Open Navicular Dislocation With Midfoot Dissociation in a 45-Year-Old Man

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Abstract
Traumatic dislocation of an intact tarsal navicular is an uncommon injury. In this article, we report a case of open medial navicular dislocation in a 45-year-old man. The injury was managed with open reduction and stabilization with Kirschner wires within the acute period. Ten months after injury, the patient developed avascular necrosis of the navicular and exhibited progressive collapse of the medial midfoot. He underwent naviculocuneiform arthrodesis 1 year after the index surgery. Two years after fusion, he was pain-free and ambulating independently.

Successful treatment of midfoot fractures and dislocations requires an intimate understanding of anatomy, biomechanics, and both short- and long-term sequelae of injury.

Take-Home Points
- Stability of the foot is dependent on both the medial and lateral longitudinal columns; injuries to a single column alone are extremely rare.
- Midfoot fractures that are recognized and treated early have generally favorable outcomes compared to those identified in a delayed fashion.
- The most frequent complication of navicular dislocation is AVN, which is said to occur in as many as 25% of cases.
- Many specialists agree that navicular dislocations are best treated with open reduction.
- Ultimately, the goals of surgical intervention are to minimize pain and to establish stability of the plantigrade foot.

In this article, we report a case of open complete navicular dislocation with talar head fracture and associated subtalar and calcaneocuboid subluxations in a 45-year-old man. The injury was managed with open reduction and stabilization with Kirschner wires (K-wires), which later required naviculocuneiform and intercuneiform fusion for posttraumatic avascular necrosis (AVN). The patient provided written informed consent for print and electronic publication of this case report.

Case Report
A 45-year-old man sustained blunt trauma to the right foot in a high-speed head-on collision. He was hemodynamically stable with isolated complaints of pain in the foot. Physical examination revealed a grossly open 10-cm wound extending from the heel pad medially to the dorsal surface of the navicular. The navicular was clearly visible through the wound.

Plain radiographs of the foot showed complete medial dislocation of the navicular with complete disruption of all 3 naviculocuneiform joints (Figures 1A-1C). The subtalar and calcaneocuboid...
Joints were subluxed but remained ligamentously stable on subsequent examination. There was marked subcutaneous soft-tissue swelling surrounding the injury.

On day of presentation, the patient was taken to the operating room for irrigation, débridement, reduction of the joints, and primary closure of the right foot wound. Minimal contamination was noted. Attempted gentle reduction maneuvers included distraction, adduction, and pronation of the forefoot with concomitant lateral pressure on the navicular. Initial reduction attempts were unsuccessful because of interposition of the flexor hallucis longus and peroneus longus tendons. Retraction of these plantar structures with the mentioned maneuvers resulted in a palpable and visible naviculocuneiform reduction. Intraoperative radiographs showed adequate reduction of the naviculocuneiform, with restoration of the normal subtalar and calcaneocuboid alignments. The naviculocuneiform joints remained grossly unstable, however, and would have readily dislocated in the absence of manual pressure. Therefore, two 0.062-inch K-wires were passed from the medial cuneiform across the talonavicular joint. Intraoperative radiographs (Figures 2A, 2B) and a postoperative radiograph (Figure 3) showed adequate alignment of the naviculocuneiform articulations.

An especially prominent medial navicular was noted on postreduction films. Initially, this suggested inadequate reduction of the naviculocuneiform joints, but, on close radiographic examination of each naviculocuneiform joint and imaging of the contralateral foot, we determined that the prominence represented a type III accessory navicular, also known as a cornuate navicular. Contralateral imaging showed an identical and asymptomatic medial prominence.

After surgery, the patient was made non-weight-bearing in a splint, received intravenous antibiotics for 48 hours, and was discharged shortly thereafter. Radiographs at 3 and 6 weeks after injury showed maintenance of the reduction. K-wires
were removed at 6 weeks. The patient was advanced to partial weight-bearing at 6 weeks and to full weight-bearing at 3 months.

Over succeeding months, the patient developed pain accompanied by significant midfoot deformity and was found to have navicular collapse consistent with AVN and posttraumatic arthritis (Figures 4A, 4B). Ten months after the initial procedure, instrumented fusion of the naviculocuneiform and intercuneiform complex was performed, along with chondral decortication, navicular decompression, and iliac crest grafting. The patient was made non-weight-bearing in a cast for 6 weeks and was then slowly, progressively advanced.

Twenty-four months after fusion, the patient was fully ambulatory with no significant discomfort or disability. The most recent radiographs showed adequate alignment and bony fusion (Figures 5A, 5B).

Discussion
The naviculocuneiform joints are important for the dissipation of loading stresses on the midfoot but provide little motion. The plantar and dorsal ligaments are thick structures that stabilize these joints, predisposing the navicular to fracture rather than isolated dislocation. The stability of the foot is dependent on both the medial and lateral longitudinal columns, and it is thought impossible to injure one column without disrupting the other. Several patterns of associated lateral column disruptions have been documented, including 3 cases similar to our patient’s, involving navicular dislocation with associated calcaneocuboid joint injuries.

Authors have proposed several mechanisms accounting for navicular dislocations. In the setting of acute trauma, the navicular displaces dorsally as the result of forefoot plantar flexion and axial loading. A severe abduction/pronation injury leading to a midtarsal dislocation followed by a spontaneous reduction can force the navicular to dislocate medially. This disruption of the naviculocuneiform joint and concurrent “nutcracker” injury to the lateral column can produce an associated disruption of the calcaneocuboid joint. Depending on the direction of the deforming force, the forefoot can dislocate superolaterally if the force is plantar or inferolaterally if the force is dorsal. The remaining soft-tissue attachments help determine the position of the navicular. A third postulated mechanism involves a complex wringing injury to the forefoot.

Most specialists agree that navicular dislocations are best treated with open reduction. The goal of surgical intervention is to establish a stable plantigrade foot and to minimize pain. The current literature supports using either wires or screws to maintain reduction of midfoot injuries. Wires can be used for both talonavicular and naviculocuneiform fixation. Screws can be placed across the naviculocuneiform joints, as there is little normal physiologic motion through these joints. The talonavicular joint and the cuboid-metatarsal joints provide most of the motion in the midfoot and should not be readily fused. Stabilization of both columns is considered necessary to avoid complications such as subluxation and midfoot deformity.

Given the postreduction stability of the lateral column in the present case, bicolumnar stabilization was not considered necessary. It is possible that subsequent collapse of the midfoot may have been attenuated in the presence of lateral fixation, but this would not necessarily have prevented complications of AVN.

Midfoot fractures that are recognized and treated early have generally favorable outcomes, though chronic pain and subsequent deformity are not uncommon. Perhaps the most frequently reported complication of navicular dislocation is AVN, which is thought to occur in approximately 25% of cases. AVN is a well-recognized complication of
hиндфут и среднепалубное травмирование. В случае воздействия на навicular, кровоснабжение к центральному-третьему водосборной области является ограниченным. Мелкие ветви главной ветви тibiальной и постериорной периферии, что обеспечивает кровоснабжение к медиальной и латеральной областям, подвергаются повреждению. Однако, неожиданно, риск для AVN высок при переломе дистракции. В некоторых случаях, последствием такого травмирования является остеонектоз. В большинстве случаев, при исследовании с помощью магнитно-резонансной томографии или костной сцинтиграфии могут быть выявлены нерегулярные участки. Рентгенография, в свою очередь, может быть использована для диагностики AVN при таких травмах.

AVN can result in the Charcot-like collapse of the medial column, leading to progressive midfoot plantar deformities. Variations of midfoot fusion are often required.

AVN may be difficult to differentiate from posttraumatic arthritis. These conditions can have similar clinical presentations and appearances on plain radiographs. In such situations, magnetic resonance imaging or bone scintigraphy may determine the diagnosis. Damage to the articular surface at time of injury and residual articular displacement, instability, and joint subluxation after injury are considered risk factors for the development of posttraumatic arthritis in the foot and ankle.

Reports suggest that the severity of the damage to the articular surface is directly proportional to the degree of arthritis. Such damage may not be initially visible, especially in axial impaction injuries, but latent deterioration of the articular surface can occur. For patients with significant dislocations of the naviculocuneiform joints, some authors advocate primary and early fusion instead of the more conservative approach used here. Primary fusions are argued to have minimal deleterious effects on function, secondary to the absence of normal physiologic motion through the affected joints. However, there is relatively little published evidence on long-term outcomes in primary versus secondary naviculocuneiform fusions.

Successful treatment of midfoot fractures and dislocations requires intimate knowledge of foot and ankle anatomy and mechanics. Surgeons must be able to anticipate, identify, and counsel patients about acute and delayed complications in these already challenging injuries.

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References