# The injured knee

***Knee injuries are probably one of the most common orthopaedic problems encountered in general practice, particularly among recreational athletes.***

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The diagnosis of knee injuries can at times be confusing. However, there are only a limited number of structures that can be injured so a systematic approach to assessing each of these is essential to avoid missing or misinterpreting something.

The force of the injury largely determines how severely any structure may be damaged. Low-energy injuries tend to cause less complex or severe injury patterns, like a torn meniscus or an isolated anterior cruciate ligament (ACL) tear, whereas high-energy injuries are often combined soft-tissue injuries with associated chondral injury or fractures.

Obtaining an accurate history of the injury is essential in trying to 'visualise' the structures that may have been stressed or torn, and is as important now as it was 100 years ago. Knowledge of pre-existing injury often helps to explain why the recent injury occurred and to cast light on what may seem confusing clinical findings.

**The important structures that may be injured are the ligaments, particularly the ACL, menisci, articular cartilage, bones, muscles and tendons, and the neurovascular structures. Each of these must be assessed individually.**

By the time you have completed your examination, if nothing else be 100% sure that you know the status of the ACL. This important structure, more than any other, holds the key to good knee function.

## Symptoms

There are 5 main symptoms that will help direct you to the underlying pathology: pain, swelling, giving way, locking and joint noises.

### Pain

This is the most common symptom and usually directs your attention to the injured structure. The painful area is often ill-defined and I find it useful to localise the problem by asking the patient to indicate *with one finger* the area of most acute pain.

Before proceeding, ask yourself whether this pain is REAL or REFERRED. The clue to whether it is referred or not is the absence of other knee symptoms in the history and negative knee findings on examination.

Imagine what underlying structures are in the area indicated. Skin, subcutaneous fat, fascia, muscles or tendon, nerves and vessels, ligaments and capsule, intra-articular structures, cartilage and bone may be involved in the injury.

### Swelling

Probably the most important information to be gained is how long after the injury any swelling occurred. If it developed within hours, then it is most likely caused by blood in the joint. ACL injury accounts for 70% of haemarthroses where no fracture is present.

Collateral ligament tears usually tear the capsule and the blood leaks into the surrounding tissues, causing diffuse swelling rather than haemarthrosis.

Swelling that occurs in the days after the injury may be synovial fluid as a result of a meniscal or ligamentous tear.

**A haemarthrosis is most frequently an indication of ACL rupture, meniscus tear, collateral ligament injury, or intra-articular fracture.**

### Giving way

This is usually a late, rather than an acute, symptom and results from the instability of a torn ligament, usually the ACL, or from something being trapped between the articular surfaces, such as a torn meniscal flap or loose body. The presenting symptom may be obvious but more frequently this is vague, such as: 'it gives in', 'the knee lets me down', 'I can't run because something will happen when I turn', etc. The more subtle nuances of instability are frequently missed.

Giving way is a protective mechanism, just like pain, resulting from reflex inhibition of the muscles (quadriceps mainly) acting on the knee. A wide range of pathologies can cause it, including ligamentous laxity, in particular the ACL (the other injured ligaments seldom if ever present with giving way), loose body, meniscal tear and articular pathology.

### Locking

Locking is the inability to fully extend the knee. Extension is mainly a 'rolling motion' of one contact surface on the other, and can be blocked by something interposed between the articular surfaces. Flexing, on the other hand, is a 'sliding motion' which cannot be blocked by an interposed fragment.

Any loose fragment can cause locking, but the classic reason is a torn meniscus.

The first time a torn meniscus displaces into the intercondylar area, tension on the capsule causes severe pain and muscle spasm of all muscle groups. The knee is completely jammed or locked – it can't flex or extend because it is so painful. With time the meniscal tear extends and each episode of locking becomes less uncomfortable, until only extension is affected and not flexion. Eventually this may become so loose that the patient may not notice any loss of extension and is aware only of 'something moving' in the knee.

**A pop or snap at the time of the injury usually signifies an ACL tear while a crunch or tearing sensation may mean a meniscal, ligamentous or articular injury.**

### Joint noises

At the time of the injury the rupture of a significant structure is often accompanied by an audible or palpable sensation. A pop or snap at the time of the injury usually signifies an ACL tear while a crunch or tearing sensation may mean a meniscal, ligamentous or articular injury. Some time after the injury a low-pitched solitary clunk signifies a large piece of tissue moving in the joint, usually a torn meniscus.

By the time a clear history has been elicited, one should be able to 'profile' the injury with a strong presumptive diagnosis.

## Examination

Adopt a routine that will avoid missing anything, such as the Apley principles of 'look', 'feel' and 'move'.

### Look

Observe how the patient moves the joint and walks into the room. Remember to look at the front as well as the back of the knee.

#### *Alignment and posture*

As viewed from the front the leg should be in slight valgus. An imaginary line from the middle of the ankle to the hip should pass through the middle of knee. Is the knee subluxed or dislocated? Is there a fracture?

From the side: Is the knee in flexion or is it able to extend fully (?flexion deformity or locked knee). Is the tibia subluxed posteriorly (posterior 'sag') indicating a posterior cruciate ligament (PCL) injury. Is the knee or patella dislocated?

#### *Surface features*

Check for wounds that may suggest which underlying structures were injured.

#### *Swelling*

In the acutely injured knee swelling will be due to blood or synovial fluid. An intact capsule will confine the swelling to the synovial space, indicating intra-articular pathology. If it is diffuse, the structures outside the joint space are likely to be involved. In the chronic recurrent injury, swelling may be due to synovial thickening which is associated with recurrent effusions.

#### *Muscle wasting*

Wasted thigh muscles indicate an injury of at least 10 days' - 2 weeks' duration. Vastus medialis will atrophy first but both hamstrings and quadriceps will be affected later.

### Feel

#### *Tenderness*

Localise the epicentre of the problem by asking the patient to indicate the maximal area of tenderness with one finger. The first step to 'knowing where you are' is to locate the joint line which is more easily identified with the knee at 90°. Flexion 'opens up' the space between the femur and tibia. Pain or tenderness along the joint line suggests a meniscal tear. Palpate the bony contours, ligament, tendons and their attachments for tenderness. Are these intact, are they tender?

#### *Swelling*

If swelling is severe and confined to the synovial space, aspirate the knee under sterile conditions. It is useful to aspirate the knee and squirt the fluid out into a dish. If blood is present look for fat globules on the surface as this will indicate an intra-articular fracture or bony avulsion of the ACL which must be investigated.

#### *Muscles*

Measure the thigh girth to confirm muscle atrophy.

### Move

Active range of motion: ask the patient to lift the leg up from the couch, maintaining it in a straight position (0º). Inability to achieve full active extension (extensor lag) suggests a tear of the extensor mechanism or fracture of the patella. Loss of passive extension is suggestive of a locked knee. Ask the patient to actively flex the knee as far as possible. For accuracy, record the range of motion in degrees, e.g. 5º - 120º, indicating a 5º flexion deformity.

### Specific tests

#### *Hip screen*

It will be prudent to do a rapid hip screen for pain and range of motion to exclude referred symptoms from the hip.

#### *Ligament tests*

For daily activities the knee functions mostly between 10º and 30º, so perform stability tests within this range.

#### *Cruciates*

The most important and significant test you can perform in the knee is to test for ACL stability. In the acute phase the Lachman test performed at 15º is essential. The injured swollen knee lies in slight flexion, just the position for performance of the test. Excessive anterior displacement of tibia on femur indicates an ACL tear while excessive posterior displacement indicates a PCL tear.

In a 'longstanding' ACL injury the following three additional tests assist diagnosis:

#### *Knuckle test*

If the patient complains of giving way, the knuckle test as described by E Trickey is useful because it mimics the instability experienced during an episode of giving way as a result of ACL deficiency (Fig. 1).

#### *Pivot shift test*

One of the most useful tests employed for chronic ACL insufficiency is the pivot shift test, which assists in determining to what extent the ACL has been torn. This is a complex flexion rotation test which recreates the clinical symptom of giving way.

#### *Drawer test*

The drawer test at 90º tests anterior and posterior motion at 90º, assessing relatively less important parts of the ACL and PCL. The most useful part of this test is to check the integrity of the PCL, especially when both the ACL and PCL have been injured.

*Fig. 1. The knuckle test as described by Trickey. Press knuckles together firmly then sharply rotate so that knuckles 'jump' one space back and forth. This motion reproduces what the patient experiences as the tibia displaces on femur when the knee gives way due to ACL laxity.*

Normally the femur lies about 1 cm behind the anterior margin of the tibia when flexed to 90º. If the PCL is torn the tibial 'step-off' will be reduced and can be seen by inspection or palpation as a 'sag'.

**If the knee is too painful to assess adequately, give an analgesic or examine under anaesthesia.**

### *Collaterals*

These are assessed by stressing the ligament at 0º and at 15º - 20º flexion. If only the collateral has been torn, the intact cruciates will continue to give the knee some medio-lateral stability in full extension, and the collateral tear will only be revealed in slight flexion when the cruciates relax.

Collateral instability at 0º indicates a more severe injury, with damage to one or both cruciates. In addition the neurovascular structures are at greater risk of injury, especially the common peroneal nerve and the politeal artery.

Radiographic stress tests should be performed if there is doubt where the movement is taking place (Fig. 2). A physeal injury in a child or a tibial plateau fracture may mimic ligament instability.

### *Menisci*

**Steinman test**

In the acute stage full-knee flexion required for the McMurray test is impossible. The Steinman test is performed with the knee

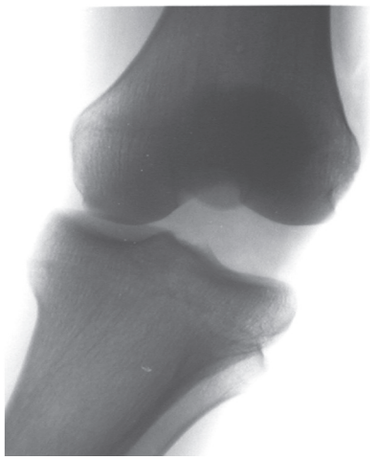

*Fig. 2. A stress test of the lateral collateral ligament demonstrating excessive opening up of the lateral compartment. The lateral collateral, PCL and ACL will be torn. The common peroneal nerve should be assessed.*

at about 90º flexion (patient sitting on examination couch with leg hanging down) and reproduces joint line pain on sharp internal (lateral meniscus) or external (medial meniscus) rotation of the tibia.

**McMurray test**

This test is usually performed in the subacute or chronic stage and will be positive with a meniscal tear. A click, crunch, clunk or pain during the test usually felt at the postero-medial or postero-lateral corners signifies a tear.

### Special investigations

Investigations should not be used to look for a diagnosis. A diagnosis should be based on an adequate history and examination. The real value of these investigations is to plan the best line of management of each injury.

All knees with *significant* injury should be examined radiographically to exclude an accompanying fracture (Fig. 3).

The initial examination should be a standard AP and lateral radiograph of the knee. MRI studies have shown a previously unrecognised high incidence of damage to other structures at the time of ligament injuries, and some orthopaedic surgeons feel this should be the primary investigation. For example, articular cartilage damage and bone bruising (microfractures) have been demonstrated in 70 - 80% of ACL and PCL injuries and somewhat less with collateral injuries. I do not believe general practitioners should request an MRI, unless this has been discussed with the relevant orthopaedic surgeon.

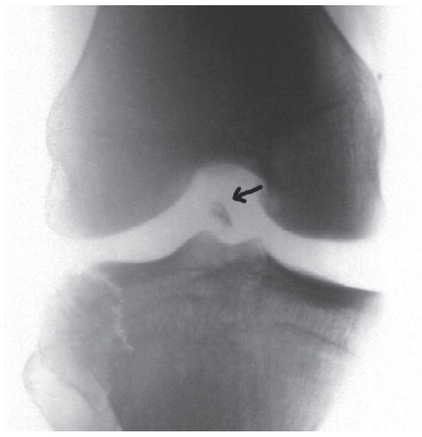

*Fig. 3. Tibial spine in association with lateral tibial plateau. The ACL must be torn*

Radiographs define bone injury well, but some difficult fractures may need a CT scan to delineate them better. If accompanying soft-tissue structures need better elucidation, such as a partial injury to the cruciates, the location of a tear of a meniscus or the medial patello-femoral ligament or a bone bruise, then one would proceed to an MRI.

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## Management

### Ligament injury

All cruciate ligament injuries are best referred to a specialist for possible repair or reconstruction.

A clear functional improvement has been shown for ACL reconstruction, so there is little controversy regarding surgical management. Reconstruction of the PCL, on the other hand, has not shown the same benefit and there is still considerable debate about the role of reconstruction. Hence for isolated PCL tears, rehabilitation and bracing initially is reasonable management. It has however been shown that associated injury, particularly to the postero-lateral corner, results in marked morbidity if not repaired. If there are associated injuries, repair or reconstruction is preferred.

Low-demand individuals aged over 50 years, who engage in only social or recreational activities, are usually managed less aggressively. Rehabilitation of the thigh muscles (most importantly the hamstrings) is essential, and a protective brace should be employed for the first 3 - 6 weeks.

Isolated medial or lateral collateral ligament injuries are treated conservatively with a brace that is usually maintained for a period of 6 weeks.

Collateral ligament injuries in association with meniscal tears must be referred for surgical repair.

### Meniscal injuries

Preservation of an injured meniscus has been shown to be important to reduce the risk of developing subsequent osteoarthritis (Fig. 4). Early referral to an orthopaedic surgeon is recommended because repair of meniscal tears in the acute phase (within 2 - 3 weeks) offers the best outcome. Beyond this time period repair should still be attempted, but removal, preferably partial, may be necessary if its microstructure has been damaged by repeated episodes of meniscal displacement.

Cadaver meniscal transplantation is gaining popularity in some centres. There is as yet no documented long-term protective benefit.

### Knee dislocation

The most severe form of ligament injury is dislocation. There is often concomitant injury to other structures due to the force of the injury (Fig. 5). Look for common peroneal or tibial nerve injury and damage to the popliteal artery.

#### *Treatment*

Reduction should be attempted immediately, on the field or by the roadside. All dislocations should be referred as an emergency for specialist treatment. There is a high incidence of arterial injury and amputation. Arteriography is performed in all cases, with emergency arterial repair if necessary.

The outcome following a dislocation has been shown to be better when the ruptured structures are repaired surgically rather than allowing them to heal in a plaster cast or brace. If there is no vascular injury, primary repair of the torn structures is undertaken if the swelling around the knee permits, preferably within 10 days to 2 weeks. If the leg is very swollen, keep the leg elevated in a temporary splint to allow the swelling to settle.

After repair the knee must be stabilised so that posterior subluxation of the tibia does not occur, e.g. by using a thick foam pad in the brace behind the calf.

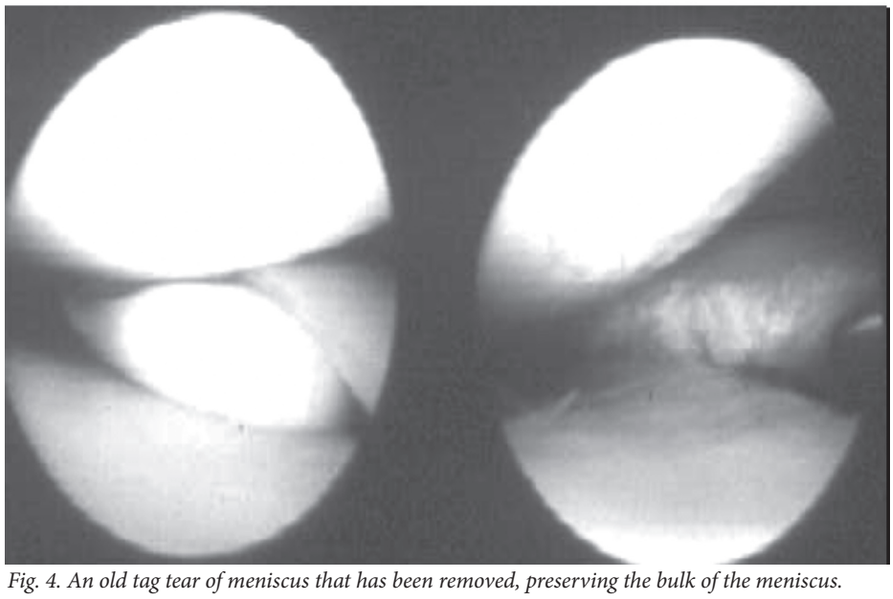

*Fig. 4. An old tag tear of meniscus that has been removed, preserving the bulk of the meniscus.*

*Fig. 5. Radiograph showing a lateral dislocation of the knee.*

### Chondral defects

A delaminating or shearing injury to the articular cartilage frequently occurs in association with ligament or meniscal injury. The current trend is to replace these fragments, especially if the subchondral bone is involved. However, these injuries are usually recognised late and a longstanding defect can be repaired by drilling the subchondral bone to stimulate cartilage re-growth, by transplantation of an adjacent osteo-cartilaginous graft, or transplantation of cultured autologous chondrocytes.

Drilling the defect is relatively quick and cheap and seems to be as effective as the other two methods.

### Rupture of the extensor mechanism

Rupture of the quadriceps mechanism is uncommon, and is the second-most commonly missed significant injury affecting the knee.

Inability to fully extend and lift the leg off the couch may be due to the pain of the injury, tightness of a haemarthrosis, or a block to extension by a loose fragment. Most importantly, make sure this is not due to rupture of the quadriceps tendon, patellar tendon or a patellar fracture.

These latter conditions cause a quadriceps lag, while full passive extension will be possible and a gap in the extensor mechanism will be palpable (Fig. 6).

Acute cases can be managed by direct suture of the tendon whereas chronic tears will need a tendon graft.

### Patella dislocation

The patella usually dislocates laterally because of the natural valgus angle at the knee. The patella may be displaced by a direct force, i.e. a blow to the patella which forces it out of its normal position, or an indirect force, i.e. a strong quadriceps muscle contraction with the lower leg in external rotation and slight

*Fig.6. Rupture of the patellar tendon. The patella is retracted proximally and the gap is easily palpable in extension. With passive knee flexion the profile of femoral condyles is easily seen, indicating the extent of the tear. Attempts at active extension will demonstrate an extensor lag exposing the femoral condyles.*

flexion, as with jumping activities.

In the acute dislocation the knee is held flexed, the lower leg is externally rotated and the valgus may be accentuated. In this position the medial femoral condyle is 'prominent' and pain is experienced on the medial side due to the torn medial retinaculum, suggesting, to the patient at least, that 'the knee has dislocated on the medial side'. Don't be misled!

### *Radiology*

Both the AP and Skyline views will show the displacement and the latter may reveal a bony avulsion from the medial border of the patella, or an osteochondral injury of the crest of the patella or femoral condyle.

### *Treatment*

Passive extension of the knee will reduce the patella dislocation.

### *'Direct blow' or 'significant force'*

It is likely that there is no underlying anatomical or tissue abnormality, or dysplasia. Investigate for an osteochondral fragment by radiography, aspiration (fat globules) and arthroscopy. First-time dislocations can be immobilised in a plaster cast in slight flexion for 4 weeks for 'low-demand' individuals, while repair of the patello-femoral ligament is preferred for 'high-demand' individuals.

### *'Indirect force' or 'low-energy force'*

Be alert for an underlying cause such as generalised tissue laxity or abnormal valgus alignment which may require surgical correction and repair of the (medial) patello-femoral ligament.

Rehabilitation of the quadriceps muscle, especially the vastus medialis obliquus (i.e. extension exercises between 0° and 15°) must be undertaken.

## *In a nutshell*

- A haemarthrosis develops within hours and indicates a serious knee injury.
- Important symptoms are the mechanism of injury, locking, giving way, and noises in the joint.
- A systematic examination for fluid in the joint, localised tenderness, range of motion, ligament or patellar instability and meniscal tears is essential for the diagnosis, and more important than most special investigations.
- An X-ray should be taken in all significant injuries to exclude a fracture.
- Isolated collateral and posterior cruciate ligament injuries are usually treated conservatively.
- Anterior cruciate and complex ligament injuries involving the menisci usually require surgical reconstruction.
- Dislocation of the knee is a serious injury with a high incidence of arterial injury.
- Ruptures of the extensor mechanism occur in middle age, are often missed and need surgical repair.
- Patella dislocations often reduce spontaneously, and are missed. Direct injuries are usually treated conservatively, but indirect injuries often need surgical stabilisation.

## *Erratum*

In the article 'The "where, when and who" of preventing malaria in travellers', by Lee Baker, which appeared on p. 284 of the June 2008 *CME*, the telephone number of the Medicines Information Centre, UCT Division of Clinical Pharmacology, was incorrect. The correct number is: (021) 406-6829.