Ankle fractures – an update of the evidence

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The number of ankle fractures in the population is expected to increase significantly due to an ageing population and the increased participation of older people in sporting activities. This will potentially result in a growing demand for physiotherapy services. An understanding of the current evidence relating to this condition is needed to ensure the provision of high-quality patient care. In this article we present an overview of the current research on the assessment, prognosis, and treatment after an ankle fracture. We also offer our thoughts on how the existing evidence can be used to guide clinical practice.

LEARNING OUTCOMES
TO SUPPORT PHYSIO FIRST QAP

1 Be aware of clinical prediction rules, supported by clinical guidelines, for the acute assessment of suspected ankle fractures.
2 Increase knowledge of the current evidence comparing surgical and non-surgical treatment of ankle fractures.
3 Have a greater awareness of the evidence for typical trajectories of recovery after an ankle fracture in different age groups.
4 Gain up-to-date understanding of the current evidence for rehabilitation after an ankle fracture.

Introduction

Ankle fractures are defined as fractures of the medial and lateral malleoli. The primary role of the malleoli is to maintain ankle joint alignment and stability. Fractures of the main weight-bearing structures of the ankle, such as tibial plafond (pilon) and talus fractures, are classified separately as these require different management strategies due to their role in bearing load at the ankle joint (Handley & Gandhe 2011). In this article, only ankle fractures affecting the malleoli will be discussed.

Ankle fractures are a very common traumatic injury, accounting for approximately 9% of all fractures (Court-Brown & Caesar 2006). In the United Kingdom, the estimated incidence of ankle fractures is 75 per 100,000 person years. Peak incidence in adult males is between 18-24 years of age and in adult females it is between 60-64 years of age (Curtis *et al* 2016). This sex difference in peak incidence probably reflects the roles of high energy trauma and reduced bone density in ankle fracture pathogenesis among younger males and older females respectively. Although the rate of ankle fractures among older adults has stabilised in recent years, projections suggest the number of ankle fractures will increase three-fold between 2006 and 2030, as a result of an ageing population (Kannus *et al* 2008) and the increased participation of older people in sporting activities (Baker *et al* 2010). This will likely result in a corresponding increase in patients with ankle fractures presenting to physiotherapy services.

Acute assessment/ differential diagnosis

In the physiotherapy clinic, patients with acute ankle injuries present a difficult diagnostic challenge. The acute symptoms of pain, swelling and bruising are common to many ankle injuries. This can make it difficult to conduct a physical examination and to ascertain injury severity. The challenge for the clinician is balancing the risks associated with delayed diagnosis and management of serious injuries, with unnecessary onward referral that is inconvenient to the patient and has implications on health resource usage.

The Ottawa Ankle and Foot (OAF) rules (**www.theottawarules.ca**) can reduce unnecessary onward referral for radiology. Current clinical guidelines recommend using the OAF rules to determine whether an X-ray is needed in patients older than five years of age with a suspected ankle fracture (NICE 2016a). They have a high sensitivity (97%) for ankle and mid-foot fractures, meaning that a false negative (incorrectly deciding there is no fracture when there is) is unlikely (Bachmann *et al* 2003). As a result, fractures are unlikely to be missed, and the negative consequences of delayed fracture diagnosis and management avoided.

However, the OAF rules should be used alongside a comprehensive patient history and clinical examination, and not

"TREATMENT AIMS TO OPTIMISE AND MAINTAIN ANATOMICAL ALIGNMENT WHILE ALLOWING THE FRACTURE TO HEAL"

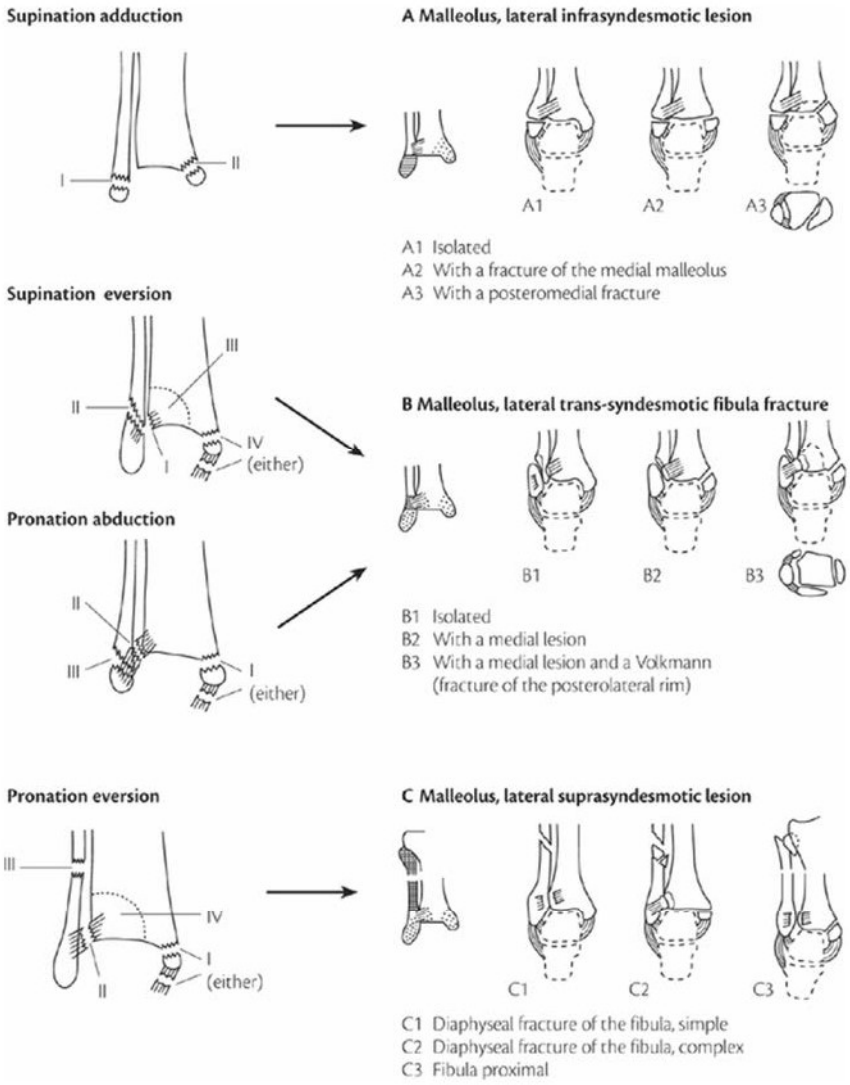

FIGURE 1: Comparison of the Lauge-Hansen (left column) and AO/OTA (right column) fracture classification systems. From *Oxford Textbook of Trauma and Orthopaedics* (2nd edition) edited by Bulstrode (2011) Fig.12.59.4 p.1393 by permission of Oxford University Press

in isolation. Clinicians should remain suspicious for a serious injury if patients are failing to improve as expected or with mechanisms of injury associated with more severe ankle injuries (See Lauge-Hansen classification, figure 1).

Fracture classification

Fractures of the ankle can be described by the number of malleoli affected or using an ankle fracture classification system. Unimalleolar fractures usually affect the lateral malleolus, bimalleolar fractures the medial and lateral malleoli, and triamalleolar fractures the medial, lateral and posterior malleoli (Donken *et al* 2012).

Physiotherapists are probably most familiar with the Danis-Weber classification system. This describes the location of the fracture relative to the distal tibiofibular syndesmosis, with type A fractures below the level of the syndesmosis, type B at the level of the syndesmosis, and type C above the level of the syndesmosis. The Danis-Weber system continues to be used as it is simple and easily understood, though its utility in guiding prognosis and treatment is limited (Handley & Gandhe 2011).

A knowledge of the other most commonly used classification systems is therefore useful. The Lauge-Hansen system is based on the position of the ankle at the time of injury whereas the AO/OTA classification system is a more comprehensive system that describes both the affected bone and fracture type (Handley & Gandhe 2011).

Classifications based on anatomical injury are helpful for determining initial fracture management but are not consistently predictive of recovery trajectory (Hancock *et al* 2005; Lin *et al* 2009a) so caution is advised when counselling patients about prognosis on the basis of fracture classification alone.

Fracture management

Once the presence of a fracture has been established, treatment typically aims to optimise anatomical alignment if required and maintain alignment while allowing the fracture to heal. This usually involves a period of immobilisation in a splint or cast and may involve a period of restricted weight-bearing.

Although there is a consensus that stable fractures should be treated non-surgically (*BOAST 12: The Management of Ankle Fractures* 2016 **www.boa.ac.uk/wp-content/uploads/2016/09/BOAST-12-Ankle-Fractures.pdf**), a Cochrane review (Donken *et al* 2012) was unable to determine whether surgical (figure 2) or conservative management of ankle fractures in adults leads to better outcomes. However, the results of this review were limited by the heterogeneity and poor quality of the included trials.

Since the Cochrane review, several randomised controlled trials (RCTs) have been conducted that provide

FIGURE 2: Ankle radiograph of an ankle fracture managed with open reduction and internal fixation surgery

more evidence to inform acute ankle fracture management. A high-quality trial that compared surgical and non-surgical treatment of stable distal fibular fractures, in adults aged between 18 and 65, showed no difference in self-reported ankle function at 12 months between groups (Mittal *et al* 2017). Surgical management also resulted in longer length of hospital stay, more adverse events and more physiotherapy visits. Similar findings were reported in a smaller, lower quality RCT, comparing surgical and conservative management of isolated lateral malleolar fractures deemed unstable on stress x-rays only, in skeletally mature participants under 65 years of age. At 12 months, self-reported ankle function was no different between groups, though 20% of the conservative group had radiographic evidence of malalignment (Sanders *et al* 2012).

The Ankle Injury Management (AIM) trial assessed whether close contact casting of unstable fractures in an older cohort of patients, i.e. over 60 years of age, who would normally be offered surgical fixation, was equivalent to surgery in terms of ankle function recovery (Willett *et al* 2016). Close contact casting is a minimally padded cast applied under general or spinal anaesthetic with the aim of maintaining good joint alignment following reduction (figure 3). This showed equivalence in self-reported ankle function and no differences in quality of life or pain between the groups at six months, which was maintained at three-year follow-up (Keene *et al* 2018). It should be noted that participants in both groups with malleolar malunion at six months had worse ankle function, highlighting the importance of maintaining alignment until union is achieved. As the use of close contact casting is now included in the British Orthopaedic Association Standards for Trauma (**www.boa.ac.uk/wp-content/uploads/2016/09/BOAST-12-Ankle-Fractures.pdf**) awareness of this initial management approach within physiotherapy is important.

What remains to be determined is the longer-term outcomes of conservative management, compared to surgical management. Surgical interventions are suggested to work by better restoring anatomical alignment compared to conservative interventions, thereby reducing post traumatic osteoarthritis (Donken *et al* 2012). It is widely thought that malunion of weight-bearing joints directly leads to post-traumatic osteoarthritis, which can result in persistent symptoms and disability, and potentially the need for further surgery (Horisberger *et al* 2009; Brown *et al* 2006). These claims, given the inherent risk and costs associated with surgery, require rigorous evaluation. Ultimately longer-term follow-up is needed to determine the comparative efficacy of surgical and conservative management for this condition. However, recent studies suggest that non-surgical management (with the option of proceeding to surgical fixation where alignment is not maintained) is a viable option for many patients following consideration of fracture severity and the patient's age, functional demands and comorbidities.

FIGURE 3: Close contact cast application: (a) moulding the cast to hold reduction of the fracture and (b) a radiograph showing the close contact cast in situ

"OLDER ADULTS WITH UNSTABLE FRACTURES TYPICALLY DO NOT MAKE A FULL RECOVERY"

Prognosis

After an ankle fracture, there is usually a rapid restoration of ankle function in the first six months (approximately 80%), but thereafter further improvement is limited, with ongoing activity limitation at two years that is worse with older age (Beckenkamp *et al* 2014). The results of recent RCTs have enhanced our understanding of how recovery may differ in different patient populations post ankle fracture. Mittal *et al* (2017) embedded an observational cohort into their study design, and also observed a trend of accelerated recovery in the first six months. However, participants (18-65 years of age with stable lateral malleolus fractures) continued to improve beyond this point to make a full recovery at 12 months. These results indicate that younger patients with stable fractures have a favourable prognosis irrespective of surgical or conservative treatment. In contrast, the participants (over 60 years of age with unstable ankle fractures) in both treatment arms of the AIM trial had a persistent deficit in ankle function at three-year follow-up (Keene *et al* 2018), indicating that older adults with unstable fractures typically do not make a full recovery.

Rehabilitation

The main impairments of the ankle, in the early phases of recovery from an ankle fracture, are pain and reduced ankle range of motion (Lin *et al* 2009a), and deficits in muscle strength (Psatha *et al* 2012; Stevens *et al* 2004). This results in difficulty with walking (Lin *et al* 2009a) and altered gait (Keene *et al* 2016). Rehabilitation aims to address these impairments and facilitate a return to the patient's baseline activities and function (Donken *et al* 2012). Patient reported outcome measures (PROMs) are useful to monitor and quantify different aspects of patient recovery and evaluate response to treatment.

The Olerud-Molander Ankle Score (OMAS) (Olerud & Molander 1984) is the most commonly used PROM in studies reporting outcomes on ankle fractures, though its routine use has been questioned due to a lack of studies evaluating its psychometric properties (Ng *et al* 2018). Alternative PROMs that have been recommended (Ng *et al* 2018) to monitor recovery from ankle fracture include the Lower Extremity Functional Scale (LEFS), though this may be inappropriate in higher level patients in the longer term (Lin *et al* 2009b), and the Ankle Fracture Outcome of Rehabilitation Measure (A-FORM) (McPhail *et al* 2014).

Rehabilitation after an ankle fracture commences either during or after immobilisation. During immobilisation treatment is usually restricted to advice, gentle range of movement, and weight-bearing if permissible, to ensure fracture healing is not compromised. Currently, the evidence to inform rehabilitation during this phase is equivocal. In their Cochrane review, Lin *et al* (2012) found no studies investigating early movement after conservative treatment of ankle fractures. In post surgical patients, using a removable splint to allow exercise was associated with reduced activity limitation and pain, and improved ankle dorsiflexion range of movement, but also led to a higher rate of adverse events. However, the methods used to combine and present the results of different studies in this review, and subsequently their relevance to clinicians, have been questioned (Keene *et al* 2014). This led to another review of early ankle movement versus immobilisation after surgical management of ankle fractures that stratified findings into the short, medium and long term, and also distinguished between minor and more serious adverse events. This showed no difference in ankle function at any follow-up point between treatment groups. However, early ankle movement was associated with an increased risk of deep and superficial surgical site infections, and fixation related complications, but a reduced risk of venous thromboembolism (Keene *et al* 2014).

The findings from these reviews indicate that early ankle movement is usually restricted to surgically managed patients. Its use requires caution in patients who may be more susceptible to surgical site infection and delayed healing but may be encouraged in patients predisposed to venous thromboembolism. Although both reviews were comprehensive and their results broadly consistent, the quality of the studies in both reviews was low. Their findings should therefore be interpreted with caution. Further high-quality research is currently being conducted in the UK to determine the comparative effectiveness of these two treatment strategies (ISRCTN15537280 **https://doi.org/10.1186/ISRCTN15537280**).

After the immobilisation period, treatment strategies can usually be progressed rapidly as the fracture heals and can therefore tolerate more stress and load. To facilitate the transition from immobilisation to walking and normal function, patients are often provided with an ankle support (Keene *et al* 2016). Preliminary research has shown that using a walker boot or ankle stirrup is associated with less pain and gait asymmetry compared to using tubigrip alone immediately following removal of immobilisation, in adults of under 65 years of age with surgically managed type A or B Danis-Weber fractures (Keene *et al* 2016).

However, a Cochrane review found no evidence to support the use of other forms of rehabilitation such as stretching, manual therapy and exercise, after the immobilisation phase (Lin *et al* 2012). The results of the Cochrane review, questioning the role of rehabilitation after ankle fracture, must be considered alongside the quality and design of studies from which

> "A COCHRANE REVIEW FOUND NO EVIDENCE TO SUPPORT THE USE OF STRETCHING, MANUAL THERAPY AND EXERCISE AS FORMS OF REHABILITATION AFTER THE IMMOBILISATION PHASE"

these conclusions are drawn. Moseley *et al* (2005) compared the addition of calf stretching and exercise, to exercise alone, while Lin *et al* (2008) compared manual therapy and exercise, to exercise alone. Both studies found no difference between treatment groups. These studies do not support the addition of manual therapy or calf stretching to a general rehabilitation programme, but as participants in all groups were prescribed exercise, it was not possible to infer whether recovery occurred as a result of, or despite, exercise rehabilitation. Nilsson *et al* (2009) was the only study in the Cochrane review that compared physiotherapy to "usual care". There was no difference between groups, however participants in the "usual care" group could be referred to physiotherapy by their doctor if deemed necessary, and participants were permitted to seek physiotherapy themselves. This resulted in an average of seven sessions of physiotherapy in the usual care group compared to 17 in the exercise group. It was, therefore, difficult to draw conclusions about the effects of physiotherapy provision from this study.

The evidence for the rehabilitation after an ankle fracture is not extensive and continues to evolve. The Cochrane review team went on to conduct a high-quality RCT comparing supervised exercise and advice, to advice alone, in patients with uncomplicated isolated ankle fractures managed either non-surgically or surgically (Moseley *et al* 2015). They found no difference in function and quality of life outcomes between groups. However, more than one-third of participants in the advice-only treatment group received out-of-trial private physiotherapy, potentially confounding

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the results. The relatively young age of participants (mean age 42) also suggests that the results may not be applicable to older adults, who tend to have worse outcomes (Beckenkamp *et al* 2014).

These observations led to the development of the AFTER trial, a pilot RCT that will assess the feasibility of conducting a future definitive RCT comparing best practice advice and progressive exercise after ankle fracture in adults aged 50 years or over (**https://doi.org/10.1186/ISRCTN16612336**).

Additional considerations and useful resources

The importance of identifying and addressing pyschological factors that may predispose to a poorer treatment outcome is well established in certain musculoskeletal conditions (NICE 2016b). The role of psychological factors in mediating treatment outcome after skeletal trauma is less definitive, but an association between psychological factors, such as catastrophising, and worse treatment outcomes does exist in this cohort of patients (Linton *et al* 2010; Vranceanu *et al* 2014). Identifying and addressing any unhelpful patient beliefs is likely to be important.

The aim of physiotherapy is often to help patients to return to the activities they enjoy. Prescription of an appropriate exercise programme should be a core component of treatment if this is to be achieved. The success of an exercise programme is dependent on the exercise prescribed being the correct type, of sufficient dose, and ultimately completed by the patient. Alongside many other factors, the type of exercise prescribed should be informed by the physical demands of the patient's activity related goals, relevant impairments identified during the clinical exam, and the patient's preferences.

To ensure the dose of prescribed exercise is sufficient, an awareness of the existing evidence underpinning exercise prescription (Ratamess *et al* 2009; Garber *et al* 2011) is essential. To facilitate patient compliance with an exercise programme, a knowledge of behavioural change strategies shown to be successful in increasing exercise adherence in patients with other musculoskeletal conditions (Meade *et al* 2018) is useful. The *Improving Health: Changing Behaviour. NHS Health Trainer Handbook* (Michie *et al* 2008) is a freely available resource that offers practical tips on how to implement behavioural change strategies and can be applied to the prescription of exercise. We would encourage readers to consult this resource.

Other useful fracture-specific resources we would like to signpost include recent guidelines *Fractures (non-complex): assessment and management* (NICE 2016a) and *BOAST 12: The Management of Ankle Fractures* (**www.boa.ac.uk/wp-content/uploads/2016/09/BOAST-12-Ankle-Fractures.pdf**)

Conclusion

The evidence we have outlined is not exhaustive but highlights prominent

> "IDENTIFYING AND ADDRESSING UNHELPFUL PATIENT BELIEFS IS LIKELY TO BE IMPORTANT"

research relating to ankle fracture assessment, prognosis and treatment. It should be used judiciously and considered alongside individual patient preferences and clinical expertise when providing patient care, in accordance with the principles of evidence-based medicine (Sackett *et al* 1996).

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