

## Complications After Open Distal Clavicle Excision

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**Abstract** Isolated distal clavicle excision performed as an open procedure has been considered safe and, in the literature, has been considered the standard for comparison with arthroscopic distal clavicle excisions. However, we noticed isolated open distal clavicle excision was associated with a number of complications. We therefore raised two questions about the complication rate in a cohort of our patients who had undergone this procedure: (1) What was the complication rate and how did it compare to that in the existing literature on this subject? and (2) Were the complications in our cohort similar to those previously reported? We studied 42 patients who underwent an isolated distal clavicle excision between 1992 and 2003. There were 27 complications (64%), which was substantially higher than rates previously reported. Complications in our cohort not previously reported included continued acromioclavicular joint tenderness and scar hypertrophy. Our study suggests complications after open distal clavicle

excisions may be more frequent than and may differ from previously reported rates and types.

**Level of Evidence:** Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

### Introduction

Excision of the distal clavicle is a common procedure for treating various disorders of the acromioclavicular (AC) joint for which nonoperative treatment fails to relieve symptoms. Distal clavicle excision has been used to treat AC arthritis [13, 14, 29, 36], osteolysis of the distal clavicle [4, 5, 31], and painful instability of the distal clavicle [8, 9, 15, 16, 23, 24, 30]. This procedure also has been used as an adjunct to acromioplasty for patients with symptomatic impingement disease [17, 21, 25].

This procedure has been reported to have a high level of patient satisfaction, and long-term studies generally have reported a high rate of good to excellent results. In a review of the English literature, we found very few complications with this procedure, whether it was performed by open [4, 7, 8, 10, 14, 15, 23, 26, 28–31, 33, 35, 36] or arthroscopic [1, 3, 10–12, 18, 20, 32, 34, 37] methods. However, we noticed isolated open distal clavicle excision was associated with several complications, such as a stiff shoulder, infection, and prolonged local tenderness, which had not been reported as frequently associated with this procedure.

We sought the answers to two questions: (1) Would the complication rate in patients undergoing isolated distal clavicle excision be higher in our cohort of patients than in the patient series previously reported in the literature? and (2) Did the complications in our cohort of patients differ from those previously reported in the literature?

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The authors have no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent was obtained.

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## Materials and Methods

We first performed a literature search via PubMed of all articles published in the English literature with the key words acromioclavicular joint, complications, or distal clavicle excision. We excluded articles that presented surgical technique alone, and we did not limit the use of an article based on variables such as randomization, prospective nature, or level of evidence. We found 17 articles reporting on open distal clavicle excision and 10 articles reporting on arthroscopic distal clavicle excision. From each of these 27 articles, we identified the types of complications and the complication rates to compare with those in our group.

To answer the question about the types of complications and the frequency seen in our practice, we retrospectively reviewed the medical records of patients identified from the senior author's (EGM) practice database, which includes 700 patients who underwent shoulder surgery from 1992 to 2002. Of those 700 patients, 197 patients had undergone distal clavicle excisions, 42 of whom had isolated distal clavicle excision. We excluded 155 patients who had distal clavicle excisions in conjunction with an open or arthroscopic acromioplasty. We limited this study to isolated distal clavicle excision because many patients who undergo combined distal clavicle excision and partial acromioplasty may have complications related to the partial acromioplasty, which would have confounded our analysis. The indications for isolated distal clavicle excision procedures were arthritis ( $n = 39$  [93%]), osteolysis of the distal clavicle ( $n = 2$  [5%]), or pain after an AC separation ( $n = 1$  [2%]). No patient had an abnormal contralateral shoulder. Among the 42 patients there were 28 men and 14 women with an average age of 44 years (range, 21–70 years).

The dominant arm was involved in 22 (52%) patients. Twenty-five (60%) patients were involved in sports; 10 (24%) of those patients participated in an overhead sport such as baseball, volleyball, swimming, or football. Before surgery, all patients had completed a questionnaire providing information on demographics, presence of an injury, mechanism of injury, and participation in sports [19, 22]. All patients had preoperative radiographs (obtained by us or others). The final diagnosis and decision for surgery were based on history, physical examination [6], radiographic findings, and the results of a diagnostic injection. We specifically reviewed the medical records of the patients for complications associated with an isolated distal clavicle excision, ie, infection, neurologic deficit, hypertrophic scar, and continued pain and tenderness over the AC joint region. The minimum followup was 1 month (mean, 16 months; range, 1–77 months). The goal of our study was to document short-term complications. The length of followup can be grouped as follows: < 3 months,

9 patients; 3 to 6 months, 3 patients; > 6 months, 30 patients. We did not specifically contact patients for followup, and patients were not followed at specific intervals after surgery.

The physical examination findings to support the diagnosis of symptomatic AC joint abnormality included local tenderness ( $n = 42$  [100%]), a positive crossed-arm stress test ( $n = 36$  [86%]), a positive active compression test for AC joint abnormality (12 of 19), or a positive arm-extension test (13 of 23). We had not used the active compression test and the extension test for AC joint abnormality for all patients because some of our patients were examined before the publication of the descriptions of those tests [6, 16]. In 37 patients (88%), diagnostic injections of local anesthetic were used by us or others to confirm the diagnosis. In the remaining patients, the diagnosis was based on the physical examination and radiographic findings alone. To rule out intraarticular causes of pain, particularly superior labrum injuries or rotator cuff abnormalities, all patients had preoperative diagnostic arthroscopy. We completed a standardized intraoperative data sheet for each patient. Several studies [2, 27] suggest diagnostic arthroscopy is indicated for patients with AC joint symptoms because superior labrum anterior and posterior lesions and AC joint conditions may cause similar symptoms.

All operative procedures were performed or directly supervised by the senior author (EGM). All patients were given intravenous antibiotics within 1 hour of their operative procedure. The distal clavicle excisions were performed with an arthrotomy rather than via arthroscopic techniques because the surgeon believed arthrotomy was the more efficient procedure and that an open technique makes verification of the amount of bone removed more accurate. Patients were given a first-generation cephalosporin, and if they were allergic to these medications, they were given either clindamycin or vancomycin preoperatively. No patient was given antibiotics in the immediate postoperative period (ie, while in the recovery room) or after discharge from the hospital. The arthroscopy and distal clavicle excision were performed with the patient in a lateral decubitus position. Traction on the arm was removed after the arthroscopy, and the arm was placed at the side. A 1-inch incision was made over the AC joint parallel to the skin lines. The AC joint was identified, and the periosteum and joint capsule were split in line with the distal clavicle. Anterior and posterior periosteal and capsular flaps were developed, and the distal clavicle was exposed circumferentially. A periosteal elevator was placed on the inferior aspect of the distal clavicle, and the distal 1 cm was removed with an oscillating saw. To avoid destabilizing the distal clavicle, care was taken to remove no more than 1 cm. Any sharp or rough edges were

débrided with a rongeur. With the surgeon's finger in the created defect, the arm was adducted across the body to make sure no impingement occurred between the distal clavicle and acromion process. The fascia and periosteum then were closed tightly with absorbable sutures.

Postoperatively the arm was placed in a simple sling, and the patient was discharged home the same day with instructions to begin pendulum exercises when comfortable, use the arm as tolerated, not to lift anything heavier than a coffee cup, and not to get the wound wet for 5 days after surgery. Physical therapy did not begin until after the first postoperative visit (7–10 days after surgery). At that time, physical therapy was scheduled twice a week at an outpatient facility of the patient's choice. The initial goal was to regain the motion of the shoulder, and the therapist was directed to achieve passive and active unlimited range of motion in all directions. Strengthening was not encouraged until 3 to 6 weeks after surgery. At that time, strengthening included isometric and isotonic strengthening exercises with low weights; progression was allowed as tolerated. Athletic activity in sports using the upper extremity was not allowed until 3 months after surgery.

Each patient was seen 7 to 10 days after surgery, at which time we removed the sutures, evaluated the neurologic status, checked the wound, and assessed range of motion. Subsequently, patients were seen at 6 weeks, 3 months, and thereafter as needed. At each office visit, we evaluated shoulder range of motion. Patients were considered to have a stiff shoulder if motion did not equal that of the contralateral extremity by 3 months after surgery.

To analyze the data, we used descriptive statistics and SPSS version 10.0 (SPSS, Chicago, IL) for all analyses. Significance was set at  $p < 0.05$ .

## Results

Complications occurred in 27 of 42 patients (64%). This complication rate was higher than that previously reported in the literature (Table 1).

Our patients had some complications not discussed in the literature, including residual AC joint sensitivity ( $n = 23$ ; 55%), scar sensitivity ( $n = 23$ ; 55%), and hypertrophic scar formation ( $n = 6$ ; 14%).

Infection occurred more frequently in our study than in published series. There were four (10%) infections—three deep (7%) and one superficial (3%). The average time from surgery to the diagnosis of infection was 10 days (range, 8–20 days). In all four patients, the diagnosis was made based on continuous wound drainage. Culture and sensitivity analysis was obtained and, although only two patients had positive cultures, the other two wounds were treated as presumed infections because of their clinical

presentation. Two cultures (two deep infections) grew organisms, methicillin-resistant *Staphylococcus* in one and *Staphylococcus aureus* in the other. The other two cultures (one from the third patient with an apparent deep infection and one from the patient with a superficial infection who 20 days after surgery presented with drainage consistent with a large stitch abscess) failed to grow an organism. The three patients with deep infections were treated with open surgical débridement and intravenous antibiotics for a minimum of 6 weeks. All of the infections resolved after treatment.

Twelve patients (29%) were considered to have a “stiff shoulder.” Of these 12, two patients had infections and one had heterotrophic ossification between the clavicle and the acromion. At the last followup for these 12 patients, the average loss of elevation compared with that of the contralateral shoulder was 25° (range, 10°–50°), loss of external rotation at the side was 10° (range, 5°–15°), and loss of internal rotation up the back was seven spinal levels (range, 4–16 spinal levels). At the last followup, 23 patients (55%) had AC joint region tenderness. Two patients (5%) had to change their jobs because of the constant aching of the shoulder and the inability to work overhead after surgery.

## Discussion

We sought to answer two questions about the complication rate in a cohort of our patients who had undergone open distal clavicle excision: (1) What was the complication rate and how did it compare to that in the existing literature on this subject? (2) Were the complications in our cohort similar to those previously reported? We found a higher complication rate for isolated distal clavicle excisions than had previously been reported in the literature (Tables 1, 2). We also found several complications not previously reported in the literature, such as patient dissatisfaction with the scar and continued local tenderness at the AC joint area postoperatively.

All patients were treated and evaluated by one surgeon (EGM), had the same surgical technique, and were examined carefully at each followup office visit. However, we did not follow these patients with standard outcome measures, so the influence of these complications on patient function and satisfaction is unknown. These findings are also limited by the fact that the study was retrospective, there was no control group, the cohort was limited to patients with isolated distal clavicle excisions, and the followup was short (minimum followup, 1 month). It is possible that the patients who were followed for less than 6 months or 1 year had no additional problems, but it is equally possible they sought treatment elsewhere for

**Table 1.** Studies of isolated open distal clavicle excision

Study (year)	Number of patients (procedures)	Diagnosis	Average followup	Average age (years)	Success (%)	Complications					Total (%)
						Infection	Pain or weakness	Stiff shoulder	Other		
Blazar et al. [3] (1998)	9	AC joint pain	NA	NA	94	NS	NS	NS	NS	NS (NA)	
Gürbüz et al. [14] (1998)	7	AC arthritis + impingement	NS	NS	100	0	0	0	0	0 (0)	
Jacob and Sallay [16] (1997)	18	AC arthritis	3 months	NS	94	NS	NS	NS	NS	NS (NA)	
Eskola et al. [8] (1996)	73	33 arthritis; 32 AC separation; 8 lateral-end clavicle	9 years	43	69	0	0	16	0	16 (21.9)	
Novak et al. [26] (1995)	21 (23)	AC joint pain (arthritis, osteolysis)	2.7 years	36	78	0	0	0	0	0 (0)	
Petchell et al. [28] (1995)	18	10 arthritis; 8 osteolysis	3 years	38	72	0	0	0	2 widened scar	2 (11)	
Slawski and Cahill [31] (1994)	14 (17)	Osteolysis distal clavicle	2 years	28	100	0	0	0	0	0 (0)	
Flatow et al. [10] (1992)	6	Osteolysis	30 months	27	50	0	0	0	2 skin numbness; 1 keloid	3 (50)	
Cook and Tibone [7] (1988)	23	AC separation (Grades I and II)	3.7 years	33	96	1	4	0	0	5 (21.7)	
Petersson [29] (1983)	50 (51)	34 traumatic group; AC degenerative arthritis	9 years	44	75	0	4	0	3 painful scars; 3 nonpainful indurated scars	10 (20)	
Cahill [4] (1982)	19 (23)	Osteolysis	> 2 years	23	86	0	0	0	3 no return to competitive sports but no pain	3 (13)	
Taylor and Tooke [33] (1977)	20	AC degenerative arthritis	NS	NS	90	NS	NS	NS	NS	NS (NA)	
Worcester and Green [36] (1968)	56	AC degenerative arthritis	4.5 years	54	100	0	0	0	0	0 (0)	
Sage and Salvatore [30] (1963)	13	AC separation	26 weeks	39	85	0	2	0	0	2 (15)	
Wagner [35] (1953)	44	22 AC separation; 12 arthritis; 10 others	3.6 years	NS	85	0	0	0	0	0 (0)	
Mumford [23] (1941)	4	Chronic AC separations	5 weeks	37	100	0	0	0	0	0 (0)	
Gurd [15] (1941)	2	AC separations	1.5 years	28	100	0	0	0	0	0 (0)	

AC = acromioclavicular; NS = no statement; NA = data not available.

**Table 2.** Results of arthroscopic distal clavicle excision

Study (year)	Number of patients (procedures)	Diagnosis	Average followup	Average age (years)	Success (%)	Complications				Total (%)
						Infection	Pain or weakness	Stiff shoulder	Other	
Lesko [20] (2001)	18	Impingement	NS	NS	100	0	0	6	0	6 (33.3)
Zawadzky et al. [37] (2000)	37 (41)	AC joint pain	6.2 years	39	93	0	0	0	0	0 (0)
Blazar et al. [3] (1998)	(8)	AC joint pain	NA	NA	74	0	0	0	0	0 (0)
Auge and Fischer [1] (1998)	8	Osteolysis	18.7 months	30	100	0	0	0	0	0 (0)
Flatow et al. [11] (1995)	41	16 osteoarthritis; 13 osteolysis; 8 AC separation	31 months	32	83	0	0	0	1 reflex sympathetic dystrophy	1 (2.4)
Snyder et al. [32] (1995)	46 (50)	AC joint pain	2 years	42	98	0	3	0	1 biceps tendonitis; 1 painful sensation	5 (10)
Kay et al. [18] (1994)	8	AC joint pain	14 months	44	100	0	0	0	0	0 (0)
Tolin and Snyder [34] (1993)	23	AC joint pain	25 months	39	96	0	0	0	0	0 (0)
Gartsman [12] (1993)	20	AC arthritis	29 months	51	85	1	0	0	0	1 (5)
Flatow et al. [10] (1992)	6	Osteolysis	30 months	27	100	0	0	0	0	0 (0)

AC = acromioclavicular; NS = no statement; NA = data not available.

complications. In the absence of long-term followup, the findings of our study should be interpreted with caution.

Other factors may have contributed to the higher complication rate described here using this technique. Our patient population may have differed from those in other studies, particularly because our study includes patients with a wide variety of diagnoses. Several studies [10, 12, 31, 36] have reported results of patient populations with only one diagnosis related to the AC joint, such as osteolysis only or degenerative arthritis only. Similarly, our patient population may reflect the referral nature of the senior author's (EGM) practice, and our findings may not be extrapolated to the practice of other surgeons. Anatomic studies have shown the ligaments that are the primary stabilizers for anteroposterior stability are the AC ligaments [4, 12]. However, although we did not remove more than 1 cm of bone at the time of surgery, distal clavicular instability could have been present in some patients. It should be realized the goals of our study were to evaluate the prevalence and variety of complications in the short term after surgery, and that longer followup is needed to determine the long-term effect of such complications on patient satisfaction and function.

Although other studies have documented stiffness as a complication of distal clavicle excision [8, 21], our rate (29%) differed from that reported elsewhere. For example, Eskola et al. [8] reported 21% of their cohort of 73 patients had stiffness at an average followup of 9 years. There may be several reasons for this variable incidence. First, our postoperative regimen may have differed from that of previous studies. It is difficult to determine whether a difference exists because most studies provide few details about the exact postoperative protocols, which might have influenced the rate of postoperative stiffness in their cohorts. Second, we did not consistently order formal outpatient physical therapy for our patients, which may have resulted in a higher prevalence of stiffness than in other studies. Lastly, given our short followup time, it is possible some patients had substantial improvement in range of motion or recovered fully over a longer period of time.

We observed hypertrophic scar formation in six patients (14%). In four of our patients, the scar was normal and did not represent any problems. However, in two female patients (4.8%), the scar was painful and lumpy. Because the postoperative scar is located in a readily visible area, the cosmetic needs of the patients may need to be considered in the operative approach. To minimize this complication, we recommend making the incision in line with the skin lines in a bayonet fashion and not in line with the long axis of the clavicle.

We found local tenderness at the AC joint region after this procedure may be prolonged and may take months to

resolve. Of the 23 patients (55%) who had AC joint region tenderness, this complication was recorded at 2 months after surgery in 10 patients and after 2 months of followup in 13 patients (range, 2–12 months). Our patients reported local sensitivity or tenderness over the incision that awakened them at night if they rolled over on the shoulder and often was aggravated by carrying objects such as a backpack or purse over their shoulders. It is unknown if this complication is secondary to scar formation, sensitivity of the prominent end of the clavicle, subclinical neuroma in the scar, or some other cause.

Our review suggests that complications after distal clavicle excision vary widely in the literature. When an open distal clavicle excision is performed, the clinician should be aware of the potential for complications, including infection, stiffness, continued AC joint sensitivity, and scar hypertrophy. The high complication rate in our patients may reflect short-term followup. Additional followup is warranted to determine the long-term consequences of these complications. Finally, a prospective, randomized study is warranted to compare different surgical techniques, and future studies should include the complications described here.

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