Soft tissue knee injuries

Jonathan N Lamb

Stephen P Guy

Abstract

Soft tissue knee injuries represent a large spectrum of pathology from the minor sprain to devastating knee dislocations. Taking a clear, focussed history and listening to the minutiae that the patient divulges give clues to the mechanism and thus the suspected patterns of injury. A thorough knee examination will allow you to narrow your differential and organize appropriate timely investigations to assist your diagnosis. This article aims to give you background information about the structure and function of the knee and diagnosis of common knee complaints.

Keywords Collateral ligament; cruciate ligament; knee injury; knee ligament; Lachman test; meniscus; patella; pivot shift test

Basic functional anatomy

It is vitally important to understand the anatomy and normal movement of the salient structures of the knee to help you work out how and why the knee may be injured.

The synovial knee joint consists of three bony structures, the femur, tibia and patella that form three distinct compartments; the medial tibiofemoral, the lateral tibiofemoral and the patellofemoral. The knee is held in place by the interplay of the articular surfaces, the joint capsule the static ligaments and the dynamic musculotendinous stabilisers.

Patellofemoral joint

This is the largest sesamoid bone in the body and is enveloped by the fibres of the quadriceps proximally and distally the patella tendon. The articular surface of the patella has the thickest hyaline cartilage in the body, essential because of the large forces that pass through the joint. There are seven facets to the patella but it is easier to break it down into a medial and lateral facet and a median ridge. The patella can be thought of as the under surface of a boat, the keel, that articulates and is stabilized by the deepened groove of the femoral trochlea. The patella fits imperfectly into the trochlea groove and the surface contact area that articulates varies with the degrees of flexion of the knee. For example the distal patella contacts the trochlea first and with increasing flexion the contact area migrates proximally up the patella with increasing knee flexion. Thus direct trauma to the patella at different flexion angles can cause pathology in different areas of the patellofemoral joint. The patella stability is maintained by different constraints at different flexion angles. In a fully extended leg the patella is relatively more mobile and is constrained by both dynamic and static stabilizing structures. Stability comes from the quadriceps tension, patella retinaculum and the lateral and medial patellofemoral ligaments (MPFL). The MPFL conveys as much as 60% of the resistance to lateral displacement of the patella.[1] As the knee flexes to 30–40° the patella engages with the trochlea which takes over as a bony constraint. Thus if a patella injury occurs beyond this degree of flexion then concern has to be raised for an osteochondral injury to the lateral side of the trochlea or the medial facet of the patella. Individuals can be at increased risk of patella injury if they have inadequate depth to their trochlea groove termed trochlea dysplasia or if their patella is too high (patella alta) (Figure 1).

Tibiofemoral joint

The tibiofemoral joints are condyloid in nature. There is asymmetry seen in the tibial plateaus with the medial tibial plateau being more deeply dished or concave and the lateral tibial plateau being convex. The knee joint is made more congruent by the menisci.

Menisci

The menisci are crescentic fibrocartilage structures between the femur and the tibia. Meniscal tears are the most common indication for surgery to the knee. Each meniscus covers the peripheral two-thirds of the corresponding surface of the tibia. The peripheral edge of the meniscus is thick, convex, and attached to the capsule of the joint. The inner border tapers away to a thin edge. The meniscus is essentially an avascular structure with only the peripheral edge (10–20%) having a blood supply from a perimeniscal capillary plexus. The blood supply to a torn meniscus will be important in the decision making whether to preserve and repair the meniscus or to perform a partial meniscectomy. The collagen fibres within the menisci are arranged radially and longitudinally, which gives the menisci strength under compressive loading. The relationship between the loss of a meniscus leading to early joint arthritis is historically well known.[2]

The meniscus has several roles in the knee:

- load transmission across the joint
- enhances the articular conformity and improves anteroposterior stability of the knee
- prevents soft tissue impingement during movement
- distributes synovial fluid across the articular surface.

Anterior cruciate ligament (ACL)

Despite a lot of research in this area the ACL functional anatomy is still being explored. The current concept is that the ACL consists of two bundles[3] – an anteromedial and posterolateral bundle – but recent basic science studies have shown that the functional fibres of the ACL have no bundles and behave more like a ribbon.[4] The tibial attachment is a broad, oval area just anterior to and between the intercondylar eminences. The femoral attachment is a semicircular area on the posteromedial aspect of the lateral femoral condyle. The anteromedial bundle is tight in flexion and the

Jonathan N Lamb *BSc(Hons) MBBS MRCS is a Specialist Trainee in Trauma and Orthopaedics at Bradford Teaching Hospitals NHS Foundation Trust, UK. Conflict of interest: none.*

Stephen P Guy *BMedSci(Hons) MBBS MRCS(Eng) DipSEM (UK&I) FRCS(Tr & Orth) is a Consultant Soft Tissue Knee Surgeon at Bradford Teaching Hospitals NHS Foundation Trust, UK. Conflict of interest: none.*

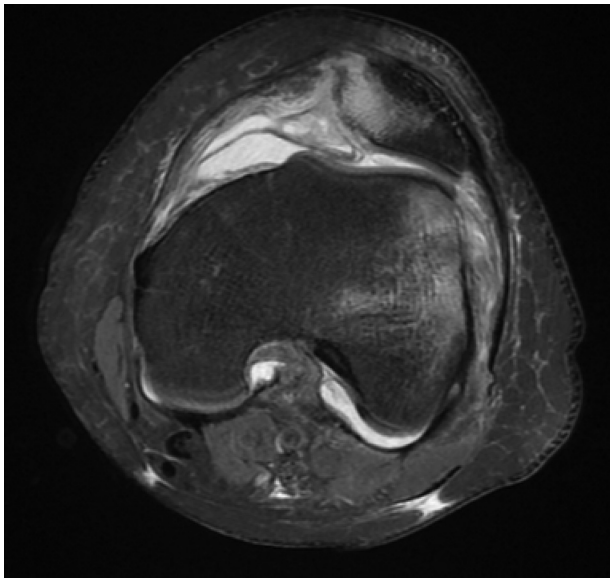

Figure 1 Axial MRI scan showing characteristic 'bone bruising' to the medial aspect of the patella and the lateral femoral condyle seen in a patella dislocation. In this case the trochlea is flat and dysplastic and is a significant risk factor for patella dislocation. They also have an effusion and have injured their medial patellofemoral ligament.

posterolateral bundle is tight in extension. The ACL is the main restraint to anterior translation of the tibia on the femur.

Posterior cruciate ligament (PCL)

The PCL attaches to the femur from a broad, crescent-shaped area in the intercondylar notch on the anterolateral border of the medial femoral condyle and inserts into a tibial sulcus on the posterior aspect of the tibia 1 cm below the joint line. The PCL has two bundles – an anterolateral bundle that is tight in flexion and a posteromedial bundle that is tight in extension. The PCL is the main restraint to posterior translation of the tibia on the femur.

Medial collateral ligament (MCL)

The MCL is composed of deep and superficial elements. The superficial fibres originate from the medial femoral epicondyle and insert into the periosteum of the proximal medial tibia. The anterior fibres tighten up during the first 90° of flexion and conversely the posterior fibres tighten up in extension. The deep MCL is a thickening of the capsule and blends intimately with the periphery of the meniscus and tibial plateau. The MCL is the main restraint to valgus force.

Lateral collateral ligament (LCL)

This is a cord-like structure easily palpated when the leg is placed in a 'figure of 4' position. It originates from the lateral femoral epicondyle and inserts onto the lateral aspect of the fibula head. As it is posterior to the axis of knee rotation the LCL is tight in extension and lax in flexion. The LCL helps resist varus force.

Posterolateral corner (PLC)

This is a complex area of the knee with more than 25 elements described, of which the LCL is a constituent. Some structures are not always present. The main stabilizers consist of the biceps femoris, iliotibial band, popliteus, popliteofibular ligament and thickenings of the joint capsule.

Posteromedial corner (PMC)

This is becoming increasingly recognized now during injury patterns and injury to this area will convey rotational instability. The posteromedial corner consists of capsular thickening of the numerous insertions of semimembranosus and the posterior oblique ligament (POL).

Movement of the knee (kinematics)

The motion seen on the knee joint is a combination of rollback and sliding at the articular surfaces. This allows for the femur to clear the tibia and thus allow for a greater degree of flexion. This also increases the lever arm of the quadriceps muscles increasing the efficiency. During knee flexion the centre of rotation of the joint moves posteriorly. MRI has shown that the rollback seen is much more in the lateral compartment of the knee compared to the medial compartment hence the tibia internally rotates relative to the femur in flexion. The asymmetry of the tibiofemoral compartments allows almost 30° of axial rotation through the full range of motion. As the knee enters final extension, the tibia externally rotates relative to the femur. This is termed the screw-home mechanism and helps lock the knee in maximum stability in full extension. The action of popliteus muscle causes internal rotation of the tibia relative to the femur and 'unlocks' the knee.

History

There is no doubt that when faced with an acutely injured knee it can be a daunting prospect, but taking a focussed history is *the most effective* way to elucidate and narrow down how significant the knee injury may be and where the pathology or pathologies lie. Also be mindful in children that a history of a knee injury does not exclude the possibility of a sarcoma. Did they land awkwardly? Was the foot fixed when they changed direction quickly? Are they on anticoagulants? Depending on the force that was passed through the knee will lead you to suspect certain patterns of injury (Table 1). I like to use a 'LIMP' index I devised.[5] Key symptoms of a sporting intraarticular injury include **L**eg giving way, **I**nability to play on, **M**arked effusion and a **P**op or snap – LIMP. This is easy to remember specifically for non-specialists and allows healthcare professionals to identify potentially significant soft tissue knee injuries so they are not discharged to re-injure their knee. Below are some examples of salient questions to ask and examples of issues they will uncover. This list is not exhaustive and there will be overlapping potential pathology that can be further explored during examination.

Pain?

- Point with one finger as to where the pain is. Onset, duration, exacerbating and relieving factors. Someone who has posterior pain in the popliteal fossa area and pain made worse by kneeling would raise concern for a PCL injury. Posteromedial joint line pain implies meniscal pathology.

