

# Biomechanical Analysis of Bioconductive Copolymer-Augmented Broström Anterior Talo-Fibular Ligament Repair and Native ATFL: A Cadaveric Pilot Study

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Disclosures: Dr. Jesse Raszewski reports that Stryker donated the implants used in this cadaveric study. Dr. Michael Greaser is a paid consultant for Stryker. Shea S. Maxey (N), Carey Clark (N), Sabir K. Ismaily (N).

**INTRODUCTION:** Ankle sprains, particularly lateral ligament injuries, are among the most common musculoskeletal injuries in athletes <sup>1</sup>. The Broström technique remains a standard for surgical repair of the anterior talofibular ligament (ATFL). Recent innovations using bioconductive copolymer augmentation may offer improved biomechanical performance over native ligament reconstruction or traditional repairs <sup>2</sup>.

**METHODS:** Four matched pairs of fresh-frozen cadaveric ankles were dissected to isolate the lateral ligament complex. One ankle from each pair underwent a standard Broström repair augmented with a bioconductive copolymer band (Artelon Flexband®), while the contralateral ankle served as a native ATFL control. Specimens were mounted in a custom 3D-printed jig and tested under direct axial load using a Vicon motion analysis system. Primary outcomes included load to 3 mm displacement (N), structural stiffness (N/mm), and ultimate load to failure (N). Significance was set at  $p < 0.05$ .

**RESULTS SECTION:** The copolymer-augmented ATFL repair group demonstrated significantly greater ultimate failure compared to native ATFL controls ( $p=0.01$ ). All native ATFLs failed at the talar insertion. All copolymer-augmented specimens failed due to fibular anchor loosening, with no failure of the copolymer material. There was no statistically significant difference between groups when testing load to 3 mm displacement (N) and structural stiffness (N/mm).

**DISCUSSION:** Compared to the native ATFL, the co-polymer augmented ATFL repair on average demonstrated a higher load to failure when measured over a 3mm displacement, a higher stiffness of the construct, and a significantly higher ultimate load to failure. The innovative 2 band construct better replicates native anatomy and kinematics, allows for bio-integration, increases overall strength and load to failure, and allows for less stress-shielding than suture tape. Suture tape compared to native ATFL has double the stiffness, one third of the elongation, and double the load to failure. This study was limited by sample size, specimen variability, simplified loading scenarios, and clinical translation. Future directions for this project would entail younger cadaveric specimens, larger cohort sizes with increased cohorts (Brostrom, Allograft, and Suture-Tape repairs), and the use of larger anchors.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Bioconductive copolymer augmentation of the Broström repair demonstrated biomechanical superiority to native ATFL in acute cadaveric testing. This technique may offer a promising alternative in lateral ligament reconstruction, particularly where increased strength and bio-integration are desired.

## REFERENCES:

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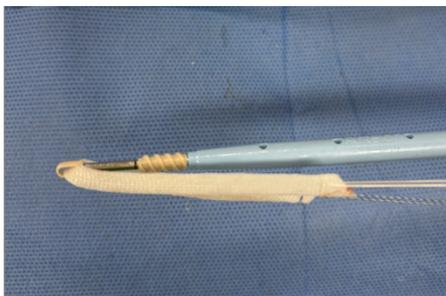


Figure 1: Use of Artelon co-polymer secured with 3.85 mm anchors one at the talar insertion of the ATFL and the other at the origin of the ATFL after proper tensioning of each.



Figure 2: A motion analysis system (Vicon) in conjunction motion trackers are placed at the origin and the insertion of the ATFL footprint were used for analysis of the native and augmented constructs.

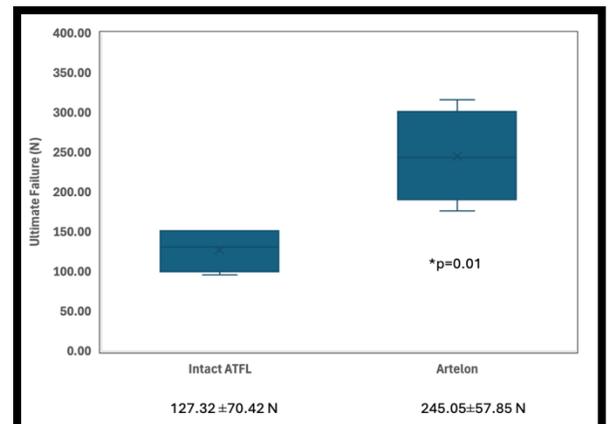


Figure 3: When the ultimate load to failure was assessed, the native ATFL demonstrated 127 newtons, compared to the copolymer augmented repair, which demonstrated 245 newtons, reaching significance.