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Current concepts of the perioperative management of closed ankle fractures

Xiaoyu Chen[1,2], Jiang An Lim[1,2], Andrew Zhou[1,2] and Azeem Thahir[1]

Abstract

Ankle fractures are common injuries that can result in substantial morbidity in the population. This review discusses the management of closed ankle fractures and outlines the recent evidence and guidelines on perioperative management. In general, a detailed history should be undertaken, followed by examination and imaging of the affected limb. Fixation is based on the AO principles of fracture management that aims towards restoring stability of the joint and reducing the risk of long-term complications. A multidisciplinary approach towards perioperative management is recommended in view of the increasing proportion of aging patients with significant comorbidities.

Keywords

Ankle fracture / Perioperative management / Older / Trauma and orthopaedic surgery / Complications

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Introduction

Ankle fractures are amongst the most common in the adult population (Juto et al 2018). It follows a bimodal distribution that affects young males and older females the most, with the former due to high-energy trauma and the latter due to low-energy falls (Hoogervorst et al 2017). There was an increasing trend of low trauma ankle fractures in the older population as a result of slipping, tripping and falls between 1970 and 2000 in Finland, and this is estimated to triple by 2030 (Kannus et al 2002). An increase is also noted with age in females, with 61% of fractures occurring as a result of falls (Elsoe et al 2018). With the publication of BOAST guidelines by the British Orthopaedic Association Standards for Trauma (BOAST 2016), a broader approach is now required to meet the challenges of changing characteristics in the patient population. This educational review of up-to-date guidelines discusses the perioperative management of closed ankle fractures.

History and physical examination

History taking

A thorough history should be undertaken to identify the mechanism of injury and potential comorbidities that may influence the choice of intervention and final outcome. Important information includes chronic diseases such as type 2 diabetes mellitus (T2DM) and osteoporosis, which have become much more common in an ageing and obese population; a study in 2011 has projected 11 million more obese adults in the UK by 2030 (Wang et al 2011). Both obesity and T2DM affect the risk of fracture, and fracture patients with T2DM are associated with a greater morbidity compared to the general population (Walsh and Vilaca 2017). In addition, there is an increasing proportion of fractures that are potentially osteoporotic, affecting women more than men (Cauley 2013). BOAST has recommended clinicians to document patient comorbidities in detail for the planning of better treatment and the mitigation of risk factors that influence fracture risk and the general outcome of intervention including smoking, alcohol abuse, medications such as steroids, renal disease, pre-existing mobility impairments (Ackland et al 2011, BOAST 2016, Schürer et al 2015).

[1]Department of Trauma and Orthopaedics, Addenbrookes Major Trauma Unit, Cambridge University Hospitals, Cambridge, UK
[2]School of Clinical Medicine, University of Cambridge, Cambridge, UK

Corresponding author:
Xiaoyu Chen, School of Clinical Medicine, University of Cambridge, Cambridge CB2 0SP, United Kingdom.
Email: xc294@cam.ac.uk

Physical examination

During the physical examination of the ankle, the principles of testing for tenderness, function and defects apply. An important test to gauge the severity of injury will be the external rotation test (Porter et al 2014) that looks at the integrity of the syndesmosis ligament, which is a fibrous structure made up of the intraosseous membrane, anterior inferior tibiofibular ligament (AITFL) and the posterior inferior tibiofibular ligament (PITFL). The clinician performs this by externally rotating the patient's affected foot, and it is positive for syndesmosis injury if pain is present. Further assessment of ankle movement along with radiographic imaging is useful for gauging the full extent of ligamentous damage (Polzer et al 2012). It is vital to remember the examination of the proximal leg for tenderness in the proximal fibula to rule out a Maisonneuve fracture which may be missed out if examination is focused solely in the ankle region (Taweel et al 2013).

While it has been suggested that separating between an ankle fracture and ligamentous injury purely from the initial physical examination is difficult (Goost et al 2014), immediate signs that can indicate a fracture include: swelling; haematoma; tenderness in either or both of the medial/lateral malleolus to pressure, or over the proximal head of the fibula in the case of a Maisonneuve injury. Further examination of other bones such as the talus, calcaneus, navicular bone, midtarsal joint and the base of the fifth metatarsal should be performed to look for pain and crepitus. In addition to identifying fractures, BOAST guidelines have recommended the assessment of skin integrity and neurovascular function in the ankle examination, as these are often compromised in very deformed ankles that are sustained in open fractures (BOAST 2016).

Imaging

Radiographs are essential in the detection and classification of an ankle fracture to guide treatment; X-rays should be centred on the ankle and include both a true lateral and mortise view (BOAST 2016). Further images of the leg and knee should be taken if clinically required, and CT imaging is indicated for more complex fractures such as those involving the posterior malleolus. The added function of being able to get 3D reconstructions of the images are useful when it comes to surgical planning, allowing clinicians to achieve accurate implantation and yield better surgical results (Lal & Patralekh 2018). The indications for ankle radiography have been explored with the Ottawa Ankle Rules developed to keep imaging to a clinical minimum (Stiell et al 1992).

Classification systems

Various classification systems have been developed to categorise ankle fractures. The first was developed by Percival Pott in the 18th century, who described them in terms of the malleoli involved. These can be isolated unimalleolar (lateral or medial), bimalleolar (medial and lateral) and trimalleolar fractures (medial, lateral and posterior) (Pott 2007). Potts' system, however, is unable to distinguish between stable and unstable fractures, making it unsuitable for guiding treatment. As a result, Pott's system has been superseded by the two systems that are most commonly used today: the Danis-Weber (DW) (Danis 1949, Weber 1972) and the Lauge-Hansen (LH) classification (Lauge-Hansen 1949).

LH classification

The LH system is based on cadaveric studies that looked at two aspects of the injured ankle to categorise fractures: the position of the foot upon trauma (supination/pronation) and the direction of the applied deforming force. This dependence on the mechanism of injury (MOI) for classification, however, can be challenged as the MOI is not always clear and may be based on speculation (Tartaglione et al 2015). In addition, the LH system's reliability has been put into question when compared with other systems that showed superior results (Rodriguez et al 2013).

DW classification

On the other hand, the DW classification is based on radiographic evidence of lateral malleolus fractures, specifically the relation of the distal fibular fracture to that of the syndesmosis. Using the DW classification, a DW Type A fracture is a fracture of the lateral malleolus occurring at the level of fibula distal to the syndesmosis. The medial malleolus is injured occasionally, but the deltoid ligament is intact. DW Type B fractures originate at the level of the syndesmosis and extend proximally in an oblique fashion. At this stage, the fracture may be stable or unstable depending on the presence of a medial malleolus fracture and/or deltoid ligament rupture. Finally, DW Type C fractures occur proximal to the level of the syndesmosis and often have an associated syndesmotic injury. These fractures are unstable, with medial malleolus fracture and deltoid ligament rupture often present (Weber 1972).

Management

The choice of treatment depends largely on factors such as the stability of the fracture and associated injuries to the region. In addition, the patient should also be identified from the history for other medical conditions that may influence the outcome of treatment. In general, stable fractures are best managed non-operatively (Pakarinen et al 2012), whereas unstable fractures offer a better outcome if treated with surgical intervention.

Stable fractures

Stable fractures are mainly seen in patients with DW type A fractures, and they do not need to be managed surgically. In general, conservative management repositions the bone fragments through the skin which is followed by immobilisation of the area in a cast/splint (Donken et al 2012). Stable fractures are managed using ankle/foot orthosis to encourage early function and full weight bearing as soon as possible (Goost et al 2014). However, an isolated type A fracture should be managed surgically if there is dislocation of fragments or joint involvement (Goost et al 2014).

Unstable fractures

Surgery is usually indicated for unstable ankle fractures commonly seen in DW type B and C fractures, as conservative management has been associated with an increased risk of early treatment failure along with malunion (Javed et al 2020). However, arguments against surgery often cite the higher complication rate and poor bone quality that result in unsatisfactory outcomes (Ehrenfreund et al 2013). Unstable fractures are often displaced bimalleolar or trimalleolar fractures, but the presence of talar shift and the widening of the syndesmosis under radiography are also indications for surgical realignment (Khan et al 2010). Surgical options tend to be via open reduction internal fixation (ORIF) or an external fixator approach. External fixation is normally utilised as a temporary approach, but in complicated fractures that require more stability it may be used together with ORIF (Ovaska 2015).

Regardless of the method used, basic AO fracture management principles of fixation should be followed. They include: fracture reduction to re-establish anatomical relationship; fracture fixation either by absolute or relative stability; preservation of blood supply to the soft tissues and bone; early mobilisation to allow for rehabilitation (Helfet et al 2003). Traditionally, fractures in the distal fibula are managed via a lateral surgical approach to the bone using a non-locking one-third tubular plate, although fixation is difficult in older patients (Moriarity et al 2018). Increasingly, locking compression plates have become popular, as it has been shown to be superior in fixing osteoporotic bones and is recommended for patients with poor bone quality and comminuted fractures (Bariteau et al 2014). This lateral approach with the plate has been effective for most distal fibular fractures and little has changed over the years (Switaj et al 2016). The locking compression plate has been associated with significantly higher rates of wound infection and hardware complications as shown in a study (Schepers et al 2011), although there are others that found no significant differences between the non-locking and locking approaches (Lyle et al 2018). As surgery aims to achieve reduction and stability of the ankle joint, BOAST has emphasised on the importance of ensuring that the syndesmosis is stable after intervention. Intraoperative radiographs should also be taken to ensure reduction of the fracture (BOAST 2016).

Postoperative management

Post-surgery, BOAST recommends patients to resume weight-bearing as soon as the pain becomes tolerable (BOAST 2016). Evidence to support this has been explored in a recent randomised trial where early weight bearing and mobilisation as tolerated tends to lead to better function and an earlier return to weight bearing activity without increasing the risk of complications (Smeeing et al 2020). In addition, patients should be given antithrombotic treatment until full function is restored (Goost et al 2014). However, this should be balanced with the risk of bleeding especially in combined antithrombotic therapy (Miller et al 2014). Furthermore, patients should be followed up in a fracture clinic within six weeks of surgery to assess possible complications and to ensure reduction has been achieved (BOAST 2016). A review of the wound and removal of sutures might be required at two weeks post-operation. Conventional fracture clinics are often busy, requiring extensive coordination to provide multidisciplinary care (Bellringer et al 2017). There has been a move towards virtual fracture clinics (VFCs) in the NHS which was shown to be safe and cost-effective (Jenkins et al 2016). Given the recent findings on asymptomatic COVID-19 transmission in hospitals (Rivett et al 2020), VFCs can be helpful in reducing prolonged contact and thus the risk of transmission while still meeting BOAST standards (Dunkerley et al 2020); however, patients who need a change of plaster and/or clinical examination may still need to be reviewed face to face (Dunkerley et al 2020).

Complications of ankle fractures

The complications from ankle fractures can be classified as either those resulting directly from the trauma or as a result of intervention (Mehta et al 2014). These complications tend to also affect diabetics, smokers and the older population more significantly (Nåsell et al 2011, Wukich et al 2011), making a thorough history taking vital in identifying them for mitigation.

Complications due to injury

Complications may arise following injury as seen in post-traumatic ankle arthritis (PTAA). This often develops in the younger and more active population where specifically in the ankle joint, up to 90% of arthritic change is a result of trauma (Delco et al 2017). Trauma in the acute setting leads to compromise of structures that normally provide stability to the ankle (bones, ligaments, soft tissues), resulting in joint surface incongruity and instability (Ewalefo et al 2018). These two changes in the long term will result in the loss of cartilage, bone-remodelling and degenerative changes

and their extent have been concluded to influence the prevalence of PTAA (Valderrabano et al 2009).

Complications due to intervention

In terms of intervention, this commonly refers to ORIF which remains the gold standard of surgical intervention for ankle fractures (Macera et al 2018). Surgery can be associated with various complications that bring significant problems in terms of quality of life and healthcare costs (Macera et al 2018). Given the increasing proportion of fractures occurring in the older population, these complications have also become increasingly common and difficult to manage (Kadakia et al 2017). Besides age, the presence of multiple comorbidities (>2) and type of fixation used have also been shown to significantly influence the risk of complications after surgery (Varenne et al 2016), emphasising the importance of a thorough history taking during consultation.

Previous literature has categorised complications as perioperative and early/late postoperative (Leyes et al 2003). Generally, postoperative wound infections make up the majority of complications, and they include superficial infection, deep infection, wound edge necrosis and dehiscence (Ovaska 2015). It is recommended that revision surgery, if required, should be carried out early and over an area large enough so as to reduce the risk of the infection expanding to the point where plastic surgery is indicated (Goost et al 2014). In an increasingly older population with multiple co-morbidities undergoing surgery, the need for a multidisciplinary approach has become more important than before (Partridge et al 2018). Postoperative co-management of older surgical patients with geriatricians have led to shorter periods of hospital stay and lower mortality (Shaw et al 2020). This provides much potential for the involvement of other professionals such as internal medicine physicians, nurses, podiatrists, physiotherapists in the holistic management of postoperative patients.

Conclusion

While the techniques and equipment used in the fixation of ankle fractures have remained relatively unchanged over the years owing to their efficacy, recent literature and 2020 guidelines from BOAST (BOAST 2020) have highlighted new challenges such as the current COVID pandemic, an ageing population, and the increasing prevalence of chronic comorbidities that can adversely affect patient outcome if ignored. It has become vital for a multidisciplinary outlook in perioperative management to keep up with these changes.

Key phrases

1. Ankle fractures are increasingly prevalent in the older population.
2. Detailed history-taking and physical examination are vital to identifying risk factors.
3. Ankle fracture management is based on restoring stability to the joint.
4. Complications can occur due to either trauma or intervention.
5. An ageing patient population requires a multidisciplinary approach.

Declarations

Competing Interests

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ORCID iDs

Xiaoyu Chen https://orcid.org/0000-0002-4727-731X
Jiang An Lim https://orcid.org/0000-0003-1610-7956
Andrew Zhou https://orcid.org/0000-0001-6656-8123

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