

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

Dean N. Papaliodis, MD, Timothy T. Roberts, MD, Maria Vanushkina, MD, Shankar Das, MD, Jordan Lisella, MD, and John DiPrea, MD

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 pro-

gressive 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.

Traumatic dislocation of the tarsal navicular (especially without a navicular body fracture) is uncommon.¹ The regional anatomy and ligamentous architecture confer stability to the midfoot.²⁻⁶ Navicular dislocation is part of a complex disruption involving structures in the adjacent column.⁶

Navicular dislocation has been associated with several bony and soft-tissue injury patterns, including comminuted intra-articular fracture of the calcaneus and associated calcaneocuboid joint subluxation; fracture and subluxation of the calcaneocuboid joint; fracture-dislocation of the calcaneocuboid joint with fractures of the third and fourth metatarsals; and a combination of fractures of the intermediate

cuneiform, the second through fourth metatarsals, and the cuboid.⁴⁻¹¹

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

Authors' Disclosure Statement: The authors report no actual or potential conflict of interest in relation to this article.



Figure 1. (A) Mortise radiograph of the right ankle. (B) Anteroposterior radiograph of the right foot. (C) Lateral radiograph of the right foot and ankle.

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.



Figure 2. (A) Lateral and (B) posteroanterior intraoperative fluoroscopy of the right foot after reduction and Kirschner-wire fixation.



Figure 3: Anteroposterior radiograph of the right foot on postoperative day 1.

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



Figure 4. (A) Lateral and (B) anteroposterior radiographs 9 months after surgery.

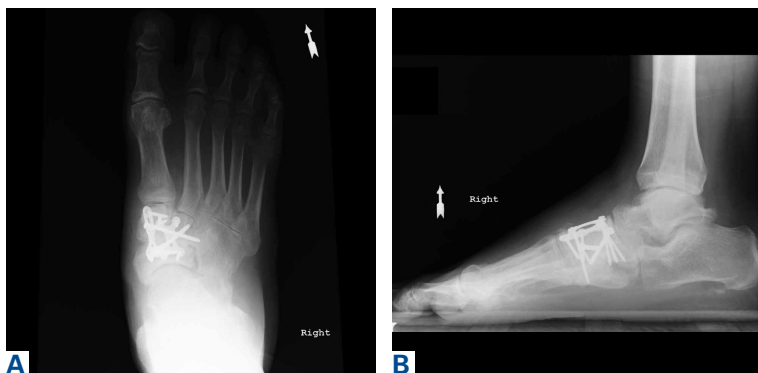


Figure 5. (A) Anteroposterior and (B) lateral fluoroscopy of the right foot after fusion with iliac crest bone graft.

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.⁶ 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.^{5,6,10}

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.⁴ A severe abduction/pronation injury leading to a midtarsal dislocation followed by a spontaneous reduction can force the navicular to dislocate medially.⁶ This disruption of the naviculocuneiform joint and concurrent "nutcracker" injury to the lateral column can produce an associated disruption of the calcaneocuboid joint.⁶ 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.¹⁰

Most specialists agree that navicular dislocations are best treated with open reduction.^{4,6} 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.⁴ The talonavicular joint and the cuboid-metatarsal joints provide most of the motion in the midfoot and should not be readily fused.⁵ 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,⁵⁻¹¹ 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.¹² AVN is a well-recognized complication of

hindfoot and midfoot trauma. In the tarsal navicular, blood supply to the central-third watershed region is marginal. Small branches of the posterior tibial and dorsalis pedis arteries that supply the medial and lateral areas are readily injured. Not surprisingly, the risk for AVN is high when the dislocated bone is severely displaced.⁶ In some circumstances, the shared blood supply of the posterior tibialis may be the only remaining osseous supply. The tendon and its soft-tissue attachments should therefore be carefully monitored during dissection and reduction.⁶ In most cases, AVN of the foot manifests clinically within the first 10 months after injury, as was the case with our patient.¹³ AVN can result in the Charcot-like collapse of the medial column, leading to progressive midfoot plantar deformities.⁴ Variations of midfoot fusion are often required.^{4,6}

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.¹⁴ Reports suggest that the severity of the damage to the articular surface is directly proportional to the degree of arthritis.¹⁴ Such damage may not be initially visible, especially in axial impaction injuries, but latent deterioration of the articular surface can occur.¹⁵ For patients with significant dislocations of the naviculocuneiform joints, some authors advocate primary and early fusion¹⁵ 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.¹⁵ 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.

Dr. Papaliadis and Dr. Roberts are Chief Residents; and Dr. Das, Dr. Lisella, and Dr. DiPreta are Attending Surgeons, Division of Orthopaedic Surgery, Albany Medical Center, Albany, New York. Dr. Vanushkina is a Resident Physician, Physical Medicine and Rehabilitation, University of Rochester Medical Center, Rochester, New York.

Address correspondence to: Dean N. Papaliadis, MD, Division of Orthopaedic Surgery, Albany Medical Center, 1367 Washington Ave, Suite 202, Albany, NY 12206-1043 (tel, 518-453-3074; fax, 518-453-1463; email, deanpapaliadis@texashealth.org).

Am J Orthop. 2017;46(3):E186-E189. Copyright Frontline Medical Communications Inc. 2017. All rights reserved.

References

1. Main BJ, Jowett RL. Injuries of the midtarsal joint. *J Bone Jt Surg Br.* 1975;57(1):89-97.
2. Pinney SJ, Sangeorzan BJ. Fractures of the tarsal bones. *Orthop Clin North Am.* 2001;32(1):21-33.
3. Vaishya R, Patrick JH. Isolated dorsal fracture-dislocation of tarsal navicular. *Injury.* 1991;22(1):47-48.
4. Early JS. Fractures and dislocations of the midfoot and forefoot. In: Bucholz WB, Heckman JD, Court-Brown C, et al, eds. *Rockwood & Green's Fractures in Adults.* 6th ed. Philadelphia, PA: Lippincott; 2005:2337-2401.
5. Rao H. Complete open dislocation of the navicular: a case report. *J Foot Ankle Surg.* 2012;51(2):209-211.
6. Dhillon MS, Nagi ON. Total dislocation of the navicular: are they ever isolated injuries? *J Bone Joint Surg Br.* 1999;81(5):881-885.
7. Kollmannsberger A, De Boer P. Isolated calcaneo-cuboid dislocation: brief report. *J Bone Joint Surg Br.* 1989;71(2):323.
8. Randall RL, Hall RJ, Slabaugh P. An unusual midfoot dislocation: a case report. *Am J Orthop.* 1997;26(7):494-496.
9. Ruthman JC, Meyn NP. Isolated plantar midtarsal dislocation. *Am J Emerg Med.* 1988;6(6):599-601.
10. Pathria MN, Rosenstein A, Bjorkengren AG, Gershuni D, Resnick D. Isolated dislocation of the tarsal navicular: a case report. *Foot Ankle.* 1988;9(3):146-149.
11. Puente CA, Alaez JP, Marti DG. Tarsal fracture dislocation with plantar dislocation of the navicular: a case study. *Foot Ankle Int.* 1996;17(2):111-113.
12. Davis AT, Dann A, Kuldjanov D. Complete medial dislocation of the tarsal navicular without fracture: report of a rare injury. *J Foot Ankle Surg.* 2013;52(3):393-396.
13. Buchan CA, Pearce DH, Lau J, White LW. Imaging of post-operative avascular necrosis of the ankle and foot. *Semin Musculoskelet Radiol.* 2012;16(3):192-204.
14. Olson SA, Furman B, Guilak F. Joint injury and post-traumatic arthritis. *HSS J.* 2012;8(1):23-25.
15. Grambart S, Patel S, Schuberth JM. Naviculocuneiform dislocations treated with immediate arthrodesis: a report of 2 cases. *J Foot Ankle Surg.* 2005;44(3):228-235.

This paper will be judged for the Resident Writer's Award.