

Cuff Repair - Open, Miniopen and Arthroscopic

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Introduction

Since Codman⁹ first described the operative treatment of full thickness rotator cuff tears, research has indicated that rotator cuff disease is the most common cause of chronic shoulder pain occurring in adults¹⁰, and treatment for the disease has become more important with the increasing population of old people and with the development of new medical equipment and surgical technologies. McLaughlin²⁵ recognized the anatomic and pathologic findings of impingement syndrome. When Neer²⁹ outlined the pathoanatomic characteristics of impingement, he suggested that anterior acromioplasty for the open repair of rotator cuff tear is essential. During the last decade, the operative repair of full thickness tears of the rotator cuff has gradually shifted through three phase: open repair, combined open and arthroscopic repair (so-called mini-open repair), and, most recently, arthroscopic repair alone.

Open Rotator Cuff Repair

The treatment of full thickness rotator cuff tears by open subacromial decompression and repair has proven successful in decreasing pain including rest pain, night pain, and pain with activities of daily living and restoring function in patients who have failed nonoperative treatment^{4,12,19,20,29,37}. additional goals of surgery are to limit the progression of rotator cuff arthropathy.

Indications for surgical intervention must be individualized and are dependent on the patient's age and physical demands, the size of the rotator cuff tear, the mechanism of injury, and the progression of pain. It is classic preference to advise initial nonoperative treatment for patients who have good active arcs of shoulder motion and strength at the time of their initial presentation and who have either a chronic rotator cuff tear or an acute extension of a small tear superposed on chronic symptoms. Such patients generally have minimal involvement of the posterior aspect of the rotator cuff (infraspinatus and teres minor). For the patients with less severe symptoms, nonoperative treatment may be simple modification of activity and a home exercise program. For patients with more severe symptoms, nonoperative treatment

includes oral anti-inflammatory medication, occasional subacromial injection of corticosteroids, and supervised physical therapy

The length of nonoperative treatment must be individualized on the basis of the pathologic changes, the patient's response to treatment, and his or her functional demands and expectations. If pain persists despite compliance with a well-supervised nonoperative treatment program, surgical intervention can be recommended, provided the pain level and functional limitation are sufficiently serious. Early surgical intervention is indicated in patients who sustain acute trauma associated with significant weakness of the shoulder and posterior cuff involvement, particularly in younger patients with higher functional demands. Patients with acute tears or large extensions of chronic cuff tears can be included in this group.

With a few exceptions, all operative procedures described in the recent literature for primary repair of chronic rotator cuff tears include the use of an anteroinferior acromioplasty to provide adequate decompression of the subacromial space^{4,19}.

The presence of clinically significant acromioclavicular joint arthritis, as defined by clinical examination, injection testing, and imaging studies, serves as the indication for concomitant formal distal clavicle resection³³. Informal surveys of shoulder surgeons indicate that 5% to 20% of patients meet this criterion. Without this primary indication for distal clavicle resection, an adequate decompression of only the undersurface of the acromioclavicular joint is generally performed when there is significant impingement in this area. Anterior acromioplasty may not be necessary in the rare case of a young patient with an acute traumatic rotator cuff tear, but it is sometimes performed to aid in surgical exposure. In patients with massive tears and a proximally migrated humerus, preservation and repair of the coracoacromial ligament is considered, and distal clavicle resection and aggressive acromioplasty are avoided.

Most surgeon prefer an anterosuperior approach to the shoulder performed along with Langer's line. The approach is usually performed in association with detachment of a small portion of the anterior deltoid from the acromioclavicular joint to the anterolateral corner of the acromion, with splitting of the fibers of the middle deltoid for a distance of 3 to 4 cm. An anteroinferior acromioplasty is performed as described by Neer²⁹. Mobilization of the cuff tendons requires release of all adhesion in the subacromial space, the coracohumeral ligament at the base of the coracoid, and occasionally the intra articular portion of the capsule when it is contracted. To avoid injury of the suprascapular nerve, dissection of the suprascapular nerve, dissection of

the supraspinatus and infraspinatus musculature medial to the glenoid margin shoulder not exceed 1.5 to 2.0 cm. Debridement of the edges of the rotator cuff tendon shoulder remove only tissue that is mechanically unsound. Releasing incision at the rotator interval may also improve lateral mobilization of the tendon for repair to a bone bed with the arm held at the patient's side.

Most tears require direct suturing of the tendon edge to a bone bed in the greater tuberosity. A shallow bone trough can be made to expose the bleeding cancellous bone bed of the tuberosity, and care is taken to preserve the cortical bone of the lateral portion of the greater tuberosity. The primary repair of the rotator cuff tear is performed utilizing heavy nonabsorbable suture. The technique for repair is dictated by the configuration of the tendon tear. Horizontal mattress suture are placed through drill holes in the tuberosity and passed through the lateral edge of the cuff tendon. In most cases, tendon-to-tendon repair is also performed along with suturing of the lateral tendon edge to a bone trough. The deltoid is sutured back to the acromion through drill holes and to the acromion through drill holes and to the deltotrapezius aponeuroses. Routine skin closure includes subcutaneous suturing.

Postoperative management after primary repair of full-thickness cuff tear must be individualized to account for the size of tear, the quality of the tissue, the difficulty of repair, and the patient's goals. In general, supine active assisted motion is started on the first postoperative day. Waist-level use of the hand can in most cases be started immediately after surgery. Active range-of-motion exercises and isotonic strengthening are usually started 6 to 8 weeks after surgery. Progression of the strengthening program must be individualized; the period required for full rehabilitation range from 6 to 12 months after surgery.

The overall clinical results with respect to shoulder pain have been reported to be satisfactory in 85% to 95% of patients who have undergone open repair of full-thickness tears^{4,12,18,20,29}. If an early satisfactory result is obtained, the pain relief and functional improvement appear to be lasting. Analysis of the 7- to 15-year follow-up of patients who underwent primary rotator cuff repair demonstrates maintenance of satisfactory clinical results without significant deterioration of function or recurrence of shoulder pain^{1,4}. Improvement in pain level is highly correlated with patient satisfaction.

Several recent retrospective studies of rotator cuff repair also report that 85% to 95% of patients have significant improvement in shoulder function following primary

rotator cuff repair^{4,12,18,20,29}. The degree of functional improvement reported is difficult to compare among these studies due to the wide variation in techniques utilized to define function and to measure shoulder strength and functional outcome. Most reports indicate that improvement in pain level correlates with the adequacy of acromioplasty and subacromial decompression³¹. Improvement of function is correlated with improvement in pain level as well as adequacy of the rotator cuff repair and healing of the rotator cuff defect¹⁸. Postoperative strength and function correlate with the preoperative size of the tear, the quality of the tendon tissue, and the ease of tissue mobilization. Significant postoperative weakness on forward flexion and difficulty with use of the arm at or above shoulder level are usually seen in the following circumstances: 1) failure of repair of a full-thickness cuff tear or a postoperative tear, particularly when the tear involves the posterior aspect of the rotator cuff (infraspinatus and teres minor); 2) deltoid detachment or denervation; and 3) rupture of the long head of the biceps tendon^{5,11,30}.

It may still be possible to achieve active elevation of the arm above shoulder level in the presence of postoperative full-thickness cuff tear as long as there is significant improvement in the postoperative pain level, full rehabilitation of the deltoid, and sufficient anterior and posterior rotator cuff musculature to maintain containment of the humeral head within the glenoid fossa during elevation of the arm¹⁸. In such cases, however, patients often have decreased strength of external rotation and abduction. Despite the persistence of weakness in patients with postoperative rotator cuff defects, improvement of the pain level and concomitant improvement of shoulder function often result in a high level of patient satisfaction^{18,36}

While tendon debridement and subacromial decompression, either by open or arthroscopic means^{7,8,13,14,36}, has been shown to lead to improvement in pain and function, the long term results appear to be less favourable than those in which the tears were repaired^{4,28,31}. Apoil and Augereau² have abandoned debridement of massive tears, reporting that after only 5 years, less than 50 % of their patients demonstrated significant pain relief with no restoration of function. In addition, at 10 years, progressive superior migration and cuff arthropathy had developed in more than 25% of their patients. Recognizing the importance of anterior and posterior stability of the glenohumeral joint in patients with massive rotator cuff tears, Burkhart⁷ has recently recommended partial repair. However, with the use of appropriate

mobilization techniques, we believe that the majority of large and massive rotator cuff tears can be repaired with overall better and more predictable results^{4,27,28,31}.

Miniopen Rotator Cuff Repair

The miniopen method involves arthroscopic evaluation of the Glenohumeral joint and arthroscopic acromioplasty combined with open repair of the full thickness tear through a small deltoid split.¹⁶ In initial studies, Blevins et al.⁶ found that fifty-seven of sixty-four patients were satisfied. In the article they noticed the limited incision used in the repair restricts the use of this technique to the treatment of smaller, less retracted tears located in the anterior portion of the rotator cuff (the anterior one-half of the infraspinatus and the supraspinatus). The miniopen approach for rotator cuff repair has become a popular method of treating small and medium sized rotator cuff tears^{40,43,44}.

As the origin of deltoid is released from the anterior acromion during the open anterior acromioplasty, deltoid pull-off has been reported following open rotator cuff repair resulting in significant functional deficits²⁰. When the anterior acromioplasty is performed arthroscopically, the deltoid origin is preserved during repair of the torn tendon.

Miniopen rotator cuff repair has produced results that are comparable to those reported for open repair^{4,10,12,19,21,29}. Weber and Schaefer⁴¹ retrospectively compared the result of mini-open versus traditional open repair in the management of small to large-sized tears of the rotator cuff. Sixty-nine patients were treated with the traditional open technique and sixty with mini-open technique with a minimum follow-up of 2 years. The amount and duration of intravenous narcotics and hospital stay of the mini-open group were significantly lower than those undergoing open repair were. They concluded that mini-open repair offers a significant decrease in perioperative morbidity with significant cost savings without compromising results. Baker and Liu^{3,35} reported the results of the comparison study of open and miniopen rotator cuff repairs in 37 patients. They found that the miniopen technique is as effective as open repair with shorter hospitalization and early return to previous activity. Advantages over traditional open repair included deltoid preservation, a

better means of assessing and treating associated intraarticular pathology, shorter hospitalization, reduced early morbidity, easier and quicker rehabilitation, and a smaller scar³⁵. The procedure may be performed on an outpatient basis using regional anesthesia.

In 1990 Levy et al.^{22,34} reported the results of 25 patients treated with miniopen rotator cuff repair. At a minimum follow-up of 1 year, 80% of the patients were rated as excellent or good using the UCLA score. All of the patients in this series with small- or moderate-sized tears had satisfactory outcomes. Paulos and Kody³⁴ report the results in 18 patients in whom the mini-open approach were used for rotator cuff repair. Sixteen patients (88%) achieved excellent or good results, and two had poor results, both in patients with workers' compensation cases pending. They recommended that the miniopen technique be used for smaller tears and conventional open repair for chronic rotator cuff greater than 2 cm.

Liu²⁴ reviewed a series of 44 patients who had full-thickness tears from small to massive size and were treated with an miniopen approach. Good or excellent results were achieved in 84% of patients, and 88% were satisfied with the result. However only two of the five massive rotator cuff tears were satisfied with their result. They determined that the size of the tear seemed to be a determining factor in the functional outcome. Blevins et al.⁶ reported the results of miniopen rotator cuff repair in 64 patients whose sizes of tear were small to massive. In this series, 83% of patients achieved good or excellent results, and 89% were satisfied postoperatively. Our series had 96% satisfactory results by using limited portal extension approach for small and medium sized tears³³. Although limited portal extension (miniopen) approach can be more technically demanding than open rotator cuff repair, the authors believe that limited portal extension approach with arthroscopic subacromial decompression is most appropriate for small- to medium- sized tear (<3cm).

As authors^{23,33,34} have noted, unaddressed acromioclavicular joint pathology or later development of acromioclavicular joint pathology can lead to an unsatisfactory result.

Arthroscopic Rotator Cuff Repair

As orthopaedists have performed the mini-open repair, they have gained familiarity with the arthroscopic appearance of full-thickness tears of the rotator cuff. There have also been improvements in arthroscopic instruments, suturing techniques, suture anchors, and knot-tying. The ability to arthroscopically measure the tear and assess the quality of the tendon and its reparability has improved¹⁵. By performing arthroscopic operation for glenohumeral instability, orthopaedic surgeons have also developed expertise in other applicable techniques, such as preparing bone for soft-tissue attachment⁴². These developments have allowed the open portion of the miniopen technique to be eliminated and the repair to be performed exclusively with the arthroscopic technique. Currently, we treat full-thickness tear of the rotator cuff arthroscopically. The use of the arthroscopic technique allows us to inspect the Glenohumeral joint and to avoid detaching the origin of the deltoid.

The preliminary results and short term follow-up after arthroscopic subacromial decompression in conjunction with arthroscopic rotator cuff repair recently been reported^{17,32,38,39}. Although we cannot document our impressions statistically, we think that arthroscopic repair results in an improved cosmetic appearance, decrease pain postoperatively, and more rapid gain in motion compared with open operative treatment of similar lesion³².

Caution is advised for orthopaedic surgeons who are considering the transition from open to arthroscopic techniques. The orthopaedic surgeon not only must master each of the individual elements described here but also must perform them in a precise and timely fashion. Experience is required in order to recognize the pattern of the tear as viewed through the arthroscope. An adequate decompression must be carried out beneath the acromion and the acromioclavicular joint. When indicated, arthroscopic resection of the distal clavicle may be necessary³³. Mobilization of rotator cuff tissue, release of adhesions and scar tissue, and repair of the tendon to a well-prepared bleeding bone bed are required. Mobilization of the tendon can be difficult in a patient who has a retracted tear. Suture anchors must be placed accurately so that the repaired tendon rests in the desired location. The orthopaedist must manage multiple strands of suture material within the tight confines of the subacromial space and tie secure knots with use of arthroscopic tools.

After adequate arthroscopic subacromial decompression, the anterolateral or anterior portal is utilized for preparing a bone bed for tendon repair. The techniques for arthroscopic rotator cuff repair to a bone bed include percutaneous insertion of

absorbable or metal tacks. Use of single or double point fixation, tacks, or staples carries the potential for loss of fixation, particularly in patients with soft cancellous bone. Loss of fixation can result in failure of tendon repair as well as mechanical irritation caused by these devices in the subacromial space.

Arthroscopic techniques appear to provide acceptable clinical results, particularly in patients with small rotator cuff tears involving a single tendon with good to excellent quality tissue and minimal tissue retraction and scarring. The challenge of arthroscopic surgery for rotator cuff repair lies in proper patient selection and improvement of the techniques for tendon to bone repair. At present, these techniques can be recommended only for use by experienced orthopaedic surgeons who are familiar with the normal and abnormal anatomy seen during both open and arthroscopic operations on the shoulder. A thorough understanding of the various conditions that produce pain in the shoulder is also necessary. An orthopaedic surgeon who performs open repairs infrequently should not attempt the arthroscopic procedure. The open operation is relatively simple and has a documented history of success^{4,12,19,26}. Further refinement of arthroscopic techniques for rotator cuff repair and analysis of long term follow-up data will facilitate definition of the appropriate indications for arthroscopic rotator cuff repair. At the present time, arthroscopic techniques for rotator cuff repair remain an area for further development and careful consideration.

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