The Role of Calcaneofibular Ligament (CFL) Injury in Ankle Instability: Implications for Surgical Management

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Introduction/Purpose: Acute inversion ankle sprains are among the most common musculoskeletal injuries. Higher grade sprains, which include anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL) injury, can be particularly problematic and often require surgical repair. The implications of CFL injury on ankle instability are unclear. We aim to evaluate the impact of CFL injury on ankle stability and subtalar joint biomechanics. We hypothesized that CFL injury will result in decreased stiffness and torque, and alteration of ankle contact mechanics compared to the uninjured ankle in a cadaveric model.

Methods: Twenty matched cadaveric ankles dissected of skin and subcutaneous tissue were mounted to an Instron with 20° of ankle plantar flexion and 15° of internal rotation. Intact specimens were axially loaded to body weight, then underwent inversion stress along the anatomic axis of the ankle from 0 to 20° (simulating inversion injury) for three cycles. ATFL and CFL were sequentially sectioned, and inversion testing repeated for each condition. Stiffness and change in torque were recorded using an Instron, and pressure and contact area were recorded using a calibrated Tekscan sensor system. Inversion angle of the talus and calcaneus relative to the ankle mortise were recorded using a three-dimensional motion capture system. Paired t tests were performed for inter and intra-group comparisons.

Results: Stiffness and torque did not significantly decrease after sectioning of the ATFL, but did decreased significantly after sectioning of CFL. Peak pressures in the tibiotalar joint decreased significantly following CFL release compared to both the uninjured ankle and ATFL-only release. Mean contact area significantly increased following CFL release compared to both the uninjured ankle and ATFL release. There was a concentration of force in the anteromedial ankle joint during weight-bearing inversion. However, the center-of-force shifts 1.22 mm posteriorly after CFL release relative to an intact ankle. Motion capture showed a significant and sequential increase in inversion angle of both the calcaneus and talus, after release of each ligament. There was significantly more inversion in the subtalar joint than the tibiotalar joint with weight-bearing inversion.

Conclusion: There is significantly lower stiffness and torque with weight-bearing inversion of the ankle joint complex following injury to both ATFL and CFL, and sequentially greater inversion of the talus and calcaneus with progressive ligament injury. This corresponds to a significant shift in the center of force in the tibiotalar joint. CFL contributes considerably to lateral ankle stability, and sprains that include CFL injury result in substantial alteration of contact mechanics at the ankle and subtalar joints. Repair of CFL may be beneficial during lateral ligament reconstruction, potentially mitigating long-term consequences (e.g., articular damage) of a loose or incompetent CFL.

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