Ultrasonic Anchor Repair of Scapholunate Ligament: A Biomechanical Cadaveric Study

Nicholas I. Pilla[1,2], Fady G. Attalla[2], Gabi Schwartz[3], Abeer Al-Barghouthi[3], Liannys Capote[1], Ashfaq Ahmed[1], Loren Latta[3,4], Elizabeth A. Ouellette[1]
[1]Baptist Health South Florida, Orthopaedic Care Miami, FL
[2]Herbert Wertheim College of Medicine, Florida International University, Miami, FL
[3]Miami Biomechanics Institute at Friedman Advanced Research Institute, Mount Sinai Medical Center, Miami Beach, FL
[4]Department of Orthopaedics, Miller School of Medicine, University of Miami, Miami, FL
Gabi.schwartz@msmc.com

Disclosures: Nicholas I. Pilla (N), Fady G. Attalla (N), Gabi Schwartz (N), Abeer Al-Barghouthi (N), Liannys Capote (N), Ashfaq Ahmed (N), Loren Latta (N), Elizabeth A. Ouellette (N)

INTRODUCTION: Scapholunate interosseous ligament (SLIL) injuries pose a significant challenge in hand surgery due to the risk of altered carpal biomechanics, progression of a gap in between the scaphoid and lunage (SLG) and progressive carpal collapse. Although numerous repair techniques exist, an optimal fixation method remains elusive. Advances in ultrasonic technology—transitioning from diagnostics to implant applications—offer potential benefits including enhanced pullout strength, ease of insertion, and reduced bony disruption. This study evaluates the biomechanical efficacy of an ultrasonic fusion anchor in restoring scapholunate alignment in a cadaveric model.

METHODS: Eight fresh-frozen cadaveric forearms with hands underwent dissection of the hand and wrist flexor and extensor tendons. Dorsally, the extensor carpi radialis longus, extensor carpi radialis brevis, and extensor carpi ulnaris were sutured together and held in a soft tissue clamp creating the wrist extensor group (WEG). Volarly, the flexor carpi ulnaris and flexor carpi radialis were sutured to form the wrist flexor group (WFG), while the flexor digitorum superficialis and flexor digitorum profundus were sutured as a separate finger flexor group (FFG). Both the AFG and FFG were held in soft tissue clamps fastened to a line through a pulley system attached to a weight to maintain a constant force during loading cycles. AFG had a constant load of 44.4 N and FFG had a constant load of 22.2 N during cycling. The load levels were established as physiological in previous studies [1-4]. WEG was attached to the MTS ram and applied cyclic loads to create a range of motion for the wrist from about 40° volar flexion to 20° dorsiflexion. Each arm was cycled 500 times at 1 Hz. After cycling AP and lateral fluoroscopic images were captured (Fig. 1). Next the load on the FFG was increased to 88.9 N to simulate a clenched fist load and AP and lateral images were repeated. After the loads were relaxed, a direct spacer of known breadth was used to measure the SLG. Next SLIL was transected and the loading and measures were repeated. Then each SLIL repaired with a 1.6mm ultrasonic fusion anchor. The loading and fluoroscopic images were repeated. The scapholunate interval and angle were analyzed using the Wilcoxon signed-rank test ($P < 0.05$).

RESULTS: PA radiographs demonstrated a significant increase in the SLG from native to post-sectioned states ($P = 0.0234$) and a significant decrease after repair ($P = 0.0156$). Clenched fist views showed a significant increase post-sectioning ($P = 0.0078$) and a reduction post-repair ($P = 0.0234$). LV radiographs revealed an increased SL angle after sectioning ($P = 0.0156$) and improvement following repair ($P = 0.0078$). Spacer measurements confirmed a marked widening of the SL interval after transection ($P = 0.0078$), restoration post-repair ($P = 0.0078$), and maintenance after cyclic loading ($P = 0.0156$) (Fig. 2).

DISCUSSION: Ultrasonic fusion anchors effectively restore scapholunate alignment and provide durable stabilization under physiologic loading. Their bioabsorbability, radiolucency, and innovative ultrasonic liquefaction mechanism offer distinct advantages over traditional fixation methods, warranting further investigation in hand surgery.

SIGNIFICANCE/CLINICAL RELEVANCE: This biomechanical study supports the use of ultrasonic anchor technology for SLIL repair.

REFERENCES: [1] Slater RR Jr, et al *J Hand Surg Am*. 1999;24(2):232-239. [2] Pollock PJ, et al *J Hand Surg Am*. 2010;35(10):1589-1598. [3] Werner FW, et al *J Hand Surg Am*. 2010;35(4):628-632. [4] Brand PW, et al *J Hand Surg Am*. 1981;6(3):209-219.

ACKNOWLEDGEMENTS: Study supported by Baptist Health South Florida, Orthoapedic Care, Miami FL

IMAGES AND TABLES:

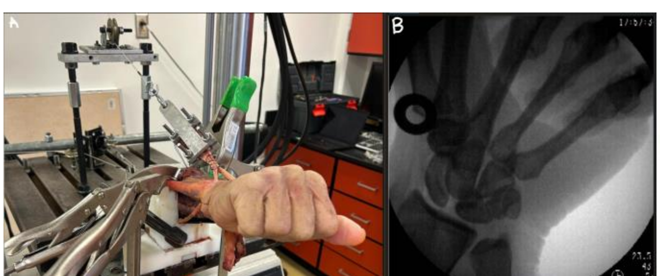

Fig. 1. The flexor tendons had constant load from weights on a pulley system, while the WEG was cycled by the MTS ram, (A). The wrist was imaged after loading in each configuration, center. The size of the gap was controlled by injury and repair, (B).

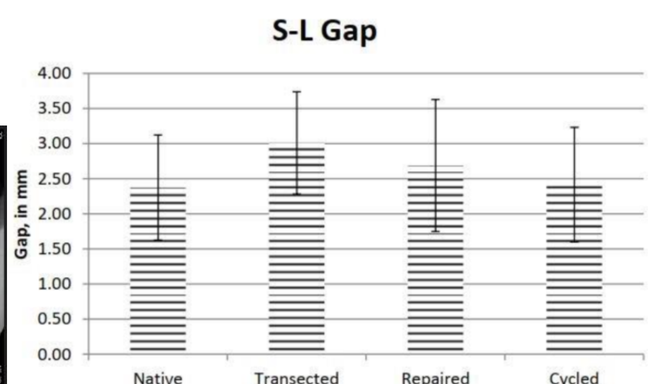

Fig. 2. Measured S-L gap size for native, transected, repaired, and cycled.