# Management of Bimalleolar Ankle Fractures

Amy Ford and Brian Mullis

## 1 Introduction

Bimalleolar ankle fractures are common musculoskeletal injuries that may emerge in a variety of different settings. While they may present similarly to unimalleolar injuries, they pose a greater threat to a patient's function than an unstable unimalleolar ankle fracture [1, 2]. As described in an earlier chapter, these injuries may result from direct or indirect trauma to the ankle, but most often they are the consequence of rotational or twisting mechanisms. Instability of the ankle joint causes translation of the talus and leads to marked changes in the biomechanics of the ankle [3]. Ultimately, the goal of treatment is to restore congruency between the talus and the mortise and to maintain this alignment during healing. This chapter will delve into the evaluation and treatment, both operatively and nonoperatively, of bimalleolar ankle fractures.

A. Ford (✉)
Orthopedics Northwest, Yakima, WA, USA

B. Mullis
Department of Orthopaedics, Indiana University, Bloomington, IN, USA
e-mail: bmullis@iu.edu

## 2 Evaluation-Physical Examination

As with any musculoskeletal injury, it is important to conduct a careful neurovascular examination as one of the initial steps in the evaluation of the patient. While neurovascular injuries are not common in the presentation of bimalleolar ankle fractures, it is important to note any abnormalities for comparison preoperatively and postoperatively (as well as before and after splinting). Additionally, the finding of baseline peripheral neuropathy on the initial examination may alter the surgeon's preoperative plan and expected postoperative protocol. More detail on the management of diabetic ankle fractures and the Charcot ankle may be found in Part IV: Chapters "Management of Acute Diabetic Ankle Fractures" and "The Neuropathic (Charcot) Ankle".

The most important determinant in the acute management of the bimalleolar ankle fracture is the soft tissue examination. Even unremarkable bony injuries may present with rapid swelling or fracture blisters that may affect the placement of surgical incisions or delay the timing of the procedure itself. Widely displaced fractures or dislocations are prone to open wounds or skin necrosis, which reflect the magnitude of injury. These complications may be exacerbated if the ankle is left unreduced long enough to compromise the vascularity of the surrounding soft tissue envelope and, depending on the degree of displace-


D. Herscovici Jr. et al. (eds.), *Evaluation and Surgical Management of the Ankle*,
https://doi.org/10.1007/978-3-031-33537-2_12

ment, this can happen within hours. The state of the soft tissues is one of the most critical factors in deciding not only the urgency of a reduction or operation, but also the ankle's readiness for a surgical procedure. Skin than is blanched, tented or taut may have compromised vascularity, and should prompt a swift closed reduction in the acute setting, while an open wound would indicate the need for early antibiotic therapy and relatively urgent surgical intervention. In the closed fracture, excessive swelling at the time of surgery would increase the possibility of difficulty with wound closure and the resulting postoperative wound complications. The provider should evaluate the appearance of the skin (contused or abraded, tense or shiny, blanched or dusky, blistering), palpate for tension, mobility, skin wrinkling with gentle pinching around the surgical site before proceeding to the operating room for definitive fixation.

## 3 Evaluation-Studies

On the basis of history and physical examination, the physician may decide to order radiographs. The Ottawa ankle rules are used as standard of care for primary and emergency medicine providers to guide the ordering of diagnostic radiographs in patients presenting with ankle pain, in order to avoid unnecessary X-rays. These rules recommend radiographs when patients have pain and tenderness to palpation along the posterior border or tip of either malleolus or inability to bear weight for four steps, either at the time of injury or in the emergency department [4]. The first studies to order in the evaluation of bimalleolar ankle fractures are standard ankle radiographs: anteroposterior (AP), mortise, and lateral views. If there is an obvious deformity, a provisional reduction may be performed prior to imaging; however, it may be helpful to obtain radiographs first in order to identify the injury and be fully prepared for the reduction. In the instance of skin tenting or vascular compromise, a reduction maneuver should be performed without delay.

Standard radiographic parameters of normal ankles, as discussed earlier in chapter "Radiologic Imaging of the Ankle", should be assessed for disruption. Change in the talocrural angle (Fig. 1) or loss of parallelism of the lateral talus with the fibula may result from fibular shortening. Incongruity of the ankle mortise, talar tilt, or wid-

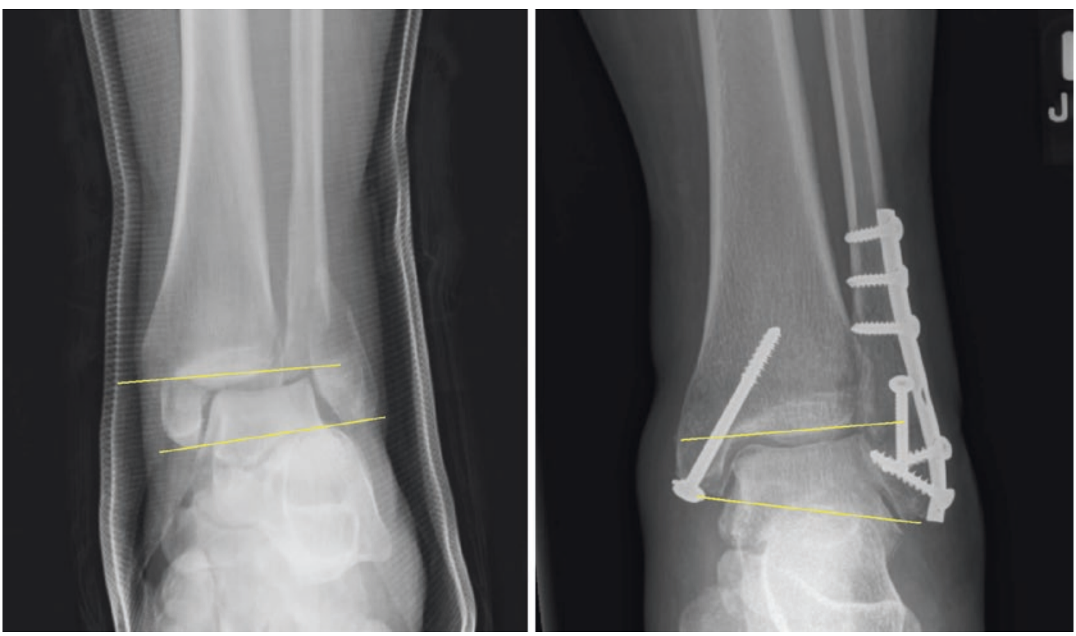

**Fig. 1** Restoration of talocrural angle after ORIF. Talocrural angle is assessed with one line parallel to the tibial plafond and one line between the tips of each malleoli. Population normal range is 79–87°

ening of the medial ankle clear space (Fig. 2) are all indicators of displacement and instability. In addition to assessing for tibiotalar instability, providers should also look for syndesmotic instability. Classically, the relationship between the tibia and the fibula at the ankle is assessed radiographically by examining the tibiofibular overlap and the tibiofibular clear space (Fig. 3), although these may be difficult to evaluate in the setting of a displaced fracture. If these are not obviously disrupted, a stress exam should be performed after surgical fixation of the ankle. This will be further discussed later in this chapter.

Computed tomography (CT) scans, while not needed routinely, may be desired when the bimalleolar ankle fracture includes a posterior malleolus fragment, or when the fracture fragments appear complex or are not fully understood on radiographs. A CT scan may elucidate the orientation of fracture lines and dictate the necessary operative approach for fracture fixation. In ankle fractures with marginal impaction

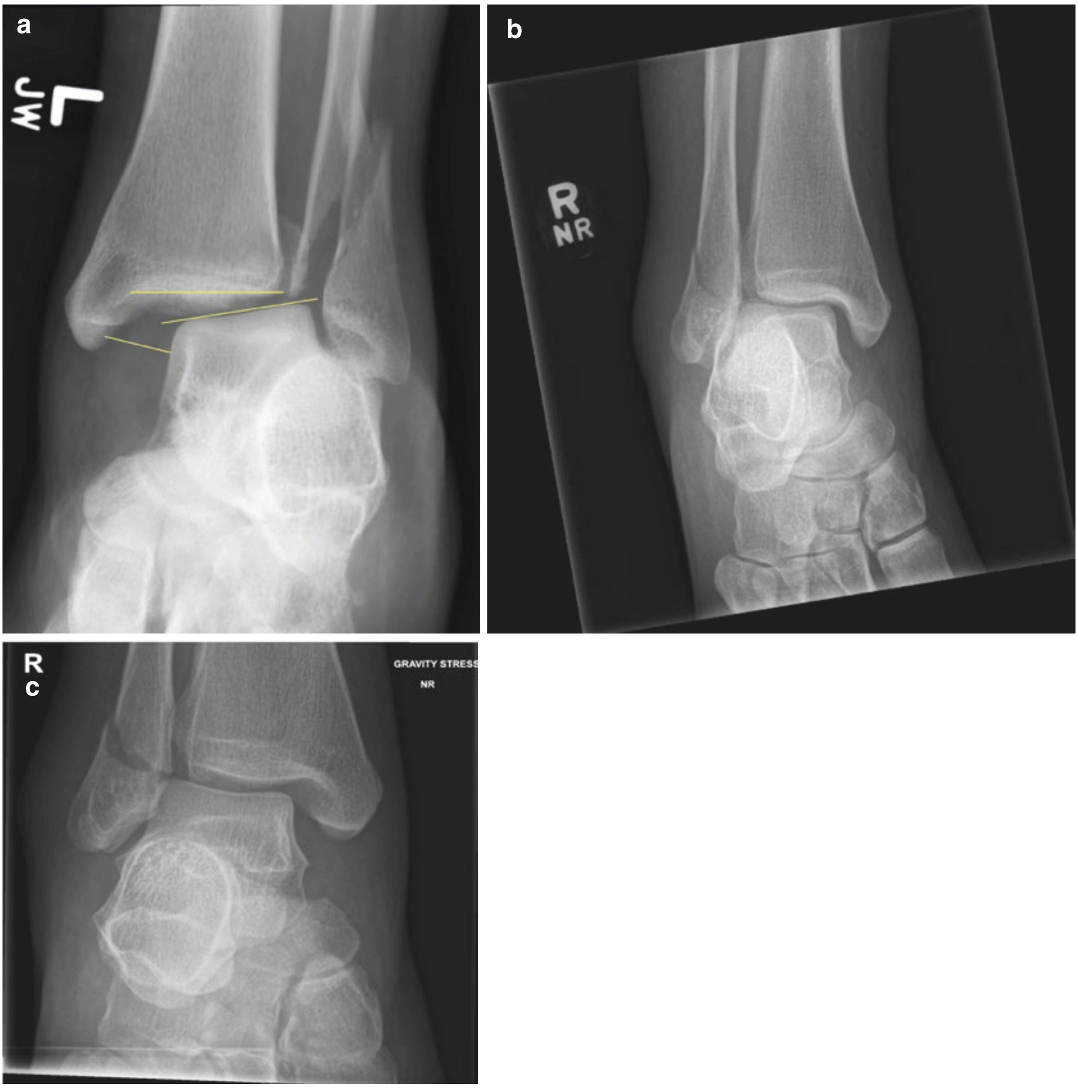


**Fig. 2** Medial clear space widening and talar tilt as indicators of ankle instability. (**a**) shows obvious widening of the medial clear space and tilt of the talus relative to the plafond on injury films. (**b** and **c**) show a more subtle medial widening which increases on gravity stress testing. Radiographs courtesy of Jan Szatkowski, MD

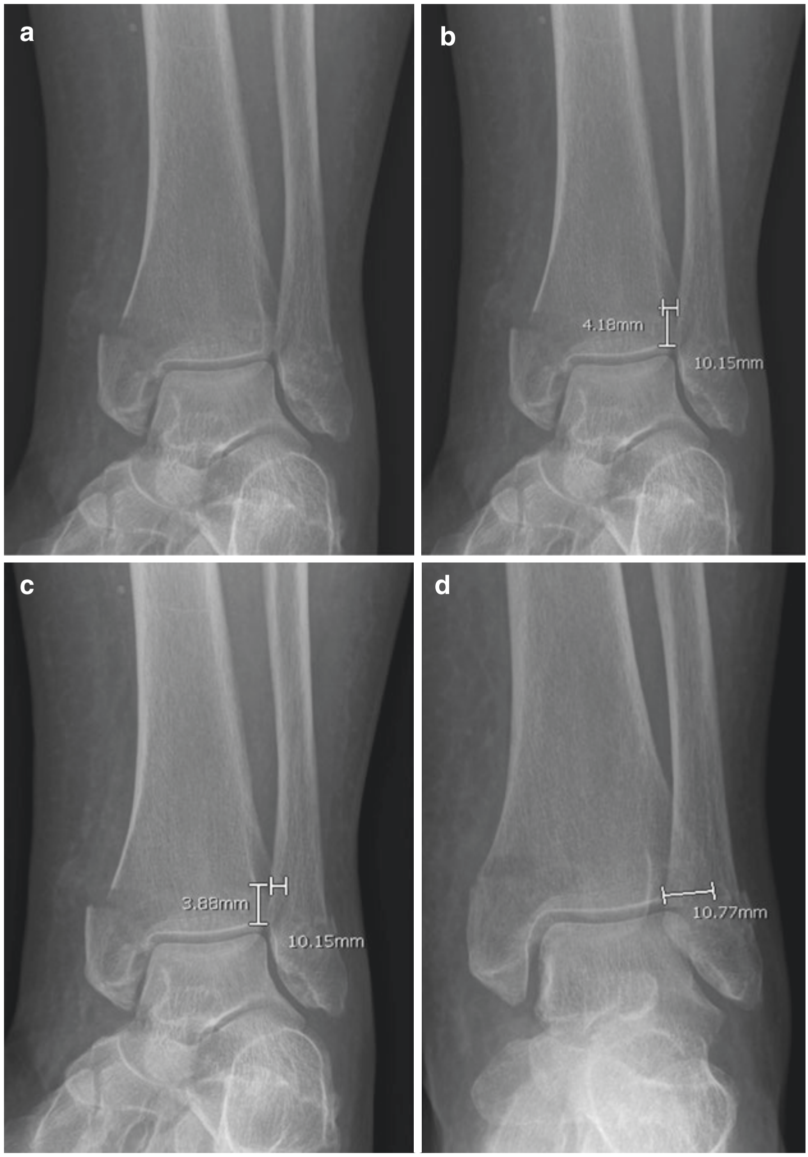


**Fig. 3** Tibiofibular clear space and tibiofibular overlap to assess for syndesmotic instability. (**a**) Radiograph of an ankle with an intact syndesmosis. At 10mm above the joint line, tibiofibular clear space should be <6mm on a mortise view (4.18mm in **b**), and tibiofibular overlap should be >1mm (3.88mm in **c**). On an AP view, maximum tibiofibular overlap should be >10mm (10.77mm in **d**)

of the joint surface due to dislocation or subluxation, a CT scan can be helpful for quantifying the degree of articular injury. This is commonly seen in supination-adduction type fractures, where the talus impacts the anteromedial tibial plafond [5]. This particular fracture pattern, which is transitional between rotational fractures and pilon fractures, is discussed in more detail in chapter "Management of Fractures of the Tibial Plafond".

## 4 Closed Reduction Techniques

Closed reduction of an ankle fracture is a skill that any provider working in an urgent care or emergency room should attempt to master. While the primary goal is to center the talus under the tibial plafond, every effort should be put forth to obtain a reduction as near to anatomic as possible. The more anatomic the reduction, the less pressure is placed on the surrounding soft tissues. Post-reduction radiographs should be standard practice to ensure that an adequate reduction has been achieved.

The method for reducing any fracture is to apply longitudinal traction, then reverse the deforming force. It may be helpful to consider the Lauge Hansen classification of the ankle fracture (see chapter "Classification of Ankle Fractures") when planning the closed reduction maneuver. For example, the most common type is the supination/external rotation fracture. In these, the talus and foot are usually dislocated in a posterolateral direction with reference to the tibial plafond. In order to achieve a reduction, typically all that is needed is adequate analgesia (possibly intravenous sedation) with the patient supine on the gurney, flexing the knee, and then pulling traction with one hand on the great toe, and the other behind the heel while rotating the foot in an adduction and internal rotation maneuver. While an assistant holds the foot suspended by the great toe with the hip externally rotated, using gravity and the intact structures to maintain reduction, the splint is applied and molded firmly toward the medial side to hold the foot and talus in position. Since the classic 1959 article by Quigley, multiple technique articles have been published describing methods for immobilization, reduction, and splinting [6, 7]. Further detail as well as an illustration of the Quigley maneuver may be found in chapter "Emergency Management of Ankle Fractures".

Adequate analgesia can be obtained by doing a "fracture-hematoma" block prior to reduction. Typically, 20 mL of 1:1 ratio of short-acting and long-acting local anesthetic can be injected into the ankle joint. Letting this mixture sit in the hematoma/hemarthrosis for 5–10 min is required to achieve good pain control for the reduction, so be patient. Sodium bicarbonate (1 mL) can also be added to the block to reduce burning with injection. This may help reduce the need for systemic narcotics but does not address patient anxiety. A calm, relaxed, and patient demeanor, along with careful explanation of what is happening and a little bit of coaching on breathing techniques can go a long way in this setting, but some patients still might require conscious sedation.

Most patients will be more comfortable lying supine during the reduction, although, the patient can be sitting. Keep in mind, the sitting patient may have a vagal response during the reduction attempt and injure themselves if they lose consciousness and fall off the bed. For these reasons the senior author recommends the patient be supine during reduction.

A successful ankle reduction is only useful if the ankle can be immobilized in the reduced position. Learning to apply a splint is an invaluable skill for the emergency or urgent care provider, as well for as the orthopedist. The splint should consist of both a posterior slab to prevent anterior or posterior translation as well as a sugar-tong slab to immobilize the position and rotation of the foot. Care should be taken to avoid any wrinkles or focal points of pressure in the splint, and to ensure that the splint is of appropriate tightness to maintain the reduction but not be overly restrictive for the patient. The padding should be neither excessive nor deficient; 2–3 layers of webril are usually sufficient. When possible, Plaster of Paris should be used rather than pre-packaged fiberglass splinting material, due to its superior ability to be molded accurately. Ten layers of plaster per slab is a common thickness. The setting of the splint is an exothermic reaction and will heat up while setting. Lukewarm water is typically used as cold water will lead to prolonged time to set up and hot water can burn the patient. Post-reduction radiographs in the splint should be standard practice to ensure appropriate reduction has been maintained.

## 5 Indications for Surgery

Most bimalleolar ankle fractures are unstable, which means that they are likely to re-displace due to muscular forces after manipulative reduction and is an indication for operative intervention in the patient who can tolerate surgery. Exceptions may include the non-displaced fracture or the minimally displaced lateral malleolus fracture with a small associated medial anterior colliculus fracture, with a maintained medial clear space less than 4 mm due to an intact deep deltoid ligament. Furthermore, closed treatment has been described and may be a better option in elderly, low-demand patients. Other indications for nonoperative treatment with this injury pattern include patients who are too high risk for anesthesia, nonambulatory patients, or others for whom the risks of surgery outweigh the benefits. Closed treatment of bimalleolar ankle fractures requires great skill at reducing and casting a fracture in the reduced position, very close follow-up with weekly radiographs, and a prolonged time in immobilization: at least 4–6 weeks in a cast, many times requiring an above the knee cast followed by below the knee cast. At long-term follow-up, patients with unstable ankle fractures have been shown to do equally well with or without surgery, if tibiotalar congruity is maintained [8, 9]. However, surgical treatment is simpler, more reliable, and usually less disruptive to the patient's life [10].

The timing of surgery depends on multiple factors, including logistical considerations such as surgeon and operating room availability, and medical considerations such as optimizing the patient's medical readiness for undergoing anesthesia. If the ankle is adequately reduced and stabilized with a splint, there is low urgency to proceed to the operating room with closed injuries. However, as in all fractures, earlier intervention will likely afford an easier surgical dissection and fracture reduction.

As discussed in previous chapters, there are certain factors that require early intervention, and others that preclude it. An open fracture should be taken to the operating room with some urgency (within 24 h, possibly sooner or immediately if there is vascular occlusion, gross contamination, or gross deformity unable to be reduced with closed reduction). At minimum, an excisional debridement and irrigation of the open fracture wound should be performed, typically with at least minimal internal fixation or external fixation. During debridement, it is important to thoroughly examine and clean the wound, including careful extension of the laceration and gentle redislocation. Care should be taken to preserve skin during the debridement. No fracture should be left subluxated or dislocated because this threatens not only the viability of the cartilage, but also the surrounding soft tissues. Soft tissue necrosis around the ankle may quickly lead to the need for a plastic surgery procedure or even amputation. Once in the operating room, treatment options include open or closed reduction and splinting, application of an external fixator, or definitive open reduction and internal fixation if the soft tissues allow. Even in the open fracture, if the wound is not grossly contaminated, definitive implants may be placed during the initial surgical encounter after a thorough irrigation and debridement. If there is too much swelling, blistering, or contaminated abrasion for surgical incisions, final fixation must be delayed until the soft tissues improve. Splinting and elevation can allow for soft tissue rest, but external fixation may be preferred to allow for easier examination of the skin while more reliably holding a reduction. External fixation may also help soft tissue swelling resolve faster as the external fixator acts to stabilize the soft tissues in addition to the bone injury. A staged surgery may then be performed once the soft tissues are appropriate.

## 6 Operative Techniques

Consider contralateral films preoperatively to help with surgical planning. This may also be done at the time of surgery, before the prep and drape, using fluoroscopy to obtain and save perfect lateral and mortise views of the uninjured ankle. These views can be particularly useful for judging fibular length and rotation and assessing the syndesmotic reduction. If the syndesmosis is found to be unstable after fixation of the malleoli, it must be addressed, and that issue will be discussed later in this chapter.

Bimalleolar fractures may include any two of the three malleoli, or a single malleolus fracture coupled with a disrupted ligament on the other side (usually deltoid), which is termed a "bimalleolar equivalent" ankle injury. When dealing with multiple injury sites around the ankle, it is important to plan the surgical incisions to allow access to each fracture while maintaining an appropriately sized skin bridge. While dogma has historically cited 7 cm as being the minimum acceptable distance between incisions, more recent literature has shown that a 5 to 6 cm skin bridge is typically well tolerated as long as the surgeon respects careful soft tissue handling, avoiding aggressive retracting, and placing the incisions within different angiosomes, which are areas of tissue that are supplied by different source blood vessels [11, 12]. Additionally, patient factors must be considered and, ideally, optimized, such as smoking, diabetes, and nutrition status. The surgical approaches to the ankle are numerous and include direct lateral, posterolateral, posteromedial, direct medial, anteromedial, direct anterior, and anterolateral.

For example, while a distal fibula fracture is commonly addressed through a direct lateral approach, a concomitant posterior malleolus fracture may also require surgical fixation. If an open approach to both is needed, the optimal route would be through a posterolateral incision. On the other hand, if the plan is to fix the fibula and supplement with syndesmotic screws as needed, with closed treatment of the posterior malleolus, then the surgeon may proceed with a direct lateral approach. If the orientation of the posterior malleolus is more medially based, the surgeon may plan to do a posteromedial approach instead. This is an example of when a CT scan may be very helpful for preoperative planning in more complex injuries.

Not every component of a bimalleolar ankle fracture must be repaired through a formal surgical approach. Any component that is nondisplaced may be treated in a percutaneous fashion, or without fixation if stable under stress views. However, if there is any concern for subtle displacement, an open reduction is preferred. Furthermore, once the fibula is stabilized, if the ankle and syndesmosis are found to be stable to stress exam, the surgeon may also choose to treat a medial or posterior malleolus in a closed manner, especially when these are small fragments. It is important to note the posterior malleolus fracture may be equivalent to a bony syndesmosis injury. In the setting of a posterior malleolus fracture, if the syndesmosis is found to be unstable after fixation of the fibula, stability may be achieved with either fixation of the posterior malleolus or syndesmotic fixation traversing the fibula and tibia. Although it has been shown that fixing the posterior malleolus leads to increased syndesmotic stability when comparing the two techniques [13], sometimes a fragment of smaller size will lead a surgeon to favor syndesmotic fixation. Functional outcomes between the two techniques have been shown to be comparable [14].

Reduction and fixation techniques will be described here, followed by a few case scenarios to reinforce the topics discussed. The lateral malleolus is the key to ankle fracture reduction and stability and is usually approached first. The exceptions may be when the joint is irreducible due to interposed medial tissue, when the lateral side is relatively more complex with a simple tension-failure medial malleolus fracture, or when there is a posterior malleolus fracture and fibular hardware may obscure x-ray views of that reduction.

A lateral malleolus fracture may present in a variety of patterns, which in turn dictate the reduction and fixation methods used. The fibula usually shortens when it is fractured, and the sooner an operation can be performed the easier it is to regain the correct length. A simple oblique fracture, typically anterior-inferior to posterior-superior, may often be reduced with small clamps, which are usually either pointed "Weber" clamps or broad serrated "lobster claws". A pointed reduction clamp is used to regain length by placing the clamp tines closer to the apices of the fracture rather than perpendicular to the fracture plane, so that once the tines are engaged, the clamp may be rotated to bring the fracture out to length and then compressed to maintain that length. Remember that the fibula is often a quite fragile bone, particularly in older patients, and aggressive clamping may crush the bone and lead to comminution with loss of "keys" to reduction.

If length cannot be obtained with the gentle use of clamps, other techniques include attaching the chosen plate (based on pre-op planning) to the distal fragment with screws and clamping it loosely to the proximal fragment with a Verbrugge clamp. A lamina spreader is then used between the end of the plate and a 3.5 mm bicortical screw placed approximately 0.5 cm proximal to the end of the plate. The fibula is lengthened by opening the lamina spreader while watching the ankle joint on C-arm; when the fibula is at the correct length, the plate is more firmly clamped to the bone and screws applied. This is the “push-pull” technique. Another option is the use of the small distractor, an instrument that uses 2.5 mm threaded tip Schanz pins in each fragment and has a knurled knob on a threaded central bar.

Once the fracture is clamped, it may be stabilized with interfragmentary lag screw fixation, usually 2.0 to 3.5 mm depending on the size of the fragments, followed by a neutralization plate (Fig. 4), or it may be stabilized with a posterolateral antiglide plate, with or without interfragmentary fixation. Positioning the clamps out of the way of the definitive fixation may be tricky and may require an intermediate step with provisional fixation like Kirschner wires or a mini-fragment plate. A small fragment one-third tubular plate is often an appropriate size for the fibula, but patient factors such as diabetes, obesity, or osteoporosis may persuade the surgeon to opt for a plate of heavier stock, such as a small fragment lateral malleolus locking plate or transitional plate, which is more robust than a one third tubular plate. The senior author prefers a lateral malleolus locking plate for comminuted fractures, but not because locking screws are needed. Rather, the pre-contoured locking plates are typically stronger plate stock with options for more screws distally. However, this comes at a cost (not just financially as these plates are more expensive). These pre-contoured plates may lead to more wound complications, so it is not advisable to use them for every fracture.

A fracture with a simple wedge intercalary fragment may still be anatomically reduced and fixed for primary bone healing as described above, but once the comminution becomes more extensive, bridge plating is typically utilized.

A transverse distal fibula fracture may require the surgeon to fashion a hook plate from a nonlocking 1/3 tubular plate (Fig. 5) in order to increase fixation into the distal segment. Although, many vendors now have a precontoured hook plate which may save operative time. Sometimes, a percutaneously placed intramedullary fibular screw or rod may be sufficient fixation for well-reduced or transverse fractures, or when the skin condition precludes plate fixation. Special techniques may need to be employed for complex ankle fractures, such as in osteoporotic bone or diabetic ankle fractures. This may require multiple small plates or supplemental wire or screw fixation, or multiple screws

**Fig. 4** Clamping of a lateral malleolus fracture and lag screw fixation followed by neutralization plating

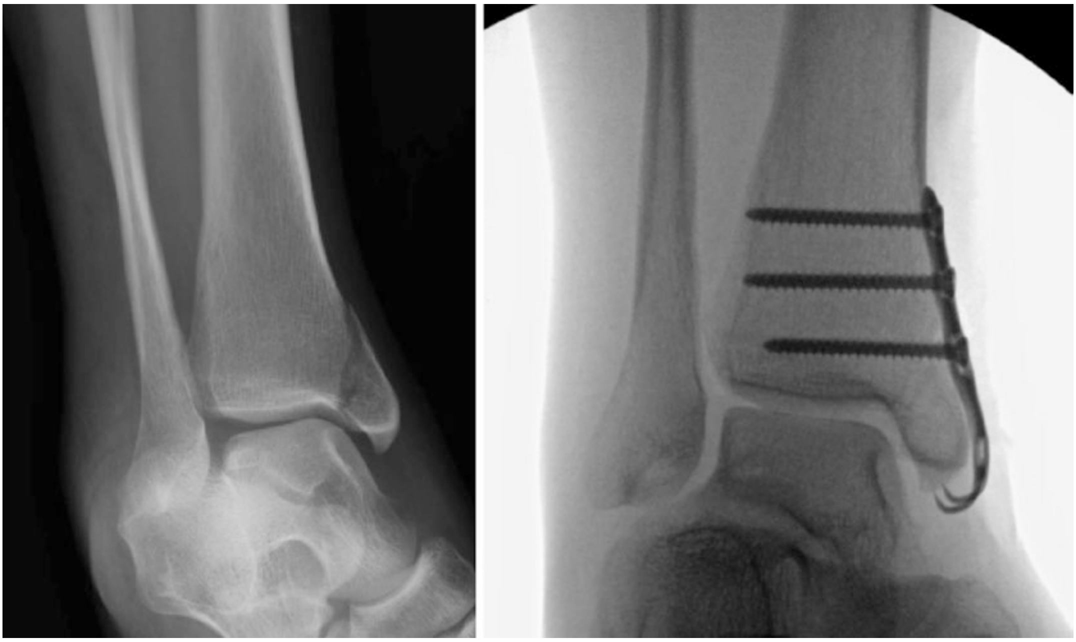

**Fig. 5** Buttress plating of a vertical medial malleolus fracture with a hook plate. The most inferior screw is right at the apex of the fracture, providing optimal buttress function

through the plate and into the tibia. Ultimately, the goal in those patients is to maximize fixation of the distal fibular fragment, as failure of that segment will lead to failure of the entire construct. The importance of the lateral malleolus reduction becomes amplified in the presence of a syndesmotic injury, as a good reduction of the lateral malleolus is necessary for an anatomic reduction of the syndesmosis. This, in turn, is critical for the stability of the ankle and a good functional outcome [15–17].

Optimal fixation of the medial malleolus fragment may depend on the fracture pattern. While two screws are sufficient for most transverse medial malleolus fractures, a small fragment may only allow room for one screw, or a screw plus a Kirschner wire. Crowding fixation into a small medial malleolus fragment may cause comminution. Small medial malleolus fractures involving only the anterior colliculus may not need fixation if the ankle mortise is anatomic after fixation of the lateral malleolus and stable on stress exam. Very distal, small fragments or comminuted medial malleolar fractures can be fixed with K-wires and a figure 8 tension band construct around a transversely placed screw. Vertically oriented fractures, such as those seen in supination-adduction type injuries, are best stabilized with a buttress plate (Fig. 5), as the deforming mechanism is a shearing force [18]. Comminuted fractures of the medial malleolus may require a combination of different techniques to stabilize the different fracture lines. It is important, also, to recognize that even after medial malleolar fixation, the deltoid ligament may still be incompetent, leading to medial instability [19]. The instability becomes evident after the bony reconstruction is completed and there is residual talar tilt with medial clear space widening, which may require additional ligamentous reconstruction. This can be achieved with direct repair, drill holes, or suture anchors depending on injury pattern and surgeon preference.

The surgeon should always be prepared to deal with a syndesmotic injury during ankle fracture fixation. A ligamentous syndesmotic injury in a bimalleolar fracture would be identified after fixation of the lateral and medial malleoli is completed. At this point, the surgeon should always stress the syndesmosis to identify instability.

Syndesmotic stress tests include the Cotton or hook test, which involves a maneuver that laterally translates the fibula, or a manual external rotation test. The external rotation stress method has been shown to be more sensitive than the lateral fibular stress method [20]. In addition to shifts in the mortise view, anterior or posterior translation of the fibula on the lateral view may be appreciated, and this may be an even more sensitive indicator of syndesmotic disruption [21]. There are several ways to assess a syndesmotic reduction, including direct open visualization at the level of the joint [22] and comparison to the saved fluoroscopic views of the uninjured side. On the lateral view, the position of the fibula relative to the tibia is particularly useful in assessing syndesmotic reduction [23]. Methods for reduction and fixation of the syndesmosis are topics of ongoing debate, with the only agreement being that accurate reduction of the syndesmosis is challenging. Historically, clamp placement followed by screw fixation from the fibula to the tibia was the standard of care. If a clamp is to be used, it must be "on-axis" with the syndesmosis in the sagittal plane. This has been shown to require one tine on the fibular ridge and the other on the anterior third of the medial distal tibia when evaluated on a lateral radiograph, although this is still subject to anatomic variability [24, 25]. However, some advocate against a clamp-based reduction, as the clamp can itself cause a malreduction in addition to overcompression of the syndesmosis. A manual digital reduction with direct visualization has been shown to improve reduction quality by comparison [26]. Similar to the trajectory of a clamp, the syndesmotic fixation should also aim posterior to anterior about 25–30°. While there is debate about whether the fixation should be transsyndesmotic (0–2 cm above the joint line) or supra-syndesmotic (2–4 cm above the joint line), consensus shows that it should not be placed above 4 cm, as this was the only level resulting in a worsened functional outcome [27]. Multiple studies have sought to evaluate the required number of screws and cortices engaged for adequate syndesmotic stability, but there has been no clear difference found in radiologic or functional outcome between tricortical or quadricortical screw fixation, regardless of the number or size of screws [28–30]. Additionally, although some surgeons routinely remove syndesmotic screws after a period of at least 8 weeks, the need for and timing of this remains controversial [31–33]. Most recently, the suture button has become an established form of syndesmotic fixation. Though widespread adoption is slowed by implant cost and surgeon preference, multiple studies have shown it to produce lower malreduction rates, lower rates of symptomatic hardware, lower rates of hardware failure, and lower rates of reoperation [34, 35].

The posterior malleolus can vary greatly in morphology, and this should direct the surgeon's approach toward fixation [36]. The posterior malleolus fracture is indicative of a bony syndesmotic disruption, as it is the location of the insertion of the posterior inferior tibiofibular ligament. Small posterior malleolus fractures may be treated in a closed fashion, with syndesmotic fixation placed in the event of instability. However, large fragments involving >25% of the articular surface should be reduced and stabilized. Accurate evaluation of fragment size requires a CT scan. There is ongoing debate about whether smaller posterior malleolus fractures should be fixed. Fixation may improve stability in cases where the syndesmosis is unstable. If the fracture is nondisplaced or minimally displaced, it can be manipulated with a percutaneous 2.5 mm threaded tip K-wire joystick and a large Weber or peri-articular clamp can be placed percutaneously around the fibula posteriorly and on the anterior distal tibia. This can be followed by percutaneous lag screw fixation with washers. If an open approach to the fracture is needed, this should also incorporate the approach to either the lateral or medial malleolus, depending on the fracture orientation, with either a posterolateral or posteromedial approach. If necessary, the fracture can be booked open and any intercalary displacement or impaction can be reduced to the talar dome. A buttress plate utilizing a small or mini fragment or T plate works well for posterior malleolus fractures. Posterior malleolar fractures are discussed further in chapter "Trimalleolar Ankle Fractures".

**Case 1: Medial and Lateral Malleoli**
In the classic bimalleolar ankle fracture, both the medial and lateral malleoli are involved. The order of reduction and fixation is mostly based on surgeon preference and fracture pattern. Sometimes, with a particularly difficult reduction, both approaches need to be made and worked through simultaneously in order to remove interposed soft tissue within the medial or lateral gutters. The medial and lateral malleoli may then be fixed with the techniques described above. Before fixation of the fibula is completed, screw holes above the joint line should be left available for syndesmotic screws if placing a plate laterally. Once the syndesmosis is stressed, those holes may be filled appropriately.

**Case 2: Lateral and Posterior Malleoli**
If an open approach to both the lateral and posterior malleoli is planned, a posterolateral approach to the ankle is made. Generally, reduction of the fibula first can help with reduction of the posterior malleolus. However, implants on the fibula will obstruct the fluoroscopic view of the posterior malleolus. Therefore, a useful technique is to reduce the fibula and secure it with provisional fixation, such as small clamps, Kirschner wires, or even lag screws, and then move on to the posterior malleolus before completing fixation of the fibula. Again, the syndesmosis should be stressed, but if the posterior malleolus is secured, one would expect it to be stable.

**Case 3: Medial and Posterior Malleoli**
This scenario may require two separate approaches if the posterior malleolus is laterally based, or a single posteromedial approach if it is medially based. The surgeon should be thoughtful about patient positioning if needing to do a dual approach, as it can be difficult to work on the medial malleolus with the patient in the prone position. Options in this case are to work entirely prone, position in the lateral decubitus position and externally rotate at the hip to do the medial approach in a functionally supine position, or to start prone and then flip to supine. Fixation may be performed with the techniques discussed above.

## 7 Rehabilitation Protocols

Weight bearing restrictions will vary depending on the treatment method employed. Closed treatment of a bimalleolar ankle fracture requires non-weightbearing on that extremity for at least 6 weeks to allow fracture healing. If there is syndesmotic injury involved, the time of restricted weight bearing may be increased to 12 weeks. For this reason and others, operative treatment of unstable ankle fractures is often preferred by patients.

With surgical fixation of the ankle, splint immobilization is usually maintained for 2 weeks or until the wounds have healed. At that point, immobilization continues in a boot, but patients are allowed to remove the boot and begin working on range of motion of their ankle to prevent stiffness. Allowing early range of motion with a removable brace after operative fixation of ankle fractures has been shown to lead to improved motion and increased functional outcome scores without increased complications compared to immobilization in a cast [37–39]; however, exceptions may be made for patients who are at high risk for wound complications [40]. Patients may typically begin early weight bearing at 2 weeks postoperatively without additional risk of wound complication or fixation failure [41, 42]. For patients with syndesmotic injuries, this topic becomes more controversial. Although there is evidence to show that they can safely be full weight bearing at 2 weeks [43], weight bearing is more typically begun at 6–8 weeks postoperatively. Diabetic or vasculopathic patients, or others with delayed healing, may require even longer periods of non-weightbearing. Physical therapy for an ankle fracture may be needed for special populations with gait difficulties, for patients who have developed ankle stiffness, or for those looking to return to high levels of activity. However, most patients who have undergone surgical fixation of an ankle fracture will not need physical therapy.

## 8 Conclusion

Surgical treatment of unstable bimalleolar ankle fractures is important for restoring ankle stability and preventing post-traumatic osteoarthritis. At 1 year postoperatively, most patients have little or no pain and few, if any, limitations in functional activity [44]. However, patients should be counseled that they should expect to see improvements in function through the first 2 years of recovery [45] and may have trouble in returning to sporting activity after their injury [46]. Syndesmotic injury further worsens outcomes, even after stabilization, and this should be emphasized to patients to set appropriate expectations [47].

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