CHAPTER **30**

POSTERIOR TIBIAL FRACTURES

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Fractures of the posterior malleolus as isolated injuries are most uncommon. They are usually associated with disruption to the other malleolli commonly producing the trimalleolar fracture. The posterior malleolus fracture most commonly occurs with the supination-external rotation and pronation-external rotation fracture patterns. Athough not common, they can occur with pronation-abduction fractures and are not usually large. Posterior malleolus fractures are not observed with the supination-adduction injuries (1).

The ankle joint involves three bones, the tibia, fibula, and talus. The distal tibia is quadrilateral in configuration ending in the articular surface forming the superior aspect of the ankle joint. The articular surface is inclined at about 15 degrees. The posterolateral aspect of the distal tibia is referred to as the posterior malleolus. The medial extension is the medial malleolus and there is a concaved recess on the lateral aspect for accommodation of the fibula. The anterior aspect of the tibia extends further lateral as the tubercle of Chaput than the posterior aspect. The posterior aspect of the tibia extends more inferiorly than the anterior. This posterior portion of the tibia has been referred to as the posterior malleolus or Volkmann's tubercle. Medially, the deltoid ligament attaches to the medial malleolus. The inferior anterior tibiofibular (anterior syndesmotic ligament) ligament attaches to the anterolateral tibia (tubercle of Chaput) extending to the anterior aspect of the lateral malleolus. The posterior inferior tibiofibular ligament attaches to the posterior malleolus and the posterior aspect of the lateral malleolus. The interosseous ligament is situated in the syndesmotic space between the distal tibia and fibula (2-4).

The biggest question is the size threshold at which the posterior malleolus fracture needs to undergo open reduction with internal fixation (ORIF). The traditional answer has been when it is 25-30% of the tibial articular surface as seen on the lateral radiograph (5-7). It is recognized that ankle fractures resulting in posterior dislocation may produce larger posterior malleolus segments. One problem with large posterior malleolus fractures is the difficulty of maintaining a closed reduction. The foot may need to be placed into plantarflexion to hold the reduction (5). While the posterior malleolus contributes to stabilizing the talus against posterior subluxation, it also can contribute to syndesmostic stability (8).

It is recognized that the exact size of the posterior malleolus fracture may be hard to determine on plain lateral radiographs. An externally rotated lateral view may help. However, a CT scan will always be useful in determining the actual configuration (9). If the posterior malleolus fracture is large enough to fix, it usually exits along the posteromedial aspect of the tibia or the medial malleolus. This fracture line can sometimes be appreciated on the AP or mortise views. While it has been recognized that trimalleolar fractures do worse than bimalleolar, the role of the posterior malleolus is hard to assess (5, 10). More recently, there has been some discussion that posterior malleolus fractures less than 25% should undergo ORIF as they may increase the risk of arthritis (11).

Once the determination has been made to perform ORIF, the next decision is how to approach the fracture. The two options are the posteromedial versus the posterolateral incision. The posteromedial approach is usually performed with the patient supine (Figure 1). It follows the posterior aspect of the tibia and curves along the inferior aspect of the medial malleolus essentially following the course of the posterior tibial tendon.

The sheath for the posterior tibial tendon is opened and the tendon is retracted posteriorly. The periosteum along the posterior aspect of the tibia is reflected exposing the fracture. The fracture can now be distracted and any osteochondral fragments in the ankle joint excised. If the medial malleolus is fractured, it is likewise exposed. A fractured medial malleolus can be distracted inferiorly, which will actually allow visualization of the articular portion of the posterior malleolus fracture. If the deltoid ligament is ruptured, then access to the ankle joint can be obtained through the anteromedial aspect of the joint. However, it may be difficult to visualize the posterior tibial articular surface. Sometimes, an arthroscope can be placed through the widened medial joint space, which can allow visualization of the posterior malleolus. It is usually done before exposing the fibula but this is a surgeon's choice.

The fibula undergoes ORIF through a standard lateral approach. The AO theory of the vassel principle would have you believe that anatomic reduction of the fibula will automatically reduce the posterior malleolus fracture because both are attached to the posterior syndesmotic ligament. While this sometimes will occur, it is more common that the posterior malleolus fracture needs to be directly manipulated. It will need to be pulled inferiorly and/or rotated to achieve an anatomic reduction. The quality of the reduction is assessed by the cortical margin along the posterior aspect of the tibia. Comminution of this cortex could be problematic for assessing reduction, but this rarely occurs.

The posterolateral approach is performed with the patient prone (Figure 2). By placing a foam block under the leg, it can actually be rotated to produce a lateral position. The approach is placed midway between the peroneal tendons and the Achilles tendon. The sural nerve will need to be protected. The dissection to the posterior malleolus is quite deep. The flexor hallucis tendon will need to be retracted medially. The periosteum is dissected along the margin of the fracture for exposure. The fibular fracture is exposed, debrided, anatomically reduced and internally fixated. The fibular plate can be applied posteriorly for an anti-glide function or laterally for neutralization. If the plate is to be applied laterally, it can sometimes be difficult to place

Figure 1A Mortise view of a supination-external rotation stage IV fracture sustained in a parachute jump.

Figure 1B. Lateral view.

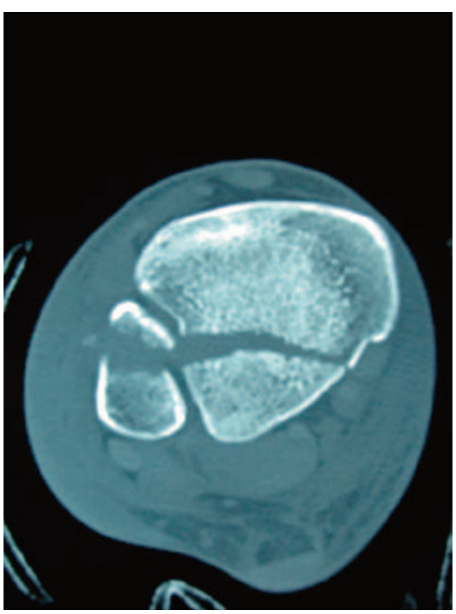


Figure 1C. CT scan demonstrating a large displaced posterior malleolus fracture.

Figure 1D. CT scan showing displacement.

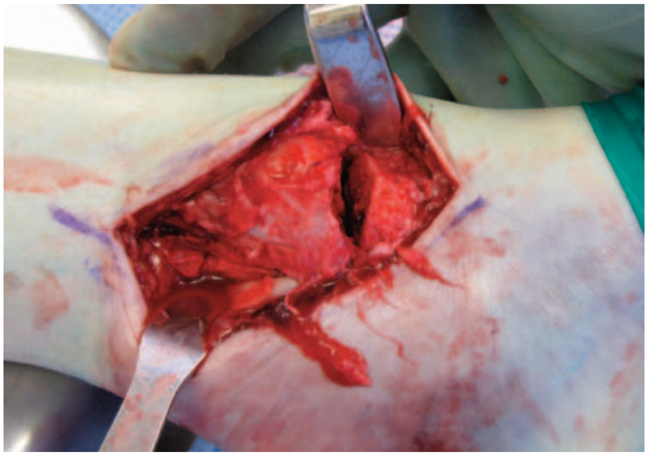


Figure 1E. Posteromedial approach with exposure of posterior tibial and medial malleolar fracture.

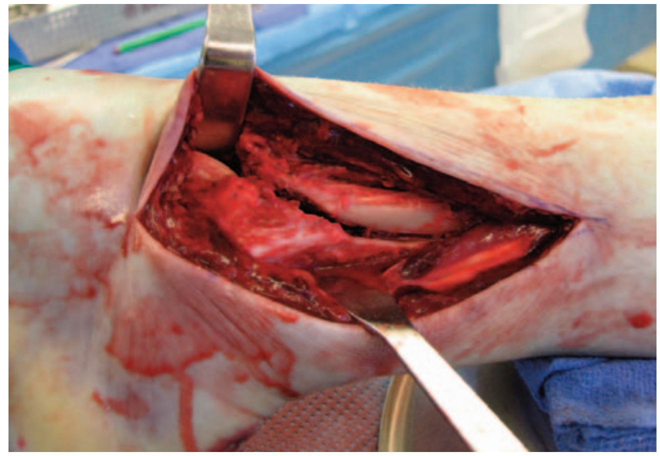


Figure 1F. Lateral approach for fibular exposure.

Figure 1G. Initial fibular reduction and fixation with reduction of the posterior malleolus and provisional stabilization with pointed reduction forceps.

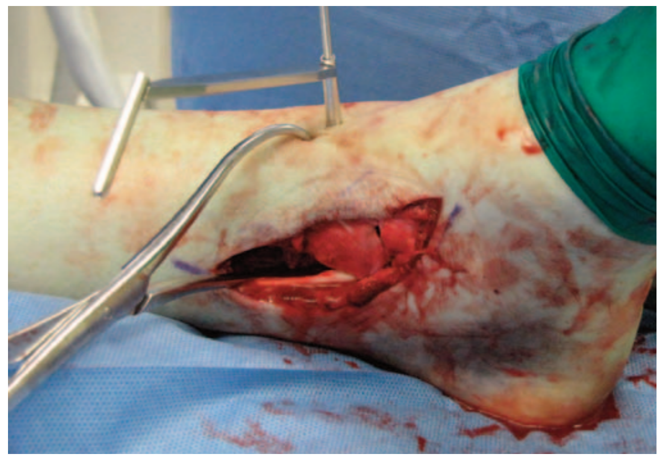
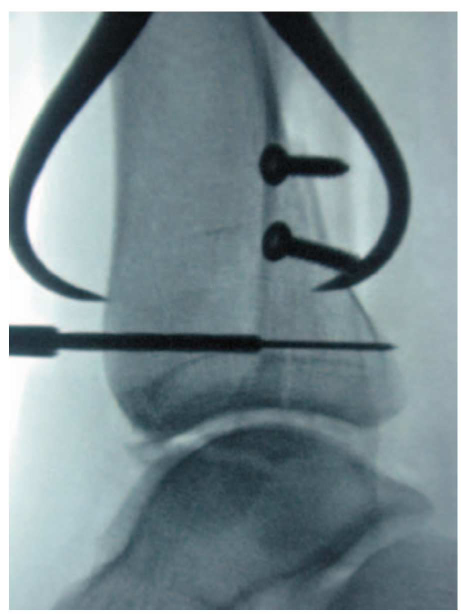


Figure 1H. Percutaneous drilling for lag screw.



Fiigure 1I. Technique for determining depth of drilling. The drill is a 2.7 mm and is a preliminary hole done prior to using a 3.5 mm drill for the gliding hole. This is done in an attempt to prevent shearing-off the guide pin with the larger drill.

Figure 1J. Mortise view of final ORIF .

Figure 1K. Lateral view of final ORIF. The fibula was fixated with an 8-hole 1/3 tubular plate with lag screws both outside and through the plate. The medial malleolus is fixated with a tension band wire over a hanging screw. The posterior malleolus is fixated with a cortical lag screw placed from anterior to posterior.

Figure 1L. CT scan reveals the posterior malleolus anatomically reduced and the cortical lag screw in good position.

Figure 1M. CT scan showing good position.

a lag screw from anterior to posterior. The posterior malleolus fracture is then reduced using the cortical margins under direct visualization. It should be noted that osteochondral fragments cannot be removed from this approach. Also, a medial malleolus fracture is hard to reduce and fixate from this position.

The second decision is how to fixate the posterior malleolus. With the posteromedial approach, the posterior malleolus fracture is fixated by placing the screw or screws from anterior to posterior (Figure 1). This is commonly done percutaneously. Care needs to be maintained not to iatrogenically injure any of the neurovascular or tendon structures along the anterior aspect of the distal tibia. Sometimes, the screws can be placed through either the posteromedial incision if retracted far enough laterally or through the lateral incision used to fixate the fibular fracture if it can be retracted enough medially. The screws are normally 3.5 mm cortical and can be either cannulated or noncannulated. The use of cannulated instrumention along with fluoroscopic visualization aids in the preparation for screw placement.

A cannulated screw is easy to place and easy to retrieve if necessary. It is possible to employ cannulated instrumentation but then place a noncannulated screw. Sometimes, a washer may be necessary to prevent subsidence of the screw past the anterior tibial cortex. This can occur with osteoporotic bone or over zealous tightening of the screw. The question is always how far to over-drill for a lag effect but not accidently go through the posterior cortex. Basically, one needs to exercise tactile control and use fluoroscopic imaging in the lateral projection. This can allow visualization of the depth of the 3.5 mm drill bit. Be careful not to shear-off the guide pin. However, one normally reduces the fibula first and many surgeons will apply a lateral neutralization plate. This usually obscures the reduction of the posterior malleolus; it may also interfere with calculation for over-drilling the lag screw. To avoid this issue, sometimes the fibula can be partially fixated with lag screws to allow lateral fluoroscopic viewing or a posterior anti-glide plate can be applied. The use of partially threaded cancellous screws placed from anterior to posterior should not be employed because of the difficulty of identifying if the threads pass on the far side of the fracture.

Through a posterolateral approach, the posterior malleolus can be fixated with lag screws placed from posterior to anterior or with a plate (Figure 2). The screws can be either 3.5 mm cortical placed with a lag effect or 4.0 mm partially threaded cancellous screws. Depending on the size of the fracture, one or two screws can be employed. A supplemental technique is the placement of an anti-glide screw over a washer or a one-hole plate at the apex of the fracture. This is placed to help prevent proximal displacement of the fracture. A plate can also be used for fixation with lag screws going through the distal holes providing more robust stability in an anti-glide function. This can be standard 1/3 tubular plate or a specifically designed posterior tibial plate.

At our institution, a variation is seen in which the fracture involves the entire posterior aspect of the tibia (12) (Figure 3). These injuries are thought of as "mini-pilon fractures." This fracture pattern occurs generally as the result of parachuting. Therefore, there is an axial loading as well as rotational forces influencing the mechanism of injury. The fracture may be a single large piece or may have an additional sagittal fracture line dividing it into two pieces. There will be one fragment posterolaterally and the other posteromedially. The posteromedial segment is most commonly the larger especially when considering the superior extension into the tibial metaphysis. However, they can be relatively the same size or sometimes the posterolateral fragment can be larger. They are usually interdigited in the mid-fracture line, the periosteum at this level intact, and effectively operate as one piece. On occasion, they may act as two individual fracture fragments. There are usually osteochondral fragments within the ankle joint. There may be also be a transverse fracture of the medial malleolus. This fracture pattern is most commonly approached posteromedially for the tibia and laterally for the fibula. This is necessary to expose the ankle joint for removal of the osteochondral fragments. It allows for excellent visualization to reduce the posteromedial tibial fracture component and place internal fixation. The screws are oriented slightly from posteromedial to anterolateral. In addition, a cortical lag screw is usually placed from anterior to posterior to capture the more lateral portion of the fracture.

Postoperatively, the patient is immobilized in either a fracture brace or a short-leg cast depending on the quality of the bone and stability of the fixation. An initial period of nonweightbearing is necessary usually for 4-8 weeks. When to begin range of motion exercises and physical therapy is at the discretion of the attending surgeon.

Figure 2A Mortise view of a supination-external rotation fracture sustained in a parachute jump.

Figure 2B. Lateral view.

Figure 2C. CT scan demonstrating the posterior malleolus and degree of displacement.

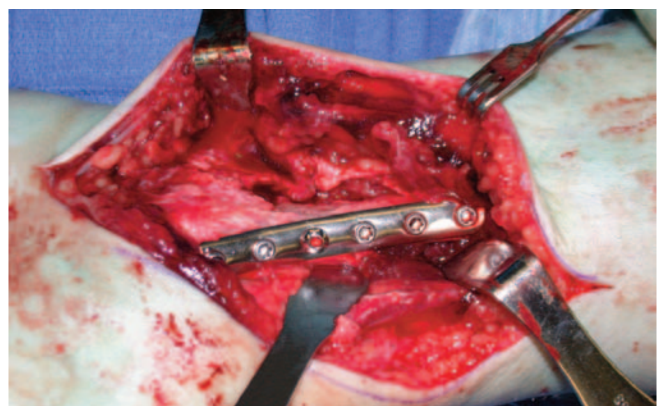


Figure 2D. Posterolateral approach to the ankle with the fibula fixated with a posterior plate.

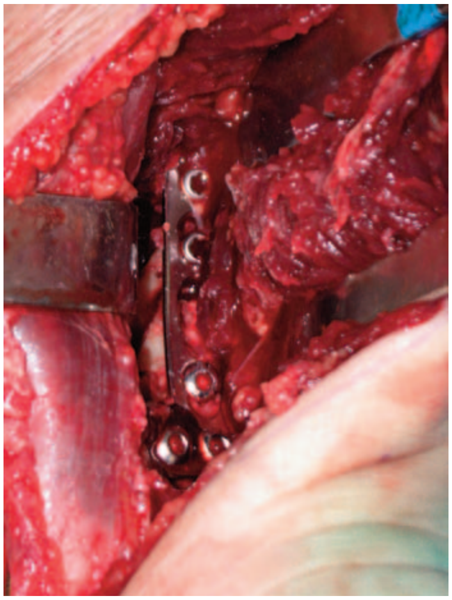


Figure 2E. Posterior malleolus fixated with a posterior plate.

Figure 2F. Mortise view of ORIF.

Figure 2G. Lateral view of ORIF.

Figure 3A Mortise view of Weber B fracture dislocation of the ankle.

Figure 3B. Lateral view.

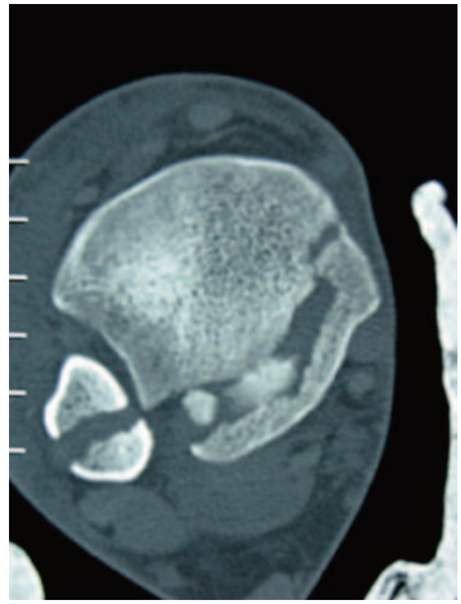


Figure 3C. CT scan demonstrating posterior tibial fracture that exits the medial malleolus and osteochondral fragments in the ankle joint.

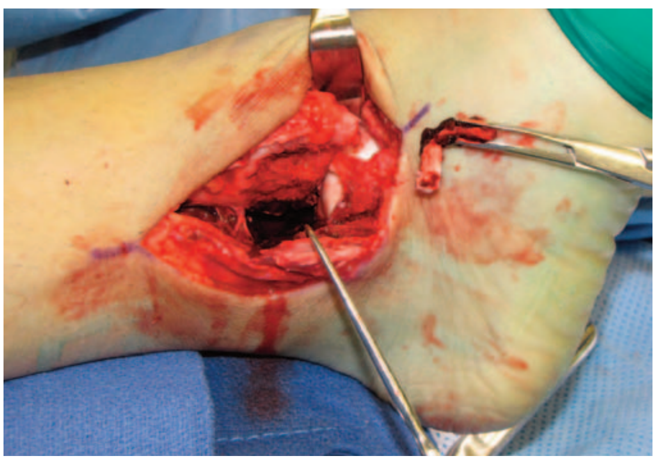


Figure 3D. Posteromedial approach. The posterior tibial fracture has been distracted and an osteochondral fracture removed.

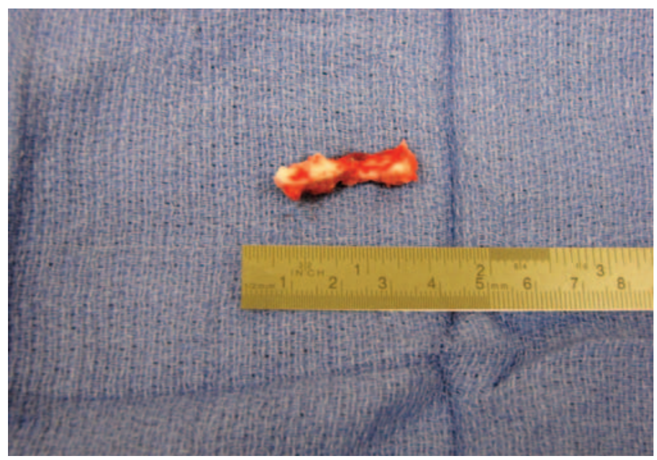


Figure 3E. Osteochondral fragment.

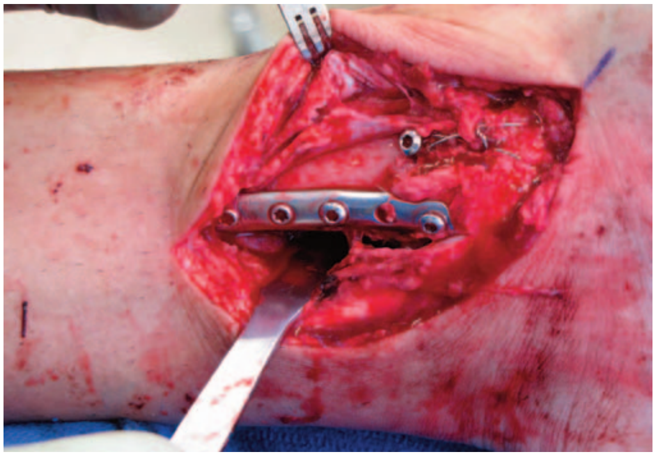


Figure 3F. Posteromedial plate applied to the distal tibia with a lag screw in distal hole and medial malleolus fixated with tension band wire.

Figure 3G. Mortise view of ORIF. The long fibular fracture was fixated with three cortical lag screws. The posterior tibial fracture was fixated with a posteromedial plate and a cortical lag screw applied from anterior to posterior. The medial malleolus was fixated with a tension band wire.

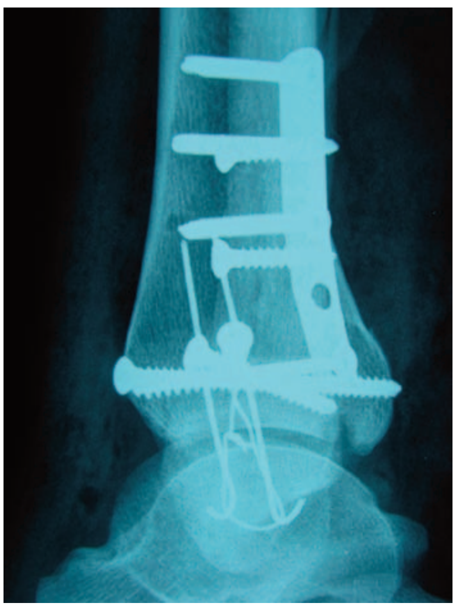


Figure 3H. Lateral view of ORIF.

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