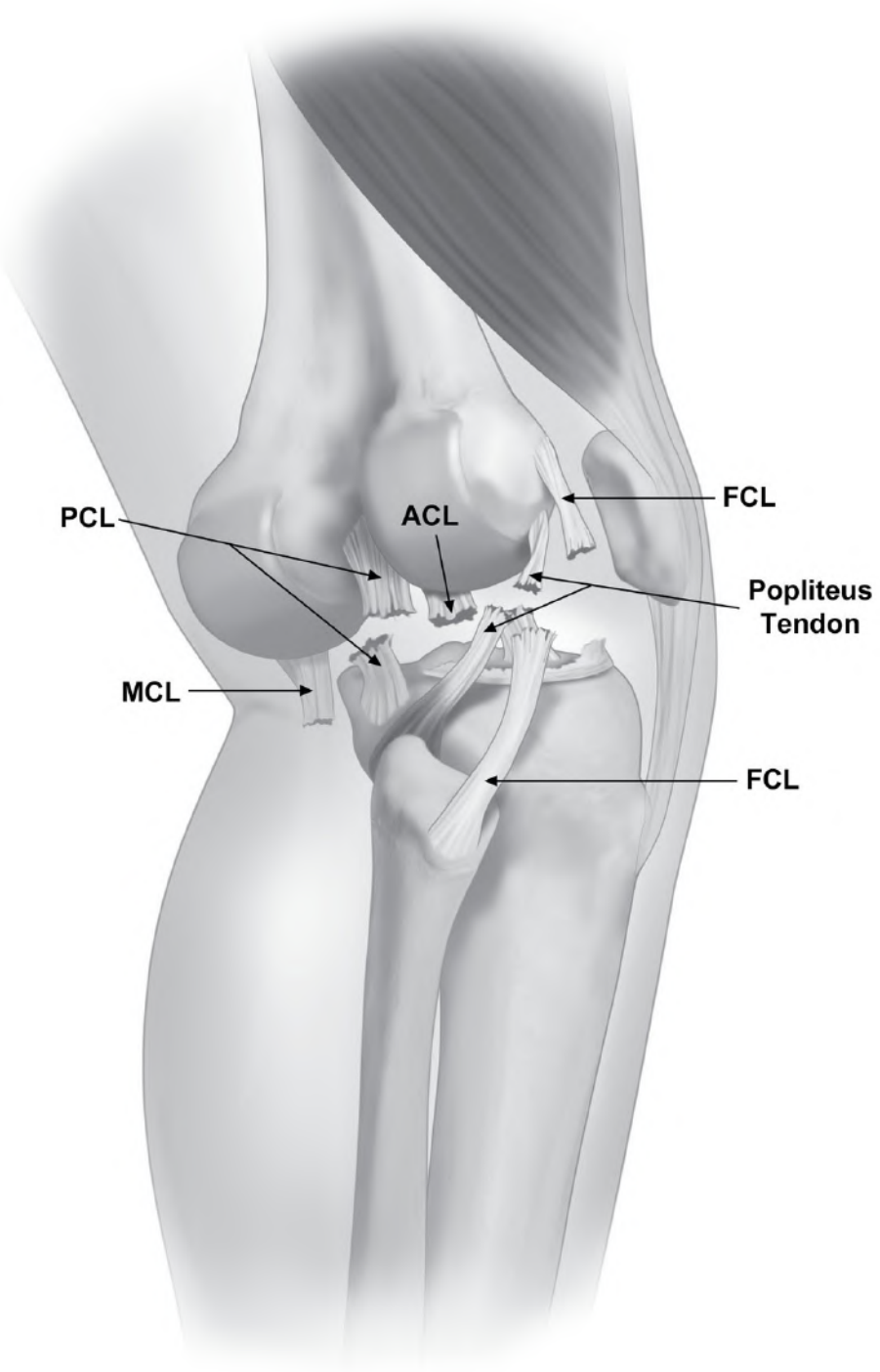


FIGURE 3.21.

Knee Dislocation

Assuming that there is no artery or nerve injury and the joint is reduced, your doctor will assess whether the joint is stable after it is reduced or if it is still slipping out of place. If it is still slipping, a cast or an external fixator, where pins are placed into the bones to hold them with metal bars, may be necessary to hold it in place. An MRI scan should be obtained to look at the status of the cartilage surfaces, ligaments, and menisci.

Decades ago, knee dislocations used to simply be casted and patients would do well for a while, but we now know that this treatment does not result in the best outcomes. Whenever possible, surgery within the first two weeks after a knee dislocation is recommended to stabilize the knee. In patients who may have an open fracture, who have severe diabetes or kidney problems, or who are elderly, this may not always be possible. However, in healthy patients with an acceptable range of motion who do not have any lacerations or problems around the area of the knee dislocation, surgery would be indicated.

That said, having surgery for a knee dislocation is serious. Patients should seek the attention of a surgeon who does a lot of these surgeries because the learning curve is long, and an experienced specialist will be quick and efficient.

In our practice, we have found that reconstructing all of the torn ligaments and repairing the torn menisci in one setting works best. After surgery, patients should be enrolled in a physical therapy regimen to ensure that the reconstructed knee ligaments do not stretch out and that the knee does not become stiff. In some patients, their body works overtime to form scar tissue because of the injury and the subsequent surgery, which may lead to significant stiffness. In order to avoid this, you should start physical therapy on the first day after surgery and work on knee motion. Be sure the physical therapists are comfortable with following the surgeon’s recommendations.

In general, most sports-related knee dislocations heal well after surgery. The incidence of artery injury is less than 1 percent, and a multi-ligament reconstruction surgery is usually effective. The results for high-velocity knee dislocations are less predictable because of the amount of injury to soft tissues and other structures. These patients may need to be followed more closely to ensure that their knee motion is progressing appropriately, they do not develop significant stiffness, and their knee ligament reconstructions do not stretch out because of other soft tissue injuries.

Because of the significant trauma associated with a knee dislocation, most patients will start to develop arthritis within ten years. This is probably a result of some of the cartilage cells being killed at the initial impact. Not a lot can be done about this, other than ensuring that the patient restores their muscle mass, so they have better shock absorption with everyday activities. Preserving the torn menisci is also essential; if the meniscus needs to be taken out, the risk of osteoarthritis will significantly increase.

THE RUNDOWN: KNEE DISLOCATION

How common: Rare; fewer than five thousand per year in the United States.

Common causes: Significant trauma during sports (skiing, football, rugby), falling from a height, or a motor vehicle accident.

Average patient: A twenty-two-year-old college running back who has a direct blow to his knee while being tackled.

What to do: A knee dislocation is a serious injury and requires immediate evaluation, most likely in a local emergency department. First, the physicians will make sure that your circulation and neurovascular status is intact. After that, you'll have x-rays to ensure that there is no fracture, followed by a reduction of the knee dislocation.

Severity of injury: Severity depends on whether the knee dislocation is still dislocated or if it is self-reduced. Knee dislocations in which the ends of the bones are still out of joint put significant stress on the nerves and arteries around the joint and need to be reduced as soon as possible. If there is an open fracture, an arterial injury, or significant fractures around the knee, this is considered a severe injury; most patients do not later return to full activities.

Treatment options: Surgery is almost always recommended. Overall, knee dislocations are best treated with a multi-ligament reconstruction. Any related injuries to the blood vessels, nerves, and bones will also affect treatment.

Expected result: Most patients who have sporting-related multiple ligament injuries will eventually be able to return to their usual activities. Those who have high-velocity injuries often do not achieve a complete recovery because there are multiple structures involved.

Return-to-activity timeline: Postoperatively, patients are on crutches with no to minimal weight bearing for a minimum of six weeks. The may start bearing weight after this time. It may take an additional one or two weeks for them to be able to drive. A complete return to normal activities, if possible, after a knee dislocation can take nine to fifteen months, depending on other associated injuries. Patients who have artery or nerve damage often have significant, permanent long-term problems.

PATELLOFEMORAL (KNEECAP) INSTABILITY

If you have a loose kneecap (patella) joint and it partially slips out of joint (subluxes) or completely slips out of joint (dislocates), this can be a debilitating problem. (See Figure 3.22.) Most individuals who have a noncontact kneecap subluxation or dislocation almost always have some underlying anatomy issues that are contributing to the problem—a too-

shallow groove where the patella sits or having the patella in the wrong position (too high or away from the groove). People who have a contact kneecap dislocation may or may not have these same genetic or anatomic issues to deal with.

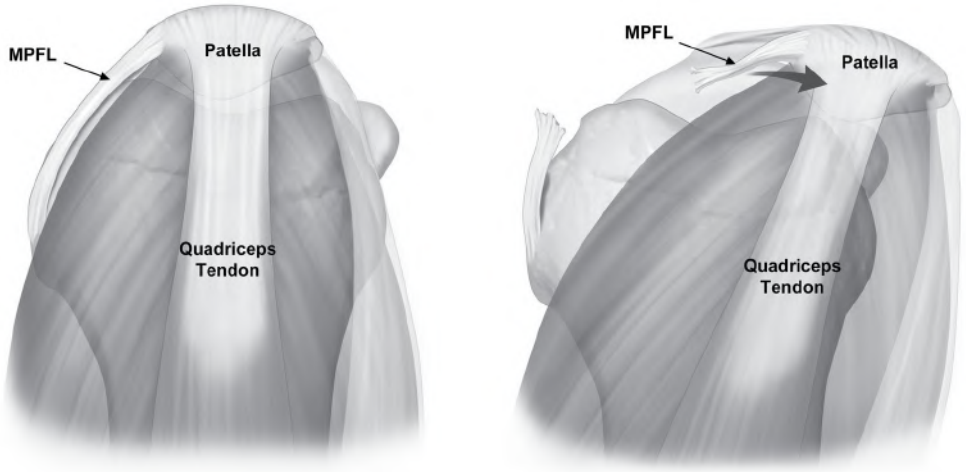


FIGURE 3.22.

Patellofemoral (Kneecap) Instability

The kneecap joint is a separate bone controlled by the quadriceps muscles; it attaches to the shinbone via the patellar tendon. When the knee is bent, the kneecap rests in a groove at the end of the thighbone, the trochlear groove. But when the kneecap is out straight, it doesn't sit within these confines, and in this position, it is most vulnerable to slipping to the outside.

Many anatomic factors can predispose you to having a kneecap dislocate. First, if your kneecap sits up higher than normal, outside the bony confines of the trochlea, it can more easily slip to the outside. This condition is called *patella alta*. If the bony confine itself is relatively flat, or flatter than usual, the kneecap is also more likely to be able to slip out. This condition is called *trochlea dysplasia*. Another issue can be the angle between the quadriceps muscles, the kneecap, and the patellar tendons' attachment on the shinbone. This is the *tibial tubercle to trochlea groove* (TTTG) angle or distance. If the TTTG is high, or above twenty millimeters (your shinbone is off in respect to your kneecap), it is like pulling on a bowstring, and the kneecap has a much higher likelihood of slipping to the outside or dislocating when the knee is out straight. Another issue can occur with the ligament that attaches the inside part of the thighbone to the inside part of the kneecap. This ligament, called the medial patellofemoral ligament (MPFL), stabilizes the kneecap. This ligament needs to be intact when the knee is out straight, or there is a much higher risk of stress causing the kneecap to slip to the outside.

The treatment of kneecap subluxation or dislocation depends on many factors. In general, as long as no piece of bone and cartilage has been knocked off the kneecap or trochlear surface with a dislocation, rehabilitation rather than surgery is recommended. First, you should get the swelling down, so the quadriceps muscles recover. Then, you'll work on strengthening the quadriceps muscles, so they can better hold the kneecap in place. If you have a relatively normal kneecap position—that is, without patella alta—and the end of the thighbone is relatively deep, without any significant trochlea dysplasia, this nonoperative treatment program has about a 90 percent chance of working.

If you do have significant patella alta or trochlea dysplasia, all bets are off. While your physician still may prescribe a program of rehabilitation to try to strengthen the quadriceps to better hold the kneecap in position, because the MPFL is torn and your kneecap sits up high or in a flat trochlea, there is a much higher risk that the kneecap will continue to slip or dislocate. While it is worth a shot to try rehabilitation, in general you have a much higher risk of dislocations in the future. Once the kneecap has dislocated twice, and certainly three times, you almost always need surgery to address the problem.

After suffering a patella subluxation or dislocation for the first time, it usually takes at least four to six weeks of rehabilitation to ensure that your motion returns, the quadriceps muscles are strong enough, and the kneecap is balanced within the end of the trochlea prior to returning back to activities.

If you do have surgery, the treatment depends on the overall bony architecture as well as the ligament on the inside of the knee. Studies show that repairing the MPFL does not result in nearly as good an outcome as completely reconstructing and replacing it, so almost all surgeons perform an MPFL reconstruction as part of their kneecap stabilization procedures. In addition, if you have a TTTG that is more than twenty millimeters, your surgeon might move the tibial tubercle farther toward the inside of the knee. If you have a high-riding kneecap, or patella alta, moving the kneecap further down the shinbone may be indicated to ensure that the kneecap sits better in the end of the trochlea. Finally, in cases where the trochlea is dome shaped or flat, your surgeon might reshape the end of the thighbone to try to make a V-shaped trochlea, called a trochleoplasty.

The rehabilitation programs after these procedures are almost all the same. In general, patients don't bear weight for six weeks on crutches. They are allowed early motion to ensure that their knee does not become stiff, with a goal of flexing past 90 degrees at about two weeks after surgery. For those

patients who solely have an MPFL reconstruction, they may work on the quadriceps by performing straight-leg raises in a brace. However, if the tibial tubercle was moved, patients shouldn't perform straight-leg raises for the first six weeks because a sudden quadriceps pull could dislodge the screws that are holding the tibial tubercle in place and lead to the need for further surgery. If a trochleoplasty was performed with these other procedures, you have to be careful about putting any significant weight on the trochleoplasty until the cartilage surfaces have time to heal. In general, when a patient has a tibial tubercle osteotomy or trochleoplasty or both, x-rays are taken at the six-week point to ensure that there is sufficient healing to be able to let them start bearing weight and doing simple exercises, such as riding a stationary bike.

THE RUNDOWN: PATELLOFEMORAL (KNEECAP) INSTABILITY

How common: It's difficult to determine the overall number of cases of kneecap instability because not everyone goes to their physician, especially if symptoms are more benign. However, there are roughly 7,500 kneecap dislocations per year in the United States.

Common causes: Sporting injuries when the knee is out straight.

Average patient: A knock-kneed adolescent female soccer player.

What to do: If the kneecap "self-reduces," or pops back in without any manipulation, then this injury is not an emergency or even urgent and can be seen in clinic with either your primary care physician or an orthopedic surgeon. Many patients with instability will have recurrent bouts of dislocation that relocate spontaneously. In these cases, rest, ice, compression, and elevation (RICE) can begin until you can be seen by a doctor. However, a kneecap that remains dislocated needs to be treated urgently and requires either an acute visit in clinic that day or a trip to the local emergency department.

Severity of injury: This depends on the details of the injury. If there is a piece of bone and cartilage knocked off, this is a more serious problem that usually requires surgery. If the patient has a high-riding kneecap (patella alta), a flat distal femur (trochlear dysplasia), or a significant tear of the MPFL ligament that holds the kneecap in place on the inside of the knee, there is a much higher risk of another dislocation.

Treatment options: Most kneecap dislocations that do not involve a cartilage problem can be treated with a program of physical therapy. In patients who have significant instability or have recurrent instability, surgery would be recommended. Surgery can range from soft tissue (ligaments and tendons) repair and reconstruction to osteotomy (cutting and moving bone) plus soft tissue surgery.

Expected result: About 80 percent of patients are able to return to activities after surgery.

The ones who have more limitations usually have some arthritis under the kneecap from the original kneecap dislocation or recurrent kneecap dislocations.

Return-to-activity timeline: Nonoperative treatment of a kneecap dislocation usually lasts four to six weeks. This involves a program of physical therapy to ensure that strength returns. Surgical treatment usually requires patients to be partial- or non–weight-bearing for six weeks. They then have to work on recovering their overall strength. Driving is usually allowed one to three weeks following return of full weight bearing. A complete return to strength usually is achieved five to seven months after surgery.

TIBIOFEMORAL MALALIGNMENT

Sure, you've heard of tibiofemoral malalignment: it's otherwise known as being bowlegged or knock-kneed. Normally, one bears weight through the center of the knee. If you're bowlegged—aka varus alignment—you're putting more weight on the inside (medial) part of your knee. If you're knock-kneed—aka valgus alignment—the outside (lateral) part of your knee bears more weight. (See Figure 3.23.) (Patients who are severely bowlegged or severely knock-kneed to the point where they have difficulty walking, and who do not have any underlying arthritis, generally need to see highly specialized knee surgeons to straighten their bones out.)

In general, men tend to be somewhat more bowlegged, and women tend to be a bit more knock-kneed. Generally, this won't interfere with your activities if your cartilage and meniscus are normal and your ligaments are intact. But having knee alignment issues can affect you if you have a cartilage problem develop on the side of your knee that is bearing more weight. Once you have worn through your protection, the meniscus, you can then progress to cartilage injury, which means symptoms can develop more quickly, and arthritis can progress more rapidly. Therefore, patients with malalignment should be carefully evaluated with long-leg x-rays to determine if preemptive treatment with the use of unloader braces or other surgical means may be indicated.

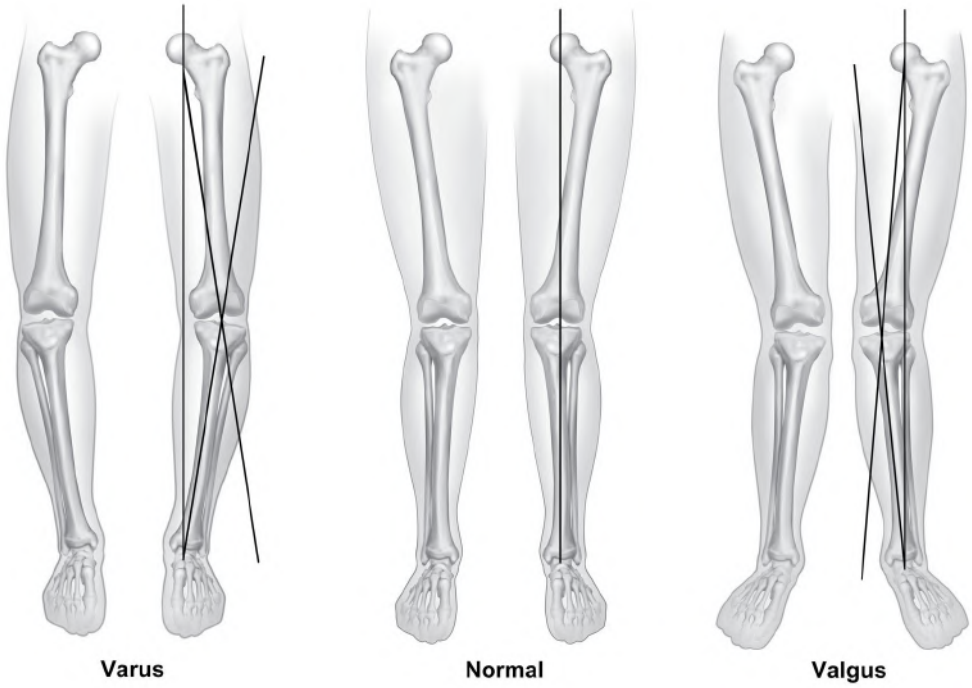


FIGURE 3.23.

Tibiofemoral Malalignment

For example, if you are bowlegged and have a cartilage problem on the inside of your knee, usually the cartilage will wear out, and you'll become more symptomatic faster than if you had normal alignment of the lower extremity. In addition, if you are bowlegged and have a medial meniscus tear taken out because it cannot be repaired, then you have a much higher risk for the development of osteoarthritis sooner because you lost that important cushion on the inside of your knee.

Likewise, if you are knock-kneed and have a lateral meniscus problem, so that the meniscus has to be taken out, you are also at a higher risk for the development of osteoarthritis faster than if you were bowlegged or had neutral alignment. The same thing goes for a cartilage problem on the outside of the knee when you are knock-kneed. Of note, lateral sided (outside of the knee) problems can lead to faster cartilage degeneration.

In general, if you need cartilage surgery or a meniscus transplant on the side of the malalignment, the chance of success is much lower unless the alignment is also corrected.

Another situation is when you have a ligament problem that was not treated initially, and the instability becomes chronic. If you are bowlegged and have an injury to the outside of your knee, such as a complete fibular collateral ligament or posterolateral corner injury (see here), it might mean you need an additional surgery. It is recommended that the bowleggedness be

corrected—the bone broken and reshaped—prior to proceeding with the ligament reconstruction on the outside of the knee; otherwise the reconstruction graft could stretch out. The same holds true for somebody who is knock-kneed and has a chronic MCL injury (see here). Surgery is recommended to straighten the knee out (a procedure known as distal femoral osteotomy). This can be performed either before or at the same time as an MCL reconstruction.

Alignment is also a factor in patients with osteoarthritis. Bowlegged patients who have osteoarthritis on the inside of their knee will put more stress on it, and this can be problematic. Using a brace (a medial compartment unloader brace) can be an excellent way to help take the stress off and allow patients to improve their knee function. A younger patient who does not have any arthritis in the rest of their knee, and for whom the brace is effective, may be an excellent candidate for a surgery that shifts the weight away from the medial compartment (proximal tibial realignment osteotomy), allowing them to increase their activities. This may be preferable to a partial knee replacement, since the results are more durable and the patients can continue to participate in activities that they would not be able to do otherwise.

It's a similar case for knock-kneed patients who have arthritis on the outside of the knee while the rest of their knee cartilage looks undamaged. In these circumstances, if a lateral compartment unloader brace works well for them, they may be candidates for surgery (distal femoral realignment osteotomy) to shift the weight back through the center of their knee. Distal femoral osteotomies are not performed as much as proximal tibial osteotomies, but in general they work well in patients who have good relief of their symptoms with the brace.

THE RUNDOWN: TIBIOFEMORAL MALALIGNMENT

How common: It is almost impossible to know exactly how many people have a deformity of their tibiofemoral joint because not everyone notices or has symptoms with malalignment. Nevertheless, this condition is much more prevalent than was previously recognized.

Common causes: Bowleggedness and knock-kneed alignment can be genetic or the result of trauma to the knee or occur after a partial meniscectomy.

Average patient: A forty-year-old man who had a previous partial medial meniscectomy in high school and who is now bowlegged. Or, on the other end of the spectrum, a six-year-old patient who is significantly bowlegged or knock-kneed.

What to do: You usually do not need to seek specific attention when you have malalignment. The workup and treatment of malalignment should be a routine part of the workup for osteoarthritis or for those with chronic knee ligament instability.

Severity of injury: The severity of being bowlegged or knock-kneed depends on how much your weight-bearing axis is away from the center of the knee. If the axis is significantly off-center, there will be extra stress placed on the affected inner or outer knee area (medial or lateral compartment).

Treatment options: The use of an unloader brace may be helpful to push you away from the area where the joint may be overloaded because of the malalignment. If the brace successfully relieves pain, surgery known as an osteotomy to correct the alignment might be indicated.

Expected result: Patients who require an osteotomy around the knee usually are able to return to activities around five to seven months postoperatively. If they have significant arthritis, they typically must avoid impact activities.

Return-to-activity timeline: Patients who are treated with an osteotomy usually need to be on crutches with no to minimal weight bearing for the first eight weeks. They then may progressively increase their weight bearing until the three-month point. Driving is usually allowed at about nine to ten weeks postoperatively. A full return to activities is usually anticipated once the surgical fracture completely heals and the patient has completely regained their strength, usually around six to nine months after surgery.

SEPTIC ARTHRITIS

Septic arthritis means that there is an infection within the knee joint. This can occur randomly—from a blood-borne bacterium from brushing your teeth that happens to settle in the knee joint or from an infection somewhere else in the body. It can happen from getting a cut on the knee. It can happen after surgery because the blood that accumulates in the knee after surgery can act as a petri dish for bacteria (it’s like a soup with all the nutrients they need to thrive) and become more easily infected when bacteria are circulating in your body.

FIGURE 3.24.

Swollen, Inflamed Knee

The treatment for septic arthritis is to proceed immediately to surgery and have the bacteria and debris generated by the infection washed out of the knee. Enzymes from the bacteria can cause the cartilage to break down over time, so you should have an arthroscopy to have the bacterial infection

cleaned out as soon as possible.

In patients who have total knee replacements or partial knee replacements, however, the treatment may be different. While sometimes the prosthesis can be salvaged (mostly when it happens quickly, within weeks to months after the procedure, although the exact timing for prosthesis salvage is variable depending on the surgeon), often the whole prosthesis and all the cement that holds it in must be taken out. A cement spacer containing antibiotics can be inserted temporarily, and then the patient is placed on antibiotics for six weeks or longer. Once symptoms and blood tests show the infection has been eradicated, usually after at least three months, then the patient may be able to have a new revision total knee replacement. The results of revision total knee surgeries are generally not as successful as the first time around, so you should take preemptive measures to avoid septic arthritis. Your doctor may prescribe prophylactic antibiotics for dental appointments and for certain other procedures in the body.

THE RUNDOWN: SEPTIC ARTHRITIS

How common: Approximately 0.025 per 1,000 people, or 8,000 cases in the United States per year.

Common causes: Patients who have psoriasis or lacerations around their knee may develop an infection deep in the joint. Other causes can include infection after surgery.

Average patient: Somebody who had a cut over the knee that penetrated the knee joint or a patient who recently had knee surgery.

What to do: Septic arthritis is considered a surgical emergency. Go to the doctor if you have concerns about warmth and swelling within the knee or fever and chills. Keep an eye out for these things especially if you've recently had surgery. Call your physician so they can recommend the best course of action; however, if this is not possible (like on a weekend), then you should go to your local emergency department to be evaluated.

Severity of injury: All cases of septic arthritis are considered serious. There are some types of bacteria that can be more harmful, but all cases should consider surgery.

Treatment options: The vast majority of patients who have septic arthritis require an arthroscopy and cleanout. One surgery might not be enough; it may require multiple procedures to clean out the joint, combined with a program of IV antibiotic treatment.

Expected result: If the septic arthritis is recognized and treated promptly, most patients can resume their usual activities. But in patients who have had septic arthritis for a period of time in their native knee, the cartilage may be damaged, and these patients may not be

able to return to full activities. For those with septic arthritis in a new total joint, it may be possible to keep the total joint in place and treat it with antibiotics. If the infection has been present for some time, however, the components will need to be removed and replaced with an antibiotic spacer for some time before they can have a new total revision knee replacement. It is a long, tenuous process, and therefore one to avoid if possible.

Return-to-activity timeline: This depends on clearing the infection from the knee. Most patients require IV antibiotics for two to six weeks after being treated, depending on the type of bacteria present. During this time, they have to take it easy and not be too active, as they are susceptible to increased inflammation and swelling, which can set their recovery back. Often there will be activity and weight bearing restrictions during this time, so the patient should follow their doctor's activity orders, stay patient, and trust the process. If the patient had a knee replacement and those components need to be removed, it may take months before the components can be replaced. This means a patient may be unable to weight bear for months following their first surgery. Again, during this time the patient should keep in mind that their knee health as well as their overall health are long-term investments; they should treat recovery like a job and follow the rules so they can get the best possible outcome.

INFLAMMATORY ARTHRITIS

Inflammatory arthritis is different from osteoarthritis (here) in terms of its symptoms and presentation. Inflammatory arthritis usually means that the joint lining is irritated, secreting enzymes that can lead to cartilage breakdown and inflammation throughout the knee. (See Figure 3.24.) Therefore, rather than just one side of the knee developing arthritis, such as after a meniscus has been taken out, the whole joint may have cartilage changes over time. The most common inflammatory arthritis is rheumatoid arthritis, in which one's immune system basically is not functioning normally, but this type of arthritis can also develop from other autoimmune diseases or causes such as Lyme disease.

FIGURE 3.24.

Swollen, Inflamed Knee

Sometimes it can be difficult to determine if you have an infection or a case of inflammatory arthritis. In general, a thorough physical exam supplemented by x-rays can often give clues as to what is going on in the knee. In many circumstances, an additional MRI scan or a CT scan of the

knee and special blood tests may be indicated to diagnose the underlying inflammatory problem.

It is important to try to minimize the amount of swelling in the knee when you do have inflammatory arthritis. Newer anti-inflammatory medications and rheumatologic drugs are very effective. However, if you continue to have swelling and decreased function, you may need to have an arthroscopy and have the joint lining debrided (removed) out with a shaver, called a synovectomy, to minimize the progression of the cartilage wear.

THE RUNDOWN: INFLAMMATORY ARTHRITIS

How common: There are many different types of inflammatory arthritis, the most common of which is rheumatoid arthritis (RA). There are 1.3 million Americans with RA, and the knee joint is one of the most commonly affected large joints in people with RA.

Common causes: Tick bites, genetic predisposition to autoimmune disease, or environmental causes.

Average patient: A forty-year-old woman with RA of multiple joints, or a thirty-five-year-old woman who was bitten by a tick.

What to do: Inflammatory arthritis is usually best diagnosed by a family physician or a rheumatologist. A lab workup is often necessary to determine if you have inflammatory arthritis. If you notice a tick bite with a bull's-eye rash on your skin, this is a sign of Lyme disease, and you should be seen by a doctor urgently to begin treatment and prevent later complications.

Severity of injury: The severity of inflammatory arthritis can depend on the amount of irritation of the joint lining. It can range from very mild soreness or swelling with activities to significant swelling and warmth within the knee. For inflammatory diseases that affect other organs, the severity is going to be dictated by the major organs compromised.

Treatment options: Treatment depends on the type of inflammatory arthritis and the severity of symptoms. It can include observation and activity modification, the use of special medications, and arthroscopy and cleaning out of the joint lining.

Expected result: Inflammatory arthritis resulting from Lyme disease may be able to be treated and cured. Other types of inflammatory arthritis may be lifelong and need to be managed with medication and surgical options.

Return-to-activity timeline: Most patients with inflammatory arthritis that cannot be cured will often have flare-ups with activities over time. Bouts of inflammation will have varying lengths but usually allow the patient to return to full activity within a couple of days to a couple of weeks of the flare-up.

PROXIMAL TIBIOFIBULAR JOINT INSTABILITY

Proximal tibiofibular joint instability can be a difficult problem to diagnose. For this reason, it is generally not recognized as often as it actually occurs.

The proximal tibiofibular joint is the joint between the calf bone (fibula) and the shinbone on the outside of one's knee. Injuries to this joint most commonly occur in a sports activity when you fall on a bent knee with your ankle out straight (like the position of your foot on a car's gas pedal). Usually, this type of injury will tear the ligaments in the back of this joint, which are the weakest of the joint's ligaments. This causes instability on the lateral or outside of your knee, specifically extra mobility of the fibular head.

This injury needs to be treated with immobilization to allow the ligaments to heal with scar tissue ("scar back in"); otherwise, the patient may have knee instability. Instability usually happens when you are squatting, and the outside of the knee feels like something is rotating away from the joint. This rotation may also stretch the nerve on the outside of the knee and lead to feelings of numbness and tingling over the top of the foot and the outside part of the leg. In some instances, patients may actually start to have some weakness in pulling their ankle up or turning their foot outward.

In order to effectively treat proximal tibiofibular joint instability, it is important to properly diagnose it. The diagnosis is usually by a clinical exam. The doctor checks the amount of rotation and translation of the joint when the knee is bent to about 90 degrees and compares it to the noninjured knee. If it does rotate more and that appears to cause the symptoms, this often will point to the diagnosis. X-rays of the proximal tibiofibular joint are often difficult to interpret because of rotation, but a widened joint may indicate a severe injury. A regular MRI scan may miss a tear of these ligaments.

One way to confirm this diagnosis is via a taping program (you may have seen professional athletes wearing colored kinesiology tape around a joint), where the tape is applied to the outside of the leg to attempt to pull the joint back into a reduced position for the proximal tibiofibular joint. If this taping makes the joint feel more stable or decreases the nerve irritation or pain, this usually indicates that surgery would be a good option.

Surgery for proximal tibiofibular joint instability has evolved over time. The current medical consensus is that reconstructing the torn ligaments is most successful at restoring function. In the past, sometimes these joints were taken out, which causes even more problems, or they were fused, which often was unsuccessful.

Reconstructive surgery most commonly uses a donor hamstring or your own hamstring tendon. The surgeon will place a tunnel through the fibula, coming out at the back of the fibula, and then entering the tibia, at the same location where the normal posterior ligaments attach; the hamstring graft is placed and fixed into these tunnels. After surgery, you are usually on crutches with no weight bearing for six weeks to allow the ligament to heal. You should then avoid squatting and lifting for a minimum of four months after surgery to make sure you do not stretch out the ligament. Usually you can get back to full activities between five and seven months after surgery.

THE RUNDOWN: PROXIMAL TIBIOFIBULAR JOINT INSTABILITY

How common: A relatively rare condition; fewer than five thousand per year in the United States.

Common causes: Falling on a bent knee with the ankle out straight.

Average patient: A twenty-two-year-old male basketball player who falls down on his bent knee with the ankle out straight in plantarflexion (with the foot flexed toward the ground).

What to do: Make an appointment to see your doctor. If you experience any warning signs such as a lot of pain, numbness, or a lot of swelling, go to the emergency department.

Severity of injury: Sprains can range from mild (grade 1) to moderate (grade 2) to severe (grade 3).

Treatment options: Treatment options include bracing for acute injuries, taping of the proximal tibiofibular joint for chronic injuries, and surgery. Mild sprains (grade 1) may just need activity modification and avoidance of sports for a couple of weeks. Moderate sprains (grade 2) may benefit from a period of immobilization and moving around on crutches, whereas grade 3 sprains should be treated with immobilization for up to six weeks to allow the ligaments to heal with scar tissue. Proceeding to surgery may be indicated if there is a significant amount of instability of the proximal tibiofibular joint.

Expected result: Most patients will be able to return to high-level activities.

Return-to-activity timeline: After surgery, patients are non–weight-bearing for six weeks. They may drive between seven to eight weeks postoperatively. They should avoid squatting and lifting for four months to prevent too much strain on the ligament reconstruction graft. A full return to activities normally takes five to seven months postoperatively.

OSGOOD-SCHLATTER DISEASE

Osgood-Schlatter disease usually occurs in young adolescents during their growth spurt. Understanding the anatomy of the knee area is crucial to understanding what the disease is.

The tendon that goes from the kneecap down to the shinbone is called the patellar tendon. At its attachment site in patients with open growth plates, a normal bump of bone has an open growth plate associated with it. Normally it is not prominent; this is called an apophysis. When you are growing rapidly, the hamstrings may be tight and stress the front part of the knee. This may result in your having to put extra stress on your knee to straighten it out and overcome the tight hamstrings. This may cause the growth plate to start to be pulled apart microscopically. Over time, this can result in the growth plate having an extra-large bump of bone, which is a typical feature of Osgood-Schlatter disease. (See Figure 3.25.)

Most young adolescents who present with Osgood-Schlatter disease are doing something physically that is overloading their joint at this location. This is mainly a clinical diagnosis rather than x-ray diagnosis, based on symptoms of pain to palpation over the tibial tubercle and with activities. The remedy is to try to avoid the activity that causes the most irritation and to work on stretching your hamstrings. Usually a program of icing, activity modification, and physical therapy will be effective to allow this area to quiet down. Once the growth plates stop growing, in the mid-teenage years, the symptoms of Osgood-Schlatter disease usually go away. In some patients, a piece of bone has been pulled off with the extra tension on the growth plate, so they may have symptoms into their adult years caused by the piece of bone located within a bursa behind the patellar tendon.

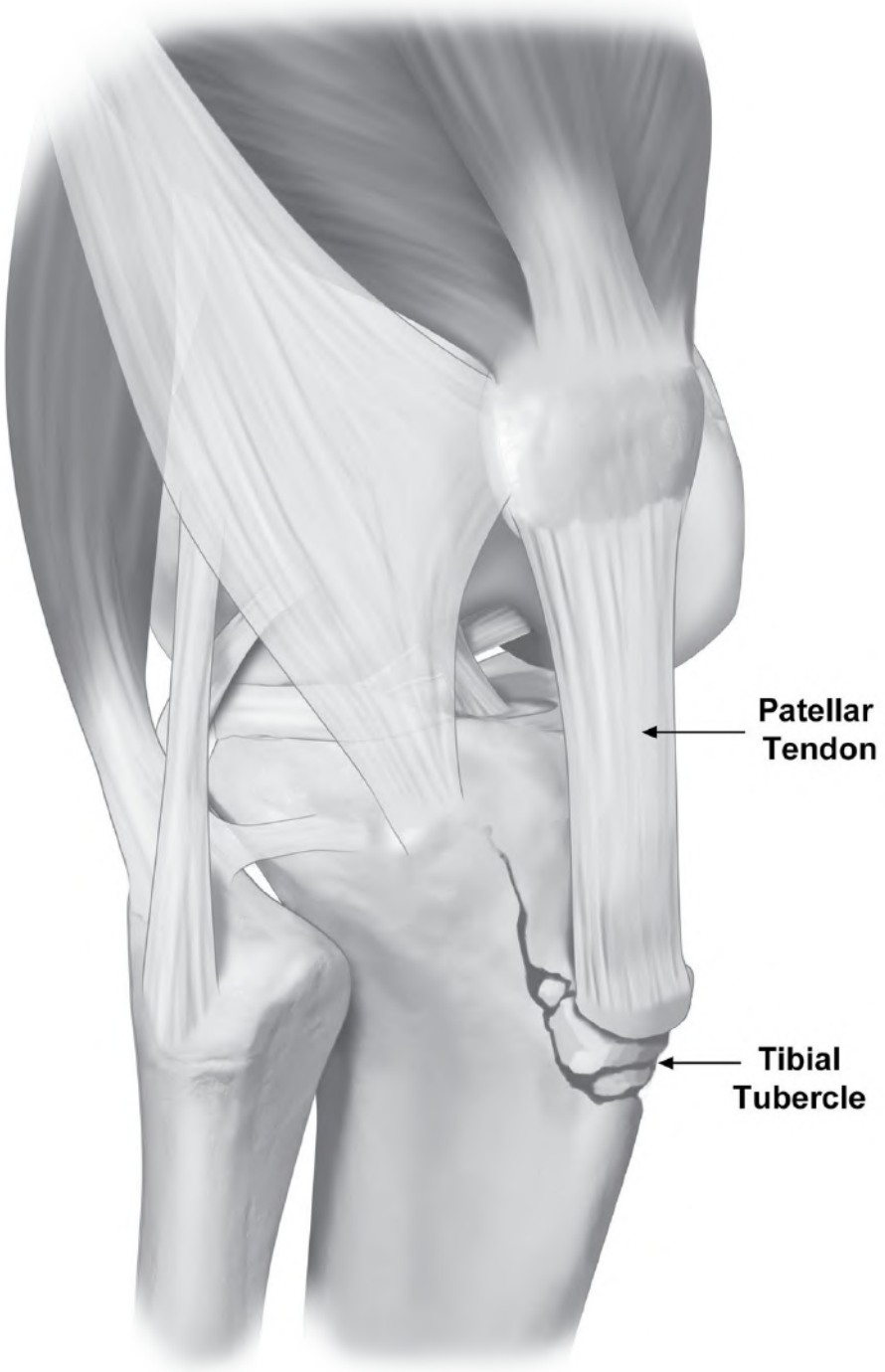


FIGURE 3.25.

Osgood-Schlatter Disease

It is rare to need surgery for Osgood-Schlatter disease. Surgery is usually reserved for removing the extra piece of bone that has been pulled off. It is generally recommended to try physical therapy first before proceeding to surgery.

THE RUNDOWN: OSGOOD-SCHLATTER DISEASE

How common: This is mainly a condition that affects adolescents. It has been reported that 9.8 percent of children age twelve to fifteen have this condition; the percentage is higher in the athletic population.

Common causes: Overuse activities while the growth plates are still open in the early teenage years.

Average patient: A fourteen-year-old boy during cross-country team tryouts.

What to do: This is something that should be seen in a primary care clinic in order to allow you to have appropriate treatment and follow-up consultations established.

Severity of injury: The level of severity for Osgood-Schlatter disease doesn't have a specific classification. It is primarily based on pain symptoms. With more pain symptoms, you should take more time to rest and scale back on activities.

Treatment options: Treatment options almost always involve rest, activity modification, and physical therapy.

Expected result: Once the growth plates close, the vast majority of cases of Osgood-Schlatter disease resolve, although you may still have a small bump in the front of your shinbone.

Return-to-activity timeline: A return to activity depends on when symptoms resolve, which can take a few weeks to a few months.

OSTEOCHONDRITIS DISSECANS

Osteochondritis dissecans, or OCD, of the knee is usually due to a growth-plate healing problem and occurs primarily in adolescents. OCD likely results from a lack of healing of one of the growth centers (ossification centers), and if a growth center does not completely heal back to the underlying main portion of the bone, the patient may experience pain from a partially detached or completely detached OCD lesion. OCD starts off as mainly a bone healing problem below the cartilage, but if the bone does not heal and it falls off, the cartilage surface will then be involved, and it is a bigger problem.

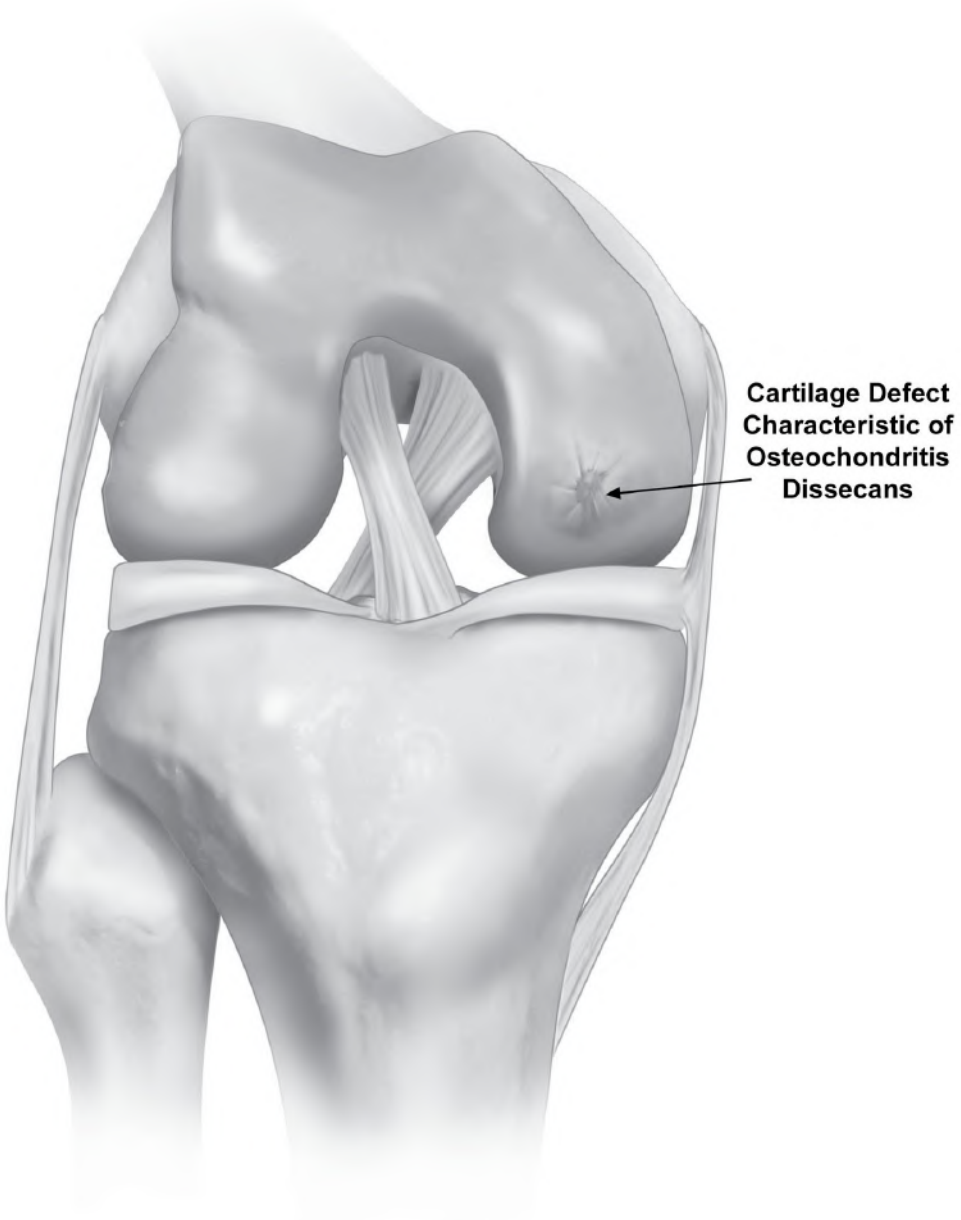


FIGURE 3.26.

Osteochondritis Dissecans

The most common location of an OCD lesion of the knee is at the lateral aspect of the medial femoral condyle—that is, on the inside of the knee (Figure 3.26). The next most common location is the lateral femoral condyle (on the outside of the knee). A lateral femoral condyle OCD is a bit more ominous because it is often quite large. Other areas can include the trochlea and patella (kneecap). If you have an OCD lesion in one knee, the chance of having an OCD lesion in the other knee is about 30 percent, so your doctor might obtain x-rays of both knees.

The prognosis for OCD lesions of the knee depends on whether you still

have open growth plates. If you do, and the lesion is not partially or completely detached, there still may be an opportunity for the bone of the OCD lesion to heal over time. The treatment in young adolescents or preadolescents who present with this is usually activity modification: they have to stop playing sports and use an unloader brace. Your doctor might want you to have a sequential MRI to determine if there are cysts present (which can indicate that these lesions are more severe) and if the bone is healing over time. While an OCD lesion can be seen on plain x-rays, it can often be difficult to determine if it is healing without an MRI scan.

Once the growth plates have closed, which for girls occurs around age thirteen to fourteen and for boys is around age fifteen to sixteen, the chance for an OCD lesion to heal is low. The treatment in these young patients depends on the symptoms they have and if it appears that the lesion is detached. Symptoms can range from mild pain with activity to more severe pain and mechanical symptoms such as knee locking, when the knee gets stuck bent or straight because the OCD lesion gets stuck in the joint and does not let the knee bend and straighten.

It is always better to try to preserve knee cartilage. Therefore, if an OCD lesion can be pinned back in place rather than taken out, this is definitely indicated.

The type of surgery for an OCD lesion depends on whether it is still in place or if it is partially or completely detached, and if the bone within the OCD lesion is one piece or if it is fragmented. Fragmented pieces do not have nearly as good a chance of healing, and these may not be repairable.

If one has a symptomatic OCD lesion that is still in place and isn’t responding to activity modification and the use of an unloader brace, then your doctor might perform a surgery that involves drilling holes across the OCD lesion, usually from outside the OCD lesion into the bone over it, to try to kick-start the healing process.

In cases where it is partially detached or completely detached, but with mainly one piece of bone and not a lot of little fragmented pieces, surgery to fix the OCD lesion would be indicated. This usually involves making a small incision, lifting up the OCD defect, scraping out the scar tissue in the base of the defect, and drilling holes across the bone from where it came out to try to maximize the healing potential. The surgeon might obtain a bone graft from the proximal tibia, above the growth plates, and possibly using platelet-rich plasma (PRP) as a membrane, again to maximize healing of the bone. These surgeries tend to work about 70 percent of the time. While this may not seem

an ideal success rate in a young patient, it is certainly better to try to save the cartilage rather than take the defect out.

If the OCD lesion needs to be removed, the result is a crater. The usual treatment is to fill it back in with an osteochondral allograft, replacing both the bone and the cartilage. Or, simply put, it means taking a piece of a donor's knee, from the same area the patient is missing bone and cartilage, and putting the donor graft in the missing hole. If you do need surgery, your medical team should check for a number of potential problems and treat them if they are present, or the chance of success with surgery is much lower. They should obtain a long-leg x-ray to make sure that your leg is not malaligned and doesn't require an osteotomy (see here), make sure that the meniscus on the lesion side of the knee is still well preserved to act as an adequate cushion, and ensure that the opposite surface of the tibia does not have any significant arthritis. When all the proper steps are followed, treating an OCD lesion of the knee with a fresh osteochondral allograft is one of the more successful orthopedic surgeries. Success rates have been described as up to 90 percent in ten years.

THE RUNDOWN: OSTEOCHONDRITIS DISSECANS

How common: A condition that heavily favors adolescents and also favors boys, so it is most common in young male athletes. Overall incidence is 0.01 per 1,000 or fewer than 5,000 new cases in the United States per year.

Common causes: The cause of OCD lesions of the knee is not known. It is probably a combination of genetic and environmental causes.

Average patient: A fifteen-year-old boy who develops knee pain during soccer practice.

What to do: Early diagnosis of an OCD lesion so that appropriate treatment can be obtained is important. This type of injury is non-urgent or emergent and can be evaluated at a clinic visit unless the piece is displaced and the knee is locked up as a result of the loose piece getting between the bones in the knee and not letting it move.

Severity of injury: This is based both on whether one's growth plates are still open and whether the lesion is still attached or is partially or completely detached.

Treatment options: For milder cases, activity modification and bracing may be all that is needed. For those cases in which the lesion is partially or completely detached, surgery is indicated.

Expected result: An adolescent with open growth plates has the potential to heal to the point where they can return to full activities. Patients who have a partially or a completely

detached OCD lesion may have further problems in decades to come.

Return-to-activity timeline: With an open reduction and internal fixation with bone grafting, patients are usually non–weight-bearing for six weeks. They will then be allowed to slowly wean off of crutches. These lesions can take five to seven months to heal, and the patient should be closely evaluated over several years—interval x-rays are routine, and an MRI may be indicated—to make sure that the surgery was successful.

PART 2

ALL ABOUT SURGERY

SHOULD I HAVE KNEE SURGERY?

When to Surgerize and When Not to Surgerize—That Is the Question

The vast majority of the time, barring a life-threatening situation, knee surgery is a choice. More importantly, it's your choice (not your doctor's or anyone else's), as all aspects of your medical care are and should be. Only after careful consideration should you arrive at the decision to have surgery.

At this point, you've been injured and received a diagnosis. You've found a physician with expertise in your type of knee injury and received treatment options. Perhaps you've sought a second opinion and mulled it over. Possibly you've made up your mind after changing it ten times. If these steps have not happened—specifically, if you have not been made aware of multiple treatment options to consider or received a second or even a third opinion—then at this point we would suggest taking a metaphorical Chutes and Ladders slide and going backward to those steps. The decision to have surgery is not trivial and one that you should not arrive at without giving it thought. Just like your decision to buy a house or take a new job or get married, choosing to have surgery is a major life decision.

In this chapter, we'll go over what questions you should be asking prior to surgery. We will describe what makes surgery the correct decision for some and the incorrect decision for others. We'll also give you a long-term view of what would come with surgery, or how your decision to have or not to have surgery affects your chances of your knee injury worsening.

Some of the big-picture questions regarding surgery are ones you should play an active role in answering. Understanding the risks, benefits, and reasoning will help you better understand your injury, prognosis, and

recovery, and can help you feel more empowered and at ease regarding your care.

MAKING THE DECISION

Following is a list of important questions you should ask prior to making your final decision on surgery. Some are these we find many of our patients ponder, while other questions some patients may not think to ask but should. By asking all of these, we hope you'll better be able to clarify if surgery is right for you personally, what surgery can help you to accomplish, and some of the physical and time costs that come with surgery.

1. Am I Confident I've Been Correctly Diagnosed?

Getting the right treatment for your knee hinges on having the right diagnosis. It is important to make sure you receive a thorough examination and have the correct x-rays and a high-quality MRI scan to ensure an accurate diagnosis so that proper recommendations can be further made. Your decision can be important for the overall health of your knee in the long term.

If you are at this point, it is most likely you have gone through everything mentioned above. However, it is never wrong to seek a second opinion. While everyone with an MD or DO behind their name has finished medical school, that does not mean their training, their expertise, or their opinions are all the same. Also, there may not be a single best doctor, but there may be a single best doctor *for you*. So seek out a second opinion; show more than one health care professional all your scans, tests, and history; and then when you understand all your options, pick the doctor and the treatment plan that you believe to be the best choice, given the information you have gathered.

2. Is My Injury Likely to Heal on Its Own?

We like to tell our patients that orthopedics is a logical field. Something that had a certain function is broken, you have lost said function, it can either heal on its own or not, and if it cannot heal, we can usually fix it with surgery. Ask your doctor how your injury tends to heal in patients like you. Your doctor should have a thorough understanding of what injuries are likely to get better on their own and which will require surgical intervention.

Chapter 3 gives a good breakdown of injury types and their likely prognosis with different kinds of treatment. Whether your personal injury will heal largely depends on your diagnosis. So again, this stresses the importance

of the first question: *Have I received the right diagnosis?* From there you can learn which options you have based on the likely positive outcomes of each possible treatment.

3. What Level of Knee Function Do I Need to Achieve?

Let's say your car has an issue with the engine, and suddenly, instead of being able to hit a top speed of 120 mph, it can only hit 85. However, you only drive the car in town, where the maximum speed limit is 50. In that case, there is no need to fix the car. A similar thought process should occur when you and your doctor think about your knee injury. What functions have been lost, and how does that affect your daily life now and in the future? Think about your personal activity level. Think about what you want to do and how active you need to be in order to be happy. Then, you and your doctor can determine to what extent the function missing is needed, and your doctor's understanding of which injuries heal without surgery and which injuries usually require surgery will allow them to provide recommendations for treatment geared toward your individual case.

Let's look at two patients, Mimi and Mia. Both of them have torn their ACLs in a similar fashion. But should both of them have knee surgery to repair it? The answer is not necessarily.

Mimi is a seventy-five-year-old woman whose activities include gardening and doing occasional water aerobics. Mia, on the other hand, is sixteen and plays sports all year long. Mimi doesn't have much reason to undergo an ACL reconstruction just because it is torn: she would have to undergo a huge rehabilitation process for a nonreciprocal benefit. Mimi chooses not to have surgery because most of her daily function does not require an intact ACL. Mia, on the other hand, needs a functioning ACL, with her high level of activity and athletics, and therefore would benefit from surgery.

The decision to have surgery depends not only on the specifics of your injury but on also your age and stage in life and your lifestyle. Keep in mind that if you know someone who had surgery for a similar knee injury, that does not necessarily mean that surgery is right for your situation. Of course, individualized treatment isn't just about a patient's age and sex. We do not treat all fifty-year-old men the exact same way, for example. Your hobbies, activity level, employment, and overall functional goals are specific to you, and all these should be taken into account when determining your best treatment option.

4. What's My Risk of Arthritis Down the Road If I Do Have the Surgery Versus If I Don't?

Another factor intricately related to all injuries is the dreaded he-who-must-not-be-named of the musculoskeletal system: osteoarthritis. Arthritis is irreversible. There is no cure for osteoarthritis, and once you have it, this can lead to further problems down the road. Thus, it's best to treat injuries to prevent arthritis or in a way that minimizes the risk of developing arthritis.

This is where age becomes an important factor in the "surgery or no surgery" question. The younger you are when you are injured, logically, the longer your body is then exposed to this post-traumatic (postinjury) state. There is more time for arthritis to develop. Therefore, our recommendations for younger patients are often more aggressive or invasive than our recommendations would be for older patients. Examples include surgically addressing any complete ligament tear, which does not heal, and repairing meniscal tears instead of doing a meniscectomy, or taking out the affected meniscus. The most important structure to preserve as a line of defense against arthritis is the meniscus—keeping it is probably the best thing one can do to make sure the joint stays healthy. Taking the meniscus out always leads to arthritis developing later and to instability of the knee. The other factor for development of arthritis is time, which is why if we take a meniscus out of a young patient, they have a lot of time to develop arthritis, whereas removing a meniscus in an older patient is less detrimental.

5. Am I Healthy Enough to Have Surgery?

One aspect that must be taken into account is overall patient health. Because surgery is elective with most knee injuries, we must consider the risks and benefits of the procedure on a holistic level. Once you know the consequences of operating or not operating in regard to your knee health, you must take into account how that surgery will affect your whole body. Are you healthy enough to undergo the stress that surgery entails, and are you healthy enough to heal following surgery? This is why your doctor needs to know your general health concerning your major organs—kidney, heart, lungs, and liver—as well as whether you have other conditions that could complicate healing, such as an autoimmune disease like diabetes. Your surgeon will send you for a preoperative exam to assess these factors (see here).

6. What Are the Alternatives to Surgery? Does It Make Sense to Try Physical Therapy First?

Physical therapy is an essential component to almost all knee recoveries, either as the only treatment or as an adjunct for surgery. To obtain optimal

outcomes, it is imperative to work on regaining strength, motion, and good muscle control. Some injuries, as mentioned in Chapter 3, can be treated effectively with physical therapy, while some need to be surgically fixed. In general, the more traumatic the injury, the less likely physical therapy alone will lead to a positive result.

7. What's the Likelihood of a Successful Outcome?

This question is difficult to assess and is multifactorial. The more severe your injury is, the less predictable the outcome. Some knee injuries are complex and do significantly better in the hands of a more experienced surgeon who is an expert on your injury. Your overall health plays an important role; patients who have fewer medical issues, are a healthy weight, and avoid risky behaviors do much better. Lastly, how well you follow instructions and how much effort you put into your rehabilitation will significantly affect your likelihood of success.

Now, nine out of ten orthopedic surgeons are pretty sure that they are a direct descendent of Zeus and therefore their surgery is going to be 100 percent perfect, amazing, and incredible. However, surgery does not always work 100 percent of the time. There is a chance your surgery will not completely succeed. It may not completely restore stability, or it may not completely relieve your pain. Or maybe worse: it does nothing for your pain or instability. Unfortunately, these are possibilities. There are no guarantees surgery will fix the issue you have presented with. However, you have picked your surgeon for a reason, you have educated yourself on your injury and your options, and if you go forward with surgery, you should be optimistic about your prognosis.

8. How Long Is the Recovery Period?

This again is highly subjective and dependent on your injury and your overall health. Some surgeries and injuries are largely pain-limited; that is, you are cleared for almost all activities immediately, and it is largely pain that guides how long the recovery period is. Other surgeries are much more time-expensive and may require up to three months of being non–weight-bearing on your injured leg, working on your range of motion, and keeping the swelling down in the meantime. No matter what, there will be a period of pain following the surgery, and some kind of therapy will be beneficial.

As you can see, surgery is not always the answer to every question. There are many decisions to make when you have to choose between surgery and

more conservative approaches like physical therapy (or toughing it out). First and foremost, it is important to understand that there is no cookie-cutter correct decision for everyone; there is only a correct decision for each patient. Your health care is ultimately up to you. This isn't 1950, when a doctor walks into a room, tells you your diagnosis and what is going to be done for it, and walks out. Now more than ever, you are in charge of your health care. We as providers are meant to educate you on the options and rationale behind them to help you choose the treatment option that works best for you.

COMMON QUESTIONS ABOUT YOUR PROCEDURE

Here we'll cover some basic questions regarding the surgery itself. Some examples of topics you may want to explore with your physician in advance include use of autograft (your own tissue) versus allograft (donor tissue) and the type of anesthesia that would be used (local versus general).

1. What Does a Procedure Entail?

For starters, you will be anesthetized, and the surgeon will be using a sharp blade to cut through your skin. Your surgeon will likely be using a drill, a saw, or a combination of the two to cut your bone in a specific manner, and then fixing grafts, fractures, or loose bone fragments with screws, staples, and other fixation devices. In essence, we will be performing carpentry on your body, and no, you won't feel any of this as it happens, so don't be too fearful. Nevertheless, to some degree you will feel the effects of all this carpentry work after surgery. For more on the specifics of procedures for different knee injuries, see Chapter 3, and for more on the surgery day itself, see Chapter 6.

2. "What Is the Difference Between "Open" and "Arthroscopic" Surgery?

While these terms are simplifications, there are two basic ways to perform orthopedic surgery: 1) make an incision large enough to directly see what you need to fix, called "open" surgery; 2) make a smaller incision just big enough to fit a camera (an arthroscope) or a tool into the knee joint, and perform the surgery utilizing the camera to provide an image on a screen, called "arthroscopic" surgery. Arthroscopic procedures are performed INSIDE a joint, in this case inside joints of the knee. (See here.) Therefore, some injuries that occur outside the joint (FCL, MCL, proximal tibia fracture, etc.) cannot be performed arthroscopically. Most injuries inside the joint can be performed arthroscopically, but not all. It depends on the specific injury, complexity, and what needs to be done. Remember it is ALWAYS OK to ask.

So if it is unclear, ask your physician why they are doing it one way or the other and they will be happy to explain.

3. What Is an Allograft Versus an Autograft?

A graft is a piece of tissue to reconstruct your torn or damaged tissue. Your surgeon can use an autograft or an allograft. An autograft is tissue taken from your own body and then used somewhere else. An example would be taking your hamstring tendons and using them to reconstruct your ACL. An allograft is tissue from a deceased donor. This tissue has been sterilized to try to ensure minimal risk of infection and adverse reaction, and it is similarly used to reconstruct or replace your damaged tissue. Usually, allografts have a higher rate of retearing, especially in younger people. Studies have demonstrated that people over forty have more or less the same odds of rerupture of the graft with both allografts and autografts. Before that age, an autograft is usually recommended.

4. Will I Have a Choice Regarding the Surgical Technique Used or Other Aspects Such as Graft Type?

Yes, and no… or maybe. In short, this is highly variable depending on your surgeon. Some surgeons have a preference for a particular surgical technique or style, including graft type, and they may be uncomfortable performing the procedure in a different manner. For a real-world example, let's say you are a Mac person: your phone is a Mac, your computer, everything. Now let's say the night before you have a big presentation due for work, you are given a Windows computer and told to get it done. Sure, you can still probably figure it out, but you would be much more efficient and likely do better work if you had your Mac. Having an open and honest discussion with your surgeon to understand the techniques they prefer to use and their reasoning is key to making an informed decision.

5. Will I Have to Go to Sleep During the Procedure? What Options Do I Have for Anesthesia?

This is a multifactorial question. In short yes, surgeries in general can be performed one of two ways: asleep or under general anesthesia; or awake, with local anesthesia that numbs up the surgical area, in combination with modified anesthesia care (MAC). Depending on what type of surgery you are having, as well as what your risk factors are, you may or may not have both of these options, but generally speaking they are both on the table.

Discuss your options with your surgeon and your primary care doctor, but

the final say regarding the decision comes down to your anesthesiologist on the day of surgery. Meeting with the anesthesiologist on the day of surgery is a good time to get the remainder of your questions regarding this topic answered, as well as to communicate your preferences.

In broad strokes, general anesthesia is when you are given medications to put you to sleep, and you are intubated—a tube is put down your throat to help you breathe. General anesthesia is a great option because then you can simply sleep through surgery. It makes it much easier for the surgeon to manipulate you, which is also helpful, because you can be paralyzed. It often is good for high-anxiety patients because you are more sedated after surgery. Still, intubation, while safe, is not without risk.

The other option is a local anesthetic or a nerve block (putting anesthetic directly on a nerve so you have no sensation in area of surgery) and doing MAC, which is giving medications to relax you but not putting you fully under and not putting in a tube. This option is phenomenal for pain control because it puts the medication directly on the nerve, so you should be numb. It also allows you to avoid getting intubated and to remain awake. On the other hand, you are not usually as relaxed or still when compared to general anesthesia, sometimes making the surgeon's job more difficult. There can also be significant risk factors with nerve blocks, including permanent nerve damage.

It is worth noting that the options are more gray than black and white. You can do a combination: undergoing general anesthesia and receiving local anesthetic to numb the area, via either a nerve block or an injection of numbing medication around your surgical site.

Be sure to ask your surgeon and primary care doctor what your anesthesia options are and what they believe to be best.

6. How Much Is My Knee Going to Hurt After Surgery?

Numerous different drugs can help make the pain tolerable. Nevertheless, after surgery your knee will hurt. Pain is subjective and unique for each patient, but as a rule of thumb, day three, two weeks, and six weeks are common time markers we use to describe pain goals. As a result of the anesthesia wearing off, your body's response, and a host of these factors, for some reason days two and three are often when the pain reaches its maximum.

The day after surgery you may wake up feeling good; you can move and

do physical therapy because of leftover anesthesia or a nerve block effect. Then that all wears off, and BAM—on day three you feel as if a truck hit you. The pain should begin to subside mildly that day, but because you are being a little more active each day, the pain may stay relatively stable. Still, there is improvement. If every day you are moving more, yet pain is stable, that means you are getting better. The two-week mark is usually about when you start to feel a noticeable improvement in pain and soreness, or when you are mostly over the acute pain hump. Then at six weeks, your pain should mostly be gone, and you should be left with just soreness.

THE PRESURGICAL CHECKLIST AND WHY IT IS SO EXTENSIVE

What to Expect Before Surgery Day

“Before I tore my ACL and meniscus, I was never afraid of sharp objects or blood. About a week before my surgery, my teacher for my sports medicine class decided to show a video of a reconstructive ACL surgery and pass around the tools that would be used to reconstruct the knee.

“Thinking I was fine, I sat through part of the video and observed the tools. But soon enough, I was overwhelmed by the complexity, detail, and, most importantly, vulnerability of the surgery. Here I would be, lying on a table unconscious, surgeons with their scalpels and scissors cutting open my knee. Even though it would be my own dad performing the surgery, I felt wildly vulnerable.

“I was terrified.

“I hated the idea of not being able to actually be awake or to fully understand how my knee would be put back together. I hated not being able to help or take part in the surgery—not being able to help myself, really. I hated that it was fully in someone else’s hands to fix me. I hobbled out of class on my crutches and hid in a closet until the video was over.

“Before this incident, and even after, with my parents as my surgeon and physical therapist, I never felt I needed to ask the questions that normal people might. Why would I need to know when the two people who are supposed to take the most care of you in the world were, in fact, taking care of me?

“But then, just before I was put under the anesthesia, I felt it—massive anxiety and fear of the unknown. I felt it bubble up suddenly and powerfully, coming out in tears and short, quick breaths. My dad, also my surgeon, was taken aback. Why was I crying, when a minute before I was fine? Jolly, even? Then I couldn’t answer him because I didn’t even know the answer myself.

"While I look back now and think that maybe watching the video in class could have been productive, I know now that while I sought to understand and learn more about the procedure, that wasn't the correct route to go about it. I wish I had asked more questions and been more particular about knowing what was going to be happening when and how it would work. Mostly, I wish I would have documented more of how my journey went, and I wish I could have taken precautions with strengthening my body in more particular ways so I could have avoided injuring myself in the first place.

"I am mostly glad I didn't know how hard it would be to recover. I had a wildly optimistic attitude and an incredibly bright outlook on how quickly I would get back onto my feet, and it is only because of these that I think I was able to recover as quickly as I did. That I was able to wake up morning after morning at 5:00 a.m. for 6:00 a.m. physical therapy sessions, able to hobble down hallways with a smile, and pass on being an honorary part of the basketball team that season. The mental toughness that the recovery required was by far, bar none, the most difficult part of the entire process, including the actual injury. According to me, my first day I would get to walk, to run, to play soccer was just around the corner—I was always only just a few sessions from my next big breakthrough of what I could do. And that got me through it all.

"Also, *Grey's Anatomy*. Which is ironic, considering the blood-and-sharp-objects thing."

—Julia Kennedy, digital specialist at Nike's Los Angeles office

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So you're going to have knee surgery, but we're not going to break out the scalpels just yet. Before the big day comes, there are still a few more hurdles to cross and checkpoints that must be met. Those tasks, or the presurgical checklist, is what this chapter is all about.

You know those pharmaceutical commercials in which the patients are always loving life and telling you how amazing the drug is and how it basically will cure your ailments, wash your car, and pay your bills? Then at the very end they quickly rattle off a laundry list of about fifty possible side effects that come with the miracle drug? The day before surgery is our version of that auctioneer-like voiceover. However, we do not want to rush through those potential risks at the rate of the Road Runner. We want to take our time. Therefore, we dedicate a whole office appointment to these risks and going over your final informed consent for surgery. In short, the preoperative checklist is about determining your personal risks of undergoing the procedure, so that they can be minimized, and also about educating you on the risks and benefits of the operation you are choosing to undergo so you are an informed patient.

The checklist is oftentimes intimidating and confusing to patients. Frequently, we get questions like, "Why do I need *more* blood work? I just

did that." Or, "What does my weight (my smoking, my diabetes) have to do with knee surgery?" Questions like these are extremely common and ones that this chapter aims to answer. Keep in mind as you read that some things we describe, like tests, labs, and so forth, are not the same for every type of surgery. For example, someone undergoing an isolated ACL reconstruction may have a shorter presurgery checklist than someone who is undergoing an operation for a knee dislocation, which may require not only ligamentous reconstruction but also surgery involving vessels and nerves. The checklist also varies by patient; for example, a sixteen-year-old otherwise-healthy high school athlete may simply have a once-over and some blood work, whereas a seventy-eight-year-old man with a prior heart attack or diabetes could have an extensive list of exams and lab work needed before getting the surgery go-ahead. That being said, we hope the explanations here leave you with an understanding of not just what presurgery involves but more importantly the when and the why.

STEP 1: THE PREOPERATIVE EXAM

Before you go under the knife, you will need to have an exam performed by another physician, usually in internal medicine or general or family medicine. *Why do I need a doctor's appointment with yet another doctor?* you may ask.

As mentioned, more than 90 percent of the time your knee operation falls into a category of surgery we call elective—that is, it's your choice, as you are not in immediate danger of death or decline. (There are times when this is not the case, as discussed in Chapter 3, such as injuries that could compromise your blood supply or involve infection. These are emergencies; however, most others are not.) Unlike what your charismatic, eccentric, and most likely supremely confident orthopedic surgeon might have you believe, having your ACL reconstructed or your knee replaced is not a matter of life or death or national security, and your safety takes priority. With this in mind, you should have a conversation with a doctor about the risks and benefits of surgery.

Let's start with the basics. The risks of having a procedure are inherently tied to your overall health. Therefore, the preoperative exam is a wellness check of sorts—a "fit for surgery" exam that tries to determine if you may be at risk for a complication.

OK, you may ask, *but why can't I have this wellness check done by my orthopedic surgeon?* It's true that in some cases, for patients who are mostly healthy, with a good medical history and no overt issues, your orthopedic

surgeon could do this exam. However, many patients have other ailments that are nonorthopedic in nature, and therefore the exam is better handled by another type of physician.

Dr. Kennedy's uncle Jim is famous for constantly teasing Dr. Kennedy's father (also an orthopedic surgeon) that he is "not a *real* doctor, just a bone doctor." Now, while somewhat of a low blow, there's a grain of truth there that in modern medicine in America, doctors are becoming specialists in a field of their choice (and most orthopedic surgeons graduate at or near the top of their medical school classes). If you asked an oncologist (cancer doctor) what plate and screw fixation they would use for a tibial plateau fracture, they would probably look at you fairly confused, while an orthopedist could give you multiple options and walk you through it. On the flip side, if you ask your orthopedist about the mechanism of action of a new chemotherapy drug, or the side effects associated with it, they most likely would have to ask Dr. Google. This is a long way of saying that we are incredibly fortunate to have doctors that are very, very good at what they do, but you'll want to see the right kind of physician for the right job. For a preoperative exam, seeing a generalist like your primary care doctor is usually best, unless you are deemed to be higher risk or have a specific problem that would be more appropriately evaluated by another type of specialist (cardiologist for a heart problem, endocrinologist for a diabetic or thyroid or other endocrine problem, or pulmonologist for a lung problem).

Here's a list of the main things your doctor will likely check during a preoperative exam. They will most likely do a head-to-toe evaluation; you can have them further explain the reasoning behind each test they'd like you to have.

A. Lungs

Obviously, the ability to breathe is an important one. Most surgery requires intubation, or placement of a tube down your throat to help you breathe once you have been given the drugs necessary to make you asleep and anesthetized. With this in mind, someone's respiratory status going into surgery is very important.

1. Physical Exam and Auscultation (Listening)

If you don't have any known lung issues, you most likely will have a simpler exam. Your doctor will listen to your lungs with their stethoscope and ask if you have had difficulties with breathing lately. Whether you smoke will get

brought up here (and again with regard to your skin, and again with regard to infection, and again and again and again). Smoking will be discussed in later chapters, but the moral of the story is that smoking is very bad for healing after surgery and keeping your body free from infection. All nicotine products carry this risk. Please quit smoking; otherwise there is a good chance your doctor will not operate on you.

2. Chest X-Ray

Most patients will get a chest x-ray, both to ensure that nothing concerning is there and also to establish a baseline for comparison's sake later on, if needed. Since surgery increases your risk for pulmonary embolisms (blood clots in the lung) and developing pneumonia, it is helpful to have a baseline x-ray to make sure your doctors know what your lungs look like while healthy.

3. Pulmonary Function Tests

Presence or absence of issues such as chronic obstructive pulmonary disease or asthma will most likely require some respiratory function tests. These are basically tests that determine how well your lungs work—that is, how much air you can breathe in and how much air you can breathe out. Believe it or not, this varies greatly by individual, and some people actually have a larger problem ridding their air of lungs than taking air in, and deficits in either can be a problem. These tests help to determine objectively how well your lungs are working. Significant problems with your lungs may require a visit with a pulmonologist.

B. Heart

Surgery puts more strain on the heart because of the anesthesia, the trauma associated with the surgery, and the recovery process. Therefore, it is necessary to ensure that your heart can handle surgery.

1. Physical Exam and Auscultation (Listening)

A wide range of possible tests can be done, but at a minimum, you will have your chest examined and your heart listened to with a stethoscope, and your doctor will ask you about any heart- or chest-related symptoms, such as chest pain with activity, palpitations (feeling like your heart is racing or fluttering), and any significant shortness of breath with activity (which can be a problem with your lungs but also could be related to your heart). If you are young, are otherwise healthy, and have no symptoms, then most likely that will be the

extent of the heart exam. If you have risk factors, known heart disease, or positive answers to the questions about symptoms, that will lead to a more detailed workup and perhaps a visit with a cardiologist.

2. Electrocardiogram (EKG)

Television dramas have made people aware of what an EKG is in broad strokes. However, they are not only ordered stat in an emergency department when a patient is having a suspected heart attack; they are often used in a much less exciting way. An EKG is a test that measures the electrical activity of the heart. To beat properly, your heart relies on electrical impulses being carried in a certain direction and order. In the context of a heart attack, this test can show where the electrical activity is abnormal—not only identifying that there's a problem but also indicating where the problem is. For purposes of the preoperative exam, this test can pick up more subtle baseline abnormalities that could cause a problem down the road or with surgery, such as ischemic damage (changes caused by your heart not having good oxygen as a result of diseases such as atherosclerosis, diabetes, and so forth). The EKG will ensure that your heart is beating at a proper rate with a proper rhythm and is healthy for surgery. This EKG can be done with your primary care doctor and does not require a visit to a cardiologist.

3. Stress Testing

Abnormalities in the EKG, symptoms like having chest pain during activity, or known heart disease can end up requiring more tests such as stress testing. These exams are complicated, but their general objective is to stress the heart, either via exercise on a treadmill or with drugs that make the heart work harder. Then, your doctor will obtain either an EKG or an echocardiogram (an ultrasound of the heart) to determine if that stress you placed on the heart caused any problems such as worsened performance or damage. These tests can help determine if your heart can take the stress of surgery.

C. Skin

A skin exam can largely be done with one of a doctor's most important tools: their eyes. You'll be assessed here for any signs of infection or of risk for infection. People with wounds or cuts near surgical areas can be at risk because those are potential hot spots for infection. Furthermore, chronic wounds may suggest an underlying problem with healing. Diabetes, chronic kidney disease, liver disease, vascular disease, smoking, and chronic disease in general can lead to impaired healing. For someone who does not heal well,

orthopedic surgery may not make sense for multiple reasons. For one, that patient may not heal what we are attempting to fix, and second, surgery involves an incision that your body will have to heal. If it can't, a chronic wound leads to… you guessed it, infection. That is a real problem.

D. Medications

Some patients have a laundry list of medications they take daily, some of which we want you to keep taking, and some of which we want you to briefly pause. This is another topic this appointment will cover. For example, if you are on an ACE inhibitor (like lisinopril), some doctors will have you hold it the morning of surgery. Most anticoagulants (such as warfarin, Xarelto, Lovenox, heparin, and clopidogrel) are stopped a certain number of days or hours before surgery to minimize bleeding risk. Another major category is diabetic medications: these are often halved or adjusted in some way the day of surgery to try to minimize large blood sugar swings during and after surgery. The key here is to talk to your doctor about all your medications. You'll receive specific instructions regarding when and how much to take.

STEP 2: PREOPERATIVE LAB TESTS AND OBJECTIVE MEASUREMENTS

Labs can tell us a lot about the overall health of a patient. For many patients, there is little lab work that is needed, while for patients with more medical conditions, multiple measurements can be helpful. Your medical team will gather some specific labs before surgery that are particularly important. As long as the results are normal or as expected, then nothing really comes of them. Abnormal or unexpected results may require further workup and even postponing or cancelling surgery.

A. Type and Cross

"Type and Cross" is an example of blood work that anyone facing a major surgery gets. It identifies what type of blood you have and which blood types are compatible with yours. Why is this necessary? One of the risks inherent to surgery is bleeding. If we are cutting into you, you are going to bleed. The good news is that most knee operations do not have a good deal of blood loss, most commonly less than five hundred cubic centimeters or half a liter. There is always a risk, no matter how miniscule, however, that you will bleed enough that your blood levels will drop to a number doctors don't like, and you may need a blood transfusion. On here we discuss what happens if your

religion or personal beliefs prevent you from receiving blood. For now, just know that this lab work helps us to be prepared in case something happens requiring a transfusion, or giving you blood products.

B. Complete Blood Count (CBC)

A CBC is a complete blood count. This helps to determine the levels of components in your blood such as hemoglobin, white blood cells, and so forth. This establishes a baseline, so we can check these values again later for comparison. Let's say, for example, we are concerned that you are developing an infection. We could check your CBC again and compare your new white blood cell levels (a marker of infection and inflammation) with your preoperative levels. Similarly, if you lost a lot of blood in surgery and we are concerned your blood amount is too low, we can check your hemoglobin and compare it to preoperative levels.

C. Complete Metabolic Panel (CMP)

This is a panel of multiple measurements that may indicate your ability to heal and your overall kidney and liver function. The CMP measures the levels of potassium, calcium, and sodium in your body; these are molecules called electrolytes, which are minerals in your body that have electric charge and are necessary for many bodily functions. When all is going well and we are healthy, our electrolytes are in a harmonious balance. However, that age-old saying "everything is good in moderation" applies to electrolytes as well. If your levels are too low or too high, that can indicate something is off-kilter.

The CMP test also measures kidney and liver function. It checks the levels of two chemicals called blood urea nitrogen (BUN) and creatinine, which can tell us how well your kidneys are functioning. Creatinine is a chemical waste produced by muscle metabolism, which your kidneys normally filter and you pee out. High levels suggest the kidneys are not functioning normally, which could indicate overall health complications, which may suggest your ability to heal after surgery is compromised. The CMP also includes the liver function tests such as alanine aminotransferase (ALT), aspartate aminotransferase (AST), and others that can help paint a picture of the liver's health. It is much more complicated than this, but in a simple sense both these lab values are about enzymes, or molecules in the body that carry out specific biochemical reactions.

These tests will not be performed for all patients, but they can be helpful in specific circumstances, like assessing kidney function in a patient with

diabetes who has some known kidney problems. But you may say, *What's up, Doc? Why does surgery on my knee affect my kidneys and liver?* The answer is that surgery is an insult to the body. It stimulates a whole-body inflammatory response to heal, and it also affects your fluid levels because you are losing blood and getting a lot of fluid.

During surgery and afterward, if you are admitted to the hospital, you will likely be hooked up to IV fluids for a period of time. All these fluids have to be filtered by the kidneys, so you need them to be in working order. The liver is intricately involved in healing and also in metabolizing the numerous drugs you will be taking, namely opioids (pain meds) and Tylenol. So both a working liver and working kidneys are paramount to undergoing a successful surgery.

D. Hemoglobin A1C

This test is largely reserved for diabetic patients, unless there is another special circumstance (like chronic steroid use) or concern for sugar control. The specifics of sugar digestion and utilization in the body is outside the scope of this book, but we'll give you the short version. The hemoglobin A1C test is a measure of the average level of sugar that is in blood over a three-month period. A normal level is less than 5.7, prediabetes is between 5.7 and 6.4, and greater than 6.5 is diagnostic of diabetes.

When you eat, sugar is ingested and eventually absorbed into the blood via digestion. From the blood, sugar can then be taken into cells and used for energy or stored in many different forms for later usage. If your body does not properly remove sugar from the blood, it causes a whole host of problems, affecting kidney function, nerve function, blood vessels, and so forth. When it comes to having orthopedic surgery, the particular concern is when your body has poor blood sugar control (high levels in the blood), you do not heal very well. This fact, combined with the fact that bacteria happen to like sugar, means that those with a high hemoglobin A1C result are at an increased risk of infection. In terms of an exact cutoff, it is largely subjective and surgeon-dependent, but multiple studies cite 8 or below as a level that is both obtainable (lowering hemoglobin A1C to 7 was not a realistic or obtainable goal for many diabetic patients) and a level that leads to significantly lower adverse outcomes like infection and increased hospital stays. Because of these cutoffs, diabetic patients should stay consistent with their diet and medication to maintain adequate control of their blood sugar levels if they want to have knee surgery.

E. MRSA (Methicillin-Resistant Staphylococcus Aureus) Test

The discovery of penicillin revolutionized how we treated infections. Unfortunately, it has also since revolutionized bacteria. Antibiotics have been a double-edged sword: as scientists have become better and better at inventing drugs to treat infection, bacteria have in turn evolved to resist these antibiotics. One such resilient bug, which is rampant everywhere from your local gym to the money in your pocket and is commonly found on your skin and in your nose, is MRSA. This a type of staph bacteria that is resistant to a class of antibiotics and therefore requires a slightly different route of treatment. It is treatable, but it is an aggressive bacteria that you want to avoid infecting your knee. If you are at higher risk for infection and are undergoing certain types of procedures, like a total knee replacement, for example, you may have your nose swabbed for this bacteria. If you test positive, the bacteria is present (this is fairly common), and you will do a five-day course of intranasal antibacterial ointment before having surgery.

F. Weight/Body Mass Index (BMI)

This is actually not a value that you need a lab test to measure; rather, it's an objective value. Given its importance, we're including it here. BMI is a calculation: your weight in kilograms divided by your height in meters, squared. Excessive body weight can be another risk factor for infection, blood clots, poor healing, and poor surgical outcomes. In Chapter 10, we'll discuss weight management, particularly when it comes to the health of your knee joint. Weight is also another area where the surgeon may have a firm cutoff. Some surgeons may choose not to operate on anyone with a BMI greater than 40 or 45.

G. Inflammatory Markers

Tests to detect inflammatory markers are not routinely done, but they can be telling. Inflammatory markers are, as the name implies, signs of inflammation within your body. The most common markers tested for are called erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP). These markers can be elevated from a variety of causes such as injury, diseases, and infection. Like most laboratory measures, these levels are highly variable and specific to individuals. Therefore, getting some baseline values of inflammation in your body before surgery can be helpful for your surgical team, allowing them to compare your baseline to future values should they be concerned you are developing a complication such as inflammation. Although these markers do not indicate specifically what's wrong, they can show that something is going

on that requires further investigation.

STEP 3: THE PREOPERATIVE VISIT WITH YOUR SURGEON AND SURGERY TEAM

The preop visit is what all of the work before surgery, including the multiple visits, physical exams, tests, and lab work, leads to. This is when the logistics for the surgery are finalized, including the presentation of information about informed consent, where and when to show up for surgery, and basics about what the surgical day entails (we'll discuss day-of-surgery in detail in Chapter 6). At this visit, you'll go over the results of your preoperative medical evaluation to be sure both you and the surgeon are happy moving forward with surgery. Last and most important, this is your best time to ask all the remaining questions your heart desires, because the day of surgery is a whirlwind and it is almost impossible to ask any questions, let alone remember answers and new information.

Informed Consent

In the most basic definition, informed consent is about you, the patient, signing paperwork providing your approval to undergo an operation and affirming that you know the procedure you are about to undertake. Put another way, you're saying, *"Yes, I've been educated on my condition and the surgical treatment for it, and I'm willing to have the surgery."* A provider will have a discussion with you to explain as many of the details about the procedure as they can. They will cover what is being done and why, and they will thoroughly lay out the risks and the benefits of the procedure. This is so you can be sure in your mind that the benefits outweigh the risks.

The provider should be a member of the surgical team. They may be the primary surgeon, a physician's assistant, a nurse practitioner, or, if at a teaching hospital, possibly a resident physician. We recommend that you make sure you fill this consent form out with a verified member of the surgical team. You should not fill out this form with another office employee, such as a registered nurse who works in clinic. That is inappropriate; if someone is going to perform surgery on you, they or a member of their team should be the one to explain the risks and benefits of the procedure. Furthermore, for your understanding, a member of the surgical team should make sure your questions are adequately answered.

Informed consent covers various aspects of care:

The risk and benefits of your procedure and surgery in general. First and foremost, you should understand what type of procedure you are having and why. Remember from Chapter 3 that there are many options (both surgical and nonsurgical) on how to treat an injury. At this point you have decided on surgery, but make sure you understand why you're having a specific type. You don't need to pass a test on all the details, but you should have a sense of why you are having a partial knee replacement versus a total, or why you are using your own patellar tendon instead of a cadaver graft for your ACL reconstruction. (For more on the types of surgeries and topics to consider discussing with your doctor, see here.)

There are also four main risk factors involved with all orthopedic surgery: (1) infection, (2) damage to surrounding structures, (3) a need for future procedures, and (4) persistence of pain or a problem that brought you to surgery.

Infection. While infection is relatively rare, occurring in 1 to 2 percent of knee procedures, it is the most concerning because it can turn a relatively minor and straightforward procedure into a nightmare process. *So*, you may ask, *how do we prevent this infection thing because it sounds like a drag?* Luckily, there are numerous things done to prevent infection. Some we have already talked about: Smokers can go ahead and not smoke, diabetics can make sure to control sugars, and patients can make a valiant effort to maintain a healthy weight. Then there are more direct things your medical team can do. Some surgeons will have you wash with a special soap both the night before and the morning of surgery. We usually give prophylactic antibiotics both during surgery and sometimes for a couple of doses postprocedure. And the operation itself is done in a sterile environment—your surgical room floor is definitely clean enough to eat off of. You'll learn more about the operating room in Chapter 6.

Damage to surrounding structures. Damage to surrounding structures is rare; however, this is an inherent risk with surgery. Most commonly, small blood vessels or superficial nerves can be damaged; symptoms can range from having no symptoms to areas of numbness on your skin. Less commonly, large local structures such as larger veins and arteries or major nerves can be damaged, which can cause complications. This is unlikely and something that can largely be avoided. It's still a risk, though, and it's important for you to make an educated and informed decision.

A need for further surgeries. This is a real possibility. The surgery may not fix your problem, or you may have further problems in the future. Take,

for example, an ACL surgery. You could have a perfectly done ACL surgery when you are twenty, which gives you back great function and stability and works well for you for years. Then you can a have a rerupture of the graft a number of years later. Therefore, it is important to ask about the risk of needing additional surgery later on.

Persistence of the pain or problem. Another possibility is that you have osteoarthritis in your fifties and have a total knee replacement. The hope is that your knee surgery addresses your symptoms and provides improvement and relief for as long as possible. Nevertheless, "as long as possible" is often not *forever*.

Receiving blood. The informed consent discussion will include your willingness to receive blood or blood products if you lose enough blood to require a transfusion. If you choose not to receive blood products, which is your prerogative, then you would need to sign a statement to that effect. There are other ways the surgical team can combat low blood levels.

Photos and video. Your willingness to allow photos and video to be taken of your procedure also falls under this catch-all form. This part of the form is usually specific to research or academic institutes and may not be included in a private practice's procedures. Photos, videos, and any aspect of patient care you receive are and will always be confidential; they are part of your medical record and cannot be shared—with one exception. Photos, videos, and information can be used in a research setting at some teaching hospitals. In that case, this information is kept confidential, and any features that would identify you as the patient are removed. Research studies help advance the field and improve care for future patients.

Your surgeon's involvement. One new aspect that should be discussed with you during the signing of your informed consent paperwork is whether your surgeon will be running two rooms. They may have a busy day of surgery and therefore be performing procedures in two operating rooms. If so, that also means there may be some parts of your procedure for which the surgeon is not physically present. This scenario is far more likely at an academic institution that has multiple residents or fellows to assist with procedures. But it can also take place in private practice.

Lately, public attention has been paid to the fact that primary surgeons are not always being present in the operating room for the key aspects of the procedure. That verbiage is important. Your *primary* surgeon is required to be in the room during the key aspects of your procedure. This frequently means they are not in the room during some of the nonkey parts: the setup, when you

undergo anesthesia and are placed in necessary position for surgery; the waking up from anesthesia and transfer to the postanesthesia care unit (PACU); and the closing, or the suturing, of your wound. The key aspects in the middle of the procedure vary but often include approach, bony preparation, and insertion of hardware. If you have further questions about this, you should ask your surgeon about the specifics of the surgery, who will be involved, and when.

Anesthesia. Some aspects of anesthesia will be discussed on these forms. The anesthesiologists will meet with you on the day of surgery and have their own discussion with you about risks and benefits.

SURGERY DAY INFORMATION

This preoperative appointment is also a time to be given as much information as possible about your surgical day: everything from when to show up, what to wear, the course of the day, and what everyone wants to know—when you can go home.

Most offices will give you some sort of packet or a website address with information regarding where to go and at what time. Depending on whether your procedure is the first or last case, there is a wide range of reporting time, when you are expected to show up. A good many things happen on the day of the surgery before you are actually wheeled to the operating room; therefore, your reporting time is usually a couple of hours before your scheduled procedure.

Again, this visit is a phenomenal time for questions, anything ranging from “Is it going to hurt?” to “How long will I be out of work?” Anything and everything you have concerns or thoughts about should be brought up because there won’t be enough time for them on the day of surgery.

STEP 4: DO YOUR HOMEWORK

Many patients want to know, “*What can I be doing, or not doing, in the time between my decision to have surgery and the big dance?”* Let’s start with what you should *not* be doing. Please avoid:

Smoking and Nicotine Products

First, know that your physician is not there to judge you for your life habits.

Your life is yours to live, and you are free to make your own decisions. That being said, from a purely scientific or objective standpoint, nicotine is bad for healing. Its use is associated with decreased healing rates of bones, tendons, ligament, and skin. The last on that list means you can get chronic wounds, leading to an increased risk for infection. Long story short: smoking opens you up to a host of risks. Many surgeons will require you to quit smoking or at least cut way down on cigarettes before surgery. Keep this in mind.

Anticoagulation Medications

Anticoagulation meds, like warfarin (Coumadin), Xarelto (apixaban), and others, prevent your body from forming blood clots. Normally, for someone with atrial fibrillation (a type of abnormal heartbeat) or another condition in which they are prone to forming clots that can block blood vessels, these drugs are helpful. But these meds make it more likely that when you bleed, you will bleed more. In surgery, when it is necessary to use a knife and tools to go through tissue and bone, you are going to bleed. Because of this, if you usually take anticoagulation medication, you will need to stop taking your medication for a certain period of time, often at least five days before surgery, and resume it following surgery. Again, the exact number of days will be surgery-specific and another topic you need to address with your surgical team as well as your primary care doctor helping to manage your medications in the days leading up to surgery. This is especially important if you are on warfarin, because your doctor will need to do a few extra blood checks to make sure you are in an acceptable range before you go forward with the procedure.

Now for what you *can* do.

Condition your knee. Just as you wouldn't want to show up for a marathon without any training, you don't want to show up for your knee surgery with it in bad shape. Huh? Isn't it in bad shape already? We don't mean actual physical strength and endurance, but rather in good shape as it relates to your inflammatory state and your range of motion (ROM). Two of the most difficult things to overcome immediately following surgery are swelling and stiffness, or decreased ROM. The more work you put in before your surgery to alleviate these, the better your outcome. You want your knee to be cool and calm and have as little swelling and as much range of motion as possible.

Many surgeons suggest some physical therapy to help with these tasks preoperatively. If you have the time and resources (money or good insurance

coverage), then it is worth it. That being said, even for those seeing a physical therapist, most of your therapy both before and after surgery can and should be done at home. Make sure you know the right exercises, and then do them again and again, and combine them with some compression, elevation, and ice (see here).

Get your sugars under control. This has already been discussed in detail, but we want to emphasize the importance of having your blood sugar well controlled. This means both the days and weeks leading up to surgery but also the night before and morning of. What to do with your diabetic medications will also be discussed at your preoperative appointment, so be sure to ask all the questions you have regarding your meds and have a thorough understanding of the plan.

Stay hydrated and well nourished. Your body is about to undergo a big insult—surgery. You need to have the nutrition and the hydration necessary for your body to heal. This is almost as important before surgery as it is after. In the weeks and days leading up to the procedure, try to eat healthy, well-balanced meals (see Chapter 10), and stay well hydrated. The night before surgery it is important to eat a good, hearty dinner and drink lots of water because the morning of surgery you will be *nil per os* (NPO), a Latin phrase meaning “nothing by mouth.” In other words, don’t eat or drink anything that morning.

Get some rest. Get a good night’s sleep, and try not to stress or even think about the surgery. At this point you have done your research, have picked a great surgical team, and have a plan. Tomorrow will mark the beginning of your recovery process. From here on out, you’ll be able to become more active as a result of the decreased pain and increased stability your knee surgery should provide. With that in mind, count some sheep, meditate, or do whatever allows you to sleep well and fully. Tomorrow is a big day!

THE DAY OF SURGERY

Ladies and Gentlemen, It Is Time for the Main Event

The time has finally come. You've been living with your knee ailment for days, weeks, months, or maybe even years, and today is the day you get to take a significant step toward healing and recovery. Yet we have noticed that the surgical day itself can be anxiety-inducing for many patients. They have never before seen the inside of an operating room and have no idea what to expect. Much of fear, especially in the medical world, comes from lack of understanding and information. Because of this, we wanted to give you a guide to what a surgical day typically looks like, so your only frame of reference isn't that of Meredith Grey in maroon scrubs. This chapter comes with the same caveat as most of the book: this is an average example, and your experience may differ slightly depending on your specific surgeon or procedure. But we hope this chapter will at least give you a good foundation about what to expect on the day of surgery.

1. WAKING UP AND EARLY A.M.

Your preparation for surgery begins the night before, with a big meal and a good night's sleep. However, starting at midnight, you are to avoid eating or drinking. To quote the movie *The Hangover*, "Don't touch it—don't even look at it." The reason? If there is food in your stomach, when you undergo anesthesia and subsequent intubation (insertion of a tube down your throat), there is a possibility that what was put down could come up. This is called aspiration: food or stomach contents going from your stomach to airway. That leads to a foreign body in your lungs, which can lead to an infection (pneumonia) and possibly your getting very sick. We like to tell patients the

pain, rehab, and orthopedic aspects of your surgery are no big deal, but the nonorthopedic complications like aspiration and pneumonia, to name a couple, cause real problems.

The risk of aspiration is serious. This means you must not cheat and eat anything the morning of surgery. Remember the previous risks and benefits discussion; if suddenly you are comparing a risk of aspiration, which can lead to pneumonia and your being sick or even dying, with the benefit of being able to have improved knee function, guess what risks now overweigh the benefits? So, in this case, *do not eat*. We don't care if your husband brought you a croissant from the streets of Paris, your wife made you an omelet that would make Bobby Flay jealous, or a master barista has poured you a delectable espresso. None of those are worth it.

With this being said, and just to make things a little confusing for you, there may be one exception to this rule: your medications. Not all medications are necessary; however, some are. Be sure to have a conversation with your surgeon so you know exactly which meds, if any, you should take the morning of surgery and what to hold. You may ask, *"How am I supposed to take my pills dry?"* Ask your doctor what is allowed. They will probably say a small sip of water (not a jumbo size Smartwater, not a liter of cola) to help you swallow will be fine.

2. CHECK IN AT THE HOSPITAL OR SURGICAL CENTER

After you have resisted the urge to consume anything, you will show up at your check-in area in the hospital or surgical center, which you should have received information about. In general, following the Vince Lombardi rule, "If you are five minutes early, you are already ten minutes late," is a good way to live. This is especially the case on your surgical day. No matter how good the directions or how prepared you are, it is easy for things to get off track. You take a wrong turn, you get lost in the building complex, and suddenly you are fifteen minutes late. Being even a little late can become a big deal the day of surgery. Remember: you aren't the only one scheduled for surgery that day, so being late can affect your and everyone else's procedures. Please be on time.

3. VISIT THE PREOP AREA

Once you have found the desk and checked in, you will be taken back to the

preoperative area. There you'll get undressed. Now this next part is not to scare you, simply to prepare you. Getting undressed means strip down naked and then throw on a skimpy gown. This is not to embarrass you. It's that the less outside clothing taken into the operating room, the easier it is to keep the environment sterile. If this is something that makes you uncomfortable, discuss it with your doctor, preferably before the day of surgery. There are some instances where wearing underwear is allowed. However, it is possible the gown will be the only accepted attire on the RSVP.

After getting in your new fashionable outfit, you will then wait in your preoperative room for a few people to pay you a visit. One of those people should be your surgeon or a member of the surgical team. They are usually in a little bit of a hurry; they will ask you last-second questions and perform the all-important site marking: putting their initials or the head surgeon's initials near the area they will operate, that is, on your left or your right knee. This is your time to answer the famous question from *Catch Me If You Can*, "Do you concur?" You need to agree with your physician on the body part and side you are having surgery on. While you would think it would never happen, there have been times in the history of orthopedic surgery where patients have had the wrong side operated on. It is rare and unlikely, but not impossible. It is your job to remind them then and there to ensure that you don't later have an awkward conversation, reminiscent of those Snickers commercials, when you wake up.

You will also meet with your anesthesia team. They will come by to discuss the specific type of anesthesia you will be getting. Once your questions have been asked and answered, they will typically get some of your medications started. If you are only receiving general anesthesia and no local or regional anesthetic, or a block, then you will probably get some type of benzodiazepine, most likely Versed (midazolam); the objective of this drug is to help you feel relaxed or sleepy for your procedure.

If you are going to get a nerve block, this would also be administered at this time. A block is medication to numb or block the sensation of a specific nerve. This is done by inserting a catheter, a sharp tube, and placing it under the guidance of ultrasound next to the nerve of interest, where it can slowly release anesthetic, thereby blocking the nerve's function or providing numbness in the area. Blocks used in knee surgery are commonly applied to the *femoral*, a nerve that courses over the front of the thigh and knee; the *sciatic*, a big nerve that ends up branching into multiple large nerves and provides sensation to the back of the leg as well as the lateral or outer part of the knee; and the *saphenous*, a nerve that provides sensation to the medial or

inside part of your knee. This anesthetic can either be given as one large dose of medication, which then lasts roughly eight to twenty-four hours, or be given slowly over a couple of days, in which case you would take home a little plastic ball or pump that contains the medicine.

4. THE OPERATING ROOM (OR)

After the final preparations in the preop area have been made, it is time to be wheeled to the operating room (also known as operating theatre, for the dramatic). You will be wheeled in your preop bed because most likely at this point you have the stability of a drunken sailor. When you arrive, you may be given a fancy hairnet or hat (if you haven't already been given one). The OR team will then introduce themselves to you as you are wheeled into the center of the room, next to the operating table.

When you are wheeled into the room, you arrive on a bed from the preop area. This bed is not the one you'll be operated on but just another step in the long sterilization process. Once you are in the room, the anesthesia team will go about getting you to sleep. Whether they do this before or after they move you onto the operating table is usually up to the anesthesiologist. However, if you are awake enough to remember any of this, you definitely will not remember anything after they ask you to count to ten. At that point the medicine will be coursing through your veins, and you will be off to dreamland.

Then the work begins to get your body into position for surgery. Depending on what type of surgery you are having on your knee, you may need to be positioned slightly on one side, or with your knee bent or straight, or with your leg in a holder or hanging off the end of the bed. The position for each surgery has been perfected over the years, and each surgeon may have their own slight preferences. All members of the team have become accustomed to exactly how that surgeon prefers things to be done, so everything runs smoothly.

Once you are in proper position, next is the surgical prep or the sterilization process. Watching *Grey's Anatomy*, *The Good Doctor*, *Chicago Med*, *Scrubs* (or whatever your guilty pleasure medical show is) has most likely introduced you to the fact that ORs are sterile environments. They are made to be as clean and germ-free as possible. Here's what that means in practice.

WHO'S WHO IN THE OR

Your surgical team is like a ship's crew. It takes more than one person to maneuver a ship to its destination, and similarly, you need more than one person to perform your surgery. All those present in the OR are members of the team, and they all work together with the shared goal of giving your knee the best possible outcome.

The surgical team's members usually include:

1. **Charge nurse**, like a combination of a boatswain and a records keeper. They are in charge of the room. They ensure that things are running smoothly, keeping track of everything and everyone—from keeping counts of tools, equipment, and implants being used to managing which personnel are in the room and at what time.
2. **Scrub tech**, the mechanic. This person is responsible for the tools used in surgery. They know everything from how to put the drills together to the exact type of angled retractor the surgeon will ask for next.
3. **Anesthesiologist**, the navigator. They are in charge of keeping you on course. They are on the other side of the sterile curtain, making sure you are pain-free and breathing well. If you are awake with some mild sedating meds and local block, then they are making sure you stay as relaxed and pain-free as possible. If you are intubated and asleep, they are ensuring that your breathing remains normal and healthy. They may be the most important person in the OR, and they are capable providers who will make sure your operation is as routine as possible. Always try to follow their recommendations. For example, if they say it would be better for you to go to sleep during the procedure, try to do so.
4. **Physician's assistants**, the first mates. They help to perform the surgery with the surgeon; they're sets of skilled hands helping to make sure your surgery goes off without any complications.
5. **Residents and fellows**, the quartermasters. These will only be present if you are at a teaching hospital or a hospital with a residency or fellowship associated. Residents are medical doctors—they have graduated medical school, passed the tests, and done the training necessary for that title. They can be considered doctors who are orthopedic surgeons in training. They are learning all the nuances that come with being a skilled surgeon and provider, and they are perfecting the skills of the craft. They also are involved in performing the procedure, and depending on their level of training and skill and the degree of difficulty of your case, they will have a variable role in how much of the surgery the attending surgeon is comfortable with them doing. Rest assured that no one is going to allow them to do anything they are not excellent at, and they are under constant guidance from their attendings. Fellows are one step further along from their residencies in their careers and are now being trained in a specific subspecialty.
6. **Attending surgeon, consultant, or primary surgeon**, the captain. All these titles mean the same thing. This is the person you chose to be the captain of your surgical ship, the one you chose to trust after all those appointments and tests. They will be the one making the critical decisions during your surgery. They are required to be in the room for all those decisions to be made about all key steps of your procedure. In a private practice setting they are performing the majority if not

all of the procedure; in a teaching center they perform all the high-level steps that are too advanced for their residents or fellows.

Furthermore, everyone present is bound by the Health Insurance Portability and Accountability Act (HIPAA) of 1996. They cannot share any information with anyone not directly involved in your care. What happens in that room might as well be a meeting of the Illuminati, since it can only be shared with you or whomever in your family or friend circle you specifically say it can be shared with.

It starts with cleaning the operative area of your body. This usually consists of shaving any body hair is near where the surgeon will be making the incision. This is done on the day of surgery; you don't do it yourself because if you were to cut yourself before surgery, there is an increased risk of infection. Next, the surgical team uses some type of cleansing antibacterial material, like alcohol or chlorhexidine, to clean off the area. Then they begin covering all areas not in area of the incision with surgical drapes. This is done by whatever members of the surgical team have already scrubbed in.

What do members of the surgical team have to do before entering the OR? Rest assured that your team goes to great lengths to keep themselves and the room clean and sterile on your behalf. For starters, everyone who enters the OR must have a mask and surgical scrub cap or hood on, period, no exceptions—even if someone is just poking their head in to ask a question. Anyone who is going to be doing patient work, that is, touching the patient after the patient is sterile, needs to scrub in.

The process goes like this: First, all hand jewelry, like rings, needs to be removed. Then, the person needs to scrub their hands with some type of surgical scrub soap. The soap usually comes with a sponge that has bristles on one side and a pick to get underneath the nails. It takes a few minutes to complete the scrub. Then they have one of two options. They keep their hands up, above the waist, and walk into the room without touching anything with their hands or arms, and someone will hand them a sterile towel so they can dry their hands. Or after washing their hands, they dry them off and then do a subsequent dry scrub, putting some sort of high-concentration alcohol or antibacterial agent on their hands, and then enter the OR without touching anything.

At this point, the first person in the room (usually the scrub tech) puts on their gown and gloves by themselves in a sterile manner. After that, someone who is already all sterile helps others put their gowns and gloves on. At the end of the process, everyone has a gown and usually two pairs of gloves on that are considered sterile. Those scrubbed in then go about making sure the

rest of the field area around you is sterile: all tables are covered with sterile drapes, all lights have sterile handles put on, and so on.

To emphasize, if anyone so much as grazes something that is nonsterile with their gown, that person has to remove everything and start over—even if this is in the middle of the case. Therefore, know that your team is very cognizant of what is sterile and what is not.

Once everything is sterile-prepped and draped, the surgical team performs the time-out, which is akin to the preflight checklist in the aviation world. The primary surgeon will make sure everyone stops what they are doing and goes over the bullet points of the case. The surgeon or charge nurse will state the patient's name and date of birth, the surgery being performed, and the side they will be operating on, as well as note that they can see the site mark, which confirms the correct side. They also mention some other aspects about antibiotics and the risks of the surgery everyone should be aware of. When it is all done, the person performing the time-out asks if everyone in the OR agrees. Only if everyone agrees do they then proceed.

The time it takes to complete a surgery is highly variable based on the difficulty of the procedure and possible complications. The basic steps include an incision and the approach, or cutting through tissue to get to the area of interest (joint, ligament, tendon, and so on). Then, the surgeons will work on the damaged structure. Last, they'll suture (sew) the wound closed. This can be done with many different types of suture material. The final layer, which is your skin, can be closed with suture or staples. The suture can be buried or exposed. Buried suture dissolves and therefore does not need to be removed later on, whereas exposed suture and staples will require removal.

At the end, you'll slowly be woken up from anesthesia, or if the surgery was done with you awake, you'll be weaned off sedatives in the OR. If a knee brace is needed, that will be placed, and then you will be transferred back to the bed you came in on. From there you are then transferred to the postanesthesia care unit, or PACU.

5. THE PACU

The PACU could otherwise be called the recovery, replenish, rejuvenate, or simply wake-up room. It is where you go after having anesthesia to wake up a little more. You'll be given pain medications and fluids—a mix of water and electrolytes—in your IV to help you feel a little better. You have just done the equivalent of competing in a big game, and you need some Gatorade.

You will continue to be monitored to make sure you do not have any reaction or complications as you come out of your anesthesia-induced haze. The team in the PACU, usually made up of nurses and an anesthesiologist, will monitor things like your heart rate, blood pressure, temperature, and level of grogginess. If there is anything amiss, there will still be plenty of people on hand to call a quick conference and check the treatment plans accordingly.

Often, a member of your surgical team will come check on you to make sure you are moving everything and have the expected sensation. You most likely will not remember this step, since you'll still be pretty loopy at this stage. Also, while you recover in this room, the surgical team will find your loved ones, or whomever brought you to surgery and whom you've given the team permission to talk to, and will tell them how the surgery went.

Postop Instructions

It is here where the team will also make a final determination on where the next stop for the train will be, that is, whether you will be going home (final stop), to an intensive care unit (first stop on a long cross-country trip), or to a medical floor (halfway on an interstate trip). For many patients, this is the final stop. Knee surgery is often an outpatient procedure, and once your pain is under good control and you are stable, you can go home. Make sure you or whomever is caring for you has received specific postop care instructions from your surgical team. Surgery days are a whirlwind, and both you and your surgical team can get very busy. Before you leave, make sure you know what the heck to do.

They should have an in-person conversation with you, and you should be sent home with some light reading material. It conveys some basic instructions on what to do after surgery and provides a contact person you can get ahold of if something goes wrong. It also gives you some parameters for what the definition of "going wrong" is. While your postop instructions will usually explain in more detail, it's worthwhile to watch out for the following red flags:

- **Fever.** Fever in the first one to two days after surgery often means you need to use a breathing machine to expand the base of your lungs. This is an incentive spirometry machine—basically a deep-breathing device. It helps you to expand or exercise your lungs to prevent lung infection.

  Fever in the immediate aftermath of a surgery is not always a

terrible sign, but it is something your team would want to know about. Fever a couple of days after surgery could mean pneumonia, and fever seven to ten days after surgery could be hinting at a wound infection.

- **Erythema (redness) around your surgical incision.** It is totally normal to have a soft pink hue around the incision, like a little blush on your cheeks. But if, a couple of weeks after surgery, your incision is full on red, and is painful and feels hot, that is *not normal*—particularly if the incision has become redder and hotter as time has gone on. If your incision initially looked great—light pink and healing—and then around day fourteen it is redder and hotter than the Red Hot Chili Peppers, then that is a problem that requires a call or emergency department visit.
- **Pain out of proportion.** This is a fairly difficult one to define. Pain scales and pain tolerance in general are subjective. Moreover, you have just had surgery. I do not care if your surgeon defined the procedure as "minimally invasive" and "no big deal." It is still surgery, and a knife was still used to cut deep into your knee, through skin, fat, muscle, and even bone. You are going to hurt a fair amount. So, "out of proportion" means out of the ordinary compared to what you have been experiencing. Here's an example: If after surgery you are requiring a few oxycodone a day to keep you comfortable, and then those pills are doing nothing to help and you're writhing in pain, that would be out of proportion. This could be a sign of compartment syndrome, infection, or a blood clot.

  Not to confuse you, but there is a footnote to this. Be aware of the three-day rule: on average the third day after surgery is usually the most painful. This is most likely for a combination of reasons, such as that the anesthetic (both general and local) takes a day or more to completely wear off. Combine that with the fact that you often begin moving a lot more on day two or three, and you have a recipe for some higher pain scores. That is not a reason to avoid movement: you should move as much as possible within your restrictions.
- **Shortness of Breath.** As a general rule, being suddenly short of

breath, particularly if you have not just been sprinting stadium steps, is concerning. Shortness of breath could mean something is wrong with your lungs, your heart, or both. Following surgery, there is a risk of a heart attack or a pulmonary embolism, which is a blood clot that has made it from somewhere else in the body, most likely legs, to your lungs. These are emergencies. If you feel short of breath, head to your local emergency department.

6. HOSPITAL STAY: GENERAL FLOOR OR THE INTENSIVE CARE UNIT (ICU)

If you are having a procedure that requires a short stay in the hospital, or if you have an indication to stay, such as a problem with your vital signs or pain that cannot be controlled, then you will be admitted to the hospital. Where you go depends on your level of care needed. Probably 99 percent of patients with elective knee surgery requiring hospitalization will be admitted to a general floor. What this means is a hospital floor with more routine care. However, if you require some extra attention, you will be admitted to the ICU.

Don’t let a trip to the ICU scare you. To touch on this briefly, if you go to the ICU that does not mean you’re going to die or even that you’re in trouble. It simply means you temporarily require more care than they can give you on a general floor. The most common cause would be an airway problem. You did not come out of your anesthesia-induced haze as well as expected, and you are not breathing properly and therefore require continued intubation. Requiring intubation is almost always a surefire way to book a ticket to the ICU without passing Go and collecting $200. The length of your continued need for intubation is usually short, under twenty-four hours, but is completely dependent on your symptoms and how you recover.

Another way to punch your ticket to the ICU is to require continuous cardiac monitoring. This can be for more serious reasons such as a heart attack or for a more common reason such as a heart arrhythmia. A heart arrhythmia is when the electrical activity of your heart is out of whack and may be causing your heart to beat improperly. This can be caused by a whole laundry list of things that are out of the scope of this book. However, if you have any questions whatsoever, the important thing to do is to ask. This is your care, and it is your right to know what is going on and why you are being treated the way you are.

If you do not require the ICU, then you will go to a general floor. There you will continue the fluids from the PACU/OR and will also continue to be treated for your pain. Your surgeon or a member of their team will most likely come by to share some of your photos and x-rays from your surgery. Your main goals for the first night of surgery are to drink a lot of fluids, eat a good meal, and rest up.

Sadly, hospitals are not resorts; they are not primarily for relaxation. You can expect to be bothered by people coming into and out of your room almost hourly, and to sleep on a bed that you consider somewhat more comfortable than a concrete floor. We like to emphasize to our patients that hospitals are for sick people and people in need of acute care. They are not meant for extended stays for healthy people, who should make it their goal to get the heck out and go home or to a skilled nursing facility or rehabilitation facility as soon as possible to get a good start on the recovery process.

With that in mind, there are four basic criteria for being able to go home after elective procedures:

1. *Is your pain under good control with oral pain medication?* Or are you able to keep pain at a stable level without any IV medication?
2. *Are you able to poop or pass gas?* It is very common to get constipated after surgery because of both the anesthesia and the pain meds. With that in mind, stooling is not a requirement for discharge; however, passing gas is a sign there is no acute problem with bowel function.
3. *Are you able to pee?* This also can be hard to do because of anesthesia, and therefore your ability to pee requires monitoring after surgery. Older men particularly have problems in this area and need to be monitored to see if they need to be catheterized (a tube inserted up their urethra to get the urine from the bladder).
4. *Are you moving around safely?* This is the most important factor to determine where you will be going when you leave the hospital. It depends in part on your living situation; whether you live alone, with your spouse, or with family members; and so on. Your medical team will want to be sure you are able to safely perform your activities of daily living. This evaluation is done by physicians, nurses, and sometimes physical therapists monitoring your movement. Most patients do well following knee surgery and are capable of going

home. Some patients, particularly elderly people, however, are not safe to return home and therefore require a short stay in either a rehab facility or a skilled nursing facility.

The morning after surgery, your team will begin working with you on these four goals. It may take some tinkering for your physician to determine the correct cocktail of both opioid (tramadol and oxycodone commonly) and nonopioid (Tylenol) medication to control the pain. The surgical team and nursing staff will also work with you on peeing and pooping by providing fluids and medications (such as senna) that help with these tasks.

Many hospitals will have you meet with a physical therapist as well while you are inpatient. They will give you some exercises, talk with you about your home environment, and be sure you are physically safe to return home. Should you not be cleared to go home, or should you choose to go to a rehabilitation facility or skilled nursing facility, most hospitals will have social workers who can assist with the process. These social workers will meet with you and find out what your goals are as well as your preferences for a location and type of facility. They will then contact the facilities and help you go about getting accepted into a facility. It can be a rather cumbersome process and as slow moving as watching people play Mahjong. But it's well worth it to find a place that can help you further your recovery process.

Discharge

When you are ready to be discharged, either home or to a facility, you will have a similar conversation as those who went home on day one (see here). A member of the surgical team will discuss the basics of what needs to be done until your next follow-up visit. They will discuss restrictions as well as concerning things you should keep your eyes peeled for. They will also suggest activities and exercises you can do. All of this should be included in a take-home packet you will be given, which should have an emergency contact number.

The following complications are rare but worth mentioning. It is not expected that you should need to go home with any of the following additions, but it is better to have you prepared just in case.

- *Oxygen.* If you have been having trouble with your breathing, or your oxygen levels have not been sufficient, you may need to go home with oxygen. It's unlikely, however, and would typically only

happen if you have an underlying lung disease such as COPD.

- *Peripheral or central line.* There is also a small possibility that if you have a known infection, either from before surgery or one that became apparent after surgery, you will go home with a catheter line in an extremity or the chest area, which would allow for administration of IV medications, such as antibiotics after a knee infection.

We do not often anticipate urinary retention being a problem; however, it does happen, more commonly in older men. If you came into the hospital for your surgery not requiring catheterization to pee, that is the way you should leave. You may need to leave with tools to self-catheterize yourself until your bladder recovers, however. Anesthesia, the meds, and the overall surgical experience can press the pause button on your urologic system just the way it can on your gastrointestinal system. If this is the case, you would catheterize yourself as needed and follow up with your doctor in the outpatient setting to help get you on a medical and intervention regiment to combat the problem until your bladder recovers.

After everything has been discussed and explained and any and all questions have been answered, you may leave the hospital! In the next chapters, we'll take a look at the recovery process.

COMMONLY PRESCRIBED MEDICATIONS

There is a long list of medications you could be taking following your knee surgery. We are going to go through most of the ones you will encounter and explain why you are given them and what they do. We will also mention some of the side effects you may have and the complications that can be associated with them, and why it is important to take your meds correctly. If you gain anything from this chapter, remember that it is extremely important to take these medications correctly. All of them play a role in your recovery, and failure to take them properly, like taking too much or too little, can cause debilitating and sometimes devastating consequences. So listen to your doctor's recommendations, and if you are at all confused, ask questions.

The exact drugs and dosages you may be prescribed is subjective depending on your situation, your health, and the surgery you've had.

OPIOIDS

Common dosing regimens:

Oxycodone 5–10 mg every 4 hours as needed (first couple of days, to be decreased significantly within a couple of days)

Tramadol 50–100 mg every 6 hours as needed (same disclaimer as above with oxycodone)

Hydromorphone 2–4 mg every 4 hours as needed (same disclaimer as above with oxycodone)

Most people have heard of opioid analgesics (analgesic means pain

control). Opioids are used for pain relief; they are a class of drug that acts on the opioid receptors found mainly in the brain and spinal cord. A number of drugs you may be prescribed fit into this class: oxycodone, OxyContin, Dilaudid (hydromorphone), Percocet (oxycodone and acetaminophen combined), tramadol, and morphine. The exact medication is not all that important because they all have similar effects; what is important to know is that these drugs are potent medications and have a real risk of addiction and dependence. Not only that, but in high enough doses they can cause respiratory depression or distress (interference with breathing) and can be fatal. They also cause a lengthy list of less scary but bothersome side effects such as constipation, nausea, dizziness, vomiting, loss of appetite, and so on. With this in mind, opioid drugs need to be used sparingly and only as prescribed.

These drugs are almost always given for breakthrough pain: that is, they are used to get you through the acute worsening pain in the early days after your knee surgery. What we tell our patients is that surgery hurts—that is expected. A little pain and discomfort is expected. If your pain is getting to a level where you are unable to function and do important things such as your physical therapy or your activities of daily living, that is when you take the opioid medication. Otherwise, try nonopioid analgesic medication like Tylenol and, depending on the surgery, nonsteroidal anti-inflammatories (Celebrex, Aleve, ibuprofen). We will discuss later why usage of these drugs is controversial; you should seek the opinion of your surgeon before using any of them after surgery. Furthermore, use these medications *only as long as you have to*. When the pain is no longer or significantly less of an issue, these medications can be retired. The time frame is usually no longer than a couple of weeks.

ACETAMINOPHEN (TYLENOL)

Common dosing regimen:

Tylenol 1,000 mg every 6–8 hours; total maximum daily dose 4,000 mg (if you have a young and healthy liver and kidney) or 3,000 mg (for older patients or those with decreased liver or kidney function)

This drug is a nonopioid analgesic and usually a first-line treatment for pain in the postoperative period because it has fewer side effects when compared to opioids. Furthermore, the risk of addiction and dependence is much lower.

This drug is not without its own risks, however. Tylenol can cause some benign side effects such as nausea, stomach pain, and loss of appetite. It can also cause a serious side effect, hepatotoxicity—aka it can be toxic to your liver. If given in high enough doses, it can cause your liver to fail suddenly. This is why following instructions is important. You will be given a dose and told not to exceed it. The dose will be dependent on a few things, such as your baseline liver function, weight, and overall health. Your baseline liver function can be altered if you drink alcohol (which is also a no-no after surgery; see here), so you should clarify your recommended dose with your surgeon. A general rule for most adults is no more than 3,000 milligrams in one day or 1,000 milligrams every eight hours. These meds should only be used for as long as pain makes them necessary, usually for only a few weeks.

NONSTEROIDAL ANTI-INFLAMMATORIES

Common dosing regimens:

Celebrex 200 mg daily

Ibuprofen 400 mg every 6–8 hours as needed (maximum daily 3,200 mg)

Naproxen 220 mg every 6–8 hours as needed

Nonsteroidal anti-inflammatories (NSAIDs) are drugs that function mainly by blocking inflammatory cascade, thereby helping to decrease swelling and therefore decrease pain and discomfort. Drugs in this class include Celebrex, Advil (ibuprofen), and Aleve (naproxen). Similar to Tylenol, these have a shorter list of side effects than opioids, and the risk of addiction is decreased. However, these medications are something of a point of contention in the orthopedic community.

While a drug that blocks inflammation after surgery would seem like a good idea in theory, not all inflammation is bad, and some inflammation after surgery is necessary to bring healing modulators to your site of surgery to assist in the healing process. In fact, there are studies that show that anti-inflammatories are associated with *decreased* healing of certain orthopedic injuries like fractures. Specifically, NSAIDs tend to inhibit healing of tendon and soft tissue to bone, through a process that is far too complicated to get into in this book. Because of these conflicting effects, NSAIDs are indicated or contraindicated depending on your surgery and your surgeon’s preference. For example, you may be told to take Celebrex daily after a total knee

replacement but told specifically not to take any NSAIDs after an ACL reconstruction. So make sure to ask your doctor their preference. They will know best based on the injury and treatment you had and their own experiences.

MUSCLE RELAXANTS

Common dosing regimens:

Flexeril 5 mg every 8 hours as needed

Baclofen 5 mg every 8 hours

Valium 2 mg every 6–8 hours as needed

Following knee surgery, it is common to have muscle spasms or cramps, which can be painful. This is because muscles were mildly damaged during the surgery, as a result of either the incision or the surgical work itself. This pain often does not improve much with analgesic medication and requires a muscle relaxant to prevent the spasms and the pain associated with them. Drugs in this class include Lioresal (baclofen), Flexeril (cyclobenzaprine), and Valium (diazepam). These drugs carry with them significant side effects and risks, some of which are similar to opioids, such as risk of respiratory depression and addiction. These should be used sparingly to prevent the muscle spasms when they are a problem in the short period following surgery. When the spasms have improved, these meds should be retired. Spasms usually last no longer than one to two weeks.

LAXATIVES AND STOOL SOFTENERS

Common dosing regimen:

Senokot-S (senna and docusate)—8.6 mg senna, 50 mg docusate, two pills per day as needed

Anesthesia, opioids, multiple medications at once: all of these do no favors for our gastrointestinal tract. In other words, all the medications associated with surgery tend to really stop up the pipes. In order to stay regular, it is important to be well hydrated: drink lots of water, not just Gatorade and other flavored beverages. Laxatives and stool softeners can also help. Laxatives help stimulate your GI tract (which the opioids and anesthesia have slowed), and stool softeners help soften your poop and make defecation easier. An

example of this combination, and probably the combination most commonly used, is senna-docusate. Senna is from a type of plant that is a laxative or bowel stimulant, and docusate is used to soften the stool. Side effects can include an upset stomach and abdominal cramps, and logically a drug that speeds your bowel and softens your stool can cause diarrhea. These drugs, however, work phenomenally well and should be used as long as you continue to use opioids to prevent constipation and the problems that can result from it.

ANTICOAGULATION DRUGS

Common dosing regimens:

Aspirin 81 or 325 mg once or twice daily

Lovenox 40 mg daily, or 30 mg twice daily if low risk; higher doses for high-risk patients (with atrial fibrillation or a history of thrombotic disease, pulmonary embolism, or heart attack)

Heparin 5,000 units twice or three times daily

Warfarin (coumadin), Eliquis (apixaban), and sometimes Plavix (clopidogrel) usually held in postoperative period and replaced with Lovenox (heparin) because of increased risk of excess bleeding

One of the risks of surgery is a deep venous thrombosis (DVT), or a blood clot. Blood at rest likes to get sticky and clump together, forming a clot. Clots in small vessels of your extremities are not the end of the world, but they can travel to other vessels and get bigger and can also travel to your lungs, causing a pulmonary embolism. You may be prescribed an anticoagulant as a preventative measure to minimize risk of this complication.

Some common drugs include aspirin, Lovenox, heparin, Warfarin (coumadin), and Eliquis (apixaban). The exact mechanism of action of each of these drugs varies, but in general they act on your body’s coagulation or clotting cascade and help prevent excess clot formation. On the flip side, all these drugs make it easier for you to bleed. They also put you at risk of conditions that stem from bleeding like anemia, or having low red blood cell concentration in your body. The bleeding risk is variable—ranging from very low in aspirin to fairly significant in other meds such as Eliquis. While you are on these medications, it is important to be cognizant of this increased risk of bleeding and try to avoid further risk factors for bleeding. These

medications are usually continued as long as the risk of clotting remains high. The time frame can be highly variable: for some patients only a couple of days, for others up to six weeks.

ANTIBIOTICS

Common dosing regimen:

Completely variable based on surgery and presence or absence of infection

One of the risk factors we have talked about at length and will continue to harp on is infection. Infection has a knack for turning a routine, straightforward injury and subsequent surgery into a nightmare experience involving multiple procedures, hospital stays, and lengthy medication treatments. Doctors do everything they can to prevent infection. They jump on top of any infection, or possible infection, early and often. If you have a known infection, or there is high enough concern for infection following your surgery, you may go home on antibiotics. These can be administered either in a pill you ingest or via fluids that need to be given through a line. This could be either a peripheral line, such as in an arm, or more central, in your chest area, allowing for the medication to be given directly into your bloodstream. Antibiotic duration is based on the type of bacteria you are infected with and where the infection is—for example, in your incision, in your blood, in your lungs. A course of antibiotics can range from a few days to six weeks.

Here it is also worth noting the possible need for prophylactic antibiotics. This mainly applies to you if you have a total knee replacement. Because you now have a couple pieces of plastic and metal in your body, you have surfaces that bacteria love to attach to and grow on. There will be times you will be required to take antibiotics prior to some things you might consider routine, such as before dental work. Speaking with your physician before you undergo any dental procedure, or any outpatient procedure in general, is recommended.

ANTI-EMETICS

Common dosing regimen:

Zofran (ondansetron) 4 mg tablet twice daily as needed

These drugs prevent vomiting and relieve nausea. Similar to laxatives and

stool softeners, these medications are largely prescribed to help with the side effects of other medications and anesthesia. The potential for nausea and vomiting is greater immediately after surgery. Anesthesia does not sit well with some patients and can cause them to feel fairly ill for twenty-four to forty-eight hours after the procedure. These meds can be helpful for getting through this acute period. The most common anti-emetic medication prescribed is Zofran (ondansetron). Zofran has a list of mostly benign side effects, like headache, fatigue, and hiccups. But it can cause some heart rhythm abnormalities, so you should not take it without discussing it with your surgical team first.

ANTACIDS AND ACID-REDUCING MEDICATIONS

Common dosing regimen:

Prilosec (omeprazole) 20–40 mg daily

Antacids prevent or block the effects of increased stomach acid. Your stomach creates a certain amount of acid in response to what enters it. Acid is necessary to keep your stomach pH (how acidic or basic your stomach fluid is) at the appropriate level. Too much acid can cause problems such as ulcers, regurgitation, and heartburn. The medications you are using postoperatively, combined with anesthesia's effects on your GI system, can lead to increased stomach acid. Taking drugs to neutralize (Tums) or decrease (Prilosec, Zantac) these higher acid levels can be helpful. These drugs can cause some nausea themselves, as well as constipation and other common side effects. Long-term use of Prilosec specifically has been linked to osteoporosis (weak bone), so it should be avoided unless needed; use only for approximately one to two weeks.

Notice a trend? A lot of these drugs have side effects, requiring you to take even more drugs to block those side effects, and before you know it you are taking a whole bunch of medications. After surgery, it's understandable that you'll need pain management. But with these risks and side effects in mind, use all medications sparingly. Aside from antibiotics when you have an infection, almost no drugs are mandatory.

The most difficult of the medications to discontinue are the pain medications, specifically the opioids. They commonly become a crutch of sorts for patients, who may view them as their life raft in a sea of pain. Still, surgical pain can and should get lessen over time. What we commonly tell patients is it improves in phases. It is worst in the couple of days following

surgery, sometimes peaking on day two or three because that's when you have no more anesthesia on board and are most aware of your pain. Then, it continues to improve until roughly the one-week or two-week mark, when pain should be mostly replaced with soreness. Typically, by six weeks, most if not all of the postsurgical pain should be gone.

During the recovery period, you can stay on top of your pain with Tylenol and nonmedication techniques such as elevation, ice, and compression. If you are able, consider obtaining a compression/icing machine. One example is Game Ready, which is discussed in detail later on here. With a combination of these techniques, you should be able to work through the acute pain and get to a point where you no longer need any medications.

PART 3

GETTING BACK TO AWESOME

Your Knee Rehab Plan

RECOVERY DOS AND DON'TS

Avoid Complications and Maximize Your Healing

While surgery may be over, the hard part is just starting. Rehabilitation can be long, painful, and taxing. It is a months-long process that involves lots of hours of physical therapy, poor sleep, fatigue, and frustration. We say this not to discourage or scare you, but rather to prepare you. Millions of people go through this process every year, and they come out the other side. If you do not treat your rehabilitation process like a job and make it a priority, however, you may be disappointed with your outcome. We don't want that for you.

Along with your commitment to postoperative therapy, another aspect that can be difficult to get a handle on during this time period is following the long list of instructions of what you can do and what you should avoid. It can seem overwhelming and confusing.

This chapter aims to provide you with a road map for what the first few days and weeks after surgery should entail. We'll help explain not just the dos and don'ts but also the whys—and tips for making it easier. First, we will look at some common complications associated with the postoperative time period.

WATCH OUT FOR POSTOPERATIVE COMPLICATIONS

Throughout this book, we have alluded to many of these complications; however, it is worth directly mentioning them all together here so that you have a handy list. These are some of the most common complications after knee surgery, the warning signs to look out for, and what to do about them.

Stiffness (Arthrofibrosis)

It is easy for your knee to get stiff after surgery. Surgery is in itself an injury of sorts that your body must respond to and heal from. It responds with inflammation and healing components (specific inflammatory modulators, white blood cells, and so forth) to try to heal the insult. The inflammation can decrease movement and range of motion after surgery, causing stiffness in the short term. Don't let stiffness keep you from moving! If you continue to keep your knee still, and refuse to fight through the pain and the stiffness, that temporary short-term stiffness can become more permanent long-term stiffness. This happens by your body laying down too much scar tissue, which then scars down your joint and makes it difficult to move or bend. This pathology is called arthrofibrosis.

This is why it is crucial to do your physical therapy exercises (see Chapter 9) and stick with them. Treat physical therapy like a job. And use all the other tools we have discussed—ice, compression, elevation, and medications—to minimize inflammation. If you do get permanent stiffness, this can lead to a repeat trip to the OR for manipulation (cranking on your knee until it bends and straightens enough) and scar tissue removal. It's best to do things right the first time.

Warning signs of stiffness:

- inability to reach your range of motion goals on time
- inability to get the knee straight at any point in the rehab process (extension or straightening is much harder to regain than flexion or bending); you do not want to lose this ability
- later in the rehab process, crepitus (crunching) or thick bands of tissue you can feel around your knee (new scar tissue)

Infection

This is one of the most, if not the most, concerning complication of surgery. As we've talked about, infection can significantly affect the recovery process, often leading to more surgery and more time in the hospital; much less frequently, it can be more ominous. You and your medical team will do everything you possibly can to avoid this complication, but it can still arise. Infection can have many signs, depending on how it manifests itself. Some things to be on the lookout for are:

- a wound that looks bright red

- a wound that feels hot to the touch
- a fever greater than 101.5 degrees Fahrenheit or 38.1 degrees Celsius
- drainage from your knee or wound
- pain that is out of proportion or suddenly much worse than before

If you have any of these symptoms, contact your surgical team right away.

Blood Clot, or Deep Venous Thrombosis (DVT)

A DVT is a fancy word for a blood clot, or a clump of blood that is blocking a vessel, usually a vein. This can cause increased swelling in the area because the vein is not allowing the blood that usually travels in that vessel to return to the heart. A DVT can lead to pain from the increased swelling and pressure. Usually these clots will resolve on their own and are not a major problem. Clots can be dislodged, however, and move to more vulnerable parts of your body, such as your lungs and brain. This is a much bigger problem.

If you have any of the following symptoms, you need to be evaluated by a physician. The earlier you catch it, the less of an issue it is.

- pain and swelling that is *new* in your lower leg, usually your calf area
- if your pain increases when you stretch your calf or pull your toes to your nose

Pulmonary Complications

Pulmonary (lung) complications that can crop up after surgery include pneumonia, atelectasis, and pulmonary embolism. Pneumonia is a lung infection, which can be very serious and life-threatening and typically requires treatment with antibiotics and hospitalization. Atelectasis is a term for some dead space in your lungs you are not getting air into, and it is common after major surgery. It usually resolves as you begin to move more or work to expand your lungs. A pulmonary embolism is a blood clot that has traveled to your lungs, which can be deadly depending on its size. A history of a pulmonary embolism usually means you have to be on anticoagulants for a very long time, if not for life.

Pay attention to the signs of a lung problem and seek speedy and proper care at your hospital in the emergency department:

- shortness of breath

- fast heart rate
- fever

Compartment Syndrome

This is a relatively rare complication; however, it is still one worth mentioning. Different groups of muscles are housed in different compartments of the knee. For instance, in the lower leg, from your knee to your ankle, muscles are separated between four different compartments, known as anterior, lateral, deep, and superficial posterior. The wall between these compartments, or what separates them, is the fascia of the muscle, which is a thick collagenous tissue layer.

Compartment syndrome happens when bleeding or edema (water) from an injury or surgery builds up inside one compartment of your leg, and the fascia surrounding the compartment does not allow the fluid to escape. The pressure that is associated with this bleeding then continues to rise as the blood accumulates, and eventually that pressure can choke off the muscles, depriving them of their blood supply and thereby depriving them of oxygen. If this pressure is not relieved, the muscles in the compartment will die and become nonfunctioning. For this reason, compartment syndrome is a surgical emergency. This surgery requires large incisions for fasciotomies, or releasing the fascia (opening the walls) to allow the blood to be evacuated and the pressure to be released.

The most accurate and common sign of compartment syndrome is pain out of proportion, and it should be taken seriously after high-energy knee injuries, especially fractures (tibial plateau fractures, tibial tubercle avulsions, and so on). Call your physician, or visit the emergency room, if you have any of the five Ps:

- pain (you develop severe pain that does not seem appropriate—it is continuing to get worse or is the worse pain you have ever felt—or your pain does not respond to your pain medication)
- pallor (pale color of skin)
- paresthesias (numbness in the affected area and also down in the foot)
- pulselessness
- paralysis (inability to activate certain muscles)

Constipation

There are quite a few reasons behind why you may get stopped up after surgery. The usual cause is the narcotic medications that you had in surgery or are taking for pain after surgery. In fact, it would not be uncommon to not have a bowel movement for a few days or even a week, depending on how regular you usually are. Those more regular may get back on track fairly quickly, but those of you who already have some irregularity, the gastrointestinal train may be experiencing long delays at the station. Things like water, medications previously mentioned (senna, docusate), and healthy meals can all help. Chronic constipation can sometimes (though rarely) be a sign of something more concerning and in and of itself can cause complications if allowed to continue for too long. Signs you should call your doctor for an appointment or see your primary care physician include:

- you have not had a bowel movement for multiple days (usually at least five or more)
- you have significant distention (bloating) and pain

Falls

This complication is almost 100 percent preventable. Most falls after knee surgery happen because people are doing things they shouldn't be doing: hopping around unsafely, walking on ice, walking without their walking aids, or going to a crowded mall, concert, or game. In the immediate aftermath of surgery, particularly if you are using a walking aid, just take it easy. Yes, you should be up and moving, and no, you shouldn't be a couch potato, but remember balance. Walking to the mailbox or around the neighborhood, as long as weather permits, is great. Attending a crowded concert or trying to run a 5k the weekend after surgery is a bad idea. Don't be afraid to ask for help, either. No matter how healthy, strong, or strong-willed you are feeling, it is always a good idea to have someone help you with your recovery. This is especially true early on in recovery to prevent taking a fall. To reduce your risk of falls:

- avoid middle of the night bathroom or snack runs without help
- avoid walking long distances on your crutches
- avoid using crutches on wet surfaces

Delirium

Confusion following surgery is also a real possibility, specifically for those in the older population. This isn't about saying funny things when coming out of anesthesia—most people do that. What we are talking about is a little more advanced: some true confusion regarding your level of alertness and orientation. While you are very much awake, you may not be completely aware of where you are, the date, and other minor factoids. This is commonly caused by anesthesia and pain medications. The colloquial term for this condition is being "snowed" or in a medication-induced haze. This is easily fixable with good hydration and holding the medication that is the culprit for the time being. Delirium rarely happens, but if it does, it usually occurs in the hospital before you go home. If it happens at home, your caregiver should call your surgical team and come up with a plan. They may want your caregiver to bring you into the office or return to the hospital. Be aware of the signs and symptoms of delirium:

- being unaware of your surroundings
- experiencing confusion

Now that you know the warning signs of complications, we can turn our focus to some advice of what to do and what not to do.

DON'TS AFTER SURGERY

Postsurgery, to help your knee heal as quickly and as fully as possible, it's crucial to follow your doctor's instructions. This is going to involve making some temporary lifestyle changes. Let's look at what not to do during this time period. The first five on the list, marked with asterisks, are hard nos—things to avoid at all costs because they put you at risk of serious complications. The others are things we also strongly advise not doing. What's the difference? Think of it this way: It's highly recommended to have a four-wheel drive car in the winter if you live in the mountains. The hard nos are laws, like the fact that it is illegal to drink and drive.

*1. Don't Go on Bed Rest**

You just had knee surgery, so you need to stay in bed all day, right? Wrong! Gone are the days when we put people in huge casts and ask them to sit completely still every day in order to heal. In fact, we do quite the opposite in modern-day orthopedics. You'll be given some walking aids, such as crutches, and many knee surgeries will allow you to be up and walking the day of or day after surgery. (We even know patients who have been allowed to

play nine holes of golf days after their surgery.) Many knee operations do have limits, either weight-bearing or range-of-motion restrictions, and you need to adhere to those. (We'll get to them on here, here.) But they will not prevent you from getting up early and often with the use of a walking aid. (For more on walking aids, see here).

Almost all of the complications following knee surgery can at least in part be prevented by doing one simple thing: *moving*. The risks of blood clots, atelectasis (increased dead space in lungs, which leads to worse air movement and increased infection risk), pneumonia (lungs collapse or are infected), pulmonary embolism, stiffness, muscle atrophy, and sometimes even increased pain are heightened by staying still. While this may be difficult to grasp at first, it actually makes a lot of sense.

For blood clots and subsequent pulmonary embolisms, one of the main risk factors is stagnant blood—and blood that stays still tends to clot. The more you move, the more your muscles compress your vessels, and the more your blood is circulated and pumped out of your legs. Atelectasis and pneumonia risks go way up when you are not moving air through your lungs. The more you stay still, the less you take deep breaths, which means the worse you ventilate your lungs. That puts you at greater risk of lung infection or pneumonia.

Stiffness, too, develops from a lack of movement. Admittedly, the pain issue can be tough to grasp. You think, *Well, my knee hurts when I move it, so I should not move it.* Sometimes you need to move through a little bit of pain. In terms of movement, whatever you have been given the OK to do by your doctor, you should try to do. The reason is that the more stiffness you allow to set in, the more painful it will be later on to get that motion back. Think of it this way: enduring a little extra pain early on as you do physical therapy and rehab can significantly help prevent or reduce chronic knee pain down the road.

*2. Don't Misuse Medications**

This one is fairly self-explanatory but worth calling attention to. In Chapter 7, we went over the different types of medications you can expect to be taking, why, and for how long. The general rule is that you are given a certain dose of a medication for a reason, and it is not to be exceeded. Do not fall into the trap of thinking, "If some is good, more must be better." When it comes to medication, this is definitely not the case. Remember: balance and moderation.

We've all seen the headlines about how opioid abuse leads to addiction, and that is a devastating long-term consequence. What is talked about less frequently is the short-term side effects and complications that can also occur from excessive use. Some of these medications can cause acute reactions and side effects, such as respiratory inhibition (making it more difficult to breathe), delirium, constipation, urinary problems, nausea, and vomiting. Use your medications as directed, and use them wisely. If you notice a drug is bothering you in some way, or if your knee pain is not being alleviated by your pain medications, tell your doctor.

*3. Don't Take NSAID Medications (Advil, Ibuprofen, or Aleve) Unless Your Doctor Says It's OK**

Wait, you said in the previous chapter that I could take these medications! As we said, it's a point of contention. Because of this, this drug gets its own discussion. *Why can't I take Aleve? It works so well for the lady with knee pain and the elderly gentlemen with back pain in the commercials. Isn't Aleve supposed to help with my pain and swelling? Isn't that a good thing?* Herein lies the irony of drugs in the NSAID (nonsteroidal anti-inflammatories) category, which includes Aleve, Advil (ibuprofen), and Celebrex. All of these do help with pain, and indeed they all decrease inflammation. However, as we previously stated, not all inflammation is bad.

At this point, most of you are staring at your book with a look of confusion reminiscent of Keanu Reeves in *Bill and Ted's Excellent Adventure*. *Wait, I thought inflammation was bad. Now it's good. Whose team is it on, anyway?* Again, the issue is balance. Too much inflammation in the body is bad because it causes pain and can lead to scar tissue and stiffness. However, *some* inflammation is necessary for healing. It has been shown in studies that while NSAIDS do prevent bad inflammation, they also prevent some good inflammation that is necessary to promote the healing of collagen. Collagen is the structural protein that bone, meniscus, tendons, and ligaments are composed of, and you need to be able to make that protein to heal. While the research and evidence regarding this phenomenon is somewhat mixed, it is fairly clear that this class of medications specifically inhibits collagenous healing between tendon or soft tissue and bone, such as that needed after a ligament repair or reconstruction. Therefore, unless your doctor specifically tells you that you can use NSAIDs because you have had a surgery that does not require much collagenous healing (an example would be a knee replacement), you should avoid this medication during the healing period. Discuss with your surgeon the exact time periods, but it is usually a minimum

of six to twelve weeks.

*4. Don't Drink Alcohol**

Maybe you're used to having a glass of wine with dinner or a Dos Equis while watching your favorite football team on Sunday. However, immediately after surgery, at least for as long as you are taking a cocktail of doctor-prescribed medications (namely opioids), you need to cease and desist drinking any alcohol. This is for a couple of important reasons. First, alcohol tends to have some effects (interactions) on some of those drugs you are taking. This is because it competes with some of the same receptors in your cells as your postsurgical medications. In some instances, it increases the effect of the drug; in others, such as some antibiotics, it can cause reactions like fast heartbeat, flushing, and a long-lasting pounding headache.

Another reason to avoid alcohol is that you are already a little less stable than you are used to being, and making this worse is dangerous. You are either crutching around on one leg, or you are getting used to walking with your recently surgerized extremity. Either way, you aren't quite as balanced as usual. Now, add in a beverage known to make the healthiest of people stumble, and you have a recipe for a disaster—a fall. For all these reasons, it is best you take a break from drinking alcohol.

As with most of these rules, there is a caveat here. If you typically consume a significant amount of alcohol each day—a six-pack of beer or half a fifth of whiskey—you cannot quit cold turkey because alcohol cessation when done abruptly and incorrectly can lead to withdrawal and be lethal. One of the most important things in all appointments and conversations with your surgeon is to be honest, and that includes being honest about your alcohol intake. Your surgeon is, as Leo would say in *The Departed*, not a cop! They are not trying to get you in trouble or report you to anyone. Devise a plan with your surgeon for how much you can be safely drinking after surgery, as the one thing worse than an alcohol-induced fall or other side effect is withdrawal from alcohol.

*5. Don't Smoke or Use Nicotine**

We have already discussed this previously in the book, but honestly it cannot be discussed enough. Continuing to smoke cigarettes or use other nicotine products after surgery has been shown to slow and reduce healing. If you do not heal, you are at risk for… you guessed it, infection. And not only that, but you're also at risk of the pain or instability persisting. Who wants that?

Everything you went through, and all the precautions you took, the soap, the antibiotics, will all be for naught because of the nicotine. To steal an expression out of Keyshawn Johnson's playbook, "C'mon, man."

What about non-nicotinic smoking? Here the evidence is less clear, although what is suspected and loosely accepted is any form of smoking leads to increased carbon monoxide levels, which can lead to decreased healing and potentially increase the risk for infection. So in general, try not to smoke anything.

As much as possible, try to quit. If not permanently, quit at least during this recovery and healing process. That way everything you have gone through will be worth it, and you can maximize your chance of a good outcome.

6. Don't Get in the Hot Tub—or Even a Bathtub

What this "don't" refers to is submersion of your surgical limb in water. Your surgeon will give you specific instructions following surgery regarding when you can and can't shower, and also how long before you can submerge your leg—like how long before you can take a dip in a swimming pool. The general rule for showering is a couple of days; however, many surgeons will allow a shower on postoperative day one depending on the surgery. Submersion of the leg is almost always permitted only after the two-week mark because it takes roughly two weeks for your incision to heal. That is usually the time your staples or sutures need to be removed, if they are nonabsorbable. Until that time, you don't want to submerge the surgical site because you run the risk of allowing fluid and outside elements into your incision, which is a risk for infection.

You should also consider avoiding heat, which tends to be pro-inflammatory. You want to limit inflammation and swelling. After two weeks, getting in pools and cold tubs is OK and even advised in many cases. Hot tubs should probably continue to be avoided for some time. For specific time frames, check with your surgeon.

7. Don't Go on a Long Flight

Long flights tend to be not ideal following surgery. If you recall, a hard no at the top of this list is bed rest, or lack of movement. Things that cause you to stay very still lead to increased risk factors. Sitting on the plane for a long time can lead not only to increased swelling and edema in your legs but to an increased risk for blood clot formation. Studies have also shown that your risk

of DVT increases significantly at increased elevation, like during a flight. Therefore we recommend avoiding unnecessary, long air travel. Of course, sometimes travel is unavoidable, especially if you have had to travel in order to undergo surgery. In that case, we recommend doing ankle pumps—moving your foot up and down like pressing on and off an invisible gas pedal—as much and as often as you can. This will cause you to rhythmically contract and relax the muscles of both your posterior lower leg (gastrocnemius, soleus complex) and your anterior leg (anterior tibialis, peroneal muscles), which can help to squeeze the lymphatic and vascular system and move the fluid out of your legs. Also, stand up and move around as much as possible when on your flight.

Let your surgeon know if you need to fly, as they can prescribe injections or pills to diminish the risks of blood clotting. If this is disclosed prior to surgery, a date that can work better for you (not so close to your trip) may also be arranged. The key for surgical procedures is minimizing every risk.

8. Don't Overdo It

This rule could simply be stated as: *Follow your instructions!* You have been given instructions for how much weight you should be putting on your leg as well as how much you should be moving your knee. These are not arbitrary guidelines or random suggestions; they are scientifically established, tried-and-true recommendations. The weight-bearing and range-of-motion instructions you receive will vary depending on the type of knee surgery you've had. There's a reason you shouldn't bear weight after a tibial plateau fracture, and a reason why you *can* bear weight after a total joint replacement. There is also a reason why you're encouraged to do as much range-of-motion movement as possible after some surgeries, while after others you're more restricted. If you have questions about why your restrictions are what they are, ask.

We like to say, "Don't overdo it, and don't overthink it." This is a good rule for your rehab: don't make things more complicated than they are. You will receive a thorough list of instructions: movements you should and should not do, activities you should do and those you should avoid. If you find yourself saying, *This really hurts. Should I be doing this?*, the answer is probably no. Sometimes rehab exercises and physical therapy can be somewhat painful, but you know those activities are OK to do. In terms of activities in your daily life that are causing a lot of pain in the immediate postoperative period, it is probably not the best choice.

We know you may be anxious to get back to your normal life, especially if you love playing sports. After you have received your new shiny knee, you *might* be able to play a round of golf the following weekend. That could be within the realm of possibility. Are you going to suit up for the Seahawks and get on the football field? Heck no! As much as we want you to be active after surgery, you can easily be too active, which can cause setbacks in your recovery. With that in mind: pay close attention to what is allowed, what is not, and how you feel, and keep that balance.

GET YOUR GEAR ON

There are many different tools that can be helpful in the postoperative period. Some of these tools and others will be discussed in more detail in the rehabilitation chapter.

1. Walking Aids: Crutches, Walkers, Wheelchairs

This probably goes without saying, but you will most likely need some sort of ambulatory or walking aid. For those of you who need to avoid weight bearing for a period of time, you will require either crutches, a walker, or a wheelchair. For those of you who are allowed to do partial weight bearing, or weight bearing as tolerated, you can have dealer's choice between four-wheeled walkers and crutches. These can be spendy, but it is worth noting you will likely have to use these things for a long time. It's also handy to have these darn things around the house for when the next orthopedic injury in the family inevitably rears its head.

If you haven't used crutches or a walker in a crow's age, they have gotten pretty fancy recently. Walkers can have two wheels, four wheels, or no wheels; they can have a seat, so you can take breaks on long walks—in short, they are amazing. Crutches also come in an assortment of styles: there are underarm ones, platform ones, and forearm ones. Again, there are enough options that you should be able to find one that works for you. We are particularly fond of Mobilegs, as we can speak from experience they are very comfortable and durable. These are underarm crutches, and the component that goes under the arm rotates and is not too firm or uncomfortable in such a sensitive area. Do your research (and maybe even try them before surgery) because it is a decision that will affect your day-to-day life at least for a short while.

2. Continuous Passive Motion (CPM) Device

Stiffness following surgery is one of the most, if not *the* most, common complication of most knee surgeries. This is why regaining good range of motion at the knee joint is crucial in the postoperative period. A CPM device is a machine that can be very effective in helping patients increase range of motion, and it also has been reported to protect cartilage after surgery. It is designed to passively (that is, requiring no energy or active

movement from you) bend and straighten your knee. You strap your knee into the device and set the estimated range of motion you want the machine to take you through. You can base this range of motion on your instructions. Then once you hit “start,” the machine will take your knee to that end range of motion you set and back to straight continuously, until you turn the machine off. You can even sleep in this machine to continue to help you with motion even at night. The CPM device can be a little aggressive, since it is bending and straightening your knee sometimes a little further then you would like in the moment, but it can be helpful. Not all surgeons like using it, but it is worth discussing with your surgeon whether one could help you. An online search for CPM devices will provide you with further information.

3. Ice-and-Compression Device, like Game Ready

Remember that we discussed how ice and compression were two great treatment modalities to reduce inflammation. These devices combine just those two things. You wrap a cuff around your knee and set a timer, and the machine will utilize cold water pumped through the system and compression of the cuff to combine cold and compression therapy. These machines do a phenomenal job of providing even, cold compression; the only downside is the price. This technology is expensive, but if you can afford it, it is phenomenally effective. Remember to always put the cuff on over a towel or a light pair of sweatpants, since placing ice packs or these cuffs directly on your skin for long periods of time can cause low degrees of frostbite. Search online for more information about products like these.

4. Compression Socks or Stockings

This recommendation harks back to the importance of trying to keep fluid out of your legs and knee. The longer you are on your feet during the day, the more likely gravity is going to win the battle and pull fluid into your legs and refuse to give it back. Compression socks can help your body and lymphatic system pump that excess fluid out of the legs and back up toward your heart.

5. Incentive Spirometry Device

This is an important tool in your arsenal immediately after surgery if you will not be very mobile immediately. If you are admitted to the hospital, this device will most likely be supplied. If not, you can find it at a medical supply store. Remember, both atelectasis and pneumonia are serious concerns following surgery. Either can lead to fevers and complications after surgery, but both can be prevented by continuing to ventilate your lungs well. How can you make sure air is getting to all the air sacks of your lungs? Use an incentive spirometry device. It helps you to do just that during those first few days when you aren’t as active as you are used to. Using this device ten times every hour for those first few days is crucial. If you can use it and avoid major complications with your lungs, it can be vital to your recovery process.

AND NOW FOR THE DOS

We spent a good number of pages telling you a laundry list of things we want you to avoid. There are also a bunch of things that you can and should be doing! So, on a more uplifting note, we will turn to these. In the following chapters of Part 3 of this book, Getting Back to Awesome, we'll take a closer look at ways you can take charge of your knee recovery, including physical therapy exercises, diet choices, and other things you can do to minimize inflammation and speed healing.

1. Do Stick with Your Physical Therapy Program

This one will be discussed in great detail in the next chapter, but this advice cannot be overstated. Don't underestimate the impact of physical therapy. You can have the best surgery ever, done by the most skilled surgeon who has ever lived, but if you do not put in the time and work in physical therapy, then you will never reach your full knee potential. This is your window of time to recover. It is, therefore, important to take therapy seriously. Treat it as a regular part of your daily schedule, like a job or school. You need to not only put in the work in your sessions with the therapist but also do the homework: do as much as you can on your own at home. If you stay committed and diligent, you will increase your odds of the best outcome possible.

2. Do RICE Your Injury (Rest, Ice, Compression, Elevation)

This is one of the key components of treating any acute injury, which you can consider surgery to be. As we have said, you want to minimize excess inflammation on your knee. These four components have been shown, time and again, to be helpful with exactly that. **Rest** goes back to our list of don'ts: don't overdo it. Follow the recommendations of your physical therapist and your surgical team, and no more. **Ice** helps to cool the knee and keep inflammation associated with it down. Ice can be an effective pain reliever. **Compression** helps to stimulate your lymphatic system. Similar to what happens when you contract your muscles, it squeezes fluid out of your legs. **Elevation** means keeping your leg elevated above your heart. Similarly, this drives fluids back in the direction of the heart with the help of gravity. How often should you be doing RICE? Often. Don't ice for more than fifteen to twenty minutes at a time, but after a fifteen- to twenty-minute break you can ice your knee again, and you can do this multiple times a day as long as there are breaks between your icing sessions. For more on the RICE method, see here.

3. Do Eat a Healing Diet

In Chapter 10, we will discuss in greater detail the importance of healthy eating, not just for body weight but also for creating an anti-inflammatory state in your body and a better long-term outcome for your knee. Some foods tend to be more pro-inflammatory, while others are known to be anti-inflammatory. Food is intricately associated with health. It is also important to get a good balance of nutrients including vitamins, minerals, and proteins.

WILL TAKING VITAMINS HELP ME HEAL FASTER?

There are no vitamins that are guaranteed to help you heal like Superman. In general, however, it is important to have a good balanced diet full of key vitamins. Vitamin A, C, and E are all known to help with the healing process and should be consumed in sufficient quantities. Vitamin D is integral to good bone health, especially long term, and should most likely be taken at baseline for most of us, specifically if you live in an area of the world where sunlight does not often visit. Taking a multivitamin if you are having trouble eating enough to maintain a nutritious diet can help.

4. Do Take Time Off from Work and Get Some Sleep

Good sleep and good rest are important for our overall health. That goes double for our health when recovering from an injury and from surgery. Your body is expending a lot of extra energy to heal, and it needs adequate rest and sleep to accomplish this.

At this point in time, it is also worth mentioning the importance of taking some time off from work. How long? It's unlikely your employer is going to give you six months off work for knee surgery, and unless there has been a complication, you probably won't be getting a lifetime disability parking permit so you don't have to walk far. Still, in the immediate aftermath of surgery, it is not a terrible idea to take some time off. How much time depends on the surgery, but anywhere from a couple of days to a couple of months is often recommended. As already mentioned, you should treat your therapy as your new job or your school in the short interim following surgery. It is hard to devote adequate time to your recovery process if you are also still putting in a forty-hour work week besides the multiple inconveniences such as icing and keeping your leg in elevation. Taking just a short leave from work and dedicating yourself to your rehab now can possibly save you from having to take a lot of time off later on, or maybe even being unable to work or having to retire prematurely, should your injury become worse or more

chronic. Discuss with your surgeon what a reasonable amount of time off is, and make sure you have a plan in place with your workplace and your family. Your employer will have paperwork that needs to be filled out, and if you need a spouse or family member to take time off to help you in your recovery, they'll need to complete the necessary paperwork as well. Most employers have some specific forms that need to be filled out, so these forms usually cannot be grabbed at your doctor's appointment. Your doctor will, however, fill out and sign whatever you need that fits within their recommendations.

5. Do Ask Questions

For some patients this is no issue whatsoever: they come in shooting off more questions than bullets in a Clint Eastwood Western. Other patients are gun shy when it comes to asking, perhaps scared to be a bother or a nuisance or appear high-maintenance. This couldn't be further from the truth. It is expected that you will have questions throughout the recovery process and want more information about your injury or treatment, and it is the doctor's job as the health care provider to inform you. A good strategy is writing your questions down whenever you think about them or collating them in the notes section of your cell phone (who goes anywhere without their cell phone these days?). Keep a running log, and then when you have an appointment, bring in that list and get the answers you need.

Remember, how you respond to surgery is subjective and unique to you. You may be one of those people who doesn't have any pain, stops pain pills on day two, has no swelling, and feels good as new by the weekend. On the other hand, your knee may swell to the size of a ripe watermelon, your pain may feel close to bear-mauling level, and you may be wondering, *Why the heck did I go through with this?* Stay calm and positive and focused on your goals—it will get better. The next chapter is all about setting and achieving both short-term and long-term goals, and it gives you instructions on how to tackle, complete, and conquer your rehab.

ACE YOUR PHYSICAL THERAPY

Regaining Your Knee Function and Strength

Most people have probably heard the saying, “Use it or lose it.” Luckily for Steve Carell’s character in *The 40-Year-Old Virgin*, that saying does not hold true for everything. But it does hold true in regard to your muscles: their size, strength, conditioning, and overall function. Patients are often surprised just how skinny their leg gets in a matter of only a few weeks of having to protect or minimally use it following an injury or knee surgery. This is because your muscles atrophy, or literally waste away from lack of use.

Rehabilitation is therefore crucial—and also quite difficult. You can have the best surgeon in the world, and undergo the perfect surgery, but if you do not take your rehabilitation seriously, and treat it like your job, then you could end up disappointed with your outcome. That’s why we have devoted a chapter to guide you through your rehabilitation and give you some tips and tricks to help you crush your physical therapy like a pro.

Rehabilitation is a key component of making it to a complete recovery. Whether you’ve just had knee surgery, you’re trying to avoid it, or you’ve come to the decision that your knee injury is best treated with physical therapy on its own, this chapter will answer many of your questions regarding rehabilitation and your knee. First, we’ll look at how to protect your knee. Then, we’ll provide some exercise suggestions for different phases of recovery.

As always, each patient’s situation is unique. The following exercise programs are meant as a guide, and you should always check with your medical provider to be sure that you are ready before embarking on any

program.

"The first thoughts going through my mind were, *Am I going to be able to play? Is the pain ever going to go away?* Going through the process I learned just how much pain I could endure, and in general I had to relearn how my body worked. Physical therapy was particularly hard. It was like my body shut down completely. I had to relearn how to move my leg, how to engage my muscles, everything. Even just getting my knee to bend was hard.

"One piece of advice I have is get everything handled before surgery. Dealing with insurance, what is covered and what is not, and how everything is going to be paid for is very stressful. It is best to get this all handled beforehand so you can focus on your recovery after surgery."

—Festus Ezeli, NBA player and champion

THE 20/80 RULE

The 20/80 rule is something we want you to keep in mind as you read this chapter. Only about 20 percent of your outcome following surgery is dependent on the surgery, and 80 percent is what you do with it, or said another way, how well you attack your physical therapy.

Try to remember that no matter how monumental the surgery felt to you, it was still only a few hours long. The rehabilitation associated with said surgery could be anywhere from a couple of months to longer than a year.

To take another perspective, while these months of rehab may be challenging both physically and mentally, remember that a few months are a lot of time, but relative to the rest of your life they are but a moment. For a sports reference, think of your rehab as a couple of plays in a game. While those couple of plays are a relatively short amount of time, they are still important: it only takes one play to change the outcome of a game. So with that in mind, go into your therapy with goals, a plan, a positive attitude, and determination to give each session your all and to stick with it. Remember you will be done with it soon, and when you are done, you want to know you did everything the best you could to get your knee back to running, jumping, kicking, and climbing for the rest of your life.

"After sustaining my injury, the most important part to beginning the healing process with my knee was to find the right doctor. With such a complex injury, I knew I had to have someone who was experienced and knowledgeable. After I made the decision to have Dr. LaPrade do my surgery, I just had to put my full trust in him and his team, and believe that they would do

the best job possible.

"I wasn't expecting the surgery and preceding weeks to be so painful, and it was a very difficult time for me. Thankfully I had loving family and friends around to help me through it. Committing to my physical therapy program and heeding the doctors' recommendations were definitely crucial in overcoming the injury and getting back to full health. I made a plan, dedicated my time to healing and PT, made sure I was taking care of myself in every possible way (nutrition, mental health, balance, etc.), and just bore down to get through it. Having a good physical therapist you can always return to is key in overcoming a major injury. I made sure I was working with people I trusted and let them guide me through the rehab journey.

"It's not easy to come back from such a major knee injury, but it's so important to stick to your rehabilitation plan! I know that my knee health will affect me greatly down the road, so taking care, taking time, and doing it right was incredibly important. I'm so grateful for all of the talented doctors, PTs, and other helpers I had! A major knee injury is not something you can recover from on your own. Luckily I had the right people by my side, and the right mindset to get through it and come back stronger."

—Laurenne Ross, World Cup and Olympian skier

PROTECTING YOUR KNEE AND THE SURGICAL REPAIR

Knee rehabilitation starts with your medical and rehabilitation team developing an appropriate treatment plan.

The first step of all treatment plans is developing strategies that protect the damaged structures in your knee. Regardless of whether your injury requires surgery or not, these strategies ensure that the damaged structures have the optimal environment in which to heal, optimizing the chances of a good outcome.

There are three main ways in which your medical team may seek to protect the injured structures, surgical repair, or reconstructions. The amount of protection required varies greatly between injuries. Some injuries that require surgery require little protection, and conversely, some injuries that do not require surgery have strict limitations.

1. Bracing

The first method of protection is by placing you in a knee brace. A knee brace is used in rehabilitation when your medical and rehabilitation team believe that the healing of the injured structures can be improved by using an external support or when there is a risk of further injury without the brace's support.

The brace used may be locked or allow you to bend your knee, depending upon your injury or the surgery performed.

There are three main types of braces that can be used:

1. *Hinged knee brace:* This brace has hinges on both sides of the brace, which allows the brace to bend and straighten. These hinges can be left unlocked to allow unrestricted movement, or stops can be placed in the hinges to limit the available motion and increase the degree of protection.
2. *Locked knee brace:* Also known as an immobilizer, this brace does not allow the knee to bend at all, keeping the leg wearing the brace in an extended position.
3. *Dynamic anterior draw brace:* This specialty brace is used in the management of PCL (posterior cruciate ligament) injuries. It provides an anterior draw force to the calf on the person wearing the brace, reducing the stress on the PCL.

BRACING FOR TOP TWENTY-FIVE KNEE INJURIES MANAGED WITHOUT SURGERY

NO BRACE: Patellar tendinopathy

Muscle strain

IT band syndrome

Anterior knee pain

Inflammatory arthritis

Meniscus tear

Cartilage injury

Patella fracture

Osgood-Schlatter disease

Proximal tibiofibular joint instability

HINGED KNEE BRACE: ACL

MCL

Tibial plateau fracture

FCL

ANTERIOR DRAW BRACE: PCL

IMMOBILIZER: Quadriceps tendon tear

Osteochondritis dissecans

Patella fracture (depends on severity)

UNLOADER: Arthritis

Tibiofemoral malalignment

BRACING FOR TOP TWENTY-FIVE KNEE INJURIES MANAGED WITH SURGERY

NO BRACE: IT band syndrome

Anterior knee pain

Proximal tibia fracture

Distal femoral fracture

Tibiofemoral malalignment/ Osteotomy

Septic arthritis

HINGED KNEE BRACE: ACL

Tibial plateau fracture

ANTERIOR DRAW BRACE: PCL

IMMOBILIZER: Meniscus tear

MCL

Cartilage injury

Patella fracture

Quadriceps tendon tear

Patellar tendon rupture

Knee dislocation

Patellofemoral arthritis

Patellar tendinopathy

FCL

Osteochondritis dissecans

Distal femoral fracture

Tibiofemoral malalignment/ Osteotomy

UNLOADER: Arthritis

Tibiofemoral malalignment/ Osteotomy

2. Weight-Bearing Restrictions

The second method to protect the surgical repair or reconstructed tissue is by limiting the amount of weight you put on your leg. By limiting the weight, your medical team is limiting the load that is being placed on the affected tissues. This restricted weight bearing may vary from a few days to a few weeks depending on your surgery, and you will most likely use crutches to help you walk during this time. Even though you may not be able to place your full weight through your leg, you will still be able to do physical therapy. The exercises will be modified for your weight-bearing status, keeping you safe while still progressing toward your rehabilitation goals.

WEIGHT-BEARING STATUS FOR TOP TWENTY-FIVE KNEE INJURIES MANAGED WITHOUT SURGERY

FULL WEIGHT BEARING: ACL

Arthritis

Muscle strain

IT band syndrome

Anterior knee pain

Patellar tendinopathy

MCL

PCL

Tibiofemoral malalignment

Proximal tibiofibular joint instability

Osgood-Schlatter disease

Patellar instability

PARTIAL WEIGHT BEARING: Meniscus tear

Inflammatory arthritis

Quadriceps tendon tear

NO WEIGHT BEARING: Patella fracture

Tibial plateau fracture

Osteochondritis dissecans

Cartilage injury

WEIGHT-BEARING STATUS FOR TOP TWENTY-FIVE KNEE INJURIES MANAGED WITH SURGERY

FULL WEIGHT BEARING: Arthritis (total knee replacement)

IT band syndrome

Tibiofemoral malalignment

PARTIAL WEIGHT BEARING: ACL

IT band syndrome

Anterior knee pain

Meniscus tear

FCL

Septic arthritis

Arthritis (total knee replacement)

NO WEIGHT BEARING: Patellar tendinopathy

MCL

Cartilage injury

Patellar fracture

Tibial plateau fracture

Proximal tibia fracture

Distal femoral fracture

PCL

Quadriceps tendon tear

Patellar tendon rupture

Tibiofemoral malalignment/ Osteotomy

Proximal tibiofibular joint instability

Osteochondritis dissecans

Knee dislocation

Patellar instability

Three different weight-bearing statuses may be prescribed to protect damaged knee structures during rehabilitation:

1. *Full weight bearing:* In situations where there is no risk of further injury or when weight bearing can help the healing process, full weight bearing is prescribed, allowing you to walk normally on your injured leg.
2. *Partial weight bearing:* This status limits the amount of weight that you place through your leg. Partial weight bearing typically means

that you mobilize with crutches, placing 30 to 40 percent of your body weight through your leg when walking. A good way to determine this is to place your leg on a scale and feel how much pressure 40 percent of your body weight feels like on your foot.

3. *No weight bearing:* In instances where any weight bearing could be damaging, non–weight-bearing status is used. In this case, you mobilize on crutches without placing your injured leg on the ground.

For more on walking aids, see here.

3. Range-of-Motion Restrictions

Depending on your injury and the surgery performed, your medical team may limit the amount of knee bend (known as *flexion*) that you can safely perform. This is intended to limit the stress on injured tissues while they complete the healing process. These limitations are typically only in place for between two and six weeks, after which time you will be allowed to bend your knee fully.

RANGE-OF-MOTION RESTRICTIONS FOR TOP TWENTY-FIVE KNEE INJURIES MANAGED WITHOUT SURGERY

NO RESTRICTION: ACL

Arthritis

Muscle strain

IT band syndrome

Anterior knee pain

Patellar tendinopathy

MCL

Nondisplaced patellar fracture

Tibial plateau fracture

PCL

FCL

Tibiofemoral malalignment

Inflammatory arthritis

Proximal tibiofibular joint instability

Osgood-Schlatter disease

Patellar instability

0 TO 90 DEGREES OF KNEE FLEXION: Meniscus tear

Cartilage injury

Quadriceps tendon tear

Osteochondritis dissecans

RANGE-OF-MOTION RESTRICTIONS FOR TOP TWENTY-FIVE KNEE INJURIES MANAGED WITH SURGERY

NO RESTRICTION: ACL

Arthritis

IT band syndrome

Anterior knee pain

Tibial plateau fracture

Proximal tibia fracture

Distal femoral fracture

Tibiofemoral malalignment/Osteotomy

Septic arthritis

0 TO 90 DEGREES OF KNEE FLEXION: Patellar tendinopathy*

Meniscus tear

MCL

Cartilage injury

Patellar fracture*

PCL

FCL

Quadriceps tendon tear*

Patellar tendon rupture

Proximal tibiofibular instability

Osteochondritis dissecans

Knee dislocation

Patellar instability

PHYSICAL THERAPY

Whether your knee injury requires surgery or will heal with an appropriate rehabilitation plan, the professional who will likely guide you through the rehabilitation process is a physical therapist (PT). Deciding on which PT to work with is an important decision, and your surgeon may have a particular PT they suggest. If you do not have an existing relationship with a PT, ask your doctor, friends, or family for recommendations. A great resource if you play team sports is asking your teammates about who has treated them in the past. Another resource is the American Physical Therapy Association's online directory of sports-certified specialist physical therapists (aptaapps.apta.org/DirectoryofCertifiedSpecialists/default.aspx). This is a directory of a group of PTs who have sat for special examinations and are well equipped to help those with knee injuries whether or not the injury was related to sports.

Before calling your PT to make an appointment, it is a smart decision to call your insurance company to understand the benefits that are afforded to you for PT under your insurance plan. In most states, you can receive care from a PT without a prescription from a physician, but you should determine whether your insurance company needs a prescription in order to pay the claim, so you can avoid unnecessary angst from unexpected bills. Many PT clinics will also accept cash payment at the time of service.

Now that you understand your insurance benefits, it's time to make an appointment. When calling the PT office, it is important to have any details about your injury (doctor's prescription, postoperative orders, rehabilitation protocols, and so forth) as well as your insurance information available. This is also a good time to ask any questions you have about the office where you will be seen. Two frequent questions that are pertinent to almost all patients are: "Where is the most convenient parking?" and "How early should I arrive to my first appointment to complete paperwork?"

With the appointment made, it is now time to attend your first visit. Clinics vary in the amount of time that they allow for a PT to complete each treatment session. The range is from fifteen minutes to one hour, with an average of thirty minutes. The clinics that allocate less time with the PT frequently have other professionals such as physical therapy assistants or athletic trainers who assist with the session. On average, expect to be in the clinic for about one hour. And remember to bring shorts and sneakers.

How Does Physical Therapy Help Your Knee Heal?

Let's zoom back in time to the moment you hurt your knee. We'll take a

closer look at how your body responded when things went wrong, so we can better see how therapy is going to help you heal. Whether you slipped and fell on a patch of ice or got tackled on the field—however it happened, upon injury you likely experienced some swelling in and around your knee. This swelling is a result of trauma to the tissues or ligaments, which respond by bleeding, and by damaged cells releasing fluid into the joint. The presence of swelling in a joint is the signal for the body to turn on the inflammatory process—an essential step in healing and one that's normal to all injuries.

While inflammation is essential to healing, it can have some uncomfortable side effects in the knee joint: pain, stiffness, and muscle atrophy.

Pain

The main side effect is, you guessed it, pain. The injury to structures inside of your knee causes an increase in the fluid within your knee. This joint swelling contains many different chemicals, some of which sensitize nerves. Your nerves send signals to the brain to alert it that something is wrong in the knee, and you feel those signals as pain.

Stiffness

Swelling is also responsible for making your knee feel stiff. You probably recall (or presently know) that trying to bend your knee after your injury was difficult. You probably felt as if your knee was tight, felt really full, or was just blocked. The reason for this feeling of stiffness is the presence of swelling within the joint. Here's what happens: Whenever the knee bends and straightens, the bones that make up the knee—the thighbone and shinbone (femur and tibia)—move into spaces that are naturally occurring in the knee and normally vacant. When swelling is present, fluid sits in these spaces. Now when you bend your knee, the ends of those bones move into the spaces where swelling fluid is sitting and act like a plunger. Without anywhere for the fluid to go, your knee feels tight, and you aren't able to bend your knee as far as you normally would. This combination of increased pain as a result of inflammation and stiffness from increased swelling has a negative effect on the muscles of the knee, which sometimes get shut down.

Muscle Atrophy

The muscles that surround your knee—your quadriceps, hamstrings, and calf muscles—are designed to create the forces that allow you to do everyday

activities such as walking, standing up, sitting down, and playing sports. When the knee sustains an injury or undergoes surgery, a number of mechanisms within the body inhibit the ability of these muscles to do their job. This is normal and one of your body's self-protection mechanisms. The consequence of your body limiting your muscles' ability to contract, however, is that they shrink in size or atrophy. Smaller muscles are less capable of providing the forces necessary for you to do daily activities or the sports you love.

A natural response after knee surgery or injury is to want to not move your knee at all—after all, it hurts. It seems intuitive that when something is hurt or broken that it needs to be still in order for it to heal. But that couldn't be further from the truth! The secret to a great recovery is to begin to gently move and strengthen the knee beginning as soon as the first day after surgery. This gentle motion has two great benefits. The first is that it creates pressure gradients within the knee that help flush out blood and swelling that sensitize the nerves of the knee and heighten the pain experience. The second is that it places subtle stresses through the repaired or reconstructed tissue. This gentle load helps to speed up the healing of this repaired tissue and actually makes it stronger.

A rehab plan that allows you to safely contract the muscles around your knee shortly after injury or after surgery will also enable you to maintain as much muscle size and function as possible. Later, you should embark on a well-constructed strength program to restore the affected muscles to their preinjury level of strength (or even better than they were before).

GOALS FOR THE FIRST SIX WEEKS

There are three main goals in the first six weeks of rehab that are common to all successful recoveries:

Goal #1: To restore normal knee bending and straightening (being able to fully extend your knee, as this is difficult to get back).

Goal #2: To resolve any swelling that is in the knee.

Goal #3: To make sure the quadriceps and hamstrings are able to contract independently and fully.

The foundation of all great outcomes following knee injury is achieving a knee that bends and straightens perfectly and has no pain or swelling, as well as ensuring the quadriceps can fire independently and fully. The best way to

achieve these goals is to start a regular and targeted exercise program the first day after surgery or soon after injury. We've outlined a simple program below that focuses on exercises that you can do independently. These exercises target improving knee bending and straightening (wall slides + patellar mobility + bike), activating the quadriceps (quad sets + bike), and eliminating swelling (ice + bike + wall slides). This regimen can be completed multiple times per day.

Physical therapy exercises can be a little different from exercises you have done when you are not injured. It is likely that you will feel some discomfort in the knee as a result of exercise. Don't worry. This is completely normal and to be expected. Rate your pain on a scale of 1 to 10 (1 being mild, 10 being excruciating). A good general rule is that discomfort between levels 1 and 4 out of 10 is normal, but pain of 7 to 10 is not. Any exercise that generates 7 to 10 pain is not productive and should be stopped.

ACUTE INJURY KNEE EXERCISE PROGRAM

EXERCISES: Wall slides

SETS / REPS / TIME: 10 minutes

FREQUENCY: 3 × a day

TIP: Place the good leg on top to provide overpressure once your knee is bending really well.

EXERCISES: Patellar mobility

SETS / REPS / TIME: 5 minutes

FREQUENCY: 3 × a day

TIP: If you see your fingers moving down toward the table, you are doing it wrong.

EXERCISES: Quad sets

SETS / REPS / TIME: 3 × 20

FREQUENCY: 3 × a day

TIP: You should see your kneecap glide up toward your hip and then your knee extend.

EXERCISES: Exercise bike

SETS / REPS / TIME: 10 minutes

FREQUENCY: 1–2 × a day

TIP: If your knee doesn't bend enough to complete a revolution, you can rock back and forth to help increase the range of motion. Also set the bike seat up higher, and plantar-flex your foot.

EXERCISES: **Ice**

SETS / REPS / TIME: 20 minutes

FREQUENCY: 3–4 × a day

TIP: Allow at least 20 minutes between icing to allow your skin to recover from the cold.

WALL SLIDES: KNEE FLEXION AND EXTENSION

START: Lie on your back, with your hips flexed to 90 degrees and feet resting on the wall. The foot of your noninjured leg should be underneath of and supporting your injured leg.

MOVEMENT: Slide the heel of your noninjured leg down the wall, keeping the affected leg resting on top and allowing your knees to bend. Return to the start position.

TIP: Bend as far as you feel comfortable, to the point of stiffness or discomfort or as far as the limitation that you medical team has recommended.

1

2

3

PATELLAR MOBILITY: KNEE FLEXION AND EXTENSION

START: Sit in a chair or on a table with your injured leg straight out in front of you. Place the pointer fingers from both hands on either side of the kneecap.

MOVEMENT: Glide the kneecap side to side.

TIP: Your fingers should move side to side. If they move downward toward the table or floor, then you are just gliding the skin over the kneecap.

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QUAD SETS: QUAD MUSCLE FUNCTION

START: Sit with your legs straight.

MOVEMENT: Glide your kneecap upward, toward your hip, by contracting your quad muscle.

TIP: No other muscle should be contracting to help the quad do its job.

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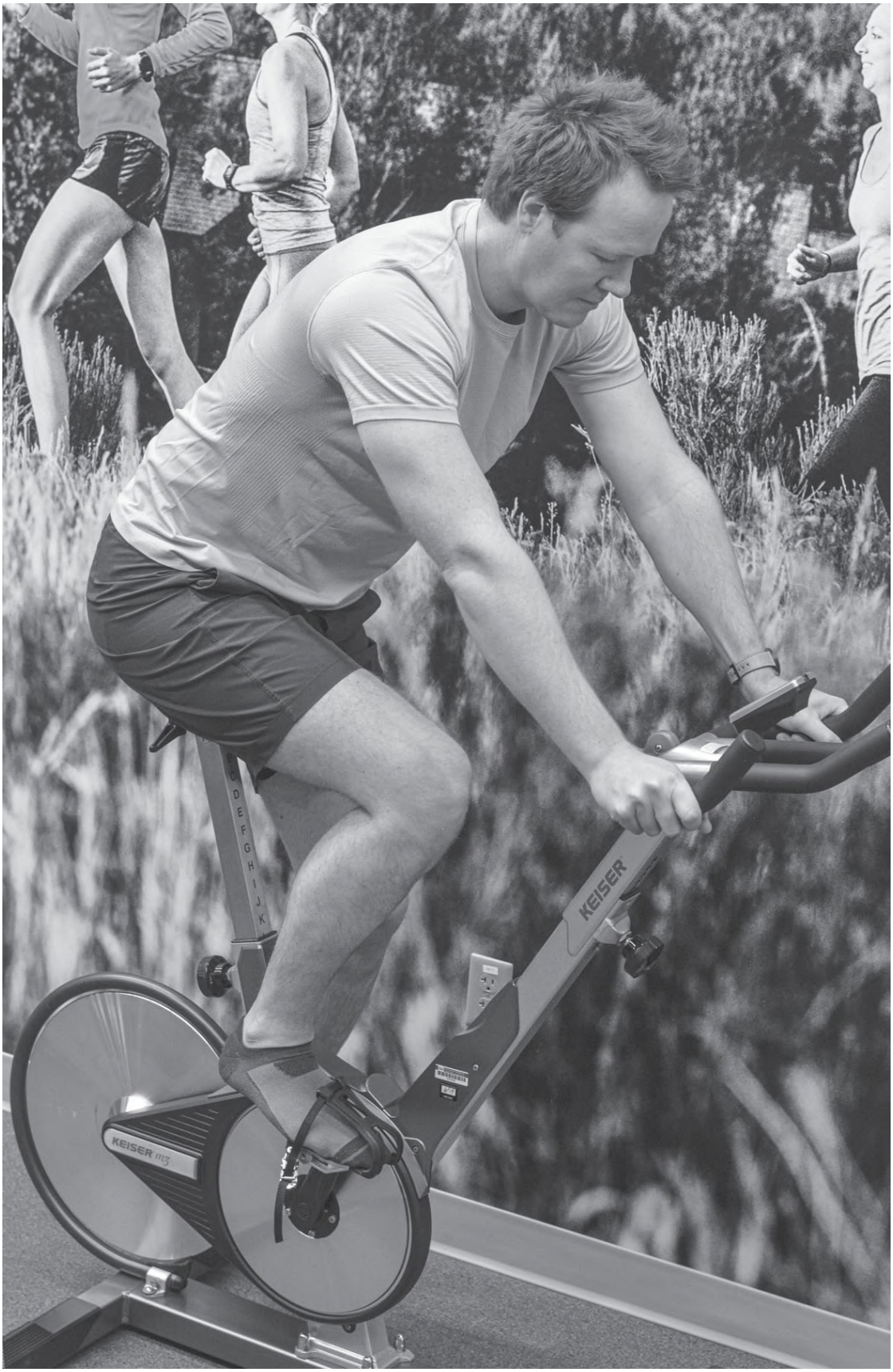
EXERCISE BIKE: KNEE FLEXION AND EXTENSION

START: When you sit on the bike seat, set the seat height so that you

have approximately 20 to 30 degrees of knee flexion at the bottom of your downstroke.

MOVEMENT: Gently complete revolutions.

TIP: You can increase your revolutions per minute to approximately seventy to eighty once you feel comfortable.



Ice

The key to successfully achieving these goals is managing pain. In addition to gentle motion, ice is a fantastic analgesic (probably the best!) and a key element in every postoperative pain control strategy. When you apply ice to the skin's surface, the nerve fibers of the skin in that area where the ice is applied have an additional stimulus to process. Instead of just sending pain signals to your brain, they also have to send the sensation of cold, and in doing so, the pain signals are scrambled, thereby reducing the pain. And, by acting to constrict blood vessels (making them smaller), ice helps to manage inflammation and swelling. Ice is a cost-effective means by which you can positively manage your pain while also limiting inflammation and swelling.

When applying ice to your knee, make sure that you have a protective barrier between your skin and the ice. A pillowcase wrapped around the knee works well. Keep the ice applied to your knee for approximately twenty minutes. Remove the ice for sixty minutes for your skin to regain its normal temperature before applying it again. In the first week after injury or surgery, complete this cycle four to six times a day. After the first week, you can reduce the frequency to one to three times a day as needed.

IT TAKES TIME

The rehabilitation process is a marathon, not a sprint. Some days you will make great progress, and others you may feel you have made no gains or even taken a step backward. This is entirely normal and even expected. One strategy that can help is to focus on your week-to-week improvement. Are you bending further than on the same day a week before? If so, then great job. Is your quad functioning better that last week? If so, you are right on track. Take the opportunity to celebrate and reward yourself for the small victories in your rehabilitation journey. It takes time to get back to 100 percent, but the end result is worth the work.

RESTORING YOUR KNEE STRENGTH

Once your knee is bending and straightening well, it's time to focus on rebuilding your strength. This is what will enable you to return to your regular activities of daily life, such as walking up or down stairs, or return to sports such as basketball or skiing. There is no point having a great knee and never using it! To take advantage of your great knee, however, you need to build up the strength of the muscles that surround it. These muscles will not only

provide the forces that allow you to walk, climb stairs, or even run, but also serve to protect your knee for future injury.

For those experiencing pain or dysfunction related to arthritis or chronic knee pain, the strength program described here is also for you. The secret to success is to make incremental changes to the amount of load you place on your knee. Between exercise sessions, the change in load is so small that your knee will barely notice the difference, but cumulatively over time the changes become significant. In practical terms, increase either the weight you are using or the amount of repetitions you are doing by no more than 10 percent each week.

There are three components of strength that are best developed sequentially:

1. *Muscular endurance:* how long you can produce force
2. *Muscular strength:* how much force you can produce
3. *Muscular power:* how fast you can produce force

It takes about six weeks of work to maximally develop each individual component. Each one of the characteristics has specific training parameters, such as how long you rest between sets and how many repetitions that you complete, which influence how efficiently you develop the characteristic that you are focusing on.

MUSCULAR ENDURANCE EXERCISES

EXERCISE: Double-leg leg press

REPS / SETS: 3 × 15

REST IN BETWEEN SETS: 45 seconds

EXERCISE: Body-weight squat

REPS / SETS: 3 × 15

REST IN BETWEEN SETS: 45 seconds

EXERCISE: Double-leg bridge with leg lift

REPS / SETS: 3 × 15

REST IN BETWEEN SETS: 45 seconds

EXERCISE: Romanian deadlift

REPS / SETS: 3 × 15

REST IN BETWEEN SETS: 45 seconds

EXERCISE: Tuck squat

REPS / SETS: 3 × 60 seconds

REST IN BETWEEN SETS: 45 seconds

DOUBLE-LEG LEG PRESS

START: Depending on the machine, either be seated or lie down on your back. Your knee should be bent to approximately 70 to 90 degrees.

MOVEMENT: Using your quad and glutes, push through your feet to straighten both of your legs at the same time.

TIP: Be careful not to favor one leg or the other. They should both straighten at the same time.

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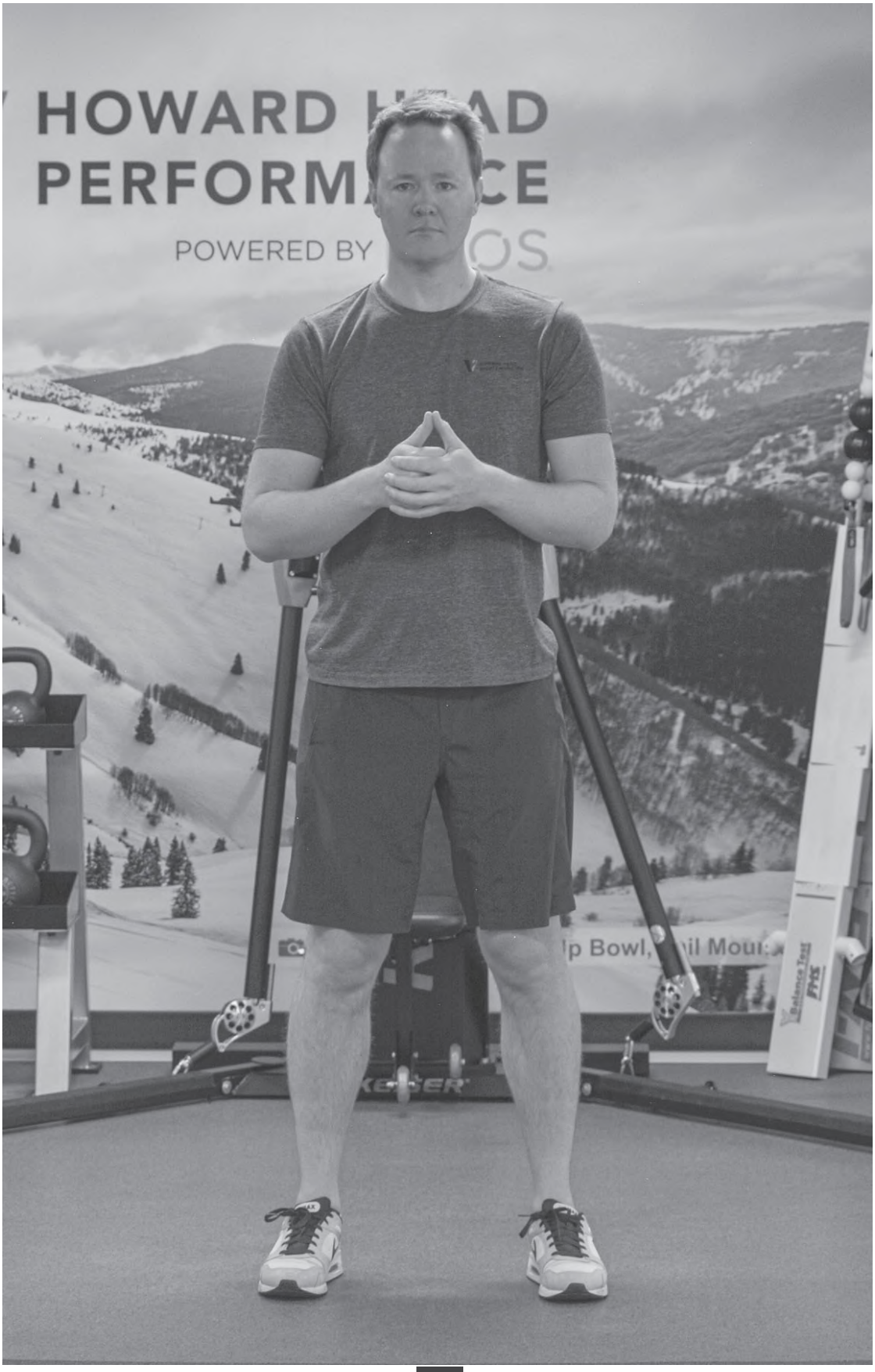
BODY-WEIGHT SQUAT

START: Stand with your feet a little broader than shoulder width apart.

MOVEMENT: Begin by flexing at the hips, and follow with flexing the knees. Lower yourself until you have approximately 70 to 90 degrees of knee flexion. Return to the start position.

TIP: Your body weight should be equally distributed between both legs.



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HOWARD HEAD
PERFORMANCE
POWERED BY EXOS
Sun Up Bowl,
Balance Test
FMS

DOUBLE-LEG BRIDGE WITH LEG LIFT

START: Lie on your back with your hips and knees bent. The heels of both feet should be within the distance of two closed fists from your bottom.

MOVEMENT: Using your glutes to produce the movement, lift your hips off the ground. At the top of the movement, your shoulder, hips, and knees should form a straight line. From this position, lift one foot two to three inches off the ground for five seconds. Return the foot to the ground, and return to the start position.

TIP: If you are using your glutes to produce the movement, you should not feel either your hamstrings or lower back working during the exercise.

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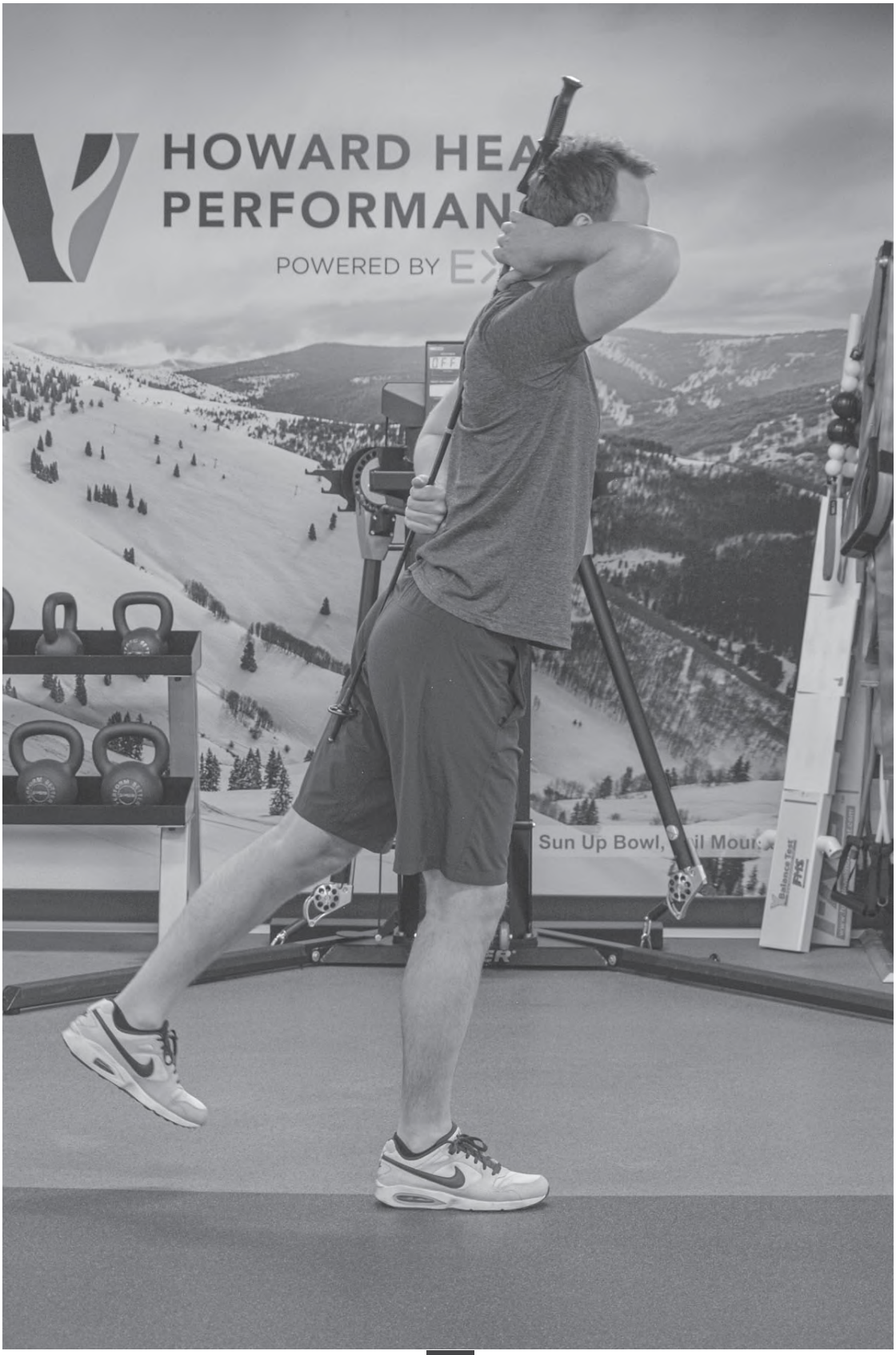
ROMANIAN DEADLIFT

START: Stand with a slight knee bend on the involved leg and the

unaffected leg straight and slightly behind the body. The bar helps with alignment.

MOVEMENT: Keeping the back leg straight, flex through the stance leg hip, lowering the chest toward the ground. Lower the trunk until you feel a stretch in the hamstring.

TIP: The knee position should remain the same as the start position through the exercise.



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TUCK SQUAT

START POSITION: From a standing position, raise your arms out in front of your body, and flex through the hips and knee to assume a deep squat position, similar to that of a downhill ski racer.

MOVEMENT: Using your quads, create small oscillation movements.

TIP: Create the oscillation movement at the knees, not the hips.

MUSCULAR STRENGTH EXERCISES

EXERCISE: Single-leg leg press

REPS / SETS: 3 × 12

REST IN BETWEEN SETS: 2 minutes

EXERCISE: Single-leg squat

REPS / SETS: 3 × 12

REST IN BETWEEN SETS: 2 minutes

EXERCISE: High box step-ups with kettlebells

REPS / SETS: 3 × 12

REST IN BETWEEN SETS: 2 minutes

EXERCISE: Romanian deadlift with kettlebell

REPS / SETS: 3 × 12

REST IN BETWEEN SETS: 2 minutes

EXERCISE: Tuck squat with cord resistance

REPS / SETS: 3 × 45 seconds

REST IN BETWEEN SETS: 2 minutes

SINGLE-LEG LEG PRESS

START: Depending on the machine, either be seated or lie down on your back. Your knee should be bent to approximately 70 to 90 degrees.

MOVEMENT: Using your quad and glutes, push through your feet to straighten your knee.

TIP: Ensure that at the end of the movement your knee is straight and not slightly bent.

SINGLE-LEG SQUAT

START: Stand on one leg, making sure to establish good balance, with your arms in athletic position at your sides. The leg that is off the ground can be slightly bent, aimed behind your body and center of gravity.

MOVEMENT: Bend the knee of the leg planted on the ground, aiming to achieve roughly 60 to 90 degrees of flexion, pushing your opposite leg farther back to maintain balance and using your arms as noted in the figures to maintain balance. Movement ends when you have returned to an upright position.

TIP: Go through this movement slowly and with control, as this is as much a strength exercise as it is a balance and proprioception exercise.

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HIGH BOX STEP-UPS WITH KETTLEBELLS

START: Stand in front of a box, holding a kettlebell in each hand.

MOVEMENT: Step forward with the affected leg, placing the affected leg's foot on the box. Extend the hip and knee of the lead leg using your quads and glutes to generate the movement so that you are now standing on the box. Return to the start position by stepping backward off the box, using the lead leg to lower your body back down to the ground.

TIP: When generating the force to stand up on the box, drive through the lead leg rather than propelling yourself forward with the rear leg.


3"
12"
P3
EXTREME

1


3"
12"
PB
EXTREME

2

ROMANIAN DEADLIFT WITH KETTLEBELL

START: Stand with a slight knee bend on the involved leg and the unaffected leg straight and slightly behind the body. Hold a kettlebell in the opposite hand of your stance leg.

MOVEMENT: Keeping the back leg straight, flex through the stance leg hip, lowering the chest toward the ground. Lower the trunk until a stretch in the hamstring is felt.

TIP: The knee position should remain the same as the start position through the exercise.

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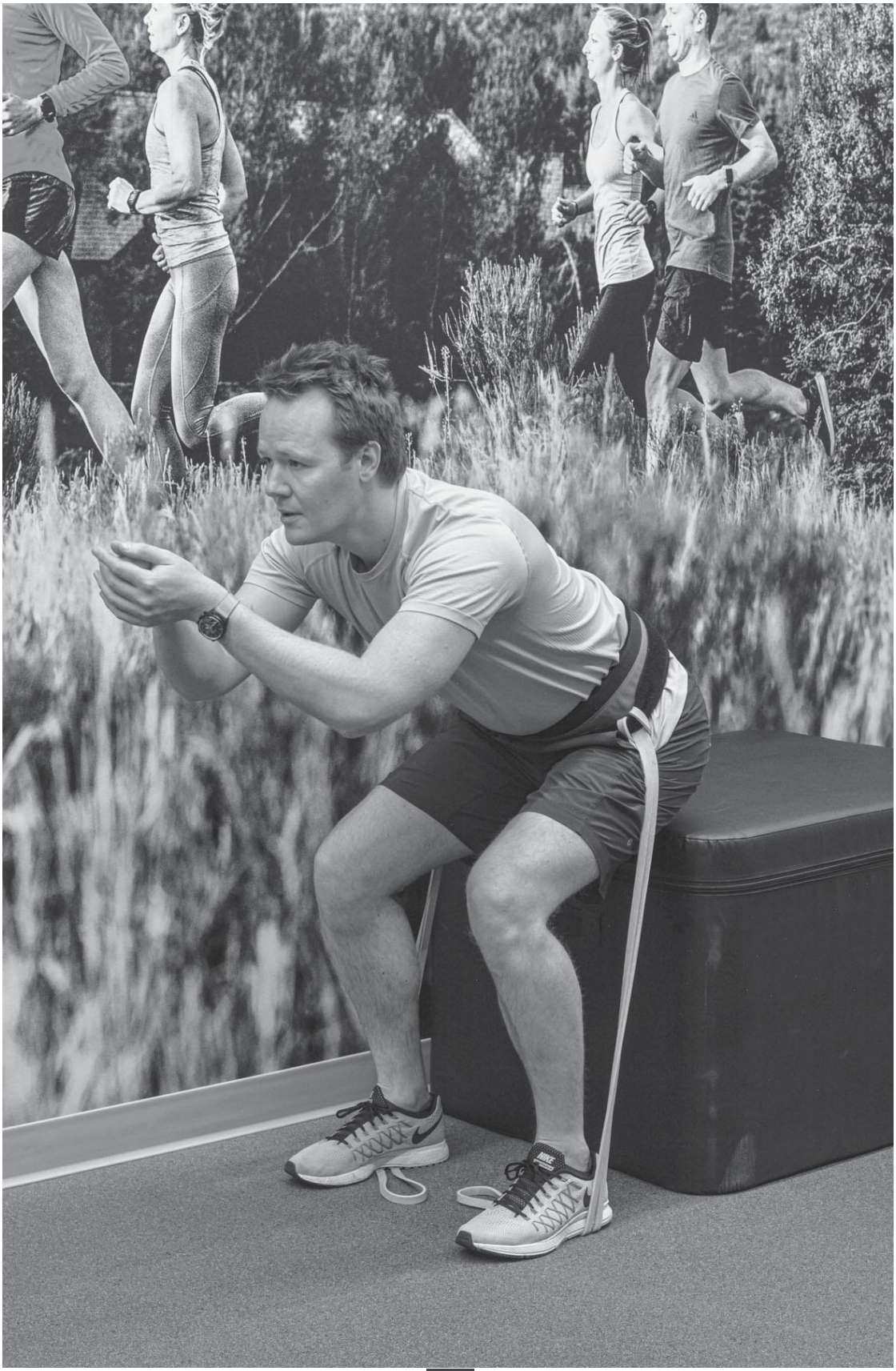
TUCK SQUAT WITH CORD RESISTANCE

START POSITION: Attach an elastic resistance band to a waist strap. Sit on a bench or chair, pull the band tight on each side, and then step to place your heels on the band to keep it taut. From the seated position, raise your arms out in front of your body and extend slightly through the hips and knees to assume a deep squat position, similar to that of a downhill ski racer.

MOVEMENT: Using your quads, create small oscillation movements. The resistance band should be taut at both the top and bottom of the movement.

TIP: Create the oscillation movement at the knees, not the hips.



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MUSCULAR POWER EXERCISES

EXERCISE: Single-leg leg press

REPS / SETS: 5 × 6

REST IN BETWEEN SETS: 3 minutes

EXERCISE: Split jumps

REPS / SETS: 3 × 6 each leg

REST IN BETWEEN SETS: 3 minutes

EXERCISE: High box jump-ups

REPS / SETS: 5 × 6

REST IN BETWEEN SETS: 3 minutes

EXERCISE: Tuck squat 1:4 jump

REPS / SETS: 5 × 6 jumps

REST IN BETWEEN SETS: 3 minutes

SINGLE-LEG LEG PRESS

START: Depending on the machine, either be seated or lie down on your back. Your knee should be bent to approximately 70 to 90 degrees.

MOVEMENT: Using your quads and glutes, push through your feet to straighten your knee.

TIP: Ensure that at the end of the movement your knee is straight and not slightly bent.

SPLIT JUMPS

START: From a standing position, step backward with one leg into a lunge stance position with one foot forward with the knee bent and the rear knee nearly touching the ground.

MOVEMENT: Extending through both legs, jump as high as possible, swinging your arms to gain lift.

TIP: Absorb the impact by reverting back to the starting position with the leg that started as the lead leg now the rear leg.

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HIGH BOX JUMP-UPS

START: Stand behind a box, with your feet a little wider than shoulder-width apart.

MOVEMENT: Flex your knees and hips to attain a squat position with your arms behind you. Extend your hips and knees, swinging your arms, and jump up onto the box landing with soft feet.

TIP: Step off the box rather than jumping off to return to the start position.

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TUCK SQUAT 1:4 JUMP

START: From a standing position, raise your arms out in front of your body, and flex through the hips and knee to assume a deep squat position, similar to that of a downhill ski racer.

MOVEMENT: Using your quads, create small oscillation movements.

On the fourth oscillation, fully extend your hips and knees to jump off the ground. On landing, return to the start position, and continue oscillating.

TIP: Create the oscillation movement at the knees, not the hips.

1

How often should you do these exercises? There is an enormous variability to answering this question, and it is difficult to generalize across all conditions. In general, people completing the aforementioned exercise programs three times per week, with one day of rest between each session, will have great strength gains. For some people who have either high athletic goals or more available time to commit to their recovery, a four-day-a-week plan may be appropriate. In this situation, back-to-back daily sessions followed by a recovery day is an option, so that there are four exercise days and three recovery days in a standard week. Be sure to first check with your medical provider on what is appropriate for your personal condition and situation.

HOW LONG WILL IT TAKE TO GET BETTER?

Some general guidelines can help inform you to make decisions regarding healing time.

The amount of time you may spend in physical therapy rehabilitating your injury is highly variable and dependent on the injury that you have sustained and what your goals are. If your goals are simply to be getting around without crutches or other walking aids, often that can be accomplished within a couple of weeks to a couple of months. If you have more physically demanding athletic goals, then it will take longer. The following bullet points provide a guideline as to the approximate time frames you can expect. The final decision to clear you for return to sports or other activities is made when you feel comfortable and confident in your knee, your medical team is satisfied with your healing and recovery, and you have passed a strength and functional movement testing program, a sample of which is included in Chapter 12. The decision to allow you to walk without ambulatory (gait) aids is usually based on three aspects: (1) your knee is healed enough to be stable to bear weight fully, (2) you are able to demonstrate good walking form (no limping) without gait aids, and (3) you are comfortable and ready to graduate from the gait aids.

- Reconstructed and repaired structures require a minimum of sixteen weeks to mature to the degree that they can begin to tolerate athletic loads. Most patients return to sports between six and twelve months after repairing and reconstructing a structure.

- Most bone injuries will be sufficiently healed in six to eight weeks. Most patients return to sports between three and six months after breaking a bone.
- Most muscle injuries require around four to six weeks to heal fully. Most patients return to sports between four and twelve weeks after a muscle injury.
- Most patients with total knee replacements are able to bear weight as tolerated immediately and graduate from ambulatory aids anywhere from a couple of days to a few weeks. Some patients are walking and even playing sports like golf within a couple weeks of surgery.

YOU CAN DO IT!

The recovery from any knee injury can be challenging. There is pain involved, and it may affect your ability to do the things you like to do or even limit your ability to work. But with a great rehabilitation plan and a strong support team including medical staff and family and friends, you will be able to make steady and significant progress toward your goals. The more persistence and effort you put in, the more likely you *will* be able to return to the activities you love. You've got this!

LOSE WEIGHT AND EAT A HEALING DIET

How Food Can Affect the Way You Recover

This chapter is not meant to fat shame you or tell you that sweets are banished from your life forever because they're, as Bobby Boucher's mother in *The Waterboy* would say, "The Devil." That would be blasphemy and hypocrisy because personally we like cookies as much as anyone. That said, if you want to maximize your healing potential, we recommend taking a closer look at your diet as a whole. The purpose of this chapter is to help you understand how your food choices can influence your knee recovery. You'll want to make sure that you're eating a balance of nutrients, and we suggest incorporating anti-inflammatory foods. We'll explore the relationship between certain foods and inflammation. But first, we'll look at how maintaining a healthy body weight conveys advantages to your knee joint.

WEIGHT AND KNEE HEALTH

"I have always been what many would call a big kid. Since the day I was born, I was above the 120th growth percentile and have stayed there since. Since I was this size at such a young age, coaches always made sure I was in the game. Football, basketball, and baseball were all I thought about as a kid and took up most of my time. In sixth grade I began playing tackle football for our local Pop Warner league. From day one I was hooked. Offensive tackle was my calling, and I was damn good at it.

"As an interior lineman you are prone to knee injuries from the wall of bodies moving and backfield action behind you. I became a statistic my second year in the game. At age twelve, I

tore my MCL and damaged my meniscus, something most kids that age don't experience. I managed to rehab my knee and was back out there in several weeks. Once I was in high school, my parents and doctor thought it was a good idea for me to wear knee braces to avoid another injury like the one I had years earlier.

"Despite wearing these braces I was still not immune to knee injuries. My sophomore year I tore my right MCL, the same one I had torn before, except this time much more severely. I spent five weeks immobilized but was lucky enough to make it back in time for basketball season. This is when I started to notice general pain in my right knee following exercise. When I tore my MCL, I again damaged my meniscus, and at a young age I was starting to run low on cartilage. As high school went on, I began to get heavily recruited by Division I football programs to play offensive tackle. As it was evident that football was going to pay for school, I put more eggs in that basket. I stopped playing basketball and made an effort to gain more weight and size to help my case as an offensive lineman. Sophomore year I was six-foot-four and two hundred fifty pounds. Junior year I was six-foot-six and two hundred seventy-five pounds. As I gained more weight, the knee pain became worse.

"I accepted a scholarship at the University of Washington in Seattle. To be a college offensive lineman (or at least a good one), you need to weigh over three hundred pounds. To get more force you need more mass—it's not easy to anchor on a bull rush when you're only two hundred sixty pounds; you'll end up in the quarterback's lap. Most college football teams like to redshirt their offensive linemen—that is, sit them out for two to three years. Then when you're ready, you might play as a junior or senior. There is a method to this if you're not familiar with offensive line play. The physical development is so key that it is almost a health hazard to play when you're undersized.

"I was lucky enough to redshirt, but as we were short on offensive linemen, I was forced to play the following year. I will be the first one to say it: I was physically not ready to be out there. I was exceptionally strong in the weight room but did not have enough mass in my butt and legs to make the needed impact. That year I was hounded by the strength and coaching staff to get my weight up. In no time I was up to three hundred fifteen pounds and starting to look the part.

"It was at this point where the injuries really started to add up. My sophomore year I fractured my left arm in our home opener, I broke my foot, wrist, and—come to find out after the fact—my back. The knee pain got worse: I would have to ice my knees after every game and practice just to keep the swelling down. Getting my knee drained was all too common, and soon I began to receive cortisone and synvisc injections to help my lack of cartilage.

"It was my senior year of college when my knee finally waved the white flag. One day at practice in fall camp, I tweaked my knee, and something did not feel right. I couldn't bend or move in a bent position, for that matter. Upon closer medical examination, it turned out the cartilage in my right knee was almost gone. Every time I bent my knee, my kneecap was

shaving off the remaining cartilage I had. Our staff tried everything to get me back on the field. Finally, my condition began to improve after roughly four weeks. It was our home opener, and I did not want to miss the game against a bitter rival. I practiced all week despite the pain; come game day, I was heavily medicated and managed to play the whole game. But the following day, when I woke up, I couldn't get out of bed. I was in so much pain I couldn't even move my leg. My knee was very swollen and clearly did not like my actions the day prior. After I talked to the doctor again, they informed me that I was at the end of my rope and would most likely not be able to play football much longer. I had to miss most of my senior season and would not be able to play in the NFL. As a three-year starter, captain, and kid who left it all out there, I was forced to leave the game I loved.

"There's a silver lining. Now, after I lost over seventy pounds, my knee pain has become much more manageable. I am able to exercise the way I want for the most part, but I have to avoid activities such as basketball and running. In due time I am sure I will need a new knee, but for the time being I will make do."

—Ben Riva, former college football player

It's true that most of us don't put our knees through this much trauma. But we've started the chapter with a story from Mr. Riva to demonstrate just how monumental an impact your weight can have on your knee health. When you go to your doctor with early signs of osteoarthritis, and they discuss nonoperative treatments, the first option physicians almost universally will recommend is weight loss.

Your knee is what's called a weight-bearing joint. Unlike your arms, which are mostly free from much of the burden of your body weight, your knee is constantly subjected to your weight and the force that weight enacts on it. It is kind of like what Yoda said: "You must feel the Force around you." Have you ever done a workout with a weight vest on? We bet you noticed the difference right away, and we can promise you: so did your knees.

Extra weight can affect the knees over time. We return to the balance of the knee joint. Remember, the knee joint has space between the femur and the tibia, created by soft tissues—the meniscus and cartilage. Think of the meniscus like one of those inflatable donuts people sit on. Logically you could reason that the donut would deform much less if a small child sat on it than if an adult did. That is because in the latter case, more mass, and thus force, is being placed on the donut. The same can be said for your meniscus. The more weight you apply to it, the more it will deform and wear down. Once you have worn your soft tissue protectants out, you end up with bone on bone contact, and that leads to osteoarthritis, which is unfortunately an irreversible and degenerative process. In addition, if you add enough weight

and force to your knee that your knee becomes inherently unstable, there is a risk for a severe traumatic injury (like a knee dislocation) with very little applied force.

For those of you who like to do the math: the force on your knee joint has been shown to be two to six times your body weight, depending on the activity you are performing. So for every kilogram of body weight you gain, you are adding two to six Newtons of force on your knee. That may not seem like much, but to put it into perspective, if the average American man gained an extra 10 percent, or say 20 pounds, then when performing a simple task like rising from a sitting position, they could be adding 90 pounds of force to their knee! For the average American woman, that would be 16 × 4.5 or 72 pounds of force. Neither of these are trivial amounts, especially considering how many times in a day you perform simple movements like standing up, not to mention more difficult ones.

Here's the good news: losing weight—even only a little weight—can really help! Imagine you have a bruise on your arm. If someone pressed lightly on the bruise, it may hurt a little, but it's bearable. Now imagine someone really mashes on it hard; that hurts significantly more. Similarly, once you have arthritis, you have a "bruise" in both of your bones of the knee joint, and it will not go away. However, you can make it hurt significantly less by pressing on it less hard—that is, losing weight. This is why one of the first things your doctor will recommend for those of you with a diagnosis of arthritis is to work on weight loss, which can help you avoid a need for surgery down the road.

The Framingham Osteoarthritis study in the 1990s showed some significant trends between weight and osteoarthritis. The risk of obese men developing osteoarthritis was five times higher and the risk for obese women was four times higher. For women, losing just eleven pounds could decrease their risk of getting osteoarthritis by 50 percent.

Other similar studies have reflected these findings, with recent studies showing that a two-unit increase in BMI (approximately five kilograms) leads to a 36 percent increase of osteoarthritis. These same studies showed 89 percent of those undergoing bariatric surgery (average weight loss of forty-four kilograms or ninety-seven pounds) had complete relief of pain from osteoarthritis in at least one joint. This is not to make an argument for bariatric surgery (that is a for a different book and a different doctor); rather it is again to emphasize that these risks are modifiable.

This data all goes to show that not only are obesity and osteoarthritis

intricately related, but you can reduce your risk by losing even a relatively small amount of weight. Ben, and many patients like him, have seen a drastic improvement in knee pain symptoms just by losing weight.

So how can you lose weight? This is where we put a major disclaimer stating we are not Jillian Michaels, Bob Harper, Shaun T, Tony Horton, or any other super trainer. We are simply medical professionals with some basic, scientifically based advice. The easiest way to combat obesity is to not allow yourself to become obese in the first place. While that is not the answer many people want to hear, it is the truth. It is far easier to maintain a healthy weight the first time around than it is to lose weight that has been gained and keep that weight off—although the latter is achievable.

The reason for this is actually much more complex than you might think. Once you reach a new weight, it can become your body's new baseline. When your body hits that new normal, your circulating levels of different hormones —glucagon, insulin, cortisol, and others—are modified, and all of these hormones affect your ability to metabolize what you take in.

So the key is to work on maintaining a healthy weight, no matter what you weigh now: eating healthy meals of good proportions and trying to exercise a minimum of three times per week.

If you want to lose weight, the way to do that is to burn more calories than you take in. Is it more complex than this, yes, but let's start here for simplicity's sake. If you burn more calories than you take in on a daily basis, your body has to use reserve stores for energy. In most cases it is the fat in your body. If fat didn't have a purpose, our body wouldn't produce it, right?

The purpose of fat is to be an energy reserve for when it is needed. Think of it as an extra gas can you would keep in your car should your main tank run out. For another example, think of the hibernating bear: bears and many animals will overeat or eat more in the summer and fall to store fat on their body that can be used for energy in the winter, when food is scarce. It is thought our body similarly has a seasonal clock that is set up to store excess fat for the harsh winter. That fat can then be burned and used for energy like wood for a fire. Other animals' weights fluctuate massively with changing seasons. Humans' weights, however, do not because our food is always in abundance. So instead of packing on the fall pounds and burning them off by beach season, we can remain hefty.

While that may have seemed to be a slight Discovery Channel tangent right there, the take-home point is that fat can be gained, and fat can be lost,

and the key principle to fat loss is to eat less than you burn. You may now ask: *How do you know how much you are burning and eating?* Even just a few years ago, that would have been quite difficult and time consuming to figure out. It would have required a lot of measuring your food, doing math to calculate calories, and trying to estimate the calories you burn working out. However, we live in the age of smart watches, apps, and simplicity. If you slap a smart watch on your wrist, most will keep track of your calories burned throughout the day, and downloading an app on your phone and plugging in your meals is an easy way to track your calorie intake (MyFitnessPal is a great app for this).

So you track your calories eaten via the app and track calories burned with the watch; you want the result of subtracting the latter form the former to be negative. How you do this is less important—there is no one right way—but there are a few different strategies that have been shown to be more efficient, especially in our fast-paced lives, when it feels as if sometimes you don't have enough time for a bathroom break, let alone a workout.

From a diet standpoint, many people understandably find it difficult to diet for a variety of reasons. Here are a few of our answers to common questions, with tips and tricks you can then pursue further on your own accord.

1. What weight loss diet should I try? Paleo, gluten free, vegetarian, vegan, Mediterranean, pescatarian… I am so confused. Multiple large cohort (involving many people) studies have been done comparing diets. There are even more being done more recently with the new popularity revolving around organic, vegetarian, and vegan diets. The problem with nearly every diet study is they are not controlled; that is, there are too many other variables like people's life habits, their genetics, their sex, age, race, overall health, and so forth. There is a lot of data out there on which diet is good or bad for heart health, cancer, diabetes, longevity, and so on; however, there is no definitive, unbiased data on which is best. Based on the evidence, the diet that probably has the most health-based advantages for the largest amount of people is the Mediterranean diet. However, what diet is best for each individual person varies, and this is likely an area of medicine and science that will greatly advance over the next decades. At a minimum, pay attention to your calories, aim to get in the recommended daily amounts of protein, vitamins and minerals, and essential fats, and aim to have as well-rounded a diet as possible.

2. I cheated on my diet. Should I just give up? The idea that you are to never ever, not on a plane, a train, in the rain, or anywhere Sam-I-Am

suggests, have a cheat meal (treats, burger, pizza) is not true. Plenty of healthy people, and even celebrities with abs chiseled from marble, take cheat meals (for a fun aside, check out Dwayne "The Rock" Johnson's Instagram the next time you have a moment, and you'll see what a cheat meal can entail). So have a cheat meal now and then; just don't overdo it. We like the idea of trying to maintain your diet 75 to 80 percent of the time. So if you can be very diligent about eating well during the week, you can treat yourself a little on the weekends. As with everything, the key is sticking with it and indulging in moderation.

3. Should I try intermittent fasting? This topic has entire books, websites, and fan clubs dedicated to it, so we will allow you to learn from the experts. The basics of this strategy are you keep the hours per day you eat more confined. Maybe you only eat between noon and 8:00 p.m. everyday. Or maybe one day a week you don't eat. While this may seem drastic, some people like the strict schedule; then you don't overthink each meal, and you know you are only going to eat from time A to time B, and that's it. The basic philosophy behind how it works is this: if you eat during fewer hours per day, you are likely to consume fewer total calories (again decreasing the calories is part of the equation).

4. What about the opposite—frequently eating smaller meals? Eating six small meals a day versus three more moderate-sized meals: the data regarding this is all over the place, with some studies showing lower insulin resistance and increased weight loss with multiple small meals (perhaps as a result of metabolism effects), and other studies showing again all that matters is total calories consumed versus burned. The moral is both probably work great.

A Note on Eating Disorders

The main gist of this review is that you should strive to eat a healthy diet. If you have a history of eating disorders, it is possible that monitoring your calories could trigger a disorder. We recommend working with your physician to ensure that you have the proper energy and nutrition to heal after your surgery.

Now let's look at a few tips and tricks for how to exercise.

1. What exercise should I do? We suggest high-intensity interval training (HIIT). This is the type of workout that provides the best bang for your buck. If you only have thirty minutes to work out that is fine—but spend those thirty minutes working your tail off. It doesn't need to be anything special—

we are not saying you need to do a CrossFit, ninja warrior, or Titan games workout. Simply hopping on the stationary bike and giving it your all for thirty minutes can be a great workout. However, don't get on that bike, pedal nonchalantly while texting your friends, and then wonder why you don't see results. Remember, like most things in life, you'll get out of it what you put in.

2. What's the best time of day to work out? While there is a whole load of data regarding the best time of day to work out, because of your job, family obligations, and life in general you may not have the luxury of an option, so the best time is whatever works for you. Now if you are flexible and want some specifics, there is some evidence that working out—specifically doing cardio or HIIT workout—first thing in the morning leads to increased weight loss, and this has something to do with your morning cortisol levels. However, the best time to gain muscle has actually been shown to be afternoon and early evening.

3. How do I stay motivated? This may be the hardest part of working out: finding the drive to show up in the first place. Goal setting—and particularly, making specific goals—is incredibly helpful. We have seen this play out in regard to our patients with their physical therapy and surgical outcomes as well. Patients who have concrete goals, such as, "I want to get back to varsity soccer," "I want to be able to hike the trails on my honeymoon," or "I want to be able to play eighteen holes without a cart," tend to do quite well because they know what they want and have something definable to track their progress toward. So do the same with your working out. Do not just say, "I want to lose weight." Give yourself a number, and furthermore give yourself a goal you want to be able to get to. These goals can be very similar to therapy goals. To take it one step further, write your goals down. It has been shown that those who put their goals in writing and vividly picture them are more likely to achieve them, so get out a pen and notepad.

FOOD AND HEALING

Not only can the amount of calories you eat affect your weight, the food choices you make may also have an effect on your healing, strength, and inflammation. Let's start with the macronutrients, the largest components that make up a food—protein, carbohydrates, and fat.

Protein

Protein is a key component in building muscle. (This is why bodybuilders go on and on about protein and ways to get more of it, via protein powders, bars, and so on.) Protein is made up of amino acids, which serve as building blocks for muscle, and therefore it plays an invaluable role in your diet.

Your protein intake can be particularly important during your recovery because protein is needed to heal. Numerous studies have demonstrated that consuming low levels of protein leads to decreased formation of collagen (a type of protein that muscles, skin, tendons, ligaments, and bone are all made of), which thereby leads to decreased healing. Protein is invaluable in helping you heal the tissues that were damaged, repaired, and reconstructed in your surgery, as well as in rebuilding your muscles in the recovery period. On the flip side, because nothing is simple, intake of too much protein can lead to digestive, vascular, and renal abnormalities. So what is the right amount? Although it's not clear-cut, recent recommendations say to aim for no less than 0.8 grams of protein per kilogram of body weight, and no more than 2 grams per kilogram. So that means an average adult female (150 pounds, or approximately 68 kilograms) should consume 54 to 136 grams of protein a day, with the sweet spot being somewhere in the middle.

Protein comes in numerous shapes and sizes, or types. If you eat animal products—meats, poultry, fish—these are all good sources of protein. You have probably heard of whey and casein (milk-based proteins). Protein can also be found in numerous plants like beans and lentils, soy (from soybeans), nuts, and pea protein (protein extracted from peas, commonly seen in plant protein powders). The list goes on. There is no universally accepted best source of protein. In moderation they all can be healthy, and in excess many can have drawbacks. For example, eating too much whey can cause digestive problems; too much red meat can increase your risk of heart disease; too much soy protein may affect estrogen levels in your bloodstream. Again, we find the saying "too much of anything is bad" is usually true with most things in life, including food. We recommend eating a variety of proteins, but each in moderation.

Below you will find a list of some foods you can easily access that are good sources of protein:

6 ounces of chicken breast

Approximately 280 calories, 6 grams of fat, 0 grams of carbohydrates, 52 grams of protein

6 ounces of sirloin steak

Approximately 414 calories, 24 grams of fat, 0 grams of carbohydrates, 46 grams of protein

6 ounces of Pacific cod (fresh caught)

Approximately 140 calories, 1 gram of fat, 0 grams of carbohydrates, 30 grams of protein

6 ounces of black beans

Approximately 175 calories, 1.6 grams of fat, 105 grams of carbohydrates, 36 grams of protein

6 ounces of lentils

Approximately 194 calories, 0 grams of fat, 35 grams of carbohydrates, 15 grams of protein

6 ounces of tofu

Approximately 129 calories, 8 grams of fat, 3.2 grams of carbohydrates (0.5 of which is fiber), 14 grams of protein

1 scoop of plant protein, vanilla flavored (dotFIT brand)

Approximately 130 calories, 2 grams of fat, 8 grams of carbohydrates, 21 grams of protein

1 cup of cooked quinoa

Approximately 222 calories, 3.5 grams of fat, 39 grams of carbohydrates, 8 grams of protein

Not sure how much protein is in your meal? For food that does not have a Nutrition Facts label, such as fresh produce and meats, you can usually find great nutrition information via a simple online search. The website Livestrong.com and the app MyFitnessPal are also helpful tools for tracking how you have been eating and the nutritional components of different foods.

Carbohydrates

Carbohydrates are the current social pariahs of the food world. These are the ones that according to magazines and some celebrities cause cancer, diabetes, heart disease, early aging, and family curses. But this is not the whole story! While it is true that *some* carbohydrates lack substantial nutritional benefit, your body needs carbs for energy. There are many kinds of carbohydrates, similar to protein. We will keep it simple and boil carbs down to two types: simple carbohydrates and complex carbohydrates. Complex carbs are bigger:

they take longer to digest. Carbs that fall in this category include whole grains—like oats, brown rice, whole wheat bread, and whole-grain pasta—and starchy vegetables, like potatoes, parsnip, squash, pumpkin, green peas, corn, and others. These carbs are very good for your digestive tract and forming stool, and they can be rich in vitamins as well. Consuming complex carbohydrates is also good for helping to fill you up and give you more long-lasting energy.

Why are complex carbohydrates important postoperatively? Well, for starters, remember the phrase and the subsequently titled book *Everyone Poops*? That author must not have known about the effects of anesthesia and opioids after surgery, because often those two wonders can make pooping incredibly difficult. Let it be said: you really can't underestimate just how uncomfortable the inability to pass a stool can be. You can get help from medications, but the three keys to staying regular are moving, a well-balanced diet rich in complex carbs, and staying hydrated. Foods that are high in complex carbs, namely fiber, are key to helping you form solid stool. Fiber specifically is quite important for digestive health because it is a carbohydrate the body can't digest. Therefore, it passes through the body undigested, it helps to form stool (yes, poop), and it helps regulate hunger and the body's sugars as well. Fiber can be taken by itself, such as in a supplement like Metamucil; it can also be obtained from many natural sources, namely fruits and vegetables, such as broccoli, pears, avocados, raspberries, artichokes, lentils, and Brussels sprouts.

Aside from the issue of healthy stool, complex carbohydrates can have many other benefits. Rice, for example, can be rich in B vitamins, which are good for health and energy. And green leafy veggies like spinach are rich in vitamin C, which is a key ingredient to healing, not to mention preventing scurvy. Vegetables and fruits in general are good sources of multiple vitamins and minerals. Carrots and sweet potatoes are good sources of vitamin A; spinach, chard, turnips, and asparagus are all sources of vitamin E; and romaine, Brussels sprouts, and spinach (again) are all great sources of vitamin K. These vitamins are crucial in your nutrition and will be mentioned again in the fats section.

The second carb category is simple carbohydrates. As the name implies, they are simpler—that is, they are smaller, they are digested faster, and therefore they are absorbed for usage faster. For these, think largely sugars: fruits, some vegetables, and then of course, sweeteners and less natural sources such as candy and baked goods. Simple carbohydrates like fruit are good for a fast source of energy—for a workout or recovery. And although

sugary sweets, from a nutritional standpoint, are mainly only good for your taste buds, an occasional treat can provide some good endorphins and happiness, which should not be overlooked. Your emotional psyche has been found to be a crucial element throughout the recovery process and has even been proven to increase the rate of wound healing.

That being said, one can easily get in trouble with too many simple carbs, namely too much sugar, because of their pro-inflammatory effect. Most Americans simply consume way too much sugar. Sugary foods are easy to grab on the go, easy to store, and therefore easy to produce and therefore readily available everywhere. The convenience, ease, and tastiness can encourage overindulgence. The pro-versus anti-inflammatory food discussion is another hot button topic right now, with numerous conflicting sources; however, sugar is a repeat offender in the pro-inflammation category. So while sugar is not the devil, in the acute recovery phase of your knee injury, it may not be your BFF either.

Here are a few examples of foods that are mainly composed of carbohydrates. Also, for those of you with a sweet tooth, or a desire to continue with your treats, we have provided some slightly healthier alternatives.

1 cup of fresh rolled oats

Approximately 305 calories, 5 grams of fat, 56 grams of carbohydrates (8 grams of fiber, 1 gram of sugar), 11 grams of protein

1 cup of sliced sweet potatoes

Approximately 115 calories, 0 grams of fat, 27 grams of carbohydrates (4 grams of fiber, 6 grams of sugar), 2 grams of protein

1 cup of long-grain white rice

Approximately 205 calories, 0 grams of fat, 45 grams of carbohydrates (1 gram of fiber, 0 grams of sugar), 4 grams of protein

1 cup of brown rice

Approximately 215 calories, 2 grams of fat, 45 grams of carbohydrates (4 grams of fiber, 1 gram of sugar), 5 grams of protein

1 cup of couscous

Approximately 175 calories, 0 grams of fat, 36 grams of carbohydrates (2 grams of fiber, 0 grams of sugar), 6 grams of protein

1 cup of whole-grain penne pasta

Approximately 145 calories, 2 grams of fat, 29 grams of carbohydrates (4 grams of fiber, 1 gram of sugar), 6 grams of protein

1 cup of fresh blueberries

Approximately: 85 calories, 0 grams of fat, 21 grams of carbohydrates (4 grams of fiber, 15 grams of sugar), 1 gram of protein

half of a large fresh grapefruit

Approximately 55 calories, 0 grams of fat, 15 grams of carbohydrates (2 grams of fiber, 12 grams of sugar), 1 gram of protein

1 mandarin orange

Approximately 40 calories, 0 grams of fat, 10 grams of carbohydrates (1.5 grams of fiber, 7.5 grams of sugar), 0.5 grams of protein

SUGAR CRAVINGS

We get it—we love dessert, too. Whenever possible, we urge you to eat whole fruit if you need a sweet snack. But when you just gotta have it, try to look for a brand that has a better nutritional profile. Ice cream lovers, instead of reaching for the traditional old-fashioned ice cream, we suggest trying Halo Top. Not only is it much lower in calories, but this brand has found a way to cut down on the simple sugars and has actually upped the protein as well. Here is a comparison of one pint of its vanilla versus a more popular brand's vanilla ice cream:

Halo Top vanilla: 240 calories; 8 grams of fat; 56 grams of carbohydrates (breakdown: 20 grams of fiber, 16 grams of sugar, and 20 grams of sugar alcohol); 24 grams of protein; 8 percent of the recommended daily allowance (RDA) of vitamin A; 52 percent of the RDA of calcium

Häagen-Dazs vanilla: 1,080 calories; 72 grams of fat; 84 grams of carbs (all sugar); 20 grams of protein; 60 percent of the RDA of vitamin A and calcium

Note: These are entire pint-size servings. Let's face facts: Who grabs a pint out of the freezer and only eats one serving (half a cup) in a bowl? If you grab that bad boy out of the freezer, it's going straight to the belly.

If you have a candy-shop sweet tooth, instead of popping Jolly Ranchers, Airheads, Sour Patch Kids, or whatever your vice may be, try replacing it with a Ziploc bag of some chopped up fresh fruits. Ones that can be particularly sweet include mangoes, berries, and watermelon. Admittedly, these still have a fair amount of sugar; however, they also have fiber, vitamins, and minerals, which can be helpful for your body.

If you're a fan of baked goods like pancakes and waffles for breakfast, instead of using the traditional pancake and waffle mixes, we like using a healthier option such as Kodiak Cakes, which can also be used to make treats like cookies and brownies. This brand makes its mix with more whole grains and therefore has more of those complex carbs, like fiber, that we want in our postoperative diet; it also has packed a little extra protein punch in there. Let's have another nutrition comparison:

Kodiak Cakes Original, half cup of mix: 190 calories; 2 grams of fat; 30 grams of carbs (5 of which are fiber, 3 are sugar); 14 grams of protein

Bisquick, half cup of mix: 225 calories; 4.5 grams of fat; 42 grams of carbs (less than 1 gram of which is fiber and 3 of which are sugar); 4.5 grams of protein

Fats

Lastly, we come to fats—*formerly* the social pariah of the nutrition world. (Remember low-fat diets?) Like the beard and the hard-part comb-over, fats are making a comeback to popularity, but for good reason. There are many different types of fats, but again we'll keep it simple and break them into two general categories: saturated (the bad) and unsaturated (the good) fats. What makes a fat saturated versus unsaturated is its chemical structure. But instead of droning on about carbon bonds, we will use a Tetris analogy. You know the computer game Tetris, right? Think of saturated fats as those long, oddly shaped blocks that you curse under your breath when you see them coming because there is nothing you can do with them. They can stack up and ruin a good game before you know it. Unsaturated fats, on the other hand, are like the nice symmetrically shaped pieces that fit perfectly and then dissolve and disappear. That is a very simplified way to think of fats. The "good fats" can be easily broken down and used by your body to perform its functions, while the "bad" ones accumulate and cause problems. Good fats are important for many bodily functions, including proper digestion and absorption of your food. Also some of those good fats, especially those high in omega-3 fatty acids, have been proven to be very healthy for your heart, and while the authors of this book mainly like bones, tendons, and ligaments, even we know how important your heart is in your overall health.

Why are fats important for you in the postoperative period? Good fats are

an excellent source of calories and can provide long-lasting energy, which can be crucial during the exhausting grind of postoperative recovery. Also, as we have mentioned, fats are important for proper digestion, specifically, for digestion of vitamins A, D, E, and K. These are fat-soluble vitamins, meaning that they dissolve or get broken down to be absorbed via fats. Without the right amount of fat in your diet and body, you could consume endless amounts of these vitamins, and you would not absorb any. It's especially important to absorb vitamin D in your postoperative period because it is a key component of healing and forming healthy, strong bone. It does this by increasing absorption of calcium in the intestines. When you do not have adequate calcium absorption in the diet, your body looks for alternative sources—your bones—and breaks down bone to acquire the calcium it needs, thereby weakening the bone. A similar process causes osteoporosis. This helps explain just how important vitamin D is to your bony health.

Fats come in a wide array and sometimes in foods you wouldn't think of as being high in fat. Here we have listed some good sources of fat to help point you in the right direction.

half of a fresh avocado

Approximately 160 calories, 15 grams of fat, 9 grams of carbohydrates, 2 grams of protein

1 tablespoon of organic peanut butter

Approximately 100 calories, 8 grams of fat, 2 grams of carbohydrates, 5 grams of protein

1 tablespoon of organic almond butter

Approximately 100 calories, 9 grams of fat, 3 grams of carbohydrates, 4 grams of protein

1 tablespoon of olive oil

Approximately 120 calories, 14 grams of fat, 0 grams of carbohydrates, 0 grams of protein

6 ounces of wild caught king salmon

Approximately 395 calories, 23 grams of fat, 0 grams of carbohydrates, 45 grams of protein

Also of note, salmon has a huge amount of marine-based omega-3: approximately 1,700 milligrams, or roughly the serving size, more than in most over-the-counter supplements.

ANTI-INFLAMMATORY SUPERSTARS

There are a few more powerhouse foods that are anti-inflammatory modulators. Here we'll take a quick look at two types of nutrients commonly touted for their anti-inflammatory effects. We will go over what they are, how they work in helping to prevent or decrease inflammation, and the foods that contain them.

Omega-3 Fatty Acids

Omega-3 fatty acids are considered essential, meaning they must be eaten because your body cannot produce them. They are a type of unsaturated fat—the good fats—and specifically, they are a polyunsaturated fat (meaning it has more than one unsaturated carbon bond). Omega-3 fatty acids make up an important part of your cell membranes, which in turn are an important modulator for making hormones that regulate blood clotting and inflammation. They have been found to be correlated with decreased incidence and symptoms of many systemic diseases, such as heart disease, prostate cancer, hypertension, rheumatoid arthritis, and many others.

So how exactly do omega-3 fatty acids do all these amazing things, and more importantly for you, how do they decrease inflammation? The answer isn't straightforward and isn't fully understood. Fatty acids seem to downregulate some key components of the inflammatory cascade—that is, they lead to decreased production of inflammatory promoters and products at the cellular level, which thereby lead to overall decreased inflammation in the body. This decrease in inflammation has been shown in studies both grossly and microscopically, by measuring markers of inflammation. Furthermore, some studies have actually found that this increase in inflammation can lead to decreases in pain that are similar to those conferred by some rheumatoid arthritis pain medications, and NSAIDs (like Aleve and aspirin) for conditions such as chronic neck and back pain. Again, there is not a consensus on the topic, but we can say omega-3 fatty acids do tend to promote an anti-inflammatory state.

So why doesn't everyone recommend taking these miracle pills from Magic Max? Well, the answer is mainly lack of sufficient scientific information. Specifically in the medical community we need to prove things work, and they cause no or minimal harm. There is relatively little data regarding omega-3's effect, especially when it relates to musculoskeletal disease and in a postoperative setting. There are a few studies of rheumatoid arthritis populations that have shown a decreased need for other forms of pain

medication in those using omega-3 supplements. But in regard to use of omega-3s for normal osteoarthritis and in a postoperative setting, information is limited.

Again, if there is a theoretical benefit, what would be the reason not to take it? There is a possible risk of bleeding. It has been shown that omega-3 consumption can decrease platelet aggregation, and the concern in the past was that it would cause decreased clotting ability and thereby increased bleeding. A few recent studies have demonstrated that omega-3 usage does not increase the bleeding risk and are completely safe when undergoing cardiac procedures, but there is no data for usage with orthopedic procedures. With this in mind, talk to your surgeon and get their opinion on the matter. Long story short: the verdict is out on omega-3s, but they have the potential to be a helpful adjuvant.

Where can you find these elixirs of health? Marine-based omega-3s can, as their name implies, be found in seafood.

Great sources of omega-3s in seafood include but are by no means limited to the following foods:

Mackerel: 4,107 milligrams per approximately 3-ounce serving

Salmon: 4,023 milligrams per 6-ounce serving

Cod liver oil: 2,664 milligrams per tablespoon

Herring: 3,181 milligrams per approximately 6-ounce fillet

Oysters: 565 milligrams per approximately 6 raw oysters

For nonmarine-based omega-3s, there are similarly many readily available options:

Flaxseeds: 2,338 milligrams per tablespoon

Chia seeds: 4,915 milligrams per ounce

Walnuts: 2,542 milligrams per ounce

Soybeans: 1,241 milligrams per half cup

There are numerous options for how to obtain your daily omega-3 equivalents in a well-rounded diet. However, if you are a picky eater and your diet does not include many natural sources of this wonder nutrient, then taking an omega-3 supplement may be something to consider. As with all medications and dietary recommendations, talk to your doctor, as they know your injury and your history. Talk to them about the benefits and risks of adding an omega-3 supplement to your diet. Most health organizations agree

that between 250 and 500 milligrams of combined EPA and DHA are adequate. Consuming omega-3 fatty acids is something with minimal risk that can possibly be beneficial, but consuming too much can pose an increased bleeding risk, so if you have problems with bleeding, it would be something to monitor.

Antioxidants

Free radicals are unstable molecules produced by the body in response to the environment and other pressures. These free radicals cause oxidative stress, which is a process that can lead to cell damage and has been linked to a variety of diseases including Alzheimer's, cancer, Parkinson's, cardiovascular disease, and diabetes. Antioxidants are sometimes called free radical scavengers because they inhibit this damage. They act by blocking these free radicals or blocking the oxidative stress (I know—very cleverly named!). Antioxidants can be both produced by the body and taken in through diet. Vitamin C and vitamin E are antioxidants, so fruits and vegetables are common sources. Hence another reason to eat lots of green things other than because your mother told you to.

One particularly promising food source is turmeric, a spice that belongs to the ginger family and gives curry its yellow color. It is commonly used in Indian cuisine and is also a medicinal herb. For a long time the effects of turmeric were less well understood; it has gained more attention recently, and our understanding is growing. The most important compound of turmeric is curcumin, which is an antioxidant and has anti-inflammatory effects.

Curcumin has been found to be associated with many different positive health benefits, including decreased rates of cancer, decreased rates of heart attack and cardiovascular disease, improved wound healing, and significantly decreased markers of systemic inflammation. In musculoskeletal studies there is good basic science as well as clinical studies that demonstrate turmeric is a good adjuvant for patients with osteoarthritis and has resulted in decreased pain and symptoms of osteoarthritis. Still, there is no significant data regarding turmeric use in the postoperative setting.

Our team would be remiss if we didn't remind you that too much is no good. Too much turmeric can be associated with digestive problems, headache and nausea, skin rash, and, in some people who are already at risk, kidney stones. Another commonality with omega-3 is possible bleeding risk. There are recent large studies that demonstrate the safety of turmeric—specifically that the bleeding risk is minimal. Again, there are minimal studies

in musculoskeletal conditions or in a postoperative setting, so consult your treating physician.

The exact mechanism by which curcumin and turmeric have their anti-inflammatory effects is not well understood. Again it appears to be related to downregulating (or shutting down) effects on the inflammatory cascade or process. Curcumin appears to lead to cell death of neutrophils, which are a cell type that promotes inflammation. In studies involving inflammatory states such as sepsis, which usually have high markers of inflammation across the board, curcumin administration appears to significantly decrease these markers. This is most likely due to curcumin's effect of blocking NF-κB, a key inflammatory marker that stimulates genes that trigger the body's inflammatory cascade. We still need to learn a good deal more about the exact mechanism, but enough is known to say that there is most definitely correlation and probably causation.

As far as getting it in your diet goes, curry is quite delectable, and given that turmeric is a main ingredient, that is a good place to start. Curcumin is not found in high concentrations in turmeric, however, so to obtain a high quantity of curcumin you usually need to take a supplement. It is also recommended that you consume black pepper with the curcumin, as curcumin is not naturally absorbed well, and black pepper increases the absorption by 2,000 percent. Again, chat with your top doc about their thoughts on this solution before trying it yourself; they know you best.

Another source is ginger, a flowering plant that originated from China and is closely related to turmeric. The root of the plant is what is commonly referred to as ginger, and is used as a spice and a medicinal herb. It comes in a variety of forms, including fresh, dried, powdered, oil, and juice, and can be used in a multitude of recipes. Similar to turmeric, ginger has a major active ingredient (gingerol), which is both an anti-inflammatory and an antioxidant.

Ginger has been used for a multitude of medical purposes, including as a common anti-nausea medication and for both morning sickness and sea sickness. Like other super supplements, it appears to be helpful for the heart and the major vessels. Studies have shown ginger to reduce fasting blood-sugar levels, hemoglobin A1C, and even cholesterol levels. All of these are good things for a healthy heart!

Ginger is also similar to curcumin in that it has some analgesic (pain reducing) and anti-inflammatory effects. It has been shown to decrease muscle pain and soreness when taken regularly and to help reduce pain and stiffness associated with osteoarthritis. It has also been found to decrease the

risk of cancer and cardiovascular disease, to have protective effects for the kidney in renal disease, and to decrease other inflammatory processes. It seems to take this effect in a similar manner to curcumin: its antioxidant effect is protective. Ginger inhibits markers of inflammation and thereby overall inflammation in the body.

What is the catch with ginger? Similar to both curcumin (turmeric) and omega-3, consuming too much ginger can cause abdominal discomfort, heart burn, indigestion, and bleeding. Ginger has been reported to reduce platelet aggregation and thereby has a theoretical risk of increased bleeding. Again there is little data regarding its effects in musculoskeletal conditions, most notably after surgery. So we repeat: speak with your physician before using it.

The best source of ginger is ginger root. It can be ground, mixed into a smoothie, put through a juicer, or cooked and eaten in bigger chunks. It can be found in a variety of foods such as natural ginger ale, gingerbread, ginger tea, and ginger sticks. Also, ginger can be obtained in supplement form, which has a much higher concentration than natural sources.

In summary, diet is a key aspect of the prevention and recovery of an injury. Maintaining a healthy weight helps keep excess force off your knees, while a balanced diet is of utmost importance for tissue healing and therefore should have a central role in your rehabilitation.

CONSIDER INJECTIONS TO RELIEVE SYMPTOMS

From Steroids to Stem Cells, Will They Make Me Heal Like Superman?

What's the deal with getting knee injections? Knee-related conditions, whether caused from injury or degenerative conditions such as osteoarthritis, often linger and can be challenging to fully eradicate. To improve the healing process and alleviate pain, there's another tool in the medical arsenal: biological injections are available to help relieve your pain and help you get back to your regular life, potentially without surgery. These injections are minimally invasive and can be especially beneficial for chronic conditions like osteoarthritis. Other times, surgeons use these biological therapies to augment surgery (a combination of surgery and injections at the same time) hoping that this will accelerate the healing process.

Most of the evidence for biological therapies is for knee osteoarthritis, and therefore this chapter will emphasize biological treatments for that condition. The jury is still out on whether these treatments are beneficial for athletes with acute injuries, although there are studies to suggest it, and there have been anecdotal claims by high-profile sports athletes that these treatments have worked for them. In general, with injections, each joint or part of the body should be considered separately, since some injuries like tennis elbow have shown promising results, whereas Achilles tendon injuries have not.

Osteoarthritis affects over fifty million adults in the United States and is the most prevalent musculoskeletal disease. Worldwide, it is estimated knee osteoarthritis affects approximately 3 percent of the population, or approximately two hundred million people. Osteoarthritis has been reported

to account for up to 18 percent of all health care visits and is associated with numerous other health issues, including increased rates of depression and other conditions such as diabetes, obesity, and heart disease. Economically speaking, osteoarthritis is the highest cause of work loss per year, costing the US economy roughly $100 billion per year. For comparison, health care costs from osteoarthritis constitute twice the costs devoted to chronic heart and lung disease.

Osteoarthritis is so common that it used to be regarded by physicians as purely a normal aging process—joint wear and tear. However, it was difficult to explain why sometimes knees that had the same amount of osteoarthritis would manifest with different symptoms from person to person, ranging from asymptomatic to very painful. Today we know this can be explained by the fact that inflammation plays a major role in how symptoms manifest. Biological therapies are commonly used to target inflammatory proteins, which diminish the inflammation and the subsequent symptoms it causes.

It is estimated that 85 percent of osteoarthritis originates from changes derived from a normal aging process (just like gray hairs and wrinkles). The remainder occurs from post-traumatic osteoarthritis (PTOA), which occurs after a knee injury such as an ACL or meniscus injury that predisposes the knee to future joint degeneration. (See Figure 11.1.)

FIGURE 11.1.
Osteoarthritis

It is important to differentiate osteoarthritis (wear and tear changes of the joint) from rheumatoid arthritis, which is an autoimmune disease (where your body attacks its own joints). In autoimmune diseases, the immune system malfunctions and attacks the body instead of intruders. In the case of

rheumatoid arthritis, it attacks the synovial membrane that encases and protects the joints, often affecting several joints at one time.

As of now, there is no cure for osteoarthritis and no treatment that can regrow cartilage for an osteoarthritic knee; the symptoms can only be managed. Biological injections can provide a great source of temporary pain relief by diminishing inflammation and improving lubrication in the joint. The optimal time to get these injections depends completely on your symptoms. If you are suffering from pain, and it's limiting your activities to a point where you feel that you cannot do things you would like to do, it is the right timing to look into these options. Sometimes waiting can lead to further muscular shrinkage as a result of inactivity, with subsequent worsening of the symptoms. The goal for us sports medicine doctors is to keep patients active to perform the activities they would like to do.

This chapter can help you determine if injections might be right for you. What are these therapies and what's the difference between them? Are they approved by the licensing agencies? What are the risks? We'll examine the pros and cons.

THE BASIC TYPES OF INJECTIONS

Analgesics (Steroids), Gel Injections (Hyaluronic Acid), and Biological (Growth Factors and/or Stem Cells from Your Own Body)

Most of these injections are comprised of the natural constituents of our body. Steroid injections utilize cortisol, a hormone in the body that reduces inflammation for pain relief (among several other functions). A lubricant injection involves hyaluronic acid (HA), one of the main molecules that forms cartilage (the coating of the bone within the joint). Platelet-rich plasma (PRP) is an injection derived from your own blood that has been centrifuged (aka stirred like clothes in a washing machine spin cycle) to obtain platelets with proteins that can aid in healing. And stem cell treatments include a procedure known as bone marrow aspirate concentrate (BMAC): a sample of your own marrow undergoes the same process as PRP to obtain not only important proteins for healing (also known as growth factors) but also a small amount of stem cells, which are intended to regenerate the affected diseased tissue. Note that it has not been proven to do so yet. Let's take a closer look at each.

Corticosteroid Injections

Steroid medicines act like the hormone cortisol, which works on our own defense system to reduce inflammation in the body. Because most bodily cells have cortisol receptors, it also affects many other functions: cortisol helps control blood sugar levels and blood pressure, regulates the metabolism, and affects salt and water balance.

Decreasing inflammation usually translates into pain relief. Several steroid drugs are FDA-approved to treat osteoarthritis, although there are conflicting reports on which one is most effective. Triamcinolone (Kenalog) is the most consistently regarded as the best type of steroid for knee osteoarthritis.

As a general rule, the less wear and tear your joint has, the more pain relief you can expect. Cortisol injections are more beneficial when there is not a lot of knee joint damage; thus, knees with advanced osteoarthritis are less likely to see good outcomes from these injections. To determine the amount of damage to your knee joint, your doctor will send you for x-rays, which will mostly show bony involvement. In a normal knee x-ray, there should be a space between the shinbone and thighbone of approximately five millimeters, which accounts for the presence of cartilage (the gristle on the end of the bone) and meniscus (which are not visible to x-rays). When the arthritic process begins to wear the cartilage down, the space between the bones becomes smaller and the meniscus starts to shift outside the joint, which creates even more narrowing of the joint space. If the degenerative process continues, bone-on-bone changes can be observed. You'll usually experience these as grinding and clicking when bending the knee, because bone spurs form from the abnormal contact between both bones.

The knee joint is contained within a bag called the capsule. Thus, an injection into any point of the knee will result in diffuse action of the liquid injected, regardless of the needle entry site. The needle needs to enter the capsule in order to take effect.

Generally, one to two cubic centimeters of cortisone are used per injection. Every doctor has a different method for injecting steroids. A cold spray is frequently used to numb the zone before the needle is inserted. Your doctor may or may not use an ultrasound to guide the needle. The most common approaches are:

- **Superolateral approach (above and outside the kneecap):** The patient lies on the table with the knee almost fully or fully extended with a thin pad support underneath the knee to facilitate relaxation.
- **Anterolateral and anteromedial approaches (both below the**

kneecap, and outside and inside to the patellar tendon respectively): The patient can sit with the knee flexed to 90 degrees for better exposure of the knee, facilitating ease of needle entry into the joint space.

The steroid should start working *within a few days*. This is important—give it time. You may feel pain relief immediately, even before leaving the office. That is an effect of the local anesthetic, such as lidocaine or bupivacaine, something not all that different from what you would get at the dentist. It will wear off in a few hours, however, usually before the steroid starts working. Sometimes the day after you get an injection, your knee will actually hurt a little worse than before. Often patients are so happy about the initial pain relief they go off and climb the highest mountain or run a marathon (metaphorically speaking, of course), and then they get reflex pain. Be aware of this possibility, not only so you are not surprised if this happens, but also so that you do not overdo it immediately following the injection. See if your knee feels better a few days after the injection, confirming that the injection was actually put correctly into the knee joint capsule.

Corticosteroid and local anesthetic injections can also sometimes aid in your diagnosis. Nerve endings in the knee are not well trained like the nerves in our fingers, which can recognize almost everything with amazing precision. If the pain is being generated from inside the joint, a complete relief of the symptoms initially should be expected after the injection. If there is no symptomatic relief, other causes of pain should be investigated. If the pain is not relieved by an intra-articular injection, at least initially with the anesthetic, it is most likely coming from somewhere outside the knee joint (skin, muscles, tendons), or it's possible that the injection never entered the joint. Your doctor will need to go back and reanalyze the clues to get the correct diagnosis.

Corticosteroids work faster than any other biologic injections, but their effects don't usually last long (only about four to eight weeks). Icing the knee after the injection and relieving the joint from impact (elliptical, biking, or swimming instead of walking, running, or jumping) have been shown to improve results. Corticosteroid injections are considered safe when given with enough time between each other, at least three to four months apart. It's possible to have side effects, such as irritation of the joint (redness, warmness, and pain), an increase in blood sugar levels (which should be considered in people with diabetes), and a thinning of the bone structure around the knee (which is rare). If your symptoms do not improve after a couple of injections,

other approaches should be attempted.

Gel Injections (Hyaluronic Acid)

A healthy knee joint has up to four milliliters of joint fluid within the joint capsule. Inside the joint capsule, specialized cells known as synoviocytes produce the components of this joint fluid: hyaluronic acid (which is also one of the main components of cartilage), salts, collagen, and different proteins. Hyaluronic acid (HA) gives the joint fluid its viscous, slippery quality. It acts like a shock absorber and lubricant in your knee joint and is needed to help the joint work properly, allowing the cartilage surfaces that coat your bones to glide on each other smoothly. When cartilage wears off, such as in the case of osteoarthritis, more fluid is produced in an attempt to improve the gliding of the surfaces and also to diminish the inflammation.

Joints affected by osteoarthritis typically have a lower concentration of HA in their joint fluid than healthy joints and therefore less protection against joint friction and impact. This condition further accelerates the joint degeneration process, setting in place a vicious cycle. A gel injection may artificially supplement the joint fluid's natural viscosity—this is known as viscosupplementation.

By injecting an engineered normal fluid component, doctors hope to temporarily lubricate the knee joint, thereby decreasing pain, improving function, and perhaps even slowing the degeneration process. Interestingly, viscosupplementation seems to work, but not for the reasons initially expected. The injected fluid doesn't stick around for long in your joint—it's frequently cleared within a day or two. Even so, pain relief can last months following a single injection or sequential HA injections. Several researchers have found that viscosupplementation provided a clinical improvement in pain and function compared to all other treatment modalities for up to twenty-six weeks, with significant improvements when compared to pre-injection.

It's thought that viscosupplementation works because of its anti-inflammatory actions. Briefly, in osteoarthritic knees, HA that is normally in the joint binds to proteins that promote inflammation and tissue damage. Injecting large amounts of HA may clear the knee of these inflammatory complexes, alleviating the pain symptoms that result from its presence.

Several versions of hyaluronan gel injections are used to treat the symptoms of knee osteoarthritis. Their effectiveness is closely related to the preparation. The natural fluid of the knee is extremely viscous (heavy). Gel products that are similar in viscosity to natural joint fluid are thought to be

more effective. Still, not all heavy gels are equal since the natural hyaluronan is only one molecule, and sometimes engineered HAs are composed of multiple smaller pieces of HA put together to make it heavier. Indeed, a single-chain HA (one piece) has been reported to be more effective. The processing technique is also important: it can be produced by the extraction of avian-derived virus molecules (AD-HA) or through bacterial processes of biological fermentation (Bio-HA). The latter is considered to be less likely to cause an immune response, which leads to swelling in about one out of two hundred fifty patients. Make sure you ask your doctor if the product you will be receiving is single chain and Bio-HA, as these characteristics have been reported to produce better outcomes.

There are two common regimens: one single viscous injection or multiple injections given every week or every other week. A recent review of several studies showed that multiple injection regimens provided better pain relief than single injections. They also showed that viscosupplementation was generally deemed safe with few to no treatment-related adverse effects reported across studies. The most common side effects of viscosupplementation are pain, swelling, and inflammation at the site of injection. Infrequently, these symptoms are pronounced enough to require immediate medical care. Additionally, a small number of people have an allergic reaction to the injected material. You should let your doctor know if you have allergies to eggs, bird feathers, or other bird products because some viscosupplementation injections may spur an allergic reaction. Finally, although it is highly unlikely, any injection into the knee carries a risk of infection.

When the pain relief wears off, you may get another series of injections. There should be at least six months in between the initial injection and the second round (although no studies have assessed this time frame). Viscosupplementation treatments can be repeated one or more times but may not work indefinitely. As with cortisone injections, when osteoarthritis is more severe, there may be less symptomatic relief.

Platelet-Rich Plasma (PRP)

Blood has four main components: red blood cells, white blood cells, platelets, and plasma. Platelets are tiny blood cells that are mainly in charge of blood clotting; they transport over 1,500 proteins responsible for stimulating the proliferation of new cells and collagen (one of the main components of cartilage) and suppressing inflammation and cell death. Plasma is the fluid that carries all the other blood cells. PRP injections aim to deliver a large

number of platelets to injured tissues in the hope that they can help an injury heal better and faster.

Platelets play a fundamental role in healing because they are a natural source of growth factors (proteins), which are stored in small bags within the platelets called α-granules. Growth factors are involved in the important stages of tissue healing and regenerative processes. They tell your body to send the proteins needed for regeneration.

PRP injections are made from your own blood, which is collected and then centrifuged at varying speeds until it separates into layers. Different types of blood cells have different weights. If blood is treated to prevent clotting and permitted to stand in a container, the red blood cells, which weigh more than the other components, will settle to the bottom; the plasma (liquid) will stay on top; and the white blood cells and platelets will remain suspended between the plasma and the red blood cells (known as the buffy coat). (See Figure 11.2.)

To accelerate and refine this process, a PRP machine is typically used to centrifuge the blood. This is carried out to exclude red blood cells from the injection solution, as these are detrimental for the joints. Furthermore, recent research has found that too many white blood cells are also disadvantageous to the joint because they cause more inflammation. Therefore, platelets and plasma, which also has numerous growth factors, constitute the most beneficial parts of the blood when treating a joint. The whole centrifuge process takes approximately twelve minutes and produces a platelet concentration of three to five times that of original plasma. (The necessary number of platelets is not well understood, and it's also not clear which growth factors are more favorable to produce the desired effects.) Immediately prior to the injection, a platelet activator may be added to initiate the clotting process, producing a platelet gel. (See Figure 11.3 for what a PRP Injection will look like.)

So how well do they work? Leukocyte-poor (low white blood cell) PRP has been shown in multiple clinical trials to be more effective than placebo, steroid, and gel injections for the treatment of osteoarthritis symptoms. As with other biological injections, multiple studies have concluded that better results can be achieved in early versus advanced osteoarthritis. When compared to corticosteroid injections for advanced knee osteoarthritis, there were no major differences in outcomes, although the magnitude of improvements tended to be greater in the PRP group. Quality-of-life and general health perception differences at six months after the injection were

significantly better for the group treated with PRP.

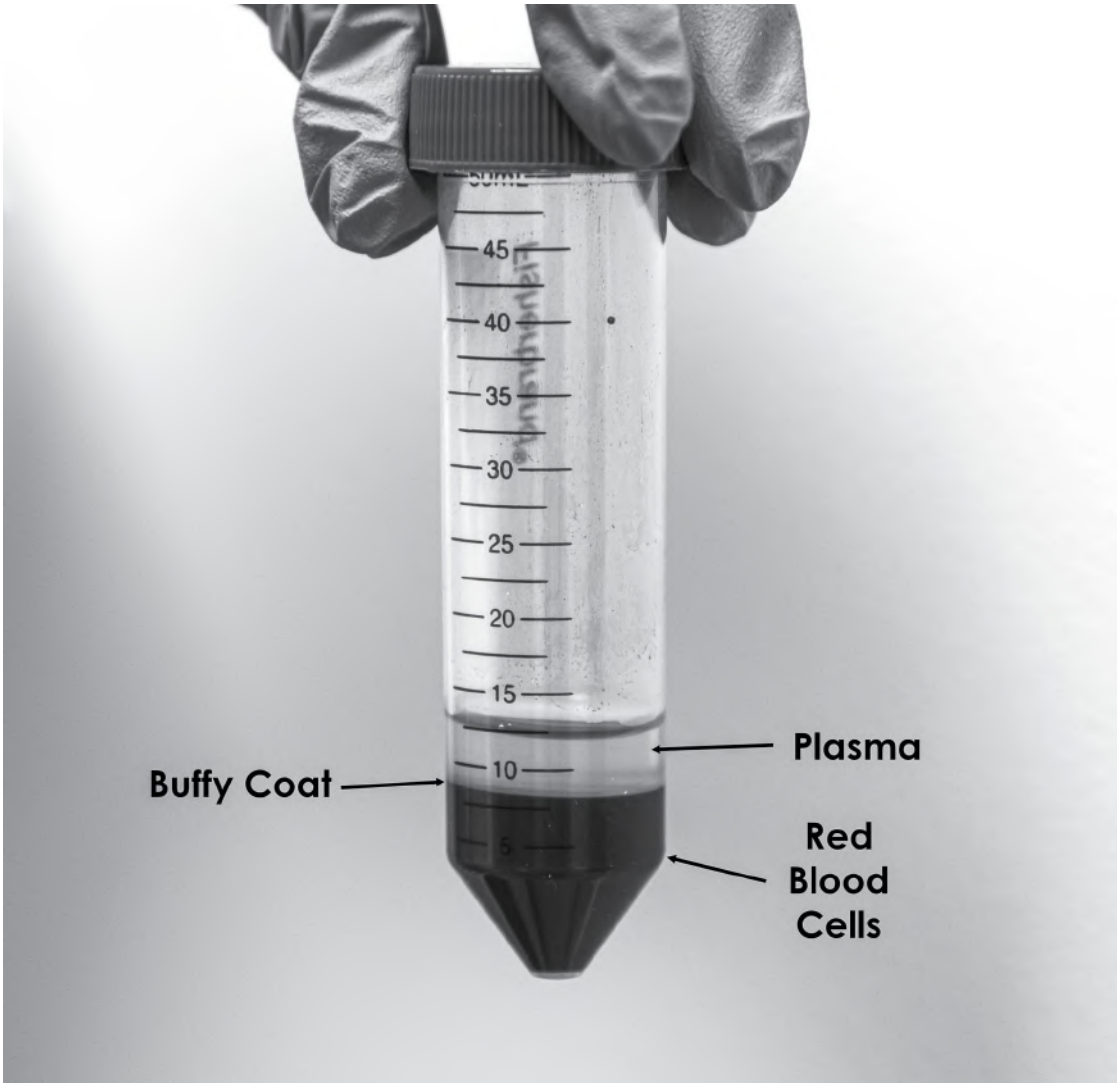


FIGURE 11.2.

Blood Component Layers

FIGURE 11.3.
PRP Injection

Regarding the number of injections needed, recent literature has shown that a minimum of two injections was more successful in treating the symptoms than a single shot for patients with early osteoarthritis. For patients with advanced osteoarthritis, multiple injections did not significantly improve the results of patients. Researchers from Italy have suggested that the average duration of symptom relief after an injection is nine months and that yearly injections could be beneficial to maintain the effects in a consistent manner. Nevertheless, although multiple studies have shown PRP to improve symptoms, no cartilage healing has been demonstrated in any studies.

A combination of a PRP injection with an HA gel injection (see here) may have an even more powerful effect, by enhancing the potential of both injections to attract your own body-healing proteins. Furthermore, some studies reported that the combination of HA and PRP could even promote cartilage regeneration and inhibit osteoarthritis inflammation, although this finding has not been replicated in a consistent manner. A recent clinical trial comparing PRP alone, HA alone, and both in combination demonstrated that combining HA and PRP resulted in a significant decrease in pain and functional limitation when compared to HA alone at one year post-treatment, and significantly increased physical function at one and three months when compared to PRP alone.

Most of the possible adverse effects associated with PRP injections are not specific to PRP but to every biological injection. They include pain, stiffness, fainting, dizziness, headache, nausea, gastritis, sweating, and rapid heart rate, which usually resolve within days. Risk of infection is a concern as with any injection that penetrates the joint. PRP preparations that have higher concentrations of white blood cells are more prone to result in inflammatory reactions.

HOW MUCH DO INJECTIONS COST?

Prices vary according to your state and also depending on the doctor or clinic performing the procedure.

- Steroid injections and HA injections for arthritis are almost always covered by insurance. If cortisone or gel injections are not covered by insurance, they can cost between $150 to $300 and $300 to $1,500, respectively.
- PRP injections range from $800 to $1,500, depending largely on the state.
- The cost of bone marrow aspirate stem cell procedures varies from $1,500 to $5,000.
- Finally, culture-expanded stem cell therapy is more expensive because you will have to travel somewhere outside the United States, often Germany, Chile, or Spain, to get the procedure, and the treatment itself requires post-harvesting stem cell processing. Costs start at $9,000 to $12,000.

Stem Cells

Many patients with knee injuries and osteoarthritis are interested in stem cell treatments because of their potential for tissue regeneration. Although this is an exciting treatment field, it's an emerging and rapidly developing one, so far mainly driven by idealized outcomes that have not been widely realized in clinical practice. In this section, we'll look at what stem cells are, how stem cell therapies work, which ones are approved by the FDA, and how effective they seem to be. Our patients often have questions about how to pursue stem cell treatments, so we've also included an FAQ later in this section.

Stem cells are a group of cells from your own body that have the possibility to become *any* type of cell in the future depending on the signals they receive. When you are conceived, you are composed of many stem cells that end up forming your organs and different tissues. This group of cells is powerful when you are born, and at that time their healing potential is strong. Throughout life, organs and tissues are constantly changing their cells; dead cells are replaced by new cells derived from your own stem cells. As you grow up, the number of stem cells you have diminishes, stem cells start to

lose their potential to regenerate, and aging signs become evident.

Besides having a regenerative potential, stem cells are powerful signaling cells: this means they can regulate the body's inflammatory response, and they can organize which proteins are needed in each case. Because of this ability, stem cells have been proposed as a potential regenerative source for patients with osteoarthritis, which has yet to be proven in vivo.

For treatment purposes, stem cells can be extracted from blood, bone marrow, fat, muscle, and virtually every tissue in the body. Research efforts are currently focused on determining the ideal source for harvesting these cells.

Here it is important to differentiate between two methods of stem cell treatment. One is a single harvesting (known as an aspiration) of the cells, which can be further concentrated via a centrifugation process similar to the one described for PRP (see here) and injected. The other, culture-expanded stem cell therapy (aka true stem cell therapy), is more targeted. The stem cells are isolated through chemical processes, tested for their regenerative capacity, cultured for a couple of weeks so that they multiply, and then reimplanted in the injured area.

For the first method, this is a same-day procedure in which the cells are extracted, concentrated, and then injected in the body. (See Figure 11.4.) The most well-known procedure is a bone marrow aspirate concentrate. This procedure is FDA-approved and requires only minimal manipulation of the harvested cells (no chemical addition). The number and type of cells present within the aspiration, however, is generally not optimal; it has been found that in bone marrow aspirates the amount of stem cells present is 0.001 percent. Also, these cells may not have the best regenerative potential; the harvesting may yield a mix of stem cells with great, medium, and poor regenerative potential. Bone marrow aspirate has a potential to diminish inflammation even further (when compared to PRP) because of the presence of interleukin-1 receptor antagonist, which is a powerful blocker of inflammation within the joint, which could explain the relative speedy action after the bone marrow injection.

FIGURE 11.4.

Bone Marrow Aspirate Collection

The second type, true stem cell therapy, may have more promise, but it is not FDA-approved, and therefore it cannot be performed in the United States if it is not within a clinical trial. (It is offered in other countries to avoid the regulatory burden, at sometimes extremely high costs.) It involves harvesting and then isolating the stem cells with the greatest potential to grow and multiplying them by sequential culturing processes that will produce millions of stem cells with the greatest regenerative potential. All of these potential benefits have been proven mostly outside the body (in the laboratory), although the results and their safety profile have not been completely established in humans. That is the reason why they are not yet approved by the FDA as of now. There are risks: if the stem cells have the appropriate signaling, they can become the desired tissue, but if they do not have the right signal, they can mistakenly create another tissue. This has been demonstrated in animal studies, in which, for example, bone was created instead of forming cartilage in cartilage defects. In addition, stem cells are similar to cancer cells, which can grow without stopping. Once the desired tissue has been made, the cells need to stop regenerating; if they keep multiplying without stopping, they can create a tumor. The evidence in the literature is not compelling, so more research is needed before use of these therapies becomes widespread.

For both types of therapies, the mode of delivery of stem cells remains a challenge. As of now there are two main ways of implanting stem cells. The first mode is to deliver the stem cells via an injection with a fluid containing the cells. This is done when there is no specific injury, but rather a disseminated injury like osteoarthritis. The second is delivery of the cells through a scaffold that can be implanted. The potential benefits of using a scaffold is that the cells can be placed exactly where they’re wanted. However, these cells may not behave as intended. Recent research has reported that the stem cells that actually induce healing may not be the same stem cells that are injected: they might be coming from different parts of the body. The injected stem cells act as signaling cells, calling other cells in your

body to repair the tissues. Also, since stem cells' actions depend on signaling (they need a signal from the environment they are in to tell them where they are and how to behave), when they are encapsulated in a scaffold, they might not be able to pick up those signals and therefore may not function in the way they're expected to, creating bone instead of cartilage, for example.

Despite the buzz and the media reports about stem cells, the information available about stem cell injection outcomes in human patients is very limited. The overall reported outcomes are decent, with a relatively safe profile. No major adverse events have been reported. Just a few randomized clinical trials have looked at the effectiveness of BMAC for the treatment of osteoarthritis. A recent review identified six trials for osteoarthritis and cartilage defects. It reported that only modest improvement was found and that a placebo effect could not be ruled out with stem cell injections. In another example, researchers from the Mayo Clinic reported on twenty-five patients who had bilateral knee osteoarthritis. BMAC was injected in one knee, and saline (a harmless fluid and salt solution) in the other knee. They reported no difference in symptoms at six months or one year postinjection between the groups. Reports on outcomes for culture-expanded stem cell therapies are also limited.

Reported side effects for a bone marrow aspirate procedure were similar to the ones described for PRP. The reported frequency of adverse effects after the procedure is 6 to 10 percent of patients. Self-limited pain and swelling are the most commonly reported adverse events. For culture-expanded stem cells, the most concerning adverse affect is that these cells can develop into unwanted tumoral cells. Furthermore, manipulation in the laboratory has risks of contamination of the cells. Researchers from Stanford and Colorado State University have also reported that unwanted tissues formed after the repair of a cartilage injury in a horse model—bone formed instead of cartilage.

STEM CELL THERAPIES: FREQUENTLY ASKED QUESTIONS

Where do I go to get these famous stem cells?

In order to get the best treatment possible, it is important to be well informed about the procedure itself and the product that is going to be delivered. Most of the US-based clinics that promote stem cell treatments are almost always doing BMAC injections. In order to get true culture-expanded stem cells, you should inquire about clinical trial sites (see clinicaltrials.gov) or travel outside of the United States. As a rule of thumb, institutions that have been recognized for their care, such as universities or long-standing private clinics,

are safer choices than clinics that advertise their products online or in the street with no true research behind them. Clinics that overemphasize the outcomes, are unclear about the indications (they sometimes say that you can use the procedure for everything), and downplay the potential complications (if they say that there are no risks associated with this procedure) should be avoided.

Be sure to check if the product you are receiving is FDA-approved or if the clinic itself has raised FDA flags at some point. Be prepared, read the information available, and inform yourself before going to a consultation. Get second and third opinions until you are sure that the product you are going to get is safe and efficacious. Inquire about the benefits and risks of each option, the price, follow-up indications, and, most important, what happens if the treatment fails. Look for a reference in the field about the clinic's studies related to this topic to ensure that the best available technique is used to deliver the stem cells.

Should I go with the most advertised product?

Most specialized clinics receive patient referrals and are known for balanced decisions, while clinics selling stem cell treatments tend to market directly to patients, often through persuasive language online and social media advertisements. Exaggerated benefits of a certain therapy, with unrealistic results (such as claiming all patients got 100 percent relief with no complications) at a high price and using patient testimonials to support their claims, should raise a red flag. Although testimonials can be genuine, they can be misleading and should not be compared with actual research to determine if the effects are real or are due to the psychological belief that the treatment will work (the placebo effect). For example, the fact that one treatment worked in one person does not necessarily reflect its efficacy in a larger population, as it might be only a small percentage of the whole sample. Therefore testimonials should be taken with extreme caution.

Are stem cells an approved treatment for my condition?

Pathologies that are widely approved for stem cell treatments are limited. The best-defined and most extensively used stem cell treatment is bone marrow transplantation to treat certain blood and immune system disorders or to rebuild the blood system after treatments for some kinds of cancer. To date, there are no approved indications for musculoskeletal injuries. A few clinical trials are currently being performed in the United States, mostly for the treatment of symptoms derived from osteoarthritis and muscle regeneration.

So I won't need a joint replacement, right? If I use stem cells, is my joint going to regenerate on its own?

No, it won't! It is important to reemphasize that none of the biological injection solutions can regenerate cartilage. Most of these injections are intended to treat the symptoms but not the structural properties of the joint. Stem cells cannot rebuild cartilage. Furthermore,

biological injections have shown that results for end-stage osteoarthritis of the knee are less than optimal. When bone-on-bone changes have occurred, biological therapies are not effective, and therefore a joint replacement procedure is recommended.

Should I use stem cell injections to prevent getting osteoarthritis?

There is no evidence to support stem cells being used as a preventative treatment for knee arthritis. Current literature on the use of stem cells only provides evidence for diseased joints. Given the fact that no therapy is without risks, it is not recommended that these therapies be used for prevention of joint degenerative disease.

What is stem cell banking?

Adult stem cells are not as powerful as embryonic stem cells because younger cells have higher regenerative potential. Both private and public cord blood banks have been developed in response to the potential for embryonic stem cells (found in umbilical cord blood) to treat diseases of the blood and immune systems. Although there are several stem cell banking facilities, there are no current accepted indications for their use. The sample can later be retrieved only by that individual and for the use by such individual or, in many cases, by their first-degree blood relatives. Health conditions that might benefit from these stem cells include different types of blood diseases, such as myeloma and lymphomas. It is unclear if saving your child's embryonic cells will be beneficial in the future and therefore is not currently recommended. Private cord blood banking can be costly, ranging from an initial fee of $500 to $2,500, with annual storage fees of $100 to $300 each year thereafter.

A clinical trial on stem cell treatment is offering to enroll me for free. Should I participate?

Because of the relatively safe profile reported in previous studies, enrolling in a clinical trial could be a good option for you if you fit the inclusion criteria for the study. All clinical trials have been screened by an institutional review board that protects patient rights and maximizes patient safety. Carefully read the informed consent form for potential advantages and complications, and make sure you ask all the questions you need answered before enrolling. Of note, you can leave the study at any point without any penalties.

We believe biological therapies will be increasingly used in the future not only in sports medicine and orthopedics but in medicine in general. Further clinical trials with long-term follow-up will help doctors determine how and when to use these therapies and if they are truly safe for patients suffering from arthritis. Several laboratories in the United States are working on biological replacements of joints (trying to regenerate cartilage, instead of using metals) after end-stage osteoarthritis, which could become the gold standard in the future.

The science on these treatments is constantly evolving. Significant changes for the most debated use of stem cells should be expected to occur in five to fifteen years. Their approval and widespread use could be accelerated, should researchers find the right therapy and timing for its use. Exciting times are coming in the field of orthopedics because these therapies can dramatically change the way we practice medicine.

PREVENT REINJURY DURING SPORTS AND ACTIVITIES

Your new knee works great. You're excited to get back to doing all of the activities you loved doing before your injury. The burning question now is, "How do you stop this from happening again?" There is no surefire way to prevent injury. Sometimes things happen that are completely out of your control, and these events may lead to reinjury or injury to another body part. But there are things you can do to reduce your risk.

Once your knee has healed, the tissues are usually never quite as strong as they were originally. That is because almost everything in the body heals with scar tissue, which is not as strong as the original ligament was. Also, the nerves that your natural tissue had are not the same in the scar tissue and may not be as effective in informing the brain where the knee is positioned. This is called proprioception: the ability of your body to know and understand the position of each part of your body at all times. This can make you more prone to injuries in the future. Nevertheless, scar tissue can function well when it is placed in the correct position in surgery, and often people recover quite well from injuries.

If you've had surgery, sometimes people say that the graft the doctor put into your knee to reconstruct your ligament is "stronger than your native ligament." Although this is technically true, studies indicate this is not the case once it is implanted into your knee. For example, after an ACL tear and a reconstruction procedure, you have a greater chance of having the graft tear in your operated knee than of having an ACL injury on the other knee, not only because of the graft but also because of the original causes of the lesion (shapes of your bones, the way you land, and so on—recall the lists of nature and nurture factors that lead to injury on here). It is also because your native

knee has better control of the nerves than the knee with the graft does.

TAKE TIME TO HEAL

First and foremost, the best way to avoid reinjuring your knee is to give your body enough time to heal the first time around (see here).

Throughout your physical therapy rehab, you have worked hard to rebuild your muscles. How do you know when you can return to playing a sport? This is an individual question with multiple factors to consider so that when you return to sports, you are not only safe and avoiding reinjury but also capable of performing at the level you are accustomed to. There are two big questions to ask yourself before you commit to returning to play:

1. Has there been enough time since my knee surgery or knee injury for all the necessary healing to take place?
2. Have I restored or exceeded my pre-injury levels of muscular strength?

To feel confident about the decision to return to sports, the answer to both of these questions needs to be yes.

Before receiving clearance from your medical team to return to sports or regular activity, it is common to complete a strength assessment to determine if your muscles have recovered from the atrophy and weakness and are strong enough for you to participate in your activity safely without any undue risk.

While the contents of these assessments vary greatly between sports medicine practices, here is a simple self-assessment that you can perform to help you understand your progress and guide your decision whether to return to sports.

RETURN TO SPORTS OR ACTIVITY ASSESSMENT

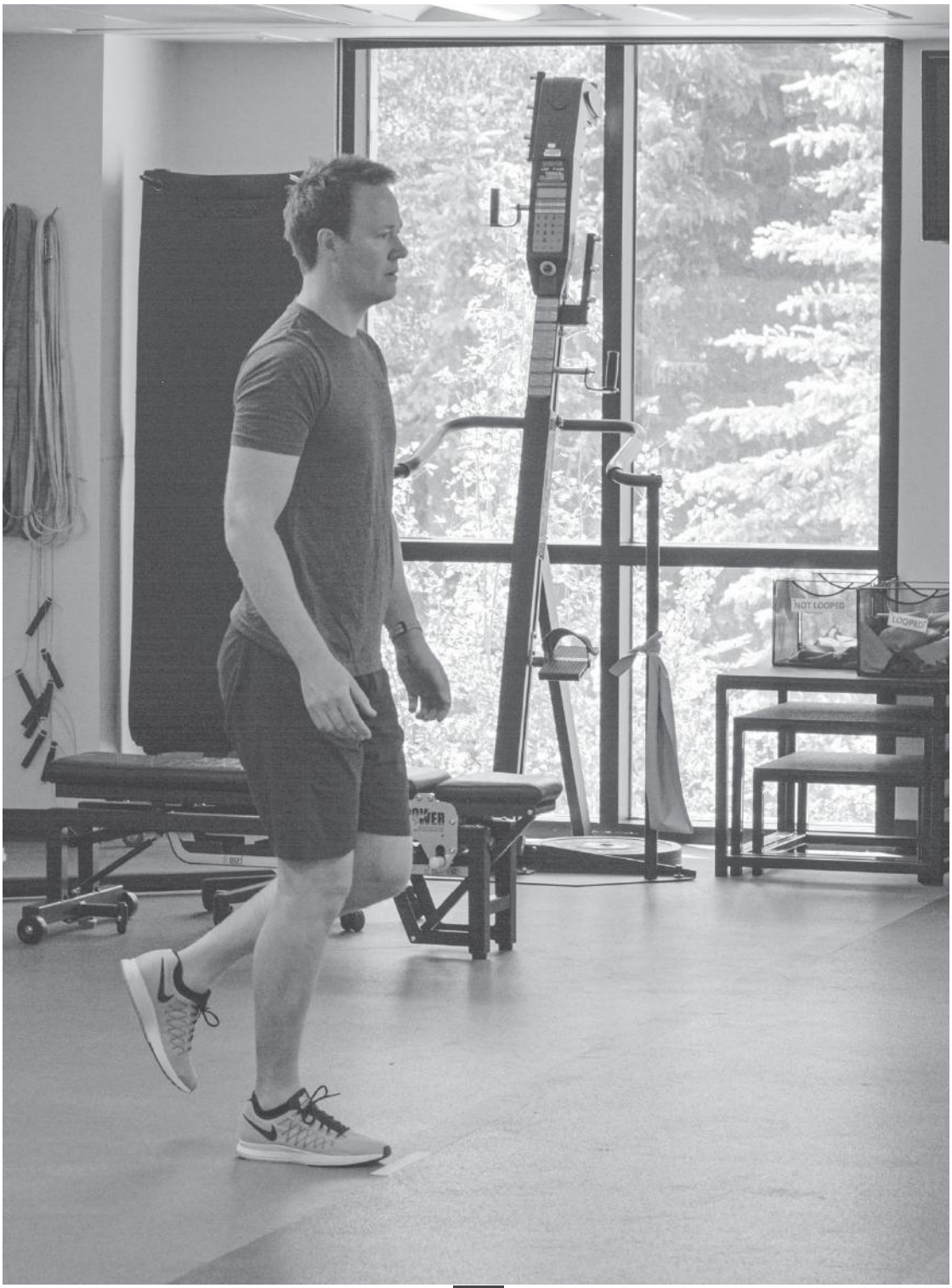
1. Girth measurement: Take a tape measure and measure ten or fifteen centimeters from the top tip of your kneecap to your thigh (Figure 12.1). From here, measure the circumference of your thigh (Figure 12.2). Then measure the same on your other leg. The measurement on the injured leg should be no less than one centimeter different from the unaffected thigh.

FIGURE 12.1.

FIGURE 12.2.

2. Single-leg hop test*: Standing on your unaffected leg (Step 1), jump forward as far as you can (Steps 2 and 3), and stick the landing (Step 4). Repeat on your affected leg. The total distance that you jump on your affected leg should be at least 90 percent of how far you were able to jump with your

unaffected side. (*Always ask your physical therapist if you are ready to perform this test before doing so.)



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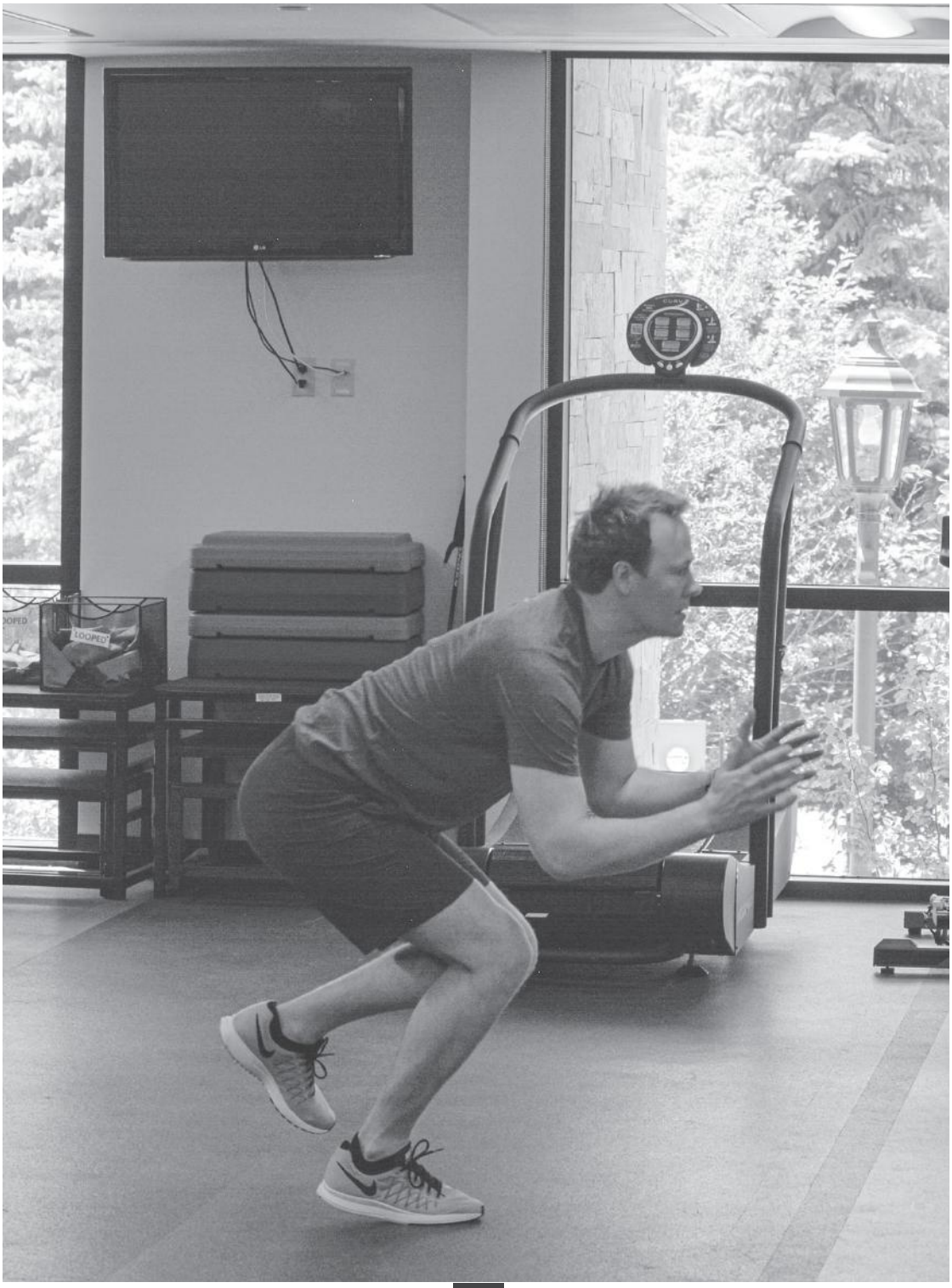

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3. Single-leg squats: Can you perform three minutes of single-leg squats on your affected side to a depth of 70 degrees of knee bend? Standing on your involved leg (Step 1), squat down to approximately 70 degrees of knee bend (Step 2), and return to the start position. It should take about three seconds to complete the movement. Repeat this for three minutes.

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If you are able to pass all three of these assessments, it may be time to talk with your medical team about getting clearance to return to sports.

AVERAGE TIME FRAMES FOR RETURNING TO SPORTS FOR THE TOP TWENTY-FIVE KNEE INJURIES

INJURY: Anterior cruciate ligament

AVERAGE RETURN-TO-SPORTS TIME FRAME: 9 months

INJURY: Posterior cruciate ligament

AVERAGE RETURN-TO-SPORTS TIME FRAME: 9–12 months

INJURY: Fibular (lateral) collateral ligament

AVERAGE RETURN-TO-SPORTS TIME FRAME: 7–9 months

INJURY: Medial collateral ligament

AVERAGE RETURN-TO-SPORTS TIME FRAME: 7–9 months

INJURY: Meniscus repair

AVERAGE RETURN-TO-SPORTS TIME FRAME: 4–6 months

INJURY: Chondral tear with allograft replacement

AVERAGE RETURN-TO-SPORTS TIME FRAME: 9–12 months

INJURY: Patellar/quadriceps tendon repair

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6–9 months

INJURY: Patellar fracture

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6 months

INJURY: Muscle strain

AVERAGE RETURN-TO-SPORTS TIME FRAME: 2–8 weeks

INJURY: Tibial plateau fracture

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6–9 months

INJURY: Proximal tibial fracture

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6 months

INJURY: Distal femoral fracture

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6 months

INJURY: Knee dislocation

AVERAGE RETURN-TO-SPORTS TIME FRAME: 12 months

INJURY: Compartment syndrome

AVERAGE RETURN-TO-SPORTS TIME FRAME: Depends on other concurrent injuries

INJURY: Patellofemoral instability

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6–7 months

INJURY: Tibiofemoral malalignment

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6 months

INJURY: Patellar tendinitis

AVERAGE RETURN-TO-SPORTS TIME FRAME: 4–16 weeks

INJURY: Arthritis

AVERAGE RETURN-TO-SPORTS TIME FRAME: 12 weeks

INJURY: Anterior knee pain

AVERAGE RETURN-TO-SPORTS TIME FRAME: 6–10 weeks

INJURY: IT band syndrome

AVERAGE RETURN-TO-SPORTS TIME FRAME: 4–8 weeks

INJURY: Septic arthritis

AVERAGE RETURN-TO-SPORTS TIME FRAME: Weeks to months if infection cleared

INJURY: Osteomyelitis

AVERAGE RETURN-TO-SPORTS TIME FRAME: Weeks to months if infection cleared

INJURY: Inflammatory arthritis

AVERAGE RETURN-TO-SPORTS TIME FRAME: Weeks to months if medications clear up swelling, etc.

If your doctor says you're not yet ready to go back to sports, do not try to cheat and get back sooner. Sometimes athletes go back sooner because their parents or coaches are pushing them: they feel pressure to win, they want to impress college scouts, or their parents want to vicariously relive their glory days. Whatever the reason, it is difficult for people in that position to be objective. That is the role of your medical providers, who have no skin in the game; their only role is to get you healthy again and advise you on what is best for your knee and your overall health.

When patients return too early, we too often see this result in a graft tearing or other surgery failing, and then their athletic careers are often compromised. Also, second-time surgeries frequently do not do as well as first-time surgeries. Make sure to communicate directly with your doctor when you feel ready to go back to activities, in order to verify that you are truly ready. When in doubt, ask.

While most people do return to their desired activities, future performance, especially in high-level athletes, is often unclear when you start out. Recovery time and postsurgery performance depends on the activity and sometimes the particular sport and position. Sports that require high-speed changes of

direction carry the highest risk of knee reinjury, like soccer, football, and basketball. But even for these sports, most of the studies have shown excellent return-to-participation rates. Nonetheless, when researchers assessed performance outcomes after a return to sports from most knee injuries, the outcomes were less than optimal, with lower rates of performance in up to a third of athletes.

THE BIG THREE THAT LEAD TO REINJURY

To understand how to reduce your reinjury risk, you must first understand the factors that contribute to injury in the first place. We talked about many of these in Chapter 1. An injury is rarely caused by a single factor but rather results from the interplay of three factors: training load, environment, and biomechanics. Let's look at each of these factors individually and consider some strategies to decrease your reinjury risk.

Training Load

Jim, an office professional, is looking to get fit and lose some weight. He decides to begin a running program. On the first day he goes from not having run for five years to running outside for fifteen minutes. The next day, he increases his run to thirty minutes. Within two weeks, he has started to run trails and is now approaching forty-five-minute runs. Then Jim wakes up one morning to discover that the front of his knee is hurting and he cannot walk down stairs without pain.

Training load is the product of how much you train (volume) and how hard you push yourself when you are training (intensity). In this situation, Jim went from a base of zero minutes of daily running to forty-five minutes on uneven terrain in just fourteen days. His body was not able to cope with this rapid increase in load volume after being a coach potato for five years and subsequently broke down, resulting in a knee injury.

Anyone who has ever begun a resistance training program has likely experienced some muscle soreness in the first day or so after completing the training. This delayed onset muscle soreness (DOMS) is a classic example of the effects that a rapid increase in training load has on muscle tissue. Your muscles were conditioned for your regular level of daily activity. The new training load caused small tears in the muscle fibers, resulting in the discomfort that you feel a few days later. This discomfort is not due to not being strong enough—you were able to lift the weight just fine. Similarly, the

muscle discomfort is not due to a problem with your biomechanics. It is simply that you did more than what your muscles were conditioned to. In our earlier example, Jim's knee injury is a classic illustration of this problem. The development of pain in the front of his knee was largely the result of the cumulative effects of his training load without sufficient rest and recovery. Treating Jim with strengthening exercises to reduce and resolve his symptoms may be appropriate, but without an accompanying reduction in his training load, Jim will be destined for a poor outcome.

So how can you prevent training load errors and minimize the risk of developing an injury? The simplest way to safely increase your activity is to use the 10 percent rule. When beginning a new activity or exercise or returning to an activity after an injury, don't increase your volume or intensity by more than 10 percent between training sessions over the course of weeks to months. Additionally, you should allow for at least twenty-four hours of rest between exercise sessions to allow your body to recover and adapt to the increased load that you have placed on it. For example, if you are used to running for twenty minutes at seven miles per hour, then your next training session should be twenty-two minutes at the same pace. This 10 percent principle allows you to make incremental gains that your body will be able to steadily adapt to.

Environment

Have you ever slipped and fallen on ice? If you have, you are already aware of the role that environment can have on injury risk. Ice does not care how well you planned to increase your training load or how perfect your exercise form is. We can't eliminate all the ice in the world or flatten all the uneven terrain, but we can minimize risk.

Unlike competing in sports, in which the time and the location of the event is almost always fixed, recreational exercise or training for competition almost always allows a degree of flexibility. For example, while a marathon almost always occurs on pavement, training for a marathon can involve running on pavement, grass, a treadmill, dirt, and even underwater. If all are equally convenient, then the grass surface may be the best option by providing a degree of cushioning, which decreases the impact of running on your recovering knee. Similarly, if it is raining or snowing outside, you can delay the time of your run to give the ground a chance to dry out and reduce your risk of slipping and falling.

While it is impossible to describe all the potential environmental

considerations, here are some suggestions to reduce your reinjury risk:

1. Choose dry surfaces over wet surfaces: slipping and falling on wet surfaces can frequently result in injury to your knee or another part of your body.
2. Choose well-lit environments where you can clearly see what is in front of you.
3. Choose stable surfaces over unstable surfaces: grass is more stable and safer to run on than loose gravel.
4. Choose moderate temperature over hot or cold temperature: extremes in temperature can result in fatigue that can contribute to injury.

The lesson here is while environment is more rigid, it is not unmoldable. There are ways to help reduce risk so you can continue to enjoy the activities you love.

Biomechanics: The Way You Move

Does your knee rest not perfectly flat, or does it not bend all the way? Does your knee collapse inward when you squat? The way you move is the third factor that contributes to injury risk.

Biomechanics is the combination of muscle strength and range of motion of the joints responsible for creating a desired movement. Sometimes, because of injury or disuse, we lose mobility in our joints and strength in our muscles, resulting in movement patterns that place us at a further risk of injury. An example of this is your knee collapsing inward when you squat or jump down from a box. Researchers have shown that people with this movement pattern are at an increased risk of suffering an ACL tear or reinjuring an already reconstructed ACL.

Fortunately, addressing faulty biomechanics that may predispose you to injury or reinjury is possible. It first involves understanding what the root cause of the faulty movement pattern is—insufficient muscular strength or reduced joint range of motion—and then completing exercises frequently prescribed by a physical therapist to address the deficits. Let’s consider collapsing knees as an example. An evaluation by your physical therapist may reveal that the muscles of the hip are too weak to control the forces that are pushing the knee inward during a squat. One possible treatment option is an exercise program that addresses this hip weakness, and over time, as your strength improves, your movement pattern will also improve and reduce the

risk of injury.

Now that you have an understanding of the contributing factors to watch out for, here are some additional ways to help prevent you from reinjuring yourself once you return to activity.

BRACE YOURSELF

During your recovery from knee injury, your medical team may have recommended that you wear a brace to protect the injured structures from further stress. Ask them if you should continue to wear a brace when you return to your regular activities. While researchers have not been able to definitively answer this question, there is some evidence to suggest two possible benefits of wearing a brace for sports activities:

1. If you are to suffer a reinjury or sustain a new knee injury, it may be less severe than had you not been wearing a brace.
2. Wearing a brace may provide a confidence boost. By increasing the level of support you feel for your knee, a brace may boost your confidence in how your knee is capable of performing.

While there are no guarantees that wearing a brace will prevent reinjury, it may offer a valuable degree of protection.

MAINTAIN YOUR KNEE STRENGTH

During your recovery after a knee injury or surgery, you likely dedicated a significant amount of time and effort to restoring the strength of the muscles in your leg. Now that you are considering returning to activity or considering doing so, it is a great time to understand the importance of a strength maintenance program. When it comes to your muscles, the saying “use it or lose it” is highly applicable. Your muscles are always adapting to the loads you place on them. If you apply a large load, like when completing the strength work associated with your recovery, your muscles adapt to become stronger. Likewise, if you stop training all together, your muscles will adapt to that decrease in load and lose strength. Since we know sufficient strength is a key factor in preventing knee injury, instituting a maintenance exercise program to maintain the level of strength you worked hard to gain is a smart choice.

Here is a sample program you can complete two times per week to help keep your knee and leg muscles at their optimum strength levels.

KNEE STRENGTH MAINTENANCE PROGRAM

EXERCISE: Bike with moderate resistance

SETS / REPS / TIME: 15–30 minutes

REST: N/A

EXERCISE: Band work

Forward/backward band walk

Lateral band walk

SETS / REPS / TIME: 2 × 10 each way

REST: 2 minutes

EXERCISE: Single-leg leg press

SETS / REPS / TIME: 3 × 12

REST: 2 minutes

EXERCISE: Balance squat with dumbbells

SETS / REPS / TIME: 3 × 12

REST: 2 minutes

EXERCISE: Romanian deadlift with kettlebell

SETS / REPS / TIME: 3 × 12

REST: 2 minutes

EXERCISE: Walking lunge with medicine ball

SETS / REPS / TIME: 3 × 12

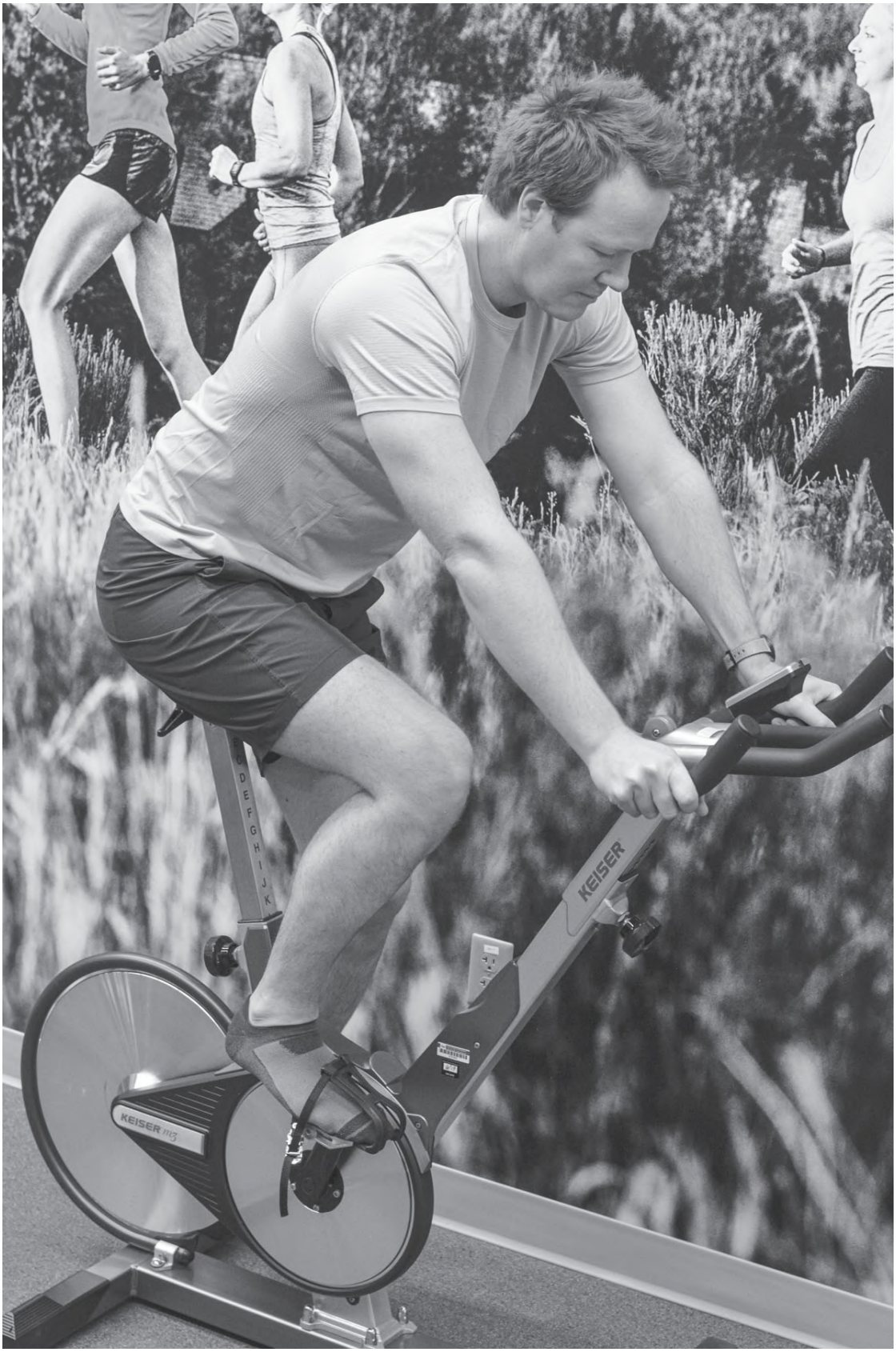
REST: 2 minutes

EXERCISE: High box step-ups with dumbbells

SETS / REPS / TIME: 3 × 12

REST: 2 minutes

BIKE WITH MODERATE RESISTANCE



BAND WORK

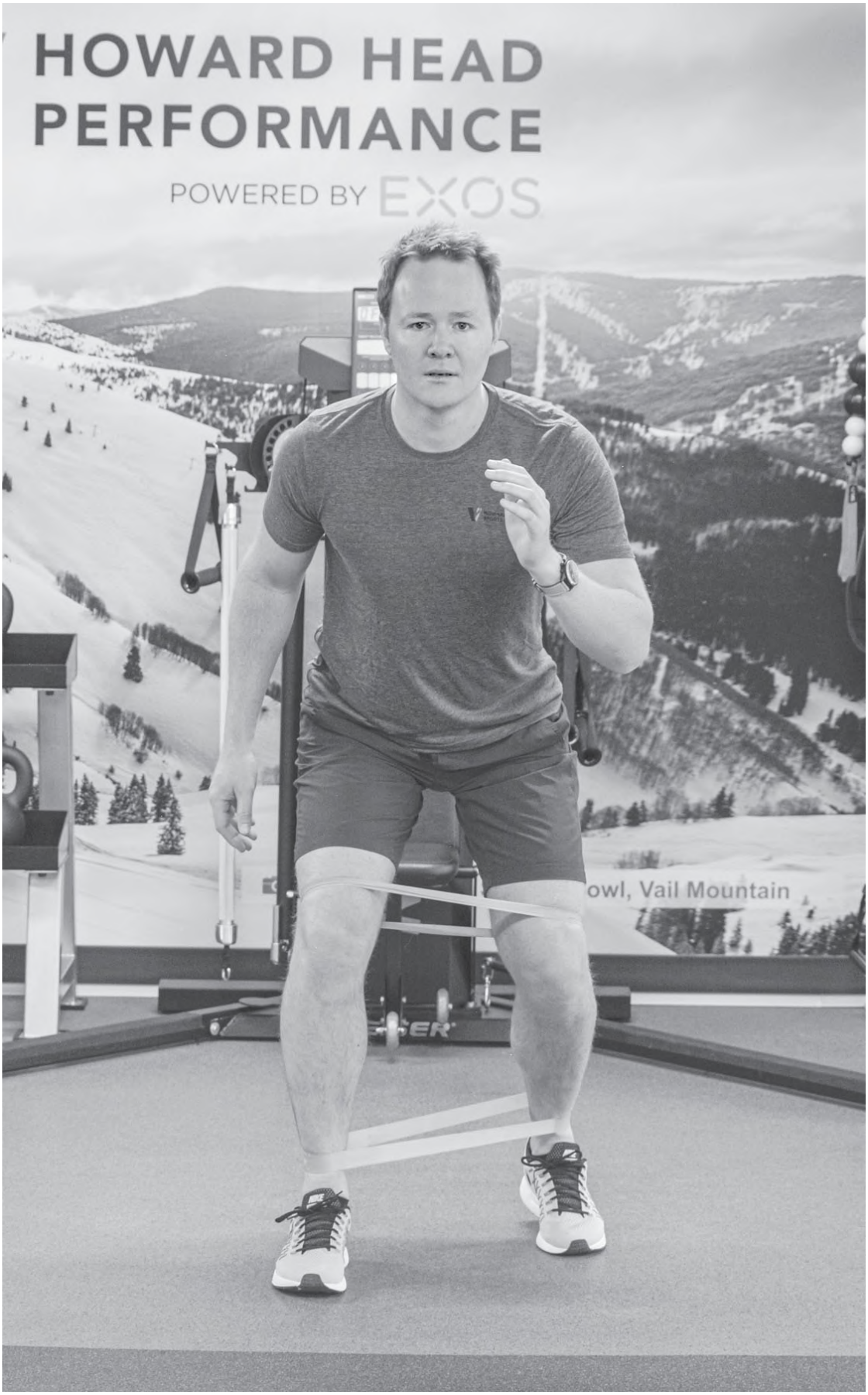
START: While standing, loop an elastic resistance band around both of your legs, and place it just above your knees. Take a second band, and after looping it around both legs, place it just above your ankles.

MOVEMENT: Assume a posture with your knees and hips slightly flexed, feet shoulder-width apart. Keeping your feet wide apart, take small alternating steps forward. After ten forward steps, complete ten backward steps to return to your start location. Now take ten large lateral steps and then ten steps to return back to the start location.

TIP: Keep your depth. As you tire, you will have a tendency to stand tall, losing your starting posture.


HOWARD HEAD
PERFORMANCE
POWERED BY EXOS
Bowl, Vail Mountain

1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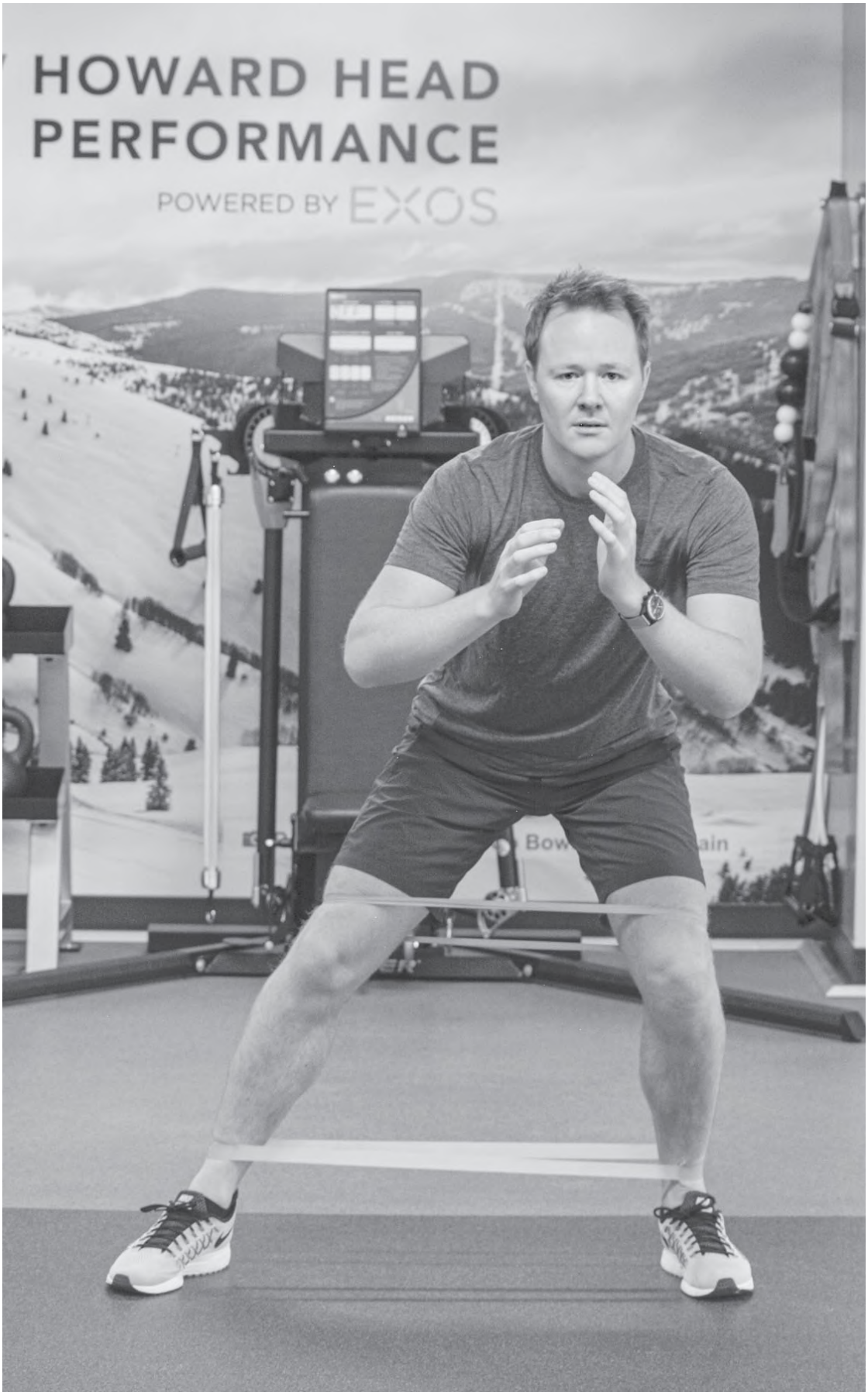
HOWARD HEAD
PERFORMANCE
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SINGLE-LEG LEG PRESS

START: Depending on the machine, either be seated or lie down on you back. Your knee should be bent to approximately 70 to 90 degrees.

MOVEMENT: Using your quads and glutes, push through your feet to straighten your knee.

TIP: Ensure that at the end of the movement your knee is straight and not slightly bent.

1

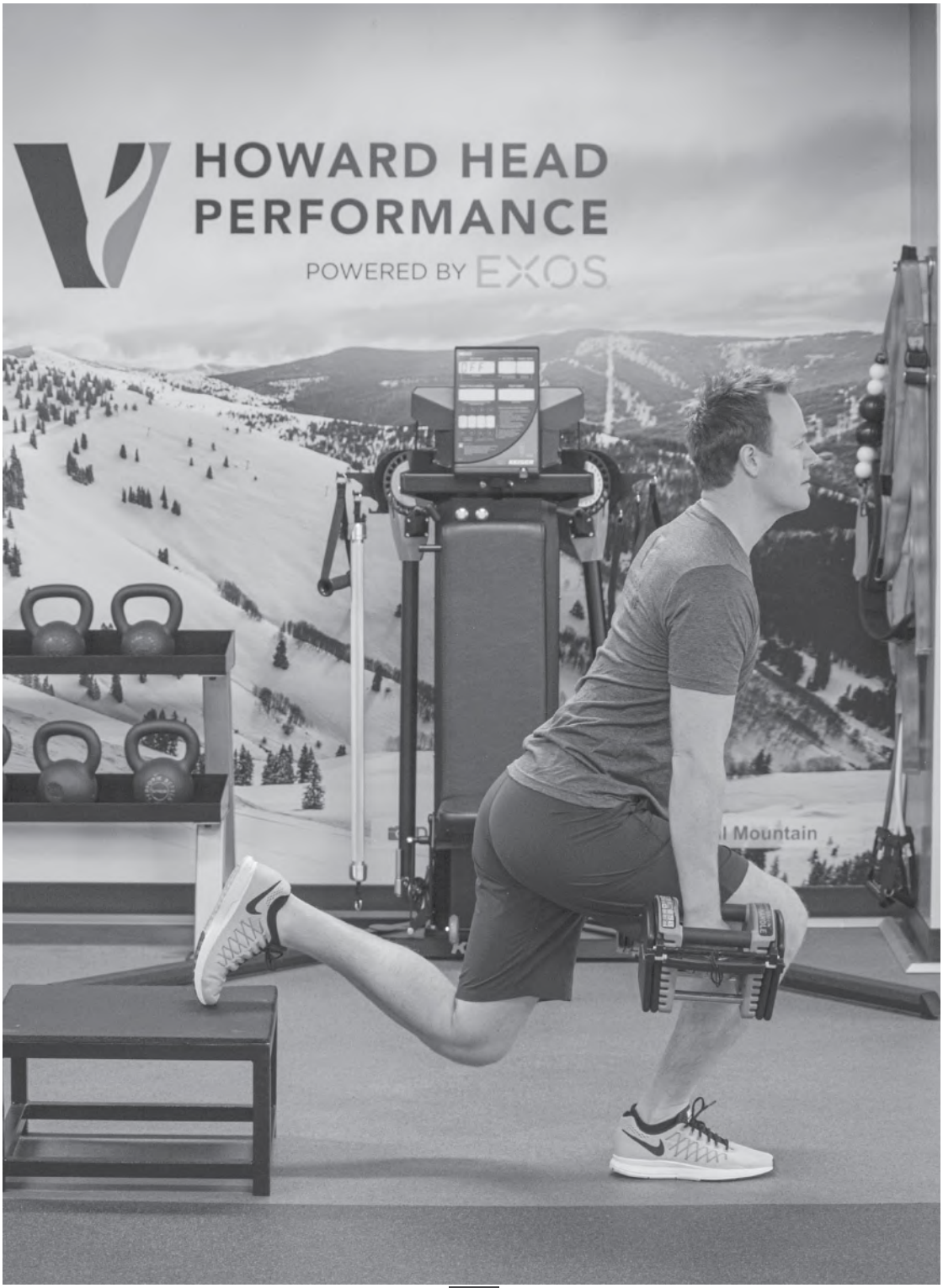
2

BALANCE SQUAT WITH DUMBBELLS

START: Stand with dumbbells in each hand and your unaffected leg elevated on a bench or step behind you.

MOVEMENT: Produce a squatting movement by flexion first through your hips and then your knee to lower yourself toward the floor. Drive through your hip and knee to return to the start position.

TIP: Keep your weight shifted forward onto your stance leg. Just the toes of your rear foot should be resting on the bench.



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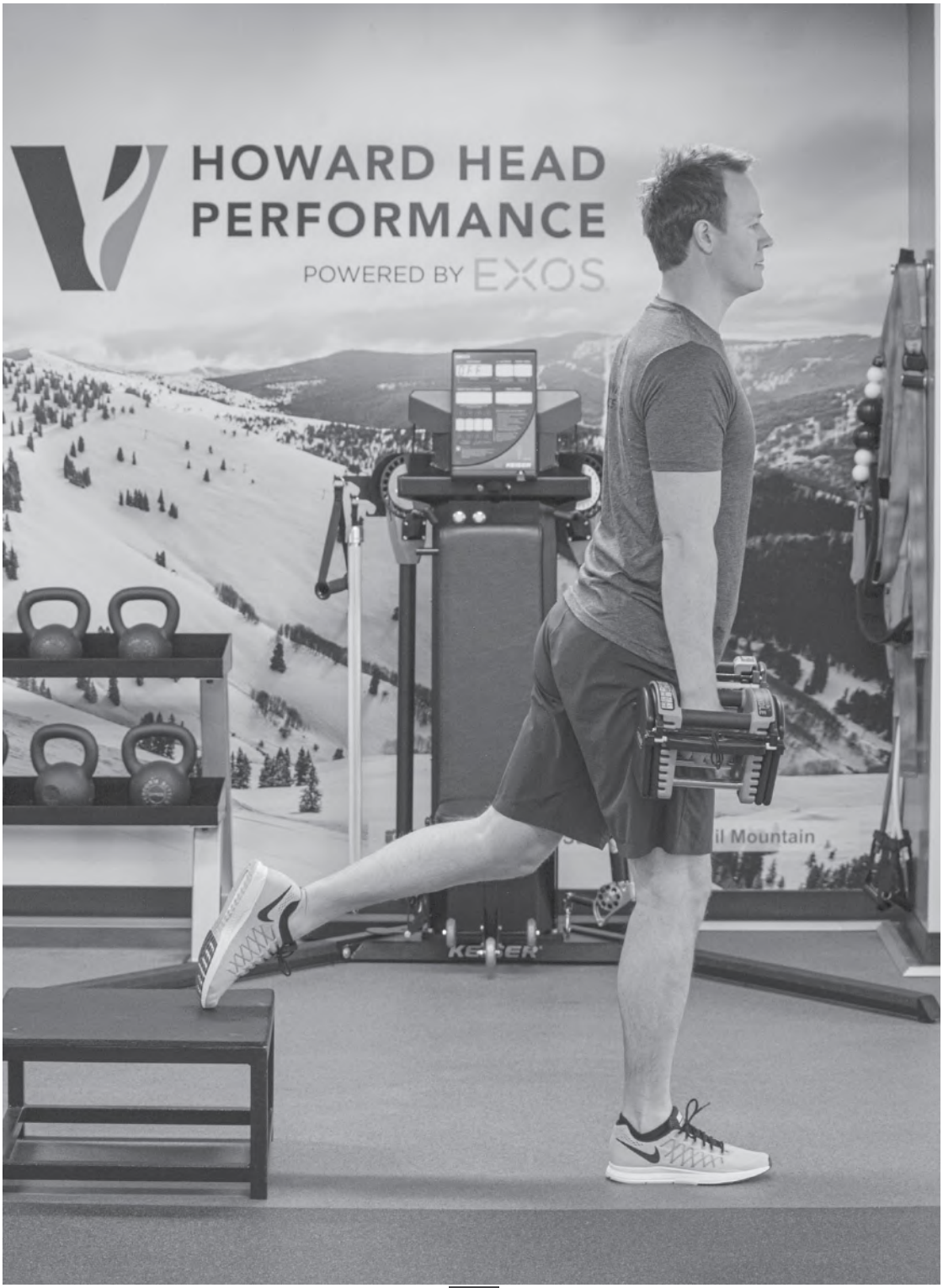

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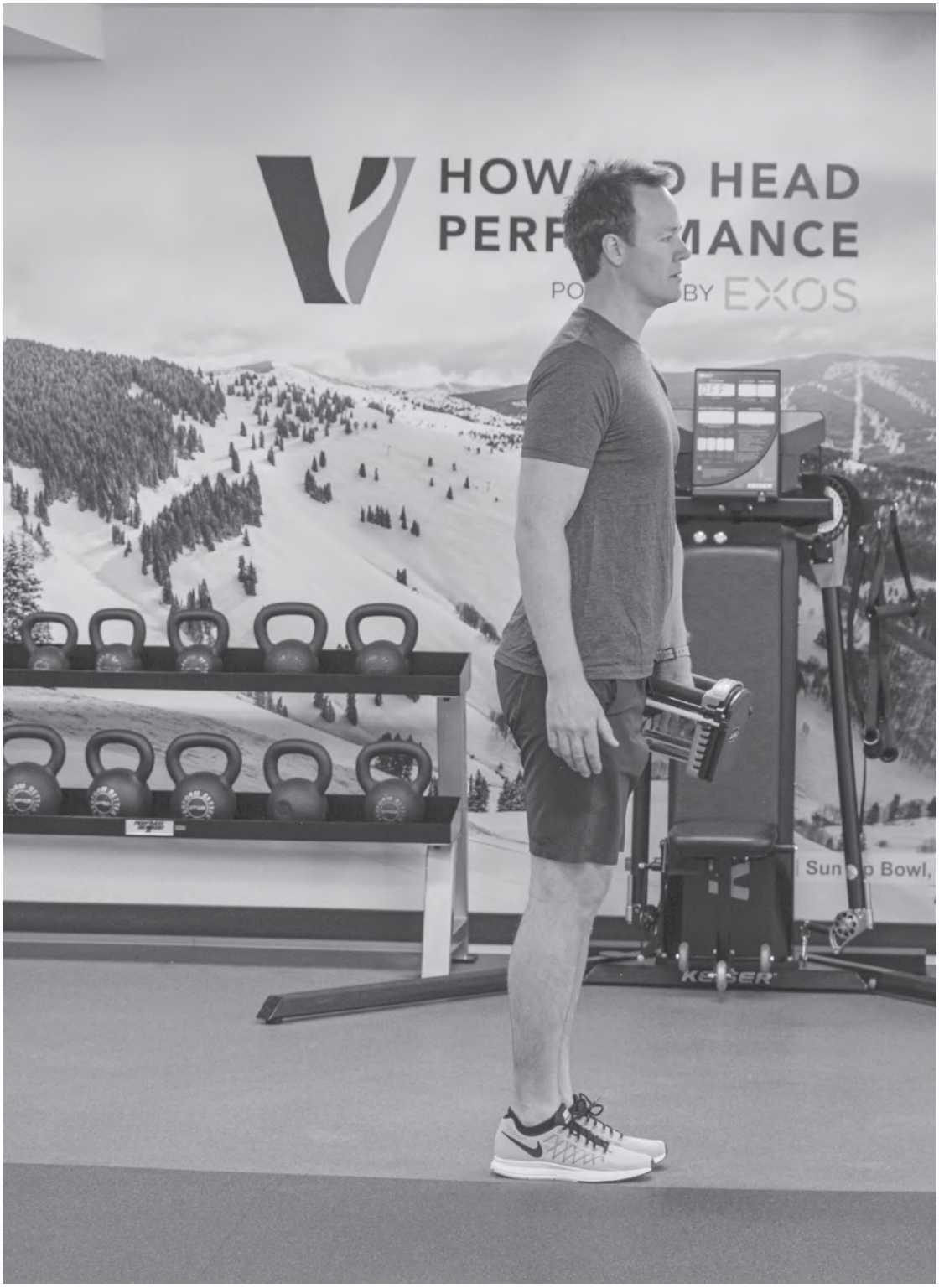
ROMANIAN DEADLIFT WITH KETTLEBELL

START: Stand with a slight knee bend on the involved leg and the unaffected leg straight and slightly behind the body. Hold a kettlebell in

the opposite hand of your stance leg.

MOVEMENT: Keeping the back leg straight, flex through the stance leg hip, lowering the chest toward the ground. Lower the trunk until you feel a stretch in the hamstring.

TIP: The knee position should remain the same as the start position throughout the exercise.



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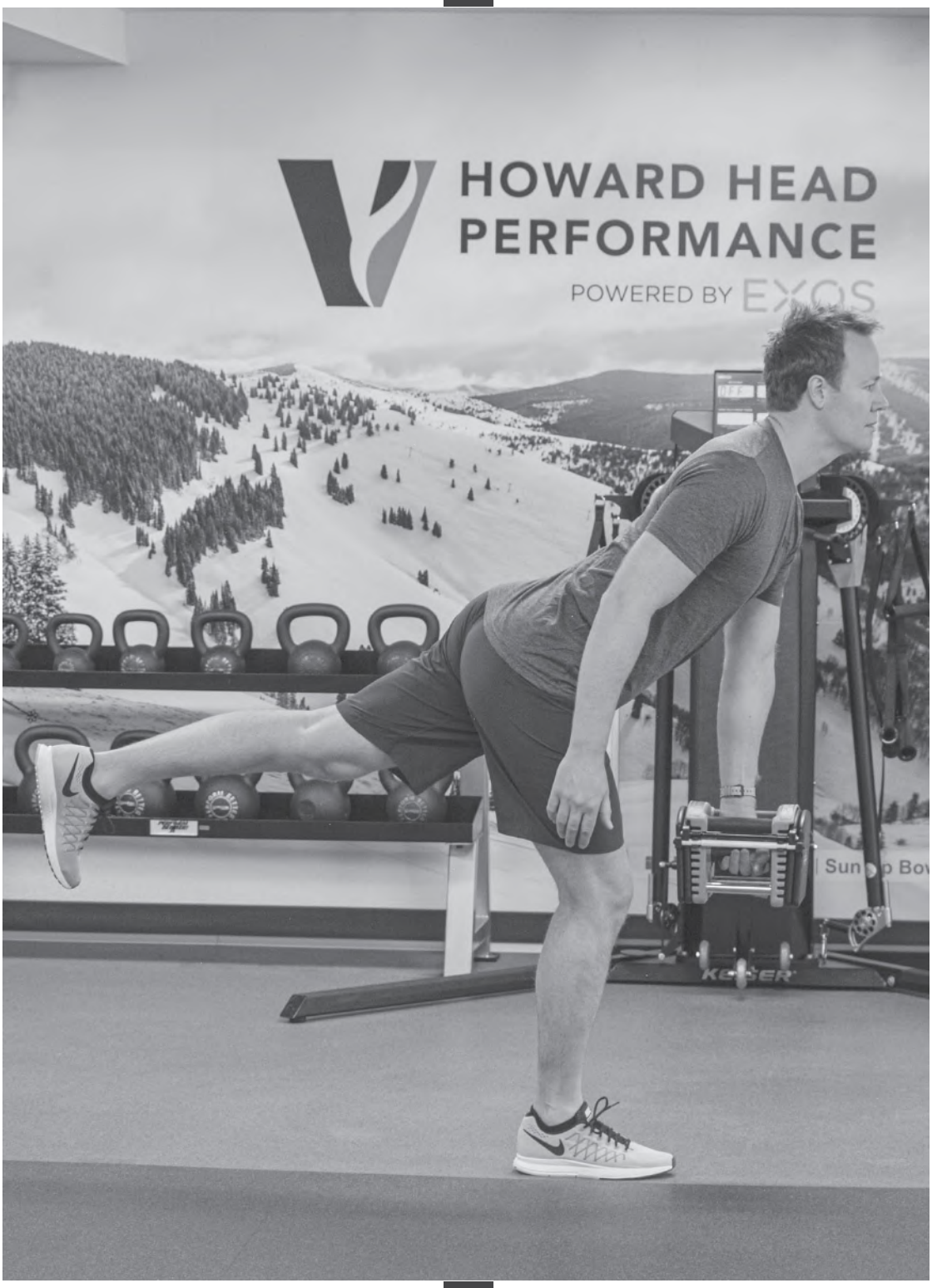

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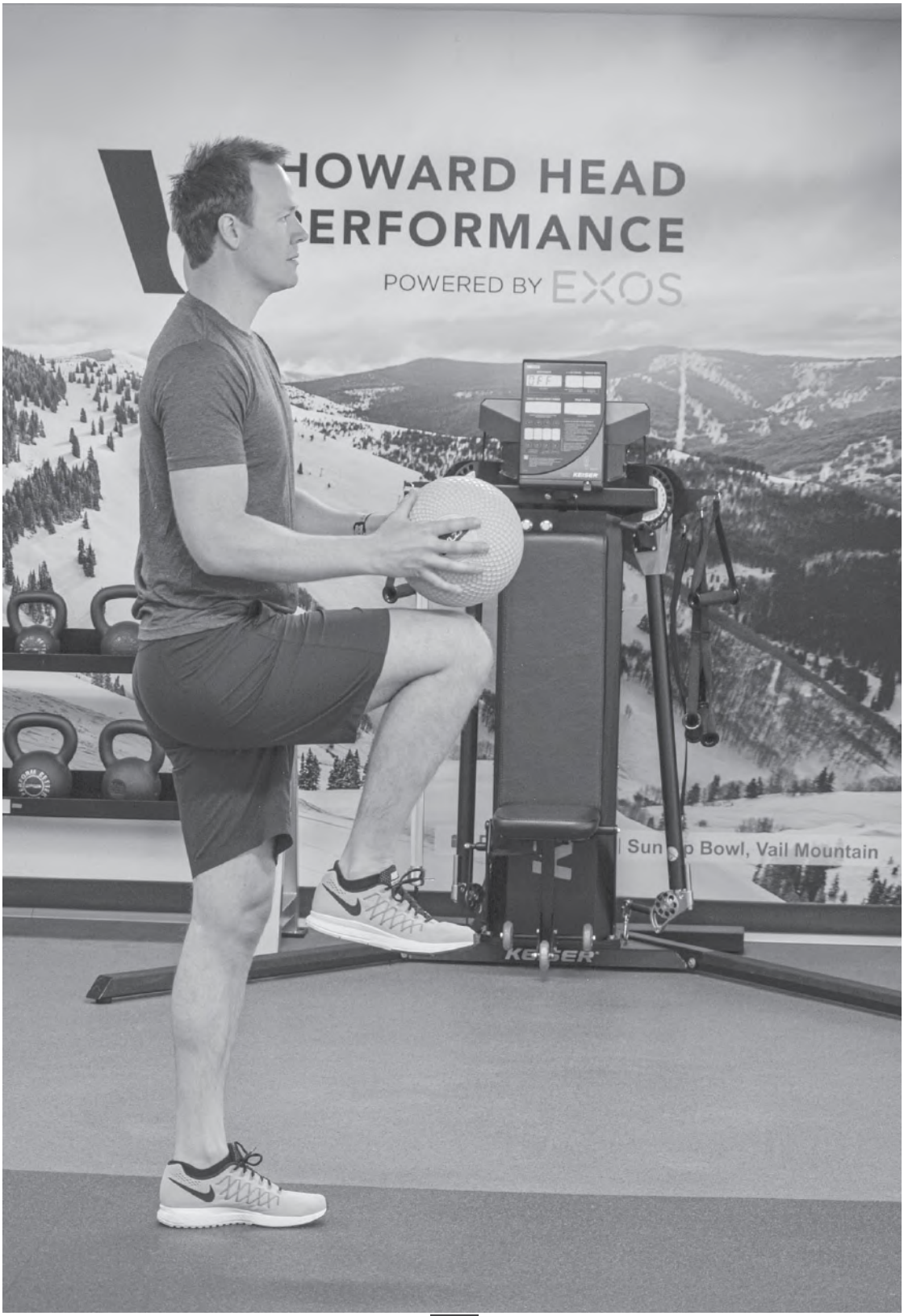
WALKING LUNGE WITH MEDICINE BALL

START: Stand on one leg, with the opposite leg raised off the ground and the hip flexed to 90 degrees. Holding a medicine ball in both hands, touch the knee of the leg that is off the ground.

MOVEMENT: Step forward into a lunge position, and simultaneously raise the medicine ball over your head. From this lunge position, drive through the hip and knee of your lead leg to stand tall and return to the start position, with the medicine ball now touching the opposite knee that was the stance leg.

TIP: Use a light medicine ball to learn this complex movement pattern before progressing to a heavier medicine ball.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HIGH BOX STEP-UPS WITH DUMBBELLS

START: Stand in front of a box, holding a dumbbell in each hand.

MOVEMENT: Step forward with the affected leg, placing your foot on the box. Extend the hip and knee of the lead leg using quads and glutes to generate the movement so that you are now standing on the box. Return to the start position by stepping backward off the box, using the lead leg to lower your body back down to the ground.

TIP: When generating the force to stand up on the box, drive through the lead leg rather than propelling yourself forward with the rear leg.

1

2

ATHLETES: TALK WITH YOUR COACH OR ATHLETIC TRAINER

ABOUT A PREVENTION PROGRAM

Indirect (noncontact) sports injuries *can* be prevented by appropriate exercise and training programs. Several well-conducted studies have shown that working on specific muscular and neuromuscular (nerves that control motion) groups can help prevent indirect knee injuries in almost every sport. For example, a stiff valgus landing (landing with the knee more extended and pointing inward) delivers more force to the joint and predisposes you to injury because balance and control issues make the knee more vulnerable. This can be detected with video motion analysis. It can also be detected by observing how you land as you jump from a height. Patients who have had an indirect ACL injury are at a higher risk of reinjury because they still have this less-than-optimal way of landing. In another example, there is evidence that athletes whose hamstrings are relatively weak in relation to their quadriceps are more likely to sustain ACL injuries.

From these observations, several programs have been developed at Olympic training centers and universities in North America and Europe to strengthen the relevant muscles, teach athletes better movement techniques, and improve proprioception (awareness of the position of your body). Furthermore, it has been shown that teams that implement prevention techniques have significantly more wins than teams that do not.

For example, the HarmoKnee prevention training program, developed by Swedish researchers, reduced the combined incidence of all types of acute knee injuries, including contact injuries, by 90 percent in soccer. Exercises developed by researchers at the Norwegian University for Sport and Physical Education in Oslo reduced the combined risk for lower extremity injuries in team handball by 47 percent. Most of the programs described in the literature feature jumping exercises (plyometrics), as well as hamstring, gluteus medius, core, and hip abductor strength exercises aimed at correcting imbalances. Both the HarmoKnee prevention training program and the similar FIFA 11+ are detailed online at harmoknee.com and fifa.com.

Two of the advantages of these preventative programs is that they require little to no equipment and are designed to be completed as a warm-up prior to exercise or training. If you compete in an individual sport, this can be an easy adjustment to make to your existing warm-ups. If you participate in a team sport, it may be most effective to have a conversation with your coach about the benefits of reducing injury rates within the team by incorporating the exercises into the regular warm-ups. Coaches love to win, and the hook that will frequently get them on board is that by completing a preventative

program, they will have more players healthy and available to play more often, improving the team's chances of winning. If your coaches are not receptive to the suggestion, take an extra fifteen minutes before training to complete the exercises on your own. You might just find your teammates joining you!

The first step to improving sports performance, while diminishing injuries through physical conditioning, is to design a program with the goals and needs of each specific sport. Not every sport requires each component of physical conditioning in equal proportions. For example, a runner should focus on running techniques to avoid overuse injuries, a swimmer training for an upcoming competition might benefit from running once a week to decrease stress on the shoulder, a basketball or soccer player should concentrate on proper landing techniques to prevent ACL injuries, and so forth.

OOPS, I DID IT AGAIN: WHAT TO DO IF YOU GET REINJURED

Should you find yourself in a situation where you have hurt your knee again, the best first step to take is to contact your medical team. They will be able to complete a thorough evaluation of your knee to determine whether this new injury is a recurrence of the original injury or an injury that is completely unrelated to your prior injury history. Getting an accurate diagnosis is the essential first step to developing the most appropriate treatment plan to get you back in the game.

Participating in the activities and sports we love comes with risk. That is what makes them so fun! With good decision making about the loads you place on your knee, the environment you choose to train in, and your commitment to maintaining high levels of muscular strength and completing preventative programs, you can directly mitigate some of the injury risk that is inherent in being active. There are no guarantees, but an active life is surely far more fulfilling than a risk-free life lived from the couch.

EPILOGUE

WILL MY KNEE EVER BE THE SAME AGAIN?

There are many factors that play into whether you can get back to high levels of activities after a knee injury. Some of these you can control, and some you can't. As we've seen, the things under your control are going to a surgeon who is adept at treating that particular problem and getting the right rehabilitation program for that particular surgery or nonoperative treatment to ensure that you get the best possible outcome.

In choosing a physician, it is important to know their overall qualifications; if you are an athlete, you should find out whether they have treated athletes with similar injuries to yours. While some injuries can be quite rare, and even the top surgeons in the country may only see a few a year, other injuries are quite common, and seeing a physician who is good at treating common problems is also important. For example, if you have a PCL tear that needs surgery and you see somebody who has not performed PCL reconstructions before, you would not expect your outcome to be as good as it would have been with an experienced surgeon. Talk to teammates, classmates, coaches, and others to see if they have recommendations for the top surgeons in your area. They may have had surgery themselves or know of athletes who have had similar surgeries and were able to get back to full competition.

It is important to recognize that not all surgeries are the same. What can seem like simple surgeries may in fact not be the best treatment for you and can result in long-term problems. For example, taking out a meniscus that can be repaired will certainly get you back to activities much quicker. However, this often dooms the overall long-term health of your knee, and it may mean that in five to ten years you will have arthritis and won't be able to participate in those sports you love. Therefore, you should have both a comprehensive short-term understanding and also a long-term overview of your knee injury, how it should be treated, and what the long-term consequences of it may be.

Once you have had surgery, the first few days after surgery can often seem to last forever. You can become depressed and worried about getting back to your activities. During this time, talk to your surgeon, their physician assistant, or your physical therapist to see if other patients have had similar concerns after surgery and how your progress in physical therapy may be in compared to that of others. Almost all patients have some difficulty sleeping, pain, and swelling around the knee, and they worry that if they do one simple thing wrong, their recovery from knee surgery will fail.

The best way to speed up the healing process is to follow your prescribed rehabilitation program as closely as possible, eat a good balanced diet with proper nutrition, get good sleep, quit smoking if you smoke, and ice your knee as much as you can. If you find yourself healing faster than the expected rate, be careful that you are not doing too much. You may be doing things that could cause your ligament grafts to stretch out or your meniscus sutures to become too stretched. Surgeons set limits on knee motion, weight bearing, and other activities based on the feeling they have of how well the repair or reconstruction can handle it for certain time frames. If you deviate from those limits, you risk causing your ligaments or repairs to stretch out and fail.

It is also important to stick with your rehab program. If you fall behind in your rehabilitation, you may have to spend more time working on achieving your goals. One of the biggest problems patients often have is that they have other life responsibilities and sometimes skip physical therapy sessions or fall behind. It is especially important to make sure that you focus on yourself and follow the instructions, especially for the first couple of weeks after surgery. This is a time that can be critical for tissue healing and making sure you do not have a stiff knee. While you can slack on your rehabilitation exercises later and make up for it by extending the overall time it takes to get back to activities, if you have too much swelling because you’re doing too much, or your knee gets stiff because you are not doing your rehabilitation exercises right after surgery, there will be long-term consequences for your knee health, possibly affecting your overall healing. Sometimes you may have to undergo a second surgery as a result.

The healing process takes time. Certain actions can significantly affect your recovery. Smoking shrinks your blood vessels, which makes the healing process slower. Avoid drinking alcohol if you are taking a blood thinner or narcotic pain medications. Keep your weight down, because extra pounds put greater pressure on your knee and can slow your recovery. And finally, strengthen the muscles in your legs and improve overall blood flow by participating in low-impact activities such as walking, swimming, or peddling

a stationary bike once your doctor gives you the green light.

It is important to recognize that human beings are not like a car when it breaks down. For a machine, new parts can be obtained that are identical to or possibly even better than the original parts. For human beings, it is all about growing and healing. Even in healthy people, healing is never guaranteed, and you have to modify your activities to give the tissues the best chance to heal successfully. This will also help you avoid second-time surgeries, as these unfortunately don't go as well as the first time around.

THE MENTAL GAME: RECOVERY TAKES PATIENCE

One of the hardest things for patients to do is to follow their rehabilitation program, eat a balanced diet, and be able to focus on healing. If you are an athlete, you may be used to working out several hours a day, and now you're literally off your game. You may have difficulty sleeping and wonder if you are ever going to recover. These types of concerns about recovery are common, and when they happen, it is often useful to talk to somebody about them. Most professional athletes have athletic trainers or physical therapists to talk to. If you don't have people like those to talk to, working with a sports psychologist may help you to improve your overall recovery and performance.

Athletes *can* often have a return of strength, function, and excellent healing of their ligament reconstructions. Still, a fairly large percentage of these athletes, sometimes 15 to 20 percent, do not have the mental capacity to go back to playing their sport, or they have a fear of reinjury. If fear is affecting your performance and attitude, it is entirely reasonable to talk to somebody, such as a sports psychologist, about it. Even high-level professional athletes have this happen, so it should be expected that a high school or college athlete may have similar anxieties.

While you can never be 100 percent sure that your knee will be the same again, the best way to try to regain your knee function and performance capacity is to choose the best doctor to treat your problem, work with a good therapist, make sure you are doing your exercises outside of therapy, and have a positive and willing attitude. There is no person after surgery who ever has a 100 percent perfect rehabilitation program, no matter how well financed they may be by their teams or how perfect their surgery went. So don't make perfection your goal! Human knees are not machines, and they act differently depending on genetics, environment, and the type of surgery they undergo.

Navigating these bumps in the road is essential to making sure that you have the best outcomes, and often being patient is the best way to ensure that you will get back to higher-level activities.

For a long time, a health care provider would come up with a huge list of don'ts for people who've recovered from a knee injury: you shouldn't jump on a trampoline, or play tackle football, or ride a motorcycle, or skydive, and so forth. It was easier to just simply say, "No, you can't do that. It is too dangerous." But people hate to be told they can't do something! It is inherently wired into us as human beings to want what we can't have and to do something we are told not to do. Doctors should instead aim to educate patients on the risks involved with certain activities and how to minimize them.

Furthermore, some don't care about the risks and want to continue to do an activity no matter what. Like the avid runner who feels the need to run even though her knees have horrible arthritis. Or the BMX rider who has broken his tibia twice but refuses to hang up the handlebars. You know what? That is OK! Yes, we are providers telling you it is OK to do something that is not necessarily the best for the health of your knee, or your health overall. We tell our patients as long as you understand the risks of an activity, and you feel the rewards are greater than the risks, then go for it. Life is too short for a whole long list of don'ts.

The key is to continue to do the activities you love in the safest manner possible or aim to minimize the environmental risk. Let's take the avid runner who needs to continue to run to feel alive. What we can do is help to work on your gait (walking and running stride), encourage you to maintain a healthy weight, and recommend you run on softer running surfaces such as grass, rather than cement or asphalt. Or another example: The soccer player who has torn her ACL twice but is relying on her on-field skill to get a college scholarship. We can educate her about at-risk movements, in combination with a strength AND flexibility program to try to help avoid another career or life-altering injury.

The take home point is, yes, you can reliably get back to the activities you love, and you can even be as successful as before, if not more successful. It is not guaranteed; it will take a combination of hard work, perseverance, and, like anything in life, a little bit of luck. Furthermore, returning to these activities will not be without risk. The sport or activity you love is what most likely led to your injury once, and it could do so again, no matter how phenomenal your surgery, rehab, or skill level is. Take solace in knowing

many patients like those mentioned throughout this book have been in the same position you are in now, and they have found ways to recover, overcome, and succeed in life, sports, and beyond after their injury.

* Usually a period of time when the knee will be kept in extension or 0 degrees of flexion