Distal femur fractures in adults

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Abstract

Fractures of the distal femur occur in a bimodal age distribution. Many are complicated by intra-articular extension and comminution. Periprosthetic fractures add to the complexity of their management. Open fractures can occur with high energy trauma. Surgical treatment is the standard of care, with fixed angle plate fixation and intramedullary nailing being the most common techniques used. Surgical management can be technically challenging. Complications include malunion, delayed union, non-union and implant failure. Persistent disability and poor clinical outcome often results. Despite the development of modern implants, no clear advantage exists for one particular implant and some poorer outcomes may relate to the surgical technique applied to management. Knowledge and correct application of the principles of fracture management are required to optimize the chance of successful outcome. This article will discuss the epidemiology, anatomy, management and surgical techniques for distal femur fractures and review the evidence for the different surgical options.

Keywords femoral fractures; femur; leg injuries; surgery

Introduction

Distal femur fractures are uncommon, but an important cause of patient morbidity.[1] Surgical management can be technically challenging,[2] with no clear advantage of any one particular surgical implant.[3] Despite increased biomechanical and clinical research alongside the development of modern implants, persistent disability and poor clinical outcome often result.[4] Some of the poorer outcomes may relate to surgical technique, with a lack of understanding of the principles of the management of these fractures.

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Epidemiology

Distal femoral fractures account for 4–6% of all femoral fractures[5] and approximately one third of all femoral shaft fractures.[6] They have a bimodal age distribution, tending to occur in young males from high energy trauma, and in elderly osteoporotic females from low energy trauma.[1,7,8] 85% of low energy fractures occur in the elderly population.[7] In low energy trauma, most fractures remain extra-articular,[7] whereas in high energy trauma over half have an intra-articular extension.[4] Extra-articular and intra-articular comminution is frequent.[4,9] Open fractures occur in 19%–54%,[10] with up to 80% being Gustilo type III.[4] Approximately 1–5% of primary knee arthroplasties[11–14] are complicated by periprosthetic fracture.

Anatomy and blood supply

The femur is a tubular bone with an anterior bow and a flare at the distal femoral condyles. The femoral shaft is oriented at 7° of valgus in relation to the knee joint.[15] The distal end of the femur is a trapezoid in cross section, described by the lateral and medial condyles, the articular margin of the trochlear and intercondylar notch (Figures 1 and 2).

The femoral diaphysis receives blood supply from nutrient arteries, which supply the inner two thirds of the cortex. The outer one third receives blood from periosteal vessels derived from the soft tissue attachments. Cortical circulation is centrifugal, with a predominant direction of blood flow from the medullary canal to the outer cortex. Fractures disrupt this circulation and reverse the normal state to a net cortical flow that is centripetal (out to in). Fracture healing becomes dependent on re-establishment of blood flow to the disrupted cortical bone that can take 2 weeks to occur. Revascularization can be endosteal, periosteal, or extraosseous derived from the surrounding soft tissues.

Fracture classification

Fractures of the distal femur are most commonly classified using the AO/OTA (Arbeitsgemeinschaft Osteosynthese/Orthopaedic Trauma Association) Fracture Classification (Table 1, Figure 3). Type C fractures are most common. They can be further divided into three groups (and then sub-groups) according to the degree of articular and metaphyseal comminution (Figure 4). C1 and C2 type fractures have a simple articular configuration. C2 and C3 fractures have metaphyseal comminution.

Periprosthetic fractures have been classified according to the Lewis and Rorabeck classification (Table 2).[16] Fractures in this population are related to bone quality, typically being osteoporotic in nature, complicated by stress shielding by the implant, distal femoral notching, arthrofibrosis and loosening of implants.[17]

Assessment and initial management

Initial management

In the high energy trauma patient, initial assessment and management should occur as per Advanced Trauma Life Support principles.[18] For both low and high energy fractures, basic first aid management including traction splinting, skin traction or other immobilization measures to stabilize the fracture should

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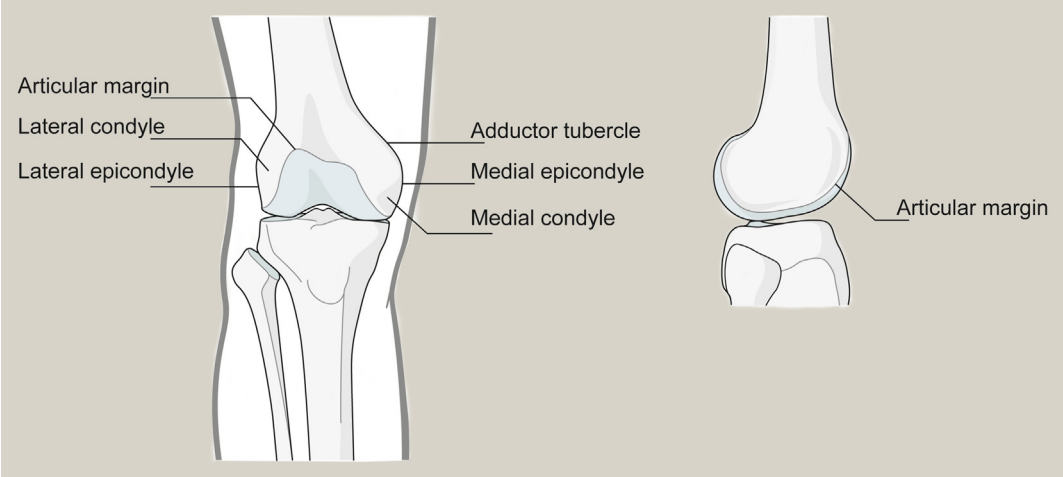

Figure 1 Anatomy of the distal femur. (Gebhard F, Kregor P, Oliver C. AO Foundation distal femur. 2008. https://www2.aofoundation.org/wps/portal/surgery?showPage=diagnosis&bone=Femur&segment=Distal. Date accessed: 06 August 2016.)

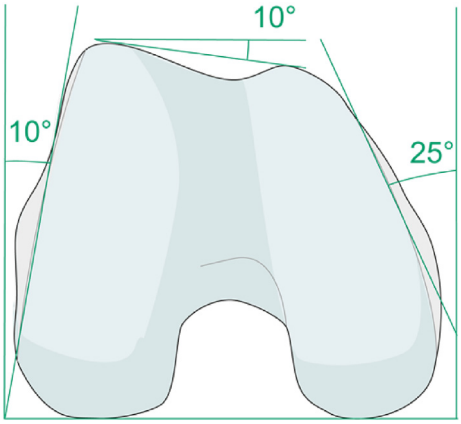

Figure 2 Trapezoidal shape of the distal femur. (Gebhard F, Kregor P, Oliver C. AO Foundation distal femur. 2008. https://www2.aofoundation.org/wps/portal/surgery?showPage=diagnosis&bone=Femur&segment=Distal. Date accessed: 06 August 2016.)

AO/OTA classification of distal femur fractures

AO/OTA classification	Description	Frequency[4]
A	Extra-articular fractures	39.6%
B	Partial articular fractures with an intact portion of the joint	3.6%
C	Extra-articular fractures with intra-articular extension	56.7%

Table 1

occur. Hypotension and haemodynamic instability should be assessed and managed, with other potential sites of blood loss excluded. A good secondary and tertiary survey should occur. The patient's physiological status should be assessed to determine whether damage control orthopaedics or early total care should occur. Assessment of the knee is difficult with a fracture present, and an examination under anaesthesia (EUA) of the knee should occur in every case that goes to theatre after fracture fixation to assess for ligamentous injury.

History

History should include the mechanism of injury and inquiry about any preceding pain or other symptoms to exclude a pathological nature to the fracture. If a total knee or hip arthroplasty is in situ, the history regarding timing of the procedure and the level of pre-injury function should occur, including symptoms suggestive of aseptic or septic loosening or instability, which may require a revision arthroplasty with concurrent surgical fixation of the fracture. Implant details need to be sourced, as this may alter management options and timing. Standard social and past medical history should occur to determine fitness for theatre.

Examination

Assessment of neurovascular status should occur in every case and be well documented. Open fractures and other ipsilateral limb or other injury should be assessed as this too may influence surgical management, timing and implant choice.

Imaging

Standard radiographic imaging, with two views of the fracture site, should occur. Full length femur X-rays should be included, which will exclude other fractures in the femur and the presence of implants in situ. In high energy fractures, a CT scan of the pelvis often occurs and fine cuts of the femoral neck should be carefully perused for femoral neck fracture. If the intra-articular component is complex, a CT scan of this location should occur.

Non-operative management

Distal femur fractures are unstable injuries. In an elderly patient it is desirable to achieve full weight bearing to enable early mobility, and surgical management with modern implants has allowed for this.[19,20] Surgical intervention has been found to be superior to non-operative management in a small randomized controlled trial involving elderly patients.[21] It is rare that non-operative treatment is offered. Non-operative management is reserved for the medically unwell or non-ambulatory patient with poor bone stock.

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