InternalBrace has Comparable Stiffness and Strength as Tightrope for Lisfranc Fixation

Justin Hopkins, MD, Nasser Heyrani, MD, Christopher Kreulen, MD, Tanya Garcia, MS, Blaine Christiansen, PhD, Eric Giza, MD

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Introduction/Purpose: Lisfranc injuries are characterized by disruption between the medial cuneiform and base of the second metatarsal. Conventional interfragmentary screws decreases the amount of diastasis, however is believed to decrease the natural physiological movement of the joint compared to suture button (Tightrope, Arthrex, Inc., Naples, FL). The InternalBrace (IB, Arthrex, Inc., Naples, FL) allows physiologic movement and collagen ingrowth, while also decreasing iatrogenic bone loss. It also prevents erosion of the suture button into the medial cuneiform and prevents irritation of the tibialis anterior tendon. We hypothesized that there was no significant difference in the mechanical properties of these three constructs.

Methods: Three groups of 10 sawbone models were used in this study. Two fourth generation 20mm cylinder sawbones with open cell foam were fixed together with either a 3.5mm conventional screw, mini Tightrope or IB with a curved button and 4.75mm biotenodesis screw. Sawbone constructs were held in a mechanical testing system (Model 809, MTS Systems Corp, Minneapolis MN) using custom fixtures. Constructs were loaded in axial tension at 0.5mm/sec until failure. Load-displacement data were plotted for each test. Yield, stiffness, ultimate strength (US), yield energy, post-yield energy and ultimate strength energy were calculated Additionally, the load and energy to 0.5mm, 1.0mm and 1.5mm of displacement were captured to relate strength at clinically relevant displacements. The residuals of an ANOVA on all mechanical testing results were not normally distributed. Therefore non-parametric comparison was used to compare fixation types (Proc NPAR1WAY, SAS 9.4, SAS Institute).

Results: Compared to IB, the screw demonstrated greater stiffness, yield load and energy, and ultimate load and energy, with smaller yield, ultimate and failure displacement. When comparing the Tightrope and IB, there was no difference in stiffness (p=0.82), although the Tightrope performed greater in terms of having a larger yield load, energy and displacement, a larger ultimate strength load, energy and displacement, and a larger failure load, energy and displacement. When assessing the load at various distances of displacement, there was no significant difference between the load at 0.5mm displacement (p=0.5, Figure 1). At greater displacement, the load was greater in the Tightrope than the IB (Figure 1).

Conclusion: In this study, IB has shown proper stiffness and strength for fixation of ligamentous lisfranc injury. However, if a diastasis of >0.5mm is evident, concerns for a clinical failure should be examined. This is the first study examining the use of an IB for treatment of a ligamentous lisfranc injury. The data supports its current clinical indications and further studies in cadaveric models are recommended.