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Acromial stress fracture after anatomic shoulder arthroplasty: a case report

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Acromial stress fractures are uncommon but an important and well-recognized complication after reverse shoulder arthroplasty (RSA).[3-5,7,8,10,14,15,19,22,24,32,39,41,43] The prevalence is highly variable and the rates have been reported to range from 0.8% to 11.2%.[1,2,22,23,25-27,29-31,37,38,44,46] The cause of acromial stress fractures after RSA has been associated with the altered biomechanics of the shoulder.[3] Theoretically, since the shoulder center of rotation is being distalized and medialized after an RSA, there is increased tension on the deltoid muscle origin, which can in turn increase strain and cause a stress reaction/fracture of the acromion. Risk factors that have been associated with acromial stress fractures include older age,[11,21,38] female sex,[23,46] inflammatory arthritic pathologies,[20] osteoporosis,[6,28,44] decreased acromial thickness,[44] severe rotator cuff disease such as massive cuff tear or cuff tear arthropathy,[47] and implant-related factors such as an onlay humeral stem design, superior baseplate screws, lateralized humeral components, and superior positioning of the baseplate.[2,12,17,18,20,45] Although an acromial stress fracture is a well-known complication after RSA, to our knowledge, it has never been reported as a complication after anatomic shoulder arthroplasty.

Case report

A 66-year-old right hand dominant male presented with chronic left shoulder pain. He had failed conservative treatment including physical therapy and a glenohumeral joint injection. He had remote history of an arthroscopic distal clavicle excision. It is unknown if an acromioplasty was performed at that time. His preoperative range of motion (ROM) was 100° of forward flexion, 20° of external rotation, and internal rotation to T12. Active motion was equivalent to passive motion. His rotator cuff strength was 4+ with resisted external rotation and forward elevation. Belly press test was inconclusive secondary to stiffness.

Preoperative radiographs demonstrated end-stage glenohumeral osteoarthritis with joint space narrowing and inferior humeral head osteophytic change. There were postsurgical changes at the acromioclavicular (AC) joint. The acromion was intact with no evidence of an os acromiale (Fig. 1). The patient presented with a magnetic resonance imaging demonstrating glenohumeral arthritis with an intact rotator cuff. A computed tomography (CT) scan was obtained for preoperative planning and manufacture of patient-specific instrumentation. The glenoid deformity was categorized as B2 based on the Walch classification.[40] The glenoid was 13.5° retroverted with 0.5° of superior inclination. The case was planned with an augmented glenoid component.

Preoperative functional outcome scores were as follows: Single Assessment Numeric Evaluation (SANE) score of 40% with the contralateral side score of 100%. Simple Shoulder Test (SST) score of 3 and American Shoulder and Elbow Surgeons (ASES) score of 43.

The patient underwent an anatomic shoulder arthroplasty with an augmented glenoid component (Biomet Comprehensive Alliance glenoid; Zimmer Biomet Warsaw, IN, USA) and a press-fit humeral stem (Zimmer Trabecular Metal; Zimmer Biomet, Warsaw, IN, USA). A deltopectoral approach was used and the coracoacromial ligament was not released. A subscapularis peel was performed and subsequently repaired with transosseously placed #5 braided suture passed in a Mason Allen configuration. There were no intraoperative complications. Figure 2 represents radiographs obtained at the first postoperative visit at 2 weeks (Fig. 2).

Institutional review board approval was not required for this case report.

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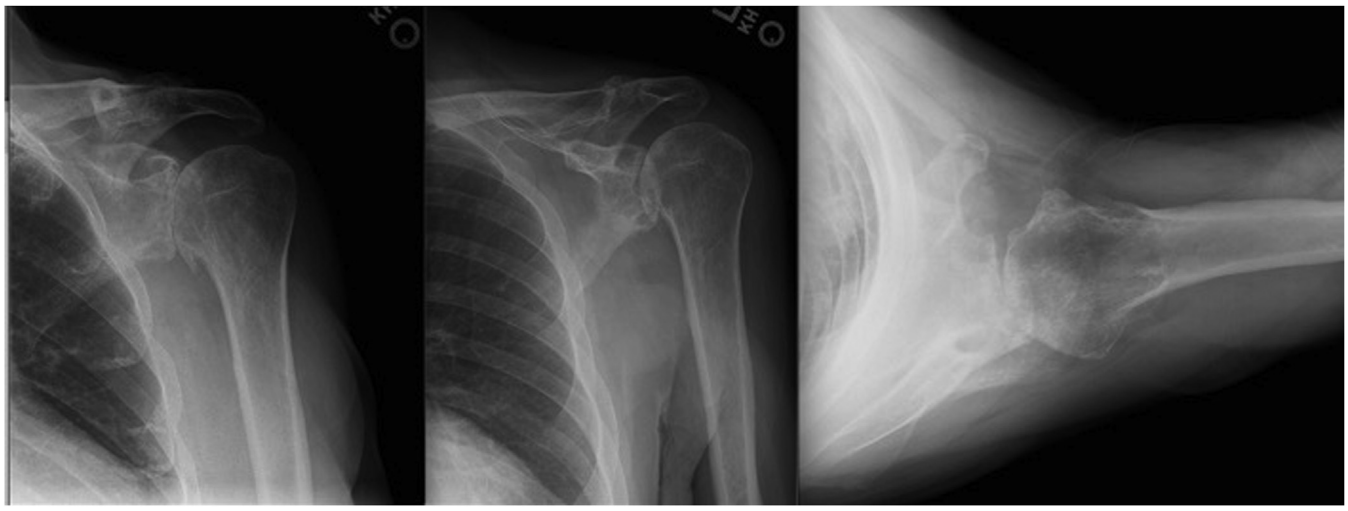

Figure 1 Preoperative AP, Grashey, and axillary views of the left shoulder demonstrating evidence of joint space narrowing, inferior humeral head osteophytic change, and postsurgical changes at the AC joint. *AC*, acromioclavicular.

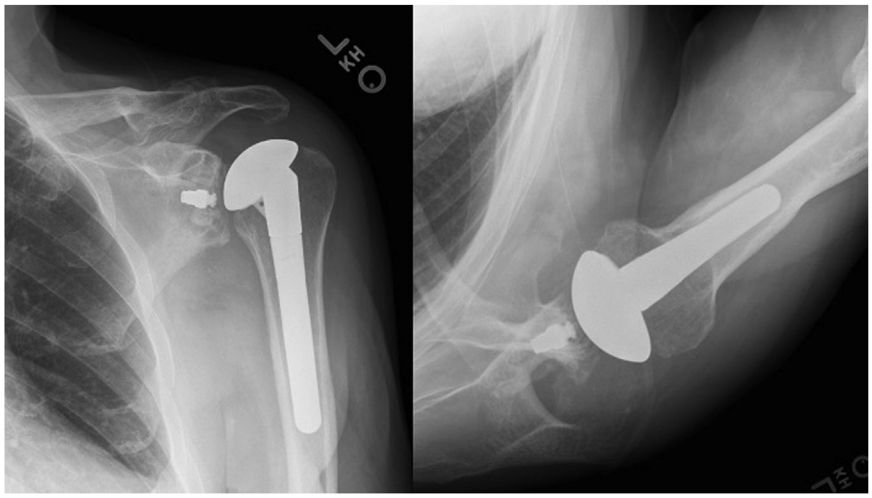

Figure 2 Postoperative Grashey and axillary views at 2 weeks, demonstrating humeral implant and an augmented glenoid component in place. No obvious evidence of any acromial pathology is appreciated.

The patient was started on passive ROM exercises at 2 weeks. At 6 weeks postoperative, patient was progressing well. The sling was discontinued and he was started on active and passive motion exercises with physical therapy.

At approximately 8 weeks postoperatively, patient was stretching his arm overhead, felt a pop in the shoulder, and started having pain. Physical examination revealed localized tenderness over the acromion superiorly. Active motion was painful and limited to 40° of forward flexion and 25° of external rotation. Figure 3 represents radiographs obtained at that visit (Fig. 3). A CT arthrogram demonstrated focal osteolysis around the inferior glenoid pegs, without evidence of rotator cuff tear or prosthetic component loosening. There was a suggestion of a linear osteolucency through the acromion but the initial interpretation was inconclusive for a fracture (Fig. 4). The initial treatment plan was activity modification and symptom management.

Five months postoperatively, the patient returned with continued acromial pain and a new deformity in the superior aspect of the shoulder. Passive ROM of the shoulder was 160° of forward flexion, 45° of external rotation, and internal rotation to T12. Active ROM was 70° of forward flexion, 45° of external rotation, and internal rotation to T12. Functional outcome scores were as follows: SANE score of 20% with the contralateral side being 100%, SST score of 3, and ASES score of 38. Radiographs demonstrated evidence of an acromial fracture (Fig. 5). A second CT scan further confirmed the diagnosis (Fig. 6). The fracture line started just posterior to the AC joint and extended laterally, classified as Levy type I and Crosby type II.[7,21]

Treatment included a sling with abduction pad and a bone stimulator to be applied to the superior aspect of the shoulder. He was treated in the brace for 6 weeks.

At the most recent follow-up, 1 year postop, the patient had no acromial tenderness. Active and passive ROM were symmetric; forward flexion to 160°, external rotation of 45°, and internal rotation to T10. Belly press test was negative. Functional outcome scores revealed a SANE score of 90% (contralateral 100%), SST score of 10 (contralateral side 100%), and ASES score of 95. Radiographs revealed a well-positioned prosthesis without evidence of loosening. The alignment of the acromion was unchanged and there was evidence of callus formation around the fracture site (Fig. 7).

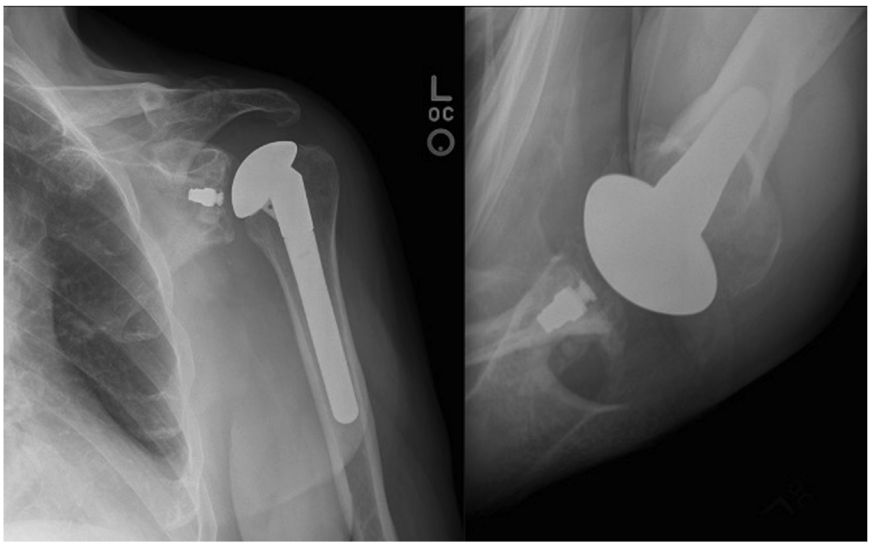

Figure 3 Postoperative Grashey and axillary views at 8 weeks after patient felt pop in the shoulder while stretching. Again, no obvious evidence of any acromial pathology was appreciated.

Figure 4 Axial CT scan cut at 8 weeks shows a possible linear osteolucency through the acromion. *CT*, computed tomography.

Discussion

Acromial stress fractures are a well-known complication after RSA.[3-5,7,8,10,14,15,19,22,24,32,39,41,43] The likely explanation is increased deltoid tension from prosthetic component design.[3] Various risk factors have been associated with acromial stress fractures after RSA. Some of these include increased age, female sex, osteoporosis, decreased acromial thickness, inflammatory arthritis, severe cuff disease such as massive cuff tears and cuff tear arthropathy, and some implant-related factors (onlay humeral stem design, superior baseplate screws, lateralized humeral components, and superior positioning of the baseplate).[2,6,11,12,17,18,20,21,23,28,38,44-47] The reported incidence is 0.8%-11.2%.[1,2,22,23,25-27,29-31,37,38,44,46]

In a native shoulder, there have been case reports of acromial stress fractures. Dennis et al reported on 3 patients with 4 acromial stress fractures associated with rotator cuff-tear arthropathy.[9] Hall and Calvert presented a case of a 42-year-old woman who sustained a stress fracture of the spine of the scapula at the base of the acromion after swinging a golf club.[13] Rupp et al described a case of acromial stress fracture after arthroscopic subacromial decompression in a 31-year-old female elite tennis player.[35] Others have also reported similar rare cases of stress fractures of the acromion.[16,34,36,42] With no history of trauma, most of these fractures have been related to violent contraction of the deltoid with an inferiorly directed force acting on the lateral aspect of scapular spine or acromion.

To date, this is the first reported acromial stress fracture after anatomic shoulder arthroplasty. The fracture occurred 8 weeks postoperatively and the patient did not have any of the commonly reported risk factors such as increased age, female sex, osteoporosis, decreased acromial thickness, inflammatory arthropathies, massive rotator cuff tear, or cuff tear arthropathy.[6,11,20,21,23,28,38,44,46,47] The increased tension on the deltoid after RSA has been associated with the cause of postoperative acromial stress fractures.[14,24] However, anatomic shoulder arthroplasty inherently recreates native anatomy and does not alter the deltoid tension significantly. The exact cause of the acromial stress fracture in our patient is unknown. As mentioned previously, our patient did not have any of the known risk factors for an acromial stress fracture. Coracoacromial ligament resection which has been shown to increase scapular spine strain[48] was also not performed in this case. If in fact he had an acromioplasty with his previous surgery, that could cause thinning and weakening of the acromion predisposing him to an acromial stress fracture. Unfortunately, due to the remoteness of his previous surgery, the details are not available. An augmented glenoid component could slightly lateralize the joint line and change the biomechanics of the shoulder, but this is unlikely to cause a significant increase in the forces going through the acromion. It is plausible that with his history of previous shoulder surgery and AC arthrosis, the stiffness in the AC segment would transfer the majority of the load to the acromion, potentially causing a stress fracture.

There are 2 main classification systems described for acromial stress fractures.[7,21] The Crosby classification is based on the

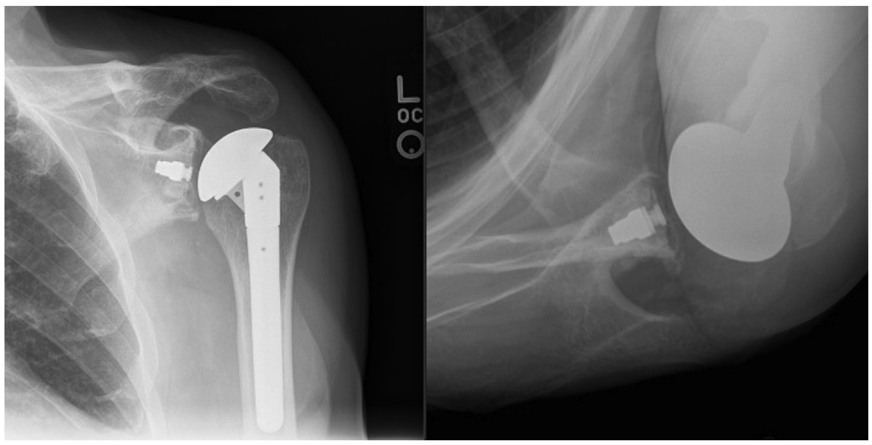

Figure 5 Radiographs at 20 weeks show evidence of acromial deformity on the Grashey view and possible fracture line on the axillary view.

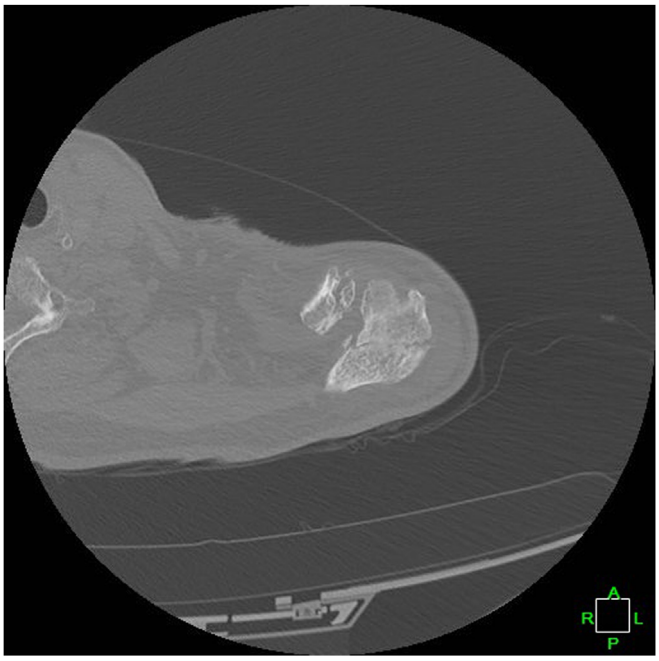

Figure 6 Axial CT scan cut at 20 weeks demonstrating a fracture line through the acromion. *CT*, computed tomography.

relationship of the fracture line to the AC joint. Crosby type I fractures are avulsion fractures of the anterior acromion. Crosby type II fractures are anterior acromion fractures that start just posterior to the AC joint. Crosby type III fractures are posterior acromion or scapular spine fractures. The Levy classification is based on the anatomic location of deltoid origin. Levy type I fractures involve a portion of anterior and middle deltoid origin. Levy type II fractures involve the entire middle deltoid and a portion of posterior deltoid origin. Levy type III fractures involve the entire middle and posterior deltoid origin. The patient in the case presented sustained a Crosby type II/Levy type I fracture. In the Crosby study, a retrospective review of 400 RSA patients, all Crosby type II fractures, had some form of AC arthrosis. The authors hypothesized that stiffness at the AC joint in these patients transfers the stress to the acromion causing fatigue fractures as patients regain motion.[7] This may have been a contributing factor in the case presented. Although the patient had a history of distal clavicle excision, he had evidence of residual arthrosis on imaging, which may have contributed to AC segment stiffness.

Our patient had a significant decrease in his ROM and functional outcome scores as a result of the acromial stress fracture. At the 5-month follow-up visit when the diagnosis was confirmed, his forward flexion was only 70°. External rotation was 45° and not severely affected. His SANE score was 20, SST of 3, and ASES of 38. Reduction in outcome scores and motion is consistent with other reports of acromial stress fractures after RSA.[15,21,38] Hattrup reviewed the outcome of RSA patients with and without acromial stress fractures. Patients with postoperative acromial fractures had a mean Visual Analog Scale score of 4.0, ASES score of 47.9, SST score of 5.6, and forward flexion of 89.3. Those without a fracture had a mean Visual Analog Scale score of 0.7, ASES score 87.7, and SST score of 10.2 with forward flexion of 152.1.[15] Teusink et al reported on 32 nonoperatively treated acromial stress fractures in a case-control study. Fracture patients had inferior ASES scores compared to nonfracture patients (58 compared to 74.2). The gain in forward flexion was also significantly less in fracture patients (26° vs. 76° in nonfracture patients). Fracture location or healing did not affect outcome in this study.[38]

Results of surgical treatment of acromial stress fractures have been variable in the literature. Some authors have reported improved outcome scores after surgical fixation,[7,33] while others have reported failure of fixation, poor outcome, and decreased motion.[39,41] Our patient in this case eventually healed his fracture after a period of immobilization and ended up with an excellent outcome at his most recent follow-up at 1 year.

Conclusion

An acromial stress fracture after anatomic total shoulder arthroplasty is rare and this is the first known reported case in the literature. As the frequency of shoulder arthroplasty continues to increase, so may the number of these cases. Therefore, acromial stress fractures should be included in the differential diagnosis when evaluating patients with pain after anatomic shoulder arthroplasty.

The patient is fully aware of this manuscript and has consented to publication.

Disclaimers:

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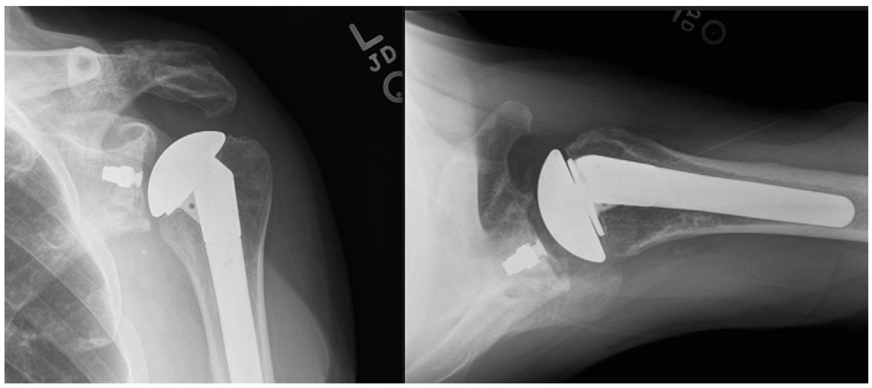

Figure 7 Radiographs at 1 year after surgery demonstrate implant in place with no obvious evidence of failure. Acromial fracture alignment is unchanged with evidence of callus formation best appreciated on the Grashey view.

Conflicts of interest: The author, his immediate family, and any research foundation with which he is affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.
Patient Consent: The patient is fully aware of this manuscript and has consented to potential publication.

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