Screw Placement to the Calcaneal Fracture Constant Fragment: An Anatomic Study

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Disclosure

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Calcaneal Fractures

- Comprise approximately 2% of all fractures\(^1\)
- Majority occur in males with a 5:1 male-to-female ratio, and in the third to fifth decades of life
- 75% result from a fall from a height, reported in as little as 3 feet\(^2\)-\(^{12}\)
- Over 98% are closed injuries
- Up to 30% are extra-articular
Calcaneal Fracture Repair

- Restore calcaneal morphology both in height and width
- Correct hindfoot varus
- Accurate joint reduction
- Closed reduction, percutaneous techniques, and open reduction internal fixation (ORIF) all indicated based on severity of injury and fracture patterns
ORIF Calcaneal Fracture

• Obtain solid fixation and reduction of the posterior facet

• Done by lag screw technique into the “constant fragment” of the stable sustentaculum tali (ST)

• After reduction of the posterior facet fragments, screws are driven into the ST, just inferior to the facet, allowing stable support of the reduction, and stability or compression across fracture lines

• Typically the screws are directed from slightly posterior lateral to anterior medial, but accurate placement can be difficult
Study Goal

• Goal of current study to describe the ST anatomy and describe anatomical landmarks
  • Useful for targeting the ‘constant fragment’ screw placement for calcaneal fracture ORIF
• Has been recent attempts to describe navigation techniques to reduce errors for screw placement exist\textsuperscript{18}
Methods

- San Diego Cadaver Anatomy Research Symposium (SCARS)
- 10 fresh frozen adult BK cadaver limbs
- Demographics collected
  - race, side
- Limbs numbered and denuded of soft tissue surrounding the calcaneus
- ST anatomically defined by measuring height – measured from the most medial point of the ST from inferior to superior, and width – measured from anterior to posterior
- Performed with digital caliper
Methods

- Orientation of the ST in relation to the lateral calcaneal wall determined using series of Steinman pins
- Pin 1 placed from the center of the ST across the calcaneus from medial to lateral, perpendicular to the long axis of the calcaneus
- Pin 2 placed from lateral to medial, inferior to the center of the posterior facet in the dense subchondral bone in the typical ‘constant fragment’ lag screw placement
- Pin 2 exited medially in the ST creating an apex with the start point of pin 1
Measurements

- Distance on the lateral calcaneal wall from pin 1 to the subtalar joint (STJ) superiorly
- Distance from pin 1 to the calcaneocuboid joint (CC) distally
- Distance from the anterior margin of the posterior facet to pin 1
- Distance from pin 1 to pin 2 on the lateral side
- Angle created from pin 1 to pin 2 as viewed from superior taken with a tractograph
Results

• The mean height of the ST was 12.8 mm (range 11.3-14.4 mm)

• The mean width of the ST was 20.8 (range 17.7-26.5 mm)

• The average position from pin 1 to the STJ was 6.6 mm (range 1.6-12.0 mm)

• The average position from pin 1 to the CC joint was 22.0 mm (range 13.5-29.3 mm)

• The average position from the front edge of the posterior facet to pin 1 was 5.0 mm (range -2.9-12.3 mm)

• The mean distance from pin 1 to pin 2 measured 16.1 mm (range 6.95-23.98)

• The average angle created from pin 1 to pin 2 was 29.8 degrees (range 14-42 degrees)
Discussion

• Using the ST reference point, the surgeon should step back the 2nd pin approximately 16mm and angle from posterior lateral to anterior medial by approximately 30 degrees.

• The guidewire is approximately 0.5-10mm inferior to the posterior facet in the dense subchondral bone.

• This guidewire should reproducibly traverse beneath the posterior facet, across the fracture line(s) into the dense ST.
Anatomic Templating

- Avoids an arbitrary start point and allows a reproducible screw placement
- Allows a better chance of successful drill/wire delivery on the 1st attempt
- If the screw targets the most medial point, more threads have the opportunity to purchase, allowing better strength
- Allowing the screw to be housed entirely within the ST cortical shell protects the surrounding soft tissue, namely the flexor hallucis longus
Summary

• Starting point of 1.5 cm and aiming 30 degrees is easily reproducible can be estimated with relative ease

• This should help the surgeon reliably target this important fixation in the ORIF of calcaneal fractures

• This could also lead to plate or instrumentation design allowing an angle of 30 degrees to be inherent to the plate out of the box
References

THANK YOU