

The Effect of Proximal Tibiofibular Joint Dislocation on Knee Mechanics: Reduction and Fixation Matters

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Purpose: Proximal tibiofibular joint (PTFJ) dislocations are under-investigated injuries that are frequently associated with high-energy lower extremity fractures. Reduction and fixation with screw or suspensory fixation is a common treatment strategy. There is limited evidence to support 1 strategy. The purpose of the study was to characterize the pathomechanics of proximal tibiofibular joint dislocation on knee motion and fibular translation before and after surgical fixation. We hypothesized that PTFJ disruption results in increased knee external rotation and anterior fibular translation. We also hypothesized that screw fixation would restore near normal motion and fibular translation with over-constraint, whereas suspensory fixation would restore normal knee kinematics without over-constraint.

Methods: Six cadaveric specimens, spanning distal femur to distal tibia, were dissected to identify the PTFJ. Specimens were fitted with a spatial digitizer to establish and measure a joint coordinate system. The knee was secured to a robotic platform at the distal femur and distal tibia-fibula. A 5-Nm external rotation force was applied to each knee and the amount of external rotation was measured for several study conditions at 0°, 30° and 90° of knee flexion. Conditions included: the native state, transection of the posterior PTFJ ligament, transection of the anterior and posterior ligaments, screw fixation, and suspensory fixation. Screw fixation was performed using a single quadricortical 3.5-mm screw. Suspensory fixation was performed using an Arthrex Tightrope device.

Results: Transection of the anterior and posterior ligaments resulted in an increase in external rotation of 4.3°, 5.9°, and 5.6° at 0°, 30°, and 90° ($P < 0.001$), respectively. Screw fixation returned external rotation to a near native state at 0° but over-constrained external rotation in several specimens at 30° and 90° of flexion. Suspensory fixation restored near native knee external rotation, with less overconstraint, compared to screw fixation at 0°, 30°, and 90° of flexion. Complete transection of anterior and posterior ligaments resulted in pathologic anterior fibular translation of 1.51 mm ($P < 0.001$), 1 mm ($P = 0.02$) and 0.44 mm ($P = 0.69$) for 0°, 30°, and 90° of knee flexion. Screw fixation restored native translation at all points with a small degree of overconstraint. Suspensory fixation also restored native kinematics with less overconstraint.

Conclusion: Disruption of the PTFJ causes a pathologic increase in knee external rotation and anterior fibular translation. Reduction and fixation with screw or suspensory fixation restores near native motion with minor alterations in constraint depending on knee position. Surgeons should reduce and stabilize these injuries to restore native knee joint kinematics.