



Rotator Cuff Repair

From Jonathan P. Braman, MD, Armin M. Tehrany, MD, and Evan L. Flatow, MD

Subacromial Decompression. Subacromial decompression is a standard treatment in repair of the rotator cuff, whether the procedure is done arthroscopically or via open technique. This removes any impingement that may be contributing to pain and creates space to accommodate the suture knots and tail, similar to the purpose of a “notch-plasty” as performed during an anterior cruciate ligament reconstruction. Recent studies have noted good short-term satisfaction in many cases with rotator cuff repair without subacromial decompression.^{1,2} However, most surgeons will perform some type of decompression if there are attritional changes noted at arthroscopy.³ Massive tears of the rotator cuff present a challenging problem for the surgeon regarding decompression of the subacromial space, because an overly aggressive decompression in the face of an irreparable tear (or a tear that may recur) can lead to anterosuperior instability and poor function. The coracoacromial ligament should be preserved when massive tears are repaired, and acromial spurs may be removed and the acromion “smoothed” without detaching the ligament in most cases.

Pattern Recognition. Rotator cuff repair begins with a careful evaluation of the tear pattern: size, shape, and tissue quality. This starts with preoperative diagnosis, imaging, and physical examination.

Predicting the size of a supraspinatus tear may be difficult on physical examination, since splinting from pain can simulate weakness, and some patients with large supraspinatus tears may have surprisingly good function. However, an external rotation lag sign (active less than passive external rotation) almost always indicates a large tear involving the infraspinatus.⁴ Similarly, a terminal active internal rotation (positive “lift-off” or “stomach press” sign) suggests involvement of the subscapularis.⁵ Imaging studies may also reveal tear extent. Both magnetic resonance imaging (MRI) and ultrasound may be used to reliably demonstrate cuff pathology.⁶⁻¹⁰ MRI can show disruption of the cuff, especially on the coronal images for the supraspinatus (Figure 1) and on the axial cuts for the subscapularis and posterior cuff. Additional information can be gathered from the sagittal images by noting the “width” of the cuff

insertion that is disrupted (Figure 2). It is also important to evaluate not only the size of the tear but also the amount of associated retraction (best visualized on the coronal cuts) and the amount of tendinosis noted on T₂-weighted images. This area of increased signal can be indicative of delamination between the layers of the cuff, a finding that can significantly alter the ease of repair intraoperatively.

In the operating room, further pattern recognition is required. Rotator cuff tears are often associated with significant bursitis. Whether the repair is performed open or arthroscopically, there is a significant risk of damage to the cuff tissue during bursectomy and decompression if the tear is not understood and the anatomy clarified intraoperatively. This requires understanding of the cuff anatomy and careful dissection until the anatomy is displayed adequately. Use of tag and retraction stitches can further assist in demonstrating the anatomy. These stitches must be kept in line with the cuff tear to maximize their utility in assessing tension on the potential repair. Delaminated tears may need débridement for reattachment of the most durable tissue. Some partial-thickness tears are best treated with completion and reattachment, while others may be best suited for débridement only. Crescent-shaped tears are easily mobilized and repaired directly to bone.¹¹ U-shaped tears are usually massive and may require margin convergence in order to help



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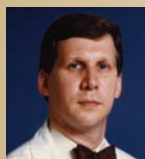




Figure 1. Normal (top) and torn (bottom) supraspinatus MRI scan.

bring the tendon edges near the greater tuberosity.¹¹ It is important to always evaluate the subscapularis tendon attachment during arthroscopic rotator cuff repair. Partial tears of the upper half of the subscapularis are commonly seen in massive rotator cuff tears involving the supraspinatus and infraspinatus tendon, and the literature has suggested poor results when tears of this nature are repaired after 6 months.¹²

Releases. During rotator cuff repair, regardless of technique, it is important to release the capsular and bursal contractures adequately in order to allow mobilization of the cuff tissue. This step allows restoration of the normal mechanical orientation of the repaired muscles. After tears become retracted, there can be adhesions between the supraspinatus and the coracoid on one side of the interval and between the subscapularis and the coracoid on the other side. These adhesions must be separated via anterior

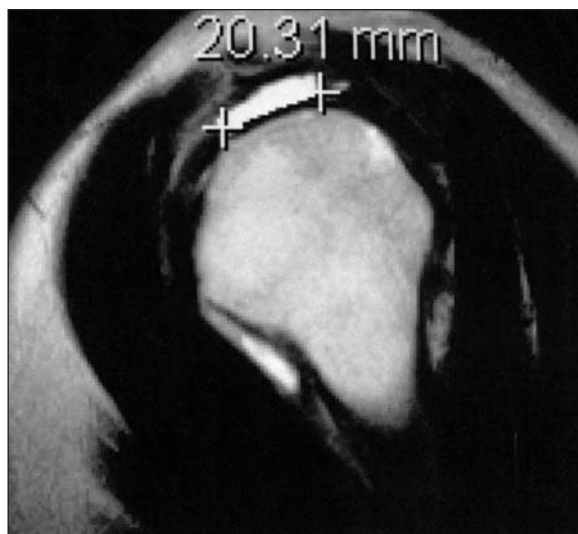


Figure 2. Sagittal MRI slice showing width of >2 cm for cuff tear.

release to anatomically recreate the cuff (Figure 3). In certain situations, posterior release between the supraspinatus and infraspinatus may be required as well. Lastly, when tears have been retracted for long periods, they may adhere to the base of the glenoid neck and may not be able to be repaired without release of these neck adhesions.

Scarring may also occur on the bursal side between the acromion and the cuff tendon or muscle. If the cuff is not adequately released from this scarring, it either will not reach the appropriate position on the greater tuberosity, requiring medialization for repair, or will be reapproximated under undue tension. Too much tension and medialization both result in a less optimal milieu for healing.

In order for the tendon to heal to the humerus, the bone and tendon edges must be adequately prepared. This requires débridement of pathological tissue from the edge of the tendon in order to “freshen” the edges without undue shortening. In addition, there must be preparation of the bone bed. Removing any excrescences that may have developed not only eliminates them as a possible source of subacromial impingement but also makes the bone more amenable to healing to tendon. It is important to preserve adequate cortical bone so that the pull-out strength of anchors is not compromised. After placement of the anchors in the lateral aspect of the cuff “footprint,” each anchor should be tested for pull-out by the surgeon to determine the stability of the anchor. If there is evidence that the anchor is not stable, it should be removed and replaced with a larger anchor. In larger tears, 2 rows of anchors can be beneficial. The medial row of anchors acts as insurance against anchor failure in addition to reduc-

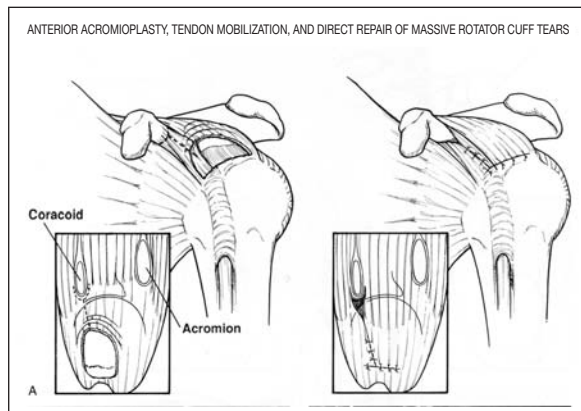


Figure 3. Anterior interval release facilitates reduced tension closure. Reproduced from Codd P, Flatow EL. Anterior Acromioplasty, Tendon Mobilization, and Direct Repair of Massive Rotator Cuff Tears. In Burkhead WZ Jr, ed. *Rotator Cuff Disorders*, 1996; 329, Figure 23-27. With permission of Lippincott Williams & Wilkins, copyright 1996.

ing the tension on the lateral anchors.¹³ It also holds the tendon to the bone over a larger area, creating a greater surface for bone-to-tendon healing.

Tendon Repair. Absorbable suture anchors have gained significant popularity and are preferred by the senior author (ELF) for their radiolucency and the fact that resorption facilitates revision, should revision be necessary. The junior author (AMT), on the other hand, prefers metal anchors for ease of use, decreased expense, and lack of reactivity in the bone. Recently, some authors have considered double-row fixation for repair of the rotator cuff footprint.¹³⁻¹⁶ Recent short-term studies comparing single- and double-row-fixation for arthroscopic rotator cuff repair have shown MRI evidence of a statistically significant improvement in rotator cuff footprint restoration with double-row-fixation. Successful repair requires that the surgeon avoid tearing the tendon when passing sutures. We prefer low-profile penetrating devices to avoid large holes in the tendon. Furthermore, alternating half-hitch knots have an advantage over sliding knots, which draw the suture through soft tendons and can have a gigli-saw effect. It is also important to pass the sutures in such a way as to bring the tendon back to the bone in the correct orientation so that anterior tendon is attached to anterior tuberosity. Finally, when tying the sutures, one must take care to tie the point where the suture passes through the tendon down to the anchor. If care is not taken in this step, the knots will not hold the tendon to the bone. Moreover, perfect knot technique improves the likelihood that knots will last until healing occurs. Alternating throws and posts improves knot reliability.¹⁷

Rehabilitation. No matter how well the cuff is repaired, the most critical aspect of repair is rehabilitation. Even perfectly reconstructed anatomy requires time to heal in a protected environment. As discussed, every tear is individual and thus will require different rehabilitation goals and requirements. Irrespective of this, there are certain constants that we use for our physical therapists. When rehabilitating arthroscopically repaired cuff tears, we use a slower rehabilitation program.

Passive range of motion is initiated as soon as the soft-tissue repair allows. For small tears, this is at the 2-week follow-up visit. Most of our patients rest their arm in a sling and perform only elbow and hand exercises until that time. At 2 weeks, an exercise program of passive external rotation with a stick to 40° and forward elevation with a pulley is initiated. This is performed under the observation of a therapist at first, but it continues at home during the following month. For medium tears, passive external rotation exercises using a stick with the elbow at the side are the only exercises allowed until the 6-week postoperative visit. Finally, for massive tears, no shoulder ROM is allowed for the first 6 weeks.

When the patients return for follow-up at 6 weeks postoperatively, they are instructed on exercises for unlimited range of motion and gentle resistive exercises for progressive strengthening. These progress until the patient can perform exercises with a home program. During the period of guided therapy, modalities such as ultrasound, heat, and ice are allowed as needed.

In the setting of an open or mini-open repair, we begin passive range-of-motion exercises earlier in the course (ie, before 2 weeks). However, if the patient's cuff tissue is less robust, or if the repair is exceptionally tight, we may limit external rotation more or immobilize the arm longer. In addition, certain types of tears (tears of the subscapularis) may require specially directed therapy. Our therapy is directed at producing a healed tendon-to-bone site first and emphasizing mobility after healing has occurred.

AUTHORS' DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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