**Talocalcaneal Interosseous Ligament Provides Greatest Talar Stability in the Sagittal Plane**

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**Introduction/Purpose:** Talar ANV, trauma, and implant failure or collapse after TAR are major challenges in foot and ankle surgery. Custom total talar implants are a promising option for such conditions and have shown promising results. However, there are no biomechanical studies examining the kinematics of total talus implant. We aimed to investigate the critical stabilizers of the native talus and the biomechanics of a total talar replacement. We hypothesize that the stability an implant is less affected by medial and lateral ligaments, with partial stability provided by the tibiotalar mortise, and the most instability occurs on the talocalcaneal joint due to absence of plantar restraint. Total talar implant will be most unstable in the sagittal plane, especially in heel-raise position.

**Methods:** Eight cadaveric samples underwent biomechanical testing in a midstance and seated heel-raise models in an E1000 Instron testing system. An OptiTrack system was used to record the 3D positions of the tibia, talus, calcaneus, navicular and first metatarsus throughout testing. The Achilles tendon was loaded in tension, while the tibia was cyclically loaded. The lateral ligaments, deep deltoid ligaments, talonavicular joint capsule, and the talocalcaneal interosseous ligament (TCIL) were sequentially released and underwent cycles in midstance and heel-raise positions after each release. The talus was removed and replaced to simulate total talar implant. Lastly, TA, EHL, and EDL were sutured into place to provide static soft tissue coverage of the talus, and final kinematics were measured. Data was analyzed to determine the joint motion and joint angles. Each ligament release was compared to one another using a one-way ANOVA, and compared to the initial condition using a one-sample t-test.

**Results:** Eight cadaveric foot and ankle models were examined (four left feet and four right feet). Under maximum force in a simulated seated plantarflexion position, gradual increase in talonavicular sagittal angle compared to initial condition was noted with sequential soft tissue releases. The talar dorsiflexion angle showed no significant change after lateral ligament, deltoid ligament, and talonavicular joint capsular releases. However, a significant increase in the talar dorsiflexion angle (4.38+/-4.04o ) was noted after the interosseous ligament release compared to initial condition (p= 0.02). Similarly, the displacement of the talus relative to the navicular was significantly increased after the talonavicular joint capsule release (1.47+/-1.33 mm, p = 0.03) and the interosseous ligament release (5.28+/-3.82 mm, p = 0.01).

**Conclusion:** In this study, we utilized native talus as a surrogate for a custom total talar implant to investigate the peritalar kinematics of the total talus implant. We found that the TCIL provides the most talar stability in the native ankle joint. Without the TCIL, the talus is most unstable in the sagittal plane, especially during the simulated heel-raise position. Significant medial and lateral stability of the tibiotalar joint maybe provided by the mortise of the ankle joint. Taken together, recreation of the TCIL or plantar stabilization of the implant should be considered to improve stability of a total talar implant.
Plantarflexion Angle at Maximum Force

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