

Case Report

Successful treatment of fractures of the base of the acromion after reverse shoulder arthroplasty: Case report and review of the literature

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ABSTRACT

Fractures of the acromion and scapula are known to occur after reverse shoulder arthroplasty. We present a case of a fracture at the base of the acromion 5 months after arthroplasty treated successfully with dual plating of the acromion. Eighteen months after fracture fixation, the patient had 160 degrees of active forward flexion, a QuickDASH of 29.5, a Constant score of 69 and she was satisfied with the result. A concomitant review of the literature produced, in addition to our patient, 56 cases. These were used to produce a classification system, based on bony and functional anatomy as follows. Tip fractures are of the most lateral or anterior portion of the acromion, those of the body of the acromion are medial to the tip but lateral to the beginning of the scapular base. Fractures at the scapular base are termed fractures of the base of the acromion and those more medial to that, fractures of the scapular spine. The functional results of these case series demonstrated poorer functional outcomes for more medial fractures. As future research in this domain increases, clarity on the nomenclature of these fractures will allow for prognostication and treatment based on fracture location as well as comparison between studies.

Key words: Acromial fracture, post-operative complication, reverse shoulder arthroplasty, scapular fracture

INTRODUCTION

Reverse shoulder prosthesis is an excellent surgical option for patients with certain shoulder pathologies, of which rotator cuff arthropathy is one.^[1-3] This is a procedure whose indications and surgical techniques are currently evolving. One area where we are gaining a greater understanding is that of managing acromial pathology. Recent studies are showing that not all acromial pathology is a contraindication to reverse shoulder arthroplasty; in both pre- and post-operative patients, small lateral fractures of the acromion can be treated non-operatively or fixed surgically with a tension band technique.^[4-6] Overall, results comparable to that of reverse arthroplasty can be achieved with either of these treatment options.

However, fractures at the base of the acromion or of the scapular spine present a different problem.^[7,8] In these types of fractures, a larger length of deltoid muscle is detached, and therefore defunctioned. In reverse shoulder arthroplasty, in order to achieve a stable shoulder, the deltoid must be tensioned a great deal. This in turn causes a deforming force and distraction at the fracture site, making for a poor healing potential. Also, as the reverse shoulder prosthesis relies on the deltoid muscle to move the arm, if the deltoid is detensioned or improperly tensioned, this will lead to poor functional capacity.^[9]

We present a case of treatment of a fracture at the base of the acromion using a 90/90 plating construct that healed in a good position. We also present a review of the literature.

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CASE REPORT

A 71-year-old right-handed woman presented with a 2-year history of right shoulder pain and dysfunction, which began abruptly when lifting a heavy load. At the initial evaluation, her range of motion was limited, particularly in active abduction as she achieved only 45 degrees in this plane. A cuff arthropathy (Hamada grade 3) was diagnosed and the decision was taken to proceed with reverse shoulder arthroplasty. To complete the pre-operative assessment, a CT scan was performed which confirmed there was no acromial pathology involved.

A reverse shoulder prosthesis and a biceps tenodesis was carried out (Delta Xtend™, Depuy, Warsaw, IN, USA) through a deltopectoral approach [Figure 1]. The patient's right arm was immobilized in a sling and the range of motion exercises were started 6 weeks after arthroplasty [Figure 1a]. Five months after surgery, she sustained a blow to the right shoulder but sought medical attention 1 month later, at her scheduled follow-up visit. Radiographs showed a displaced fracture at the base of the acromion [Figure 1]. A CT scan was performed to better characterize the fracture. This showed that both the humeral and glenoid components were well fixed and the only pathology was the fracture.

She was taken to the operating room and her previous incision was extended into a "sabre" incision to better expose the acromion. Two small fragment (3.5 mm) locking plates (Synthes, West Chester, PA, USA) were used in a 90°/90° configuration; one was a fragment specific clavicular plate and the other a reconstruction plate. The fragment specific clavicular plate was applied on the superior edge of the scapular spine in a compression mode. Distally, 2.7 mm locking screws were used. A second reconstruction plate was applied from the posterior acromion to the posterior cortex of the scapular spine, in the infraspinatus fossa. Long screws were placed from

the posterior to the anterior acromion. Fixation was solid, but in order to protect the construct, the patient was placed in an abduction brace for 6 weeks.

Eighteen months after fracture fixation, the patient was satisfied with the clinical result [Figure 2]. She was capable of 125 degrees of abduction, 160 degrees of forward flexion, 85 degrees of external rotation in adduction, and 60 degrees of internal rotation. Her QuickDASH score was 29.5 (compared to 82.5 pre-op) and Constant score was 69 on the affected side compared to 85 on the left side, for a "good" functional outcome.

LITERATURE REVIEW

A MEDLINE search using the key words [acromion fracture], [scapula fracture], [reverse arthroplasty] was performed. Six relevant articles were identified, with a total of 57 cases. We then sought to classify and separate the cases by location; there were 30 cases of fractures at the base of the acromion, and scapular spine. When our case is added, we have a total of 31 cases. Results are summarized in Table 1. In brief, of the 30 more proximal cases, 21 were treated non-operatively in a sling, 7 were treated with open reduction and open fixation and one with revision of the prosthesis. Of those treated non-operatively, and for whom results are published, fourteen had a non-union, four had a malunion and in two cases, it was unclear whether union was achieved. For patients receiving fixation of the fracture, there was one non-union, two repeat fixations, and one patient required removal of the fixation. The patient who had a revision of the prosthesis had a malunion of the acromion.

DISCUSSION

Although recent studies have shown that good outcomes may be achieved with non-surgical management of lateral

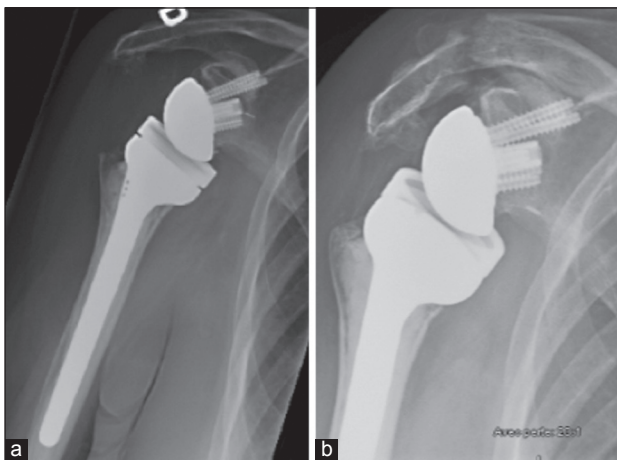


Figure 1: Antero-posterior radiographs showing the patient's right shoulder immediately after reverse shoulder arthroplasty (a) and after fracture, 5 months later (b). The post-operative image shows no pre-existing acromial pathology



Figure 2: Antero-posterior radiograph of the right shoulder demonstrating the dual plating technique. This radiograph was taken at final follow-up (18 months)

Table 1: Results of the literature review. In the fracture location column, the fracture description provided by the authors is presented. Our classification of the fracture follows in the classification column

Article	N	Fracture location	Classification	Treatment	Follow-up (months)	Clinical results
Walch (2009)	3	Scapular spine	Scapular spine	Non-operative	Min 24	1 non-union, 2 mal-unions, AFE= 45-110, Constant=15-44
	1	Scapular spine	Scapular spine	Tension band fixation	Min 24	Failure of fixation, non-union, Constant score=43
Hattrup (2010)	9	3 Acromion, 6 Scapular spine	3 Body of acromion, 6 scapular spine	Sling	Mean 30 (12-48)	1 potential union††, 8 non-union, VAS (pain) 4.0, ASES=48.5, SST=5.1
Hamid (2011) ^[10]	4	Base of scapular spine	Scapular spine	Abduction sling	Mean 35 (16-51)	2 non-union, 2 mal-union, AFE*=66, mean ASES**=60
	3	Midacromion	Body of acromion	Abduction sling	Mean 35 (16-51)	3 non-union, AFE=55, mean ASES=74
	1	Lateral acromion	Tip	Abduction sling	Mean 35 (16-51)	Non-union, AFE=140, ASES=97
Wahlquist (2011)	3	Acromial base	Base of acromion	Sling, bone stimulator	12-26	2 unions at 13 months, one required ORIF with lag screw and tension band (unclear if united), AFE=95-150, Neer Functional Outcomes=56-76
	2	Acromial base	Base of acromion	ORIF with plating +/- bone graft	7-12	7.5 - 42 weeks to union, one revision ORIF, AFE=40-125, Neer Functional Outcomes=77
Crosby (2011)	16	Avulsion near coraco-acromial ligament insertion	Tip	Supportive care	Mean 27 (27-54)	None had persistent pain at fracture site, 1 revision for glenoid component failure, 1 revision for joint instability
	10	Acromion, posterior to AC joint	Tip	ORIF +/- AC joint resection or sling	Mean 3 (3-21)	No pain for surgically treated patients, persistent pain for non-operative patients
	4	Posterior acromion/scapular spine	Base of acromion/scapular spine	ORIF	Min 12	No pain at fracture site, 1 required repeat fixation, one required implant removal
Levy (2012)	1	Acromial base	Base of acromion	Shoulder immobilizer, subsequent revision of prosthesis	20	Malunion, AFE=70, ASES=13.3, VAS (pain)=9, SST‡=0

*AFE = Active forward elevation; **ASES = American shoulder and elbow surgery score; †Visual analog scale; ††Authors report radiographic evidence of union on plain radiographs but no CT scan was obtained to confirm healing; ‡SST = Simple shoulder test

acromial fractures, the same does not hold true for basal acromial fractures.^[5-9] The likely reason for this is that with fractures at the base of the acromion, a large length of the deltoid is defunctioned and the deltoid muscle is essential to the functioning of the reverse shoulder prosthesis.

Previously described techniques, such as tension band fixation achieved poor functional results for fractures at the base of the acromion.^[4,7] We postulate that this is because the fixation method is insufficient to withstand the forces generated by the deltoid muscle — a tension band can neutralize forces parallel to the axis of the band but in the case of the deltoid, force vectors are generated in different directions. The dual locking plate technique described provides very rigid fixation. It also allows for compression along the fracture site and resists motion in all directions. Good screw purchase can be achieved by angling the screws either toward the scapular spine or the coracoid. The locking option enables good fixation and improves cut-out strength in osteopenic or osteoporotic

bone. In addition to the stable fixation achieved with this technique, we further recommend immobilization of the affected shoulder using a sling and an abduction pillow to detension the deltoid, thus at least partially removing the distractive forces at the fracture site. Also essential to achieving a good functional result is regaining function of the shoulder. We thus also recommend a program of range of motion exercises followed by strengthening exercises to maximize functional capabilities.

Based on results from previous studies, bony and functional anatomy, and functional outcomes, fractures were classified by location. Fractures of the tip were those of the most lateral or anterior portion of the acromion. Fractures of the body of the acromion are those medial to the tip of the acromion and lateral to the beginning of the scapular base. The scapular base is the lateral border of the scapular spine, which is smooth and round. In our nomenclature, fractures at the scapular base are termed fractures at the base of the acromion as functionally, this zone connects the acromion

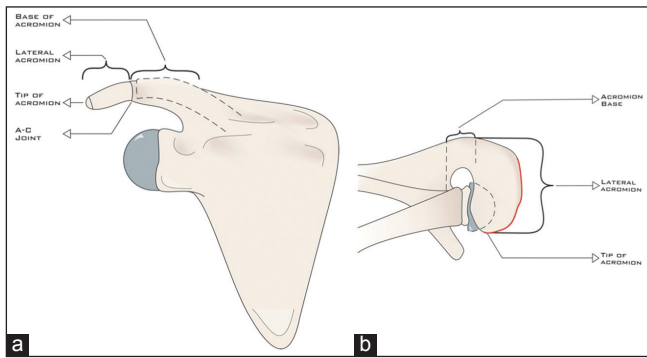


Figure 3: Coronal (a) and axial (b) representations of the proposed classification scheme for acromial fractures associated with reverse arthroplasty

to the rest of the scapula and this term avoids confusion with any more medially occurring fractures. Scapular spine fractures are those medial to the scapular base. This is represented in Figure 3.

We propose the above mentioned classification system as it provides a nomenclature for acromial fractures that is descriptive and is based on the anatomy and functionality of the scapula. As the results from the review of the literature indicate, the more medial the fracture, the worse the prognosis with non-operative treatment. Thus, this classification system may be used to predict outcomes and determine treatment offered. It differs from other classification systems (Crosby) in that it further subclassifies more medial fractures, which are the more ominous fractures. As more research is carried out in this field, this will allow for more standardization amongst reports.

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