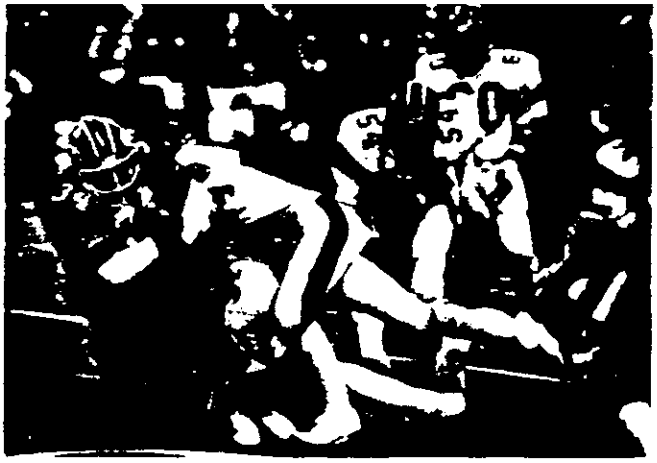
# Chapter 6

# The Knee



The knee is a complicated joint, and athletic knee injuries can be very involved. After first aid for most knee injuries, physician referral is recommended.

Fortunately, it has been found that many of the more serious knee injuries in sports can be prevented. The key is that the athlete work to strengthen the quadricep and hamstring muscle groups.

For those injuries that do occur, knees that are protected by strong muscles often suffer less severe problems. Rehabilitation time is also reduced if the knee musculature is strong to begin with.

## Anatomy

The knee is the largest joint in the body. Despite its size, though, it is structurally very weak.

### Bones

The joint's primary weakness is due to its relatively unstable bone structure.

To illustrate this instability, consider the femur, or thigh bone. The femur is the longest and strongest bone in the body. However, it sits precariously on top of the smaller tibia, which is the main weight-bearing bone of the lower leg.

These two bones slide back and forth on each other, even in non-stressful, non-athletic activities. Subtracting further from the joint's stability is the small amount of normal rotation by the femur on the tibia.

Not everything in this joint's structure is detrimental to stability, though. The distal end of the femur has two slightly convex surfaces, called condyles. These condyles articulate with the slightly concave surfaces of the tibia.

However, once the knee starts to bend, whether the action is walking, running or climbing stairs, what little contribution to stability these convex and concave surfaces have is greatly diminished.

The femur and tibia are only two of the four bones of the knee joint. The next largest bone is the fibula, the non-weight-bearing bone of the lower leg. The fibula articulates at the knee only with the tibia, and serves as the attachment for the lateral collateral ligament.

The fourth bone of the knee joint is called the patella, or knee cap. The patella, encased in the powerful patellar tendon, moves up and down in front of the knee in the space between the two condyles of the femur.

### Ligaments

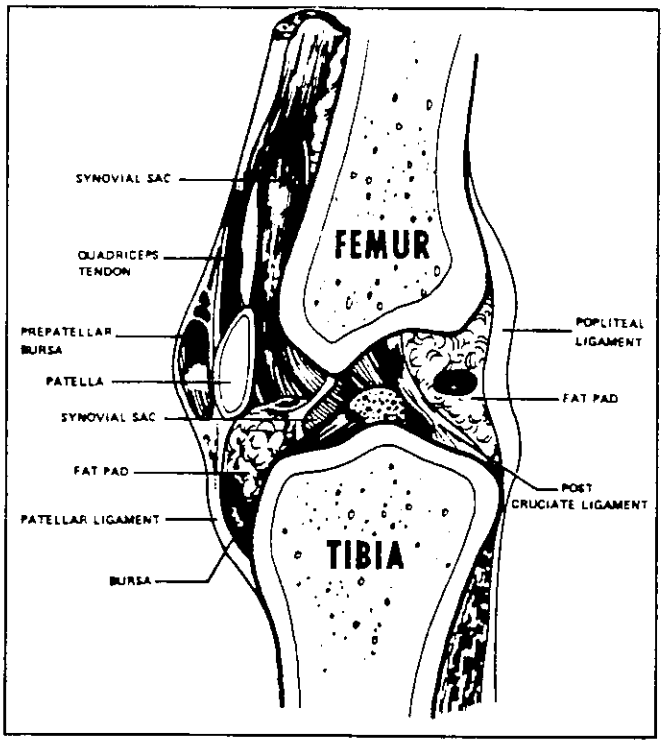
The instability of the knee's bony structure is partially compensated for by strong ligaments and potentially even stronger muscle support.

Four important ligaments help stabilize the knee: the medial collateral ligament, the lateral collateral ligament, and the anterior and posterior cruciate ligaments.

On the medial side of the knee, the broad, flat medial collateral ligament (MCL) helps secure the femur to the tibia. It also connects to the cartilage of the knee, the medial meniscus.

Located on the other side of the knee, the lateral collateral ligament (LCL) is not quite as strong as the medial ligament. The LCL is cord-like, rather than a broad band. Unlike the MCL, the LCL does not attach to the lateral meniscus.

The two cruciate ligaments form an "x" in the center of the joint. (Cruciate comes from the Latin word meaning cross.) These ligaments restrict anterior and posterior movement of the femur on the tibia.




*Although the knee is the largest joint in the body, it is very weak because of its relatively unstable bone structure.*

### Muscles

More than any other joint, the knee is dependent on good muscle support. In fact, there are 13 muscles that support the knee. Most of the support comes from the large muscle groups of the thigh (both front and back) as well as the gastrocnemius muscle of the lower leg.

These supporting muscle groups are the quadriceps (on the front of the thigh) and the hamstrings (on the back of the thigh).

The quadriceps muscles, which extend (straighten) the lower leg, converge to form the patellar tendon. As mentioned earlier, this tendon encases the patella. The quads insert on the front of the tibia on the tibial tubercle.

The hamstring muscle group flexes (bends) the leg and also helps control the rotary movements of the tibia. Called a natural knee brace by many athletic trainers, the hamstrings originate on the pelvis and femur and divide to attach below the knee on the tibia and fibula.

(While the quadriceps and hamstrings are of greatest concern to the athletic trainer and coach, other muscles also provide support and control movement of the knee. These muscles include the adductors, abductors and the gastrocnemius.)

### Cartilage

The knee joint contains two tough, fibrous cartilages, known as menisci. They are called the lateral meniscus and medial meniscus.

These menisci rest on top of the tibia in its two shallow concave indentations. The menisci form a cushioned base for the medial and lateral condyles of the femur. Other functions of the menisci include shock-absorption, adding to joint stability, and helping to smooth the gliding and rotating movements of the femur and tibia against each other

### Other Structures

Other structures in the knee of special concern in athletics are the bursae and the synovial membrane.

The bursae (there are about 13 in the area of the knee) are closed, fluid-filled sacs. These sacs serve as cushions against friction over a prominent bone, or where a tendon moves over a bone.

The synovial membrane is a large, closed sac that lines the inside of the knee joint, helping to lubricate the tendons, ligaments and bones.

## Mechanism of Injury

Because the knee doesn't operate only as a hinge joint — the femur also rotates and slides on the tibia — there are several ways the joint can become injured. And, when an injury occurs, chances of it requiring surgery are much greater than with any other joint in the body.

In athletics, the most common knee injuries are contusions, ligament sprains and torsion injuries.

*Contusion injuries* are caused by a direct blow or by falling on the knee. Besides muscular contusions, direct blows or falls can also damage the bursae that protect the bones and other structures of the knee. (Muscular contusions will be dealt with in the next chapter.) Athletes are likely to suffer knee contusions in basketball, volleyball, wrestling and football.

*Ligament sprains* can be caused by blows from any direction, and are compounded when the athlete's foot is planted. Most knee sprains occur in football when a player is struck on the lateral side of the leg. In this type of injury, the medial ligament is usually stretched and torn.

*Torsion injuries* occur when the feet are fixed and the body is twisted. This type of injury happens mostly in football. (The longer the cleat on the shoe, the greater the risk of torsion injury.) A blow severe enough to cause ligament damage will often result in some excessive torsion. Torsion injuries sometimes damage the ligaments, but most often involve the menisci.

Other, usually less severe knee injuries can be caused by muscular weakness or imbalance, overuse or repetition, poor running mechanics or improperly fitted shoes.

Vocabulary

***anterior*** *— the front of the body or of a body part*

***articulate*** *— to connect by a joint*

***bursae*** *— closed, fluid-filled sacs that serve as cushions against friction over a prominent bone or where a tendon moves over a bone*

***collateral ligaments*** *— two of the four ligaments that help stabilize the knee; lateral and medial*

***condyles*** *— rounded protuberances that occur at the end of some bones*

***cruciate ligaments*** *— two of the four ligaments that help stabilize the knee; anterior and posterior*

***distal*** *— farthest away from the center of the body*

***extension*** *— straightening a joint or increasing the angle between two bones*

***femur*** *— thigh bone; longest and strongest bone in the body*

***fibula*** *— long, thin outer bone of the lower leg*

***flexion*** *— bending at a joint or decreasing the angle between two bones*

***hamstrings*** *— muscles on the back of the thigh; originate on the pelvis and femur and divide to attach below the knee*

***lateral*** *— away from the midline of the body; toward the side*

***medial*** *— toward the midline of the body*

***meniscus*** *— one of two tough, fibrous cartilages that form a cushion for the condyles of the femur; absorb shock, add joint stability and help smooth the movements of the femur and tibia against each other*

***patella*** *— knee cap*

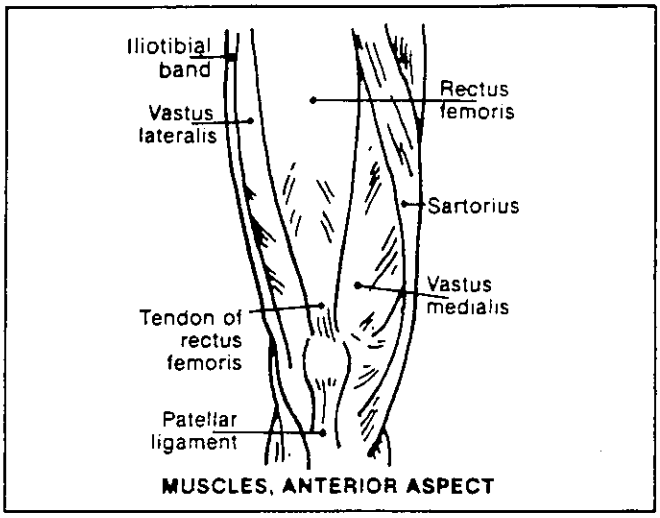
***posterior*** *— the back of the body or of a body part*

***quadriceps*** *— muscles on the front of the thigh; converge to form the patellar tendon*

***tibia*** *— the shin bone; inner and larger bone of the lower leg*

***torsion injury*** *— occurs at the knee when the feet are fixed and the body is twisted; sometimes damages ligaments, but most often involves the menisci*

***tuberosity*** *— large, rounded protuberance on a bone*



MUSCLES, ANTERIOR ASPECT

*More than any other joint, the knee depends on good muscle support, most of which is provided by the large muscle groups on the front and back of the thigh.*

In addition, some athletes are susceptible to certain knee conditions that are related to the growth process.

**Patellar Tendinitis**

The patellar tendon emanates from the quadriceps muscles. One of the primary movements of the quads is lower leg extension. This movement is part of the jumping process, and the forces generated can be great. The stress that jumping and kicking place on the patellar tendon can cause inflammation just above or below the patella.

Pain is usually reported by the athlete after exercising; some swelling may be present.

Use cold to reduce pain and inflammation. The physician may also prescribe rest. As with many knee problems, strong and flexible hamstrings and quadriceps muscles often can prevent or alleviate patellar tendinitis.

**Chondromalacia Patellae**

*Chondromalacia patallae* is a painful degenerative condition that results in the irritation and softening of the cartilage of the back of the patella. Running, jumping, kneeling and climbing stairs can elicit the pain.

One cause of this condition is muscular weakness or imbalance. This can cause the patella to become off center as it moves in the femoral groove.

Other causes of chondromalacia patellae are related to the individual athlete's body structure. Whether the cause is muscular or structural, strengthening the quadriceps through straight leg raises and limited range of motion resistance exercises can often correct the problem.

Other treatments include cold application before and after activity, isometric strengthening exercises and use of knee pads.

**The Female Athlete's Knee**

Because of the structural difference in pelvic girdle width between males and females, patellar problems may be more prevalent for women than men. The female's wider pelvis creates a sharper angle where the femur attaches to the pelvis. This sharper angle changes the line of pull of the quadriceps muscles and may cause the patella to be pulled in a lateral direction upon muscle contraction. This change in mechanics can cause chronic conditions such as chondromalacia patellae, patellar dislocation or subluxation.

If a female athlete is suffering from one of these chronic knee injuries, strengthening the medial portion of the quadriceps (the vastus medialis) will usually prevent any lateral sliding of the patella. The vastus medialis muscle group can be strengthened by performing complete range of motion resistance exercises. If chronic knee pain persists, refer the athlete to the team physician.

The team physician may also recommend ice massage before and after activity, or rest and modification of activity.

**Osgood-Schlatter Condition**

The *Osgood-Schlatter condition* is common to adolescent males, and is characterized by swelling below one or both knees. It involves the growth center of the tibial tubercle, to which the patellar tendon attaches. Depending on its severity, the Osgood-Schlatter condition can lead to permanent knee damage.

Osgood-Schlatter condition was first described early in this century as a partial separation of the tibial tubercle from the tendon. Later, it was described as an inflammation of the tibial tubercle, rather than a bone separation.

Whatever the cause, this inflammation is aggravated by activity and relieved by rest. Tenderness tends to be most marked at the patellar tendon's insertion point. The athlete will complain of severe pain on jumping, running or kneeling, and after athletic activity.

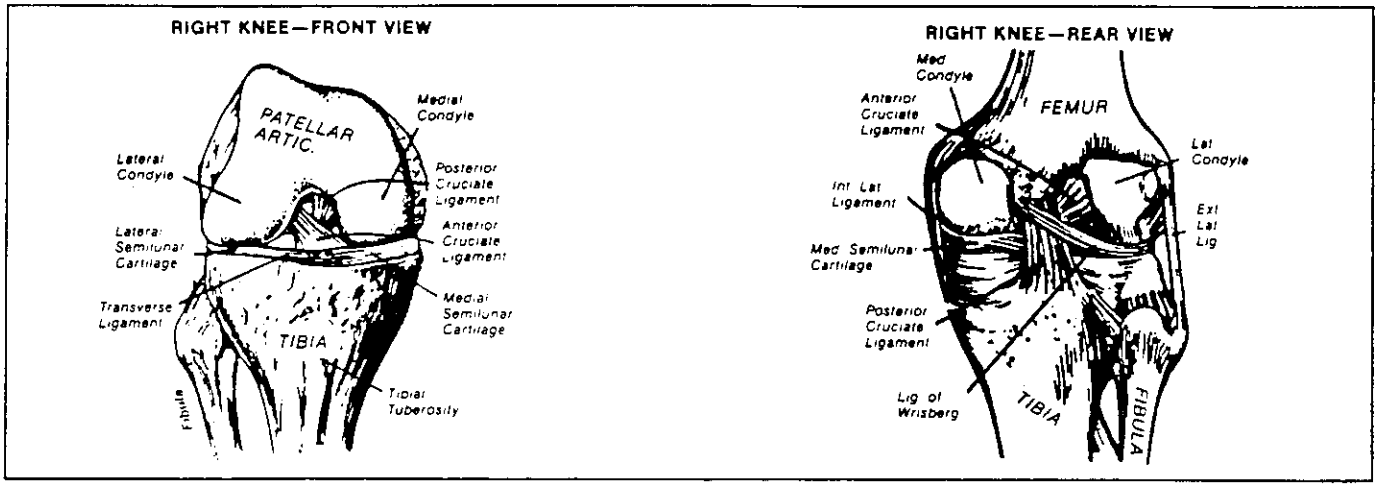
In cases of long duration, the front of the knee appears enlarged and a bony prominence can be felt. Although Osgood-Schlatter symptoms disappear after adolescence, this bony prominence remains.

The athlete's physician may recommend treatment ranging from restriction or modification of sports activity to immobilization in a cast.

## Treatment

Coaches and student athletic trainers should not try to determine whether a knee injury is minor or more severe. Without medical training, an evaluation is not possible. It's possible for a knee to be severely injured and exhibit little swelling or pain; therefore, knee injuries call for immediate referral to a physician.

Regardless of the mechanism of injury, the student trainer's response to knee injuries is basic first aid: compression, cold and elevation, followed by referral to a physician.




*Strong ligaments and potentially stronger muscle support help compensate for the relative instability of the knee's bony structure. Muscle strength and balance are essential in preventing knee injuries.*

He or she should start applying the elastic wrap below the knee, wrapping toward the heart. Then, cold should be applied all around the joint. With support below the knee, the athlete's entire leg should be elevated. The physician's guidelines may call for the use of crutches by the athlete until the examination is made.

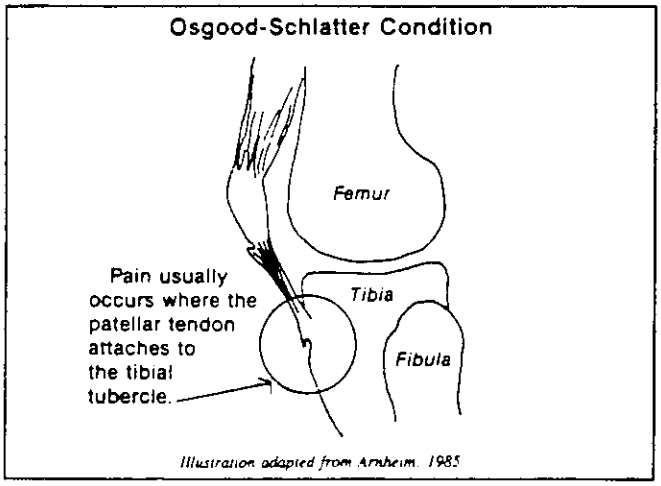
Delaying referral to a physician for examination and treatment may reduce the chance of the athlete making a complete recovery.

## Rehabilitation

The physician should recommend a specific knee rehabilitation program, depending on the injury. The student trainer can help supervise the athlete's progress toward recovery.

Before returning to competition, the following rehabilitation guidelines must be met:

1) No pain during running, jumping or cutting
2) Full range of motion
3) Muscular strength must be equal to that of the uninjured leg.
4) Strength increase in proportion to the athlete's size and sport.




*Osgood-Schlatter condition is common in adolescent males and involves swelling below one or both knees. Although symptoms disappear after adolescence, a bony prominence on the front of the knee remains.*

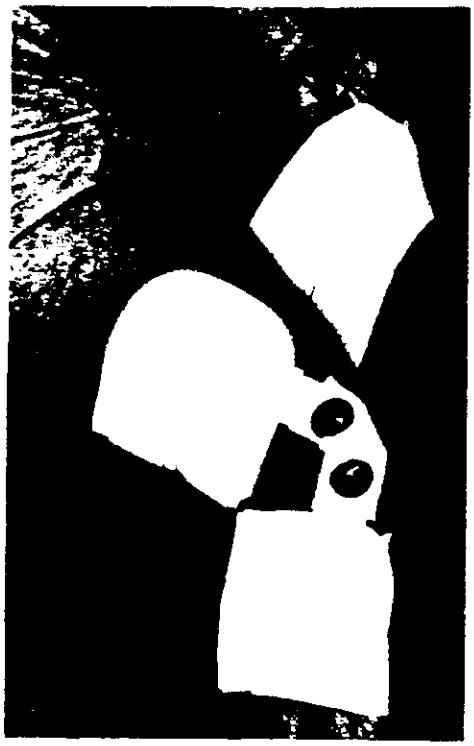
## Prevention

As stated above, the best way to prevent knee injuries is through muscle development. It is recommended that all athletes have the strength of their quadriceps and hamstring muscle groups checked. The larger and older the athlete, the stronger these muscle groups need to be.

Typically, the quadriceps of young athletes are much stronger than the hamstrings. To help prevent knee injuries, it is recommended that the hamstrings be at least half as strong as the quadriceps. Within the last few years, the emphasis placed on hamstring strength has played a large role in preventing knee injuries.

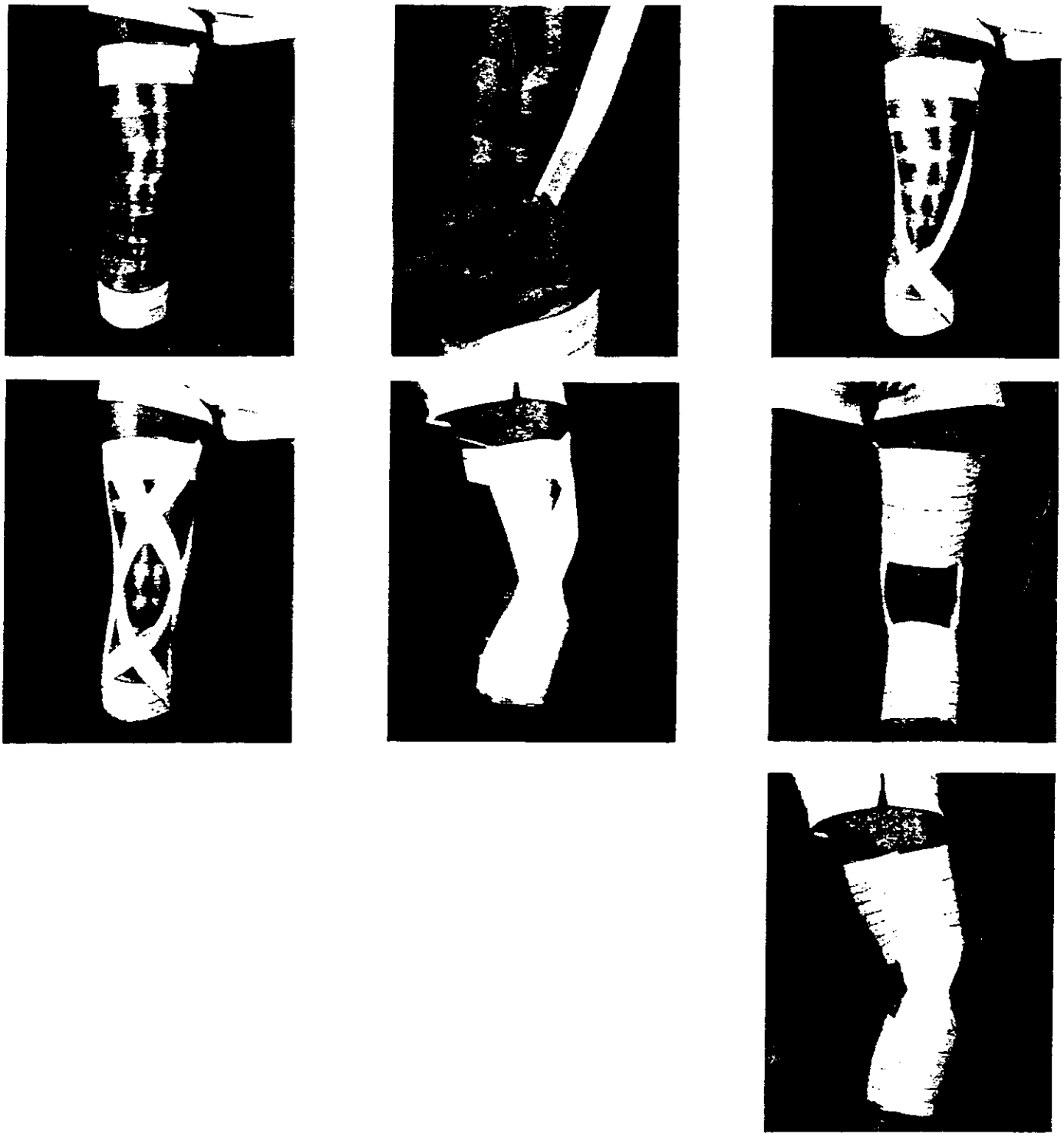
Muscle balance, as well as strength, is necessary to prevent injury. During strength training, the athlete should work to have the strength of the corresponding muscle group of the left leg equal to that of the right leg.

The only way to build this strength is through resistance exercises, or weight training. As with all muscles, strength is lost if the muscle is not exercised regularly. It is therefore important that athletes perform strengthening exercises in-season as well as during the off-season. The student trainer can help to institute and supervise such a strength program.



*A preventive knee brace can help protect the knee and reduce the incidence of medial-collateral ligament injuries. However, strong thigh muscles are the key to preventing knee injuries.*

*A method for taping the collateral ligaments of the knee.*



## Review Questions — Part One

1. After first aid for most knee injuries, referral to a _____ is recommended.
2. The key to preventing many knee injuries involves _____ the _____ and _____ muscle groups.
3. The knee is the largest joint in the body; structurally, it is very _____ .
4. The main weight-bearing bone of the lower leg is the _____ .
5. The non-weight-bearing bone of the lower leg is the _____ .
6. The patella is encased in the powerful patellar _____ .
7. The _____ ligaments prevent side-to-side movement of the knee, while the _____ ligaments restrict front-to-back motion.
8. Muscle _____ , as well as strength, is necessary to prevent knee injuries.

## Review Questions — Part Two

1. Name the four bones of the knee joint.
   1.
   2.
   3.
   4.
2. Which muscle group is sometimes referred to as a "natural knee brace"?
3. What are the functions of the menisci?
4. What rehabilitation guidelines must be met before a player returns to competition?
5. What should the student trainer do for most acute knee injuries?
6. Name the four most important ligaments of the knee.
   1.
   2.
   3.
   4.
7. Explain why most knee ligament injuries in football are to the medial side.
8. Describe the Osgood-Schlatter condition. Why is it common to adolescents?