Prevalence of Cavovarus Foot Deformity and Other Risk Factors in Patients with Navicular Stress Fractures

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Conflict to Disclose

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My disclosure is in the Final AOFAS Mobile App.
I have a potential conflict with this presentation due to:
2 senior authors serve on AAOS &/or AOFAS committees
Background:

- Navicular Stress fractures are problematic to treat
  - Tenuous blood supply
- Numerous theories have been suggested for foot type as a predisposition\(^2,3\)
  - Pes planus
  - Pes cavus
  - Short 1\(^{st}\) MT
  - Long 2\(^{nd}\) MT
  - Metatarsus adductus
- No large studies supporting this radiographically
Study Questions

• Primary:
  – Is there a prevalent foot type common to patients with navicular stress fractures?

• Secondary:
  – Are there other factors for stress fractures that are prevalent in this population?
Methods

- Retrospective Chart Review of our Foot and Ankle Registry (2006-2014)
- Searched by ICD9 code with stress fracture of tarsal bone unspecified or navicular fracture
- Reviewed charts to find those patients with navicular stress fractures

Inclusion Criteria
- Navicular Stress Fracture diagnosis
- Must have WB AP and Lateral foot x-rays

Exclusion Criteria
- Patients with traumatic fractures
- Patients without WB radiographs
Findings

- 46 feet in 44 patients had navicular stress fractures
  - 19M:25F
  - 17pts (17 feet) ages 15-21 yrs
  - 19pts (20 feet) ages 22-59 yrs
  - 8pts (9 feet) ages 60 yrs +
  - 6 high school athletes, 6 college athletes, 1 professional baseball player, 1 elite gymnast
- 2 of the 46 patients had a prior ankle fusion with the foot in cavovarus alignment
  - Calcaneal pitch was 25.6 deg and 28.6 deg, respectively
  - MC to base of 5th height 30.8 mm and 21.6 mm
- Other injuries
  - 2 patients with bilateral navicular stress fractures
  - 1 bilateral navicular stress fx patient had bilateral 2nd MT stress fx
  - 3rd and lateral cuneiform stress fracture
  - 4th MT stress fracture contralaterally
  - Contralateral 2/3rd stress fractures
  - 3rd MT stress fracture and a base of the 5th MT nonunion
  - One patient had a contralateral jones fracture
  - 1 patient had a peroneal tendon tear
Results (excluded 2 ankle fusion patients)

• Calcaneal Pitch\(^1\)
  – Over 20 degrees (cavovarus): 52.3% (23/44)
  – Less than 20 degrees (neutral to valgus): 47.7% (21/44)

• Medial Cuneiform to Base of 5\(^{\text{th}}\) MT height\(^6\)
  – More than 14 mm (cavus): 72.7% (32/44)
  – Between 10-14 mm (neutral): 18.2% (8/44)
  – Less than 10 mm (planus): 0.09% (4/44)

• Talo-1\(^{\text{st}}\) Metatarsal Angle\(^1\)
  – More than + 4 (cavus): 43.2% (19/44)
  – Between -4 to +4 (neutral): 34.1% (15/44)
  – Less than – 4 (planus): 22.7% (10/44)
Results

• Comparison to previous literature
  – Torg clinical exam of 21 patients\(^5\)
    • 10 cavus (47%) 4 planus (19%) 7 normal (33%)
  – Anderson et al 7 navicular stress fractures with weight bearing radiographs\(^2\)
    • Avg of 3.7 degrees for Meary angle (0-8 degrees)
    • Avg of 25.4 degrees for Calcaneal Pitch (10-32 degrees)
  – Suggests trend to cavus foot
• Based on Meary’s angle - Our study
  – 43.2% cavus, 22.7% planus, 34.1% normal
• 4/9 navicular fractures in patients over 60
  – the patient was taking synthroid
  – 1 patient of 9 (only in study without access to PMH)
  – possible relationship with hypothyroidism in elderly with navicular stress fracture
Discussion

• Up to 72.7% of navicular stress fractures have radiographic findings of cavovarus foot alignment

• Supports the notion that a cavovarus foot spends more time with the transverse tarsal joint locked, creating a stiff medial column when walking, thus leading to increased force transferred through the navicular

• These findings suggest a relationship between navicular stress fractures and cavovarus foot alignment

• Furthermore, orthotics (lateral posting and recessed a 1st ray) may assist in preventing refracture or other associated cavovarus pathologies
Study Limitations

- For weight bearing xrays, no pressure measurement to identify how much pressure was applied
- Radiographic measurements were made on initial presentation or once the patient was fully weight bearing at a minimum of 3 months post op
- Retrospective Review
- Questions if orthotics for those patients with cavovarus foot alignment may benefit in preventing re-fracture or other cavovarus foot alignment pathologies
  - Should be studied in a prospective fashion
Summary

• Up to 72.7% of navicular stress fractures have radiographic findings suggestive of cavovarus foot alignment

• This may play a role in diagnosing a treatable associated foot alignment type, possibly preventing refracture, delayed union, and/or nonunion

• Fusion of the ankle with the foot in a cavovarus alignment may put the foot at risk for navicular stress fracture

• 4/9 navicular fractures in patients over 60 yrs were in patients with hypothyroidism
References


