LATERAL COLUMN LENGTHENING FOR POSTERIOR TIBIAL TENDON DYSFUNCTION AND FLATFOOT

INTRODUCTION:
Posterior tibial tendon dysfunction (PTTD) is the most common cause of the adult flatfoot and is treated with a variety of operations such as tendon transfers, ligament reconstruction, osteotomies, and arthrodeses. Lateral column lengthening with a calcaneocuboid fusion (LCL) (Fig. 1) has been reported for treatment of PTTD in adults (1) to correct the deformity, while minimizing loss of motion in the hindfoot and midfoot. The purpose of this study was to evaluate the effect of LCL on ankle/foot function in flatfoot.

MATERIALS AND METHODS:
Fifteen fresh-frozen lower extremities without foot-ankle pathology were evaluated. The tibia and fibula were embedded in PMMA and specimen was mounted in a dynamic ankle testing apparatus (2) designed to recreate the normal stance phase dynamics. Tendons of the gastrocnemius-soleus, posterior tibial, flexor hallucis longus-flexor digitorum longus, anterior tibial, and extensor hallucis longus-extensor digitorum longus were attached to computer-controlled pneumatic cylinders using cables to simulate their muscle action. The force profile for each muscle group was based upon anatomic and electromyographic data (3, 4). The leg was advanced in the sagittal plane according to gait analysis data (3, 4). Axial and fore-aft shear forces were applied with servomotors with force profiles from gait analysis data. Each specimen was pretested three times throughout the entire stance phase to reduce the viscoelastic effect of soft tissues. The leg was then continuously moved from tibial flexion (~20 degrees (heel-strike)), to 40 degrees flexion (pre-swing) while applying forces to the six muscle groups. A consistent flatfoot deformity developed sectioning peritalar soft tissue structures. LCL was performed by distracting the calcaneocuboid joint, inserting a 1 cm wedge from a foam plastic bone, and applying fixation with multiple threaded pins. A magnetic tracking system recorded six degree-of-freedom metatarsal-tibial and calcaneal-tibial joint motions. Three test conditions were evaluated successively: normal, flatfoot and LCL. Statistical analysis included repeated measure ANOVA to evaluate the effect of each test condition on foot kinematics, with statistical significance set at p<0.05 level. Significant effect was analyzed using the Student-Newman-Keuls multiple comparison procedure.

RESULTS:
Kinematics measurements were consistent among the 15 specimens tested and in multiple trials of the same specimen. Maximum metatarsal-tibial dorsiflexion was 25.8±3.8˚ (mean ±SD) in normal, 25.7±5.3˚ in flatfoot, and 26.1±4.0˚ in LCL which was not significantly different than normal or flatfoot conditions (Fig. 2). Maximum metatarsal-tibial external rotation was 7.6±4.3˚ in normal, 15.9±7.1˚ in flatfoot (significantly different than normal), and 4.1±4.4˚ in LCL which was significantly different than flatfoot condition (Fig. 3). Maximum metatarsal-tibial eversion was 8.7±5.6˚ in normal, 18.5±8.5˚ in flatfoot (significantly different than normal), and 8.5±4.3˚ in LCL which was significantly different than flatfoot condition. Maximum calcaneal-tibial dorsiflexion was 14.7±3.5˚ in normal, 14.5±4.4˚ in flatfoot (NS), and 18.2±3.4˚ in LCL which was significantly different than normal and flatfoot conditions. Maximum calcaneal-tibial external rotation was 2.6±2.4˚ in normal, 7.4±4.1˚ in flatfoot (significantly different than normal), and 7.4±3.6˚ in LCL which was significantly different than normal condition. Maximum calcaneal-tibial eversion was 6.2±3.2˚ in normal, 11.0±4.2˚ in flatfoot (significantly different than normal), and 10.3±3.8˚ in LCL which was significantly different than normal condition (Fig. 4).

DISCUSSION:
LCL improved foot alignment when viewed clinically, and the present study demonstrated that foot and ankle movement was maintained. However, LCL primarily addressed the forefoot (met-tib) malalignment; hindfoot (cal-tib) deformity remained. This study will provide important baseline information for future studies, such as comparison of following other operations for flatfoot.

REFERENCES:

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