Navicular Stress Fractures: A Primer

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ABSTRACT

Navicular stress fractures (NSF) can be difficult injuries to diagnose and can end up career in athletes. The lack of blood supply to the navicular bone makes this injury difficult to heal and confoundingly gives minimal visible symptoms such as swelling and bruising.

Keywords: Foot and ankle, Navicular bone, Navicular stress fractures.

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Navicular stress fractures (NSF) can be difficult injuries to diagnose and can end up career in athletes.^{1,2} The lack of blood supply to the navicular bone makes this injury difficult to heal and confoundingly gives minimal visible symptoms such as swelling and bruising.^{3,4} Many patients, such as basketball players and dancers, complain of symptoms only when they are jumping or on their toes. This is why athletes relate they can jog but not sprint without pain and can therefore be difficult to diagnose early on.⁵⁻¹⁰ In fact, one study showed on average it took almost 9 months to arrive at the correct diagnosis.⁶ Furthermore, despite magnetic resonance imaging (MRI) being a more common diagnostic test, it was helpful in correctly diagnosing NSF in 71% of patients, whereas computed tomography (CT) was 100% correlated with a correct diagnosis⁶ (Fig. 1).

According to Fitch et al., NSF was first recognized by Towne et al. in 1970.^{4,11} Patients typically have pain in the midfoot, including the “N-spot” that is the high point of the navicular as well as vague anterior ankle and arch pain.^{4,6,8} As noted previously, there is minimal swelling and bruising. This injury can occur after an ankle of midfoot sprain.⁶ Treatment from the 1970s time period until the end of the 1990s primarily involved nonsurgical care with a period of nonweight-bearing of 6–8 weeks in a below-knee cast.^{4,7,9,11} In 2000, Saxena et al. published their early results using a classification system using CT frontal plane images with ≤ 0.6 mm slices. They described three stages of injury with progressive severity: type I, II, and III (Table 1). These authors added another

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less severe stage in 2011 termed type 0.5, which is essentially a stress reaction seen on MRI with no fracture identified via CT (12).

Table 1: Computed tomography Classification of navicular stress fractures (using ≤ 0.6 mm cuts in frontal plane)

Type 0.5 = CT negative for fracture, MRI positive for signal change within body of navicular
Type I = CT shows dorsal cortical fracture
Type II = CT shows fracture propagates into mid-portion of navicular
Type III = CT shows complete fracture through navicular

Based on Ref. 3 and 12

Figs 1A and B: (A) Magnetic resonance imaging of navicular stress fracture failing to demonstrate fracture; (B) Computed tomography of same patient demonstrating type II navicular stress fractures

Figs 2A and B: (A) Computed tomography of a type I navicular stress fractures; (B) Same patient after two sessions of focused extracorporeal shock wave therapy and six weeks of nonweight-bearing in a boot

What Saxena et al. consistently showed in all their studies is, the more severe the injury (types II and III), the longer the healing time and the more likely surgery is recommended.^{3,6,8} In fact, in order to achieve a reasonable healing time (4 to 5 months), surgery is recommended for type II and III injuries.^{6,12} Studies have shown delayed treatment, even with surgery, is associated with less than ideal outcome, such as arthrosis, delayed union, refracture, and cessation of desired activity.^{1,2,5,6,10,12}

Nonsurgical treatment is recommended for type 0.5 and I injuries.^{6,12} For type 0.5, weight-bearing in a boot for 3–6 weeks appears acceptable, whereas for type I, in addition to immobilization a below-knee boot, a period of nonweight-bearing for 6 weeks, and 2–4 more weeks (until pain-free) is required.⁶ For athletes, a patient with a type I injury could also consider surgery, as some studies show faster healing with ORIF.^{3,6,8} Shockwave can be utilized for all navicular stress fractures as an adjunct; immobilization still should be performed¹³ (Fig. 2). For NSF types II and III, surgery is performed, typically with one or two 4.0 mm partially threaded screws, generally placed from lateral to medial but is certainly based on fracture pattern and can be modified. The incisional approach is typically lateral to the neurovascular bundle over the talonavicular joint. Autogenous bone graft can be utilized (usually from the lateral calcaneus) if there is sclerosis, cystic areas, avascular necrosis, and non-union. The same postoperative immobilization regimen what is used for type I injuries is used for types II and III. The average return to sports is 4 months, although full healing and activity can be longer. Refracture and persistent delayed union can be noted. Vitamin D status should be verified and supplemented as needed. Saxena et al.'s 2017 study in a large series of athletic patients had several interesting findings. Nonsurgical treatment in athletes under the age of 21 years appears more common with refracture. Screw removal was required in 11%. Despite anatomic reduction, arthrosis of the adjacent joints can occur in 13%.⁶ Instead of arthrodesis in an athlete, arthrodiastasis can be performed.¹⁴ Treatment for avascular necrosis of an NSF can involve extracorporeal shock wave therapy (ESWT) and also a vascularized bone graft, although outcomes in athletes, particularly for the latter, is undocumented.¹⁵

Navicular stress fractures are significant injuries that involve significant downtime, possibly a loss of a season or worse. A provider should have a high index of suspicion for an athlete with persistent vague, atraumatic midfoot, or anterior ankle pain, particularly in the "N-spot". The consequence of missing this diagnosis and proper treatment is further downtime and poorer outcome, including re-fracture, arthrosis, and cessation of activity. Anecdotally, this author has seen associated medial ankle impingement with some cases of NSF. This association should be further studied. CT with ≤ 0.6 -mm cuts should be used to determine the type of injury. As of now, the proposed treatment recommendations of nonsurgical for types 0.5 and acute type I and ORIF for types II and III appear well supported in the literature. ESWT's role in accelerating healing appears favorable and deserves more research.

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