

The Biomechanical Efficacy of Tape Cerclage as an Augment or Standalone for Coracoclavicular Ligament Reconstruction

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Disclosures

- Augustus D. Mazzocca and Paul J. Cagle serve as a paid consultants for Arthrex inc.
- Augustus D. Mazzocca is a paid consultant for Restor3D

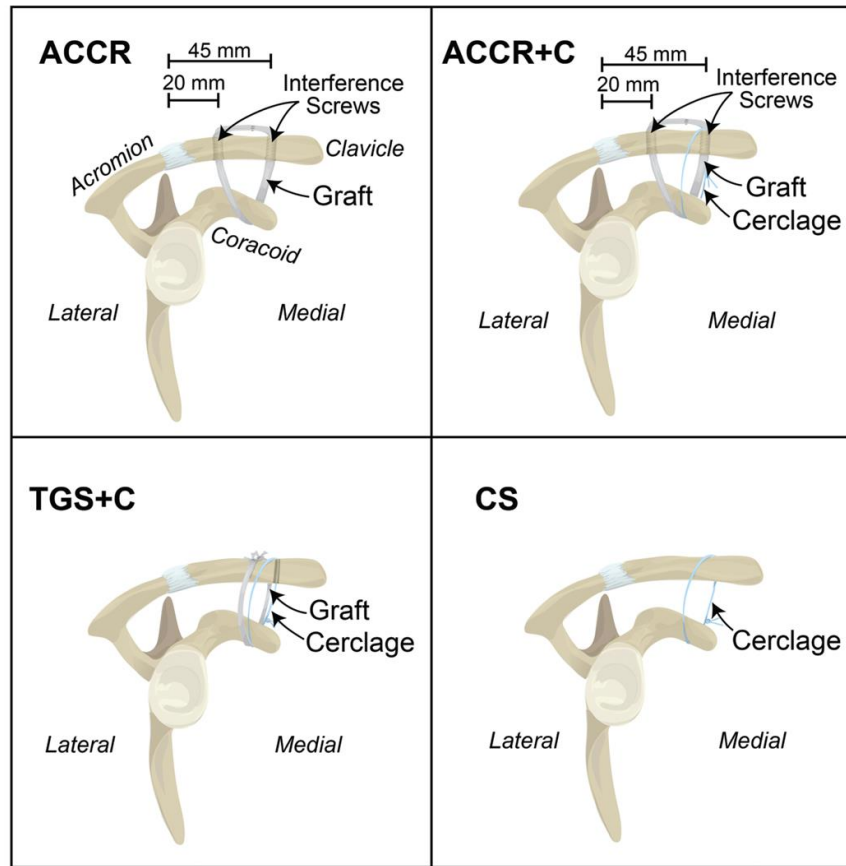
Background/Purpose

- Loss of the initial reduction of the acromioclavicular (AC) joint following coracoclavicular (CC) ligament reconstruction remains a significant concern
- Previous studies have investigated the role of suture cerclage augments for these repairs; however, these cerclages were composed of relatively weak polydioxanone suture, and did not significantly improve CC repair strength
- With the advent of high-strength suture tapes, there is growing interest in the use of these materials as an augment for CC reconstruction
- The goal of this study is to determine the efficacy of a high strength suture-cerclage system as an augment for the reconstruction of the CC ligamentous complex

Methods

- 24 fresh frozen human cadaveric shoulders were utilized
- All soft-tissue was removed except for the AC joint capsule, the CC ligaments, and the coracoacromial ligament
- With the AC and CC ligaments intact, superior displacement of the specimens was tested with a 70 N superiorly directed load.
- The AC and CC ligaments were then transected, and one of four repair techniques were used to reconstruct the CC ligamentous complex (Fig 1).
 - Anatomic coracoclavicular ligament reconstruction (ACCR)
 - ACCR with tape cerclage augmentation (ACCR + C)
 - Tendon graft sling with tape cerclage augmentation (TGS + C)
 - Tape cerclage-only sling (CS)

Four CC ligamentous reconstruction techniques



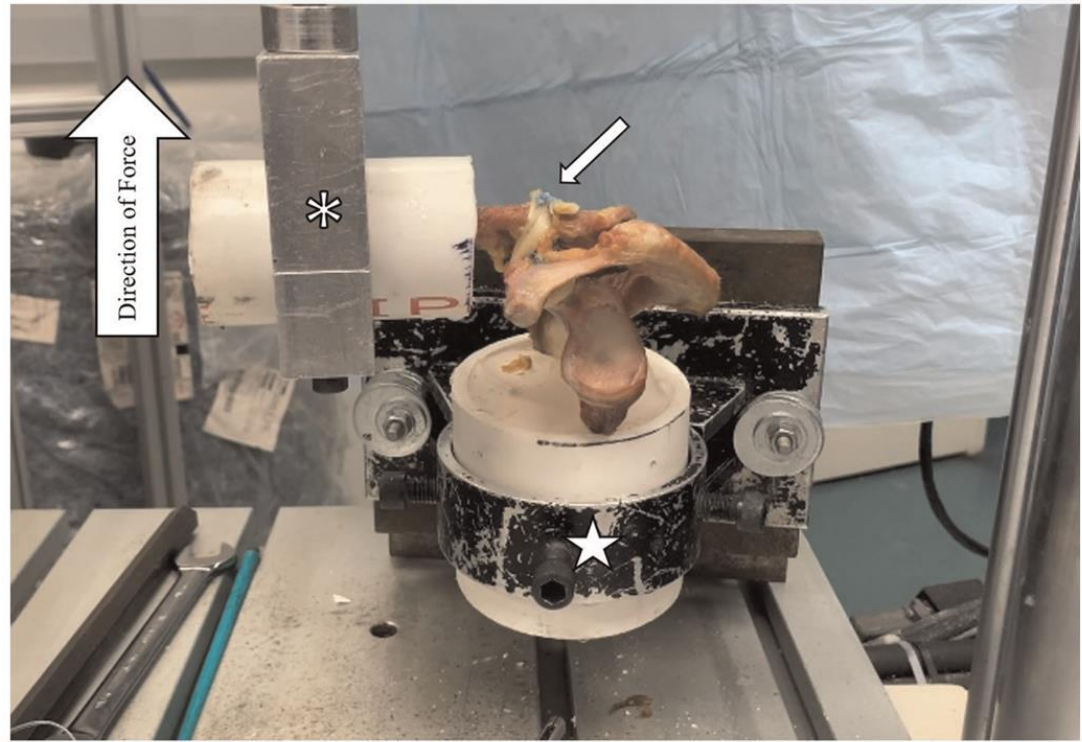
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Figure 1. Repair diagrams outlining anatomic coracoclavicular ligament reconstruction (ACCR), ACCR with tape cerclage augmentation (ACCR + C), tendon graft sling with tape cerclage augmentation (TGS + C), and a tape cerclage-only sling (CS).

Methods continued

- Following the repairs, the specimens mounted in a servohydroaulic testing system (MTS) (Figure 2)
- Specimens underwent preconditioning for 10 cycles at 0-25N of superiorly directed force
- Next, 3000 cycles between 10 and 70 N were applied in a superior direction at 1Hz.
 - Displacement of the repair with 70 N force at final cycle was compared with displacement at the initial cycle to determine cyclic displacement.
- Finally, 120 mm/min superior displacement was applied to the clavicle until catastrophic failure was noted, the force at failure and the mechanism of failure was recorded.

Testing System mounting apparatus



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Figure 2. The apparatus utilized for cyclic loading and load-to-failure testing. Force was applied in a superiorly directed vector. The scapula (☆) and clavicle (*) were mounted 90° from each other within the mounting system. The repair (arrow) was performed with the specimen mounted in the apparatus.

No difference in native displacement between the four groups

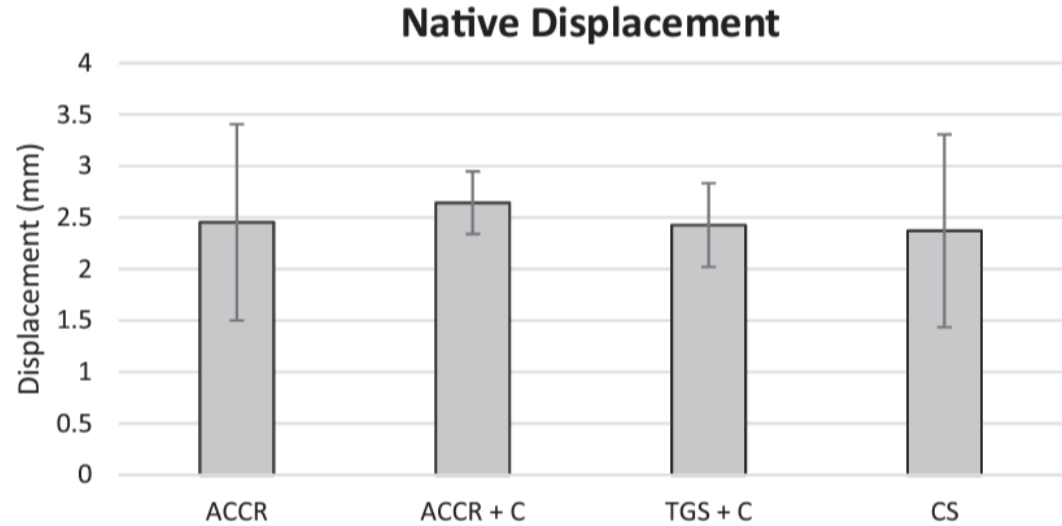


Figure 3. Comparison of native displacements of the clavicle relative to the scapula with superiorly directed force before dissection of the acromioclavicular and coracoclavicular ligaments. No difference in native displacement was observed among the groups. Values are presented as mean \pm SD. ACCR, anatomic coracoclavicular ligament reconstruction; C, cerclage; CS, cerclage sling; TGS, tendon graft sling.

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ACCR + C, TGS + C, and CS all demonstrated **less cyclic displacement** compared with ACCR

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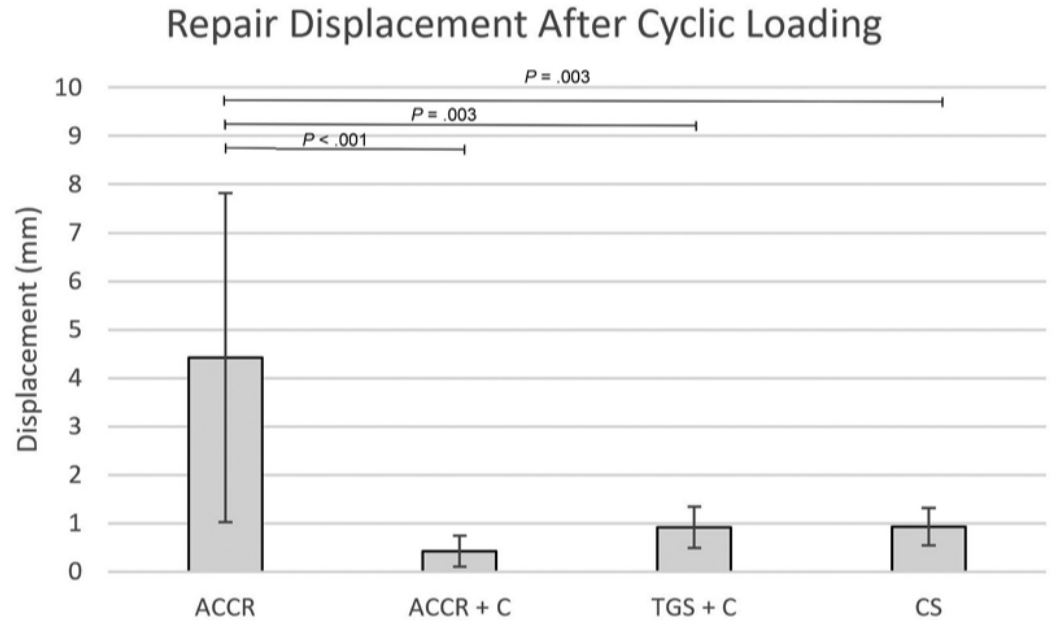


Figure 4. Comparison of displacement of the repair constructs after 3000 cycles of cyclic loading between 10 and 70 N. The ACCR group demonstrated significantly greater displacement after cyclic loading when compared with the repairs utilizing tape cerclages. Values are presented as mean \pm SD. ACCR, anatomic coracoclavicular ligament reconstruction; C, cerclage; CS, cerclage sling; TGS, tendon graft sling.

ACCR + C, TGS + C, and CS all demonstrated **greater load at ultimate failure** compared with ACCR

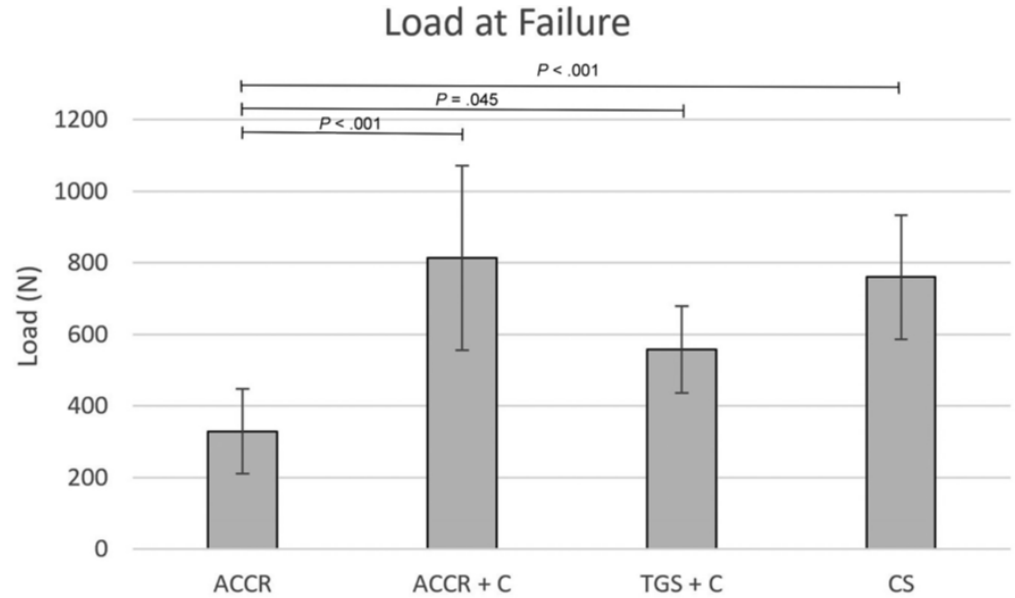


Figure 5. Comparison of ultimate load at failure based on repair group. All groups utilizing tape cerclages demonstrated significantly greater load at failure relative to the ACCR group. Values are presented as mean \pm SD. ACCR, anatomic coracoclavicular ligament reconstruction; C, cerclage; CS, cerclage sling; TGS, tendon graft sling.

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ACCR + C, TGS + C, and CS all demonstrated **greater construct stiffness** compared with ACCR

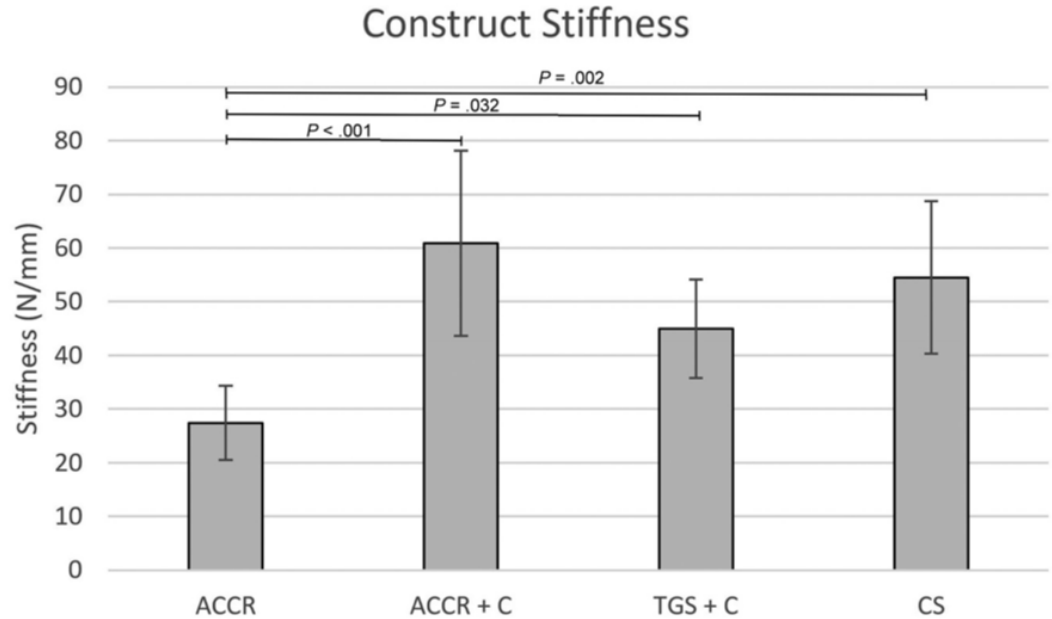


Figure 6. Comparison of construct stiffness. ACCR repairs were significantly less stiff when compared with the remaining repair techniques. Values are presented as mean \pm SD. ACCR, anatomic coracoclavicular ligament reconstruction; C, cerclage; CS, cerclage sling; TGS, tendon graft sling.

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Conclusions

- CC ligamentous complex reconstructions utilizing a suture-tape cerclage augmentation demonstrated greater stiffness, greater load at ultimate failure, and less displacement with cyclic loading compared with non-augmented reconstructions.
- Clavicle fracture at ultimate failure occurred in 1 ACCR, 1 ACCR + C, 4 TGS + C, and 2 CS repairs; Coracoid fracture at ultimate failure occurred in 0 ACCR, 4 ACCR + C, 1 TGS + C, and 1 CS repairs
 - The greater strength conferred by the cerclage augmentation may result in a greater number of clavicle and coracoid fractures
- Further study is needed to determine the clinical efficacy of suture-tape cerclage as an augment for CC reconstruction.

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