

# Hind foot fractures of the calcaneus and talus

## Introduction

The foot has two vital functions, first to support the body while standing or walking and second to act as a lever in propelling the body forward. Hence any damage to the structures that make up the foot will have a significant impact its function. Fractures of the hind foot are not uncommon and make up 2% of all fractures seen in adults. They are frequently missed, especially osteochondral fractures and fractures of the lateral and posterior processes of the talus which are radiographically difficult to detect. Controversies remain over the ideal management of these fractures and no one surgical strategy has eliminated the often significant long-term disability associated with these injuries. These difficulties make hind foot fractures an area of potential disaster, both for the patient and doctor.

## Anatomy and function of the hind foot

The importance of fractures of the hind foot become apparent once the anatomy is appreciated (Figure 1). The principal bones of the hind foot are the talus and calcaneus. These two bones make up the central components in the ankle, subtalar and midtarsal joints. Any of these joints may be involved in the injury.

### Ankle joint

This is made up of the tibia, fibula and talus, and is a synovial hinge joint. The articular surfaces are enclosed by the joint capsule, reinforced by collateral ligaments. This allows dorsiflexion and plantarflexion movements only.

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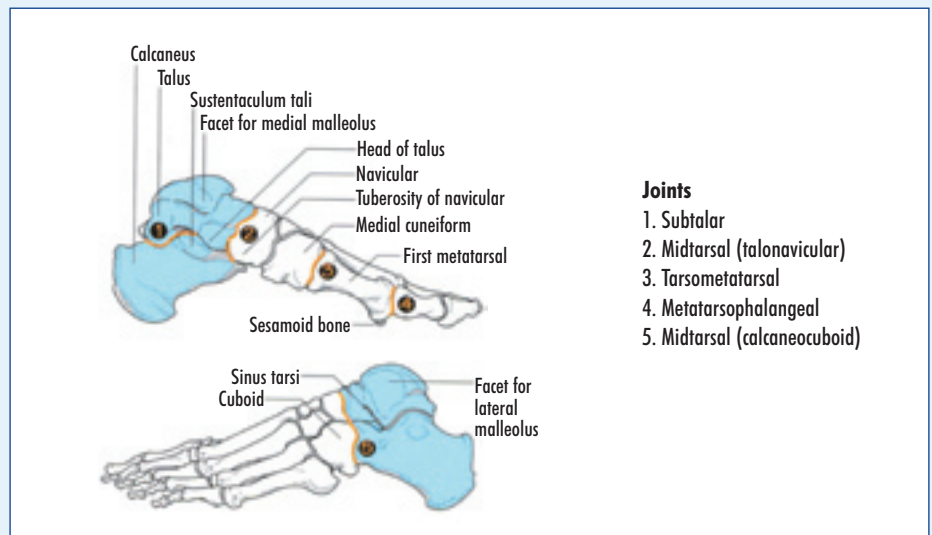


Figure 1. Medial and lateral images of the bones of the foot. The main joints are number and listed to the right. The region of the hind foot is shaded.

### Subtalar joint

This is made up of:

1. The talocalcaneal joint – the articulation of the upper surface of the calcaneus with the lower surface of the talus (synovial plane joint)
2. The talocalcaneonavicular joint – the articulation between the head of talus and the sustentaculum tali (synovial ball and socket joint).

This joint allows eversion and inversion movements.

### Midtarsal joint

This is made up of:

1. The calcaneocuboid joint – the articulation of the anterior surface of the calcaneus and the posterior surface of the cuboid (synovial plane joint)
2. The talonavicular component of the talocalcaneonavicular joint.

This joint assists with eversion and inversion movements.

## Hind foot fractures

### Calcaneal fractures

The os calcis is the most frequently fractured tarsal bone (more than 60% of tarsal fractures). Calcaneal fractures are most commonly seen in young men. They are often bilateral (~10%) (Lance et al, 1964) owing to the mechanism of injury which is usually a high energy axial force (Carr, 1993) directed through the laterally situ-

ated plantar tuberosity of the calcaneum. Hence there are often other associated fractures, e.g. compression fractures of the lumbar spine (~10%) and other lower limb fractures (~26%) (Cave, 1963). Other recognized mechanisms of injury include motor vehicle collisions, blunt-force injury causing extra-articular fractures of the calcaneal body and plantar tuberosity, abrupt contraction of the Achilles tendon causing avulsion injuries, and stress fractures in athletes. Open fractures are rare (<2%).

### Talar fractures

The rate of reported fracture of the talus is about 2% of all foot fractures, making it rare. However, the implications of this fracture are huge as the talus is one of the most important bones in the functioning of the foot. It also has a rather tenuous blood supply, making it vulnerable to injury or interruption, and three-fifths is covered by articular cartilage, hence avascular necrosis and arthritis are common complications. It is therefore important to recognize these injuries and treat them appropriately to avoid these complications. The usual mechanism of injury is sudden hyperextension of the foot. They often occur in young athletes, but should be suspected at any age and are usually the result of a motor vehicle accident or fall from height.



Figure 2. Bruising and swelling seen with calcaneal fractures.

Documentation of the history should include:

- Mechanism of injury. This will focus the attention to the correct area, highlight other potential injuries and indicate severity
- Age. This will affect the type of injury, outcome and treatment
- Occupation. As hind foot fractures have significant morbidity, those patients whose occupation involves walking and/or in which balance is important should be forewarned of possible long-term difficulties
- Smoking and co-morbidity. These will affect surgical management.

### Examination of the hind foot

The basic rules of look, feel and move still apply:

Look: Swelling, widening of heel, bruising often medially (Figure 2)

Feel: Local tenderness

Move: Unable to weight bear.

Talar fractures are more difficult to diagnose clinically, but the history is key and the patient cannot usually weight bear comfortably or at all. Calcaneal fractures are usually more dramatic.

### Investigations

Once a hind foot fracture is suspected all patients should have their foot elevated

and supported, and analgesia should be given until the diagnosis is proven or excluded.

The first-line investigation is plain film radiography. This should include the following views:

1. Ankle/hind foot anteroposterior and lateral
2. Axial projection (to visualize the heel)
3. If a talar fracture is suspected films may be taken in plantar and dorsiflexion to aid the diagnosis.

Bohler's angle (Bohler, 1931) (Figure 3) is a line drawn along the superior border of the posterior part of calcaneal body and one drawn from the anterior articular process of the calcaneum through the posterior articular facet of the subtalar joint. If Bohler's angle is 35–40° the calcaneus is normal, if it is <40° (often 0) the calcaneus is fractured. Having confirmed the diagnosis through plain film radiography, computed tomography may be of great use in planning possible surgery.

### Fracture classification

For the purposes of accident and emergency the following rule of thumb can be applied to hind foot fractures.

1. Is there a fracture? – yes/no
2. If so which bone, calcaneum or talus?
3. If talus, refer as there is a high likelihood of long-term complication
4. If the calcaneum – is it intra- or extra-articular?
5. If intra-articular (70%) this needs referral as there is a high rate of complications
6. Extra-articular fractures are mostly treated conservatively unless they are displaced, in which case advice should be sought.

### Talar fractures

These fall into three groups:

1. Fracture of the body
2. Fracture through the neck (50%): types I–IV (Hawkins classification) (Table 1)
3. Osteochondral fractures.

Unfortunately all these fractures carry a high risk of long-term complications such as avascular necrosis or arthritis, therefore all need orthopaedic review. Many will be treated conservatively, some by open reduction and internal fixation, but most will be non-weight bearing for several weeks.

Figure 3. Measurement of Bohler's angle.

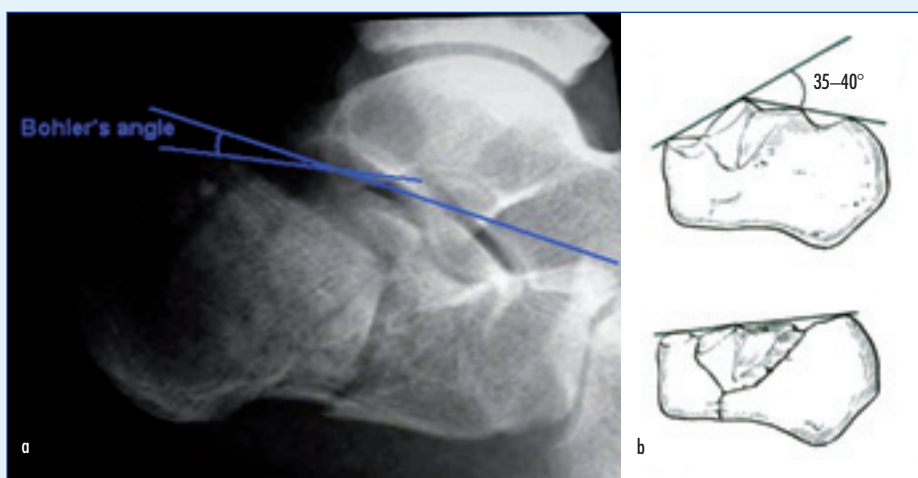


Table 1. Hawkins classification of talar neck fractures

Radiographic findings		Risk of AVN
Type I	Non-displaced fracture line	0–13%
Type II	Displaced fracture, plus subluxation or dislocation of subtalar joint	20–50%
Type III	Displaced fracture, dislocation subtalar and tibiotalar joints	69–100%
Type IV	Displaced fracture and disruption of talonavicular joint	High

AVN = avascular necrosis.

**Calcaneal fractures**

The pattern of injury seen will determine treatment and falls into seven main categories which are summarized in *Table 2*. These can be extra- or intra-articular. Extra-articular fractures tend naturally to have a better prognosis. More than one

injury usually always warrants referral, and soft tissue or neurovascular injuries must not be overlooked.

Many systems have been used to describe these fractures including the Sanders classification and the Essex-Lopresti (1993) system.

**Long-term outcome**

Most studies have found a very poor long-term outcome in the more serious fractures of the hind foot (Hildebrand et al, 1996; Loucks and Buckley, 1999). There is not yet an answer as to which treatment offers the best outcome as both conservative and surgical options have been shown to have beneficial results (Buckley et al, 2002). Each case has to be taken on its own merit and if in doubt senior review should be sought as mistakes can be costly. **BJHM**

*Conflict of interest: none.*

Bohler L (1931) Diagnosis, pathology, and treatment of fractures of the os calcis. *J Bone Joint Surg* **13**: 75–89

Buckley R, Tough S, McCormack R, Pate G, Leighton R, Petrie D, Galpin R (2002) Operative compared with nonoperative treatment of displaced intra-articular calcaneal fractures: a prospective, randomized, controlled multicenter trial. *J Bone Joint Surg Am* **84-A**(10): 1733–44

Carr JB (1993) Mechanisms and pathoanatomy of the intraarticular calcaneal fracture. *Clin Orthop* **290**: 36–40

Cave EF (1963) Fracture of the os calcis – the problem in general. *Clin Orthop* **30**: 64–6

Essex-Lopresti P (1993) The mechanism, reduction technique, and results in fractures of the os calcis, 1951–52. *Clin Orthop* **May**: 3–16

Hildebrand KA, Buckley RE, Mohtadi NGH, Faris P (1996) Functional outcome measures after displaced intra-articular calcaneal fractures. *J Bone Joint Surg [Br]* **78B**: 119–23

Lance EM, Carey EJ Jr, Wade PA (1964) Fractures of the os calcis: a follow up study. *J Trauma* **4**: 15–56

Loucks C, Buckley R (1999) Bohler's angle: correlation with outcome in displaced intra-articular calcaneal fractures. *J Ortho Trauma* **13**(8): 554–8

**Table 2. The common classification of calcaneal fractures, their treatment, outcomes and which to refer**

Fracture type	Early treatment	Late treatment	Outcome
Vertical fracture of the tuberosity*	Tight bandage, elevation	Loose bandage and crutches	Good
Horizontal fracture	Non-avulsion* Manipulation	Below knee plaster and crutches (5 weeks)	Healing by 5 weeks
	Avulsion† Elevation – refer for surgery	Open reduction and internal fixation	Healing by 8 weeks
Fractures of the sustentaculum tali*	Crepe bandage	NWB for 6 weeks	Healing by 6–8 weeks
	Below-knee cast	Crutches and/or walking heel	
Anterior calcaneal fractures‡	Treat as for # of sustentaculum tali unless calcaneal shortening or midtarsal instability – refer		Healing by 6–8 weeks
Fracture of the body no displacement‡	Pressure bandaging, bedrest and elevation. Refer for review (may need pinning)	Crutches and touch weight bearing	Good, may have residual heel pain
Fractures of the body with displacement and subtalar involvement‡	Conservative vs surgery? all need referral		Poor
Central crushing fractures‡	Need referral	Often long-term complication	Poor need follow up

\* relatively stable or safe fracture which can be reliably treated conservatively; ‡ those fractures which must be handled carefully and should be reviewed by an orthoped on admission; † those which need inpatient management or specialist review and are usually intra-articular.

NWB = non weight-bearing

**KEY POINTS**

- Fractures of the hind foot account for around 2% of those seen in adults.
- The hind foot comprises a number of joints the integrity of which is vital for pain-free walking.
- Accurate diagnosis and prompt management will help to achieve an optimal outcome.

**Further reading**

Barei DP, Bellabarba C, Sangeorzan BJ, Benirschke SK (2002) Fractures of the calcaneus. *Orthop Clin North Am* **33**(1): 263–85

Bucholz RW (2005) (1996) *Rockwood and Green's Fractures in Adults*. Volume 2. Lippincott Williams and Wilkins, Philadelphia

Crosby LA, Kamins P (1991) The history of the calcaneal fracture. *Orthop Rev* **20**: 501–9

McRae R (2003) *Pocketbook of Orthopaedics and Fractures*. Churchill Livingstone, London