5 points on

Ankle Fractures: It Is Not Just a "Simple" Ankle Fracture

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Ankle fractures are one of the most common fractures encountered by orthopedic surgeons. Understanding the full extent of the injury, including the ligaments, syndesmosis, and extent and significance of the posterior malleolus, is essential for a correct diagnosis and decision regarding treatment. The treatment of the majority of these fractures is straightforward, and most surgeons are familiar with the techniques for treating them successfully. However, the drawback is that some of the more complex fractures are not correctly recognized as such and are believed to be "just a simple ankle fracture." An anatomical reduction and maintenance of reduction until healing is crucial for an optimal outcome. In this review, we direct attention to identifying those ankle fractures that are not "simple" and managing them accordingly.

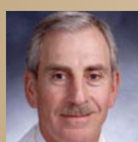
1 Syndesmosis injuries

Syndesmotic injuries have classically been addressed surgically, though the literature includes few reports regarding nonoperative management of these injuries.[1] Diagnosing syndesmotic injuries on the basis of plain x-rays is a problem, and even stress x-rays are not absolutely reliable.[2] Computed tomography and magnetic resonance imaging, which have been proposed as diagnostic tools, are unlikely to become routine methods of assessment for these injuries. External rotation stress radiography is the method used most often to assess syndesmotic integrity.[3] As it has been shown that the accuracy of reduction based on intraoperative image intensifier views alone is unreliable,[4] it may be advisable to directly reduce all syndesmotic disruptions. Doing so allows direct assessment of the reduction by visualization and palpation of the anterior edge of the fibula at the anterior border of the incisura.

Many techniques for stabilizing the syndesmosis have been described: 1 screw versus 2 screws, screws of different diameters, tricortical versus quadricortical screws, bioresorbable devices, wires, and so forth. Although larger- diameter (4.5-mm) screws have the drawback of being more prominent subcutaneously and often bother the patient, they are also identified more easily when hardware must be removed, and therefore they are preferred by surgeons planning to remove fixation at a later stage. On the other hand, screws 3.5 mm in diameter have less prominent heads, but their removal sometimes requires fluoroscopic guidance. Although tricortical syndesmotic screws have the advantage of avoiding prominent hardware on the medial side, removal can be a problem when they break at the level of the syndesmosis. Some surgeons therefore prefer quadricortical screws, which, should they break, can be removed percutaneously from the medial side. Use of locking screws with one-third tubular plates allows for fixed-angle stabilization, which may be advantageous biomechanically and may help in avoiding overcompression of the ankle mortise. Unfortunately, biomechanical and clinical data regarding this technique are not available.

Our preferred method is to reduce the syndesmosis under direct visualization and to use two 3.5-mm tricortical positional screws through a regular nonlocking one-third tubular pate (Figure 1). This plate gives additional rotational control and leads to a more even buttress force for stabilization of rotational forces as the syndesmosis



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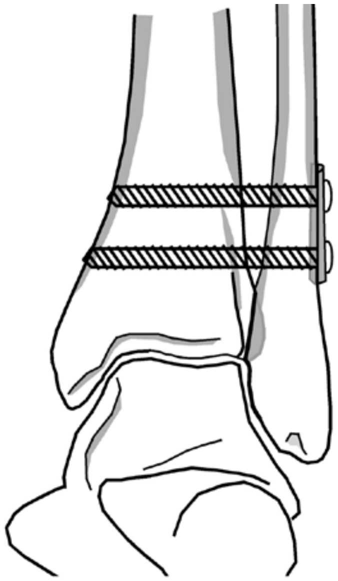

Figure 1. Syndesmotic screws through one-third tubular plate. The screw threads end at the level of the cortex—which has the advantage of being less proud compared with bicortical screws but still amenable to removal from the medial side should they break and become symptomatic. Illustration by Clément M.L. Werner, MD.

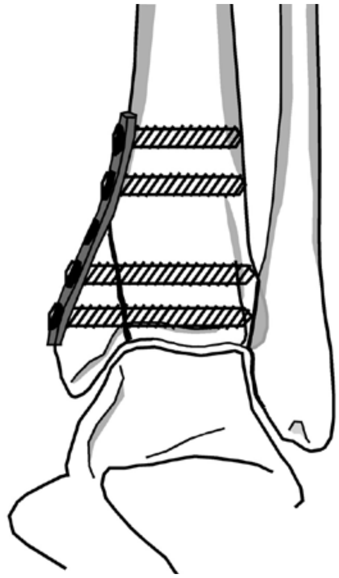

Figure 2. Medial malleolus antishear plate, with 2 lag screws across fracture (these can go either through the plate or next to it, depending on fracture orientation). Illustration by Clément M.L. Werner, MD.

heals. In addition, syndesmotic stability may be restored with fixation of the posterior malleolus instead of with syndesmotic screws (see point 3 for further elaboration on this point). Although further investigation is warranted, this may obviate the need for syndesmotic screw fixation in select patients. We routinely remove syndesmotic screws at 12 weeks.

2 Oblique (shear) fractures of the medial malleolus

The fracture pattern of the medial malleolus can greatly vary and has been described to be more vertical in Danis-Weber A (adduction) fractures and more horizontal in Danis-Weber B and C (abduction and external rotation) fractures. Although both Danis-Weber and Lauge-Hansen classifications provide information regarding certain injury mechanisms, these classifications are not universally applicable. In addition, the mechanical stress pattern occurring in the ankle after open reduction and internal fixation is not necessarily identical to the injury mechanism. Whereas more horizontal fractures can often be dealt with conservatively,[5] for more vertical fractures it is advisable to provide maximal stress resistance against the 2 most commonly encountered mechanical forces on the medial side (varus stress, axial compression), regardless of initial injury mechanism. This is especially true for the relatively vertical medial fracture patterns, which tend to migrate proximally and especially so if fixed only with 2 oblique lag screws, as initially proposed in the early versions of the AO (Arbeitsgemeinschaft für Osteosynthesefragen) manual. These vertically oriented medial malleolar fractures are occasionally associated with marginal impaction of the medial articular surface. Disimpaction and restoration of the articular surface leave a metaphyseal defect that may further compromise the stability of medial-to-lateral lag screws. Therefore, we tend to apply an additional antiglide plate on the medial side (Figure 2), while the lag screws can be inserted either through the plate or next to it, depending on how far proximal the fracture spike extends. Care must be taken not to extend the plate too distally in order to avoid prominence, especially with shoe wear.

3 Posterior malleolar fractures

The posterior malleolus (aka Volkmann fragment) is involved in up to 25% of ankle fractures. If the stability of this fragment is not restored, the result may be talar subluxation or articular incongruity, either of which can lead to posttraumatic arthritis. The posttraumatic arthritis prognosis correlates with the size of the posterior malleolar fragment, with larger fragments (those involving >25% of the articular surface) having poorer outcomes.

Although much controversy surrounds treatment of this type of fracture, small avulsion fragments may be effectively treated nonoperatively,[6] especially as the weight-bearing area involved is minimal in fractures involving less than 25% of the total articular surface. However, posterior syndesmotic ligaments are invariably attached to a small avulsion fragment,[7] and, even when there is gross tibiotalar stability, the posterior restraining buttress of the ankle is disrupted. In our anecdotal experience, the results can be microinstability of the tibiotalar joint and subsequent early posttraumatic articular degeneration. Although this topic demands further study, perhaps more attention should be paid to reconstruction of these posterior structures.

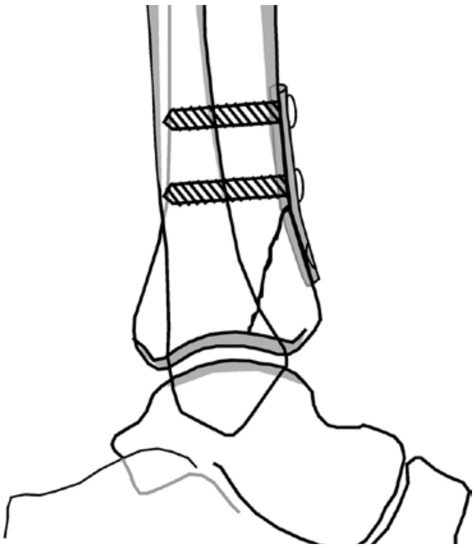

Figure 3. Posterior malleolus antishear plate (additional lag screws across fracture can be inserted). Illustration by Clément M.L. Werner, MD.

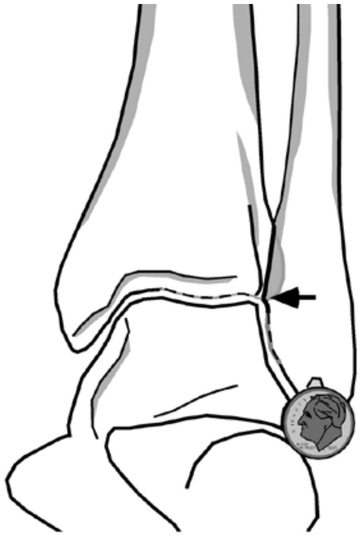

Figure 4. Signs for rotational and longitudinal alignment on the mortise view of the ankle: “dime sign,” alignment of medial fibula and tibial plafond (dotted line), depiction of “Mueller’s nose” (arrow). Illustration by Clément M.L. Werner, MD.

Also controversial is whether anatomical reduction and fixation are essential for fragments involving more than 25% of the joint surface.[1,6,8] The decision to perform anatomical reduction and fixation is often dictated by intraoperative clinical or radiographic signs of posterior tibiotalar instability. Most authors recommend internal fixation for posterior fragments involving more than 25% to 30% of the articular surface.[6] Unfortunately, plain-x-ray-based assessment of the size of the posterior malleolar fragment is not very accurate.

Posterior malleolar fractures can be fixed either by percutaneously applying anteroposterior lag screws or by using an open posterolateral Harmon approach. The Harmon approach has a few advantages: It allows direct visualization of the posterior malleolus, an antiglide plate can be applied at the fracture apex, and the fibula can be plated posterolaterally through the same incision.

Results from a recent study showed that fixation of the posterior malleolar fragment might restore the posteroinferior tibiofibular ligament and might obviate the need for syndesmotic screws.[7] On the other hand, an earlier investigation demonstrated that the posterior malleolus might be adequately stabilized with stable fixation of the fibular fragments.[9]

On the basis of our experience, we tend to stabilize the posterior malleolar fragment, even when it involves less than 25% of the articular surface, to restore the posterior buttress and minimize talar instability (Figure 3).

4 Fibula fracture fixation

Anatomical reduction of the fibula is crucial if high contact forces and subsequent osteoarthritis of the lateral aspect of the ankle joint are to be prevented. Malreduction of the fibula in terms of malleolar widening can be well controlled through assessment of the tibiofibular overlap on any anteroposterior x-ray (overlap should be <6 mm). Longitudinal or rotational malreductions of the fibula, on the other hand, are more difficult to detect.[10] These malreductions may be avoided through intraoperative open reduction of the syndesmosis but also through observation of radiographic signs (Figure 4): (1) The congruity of a line drawn from the medial border of the fibula toward the tibial plafond, (2) the “dime sign,” and (3) the depiction of “Mueller’s nose” (the distal anteromedial border of the fibula involved in the tibiofibular joint). For a Maisonneuve fracture, we tend to perform open reduction to avoid any distal malrotation.

Lateral plates with lag screws, lag screws alone, posterior antiglide plates, and other constructs have been proposed for fibula fracture fixation. Although lateral plates might be the easiest to install, they are often subject to symptomatic hardware and leave that hardware under the incision.[11] Lag screws alone might obviate the need for hardware removal, but the technique might not be applicable to patients with osteopenia.[12] Posterior antiglide plates have the most torsional force resistance but have been associated with peroneus brevis tendon irritations.

The osteoporotic bone found in many older patients and in highly comminuted fracture patterns poses a special challenge. Often required is stronger fixation through use of a stronger, limited-contact, dynamic compression plate or locking plate on the fibula; use of 2 plates; and/or placement of additional longer screws into the tibia (similar to syndesmotic screws, even if syndesmotic screws are not indicated) (Figure 5).

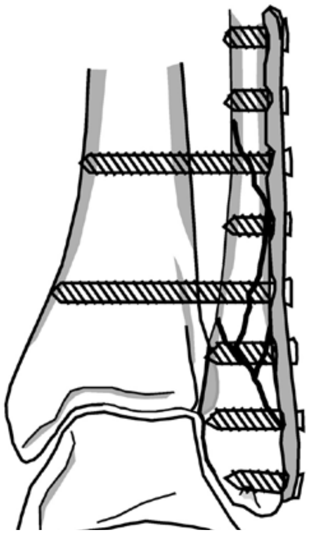

Figure 5. Additional fixation to the tibia makes osteosynthesis more reliable in osteoporotic bone (similar to syndesmotic screws, even if syndesmotic screws are not indicated). Illustration by Clément M.L. Werner, MD.

5 Postoperative management

Controversy exists as to how to treat these injuries after surgery. Postoperative treatment obviously depends on many factors: patient age, strength of installed construct, patient adherence to non-weight-bearing, time between index operation and patient discharge, and associated injuries. The postoperative protocol may range from full weight-bearing in a boot to non-weight-bearing in a cast. Immediate weight-bearing has been shown to be of some benefit in terms of shorter time to full weight-bearing and shorter time to return to work.[13] However, this protocol might be restricted to motivated, adherent patients with stable osteosynthesis.

Most patients are placed in a splint immediately after surgery. This splint can be replaced with a walking boot after initial swelling subsides but before discharge. The patient is to toe-touch weight-bear until the first postoperative visit. If the wound is healing, the sutures can be removed and the ankle placed in a boot for an additional 5 to 6 weeks. During this phase, the patient is allowed to toe-touch weight-bear and is encouraged to start range-of-motion exercises with physical therapy.

All patients require regular follow-up x-rays, especially the first several weeks after surgery. Within this time frame, before the bone has healed, it is still possible to address any reduction loss with additional surgery.

Summary

That all ankle fractures are not "simple" is quite clear. Recognizing those that are more involved, due to their ligamentous, syndesmotic or posterior malleolar involvement via subtle radiographic and clinical signs and managing them accordingly is essential for an optimal outcome.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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