# PRONATION-ABDUCTION FRACTURES

*George S. Gumann, DPM*

*(The opinions of the author should not be considered as reflecting official policy of the US Army Medical Department.)*

Pronation-abduction fractures are not a common mechanism of injury. Yde (1) reported a 1.96% incidence. Experience demonstrates that they are more common than reported by Yde. The foot is pronated at the time of injury and the talus is directed in a lateral direction in the frontal plane without any external rotation. The injury thus starts on the medial side. While Lauge-Hansen classified this injury into its own category, Danis-Weber grouped it in with type B fractures (2).

In the Lauge-Hansen Classification, stage I presents as a transverse fracture of the medial malleolus or a rupture of the deltoid ligament. It is the same stage as seen in pronation-external rotation fractures. If an isolated injury, then it is a medial malleolus fracture as a ruptured deltoid ligament is probably not a clinical occurrence. If the medial malleolus fracture is nondisplaced, it can be treated in a short-leg cast for 7-8 weeks. It is recommended to perform radiographic follow-up in 2 weeks for loss of position. If the fracture is displaced, then it is usually treated with open reduction and internal fixation (Figure 1). The fragment is usually large and can be fixated with two 4.0 mm partially-threaded screws. If the bone is osteoporotic, then a tension band wire can be employed. Place the tension wire over a hanging screw, which engages both tibial cortices. In the rare occurrence that only the anterior colliculus is fractured, the fixation can be one 4.0 mm cancellous screw with a parallel Kirschner wire (K-wire) as a second point of fixation or one can utilize 2 smaller-sized screws (3-5).

Sometimes, this fracture can be approached through an arthroscopically assisted percutaneous technique. A 4.0 mm arthroscope is introduced through an anterolateral portal and the fracture visualized. The anteromedial portal is used to debride any hematoma and synovium that may obscure the fracture. The fracture is reduced percutaneously with a pointed reduction forceps under arthroscopic and fluouroscopic control. If successful, fixation is delivered in the form of cannulated cancellous screws. However, interposed periosteum in the fracture site may negate this method. The deltoid ligament is not routinely repaired as it is a secondary stabilizer (6). However, if the medial side is opened, then sutures are placed for primary repair. One must realize that the sutures are placed in the superficial portion of the deltoid ligament.

Figure 1A. Demonstrates a pronation-abduction stage I injury with transverse fracture of the medial malleolus at the level of the plafond.

Figure 1B. Open reduction internal fixation with two 4.0 mm partially-threaded cancellous screws of a pronation-abduction stage I injury.

Figure 1C. Fixation of the pronation-abduction stage I injury.

Figure 2A. Demonstrates what appears to be a normal radiograph in a patient sustaining an ankle injury. Clinical evaluation suggested a high ankle sprain indicating a pronation-abduction stage II injury.

Figure 2B. Confirms diastasis under fluoroscopy.

Figure 2C. Demonstrates arthroscopic evaluation of ankle for articular damage.

Stage II represents a rupture of the syndesmotic ligaments. The talus slides laterally pushing the fibula away from the tibia. There is rupture of the anterior and posterior syndesmotic ligaments and sometimes the interosseous ligament. If strictly a ligamentous injury, it represents a "high ankle sprain." If stable, it can be managed in a cast. However, instability requires surgical intervention. Sometimes, manual stress testing is necessary to make this determination. Surgical management can be either traditional open reduction internal fixation or percutaneously (5). This is a good scenario to arthroscopically assess the ankle for articular damage followed by percutaneous reduction and internal fixation (Figure 2).

Stage III presents the hallmark of the injury pattern with the fibula fracturing in an oblique configuration at the level of the syndesmosis (Figure 3). It can look somewhat like a supination-external rotation fibular fracture on the anterior-posterior or mortise views. The difference can best be seen

Figure 2D. Shows ankle mortise anatomically reduced and fixated with two 4.5 mm cortical screws.

Figure 3A. Demonstrates a pronation- abduction stage III bimalleolar fracture. There is a transverse fracture of the medial malleolus and an oblique fracture of the fibula at the level of the syndesmosis.

on the lateral radiograph. The fibula fracture forms an apex or transverse line instead of a curved or spiral fracture seen in supination-external rotation fractures.

Sometimes the fracture cannot be easily detected on the lateral view. On less common occasions, the fracture of the fibula can be transverse on the AP and mortise views. Sometimes, the fibular fracture can be above the syndesmosis like a pronation-external rotation fracture (Figure 4). Exposure of the fibular fracture is done with a lateral approach. The fibular fracture is anatomically reduced and fixated with a laterally applied plate. The plate is not only a neutralization but also an anti-glide plate as it captures the apex of the fracture that exits the lateral aspect of the fibula. One of the problems is that the reduction forceps are applied in a medial to lateral direction. Subsequently, the reduction can be lost by releasing the clamps to allow the plate to slide along the fibula. One technique to help this situation is to deliver a temporary K-wire to stabilize the fracture. A lag screw cannot be placed from anterior to posterior as in the supination-external rotation fracture because the fracture is essentially in the sagittal plane. This means that the lag screw must be placed through the plate from lateral to medial. It needs to be angled somewhat in a superior direction to make it perpendicular to the fracture. Sometimes 2 cortical lag screws can be placed through the plate (3-5). Always, determine the stability of the reduction with manual testing under fluoroscopic control.

Figure 3B. Postoperative radiograpaph demonstrates an anatomic reduction with the medial malleolus fixated with 2 cancellous screws and the fibula fixated with a one-third tubular plate with 2 cortical lag screws through the plate.

A variation of the pronation-abduction mechanism can produce a fracture above the syndesmosis. This usually occurs in the distal one-third of the fibula (Figure 4). It is also anatomically reduced and fixated with a direct surgical exposure. A one-third tubular plate is applied to the lateral aspect of the fibula with a cortical lag screw through the plate. If the fracture configuration is transverse, then no lag screw is possible. This configuration will mimic the pronation-external rotation type fracture in that a transyndesmotic screw may be required for syndesmotic stability. There is great controversy about exactly how to stabilize the syndesmosis. Such issues include the size of the screw, whether it is a positional or lag screw, the number of screws, 3 or 4 cortices, position of the talus when placing the screw, whether to weight bear or not, whether to remove the screw or not, and the timing for screw removal. Actual preference is either a 3.5 or 4.5 cortical screw placed as a positional screw through the plate engaging 4 cortices. Occasionally, the screw will be placed below the plate. It is angled in an anteromedial direction delivered with the foot near neutral position. It is left exposed several millimeters on the medal side for easy removal in case it breaks (3-5).

This fracture pattern can sometimes produce significantly comminuted fractures of the fibula at and above the syndesmosis (Figure 5). If there is a medial malleolus fracture, then reverse AO technique by reducing and fixating the medial slide first. This provides medial stability so that the fibula can be manipulated. With comminuted fractures, the reduction of the fibula can be difficult to gauge. Strategies include applying a plate to the lateral malleolar segment and pulling distally with a bone hook to gain length. One can apply a distraction device superiorly to the plate to gain length. Another technique is to just grasp the lateral malleolus with a reduction forceps, pull distally, and K-wire to the tibia and/or talus. Without bony landmarks, it is hard to ascertain if the reduction is anatomic. Clinically, inspect the superior aspect of the articular facet on the lateral malleolus to see if it aligns with cartilage on the inferior aspect of the tibia. On intra-operative radiographs, this should demonstrate an unbroken Shenton's line. Other indications that the fibula is not anatomically reduced would be a widened medial joint space, valgus tilt to the talus, and widening of the syndesmotic interval. When reduced, the fibula can be fixated with a one-third tubular plate. A locking plate may impart better stability. There is usually no chance to employ a lag screw. Sometimes, a transyndesmotic screw is necessary.

Another problem encountered with severe pronation-abduction fracture dislocations is impaction of the lateral tibial plafond. This may be minimal and go unrecognized on the radiographs or it can be obvious. If present, the tibial plafond needs to be osteotomized and disimpacted. The defect is filled with local cancellous bone graft and needs to be buttressed with internal fixation. This development can lead to avascular necrosis and collapse of the lateral tibial plafond causing the ankle to drift into valgus.

Figure 4A. Demonstrates an oblique fracture of the distal one-third of the fibula with diastasis and widening of the medial joint space.

Figure 4B. Postoperative radiograph demonstrating an anatomic reduction with fibula fixated with one-third tubular plate with lag screw and a transyndesmotic screw through the plate. The medial joint space was explored for excision of an osteochondral fragment and deltoid ligament repaired.

Postoperatively, the patient is immobilized in a fracture brace or short-leg cast for about 8 weeks. An initial period of nonweight bearing is employed. The duration is best determined by the attending surgeon. If a fracture brace is utilized, then range of motion exercises can be initiated when warranted. Sutures are removed at the appropriate time. At the time of osseous consolidation, the immobilization is discontinued and the patient sent to physical therapy.

Figure 5A. Demonstrates a pronation-abduction stage III fracture dislocation with severely comminuted distal fibular fracture.

Figure 5B. Stage III fracture.

Figure 5C. Demonstrates initial open reduction internal fixation of the medial malleolus reversing AO philosophy.

Figure 5D. Demonstrates reduction of the fibula with provisional fixation.

Figure 5E. Demonstrate open reduction internal fixation involving a locking plate on the fibula bridging the fracture, a transyndesmotic screw and the medial malleolus fixated with 2 cancellous screws.

Figure 5F. Internal fixation of the stage III fracture.

## REFERENCES

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