

Effect of Deltoid Ligament Repair versus Syndesmosis Fixation on Ankle Joint Stability After Bimalleolar Equivalent Ankle Fracture: A Biomechanical Analysis

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Introduction/Purpose: The current standard for stabilization of the talus within the ankle mortise after bimalleolar equivalent ankle fracture is open reduction and internal fixation (ORIF) of the lateral malleolus followed by syndesmotic screw fixation of the syndesmosis. Syndesmotic fixation may be associated with complications such as mal-reduction, joint stiffness, altered ankle biomechanics, and potential additional surgery for hardware removal. Consequently, some surgeons advocate ORIF of the lateral malleolus in conjunction with deltoid ligament repair rather than syndesmosis fixation. To our knowledge, clinical reports of this treatment option lack biomechanical evidence to support this approach. The purpose of this investigation was to compare ankle joint stability and contact pressures in a bimalleolar equivalent ankle fracture model treated with trans-syndesmotic screw fixation versus deltoid ligament repair.

Methods: We prepared and tested seven fresh frozen cadaveric whole lower leg specimens with an undisturbed proximal tibiofibular joint. We tested each leg was tested under five conditions: (1) intact, (2) syndesmosis disrupted and deltoid ligament sectioned, (3) syndesmosis reduced w/ screw fixation, (4) deltoid repaired, and (5) both syndesmosis and deltoid ligament repaired. Under a nominal axial load, we applied controlled anterior, posterior, lateral, and medial drawer stresses to the foot using a custom-built testing apparatus and documented the resulting talar translation relative to the tibia. We also applied controlled internal and external rotation stresses to the ankle model and measured the provoked ankle joint rotations. In each condition, we measured peak ankle contact pressure (PACP) using a Tekscan pressure sensor under a physiologic axial load simulating single-limb stance.

Results: Concurrent disruption of the syndesmosis and the deltoid ligament significantly ($p<.05$) increased anterior drawer, lateral drawer, and internal and external rotation. Subsequent deltoid repair significantly reduced anterior displacement to normal levels, but syndesmosis fixation did not. Lateral drawer was not significantly corrected until both deltoid ligament and syndesmosis were repaired. Deltoid repair and syndesmosis fixation each reduced internal rotation significantly, with further reduction to normal levels when both were repaired. External rotation remained elevated relative to the intact condition regardless of which structures were repaired. Deltoid repair and syndesmosis fixation achieved similar levels of posterior, lateral and medial drawer reduction, but these measures did not approach normal values until both were repaired. No significant differences in PACP were identified among the five tested conditions.

Conclusion: Isolated repair of the deltoid ligament after a bimalleolar equivalent ankle fracture achieves markedly better anterior displacement stability than does fixation of the syndesmosis with a screw. Under the described testing conditions, the two procedures offer similar posterior, medial, and lateral talar displacement stability and similar levels of internal and external rotational stability. Given the complications that may be associated with rigid syndesmotic screw fixation, our investigation suggests that deltoid repair may represent a reasonable alternative to syndesmosis fixation.

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