Coracoid Fracture After Reverse Total Shoulder Arthroplasty: A Report of 2 Cases

Oke A. Anakwenze, MD, Vamsi K. Kancherla, MD, Gregory F. Carolan, MD, and Joseph Abboud, MD

Abstract

Although reverse total shoulder arthroplasty is largely successful, there are still complications that require appropriate diagnostic workup and treatment. These 2 cases of patients with a coracoid fracture were encountered at 3 months and 15 months after reverse total shoulder arthroplasty. One patient presented with new-onset pain in the coracoid region without significant functional deficit, and the other presented with functional deficit and complaint of a strange noise at the anterior aspect of the operative shoulder. While standard radiographs did not detect the fracture, computed tomography imaging was sufficient to establish the diagnosis. Ultimately, nonoperative management led to resolution of these symptoms.

Reverse total shoulder arthroplasty (RTSA) performed in carefully selected patients often leads to satisfactory outcomes.[1,2] In recent years, its indications and the number performed per year have expanded. Subsequently, there has been a concomitant rise in reported complications,[2,3] with a rate ranging from 19% to 68%.[2,3] Some common complications include scapular notching,[2-4] fracture,[2,3,5-7] dislocation,[2,3,7] and infection.[2,3,7]

In this series, we describe 2 cases of coracoid fracture after RTSA. The patients provided written informed consent for print and electronic publication of these case reports.

Case Series

Case 1

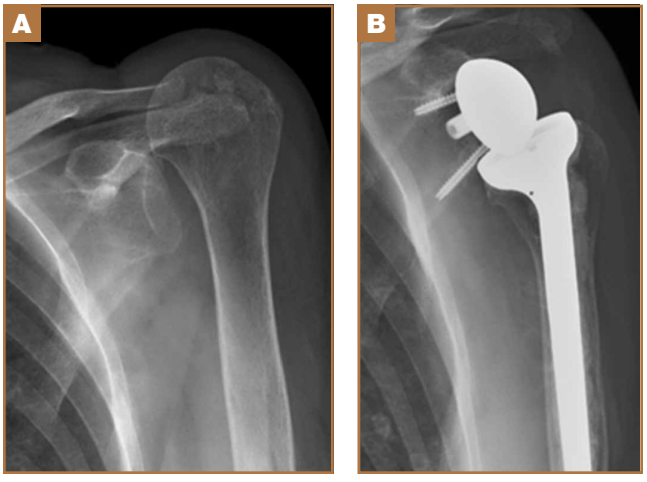
An independently functioning 81-year-old right hand–dominant woman (BMI, 22.1 [height, 160 cm; weight, 56.7 kg]) presented with increasing left shoulder pain and dysfunction after a motor vehicle accident 2 months earlier. She had reported vague chronic left shoulder pain in the past, but after the accident her pain was significantly worse. A subacromial corticosteroid injection by her primary care physician provided temporary symptomatic relief, but her symptoms recurred.

On presentation, there was obvious anterior superior escape of the humeral head, which was accentuated by shoulder shrug. Her deltoid motor function was found to be intact, and her active shoulder range of motion was severely limited (pseudoparesis). There was notable crepitation as well as significant weakness and pain with abduction and external rotation strength testing.

Radiographic imaging showed anterior superior escape of the humeral head with some early degenerative changes (Seebauer type IIB[8] [**Figure 1A**]). Magnetic resonance imaging confirmed a full-thickness retracted massive rotator cuff tear with complete involvement of the supraspinatus, infraspinatus, and most of the subscapularis muscles. Significant glenohumeral degenerative changes consistent with cuff tear arthropathy were also seen without any evidence of fracture.

After thorough discussion of options, risks, and benefits, the decision was made to proceed with RTSA. The patient underwent the procedure without complications. A DePuy Delta

Figure 1. Case 1—(A) Anteroposterior radiograph of the left shoulder showing marked superior subluxation of the humeral head. (B) Postoperative anteroposterior radiograph shows satisfactory implantation of reverse arthroplasty prosthesis.



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Xtend prosthesis was used with a cemented humeral stem, polyethylene, and glenosphere, sizes of 12, +3, and 38, respectively. The glenosphere component, positioned inferiorly to avoid scapular notching, was secured with 3 screws, and the stem was placed in neutral version. The patient's shoulder was reduced, ranged, and noted to be stable, allowing for supple passive range of motion without evidence of excessive tightness. She was placed in a sling with the shoulder positioned in neutral alignment. Her postoperative radiograph (**Figure 1B**) showed satisfactory implantation of the reverse total shoulder prosthesis. Her postoperative course was uneventful, and rehabilitation consisted of 6 weeks of sling protection, with advancing passive and active range of motion. Strengthening exercises were initiated 6 weeks after surgery.

At the patient's 6-week postoperative visit, she demonstrated pain-free passive elevation to 80° and active forward elevation to 70°. At her 3-month postoperative visit, she reported a 1-week onset of anterior shoulder pain accompanied by a strange noise at the anterior aspect of the operative shoulder. She denied any recent trauma. She continued to have minimal shoulder pain with passive forward flexion of 80°; however, her active forward elevation was very limited because of pain in the anterior aspect of her shoulder. Active external rotation was noted to be 20° and internal rotation was to her buttock. She had pain to palpation of the coracoid process. Radiographs were unchanged from immediate postoperative radiographs. Computed tomography (CT), which was ordered to ensure that the implant was stable with no loosening, showed satisfactory alignment of the prosthesis and no loosening. However, CT was notable for a nondisplaced fracture through the base of the coracoid (**Figures 2A-2D**). The patient stopped formal physical therapy, and sling immobilization was initiated. After 3 weeks, the sling was discontinued and physical therapy was begun again. She responded satisfactorily to this treatment approach, and, at her 6-month postoperative follow-up, she was without pain, instability, or crepitation. Her range of motion had improved with pain-free active forward flexion, external rotation, and abduction of 100°, 15°, and 90°, respectively. At 28-month postoperative follow-up, her visual analog scale, American Shoulder and Elbow Surgeons score, and Simple Shoulder Test score were 3, 73, and 67, respectively.

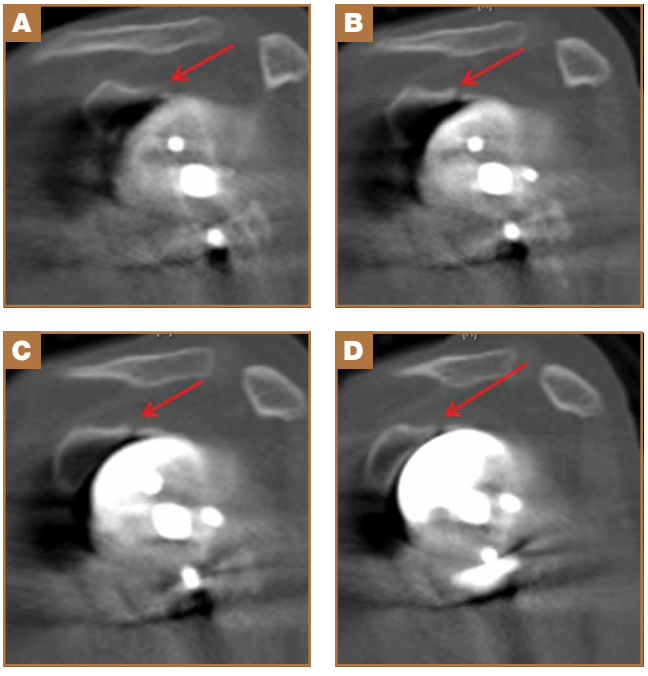

Figure 2. Case 1—(A-D) Computed tomography sagittal slices (from lateral to medial) showing nondisplaced periprosthetic fracture (red arrow) through the base of the coracoid and also involving a small portion of the anterior-superior glenoid.

Case 2

A 68-year-old, right-handed woman (BMI, 22.5 [height, 160 cm; weight, 57.6 kg]) presented with right shoulder pain and dysfunction of 3 years' duration. She had undergone an open rotator cuff repair at an outside facility 4 years ago that was unsuccessful. At the time of her presentation to our institution, she had already undergone a failed course of physical therapy. A trial of corticosteroid subacromial injections did not adequately manage her symptoms.

On presentation, her active forward flexion, abduction, and external rotation were 40°, 30°, and 10°, respectively. She had full passive range of motion and pain with active and passive shoulder motion. Radiographic imaging showed superior migration of the humeral head with evidence of glenohumeral arthropathy suggestive of rotator cuff arthropathy (Seebauer type IIA[8]). After thorough discussion of options, risks, and benefits, the decision was made to proceed with RTSA. She underwent the procedure without complications. A DePuy Delta Xtend prosthesis was used with a cemented humeral stem, polyethylene, and glenosphere, sizes of 8, +3, and 38, respectively. The glenosphere component, positioned inferiorly to avoid scapular notching, was secured with 4 screws, and the stem was placed in neutral version. Her shoulder was reduced, ranged, and noted to be stable, allowing for supple passive range of motion without evidence of excessive tightness. She was placed in a sling with the shoulder positioned in neutral alignment. Her postoperative radiographs revealed satisfactory implantation of the reverse total shoulder prosthesis. Her postoperative course was uneventful. She was taken out of her shoulder immobilizer 4 weeks after surgery and began home-based physical therapy.

At 1 year after surgery, the patient had minimal shoulder pain with active forward flexion, external rotation, and abduction of 135°, 20°, and 85°, respectively. She presented to our clinic 15 months after RTSA with acute onset of pain about her anterior shoulder. She denied any recent trauma or infectious exposures. On examination, her motion was unchanged from prior examinations. However, she was tender on palpation of the coracoid. Radiographs at that time were unchanged (**Figures 3A, 3B**). Laboratory tests (erythrocyte sedimentation rate, C-reactive protein, and complete blood count with differential) that were subsequently ordered to rule out an occult infection were within normal limits. Computed tomography, which was

ordered for further assessment and to ensure that the implant was stable with no loosening, showed satisfactory alignment of the prosthesis without loosening. However, a lucency was noted in the midportion of the coracoid that was suggestive of a fracture (**Figures 4A, 4B**). A conservative plan of treatment was advised with sling immobilization for 3 weeks and follow-up visits. The patient responded satisfactorily to this treatment approach, and, at her latest follow-up, 8 months after presenting with a coracoid fracture, she was pain-free. At the 5-year postoperative follow-up, her visual analog scale, American Shoulder and Elbow Surgeons score, and Simple Shoulder Test score were 1-2, 78, and 75, respectively.

Discussion

The reverse prosthesis, a semi-constrained ball-and-socket device, provides satisfactory functional outcomes when used in carefully selected patients with rotator cuff arthropathy and pseudoparalysis, failed shoulder arthroplasty, and fracture sequelae.[1,9-11] By the traditional Grammont principles of medializing the center of rotation and lowering the humerus, shear forces about the glenoid are reduced and the deltoid muscle is tensioned, allowing for adequate torque generation, required to facilitate shoulder motion.[12,13] While long-term outcomes concerning durability and survivorship are pending, some studies have attempted to improve our understanding of implant and functional longevity. Guery and colleagues[14] noted an implant survival of 91% at 120 months. However, increased pain and decreased function were seen at the 6-year mark.[14] A more recent study by Cuff and colleagues[15] revealed 94% implant survivorship and sustained improvement in range of motion and pain at 5 years.

Despite considerable success, RTSA can be associated with a myriad of complications. The most common complications of RTSA include scapular notching (44%-96%), glenoid side failure (5%-40%), instability (2.4%-31%), and infection (1%-15.3%).[2,3] In the setting of inflammatory arthropathy, there is an increased risk for intraoperative and postoperative fractures.[16,17] To date, there are only 2 reported cases of coracoid process fractures after RTSA.[18,19] In the case by Nolan and colleagues,[18] conservative management with a sling for 6 weeks led to successful resolution of symptoms. Although little information is provided on the management of these rare fractures, literature on the slightly more common scapular (0.9%-7.2%) and acromial (0.9%-4.9%) fractures suggest that periscapular fractures are on the rise, may increase the risk for revision surgery, and can lead to inferior outcomes when compared with patients without fractures.[5,20,21]

Acromial fractures after RTSA have been reported to occur at a rate of 0.9% to 4.9%.[5,21] This is a concern because of RTSA reliance on a functional deltoid.[5,6] The cause of these fractures remains to be fully elucidated. Wahlquist and colleagues[6] in 2011 reported the cases of 5 patients that sustained acromial base fractures after RTSA. All 5 patients were noted to have unsatisfactory functional results despite achieving union (3 were treated with open reduction and internal fixation, and 2 were treated nonoperatively). Acromial fractures tend to present with pain within 6 months of surgery, which may indicate excessive constraint about the scapula, eventually leading to fracture. Furthermore, disruption of this bony structure can lead to devastating results because the acromial base serves as a fulcrum for the deltoid.

Despite a well-placed reverse prosthesis, there is increased reliance on surrounding glenohumeral musculature, resulting from poor rotator cuff function and biomechanical differences compared with a native shoulder. Both our patients were found to have relatively small body habitus. It is possible that, by nature of their smaller statures, they were more susceptible to consequences of excessive joint and soft-tissue tension after RTSA. One explanation for acromial fractures after RTSA is that, by excessively lengthening and/or lateralizing the deltoid, the tension on the acromion in these elderly patients may be sufficient to cause a fracture. A similar mechanism may explain their coracoid fractures. As the arm is lengthened and the prosthesis is tightened, the conjoint tendon is significantly tensioned. We routinely check the tension of these muscles as an extra confirmation of joint stability. However, excessive tension for a significant dura-

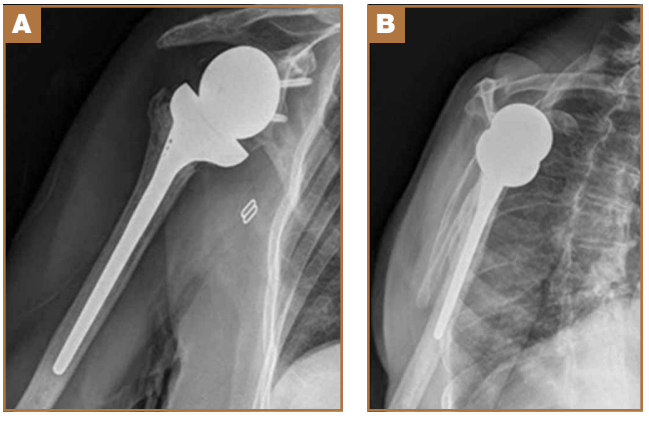

Figure 3. Case 2—(A) Anteroposterior and (B) scapula-Y radiographic images of the left shoulder, 15 months after reverse shoulder arthroplasty, showing implant in satisfactory position with no apparent evidence of bony abnormality.

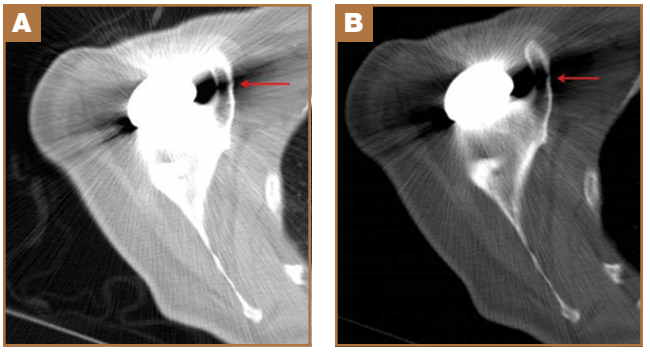

Figure 4. Case 2—(A, B) Computed tomography axial slices (from caudal to cranial) showing a lucency at the level of the coracoid (red arrow), in the region of the patient's discomfort, representing a fracture.

tion may provide too much stress for bone turnover to match with the inherent repair process, potentially causing a fracture. Recent evidence has also found that bone mineral density of the coracoid diminishes with age, suggesting some predisposition to fracture with lower-energy mechanisms.[22]

Another possible cause for coracoid fractures may be the orientation of the implants. While we did not have mechanistic evidence, it is possible that, with adduction and internal rotation, prosthetic impingement against the coracoid is feasible, particularly in patients of small stature. Although a glenoid implant placed high can increase the chance for coracoid–implant impingement, the fact that the patients improved without revision makes chronic mechanical impingement less likely. Drill holes, especially multiple ones, placed throughout the base of the coracoid may also predispose to coracoid fractures.

Patients with periscapular fractures (acromion, scapular spine, or coracoid) after RTSA often present with pain and occasional deficits in function. Both patients in this series noted pain out of proportion to examination. The onset of this pain differed, with 1 patient noting pain within the first 3 months and 1 noting discomfort later. Neither patient had any trauma. In the presence of significant symptoms, negative radiographs, and a poor response to conservative treatment, we recommend advanced imaging to rule out fracture. However, prior to obtaining advanced imaging, proper radiographic techniques should be utilized. Eyres and colleagues,[23] in a series of 12 fractures of the coracoid process, relied primarily on coracoid views directed 45° in a cephalic direction and thin-slice CT. An isotope bone scan identified 1 case not initially found on radiographs.[23]

Conservative management with use of a sling until resolution of symptoms was successful in our series. If symptoms persist, a bone stimulator can be used prior to implementing a surgical solution; however, current evidence does not expound on timing and utility of such modalities. Perhaps as important as treatment is education of the patient and the rehabilitation team about the importance of identifying increasing pain as a potential sign of impending fracture in this population. Subsequent activity modification until the pain resolves can help avoid the setback in postoperative recovery that this complication may cause.

Conclusion

We present 2 patients with coracoid fractures encountered at 3 months and 15 months after RTSA. Nonoperative management proved adequate in treating both cases. We suggest a high level of suspicion for possible fracture in the patient who comes in with new-onset pain in a localized region with or without functional deficits.

Dr. Anakwenze is Attending Surgeon, Department of Orthopaedic Surgery, Kaiser Permanente, San Diego, California. Dr. Kancherla is Resident, and Dr. Carolan is Attending Surgeon, Department of Orthopaedic Surgery, St. Luke's University Health Network, Bethlehem, Pennsylvania. Dr. Abboud is Attending Surgeon, Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University Hospitals, Philadelphia, Pennsylvania.

Address correspondence to: Vamsi K. Kancherla, MD, Department of Orthopaedic Surgery, St. Luke's University Health Network, 801 Ostrum St, PPHP2, Bethlehem, PA 18015 (tel, 847-809-1118; fax, 484-526-1593; email, KancheV@slhn.org).

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