The Effect of Dorsal Plate Positioning on Dorsiflexion Angle in Arthrodesis of the First Metatarsophalangeal Joint: A Cadaveric Study

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Presenter: Jesse Lewis, MD

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

- First metatarsophalangeal (MTP) joint arthrodesis commonly used in the treatment of advanced hallux rigidus, as well as rheumatoid forefoot, and failed valgus valgus correction

- Likely to become more common as the population continues to age—projected 20% of US population will be >65 yoa by 2030

- Though outcomes in symptom improvement, patient satisfaction, and bony union are generally reported as excellent, successful results depend on the correct positioning of the joint

- General consensus that optimum fused dorsiflexion angle is within range of 20 to 25 degrees (radiological)

- Dorsal plates are commonly used as part of fusion construct
Background

- When malpositioning occurs, most common problem is excessive dorsiflexion (plantar pain, shoe difficulties).

- Increases in dorsiflexion angle have been shown to lead to increases in pressure beneath the metatarsal head.

- Revision surgery with correction to lesser angle can lead to symptom resolution and return to normal shoe wear.

- The relationship of dorsal plate positioning along the longitudinal axis during fusion has not been investigated in regards to effect on final dorsiflexion angle.

- Inadequate exposure (EHL), failure to understand change in joint position (more distal) with cup-&-cone reaming, and using precontoured plates for templates for plate positioning rather than patient anatomy can lead to proximal placement of the dorsal plate.
Purpose

Does changing in the position of the dorsal plate along the longitudinal axis have any effect on final dorsiflexion angle?

- **Hypothesis:** There is likely a range where plate position results in optimal dorsiflexion angles, where more proximal positions lead to excessive dorsiflexion

How does the use of precontoured vs straight plates effect this relationship (if any)?

- **Hypothesis:** Precontoured plates likely lead to higher dorsiflexion angles regardless of positioning
Materials and Methods

- Ten fresh frozen cadaver right foot specimens - No evidence of previous surgery, first ray or other foot deformity w/ mean age of 67.7 yrs (range, 41 to 75 yrs) randomized to either zero degree dorsiflexion plate or 10 degrees precontoured plate group

- All feet prepared as routine with exception of advancement of k-wire under mini c-arm fluoroscopy into proximal phalanx and metatarsal after cup-&-cone reaming to use later for radiographic measurements
Materials and Methods

• Chose plate positions to be 0mm, 3mm, and 6mm from initial

• This allowed measurable plate movement, while still having adequate bone in proximal phalanx base for plate fixation

• Placed joint in 10 deg of clinical dorsiflexion and provisionally pinned plate in place

• Mini c-arm, simulated weight bearing and Freer test to confirm desired position

• Plate then fixed with two 3.5mm non-locking screws with bicortical fixation (distal then proximal)
Materials and Methods

- Plated specimen taken for final imaging (lateral of foot)
- Distal edge of plate marked
- Plate removed and **advanced 3mm proximal** to mark
- All above steps repeated without trying to achieve any particular clinical results

- Using a manual goniometer, dorsiflexion angles were obtained/recorded for all specimens - > **Three measurements total for each specimen**
Results

- Mean DFA for both groups at 0mm: **21.9 degrees** (16-30)
- Mean DFA at 3mm: **26.2 degrees** (18-37)
- Mean DFA at 6mm: **29.8 degrees** (24-44)

- Proximal placement of dorsal plates in 1st MTP fusions positively correlated with increased dorsiflexion angles (p=0.04)

- The increase in mean DFA from the initial position to the 6mm position = 7.9 degrees (p=0.004)

- Conclusion: There is a relationship between changes in position of the dorsal plate in 1st MTP fusions and final dorsiflexion angles

- Relevance: More proximal placement -> Higher dorsiflexion angles

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Abbreviations: S, straight-plate specimens; P, precontoured-plate specimens
Results

- Mean DFA for straight plate group: 23.9 degrees
- Mean DFA for precontoured plate group: 28.1 degrees

- Significantly higher dorsiflexion angles for identical proximal changes in position with the precontoured plate versus the straight plate (p=0.01)

- Conclusion: Precontoured plates will increase dorsiflexion angles regardless of positioning along the longitudinal axis

- Relevance: Individualize plate selection based on bony anatomy
Surgical Pearls

• Failure to fully dissect and visualize the proximal phalanx (*EHL) base could lead to placement of the plate too proximally.

• After cup-&-cone reaming the actual joint position is distal to the base of the proximal phalanx.

• Pin the joint/toe in a preferred position before choosing a plate; choose a plate based on patient anatomy.

• Use fluoroscopy and simulated weight bearing to confirm desired position before final fusion.
References:


