Subacromial decompression

TREATMENT FOR SMALL- AND MEDIUM-SIZED TEARS OF THE ROTATOR CUFF

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We report the results of arthroscopic subacromial decompression and debridement of the rotator cuff for chronic small- and medium-sized tears in 114 patients (118 shoulders) between two and five years after surgery.

The mean Constant score was improved to 69.8, and 88 shoulders (74.6%) had a satisfactory outcome. Of patients under the age of 60 years the outcome was satisfactory in 59.3%, and in those over 60 years, in 87.5% ($p < 0.001$). An unsatisfactory outcome was related to manual work ($p < 0.001$) and a duration of symptoms of more than 12 months ($p < 0.05$). The outcome was not related to the size of the tear, the muscles involved or biceps pathology. Further surgery was required in 25 patients after a mean of 13.7 months (3 to 35); ten tears had progressed in size, but none became irreparable. There was no relationship between the increase in the size of the tear and its initial size, the muscles involved or the presence of biceps pathology. No tear became smaller with time.

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The options for the management of chronic small- and medium-sized tears of the rotator cuff are non-operative treatment,¹⁻⁶ open repair and subacromial decompression,⁷⁻¹⁵ arthroscopic decompression and debridement of the cuff without repair,¹⁶⁻²² and more recently, arthroscopic repair.²³⁻²⁹ Most authors consider that subacromial decompression should be an integral part of the operative procedure.^{10,11} Some recommend that repair of the cuff should be performed for most if not all patients.^{16,17,21} Subacromial decompression with simple debridement of the cuff in large tears often has a poor outcome. A few patients with

small- and medium-sized tears in these studies had a favourable outcome with subacromial decompression alone. Other studies, however, have found no difference in the outcome after subacromial decompression alone, for an intact cuff compared with the same treatment for a full-thickness tear of less than 2 cm.³⁰

Our aim in this study was to assess the role of subacromial decompression alone as a treatment for chronic small and medium tears of the cuff, to assess factors associated with poor outcome and to determine the influence of decompression on the progression of a tear.

Patients and Methods

Data were collected from patients undergoing subacromial decompression for small- and medium-sized tears of the cuff between January 1996 and March 1999. We included all patients who had these tears without subjective weakness, had not responded to non-steroidal anti-inflammatory medication and had had at least one injection of steroid into the subacromial bursa and a three-month course of physiotherapy. These criteria were met in 135 patients (140 shoulders); 21 patients (22 shoulders) were subsequently lost to follow-up, but their demographic data and operative findings did not differ from the whole group.

There were 62 men (65 shoulders) and 52 women (53 shoulders) with a mean age at the time of surgery of 61 years (37 to 87). There were 79 right and 39 left shoulders and the dominant arm was operated on in 82 (69.5%). The mean duration of symptoms was 32 months (3 to 225). A traumatic episode initiated symptoms in 35 cases.

Of the 114 patients, 27 (31 shoulders) were manual workers involved in repetitive overhead work or heavy lifting with an outstretched arm, 28 had a sedentary job and 59 were housewives or retired. Of the 27 manual workers, 12 were able to work with moderate difficulty, 13 with extreme difficulty and two were not able to work. Of the 28 sedentary workers, five were able to work easily, three with mild difficulty, 13 with moderate difficulty, six with extreme difficulty and one not at all. Forty-seven patients participated in sport for leisure, 19 enjoyed a manual leisure activity and 48 had sedentary hobbies. Of the 66 patients participating in sport or manual hobbies, five were able to continue their activities easily, six with little diffi-

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culty, 20 with moderate difficulty, 26 with extreme difficulty and nine not at all.

Operative technique. After examination under anaesthesia for range of movement and stability, the patient was placed in the lateral decubitus position. The glenohumeral joint was inspected arthroscopically from a posterior portal. The arthroscope was then moved to the subacromial bursa and a lateral portal used for decompression. Flaps of cuff which might have caused mechanical obstruction were removed. The surgical procedure has already been described.³¹ No additional procedures were performed. The extent of the tear was assessed using the classification of Post, Silver and Singh.³² There were 27 small (1 cm diameter or less) and 91 medium-sized tears (1 to 3 cm). We excluded large (3 to 5 cm) and massive tears (> 5 cm). All involved the supraspinatus tendon, with involvement of this tendon alone in 74 shoulders and extension anteriorly into the subscapularis in 16 and posteriorly into the infraspinatus in 28. The biceps tendon was normal in 70 shoulders, inflamed in six, degenerative or partially torn in 28, subluxed in three and completely torn in 11.

All patients were discharged on the day of surgery and wore a sling for comfort for three to four days. Active movement was allowed immediately, but strenuous, repetitive overhead activities were avoided for three weeks.

Method of evaluation. The patients were followed up at three weeks, three and six months, one year and at final review. All were examined and completed a questionnaire at one year; 21 did so again at the final review and 93 were interviewed by phone and completed a postal questionnaire. Assessments were made using the score of Constant and Murley,³³ and a numerical patient satisfaction scale.³⁴ The mean follow-up was 40.6 months (24 to 62).

Statistical analysis. The mean and standard deviation were calculated and the paired Student *t*-test and chi-squared test were used to analyse the data. A *p* value of less than 0.05 was considered to be significant.

Results

The outcome was considered to be satisfactory if no revision surgery was performed and the patient thought that the shoulder was better or much better. The outcome was considered to be unsatisfactory if revision surgery was required or the patient felt that the shoulder was the same or worse. Using these criteria, 88 shoulders (74.6%) were considered to be satisfactory, and 30 (25.4%) unsatisfactory. The mean Constant score at the final review or just before revision surgery was 69.8 and the mean numerical patient satisfaction scale was 7.4 (Table I).

Pain. The mean Constant score for pain was 10.9; 54 shoulders had no pain, 31 mild pain, 31 moderate pain and two had severe pain. Eighty-five shoulders (72%) had no or mild pain.

Activities of daily living. The mean Constant score for activities of daily living was 15.6; 71 shoulders (60.2%) could be used comfortably for overhead activities.

Range of movement. The mean gain in active forward elevation was 11.6°, in abduction 21.5°, in external rotation with the arm at the side 3.1°, and in internal rotation in extension 2.4 vertebral levels (Table II). All gains in movement were significant (*p* < 0.01 for forward elevation and external rotation and *p* < 0.001 for abduction and internal rotation).

Power. The mean Constant score for power was 7.6.

Occupation. Of the 27 manual workers, 12 (44%) returned to the same occupation at the same level of activity, five returned to the same occupation at a reduced level of activity, six changed jobs and four (6 shoulders) retired early. The mean time off work for manual workers was 44 days (7 to 180). Of the 28 sedentary workers, 22 (81.5%) returned to the same occupation at the same level of activity, in four at a reduced level. One changed his job and one retired early. The mean time off work for sedentary workers was 14 days (0 to 42).

Table I. Mean ($\pm$ SD) Constant scores at final review or just before revision surgery in relation to outcome

	Whole group	Satisfactory outcome	Unsatisfactory outcome
Constant score	69.8 $\pm$ 16.6	76.6 $\pm$ 12.4	50.1 $\pm$ 10.6
Numerical patient satisfaction	7.4 $\pm$ 2.6	8.5 $\pm$ 1.8	4.0 $\pm$ 1.3
Pain	10.9 $\pm$ 4.3	12.8 $\pm$ 3.1	5.5 $\pm$ 2.2
Activities of daily living	15.6 $\pm$ 5.2	17.8 $\pm$ 3.5	9.1 $\pm$ 3.7
Power	7.6 $\pm$ 4.7	8.8 $\pm$ 4.7	3.8 $\pm$ 2.4

Table II. Mean ($\pm$ SD) values for ranges of movement in degrees before operation and at final review

	Preop	Postop
Forward elevation	154.3 $\pm$ 34.4	165.9 $\pm$ 26.4
Abduction	139.4 $\pm$ 39.3	160.9 $\pm$ 31.2
External rotation in adduction	45.5 $\pm$ 9.1	48.6 $\pm$ 7.5
Internal rotation in extension	Able to reach LV*	Able to reach DV*

*LV, lumbar vertebra; DV, dorsal vertebra

Sports and manual leisure activity. Of the 66 patients participating in sport or manual leisure activities, 48 (49 shoulders; 72.7%) returned to the same level of activity, nine returned to the same sport at a reduced level, five changed sport and four stopped all sporting activity.

Complications. There were no intra- or postoperative complications.

Factors affecting outcome. There was no correlation between an unsatisfactory outcome and arm dominance, gender or a history of trauma.

Age. The outcome was unsatisfactory in 22 of 54 shoulders (40.7%) in patients under the age of 60 years and in eight of 64 shoulders (12.5%) in those older than 60 years (chi-squared test, $p < 0.001$).

Manual work. It was also unsatisfactory in 15 of 31 shoulders (48.4%) in manual workers and 15 of 87 shoulders (17.2%) in sedentary workers and those who were retired (chi-squared test, $p < 0.001$).

Sport and manual leisure activity. The outcome was unsatisfactory in 13 of 67 shoulders (19.4%) in patients with sporting or manual leisure activities and in 17 of 51 (33%) without a physical hobby ($0.1 > p > 0.05$).

Duration of symptoms. Of the 37 patients with a duration of symptoms of one year or less, five (13.5%) had an unsatisfactory outcome. Of the 81 with symptoms for more than one year, 25 (30.8%) had an unsatisfactory outcome (chi-squared test, $p < 0.05$).

Size of tear. Of the 27 small-sized tears eight (29.6%) had an unsatisfactory outcome. Of the 91 medium-sized tears, 22 (24.2%) were unsatisfactory (chi-squared test, $p > 0.5$).

Muscles involved. Of the 74 tears affecting only supraspinatus, 22 (29.7%) had an unsatisfactory outcome. Of the 28 with tears of both supraspinatus and infraspinatus, seven (25%) were unsatisfactory. Of the 16 with tears of supraspinatus and subscapularis, one (6.3%) had an unsatisfactory outcome (chi-squared test, $0.5 > p > 0.1$).

Biceps pathology. The outcome was unsatisfactory in 21 of 76 shoulders (27.6%) with normal or inflamed biceps tendons, in eight of 31 (25.8%) with degenerative or subluxed biceps tendons, and in one of 11 (9.1%) with a torn biceps tendon (chi-squared test, $0.5 > p > 0.1$).

Degeneration, subluxation or tear of the biceps was associated with medium-sized rather than small tears (chi-squared test, $p < 0.02$). There was no difference in the incidence of biceps pathology between those with tears of the supraspinatus alone and those with tears of both supraspinatus and infraspinatus (chi-squared test, $p > 0.5$). Biceps pathology was regularly associated with tears of both supraspinatus and subscapularis, as opposed to those with tears of supraspinatus alone (chi-squared test, $p < 0.02$).

Co-planning of anteroinferior clavicle. At the time of surgery, co-planning of the anteroinferior clavicle had been performed in four of 30 shoulders (13.3%) with an unsatisfactory outcome, and in 17 of 88 (19.3%) with a satisfactory outcome (chi-squared test, $0.5 > p > 0.1$).

Revision surgery. Of the 30 shoulders with an unsatisfactory outcome, 25 underwent revision surgery and one awaits a cuff repair. Four patients, with an unsatisfactory outcome had no further surgery. The mean interval between subacromial decompression and revision surgery was 13.7 months (3 to 35). All previous subacromial decompressions were thought to have been adequate at the time of revision surgery. Of the 25 revision procedures, 22 were open cuff repairs, one was an open cuff repair with a biceps tenodesis, one an arthroscopic cuff repair and one an arthroscopic acromioclavicular joint excision. Of the 18 cuff repairs with follow-up for more than two years, 16 (88.9%) were better or much better. The mean Constant score improved from 50.5 to 71.1 and patient satisfaction improved from 4.2 to 7.1.

Progression of the tear. The size of each tear and involvement of local muscles were measured after debridement with the shoulder placed in the same position and under traction, as for the arthroscopic procedure. A tear was considered to have progressed if its greatest diameter had increased by more than 5 mm. This was observed in ten of 25 patients (40%). Three of the seven small-sized tears (42.8%) had progressed to a medium-sized defect. Seven of the 18 medium-sized tears (38.9%) had progressed, four remained medium-sized and three became large-sized. No tear became smaller. There was no relationship between the size of the tear and the incidence of progression (chi-squared test, $p < 0.05$).

In terms of muscle involvement, eight of 17 tears (47.1%) of supraspinatus alone progressed. Four still affected supraspinatus alone, two progressed to involve infraspinatus and two to involve subscapularis. Of the tears involving supraspinatus and infraspinatus, two of seven had progressed. One still affected the same two tendons but one spread to involve subscapularis. The single tear involving supraspinatus and subscapularis did not progress. There was no relationship between muscle involvement and the incidence of progression of the tear (chi-squared test, $0.5 > p > 0.1$).

Three normal biceps tendons had degenerated at the time of revision surgery, one requiring tenodesis. One degenerative biceps tendon had ruptured at the time of revision surgery. There was no relationship between biceps pathology at the time of the initial procedure and the incidence of progression of the tear (chi-squared test, $p > 0.05$).

Discussion

If subacromial decompression is to be considered as the single treatment for chronic small- and medium-sized tears, it has to be more effective than non-operative management and produce results comparable with those of repair of the cuff. The non-operative management has a satisfactory outcome variously quoted as between 44% and 82% of shoulders.¹⁻⁶ Itoi and Tabata² reported a satisfactory outcome in 82% of 62 shoulders treated non-operatively, but

shoulders with persistent symptoms were treated operatively and excluded from the study, and 50% of non-operatively treated patients were lost to follow-up. Current opinion predicts a satisfactory outcome in no more than 50% of such patients.³⁵ Only a modest improvement in shoulder function and comfort follows non-operative management.⁶

Zvijac et al²¹ rated as satisfactory 11 of 13 (84.6%) small- and medium-sized tears treated by subacromial decompression, followed for six years. Ellman et al¹⁶ rated as satisfactory nine of ten tears (90%) of diameter 2 cm or less, which had been treated by subacromial decompression and followed for between two and seven years. Gartsman¹⁸ rated as satisfactory 13 of 16 small- and medium-sized tears (81.3%) treated by subacromial decompression and followed for between two and four years. These results are similar to those of open,^{9,10} mini-open,²³ arthroscopically assisted²⁸ and all arthroscopic^{24,29} cuff repairs. Hoe-Hansen et al³⁰ found no significant difference between the results of subacromial decompression for patients without a tear of the cuff and with a tear measuring less than 2 cm in diameter, at six years.

Oglivie-Harris and Demazière³⁶ compared subacromial decompression with open cuff repair, in tears measuring between 1 and 4 cm in diameter, and found similar results in terms of relief from pain, range of active flexion and patient satisfaction. Patients had better function and strength after open repair but took considerably longer to regain both range of movement and strength. Montgomery, Yerger and Savoie³⁷ found open repair of the cuff to be superior to subacromial decompression in tears of all sizes and could not identify any group of patients who would benefit from subacromial decompression alone.

To our knowledge, this is the largest single-centre study to assess the outcome of subacromial decompression and debridement of the cuff with no associated procedures for the management of chronic small and medium tears of the cuff. Our results are satisfactory in 74.6% of shoulders at follow-up of 24 to 62 months.

Age was a significant factor in determining the outcome. Kempf et al²² reported a less satisfactory outcome in patients under the age of 60 years. By contrast, Romeo et al¹⁵ found a poorer outcome in women but not in men above the age of 65 years after repair of the cuff. Hattrup¹⁴ found inferior results in patients above the age of 65 years after repair, but this was associated with a larger size of tear above that age. Many have found no relationship between age and the results of subacromial decompression alone or decompression combined with repair.^{7,21,26,37}

We observed a satisfactory outcome with subacromial decompression alone for small- and medium-sized tears in 51.6% of manual workers and in 82.8% of sedentary workers and non-workers. Packer et al¹¹ made similar observations. Sporting and manual leisure activities did not appear to affect the outcome.

A duration of symptoms of more than one year led to a less satisfactory outcome. Bokor et al³ found that patients presenting with pain for less than three months did significantly better after non-operative treatment than patients presenting with pain for more than six months. Therefore, continuing non-operative management for more than three months in patients without clinical improvement appears to be unjustified. There was no difference in the outcome after subacromial decompression for small and medium-sized tears in our study. Previous studies of subacromial decompression alone for tears of the cuff have shown a significantly worse outcome in larger tears.^{16,21,22} Some studies, however, have shown that the size of the tear has no effect on outcome.^{10,13,23,29} Others report that large and massive tears have a worse outcome than small and medium tears.^{12,15,26-28,38}

In terms of muscle involvement, our results show no difference in outcome between tears affecting supraspinatus alone, supraspinatus and infraspinatus or supraspinatus and subscapularis. This is probably because involvement of infraspinatus and subscapularis was limited to the superior part of these muscles and because all these tears were small- or medium-sized. Therefore, these findings should be interpreted with caution and not compared with the results of complete, two-tendon tears. Biceps pathology appears to correlate with the size of the tear and with tears of supraspinatus and subscapularis rather than with those of supraspinatus alone or supraspinatus and infraspinatus. We found no correlation between biceps pathology and the outcome of subacromial decompression for chronic small- and medium-sized tears. We therefore do not recommend biceps tenotomy or tenodesis as part of the procedure. This appears to contrast with the findings of Kempf et al²² who found biceps tenotomy to be effective, although they were mainly dealing with massive tears.

Larger tears appear to be associated with older age.¹⁴ Although tears can be assumed to progress over time, this is not well documented in the literature. Hyvonen, Lohi and Jalovaara³⁹ found that 12 of 96 shoulders treated by open acromioplasty had an intact rotator cuff (joint side tears were not excluded), and progressed to a full-thickness tear at a mean interval of nine years. Yamaguchi et al⁴⁰ found that nine of 23 asymptomatic tears progressed by more than 0.5 cm in their greatest diameter at a mean interval of 5.5 years. No tear became smaller in size. Montgomery et al³⁷ found that five of 27 large and massive tears treated by subacromial decompression alone, progressed to cuff arthropathy over a period of three to five years.

As far as we are aware, the effect of subacromial decompression on the progression of small and medium tears has not been described. No tear enlarged by more than 2 cm in its greatest diameter and no tear became irreparable. We observed no relationship between progression of the tear and its initial size, the muscles involved or whether there was pathology affecting the biceps tendon. Therefore, prediction of which tears should be repaired to

avoid progression was not possible. The results of open repair for small and medium tears of the cuff after an unsatisfactory subacromial decompression did not appear to be compromised by the previous surgery or progression in the size of the tear.

The accuracy of the measurement of the size, involvement of muscles and biceps pathology merit some discussion since the relationship of these variables to the outcome of subacromial decompression and progression of the tear forms the basis of this study. Gartsman,⁴¹ using a technique of sizing similar to ours, found that dimensions were equally well judged by arthroscopic and open techniques. Thomazeau et al.³² found that the arthroscopic assessment of involvement of the tendon was excellent for supraspinatus and biceps, good for subscapularis, but limited for infraspinatus. We experienced similar difficulties. We have used the superior margin of the anatomical neck without articular cartilage as the landmark for the superior margin of infraspinatus.⁴³ The accuracy of this landmark has been questioned.⁴⁴ Since the involvement of the superior margin of infraspinatus did not appear to affect the outcome or progression of tears in our study, we feel that our findings are valid.

Although our study has several limitations as a controlled trial, we present evidence that subacromial decompression alone for chronic small and medium tears, produces an unsatisfactory outcome in patients under the age of 60 years and in manual workers. We recommend repair of the rotator cuff for these patients. Subacromial decompression alone, however, gives a satisfactory outcome in patients over the age of 60 years in the short to medium term.

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