Management of adult ankle fractures

Introduction

The aims of treatment of adult ankle fractures are to restore and maintain the alignment between tibia and talus, prevent future ankle instability, reduce the risk of post-traumatic osteoarthritis by restoring the articular congruence and allow for soft tissue healing.

The decision about whether to manage a patient operatively or non-operatively largely relies on the clinician's assessment of joint stability (clinical and radiological), patient characteristics and the status of the soft tissue envelope (*Table 1*).

Non-operative

Non-operative treatment is most commonly indicated in patients with stable fracture patterns, but also in those patients with unstable fractures in whom surgery is inappropriate.

Stable fractures are, by definition, unlikely to displace. Therefore, patients with these fractures may be managed in a functional brace with a view to starting range of motion exercises early in treatment (Thomas et al, 2009). Most studies advocate non-weightbearing for up to 6 weeks to avoid axial loading as this may cause fracture displacement.

Unstable fractures are those that are likely to displace. These include bimalleolar and trimalleolar fractures, fractures with an associated deltoid ligament rupture, and comminuted fibular fractures with shortening. The risk of managing these fracture types non-operatively is that of mal-union. Mal-united ankle fractures may result in abnormal contact pressures in the ankle joint, an increased risk of post-traumatic osteoarthritis and a poor functional outcome (Burns et al, 1993).

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Operative

Operative intervention is indicated in all unstable ankle fracture patterns. Initial reduction of displaced fractures and splinting should occur at the time of assessment, in the emergency department. Elevation of the affected extremity will help to reduce swelling and pain. Adequate preoperative hydration and good analgesia are essential.

The goals of operative intervention with ankle fractures are to restore fibula length and correct rotation, to reconstitute the medial constraint in order to confer ankle stability and to deal with the syndesmotic injury if evident. This is most commonly achieved with a combination of plates and screws in accordance with AO principles (Barbosa et al, 2006). *Figures 1–4* show examples of different fixation methods.

The principles of operative stabilization of an ankle fracture are not dissimilar to those of other joints. Restoration of fibula length and rotation is important to ensure tibiotalar congruity is maintained. Restoration of the ankle mortise by eliminating any talar shift enables joint contact pressures to be normalized. In a biomechanical model Burns et al (1993) showed that deltoid incompetence resulting in a syndesmotic diastasis of as little as 0.73 mm can result in a 42% increase in the tibiotalar contact pressure.

Owing to the arrangements of the posterior ankle ligaments, posterior malleolar fractures do not always need to be fixed. Fixation of the medial and lateral aspects of the joint alone will often restore joint stability. However, screw fixation may be indicated if there is significant posterior talotibial joint subluxation, if an articular 'step' greater than 2–3 mm exists or if the fragment involves over one-third of the articular surface.

An external fixator may be indicated if there is significant periarticular comminution or compromise to the ankle soft tissue envelope precludes open reduction and rigid fixation.

Syndesmotic injuries or 'high ankle sprains' may go unrecognized, especially if there is no significant talar shift. Proponents of operative stabilization argue that the best functional outcome is attained with accurate reduction of the syndesmosis (Mont et al, 1992; Kennedy et al, 2000).

The choice of technique for operative stabilization of the syndesmosis remains controversial. While conventionally a screw fixation has been used, more recent studies have trialled the use of suture button devices (DeGroot et al, 2011) and bio-reabsorbable screws, citing the advantage of not having to be subsequently removed from the patient (Kaukonen et al, 2005). The latter have been associated

Table 1. Guide to stratification of ankle fractures

Fracture type		Management
Stable	Weber A	Full weight bearing and ankle brace
	Isolated Weber B with no talar shift or medial tenderness	
Potentially unstable	Isolated Weber B with no talar shift	Non-weight bearing and plaster of Paris or functional brace
	Isolated Weber C with no talar shift	
Unstable	Bi- or tri-malleolar fractures	Operative
	Fracture dislocation	
	Lateral malleolar fractures with deltoid or syndesmosis injury or talar shift	

adapted from Westerman and Porter (2007)

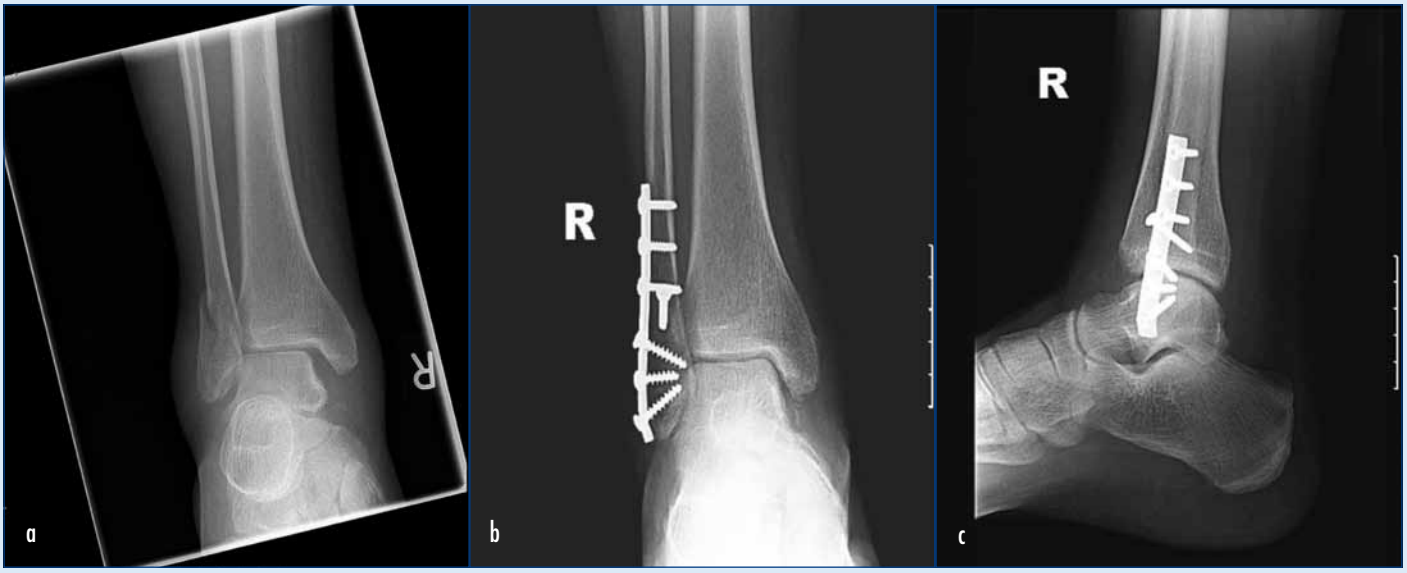


Figure 1. a. Anteroposterior X-ray of a Weber B fracture. b. Open reduction internal fixation of the fracture in anteroposterior and (c) lateral views.

with reports of osteolysis, foreign body reaction, late inflammatory reaction and osteoarthritis as a result of polymer debris entering the joint (Hovis and Bucholz, 1997).

There is increasing evidence in favour of early mobilization after operative stabilization of ankle fractures. In a systematic review of nine randomized controlled trials, Thomas et al (2009) concluded that early motion in a brace is associated with a quicker return to work and improved range of motion at 12 weeks compared to cast immobilization. There was, however, an increased risk of wound infection in the early mobilization group.

Patients with diabetes

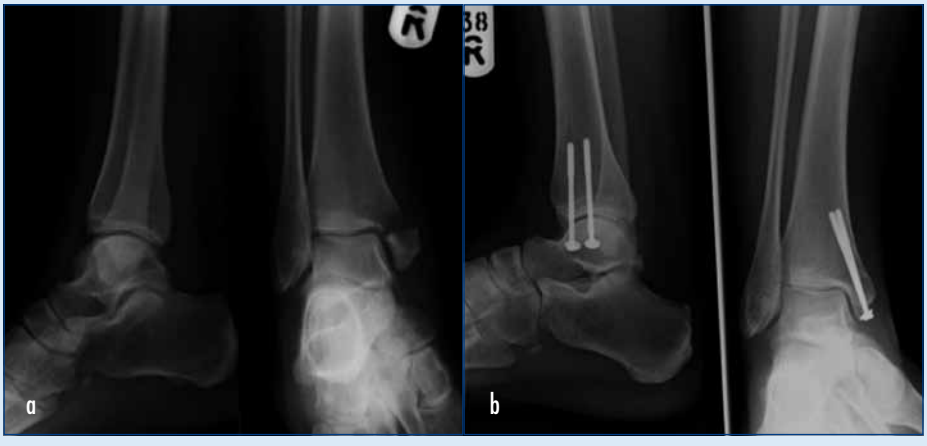
As the prevalence of diabetes mellitus has continued to increase, so too has the number of ankle fractures seen in this population (Blotter et al, 1999).

Treatment of these injuries in patients with diabetes mellitus is fraught with high complication rates, mainly related to poor wound healing, poor bone healing capacity and neuropathy (Connolly and Csencsitz, 1998; Flynn et al, 2000).

Recognizing these risks is essential when offering diabetic patients surgery. Patients with associated neuropathy may require supplemental fixation. Meticulous attention to soft tissue handling and close postoperative surveillance is warranted in this patient group.

All diabetic patients undergoing surgery may benefit from a prolonged period of non-weight bearing followed by protected weight bearing (Wukich and Kline, 2008).

Figure 2. a. Anteroposterior and lateral views of an isolated medial malleolus fracture, with subsequent (b) screw fixation with partially threaded cancelous screws.



Emergencies

Ankle fracture dislocation implies an ankle fracture with significant joint deformity. Imaging should not delay treatment. Although X-rays may confirm a dislocation, they add little to management and so should not be prioritized over immediate reduction. This will help reduce the risk of soft tissue complications such as severe swelling, neurovascular compromise and compartment syndrome.

Reduction is typically achieved in an emergency department with appropriate analgesia, conscious sedation if required and appropriate monitoring equipment. The knee is flexed and the hindfoot is grasped. Traction is applied against the tibia and any posterior deformity corrected first by bringing the foot anteriorly. Following this any external rotation or abduction deformities are corrected (McRae, 2006).

The foot position with reference to the tibia is a reliable indicator of joint alignment. Often, raising the entire foot off the examination bed by holding on to the great toe restores the ankle alignment relatively easily. An assistant may then apply the back slab while the foot is suspended in the air by the big toe by the examining doctor. Following reduction the neurovascular status of the foot should be reassessed and X-rays obtained to confirm reduction and identify the fracture pattern. Fracture dislocations of the ankle are inherently unstable and when the soft tissues permit, will ultimately require operative fixation.

Open fractures of the ankle are complex and should be managed according to current guidelines (Nanchalal et al, 2009). Immediate management is systematic and follows Advanced Trauma Life Support principles, consisting of a primary survey to identify and treat any life-threatening injuries, before a more thorough secondary survey. Any wounds overlying an ankle injury should be handled only to remove gross contaminants, photograph the injury and then to dress it with a sterile dressing. Exploration should not be undertaken in the emergency department. Intravenous antibiotics and antitetanus prophylaxis (if appropriate) should be given at the earliest available opportunity and the limb should be immobilized in a plaster backslab.

Initial surgery aims to clean the wound, debride necrotic tissue and improve skeletal stability. This should be conducted in most cases within 24 hours of injury. Delaying surgery until the next available trauma list allows for more senior input from both orthopaedics and plastic surgery, ensuring a high quality debridement. However, certain factors necessitate immediate surgery (gross contamination, compartment syndrome, devascularized limb, multiply injured patient).

Following debridement a more accurate assessment of soft tissue loss is made. The Gustilo and Anderson (1976) classification is useful at this stage in classifying the wound. If tissue cover is impossible at the first stage then a spanning external fixator should be used to immobilize the skeleton and a vacuum foam dressing should be applied. Definitive orthopaedic fixation should only be performed when soft tissue cover is achievable (i.e. as part of a combined procedure with a senior plastic surgeon).

Complications

These may be considered as acute or chronic, according to time of onset.

Acute

Swelling

This will develop soon after fracture. Surgery should not be considered if swelling is excessive as wound closure may be difficult. Strict elevation and ice-packing is crucial. Fracture blisters reflect a tight soft tissue envelope.

Compartment syndrome

This is a rare complication in ankle fractures (Zachariah et al, 2005) but is an orthopaedic emergency. Increased tissue swelling within musculo-fascial compartments leads to elevated intra-compartmental pressure. When this pressure exceeds the capillary perfusion pressure of the compartment, tissues become ischae-

Figure 3. a. Anteroposterior X-ray of a trimalleolar fracture dislocation in an osteoporotic 69-year-old woman with a large posterior malleolar fragment requiring fixation (b and c).

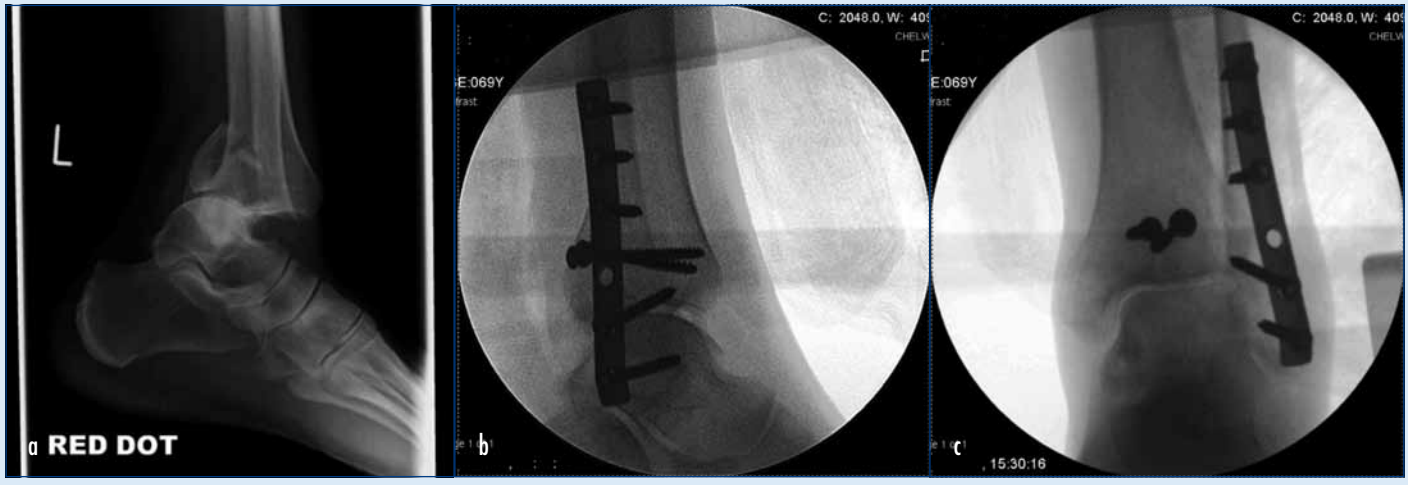


Figure 4. a. Computed tomography in the sagittal plane of a comminuted fracture of the tibial plafond (intra-articular surface – Pilon fracture) requiring (b) a temporary external fixator that was then converted to (c) a definitive Taylor Spatial frame.

mic and necrosis ensues. Clinical assessment is unreliable so a high index of suspicion is warranted in all patients who have sustained high-energy injuries. An open fracture does not exclude compartment syndrome. Disproportionate pain on passive joint extension is a reliable indicator of impending compartment syndrome in the early stages. If clinically suspected the patient should undergo emergency decompression of all four leg compartments (anterior, peroneal, superficial and deep posterior) via two large incisions (fasciotomy).

Chronic

Swelling and stiffness

This may persist for several weeks and months, even after the fracture has united. Provided the fracture has healed in a satisfactory position the patient can be reassured and given advice or physiotherapy.

Mal-union or non-union

Fractures that heal in an unsatisfactory position or fail to unite will result in a poor functional outcome. Depending on the degree of disability, this may necessitate revision surgery.

Instability

Deltoid incompetence that fails to be recognized at the time of the original injury may result in eversion instability and ongoing pain.

Post-traumatic osteoarthritis

There is increasing evidence to implicate chondral impaction from the original axial loading ankle injury as the cause of post-traumatic ankle arthritis (Aktas et al, 2008).

Foot and ankle specialists thus advocate diagnostic ankle arthroscopy to be performed in conjunction with operative stabilization of fractures in order to confer prognostic information, address osteochondral lesions of the talus, remove loose bodies and better verify syndesmotic disruptions (Leontaritis et al, 2009).

Conclusions

Early management of the fractured ankle requires prompt reduction of the subluxed joint followed by provisional immobilization, adequate pain control and appropriate imaging. The choice of operative *vs* non-operative treatment in the definitive management of ankle fractures is dictated by both patient factors (poor healing capacity, e.g. diabetes, poor compliance with non-weight bearing) and surgical factors (fracture pattern, open or closed fracture). Open fractures should be treated with intravenous antibiotics and early surgical debridement of the soft tissues before fracture fixation. **BJHM**

Conflict of interest: none.

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KEY POINTS

- Early reduction of any deformity, adequate splinting and formal assessment of neurovascular status are essential steps in the early management of any ankle fracture.
- The choice of operative *vs* non-operative treatment of ankle fractures is influenced by both patient factors and surgical factors, such as fracture stability, open or closed fractures and syndesmosis involvement.
- Diabetics with ankle fractures are more prone to complications. Tight glycaemic control and closer follow up is advocated.
- Open fractures should be managed according to British Orthopaedic Association/British Association of Plastic, Reconstructive and Aesthetic Surgeons joint guidelines.

Further reading

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