

Biomechanical Changes in the Ankle Joint after Syndesmosis and Deltoid Injury and Subsequent Repair in a Cadaveric Model

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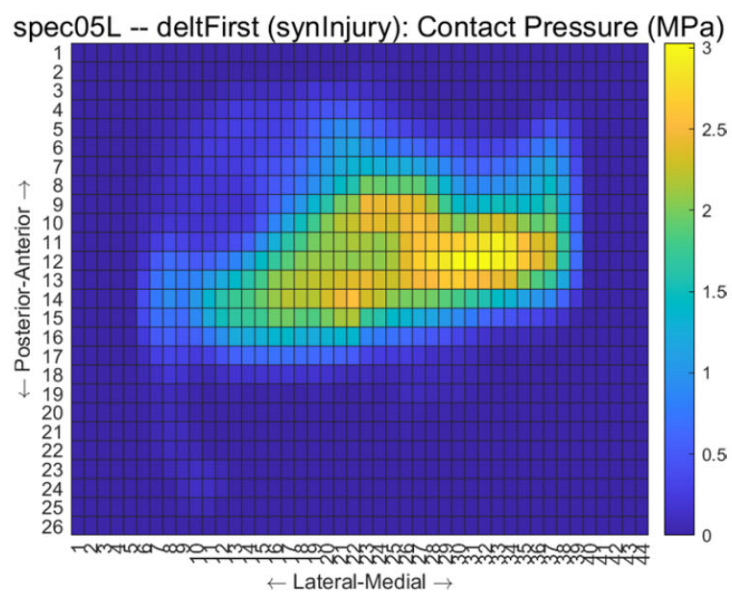
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Introduction/Purpose: Recent studies have stressed the important role of the deltoid ligament in maintaining global ankle stability. However, controversy remains around whether deltoid ligament repair is necessary in addition to syndesmotic repair when addressing injuries to both. The purpose of this study was to measure differences in tibiotalar joint contact pressures and tibiotalar contact area in the presence of deltoid ligament injury, syndesmotic injury, and after their respective repairs using a cadaveric model. Our hypotheses were 1) injury to the syndesmosis and deltoid would increase contact pressures and decrease contact area, 2) repaired injuries would restore biomechanics to near native state, and 3) that there would be similar tibiotalar contact pressures and contact area with syndesmosis repair alone compared to syndesmosis and deltoid ligament repair.

Methods: Twelve human cadaveric lower extremities were randomized and tested under a series of conditions: 1) native, 2) sectioning of syndesmosis or deltoid, 3) sectioning of both the syndesmosis and deltoid, 4) repair of syndesmosis or deltoid, 5) repair of both. In one group, the syndesmosis was sectioned and repaired first and in the other the deltoid was sectioned and repaired first. The syndesmosis was repaired with a single high-tensile strength suture mechanism and deltoid ligament repairs were performed with a single suture anchor. Specimens were tested under each condition with an axial compressive and torsional load. Contact pressures and area within the ankle were measured with a digitized pressure sensor (Tekscan, Boston MA). Changes in contact pressure and area were compared with two-way repeated measure analysis of variance and significant findings were tested with post-hoc pairwise comparisons of estimated marginal means with Bonferroni-adjusted p-values for multiple comparisons ($\alpha = 0.05$).

Results: The highest mean contact pressure was seen when the deltoid was injured, but the syndesmosis was still intact (4.43 ± 1.328 mPa) compared to mean contact pressure of 3.142 ± 0.511 mPa in the native condition. The lowest mean contact pressure was seen when the deltoid was repaired, but the syndesmosis was still disrupted (3.068 ± 0.477). However, these differences in mean contact pressures did not differ significantly with pairwise comparison. Total contact area was significantly less following syndesmosis repair in isolation when compared to the native condition ($609.55 \pm 312.37 \text{ mm}^2$ vs 903.854 mm^2 $p=0.0183$). When the syndesmosis was repaired, irrespective of the state of the deltoid, the distribution of contact pressures shifted from the medial half of the joint to the lateral half of the joint in all but one specimen. Conversely, after deltoid ligament repair the distribution of pressure remain concentrated in the medial half of the joint, like the native state.

Conclusion: We did not find a significant difference in overall mean ankle contact pressures between the various tested conditions. However, there can be a significant decrease in the joint contact area and a shift in the distribution of contact pressures within the joint after syndesmosis repair that was not seen after deltoid repair. In fact, with a deltoid repair alone, the distribution of contact pressures and the joint contact area did not differ significantly from the native state. These changes in contact area and distribution of pressures may affect long-term clinical and radiographic outcomes.



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