Diagnosis and immediate care of fractures of the knee

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In the UK the three commonest bony injuries around the knee are tibial plateau fractures, supracondylar and intercondylar fractures of the femur and patellar fractures. This review will summarize the initial management of these injuries and of rarer but significant more minor fractures that must not be missed. The review will concentrate on the injury to the knee, but every trauma patient must be assessed fully following advanced trauma life support guidelines.

GENERAL PRINCIPLES

The entire lower limb should be fully examined including the hip and ankle. A full neurological and vascular examination is mandatory as associated soft tissue injuries help to guide management and determine the prognosis.

After initial assessment realignment of the limb to a near anatomical configuration is recommended with splintage either using plastic splints or plaster of Paris backslabs. This reduces the risk of further soft tissue injury and bleeding, and makes the patient more comfortable. This may require systemic analgesia but should not be delayed.

Anteroposterior (AP) and lateral radiographs of the knee should be obtained. These are then followed by full-length X-rays of the tibia and/or femur to rule out more proximal or distal injuries. Occasionally tunnel, oblique and skyline views are necessary to identify intra-articular injuries.

Any fracture that involves the knee joint will result in a haemarthrosis. In cases where a fracture is strongly suspected but the radiographs are equivocal, aspiration may be diagnostic as fat globules in a bloody aspirate invariably indicate a bony injury. This procedure also relieves some of the discomfort associated with knee swelling.

Most patients with fractures around the knee should be referred to the on-call orthopaedic surgeon for further evaluation and definitive treatment.

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TIBIAL PLATEAU FRACTURES

Tibial plateau fractures comprise 1% of all fractures and 8% of fractures in the elderly (Hohl, 1967). This injury demonstrates a bimodal pattern involving men in their 40s and women in their 70s, reflecting high energy and low energy mechanisms respectively. Tibial plateau fractures involve the articular surface of the proximal tibia as a result of a combination of axial loading and varus or valgus stress (*Figure 1*). The majority affect the lateral plateau (55–70%); 10–23% are isolated medial plateau injuries and 10–30% are bicondylar (Hohl, 1967). The most widely used classification is the one proposed by Schatzker et al (1979) where the fractures are grouped into six types.

Magnetic resonance imaging has shown a higher incidence of associated ligament injuries than previously estimated (Bennett and Browner, 1994). Approximately one third of all tibial plateau fractures have associated ligament injuries (Delmarter et al, 1990): anterior cruciate ligament and medial collateral ligament injuries are seen with lateral plateau fractures; cruciate ligament and lateral collateral ligament injuries (occasionally with peroneal nerve or popliteal vessel damage) are seen with medial plateau fractures. The rarer medial and bicondylar fractures should alert the examining doctor to associated injuries.

Figure 1. A lateral tibial plateau fracture with depression of the joint surface of the lateral tibial plateau.

Patients present with a swollen knee and are unable to weight bear on the affected extremity. The history is of a valgus stress injury, e.g. bumper impact on the knee or sporting accidents. Falls from a height also can cause this type of fracture. In high energy injuries, neurovascular damage and compartment syndrome must be excluded.

If standard AP and lateral views do not show a suspected fracture, 40° oblique views may be obtained.

Patients with stable fractures can be treated non-operatively in a plaster of Paris cast and then a cast brace. A stable fracture has less than 10° of laxity in extension when varus or valgus stress is applied.

Surgical indications are continuing to evolve (Honkonen, 1994). The aim is to accurately reduce and fix the fracture so as to allow early motion and enhance cartilage regeneration. Surgical options include open reduction internal fixation, arthroscopic-assisted minimal fixation, and the use of hybrid external fixators or circular frames.

SUPRACONDYLAR AND INTERCONDYLAR FRACTURES OF THE FEMUR

The supracondylar area of the femur is the zone between the femoral condyles and the junction of the metaphysis with the femoral shaft. This comprises the distal 9 cm of the femur, as measured from the articular surface (the treatment of diaphyseal fractures of the dis-

tal femur is considerably different). There is no universally accepted classification of supracondylar fractures of the femur. Severe soft tissue damage, comminution, fracture extension into the knee joint and injury to the quadriceps mechanism lead to unsatisfactory results in many cases. Isolated fractures of the femoral condyles are uncommon. They are occasionally seen in association with dislocations of the knee joint.

The mechanism of injury is thought to be axial loading with varus or valgus rotational forces. In younger patients, the injury typically occurs after high energy trauma related to motor vehicle or motorcycle accidents. Vascular injury is not uncommon (2–3%) (Wiss, 1996). In elderly patients, fractures frequently occur after a fall or slip on a flexed knee, leading to comminuted fractures in osteoporotic bone.

Examination will reveal swelling, inability to weight bear, reduced range of movement, and characteristic deformities produced by the direction of the initial fracture displacement and by the pull of the thigh muscles. Limb shortening and angulation at the fracture site are evident. The strong adductors create a typical varus deformity and the pull of gastrocnemius often produces posterior angulation or displacement of the distal fragment. In fractures with intercondylar extension, the muscles attached to the respective femoral condyles lead to splaying and rotational malalignment.

Displaced fractures should be operatively stabilized using intramedullary nails, plates or hybrid external fixators. The advantages of surgical fixation include accurate reduction of the articular surface and early functional rehabilitation of the knee, reducing morbidity. Undisplaced fractures can be treated in a cast but careful follow-up is necessary to ensure that the fracture does not slip.

PATELLAR FRACTURES

Patellar fractures constitute 1% of all fractures and occur in all age groups (Bostrom, 1972) (*Figure 2*). Their incidence is twice as high in males as in females (Nummi, 1971). They are usually classified by fracture pattern, e.g. stellate, transverse. Transverse fractures are most common, constituting 50–80% of all patellar fractures, of which 80% are in the central or lower third of the patella (Nummi, 1971). They can result from either direct or indirect trauma.

Direct injuries are often seen in road traffic accidents as a dashboard injury resulting in comminuted and displaced fractures. Associated ipsilateral fractures are common and should be looked for, i.e. femoral shaft, proximal tibia and posterior dislocation of the hip. Direct trauma usually results in incomplete, stellate or comminuted fractures. If the medial and lateral expansions are not torn, there is no separation of the fragments and the patient may demonstrate active knee extension against gravity.

Indirect injuries result from a violent contraction of the quadriceps with the knee flexed, usually resulting in a transverse fracture with tears of the medial and lateral retinacular expansions. The most significant effect of a patellar fracture is disruption of the extensor mechanism. Clinical findings include point tenderness over the fracture site and a palpable defect if the fracture fragments have separated. The ability of the patient to straight leg raise helps to dictate management. Extensor mechanism insufficiency and radiographic evidence of articular displacement are indications for surgical intervention.

AP, lateral and skyline views are routinely used in the diagnosis – the latter are useful in excluding vertical marginal fractures which are often missed.

Figure 2. A displaced patellar fracture. Admission and fixation are mandatory in order to reconstitute the extensor mechanism of the knee.

Treatment aims to ensure continuity of the extensor mechanism, and restore or preserve the articular surface of the patella. Fractures with a 3–4 mm cortical separation or a 2–3 mm step in the joint surface (Bostrom, 1972) usually need internal fixation and should be referred to an orthopaedic surgeon immediately. Undisplaced fractures or extra-articular fractures of the inferior pole can be treated non-operatively if the extensor mechanism is clinically intact. The patient is placed in a long leg cylinder cast and can partially weight bear. Orthopaedic review within a week is mandatory.

RARE FRACTURES

Other rare but commonly missed fractures include tibial spine and intercondylar eminence fractures. These are common in adolescents and infrequent in adults. Knee instability is common and the integrity of the cruciate ligaments and collateral ligaments must be evaluated. Careful review of the X-rays is necessary, particularly if aspiration of a haemarthrosis confirms the presence of a fracture. Tunnel or oblique views may be of benefit. Orthopaedic review is mandatory as these fractures often require early surgical intervention.

Osteochondral fractures are easily missed. They are particularly common in young patients and in high energy trauma. In patellar dislocation, these often affect either the medial patellar facet or the lateral femoral condyle and require early senior review. **HM**

Bennett WF, Browner B (1994) Tibial plateau fractures; a study of associated soft tissue injuries. *J Orthop Trauma* **8:** 183

Bostrom A (1972) Fractures of the patella: A study of 422 patellar fractures. *Acta Orthop Scand* **143** (Suppl): 1–80

Delmarter R, Hohl M, Hopp E (1990) Ligament injuries associated with tibial plateau fractures. *Clin Orthop* **250:** 226

Hohl M (1967) Tibial condylar fractures. *J Bone Joint Surg* **49A:** 1455–67

Honkonen SE (1994) Indications for surgical treatment of tibial condyle fractures. *Clin Orthop* **302:** 199–205

Nummi J (1971) Fracture of the patella. A clinical study of 707 patellar fractures. *Ann Chir Gynaecol Fenn Suppl* **179:** 1–85

Schatzker J, McBroom R, Bruce D (1979) Tibial plateau fractures: The Toronto Experience 1968-1975. *Clin Orthop* **138:** 94

Wiss D (1996) Supracondylar and intercondylar fractures of the femur. In: Rockwood C, Green D, Bucholz R, eds. *Fractures in Adults*. 4th edn. JB Lippincot, Philadelphia: 1972–2000