

# The Effect of Greater Tuberosity Decortication (Biogrooves) on Rotator Cuff Fixation: A Biomechanical Study

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**Disclosures:** Calibo (N), Hollenbeck (N), Perleberg (N), Castro (N), DeFoor (N), Tashman (5-Department of Defense (DoD) and National Institute of Health (NIH)), Provencher (5-Department of Defense (DoD) and National Institute of Health (NIH)); 1-Arthrex, Inc and ArthroSurface, Inc; 3B- 8-SLACK, Inc, AANA, AAOS, AOSSM, ASES, ISAKOS, The San Diego Shoulder Institute, and The Society of Military Orthopaedic Surgeons)

**INTRODUCTION:** Insufficient tendon-bone healing is widely recognized as a principal cause of high failure rates after rotator cuff repair. Medical literature consistently identifies the inability to restore a robust, native-like tendon-bone interface as a key biological limitation, resulting in the formation of mechanically inferior scar tissue<sup>1,2</sup>. Maximizing footprint contact and minimizing micromotion at the tendon interface are critical technical goals in rotator cuff repair that directly address the challenge of insufficient tendon-bone healing<sup>3,4</sup>. Improved healing of decorticated bone has been attributed to the increased access to the underlying bone marrow, but these improved healing properties could also be the results of improved mechanical interdigitation at the tendon-bone interface which minimize micromotion and increase fixation strength. Engineering analogies illustrate this principle, as grooves can increase surface conformity and resistance to shear, similar to the treads in tires or the scoring of brake pads. Despite this rationale, the effect of groove configuration on rotator cuff repair biomechanics has not been systematically evaluated. The aim of this study is to determine the effect of groove number and size on tendon displacement. It is hypothesized that a decorticated footprint with two large grooves (greater depth and width) would result in reduced tendon displacement compared with shallower or singular grooves.

**METHODS:** Six fresh-frozen shoulders were acquired for the study. At the time of submission three fresh-frozen cadaveric supraspinatus tendons (mean age: 63.3, age range:62-64, 3F) had undergone biomechanical testing. All specimens were prescreened via dry arthroscopic exam and excluded if there was gross evidence of rotator cuff pathology, greater tuberosity asymmetries (e.g. footprint size variation, cysts, or poor bone quality). The supraspinatus muscle of all specimens was sharply dissected from the humeral origin. A repeated-measures design was employed, testing each specimen across five conditions: (1) no groove, (2) one 2-mm groove, (3) two 2-mm grooves, (4) two 3-mm grooves, and (5) one 3-mm groove, all with a standardized width of 6 mm. A double-row repair was performed on PCF-25 Sawbone blocks using three medial all-suture anchors and two lateral 4.75-mm knotless anchors. For each subsequent condition, the tendon was elevated, the next groove geometry prepared, and the tendon re-secured using the original anchor sites and suture paths. Grooves were isosceles in cross section and created with a high speed rotary tool (Dremel) fitted with a 20 degree cutting bit to ensure consistency. Each construct was mounted on a servo hydraulic testing machine, preloaded 10 N to remove slack, then loaded to 70 N peak force to simulate a non-destructive creep enabling measurement of displacement due to viscoelastic creep. Ultrasound imaging (15 MHz Canon Aplio i800 probe) was performed at unloaded, 10 N, and 70 N states to qualitatively assess tendon-bone displacement and footprint infill. Means and standard deviations were reported for preliminary results, and a repeated measures ANOVA with a Bonferroni post hoc test will be completed upon study completion to compare means across groove states.

**RESULTS SECTION:** In preliminary testing, three supraspinatus specimens completed biomechanical testing across all groove states. At 70 N peak load, mean displacement was greatest in the no groove condition ( $4.3 \pm 0.35$  mm). A single 2-mm groove reduced displacement by ~20% ( $3.44 \pm 0.19$  mm) while two mm grooves produced a ~25% reduction ( $3.24 \pm 0.19$  mm). The two 3-mm groove condition yielded the lowest displacement at  $2.56 \pm 0.40$  mm representing a ~40% reduction with similar results from a single 3 mm groove at ( $2.89 \pm 0.43$  mm). Formal statistical analysis (repeated measures ANOVA with Bonferroni post hoc test) will be performed once testing of all six specimens is complete.

**DISCUSSION:** This study evaluated the effect of standardized groove geometry on tendon-bone mechanics following rotator cuff repair. Consistent with the stated hypotheses, two large (3-mm) grooves produced the lowest displacement, supporting the concept that deeper and multiple grooves reduce tendon micromotion through improved footprint and infill. Even a single 3-mm groove improved stability relative to the no groove condition. The improved stability at the deeper groove depth may suggest that groove depth is a more critical determinant than groove number. Limitations include potential order effects due to the viscoelastic properties of tendon in a repeated measures design, as well as the absence of biologic assessment. Notwithstanding, consistent reductions across all specimens provide strong preliminary evidence for the benefit of standardized groove preparation.

**SIGNIFICANCE/CLINICAL RELEVANCE:** These finding demonstrate that a standardized footprint decortication with two large grooves reduces tendon displacement and improves tendon-bone infill, suggesting a simple, reproducible method to mechanically optimize the healing environment. If confirmed in the completed cohort studies, this technique could improve rotator cuff repair integrity.

**REFERENCES:** 1. Zumstein MA. *Orthop Traumatol Surg Res.* 2017;103:S1–10. 2. Rossi LA. *Orthop J Sports Med.* 2019;7:2325967119868674. 3. Wang H. *Am J Sports Med.* 2023;51:2842–49. 4. Hyatt AE. *Arthroscopy.* 2016;32:544–50.

## IMAGES AND TABLES:

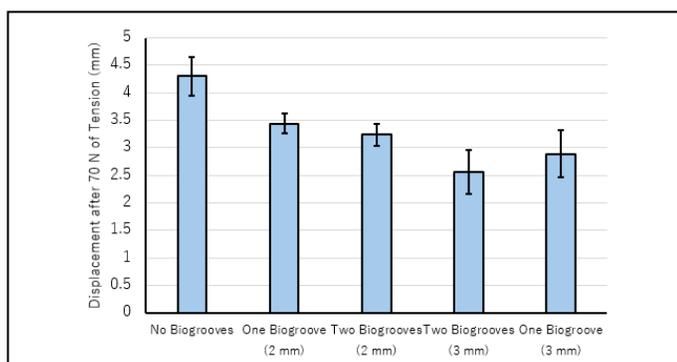


Figure 1: Supraspinatus Tendon Displacement after Peak Load (70N) Deeper and multiple biogroove preparations trended toward reduced displacement compared with the no-groove state, indicating improved

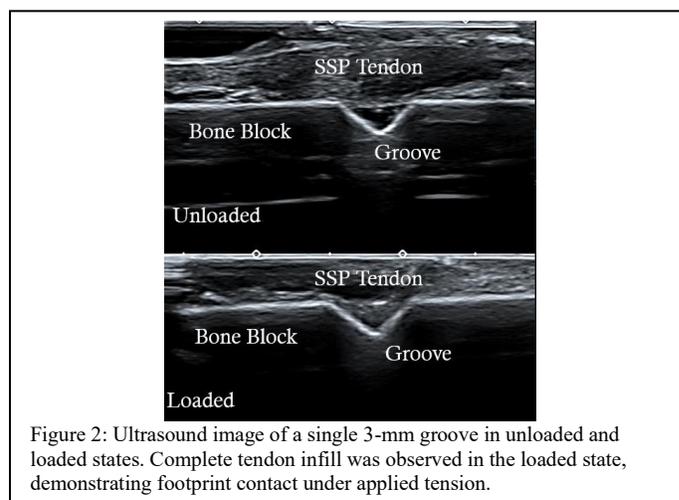


Figure 2: Ultrasound image of a single 3-mm groove in unloaded and loaded states. Complete tendon infill was observed in the loaded state, demonstrating footprint contact under applied tension.