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. Subtalar implant or arthroereisis has been advocated for flatfeet in children and more recently for PTTD in adults (1, 2). The implant placed in the sinus tarsi of the subtalar joint is believed to effectively correct the deformity, while maintaining joint mobility. The purpose of this study was to evaluate the effect of subtalar arthroereisis for flatfoot on ankle/foot function.

MATERIALS AND METHODS:
Six 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 (3) 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 (4, 5). 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 from sectioning peritalar soft tissue structures. Subtalar arthroereisis (Subtalar MBA System, KMI) was performed with an implant placed into the lateral aspect of the sinus tarsi. A magnetic tracking system recorded six degree-of-freedom calcaneal-tibial and metatarsal-tibial joint motions. Three test conditions were evaluated successively: normal, flatfoot and subtalar arthroereisis. Statistical analysis included a paired T test to evaluate the effect of each test condition on foot kinematics, with statistical significance set at p<0.05 level.

RESULTS:
Kinematics measurements were consistent among the six specimens tested and in multiple trials of the same specimen. Maximum metatarsal-talus dorsiflexion was 14.3±2.3˚ (mean ±SD) in normal, 16.4±3.6˚ in flatfoot, and 9.6±2.7˚ in subtalar arthroereisis which was significantly different than intact (p=0.04) and flatfoot (p=0.001) conditions (Fig. 1). Maximum metatarsal-talus external rotation was 9.7±9.6˚ in normal, 13.9±4.5˚ in flatfoot, and 47±4.7˚ in arthroereisis which was significantly different than flatfoot (p=0.002) condition. Maximum metatarsal-talus eversion was 12.1±3.2˚ in normal foot, 15.7±3.5˚ in flatfoot, and 21±6.5˚ in arthroereisis which was significantly different than intact (p=0.03) and flatfoot (p=0.002) conditions. Maximum metatarsal-tibial dorsiflexion was 27.6±6.2˚ in normal, 26.3±7.9˚ in flatfoot, and 24.5±5.7˚ in arthroereisis which was not significantly different than intact or flatfoot conditions. Maximum metatarsal-tibial external rotation was 10.1±2.6˚ in normal, 14.4±4.5˚ in flatfoot (p=0.006), and 5.0±3.7˚ in arthroereisis which was significantly different than intact (p=0.007) and flatfoot (p=0.002) conditions. Maximum metatarsal-tibial eversion was 12.5±2.3˚ in normal, 16.4±3.4˚ in flatfoot (p=0.004), and 4.4±4.3˚ in arthroereisis which was significantly different than intact (p=0.001) and flatfoot (p=0.0008) conditions (Fig.2). Maximum calcaneal-talus dorsiflexion was 16.0±5.4˚ in normal, 14.9±4.3˚ in flatfoot (NS), and 13.5±4.4˚ in subtalar arthroereisis which was not significantly different than intact or flatfoot conditions. Maximum calcaneal-tibial external rotation was 4.9±1.7˚ in normal, 5.6±2.6˚ in flatfoot (NS), and 1.8±0.9˚ in arthroereisis which was significantly different than intact (p=0.015) and flatfoot (p=0.01) conditions. Maximum calcaneal-tibial eversion was 7.1±1.5˚ in normal foot, 9.0±1.9˚ in flatfoot (p=0.004), and 0.1±3.1˚ in arthroereisis which was significantly different than intact (p=0.007) and flatfoot (p=0.002) conditions.

DISCUSSION:
Subtalar implant improved arch alignment when viewed clinically, and the present study demonstrated that foot and ankle movement is maintained. However, kinematics was abnormal as the implant distracted the sinus tarsi and overcorrected hindfoot position (cal-tib) and forefoot position (met-tal, met-tib). This study will provide important baseline information for future studies, such as comparison of following nonimplant operations for flatfoot.

REFERENCES:
1. Dereymaeker GP: Presented at AOFAS Annual Meeting July 15, 2000

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