The foot is a complex structure in which many different joint axes are orientated in three dimensions. The foot can be divided into three zones: the hind foot, mid foot and forefoot, each containing a different set of bones. The hind foot comprises the tarsal bones and the calcaneus; the mid foot comprises the cuboid and navicular bones, and the medial, intermediate and lateral cuneiform bones; and the forefoot comprises the metatarsals, sesamoids and phalanges (Lumley 2008).

The posterior joint facet of the calcaneus receives the insertion of the Achilles tendon (Figure 1) from the extension of two muscles in the lower leg, the gastrocnemius and the soleus (Lumley 2008).

Calcaneal tuberosity fractures that are localised to the posterosuperior aspect of the calcaneus and that do not involve the subtalar joint have been recognised since the mid 19th century (Malgaigne 1843).

The identification and management of an injury involving multiple metatarsal fracture is discussed in a case study on page 26.

Avulsion calcaneal tuberosity fracture is an uncommon but potentially serious condition, with delays in treatment sometimes leading to long-term pain, disability and functional limitation. In this article, the authors refer to a case study of a patient with a fractured calcaneal tuberosity and multiple metatarsal fractures. They also discuss the results of a literature review of fracture patterns and classifications that can aid treatment.

Keywords
Avulsion fracture, calcaneus, reduction and fixation

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The authors undertook a literature review in which they searched the Amed, British Nursing Index, CINAHL, EMBASE, HMIC and Medline databases using the search term ‘foot and fracture’, ‘metatarsal fracture’, ‘calcaneal tuberosity fracture’. All articles on patients who had presented to emergency departments (EDs) with calcaneal and metatarsal fractures published over the past ten years were included in the review, although articles about patients who presented with open-wound calcaneal fractures were excluded.

They found few reports but ascertained that calcaneal tuberosity fractures account for no more than 3 per cent of all calcaneal fractures (Rijal et al 2012). The different depth insertion of Achilles tendon on the calcaneus tuberosity makes the pattern of avulsion fracture as diverse as the available treatment options. This variability in

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Case study

A 70-year-old woman with severe pain but no numbness in the right foot was brought to the emergency department (ED) in a wheelchair. While cleaning her windows, she had fallen from a 1.2m-high ladder onto solid ground and had injured her right foot. She was unable to bear weight.

Clinical assessment involved feeling all structures below the knee, including the head of the fibula, the calf, the Achilles tendon, the heel, the malleoli and metatarsals. This revealed gross swelling, bruising and a deformity to the heel, a tenderness over the metatarsals, and a palpable bony spike in the soft tissues between the body of the calcaneus and the bulk of Achilles tendon, which indicated an avulsion fracture. The Thompson’s test to assess rupture of the Achilles tendon was not carried out because the patient was in severe pain and there were no signs of compartment syndrome.

Initial X-ray examination included lateral and anteroposterior views of the right ankle and foot to determine whether there was a fracture. The X-rays revealed significant displaced fracture of the calcaneus, with a large fragment having been displaced by the pulling of the Achilles tendon. A large amount of overlying soft tissue swelling could also be seen in the lateral view (Figure 2).

Cumminuted oblique and transverse fractures in the mid and distal regions of the third and fourth metatarsals, and in the distal region of the fifth metatarsal, were shown in the anteroposterior view (Figure 3). Distal fragments was angulated laterally and there was lateral displacement of the fourth mid metatarsal transverse fracture. None of these fractures extended to the articular surfaces.

The patient was referred to the local orthopaedic clinic team, who discovered poor bone quality due to osteophytosis and joint space narrowing at the metatarsophalangeal joint of the big toe. It was clear the patient needed surgery because the fragment was about to perforate the skin, so she was admitted to hospital, where she was advised to lay on her left side with her right foot elevated.

Within one day of initial trauma, open reduction and internal fixation of the displaced calcaneal fracture was undertaken in theatre. This involved insertion of a guide wire, followed by a pair of 4.5mm cannulated cancellous screws and washers (Figure 4), then removal of the guide wire. After the operation, the patient’s foot was put into a slight equinus position and an above-knee plaster cast was applied.

Seven days after surgery, the patient was discharged and advised not to bear weight. At an outpatient’s appointment one week later she had a below-knee cast fitted to maintain her ankle in planter flexion for a further two weeks, when a corrective cast was applied. Two weeks later, application of a second corrective cast brought the ankle to a neutral position.

The patient’s postoperative course was considered good because, on her return to orthopaedic clinic six weeks later, she had no signs of infection and the operation was judged to have been a success (Figures 5 and 6). Within 12 weeks of discharge, she was wearing a functional boot cast and could bear weight fully.
fracture type has led to the development of several classification schemes that can inform treatment plans and prognoses.

Lee et al (2012), for example, state that fracture pattern is determined by bone quality, mechanism of injury or the strength of the fibres of the Achilles tendon. They identify four types of avulsion fracture:

■ Type I fractures are simple extra-articular avulsion fractures that usually occur as a result of minor trauma, for example after short falls. Treatment often involves screw fixation (Lee et al 2012).

■ Type II fractures are oblique or beak-type fractures that usually occur as a result of significant trauma caused by, for example, a direct blow. Treatment often requires emergency reduction to prevent skin necrosis.

■ Type III fractures are infrabursal avulsion fractures involving superficial fibres of the Achilles tendon that usually occur as a result of significant trauma. Treatment can be conservative due to the preserved function of the Achilles tendon.

■ Type IV fractures involve deep fibres of the Achilles tendon and usually occur as a result of severe trauma caused, for example, by a fall involving strong muscular contraction and with the heel fixed to the ground. Because these fractures tend to occur in people aged between 12 and 15, surgical treatment is recommended to maintain athletic ability (Guerado et al 2012).

Examples of the four fracture types are shown in Figure 7.

Discussion

The patient discussed in the case study, page 26, had sustained a type II fracture, involving a significantly displaced calcaneal fracture and multiple metatarsal fractures.

Traditionally, management and treatment of such fractures have been dictated by the age, health and functional demands of the patient concerned, as well as by the degree of separation of the fracture fragments.

The precise mechanism of displacement in the patient’s fracture were not known, but it was hypothesised that the patient’s Achilles tendon had pulled on, and displaced, the large fragment of bone.

In all type II fractures, the posterior skin of the heel must be assessed. If it is tented or blanched, as it was in the patient discussed in the case study, patients are at high risk of skin necrosis of the posterior heel and must be referred to an orthopaedic team for possible reduction and fixation (Guerado et al 2012).

Open reduction and internal fixation of type II fractures have produced good or excellent clinical results, and have ensured that patients can, for example, wear shoes or return to work within ten weeks. Displacements of less than 1cm have been treated with equinus casts or functional boots with great success.

It should be noted, however, that calcaneal tuberosity fractures can be accompanied by potentially serious complications such as osteomyelitis and malunion, as well as by irritation caused by casts (Eren et al 2012, Guerado et al 2012, Lee et al 2012).

References


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Conflict of interest

None declared