Fractures around the knee

Tibial plateau

Anatomy and function

The proximal tibia forms the distal surface of the knee joint. The medial plateau is larger and concave anteroposteriorly and mediolaterally. The lateral plateau is smaller, higher and convex in both anteroposterior and mediolateral directions. The central non-articular area comprises the tibial spines with the anterior cruciate ligament taking origin from the anterior spine.

The medial plateau is stronger than the lateral and injuries to the medial side are frequently associated with significant soft tissue trauma as they result from more violent injuries.

Mechanism of injury

Fractures of the tibial plateau have a bimodal distribution. In the younger age group they result from high-energy trauma or falls from a height. The second group occur in the elderly with more osteoporotic bone. Fractures occur from varus or valgus directed forces, axial compression or a combination of both. Shearing or compressive forces from the femoral condyles result in split or depression fractures.

Clinical picture

Evaluation of the patient begins with a careful history. Any patient who has sustained a significant fall must be assumed to have other injuries until proven otherwise.

The patient complains of pain, swelling of the knee as a result of a haemarthrosis and inability to weight-bear on the affected side.

Having been administered appropriate analgesia the patient is examined. Careful evaluation of the soft tissue envelope must be performed. As tibial plateau fractures following significant trauma may be associated with a knee dislocation at the time of impact, which then relocates, the neurological and vascular status of the limb should be carefully assessed. Particular attention should be made to assessing the function of the common peroneal nerve (ankle and toe dorsiflexion and sensation over the first web space). Joint stability is assessed by examination of the collateral ligaments and cruciate ligaments.

Radiographs of the knee, both anteroposterior and lateral views, may not confirm the injury. Oblique view radiographs are often helpful in evaluating the nature of the injury in these cases.

The presence and location of a fracture with the degree of displacement and any joint surface depression is noted.

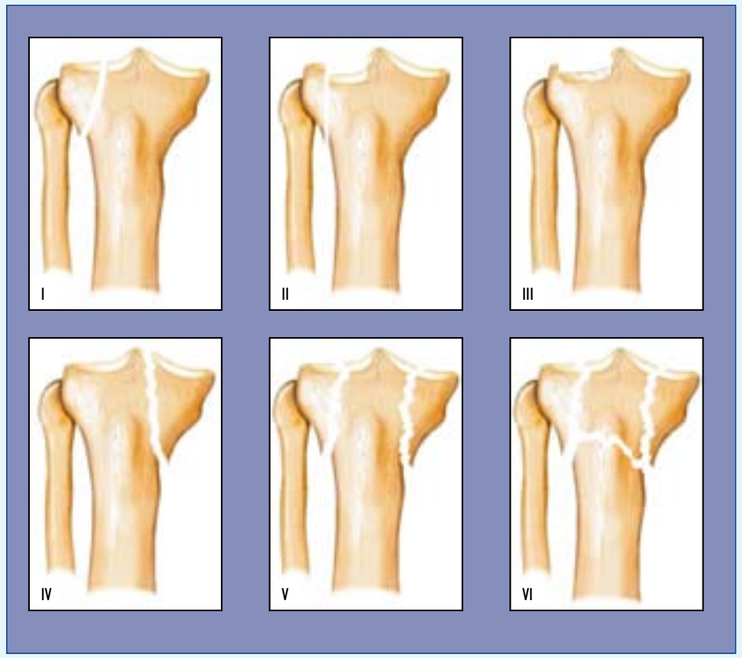

Figure 1. Diagrammatic representation of Schatzker's classification of tibial plateau fractures.

Classification

Tibial plateau fractures are commonly classified according to Schatzker and McBroom (1979) (*Figure 1*):

I A split fracture of the lateral plateau

II A split depression fracture of the lateral plateau (*Figure 2*)

III A pure depression fracture of the lateral plateau (*Figure 3*)

IV A medial plateau fracture (*Figure 4*)

V A bicondylar fracture with metaphyseal continuity

VI A bicondylar fracture with metaphyseal–diaphyseal discontinuity.

Figure 2. Schatzker II fracture of the left tibial plateau. a. Lateral radiograph. b. Anteroposterior radiograph. Note double shadow of articular surface on lateral radiograph (remember that the lateral plateau should be higher than the medial). c. Coronal computed tomography slice showing split depression.

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Figure 3. Anteroposterior and lateral radiographs showing Schatzker III fracture right tibial plateau.

It is often difficult to fully assess the nature and configuration of the fracture from plain radiographs and the patient should be further evaluated with computed tomography (CT) (*Figure 2*).

Definitive management

If the fracture is undisplaced, there is no articular fragment depression or there is limited displacement and/or depression then non-operative management of the fracture with a cast brace is appropriate. This allows for early joint movement to prevent stiffness but the patient remains non-weight-bearing initially. Weekly radiographs are required in the first few weeks to ensure that the fracture position is maintained.

Those patients with displaced fractures or depression of the articular surface require operative fracture reduction and fixation. Failure to restore bony anatomy and ligament function results in joint instability. This can be achieved by a variety of different methods; the decision is made based on the degree of bony deformity and the associated soft tissue injury. Options range from elevation of the joint surface and holding with percutaneous screws (*Figure 5*), arthroscopic-assisted surgery, bone grafting, buttress plating (*Figure 6*) or circular frame external fixation.

Initial management

Initial management is splintage of the knee, usually with an above-knee backslab that incorporates medial and lateral support around the knee to prevent rotation. These fractures are articular injuries and usually require operative intervention, as definitive management, to restore the congruity of the articular surface.

Figure 4. Anteroposterior radiograph showing Schatzker VI fracture of the right tibial plateau.

Figure 5. Anteroposterior radiograph showing percutaneous screw. Fixation of Schatzker I fracture of the left tibial plateau.

Distal femur

Anatomy and function

The distal femur is divided into a supracondylar and intercondylar area. The distal femur flares in its metaphyseal region into two condyles. Anteriorly the articular surface has a depression, the trochlear groove, for patellofemoral articulation. Posteriorly is the intercondylar notch. At the maximum flare medially is the adductor tubercle. In the sagittal plane the femoral shaft is aligned with the anterior half of the condyles.

Mechanism of injury

Distal femoral fractures account for 4–7% of all femoral fractures. They occur in the young age group as a result of high-energy trauma caused by a direct load on the flexed knee. These are frequently open and highly comminuted injuries and associated injuries must be excluded (e.g. ipsilateral acetabular fractures, hip dislocation, femoral neck or shaft fracture). In the elderly this injury is the result of low energy trauma, a simple fall on the flexed knee.

Clinical picture

The patient usually presents with a painful, swollen knee secondary to a haemarthrosis and inability to move the limb. Initial

Figure 6. Anteroposterior and lateral radiographs of buttress plating of a Schatzker II fracture.

management involves taking a careful history; in the case of high-energy injuries the patient should be managed following advanced trauma life support (ATLS) guidelines. Careful evaluation of the distal neurovascular status of the limb should be performed. The patient should be administered appropriate analgesia and the affected limb splinted with an above-knee plaster backslab while applying gentle in-line traction to the leg to help to reduce the fracture. Diagnosis is made from appropriate anteroposterior and lateral radiographs of the knee and distal femur.

Classification

Fractures are either an extra-articular supracondylar fracture or intra-articular intercondylar fracture, displaced or undisplaced.

Owing to the muscle forces on the fracture fragments supracondylar fractures tend to shorten with posterior angulation and displacement of the distal fragment secondary to the pull of the two heads of gastrocnemius. Intracondylar fractures are associated with malrotation of the fragments.

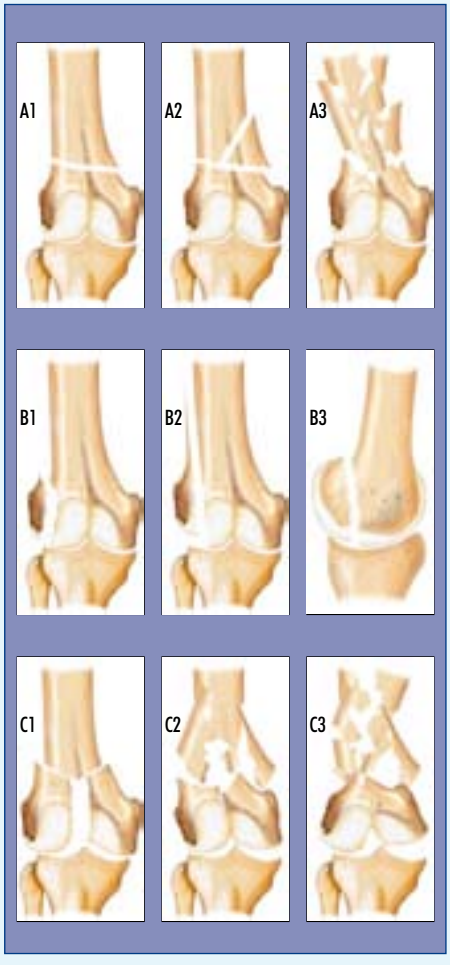
These fractures are classified according to the AO system described by Muller et al (1979) (*Figure 7*):

Type A Extra-articular fractures (*Figure 8*)

Type B Partial articular fractures (unicondylar)

Type C Bicondylar fractures.

Figure 7. Diagrammatic representation of distal femoral fractures.



Initial management

Administer adequate analgesia to the patient before splinting the leg in an above-knee backslab, with a plaster backshell and U slab to allow for rotational stability of the knee. Assess the distal neurovascular status of the limb following reduction and immobilizing the fracture.

Definitive management

The aim of further treatment is to restore length, rotation, axial alignment and articular congruency.

Undisplaced fractures can be treated non-operatively with a cast brace, which allows for early controlled knee movement. Regular radiographs are required to ascertain that fracture position is maintained.

Operative intervention is indicated for displaced intra-articular fractures, open fractures, fractures with associated vascular compromise, in association with ipsilateral tibial fractures and in polytrauma cases. A better functional result and fewer complications are achieved following open reduction and internal fixation even in the elderly group (Butt et al, 1995). Methods of internal fixation are either supracondylar nailing (*Figure 9*), angled fixation devices (dynamic condylar screw) (*Figure 10*) or LISS (less invasive skeletal stabilization) plating. BJHM

Figure 8. Anteroposterior and lateral radiographs of type A fracture left distal femur.

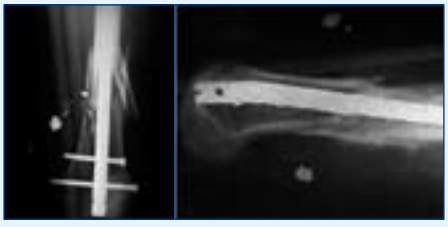


Figure 9. Anteroposterior and lateral radiographs of supracondylar nail fixation of type A fracture.

Figure 10. Anteroposterior and lateral radiographs showing dynamic condylar screw fixation of left distal femoral fracture.

Conflict of interest: none.

Butt MS, Krikler SR, Ali MS (1995) Displaced fractures of the distal femur in elderly patients. *J Bone Joint Surg* **77-B:** 110–14

Muller MG, Allgöwer M, Schneider R, Willenegger H (1979) *Manual of Internal Fixation.* Springer Verlag, New York

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KEY POINTS

- Fractures around the knee in the young patient are a result of high-energy trauma.
- Patients present with painful, swollen knees after injury and unable to weightbear.
- Initial management involves advanced trauma life support principles, analgesia and splinting of the limb.
- The key to definitive management is restoring the congruity of the joint surface which usually requires operative intervention.