A case series of three patients with rare pantalar dislocation

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Total pantalar dislocations are rare, significant surgical challenges for foot and ankle surgeons. These dislocations can be very difficult to manually close-reduce, requiring immediate surgical intervention secondary to arterial impingement, pain and risk of skin necrosis attributable to skin tenting. In this case series, we report on three patients who presented to the emergency room following a traumatic ankle injury. Ankle radiographs and computed tomography (CT) scans were obtained, revealing pantalar dislocations. Closed reduction utilizing Charnley’s principles was attempted in the emergency room through manual accentuation of the deformity, traction and reduction. Closed reduction was unsuccessful in all three patients which led to immediate surgical intervention consisting of open reduction of the dislocated talus with internal fixation of concomitant fracture patterns. Postoperatively, all patients were carefully monitored for avascular necrosis of the talus with serial radiographs. One year following surgical intervention, no evidence of talar avascular necrosis (AVN) was observed and two of the three cases developed subtalar joint arthritis. This case report serves to display the treatment and outcomes of a rare dislocation with follow up to complete return to normal activity.

Keywords: pantalar dislocation, subtalar joint dislocation, ankle joint dislocation, talonavicular joint dislocation, talar dislocation, talar fracture

A pantal dislocation is typically a high-energy injury referred to as a simultaneous dislocation of the talonavicular joint, subtalar joint and talocrural joint [1]. These dislocations are more prevalent in males 20 to 45 years old and often occur secondary to a fall. The most common total talar dislocation pattern is anterolateral which occurs in approximately 85% of all pantalar dislocations [1]. Pure pantalar dislocation without an associated fracture is more common than cases with accompanying fracture patterns. However when prevalent, ankle fractures are the most common concomitant fracture [1].

Pantalar dislocations represent very rare injuries and are thought to account for only 0.06% of all dislocations and 2% of all talar injuries [2]. The talus is the only bone in the lower extremity without muscular attachment; however, it is supported by multiple, strong ligamentous connections accounting for the rarity of the injury [3]. Two-thirds of the talus is covered by articular cartilage and supplied by an intricate, predominantly extraosseous, anastomotic arterial network. This makes the talus prone to debilitating consequences following complete dislocation including avascular necrosis (AVN), infection and post-traumatic arthritis [2].

A variety of treatment techniques of total talar dislocations have been described, including closed reduction with conservative management, open reduction internal fixation, external fixation and primary talcetomy with arthrodesis [2,4]. In this case series, we report on three patients with differing pantalar dislocation patterns all treated with open reduction internal fixation.

Case 1

A twenty-four-year-old male presented to the emergency room with a chief complaint of right ankle pain and deformity following a fall during a basketball game. Clinically, the right foot was rigidly translated 90 degrees medial in relation to the leg (Figure 1). The patient reported severe pain to the right ankle as well as numbness to all of his digits.
The dorsalis pedis artery of the right foot was palpable however, the posterior tibial artery was nonpalpable and absent on doppler ultrasound. Radiographs and a CT scan of the right ankle were obtained depicting lateral dislocation of the talus from the ankle joint, subtalar joint and talonavicular joint, as well as a displaced posterior talar body fracture (Figures 2 and 3).

Closed reduction of the talar dislocation was attempted in the emergency room under conscious sedation. Using Charnley’s principles of closed reduction, one assistant supported the leg with the knee flexed at 90 degrees and the deformity was exaggerated. Traction was then applied by grasping the heel and the forefoot and lastly reduction of the deformity was attempted by applying manual pressure to the head of the talus. However, the attempt at closed reduction was unsuccessful. Due to the patient’s neurovascular compromise, he was boarded for emergent surgical intervention.
and plantar aspect of the calcaneal body. which driven deformity Steinmann performed Intraoperatively, of performed. right talar under The subtalar joint. be talonavicular, and displaced ankle completely from the head Figure 1 Case fracture. talonavicular joint body as displaced well dislocation from the ankle Figure 3 Preoperative CT images for Case 1 revealing lateral dislocation of the talus from the ankle joint, subtalar joint and talonavicular joint as well as a displaced posterior talar body fracture. Figure 4 Intraoperative image for Case 1 revealing the talar head upon initial incision and dissection. The talus is noted to be completely displaced from the talonavicular, ankle and subtalar joint. The patient was taken to the operating room where, under general anesthesia, open reduction of the right talar dislocation with open reduction internal fixation of the right talar body fracture was performed. Intraoperatively, an attempt at closed reduction of the deformity was performed utilizing a Steinmann rod which was driven transversely through the posterior and plantar aspect of the calcaneal body.

Using a joystick technique, traction was applied to the Steinmann rod to attempt closed reduction by exaggerating the deformity, distracting the subtalar joint and reducing the deformity by applying manual pressure to the head of the talus. However, this attempt was unsuccessful so the decision was made to perform an open reduction. An initial incision was made along the lateral gutter of the ankle extending to the fourth metatarsal base. Upon initial incision lateral to the ankle joint, the talar head was immediately noted and the talus was observed to be displaced from the talonavicular, ankle and subtalar joints (Figure 4). A second incision was then made at the medial aspect of the ankle joint extending to the navicular tuberosity. Using a sagittal saw, an oblique medial malleolar osteotomy was made to permit greater exposure of the ankle joint and talar body fracture. The medial malleolus was reflected plantarly, with care to leave the deltoid ligament intact, and the posterior talar body fracture was identified. With incisions medial and lateral to the subtalar and ankle joints, the talus was then able to be reduced through the joystick technique. The ankle joint, subtalar joint and talonavicular joint were realigned and the displaced talar body fracture was noted to be reduced. Using standard AO (Arbeitsgemeinschaft für Osteosynthesefragen) technique, the talar body fracture was fixated with three 3.0mm screws posterior-medial to anterior-lateral. Fluoroscopy confirmed appropriate fracture reduction and screw placement. The medial malleolar osteotomy was then reduced and fixated with two 4.0mm screws again using standard AO technique (Figure 5).

Figure 3 Preoperative CT images for Case 1 revealing lateral dislocation of the talus from the ankle joint, subtalar joint and talonavicular joint as well as a displaced posterior talar body fracture.

Figure 4 Intraoperative image for Case 1 revealing the talar head upon initial incision and dissection. The talus is noted to be completely displaced from the talonavicular, ankle and subtalar joint.

Figure 5 Immediate postoperative AP and lateral radiographs for Case 1 showing reduction of the talar body fracture with three screws as well as realignment of the ankle joint, subtalar joint and talonavicular joint. Two screws are shown placed inferior to superior through the medial malleolus to reduce and stabilize the medial malleolar osteotomy.
Both medial and lateral incisions were then flushed and closure was completed with the insertion of silastic drains to both incisions. The patient’s neurovascular status was noted to be intact following the procedure with palpable pedal pulses. Postoperatively, the patient was immobilized and instructed to remain non-weight bearing to the right lower extremity. The patient was admitted to the hospital overnight for observation.

Postoperatively, management for this patient included twelve months of follow up with serial radiographs. He remained non-weight bearing in a controlled ankle movement (CAM) walker with assistance of crutches for eight weeks. Four weeks postoperatively, the patient developed a lateral, superficial wound dehiscence with no signs of infection. Subtalar joint range of motion was noted to be limited to five degrees of eversion and ten degrees inversion and ankle joint range of motion was noted to be limited to negative five degrees of dorsiflexion. The patient began eight weeks of physical therapy at four weeks postoperatively with goals to increase range of motion of the ankle and subtalar joints.

The lateral wound dehiscence was treated with local wound care and resolved uneventfully within four weeks. Two months postoperatively, radiographs revealed consolidation of the talar body fracture and medial malleolar fracture with no evidence of talar AVN. The patient was permitted partial-weight bearing in his CAM walker at this time.

Three months postoperatively the patient was transitioned back into normal shoe gear as tolerated. By his four-month follow-up appointment, subtalar joint range of motion was noted to be eight degrees of eversion and fifteen degrees of inversion. Ankle joint range of motion was zero degrees of dorsiflexion and forty-five degrees of plantarflexion.

One year postoperatively, the patient denied pain to the right lower extremity and had returned to full activity. Radiographs of the right foot and ankle revealed consolidation of the medial malleolar osteotomy and talar body fracture with no evidence of AVN or subtalar joint arthritis (Figure 6).

Case 2

A seventeen-year-old male presented to the emergency room with a chief complaint of right ankle pain and deformity after being tackled during football practice. The personal trainer attempted a closed reduction of the deformity on the field but was unsuccessful. Clinically, the right foot was translated 90 degrees lateral in relation to the leg with medial ankle skin tenting noted. Pedal pulses were strongly palpable and sensation was intact to the right lower extremity. Radiographs and a CT scan were obtained revealing a vertical talar neck fracture with pantalar dislocation along with an oblique medial malleolus and posterior malleolar ankle fracture (Figures 7 and 8). Secondary to severe dislocation, the patient was admitted to the hospital overnight and boarded for urgent surgical intervention the following day.

The patient was brought to the operating room and under general anesthesia, open reduction internal fixation of the right talar neck fracture and medial malleolar fracture was completed. Intra-operatively, a linear incision was then made along the medial malleolus extending to the navicular tuberosity. The medial malleolar fracture was noted to be completely displaced with a small thread of deltoid fiber remaining. The talar body was noted to be in valgus with the talar dome facing lateral. The posterior tibial and the flexor digitorum longus tendons were wrapped around the talar body impeding reduction of the fracture. Manual reduction of the talar body was attempted by retracting the tendons distally, however this was unsuccessful. A second incision was then made along the lateral gutter of the ankle extending to the fourth metatarsal base.

Figure 6 One year postoperative AP and lateral radiographs for Case 1 showing consolidation of the medial malleolar osteotomy and talar body fracture with no evidence of talar avascular necrosis or subtalar joint arthritis.
The extensor tendons were noted to be impeding visualization of the fracture so the tendon to the fourth digit was transected and tagged for repair following reduction. To reduce the talus, the deformity was exaggerated, the calcaneus was distracted and a manual force was applied to the talus body. The subtalar joint, talonavicular joint and ankle joint were noted to reduce and the talar neck fracture was noted to be anatomically aligned. The talar neck and medial malleolar fractures were then both fixated using two 4.0mm screws using standard AO technique (Figure 9). At this time, the long extensor tendon to the fourth digit, deltoid ligaments and both flexor and extensor retinaculum were repaired. Both incisions were then irrigated and closed. Following deflation of the tourniquet, the patient's vascular status was noted to be intact with palpable pedal pulses. The patient was then immobilized and instructed to remain non-weight bearing to the right foot.

Postoperatively, the patient followed up for twelve months for management and serial radiographs. The patient remained non-weight bearing to the right lower extremity for six weeks and radiographs at this time revealed consolidation of the fracture patterns with no evidence of displacement or talar AVN. Limited ankle joint range of motion of negative five degrees of dorsiflexion and fifteen degrees of plantarflexion was noted. Subtalar joint range of motion was also limited to five degrees eversion and ten degrees inversion. The patient was permitted partial-weight bearing in a CAM walker and sent to physical therapy for eight weeks with goals to increase ankle joint and subtalar joint range of motion.

Ten weeks postoperatively, the patient was permitted full-weight bearing to the right lower extremity in his CAM walker. Following completion of physical therapy fourteen weeks postoperatively, ankle joint range of motion was noted to increase to zero degrees.
of dorsiflexion and twenty degrees of plantarflexion and the patient was transitioned to normal shoe gear at this time.

One year postoperatively, radiographs of the right foot were taken showing consolidated fracture patterns and again no signs of talar AVN and narrowing of the subtalar joint (Figure 10). The patient reported no pain to the right foot and ankle at this time with some residual ankle and subtalar joint stiffness. The patient had returned to full activity without restrictions.

Case 3

A seventy-nine-year-old male presented to the emergency room with chief complaint of left ankle pain and deformity after sustaining a fall from a ladder. Clinically, the left foot was translated 90 degrees medial in relation to the leg with lateral skin tenting noted (Figure 11). Dorsalis pedis and posterior tibial pulses were nonpalpable to the left foot and absent on doppler ultrasound. Sensation was absent to the digits of the left foot. Radiographs and a CT scan of the left foot and ankle were obtained which demonstrated a bimalleolar ankle fracture with talar dislocation from the subtalar joint, talocrural joint and talonavicular joint (Figures 12 and 13). The talus was noted to be rotated 90 degrees internal with the talar dome facing medial within the ankle mortise. Closed reduction with conscious sedation was attempted in the emergency room using Charnley’s principles with no improvement. Due to severity of the injury and neurovascular compromise, the patient was boarded for emergent surgical intervention.

The patient was taken to the operating room and under general anesthesia, open reduction of the talar dislocation and open reduction internal fixation of the lateral malleolar fracture, was performed. Intra-operatively, a linear incision was made from the tip of the lateral malleolus to the base of the fourth metatarsal. The talar head was noted to be dorsally and laterally dislocated on the navicular. A large cartilage defect was noted comprising about 40% of the talar head down to subchondral bone. A medial incision was then made overlying the medial malleolus to gain access to the talus for reduction.

During dissection, tearing was noted to the ankle and subtalar joint capsule, deltoid ligaments, anterotalofibular ligament, and calcaneofibular ligament. The talar body was noted to be rotated ninety-degrees medial within the ankle joint.

Figure 11 Preoperative clinical images for Case 3 showing the left foot translated 90 degrees medial in relation to the leg with lateral skin tenting noted.

Figure 12 Preoperative AP and lateral radiographs for Case 3 demonstrating a fibular fracture with talar dislocation from the subtalar joint, talocrural joint and talonavicular joint. The talus is noted to be rotated 90 degrees internal with the talar dome facing medial within the ankle mortise.

Figure 13 Preoperative CT scans for Case 3 revealing a distal fibular fracture with talar dislocation from the subtalar joint, talocrural joint and talonavicular joint. The talus is noted to be rotated 90 degrees internal with the talar dome facing medial within the ankle mortise.
Steinman rods were then placed in the posterior calcaneal body and forefoot and were used to attempt reduction of the deformity through the joystick technique. This was unsuccessful so a medial malleolar osteotomy was performed to assist in reduction. The talar body was then de-rotated and the ankle and subtalar joints were reduced; however, the talonavicular joint remained dislocated. An oblique osteotomy of the dorsal surface of the navicular was made which allowed complete reduction of the talonavicular joint. To stabilize the reduction, a Steinman rod was driven through the calcaneus, talus, and tibia. A second rod was driven across the talonavicular joint. Next, two 4.0mm screws were used to fixate the medial malleolar osteotomy and the lateral malleolar fracture was fixated with one 4.0mm screw (Figure 14). Following internal fixation, the medial and lateral ankle ligaments were repaired. The incisions were then irrigated and closed. Following deflation of the tourniquet, the patient’s vascular status was intact with palpable pedal pulses. The patient was immobilized and instructed to remain non-weight bearing.

Postoperatively, the patient was followed for twelve months with serial radiographs. He remained non-weight bearing to the left lower extremity for eight weeks and at that time, radiographs revealed narrowing of the subtalar joint with no evidence of talar AVN and consolidation of the fracture patterns. The temporary Steinmann rods were removed from the calcaneus and talonavicular joint and the patient was permitted partial-weight bearing in his CAM walker.

Twelve weeks postoperatively, ankle joint range of motion was noted to be within normal limits with limited subtalar joint range of motion of three degrees eversion and six degrees inversion. The patient was sent to physical therapy at this time with goals of increasing subtalar joint range of motion with gait training and strengthening of the left lower extremity.

Full-weight bearing to the left lower extremity was permitted at three months in the CAM walker and the patient continued physical therapy for gait training, strengthening and range of motion exercises. At five months postoperatively, the patient was transitioned out of his CAM walker and into normal shoe gear. At six months postoperatively, the patient had completed physical therapy and was ambulating without assistance with no pain to the left foot and ankle.

At his twelve-month follow-up, the patient’s subtalar joint range of motion was noted to be limited to five degrees of eversion and ten degrees inversion. Radiographs demonstrated complete consolidation of the ankle fracture without displacement, no evidence of talar AVN, but continued narrowing of the subtalar joint (Figure 15). The patient noted mild pain to the subtalar joint after long periods of ambulation.
Discussion

Talar dislocations are very rare injuries, with complete talar dislocations accounting for only 0.06% of all dislocations and 2% of all injuries to the talus [2]. Most talar dislocations have only been described in the setting of talar neck fractures which account for 0.3% of all fractures [5]. Fractures of the talar neck are commonly categorized using the Hawkins classification system, first described in 1970. The original Hawkins classification included three fracture types. Type I indicated a nondisplaced vertical talar neck fracture, type II indicated a vertical talar neck fracture with subtalar joint dislocation and type III indicated a vertical talar neck fracture with subtalar joint and tibiotalar joint dislocation [6]. Later, in 1978, Canale and Kelly added type IV to the classification system which described a talar neck fracture with total dislocation from all joint articulations including the subtalar joint, tibiotalar joint and talonavicular joint [6].

Secondary to the delicate arterial supply of the talus, AVN has remained a devastating outcome following dislocation. The purpose of Hawkins’ report in 1970 was not only to describe vertical talar neck fractures and associated dislocation patterns, but to also report on the incidence of talar AVN [6]. Hawkins reported no cases of AVN in type I injuries and suggested only one of the three main blood vessels to the talus were disrupted. In type II injuries, Hawkins suggested a likely disruption of two of the main blood vessels and reported a 42% incidence of AVN of the talus. With type III talar neck fractures, Hawkins reported a 91% incidence of talar AVN which suggested the disruption of all three major sources of perfusion to the talus [6]. Canale and Kelly however, reported only a 52% incidence of talar osteonecrosis for type IV fractures. Limitations of Hawkins’ original report, such as modern surgical implants, operative technique, surgical timing, and use of advanced imaging may be responsible for the discrepancy in rates of AVN [6].

Jordan, et al., performed a systematic review on talar neck fractures to determine a better understanding of postoperative outcomes based on the Hawkins classification. A total of 340 talar fractures were reviewed with an overall incidence of AVN to be 26.47%. It was found that osteonecrosis occurred in 55% of type IV or total talar dislocations [7]. Weston, et al., performed a systematic review of 39 articles, looking at 86 cases of total talar dislocation. Of the cases included, 73 were open and 43 had associated fracture patterns. The authors found a much lower rate of osteonecrosis of the talus with pantalar dislocations, yielding an overall 26% incidence and a 24% incidence in the setting of isolated talar dislocation without an associated fracture pattern [2].

Early reports attributed lower rates of osteonecrosis to early anatomic reduction; however, Lindvall, et al., found that the rate of AVN was not related to the timing of the surgery, but rather to the initial degree of fracture displacement and the presence of an open fracture [8]. Vallier, et al., observed 81 talar neck and body fractures to determine whether or not a delay in open reduction internal fixation increased the rate of talar AVN. Similarly to Watson, et al., the authors found an overall rate of osteonecrosis for all injury types to be 25% with type IV injuries at 33% [9]. The authors determined that time of reduction of up to eighteen hours after the injury did not result in a significant change in the rate of AVN [9].

Biz, et al., also evaluated surgical timing of talar fractures and dislocation. They found no significant difference in functional outcome between talar neck and body fractures [10]. They also found no impact on the development of osteonecrosis with a surgical time of zero to eleven days. There was no statistical correlation between the time to surgery and long-term outcomes and the authors determined lower functional outcomes were associated with comminuted fractures and a greater degree of displacement [10].

Multiple studies suggest a much higher rate of subtalar joint arthritis with talar neck fractures in comparison with osteonecrosis. Jordan, et al., found an overall rate of post-traumatic arthritis to be 51.69% with rates of 25% in Hawkins type I, 41.33% in type II, 54.24% in type III and 72.73% in type IV. Vallier, et al., had similar findings in rates of post-traumatic arthritis following talar neck fractures [9].

Multiple approaches to reduce talar dislocations have been reported. An anterior approach has been described, but is limited due to inadequate exposure, increasing the risk of malreduction and devascularization of the talus. The dual approach with incisions placed both medial and lateral to the talus provides greater exposure to enhance reduction, but
can be more challenging [11]. The posterior approach has also been reported with advantages in fixation stability when placing a screw from posterior to anterior, but carries demonstrated risk of subtalar joint violation [11]. Ziran, et al., advocated for a medial malleolar osteotomy in cases of comminuted talar fractures to further increase exposure to the medial talus [12]. A medial malleolar osteotomy has been proven a safe approach to preserve the deltoid ligament and associated deltoid branch of the posterior tibial artery [13]. Fournier, et al., compared the surgical approaches in a case series of 114 talar fractures treated with open reduction internal fixation. The authors found no significant difference between surgical approaches; however, the anterior approach was much more commonly utilized in this case series. The authors ultimately recommended a dual approach to better preserve talar blood supply and obtain a more precise reduction [11].

Fournier, et al., found that screw fixation for simple fractures provided adequate stabilization. The authors recommended plate fixation in the setting of comminuted talar neck fractures to prevent varus malposition [11]. Pavic presented four patients, one total talus dislocation and three subtalar joint dislocations, who all underwent talocalcaneal transfixation using Kirschner wires. The results of Pavic’s study revealed subtalar joint arthritis but no signs of talar AVN [14].

This case series confirms the challenges associated with treating total talus dislocations, as these injuries are accompanied by long-term functional and radiological complications. As supported by recent literature, two of the three patients in this case series developed subtalar joint arthritis even with adequate reduction and fixation. Decreased prevalence of talar AVN with total talus dislocation in comparison with osteoarthritis was also supported by this case series. All three patients were treated for a traumatic pantalar dislocation with open surgical reduction and fixation with full return to normal activity one year postoperatively. While recent literature has suggested that severity of initial injury has a greater impact on AVN compared with time to surgery, this case series revealed great long-term results with urgent open reduction internal fixation. This author also advocates for a dual incision approach for maximizing exposure and reduction while preserving the blood supply to the talus. Incidence of osteoarthritis is a known and expected long term complication following talar fracture and dislocation.

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References


