Mini-Open Rotator Cuff Repair Does Not Result in Intractable Stiffness

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Abstract

We conducted a study to determine whether intractable postoperative stiffness or deltoid damage results from primary arthroscopic anterior acromioplasty and mini-open repair of full-thickness tears of the superior rotator cuff. Eighty-three repairs (80 patients) were available for follow-up at a mean (range) of 57.2 (12-98) months. Range of motion at presentation and motion in contralateral shoulder at final follow-up were used for comparison. Significant improvements were seen in active forward elevation, passive forward elevation, and active external rotation at 90° abduction. Final motion in the operative and contralateral shoulders was similar. American Shoulder and Elbow Surgeons shoulder index improved significantly ($P<.0001$) from 50.0 before surgery to 88.3 after surgery. Although 1 patient had a symptomatic retear that required revision surgery, there were no cases of intractable stiffness, and there were no cases of deltoid damage.

Various operative techniques have been used to repair rotator cuff tears. Currently, both mini-open and all-arthroscopic repairs are common. Several studies have found that these 2 techniques have similar results.[1-4] In a retrospective study comparing all-arthroscopic and mini-open repairs, Severud and colleagues[5] found no statistically significant difference in outcome measures, but did report 4 cases of fibrous ankylosis in the mini-open repair group. Their study has been cited[6,7] as evidence of increased postoperative stiffness with mini-open repairs, despite there being no statistically significant difference in final range of motion (ROM) between the mini-open and all-arthroscopic groups in the cited study. Deltoid injury from retraction also has been a concern with the mini-open technique.[8]

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We conducted a study to assess whether mini-open repair of full-thickness tears of the superior rotator cuff was associated with intractable postoperative stiffness or deltoid damage. As normal ROM varies significantly, comparison with the contralateral, normal shoulder provides the best measure of restoration of motion. In addition, change in American Shoulder and Elbow Surgeons (ASES) shoulder index was determined. The influence of worker compensation status was also assessed.

Materials and Methods

After obtaining institutional review board approval, we evaluated all patients who underwent mini-open rotator cuff repair and anterior acromioplasty by the same surgeon. The inclusion criterion was a chronic tear of the superior rotator cuff confirmed by magnetic resonance imaging (MRI). Patients with acute tears were not included. All tears initially were managed with subacromial corticosteroid injection and physical therapy; if symptoms remained after this trial of nonoperative management, surgery was presented as an option. Patients with partial or irreparable tears, ipsilateral proximal humerus fractures, augmentation of the repair with a tendon transfer or graft interposition, or a prior failed rotator cuff repair were excluded. Of the 99 patients (102 repairs) meeting these criteria, 2 died of causes unrelated to rotator cuff disease, 14 could not be reached, and 3 declined to participate in the study, leaving 80 patients (80.8%, 83 repairs) available for analysis. Mean (range) follow-up was 57.2 (12-98) months.

Age at surgery, arm dominance, worker compensation status, and mechanism of injury were documented for each patient. Preoperative ASES scoring surveys were evaluated to calculate shoulder index.[9] Preoperative active forward elevation, passive forward elevation, active external rotation at 90° abduction, active external rotation at the side, and active internal rotation (vertebral level reached by thumb) were documented. Presence of external rotation lag sign and ability to perform the liftoff test were noted. Surgery was performed in the sitting position. Diagnostic arthroscopy, performed through the standard posterior portal, included inspection of the glenohumeral joint and the subacromial space. An anterolateral portal was made for arthroscopic subacromial bursectomy and anterior acromioplasty.

Table I. Mean Range of Motion Before and After Surgery

	Before	After	*P* Value
Active forward elevation	144°	164°	.001
Passive forward elevation	152°	168°	.0001
Active external rotation at 90° abduction	79°	79°	.786
Active external rotation at side	35°	40°	.024

Table II. Comparison of Operative and Contralateral Shoulders at Final Follow-Up

	Operative	Contralateral	*P* Value
Active forward elevation	164°	164°	.908
Passive forward elevation	168°	169°	.183
Active external rotation at 90° abduction	79°	80°	.213
Active external rotation at side	40°	43°	.028

Tear size, the product of the anterior-posterior and medial-lateral measurements,[2] was documented at this time. Extra-articular and intra-articular adhesions were released, and tagging sutures were placed to assess cuff mobility. The arthroscope was removed, and the anterolateral portal was extended to 2.5 cm or 3 cm. The deltoid was split in line with its fibers, and the deltoid origin was not disrupted. The torn edge of the rotator cuff was then secured to the greater tuberosity with sutures either placed through bone tunnels or suture anchors. The long head of the biceps was then tenodesed to the transverse humeral ligament with heavy nonabsorbable suture in its groove between the 2 tuberosities, followed by arthroscopic release of the tendon from the supraglenoid tubercle and excision of the intra-articular portion. Then the split in the deltoid fascia was repaired, and subcuticular closure of the skin performed.

At time of enrollment in the study, all patients were invited to return for repeat examination. Shoulder ROM was assessed with a goniometer by a single, independent examiner, who did not participate in the preoperative care, the surgery, or the postoperative regimen. The condition of the deltoid origin at the lateral aspect of the acromion was examined for clinical evidence of dehiscence. The ASES scoring survey was completed again. Patients were asked to rate overall satisfaction with their surgery results. Return to work status, with or without modification, was determined as well. Three patients were unable to return to the office but completed the ASES survey by phone and were included only in the calculation of patient satisfaction and improvement in ASES score.

GraphPad InStat (GraphPad Software, La Jolla, California) was used to analyze the data, paired 2-tailed *t* test was used to analyze ROM differences, and Mann-Whitney test was used to analyze changes between preoperative and postoperative shoulder index and, in the subgroup analysis, to detect differences between repairs using bone tunnels and repairs using a single row of suture anchors. The null hypothesis was rejected, and significance was assumed at $P<.05$.

Results

The 80 evaluated patients (83 repairs) consisted of 44 men and 36 women. Mean (range) age was 58.9 (44-90) years. The dominant extremity was affected in 59 cases (71.1%). Forty-seven patients (58.8%) had a history of a traumatic injury to the affected shoulder. Eight patients (10%) filed worker compensation claims. Mean (range) tear size was 8.3 (1-24) cm^2. No partial tears were included in this study. Of the 83 repairs, 40 (48.2%) were performed with a single row of bone anchors, 23 (27.7%) with a double row of anchors, 19 (22.9%) with bone tunnels, and 1 (1.2%) with a combination of tunnels and anchors.

Arthroscopic subacromial decompression and biceps tenodesis were performed in all cases. No other procedures were performed. There were no intraoperative complications.

After surgery, exercises for passive forward elevation and external rotation at the side were started at 48 hours to 72 hours. Active rehabilitation was instituted at 4 weeks to 6 weeks. Strengthening was introduced at 12 weeks.

Postoperative bruising in the anterior aspect of the arm, consistent with failed biceps tenodesis, occurred in 1 patient. At final follow-up, this patient had no pain (shoulder index, 100). Another patient, at postoperative month 11, had a symptomatic rotator cuff retear, which MRI confirmed. Revision rotator cuff repair was performed. At final follow-up, this patient reported occasional mild discomfort (shoulder index, 81.7). The incidence of retear in asymptomatic patients was not evaluated radiographically. There were no cases of intractable stiffness requiring any form of intervention. No patient underwent subsequent surgery at another institution.

Before surgery, compared with the contralateral shoulder, the affected shoulder lacked a mean of 19°

active forward elevation, 10° passive forward elevation, 5° active external rotation at 90° abduction, and 5° active external rotation at the side. After surgery, active forward elevation, passive forward elevation, and active external rotation at the side were significantly improved, but active external rotation at 90° abduction was unchanged (Table I). At final follow-up, there was no significant difference in active forward elevation, passive forward elevation, or active external rotation at 90° abduction between the operative and contralateral shoulders (Table II). The operative shoulder lacked 3° active external rotation at the side (P = .028). On physical examination, no patient had clinically evident dehiscence of the deltoid origin over the lateral aspect of the acromion.

Preoperative ASES surveys were available from all patients. The 3 patients with bilateral disease completed a survey before each of their 2 surgical interventions. Two patients (2.5%) reported no pain at time of presentation (but ongoing pain at night or with use), 7 (8.8%) reported mild pain, 35 (43.8%) reported moderate pain, and 36 (45%) reported severe pain. Night pain was reported by 71 patients (88.8%). Mean (SD) preoperative shoulder index was 50.0 (24.5; range, 0-95).

Postoperative ASES surveys were completed by all patients. Mean shoulder index improved significantly (P<.0001) to a mean (SD) of 88.3 (14.4; range, 45-100). At final follow-up, 41 patients (51.3%) reported no pain in the operative shoulder, 29 (36.3%) reported mild pain, 9 (11.3%) reported moderate pain, and 1 (1.3%) reported severe pain. Forty-eight patients (60%) were very satisfied with the surgical result, 28 (35%) were satisfied, 3 (3.8%) were somewhat satisfied, and 1 (1.3%) was dissatisfied. Fifty-five of the 58 patients (94.8%) who had been working before surgery returned to work. Eight of these 55 patients (14.5%) required job modification.

Compared with the rest of the patient population, patients who filed worker compensation claims had a lower mean shoulder index (81.4 vs 89.8), though the difference was not significant (P = .113).

Discussion

It is important to note that we wanted to determine whether mini-open rotator cuff repair leads to postoperative stiffness or deltoid damage. Although patient satisfaction and change in ASES shoulder index were evaluated as ancillary to this goal, long-term integrity of repair was not examined, as it was not germane to the single, stated objective of the study.

Other investigators have shown that claims from frequently cited observational studies may continue to be supported despite adequate contradictory evidence.[10] Clear evidence that mini-open repairs are more often associated with intractable stiffness does not exist. In a matched comparison of all-arthroscopic and mini-open repairs, Kang and colleagues[11] found no difference in ROM at 3 months and 6 months; however, 1 patient in the arthroscopic group had a painful contracture that required subsequent capsular release. Similarly, Verma and colleagues[12] found no difference in motion, but 1 patient in their arthroscopic group required reoperation for stiffness. Buess and colleagues[13] found improved mobility with an all-arthroscopic technique in a comparison of mini-open and arthroscopic repairs, but 4 of the 66 patients in the arthroscopic group returned for arthroscopic release of "frozen shoulder" (only 1 patient in the mini-open group had this complication). A review of the literature comparing arthroscopic and mini-open repairs found more overall cases of arthrofibrosis with mini-open repairs (9 vs 5),[14] but the review did not include the studies just mentioned[11-13]; had these studies been included, the numbers would have been comparable. Intractable stiffness is a rare complication of open, mini-open, and all-arthroscopic repairs. The literature does not support the claim that all-arthroscopic repairs inherently lead to fewer cases of postoperative loss of motion.

The cohort of patients in the present study experienced significant improvement in both ROM and ASES shoulder index. No patient achieved less than 120° of active forward elevation—which in previous studies has been used as an indicator of intractable stiffness.[5] However, the best standard for comparison is each patient's contralateral shoulder, assuming it was normal, as was the case in all but 3 of our patients. Our patients achieved a final mean active and passive forward elevation, active external rotation at 90° abduction, and active external rotation at the side that were all within 3° of their contralateral sides. The 3 patients with bilateral repairs had full ROM (mean active forward elevation, 169°; mean active external rotation at 90° abduction, 77°; mean active external rotation at the side, 45°).

The retrospective nature of this study is its main limitation. Another potential limitation is that a comparison group was not available. However, our objective was not to compare various techniques, but to evaluate a single technique using the patient's contralateral shoulder as the standard of normalcy for that individual. In addition, our results are similar to those of Lee and colleagues,[15] who retrospectively reviewed all-arthroscopic repairs. Both mini-open repairs and all-arthroscopic repairs are viable options. As these techniques have similar complication rates and outcome measure improvements, which to use should be based on surgeon preference.

Authors' Disclosure Statement

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

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