Ankle fractures in the elderly: an overlooked burden

Ankle fractures in the elderly are a complex under-recognized burden which require a multidisciplinary approach to management. This article discusses the holistic approach required, including the up-to-date surgical management options and the areas for future development.

Ankle fractures represent a significant burden to the NHS. Although the clinical management is well defined in the young adult (Sarraf et al, 2013; Shearman et al, 2013) and paediatric populations (Wuerz and Gurd, 2013), ankle fractures in the ageing population present a major challenge. The numbers of these injuries are increasing, and there is no conclusive evidence to suggest which method of treatment is best (Court-Brown and Caesar, 2006; Ensrud, 2013; Haghpanah, 2014; Court-Brown et al, 2014). Elderly patients have increased comorbidities, which may make surgical management difficult, with the potential for significant complications and mortality. However, at the same time they may have high expectations for functional outcome post injury (Salomon et al, 2012; Toole et al, 2014; Zaghloul et al, 2014). The management of elderly patients with ankle fractures can be considered with reference to patient, soft tissue, bone and financial factors (*Figure 1*).

Patient factors

Comorbidities

Reports suggest elderly ankle fractures are associated with significant complication risks and mortality. Zaghloul et al (2014) reported a complication rate of 21% and Toole et al (2014) presented a 27% mortality rate at 2.5 months for open ankle fractures in elderly patients.

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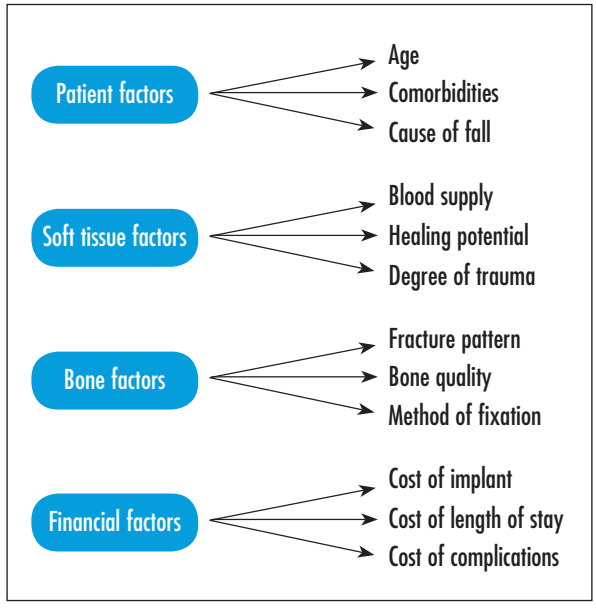
Medical comorbidities undoubtedly increase the surgical and anaesthetic risks and are a significant burden. For example, significant cardiac pathology requires preoperative echocardiogram assessment, spinal anaesthesia, the use of arterial line blood pressure monitoring and postoperative high dependency care. This degree of preoperative optimization adds to delays in surgery, increased length of stay and potential for complications.

Delayed presentation

Elderly patients with ankle fractures frequently present late as the patient may be isolated and unable to call for help. Elderly patients spending a prolonged period lying on the floor risk rhabdomyolysis, renal failure and a body crush injury with compartment syndrome. If the injury included significant bone displacement or a dislocation, swelling and soft tissue damage will exacerbate postoperative wound healing problems. Patients may also 'struggle on' with a fractured ankle, making subsequent surgical management complicated.

Figure 1. The challenges of ankle fractures in elderly patients by subgroup with examples of the specific difficulties encountered.



Medical cause of fall

Similarly to patients sustaining a fractured neck of femur, an elderly patient with an ankle fracture may have an underlying medical cause for the fall. Recurrent falls are common in the elderly and often cause repeated hospital admission and fractures. The aetiology of these falls includes infection, difficulties with balance, or cardiac disease and these causative factors can frequently delay surgery, increase length of stay and be associated with increased morbidity and mortality. Therefore, a multidisciplinary approach should be undertaken to the management of elderly patients with ankle fractures.

Compliance with weight bearing

The rehabilitation of elderly patients with ankle fractures is frequently challenging, and involves the multidisciplinary team, including physiotherapy and occupational therapy, as well as needing an extended rehabilitation programme. It is usually difficult for an elderly patient to partially weightbear through an ankle as significant upper body strength is needed, and non-weightbearing often results in patients being bed or wheelchair bound. Therefore, allowing elderly patients to fully weight bear following ankle surgery is always preferable, so adequate surgical fixation in osteoporotic bone is essential.

Soft tissue factors

Challenges of wound healing in the elderly

Ageing causes the skin to lose its structural and morphological characteristics, making the skin more susceptible to internal and external damage and possibly slowing recovery.

Venous ulceration is common (Margolis et al, 2002) and elderly patients with comorbidities are at risk of developing venous ulceration (Vlajinac et al, 2014). Prolonged immobilization following surgery adds to the existing risk of developing a venous ulcer with the increased risk of deep vein thrombosis. Ulceration from peripheral vascular disease may further compound the risk of a postoperative complication. Steroids potentially inhibit wound healing, increase the risk of infection and may add complexity to the fracture pattern through steroid-induced osteoporosis.

Peripheral vascular disease, prevalent in the elderly population (Meijer et al, 1998), reduces oxygen supply to the tissues and prevents quick recovery at the site of injury. Diabetes can lead to impaired vascular flow, thus causing poor tissue oxygenation and resulting in reduced perfusion and inadequate angiogenesis. Hyperglycaemia, secondary to diabetes, can also add to the oxidative stress, making wound healing even more challenging (Vincent et al, 2004). Furthermore, there is inadequate bacterial clearance in individuals with diabetes as a result of effects on immunity such as defective T cell immunity and phagocytosis, not only affecting healing but also increasing risks of infection.

Trauma

The soft tissue injury may not match the degree of force applied to the ankle joint at the time of injury. These patients often present with a frank dislocation of the ankle joint with relatively low energy trauma or an open fracture with a large skin split (*Figure 2*). Wallis et al (2014) presented a small follow-up study (n=15) of open ankle fractures in elderly patients where the mortality rate was 13% and the amputation rate was 27%.

Furthermore, elderly patients are remaining more active, driving and participating in sports, with the concomitant increased risk of trauma. It can therefore be expected that there will be an increase in the incidence of ankle fractures in elderly patients (Toole et al, 2014), although there are currently no data to support this.

Open fractures

Specific challenges exist for open ankle fractures in elderly patients. Peripheral vascular disease not only impairs wound healing, but may compromise any potential local tissue that could be used for flap reconstruction, increasing the risk of failure. Venous hypertension and the associated lipodermatosclerosis may render a local flap impossible. Comorbidities such as diabetes may further increase the risk of wound breakdown, but also of infection (*Figure 3*). Ovaska et al (2015) have recently reported a complication rate of over 50% in a group of patients with open fractures and an average age of 58 years.

Antibiotics significantly reduce the risk of infection following open fracture. The standard approach for an open ankle fracture where the wound cannot be closed primarily would be wound debridement and external fixation followed by definitive fixation and skin coverage, ideally within 72 hours. In elderly patients with open ankle fractures relative low energy causes the skin split and therefore the grade of open fracture does not match the force. These fractures may be relatively clean with less soft tissue swelling and so thought must be given to closing these wounds primarily with definitive fixation (*Figure 4*). This means the patient only requires one operation and can begin rehabilitation earlier.

Figure 2. Example of an open 'skin split' fracture.

Bone factors

Osteoporosis is common in the elderly, making fracture management more difficult, and may be secondary to chronic renal failure, diabetes or conditions requiring long-term steroid use. All such conditions negatively impact on healing potential and increase the complication risk. Alternative methods of fixation must be considered in osteoporotic ankle fractures with senior surgical involvement from an early stage.

Mechanism of injury

The elderly patient often has an ankle fracture that does not fit a specific classification or pattern of injury (*Figure 5*).

Figure 3. Example of a major wound complication.

Figure 4. The skin edges may be easily opposable and primary closure for a relatively large wound may be possible.

The Weber classification is a simple anatomical classification, although it does not dictate management or predict outcome (*Table 1*).

The most important factor determining ankle fracture management is the joint's stability (*Table 2*). *Figure 6* is an example of an unstable ankle fracture.

Historical management

Patients of all age groups with unstable ankle fractures have an optimal outcome with operative management (Ali et al, 1987). In the elderly, surgical fixation may afford earlier mobilization and avoid prolonged bed rest with its inherent risks.

The method of fracture fixation has been primarily determined by the fracture pattern and bone quality. Common principles of fixation, such as anatomical fracture reduction and interfragmentary compression of the fracture using a lag screw, are difficult to achieve in osteoporotic bone. Consequently, other techniques have been developed to provide early weightbearing, mobilization and discharge home.

Figure 5. Atypical fracture pattern: there is a vertical fracture of the medial malleolus with the suggestion of involvement of the tibial plafond. The fibular fracture is distal and transverse.

Table 1. Weber classification

Weber fracture classification	Position of fibular fracture	Stability
A	Below syndesmosis	Usually stable
B	At syndesmosis	Stable or unstable
C	Above syndesmosis	Unstable

New techniques

Locking plates use screws with threaded heads which 'lock' into the plate, affording better angular stability (Egol et al, 2004), and have been used in various anatomical locations (Aksu et al, 2010; Nayak et al, 2011; Loveridge et al, 2013; Pascarella et al, 2014). Such plates are pre-contoured and low profile to minimize wound complications. Fibula locking plates have multiple distal screw placement options to improve fixation (*Figure 7*). However, the evidence base for using locking plates in the ankle is still being developed (Minihane et al, 2006; Kim et al, 2007; Schepers et al, 2011; Davis et al, 2013; Eckel et al, 2013; White et al, 2013; Bariteau et al, 2014; Hallbauer et al, 2014).

Intramedullary fibular nails can be inserted from distal to proximal through a small incision and may benefit elderly patients. The stability of these devices is enhanced with interlocking screws inserted through both fibula and tibia. Similiarly, evidence is being developed on indications and outcomes of use (Ramasamy and Sherry, 2001; Rajeev et al, 2011; Bugler et al, 2012). Historically, surgeons have used simple pins as an intramedullary device to fix the fibula with promising results (Pritchett, 1993; Lee et al, 2007).

A hindfoot nail (calcaneotalotibial nail) is a further option for stabilizing an ankle fracture. A large diameter nail is inserted from the plantar aspect of the calcaneum up through the talus and into the tibia (*Figure 8*). Concerns include the potential for implant failure in high demand patients as no formal ankle fusion is undertaken. However, for low demand patients this is a viable option. Early results are promising with low complication rates and good functional scores when the correct patient is selected (Lemon et al, 2005; Amirfeyz et al, 2008; Al-Nammari et al, 2014).

External fixation remains a useful temporizing measure where the soft tissue injury is severe, with definitive fixa-

Table 2. Examples of stable or unstable ankle fracture patterns

Stable	Low energy
	No 'talar shift'
	Single malleolus fractures
	Fibular fracture with no medial tenderness or fracture
	Ankle joint congruent on X-ray
	Remains congruent on weight-bearing views
Unstable	Bi- or trimalleolar fracture
	Fracture dislocation
	Medial malleolar fractures
	High fibular fractures (Weber C or Maisonneuve)
	Talar shift, diastasis, subluxation or dislocation
	Displacement on weight-bearing X-rays

Figure 6. Fracture dislocation following low energy fall – an unstable fracture.

Figure 7. An example of a fibula locking plate with multidirectional distal screws to improve fixation. a. Anteroposterior view. b. Lateral view.

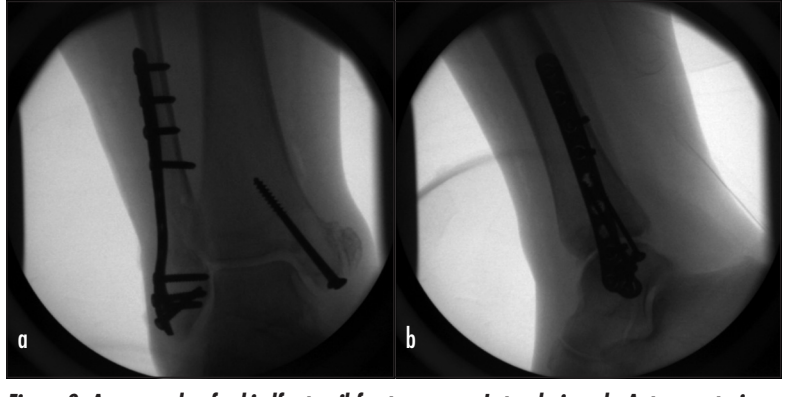
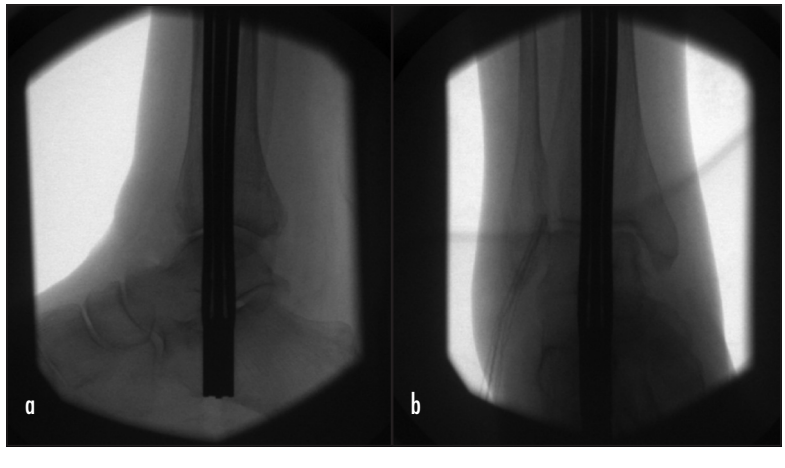


Figure 8. An example of a hindfoot nail for trauma. a. Lateral view. b. Anteroposterior view.



tion performed once soft tissue swelling has subsided (*Figure 9*). To date there is no evidence that the use of external fixation increases wound infection after definitive fixation and may reduce the risk as the soft tissues have been allowed time to settle.

Non-operative management is an alternative in those lowest demand patients with an unstable ankle fracture and those with very poor quality soft tissues. However, patients undergoing surgical management have a superior outcome, and thus non-operative treatment is really only considered appropriate for bedbound patients (Anand and Klenerman, 1993).

Financial factors

The management of these injuries is a significant financial burden. In the past, in the authors' institution, a patient over the age of 75 years with an ankle fracture could expect a length of stay of 24.4 days (range 3–85 days) at a cost of £9760 (£400 a day). With current 'ortho-plastic' management this has reduced to 13 days (range 2–24 days) at a saving of £4560 per patient. Furthermore, age is a significant risk factor for a postoperative complication, the treatment of which adds to the costs in terms of further surgery, antibiotics and the need for dressings for example. The fixation of elderly ankle fractures with new technology increases implant cost; a fibular locking plates costing 11 times more than traditional fixation (£23 *vs* £253) and locking screws are over six times the cost of traditional screws. The added cost of a temporising external fixator is estimated to be £179. Therefore appropriate evidence-based management is critical to the care of these patients.

Figure 9. A temporizing spanning external fixator with a 'box' configuration.

KEY POINTS

- Elderly patients with ankle fractures often have multiple medical comorbidities which can complicate the preoperative, intraoperative and postoperative period.
- Poor soft tissues and medical conditions such as peripheral vascular disease increase the risk of wound complications.
- Open ankle fractures in the elderly often result from low energy with a large split in the skin.
- Fractures do not follow a standard pattern in the elderly and careful assessment of the stability of the injury with surgical fixation of unstable fractures is required.
- Newer methods of fixation such as locking plate fixation may be of benefit but further studies are required.
- There is a significant cost associated with these injuries in this group of patients and a multidisciplinary ortho-plastic approach is required to improve the outcomes.

Local experience

The local approach for ankle fractures in elderly patients involves an ortho-plastic management plan aimed at minimizing further soft tissue trauma and wound complications, while allowing early weightbearing to minimize medical complications. These complex fractures require the combined expertise of senior orthopaedic and plastic surgeons. External fixation is often used providing initial stability while avoiding the zone of injury. Definitive operative fixation can be undertaken when soft tissue swelling has adequately resolved. The use of plaster of Paris is minimized.

Intraoperatively the use of tourniquets and self-retaining retractors is also minimized, with a tension-free skin closure achieved to reduce wound dehiscence, deep infection, non-union and potentially amputation. If direct tension-free wound closure is not possible, local tissue is introduced in the form of flaps based on identifiable perforators in the lower limb.

In the authors' institution using these measures, the 1-year mortality rate is 2% from 48 surgically treated fractures in patients over 75 years old with no cases currently requiring amputation.

Conclusions

Managing the elderly patient with an ankle fracture is a significant and emerging challenge. Great care must be afforded to these patients as there are significant local and systemic differences to similar fractures in younger patients. Medical management of these patients is complex, requires a multidisciplinary approach and is commonly underappreciated. The challenge and cost of these fractures is likely to increase. While new surgical fixation techniques have added to the options available to the trauma and orthopaedic surgeon, the evidence to support their use remains unclear and larger studies are required. An ortho-plastic approach to these patients is vital to achieving an infection-free union and a patient who can walk out of hospital. BJHM

Conflict of interest: none.

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