Fractures of the femur and tibial shaft

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Abstract

Fractures of the femoral and tibial shaft are common injuries. They exhibit a bimodal age distribution and are frequently associated with other injuries. Their fracture patterns vary, and so are managed using a range of treatment options.

The first priority is to check that there are no life-threatening injuries or acute complications associated with the injuries sustained. Once these are ruled out, the orthopaedic team can begin planning the treatment option best suited to the fracture and patient. For femoral fractures this usually involves intramedullary nailing, or plating, across the fracture site. Conservative and mono-lateral external fixation of the femur is now considered inadvisable because of the higher risk of complications and decreased rehabilitation potential. For tibial fractures the options are either conservative management, in a non-weight-bearing cast, or intramedullary nailing or plating. External fixation remains a useful modality in severe deformity or open fractures of the tibia. Complications commonly associated with both these fractures include venous thromboembolism, infection, compartment syndrome, fat embolism, vascular injury and mal- or non-union of bone.

Keywords Complications; conservative; femoral fracture; intramedullary nailing; management; plating; tibial fracture

Introduction

Fractures in the shafts of both the femur and tibia are common injuries. In the femoral shaft, this refers to a fracture in any part of the bone from the lesser trochanter to the metaphyseal flare of the condylar region of the knee. In the tibia, this can be any extra-articular fracture in the bone between the knee and ankle.

Such fractures can occur in association with prostheses already in situ (i.e. total hip or knee joint replacements). However, the management of these injuries is beyond the scope of this review. Equally, lower energy fractures can occur secondary to poor quality bone or through lesions (benign and malignant). In assessing patients where this is suspected, it should be noted that the management of these patients can vary greatly from that of the trauma patient.

The tibia is the most commonly fractured long bone with an incidence of approximately 14 per 100,000 per year[1] whilst femoral fracture incidence is 10 per 100,000 per year.[2] Both have a bimodal age distribution. Many high-energy injuries result from road traffic incidents or sporting injuries in the younger age range, whilst low-energy injuries (e.g. falling from a standing height) usually occur due to pre-existing bone weakness, that is, osteoporosis, in the elderly. The high-energy fractures may be associated soft tissue injury, open wound injury, and polytrauma.

Fracture classifications

Femoral and tibial fractures and subsequent patterns are classified by the Arbeitsgemeinschaft fűr Osteosynthesefragen/Orthopaedic Trauma Association (AO/OTA) group. This system assigns an alphanumeric code to each fracture, which allows for a classification based on anatomical location, fracture morphology and complexity. There is a free internet-based resource entitled 'AO surgery reference'.[3] The authors commend this to anyone treating these fractures, for use as a training tool as well as a quick means of classifying the fracture in question. Other classifications do exist, but this is by far the most accessible. For open tibial fractures, the most commonly used classification remains the Gustillo and Anderson system (Table 1).

Diagnosis and management

All patients admitted following high-energy trauma require initial management following advanced trauma life support (ATLS) guidelines. Once life-threatening injuries have been addressed, or ruled out, lower limb injuries can then be assessed. It is critical to examine the soft tissues overlying any bony injury and the neurovascular status of the distal limb. On satisfactory assessment, the limb should be aligned and held in position using either a cast or traction.

Open injuries will require full assessment in the accident and emergency department. Intravenous antibiotics should be administered, as soon as possible in the presence of any open fracture. Tetanus risk will also need to be addressed, based on the level of contamination and local guidelines. Open wounds should be handled minimally (e.g. to remove gross contamination or to photograph) and should then be dressed in saline-soaked gauze. These patients should be managed jointly by orthopaedic and plastic teams to address the bony and soft tissue elements of the injury. We suggest adherence to the British Orthopaedic Association Standard for Trauma (BOAST) guideline 4.[4]

Any vascular deficit to the distal limb needs immediate attention and any active haemorrhage should be controlled by direct pressure or tourniquet. Any deformity or dislocation in a pulseless limb should be addressed urgently, splinted and reassessed for neurovascular deficit.[5] Any further concerns should involve discussion with the vascular surgeons. This is discussed later in this review.

Assessment must include monitoring for the possibility of an evolving compartment syndrome in the injured limb. The alertness of the patient, neurovascular status and pain response to passive movement of the muscles within the affected compartment, as well to analgesia, must be documented on admission, and hourly, until the limb is deemed at low risk of developing compartment syndrome, as recommended in BOAST guideline 10.[6] Nerve blocks for pain following a limb fracture have, historically, been deprecated to avoid masking the syndrome. Monitoring of compartment pressures is undertaken in some centres, however it should be noted that this can only assist with a

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The Gustillo and Anderson System for open fractures

Classification	Description
Type 1	Minimal soft tissue injury, simple fracture and wound no more than 1 cm
Type II	Soft tissue coverage is adequate, minimal comminution but wound is greater than 1 cm
Type IIIA	High-energy injury, extensive soft tissue damage, contaminated and comminuted fracture, but bone remains adequately covered
Type IIIB	High-energy injury, extensive soft tissue damage and periosteal stripping with bone exposure
Type IIIC	As above but injury is also associated with an arterial deficit requiring repair

Table 1

clinical diagnosis. If direct measurement is used, the compartment pressure should not be less than 30 mmHg below the diastolic blood pressure measurement. An absolute measurement of 40 mmHg with clinical symptoms is an indicator for urgent surgical decompression.

In high-energy trauma, it is important to remain alert to the possibility of other coexisting injuries. Careful assessment of the joints above and below the fracture site is essential as well as a full assessment of the contralateral limb.

Low-level trauma, resulting in fracture of the femur or tibia must be treated with caution in case of metabolic bone disease or malignancy, as mentioned earlier. Careful review of the mechanism of injury and assessment of the medical co-morbidities of the patient, will help to guide the management process.

All suspected lower limb fractures should have an anteroposterior (AP) and lateral image of the injury site. In the case of a femoral fracture an AP view of the pelvis as well as an AP and lateral view at the knee are required (Figure 1). For tibial fractures an AP and lateral view of both the knee and ankle should be sought (Figure 2). Further imaging is not usually required unless an intra-articular extension is suspected.

Anatomical considerations

The femur has several anatomical features to consider when planning fracture reduction and fixation. When viewed axially it is roughly circular and has the roughened linea aspera posteriorly providing muscle attachments. In the sagittal plane, it has an anterior bow and in the coronal plane curves towards the midline. Numerous muscle attachments on the femur account for the deformity forces observed when assessing these fractures (Figure 3A and B).

The tibia in the axial plane is more triangular than the femur and its subcutaneous anteromedial surface renders it more susceptible to an open injury when a fracture occurs. This feature also accounts for its lower blood supply compared to the femur.

Surgical decision-making

In the UK, there is a trend towards operative management of femoral shaft fractures. Conservative treatment is rare but

Figure 1 Example of a femoral shaft fracture.

Figure 2 Example of a tibia shaft fracture.

remains an option. Low-energy tibial shaft fractures can be managed non-operatively dependent on their stability and level of displacement. A long leg cast can be applied and the fracture site observed in clinic to ensure the position is maintained. Converting this cast to a below knee cast or functional brace, at around 6 weeks, allows knee movement. Surgical options include intra-medullary nailing or applying either a plate or external fixation device to the femur or tibia.