Arthroscopic Repair of Large and Massive Rotator Cuff Tears

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Purpose: The purpose of this study was to evaluate the outcome of arthroscopically repaired large and massive rotator cuff tears at 1- to 5-year follow-up. **Type of Study:** Retrospective chart review. **Methods:** Sixty consecutive patients who had arthroscopically repairable large or massive tears were identified by retrospective chart review. Large tears are defined as defects in the cuff measuring from 3 to 5 cm and massive tears measuring greater than 5 cm. Ten of these patients were lost to follow-up before 1 year postoperatively and were excluded from the study. The remaining 50 were the focus of this study. **Results:** Thirty-seven patients had large tears and 13 had massive tears. Follow-up averaged 32 months (range, 12 to 63 months). Based on the University of California Los Angeles shoulder rating, 88% of patients had good or excellent outcomes. Although 6 patients were considered failures based on the UCLA score, 98% of patients were satisfied with the result. Only 1 of these failures underwent a second operation for revision repair. There was no significant difference in final scores when comparing the massive tears to the entire group, but all preoperative scores were lower for those with massive tears than the large tears. **Conclusions:** Arthroscopic management of large and massive tears results in good or excellent outcomes in 88% of patients, which is comparable to reported outcomes following open repairs. **Key Words:** Large—Massive—Rotator cuff tears—Repair.

The rotator cuff has long been known to play a critical role in shoulder function and tears of the rotator cuff are a common cause of shoulder pain and disability.[1] Codman[2] is credited with the first surgical repair of a full-thickness tear of the rotator cuff tendon in 1911. Subsequent debate has centered on surgical repair versus nonsurgical management of these lesions. This controversy is especially intense over the optimal treatment of large and massive tears of the rotator cuff. Some surgeons feel that arthroscopy is contraindicated in treating large tears and favor an open approach.[3-6] Factors such as difficulty in recognizing the tear pattern and obtaining adequate mobilization contribute to this opinion.[3-6] Others have found tear chronicity and mobility to be better indicators of its reparability using arthroscopic techniques.[7-11] Still, others have favored simple debridement and decompression for large and massive tears.[12-16] More recently, we have been treating the majority of these large and massive tears by arthroscopic repair and decompression. The purpose of the current study was to retrospectively evaluate the outcomes of patients with large or massive rotator cuff tendon tears who were treated with an arthroscopic decompression and repair.

METHODS

Sixty consecutive patients who had large or massive rotator cuff tendon tears that were repaired arthroscopically were identified by retrospective chart review. Large tears are defined as defects in the cuff measuring from 3 to 5 cm in 2 or more planes (i.e., 3 cm in width and length was minimum tear size). All were retracted at least to the level of the glenoid. Massive tears were measuring greater than 5 cm. Inclusion criteria for the study population included the presence of a large or massive rotator cuff tear that

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was repaired using an entirely arthroscopic technique and a minimum of 12 months follow-up. Ten of these patients were lost to follow-up before the 1-year postoperative follow-up. The remaining 50 patients are the focus of this study.

Arthroscopic reparability was determined by our ability to adequately mobilize the cuff to the tuberosity and the stitch-holding capability of the tissue. Each patient also underwent arthroscopic subacromial decompression and distal clavicle excision. During this study, we routinely performed distal clavicle excision on each patient undergoing rotator cuff repair to eliminate a secondary source of pain. Conservative treatment included at least 1 month of formal physical therapy (usually 3 to 6 months minimum), subacromial injection of steroids, anti-inflammatory medication, and attempted control of symptoms by activity modification. Indications for surgery were a failure of nonoperative management, continued pain, and functional impairment.

A modified UCLA shoulder rating scale was used to evaluate preoperative and postoperative shoulder pain, function, and range of motion, strength, and patient satisfaction. The maximum score obtainable is 35. The scores were further divided according to Ellman[13] into excellent (34-35 points), good (28-33 points), fair (21-27 points), and poor (0-20 points). Satisfactory or successful results were considered to be in the good or excellent categories. Patient satisfaction was considered separately and was determined simply by asking the patients if they were satisfied with the outcome. Data were then analyzed with SPSS computer software and Student *t* test.

Twenty-nine of the procedures were in men, and 21 were in women. The average age of the patients was 61 years (range, 41 to 76 years). The dominant extremity was affected in 36 patients. Duration of symptoms preoperatively averaged 10 months (range, 1 to 60 months). Three patients were operated on within 1 month of onset of symptoms and were considered to have acute rotator cuff tears based on no prior symptoms. The remaining tears were chronic.

All of the patients in the present study had large or massive rotator cuff tears that were repaired by arthroscopic techniques. The exact surgical technique used in repairing the tendons was determined intraoperatively. Forty-seven tears had a component of medial retraction as well as anterior and posterior displacement of the tendons. These tears were repaired with a combination of suture anchors in the greater tuberosity and margin convergence sutures. Three patients had what appeared to be a coronal split in the cuff with posterior displacement in the tendons. These tears were repaired with only margin convergence sutures that reapproximated the anterior and posterior cuff to each other and the greater tuberosity.

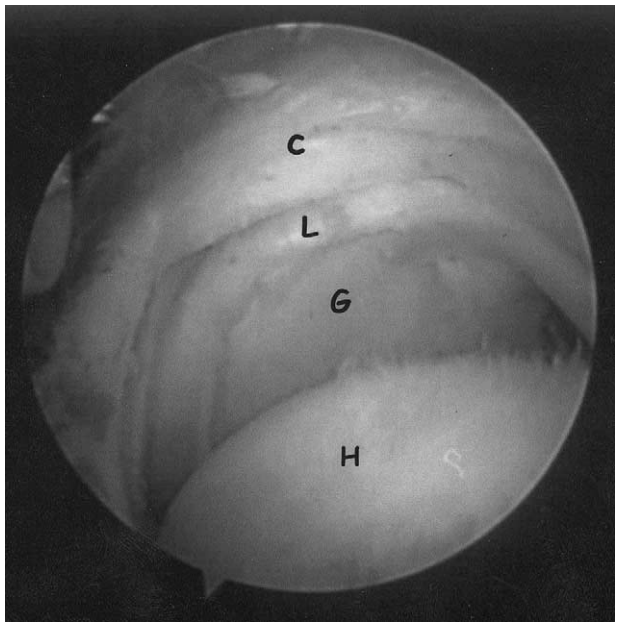
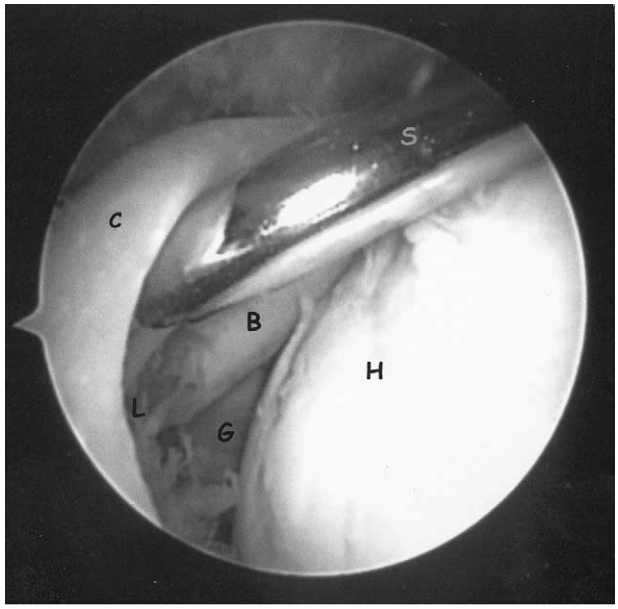


FIGURE 1. Arthroscopic image of right shoulder with massive rotator cuff tear. View from lateral portal.

The average preoperative UCLA score was 15.3 (range, 5-24). Preoperative pain score averaged 4.18, and preoperative function score averaged 5.22. Preoperative scores for forward flexion and strength were 2.8 and 2.84, respectively. Preoperative maximum forward flexion averaged 81° (range, 45° to 140°).

Surgical Technique

The surgical technique consisted of diagnostic arthroscopy of the glenohumeral joint to identify and treat any associated intra-articular abnormalities. Next, the arthroscope was introduced into the subacromial space and a lateral portal established. The subacromial space was debrided to allow adequate visualization of the cuff tear and acromial anatomy. The tear was inspected from the posterior and the lateral portal (Fig 1). Our attention was directed first to mobilizing the rotator cuff in order to facilitate a repair. Using a full-radius shaver blade, the cuff was released on its capsular side, taking care not to damage the biceps tendon or the labrum (Fig 2). This included a release of adhesions from the scapular spine. Next, the cuff was released on its bursal side, including release of the coracohumeral ligament (Fig



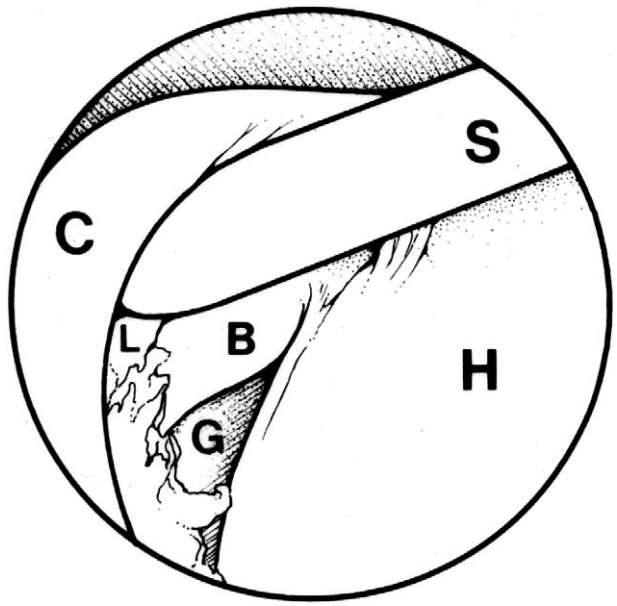


FIGURE 2. Right shoulder from posterior portal. Capsular side release of retracted rotator cuff tendons. (C, cuff tendon; L, labrum; B, biceps tendon; H, humeral head; G, glenoid; S, shaver)

3). A bony trough was then created in the greater tuberosity just lateral to the articular margin (Fig 4). After adequate mobilization of the cuff was accomplished to facilitate a repair, subacromial decompression was performed followed by distal clavicle resection. Most large or massive tears are crescent-shaped and have a component of detachment with retraction as well as a coronal split in the cuff. The best repair technique in our experience combines margin convergence sutures and suture anchors. One or more convergence sutures are placed first that lateralize the free margin of the tear (Fig 5). Then one or more suture anchors are placed lateral to the bony trough to repair the cuff to bone (Fig 6). When adequate mobilization is obtained and the tear pattern is properly identified, an anatomic repair can be obtained in most cases (Fig 7A and 7B).

RESULTS

At an average follow-up of 32 months (range, 12 to 63 months), 44 patients (88%) had a good or excellent outcome according to the modified UCLA shoulder rating scale. The average postoperative UCLA score increased by an average of 17.1 points to 32.4. The pain scores improved by 4.4 points to 8.6, indicating only "occasional or slight" pain in most patients. The function scores improved by an average of 4 points to 9.24, which indicates nearly normal function. Forward flexion scores improved to 4.76 and measured postoperative forward flexion increased by an average of 89° to 170°. Strength scores also improved by an average of 2 points to 4.86, indicating nearly normal strength. All of these improvements in scores were statistically significant ($P < .0001$). Further, there was not a difference in the outcomes for patients with massive tears versus large tears.

Six patients (12%) were considered failures by the shoulder rating scale, with 4 of these having large tears and 2 massive tears, but 49 patients (98%) were satisfied with the result. Only 1 patient (2%) required reoperation. This patient sustained a fall 2 months postoperatively and he retore his rotator cuff. After revision arthroscopic repair, he had a good outcome with full functional recovery and pain only after heavy activities.

DISCUSSION

It has long been recognized that repair of large and massive rotator cuff tears can prove difficult. Often, the tendons are retracted and the muscle has undergone fatty degeneration. Despite aggressive attempts, many surgeons are unable to close the defect in the cuff. The common perception is that a residual hole in the cuff directly translates into an unsuccessful result. This perception has led to the development of several techniques to deal with these residual defects. These techniques include transposition of the intact subscapularis tendon to cover the superior defect,[17] implanta-

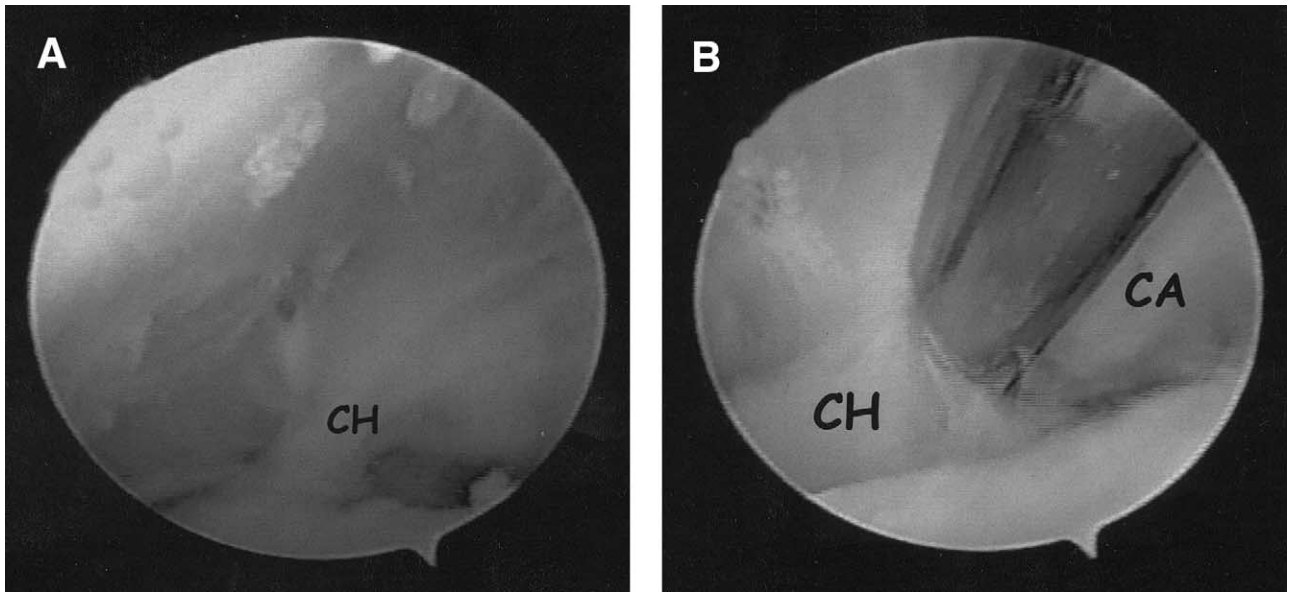


FIGURE 3. Coracohumeral ligament release. (A) arthroscopic image of right shoulder from posterior portal. (B) Same view performing release with shaver introduced through lateral portal. (CH, coracohumeral ligament; CA, coracoacromial ligament)

tion of fascial autograft or allograft tissue,[18] repair of the existing tendon more medially onto the articular surface,[19] latissimus dorsi tendon transfer,[20] free tendon transfer,[21] or simple decompression with debridement of the rotator cuff.[12-16,22] However, several authors have found that a "watertight" closure of the rotator cuff is not needed to attain a successful outcome.[23-25] These investigators have used imaging studies to show residual defects in the rotator cuffs of patients with successful outcomes following open rotator cuff repair.

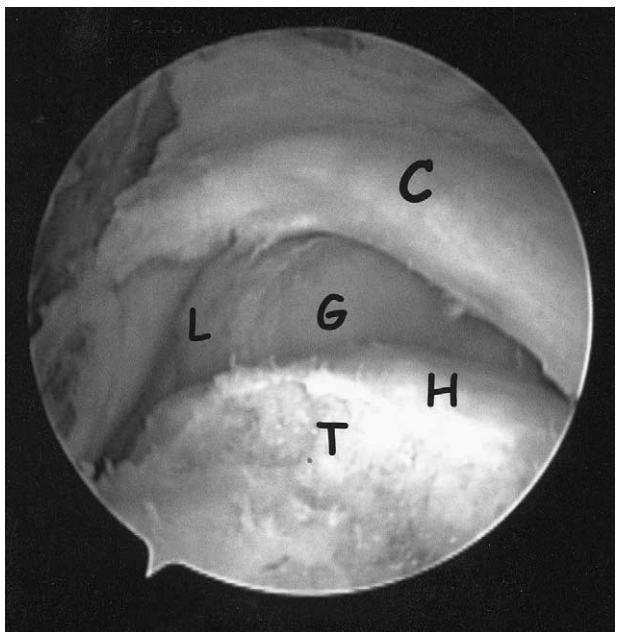


FIGURE 4. Arthroscopic image of right shoulder from lateral portal. Bony trough just lateral to articular surface. (C, cuff; G, glenoid; L, labrum; H, humeral head; T, trough)

The difficulty encountered in attempting to close large defects has led some surgeons to treat these tears with simple debridement and decompression without repair.[12-16,22] Early studies reported satisfactory results in greater than 80% of patients with this form of treatment.[12,13,15] These patients had significant improvement in function and reduction in pain. However, each investigator recommended this procedure in selected patients only, noting that traditional open repair for routine rotator cuff tears should not be abandoned. They emphasized that a vigorous attempt at mobilization and repair is always recommended, with debridement reserved for truly irreparable tears. Further, these results deteriorate with time and have not equaled those where the tear was repaired.[19] Montgomery et al.[22] performed a prospective study directly comparing the results of debridement versus open repair and found the repair group faired significantly better than the debridement group. These results were further verified when this same group of patients was examined at long-term follow-up (6 to 9 years) by

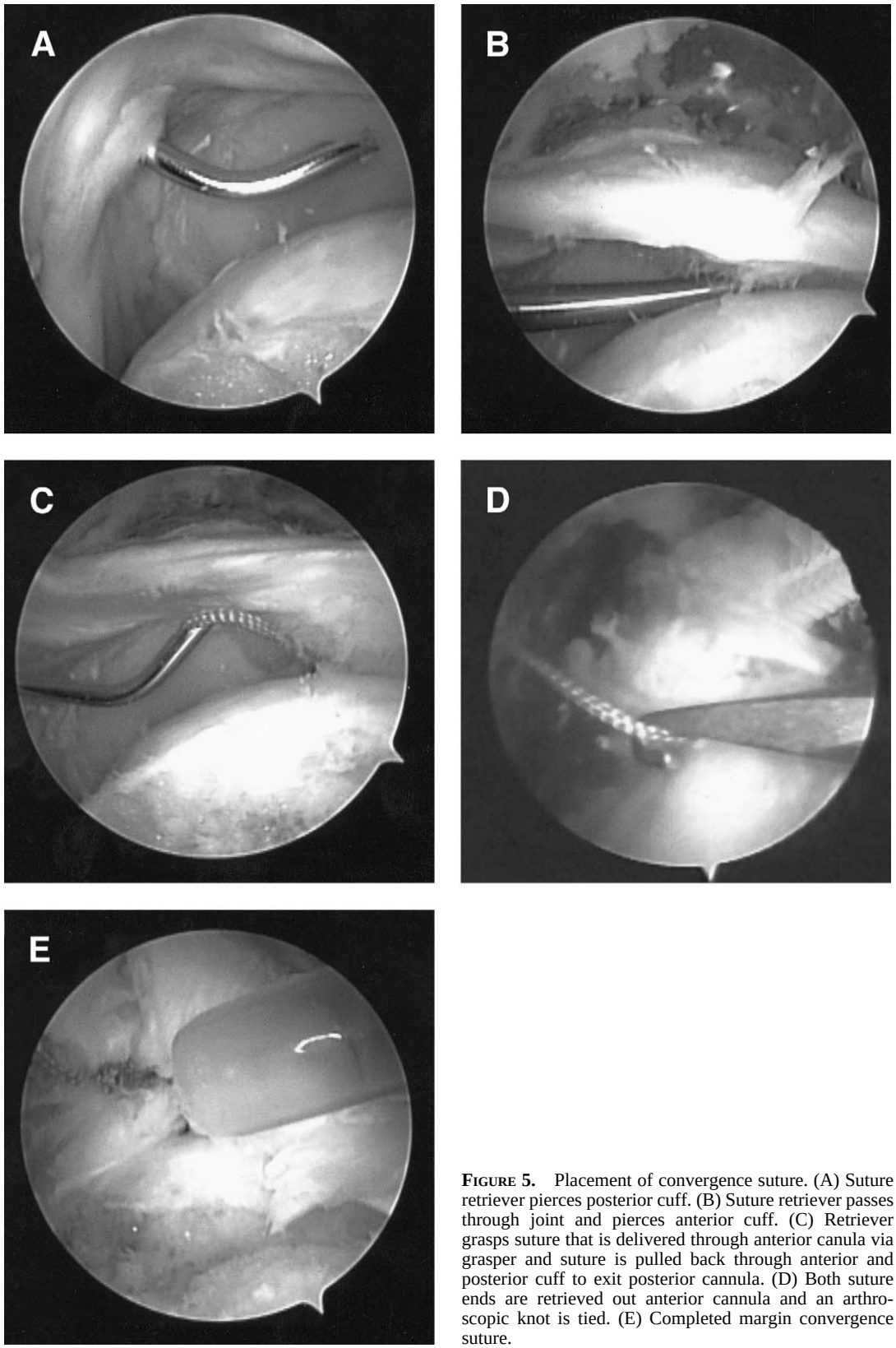


FIGURE 5. Placement of convergence suture. (A) Suture retriever pierces posterior cuff. (B) Suture retriever passes through joint and pierces anterior cuff. (C) Retriever grasps suture that is delivered through anterior canula via grasper and suture is pulled back through anterior and posterior cuff to exit posterior cannula. (D) Both suture ends are retrieved out anterior cannula and an arthroscopic knot is tied. (E) Completed margin convergence suture.

Melillo et al.[19] Overall, 87% of the repair group and only 8% of the debridement group were rated as satisfactory. Further, 23 of the 25 patients in the debridement group required further surgery.

More recently, Burkhart et al.[25] provided a biomechanical argument of why some tears do well with debridement while others do not. They analyzed the results of a previously unreported technique of partial repair for the massive irreparable cuff tear. They described restoration of the force couples and "suspension bridge" system of force transmission in the shoulder.[25] The goal of the partial repair is to create a "functional cuff tear" by restoring the normal mechanics of the shoulder. Complete coverage of the humeral head was not required to attain this goal. The results in their 14 patients were dramatic. Despite postoperative residual defects in the cuff measuring 1×3 cm, active elevation improved by 90.8°, strength improved an average of 2.3 grades on a 0 to 5 scale, and the average UCLA score improved from a preoperative value of 9.8 to a postoperative value of 27.6. Thirteen patients (98%) were satisfied with the result. They concluded that a residual hole in the rotator cuff is not necessarily painful and that the location of the hole is the primary determinant of rotator cuff function. Further, they strongly recommended against tendon transposition to cover a defect. They suggest that the mechanics of the shoulder are unfavorably altered by this procedure. These concepts may apply to our patients with massive tears. Although we were able to repair these tears, we are not certain that all of them healed with the defects completely closed. As other authors have reported,[23-25] it is likely that many of these patients would have residual defects despite a successful result.

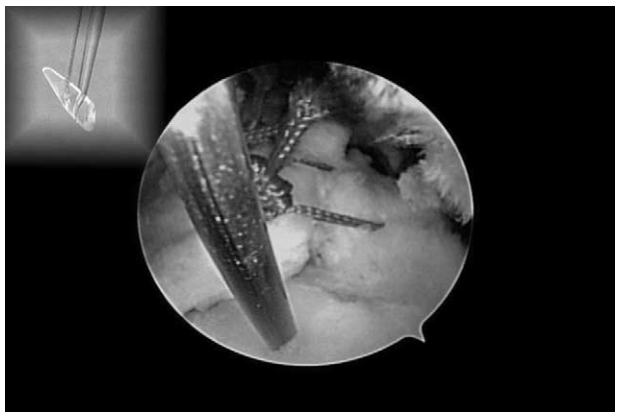
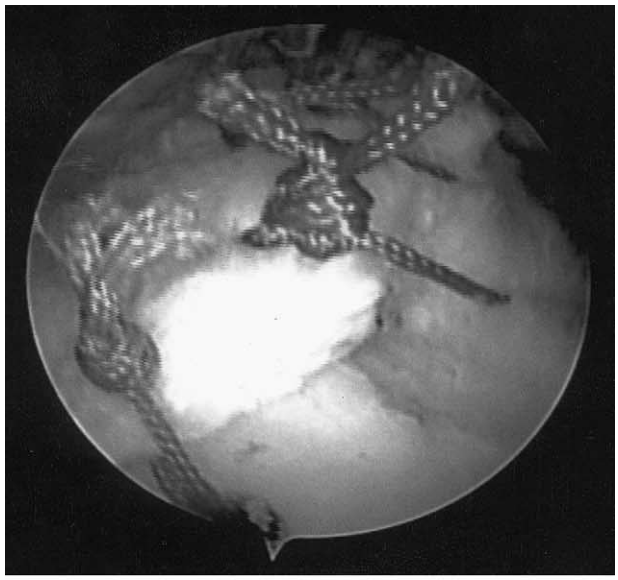


FIGURE 6. Anchor placement.



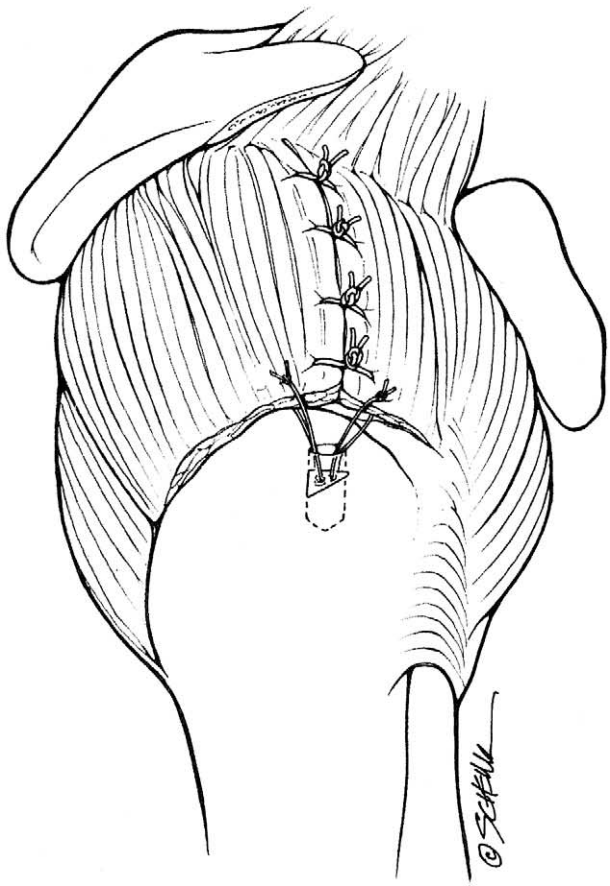


FIGURE 7. Completed repair of right rotator cuff tear.

There have been a limited number of studies that specifically evaluate the outcomes of open surgical repair of large and massive rotator cuff tears.[19,26,27]

These investigators found that most tears, regardless of size, are repairable when appropriate mobilization techniques are utilized. Bigliani et al.[26] reviewed several articles and reported the results of open repair of a massive rotator cuff tear in 61 patients. Fifty-two of the patients (85%) had a satisfactory result. Rokito et al.[27] reported the results of open repair of 17 large and 13 massive rotator cuff tears. Twenty-three of their patients (77%) had a good or excellent result. Melillo et al.[19] had good or excellent results in 87% of their patients who underwent open repair of large or massive tears. All of these studies used the traditional open repair techniques.

With improvements in arthroscopic technique and instrumentation, there has been a tremendous amount of interest in arthroscopic treatment of these massive tears. Most early reports of arthroscopic-assisted rotator cuff repairs cited tear size as an indication to perform an open repair.[3-6] These authors were of the opinion that large and massive tears were not manageable with the arthroscopic technique and favored a traditional open approach. However, as surgeons have become more experienced with the techniques of arthroscopic repair and recognizing tear patterns through the arthroscope, they have been more inclined to perform all repairs arthroscopically.[9,10] The main factor limiting the ability to repair a tear arthroscopically is degree of retraction following an extensive mobilization and not the size of the tear.[9,10] It is our opinion that the ability to mobilize a tear to the tuberosity or to restore the force couples by partial repair is a better determinant of outcome than the size of the tear.

The good or excellent outcomes in 88% of the patients in the current study equal that of most other studies dealing with all sized tears.[3-11,20,22,25-29] Based on the improvements in the modified UCLA shoulder rating scale, the patients had significant improvements in function, strength, and relief of pain following the arthroscopic repair. Further, an average gain of 91° in forward flexion was obtained. Because we did not perform postoperative imaging studies to evaluate the status of the repair, we cannot comment on the status of the repair. We can only speculate that a certain percentage of patients have residual holes in their cuff that does not effect the functional status of their shoulder. We concur with the findings of Burkhart et al.[25] that a complete closure of the defect is not necessary for a good or excellent result. It is our opinion that the ability to mobilize a tear to the tuberosity or to restore the force couples by partial repair is a better determinant of outcome.

Currently, there is very little debate over the optimal treatment of small to medium sized tears. Most surgeons agree that operative repair is indicated in those patients who fail a trial of conservative management. There has been a recent interest in developing techniques to repair these lesions arthroscopically. Some have had very successful results using an arthroscopic-assisted mini-open approach to repairing these tears.[4-7] Others have had equal success utilizing a purely arthroscopic technique.[7-11] Several of these studies have indicated that large and massive tears do not do as well with the arthroscopic technique.[3-6]

The current study shows that large and massive tears can be successfully repaired arthroscopically and the results equal those reported for the traditional open repair techniques. Also based on the findings of this study, there is not a difference in the manageability of massive tears (>5 cm) arthroscopically compared with large tears (3 to 5 cm). Our patients with the massive tears had outcomes equal to those with large tears.

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