Soft tissue knee injuries

Kanishka M Ghosh

David J Deehan

Abstract

Soft tissue injuries of the knee are some of the most common and clinically challenging musculoskeletal disorders in patients presenting to the emergency department. Establishing clear-cut diagnostic and therapeutic objectives for these injuries is critical. The aim of this article is to outline the pathophysiology and management principles of the most common of these injuries.

Keywords Anterior cruciate ligament; collateral ligament; drawer test; extensor mechanism injuries; knee; Lachman's test; ligaments; McMurray test; menisci; patella; pivot shift test; provocative tests

Functional anatomy[1]

The human knee joint is a synovial joint comprising two condyloid articulations of the femoral and tibial condyles, plus the sellar patellofemoral joint. It acts through both gliding and rolling in addition to a hinge type mechanism. It has little intrinsic stability and relies upon active and passive intrinsic and extrinsic stabilizers to provide limb support and flexibility (Table 1).

The posterolateral corner provides additional restraint to external rotation of the tibia and is often injured in association with a posterior cruciate ligament (PCL) rupture. It consists of the popliteus, the popliteo-fibular ligament, lateral capsule and arcuate ligament and the fabello-fibular ligament.

The menisci are intra-articular crescent shaped fibrocartilaginous structures, triangular in cross-section and serve to deepen the articular surface of the tibial plateau and have a role in the stability, lubrication and nutrition of the joint. Only the periphery of the menisci are vascularized from branches of the medial and lateral genicular arteries thereby influencing the surgical decision to repair or resect. The collagen fibres of the menisci are arranged radial and longitudinally. The combination of fibres allow for the menisci to expand under compressive load so as to distribute stress by increasing contact area.

Patellar stability is conferred through the reciprocal bony anatomy of the retropatellar V-shape and the trochlea, dynamic tension in the vastus medialis oblique and vastus lateralis and static restraints of the retinaculae. The medial retinaculum consists of the medial meniscopatellar ligament and the medial patellofemoral ligament (MPFL). The MPFL is a primary stabilizer to patellar lateral subluxation (53−60% restraining forces) especially at low flexion angles.[2]

***Kanishka M Ghosh** MD(Res) MRCS is a Specialty Trainee in Orthopaedics at the Freeman Hospital, Newcastle, UK. Conflicts of interest: none declared.*

***David J Deehan** MD MSc FRCS(Tr & Orth) is a Professor of Orthopaedics at the Freeman Hospital, Newcastle, UK. Conflicts of interest: none declared.*

Soft tissue kinematics

The motion of the knee joint and interplay of the cruciates has classically been portrayed as a four-bar linkage system (Figure 1). As the knee flexes, the centre of joint rotation moves posteriorly, causing rolling and gliding to occur at the articulating surfaces. Ligaments anterior to the flexion axis stretch as the joint flexes and ligaments posterior to the axis shorten.

History

A careful history will allow the clinician to direct their examination approach and rapidly determine a diagnosis. It is particularly important to detail the mechanism of injury, associated swelling, its chronology and finally the patient's previous history of injury and current functional limitation. Look out for red flags (Box 1).

The primary mechanisms of soft tissue injury to the knee are direct trauma, varus or valgus force (with or without rotation), hyperextension, flexion with posterior translation, a twisting force and overuse (Table 2).

Concurrent sensations such as a 'snap' or a 'pop' felt at the time of injury is indicative of an anterior cruciate ligament (ACL) rupture. Knee locking, clicking or catching may be suspicious of a meniscal injury (e.g. a bucket-handle meniscal tear). Symptoms of knee instability can be associated with ACL and/or meniscal injury or patella subluxation. Ask the patient if they can point "with one finger" to where the pain is located.

If the knee became swollen following injury it is important to know when this occurred. Sudden swelling (within an hour) is usually as a result of an acute haemarthrosis caused by injury to a vascular structure (e.g. ACL or a peripheral meniscal tear).

Examination

Look

It is imperative to have a view of the entire lower limb. Observe uninterrupted gait over an appropriate distance (use the corridor if necessary). Inspect the limb from the front, side and the posterior aspect (scars, cysts). Coronal (varus, valgus) and sagittal (fixed flexion) alignment and asymmetry must be recorded. Ask the patient to lie supine with a pillow under their head and arms lying relaxed on the abdomen. Key findings include scars, bruising, swelling (magnitude and position) and a posterior sag (PCL injury) (Figure 2).

Feel

Check the temperature of the joint using the back of your hand. Sweep the hand over the medial and lateral compartments to check for fluid shift followed by a patellar tap test to check for an effusion. Palpate the border of the patella followed by the medial, lateral and posterior joint line and tibial tuberosity to check for tenderness. Palpate posteriorly for a possible poplitaeal aneurysm and finally check peripheral pulses.

Origin/insertion/restraining function of the four principal ligamentous (static) stabilizers of the knee joint

Ligament	Origin	Insertion	Restraint
ACL	Intercondylar notch — posteromedial aspect of lateral femoral condyle	Intercondylar eminence of tibia	Anterior translation of the tibia relative to the femur
PCL	Intercondylar notch — anterolateral border of medial femoral condyle	Extra-articular — back of tibial plateau (1 cm distal to joint line)	Posterior tibial displacement
MCL	Superficial fibres — medial femoral condyle Deep fibres — capsular thickening	Superficial fibres — periosteum of proximal tibia Deep fibres — edge of tibial plateau and medial meniscus	Valgus angulation
LCL	Lateral femoral condyle	Lateral aspect of the fibular head	Varus angulation

ACL, anterior cruciate ligament; LCL, lateral collateral ligament; MCL, medial collateral ligament; PCL, posterior cruciate ligament.

Table 1

Move

Flexion and extension of the knee should be examined and recorded both actively and passively. Assess the extensor apparatus by asking patient to perform a straight leg raise. If a flexion deformity exists, differentiate this between true fixed flexion deformity and an extensor lag. An extensor lag can be corrected passively. Hilton's law states a nerve that innervates a joint also tends to innervate the muscle that moves the joint and the skin that covers the distal muscle attachments of those muscles. Therefore check hip movements — hip pathology is often referred to the knee, particularly in children.[3]

Provocative tests

Valgus and varus stress test

This test assesses medial collateral ligament (MCL)/medial capsule and lateral collateral ligament (LCL) integrity respectively. It should be performed in full extension (if positive suggestive of gross disruption and involvement of the posterior structures) and at 30° of knee flexion. Examine both sides for absence of symmetry and laxity should be graded according to the American Medical Association Guidelines for grading MCL or LCL complex injuries:

Grade I	0–5 mm joint line opening
Grade II	5–10 mm joint line opening
Grade III	>10 mm opening/no firm endpoint performed with knee in 30° of flexion[4]

Schematic diagram of the four-bar mechanism

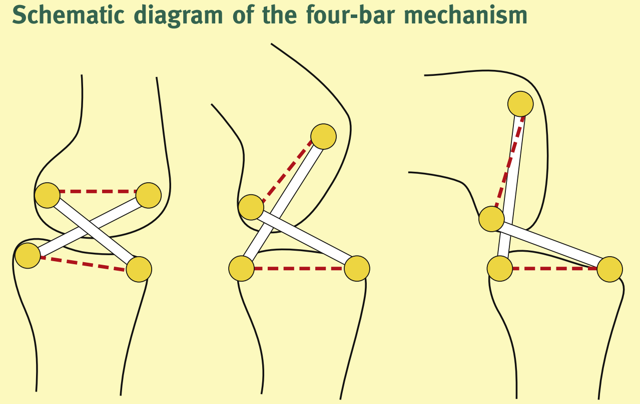

Figure 1

Anterior drawer test

The anterior drawer has classically been used to test the integrity of the ACL. A positive test result is indicated by increased anterior translation and a soft endpoint and graded similar to the Lachman test (Table 3). The anterior drawer test has been found to have poor sensitivity and specificity for isolated ACL rupture when compared to the Pivot Shift and Lachman test and an intact MCL will restrict anterior translation at 90°.[5]

Posterior drawer test

This test is reported to be the most sensitive in the evaluation of isolated PCL injuries. As with the anterior drawer the patient is in a supine position with the knee flexed at 90°. Comparison with the uninjured side may reveal a 'posterior sag' (Figure 2). Prior to applying any force it is important to establish the normal relationship between the medial tibial plateau and the medial femoral condyle. The examiner then places both hands along the anterior aspect of the proximal tibia with the thumbs lying on the anterior joint line of both the medial and lateral compartments. A posteriorly directed force is applied equally with both hands and graded based on the amount of pathologic posterior tibial translation that occurs (Figure 3).

Lachman test

This test offers a high sensitivity and specificity (approaching 95%) when assessing the integrity of the ACL. With the patient supine and the knee positioned at around 30° flexion (Figure 4), the examiner stabilizes the anterolateral distal femur with one hand and uses the other hand to exert firm pressure on the posterior aspect of the proximal tibia in an attempt to induce

