Soft tissue knee injuries

Anatomy and function

The knee is the largest joint in the body. It is a synovial joint of the modified hinge (condyloid) type between the distal end of the femur, the patella and the proximal end of the tibia. The femoral articular surface is formed of three surfaces: a middle concave surface for the patella (trochlea), and medial and lateral condylar surfaces for the tibia which are markedly convex. The upper surface of each tibia is oval and slightly concave (*Figure 1*).

The capsule is attached to bone near the margins of the articular surfaces. The patellar tendon extends from the apex of the patella to the tibial tuberosity. There are two collateral ligaments on either side of the knee: the medial collateral ligament (MCL) is a broad flat band originating from the femur and inserting into the proximal tibial metaphysis (Gerdy's tubercle), which has attachments to the capsule. The lateral collateral ligament (LCL) is a rounded cord originating from the lateral femur extending to the head of fibula and is distinctly separate from the capsule.

The anterior cruciate ligament (ACL) runs upwards, backwards and laterally from the tibial spines to the medial surface of the lateral femoral condyle (*Figure 2*). Its function is to prevent anterior translation of tibia on femur but it also provides rotatory stability.

The posterior cruciate ligament (PCL) runs forwards, upwards and medially from the back of the intercondylar notch of the tibia to the lateral surface of the medial femoral condyle (*Figure 2*). It prevents the tibia sagging back on the femur and also provides rotatory stability.

The menisci are two crescentic pieces of fibro-cartilage with thickened outer margins (*Figure 2*). Each lies on a tibial condyle with its ends (anterior and posterior horns) attached to the intercondylar region and the outer margin attached to capsule. The medial meniscus is larger and semicircular. The lateral meniscus is smaller and is C-shaped. The lateral meniscus is separated by capsule posteriorly so is more mobile than medial meniscus.

Their primary function is to contribute to load distribution and improve stability of the knee joint.

The knee is capable of flexion, extension and rotation. Flexion occurs as a result of hamstring action, aided by gastrocnemius; the range of motion is restricted by apposition of the surfaces of the calf and thigh. Extension is a function of the quadriceps and iliotibial tract muscles. A small amount of medial rotation and lateral rotation is produced by hamstrings when the knee is flexed to 90°. The femoral condyles roll back on the tibial condyles during flexion and the capsular and cruciate ligaments become taut when leg nearly straight.

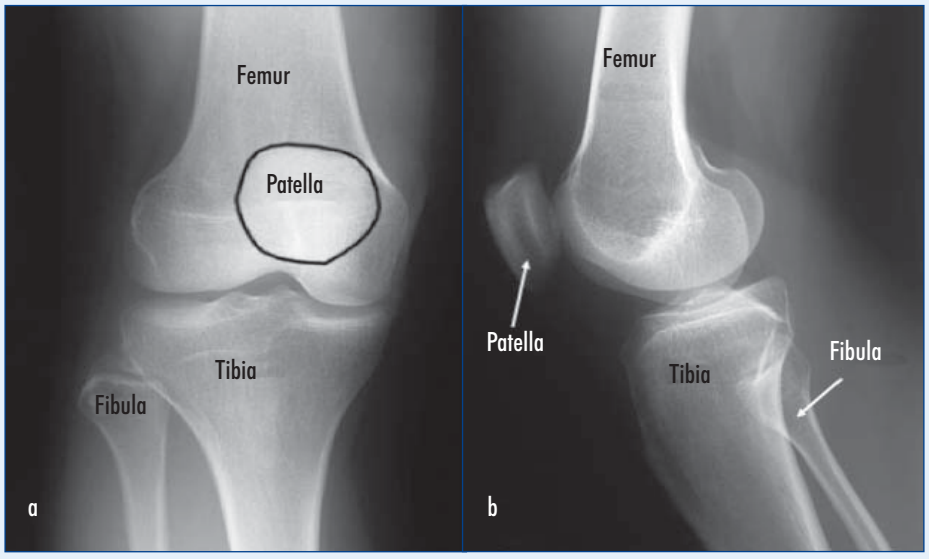
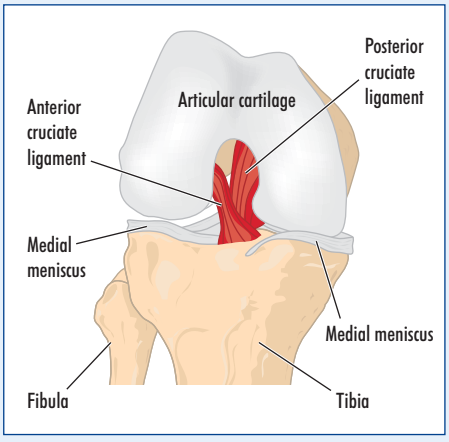


Figure 1. Bony anatomy of the knee joint. a. Anteroposterior and (b) lateral radiographs.

Figure 2. Menisci and cruciate ligaments.



Mechanisms of injury and clinical findings

The knee is the most commonly injured joint in sport and exercise, and soccer and rugby carry the highest risk (Nicholl et al, 1991). Knee injuries can result from contact and non-contact mechanisms. Around 40% of knee injuries are ligamentous (Myasaka et al, 1996). The resulting lesions may be isolated, combined, partial or complete and may be associated with bony injuries.

When considering mechanisms of soft tissue injury to the knee it is most appropriate to discuss this by particular anatomical structure including clinical findings. However, most mechanisms will be responsible for a sequence of injury, involving multiple structures at their most severe. This must be borne in mind when examining the knee joint for soft tissue injury.

The first examining doctor often assesses a soft tissue knee injury in its acute stages, and may be able to collect vital information. The history is fresh in the patient's mind and may be of considerable value in determining the diagnosis. Moreover, some signs and symptoms may be more easily gleaned before swelling, bruising and pain inhibition set in. In every case the assess-

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ment should include an examination of both knees as well as an assessment of the hip and ankle on the affected side. A neurovascular assessment is mandatory. The examiner is almost always fortunate in having the contralateral limb for comparison.

Collateral ligament injuries

The patient reports a history of twisting or wrenching the knee. The injury commonly occurs while the knee is flexed. Occasionally a pop is heard or felt – this does not necessarily imply an ACL tear.

MCL injuries (*Figure 3*) are much more common. Look for bruising and feel for medial tenderness above or below the joint line. The knee should be stressed into valgus first with the knee extended, and then with the knee held in 30° of flexion. If the knee opens up in full extension, several ligaments have been injured, the extremity must be assessed for a vascular injury and immediate orthopaedic referral is required.

The LCL is more rarely injured. The knee joint opens up with varus stress. Always assess for associated injuries and look for a foot-drop as the common peroneal nerve may be injured.

X-rays are mandatory to exclude bony injuries or avulsions in both situations.

Cruciate ligament injuries

ACL injuries account for up to 50% of documented ligamentous knee injuries (Myasaka et al, 1996). Contrary to popular belief, ACL injuries are more commonly seen after non-contact rather than contact injuries. Patients often describe one of the following modes of injury:

1. Deceleration. These may be seen in basketball or football players who change direction. If the lower leg is internally rotated at the time, the ACL is at risk.
2. Flexion, valgus or external rotation. As the knee is bent and twisted out (for example if a football or rugby boot is stuck in the turf or a ski binding does not release the boot in a twisting fall), the medial knee ligaments are initially injured, and then the ACL gives way. These injuries are often associated with medial meniscal tears – the so-called unhappy triad of O'Donoghue.
3. Hyperextension. This may be seen in basketball and volleyball players who land awkwardly and in gymnasts during the dismount. It is the mechanism of injury in some footballers who cannot control their landing after going up for a header.
4. A direct blow to the knee or shin can also lead to an ACL tear. These injuries are usually associated with damage to other structures within the knee.

In over 50% of cases, the patient will hear a pop or feel tearing within the knee. The patient is usually unable to continue playing sport and the knee swells rapidly. The swelling is the result of haemarthrosis (bleeding into the joint) and 80% of patients attending accident and emergency with acute haemarthroses have sustained ACL injuries. Other causes of haemarthroses include osteochondral fractures (aspiration will reveal fat globules as well as blood) and peripheral meniscal tears.

Anteroposterior knee stability should be assessed at 20° (Lachmann) and 90° (anterior drawer – *Figure 4*) flexion and compared to the other side. A positive pivot shift test is pathognomic but is difficult to perform in the acute setting because of pain inhibition.

PCL injuries require a greater force: these are more commonly direct blows to the anterior aspect of the knee (*Figure 5*) or severe hyperextension injuries. The initial symptoms are similar to those for ACL injuries. Examination reveals the posterior sag sign when the knee is flexed to 90° in comparison to the uninjured side. The posterior drawer test may be positive.

Plain radiographs are required in order to exclude bony avulsions for both types of injury.

Figure 3. Medial collateral ligament rupture.

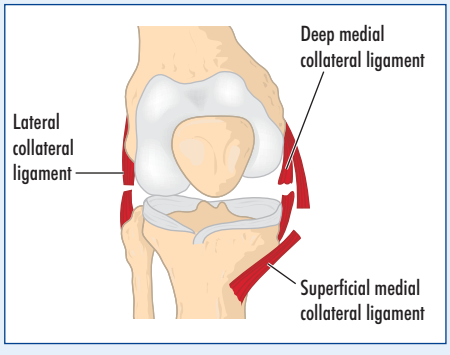


Figure 4. Anterior drawer test for diagnosis of anterior cruciate ligament rupture.

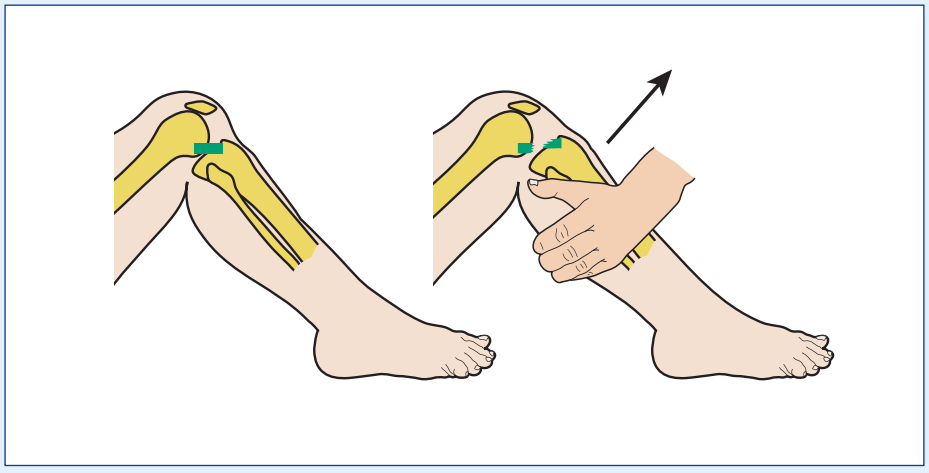
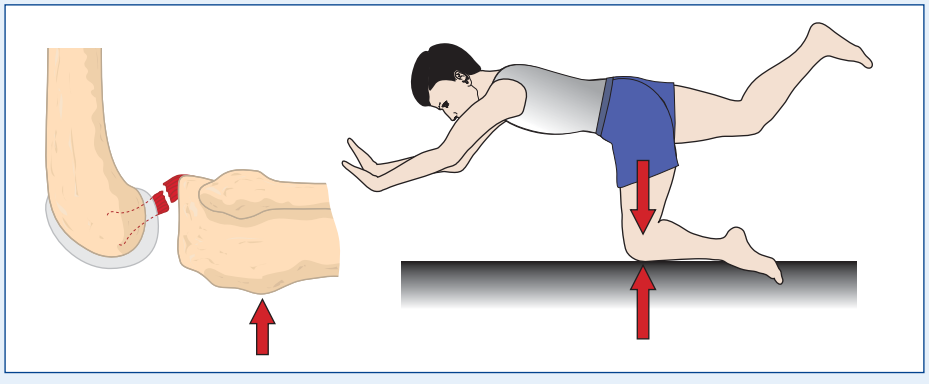


Figure 5. Mechanism of posterior cruciate ligament rupture.



Meniscal injuries

These injuries usually result from a rotational stress applied to a flexed, weight bearing knee. Medial meniscus injuries are more common than lateral meniscus injuries; this is because the medial meniscus is less mobile owing to its capsular attachments. Tears cause characteristic symptoms of pain, swelling, locking and giving way. On examination, there is often an effusion, and the patient is very tender on palpation of the joint line (not above or below) and cannot squat down fully. McMurray's test (rotation of the tibia on the femoral condyles with the knee in deep flexion) may be positive (painful) if a tear exists. If the joint is rested, the symptoms usually subside, only to return with twisting or trivial straining of the joint. The knee may also give way spontaneously.

Locking (the inability to straighten the knee) can occur in certain types of tears where the displaced meniscus blocks full extension of the joint. This becomes an urgent surgical problem as the knee must not be left in a fixed flexed position. Patients with true locking are either admitted directly or referred urgently to the next available clinic.

Patellar dislocation

Many patients are predisposed to this through anatomical variants and poor knee biomechanics. Patellar dislocation usually results from sudden contraction of the quadriceps muscle, especially when the knee is in valgus and externally rotated, e.g. when running and dodging to one side. The patella dislocates laterally and can spontaneously reduce in some cases. The patient reports the knee as having gone 'out of joint', and is left with medial knee pain above and below the joint line, indicative of a medial patellar retinaculum tear rather than a meniscal or medial collateral ligament injury.

If the patella remains dislocated, it can usually be easily reduced with distraction of the patient, analgesia and gentle knee extension with a medial force applied to the patella.

Radiographs are mandatory regardless of whether the patella has spontaneously relocated or not. Anteroposterior and lateral views of the knee and skyline views of the patella are required. Osteochondral fractures are managed with acute surgical intervention within a week.

Extensor apparatus failure

If the patient is unable to straight leg raise and does not have X-ray evidence of a patellar fracture, an injury to the quadriceps tendon or patellar tendon should be suspected. A gap in the affected tendon is often palpable. The mechanism of injury is usually related to a sudden deceleration of the lower leg relative to the rest of the body such as a stumble on a wet or muddy surface. These patients must be referred to the inpatient team for tendon repair.

Clinical picture and investigations

A full history must be taken, including determination of the mechanism of injury, whether the patient was able to carry on participating in the activity or able to bear weight after the injury, and whether the knee became swollen immediately (most probably a haemarthrosis) or over the next 24–48 hours (traumatic effusion) as this will influence suspicion of injury to particular structures. Aspiration of a haemarthrosis (see later) is a very effective pain-relieving measure and can be diagnostic in terms of confirming bleeding in the joint and for

observation for fat globules interspersed in the blood as this evidences a fracture. If a patient is first assessed some days or weeks after an injury then it is important to determine weight-bearing status since the injury, whether the pain has settled and whether the knee has clicked, locked or given way.

Plain radiographs of the knee (antero-posterior and lateral) are mandatory for all suspected soft tissue injuries, to exclude fracture and avulsion injuries. Skyline views of the patella may be requested for suspected cases of dislocation.

Magnetic resonance imaging has become the gold standard method of detecting soft tissue injuries of the knee, but should be requested by the orthopaedic team at assessment, typically at least 2 weeks after injury, when the soft tissues have settled and the knee has been re-assessed.

Accident and emergency management

If there is any doubt over the injury in this area, orthopaedic opinion should be sought. Interpretation of X-rays can be difficult. All fractures must be discussed with the orthopaedic team. Isolated soft tissue injuries can usually be treated acutely with rest, ice, compression and elevation (RICE). Patients should be given a brace, one which allows little or no movement if in doubt. Crutches, instructions to the patient not to bear weight and anti-inflammatory medication if suitable should also be administered. Referral to the next available clinic must be arranged for further assessment and examination as commonly, more useful clinical information can be gained from the knee joint 2–4 weeks after injury (*Figure 6*).

Further management

Collateral ligament injuries are treated conservatively with 4–6 weeks of bracing as standard, with increasing range of movement and physiotherapy thereafter.

Meniscal injuries may need magnetic resonance imaging to confirm the diagnosis. If the tear is small, some patients have a good outcome with physiotherapy alone; if the tear is peripheral it may heal as the blood supply is good in this area. Most patients require surgical intervention in the form of an arthroscopy to remedy the problem. This can be carried out safely, non-acutely.

Cruciate ligament ruptures and associated injuries (i.e. meniscal and collateral ligament tears) are initially treated conservatively with bracing and physiotherapy; professional athletes may undergo surgical intervention much earlier if diagnosis is made acutely for earlier return to sport. Decisions regarding reconstruction of the cruciate ligaments are made after a comprehensive assessment of each individual's activity level and expectations as well as age and other factors such as likelihood of compliance of an extended rehabilitation programme.

Patella dislocation must be braced at the very least in full extension for a moderate period. First time dislocations may be treated in a long leg cylinder cast for up to 10 weeks. Physiotherapy, particularly strengthening of the vastus medialis obliquus muscle, forms the mainstay of treatment.

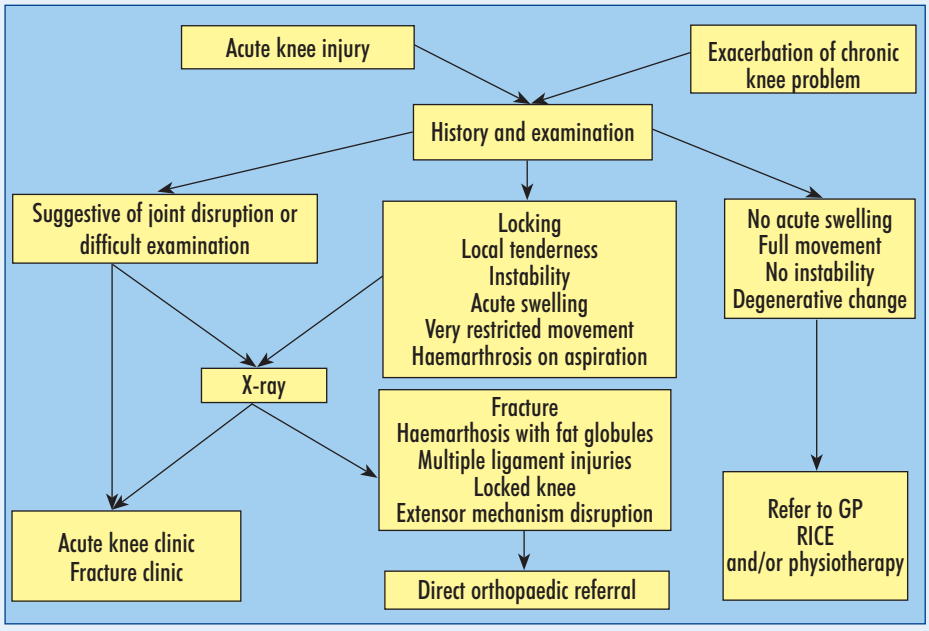
Extensor tendon rupture almost always requires reconstruction. Diagnosis is often confirmed using ultrasound. **BJHM**

Conflict of interest: none.

Myasaka KC, Daniel D, Stone ML (1996) The incidence of knee ligament injuries in the general population. *Am J Sports Med* **24:** 99–103

Nicholl JP, Coleman P, Williams BT (1991) *Injuries in Sport and Exercise: Main report.* A national study of the epidemiology of exercise-related injury and illness. A report to the Sports Council. Medical Care Research Unit, Department of Public Health Medicine, Sheffield University Medical School, Sheffield

Figure 6. Management of acute soft tissue knee injuries. RICE = rest, ice, compression and elevation.



KEY POINTS

- The knee is the most commonly injured joint in sport and exercise, and soccer and rugby carry the highest risk.
- Knee injuries can result from contact and non-contact mechanisms, and the resulting lesions may be isolated, combined, partial or complete and may be associated with bony injuries.
- The history is of considerable value in determining the diagnosis.
- Anterior cruciate ligament injuries account for up to 50% of documented ligamentous knee injuries, and are more commonly seen after non-contact rather than contact injuries.
- Posterior cruciate ligament injuries require a greater force: these are more commonly direct blows to the anterior aspect of the knee or severe hyperextension injuries.
- Meniscal injuries usually result from a rotational stress applied to a flexed, weight-bearing knee.
- Plain radiographs of the knee are mandatory to exclude fracture and avulsion injuries.
- Isolated soft tissue injuries can usually be treated acutely with rest, ice, compression and elevation (RICE).