

Recognizing
The National
Bone and Joint Decade
2002–2011

Questions
& Answers
about . . .

Knee
Problems

National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)
National Institutes of Health
Public Health Service • U.S. Department of Health and Human Services

For Your Information

This publication contains information about medications used to treat the health condition discussed here. When this booklet was printed, we included the most up-to-date (accurate) information available. Occasionally, new information on medication is released.

For updates and for any questions about any medications you are taking, please contact the U.S. Food and Drug Administration at 1-888-INFO-FDA (1-888-463-6332, a toll-free call) or visit their Web site at www.fda.gov.

This booklet is not copyrighted. Readers are encouraged to duplicate and distribute as many copies as needed.

Additional copies of this booklet are available from:

National Institute of Arthritis and Musculoskeletal
and Skin Diseases
NIAMS/National Institutes of Health
1 AMS Circle
Bethesda, MD 20892-3675

You can also find this booklet on the NIAMS Web site at www.niams.nih.gov.

Table of Contents

What Do the Knees Do? How Do They Work?	1
What Causes Knee Problems?	2
What Are the Parts of the Knee?	3
How Are Knee Problems Diagnosed?	6
What Are Some Common Knee Injuries and Problems?	8
Arthritis	8
Chondromalacia	13
Meniscal Injuries (Injuries to the Menisci)	15
Cruciate Ligament Injuries	17
Medial and Lateral Collateral Ligament Injuries	19
Tendon Injuries	20
Osgood-Schlatter Disease	21
Iliotibial Band Syndrome	23
Osteochondritis Dissecans	24
Plica Syndrome	25

What Kinds of Doctors Evaluate and
Treat Knee Problems? 27

How Can People Prevent Knee Problems? 29

What Types of Exercise Are Best for People
With Knee Problems? 30

What Research Is Being Conducted
on Knee Problems? 31

Where Can People Find More Information
About Knee Problems? 34

Key Words 39

Information Boxes

Joint Basics 2

Lateral View of the Knee 3

About Total Knee Replacement 28

Knee problems are very common, and they occur in people of all ages. This booklet contains general information about several knee problems. It includes descriptions and a diagram of the different parts of the knee. Individual sections of the booklet describe the symptoms, diagnosis, and treatment of specific types of knee injuries and conditions. Information on how to prevent these problems is also provided.

What Do the Knees Do? How Do They Work?

The knee is the joint where the bones of the upper leg meet the bones of the lower leg, allowing hinge-like movement while providing stability and strength to support the weight of the body. Flexibility, strength, and stability are needed for standing and for motions like walking, running, crouching, jumping, and turning.

Several kinds of supporting and moving parts, including bones, cartilage, muscles, ligaments, and tendons, help the knees do their job. (See Joint Basics, below.) Each of these structures is subject to disease and injury. When a knee problem affects your ability to do things, it can have a big impact on your life. Knee problems can interfere with many things, from participation in sports to simply getting up from a chair and walking.

Joint Basics

The point at which two or more bones are connected is called a joint. In all joints, the bones are kept from grinding against each other by lining called cartilage. Bones are joined to bones by strong, elastic bands of tissue called ligaments. Muscles are connected to bones by tough cords of tissue called tendons. Muscles pull on tendons to move joints. While muscles are not technically part of a joint, they're important because strong muscles help support and protect joints.

What Causes Knee Problems?

Knee problems can be the result of disease or injury.

Disease

A number of diseases can affect the knee. The most common is arthritis. Although arthritis technically means “joint inflammation,” the term is used loosely to describe many different diseases that can affect the joints. We'll describe some of the most common forms of arthritis and their effects on the knees a bit later in the booklet.

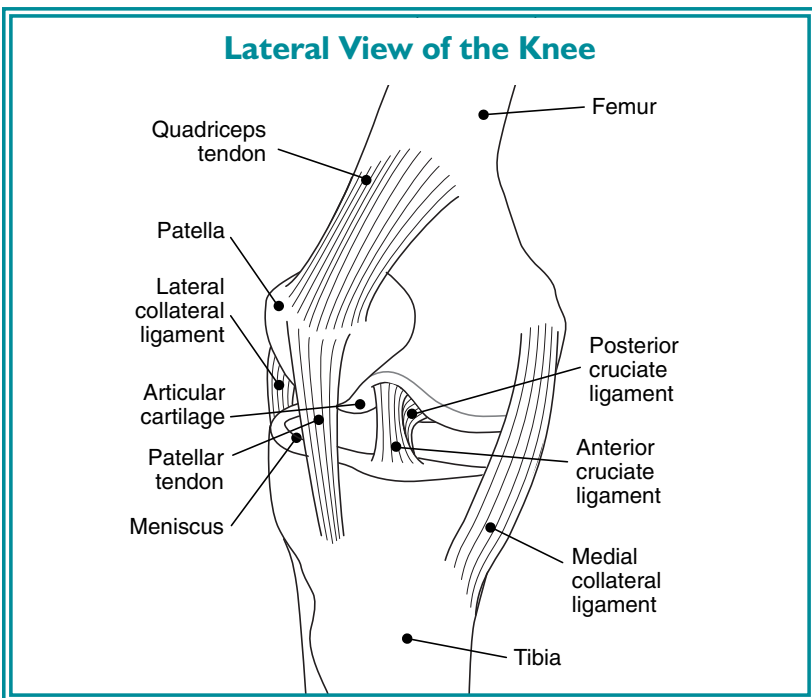
Injury

Knee injuries can occur as the result of a direct blow or sudden movements that strain the knee beyond its normal range of motion. Sometimes knees are injured slowly over time.

Problems with the hips or feet, for example, can cause you to walk awkwardly, which throws off the alignment of the knees and leads to damage. Knee problems can also be the result of a lifetime of normal wear and tear. Much like the treads on a tire, the joint simply wears out over time. We'll discuss some of the most common knee injuries later in this booklet, but first we'll take a look at the structure of the knee joint.

What Are the Parts of the Knee?

Like any joint, the knee is composed of bones and cartilage, ligaments, tendons, and muscles. See the diagram, and take a closer look at the different parts of the knee.



Bones and cartilage

The knee joint is the junction of three bones: the femur (thigh bone or upper leg bone), the tibia (shin bone or larger bone of the lower leg), and the patella (knee cap). The patella is 2 to 3 inches wide and 3 to 4 inches long. It sits over the other bones at the front of the knee joint and slides when the knee moves. It protects the knee and gives leverage to muscles.

The ends of the three bones in the knee joint are covered with articular cartilage, a tough, elastic material that helps absorb shock and allows the knee joint to move smoothly. Separating the bones of the knee are pads of connective tissue called menisci (men-NISS-sky). The menisci are two crescent-shaped discs (each called a meniscus (men-NISS-kus) positioned between the tibia and femur on the outer and inner sides of each knee. The two menisci in each knee act as shock absorbers, cushioning the lower part of the leg from the weight of the rest of the body as well as enhancing stability.

Muscles

There are two groups of muscles at the knee. The four quadriceps muscles on the front of the thigh work to straighten the knee from a bent position. The hamstring muscles, which run along the back of the thigh from the hip to just below the knee, help to bend the knee.

Tendons and ligaments

The quadriceps tendon connects the quadriceps muscle to the patella and provides the power to straighten the knee. The following four ligaments connect the femur and tibia and give the joint strength and stability:

- The medial collateral ligament (MCL), which runs along the inside of the knee joint, provides stability to the inner (medial) part of the knee.
- The lateral collateral ligament (LCL), which runs along the outside of the knee joint, provides stability to the outer (lateral) part of the knee.
- The anterior cruciate ligament (ACL), in the center of the knee, limits rotation and the forward movement of the tibia.
- The posterior cruciate ligament (PCL), also in the center of the knee, limits backward movement of the tibia.

The knee capsule is a protective, fiber-like structure that wraps around the knee joint. Inside the capsule, the joint is lined with a thin, soft tissue called synovium.

How Are Knee Problems Diagnosed?

Doctors diagnose knee problems based on the findings of the medical history, physical exam, and diagnostic tests.

Medical history

During the medical history, the doctor asks how long symptoms have been present and what problems you are having using your knee. In addition, the doctor will ask about any injury, condition, or health problem that might be causing the problem.

Physical examination

The doctor bends, straightens, rotates (turns), or presses on the knee to feel for injury, and determine how well the knee moves and where the pain is located. The doctor may ask you to stand, walk, or squat to help assess the knee's function.

Diagnostic tests

Depending on the findings of the medical history and physical exam, the doctor may use one or more tests to determine the nature of a knee problem. Some of the more commonly used tests include:

- **X ray (radiography)** – a procedure in which an x ray beam is passed through the knee to produce a two-dimensional picture of the bones.

- **Computerized axial tomography (CAT) scan** – a painless procedure in which x rays are passed through the knee at different angles, detected by a scanner, and analyzed by a computer. CAT scan images show soft tissues such as ligaments or muscles more clearly than conventional x rays. The computer can combine individual images to give a three-dimensional view of the knee.
- **Bone scan (radionuclide scanning)** – a technique for creating images of bones on a computer screen or on film. Prior to the procedure, a harmless radioactive material is injected into your bloodstream. The material collects in the bones, particularly in abnormal areas of the bones, and is detected by a scanner.
- **Magnetic resonance imaging (MRI)** – a procedure that uses a powerful magnet linked to a computer to create pictures of areas inside the knee. During the procedure, your leg is placed in a cylindrical chamber where energy from a powerful magnet (rather than x rays) is passed through the knee. An MRI is particularly useful for detecting soft tissue damage.
- **Arthroscopy** – a surgical technique in which the doctor manipulates a small, lighted optic tube (arthroscope) that has been inserted into the joint through a small incision in the knee. Images of the inside of the knee joint are projected onto a television screen.

- **Joint aspiration** – a procedure that uses a syringe to remove fluid buildup in a joint, and can reduce swelling and relieve pressure. A laboratory analysis of the fluid can determine the presence of a fracture, an infection, or an inflammatory response.
- **Biopsy** – the examination of a piece of tissue under the microscope.

What Are Some Common Knee Injuries and Problems?

There are many diseases and types of injuries that can affect the knee. These are some of the most common, along with their diagnoses and treatment.

Arthritis¹

There are some 100 different forms of arthritis, rheumatic diseases, and related conditions. Virtually all of them have the potential to affect the knees in some way; however, the following are the most common:

- osteoarthritis. Most people with knee problems have a form of arthritis called osteoarthritis. In this disease, the cartilage gradually wears away and changes occur in the adjacent bone. Osteoarthritis may be caused by

¹ The National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse has separate publications on the different forms of arthritis mentioned in this section. See the end of this booklet for contact information.

joint injury or being overweight. It is associated with aging and most typically begins in people age 50 years or older. A young person who develops osteoarthritis typically has had an injury to the knee or may have an inherited form of the disease.

- rheumatoid arthritis. Rheumatoid arthritis, which generally affects people at a younger age than osteoarthritis, is an autoimmune disease. This means it occurs as a result of the immune system attacking components of the body. In rheumatoid arthritis, the primary site of the immune system's attack is the synovium, the membrane that lines the joint. This attack causes inflammation of the joint. It can lead to destruction of the cartilage and bone and, in some cases, muscles, tendons, and ligaments as well.
- other rheumatic diseases. These include:
 - **gout** – an acute and intensely painful form of arthritis that occurs when crystals of the bodily waste product uric acid are deposited in the joints
 - **lupus** – an autoimmune disease characterized by destructive inflammation of the skin, internal organs, and other body systems as well as the joints
 - **ankylosing spondylitis** – an inflammatory form of arthritis that primarily affects the spine, leading to stiffening and in some cases fusing into a stooped position

- **psoriatic arthritis** – a condition in which inflamed joints produce symptoms of arthritis for patients who have or will develop psoriasis
- **infectious arthritis** – a term describing forms of arthritis that are caused by infectious agents, such as bacteria or viruses. Prompt medical attention is essential to treat the infection and minimize damage to joints, particularly if fever is present.

Symptoms

The symptoms of arthritis are different for the different forms. For example, people with rheumatoid arthritis, gout, or other inflammatory conditions may find the knee swollen, red, and even hot to the touch. Any form of arthritis can cause the knee to be painful and stiff.

Diagnosis

The doctor may confirm the diagnosis by conducting a careful history and physical examination. Blood tests may be helpful for diagnosing rheumatoid arthritis, but other tests may be needed too. Analyzing fluid from the knee joint, for example, may be helpful in diagnosing gout. X rays may be taken to determine loss or damage to cartilage or bone.

Treatment

Like the symptoms, treatment varies depending on the form of arthritis affecting the knee. For osteoarthritis, treatment is targeted at relieving symptoms and may include pain-reducing medicines such as aspirin or acetaminophen (Tylenol²); nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen (Motrin, Nuprin, Advil); or in some cases injections of corticosteroid medications directly into the knee joint. Other treatments for the pain of knee osteoarthritis include injections of hyaluronic acid substitutes and the nutritional supplements glucosamine and chondroitin sulphate. For more information about the use of these two supplements, see the section titled “What Research Is Being Conducted on Knee Problems?”

People with diseases such as rheumatoid arthritis, ankylosing spondylitis, or psoriatic arthritis often require disease-modifying antirheumatic drugs (DMARDs) or biologic response modifiers (biologics) to control the underlying disease that is the source of their knee problems. These drugs are typically prescribed after less potent treatments such as NSAIDs or intra-articular injections are deemed ineffective.

² Brand names included in this booklet are provided as examples only, and their inclusion does not mean that these products are endorsed by the National Institutes of Health or any other Government agency. Also, if a particular brand name is not mentioned, this does not mean or imply that the product is unsatisfactory.

DMARDs are a family of medicines that may be able to slow or stop the immune system from attacking the joints. This in turn prevents pain and swelling. DMARDs typically require regular blood tests to monitor side effects. In addition to relieving signs and symptoms, DMARDs may help to retard or even stop joint damage from progressing. However, DMARDs cannot fix joint damage that has already occurred. Some of the most commonly prescribed DMARDs are methotrexate, hydroxychloroquine, sulfasalazine, and leflunomide.

Biologic response modifiers, or biologics, are a new family of genetically engineered drugs that block specific molecular pathways of the immune system that are involved in the inflammatory process. They are often prescribed in combination with DMARDs such as methotrexate. Because biologics work by suppressing the immune system, they could be problematic for patients who are prone to frequent infection. They are typically administered by injection at home, or by an intravenous infusion at a clinic. Some commonly prescribed biologics include etanercept, adalimumab, infliximab, and anakinra.

People with any type of arthritis may benefit from exercises to strengthen the muscles that support the knee and weight loss, if needed, to relieve excess stress on the joints.

If arthritis causes serious damage to a knee or there is incapacitating pain or loss of use of the knee from arthritis, joint surgery may be considered. Traditionally, this has been done

with what is known as a total knee replacement. However, newer surgical procedures are continuously being developed that include resurfacing or replacing only the damaged cartilage surfaces while leaving the rest of the joint intact.

Chondromalacia

Chondromalacia (KON-dro-mah-LAY-she-ah), also called chondromalacia patellae, refers to softening of the articular cartilage of the kneecap. This disorder occurs most often in young adults and can be caused by injury, overuse, misalignment of the patella, or muscle weakness. Instead of gliding smoothly across the lower end of the thigh bone, the knee cap rubs against it, thereby roughening the cartilage underneath the knee cap. The damage may range from a slightly abnormal surface of the cartilage to a surface that has been worn away to the bone. Chondromalacia related to injury occurs when a blow to the knee cap tears off either a small piece of cartilage or a large fragment containing a piece of bone (osteochondral fracture).

Symptoms

The most frequent symptom is a dull pain around or under the knee cap that worsens when walking down stairs or hills. A person may also feel pain when climbing stairs or when the knee bears weight as it straightens. The disorder is common in runners and is also seen in skiers, cyclists, and soccer players.

Diagnosis

Your description of symptoms and an x ray usually help the doctor make a diagnosis. Although arthroscopy can confirm the diagnosis, it's not performed unless conservative treatment has failed.

Treatment

Many doctors recommend that people with chondromalacia perform low-impact exercises that strengthen muscles, particularly muscles of the the inner part of the quadriceps, without injuring joints. Swimming, riding a stationary bicycle, and using a cross-country ski machine are examples of good exercises for this condition. Electrical stimulation may also be used to strengthen the muscles.

Increasingly, doctors are using osteochondral grafting, in which a plug of bone and healthy cartilage is harvested from one area and transplanted to the injury site. Another relatively new technique is known as autologous chondrocyte implantation, or ACI. It involves harvesting healthy cartilage cells, cultivating them in a lab and implanting them over the lesion.

If these treatments don't improve the condition, the doctor may perform arthroscopic surgery to smooth the surface of the cartilage and "wash out" the cartilage fragments that cause the joint to catch during bending and straightening. In more severe cases, surgery may be necessary to correct the angle of the knee cap and relieve friction between it and the cartilage, or to reposition parts that are out of alignment.

Meniscal Injuries (Injuries to the Menisci)

The menisci can be easily injured by the force of rotating the knee while bearing weight. A partial or total tear may occur when a person quickly twists or rotates the upper leg while the foot stays still (for example, when dribbling a basketball around an opponent or turning to hit a tennis ball). If the tear is tiny, the meniscus stays connected to the front and back of the knee; if the tear is large, the meniscus may be left hanging by a thread of cartilage. The seriousness of a tear depends on its location and extent.

Symptoms

Generally, when people injure a meniscus, they feel some pain, particularly when the knee is straightened. If the pain is mild, the person may continue moving. Severe pain may occur if a fragment of the meniscus catches between the femur and the tibia. Swelling may occur soon after injury if there is damage to blood vessels. Swelling may also occur several hours later if there is inflammation of the joint lining (synovium). Sometimes, an injury that occurred in the past but was not treated becomes painful months or years later, particularly if the knee is injured a second time. After any injury, the knee may click, lock, feel weak, or give way. Although symptoms of meniscal injury may disappear on their own, they frequently persist or return and require treatment.

Diagnosis

In addition to listening to your description of the onset of pain and swelling, the doctor may perform a physical examination and take x rays of the knee. An MRI may be recommended to confirm the diagnosis. Occasionally, the doctor may use arthroscopy to help diagnose a meniscal tear.

Treatment

If the tear is minor and the pain and other symptoms go away, the doctor may recommend a muscle-strengthening program. The following exercises after injury to the meniscus are designed to build up the quadriceps and hamstring muscles and increase flexibility and strength:

- warming up the joint by riding a stationary bicycle, then straightening and raising the leg (but not straightening it too much)
- extending the leg while sitting (a weight may be worn on the ankle for this exercise)
- raising the leg while lying on the stomach
- exercising in a pool (walking as fast as possible in chest-deep water, performing small flutter kicks while holding onto the side of the pool, and raising each leg to 90 degrees in chest-deep water while pressing the back against the side of the pool).

Before beginning any type of exercise program, consult your doctor or physical therapist to learn which exercises are appropriate for you and how to do them correctly, because doing the wrong exercise or exercising improperly can cause problems. A health care professional can also advise you on how to warm up safely and when to avoid exercising a joint affected by arthritis.

If your lifestyle is limited by the symptoms or the problem, the doctor may perform arthroscopic or open surgery to see the extent of injury and to remove or repair the tear. Most young athletes are able to return to active sports after meniscus repair.

Recovery after surgical repair takes several weeks. The best results of treatment for meniscal injury are obtained in people who do not show articular cartilage changes and who have an intact anterior cruciate ligament.

Cruciate Ligament Injuries

These are sometimes referred to as sprains.³ They don't necessarily cause pain, but they are disabling. The anterior cruciate ligament is most often stretched or torn (or both) by a sudden twisting motion (for example, when the feet are planted one way and the knees are turned another). The posterior cruciate ligament is most often injured by a direct impact, such as in an automobile accident or football tackle.

³ The National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse has a separate publication on sprains and strains. See the end of this booklet for contact information.

Symptoms

You may hear a popping sound, and the leg may buckle when you try to stand on it.

Diagnosis

The doctor may perform several tests to see whether the parts of the knee stay in proper position when pressure is applied in different directions. A thorough examination is essential. An MRI is accurate in detecting a complete tear, but arthroscopy may be the only reliable means of detecting a partial one.

Treatment

For an incomplete tear, the doctor may recommend an exercise program to strengthen surrounding muscles. The doctor may also prescribe a brace to protect the knee during activity. For a completely torn anterior cruciate ligament in an active athlete and motivated person, the doctor is likely to recommend surgery. The surgeon may reconstruct torn ligament by using a piece (graft) of healthy tissue from you (autograft) or from a cadaver (allograft). Although synthetic ligaments have been tried in experiments, the results have not been as good as with human tissue. One of the most important elements in a successful recovery after cruciate ligament surgery is a 4- to 6-month exercise and rehabilitation program that may involve using special exercise equipment at a rehabilitation or sports center. Successful surgery and rehabilitation will allow the person to return to a normal lifestyle.

Medial and Lateral Collateral Ligament Injuries

The medial collateral ligament is more easily injured than the lateral collateral ligament. The cause of collateral ligament injuries is most often a blow to the outer side of the knee that stretches and tears the ligament on the inner side of the knee. Such blows frequently occur in contact sports like football or hockey.

Symptoms

When injury to the medial collateral ligament occurs, you may feel a pop and the knee may buckle sideways. Pain and swelling are common.

Diagnosis

A thorough examination is needed to determine the kind and extent of the injury. In diagnosing a collateral ligament injury, the doctor exerts pressure on the side of the knee to determine the degree of pain and the looseness of the joint. An MRI is helpful in diagnosing injuries to these ligaments.

Treatment

Most sprains of the collateral ligaments will heal if you follow a prescribed exercise program. In addition to exercise, the doctor may recommend ice packs to reduce pain and swelling, and a small sleeve-type brace to protect and stabilize the knee. A sprain may take 2 to 4 weeks to heal. A

severely sprained or torn collateral ligament may be accompanied by a torn anterior cruciate ligament, which usually requires surgical repair.

Tendon Injuries

Knee tendon injuries range from tendinitis (inflammation of a tendon) to a ruptured (torn) tendon. If a person overuses a tendon during certain activities such as dancing, cycling, or running, the tendon stretches and becomes inflamed. Tendinitis of the patellar tendon is sometimes called jumper's knee because in sports that require jumping, such as basketball, the muscle contraction and force of hitting the ground after a jump strain the tendon. After repeated stress, the tendon may become inflamed or tear.

Symptoms

People with tendinitis often have tenderness at the point where the patellar tendon meets the bone. In addition, they may feel pain during running, hurried walking, or jumping. A complete rupture of the quadriceps or patellar tendon is not only painful, but also makes it difficult for a person to bend, extend, or lift the leg against gravity.

Diagnosis

If there is not much swelling, the doctor will be able to feel a defect in the tendon near the tear during a physical examination. An x ray will show that the patella is lower than normal

in a quadriceps tendon tear and higher than normal in a patellar tendon tear. The doctor may use an MRI to confirm a partial or total tear.

Treatment

Initially, the treatment for tendinitis involves rest, elevating the knee, applying ice, and taking NSAID medications such as aspirin or ibuprofen to relieve pain and decrease inflammation and swelling. A series of rehabilitation exercises is also useful. If the quadriceps or patellar tendon is completely ruptured, a surgeon will reattach the ends. After surgery, a cast is worn for 3 to 6 weeks and crutches are used. For a partial tear, the doctor might apply a cast without performing surgery.

Rehabilitating a partial or complete tear of a tendon requires an exercise program that is similar to but less vigorous than that prescribed for ligament injuries. The goals of exercise are to restore the ability to bend and straighten the knee and to strengthen the leg to prevent repeat injury. A rehabilitation program may last 6 months, although people can return to many activities before then.

Osgood-Schlatter Disease

Osgood-Schlatter disease is a condition caused by repetitive stress or tension on part of the growth area of the upper tibia (the apophysis). It is characterized by inflammation of the patellar tendon and surrounding soft tissues at the point

where the tendon attaches to the tibia. The disease may also be associated with an injury in which the tendon is stretched so much that it tears away from the tibia and takes a fragment of bone with it. The disease most commonly affects active young people, particularly boys between the ages of 10 and 15, who play games or sports that include frequent running and jumping.

Symptoms

People with this disease experience pain just below the knee joint that usually worsens with activity and is relieved by rest. A bony bump that is particularly painful when pressed may appear on the upper edge of the tibia (below the knee cap). Usually, the motion of the knee is not affected. Pain may last a few months and may recur until the child's growth is completed.

Diagnosis

Osgood-Schlatter disease is most often diagnosed by the symptoms. An x ray may be normal, or show an injury, or, more typically, show that the growth area is in fragments.

Treatment

Usually, the disease resolves without treatment. Applying ice to the knee when pain begins helps relieve inflammation and is sometimes used along with stretching and strengthening exercises. The doctor may advise you to limit participation in vigorous sports. Children who wish to continue moderate or

less stressful sports activities may need to wear knee pads for protection and apply ice to the knee after activity. If there is a great deal of pain, sports activities may be limited until discomfort becomes tolerable.

Iliotibial Band Syndrome

Iliotibial band syndrome is an inflammatory condition caused when a band of tissue rubs over the outer bone (lateral condyle) of the knee. Although iliotibial band syndrome may be caused by direct injury to the knee, it is most often caused by the stress of long-term overuse, such as sometimes occurs in sports training and, particularly, in running.

Symptoms

A person with this syndrome feels an ache or burning sensation at the side of the knee during activity. Pain may be localized at the side of the knee or radiate up the side of the thigh. A person may also feel a snap when the knee is bent and then straightened. Swelling is usually absent and knee motion is normal.

Diagnosis

The diagnosis of this disorder is typically based on the symptoms, such as pain at the outer bone, and exclusion of other conditions with similar symptoms.

Treatment

Usually, iliotibial band syndrome disappears if the person reduces activity and performs stretching exercises followed by muscle-strengthening exercises. In rare cases when the syndrome doesn't disappear, surgery may be necessary to split the tendon so it isn't stretched too tightly over the bone.

Osteochondritis Dissecans

Osteochondritis dissecans results from a loss of the blood supply to an area of bone underneath a joint surface. It usually involves the knee. The affected bone and its covering of cartilage gradually loosen and cause pain. This problem usually arises spontaneously in an active adolescent or young adult. It may be due to a slight blockage of a small artery or to an unrecognized injury or tiny fracture that damages the overlying cartilage. A person with this condition may eventually develop osteoarthritis.

Lack of a blood supply can cause bone to break down (osteonecrosis⁴). The involvement of several joints or the appearance of osteochondritis dissecans in several family members may indicate that the disorder is inherited.

⁴ The National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse has a separate publication on osteonecrosis. See the end of this booklet for contact information.

Symptoms

If normal healing doesn't occur, cartilage separates from the diseased bone and a fragment breaks loose into the knee joint, causing weakness, sharp pain, and locking of the joint.

Diagnosis

An x ray, MRI, or arthroscopy can determine the condition of the cartilage and can be used to diagnose osteochondritis dissecans.

Treatment

If cartilage fragments have not broken loose, a surgeon may fix them in place with pins or screws that are sunk into the cartilage to stimulate a new blood supply. If fragments are loose, the surgeon may scrape down the cavity to reach fresh bone, add a bone graft, and fix the fragments in position. Fragments that cannot be mended are removed, and the cavity is drilled or scraped to stimulate new cartilage growth. Research is being done to assess the use of cartilage cell and other tissue transplants to treat this disorder.

Plica Syndrome

Plica (PLI-kah) syndrome occurs when plicae (bands of synovial tissue) are irritated by overuse or injury. Synovial plicae are the remains of tissue pouches found in the early stages of fetal development. As the fetus develops, these pouches nor-

mally combine to form one large synovial cavity. If this process is incomplete, plicae remain as four folds or bands of synovial tissue within the knee. Injury, chronic overuse, or inflammatory conditions are associated with this syndrome.

Symptoms

Symptoms of plica syndrome include pain and swelling, a clicking sensation, and locking and weakness of the knee.

Diagnosis

Because the symptoms are similar to those of some other knee problems, plica syndrome is often misdiagnosed. Diagnosis usually depends on excluding other conditions that cause similar symptoms.

Treatment

The goal of treatment is to reduce inflammation of the synovium and thickening of the plicae. The doctor usually prescribes medicine such as ibuprofen to reduce inflammation. People are also advised to reduce activity, apply ice and an elastic bandage to the knee, and do strengthening exercises. A cortisone injection into the plica folds helps about half of those treated. If treatment fails to relieve symptoms within 3 months, the doctor may recommend arthroscopic or open surgery to remove the plicae.

What Kinds of Doctors Evaluate and Treat Knee Problems?

After an examination by your primary care physician, he or she may refer you to a rheumatologist, an orthopaedic surgeon, or both. A rheumatologist specializes in *nonsurgical* treatment of arthritis and other rheumatic diseases. An orthopaedic surgeon, or orthopaedist, specializes in *nonsurgical and surgical* treatment of bones, joints, and soft tissues such as ligaments, tendons, and muscles.

You may also be referred to a physiatrist. Specializing in physical medicine and rehabilitation, physiatrists seek to restore optimal function to people with injuries to the muscles, bones, tissues, and nervous system.

Minor injuries or arthritis may be treated by an internist (a doctor trained to diagnose and treat nonsurgical diseases) or your primary care physician.

About Total Knee Replacement

Joint replacement is becoming more common, and hips and knees are the most commonly replaced joints. In 2003, more than 638,000 hip or knee replacement surgeries were performed.

The new joint, called a prosthesis, can be made of plastic, metal, or both. It may be cemented into place or uncemented. An uncemented prosthesis is designed so that bones will grow into it.

First made available in the late 1950s, early total knee replacements did a poor job of mimicking the natural motion of the knee. For that reason, these procedures resulted in high failure and complication rates. Advances in total knee replacement technology in the past 10 to 15 years have enhanced the design and fit of knee implants.

Total knee replacement is often the answer for people when x rays and other tests show joint damage; when moderate-to-severe, persistent pain does not improve adequately with nonsurgical treatment; and when the limited range of motion in their knee joint diminishes their quality of life.

In the past, patients between 60 and 75 years of age were considered to be the best candidates for total knee replacement. Over the past two decades, however, the age range has been broadened to include more patients older than 75, who are likely to have other health issues, and patients

younger than 60, who are generally more physically active and whose implants will probably be exposed to greater mechanical stress.

About 90 percent of patients appear to experience rapid and substantial reduction in pain, feel better in general, and enjoy improved joint function. While most total knee replacement surgeries are successful, failure does occur and revision is sometimes necessary. Risk factors include being younger than 55 years old; being male; being obese; and having osteoarthritis or other illnesses.

How Can People Prevent Knee Problems?

Some knee problems, such as those resulting from an accident, cannot be foreseen or prevented. However, a person can prevent many knee problems by following these suggestions:

- Before exercising or participating in sports, warm up by walking or riding a stationary bicycle, then do stretches. Stretching the muscles in the front of the thigh (quadriceps) and back of the thigh (hamstrings) reduces tension on the tendons and relieves pressure on the knee during activity.
- Strengthen the leg muscles by doing specific exercises (for example, by walking up stairs or hills, or by riding a stationary bicycle). A supervised workout with weights is another way to strengthen the leg muscles that support the knee.

- Avoid sudden changes in the intensity of exercise. Increase the force or duration of activity gradually.
- Wear shoes that both fit properly and are in good condition. This will help maintain balance and leg alignment when walking or running. Knee problems can be caused by flat feet or overpronated feet (feet that roll inward). People can often reduce some of these problems by wearing special shoe inserts (orthotics).
- Maintain a healthy weight to reduce stress on the knee. Obesity increases the risk of osteoarthritis of the knee.

What Types of Exercise Are Best for People With Knee Problems?

Ideally, everyone should get three types of exercise regularly:

- **Range-of-motion** exercises to help maintain normal joint movement and relieve stiffness.
- **Strengthening** exercises to help keep or increase muscle strength. Keeping muscles strong with exercises such as walking up stairs, leg lifts, dips, or riding a stationary bicycle helps support and protect the knee.
- **Aerobic or endurance** exercises to improve function of the heart and circulation and to help control weight. Weight control can be important to people who have arthritis because extra weight puts pressure

on many joints. Some studies show that aerobic exercise can reduce inflammation in some joints.

If you already have knee problems, your doctor or physical therapist can help with a plan of exercise that will help the knee(s) without increasing the risk of injury or further damage. As a rule of thumb, you should choose gentle exercises such as swimming, aquatic exercise, or walking over jarring exercises such as jogging or high-impact aerobics.

What Research Is Being Conducted on Knee Problems?

Studies of the various forms of arthritis are helping doctors better understand these diseases and develop treatments to stop or slow their progression and damage to joints, including the knees.

Studies are also underway to discover and/or develop safer and more effective pain relief, particularly for osteoarthritis of the knee. In recent years, the nutritional supplement pair glucosamine and chondroitin has shown some potential for reducing the pain of osteoarthritis, though no conclusive proof has emerged to date. Both of these nutrients are found in small quantities in food and are components of normal cartilage.

The recently concluded Glucosamine/Chondroitin Arthritis Intervention Trial (GAIT), which was co-sponsored by the National Center for Complementary and Alternative

Medicine and the National Institute of Arthritis and Musculoskeletal and Skin Diseases, assessed the effectiveness and safety of these supplements, when taken together or separately.

The trial found that the combination of glucosamine and chondroitin sulfate did not provide significant relief from osteoarthritis pain among all participants. However, a smaller subgroup of study participants with moderate-to-severe pain showed significant relief with the combined supplements.

The 4-year trial was conducted at 16 sites across the United States. The results were published in the Feb. 23, 2006 edition of the *New England Journal of Medicine*.

Scientists continue to experiment with procedures that may help replace lost or damaged joint cartilage. One procedure that has met with success involves growing a person's own cartilage cells in a dish and then grafting the new cartilage onto damaged areas of the joint. While the procedure has been successful in repairing cartilage injuries at the end of the femur, at present it is not recommended for arthritis-related damage, and its potential use in arthritis is still uncertain.

Other areas of research involve trying to better understand how and why joint injuries occur and the measures that should be taken to prevent them; investigating the role of exercise in protecting the knee; and developing less invasive surgeries and better joint prostheses.

In December 2003, NIAMS and other groups at the National Institutes of Health sponsored the Consensus Development Conference on Primary Total Knee Replacement. The conference findings underscored the value of knee replacements for end-stage arthritis, and identified avenues for further research. A summary of the conference is available at:

[http://consensus.nih.gov/2003/
2003TotalKneeReplacement117html.htm](http://consensus.nih.gov/2003/2003TotalKneeReplacement117html.htm)

Where Can People Find More Information About Knee Problems?

- **National Institute of Arthritis and Musculoskeletal and Skin Diseases**

National Institutes of Health

1 AMS Circle

Bethesda, MD 20892-3675

Phone: 301-495-4484 or

877-22-NIAMS (226-4267) (free of charge)

TTY: 301-565-2966

Fax: 301-718-6366

NIAMSInfo@mail.nih.gov

www.niams.nih.gov

NIAMS provides information about various forms of arthritis and other rheumatic diseases; as well as other bone, muscle, joint, and skin diseases. It distributes patient and professional education materials and refers people to other sources of information. Additional information and updates can also be found on the NIAMS Web site.

- **NIH Osteoporosis and Related Bone Diseases~
National Resource Center**
2 AMS Circle
Bethesda, MD 20892-3676
Phone: 202-223-0344 or 800-624-BONE
TTY: 202-466-4315
Fax: 202-293-2356
NIAMSBoneInfo@mail.nih.gov
www.niams.nih.gov/bone

The NIH Osteoporosis and Related Bone Diseases~National Resource Center provides patients, health professionals, and the public with an important link to resources and information on metabolic bone diseases. The mission of NIH ORBD~NRC is to expand awareness and enhance knowledge and understanding of the prevention, early detection, and treatment of these diseases as well as strategies for coping with them. The Center provides information on osteoporosis, Paget's disease of bone, osteogenesis imperfecta, primary hyperparathyroidism, and other metabolic bone diseases and disorders.

- **American Academy of Orthopaedic Surgeons**

P.O. Box 1998

Des Plaines, IL 60017-1998

Phone: 847-823-7186 or

800-824-BONE (2663) (free of charge)

Fax: 847-823-8125

www.aaos.org

The Academy provides education and practice management services for orthopaedic surgeons and allied health professionals and patients. It also serves as an advocate for improved patient care and informs the public about the science of orthopaedics. The orthopaedist's scope of practice includes disorders of the body's bones, joints, ligaments, muscles, and tendons. The Academy produces a variety of educational programs and informational brochures that are available free to the public. For a single copy of an AAOS brochure, send a self-addressed stamped envelope to the address above or visit the AAOS Web site.

- **American College of Rheumatology**

1800 Century Place, Suite 250

Atlanta, GA 30345–4300

Phone: 404–633–3777

Fax: 404–633–1870

www.rheumatology.org

This national professional organization can provide referrals to rheumatologists, and to allied health professionals such as physical therapists. One-page fact sheets are available on various forms of arthritis. Lists of specialists by geographic area and fact sheets are also available on this Web site.

- **American Physical Therapy Association**

1111 N. Fairfax Street

Alexandria, VA 22314

Phone: 703–684–2782 or

800–999–APTA (2782) (free of charge)

www.apta.org

The goal of the American Physical Therapy Association is to foster advancements in physical therapy practice, research, and education. The Association publishes a free brochure titled *Taking Care of the Knees*.

- **Arthritis Foundation**

P.O. Box 7669

Atlanta, GA 30357-0669

Phone: 404-872-7100 or 800-568-4045 (free of charge)

or call your local chapter (listed in the telephone directory)

www.arthritis.org

The Foundation has several free brochures about the various forms of arthritis that affect the knee, coping with arthritis, arthritis treatment, and exercise. A free brochure on protecting your joints is titled *Using Your Joints Wisely*. The Foundation also can provide addresses and phone numbers for local chapters and physician and clinic referrals.

Key Words

Ankylosing spondylitis – An inflammatory form of arthritis that primarily affects the spine, leading to stiffening and possible fusion.

Anterior cruciate ligament (ACL) – A ligament in the knee that crosses from the underside of the femur to the top of the tibia. The ligament limits rotation and the forward movement of the tibia.

Arthritis – A term used to refer to some 100 diseases that affect the joints. These diseases cause pain, inflammation, stiffness, damage, and/or malformation. The most common forms of arthritis are osteoarthritis and rheumatoid arthritis.

Avascular necrosis – A disease in which a temporary or permanent loss of the blood supply to the bones causes the bone tissue to die and the bone to collapse. This condition is also known as osteonecrosis, aseptic necrosis, and ischemic necrosis.

Arthroscopy – A surgical technique that involves making a small incision in the skin over the joint. A small lighted tube (arthroscope) with a camera is inserted through this incision. It takes images of the inside of the joint and projects them onto a television screen. While the arthroscope is inside the knee joint, the surgeon may insert surgical tools through additional small incisions to remove loose pieces of bone or cartilage or to repair torn ligaments or menisci.

Biopsy – A procedure in which tissue is removed from the body and studied under a microscope. A biopsy of joint tissue may be used to diagnose some forms of arthritis.

Bone scan (radionuclide scanning) – A technique for creating images of bones on a computer screen or on film. Prior to the procedure, a very small amount of radioactive dye is injected into the bloodstream. The dye collects in the bones, particularly in abnormal areas of the bones, and is detected by a scanner. This test detects blood flow to the bone and cell activity within the bone, and can show abnormalities in these processes that may aid diagnosis.

Cartilage – A tough, elastic material that covers the ends of the bones where they meet to form a joint. In the knee, cartilage helps absorb shock and allows the joint to move smoothly.

Computerized axial tomography (CAT) scan – A painless procedure in which x rays are passed through the knee at different angles, detected by a scanner, and analyzed by a computer. This produces a series of clear cross-sectional images (slices) of the knee tissues on a computer screen. CAT scan images show soft tissues such as ligaments or muscles more clearly than conventional x rays. The computer can combine individual images to give a three-dimensional view of the knee.

Corticosteroids – Powerful anti-inflammatory hormones made naturally in the body or manmade for use as medicine. Oral corticosteroids may be used to treat systemic

inflammatory diseases, such as rheumatoid arthritis or lupus. Corticosteroid injections may be used to reduce inflammation in a joint with arthritis, such as the knee.

Femur – The thigh bone or upper leg bone. The femur is one of three bones (the other two are the tibia and the patella) that join to form the knee joint.

Gout – An acute and intensely painful form of arthritis. This condition occurs when crystals of the bodily waste product uric acid are deposited in the joints.

Hamstring – Prominent tendons at the back of the knee. Each knee has a pair of hamstrings that connect to the muscles that flex the knee. The hamstring muscles, which bend at the knee, run along the back of the thigh from the hip to just below the knee.

Iliotibial Band Syndrome – An inflammatory condition in the knee caused by the rubbing of a band of tissue over the outer bone (lateral condyle) of the knee. Although iliotibial band syndrome may be caused by direct injury to the knee, it is most often caused by the stress of long-term overuse, which sometimes results from sports training.

Internist – A doctor trained to diagnose and treat nonsurgical diseases.

Lateral collateral ligament (LCL) – The ligament that runs along the outside of the knee joint. It provides stability to the outer (lateral) part of the knee.

Ligament – A tough band of connective tissue that connects bones to bones.

Lupus – An autoimmune disease characterized by destructive inflammation of the skin, internal organs, and other body systems as well as the joints.

Magnetic resonance imaging (MRI) – A procedure that uses a powerful magnet linked to a computer to create pictures of areas inside the knee. Magnetic energy stimulates knee tissue to produce signals that are detected by a scanner and analyzed by a computer. This creates a series of cross-sectional images of a specific part of the knee. An MRI is particularly useful for detecting soft tissue damage or disease.

Medial collateral ligament (MCL) – The ligament that runs along the inside of the knee joint, providing stability to the outer (medial) part of the knee.

Meniscus – A pad of connective tissue that separates the bones of the knee. The menisci (plural) are divided into two crescent-shaped discs (the lateral and medial) positioned between the tibia and femur on the outer and inner sides of each knee. The two menisci in each knee act as shock absorbers, cushioning the lower part of the leg from the weight of the rest of the body as well as enhancing stability.

Orthopaedic surgeon – A doctor who has been trained in the nonsurgical and surgical treatment of bones, joints, and soft tissues such as ligaments, tendons, and muscles.

Osgood-Schlatter disease – A disease often caused by repetitive stress or tension on part of the growth area of the upper tibia (the apophysis). It is characterized by inflammation of the patellar tendon and surrounding soft tissues at the point where the tendon attaches to the tibia. The disease may also be associated with an injury in which the tendon is stretched so much that it tears away from the synovium.

Osteoarthritis – A disease in which the cartilage that cushions the ends of the bones is lost, leading to joint pain and stiffness. The most common form of arthritis, osteoarthritis grows more common with age.

Osteochondritis dissecans – A condition that results from a loss of the blood supply to an area of bone underneath a joint surface. The condition usually involves the knee. In osteochondritis dissecans, the affected bone and its covering of cartilage gradually loosen and cause pain. This problem usually arises spontaneously in an active adolescent or young adult. It may be due to a slight blockage of a small artery or to an unrecognized injury or tiny fracture that damages the overlying cartilage. A person with this condition may eventually develop osteoarthritis.

Patella – The bone that sits over the other bones at the front of the knee joint and slides when the leg moves. Commonly referred to as the knee cap, the patella protects the knee and gives leverage to muscles.

Plica syndrome – A syndrome that occurs when plicae (bands of synovial tissue) are irritated by overuse or injury. Synovial plicae are the remains of tissue pouches found in the early stages of fetal development. As the fetus develops, these pouches normally combine to form one large synovial cavity. If this process is incomplete, plicae remain as four folds or bands of synovial tissue within the knee. Injury, chronic overuse, or inflammatory conditions are associated with this syndrome.

Quadriceps muscle – The large thigh muscle that comes down from the femur and over the patella, and then anchors into the top of the tibia. Its function is to straighten the leg.

Quadriceps tendon – The tendon that connects the quadriceps muscle to the patella and provides the power to extend the leg.

Rheumatic diseases – Characterized by signs of inflammation (redness, heat, swelling, pain) and loss of function of joints, tendons, ligaments, bones, and/or muscles. Some rheumatic diseases can also involve internal organs.

Rheumatologist – A doctor specializing in the diagnosis and treatment of arthritis and related disorders.

Rheumatoid arthritis – A disease in which the immune system is believed to attack the linings of the joints. This results in joint pain, stiffness, swelling, and destruction.

Synovium – The membrane lining the joints, the synovium produces joint fluid.

Tendon – The flexible but tough connective tissue that attaches muscles to bones.

Tibia – The shin bone or larger bone of the lower leg. The tibia is one of three bones (the other two are the femur and the patella) that join to form the knee joint.

X ray (radiography) – A procedure in which an x ray (high-energy radiation with waves shorter than those of visible light) beam is passed through the knee to produce a two-dimensional picture of the bones. X rays are often used in diagnosing knee problems.

Acknowledgments

The NIAMS gratefully acknowledges the assistance of Barbara Mittleman, M.D., and James Panagis, M.D., M.P.H., NIAMS, NIH; John H. Klippel, M.D., Arthritis Foundation, Atlanta, Georgia; Frank A. Pettrone, M.D., Arlington/Vienna, Virginia; Khaled J. Saleh, M.D., the University of Virginia, Charlottesville, Virginia; and W. Norman Scott, M.D., Beth Israel Medical Center, New York, New York, in the preparation and review of this booklet.



The mission of the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), a part of the Department of Health and Human Services' National Institutes of Health (NIH), is to support research into the causes, treatment, and prevention of arthritis and musculoskeletal and skin diseases; the training of basic and clinical scientists to carry out this research; and the dissemination of information on research progress in these diseases. The National Institute of Arthritis and Musculoskeletal and Skin Diseases Information Clearinghouse is a public service sponsored by the NIAMS that provides health information and information sources. Additional information can be found on the NIAMS Web site at www.niams.nih.gov.



U.S. Department of Health and Human Services
Public Health Service
National Institutes of Health
National Institute of Arthritis and
Musculoskeletal and Skin Diseases

NIH Publication No. 06-4912
May 2001
Revised May 2006