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Management of open pantalar fracture dislocation with definitive multiplanar external fixation

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Pantalar dislocation is a rarely occurring and reported injury. We report on an elderly patient that sustained an open pantalar dislocation injury treated primarily with multiplanar external fixation with good early recovery without infection or evidence of immediate avascular necrosis. To our knowledge, this is the first description of the treatment of pantalar dislocation with multiplanar external fixation as definitive fixation.

Keywords: pantalar fracture dislocation, external fixation, open fracture management

Pantalar dislocation is a serious yet rarely reported injury typically associated with high-energy traumas. Pantalar dislocation comprises 2-10% of all talar injuries and 0.06% of dislocations [1,2,3]. A pantalar dislocation involves the displacement of the talus upon its surrounding articulations on the tibia, calcaneus, and navicular. When fracturing occurs, this injury is typically associated with concomitant malleoli fractures due to excessive pronation or supination causing the anterolateral or anteromedial displacement of the talus at all its three articulations [4]. More common, closed pantalar dislocations with or without fractures can also occur [5]. Complications of this injury include avascular necrosis, infection, delayed healing, and post-traumatic arthritis [6]. Avascular necrosis of the talus is a common sequela after talus dislocation. Uniquely, the talus lacks any musculotendinous attachments and is stabilized between the bimalleolar fork and tarsus by robust ligamentous attachments [7]. The blood supply to the talus is supplied extraosseously by the anterior tibial, posterior tibial, and peroneal arteries. Internal vascular supply is provided by branches of the extraosseous arteries including the tarsal canal, sinus tarsi, and deltoid vessels [8]. Overall, the blood supply forms a tenuous radial anastomosis. The talus is at increased risk for vascular compromise given its superficial blood supply scantily penetrating vasculature. The talus is approximately 60% articular and therefore has decreased intraosseous vascular perforations [9].

Pantalar dislocation treatment has varied from primary fusion with talectomy, closed reduction alone, percutaneous pinning, and internal and external fixation [10, 11, 12, 13, 14, 15, 16]. Although there is no established guideline for pantalar dislocation management even recent studies show a high percentage of osteonecrosis 24% - 86% [17,6]. For dislocations with associated fracturing, internal fixation is clearly favored with possible temporizing via external fixation utilized in the early injury process. We describe the treatment of an open pantalar fracture dislocation which was primarily treated with external fixation. To our knowledge, this is the first manuscript to describe external fixation as a definitive treatment.

Case Report

An 88-year-old female sustained a motor vehicle accident involving an end-to-side collision with another vehicle. Upon arrival at our level 2 trauma center, she was diagnosed with polytrauma including closed fractures of the ribs, shoulders, and wrist. After initial assessment and stabilization, she was noted to have an open fracture of the left ankle with pantalar dislocation (Figures 1a, 1b, 1c, and 2). A handheld Doppler revealed audible PT, DP, and peroneal arteries. Timely antibiotics were administered in the ED setting. Closed reduction of the left ankle was attempted in the ED but was unsuccessful. Our team was not consulted until 6 hours after the injury.

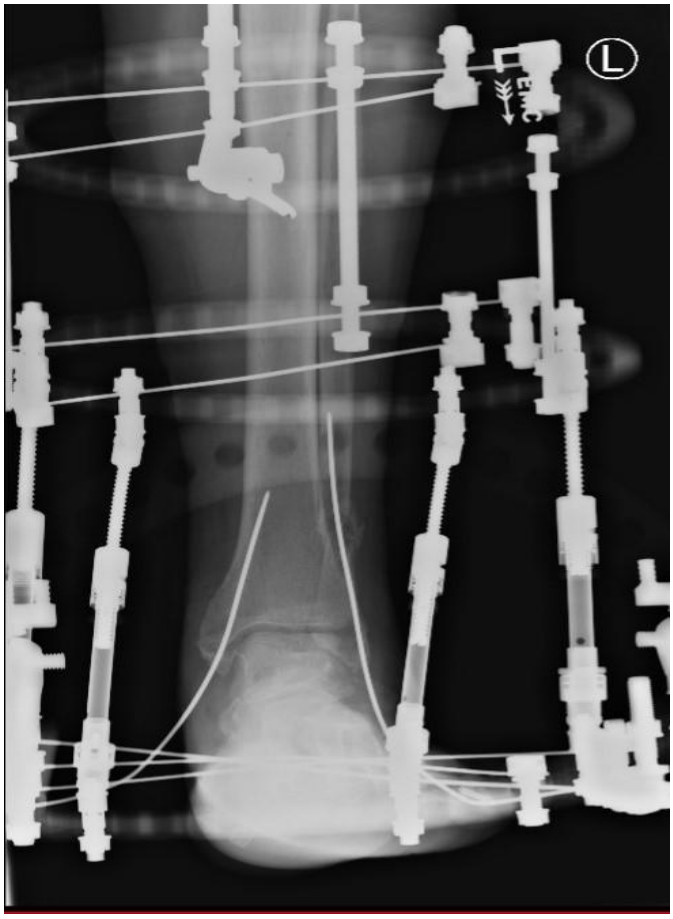
Figure 1a, 1b, 1c Left foot anterolateral pantalar dislocation with associated fracture of the distal tibia, medial malleolus, and fibula.

Surgery was performed approximately 10 hours after the initial incident once the patient was stabilized. Upon consultation with infectious disease, with considerations of the extended period before the index procedure, the patient was recommended to receive 6 weeks of IV antibiotic treatment.

Figure 2 Clinical photo of open fracture. Noted are the medial tibia and tibial plafond protruding from the wound. The wound measured 10 cm x 5 cm x 3 cm deep open wound. This open fracture was classified under the Gustillo-Anderson classification, the most widely used open fracture classification. After surgical debridement, our case involved a Gustillo-Anderson grade II, open wound >1 cm with adequate soft tissue coverage.

Procedure Description

Following general anesthesia without a tourniquet, the open lesion was thoroughly irrigated with normal saline. Wound cultures were collected. No additional open incisions were made. Reduction of the talus into the talonavicular joint was attempted but we experienced soft tissue impingement. Closer inspection through the fracture lesion noted that the posterior tibial tendon was preventing talar reduction onto the navicular. The tendon was manually retracted medially while the foot was placed in supination. The navicular was then reduced with manual compression with a periosteal elevator against the talonavicular joint.



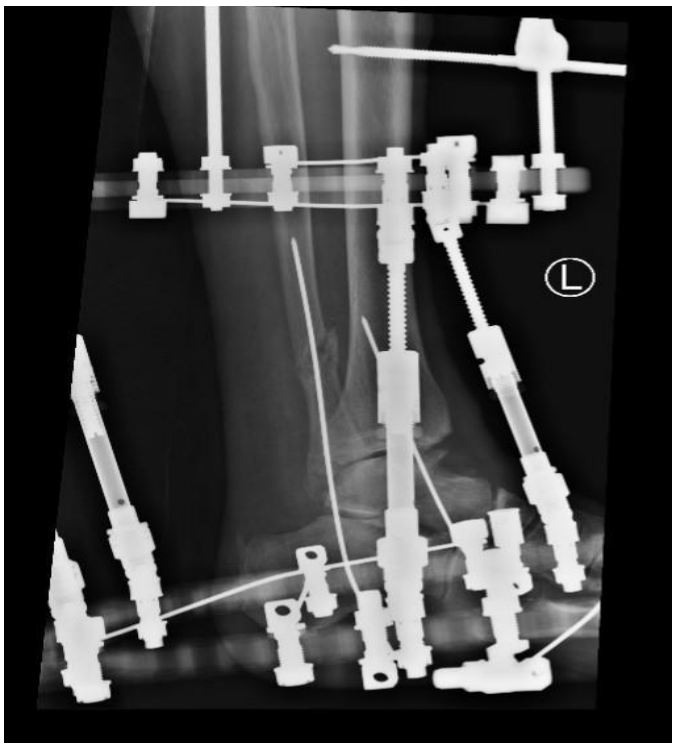


Figure 3a, 3b Post reduction and stabilizing with external fixation.

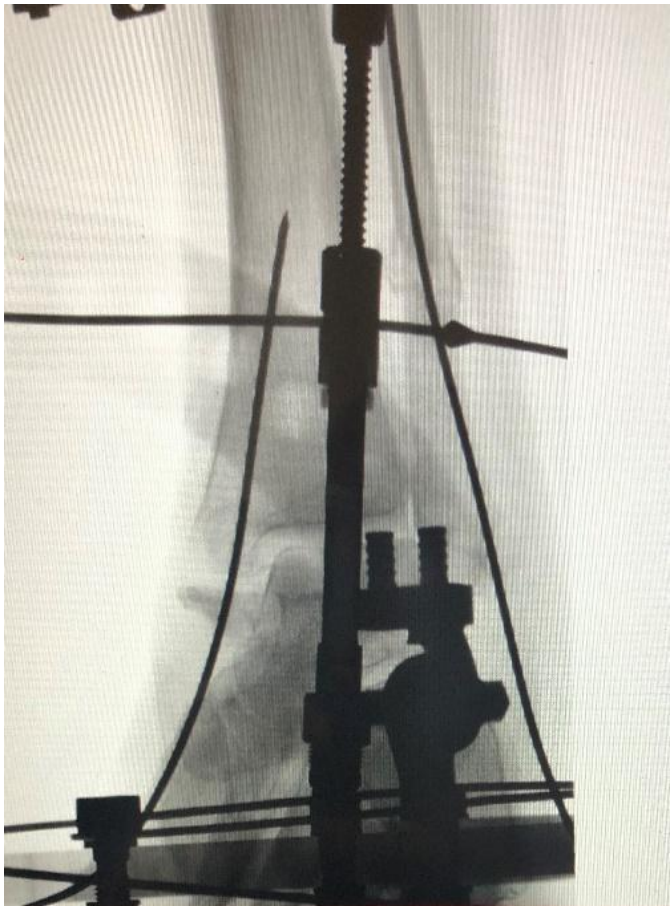


Figure 4 Widening of the medial malleolus noted 8 weeks postoperatively. Note the olive wire was also added to help reduce any syndesmotic gap.

Figure 5 The wound on the medial ankle has healed successfully at 2 weeks.

Next, utilizing Charnely's principles we exaggerated the pronated ankle deformity, distracted the foot as a unit, and reduced the foot beneath the talocrural joint via a supinatory force. This enabled the successful reduction of the fracture-dislocation.

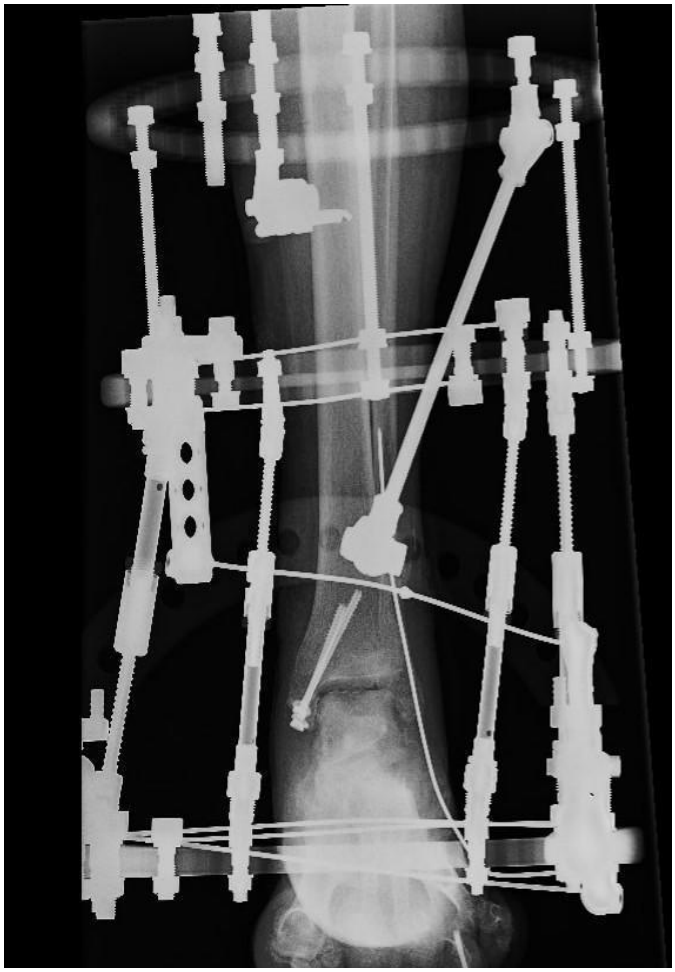
Next, a block of two circular rings was applied to the tibia. Each ring was composed of two smooth wires and one half-pin. A foot plate was then applied. The foot and footplate construct was inverted, adducted, and manually distracted from the tibia. The foot plate was then attached to the tibial block with adjustable threaded rods to maintain this reduced position upon the leg.

The fibula was reduced and stabilized by inserting a 2 mm wire from the inferior lateral aspect of the distal fibula to superiorly ascending the shaft of the fibula through the fragment site. The distally protruding wire was carefully conformed to lay upon the lateral foot plate on a raised post.

For the medial malleolus fracture, a 2 mm wire was inserted through the fracture fragment and driven proximally. Once again, the wire was conformed to lay upon the medial foot plate on a raised post. This wire was inserted inferior to the open wound. The wound was loosely approximated with 2-0 Prolene. It was not completely closed and was packed with iodoform to allow for drainage. After 3 days the iodoform was removed and the remaining wound was left to heal secondarily (Figures 3a, 3b).

During the current admission, a secondary procedure under IV sedation was performed where a single olive wire was placed to stabilize the syndesmosis. This secondary procedure was performed primarily due to concerns regarding syndesmotic widening during serial radiographic assessment which was not noted during the index procedure. During this procedure, a frame adjustment was also performed to better align the foot upon the leg (Figure 4). Successful wound healing was noted at 8 weeks postoperatively (Figure 5).

Eight weeks after the index procedure, a remaining gap was identified at the medial malleolus fracture site. It was decided to supplement the construct with internal fixation at this site. We utilized a small incision approach at the distal end of the medial malleolus to reduce and fixate via two cannulated screws and washers (Figures 6a, 6b).



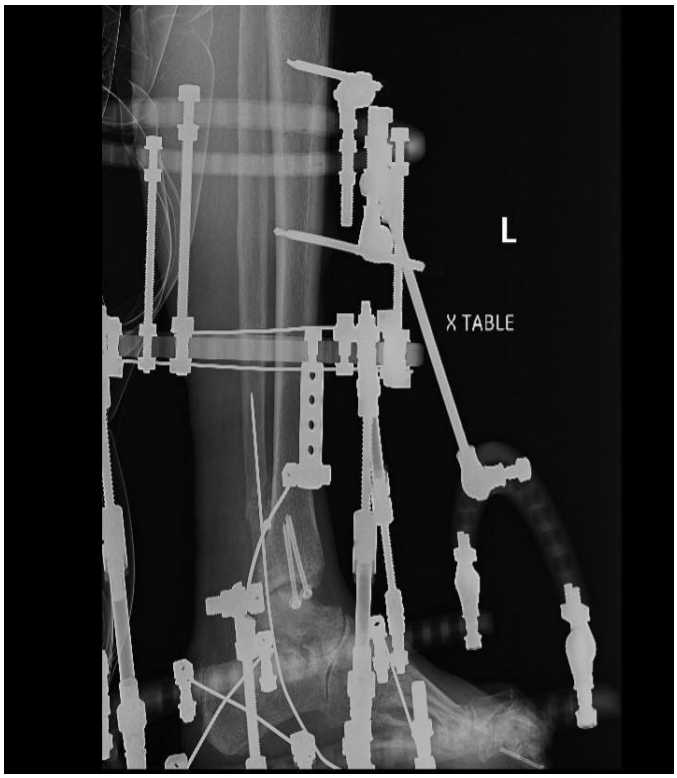


Image 6a and 6b Two cannulated screws with washers reduced the medial malleolus fracture.

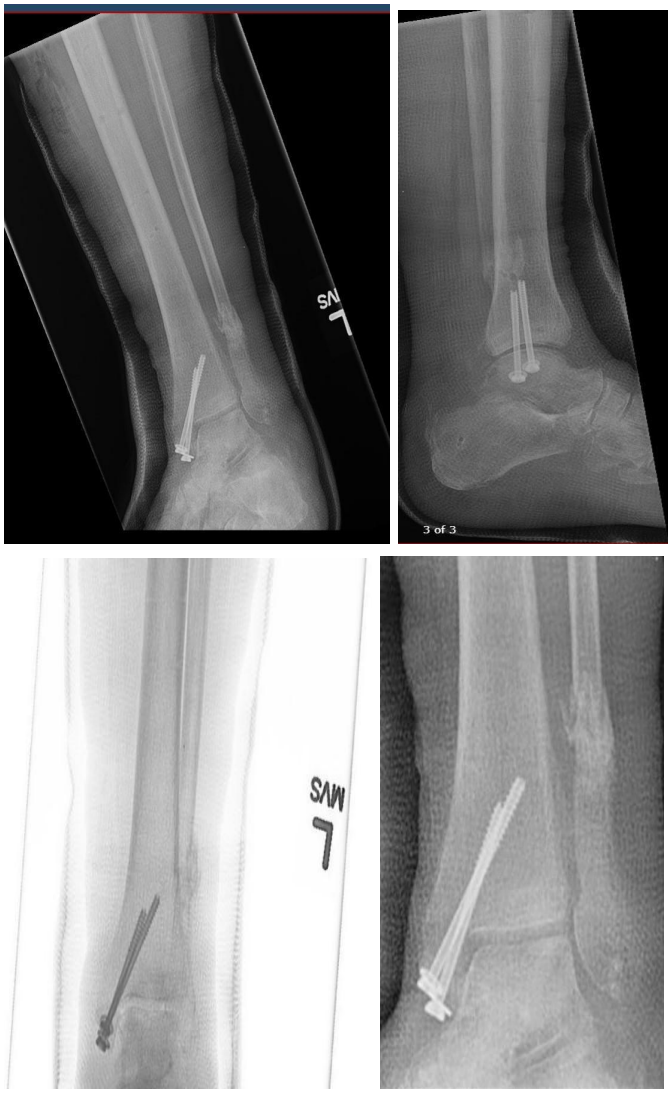


Figure 7a, 7b, 7c, 7d All fracture areas and dislocated joints have been restored.

At this time, repeat culture and sensitivities were collected of the bone and soft tissue which were negative for growth. Per infectious disease recommendations, the patient had completed their 6-week course of antibiotics at this time.

Partial weight-bearing on the frame was allowed at 3 months' time. The external fixation frame was removed at 4 months at which point complete bony consolidation was evident (Figures 7a, 7b, 7c, 7d). Full weight bearing was recommended at the time of external fixator removal. At 5 months she was walking independently with a walker with no pain and all wounds remained healed (Figures 8a, 8b). She remains in an Arizona AFO for stability and fall risk mitigation.

Figure 9a Clinical photo of healed foot ankle in weight-bearing stance, **9b** All wounds remain well healed.

During the index procedure, the patient was noted to have a closed minimally displaced intra-articular medial malleolar fracture of the right ankle. This was the injury that was missed during her initial trauma assessment and discovered when utilizing the right extremity as a radiographic reference intraoperatively. Her right bimalleolar fracture was successfully and uneventfully fixated with the standard AO technique (Arbeitsgemeinschaft für Osteosynthesefragen) 3 days after this initial surgery. Discussion of this fracture is outside of the scope of this article.

Discussion

Management of pantalar fracture-dislocation is challenging, especially without consensus guidelines. Advanced age and open fractures have been shown to increase the risk of complications in the setting of ankle fractures [18]. Age alone is significantly correlated with decreased wound healing outcomes [19]. The difficulty compounds in the setting of polytrauma, advanced age, and open fracture such as in our case. After the initial trauma assessment, emergent reduction and stabilization of the patient's pantalar fracture-dislocation were required. Additionally, our patient required attention to her contralateral closed ankle fracture. Given these challenging constraints, we believe that stabilization with external fixation as the definitive fixation accomplished this. External fixation allowed us immediate temporization, access to the open wound site, post-operative adjustments, and minimal

incisions to be made. It also allowed us to introduce internal fixation on an already stabilized foot and leg.

Although tourniquet use has shown no correlation to postoperative wound healing and infections they are still associated with postoperative pain, skin issues, and DVT [20, 21, 22]. External fixation allows for minimal incision techniques which minimize bleeding and do not require the use of a tourniquet. In our case, any decreased chance of thrombosis was welcome as our patient would spend a prolonged period of time on bed rest.

As the survivability of motor vehicle accidents increases, rare foot and ankle injuries like pantalar dislocations are being seen in increased frequency [23]. We add this case to the body of literature and provide an additional approach for patients with this unique injury that may not be candidates for open reduction internal fixation. The combination of external fixation and internal fixation for the treatment of ankle fractures in compromised hosts is well documented, especially in the setting of diabetes [24,25,26,27]. External fixation for the definitive treatment of distal tibial plafond fractures has been noted as compared to internal fixation [28,29]. It has been described for the successful management of diaphyseal fractures of the lower and upper extremities and noted in lower-resourced populations [30,31].

Recent studies have noted an increased likelihood of unexpected reoperation in geriatric patients who underwent definitive external fixation [32]. Unlike in our case, their cohort only included the use of uniplanar external fixation in the setting of low-energy geriatric ankle fractures. Still, the result was consistent with our patient who required one unexpected visit to the operating room for screw fixation of the displaced medial malleolus. Our patient underwent four total visits to the operating room for the index procedure, Syndesmosis wire and frame adjustment, medial malleolus internal fixation, and frame removal. It is important to note that all procedures after the index procedure were performed under minimal IV sedation with common peroneal and saphenous nerve blocks.

To our knowledge, Boden, et al., record the longest mean follow-up period of greater than 3 years [17]. Our follow-up period only extends 10 months post-injury as this is an active case. There is still a paucity of literature including comprehensive long-term outcomes of pantalar dislocations. Complications and limb functionality need to be more thoroughly studied to determine the viability of external fixation as a definitive treatment for pantalar fracture-dislocations. Cases like the one described in this manuscript can be complicated further with fractures of additional tarsal bones, medical comorbidities, and increased central trauma. We believe our efforts were worthwhile and successful but careful consideration of the patient and their needs must be made before deciding on a fixation method.

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