Osteolysis of the Distal Clavicle: Long-term Results of Arthroscopic Resection

Mark Zawadsky, M.D., Guido Marra, M.D., J. Michael Wiater, M.D., William N. Levine, M.D., Roger G. Pollock, M.D., Evan L. Flatow, M.D., and Louis U. Bigliani, M.D.

Purpose: The purpose of this study was to evaluate the outcome of arthroscopic distal clavicle resection by the direct superior approach for treatment of isolated osteolysis of the distal clavicle. **Type of Study:** Case series. **Materials and Methods:** Forty-one shoulders in 37 patients underwent arthroscopic resection of the distal clavicle. Thirty-three patients were male and 4 female, with an average age of 39 years. All patients complained of pain localized to the acromioclavicular joint region. Symptoms began after a traumatic event in 18 shoulders and were associated with repetitive stressful activity in 23 shoulders. **Results:** At an average follow-up of 6.2 years, 22 shoulders had excellent results, 16 had good results, and 3 were failures. All 3 failures occurred in patients with a traumatic etiology. **Conclusions:** Arthroscopic resection for osteolysis of the distal clavicle has results comparable to open excision with low morbidity. Patients with a traumatic etiology had slightly worse results compared with patients with a microtraumatic etiology. **Key Words:** Arthroscopy—Clavicle—Osteolysis—Resection—Results.

Osteolysis of the distal clavicle is an uncommon cause of shoulder pain that can occur after acute injury or repetitive microtrauma. Open resection of the distal clavicle, as described independently by Mumford[1] and Gurd[2] in 1941, has been shown to be a reliable treatment for isolated painful acromioclavicular joint pathology refractory to nonoperative treatment.[1-11] Arthroscopic resection of the distal clavicle has been reported to provide pain relief and allow a return to function comparable to open techniques.[12-15] The arthroscopic approach offers the advantages of decreased morbidity, with fewer postoperative restrictions on motion, earlier return to normal activity, and improved cosmesis.[14] However, there have been few reports on the results of arthroscopic treatment of isolated osteolysis of the distal clavicle.

Microtraumatic osteolysis has been reported to be caused by repetitive stressful activity resulting in cumulative subchondral stress fractures followed by a subsequent hypervascular response.[16-18] Osteolysis may also follow acute trauma to the acromioclavicular joint, particularly intra-articular fractures and grade I or II acromioclavicular separations.[15,19]

Although arthroscopic treatment of osteolysis of the distal clavicle has been described,[12,20,21] little information is available about the results of this technique.[15,16,22,23] We reviewed our experience with arthroscopic distal clavicle resection as a treatment for recalcitrant, isolated acromioclavicular joint pain caused by osteolysis of the distal clavicle.

MATERIALS AND METHODS

The medical records of all patients who underwent arthroscopic distal clavicle resection between 1989 and 1997 were reviewed retrospectively. Thirty-seven

consecutive patients with isolated osteolysis of the distal clavicle were identified. Four patients had staged bilateral procedures, for a total of 41 shoulders in the study group that underwent arthroscopic distal clavicle resection for treatment of isolated osteolysis of the distal clavicle. Patients with other associated shoulder pathology were excluded.

All 37 patients were available for follow-up at an average of 6.2 years (range, 2 to 10 years). There were 33 male and 4 female patients with an average age of 39 years (range, 22 to 54 years). The dominant arm was affected in 63% of cases. All patients complained of anterosuperior shoulder pain that localized to the acromioclavicular joint. The pain often radiated to the trapezius and base of the neck. Pain was graded as none, mild, moderate, and severe by the operating surgeon. Symptoms began after a traumatic event in 18 shoulders; the onset of symptoms was associated with repetitive stressful activity in the remaining 23 shoulders. Eighteen shoulders had a history of trauma, with 7 injuries caused by a fall or other direct trauma to the shoulder, 6 by lifting a heavy object, and 5 the result of a motor vehicle accident. Twenty-three shoulders had repetitive microtrauma as the cause, with 14 cases occurring in weight lifters, 3 in swimmers, 3 in basketball players, and 3 in laborers.

All patients had tenderness to direct palpation of the acromioclavicular joint and pain with passive horizontal adduction of the arm. Shoulder extension and internal rotation also exacerbated symptoms. Preoperative active range of motion was normal in all shoulders, with an average forward elevation of 171°, average external rotation of 74°, and average internal rotation to the T7 vertebral level. All patients had normal muscle strength.

Standard radiographic evaluation was performed on all patients. The evaluation included an anteroposterior view of the shoulder in the scapular plane with the humerus in neutral, internal, and external rotation; a supraspinatus outlet view; and an axillary view. Coned-down acromioclavicular joint views were obtained when standard anteroposterior radiographic views were inconclusive. Radiographic evidence of osteolysis consisted of cystic changes and resorption of the distal end of the clavicle (Fig 1). The acromion remained normal in appearance. Additional studies such as bone scans or magnetic resonance imaging scans were not obtained. The diagnosis of osteolysis of the distal clavicle was made based on the clinical and plain radiographic findings.

All patients underwent a course of conservative treatment consisting of nonsteroidal anti-inflammatory

FIGURE 1. A widened acromioclavicular joint space and indistinct border of the end of the clavicle indicate osteolysis in a 24-year-old weight lifter.

medication, physical therapy, and activity modification. Thirty-nine of the 41 patients (95%) had acromioclavicular joint injections with good, temporary relief of symptoms. Patients were considered candidates for surgery after failing conservative treatment. The duration of preoperative symptoms averaged 22 months (range, 3 to 120 months).

Results were rated as excellent, good, and poor. The result was considered excellent if the patient had no pain, full range of motion, and no functional limitations. The result was considered good if there was slight or occasional pain with no compromise in function or activity and no limitation in range of motion. A poor result did not meet the above criteria.
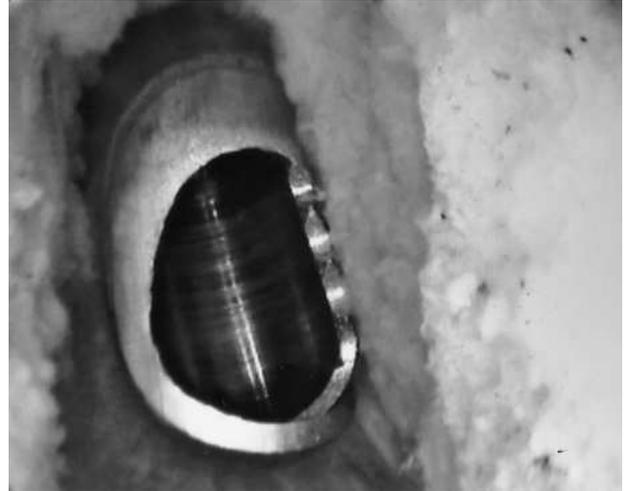
Operative Technique

The operative technique used at our institution has been described previously[12,15,19] and will be briefly reviewed here. Regional interscalene anesthesia is routinely used,[24,25] and the patient is placed in the beach-chair position.[26] A direct superior approach to the acromioclavicular joint was used in all cases. The portal sites are injected with 1% lidocaine with epinephrine to reduce skin bleeding and provide comfort while the interscalene block is taking effect. Two small-bore needles (22 gauge, 1.5 inch) are used to determine the location and orientation of the joint so as to allow precise introduction of the instruments. This is critical because variations in joint inclination can be difficult to appreciate otherwise. The 4.0-mm

30° arthroscope and instruments are placed through direct anterosuperior and posterosuperior portals into the acromioclavicular joint (Fig 2). A 2.7-mm arthroscope can be placed initially if the joint space is narrow. The direct superior approach avoids violation of the glenohumeral joint or subacromial bursa. The capsule and ligaments of the acromioclavicular joint are not incised but are subperiosteally elevated to expose the distal clavicle, allowing direct visualization of the bone during the resection. The meniscus and intra-articular soft tissues are resected with a 5.0-mm motorized full-radius resector (Fig 3). After this, the distal clavicle is excised with a power burr. If the joint space allows, a 6.0-mm burr is used. If the joint space is too tight, bone resection is initiated with a smaller burr to create room for the larger burr. Approximately 4 to 7 mm of the distal clavicle are removed (Fig 4). Care is taken to avoid an uneven resection, which can lead to persistent pain. After the instruments have been removed, 0.25% bupivacaine hydrochloride without epinephrine is injected into the joint to reduce postoperative pain. The portals are closed with subcuticular absorbable sutures. Diagnostic glenohumeral and subacromial arthroscopic examinations were not performed in this study because these patients were diagnosed with isolated acromioclavicular pathology. A sling is used for comfort in the immediate postoperative period, usually for the first 24 hours. Passive exercises are begun on the first postoperative day, and active motion is usually started within several days, after the initial operative pain subsides.

FIGURE 3. After debridement of the joint with the motorized soft tissue resector, the distal clavicle and medial acromion are clearly visualized.

RESULTS

The overall results for the 41 shoulders were excellent in 22 (54%), good in 16 (39%), and poor in 3 shoulders (7%). Therefore, 93% had a good or excellent result, with no significant compromise in function and either slight or no postoperative pain (Table 1). Postoperative active range of motion was essentially unchanged in all shoulders, with an average forward

FIGURE 2. Skin markings outlining the distal clavicle, acromion, acromioclavicular joint, and coracoid process are made. The anterior portal is made 3 to 5 mm anterior and in line with the acromioclavicular joint. The posterior portal is made posterior to and in line with the acromioclavicular joint in the notch formed by the acromion and distal clavicle.

FIGURE 4. The postoperative radiograph from the patient in Fig 1 shows an even resection of 7 mm of bone from the distal clavicle.

TABLE 1. *Patient Data*

	Traumatic	Microtraumatic
No. of patients	18	23
Male:female	15:3	22:1
Preoperative pain		
None	0	0
Mild	0	1
Moderate	13	16
Severe	5	6
Postoperative pain		
None	6	16
Mild	9	7
Moderate	3	0
Severe	0	0
Etiology		
Fall/direct trauma	7	
Lifting object	6	
Motor vehicle accident	5	
Weight lifting		14
Swimming		3
Basketball		3
Manual labor		3
Results		
Excellent	6	16
Good	9	7
Poor	3	0

elevation of 174°, average external rotation of 73°, and average internal rotation to the T8 vertebral level.

Pain decreased considerably after surgery. Preoperatively, 11 shoulders (27%) had severe pain, 29 (71%) had moderate pain, and 1 (2%) had mild pain. Postoperatively, there were 22 shoulders (54%) with no pain, 16 (39%) with mild pain, and 3 (7%) with moderate pain and continued compromise of function. Thus, while 98% had moderate to severe pain before surgery, 93% had mild or no pain at latest follow-up.

In the repetitive microtrauma group that included 23 shoulders, preoperative pain levels were mild in 1 shoulder (4%), moderate in 16 (70%), and severe in 6 (26%). Postoperatively, 16 shoulders had no pain and 7 had mild pain. No patient reported a significant compromise in function. In the traumatic group of 18 shoulders, 13 shoulders (72%) had moderate and 5 (28%) had severe pain preoperatively. Postoperatively, 6 shoulders had no pain, 9 had mild pain, and 3 had moderate pain.

The 3 patients with moderate pain also reported continued compromise in shoulder function, and they constituted the failures. All 3 shoulders with poor results had a history of trauma to the acromioclavicular joint. Two of the 3 shoulders sustained direct trauma in a fall, and the other was the result of a motor vehicle accident. All 3 of these shoulders with continued postoperative pain and compromise of function ultimately required an open acromioclavicular joint stabilization with a modified Weaver Dunn technique.[27] One shoulder had a simultaneous subacromial decompression procedure. There was no evidence of an uneven resection or bony regrowth noted at the second procedure. After the stabilization procedure, 1 patient had no pain and 2 patients had mild pain. All 3 patients reported no significant compromise in shoulder function.

DISCUSSION

Osteolysis of the distal clavicle can be managed nonoperatively in most cases.[7-9] However, in those cases that are refractory to conservative measures, excision of the distal clavicle has proven to be a reliable treatment.[1-6,8,10-11] Arthroscopic resection of the distal clavicle was initially described as part of a larger reconstructive procedure to debride the inferior osteophytes that contribute to impingement pathology.[15,28,29] The superior arthroscopic approach initially described by Johnson[30] allows for direct visualization of the acromioclavicular joint without disruption of the ligamentous capsule. This preserves joint stability and prevents excessive posterior translation and painful abutment of the distal clavicle against the acromion.[12,15,31] We believe that in cases of shoulder pathology isolated to the acromioclavicular joint, such as post-traumatic arthritis and osteolysis, a direct superior approach is useful as it avoids violation of the uninvolved subacromial bursa and glenohumeral joint.[12,15,19] Because of this, it is essential that other diagnoses be excluded. Careful physical examination and diagnostic injection of the acromioclavicular joint with local anesthetic is extremely helpful in evaluating patients for surgery.[18]

Adequate bone resection can be obtained arthroscopically as shown in both clinical and cadaveric studies.[12,15,19,31-33] Care should be taken to avoid an uneven resection of bone, which is associated with continued pain after surgery.[12,15,19,31] The amount of bone that needs to be resected has been an area of controversy. At our institution, we routinely resect 4 to 7 mm of distal clavicle and have previously reported satisfactory results with this technique.[12,15,19,31] Auge and Fischer[16] reported satisfactory results with a similar amount of resection in cases of atraumatic osteolysis. In the present study, satisfactory results were obtained with this technique in 93% of the shoulders. In cases of atraumatic osteolysis, all results were

good or excellent. Of the traumatic cases, 83% had good or excellent results. These results compare favorably with those reported for open resections, which range from 68% to 74% in 3 large studies.[4,6,10]

Snyder et al.[23] and Petersson[6] have independently reported that calcifications appear in follow-up radiographs after distal clavicle resection in two thirds of patients at 9-year follow-up.[6,23] These calcifications had no adverse effect on outcome. We did not perform routine radiographs at follow-up visits unless warranted by clinical examination. In our study, there did not appear to be any degradation of operative results with respect to pain relief at latest follow-up, averaging 6.2 years.

All 3 patients with a poor result had a history of trauma to the acromioclavicular joint and preoperative instability. Previous work has shown that patients with prior grade II acromioclavicular separations and subtle acromioclavicular instability have a high failure rate when treated with arthroscopic distal clavicle resection.[12,14,31] Cadaveric studies by Matthews et al.[33] and Branch et al.[32] show that a 5-mm resection is adequate to prevent bony abutment in both rotationally and axially loaded shoulders if the coracoclavicular and acromioclavicular ligaments are intact. That all 3 patients in the current study obtained satisfactory results after an open stabilization procedure suggests that instability was a major contributor to symptoms. As suggested by Branch et al.,[32] instability may cause postoperative symptoms by means of increased tension on the soft tissues of the acromioclavicular joint and trapezius attachment, not by continued bony abutment. This is supported by the fact that the presence of instability can also produce unsatisfactory results in open procedures where a larger resection is performed.[12,14,31]

It can be difficult to determine whether pain after a history of trauma to the acromioclavicular joint is caused by osteolysis of the distal clavicle or by subtle instability. Therefore, a careful assessment of acromioclavicular stability is mandatory before recommending surgery. This should include translation testing of the distal clavicle in the anteroposterior and superoinferior planes, as well as careful scrutiny of preoperative radiographs for evidence of prior low-grade acromioclavicular separation. In this setting, arthroscopic distal clavicle resection is a reasonable initial treatment option with low morbidity. However, the patient should be warned that open stabilization of the acromioclavicular joint may be necessary should pain continue after arthroscopic resection of the distal clavicle.

CONCLUSIONS

Arthroscopic distal clavicle resection using a direct superior approach resulted in no or mild pain at long-term follow-up and good to excellent results in 93% of shoulders in our study. This is compared with 98% of shoulders that had moderate or severe pain before surgery. This procedure is an effective treatment for symptomatic osteolysis of the distal clavicle.

REFERENCES

1. Mumford EB. Acromioclavicular dislocation: A new operative treatment. *J Bone Joint Surg Am* 1941;23:799-801.
2. Gurd FB. The treatment of complete dislocation of the outer end of the clavicle: A hitherto undescribed operation. *Ann Surg* 1941;63:1094-1098.
3. Slawski DP, Cahill BR. Atraumatic osteolysis of the distal clavicle: Results of open surgical excision. *Am J Sports Med* 1994;22:267-271.
4. Escola A, Santavirta S, Viljakka T, Wirta J, Partio E, Hoikka V. The results of operative resection of the lateral end of the clavicle. *J Bone Joint Surg Am* 1996;78:584-587.
5. Grimes DW, Garner RW. The degeneration of the acromioclavicular joint: Treatment by resection of distal clavicle. *Orthop Rev* 1980;9:41-44.
6. Petersson CJ. Resection of the lateral end of the clavicle: A 3 to 30 year follow-up. *Acta Orthop Scand* 1983;54:904-907.
7. Taylor GM, Tooke M. Degeneration of the acromioclavicular joint as a cause of shoulder pain. Proceedings and reports of the Candian Orthopaedic Association. *J Bone Joint Surg Br* 1977;59:507.
8. Worcester JN, Green DP. Osteoarthritis of the acromioclavicular joint. *Clin Orthop* 1968;58:69-73.
9. Murphy OB, Bellamy R, Wheeler W, Brower TD. Post-traumatic osteolysis of the distal clavicle. *Clin Orthop* 1975;109:108-114.
10. Cook FF, Tibone JE. The Mumford procedure in athletes: An objective analysis of function. *Am J Sports Med* 1988;16:97-100.
11. Wagner CJ. Partial claviculectomy. *Am J Surg* 1953;85:259-265.
12. Flatow EL, Duralde XA, Nicholson GP, Pollock RG, Bigliani LU. Arthroscopic resection of the distal clavicle with a superior approach. *J Shoulder Elbow Surg* 1995;4:41-50.
13. Gartsman GM, Combs AH, Davis PF, Tullos HS. Arthroscopic acromioclavicular joint resection: An anatomical study. *Am J Sports Med* 1991;19:2-5.
14. Gartsman GM. Arthroscopic resection of the acromioclavicular joint. *Am J Sports Med* 1993;21:71-77.
15. Bigliani LU, Nicholson GP, Flatow EL. Arthroscopic resection of the distal clavicle. *Orthop Clin* 1993;24:133-141.
16. Auge WK, Fischer RA. Arthroscopic distal clavicle resection for isolated atraumatic osteolysis in weight lifters. *Am J Sports Med* 1998;26:189-192.
17. Cahill BR. Osteolysis of the distal part of the clavicle in male athletes. *J Bone Joint Surg Am* 1982;64:1053-1058.
18. Neer CS II. Less frequent procedures. In: *Shoulder reconstruction*. Philadelphia: WB Saunders, 1990;421-486.
19. Flatow EL, Cordasco FA, Bigliani LU. Arthroscopic resection of the outer end of the clavicle from a superior approach: A critical, quantitative, radiographic assessment of bone removal. *Arthroscopy* 1992;8:55-64.
20. Henry MH, Liu SH, Loffredo AJ. Arthroscopic management of the acromioclavicular joint disorder: A review. *Clin Orthop* 1995;316:276-283.

21. Tolin BS, Snyder SJ. Our technique for the arthroscopic Mumford procedure. *Orthop Clin North Am* 1993;24:143-151.
22. Kay SP, Ellman H, Harris E. Arthroscopic distal clavicle excision: Technique and early results. *Clin Orthop* 1994;301:181-184.
23. Snyder SJ, Banas MP, Karzel RP. The arthroscopic Mumford procedure: An analysis of results. *Arthroscopy* 1995;11:157-164.
24. Brown AR, Weiss R, Greenberg CP, Flatow EL, Bigliani LU. Interscalene block for shoulder arthroscopy: Comparison with general anesthesia. *Arthroscopy* 1993;9:295-300.
25. Pollock RG, Brown AR, Flatow EL, Bigliani LU. Regional anesthesia for shoulder arthroscopy: The interscalene block. *Cont Orthop* 1993;26:452-457.
26. Skyhar MJ, Altchek DW, Warren RF, Wickiewicz TL, O'Brien SJ. Shoulder arthroscopy with the patient in the beach-chair position. *Arthroscopy* 1988;4:256-259.
27. Post M, Bigliani LU, Flatow EL, Pollock RG. *The shoulder: Operative technique.* Baltimore: Williams & Wilkins, 1998;246-249.
28. Ellman H. Arthroscopic subacromial decompression: Analysis of one to three year results. *Arthroscopy* 1987;3:173-181.
29. Esch JC, Ozerkis LR, Helgager JA, Kane N, Lilliot N. Arthroscopic subacromial decompression: Results according to the degree of rotator cuff tear. *Arthroscopy* 1988;4:241-249.
30. Johnson LL. *Diagnostic and surgical arthroscopy.* St. Louis: CV Mosby, 1981.
31. Levine WN, Barron OA, Yamaguchi K, Pollock RG, Flatow EL, Bigliani LU. Arthroscopic distal clavicle resection from a bursal approach. *Arthroscopy* 1998;14:52-56.
32. Branch TP, Burdette HL, Shahriari AS, Carter FM, Hutton WC. The role of the acromioclavicular ligaments and the effect of distal clavicle resection. *Am J Sports Med* 1996;24:293-297.
33. Matthews LS, Parks BG, Pavlovich LJ, Guidice MA. Arthroscopic versus open distal clavicle resection: A biomechanical analysis on a cadaveric model. *Arthroscopy* 1999;15:237-240.