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Open Rotator Cuff Repair without Acromioplasty

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Background: In most clinical reports on rotator cuff repair, acromioplasty was done as part of the procedure. In this prospective study, we evaluated the hypothesis that rotator cuff repair without acromioplasty would result in a substantial improvement in shoulder comfort and function.

Methods: Ninety-six consecutive primary repairs of full-thickness tears of the rotator cuff were performed through a deltoid-muscle-splitting incision that preserved the integrity of the coracoacromial arch and the deltoid insertion. All patients were invited to participate in a prospective study involving periodic self-assessment of shoulder function with the Simple Shoulder Test and general health status with the Short Form-36 (SF-36) questionnaire, both of which are validated instruments. Sixty-one patients provided follow-up information for at least two years postoperatively, and the average duration of follow-up was five years. Thirty-four of the tears involved the supraspinatus tendon alone; sixteen involved the supraspinatus and infraspinatus tendons; and eleven involved the supraspinatus, infraspinatus, and subscapularis tendons.

Results: The percentage of shoulders that could be used to perform each of the twelve functions on the Simple Shoulder Test was significantly increased postoperatively (p < 0.002). Men and women had different degrees of function preoperatively (p < 0.00000001) and postoperatively (p < 0.001), but the improvement in function was essentially identical for the two genders. The mean improvement in the number of shoulder tests that could be performed was best for the patients with one-tendon tears (4.9 tests), next best for those with two-tendon tears (3.6 tests), and worst for those with three-tendon tears (3.3 tests). SF-36 scores for physical role (p < 0.003) and comfort (p < 0.0001) were significantly improved postoperatively.

Conclusions: Significant improvement in self-assessed shoulder comfort and in each of the twelve shoulder functions was observed after rotator cuff repairs performed without acromioplasty. The technique that we used is very similar to that described by Codman almost seventy years ago.

Level of Evidence: Therapeutic Level IV. See Instructions to Authors for a complete description of levels of evidence.
the repaired tendon. The resulting adhesions that form in the humeroscapular interface between the acromion and the rotator cuff can limit motion and cause discomfort. Budoff et al. demonstrated that debridement of partial-thickness rotator cuff tendinosis or tears without acromioplasty was an effective long-term treatment.

In the current prospective study, we evaluated the hypothesis that repair of full-thickness rotator cuff tears without acromioplasty can result in substantial improvement in shoulder comfort and function.

Materials and Methods

From November 17, 1992, to December 19, 2000, the senior author (F.A.M. III) performed ninety-six consecutive open repairs of primary full-thickness tears of the rotator cuff without acromioplasty. All patients were invited to participate in a prospective end-result study by providing periodic self-assessment of shoulder function with use of validated instruments. Sixty-one patients provided follow-up data for at least two years postoperatively. The duration of follow-up ranged from two to ten years, and the average duration (and standard deviation) was 5 ± 2.2 years. The remaining thirty-five patients did not send back questionnaires at least two years after the surgery and were, therefore, not included in the study. We did not determine the reasons for their lack of long-term participation. Patients with an irreparable rotator cuff tear, previous rotator cuff or acromial surgery, or a partial-thickness rotator cuff tear were not included in the study. Patients with a Workers’ Compensation claim also were not included because a prior investigation showed that the preoperative characteristics of such patients differ significantly (p < 0.001) from those of patients whose shoulder problems are not covered by Workers’ Compensation insurance. Preoperative shoulder function and general health status were assessed with the Simple Shoulder Test and the Short Form-36 (SF-36), respectively. Simple Shoulder Test and SF-36 questionnaires were mailed to the patients at six-month intervals after the surgery.

The Simple Shoulder Test is a standardized twelve-question questionnaire for self-assessment of shoulder function. It has high test and retest reproducibility, is sensitive to a wide variety of shoulder disorders, and is practical for documenting the efficacy of treatment of shoulder conditions. It also has high test and retest reliability, can be completed by the patient in a short amount of time, is easy to score, and has satisfactory responsiveness. Patients without rotator cuff disease or another shoulder disorder can perform all twelve functions of the Simple Shoulder Test, and the questionnaire has been used to show the substantial variability in the clinical expression of full-thickness rotator cuff tears.

The SF-36 is a validated, standardized questionnaire for self-assessment of general health status that is commonly used in the United States. It has been applied to the evaluation of shoulder disorders.

In this series, the surgical goals were based on the principles enunciated by Codman—namely, that the tendon is repaired to give power to the arm and a frictionless lower bursal surface is created to relieve inflammation and pain. The surgical technique has been previously described in detail. The operation begins with an incision along the Langer lines approximately 1 cm distal to the anterolateral border of the acromion. The “deltoid-on” approach avoids any detachment of the deltoid from the acromion or clavicle. It is carried out through a 3-cm split in the most prominent anterolateral raphe of the deltoid muscle near its origin from the acromion. The different aspects of the rotator cuff are exposed through this deltoid split by positioning the arm as needed in flexion and extension and in internal and external rotation as advocated by Codman.

The hypertrophic bursa is resected from the subacromial space and from the surface of the rotator cuff to allow adequate visualization of the torn rotator cuff and to ensure a smooth rotator cuff surface to articulate with the undersurface of the coracoacromial arch. The undersurface of the coracoacromial arch usually is smooth to palpation. If prominent excrescences are palpated, they are smoothed without resection of the coracoacromial arch or the acromion. Although, in some cases, radiographs show calcification in the coracoacromial ligament, this calcification typically does not encroach on the rotator cuff as it moves beneath the arch. Calculation within the ligament is not resected unless it disrupts the smooth contour of the inferior surface of the coracoacromial arch. The extent of the rotator cuff tear is then defined in terms of which tendon or tendons are torn.

The rotator cuff is mobilized as necessary and is repaired under gentle tension into a trough at its anatomic insertion with use of simple number-2 braided polyester sutures passed through transosseous tunnels, as advocated by Codman and Matsen et al. The sutures are placed 6 mm apart. The number of sutures used depends on the length of the detachment. The trough is intended to effect a smooth transition from tendon to bone with use of an “inlay” rather than an “onlay” technique to optimize the contact area between the tendon and bone, to prevent joint fluid from entering the repair site, to maintain bone-tendon contact even if unexpected traction is applied to the repair, and to expose the tendon edge to the healing tissue from the subchondral bone. When a side-to-side component of the repair is needed, simple sutures are used, with the knots buried again to allow a smooth upper surface of the repaired cuff. Every effort is made to reestablish the normal smoothness of the convex aspect of the cuff and its insertion as well as to preserve the integrity and smoothness of the undersurface of the coracoacromial arch. Finally, the deltoid is closed in a side-to-side fashion with number-0 polyglycolic acid absorbable sutures.

In this study, the efficacy of the procedure was defined as the difference between the final and the initial Simple Shoulder Test and SF-36 scores. The percent efficacy was defined as the mean efficacy divided by the mean preoperative value for each test. Responsiveness was determined on the basis of the standardized response mean, which is defined as the mean efficacy divided by the standard deviation of the efficacy. Responsive-
ness is defined as large if the value is >0.80, moderate if it is between 0.50 and 0.80, and poor if it is <0.50.

Statistical Analysis
The Student t test was used to compare the preoperative and follow-up values of continuous data, such as the SF-36 scores. The chi-square test was used to compare the preoperative and follow-up values for noncontinuous, categorical data, such as the Simple Shoulder Test functions.

Results
Patient Characteristics
The average patient age was 61 ± 11 years (range, thirty to eighty-four years). Forty-two of the sixty-one patients were men. The supraspinatus tendon only was ruptured in thirty-four patients (56%); both the supraspinatus and the infraspinatus were ruptured in sixteen patients (26%); and the supraspinatus, infraspinatus, and subscapularis were all ruptured in eleven patients (18%). All sixty-one patients provided follow-up data for at least two years (range, two to ten years; average, 5 ± 2.2 years). The effectiveness of the procedure was correlated with age, gender, and the number of tendons involved.

General Health Status (SF-36)
There was significant postoperative improvement in two of the eight parameters of the SF-36: the average physical role function score improved from 33 points preoperatively to 56 points postoperatively (p < 0.003), and the average comfort score improved from 40 to 67 points (p < 0.0001). The changes in the remaining parameters were not significant: physical function improved from 66 to 70 points; social function, from 78 to 79 points; emotional role decreased from 74 to 69 points; mental health improved from 74 to 79 points; vitality, from 61 to 63 points; and general health decreased from 75 to 74 points.

Shoulder Function (Simple Shoulder Test)
The patients were able to perform a mean of five of the twelve functions on the Simple Shoulder Test before the surgery and a mean of nine at the time of the last follow-up (p < 0.0001). Thus, the average efficacy was six, and the percent efficacy was 120%. As reflected by the total number of Simple Shoulder Test functions that the patients could perform, these rotator cuff repairs had a large responsiveness, as indicated by a standardized response mean of 1.09. As seen in Figure 1, the percentage of shoulders that could be used to perform each of the twelve Simple Shoulder Test functions was significantly increased after rotator cuff repair without acromioplasty.

Influence of Age, Gender, and Number of Tendons Involved
With the numbers available, patient age did not correlate with improvement after the rotator cuff repair. The mean number of functions that the women could perform improved from 2.3 before the surgery to seven at the time of the last follow-up (p < 0.0001). Therefore, while men and women had significantly different degrees of function preoperatively (p < 0.00000001) and postoperatively (p < 0.001), the im-
The patients with only one torn tendon had the greatest improvement in the number of shoulder functions that they could perform (from 5.2 to 10.1), those with two torn tendons had the next greatest improvement (from 4.8 to 8.4), and those with three torn tendons had the least improvement (from 5.6 to 8.8).

There were no surgical or perioperative complications in this group of patients.

**Discussion**

Acromioplasty has been advocated as an integral part of rotator cuff repair. Blevins et al. reported that fifty-seven (89%) of sixty-four patients were satisfied with the result of a mini-open method of rotator cuff repair that included an arthroscopic acromioplasty and resection of the coracoacromial ligament. Gartsman et al. performed arthroscopic acromioplasty with rotator cuff repair, after which the mean University of California Los Angeles score improved from 12.4 to 31.1 points, the mean shoulder index of the American Shoulder and Elbow Surgeons improved from 30.7 to 87.6 points, and the mean rating with the Constant and Murley system improved from 41.7 to 83.6 points. Hawkins et al. reported that 86% of their patients had relief of pain after repair combined with acromioplasty. Romeo et al. reported a mean value of ten on the Simple Shoulder Test after rotator cuff repair with acromioplasty, a result that is comparable with the average outcome of the repairs without acromioplasty in the current series of patients.

Some surgeons have not included acromioplasty as a routine part of rotator cuff surgery. For example, Budoff et al. reported that partial-thickness tears were treated effectively without acromioplasty.

The current study showed that substantial and significant improvement in shoulder comfort and the ability to perform specific shoulder functions can be achieved with repair of full-thickness rotator cuff tears without acromioplasty or section of the coracoacromial ligament.

Although dissimilarities in assessment metrics have made it difficult to compare results among different series, McKee and Yoo used the same assessment tools as were used in the current study when they evaluated the results of rotator cuff surgery with acromioplasty. They followed sixty-seven patients, who had an average age of fifty-six years, for twenty-four months after the surgery. Thirty-one patients had a rotator cuff repair as part of the surgery, although the data in that group were not analyzed separately. The results in the study by McKee and Yoo included an improvement from 21 to 42 points in the average physical role function score of the SF-36 and an improvement from 39 to 66 points in the average comfort score. The patients in the study by McKee and Yoo could perform an average of four functions on the Simple Shoulder Test before the rotator cuff surgery, which improved to an average of nine functions after the surgery (p < 0.00001). Our patients could perform an average of five functions before the rotator cuff repair, which improved to an average of nine functions after the surgery (p < 0.0001). Although the cohorts in the two studies were not identical, it is of interest that the improvements in the SF-36 and Simple Shoulder Test results were similar.

While it has been theorized that subacromial impingement contributes to the progression of cuff degeneration, it has not been established that acromioplasty effectively prevents progressive failure of the rotator cuff. It has been suggested that the primary mechanism of rotator cuff failure is tension, which is more likely to occur as a person ages and the cuff tendons undergo normal degenerative changes and weaken. Furthermore, while animal studies modeling subacromial impingement showed partial-thickness rotator cuff tears on the bursal side of the cuff, most partial-thickness tears in humans are found on the articular side of the rotator cuff. Finally, the gross and histological appearance of tendon adjacent to rotator cuff defects does not suggest either inflammation or abrasive wear. These findings all suggest that acromial abrasion on the cuff may not be the common pathogenetic factor in cuff failure.

While the prevalence of complications after acromioplasty has not been rigorously documented, avoidance of acromioplasty eliminates those risks, which include the potential for deltoïd detachment or weakening, anterosuperior instability, and formation of adhesions of the rotator cuff to the bleeding cancellous bone of an osteotomized acromion.

The current study has several limitations that are similar to the limitations of the study by McKee and Yoo. First, imaging tests were not done at the time of follow-up to determine the integrity of the rotator cuff. Second, the average duration of follow-up was only five years. Finally, there was no direct comparison between patients who had rotator cuff repair with acromioplasty and section of the coracoacromial arch and those who had rotator cuff repair without those procedures. However, none of these limitations compromised our conclusion that repair of full-thickness rotator cuff defects without acromioplasty resulted in significant functional improvement.
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