CHAPTER **24**

PRONATION-EXTERNAL ROTATION FRACTURES

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INTRODUCTION

Pronation-external rotation injuries represent the second most common pattern associated with ankle fractures. They are consistent with the Danis-Weber Type C fracture.[1,2] The stages[2,3] of pronation-external rotation fractures are: Stage I (rupture of the deltoid ligament or fracture of the medial malleolus); stage II (rupture of the anterior inferior tibiofibular [anterior syndesmotic] ligament and the interosseous membrane); stage III (spiral fracture of the fibula above the level of the syndesmosis); and stage IV (rupture of the posterior inferior tibiofibular [posterior syndesmotic] ligament or fracture of the posterior malleolus).

STAGE I

Stage I represents injury to the medial structures of the ankle. The foot is in a pronated position at the time of injury with the leg internally rotating, which produces a relative external rotation of the talus in the ankle mortise. The ankle fracture rotates through a fibular axis.[2-4] Theoretically, this produces either a rupture of the deltoid ligament or a transverse fracture of the medial malleolus. However, an isolated complete rupture of the deltoid ligament probably does not occur clinically. If the deltoid is ruptured it is associated with other injured structures involving the syndesmosis (diastasis) and fibula (fracture). The transverse fracture of the medial malleolus represents a pull-off fracture and is usually large. If the medial malleolus fracture is nondisplaced, then management involves a short-leg cast for 7-8 weeks. An initial period of nonweight bearing for 2-4 weeks may be considered but normally the fracture is relatively stable.

If the fracture is displaced, then operative intervention is considered. The medial injury is easily approached through a curved incision, which may be placed anteromedially, medially, or posteromedially. Under normal circumstances, preference is given to a hockey-stick shaped incision placed along the anterior and inferior aspect of the medial malleolus. This is used to approach both a ruptured deltoid ligament or a medial malleolus fracture. It should be noted that not all deltoid ligament ruptures are surgically repaired.[5] In the presence of a deltoid ligament rupture, the medial side is opened when there has been a dislocation of the ankle, there is osteochondral damage on the medial talar dome that needs to be addressed, or reduction of the fibular fracture fails to reduce the ankle mortise.

If the medial malleolus is fractured, it is exposed and the medial joint space inspected for osteochondral fractures. It is then anatomically reduced, and can be fixated employing several techniques.[6-8] If the fracture is large, then two 4.0 mm partially-threaded cancellous screws are placed. They can be either cannulated or non-cannulated. Another fixation technique if the fracture is osteoporotic, smaller in size, comminuted, or if the screws fail to purchase is tension band wire. The wire may be placed through a drill hole in the tibial metaphysis but is more commonly placed over a unicortical hanging screw. If the tibia is osteoporotic, then make sure the hanging screw engages both the medial and lateral cortex for increased stability. Two other options for fixation of a smaller sized medial malleolus fracture are utilizing 1 cancellous screw with adjacent Kirschner-wire or employing 2 smaller size cancellous screws. The location of the incision is changed to the posteromedial aspect of the tibia if there is a fracture involving the posterior aspect of the tibia. This allows excellent exposure to the posterior aspect of the tibia.

STAGE II

Stage II represents injury to the anterior syndesmosis and interosseous ligament/membrane.[2-4] This is a rare injury and sometimes may only be uncovered by stress external rotation radiographs. In a strictly ligamentous injury, it represents an unstable diastasis. The anterior syndesmotic injury usually presents as a mid-substance ligamentous disruption of the anterior inferior tibiofibular ligament. However, there can be an osseous avulsion off either the anterolateral aspect of the tibia (Chaput fracture) or the distal fibula (Wagstaffe fracture). This injury requires transydesmotic stabilization (see discussion later). Stage II can also present with a fracture of the medial malleolus and a diastasis.

STAGE III

Stage III represents a fracture of the fibula above the syndesmosis.[2-4] The fracture can occur anywhere from just above the syndesmosis to the neck of the fibula (Maisonneuve fracture). The fracture configuration is classically described as spiral. It is uncommon for this fracture pattern to be non-displaced and usually requires open reduction and internal fixation (ORIF). The approach and internal fixation varies depending on the location of the fracture.[6-8] If the fracture is in the distal one-third of the fibula, it is approached through a direct incision over the fracture site. The fibular fracture can be spiral or oblique-spiral in configuration. This fracture pattern sometimes produces a butterfly fragment. It can also be significantly comminuted.

After anatomic reduction, stabilization is performed with 1 or more cortical lag screws from anterior to posterior for a spiral fracture followed by application of a one-third tubular plate for neutralization. The plate can be locking or non-locking. If the fracture is more oblique in configuration, then the cortical lag screw is placed through the plate from lateral to medial. Sometimes, lag screws are employed both outside as well as through the plate at the same time. If there is comminution involving several large fragments, then these can be incorporated into the reduction and stabilized with individual lag screws or held reduced by the plate. If the comminution is extensive and the fragments small, then they are left in place and stabilized with a plate that bridges the fracture. The only question that remains is the stability of the syndesmosis.

Theoretically, since the posterior syndesmosis is intact, then anatomic reduction rigid internal fixation of the fibula along with suturing the anterior syndesmotic ligament should produce a stable ankle mortise. There is literature that indicates if the fracture is within 3.5 cm of the syndesmosis, transyndesmotic fixation is not required.[9] The best advice to give is that every fracture needs to have stress external rotation radiographs performed after reduction and placement of internal fixation. If there is any indication of instability demonstrated by an increased medial joint space (lateral talar subluxation) or increased syndesmotic interval, then transyndesmotic fixation needs to be placed. Traditionally, this has been accomplished with a positional screw.[10] Recently, there has been interest in using a button suture technique.[11]

If the fibular fracture is in the upper one-half of the fibula, the surgical approach is different. The fracture site is not exposed because of the muscular coverage or the danger of iatrogenic damage to the common peroneal nerve. Here, an indirect approach is performed. An incision is made over the lateral aspect of the ankle. The fibula is pulled distally while internally rotating to gain the proper length and rotation. The fracture is provisionally stabilized with a large pointed reduction forceps about the ankle. Transyndesmotic stabilization is performed with one or more screws.[12]

The controversies regarding a transyndesmotic screw are as follows:

Should the screw be a positional or a lag screw? What size screw to use? How many screws should be placed? How many cortices should be engaged? At what level should they be placed? What position should the foot be in when placing the screw? Should the patient be weight bearing or non-weight bearing? Should the screws be removed or left in?

The author's preference for transyndesmotic fixation is to employ a 4.5 mm cortical screw without lag technique. On occasion, a 3.5 mm cortical screw may be used. It is rare that a lag screw is employed. The syndesmosis is provisionally held reduced with a large pointed reduction forceps prior to screw placement. If the fibular fracture has been fixated with a plate, then the transyndesmotic screw is placed either through (more commonly) or below the plate depending on the level of the fracture. If the fibula was plated, then normally one transyndesmotic screw is placed. But if significant instability is present, 2 screws will be utilized. If the fibula fracture was addressed indirectly, then 2 transyndesmotic screws are always employed. In very osteoporotoic bone or patients with diabetes, multiple transyndesmotic screws may be placed in a tibia-profibula configuration. The screws are placed in a posterolateral to anteromedial direction and engage 4 cortices. The screws are placed with the foot in close to neutral position but not dorsiflexed. The weight bearing status is determined by the patient's circumstances but usually is for 4-6 weeks. The transyndesmotic screws are removed no sooner than 3 months.

STAGE IV

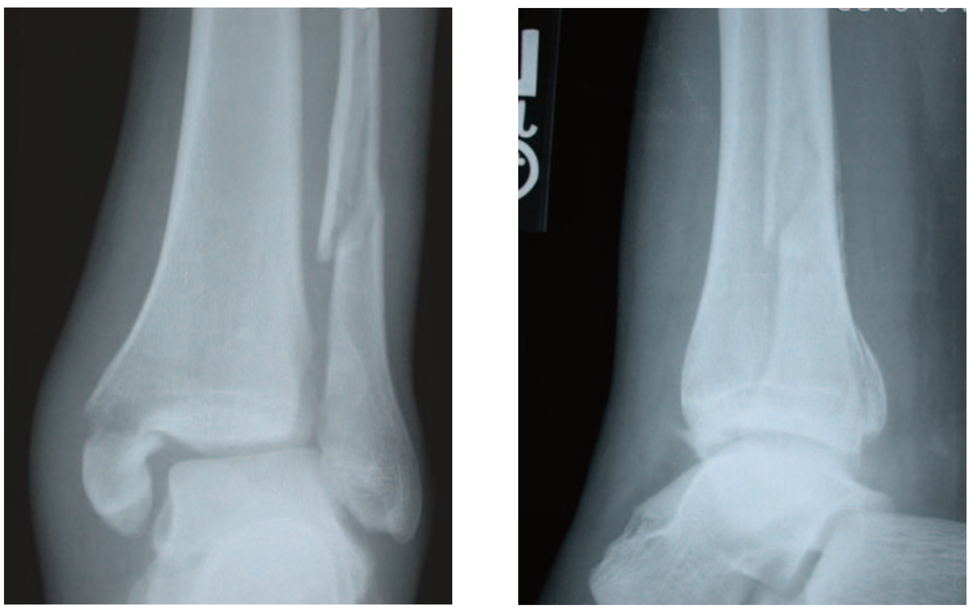
Stage IV presents as a ruptured posterior syndesmotic ligament or a fractured posterior malleolus.[2-4] Obviously, the posterior syndesmotic ligament is not repaired. The posterior malleollar fracture is anatomically reduced and fixated if it represents 25-30% of the tibial articular surface on the lateral radiograph.[6-8,13-15] If the posterior malleolar fracture is large enough to fix, it usually exits near the posterior aspect of the medial malleolus. If there is some concern about the size of the posterior malleolar fracture, then a computed tomography scan can be ordered.

As indicated previously, if the posterior malleolus needs reduction, it is usually approached through a posteromedial incision. This incision allows good visualization along the posterior aspect of the tibia. The fracture can be aligned employing the cortical margins. If there is an associated medial malleolar fracture, it can be retracted inferiorly allowing aligment of the articular margins along the posterior tibia. The fixation screw is placed from anterior to posterior utilizing a cortical lag screw that can be placed through existing incisions or percutaneously. Use a cortical screw so there can be no questions about the threads crossing the fracture.

It is less common to approach a posterior malleolus fracture through a posterolateral incision. The lag screws are then placed from posterior to anterior and are usually partially-threaded cancellous. Sometimes, an anti-glide screw with washer can be placed at the apex of the fracture. A plate can sometimes be utilized to secure a large posterior malleolus fracture. Occasionally, the fracture of the posterior tibia may include a posterolateral and a posteromedial fragment. In this case, the posteromedial fracture usually exits through the medial aspect of the medial malleolus, and the screws can be placed from posteromedial in an anterolateral direction.

While initial surgical intervention is ideal, closed fractures can be fixated anywhere up to about 3 weeks. Many different factors will dictate the timing of ORIF. Any dislocation needs to be reduced and immobilized as soon as possible. Open fractures are treated emergently with ORIF normally at the time of initial debridement.[16] Serial debridments and wound closure are based on the severity of the injury. Short term therapuetic antibiotics are utilized.

Postoperative management needs to be individualized. Immobilization can be a cast or a fracture brace for 8-12 weeks. Under normal circumstances, a fracture brace is employed and range of motion exercises are started about the third postoperative day. Sutures are removed in 7-14 days. An initial period of nonweight bearing is ultilized and can be from 2 weeks up until the time of transyndesmotic screw removal. Physical therapy is started at about 5-6 weeks.



Figures 1A (left) and 1B (right). Demonstrates an oblique-spiral fracture of the distal one-fourth of the fibula, with a transverse fracture of the medial malleolus and a small posterior malleolus fracture.

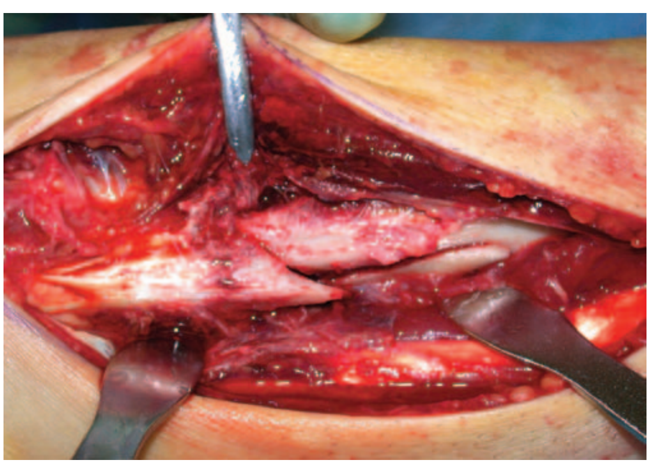


Figure 1C. Reveals the comminuted fibular fracture.

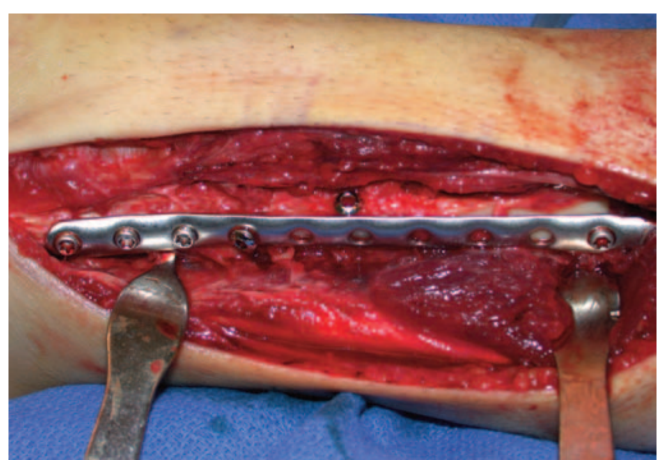
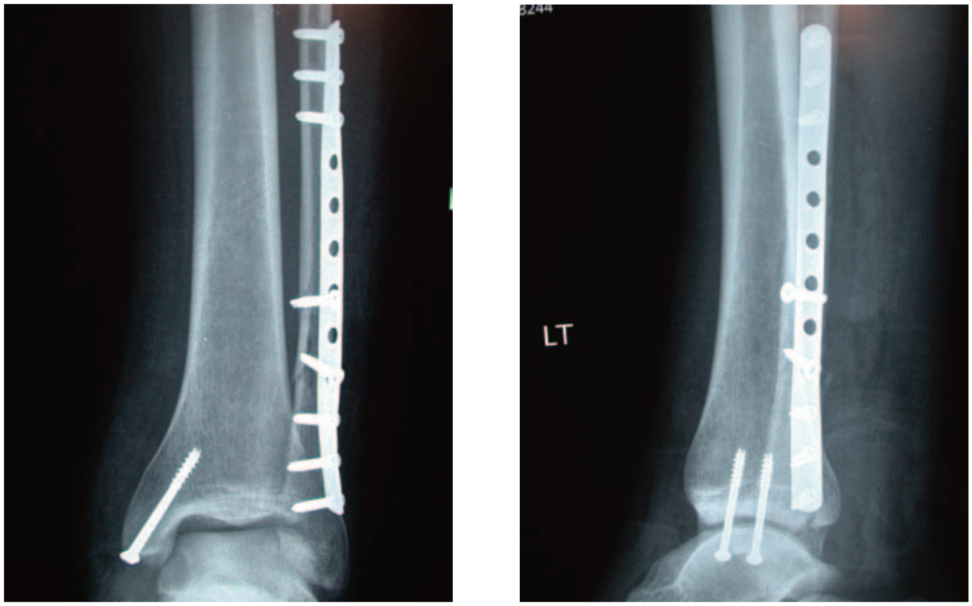
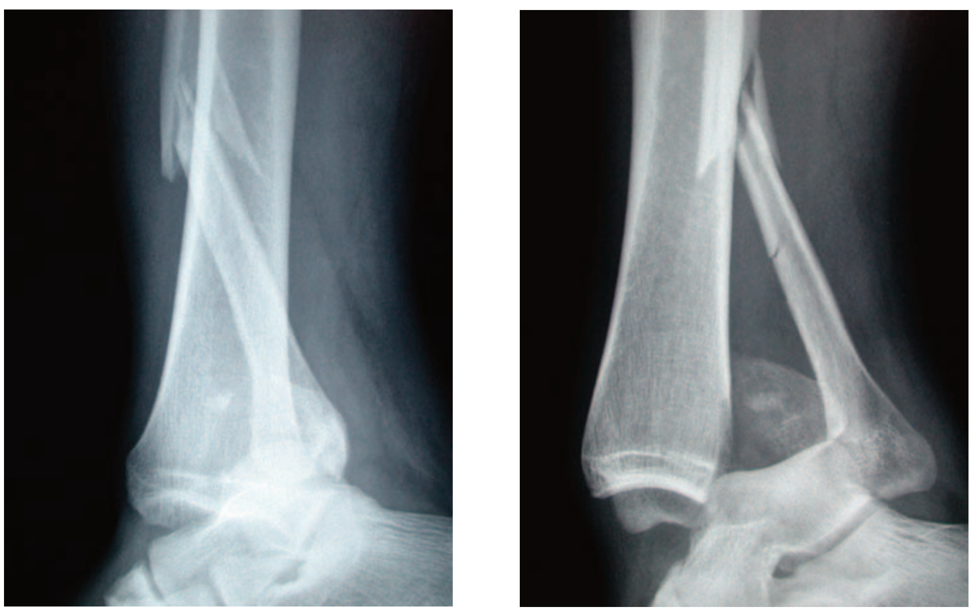


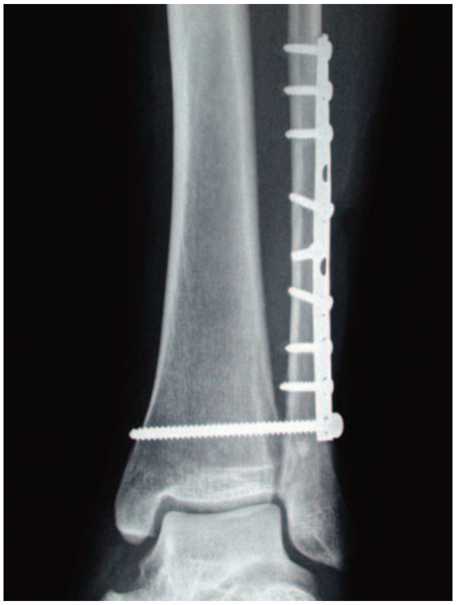
Figure 1D. Demonstrates the reduction and fracture stabilization with one-third tubular locking plate and screws.



Figures 1E (left) and 1F (right). Demonstrates an anatomic reduction of the ankle with good position of the internal fixation. Stress external rotation testing revealed a stable syndesmosis therefore no transyndesmotic fixation was placed.

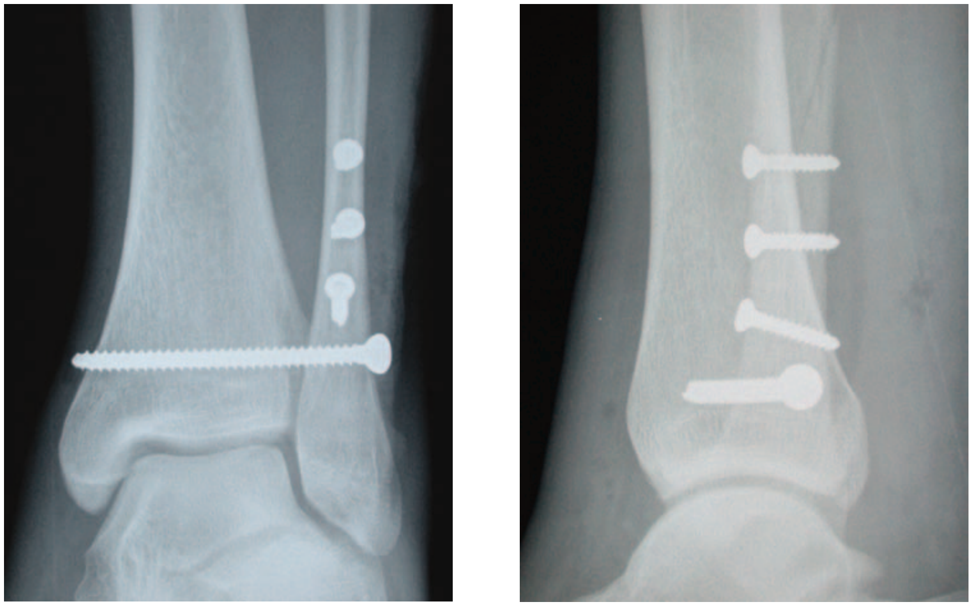


Figures 2A (left) and 2B (right). Demonstrates a closed fracture dislocation of the ankle with a comminuted fibular fracture, a ruptured deltoid ligament and a posterior malleolus fracture.




Figures 2C (left) and 2D (right). Demonstrates an anatomic reduction of the ankle with the fibula fixated with one-third tubular plate and screws. The medial side was opened, the joint explored, and the deltoid ligament repaired. The transyndesmotic screw was placed through the plate. The posterior malleolus did not involve a significant portion of the articular surface and was left alone.


Figures 3A (left) and 3B (right). Demonstrates a long spiral fracture of the fibula starting just above the syndesmosis with a widened medial joint space.



Figures 3C (left) and 3D (right). Demonstrates an anatomic reduction with the fibula fracture fixated with three lag screws without a plate and a transyndesmotic screw.

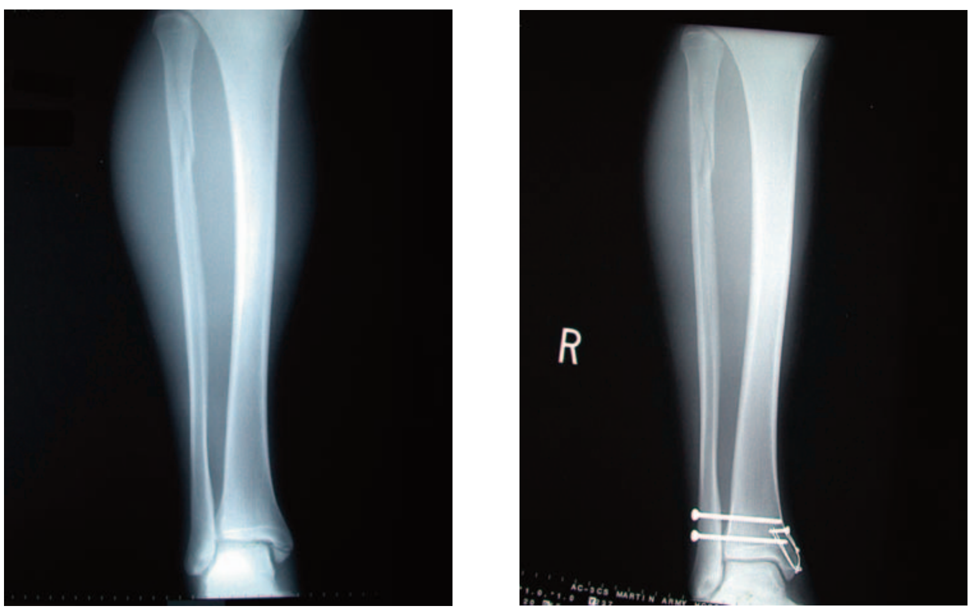


Figure 4A (left) and 4B (right). Demonstrates a Maisonneuve fracture of the fibula along with a fracture of the medial malleolus. The fibular fracture was reduced indirectly and fixated with 2 transyndesmotic screws. The medial malleolus was fixated with a tension band wire.

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