Pilot Biomechanical Evaluation of Spring Ligament Augmentation with the Internal Brace in a Cadaveric Flatfoot Model

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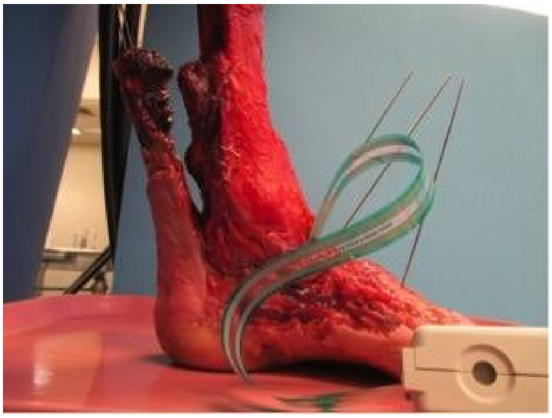
Introduction/Purpose: Surgical reconstruction for flexible acquired flatfoot deformity from posterior tibial tendon dysfunction has been described and often includes a medial displacing calcaneal osteotomy (MDCO), Flexor digitorum longus (FDL) transfer, and possible spring ligament repair. However, the spring ligament is often attenuated leaving surgeons with few options for robust repair. Meanwhile, the Internal Brace (Arthrex, Naples, Florida) has been reported in a patient series as an excellent adjunct for spring ligament augmentation for the treatment of flatfoot correction with good clinical results. However, there are no biomechanical studies, which evaluate its safety or efficacy. The aim of this study is to perform a biomechanical comparison of spring ligament repair with Internal Brace augmentation to controls undergoing reconstruction of a flatfoot model.

Methods: 4 paired (8 total), below the knee, cadaveric specimens, age 45.3 years (range; 30-60), without pre-existing foot deformity were utilized. Flatfoot model was achieved as described in the literature. Surgical reconstruction included MDCO (7.5 mm calcaneal plate), a spring ligament repair reefing (2-0 fiber wire suture), and an FDL transfer through a navicular bone tunnel with interference fixation via a biotenodesis screw (Arthrex, Naples, Florida). The experimental group received spring ligament augmentation with an internal brace as described by the manufacturer's specifications. After potting, specimens were loaded statically to measure contact pressures and flatfoot correction. Achilles was tensioned to 350 N and cyclic loading was performed in a stepwise fashion after preconditioning. Loading occurred at 1 Hertz for 100 cycles, increasing at 100 N intervals to 1800N. Tekscan contact pressures, radiography, and digitized measurements were repeated. Spring ligament repair site was evaluated and failures were recorded.

Results: There was a statistically significant difference under cyclic loading of the internal brace augmented repair compared to standard suture repair alone ($p=0.001$). There were no failures of the internal brace device. Control spring ligament repair failed via suture cutout. There was 1 catastrophic specimen failure through the tibio-talar joint in each group (1000N control; 1800N experimental). The average change in talometatarsal angle was not statistically significant between the control (4.31±2.82) and the internal brace (4.06±2.74) ($p=0.66$) after loading. There was no difference in the change of peak intra-articular contact pressure at the talonavicular joint between flatfoot model and surgical correction when comparing the internal brace reconstruction (1478.8±306.6 pKa) and controls (1816.5 ±436.7pKa) ($p=0.79$).

Conclusion: The use of the Internal Brace device to augment spring ligament reefing repair appears biomechanically safe and effective under cyclic specimen loading in a pilot, cadaveric flatfoot reconstruction model. Furthermore, it does not appear to alter intra-articular talonavicular joint contact pressures.



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