INTRODUCTION: Syndesmotic injuries of the ankle commonly occur via an external rotation force applied to the ankle joint. The effects of rigid or non-rigid fixation of the syndesmotic injury can be assessed by evaluating the three-dimensional kinematics behavior of tibiofibular diastasis. The specific aims of this study were: 1) to determine the physiological range of motion of the distal tibiofibular joint; 2) to determine if the non-rigid anatomic syndesmosis reduction fixation will maintain the reduction while permitting some physiologic motion; and 3) to compare the non-rigid reduction method to rigid metallic screws fixation with regards to syndesmotic stability.

METHODS: Ten fresh-frozen lower extremity cadavers were used (2 left, 8 right). A specially designed apparatus was used to stabilize the specimen and rotate the ankle joint from external rotation 35° to internal rotation 25° at a rate of 6°/sec for 10 cycles (Figure 1). Reflective sphere markers (five markers on each bone) were implanted into tibia and fibula, and Six Vicon cameras were used to capture the movement of the specimen. Group I was fixed with a novel suture construct across the syndesmosis joint (Figure 2a), and Group II was fixed with a metallic screw (Figure 2b). Torque, rotational angle, and three dimensional syndesmotic diastasis readings were recorded.

RESULTS: Three-dimensional tibiofibular diastasis was identified. The fibula displaced in the sagittal and coronal planes (external rotated: 8.6 ± 1.7 mm posteriorly, 2.4 ± 1.0 mm laterally, and 1.4 ± 1.0mm superiorly; internal rotated: 1.8 ± 1.3 mm posteriorly, 0.7 ± 0.3 mm laterally, and 1.6 ± 0.6 mm superiorly). No significant difference was detected between the two Groups in terms of overall syndesmotic diastasis. The sectioning of the syndesmotic ligaments and the deltoid ligament resulted in a significant decrease in foot torsional force (p<0.05) especially during external rotation. The ligaments sectioned specimen lost 57% (externally rotated 35°) and 17% (internally rotated 25°) torsional strength compared to intact specimen. No significant difference in foot torsional strength loss between the two groups was observed for either 35° external rotation or 25° internal rotation.

DISCUSSION: The principal conclusion was that Group I and Group II were found to produce similar biomechanical stability in a cadaveric model of a syndesmosis fixation. The relationship between human foot internal-external rotation and the torque force was explored in an effort to understand foot biomechanics, and we also explored the three dimensional physiological motion of the syndesmotic joint.

CLINICAL RELEVANCE: This study advanced our overall understanding of the biomechanics of syndesmotic diastasis. This study could indicate a better option for operative treatment of syndesmotic injuries of the ankle where preservation of soft tissue and rigid stabilization are needed.

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