Acromial Fracture After Reverse Shoulder Arthroplasty

Nady Hamid, MD, Patrick M. Connor, MD, James F. Fleischli, MD, and Donald F. D'Alessandro, MD

Abstract

In this article, we report on our experience with patients who sustained a fracture of the acromion after reverse shoulder arthroplasty (RSA), and on the results of a comprehensive survey regarding this complication—a survey of American Shoulder and Elbow Surgeons (ASES) members.

Patients were assessed with radiographs and validated functional outcome measures. Eight (4.9%) of the 162 patients that underwent RSA had radiographic evidence of postoperative fracture of the acromion. Mean active forward elevation was 71°, and mean ASES score was 70. Four patients reported no pain; 2 had mild pain; 1 had moderate pain; and 1 patient had severe pain. Six of the 8 fractures did not unite.

Survey results showed that 74% of ASES respondents treated these patients nonoperatively and that 53% of respondents thought that acromial fractures after RSA led to reduced shoulder function, but without persistent pain.

The natural history of nonoperative management is characterized by reduced global shoulder function and a high rate of nonunion. However, most of the patients who experienced this complication did not report chronic pain. Given these patients' outcomes, and the surveyed opinions of ASES members, conservative management is a reasonable option for this complication.

Reverse shoulder arthroplasty (RSA) has gained wide popularity and has revolutionized management of complex shoulder pathology. Early and midterm clinical results have been encouraging.[1-6] However, postoperative complications (such as instability, infection, and periprosthetic fracture) are of concern, as they leave few salvage options.[7] One such complication is postoperative fracture of the acromion or scapular spine. As the disease of cuff tear arthropathy evolves, acetabularization of the humeral head into the acromion can significantly weaken the acromion.[1] In addition, tensioning of the deltoid during surgery can place even more stress on this weakened bone and lead to postoperative fracture of the acromion in this elderly and often osteoporotic patient population. Acromial fracture can have potentially disastrous consequences, as the acromion is the primary site of origin for the deltoid muscle, which is a key element in the function of the reverse prosthesis.[1,8,9] Walch and colleagues[10] reported 4 patients with postoperative fracture of the acromial spine in a series of 457 patients who underwent RSA. These patients had persistent pain and dysfunction and were dissatisfied with their outcomes. On the other hand, Frankle and colleagues[7] reported on 2 cases of sustained postoperative acromial fractures, which appeared not to hinder clinical outcomes. As a result, the specifics, natural history, and optimal management of this complication remain unclear.

In this article, we report on our experience with patients who sustained a post-RSA fracture of the acromion and on the results of a comprehensive survey regarding this complication—a survey of American Shoulder and Elbow Surgeons (ASES) members. Our hypothesis was that post-RSA acromial fractures lead to nonunion and inferior clinical performance.

Materials and Methods

After obtaining investigational review board approval, we retrospectively reviewed our institution's cases of post-RSA fracture of the acromion. Between January 2004 and March 2007, 173 patients (118 female, 55 male) underwent RSA. Indications for RSA included cuff tear arthropathy or irreparable rotator cuff tear (118), fracture (35), and revision arthroplasty (20). Clinical and radiographic follow-up (mean, 14 months; range, 9-66 months) was available for 162 of the 173 patients. All procedures were performed by the senior authors (P.M.C and D.F.D) through an anterior deltopectoral approach using the Aequalis Reverse Shoulder Prosthesis (Tornier, Edina, Minnesota) or the Zimmer Trabecular Metal Reverse Shoulder System (Zimmer, Warsaw, Indiana). Polyethylene spacers of various sizes were used; in each case, the largest spacer that did not excessively tension the soft tissues was inserted. After surgery, patients were placed in an abduction sling. There was no formal physical therapy. Active forward elevation (AFE) of the shoulder was restricted for 4 to 6 weeks after surgery, followed by a gradual advance in activities.

Dr. Hamid, Dr. Connor, Dr. Fleischli, and Dr. D'Alessandro are Orthopaedic Surgeons, Sports and Shoulder/Elbow Center, OrthoCarolina, Charlotte, North Carolina.

Address correspondence to Nady Hamid, MD, Department of Orthopaedic Surgery, Washington University Orthopedics, 660 S. Euclid Ave, Campus Box 8233, St. Louis, MO 63110, (tel, 704-323-5000 ; fax, 704-355-7902; e-mail, nady_hamid@hotmail.com).

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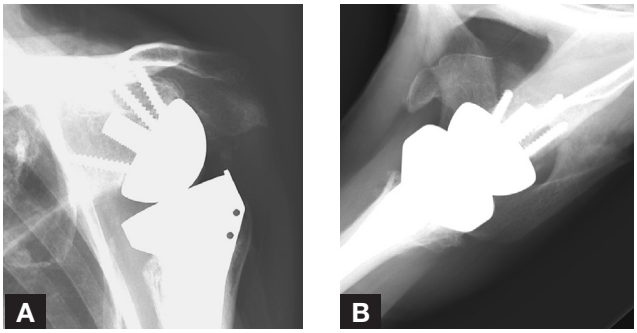

Figure 1. Anteroposterior (A) and axillary (B) radiographs show postoperative fracture of acromion after reverse shoulder arthroplasty.

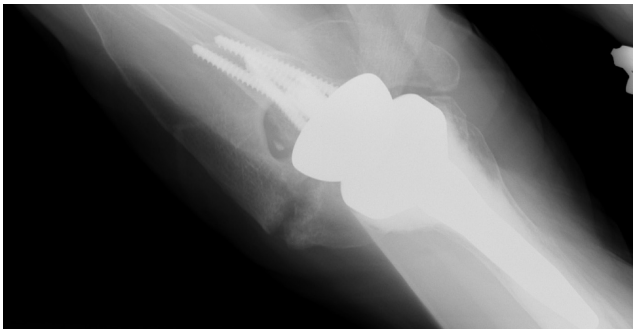

Figure 2. Nonunion of acromial fracture.

All radiographs were reviewed to identify patients who sustained a post-RSA fracture of the acromion or scapular spine. Patients with preoperative acromial insufficiency (os acromiale, acromial fracture) were excluded. Patients who sustained an acromial fracture after surgery were asked to return for reassessment with standardized functional outcome measures, including the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire; the ASES Shoulder Assessment; and a measure of general well-being, the 12-item Short Form Health Survey (SF-12).[11-13] Plain anteroposterior, lateral, and axillary radiographs were obtained at time of reassessment.

Of the 162 patients, 8 (4.9%) sustained a post-RSA fracture of the acromion (Table, Figure 1). All 8 were elderly women (mean age, 76.3 years; range, 63-91 years). Six of these 8 patients had a diagnosis of osteoporosis. Indications for RSA were cuff tear arthropathy (7) and irreparable rotator cuff tear (1). One patient sustained a fall directly on her shoulder, and 1 was in a motor vehicle collision. The other 6 patients experienced an acute increase in shoulder pain and limited mobility with no history of trauma. All 8 patients were treated nonoperatively, with immobilization in an abduction sling and gradual return to activities as symptoms permitted. Final outcome assessment was performed a mean of 35 months (range, 16-51 months) after surgery.

To better appreciate the international standard of care and current trends in the management of post-RSA acromial fractures, we electronically sent a survey to all active ASES members. This brief, 7-question survey focused on respondents' preferred treatment and on their opinions concerning the natural history of post-RSA acromial fractures that are managed nonoperatively.

Results

Clinical and radiographic results are listed in the Table. Overall, mean AFE was 71°, and mean ASES score was 70. At reassessment, 4 patients reported no pain; 2, mild pain; 1, moderate pain; and 1, severe pain. Most recent radiographs showed that 6 of the 8 fractures failed to unite with distraction at the fracture site (Figure 2), and the other 2 fractures healed with significant inferior tilt to the acromion (Figure 3). Of the 8 fractures, 4 occurred at the base of the scapular spine (mean AFE, 66°; mean ASES score, 60), 3 at the midacromion or mesoacromion (mean AFE, 55°; mean ASES score, 74), and 1 at the lateral acromion or preacromion (AFE, 140°; ASES score, 97).

Fifty-four ASES members (18%) responded to the electronic survey. The majority (61.5%) had encountered this complication within their practice, and most (75%) had treated their patients nonoperatively (Figure 4).

Table. Patient Characteristics and Results

Pt[a]	Age, y	Osteoporosis	Size of Polyethylene Spacer, mm	Time to Fracture, mo	Fracture Location	Fracture Healing	AFE,°	Pain	Measure Scores			
									DASH	ASES	SF-12 Mental	SF-12 Physical
1	87	Yes	12	3	Midacromion	Nonunion	50	Mild	20	98	62	43
2	82	No	9	2	Midacromion	Nonunion	65	Moderate	65	28	62	21
3	87	Yes	9	38	Base	Nonunion	90	None	32	93	61	43
4	91	Yes	12	5	Base	Malunion	40	Severe	77	24	35	25
5	69	Yes	12	2	Base	Nonunion	65	Mild	58	49	56	43
6	63	Yes	9	48	Midacromion	Nonunion	50	None	23	95	45	53
7	63	No	12	13	Base	Malunion	70	None	58	73	62	41
8	68	Yes	15	2	Lateral	Nonunion	140	None	5	97	60	44

Abbreviations: AFE, active forward elevation; ASES, American Shoulder and Elbow Surgeons Shoulder Assessment; DASH, Disabilities of the Arm, Shoulder, and Hand questionnaire; SF-12, 12-item Short Form Health Survey.

[a]All 8 patients were women.

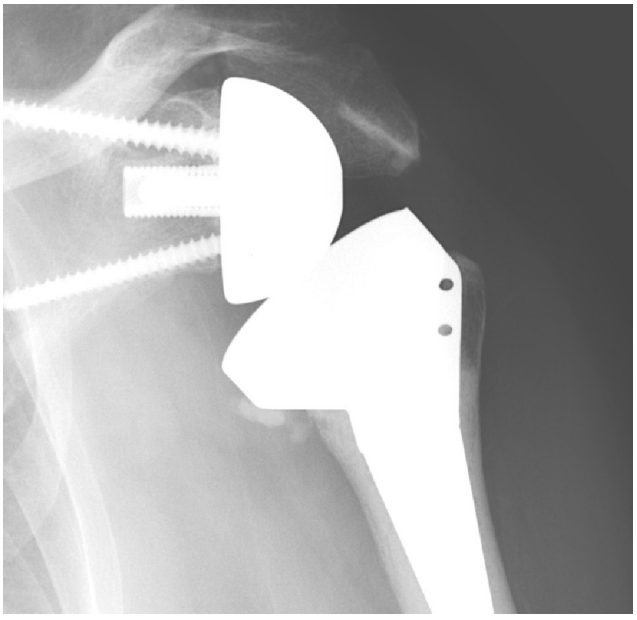

Figure 3. Malunion of acromial fracture with inferior tilt.

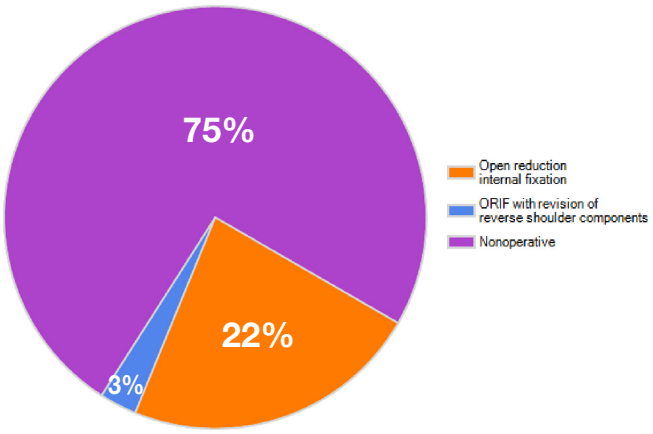

Figure 4. American Shoulder and Elbow Surgeons survey results: "How have you treated patients who sustained an acromial fracture after reverse shoulder arthroplasty?"

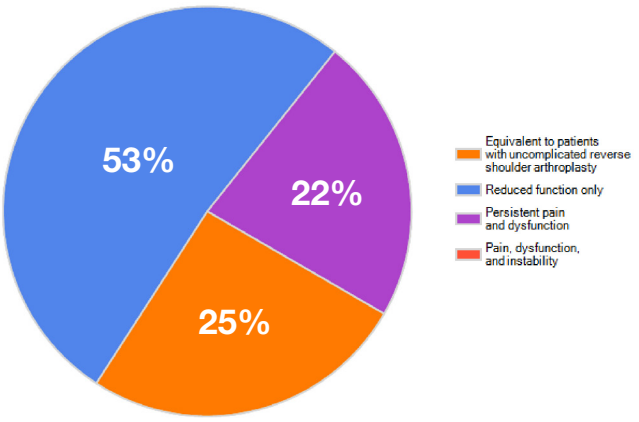

Figure 5. American Shoulder and Elbow Surgeons survey results: "What has been your experience with the clinical outcome of patients sustaining an acromial fracture after reverse shoulder arthroplasty?"

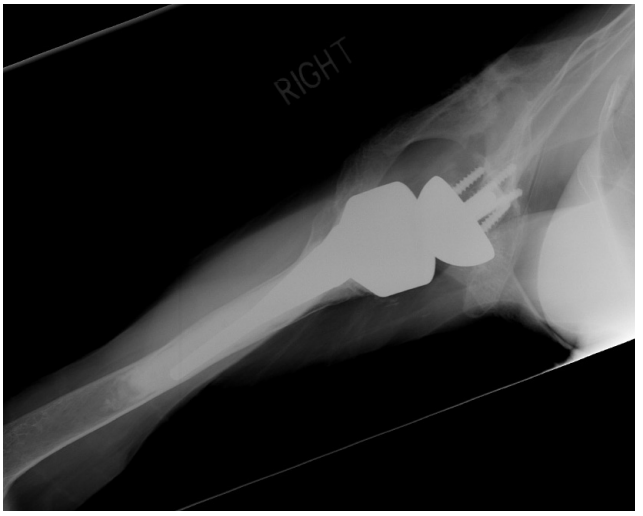

Figure 6. Fracture of acromion at base of scapular spine after reverse shoulder arthroplasty.

Fifty-three percent of respondents had seen post-RSA acromial fractures lead only to reduced function (Figure 5). An additional 22% indicated that this complication leads to persistent pain and dysfunction. Interestingly, 25% of respondents indicated that this complication has no effect on clinical results. Replies to "What has been your experience with healing of the acromial fracture?" were malunion (32.4%), nonunion (29.4%), union (20.6%), and unpredictable (17.6%). Regarding surgical experience, 14.6% of respondents performed 1 to 5 RSAs per year; 16.7% performed 6 to 10 per year; 22.9% performed 11 to 20 per year; 20.8% performed 21 to 40 per year; 18.8% performed 41 to 60 per year; and 6.3% performed more than 60 per year. Respondents used a variety of different RSA systems, manufactured by Tornier (32.1%), Zimmer (17.0%), DePuy (28.3%), DJO (11.3%), Biomet (9.4%), and Exactech (1.9%).

Discussion

RSA has revolutionized our approach to many debilitating shoulder diseases. In the United States, RSA has been available since its approval by the Food and Drug Administration in 2004. Since then, its use and popularity have increased, despite the relative paucity of reports on results and complications. As use of this surgery continues to grow, and its indications broaden, we must highlight its potential complications and their implications for clinical outcomes.

Although acromial fracture is a well-known complication of RSA, few investigators have dedicated reports to it. Walch and colleagues[10] retrospectively reviewed the cases of all patients who underwent RSA at 5 surgical centers in France over an 11-year period to investigate the effect of acromial insufficiency on clinical outcome. Of the 457 patients, 41 had evidence of preoperative acromial insufficiency—os acromiale (23 cases), fatigue

fracture and fragmentation (17), and acromial stress fracture nonunion (1). These 41 patients had equivalent clinical results with respect to motion, Constant score, and their subjective perceptions. However, 4 of the 41 were diagnosed with a postoperative fracture of the acromion or scapular spine within the first year after surgery and were found to have inferior objective and subjective clinical results. Of these patients, 3 had no history of trauma and were treated nonoperatively. The fourth fell and sustained a fracture that was managed with open reduction and internal fixation (ORIF), which failed (the hardware was subsequently removed). Three of the 4 patients were disappointed with their outcomes. Mean AFE for the 4 patients was only 81°, and mean Constant score was only 35. The authors concluded that preoperative acromial insufficiency does not lead to inferior clinical results, but postoperative acromial fracture leads to inferior objective and subjective clinical results.

Frankle and colleagues,[7] in a series of 60 patients with a minimum 2-year follow-up, reported on 2 patients with postoperative acromial fracture. One patient was treated nonoperatively, the other with ORIF. Both recovered uneventfully and were satisfied with their outcomes. Werner and colleagues[6] reported 4 postoperative acromial fractures in a series of 58 patients. Of the 4 patients, 2 underwent ORIF, and 2 of the fractures were managed conservatively. Details regarding clinical outcomes were not provided.

The overall incidence of postoperative acromial fracture in our series was 4.9%. Walch and colleagues[10] reported that 4 (0.9%) of their 457 patients sustained a post-RSA acromial fracture, Frankle and colleagues[7] reported 2/60 (3.3%), and Gerber and colleagues[3] reported 4/58 (6.9%). Patients who undergo RSA have several preexisting factors that place them at high risk for insufficiency fractures. All of our 8 patients were elderly women; 6 of them had osteoporosis, and 7 of them had cuff tear arthropathy with acetabularization of the acromion. These factors, along with an increase in passive tension of the deltoid on the acromion, can lead to fatigue, stress, or complete fracture. Fracture location also may have clinical implications. Medial fractures of the scapular spine (Figure 6) lead to significantly more deltoid incompetence than fractures of the lateral acromion. The expectation is that, when these medial scapular spine fractures fail to unite, there will be a significant loss of arm elevation. Our patients with medial scapular spine fractures had a mean AFE of only 66°. We have limited experience in surgical management of postoperative acromial fractures, but others have advocated surgical management for scapular spine fractures and conservative management for the more lateral acromial fractures.[3]

In our series, the functional status of patients who sustained a post-RSA acromial fracture was significantly altered. The most striking finding was limited AFE. Many of these fractures fail to unite, leaving the deltoid with less of a proximal anchor. Mean AFE in this series was 71°, and mean ASES score was 70. Although we did not have a control group for direct comparison, the clinical outcomes of our patients appear to be significantly inferior to those of other RSA patients reported in the literature.[7,14-18] At our institution, in a prospective series of 62 consecutive post-RSA patients without acromial fracture, mean AFE was 128°, and mean ASES score was 82.[14] It would appear that postoperative acromial fracture leads to inferior clinical outcome, but more studies are needed to determine whether surgical management of this complication results in improved patient outcomes.

The ASES survey results were consistent with our clinical experience. Most respondents encountered the complication and preferred nonoperative management. Although responses varied, 51.6% of respondents thought that this complication leads to reduced long-term function, but without chronic pain or instability. Radiographic evidence of healing also varied, according to survey responses. Not surprisingly, the incidence of nonunion was high, as the deltoid leads to significant distraction at the fracture site. Overall, the survey results and patient outcomes in this case series may be useful to surgeons when discussing this complication and the prognosis with patients.

This case series was limited by its small sample size, relatively short clinical follow-up (mean, 35 months), and lack of control group (no direct comparison of clinical outcomes between patients who sustained a post-RSA acromial fracture and patients who did not). All patients were drawn from a single center in the United States, and all management reflects the experience of 2 surgeons. No patient in this series underwent surgery, so conclusions cannot be drawn regarding the superiority of operative vs nonoperative management. In addition, the survey had a low response rate, accuracy of answers was subject to the recollection of respondents, and the responses given may not adequately reflect the overall experience of the ASES as a whole.

Conclusions

Acromial fracture is a relatively unusual, but significant, complication after RSA. The natural history of nonoperative management is characterized by reduced global shoulder function and a high rate of nonunion. However, most of the patients who experienced this complication did not report persistent pain. Given these patients' outcomes, and the surveyed opinions of ASES members, conservative management is a reasonable option for this complication.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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