Initial Fixation Strength of Massive Rotator Cuff Tears: In Vitro Comparison of Single-Row Suture Anchor and Transosseous Tunnel Constructs

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Purpose: The purpose of this study was to compare the in vitro repair integrity of massive rotator cuff tears fixed with transosseous tunnel and single–lateral row suture anchor techniques. **Methods:** A 5 × 2–cm crescent-shaped rotator cuff tear was created in 6 matched pairs of cadaveric shoulders. Paired shoulders were repaired with 3 transosseous tunnels and 6 Mason-Allen sutures or with 3 screw-in suture anchors and 6 simple sutures. The repairs were cyclically loaded at physiologic forces along the respective directions of pull when the arm was in 90° of scapular plane elevation. Gap formation and repair displacements were monitored with digital video imaging at 3 sites for each repair. **Results:** There was no significant difference between the maximal gapping of the repair constructs. After 4,000 cycles, the mean maximal gapping at any position along the repair was 6.2 ± 2.99 mm in the transosseous tunnel construct and 4.9 ± 1.27 mm in the suture anchor repair construct ($P = .40$). Gapping was significantly less in the anterior region when compared with the posterior region of the repair ($P = .015$). **Conclusions:** There is no difference in cyclic loading of transosseous and single-row suture anchor repair techniques. Significantly greater gap formation occurs at the posterior aspect of repairs of massive rotator cuff tears in this in vitro model. **Clinical Relevance:** Initial fixation strength of single-row suture anchor repairs is equivalent to that of transosseous repairs. Further research is required to determine the unknown clinical significance of increased posterior repair gap formation. **Key Words:** Rotator cuff tear—Massive—Suture anchor—Tendon fixation—Biomechanical—Cadaver.

A number of studies show that functional outcomes correlate with rotator cuff repair integrity.[1-3] Clinical studies evaluating rotator cuff repair integrity after open and arthroscopic repairs show that larger tears have higher retear rates than smaller tears.[1-4] Other factors may also have a role in influencing repair integrity, including patient age, rotator cuff muscle quality, and postoperative rehabilitation. Retear rates after arthroscopic repair of single-tendon rotator cuff tears are reported to be as low as 29%, which is similar to the retear rate after open repair of small tears.[1,3] In contrast, the retear rates after arthroscopic repair of massive rotator cuff tears have been reported to be as high as 95%, which is higher than the reported retear rate for open massive repairs.[1,4] It appears that larger tears repaired with arthroscopic techniques have increased retear rates compared with open repairs of larger tears. The reason for this difference has not been clearly elucidated.

Numerous studies have evaluated the initial fixation strength of a variety of rotator cuff repair techniques.

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These studies have used a variety of experimental models. Generally, cyclic loading (as opposed to load to failure) is considered to be more representative of in vivo failure mechanics.[5] Studies comparing cyclic loading response between open and arthroscopic techniques have produced conflicting results. Several studies have compared transosseous tunnels and suture anchors in a cyclic loading model. Burkhart et al.[6,7] found a significantly higher number of cycles to failure using a suture anchor construct compared with transosseous tunnels. Other authors found no significant difference in the number of cycles to failure between transosseous tunnels and a single row of suture anchors.[8,9] Most biomechanical studies have used high physiologic forces (unlike those applied during postoperative rehabilitation) and have only loaded supraspinatus tendon repairs.[6-9] These studies only evaluated small- and medium-sized tears (i.e., tears between 1 and 3 cm). The application of current techniques to larger rotator cuff tears has not been well studied. Increasing experience with arthroscopy has led surgeons to repair larger tears completely with an arthroscopic technique.

The purpose of this study was to comparatively evaluate the initial biomechanical strength of two different rotator cuff repair techniques (transosseous tunnels and a single lateral row of suture anchors) to repair a massive rotator cuff tear under cyclic loading by use of a cadaveric model. We wanted to determine whether the initial construct strength is the reason for higher failure rates with arthroscopic repairs, compared to open repairs, of larger rotator cuff tears. We hypothesized that gapping at the repair site after a single–lateral row suture anchor technique would be greater than that after a transosseous tunnel repair.

METHODS

Six matched pairs of fresh-frozen human cadaveric shoulders were used in this study. The mean age of the specimens was 56 years (range, 50 to 60 years). All had intact rotator cuffs. The specimens were maintained at −20°C until approximately 12 hours before testing. The shoulders were dissected to isolate the humerus from all of the soft tissue except for the subscapularis, supraspinatus, and infraspinatus muscles and tendons. The humeri were cut proximal to the epicondyles and potted in 51-cm-long and 12.7-cm-diameter sections of plastic pipe by use of Smooth Cast 300 (Smooth-On, Easton, PA). The individual specimens were prepared and tested during the same day to avoid refreezing and thawing.

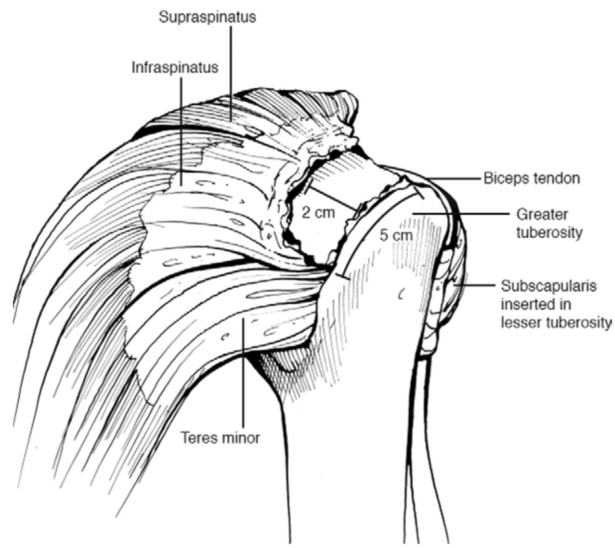

FIGURE 1. The 5 × 2–cm crescentic tears created to replicate massive rotator cuff tear with tendon loss.

A 5-cm-long (anterior-to-posterior dimension) by 2-cm-wide (lateral-to-medial dimension) rotator cuff tear was created in each shoulder, starting anteriorly at the rotator cuff interval and extending posteriorly along the greater tuberosity into the infraspinatus tendon (Fig 1). An ellipse of rotator cuff tendon was excised with a knife blade to create a broad crescent-shaped tear, simulating a massive rotator cuff tear with tendon loss and retraction. The shoulders were then block-randomized so that each repair technique (transosseous tunnels *v* single lateral row of suture anchors) was evaluated within each pair.

The single–lateral row suture anchor repair was completed by use of 3 Linvatec SuperRevo 5.5-mm suture anchors (Linvatec, Largo, FL) loaded with 2 strands of No. 2 braided nonabsorbable polyester sutures. The rotator cuff footprint was lightly decorticated with a bur. Each anchor was placed at the lateral edge of the rotator cuff insertion footprint, separated by 10 mm, and inserted at a 45° angle to the surface of the bone. One limb of each pair of the sutures from the anchor was passed through the tendon 10 mm medial to the free edge and tied with a slipknot followed by 3 alternating half-hitches to the other end of the suture strand (Fig 2A).

The transosseous tunnel repair was performed by use of 3 tunnels separated by 10 mm, which were created via a 1.5-mm drill bit and a large Mayo needle. The medial holes of the tunnels were placed just lateral to the articular surface of the humeral head.