The Minimal Screw Length for Tricortical Syndesmosis Fixation in Ankle Fracture: A Cadaveric Study

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Introduction: Syndesmotic injuries of the ankle commonly occur via an external rotation force applied to the ankle joint. The effects of the screw length for single tri-cortical syndesmosis fixation of a syndesmotic injury can be assessed by evaluating the three-dimensional kinematic behavior of the tibiofibular diastasis. Previous studies have explored the differences of three versus four cortices showing no difference between both fixation methods1,2. To our knowledge no study has shown the kinematic behavior using a biomechanical study of single tricortical screw fixation with varied lengths. The specific aim of this study was to determine the minimal tri-cortical syndesmosis screw length for tibiofibular syndesmosis reduction fixation.

Methods: Fifteen fresh-frozen cadaveric lower extremities used for testing. A specially designed apparatus was used to stabilize the specimen and rotate the ankle joint in 25° of internal rotation and 35° of external rotation for 9 cycles in each direction (Figure 1). Three stages were tested: intact (Stage I), injury (Stage II) and fixation (Stage III). For Stage III, fixation was accomplished with a single 3.5 mm cortex metallic syndesmosis screw with 3 different predetermined screw lengths. Group I was fixed with threads less than 35% across the width of the metaphysis of the tibia after syndesmotic fixation 4 cm proximal to the plafond; Group II was fixed with the screw threads between 35% and 65% across the width of the metaphysis of the tibia after syndesmotic fixation; and Group III was with the screw threads juxtaposing the far cortex of the tibia after syndesmotic fixation (> 65% across the width of the metaphysis of the tibia) (Figure 2). Axial loading, torque, rotational angle, and three dimensional syndesmotic diastasis readings were recorded.

Results: Our torque results indicated that after the deltoid, anterior tibiofibular ligament and interosseous ligaments were sectioned, the foot lost 61% and 74% torsional strength compared to intact specimen for the foot internally rotated 25° and externally rotated 35°, respectively (Figures 3 and 4). However, there was no statistically significant difference detected in foot torsional strength between the three groups of screw fixation specimen and simulated injury specimen for either foot rotations. The torque of the three Groups when external rotated 50º was found not significantly different between each group (Group I: 9±5 Nm; Group II: 8±3 Nm; Group III: 13±5 Nm). However, two fractures of the fibula were detected for Group I, three were detected for Group II, and four were detected for Group III.

Discussion: This study supports the hypothesis that there is no significant difference in stability between different screw length constructs for tricortical syndesmosis screw fixation. This study shows that fixation of the distal tibiofibular sydesmosis with differing screw lengths did not provide a difference in torque applied to the syndesmosis. Fixation did not provide a difference in torque from sectioned ligaments to fixation in our study. Therefore, it is advised that patients should not bear weight in the period necessary for ligaments to heal.

Significance: The findings of this study advanced our overall understanding of the biomechanics of syndesmosis fixation by demonstrating that in a tri-cortical fashion with purchase of two threads beyond the lateral tibial cortex syndesmosis fixation can achieve a similar degree of stability as the other fixation configurations. This study may indicate a better option for operative treatment of syndesmotic injuries of the ankle where preservation of soft tissue and rigid stabilization with allowed movement across the syndesmosis are required.

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