

Knee fractures and dislocations

Knee fracture – overview

Knee fracture refers to fractures of any of the parts of bone involved in the joint itself. This includes fractures of:

- **Patella:** accounts for 1% of all fractures, most common in ages 20–50.
- **Femoral condyles:** these usually fracture when the knee is stressed.
- **Tibial eminence:** caused by accidents, such as a blow to the proximal tibia when the knee is flexed, or if the knee is hyperextended during an accident. Usually seen in patients aged 8–14.
- **Tibial tuberosity:** more common in men than in women, and in younger patients rather than adults; often seen in athletes, especially those involved in jumping sports.
- **Tibial plateau:** compressive fractures of the articular surface, typically from extreme force such as fall from a height or being hit by a vehicle, although in patients with osteoporosis minimal force may be needed.
- **Segond's fracture:** this is an avulsion fracture of the lateral tibial condyle immediately beyond the articular surface with the knee. Although not directly a part of the knee joint, it occurs in association with tears of the anterior cruciate ligament (ACL), medial meniscus and lateral capsular ligament, and is thus included here.

Knee fracture can result in neurovascular compromise or compartment syndrome. Soft tissue infection or osteomyelitis may occur with open fractures. Other complications include non-union, delayed union, osteoarthritis, avascular necrosis, fat embolism, and thrombophlebitis. See also the separate [Complications from Fractures](#) article.

Fractures around the knee are common in children, but the pattern of knee fractures differs. The relatively high proportion of cartilage in growing children may make diagnosis difficult, especially on plain X-ray, and stress radiographs or MRI may be necessary.

Dislocations – overview

Knee dislocation

This is a relatively rare injury resulting from dislocation between the femur and tibia. It is a highly traumatic event which may be associated with serious vascular injury. It often presents with multisystem trauma, and it is a high-energy traumatic injury usually associated with road traffic accidents and severe falls. It results in marked soft tissue damage.

Patellar dislocation

This is common, especially in young active individuals. Most dislocations are lateral, and are accompanied by pain and swelling. Damage to the medial ligaments is common. Dislocation may occur when the foot is planted on the ground and a rapid change of direction or twisting occurs. Usually pre-existing ligamentous laxity is present, and when patellar dislocation has occurred once, it may recur owing to the consequent ligament damage. Relocation to the patellar groove is often spontaneous as the leg is straightened^[1].

Assessment and investigations

Pre-hospital care of knee injuries

- Full assessment of associated injuries and immediate resuscitation if necessary.
- Continue to monitor vital signs until handover to secondary care.
- Careful neurovascular assessment in case of any compromise.
- Apply a sterile dressing to any open wounds.
- Splint the injury.
- Provide appropriate and adequate pain relief.

- Acute knee dislocations often spontaneously reduce, but dislocation involves significant intra-articular injury, including neurovascular injury. Evaluation and initial management must be performed rapidly to prevent limb-threatening complications.

Investigation of knee injuries

- The Ottawa knee rules can be used to exclude knee fractures with accuracy after acute knee injury^[2].
- The Ottawa knee rules suggest a knee X-ray is only required if any of the following is true^[3]:
 - Age 55 years or older.
 - Tenderness at the head of the fibula.
 - Isolated tenderness of the patella.
 - Inability to flex a knee to 90°.
 - Inability to weight-bear for four steps.
- CT scans may be required to delineate fully the extent of tibial plateau fractures and other complex knee fractures.
- MRI scans may be required to assess associated soft tissue injuries – eg, ligament and/or meniscal injuries.
- Arthrocentesis may be of use in diagnosis (eg, blood and fat globules indicate an intra-articular knee fracture) and to reduce tense effusions.

Patellar fracture^[4]

- May follow a direct blow to the patella, sudden forceful knee flexion or contraction of the quadriceps muscle.
- Fractures vary from slight cracks to multiple breaks.
- Haemarthrosis can be associated.

- Patellar fracture may be:
 - Stable (all bone parts fully aligned).
 - Displaced (requiring surgery).
 - Comminuted (broken into three or more parts and therefore very unstable).
 - Open - open fractures often involve more soft tissue damage, have a higher risk for complications and take a longer time to heal.
- It presents with pain, swelling, crepitus and difficulty with extending the knee.
- Displaced, transverse fractures result in an inability to straight leg raise, which can also be caused by rupture of a quadriceps tendon or a patellar tendon.
- X-rays: may be difficult to interpret because the patella overlies the distal femur and subtle fractures may be obscured.
- Bipartite patella is a rare variant where the patella is in two parts, and can cause a misdiagnosis of patellar fracture. It is usually bilateral, the accessory bone is usually in the upper, lateral part of the patella.

Initial management

- Vertical fractures: analgesia, immobilise in a non-weight-bearing cylinder plaster of Paris (POP), provide crutches and arrange orthopaedic follow-up.
- Transverse fractures: tend to displace due to the pull of the quadriceps. Provide analgesia and immobilise in a POP backslab but refer to the orthopaedic team for probable open reduction and internal fixation.
- Whatever the treatment, early rehabilitation is recommended in order to avoid contractures of the knee joint capsule and cartilage degeneration.

Patellar dislocation^[5]

- The patella usually dislocates laterally.
- Annual incidence is around 6 per 100,000 of the general population but 29 per 100,000 adolescent patients.
- It is most common in patients aged 10-17. The most commonly affected group is not inactive girls (as much literature suggests) but active adolescents of either sex.
- There may be underlying reasons for the instability (see 'Factors', below).
- The dislocation is usually caused by a twisting injury or a direct blow, with the knee in slight flexion, and most commonly results from sports and dancing injuries.
- There may be an associated osteochondral fracture, particularly if haemarthrosis is present.
- The dislocation may reduce spontaneously and there may be a history of recurrent dislocation.
- The condition has significant morbidity and a significant recurrence rate, but there is limited evidence-based literature supporting any one treatment approach.
- Over 50% fail to return to significant sporting activity or report limitation on strenuous activity, and this has led to some advocating surgical intervention.

Assessment

- Patellar dislocation presents with knee pain, usually with a large effusion (this may be haemarthrosis).
- There is tenderness around the medial retinaculum.
- The knee is held in flexion with lateral displacement of the patella.
- Patients may describe a popping sensation as the patella slips sideways out of its groove.
- X-rays: usually not required prior to reduction of the dislocation.

Management^[5]

- Management of a first-time traumatic dislocation is normally non-operative unless there is an osteochondral fracture, substantial disruption of the medial patellar stabilisers or a laterally subluxated patella with normal alignment of the contralateral knee.
- Reduction can be achieved using Entonox[®]. Standing on the lateral side of the limb, the affected knee is held gently and the patella levered medially, smoothly but firmly, with both thumbs. It is helpful for an assistant to extend the knee gently as the dislocation is reduced. Successful reduction rapidly relieves symptoms.
- Once reduced, provide adequate analgesia, arrange X-rays, immobilise in a cylinder cast POP (canvas back-splint for recurrent dislocation) and arrange orthopaedic follow-up.
- Most clinicians suggest a short period of immobilisation (3–6 weeks) followed by rehabilitation with or without a patellar brace.
- Currently, there is no firm evidence that the natural history of the primary patellar dislocator is improved by acute surgical intervention, although after a second dislocation, repeat events become much more likely (49%) and surgery may be indicated.
- Recurrence rates are 15–44% after conservative treatment.

Factors predisposing to patellar instability

- Patella alta (an unusually high-riding patella).
- A distance of >20 mm between the tibial tubercle and the trochlear groove.
- Trochlear dysplasia.
- Relative weakness of vastus medialis obliquus.
- Torn medial patellofemoral ligament.

Management

This is usually with physiotherapy, focusing on strengthening the glutei and vastus medialis obliquus.

Recurrent dislocation

- This happens more easily with each episode of dislocation and is often bilateral.
- Conservative treatment: reduce the dislocation and apply a plaster backslab, followed by strengthening exercises for the quadriceps.
- The tendency to dislocation may resolve without further intervention but surgery may be required if it is persistent despite conservative management.

Spontaneous reduction or patellar subluxation

- Tenderness is usually greatest over the medial aspect of the upper patella.
- A POP or splint may be used for severe pain and tenderness; otherwise, refer to physiotherapy and arrange orthopaedic follow-up.

Knee dislocation^[6]

- Acute knee dislocations are rare. They often spontaneously reduce (50%) before initial evaluation; hence, the true incidence is unknown.
- If not reduced then reduction requires intravenous opioid analgesia and sedation; reduction is achieved by traction and correcting the deformity.
- Check distal artery and nerve function after reduction. A long leg POP backslab should be applied and the patient admitted to hospital.
- There is usually gross deformity of the knee with swelling and immobility.
- There may be fractures of the tibial spine or the tip of the fibula, due to ligament avulsion.
- There may also be an injury to the popliteal artery and nerve (distal pulses and sensation should be checked and monitored). Popliteal artery damage may not be initially evident but may develop some hours later.
- The condition causes severe disruption of the cruciate and collateral ligaments and other soft tissues of the knee, resulting in multidirectional instability.

- Associated meniscal, osteochondral and neurovascular injuries are often present and can complicate management.
- The substantial risk of associated vascular injury mandates that vascular integrity be confirmed by angiography in all suspected knee dislocations.
- Evaluation and initial management are needed rapidly to prevent limb-threatening complications.
- Definitive management of acute knee dislocation remains a matter of debate.
- Surgical reconstruction or repair of all ligamentous injuries likely can help in achieving the return of adequate knee function.

Femoral condylar fractures

- Fractures to the femoral condyle may be supracondylar, intercondylar or condylar or (rarely) coronal.
- They are often due to axial loading with valgus or varus stress.
- Most common is fracture of the lateral condyle combined with patellar dislocation, typically during high-speed, high-impact activities such as downhill skiing or parachuting.

Presentation

- The patient is often unable to weight-bear and has pain over the distal femur; there is often a haemarthrosis.
- Neurovascular structures are close, particularly the popliteal artery, and so a thorough neurovascular examination is essential.

Management

- Conservative management may be sufficient for non-displaced fractures.
- Open fractures, displaced fractures and fractures associated with neurovascular injury need operative fixation.

Tibial eminence fractures^[7]

- Tibial eminence avulsion fractures occur most often in children aged 8-14 years.
- They result from both contact and non-contact injuries. Higher energy is required to cause the injury in an adult.
- Associated intra-articular injuries are common.
- They may be caused by a direct blow to the proximal tibia with the knee flexed - eg, falling off a bicycle.
- They may also be caused by hyperextension with varus or valgus stress - eg, road traffic accidents or sports injuries.

Presentation

- May present with a knee effusion and pain.
- There may be an avulsion of the tibial attachment of the ACL. MRI is usually needed to evaluate the injury.

Management^[8]

- Non-operative treatment may be used for non-displaced or minimally displaced fractures, with immobilisation for 4-6 weeks.
- Displaced fractures require reduction and fixation.
- Meniscal trapping is rare and should be looked for^[9].
- Operative reduction and internal fixation is required for displaced fractures.
- Long-term consequences include some residual laxity of the ACL which does not usually manifest itself in subjective instability.

Tibial tubercle fractures^[10]

- These are uncommon, complex, high-energy injuries.
- These are particularly common in adolescents and particularly in females.

- They usually occur with sports involving jumping – eg, basketball, gymnastics and football.

Presentation

- Pain over the anterior tibia about 3 cm distal to the articular surface.
- In severe fractures, the patient may be unable to extend the knee.
- Diagnosis is usually by lateral radiograph, although this two-dimensional approach can underestimate the degree of injury and CT/MRI is often preferred.

Management

- Conservative treatment with knee immobilisation may be used for non-displaced fractures.
- Displaced fractures usually require open reduction and internal fixation.

Tibial plateau fractures^[11] ^[12]

- Falls on to an extended leg can cause compression fractures of the proximal tibia.
- They result from impaction of the femoral condyle into the tibial plateau, caused by axial loading with valgus or varus forces – eg, a fall from a height or a pedestrian involved in a road traffic accident.
- They may be caused by only minor trauma in the elderly and in patients with osteoporosis.
- Usually involve cortical interruption, depression or displacement of the articular surfaces of the proximal tibia without significant injury to capsule or ligaments.
- There are usually associated soft-tissue lesions that affect treatment.

- Symptoms include:
 - Pain exacerbated by weight-bearing.
 - Knee swelling.
 - Limitation of flexion.
 - Knee deformity.
 - Pale cool foot or pins and needles in the foot suggest neurovascular compromise.
- The tibial plateau is made of cancellous bone, which has a honeycombed appearance and is relatively soft. The femoral impact often causes the cancellous bone to compress and remain sunken.
- The lateral tibial plateau is fractured more frequently than the medial plateau.

Assessment

- Tibial plateau fractures present with tenderness over the medial or lateral margins of the proximal tibia, swelling, haemarthrosis and ligament instability. The patient is unable to weight-bear.
- X-ray changes may be subtle: breaks in the articular surfaces of the proximal tibia, avulsions from the ligament attachments or loss of height from the medial and lateral tibial plateaux.
- CT is normally needed in order to determine the best approach to management.

Management

- Analgesia, long-leg POP backslab and referral to the orthopaedic team.
- Open reduction and internal fixation is the gold standard treatment.
- Non-surgical treatments include casting and bracing.
- Open fractures require emergency treatment to cleanse the fracture surfaces and minimise the risks of infection.
- Elevation is often required; sometimes, open reduction and internal fixation with bone grafting is required.

- If soft tissue damage is severe, external fixation may be preferred.
- In severe cases compartment syndrome due to swelling in the calf may necessitate fasciotomy.
- Long-term outcomes include loss of full range of motion and loss of stability.
- Possible complications include knee joint deformity, joint stiffness and osteoarthritis.

Segond's fracture^[13] ^[14]

- An avulsion fracture of the tip of the lateral tibial condyle.
- The fracture is a consequence of knee joint injury and is therefore included here, although technically the fracture itself is not within the joint.
- More than 75% are associated with a tear of the ACL.
- Associated meniscal tearing is common (66–75%).
- When combined with a tibial plateau fracture, studies suggest that ACL avulsion is likely^[15].
- Usually results from abnormal varus stress to the knee, combined with internal rotation of the tibia. This is unlike the usual cause of ACL tear, which is valgus stress, and is usually seen in falls and certain sports (especially skiing, basketball and baseball).
- X-ray may show a curvilinear or elliptic bone fragment parallel to the lateral aspect of the tibial plateau.
- The chip of bone may be very small and difficult to see on Xray - MRI may be necessary.

Knee fracture and dislocation prognosis

- The prognosis is good for patellar and tibial spine or tubercle fractures.
- The prognosis is not as favourable for tibial plateau and femoral condylar fractures.

- The prognosis following patellofemoral dysfunction is variable. Some patients continue to have long-term instability or pain following conservative treatment for acute patellar dislocations.
- Tibiofemoral dislocations are rare and usually associated with high-impact trauma. These are multi-ligamentous injuries, most often involving both cruciate ligaments with medial and/or lateral ligament tears. There is an associated risk of popliteal artery and peroneal nerve injury, even if reduced^[16].

Dr Mary Lowth is an author or the original author of this leaflet.

Further reading

- [Coon MS, Best BJ](#); Distal Femur Fractures. StatPearls, Jan 2020.

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