The Effect of Medializing Calcaneal Osteotomy on Hindfoot Alignment in the Reconstruction of Adult Acquired Flatfoot Deformity

Presenting Author:
Jeremy Chan, BS – New York, New York

Additional Authors:
Benjamin Williams, BS
Elizabeth Young, BS
Carolyn Sofka, MD
Jonathan T. Deland, MD
Scott J. Ellis, MD

Summary:
Successful correction of valgus hindfoot alignment in Adult Acquired Flatfoot Deformity is likely influenced by the degree of medializing calcaneal osteotomy (MCO) performed. However, it is not known whether accessory flatfoot reconstruction procedures significantly contribute as well. This study evaluated several common flatfoot procedures and radiographic parameters for correlation with the radiographic change in hindfoot alignment. Our results indicate that correction of hindfoot alignment is primarily determined by the MCO procedure and can be modeled linearly.

Background:
Successful reconstruction of the Adult Acquired Flatfoot Deformity (AAFD) depends on correcting hindfoot valgus which can be imprecise. Although postoperative hindfoot alignment is likely influenced by the degree of medializing calcaneal osteotomy (MCO) performed, it is not known if other reconstruction procedures significantly contribute as well. The purpose of this study was to evaluate the correlation between common reconstructive procedures and hindfoot alignment. Our hypothesis was that a linear relationship exists between the amount of MCO and the change in hindfoot alignment.

Materials and Methods:
Thirty-two feet in 32 patients (20 left, 12 right) with stage II AAFD undergoing MCO along with lateral column lengthening (LCL) (n=20), Cotton osteotomy (n=13), first tarsometatarsal (TMT) fusion (n=15), flexor digitorum longus (FDL) transfer (n=30), spring ligament reconstruction (n=5) and gastrocnemius recession (n=29) between September, 2008 and December, 2010 were assessed. The cohort consisted of 13 men and 19 women (mean age 58.0, range 22-77 years) with available operative notes as well as preoperative and postoperative radiographs read on average 34.1 weeks after surgery. Hindfoot alignment was determined using the apparent moment arm between the tibial axis and contact point of the heel. Other parameters included the AP talonavicular uncoverage, AP talus-1st metatarsal (T-1MT), and lateral T-1MT angles. Spearman’s correlation coefficients and the Wilcoxon rank-sum test were used to determine whether each of the reconstructive procedures and radiographic parameters were associated with the change in hindfoot alignment. Linear regression was performed to assess the relationship between each procedure and the change in hindfoot alignment.

Results:
Three variables, the amount of MCO (p<0.001) and LCL (p<0.001) performed and spring ligament reconstruction (p<0.001), were significantly associated with the change in hindfoot moment arm. The amount of Cotton osteotomy (p=0.57) performed, the change in AP talonavicular uncoverage (p=0.45), AP T-1MT (p=0.21), and lateral T-1MT (p=0.08) angles as well as whether gastrocnemius recession (p=0.46), first TMT fusion (p=0.07) or FDL transfer (p=0.97) was done did not significantly influence the change in moment arm. Similarly, relevant demographic parameters including age, height, weight and BMI were not correlated with the change in moment arm. Multivariate regression analysis revealed that LCL and spring ligament reconstruction made minimal contributions to the model. Therefore, only MCO was included in our final linear regression. The model for MCO showed a good fit (Rsq=0.96, p<0.001) and indicated that each millimeter of medialization performed corresponded to a 1.53mm change in moment arm (Figure1).
Conclusion:
These results indicate that the correction in hindfoot alignment obtained in flatfoot reconstruction is primarily determined by the MCO procedure and can be modeled linearly. We believe that the hindfoot alignment view can serve as a valuable preoperative measurement to help surgeons titrate the proper amount of correction intraoperatively.

Figure 1: Linear Regression Model for the Medializing Calcaneal Osteotomy

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\text{Change in Moment Arm (mm)} = 1.529 \times \text{Amount of MCO (mm)} - 1.263
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1 Saltzman CL, el-Khoury GY. The hindfoot alignment view. Foot Ankle Int. 1995 Sep;16(9):572-6.