The Effect of Varying Tension of a Suture Button Construct in Fixation of the Tibiofibular Syndesmosis: Evaluation Using Stress Computed Tomography (CT)

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Background/Purpose: Traditional screw fixation of the syndesmosis can be prone to malreduction. Suture button fixation, however, has recently shown potential in securing the fibula back into the incisura even with intentional malreduction. Yet, if there is sufficient motion to aid reduction, the question arises whether or not this construct is stable enough to maintain reduction under loaded conditions. To date, there have been no studies assessing the optimal biomechanical tension of these constructs. The purpose of this study was to assess optimal tensioning of suture button fixation and its ability to maintain reduction under loaded conditions using a novel stress CT model.

Methods: Eight cadaveric lower limbs disarticulated at the knee were used. The limbs were placed in a modified external fixator jig that allows for the application of sustained torsional (5 Nm), axial (500 N), and combined torsional/axial (5 Nm/500 N) loads. Baseline unloaded and loaded CT scans were obtained. Bone tunnels were predrilled to pass the suture button devices prior to sectioning of the syndesmosis, ensuring no malreduction prior to drilling. The syndesmosis and the deltoid ligament complex were then sectioned. The limbs were then randomized to receive a suture button construct tightened at 4 kg force (loose) or 8 kg (standard tightness). Four measurements were taken from axial slices 10 mm above the tibiotalar joint: a measure of medial/lateral translation (ML), a measure of anterior-posterior translation (AP), a ratio of anterior-posterior translation (d/e), and an angle created by a line parallel to the incisura and the axis of the fibula (angle). For AP and ML, a positive number indicates movement in the anterior and medial directions. For the d/e ratio, a negative value signifies the fibula was translated posteriorly. A positive value for fibular angle indicates external rotation.These measurements have all been previously described. Each measurement was taken at baseline and compared with the 3 loading scenarios. A repeated-measures analysis of variance with a Bonferroni correction for multiple comparisons was used to test for significance.

Results: The mean difference between the baseline repaired and stressed repaired specimens is shown in Figure 1a. Significant posterior translation was seen in the 4 kg group with axial loading when measurement AP was compared. Additionally, ratio d/e showed significant posterior translation in both the 4 kg and 8 kg groups under torsion and combined loads. There was significant external rotation of the fibula under axial load in the 4 kg group when compared with baseline scans. Additionally, when compared with the 8 kg group, the 4 kg group showed significantly more external rotation under the same torsional load (12.03° vs 8.63°). Both groups showed a trend of increasing external rotation especially under torsional loading.

See pages 47 - 108 for financial disclosure information.

Conclusion: Stress CT demonstrated notable motion with a suture button fixation construct, especially under torsional loads. Care should be taken to ensure that this construct is properly tensioned and loads should be minimized until healing has occurred.

Figure 1a.

		Fixed at 4kg	Fixed at 8kg
AP (mm)	**Baseline**	-	-
	Axial	**-1.68 (2.05) ***	-1.70 (1.06)
	Torsion	2.78 (10.56)	0.4 (6.36)
	Combined	2.42 (10.09)	1.08 (6.08)
ML (mm)	**Baseline**	-	-
	Axial	0.17 (0.71)	-0.1 (1.05)
	Torsion	0.97 (3.20)	0.59 (1.77)
	Combined	0.65 (2.55)	0.34 (1.75)
d/e	**Baseline**	-	-
	Axial	-0.39 (0.72)	-0.32 (0.59)
	Torsion	**-1.53 (0.45) ***	**-1.55 (0.55) ***
	Combined	**-1.48 (0.45) ***	**-1.25 (0.53) ***
Angle (degrees)	**Baseline**	-	-
	Axial	**0.27 (2.82) ***	3.22 (6.22)
	Torsion	**12.03 (3.75)****	8.53 (3.51)
	Combined	10.78 (4.55)	9.87 (4.24)

* $p<0.05$ when compared with a non-stressed repaired baseline
** $p<0.05$ when compared with the 8 kg repair group

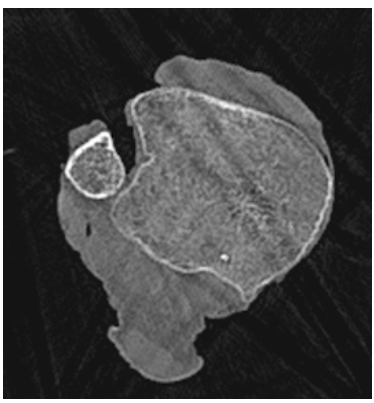

Figure 1b. - Axial CT scan. Shows a cadaveric specimen with a syndesmotic injury repaired with a suture button under 4kg tension with a combined torsion and axial load applied.