Restoration of Tibiofibular Kinematics with a Tricortical Screw or Suture Button Fixation After Syndesmotic Ankle Injuries

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Introduction/Purpose: Anterior inferior tibiofibular ligament (AITFL), Posterior inferior tibiofibular ligament (PITFL) and Interosseous membrane (IOM) disruption is a predictive measure of residual symptoms after ankle injury. In unstable injuries, the syndesmosis is treated operatively with cortical screw fixation or a suture button apparatus. Biomechanical analyses of suture button versus cortical screw fixation methods show contradicting results regarding suture button integrity and maintenance of fixation. The objective of this study is to quantify tibiofibular joint motion in syndesmotic screw and suture button fixation models compared to the intact ankle.

Methods: Five fresh-frozen human cadaveric specimens (mean age 58 yrs.; range 38-73 yrs.) were tested using a 6-degree-of-freedom robotic testing system. The tibia and calcaneus were rigidly fixed to the robotic manipulator and the subtalar joint was fused. The full fibular length was maintained and fibular motion was unconstrained. Fibular motion with respect to the tibia was tracked by a 3D optical tracking system. A 5Nm external rotation moment and 5Nm inversion moment were applied to the ankle at 0°, 15°, and 30° plantarflexion and 10° dorsiflexion. Outcome variables included fibular medial-lateral (ML) translation, anterior-posterior (AP) translation, and external rotation (ER) in the following states: 1) intact ankle, 2) AITFL transected, 3) PITFL and IOM transected, 4) 3.5mm cannulated tricortical screw fixation, 5) suture button fixation. An ANOVA with a post-hoc Tukey analysis was performed for statistical analysis (*p<0.05).

Results: Significant differences in fibular motion were only during the inversion moment. Fibular posterior translation was significantly higher with complete syndesmosis injury compared to the intact ankle at 0°, 15°, and 30° plantarflexion and the tricortical screw at 15° and 30°. Significantly higher fibular posterior translation was observed with the suture button compared to the intact ankle at 15° and 30° plantarflexion and to the tricortical screw at 15°. ER was significantly increased with complete injury compared to the tricortical screw at 0° and 30° plantarflexion. The suture button demonstrated significantly greater ER at 0° plantarflexion and 10° dorsiflexion compared to the intact ankle. The only significant difference in ML translation exists between the tricortical screw and complete injury at 30° plantarflexion.

Conclusion: The suture button did not restore physiologic motion of the syndesmosis. It only restored fibular ML translation. Significant differences in AP translation and ER persisted compared to the intact ankle. The tricortical screw restored fibular motion in all planes. No significant differences were observed compared to the intact ankle. These findings are consistent with previous studies. This study utilized a novel setup to measure unconstrained motion in a full length, intact fibula. Physicians should evaluate AP translation and ER as critical fibular motions when reconstructing the syndesmosis with suture button fixation.
AITFL = anterior inferior tibiofibular ligament. PITFL = posterior inferior tibiofibular ligament. IOM = interosseous membrane

FIGURE 1: Anterior-posterior translation of the fibula with 5Nm inversion moment. (Mean +/- SD). *p<0.05

FIGURE 2: Transverse rotation of the fibula with 5Nm inversion moment. (Mean +/- SD) *p<0.05

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