# Chapter 4
# Bimalleolar Ankle Fracture: Medial Plate

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## Clinical Scenario

A 37-year-old female presents to the emergency department with an isolated left-ankle injury. She slipped and fell going down her basement stairs and twisted her left ankle. She is a healthy woman with no significant medical history and she is a non-smoker.

On physical examination, the patient has swelling and tenderness of the left ankle. There is obvious deformity of the ankle but the skin is intact and non-threatened. Distal motor and sensory examination is intact.

Initial injury X-rays (Fig. 4.1) reveal a fracture-dislocation of the ankle consistent with a supination-adduction (SAD) mechanism per Lauge-Hansen classification [1]. A transverse

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FIGURE 4.1 Initial injury AP and lateral radiographs

fibula fracture at the level of the mortise and a vertical medial malleolus fracture are the characteristic radiographic findings of an SAD-type ankle fracture.

The patient underwent closed reduction of the ankle under hematoma block, was placed into a plaster splint, and was scheduled for surgical management.

## Treatment Considerations and Planning

The vertical nature of the medial malleolus fracture line lends itself well to fixation with an anti-glide/buttress construct. Usually, a one-third tubular plate is sufficient.

The classic sequence of events in a SAD ankle fracture involves the talus being driven medially against the medial malleolus (Fig. 4.2). This has the potential to cause marginal impaction at the medial tibial plafond [2]. A CT scan of the ankle is often useful in confirming the presence/absence of medial impaction at the articular surface (Fig. 4.3). The impaction may be located at the axilla of the medial plafond or on the medial aspect of the stable distal

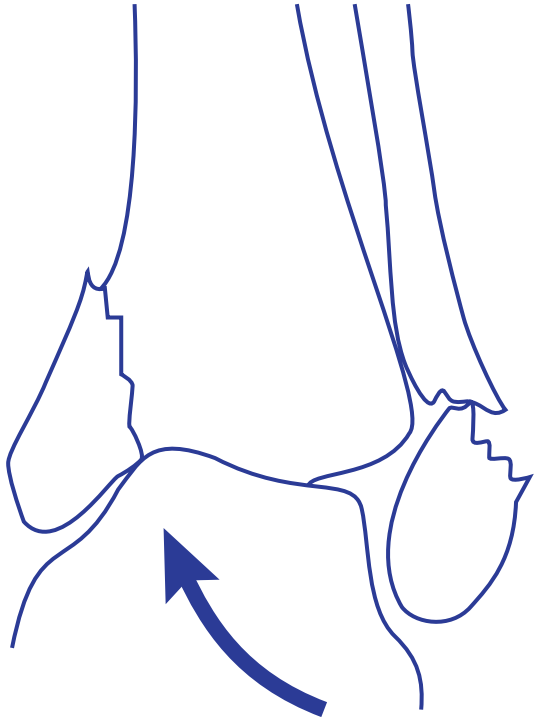

FIGURE 4.2 Supination-adduction fracture mechanism results in talus being driven medially into the axially of the medial malleolus

tibia articular surface (Fig. 4.4). It is important to recognize the marginal impaction in order to address and correct it at the time of surgery. A CT scan can also be useful in identifying the location of the apex of the medial fracture, allowing exact placement of the most optimal surgical incision (Fig. 4.5).

## Surgical Timing

Most ankle fractures will allow for acute open reduction internal fixation. Delay in medial plating is recommended in instances of extreme significant swelling (without skin wrinkling),

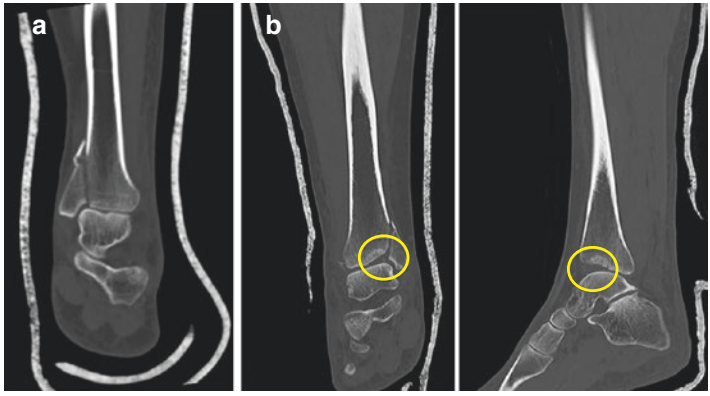


FIGURE 4.3 CT scan of the ankle demonstrating (**a**) absence of marginal impaction, (**b**) presence of marginal impaction (**note: **b** images are from different patient)

local abrasions associated with the injury or haemorrhagic blistering at the site of intended incision due to the concern for the inability to close the surgical incision, or subsequent wound healing and infection issues.

## Surgical Tact

### *Position*

The surgery is performed on a radiolucent table with a stack of blankets or a foam block used to create a platform to allow for acquisition of lateral imaging without lifting or manipulating the leg (Fig. 4.6). Patients should be positioned supine with a bump placed under the ipsilateral hip especially if the leg lies in significant external rotation at rest such that the foot points straight up and down. This allows for access to both the medial and lateral sides of the ankle. The authors prefer to use a tourniquet; however this is not mandatory.

FIGURE 4.4 Marginal impaction seen on AP radiograph (** note: different patient from case example)

## *Approach*

Careful evaluation of the CT scan can help with planning the medial surgical approach. It is important to plan an incision that will allow you to visualize the fracture line, and place a plate over the apex of the fracture to create a buttress. As many of these injuries involve articular impaction, visualization of this portion of the ankle joint to allow for reduction of

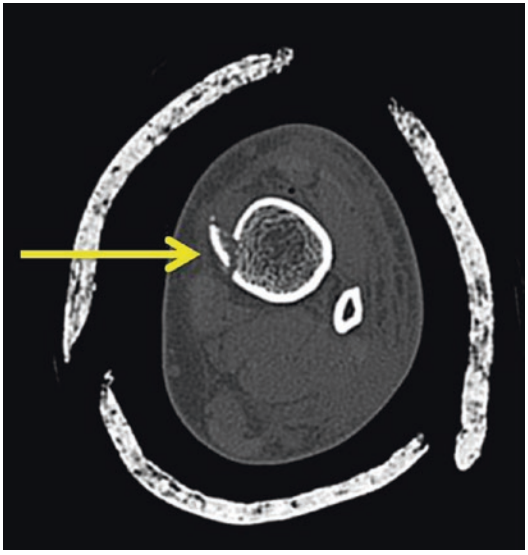

FIGURE 4.5 Identifying the apex (*yellow arrow*) of the medial fracture in order to plan the surgical approach

FIGURE 4.6 Setup and patient positioning for ankle fracture surgery

the joint surface and bone grafting or fixation is useful. Typically, an anteromedial incision permits adequate access to address these surgical goals.

Once the skin incision has been made, care should be taken to identify and protect the saphenous vein. Along the same course run the distal branches of the saphenous verve.

Injury to these small nerve branches can lead to a painful neuroma. Otherwise, apart from subcutaneous tissues, the exposure is taken directly down to bone. The apex of the fracture is identified and one can proceed with fracture reduction and fixation.

## *Fracture Reduction and Fixation*

Supination adduction injuries involve medial translation of the talus. This impacts into the medial malleolus and causes fracture and displacement. The talus then subluxes medially. For this reason we find approaching the medial side of these injuries first to be helpful. As the fracture is reduced, and a buttress plate is applied, the talus reduces into the ankle mortise and an indirect reduction of the fibula occurs. This makes the eventual reduction and fixation of the fibula easier.

First the fracture is approached. Care is taken to avoid stripping periosteum from the bone beyond that needed to see and achieve the reduction. Often infolded periosteum and hematoma need to be debrided from within the fracture. A laminar spreader may then be used to book open the fracture to expose any areas of articular impaction.

Any impacted fragments are pushed back down into position. The talus can often be used as a mould to avoid overreduction of the impacted articular portion. Once pushed down into position, the void left behind the fragments can be addressed. We typically use cancellous allograft chips either alone or mixed with demineralized bone matrix and vancomycin powder. Alternatively, calcium phosphate bone graft substitute can be used.

Once the articular surface of the tibial plafond has been addressed the medial malleolus fragment can be reduced into position. The provisional reduction can be maintained with small K-wires. A one-third tubular plate or other small fragment low-profile plate is selected and slightly under contoured to allow for a buttress effect. The plate is laid over the

apex of the fracture and the proximal screws are placed first to compress the primary fracture line. Distal lag screws through the plate should be placed in order to apply compression across the fracture line.

C-arm fluoroscopy is used throughout to confirm an anatomic reduction of the joint surface and reduction of the ankle mortise and extra-articular placement of screws.

Once the medial side has been addressed attention can be turned to the fibula fracture. Unlike many ankle fractures, SAD patterns are associated with a transverse fracture pattern. This may be amenable to either plate fixation or occasionally an intramedullary screw/wire.

### *Closure*

The wound is closed in layers. Given the high risk of wound complications with ankle fractures we prefer to use nylon sutures for the skin closure.

## Post-operative Protocol

Post-operatively, the authors prefer to keep the patient in the plaster splint placed in the operating room at the end of surgery for 2 weeks. The patient is mobilized touch-down weight bearing on the affected leg. At 2-week follow-up, the leg is removed from the plaster splint and is allowed to begin active and passive range of motion of the ankle. The patient's weight-bearing restriction is lifted at 6 weeks post-operatively and the patient is encouraged to progress weight bearing as tolerated, first in an aircast boot and then weaning out of the boot when comfortable. Formal physical therapy is not necessarily required; however, certain patient populations may benefit, such as older patients for supervised guidance on gait training, ankle strengthening and proprioception, or athletes for sport-specific rehabilitation.

## Follow-Up and Outcome

In general, patients are seen in follow-up at approximately 2 weeks, 6 weeks, and 3 months post-surgery. Weight bearing can begin between 6 and 12 weeks post-operatively depending on the degree of articular involvement and quality of the fixation. By 3 months post-operatively, our patient had returned to ambulating in regular shoes without the need for assistive ambulatory aid. She was pain free and her X-rays demonstrate good healing of the fracture (Fig. 4.7). She was discharged with instructions to gradually return to all of her activities and advised on the possibility for the need for hardware removal.

Fixation with a medial plate can result in irritation from the hardware, especially in thin patients. If required, symptomatic hardware can be removed after the fracture has completely healed typically after 9–12 months.

Outcomes of supination-adduction medial malleolus fractures treated with plating are good in the literature. In a case report of eight patients with associated marginal impaction,


Figure 4.7 Final AP, mortise, and lateral radiographs of patient at 3-month follow-up

McConnell and Tornetta reported 100% union in 8 weeks, good-excellent clinical outcome scores, and one patient requiring screw removal [2]. More recently, Ebraheim et al. reported on six patients with vertical medial malleolus fractures treated with plating [3]. Ultimately all six patients achieved union with an average AOFAS score of 84 at 6 months post-operatively; however, the authors rated 17% of patient as having a delayed union.

## Salient Points/Pearls

- Supination-adduction injuries often involve articular impaction. Obtain a CT scan to fully evaluate the articular surface and to locate the apex of the fracture to plan your surgical approach.
- Unlike most other ankle fracture types, in the case of a SAD fracture pattern, fixation of the tibia first may make the overall reduction easier, and often results in near-anatomic realignment and reduction of the fibula.
- During the medial approach, watch out for the saphenous vein and nerve. Although small, injury to the saphenous nerves may result in a painful neuroma.
- Reduction of the articular surface may require bone grafting or use of bone graft substitutes.

## References

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2. McConnell T, Tornetta P. Marginal plafond impaction in association with supination-adduction ankle fractures: a report of eight cases. J Orthop Trauma. 2001;15(6):447–9.
3. Ebraheim NA, Ludwig T, Weston JT, Carroll T, Liu J. Comparison of surgical techniques of 111 medial malleolar fractures classified by fracture geometry. Foot Ankle Surg. 2014;20(4):276–80.