# Open distal clavicle resection : isolated or with adjunctive acromioplasty

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The purpose of this study was to assess outcomes following open distal clavicle resection for acromioclavicular joint arthritis or distal clavicle osteolysis, with and without associated acromioplasty.

Patients with painful clinical findings limited to the acromioclavicular joint had isolated distal clavicle excision (23 shoulders). Patients with acromioclavicular joint abnormalities and rotator cuff tendinopathy also underwent acromioplasty (41 shoulders).

At average follow-up of 8.3 years, pain scores improved from 4.7 (1 to 5 scale) to 2.3 (p < 0.001). Patient satisfaction improved from 1.8 (1 to 10 scale) to 8.3 (p < 0.001). Postoperatively the mean Simple Shoulder Test (SST) score was 10.9. The mean American Shoulder and Elbow Surgeons (ASES) Score was 88.3. There were no statistical differences in pain, satisfaction, motion, and shoulder scores between the two groups. Results of distal clavicle resection with or without acromioplasty are favourable with a low rate of complications and seldom is further surgery required.

**Keywords** : distal clavicle ; clavicle resection ; acromioplasty.

## INTRODUCTION

Surgical resection of the distal clavicle initially focused on posttraumatic conditions (*13,20*). This same procedure has been extended to include treatment of degenerative arthritis (*4,14,15,17,27,28,36*) or distal clavicle osteolysis (*32*) that commonly occur with lesser injuries or aging (*28,29*). Pain and tenderness may be localized to the acromioclavicular joint or may be more widespread, introducing a confounding setting where acromioclavicular problems are combined with rotator cuff tendinopathy (*4,10,31,35*). A number of authors have reported results based on isolated distal clavicle excision and

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these are generally favourable (*1,13,14,18,34*) while other authors have reported a higher proportion of unfavourable results than might be anticipated (*5,9,12,28*). These less satisfactory outcomes have been associated with patient selection, instability, weakness, or unknown factors (*5,9,12,28*). A recent review article summarizing outcomes expressed a wide distribution of satisfactory results, ranging from 50 to 100% (*30*).

The purpose of this study is to review our experience with open distal clavicle excision. Patients with symptoms, signs, and radiographic findings limited to the acromioclavicular joint had isolated distal clavicle excision. A second group with signs, symptoms, and radiographic features indicative of symptomatic acromioclavicular arthritis but who also had associated rotator cuff tendinopathy had, in addition to distal clavicle excision, anterior-inferior acromioplasty as a part of the surgical procedure. We wish to assess patient outcomes, identify risk factors associated with a poor outcome, and outline any need for further treatment.

## MATERIALS AND METHODS

One hundred and forty open distal clavicle excisions were performed in 131 patients between 1988 and 2003 for atraumatic and chronic post-traumatic conditions of the acromioclavicular joint. Any patients with previous Grade 2 or Grade 3 acromioclavicular separations or with full-thickness rotator cuff tears were excluded. Two patients had died during the follow-up period. Twenty-four patients declined to participate in the study and 47 were not able to be contacted for final follow-up evaluation. Thus, this study includes 64 shoulders in 58 patients. Twenty-three shoulders had isolated open distal clavicle excision (Group 1), and 41 shoulders had open distal clavicle excision with concomitant acromioplasty (Group 2). The average follow-up to final evaluation was 8.3 years from the time of surgery (range, 2 to 17.1 years). The study was conducted in accordance with our Institutional Review Board. All persons gave their informed consent prior to their inclusion in the study.

Forty-three of the patients were men, and fifteen were women. The average patient age at the time of surgery was 48 years (range, 23 to 73 years). The dominant extremity was involved in 58 of the affected shoulders. In 40 shoulders the pain had an insidious onset, in 24 shoulders a history of minor trauma was given and in eight of

these, workman's compensation claims were pending. There was pain at rest in 56 shoulders and pain with use in all shoulders. There was tenderness of the AC joint in 62 shoulders, and pain with cross-body adduction in 63 shoulders ; in addition, 41 shoulders had impingement related pain with a painful arc in elevation and discomfort with forced flexion or forced internal rotation with the arm at 90° of abduction. Radiographically, acromioclavicular arthritis was present in 54 shoulders. This was associated with distal clavicle osteolysis in seven. The acromiohumeral distance was normal in all patients. There was no evidence of glenohumeral arthritis in any shoulder. When there were positive physical symptoms and signs of rotator cuff irritation, a shoulder arthrogram or MRI was performed. No rotator cuff tears were present. There was previous surgery in two patients ; one patient had arthroscopic acromioclavicular joint resection done elsewhere four years earlier with recurrence of focal symptoms and signs, and a second patient had arthroscopic subacromial decompression a year earlier.

The surgical approach was through a 3 to 4 cm anterior-superior shoulder strap incision, 0.5 cm medial to the acromioclavicular joint if isolated distal clavicle excision was planned or over the acromioclavicular joint if anterior-inferior acromioplasty was also planned. A 2 cm incision was made between the deltoid and trapezius on the superior aspect of the clavicle and the deltoid was split for 2 cm distal to the AC joint. The distal 1.5 cm of the clavicle was subperiosteally exposed preserving the medial to lateral continuity of the trapezius and preserving the posterior aspect of the acromioclavicular ligaments. The distal clavicle was then excised with an oscillating saw with 1 to 1.5 cm of distal clavicle removed. The average distal clavicle excision was 1.2 cm. Following distal clavicle excision and thorough irrigation, the deltoid muscle was then advanced superiorly and sutured to the trapezius fascia eliminating the defect created by bone excision. The decision as to whether or not to perform a concomitant acromioplasty was made before surgery based upon more diffuse shoulder symptoms (in addition to the focal acromioclavicular joint symptoms) and positive signs of rotator cuff irritation, as mentioned above. If an anterior acromioplasty was also performed, the deltoid was released from the anterior aspect of the acromion, the coraco-acromial ligament was excised and the undersurface of the anterior acromion was removed with an oscillating saw, rendering it flat. In this circumstance the deltoid was then re-approximated to the anterior acromion with transosseous sutures. Following surgery a shoulder immobilizer and sling were supplied

for use for three to four weeks following surgery. A passive shoulder motion program was started on the first postoperative day and converted to an active assisted motion program at three to four weeks. Strengthening with isometrics was initiated at five to six weeks and with elastic straps at eight to ten weeks.

Clinical assessment of the patients was performed preoperatively, on follow-up visits and at latest follow-up with a shoulder analysis sheet (33). Pain was graded on a 1 to 5 scale (8,25) with no pain graded as 1, slight pain as 2, moderate pain after unusually vigorous activities as 3, moderate pain as 4, and severe pain as 5. Patient satisfaction was evaluated on a 10 point scale with 1 point representing dissatisfaction and 10 points representing being most satisfied. Active elevation and external rotation were recorded in degrees, internal rotation was graded by the posterior spinal segment the patients could reach with their thumb. Subjective strength was also evaluated on a 10 point scale with 1 point representing paralysis and 10 points representing normal strength. Patients rated their preoperative and postoperative activity levels as sedentary, light, moderate or strenuous. Each shoulder was also evaluated using the Simple Shoulder Test (SST) (20) and the American Shoulder and Elbow Surgeons Score (ASES) (23).

Descriptive statistics were reported as mean (minimum, maximum) for continuous variables and with frequencies and percentages for categorical variables. The preoperative to postoperative changes in activity level were assessed using Wilcoxon Signed Rank Tests, associations with continuous ordinal outcomes were assessed using Spearman's Rank Correlations for Continuous and Ordinal Variables and Kruskall-Wallis or Wilcoxon Rank Sum tests as appropriate for categorical variables. P values less than 0.05 were considered statistically significant. Analysis was performed on JMP Software (SAS Institute, Cary, NC).

## RESULTS

One patient developed a superficial wound infection resolving with wound care and oral antibiotics. Two patients had subsequent shoulder surgery. One of these had isolated distal clavicle excision and underwent subacromial decompression three years postoperatively. The second with combined distal clavicle excision and acromioplasty had arthroscopic labral debridement and repeat subacromial-subdeltoid bursal debridement 16 years later.

Overall, the preoperative pain score significantly improved (p < 0.001), from 4.7 (range, 3 to 5) to 2.3 (range, 1 to 5) postoperatively (table I). Postoperatively, there was moderate or severe pain in six shoulders (9.4%). Four of these six shoulders had concomitant acromioplasty performed. The pain score was not statistically affected by age, gender, hand dominance, a history of trauma, worker's compensation claims, previous surgery, or the diagnosis of osteolysis (p > 0.05).

Preoperative patient satisfaction was rated as a mean of 1.8 (range, 1 to 7), and significantly improved postoperatively to 8.3 (range, 2 to 10) (p < 0.001). Patient satisfaction was not significantly affected by age, gender, hand dominance, history of trauma, worker's compensation claims, previous surgery, or the length of distal clavicle excised (p > 0.05). Postoperative patient satisfaction was higher in those with a diagnosis of osteolysis than in those without this diagnosis (p = 0.05). Those involved in heavy manual labour had a lower postoperative patient satisfaction rating than those involved with lighter work activities (p = 0.04).

Table I. — Results – Postoperative pain, satisfaction, active forward elevation, and subjective strength in the isolated distal clavicle resection group (Group 1) and the distal clavicle resection with acromioplasty group (Group 2). There is no significant difference between the two groups for any parameter

|  | Group 1 | Group 2 | p-value | Overall |
|---|---|---|---|---|
| Postoperative pain score | 2.1 (1-3) | 2.3 (1-5) | 0.98 | 2.3 (1-5) |
| Postoperative satisfaction | 8.3 (6-10) | 8.2 (8-10) | 0.89 | 8.3 (2-10) |
| Postoperative active forward elevation (degrees) | 174 (160-180) | 176 (160-180) | 0.99 | 175 (160-180) |
| Postoperative subjective strength | 9.0 (8-10) | 9.2 (7-10) | 0.49 | 9.2 (7-10) |

Preoperative forward elevation averaged 161° (range, 90° to 180°) and improved slightly to 175° (range, 100° to 180°) postoperatively (p = 0.99). Preoperative external rotation averaged 65° (0° to 90°) and postoperatively improved slightly to 75° (0° to 90°) (p = 0.99). Average preoperative internal rotation was T12 and increased to T10. Post-operative elevation was not significantly affected by age, gender, hand dominance, a history of trauma, worker's compensation claims, previous surgery, or the length of distal clavicle excised. The average postoperative subjective strength score was 9 (range, 6 to 10). There were higher postoperative strength ratings in shoulders with preoperative impingement signs which had acromioplasty (p = 0.02).

At final evaluation, 32 shoulders did not have a change from preoperative to postoperative self-evaluated activity level, seven had an increase of one level, 14 had a decrease of one level, nine had a decrease of two levels and one had a decrease of three levels. There was a statistically significant decrease in patient activity level from preoperative to postoperative (p = 0.004). There was a positive correlation between age at surgery and decrease in activity level (p = 0.007). The median age of patients at the time of surgery with shoulders that had a decrease in activity level was 66.5 years while the median age of patients that did not experience a change in activity level was 48.7 years. There was no association between length of follow-up and activity level (p = 0.12). Postoperatively the mean SST score was 10.9 (range, 5 to 12) (table II). This score was not significantly affected by any of the parameters analyzed. The mean ASES score was 88.3 (range, 43 to 100) (table III). The ASES score was somewhat lower in women (p = 0.05).

Comparing the isolated distal clavicle excision group (Group 1) to the combined distal clavicle excision and acromioplasty group (Group 2), there were no statistical differences in demographic data,

Table II. — Postoperative Simple Shoulder Test Score — Group 1 represents those shoulders with isolated distal clavicle resection, Group 2 represents those shoulders with distal clavicle resection and acromioplasty. There is no significant difference between the two groups

| | # Patients with Yes Responses | | |
| --- | --- | --- | --- |
| | Group 1 n = 23 | Group 2 n = 41 | Overall n = 64 |
| 1. Does your shoulder allow you to sleep comfortably ? | 17 | 31 | 48 |
| 2. Is your shoulder comfortable with your arm at rest by your side ? | 23 | 40 | 63 |
| 3. Can you wash the back of your opposite shoulder ? | 19 | 36 | 55 |
| 4. Can you place your hand behind your head with the elbow straight out to the side ? | 23 | 39 | 62 |
| 5. Can you reach the small of your back to tuck in your shirt with your hand ? | 23 | 38 | 61 |
| 6. Can you lift 8 pounds to the level of your shoulder without bending your elbow ? | 22 | 38 | 60 |
| 7. Can you lift 1 pound to the level of your shoulder without bending your elbow ? | 23 | 41 | 64 |
| 8. Can you place a coin on a shelf at the level of your shoulder without bending your elbow ? | 23 | 41 | 64 |
| 9. Do you think you can toss a softball overhand 20 yards ? | 20 | 27 | 47 |
| 10. Would your shoulder allow you to work full time at your regular job ? | 22 | 35 | 57 |
| 11. Do you think you can toss a soft ball underhand 20 yards. | 22 | 36 | 58 |
| 12. Can you carry 20 pounds at your side ? | 22 | 38 | 60 |
| Total Score | 11.2 (7-12) | 10.7 (5-12) | 10.9 (5-12) |

Table III. — ASES Scores for pain, function, and total score for the isolated distal clavicle resection group (Group 1) and the distal clavicle resection with acromioplasty group (Group 2). There is no significant difference between the two groups

|  | Group 1 | Group 2 | p-value | Overall |
|---|---|---|---|---|
| ASES pain score | 44.6 (30-50) | 42.9 (20-50) | 0.13 | 43.5 (20-50) |
| ASES function score | 46.6 (36.6-50) | 42.1 (11.7-50) | 0.54 | 43.7 (11.7-50) |
| ASES total score | 91.8 (66.6-100) | 86.3 (43.3-100) | 0.29 | 88.3 (48.3-100) |

preoperative functional scores, or preoperative pain scores. There were no differences in postoperative pain scores, patient satisfaction, active forward elevation, subjective strength, SST scores, ASES pain scores, ASES functional scores, or ASES total scores (p > 0.05) (tables I to III).

## DISCUSSION

These results relative to pain, patient satisfaction, motion, strength, SST score, and ASES score are consistent with favourable results of prior studies related to distal clavicle excision (1,3,4,13,14,26). Over this follow-up period averaging 8.3 years it was unusual for a new shoulder problem to develop and the need for further surgery was quite low. This is probably true as our study population is a relatively homogeneous group of patients with either osteoarthritis of the acromioclavicular joint, osteoarthritis associated with a history of trauma without instability, or post-traumatic osteolysis. In contrast to some of the prior studies with more variable outcomes (5,9,12,28), patients with instability of the acromioclavicular joint were excluded since these patients usually undergo a concomitant stabilization procedure in our practice.

As represented in this patient group, acromioclavicular joint disease often co-exists with rotator cuff tendinopathy – the impingement syndrome – and distal clavicle resection is performed with concomitant anterior-inferior acromioplasty. Studies have also shown very reasonable results when these procedures are performed concurrently and imply that failure to diagnose and treat these coexisting conditions can be a potential cause of a poor surgical outcome (18,21,22,36). The results of these patients (Group 2) were not different than those

who did not have acromioplasty (Group 1). However, we do not routinely perform acromioplasty at the time of distal clavicle excision unless there are clear, coexistent symptoms and signs of subacromial impingement present preoperatively.

There have been several factors associated with an unsatisfactory result in earlier studies including fracture of the lateral end of the clavicle, a large amount of distal clavicle excision, the presence of worker's compensation claims and pre-existing or iatrogenic claviculoscapular instability (5,11,28,30). Fortunately, as a combined result of patient selection and perhaps due to technical details of our surgical procedure including a limited amount of distal clavicle excision, preservation of the medial to lateral continuity of the trapezius muscle and fascia, preservation of the posterior aspect of the acromioclavicular ligaments, transposition of the deltoid muscle into the resection defect, and a conservative postoperative protection and rehabilitation plan, we have not experienced these things in this study group.

The limitations of this study are those inherently related to a retrospective review. However, patient data was collected in a consistent way preoperatively, postoperatively, and in follow-up assessment. This consistent method of data collection allowed us to perform a rather thorough statistical analysis among patient characteristics, variations in surgical technique, and postoperative outcome parameters. A high level of pain relief, patient satisfaction, maintenance of motion and strength, and positive responses for functional parameters on the Simple Shoulder Test and ASES score did not allow the degree of variability that would be necessary to further assess the various factors that might affect surgical outcome. No factors affected pain level. There was higher postoperative patient satisfaction

in shoulders with osteolysis of the distal clavicle and lower satisfaction in shoulders in those involved with heavy manual labour. Postoperative subjective strength was somewhat higher in those with impingement and treatment for it, but was high in both groups. Activity level was less in older patients. SST scores were not affected by any parameter. ASES test scores were somewhat lower in women. However it should be emphasized that in each of these circumstances the differences just met the standard of statistical significance ($p \leq 0.05$), and it is hard to have a strong amount of confidence that any of these findings are clinically meaningful. As such, there were no profound risk factors for an unsatisfactory outcome.

In conclusion, for patients with focal symptoms, signs and radiographic changes who are nonresponsive to conservative treatment, distal clavicle excision is a successful procedure for degenerative arthritis of the acromioclavicular joint or trauma related changes without substantial instability. When additional symptoms and signs are present indicative of rotator cuff tendinopathy, the addition of anterior acromioplasty to distal clavicle excision is equally effective. Contemporarily, many surgeons would prefer an arthroscopic approach for treatment of this condition. There are limitations with this long-term study due to a lower percentage of patient follow-up ; however, given the detailed and consistent analysis of a rather homogeneous patient response to this surgery, this study can serve as a benchmark for further surgical reports when treatment is offered either arthroscopically or by the open method. The open procedure is clearly an acceptable option with favorable outcomes in carefully selected patients, few complications, and seldom is further surgery required – over a long follow-up period. The arthroscopic method of distal clavicle excision is also quite acceptable (*1,3,4,7,13, 14,17,18,24*) and probably will become more commonly used as ongoing technical improvements occur (*6,19,30*). Currently we now perform isolated distal clavicle excision using an open method and do the acromioplasty arthroscopically – although there may be no appreciable clinical difference between the open and arthroscopic approaches (*2,30*).

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