Arthroscopic subacromial decompression

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In this study, we analyzed the results of two series of patients treated for impingement syndrome by undergoing arthroscopic subacromial decompression (ASD). Patients had not responded to nonoperative treatment. Group 1 included 112 consecutive patients (average age, 41 years) with 96 (77%) patients available for 2-year follow-up. Group 2 (28 patients, 29 shoulders; average age, 43 years; range, 22 to 72) had ASD and the subacromial space digitally palpated to determine if adequate decompression was performed. Twenty-two (85%) of 26 shoulders were available for follow-up. At follow-up, pain, function, range of motion, strength, impingement signs, and patient satisfaction were assessed. In group 1, according to the Neer criteria, 48% of the patients were graded as satisfactory and 52% unsatisfactory. Workers' Compensation patients had a satisfactory rate of 32%, whereas non–Workers' Compensation patients had a satisfactory rate of 59%. Twenty patients had open acromioplasty after ASD. Inadequate decompression was noted in 14 of 20 failed patients. In group 2, 86% of the patients were graded as satisfactory according to the Neer criteria, with 14% unsatisfactory, which included the 2 failures. The 2 (9%) of 22 shoulders that failed the ASD went on to further surgical treatment. Average follow-up was 56 months (range, 13 to 78 months). The average American Shoulder and Elbow Society score at follow-up was 90.4. No difference between Workers' Compensation cases and the other cases was seen (P < .7). Finger palpation can help to improve outcomes by allowing the surgeon to assess the adequacy of decompression. (J Shoulder Elbow Surg 2001;10:225-30.)

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1058-2746/2001/$35.00 + 0 **32/1/114679**
doi:10.1067/mse.2001.114679

INTRODUCTION

Impingement of the rotator cuff in the subacromial bursa between the humeral head and the coracoacromial arch is a common cause of shoulder pain. Neer[25] applied the phrase "impingement syndrome" in 1972 when he described the mechanism involved in this disorder. Neer[25] proposed that repetitive trauma to the supraspinatus tendon as it passes beneath the coracoacromial ligament and the anterior one third of the acromion contributes to the pathology. He described three stages of the impingement syndrome.[26] Stage I was characterized by reversible edema and hemorrhage within the cuff and bursa, typically in patients younger than 25 years old. Stage II revealed irreversible changes including fibrosis and tendinitis, seen in patients 25 to 40 years old. Stage II has recently been modified to include small tears of the rotator cuff after patient diagnosis and treatments are reviewed.[17] In stage III impingement, chronic changes such as tears of the rotator cuff, biceps rupture, and bone changes are seen and usually occurs in patients 40 years of age and older.

Open decompression was described by Neer[25] for stage II and III lesions. He believed that the development of traction spur within the coracoacromial ligament or an osteophyte in the distal clavicle played a role in patients' symptoms. The procedure included debridement of the subacromial bursa, resection of the coracoacromial ligament and the anteroinferior acromion, as well as any underhanging osteophytes from the acromioclavicular joint. Neer's initial results as well as other follow-up studies* have shown excellent outcomes, with success rates from 80% to 95%.

Ellman[8] described a method to decompress the subacromial space by using arthroscopic techniques that he believed had the advantage of sparing the origin of the deltoid. The arthroscopic subacromial decompression (ASD) procedure involved a release of the coracoacromial ligament, resection of the undersurface of the anterior acromion, and debridement of any hypertrophic bursa. Ellman[8] reported satisfactory results in 88% of patients at 1 to 3 years of follow-up. Many variations of this technique have been reported.†

Since the initial reports, other authors[9,29,37,38,42,45] have reported their results after ASD. Their results have

*References 3-5, 11, 12, 16-19, 21-24, 28, 34, 36, 39, 40, 43-45.
†References 2, 6, 10, 14, 15, 33, 41, 46, 47.

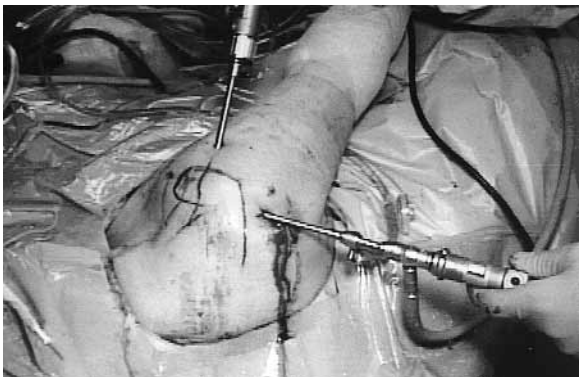

Figure 1 Arthroscopic setup includes posterior portal into subacromial space and second lateral portal placed 2 fingerbreadths or 3 cm lateral to anterolateral corner of acromion in anterior one-third line. Through this lateral portal, arthroscopic debridement of subacromial bursa was performed.

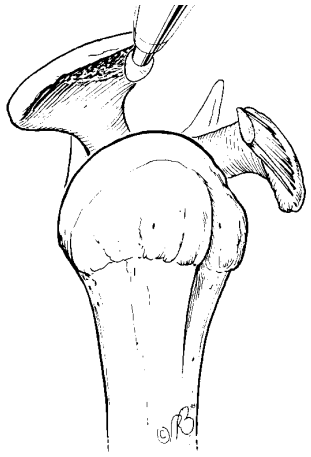

Figure 2 Anterior acromion is resected with high-speed bur, resulting in flat undersurface, which decompresses subacromial space in effort to relieve symptoms.

been reported as 73% to 88% good to excellent and approached the results of the previously reported open subacromial decompressions.

We have previously reported our results for 108 patients who underwent an open acromioplasty for chronic rotator cuff impingement without a full thickness rotator cuff tear.[18] In this group, 87% of the patients had a satisfactory result after the open decompression. The satisfaction rate in Workers' Compensation patients was much lower than non–Workers' Compensation patients. Several authors[9,14] have reported results vary based on Workers' Compensation status. For comparison between studies, it is important to analyze Workers' Compensation patients separately.

To analyze the results of ASD, the first 112 patients who underwent this procedure under the direction of the senior author between 1985 and 1989 were evaluated. Identical criteria that had been established for the evaluation of the open decompression were used to evaluate the patients who had the ASD procedure. Critical analysis of the high failure rate in the ASD group of patients led to the development of a technique (finger insertion) to assess decompression and improve the technique.

The purpose of this study was to analyze the outcome of patients treated by ASD alone and ASD plus digital palpation of the undersurface of the acromium including the rotator cuff.

MATERIALS AND METHODS

Two groups of patients who underwent ASD were reviewed retrospectively. All patients had failed nonoperative treatment. After the ASD, all patients had a minimum of 2-year postoperative follow-up.

Group 1

A total of 112 patients underwent ASD between 1985 and 1989. Ninety-six (86%) of 112 patients were available for follow-up at a minimum of 2 years after surgery. The remaining 16 patients could not be located for follow-up. Of these 96 patients, 59 were men and 37 were women (average age, 41.2 years). Thirty-eight (40%) were involved in Workers' Compensation cases. The dominant arm was involved in 64 patients (68%).

Group 2

Between 1991 and 1994, 29 shoulders in 26 patients (1 bilateral) underwent isolated ASD. In this group of patients, the lateral portal was enlarged to allow palpation of the acromioplasty. Three shoulders required open repair for full-thickness rotator cuff tears and were not included in the study group. Twenty-two (85%) of the remaining 26 patients were available for a 2-year postoperative follow-up. The average age was 43 years (range, 22 to 72 years). There were 11 men and 10 women (11 shoulders). Nine (41%) of the 22 shoulders were classified as Workers' Compensation cases.

In both groups, physical examination demonstrated positive impingement signs in all patients. Subacromial injection with lidocaine relieved the pain temporarily in the majority of the patients.

Surgical technique

Patients were administered a general anesthesia and placed in the lateral decubitus position with traction applied to the involved arm. Glenohumeral inspection was followed by inspection of the subacromial space. The subacromial decompression included a partial bursectomy, division of the coracoacromial ligament, and an anterior-inferior acromioplasty. In group 1 patients, decompression was completed when the acromion was considered flat. Underhanging osteophytes on the inferior clavicle were removed (Figures 1 and 2).

For patients in group 2, the same procedure was performed, followed by enlargement of the lateral arthroscopic portal to 1.5 cm to 2 cm, extending from distal to proximal. Digital examination of the subacromial space was performed through this lateral portal (Figure 3). The under-

Table I Postoperative scores

Scoring system	Group 1 (n = 96) No. of patients (%)	Group 2 (n = 22) No. of patients (%)
Neer criteria		
Satisfactory	46 (48%)	19 (86.4%)
Unsatisfactory	50 (52%)	3 (13.6%)
	Average score	Average score
UCLA*	22.7	32.5
ASES†		90.4

*University of California at Los Angeles (UCLA) score = 35 (maximum).
†American Shoulder and Elbow Society (ASES) score = 100 (maximum).

Figure 3 After decompression of acromion, digital examination of subacromial space is then performed through lateral portal. Undersurface of acromion is palpated to determine adequacy of decompression.

surface of the acromion was palpated to determine the adequacy of decompression. A file was used through the extended lateral portal to complete any necessary additional decompression. The rotator cuff was also palpated from this portal.

After surgery, patients in groups 1 and 2 were prescribed a rehabilitation program consisting of range-of-motion exercises followed by strengthening exercises, specifically concentrating on the rotator cuff. Exercises progressed as the patient's pain permitted.

Outcome assessment

Patients' symptoms, function, and activity level were scored on a self-administered questionnaire. A clinical examination was performed by an orthopaedic surgeon who assessed the patient's range-of-motion and strength. For comparison with our previous study[18,19] and other studies,[24,33,34,37] all patients were evaluated by using a modified Neer criteria[27] and the UCLA scoring system.[20] Patients in group 2 were also evaluated by using the American Shoulder and Elbow Society (ASES) scoring system.[35]

Statistical methods

Descriptive statistical analysis of variant testing and chi-square analysis were used as applicable (Systat; SPSS, Inc, Chicago, Ill). Statistical significance was established at a level of $P < .05$. Associations between categoric variables were assessed with use of chi-square tests or, if assumptions were not met, with use of exact tests. Post hoc power was determined (SamplePower; SPSS, Inc).

RESULTS

Data were collected on 96 patients in group 1 and 22 patients in group 2. In group 1, average follow-up was 30 months (range, 24 to 52 months). Average follow-up in group 2 was 57 months, with a range of 24 to 78 months. Patient results (postoperative scores) are summarized in Table I. The scores of the Neer criteria, UCLA, and ASES systems for patients with Workers' Compensation and for patients not on Workers' Compensation appear in Table II. Thirty-two of the 50 unsatisfactory patients in group 1 obtained no relief after the ASD. Eighteen (36%) of the 50 obtained partial relief of pain but did not fulfill the strict Neer criteria for a satisfactory result. Satisfaction was statistically greater in group 2 ($P < .05$). Post hoc power analysis identified sufficient power (94%).

Table II Comparison of Workers' Compensation (WC) patient scores with non–Workers' Compensation (NWC) patient scores

Scoring system	Group 1 (n = 96) No. of patients WC	NWC	Group 2 (n = 22) No. of patients WC	NWC
Neer criteria				
Satisfactory	12	34	9	10
Unsatisfactory	26	24	0	3
	Average score		Average score	
UCLA*	17.2	26.3	33.3	32.7
ASES†			87.5	92.7

*University of California at Los Angeles (UCLA) score = 35 (maximum).
†American Shoulder and Elbow Society (ASES) score = 100 (maximum).

According to the UCLA scoring system, 8 patients in group 1 scored excellent, 18 patients' scores were good, 27 patients were fair, and 43 patients had a poor result. Average UCLA scores did not differ with regard to Workers' Compensation status.

Twenty (21%) of the 96 patients in group 1 who failed the arthroscopic procedure underwent further surgery consisting of open acromioplasty. Follow-up was obtained on these patients after the open procedure. The average follow-up period was 33 months. Five of the 20 patients obtained complete relief of

symptoms after the open procedure. The UCLA score improved in these patients from 14.5 before surgery to 32.6 after surgery. The open procedure revealed an inadequate ASD in all 5 cases. Four of the 20 patients obtained partial relief after the open acromioplasty. The open procedure revealed an inadequate ASD in 3 of the 4 cases. Eleven of the 20 obtained no relief from the open procedure. At the time of the open procedure of the failed group 1 patients, the following associated pathologies were identified: rotator cuff tears, acromioclavicular joint arthritis, biceps tendinitis, and anterior instability. Seven cases also showed inadequate decompression at the time of the open procedure.

In group 2, after completion of the arthroscopic procedure and before finger palpation, 18 (69%) of the 26 shoulders required additional filing to complete the acromioplasty. In these 18 patients, the initial arthroscopic acromioplasty was inadequate leaving behind residual spurs. This additional filing was completed through the palpation portal. Two (9%) of 22 shoulders in group 2 failed the procedure and required open decompression at 6 and 18 months after ASD.

DISCUSSION

Arthroscopic subacromial decompression (ASD) was pioneered by Ellman.[8] Recent anatomic studies by Edelson and Luchs[7] and Gartsman et al[13] helped us gain a clearer understanding of the anatomy and technique. Some patients benefit from ASD, which include smaller more cosmetic scars with early mobility (deltoid attachment maintained) and sometimes an earlier return to normal activity. Now, we digitally palpate the glenohumeral joint, and inspect the capsule, labrum, biceps tendon, and articular surfaces. The surgery is performed as an outpatient procedure.

The disadvantage of ASD, when compared with an open decompression, is the technically demanding nature of ASD as demonstrated in this report. The procedure requires a steep learning curve for the surgeon. The setup and positioning are more intricate and time consuming. More expensive equipment is needed for ASD than for an open decompression.

Several reports* in recent years show comparable results of ASD when compared with open series. However, in the current report, poor results were seen in the initial group of patients having ASD, with 52% having an unsatisfactory result. The inferior results in group 1 concerned us; thus, we added palpation of the acromioplasty to our group 2 series.

In comparing group 1 with the previous series of open acromioplasties, the groups were similar with respect to age, male-female ratio, and incidence of dominant arm involvement. Our overall satisfactory rate of 48% is significantly lower than our satisfactory rate of 87% in the previous series of open acromioplasties.[18] Our initial arthroscopic results are also inferior to other series of arthroscopic decompressions.[2,8,33,42]

Several authors[9,11,14,31] have shown varying outcomes in acromioplasty in Workers' Compensation populations. Frieman and Fenlin[11] found that successful results can be predicted with open acromioplasty. Usually, results are inferior in Workers' Compensation cases.[11,18,38] However, Ellman and Kay[9] had 24% of their patients involved in Workers' Compensation cases; they had an excellent success rate in this group. In our study,[18] we had a success rate of 77% in our Workers' Compensation group treated with an open acromioplasty compared with a 92% success rate in non–Workers' Compensation patients.[18] In the present study, with the patients treated arthroscopically, the Workers' Compensation cases in group 1 had a satisfaction rate of 32%, whereas patients without Workers' Compensation cases had a satisfaction rate of 59%. All Workers' Compensation cases in the second group had satisfactory results according to the Neer criteria. Digital palpation of the acromion may provide a mechanism for improving Workers' Compensation cases outcomes.

The modified technique of ASD (group 2) with digital palpation resolved several of the disadvantages and provided more reproducible outcomes. The undersurface of the acromion was easily palpated to assess the adequacy of the surgeon's decompression. This modification of the technique has led to more successful outcomes. In our study, at the time of finger palpation, 18 shoulders required additional decompression, which was addressed during the procedure (ASD). The high rate of inadequate decompression may explain why poor results were seen in group 1. By analyzing the failures, patient outcomes were improved by an additional mechanism that enabled us to evaluate the adequacy of decompression through palpation.

This technique offers a method to prevent inadequate decompressions through the feedback mechanism of digital palpation during the learning process of the procedure.

Later, we modified the procedure to use a precision acromioplasty technique much like that described by Sampson et al.[41] In this technique, which is now considered standard by many, the bur is placed in the posterior portal with the arthroscope in the lateral portal. The manner of bone resection is akin to the cutting block technique used in total knee systems. The posterior aspect of the undersurface of the acromion serves as the cutting block to guide the resection anteriorly by using sweeping motions from lateral to medial while maintaining the angle of the bur. With the use of this technique, we have had fewer failures. Finger palpation may be used during the learning phase of the procedure, at revision decompressions, or when we are unsure of rotator cuff pathology or adequacy of the

*References 1, 9, 15, 21, 22, 29, 30, 32, 37, 39, 45, 47.

decompression. Through finger palpation, we have learned the areas where our decompression was inadequate. Now, we address these areas more effectively at the time of the initial ASD procedure. Group 1 had a fairly low success rate. Applying the modifications that we learned through our studies and analyses of our surgical technique helped us to improve the success rate in group 2.

In conclusion, there are advantages to the arthroscopic method. If the success rates are comparable to those of open acromioplasties, the procedure of choice is arthroscopic decompression of the subacromial space for rotator cuff impingement. It is beneficial for surgeons early in the learning curve of ASD to perform digital palpation of the acromion surface to ensure adequate subacromial decompression. In this technically demanding procedure, testing the adequacy of decompression by finger palpation may help provide more reproducible successful results.

Group 1 was made up of patients diagnosed and treated at St Joseph's Hospital, London, Ontario, Canada. The authors wish to thank Karen Briggs for assistance in data collection and analysis and manuscript preparation.

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