KNEE INJURIES

Injuries to the knee can be either traumatic or overuse injuries. Recognizing which mechanism of injury is at fault will assist the certified athletic trainer in making correct assessments and directing appropriate interventions. The pathologies (conditions) listed here may be isolated or occur in combination with other injuries.

Patellofemoral Problems

Knee pain and dysfunction arising from the patellofemoral joint can be one of the most challenging for both athlete and trainer. It is not always easy to identify this region as the source of the athlete's complaints, or to isolate the causative factors from the many possible causes. Understanding the biomechanics of the knee and entire lower extremity is essential for successful management of patellofemoral problems.

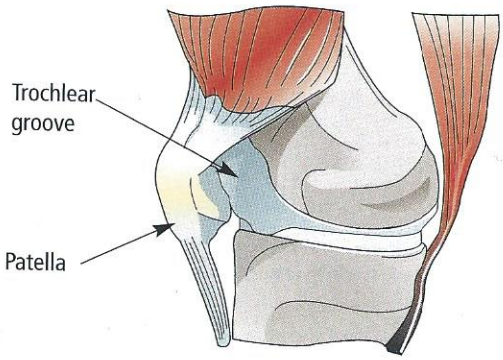

Figure 18-6 Trochlear groove

The patellofemoral joint is composed of the articulation of the patella with the femur. The patella is shaped like a triangle with its apex directed inferiorly. Superiorly, it articulates with the trochlear groove found between the condyles on the distal articulating surface of the femur (Figure 18-6).

Signs and Symptoms

crepitus A grinding noise or sensation within a joint.

The classic complaint with a patellofemoral problem is aching pain in the front of the knee. More often than not, it is of gradual onset. The athlete may indicate that the site of pain is behind the kneecap. The athlete may also complain of the knee giving way. This is thought to be a protective response to pain caused by an aggravating factor, such as stair climbing. Some athletes may complain of a grinding noise, known as **crepitus**. This may be a concern to the athlete, but it is generally a benign condition.

The patella is subjected to increased forces with bent-knee weight-bearing activities, such as walking up and down stairs, squatting, and running. These activities tend to elicit pain in the patellofemoral joint. Pain can increase after prolonged knee flexion. This commonly occurs during long car rides or sitting in class or a theater.

Swelling is not common, but may occur in some instances. If present, it should be mild. Occasionally a biomechanical assessment will reveal that the femurs of the legs are rotated inward. A frontal view with the athlete standing can reveal this. Instead of the patellae facing forward, the patellae may appear to face

Fun Facts

Pain that increases after prolonged knee flexion is often called *movie goer's sign*.

inward, indicating internally rotated femurs. This condition is termed *squinting patellae*. Excessive foot pronation, or lowering of the arch, can allow the lower extremity to rotate inward. Similarly, tight hip internal rotators and weak hip external rotator muscles may cause this condition as well.

The patella should slide or track in the center of the trochlear groove as the knee bends and extends (Figure 18-6). When the structures around the patella are out of balance, lateral tracking of the patella can occur. Palpation of the space between the undersurface of the medial and lateral borders of the patella and the femur can indicate if a patella is tilting (Figure 18-7). The amount of space should be the same. With a lateral tilt, the space will be greater under the medial border than the lateral.

Figure 18-7 Palpating the patellar orientation on the femur

Patellofemoral provocation tests, such as a forward lunge or step-down test, can reproduce the pain the athlete complains of. With these tests there is often a relative lack of control. Comparison to the uninvolved side is always recommended.

Treatment

Treatment of patellofemoral problems consists of correcting suspected causes. An athlete who pronates may need support with a shoe insert to support the arch, or low-dye taping. Weak external rotators of the hip and vastus medialis should be strengthened, and tight hip internal rotators should be stretched. Specialized taping of the patella can be effective (Figures 18-8A–C). The athlete with a lateral-tracking patella

Figure 18-8A Patellar medial glide tape was developed by Jenny McConnell, PT. This photo shows application of cover roll skin tape across the patella and around the medial leg.

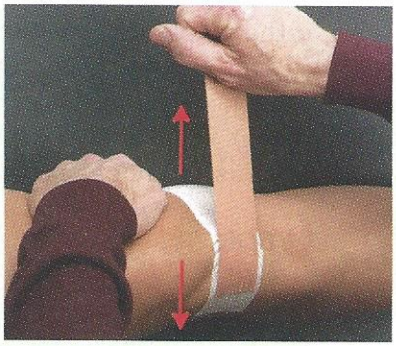

Figure 18-8B Application of short-stretch tape. After tape is secured to the patella, one hand lifts the medial leg muscles as tension, while a medially directed pull on the tape is used to glide the patella medially.

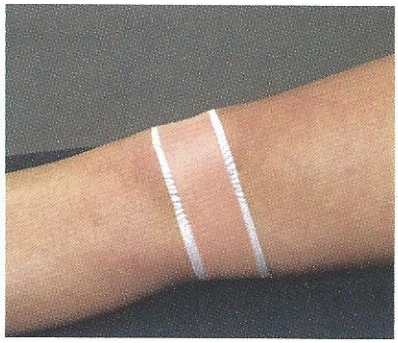

Figure 18-8C Finished knee taping

A B

Figure 18-9A-B Commercial braces are available that offer support and compression, as well as helping to discourage lateral tracking of the patella.

may also be helped by a brace designed to resist this condition (Figure 18-9).

Bracing and taping should not be the sole treatment, however. They are used to make the patient comfortable for the rehabilitation process. Athletes must be fully rehabilitated before returning to athletics. It is very important to select strengthening exercises that do not cause pain, as pain may result in muscular inhibition and be counterproductive.

Patellar Tendonitis

Inflammation of the patellar tendon is often seen in sports that involve jumping. In fact, this condition is often referred to as *jumper's knee*. Sports that require fast running and abrupt changes of direction also place high forces on the patellar tendon. This high-force, repetitive strain frequently causes tendonitis of the patellar tendon.

Signs and Symptoms

Athletes with patellar tendonitis complain of anterior knee pain. The location of the pain is below the patella, over the site of the patellar tendon. Local tenderness on the tendon is a cardinal sign of patellar tendonitis. In some cases a small amount of local swelling occurs.

Treatment

Patellar tendonitis is usually the result of repetitive stress on the patellar tendon. Activity modification should be considered to allow the

tendon time to heal. Nonimpact activities such as cycling and swimming will allow the patellar tendon to heal. If the athlete has tight quadriceps, stretching them may help take strain off the patellar tendon. Ice application soon after exercise will help keep inflammation from activity in check. Specialized braces and taping techniques may help control symptoms of patellar tendonitis.

Special Tests

The test demonstrated in Figure 18-10 can help detect patellar tendonitis. Figure 18-11 demonstrates the patellar dislocation apprehension test.

Figure 18-10 This test helps to detect patellar tendonitis and irritation. The athlete sits on the edge of a table with the knee in 90° of flexion. The examiner taps the patellar tendon one to three times in rapid succession. A positive sign is sharp pain elicited on the patellar tendon.

Fat Pad Syndrome

A painful condition in the infrapatellar region (area just below the patella) is fat pad syndrome. The *infrapatellar fat pad* (also known as Hoffa's fat pad) is a region of fatty tissue lying deep under the patellar tendon. This structure can become inflamed and painful. Because the infrapatellar fat pad lies underneath the patellar tendon, it is often confused with patellar tendonitis.

Signs and Symptoms

Pain just below the patella is a characteristic sign of fat pad syndrome. Movement of the knee often aggravates the symptoms, and often the knee is tender to palpation. Tenderness and swelling may be demonstrated in the anterior portion of the knee.

Treatment

Strengthening exercises that avoid full knee extension, or leg presses that avoid full knee extension, may be tolerated well. The athlete may have to avoid

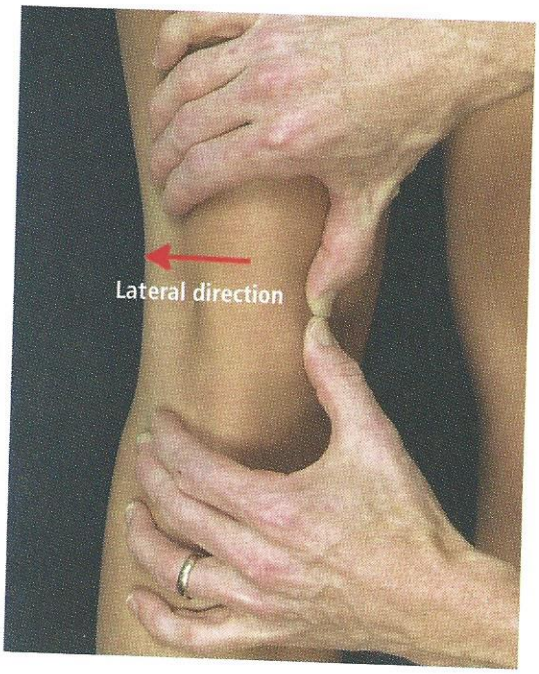

Figure 18-11 The patellar dislocation apprehension test is used to see if the athlete resists lateral positioning of the patella. If the athlete guards (flexes the quadriceps) and does not allow lateral movement of the patella, the examiner knows that an injury exists. This test is done by using both thumbs positioned medially on the patella. Gentle pressure is applied across the patellofemoral joint.

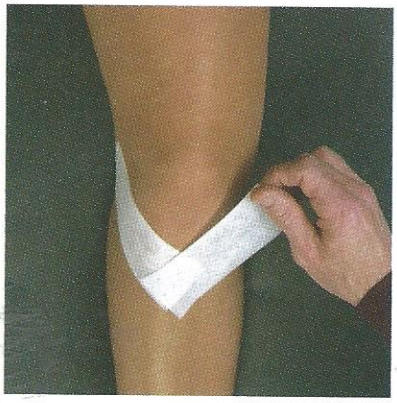

Figure 18-12A The fat pad unloading tape application was developed by Jenny McConnell, PT. Cover roll skin tape is placed in a V along the inferior borders of the fat pad.

Figure 18-12B Application of short-stretch tape. The fat pad is lifted upward (parallel to the tape) while tension is applied to the two pieces of the short-stretch tape.

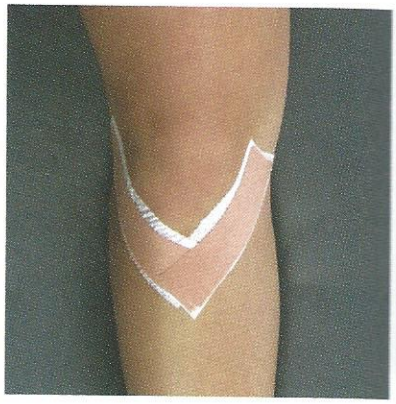

Figure 18-12C Finished knee taping

activities that require rapidly kicking the knee into full extension. Specialized taping (Figure 18-12), icing, and anti-inflammatory medications may help the athlete through the acute phase of this injury.

Special Tests

Figures 18-13A and B demonstrate a test to identify fat pad syndrome.

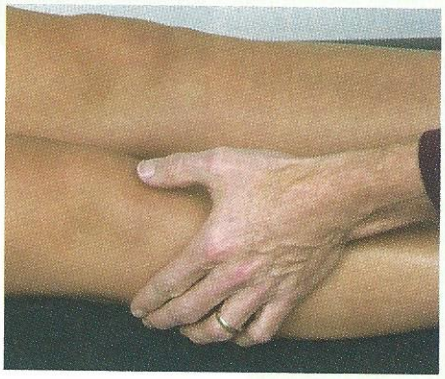

Figure 18-13A Fat pad compression test: Pressure is applied to the proximal patellar tendon with quadriceps contracted, stressing only the tendon and not the fat pad.

Figure 18-13B Pressure is applied over the proximal patellar tendon with a relaxed tendon, allowing compression of the fat pad.

Medial Collateral Ligament (MCL) Sprain

A blow to the outside of the knee, as in a football tackle, or a high-energy twisting maneuver are common causes of MCL injuries. These forces result in stretching and a **valgus** (outward) force on the medial tibiofemoral joint, which can damage this ligament. Pain and tenderness are felt on the medial aspect of the knee. Extracapsular ligament sprains (the medial collateral and lateral collateral ligaments) are classified by their severity, on the Grade I to Grade III scale (Table 18-1). The injured athlete may have difficulty bearing weight on a leg with an acute Grade II or III sprain.

valgus *Outward bending or twisting force.*

Signs and Symptoms

Examination may reveal limited motion in full flexion and extension, as well as swelling of the medial knee. Tenderness may be located on the MCL at the joint line, or on either of its bony attachment sites onto the tibia or femur. Varying degrees of pain and laxity may be present with valgus stress testing for MCL injury.

Table 18-1 Ligament Sprain Classification for the Medial Collateral and Lateral Collateral Ligaments

GRADE I SYMPTOMS:

- Mild tenderness on the inside of the knee over the medial collateral ligament (lateral side of the knee for the lateral collateral ligament).
- Usually no swelling.
- When the knee is bent to 30 degrees and force is applied to the outside of the knee (stressing the medial collateral ligament), pain is felt, but there is no joint laxity (looseness). When force is applied to the inside of the knee, the test is for the lateral collateral ligament.

GRADE II SYMPTOMS:

- Significant tenderness on the inside of the knee for the medial collateral ligament and the outside of the knee for the lateral collateral ligament.
- Some swelling seen over the ligament.
- When the knee is stressed as for grade I symptoms, there are pain and laxity in the joint, although there is a definite end point (the knee cannot be bent sideways completely).

GRADE III SYMPTOMS:

- There is a complete tear of the ligament.
- Pain can vary and is sometimes not as bad as that of a grade II sprain.
- When the knee is stressed, there is significant joint laxity.
- The athlete may complain that the knee is very wobbly or unstable.

Treatment

Acute injuries should be treated with PRICE (protection, rest, ice, compression, and elevation). Protection may come from a protective wrap, brace, or crutches. Once the acute phase passes, rehabilitation may proceed. Gentle active and passive range of motion, such as bending and extending the knee, can be performed in pain-free ranges. Care should be taken to avoid valgus and twisting forces. Once the knee obtains 110 degrees to 115 degrees of flexion, cycling may be initiated. Submaximal effort strengthening can commence in the subacute stage, but only if tolerated without pain. Once the knee has full range of motion and normal strength, a functional progression should begin. All knee ligament injuries should be evaluated by the athlete's physician.

Special Test

The valgus stress test checks for MCL stability (Figure 18-14).

Lateral Collateral Ligament (LCL) Sprain

The LCL is on the lateral side of the knee and is not frequently involved in sports injuries. It can be injured by a blow to the medial side of the knee, resulting in a **varus** (inside) stress to the knee joint.

varus *Inward bending or twisting force.*

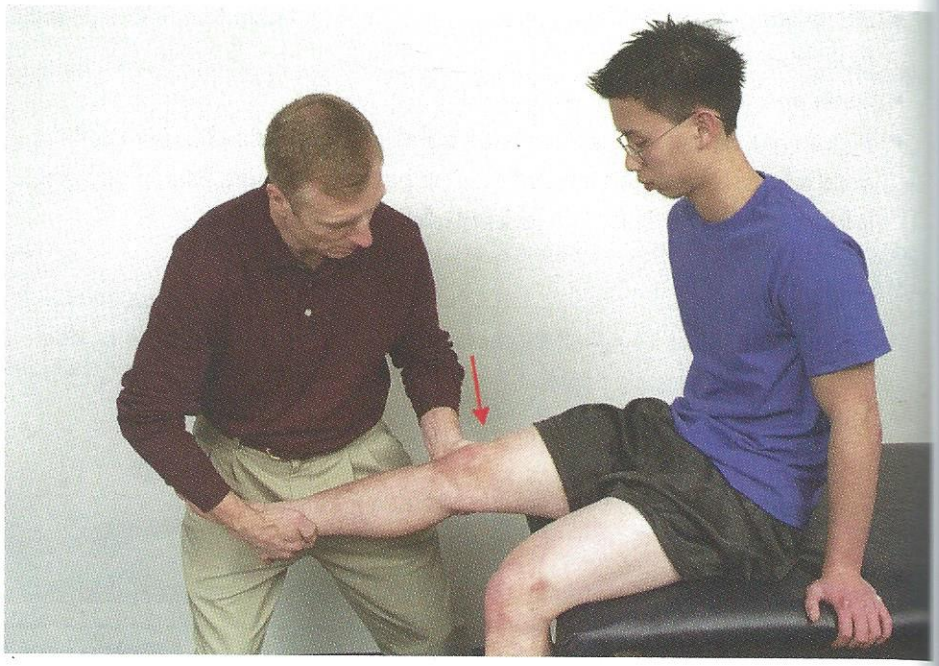

Figure 18-14 With the athlete's leg at full extension, the examiner presses laterally at the knee, while holding the leg at the ankle. Increased movement (compared to the uninjured knee) may be an indication of MCL damage.

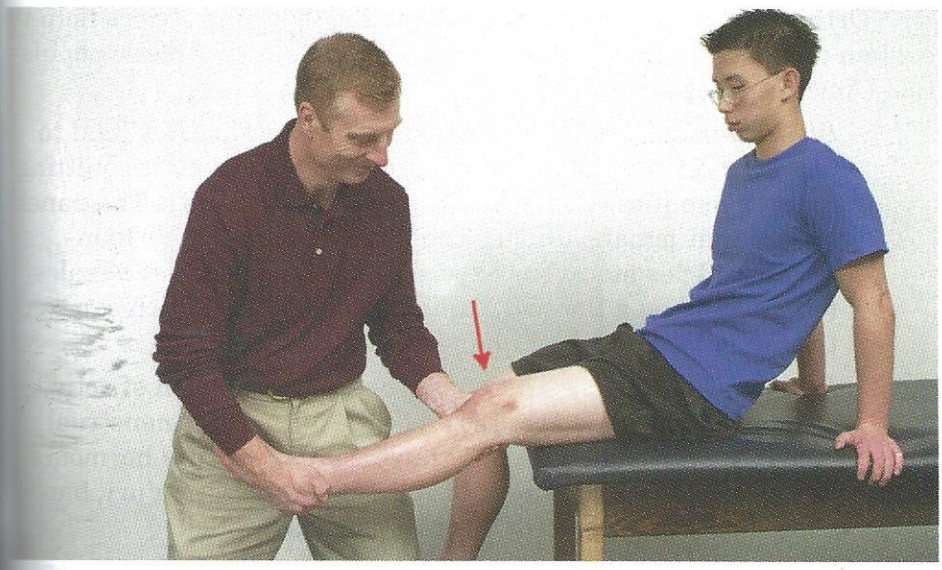

Figure 18-15 The varus stress test checks for LCL stability. With the athlete's leg at full extension, the examiner presses medially at the knee, while holding the leg at the ankle. Increased movement (compared to the uninjured knee) may be an indication of LCL damage.

Signs and Symptoms

Injury is confirmed with tenderness to palpation. Pain and laxity will be present with a varus stress test.

Treatment

Treatment of LCL sprains is similar to that for MCL sprains (see preceding sections).

Special Test

The varus stress test checks for stability in the LCL (Figure 18-15).

Torn Anterior Cruciate Ligament

Before the passage of Title IX, which greatly expanded female sports participation, anterior cruciate ligament (ACL) injuries were seen primarily in male athletes. The incident of ACL injuries has since leveled, so that now more ACL tears are diagnosed in female than male athletes. Research has shown that females who participate in basketball and soccer are four to six times more likely to sustain an injury to the ACL than males who play the same sport. Seventy percent of ACL injuries in females come from noncontact situations. Each year, 1 in 10 female collegiate athletes and 1 in 100 female high school athletes will sustain a serious knee injury.

Orthopedic researchers reported that the following factors help to explain the increase in ACL injuries among the female athletic population (American Academy of Orthopaedic Surgeons, 1999).

- *Biomechanical factors.* Experts reported that females tend to use their quadriceps muscles more than male athletes, putting them at significantly increased risk of ACL injuries. The panel agreed that female athletes should learn to use their hamstring muscles more. The experts also concluded that females tend to land on a flat foot, rather than the toes, which can contribute to the increased injury rate.
- *Hormonal influences.* There need be no modification of activity or restriction from a sport at any time during the menstrual cycle, experts said. They also stated that a woman's hormones do not increase the chances of sustaining an ACL injury, but suggested that further investigation is warranted.
- *Environmental factors.* Functional knee braces do not prevent ACL injury, experts reported. They agreed that although the surface of an athletic shoe may improve performance, because it provides good traction on certain surfaces, it may also increase the risk of injury.
- *Anatomic risk factors.* The experts found insufficient data to support the theory that ACL size is related to injury risk. They also reported that no consensus could be reached on the role of the size of the femoral notch (the area within the knee that contains the cruciate ligaments) in injury occurrence.

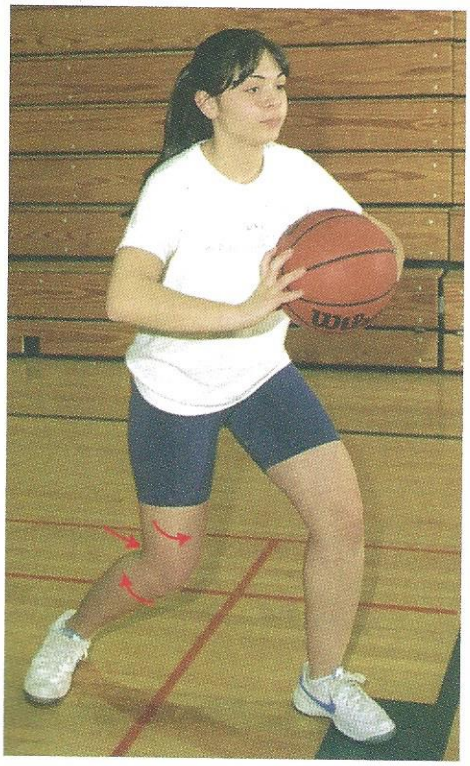

Figure 18-16 Noncontact situations that place a loaded knee joint in a combined position of flexion and interior rotation of the femur, valgus force, and external rotation of the tibia on the femur, can rupture the ACL.

Injury to the ACL can be from contact or noncontact causes. As with the medial collateral ligament, a blow to the lateral knee can be a contact cause. Situations that place a loaded knee joint in a combined position of flexion, valgus, and rotation of the tibia on the femur, can rupture the ACL in a noncontact manner. An example is a basketball player making a rapid change of direction (Figure 18-16), or a falling skier could suffer this type of injury. Once an ACL is stretched or ruptured, it will not heal (Figure 18-17). ACL injuries are sometimes accompanied by meniscus tears and MCL sprains.

The anterior cruciate ligament (ACL) and the posterior cruciate ligament (PCL) do not follow same the grading scale as for MCL and LCL sprains. Either they are damaged or are not damaged. There is no middle ground.

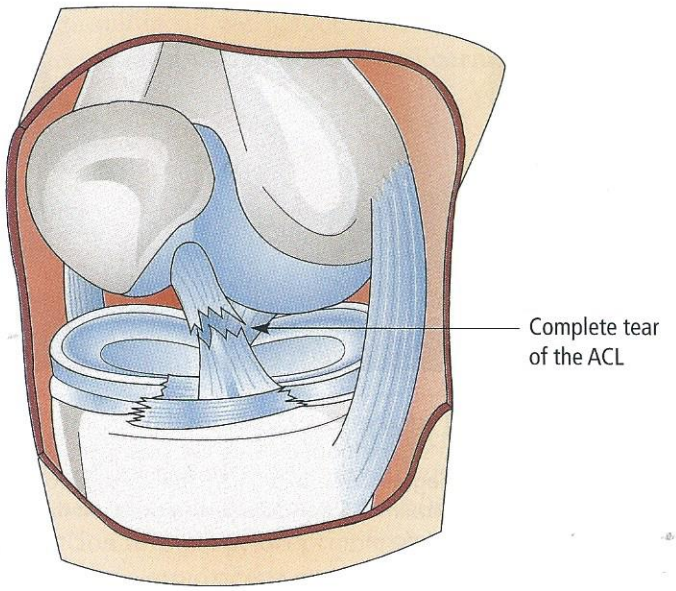

Figure 18-17 An ACL tear

Signs and Symptoms

A classic sign of an ACL injury is the athlete complaining that she heard or felt a "pop," followed by rapid **effusion** (swelling within the joint cavity). Some athletes may attempt to stand after rupture, only to have the knee buckle. The athlete may feel nauseated for a few minutes after the injury. Ligament integrity can be assessed with the Lachman's maneuver (Figure 18-18) or anterior drawer test (Figure 18-19). This test must be done within five minutes of the injury or protective muscle guarding will set in, making the test invalid. Other injuries to the knee, such as a torn meniscus, could also prevent valid testing of this ligament. If special tests for ACL laxity are positive, the ligament may be torn; special tests are not always definitive, however. Diagnosis by the athlete's physician, in conjunction with a magnetic resonance imaging (MRI) examination, will confirm the diagnosis.

effusion *Swelling within the joint cavity.*

Treatment

Acute care should include splinting, icing, and compressive wrapping. The athlete will need crutches. All athletes with suspected ACL tears should be referred to their family physicians for definitive diagnosis. Reconstructive surgery is the treatment of choice. The ACL can be replaced with a graft harvested from the athlete's patellar tendon or hamstring, or from a cadaver. Surgery, followed by a comprehensive

Figure 18-18 Lachman's maneuver: With the athlete lying in a supine position, the examiner places his knee under the athlete's knee, allowing flexion of about 20 degrees. The athlete must be relaxed. The examiner stabilizes the distal femur with one hand and pulls the proximal tibia forward with the other. Excessive movement (compared to the uninjured leg) may indicate ACL damage.

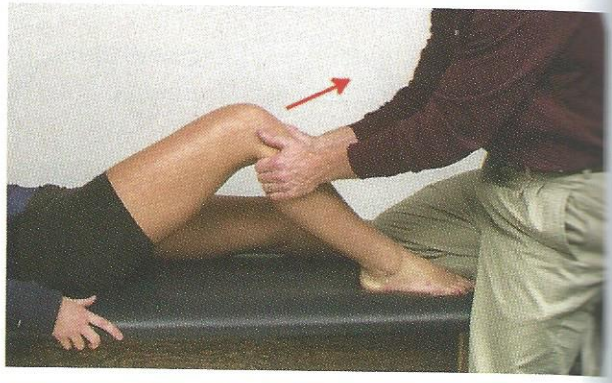

Figure 18-19 Anterior drawer test: The athlete is in a supine position with the knee bent approximately 90 degrees. The examiner applies anterior force to the proximal tibia. Excessive movement may indicate ACL damage.

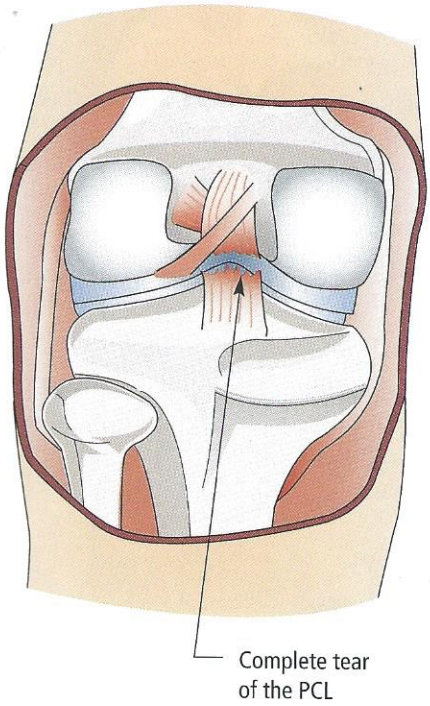

Figure 18-20 Posterior cruciate ligament tear

rehabilitation program under the direction of a physical therapist, should return the athlete to full participation within 6 to 12 months.

Special Tests

Figures 18-18 and 18-19 show tests for injury to the ACL.

Posterior Cruciate Ligament Tear

Posterior cruciate ligament injuries account for between 3% and 20% of all knee ligament injuries (Figure 18-20). Much less research has been done on the PCL because it is injured far less often than the ACL.

The most common cause of PCL injuries is athletic, motor vehicle, or industrial accidents. Most athletic PCL injuries occur during a fall on the flexed (bent) knee with the foot plantar flexed (the toes pointing down with the top of the foot in line with the front of the leg). The tibia strikes the ground first and is pushed backward.

Hyperflexion (bending too far) of the knee without a direct blow to the tibia can also cause an isolated PCL injury, in which no other ligaments are damaged. The PCL can be injured in other ways, but these usually

involve more ligaments as well, such as the ACL, medial and lateral collateral ligaments, and the posterolateral corner (back outer side) of the knee.

Signs and Symptoms

A positive "sag test" is diagnostic of a PCL tear. The sag test is conducted with the athlete lying in the supine position, with the knee bent at 90 degrees. The knee should not have the appearance of bending (sagging) backwards. MRI imaging will reveal tears within this ligament.

Treatment

Immediate care uses the PRICE approach. Suspected PCL tears should be assessed by the athlete's physician.

Physical therapy and a strong rehabilitation program aimed at strength restoration and proprioception enhancement are important for PCL injuries. Specific quadriceps strength and endurance training will compensate for the torn PCL, although there may be a small decline in the athlete's ability to participate in high-level activities. Rehabilitation may take several months. Some athletes choose to wear a knee brace for athletic participation. Surgery can be avoided in most cases.

Meniscus Tears

Each knee contains two menisci, one medial and one lateral. They are fibrocartilaginous disks that act as cushions between the ends of the femur and the tibia and fibula. The top of the tibia is flat, and the ends, or condyles, of the femur are rounded. The menisci help make a more concave surface for the condyles to rest and glide on, and thus make the knee joint more stable (refer to Figure 18-2).

The medial meniscus is attached to the ligaments on the back and medial side of the knee. Because it is attached so securely, it does not move freely. This causes it to be torn more often than the lateral meniscus, which is on the outside half of the joint. The lateral meniscus is attached only at the back of the knee and moves more freely as the knee is bent and straightened.

The menisci can be torn when the knee is twisted suddenly and one or both menisci become trapped between the femur and tibia. They can also be torn when the ligaments in and around the knee are torn. As one ages, the menisci can lose their rubbery consistency and soften and fray. These weakened structures can be torn more easily, with just a misstep around the house.

Signs and Symptoms

Unlike ACL injury, which causes rapid swelling, isolated meniscal tears develop mild knee swelling slowly over several hours or more.