

## Significant Increases in Sagittal Translation and Transverse Rotation of the Fibula Occur with Sequential Disruption of the Syndesmosis

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### Summary:

This study demonstrates that significant fibular motion occurs with isolated AITFL disruption and only minimally increases with sequential PITFL and IOM transection. Clinical diagnostic protocol should be expanded to evaluate beyond ML translation of the fibula and account for sagittal and rotational displacements as well.

### Abstract:

**INTRODUCTION:** Injury to the Anterior inferior tibiofibular ligament (AITFL), Posterior inferior tibiofibular ligament (PITFL) and Interosseus membrane (IOM) predicts residual symptoms in ankle sprains. Limited kinematic knowledge of the tibiofibular joint results in missed diagnosis and poor clinical outcomes. Lateral fibular displacement on radiologic assessment signifies syndesmotic disruption which dictates operative management. Previous studies demonstrated that fibular motion is multiplanar after injury. The purpose of this study is to determine increases in fibular motion with sequential syndesmotic injury and the contribution of the AITFL.

**METHODS:** Five fresh-frozen human cadaveric tibial plateau-to-toe specimens with a mean age of 58 years (range 38-73 years) were tested using a 6-degree-of-freedom robotic testing system. The tibia and calcaneus were rigidly fixed. The subtalar joint was fused. The full fibular length was maintained and fibular motion was unconstrained. A 5Nm external rotation moment and 5Nm inversion moment were applied to the ankle at 0°, 15°, and 30° plantarflexion and 10° dorsiflexion. The motion of the fibula was tracked by a 3D optical tracking system. Outcome variables included fibular medial-lateral (ML) translation, anterior-posterior (AP) translation, and external rotation (ER) during each max moment and flexion angle in the following conditions: 1) intact ankle, 2) AITFL transected, 3) PITFL and IOM transected. Statistical analysis included an ANOVA with a post-hoc Tukey analysis to compare the changes in fibular motion between the intact and injury models at each applied moment and flexion angle (\*p<0.05).

**RESULTS:** The only significant differences in fibular motion were during the 5Nm inversion moment. The posterior translation of the fibula was significantly greater with AITFL injury compared to the intact ankle at 15° and 30° plantarflexion. Significant increases in posterior translation between the intact ankle and AITFL, PITFL, and IOM injury exists at 0°, 15°, and 30° plantarflexion. No significant motion differences were observed between the AITFL injury and combined injury at any condition. When comparing the intact ankle and combined injury, significant increases in ER exist at 0° and 30° plantarflexion and 10° dorsiflexion. The only significant difference in ER between the intact ankle and AITFL injury exists at 0° plantarflexion.

**DISCUSSION:** The data from this study showed that transecting the AITFL resulted in the largest increases fibular motion with only minimal further fibular displacement with transection of the PITFL and IOM. Total syndesmotic disruption creates significant fibular motion compared to the intact ankle but, a significant portion of the

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displacement of the fibula already occurs after isolated AITFL injury. A previous study demonstrated no measureable fibular ML displacement with syndesmosis injury but this was not supported by the current findings. This study utilized a novel setup with unconstrained motion in a full length, intact fibula. Basing clinical syndesmotic stability on ML translation alone could underestimate sagittal and rotation instability in AITFL injuries. Evaluating fibular AP translation and ER are not part of current standard diagnostic protocols. Physicians may consider more aggressive treatment of isolated AITFL injuries.