Talonavicular Arthrodesis: 
A Biomechanical Study of Compression Staple Utility

Cameron Barr, MD
Brent Parks, MSc
Michael Tsai, BS
Stuart Miller, MD

MedStar Union Memorial Hospital
Department of Orthopaedic Surgery
Foot and Ankle
Talonavicular Arthrodesis: 
A Biomechanical Study of Compression Staple Utility

Cameron Barr, MD

My disclosure is in the Final AOFAS Mobile App.
I have no potential conflicts with this presentation.
Background

- Talonavicular arthrodesis
  - Indications
    - Arthritis
    - Hindfoot malalignment
  - Isolated procedure or component of double/triple arthrodesis
  - Nonunion rate up to 37%
Background

• Talonavicular fixation
  – “Gold standard” is one to three retrograde screws
  – Compression staples also being used for fixation
    • Used in isolation or in combination with screws
Purpose

- Although staples have the benefit of inherent compression and ease of insertion, there are few clinical or biomechanical studies evaluating their utility.
- The purpose of this study was to determine if the addition of a compression staple to a screw for talonavicular arthrodesis is associated with a significant biomechanical advantage.
Methods

- Forty (20 matched pairs) of cadaveric specimens
- TN joints dissected free and randomly assigned fixation with:
  - One 5.5mm cannulated screw
  - One 5.5mm cannulated screw and one 20mm Nitinol compression staple
Methods

• 10 matched pairs tested in cantilever bending
  – plantar-dorsal
  – 1mm/second

• 10 matched pairs tested in torsion
  – external rotation of the navicular
  – 0.25 degrees/second

• Outcome measures
  – Bending stiffness
  – Bending load at 10mm of displacement
  – Torsional stiffness
  – Torque at 10° of rotation
Results: Bending

• Initial bending stiffness
  – Single screw: 9.3 N/mm
  – Screw and staple: 13.2 N/mm
  – p=0.32

• Bending load at 10mm displacement
  – Single screw: 29.5 N
  – Screw and staple: 48.0 N
  – p=0.14
Results: Torsion

• Initial torsional stiffness
  – Single screw: 0.29 Nm/deg
  – Screw and staple: 0.38 Nm/deg
  – $p=0.30$

• Torque at 10° of rotation
  – Single screw: 3.54 Nm
  – Screw and staple: 3.26 Nm
  – $p=0.68$
Discussion

• Data suggest that there is no significant biomechanical advantage with the addition of a staple to a single screw for talonavicular joint fixation

• So what?
  – Recent explosion of compression staples on the market
  – Cost of compression staple is 10X that of screw (at our institution)
Conclusion

- Staples have the benefit of inherent compression and ease of insertion
- No biomechanical advantage when adding staple to a screw for TN arthrodesis
- Surgeons need to use clinical cost-conscious decision making
- Further in-vivo studies are needed to assess for any clinically significant differences.
References


5. Rosenfeld, JF; Parks, BG; and Schon, LC: Biomechanical investigation of optimal fixation of isolated talonavicular joint fusion. Am J Orthop. 34(9):445 – 8, 2005.

