



# Rare, Non-Displaced, Sagittal Plane Fractures of the Navicular Body

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### INTRODUCTION

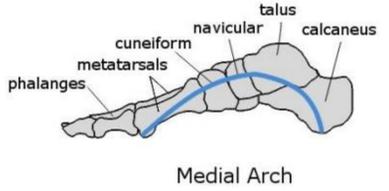
Isolated fractures of the navicular bone are rare.<sup>1</sup> The navicular plays an essential role in the medial longitudinal arch and the stability of the midfoot structure as the keystone.<sup>2</sup> Loss of the height or alignment of the keystone can result in loss of 90% or greater of complex hindfoot motion.<sup>3</sup>

Classification systems have been derived for fractures of the navicular and corresponding midfoot. Sangeorzan<sup>4</sup> classified displaced, intra-articular fractures of the tarsal navicular, while Watson and Jones<sup>5</sup> classified multiple navicular fracture patterns including the stress fracture. Main and Jowett<sup>6</sup> were the first authors to describe multiple, potential mechanisms of action of the navicular fracture.

Main and Jowett is still the most cited and recognized classification system of navicular fracture mechanisms. The classification system was based solely on assessment of radiographic appearance of midtarsal fractures. It was developed by considering the direction of the fracture, the disruption of joints and malalignment of the foot.

As stated by Main et al. tarsal navicular body fractures result from axial loading forces that occur frequently when falling from a height. The longitudinal compression forces on the talus lead to compression of the navicular into the cuneiforms, and the navicular to absorb the shock of impact.

We present two cases of high impact injury causing sagittal plane fractures through the navicular body, without dislocation of the navicular or surrounding structures. Our case report reveals fracture patterns that appear consistent with stress fractures while the mechanism of action correlates to dislocated, comminuted, corresponding fracture patterns.



### CASE DESCRIPTION

**Patient 1:**  
A 17-year-old male, presented to the emergency department after a bike riding accident. The patient reported being 10-15 feet in the air doing a trick when he fell and landed directly on his right foot. He explained that he landed with his foot being pointed(plantarflexed) and landing on the ball of his foot first. Plain radiographs were taken revealing a non-displaced, fracture in the sagittal plane through the body of the navicular. No comminution or dislocation was noted(Image 2). The patient had surgery three weeks from initial injury date. The fracture site was reduced percutaneously with a point-to-point clamp and a guide wire was used to stabilize the fracture site. Guide wire alignment and fracture reduction were then assessed with fluoroscopy imaging intra-operatively. Next, a small stab incision was made on the medial aspect of the navicular and a 4.0 mm cannulated, partially threaded screw was placed across the fracture site. He was placed in a CAM boot to remain non-weight bearing with use of crutches. The sutures were removed at four weeks and the patient was permitted partial weight-bear in a CAM boot at this time. The patient was seen at eight weeks in zero out of ten pain. The radiographs revealed bony callous with cortical healing across the fracture site(Image 4). He was advised to continue use of CAM boot for two more weeks and then transition into normal shoe gear. The patient started his wrestling season at ten weeks post-op, and he was pain free. The patient was seen at three months post operatively and had been ambulating in supportive shoe gear without pain and participating in wrestling and snow-boarding.

#### Patient 2:

A 26-year-old female, presented to our office after being referred from an orthopedic surgeon. The patient fell down a flight of stairs and stated that she landed on the ball of her left foot. She was seen in our office a week after her initial injury. Plain radiographs showed a simple, non-displaced, sagittal plane fracture through the body of the navicular(Image 1). Surgery was performed one week after initial injury date. The fracture site was reduced percutaneously and stabilized with a point-to-point clamp. Next, two guide wires were placed from medial to lateral, crossing the fracture site. A small stab incision was then made medially and two 4.0 mm cannulated, partially threaded screws were placed across the fracture site. Fluoroscopy imaging was performed intra-operatively to confirm proper reduction of the fracture site and alignment of the screws. The patient was placed in a CAM boot to remain non-weight bearing with use of crutches. Sutures were removed at four weeks and patient was allowed to partial weight-bear in CAM boot. The patient was seen at eight weeks in two out of ten pain. The radiographs revealed bony callous healing across the fracture site at this time(Image 3). She was advised to slowly transition out of the CAM boot over the following two weeks. The patient was seen again at three months post operatively and she was playing with her kids pain free at this time.

#### Pre-Operative Fracture Patterns

Image 1 (Left) Image 2 (Right)



#### Post-Operative Fractures at 8 Weeks

Image 3 (Left) Image 4 (Right)



### CLINICAL SIGNIFICANCE

These isolated fracture patterns with associated mechanism of action are rarely cited in literature.

Cases of non-displaced, sagittal plane fractures are most commonly seen as stress fractures.

Most high impact falls have shown significant dislocation of the navicular counterparts or surrounding structures.<sup>9</sup>

Though both cases resulted from traumatic falls with longitudinal compression and an axial loading mechanism, they showed non-displaced, sagittal, navicular body fractures, without dislocation or comminution.

This fracture pattern and corresponding mechanism of injury does not fit into any previously cited classification system.

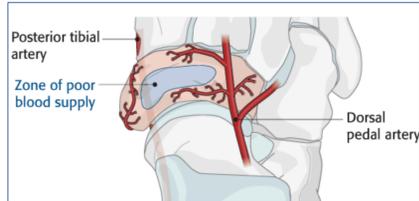


Photo Credit: AO Surgery Reference

### DISCUSSION

Isolated fractures through the body of the navicular lack significant blood flow<sup>10</sup> and frequently require internal fixation to ensure higher healing probabilities.

Due to the avascularity of the body of the navicular<sup>3</sup> and young age of patients, it was appropriate to have surgical correction of the fracture site to help prevent non-union, avascular necrosis and future displacement or arthritic changes. Both patients having suffered traumatic falls with minor osseous injury, had excellent surgical outcomes.

We propose the concept that there is potentially another mechanism of injury with corresponding fracture pattern, that is not previously cited in literature.

This is a mechanism in which the foot is accepting forces in an axial loading fashion, while the navicular is able to completely absorb the forces of the impact due to the talus and corresponding cuneiforms compressing at equal energies.

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