The Contribution of Lateral Column Lengthening to the Correction of Forefoot Abduction in Stage IIB Adult Acquired Flatfoot Deformity Reconstruction

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Summary:
Successful correction of forefoot abduction in stage IIB Adult Acquired Flatfoot Deformity (AAFD) is likely affected by the amount of lateral column lengthening (LCL) performed. However, it is not known whether concomitant flatfoot reconstruction procedures contribute as well. This study evaluated the correlation between common flatfoot procedures and the radiographic change in forefoot abduction. Our results indicate that correction of forefoot abduction, as measured by lateral incongruency angle, is primarily determined by the LCL procedure, and that this relationship can be modeled linearly.

Introduction:
The clinical success of stage IIB flatfoot reconstruction depends, in part, on the proper correction of forefoot abduction intraoperatively, which can be imprecise. Although the correction of forefoot abduction is likely influenced by the amount of LCL performed, it is not known if other reconstruction procedures significantly contribute as well. Previous work has demonstrated that the change in hindfoot alignment following flatfoot reconstruction is linearly related to the amount of translation performed in a medializing calcaneal osteotomy (MCO). The purpose of this study was to evaluate the correlation between common reconstructive variables and the observed change in forefoot abduction. Our hypothesis was that a linear relationship exists between the amount of LCL and the change in forefoot abduction.

Methods:
Forty-one feet in 41 patients (24 left, 17 right) with stage IIB AAFD who underwent reconstruction involving an Evans-type LCL between January 2007 and July 2012 were assessed retrospectively. The cohort consisted of 15 men and 26 women (mean age 58.2; range, 25 to 77 years) with a mean body mass index (BMI) of 27.6 (range, 18.2 to 40.9). Preoperative and postoperative AP radiographs of the foot at a minimum of 40 weeks (mean, 23.6 months) after surgery were reviewed to determine correction in forefoot abduction as measured by talonavicular coverage (TNC) angle, talonavicular uncoverage percent, talus-1st metatarsal (T-1MT) angle and lateral incongruency angle, which has been shown to be a reliable measure for stage IIb deformity (Ellis, Foot Ankle Int, Dec 2009). Sixteen demographic and intraoperative variables were evaluated for association with change in forefoot abduction including age, gender, height, weight, BMI, as well as the amount of LCL (n=41) and MCO (n=30) performed, LCL graft type (11 allograft, 30 autograft), Cotton osteotomy (n=15), first tarsometatarsal fusion (n=24), flexor digitorum longus transfer (n=40), spring ligament repair (n=40), gastrocnemius recession (n=40) and any one of the modified McBride/Akin/Silver procedures (n=11). Pearson’s correlation coefficients and the Wilcoxon
rank-sum test were used to determine whether each of the reconstructive procedures were associated with correction in forefoot abduction. Individual variables found to have significant associations were then used to construct a regression model.

**Results:**
Three variables were found to significantly affect the change in lateral incongruency angle. These were weight (p=0.038), foot laterality (p=0.046) and the amount of LCL performed (p<0.001). No variables were found to be significantly associated with the change in TNC angle, talonavicular uncoverage percent or T-1MT angle. Multivariable regression analysis revealed that LCL was the only significant predictor of the change in lateral incongruency angle. The final regression model for LCL showed a good fit (R_squared=0.70, p<0.001) and indicated that each millimeter of LCL performed corresponded to a 6.8 degree change in lateral incongruency angle (Figure 1).

**Conclusion:**
These results indicate that the correction of forefoot abduction in flatfoot reconstruction is primarily determined by the LCL procedure, and that this relationship can be modeled linearly. We believe that the lateral incongruency angle can serve as a valuable preoperative measurement to help surgeons titrate the proper amount of correction performed intraoperatively.

![Figure 1: Linear Regression Model for Lateral Column Lengthening](image)

Change in Lateral Incongruency Angle (degrees) = 6.849 × Amount of LCL (mm) + 5.593

N = 41
R^2 = 0.70
p < 0.001