Effects of Variations in Dwyer Osteotomy Determined by 3D Patient-Specific Computer Modeling

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My disclosure is in the Final AOFAS Mobile App.

I have no potential conflicts with this presentation.
Introduction

- The purpose of the study is to report on the use of pre-operative imaging analysis with computer modeling software Mimics (Materialize, Plymouth MI) to determine optimal parameters for surgical correction in patients with hindfoot varus deformity undergoing Dwyer osteotomy.
Methods

- Patients with the diagnosis of hindfoot varus deformity who had undergone a Dwyer (lateral closing wedge) calcaneal osteotomy classified as Current Procedural Terminology [CPT] code 28300 were added to a retrospectively collected database.
- Pre-operative CT scans were analyzed with Mimics computer modeling software.
- Distance from osteotomy to calcaneal tuberosity: 15, 20, and 25mm.
- Angle of the osteotomy in the sagittal plane measured 60 and 75 degrees off of the longitudinal axis of the calcaneus.
- The wedges of bone resected measured 6, 9, and 12 mm on the lateral calcaneus.
- The posterior portion of the calcaneus was then rotated such that two osteotomies converged. The angle formed by the tibia-talus axis and the calcaneal-tuber axis was then measured at each iteration of the osteotomy.
Figure 1. Coronal, Axial and Sagittal 2D Reconstructions

(a) Tibia-talus axis, (b) Calcaneal tuberosity axis, (c) Different Sagittal Angles
Results

- Six patients (4 female) average age 54 years received preoperative CAT scans prior to a calcaneal osteotomy.
- Both position and size of osteotomy had statistically significant effects on amount of correction and % of initial varus deformity corrected. The sagittal angle was not significant.
- Increasing position of osteotomy from 20 to 25 mm increased the amount of correction by an average of 2.4 degrees, with a 12% reduction of overall deformity (p <0.05 by paired t-test).
- Increasing the size of the wedge from 6 to 12mm increased the amount of correction by an average of 8.26 degrees, with a 44% reduction of overall deformity (p <0.05 by paired t-test).
- Changing the sagittal angle from 60 to 75 degrees was not statistically significant, but increased the amount of correction by an average of 1.29 degrees, with a 7% reduction of overall deformity (p >0.05 by paired t-test).
Figure 2. Average Correction Based off of Distance, Resection, and Sagittal Angle

**Average Correction Based on Distance from Calcaneal Tuberosity**

- 20mm vs 25mm Distance
- Amount of Correction (Degrees)

**Average Correction Based on Amount of Resection**

- 6mm vs 12mm Wedge
- Amount of Correction (Degrees)

**Average Correction Based on Sagittal Angle of Osteotomy**

- Sagittal Angle of Osteotomy
- Amount of Correction (Degrees)
Figure 3. 3D Representation of Dwyer Osteotomy Modeling
Conclusions

- This is the only study to date which uses Mimics computer modeling software in the analysis of pre-operative imaging prior to Dwyer osteotomy to determine optimal realignment of the hindfoot in patients with varus deformity.

- Both the amount of bone resected and the location along the calcaneus had statistically significant effects on the amount of correction possible. The sagittal ankle of the cut was not statistically significant.

- Future studies will apply linear mixed effects models to better account for repeated measures study design, and to develop equations for predicting correction angle based on osteotomy variables.
References


