To APE or not to APE? Case Series and Novel Technique of Arthroscopic Polyethylene Exchange for Metal-Backed Glenoids in Total Shoulder Arthroplasty

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Introduction

Anatomic TSA is a very good solution for active patients with end-stage glenohumeral arthritis[1,2]. Despite excellent results for pain relief and functional improvement, glenoid loosening has continued to be a common cause of failure in anatomic TSA[3–8]. Loosening is typically caused by poor glenoid implant placement or rotator cuff failure[9].

Glenoid implant placement can be a particularly challenging issue in patients with glenoid deformity. Several studies have shown an increased complication rate in patients with biconcave glenoids, or in those with excessive retroversion[10,11]. Corrective reaming has classically been used to address posterior erosion; however, this has been shown to only be effective to about 15 degrees[12]. The attempt at correcting more retroversion can potentially lead to joint line medialization and peg perforation through the glenoid vault[13]. Other techniques to address glenoid deformity include bone grafting, augmented glenoid components, and metal-backed glenoid implants[14].

Metal-backed glenoids were initially introduced as a solution to the problem of loosening of polyethylene glenoid implants. Modular implants were developed to offer the benefit of secure fixation to the glenoid, along with ease of revision to reverse shoulder arthroplasty, as the metal portion of the glenoid component does not need to be removed[15]. Concern began to arise as several studies showed a greatly increased revision rate in metal-backed implants compared to their all-polyethylene counterparts[16–20].

Due to these reports of increased failure, more caution has been employed with their use, and several design modifications have been made with more modern implants. Recent studies have shown promise with these modern designs[21,22]. At our institution, metal-backed implants are implemented with very narrow indications, typically in younger patients with severe glenoid deformity. This is a population in which polyethylene glenoids tend to fail more frequently[10,11]. Due to the patients' age, there is a high likelihood of revision surgery during their lifetime. To minimize the morbidity of multiple open surgeries, we created a novel, arthroscopic technique for polyethylene exchange.

Materials and Methods

Surgical Technique:

We perform this procedure in the beach chair position; however, the lateral decubitus position can also be used. After induction of anesthesia, a standard posterior viewing portal is developed. The camera is introduced into the shoulder and a diagnostic arthroscopy is performed. Next, an anterior working portal is created. If a deltopectoral approach was used for the primary surgery, the portal can be made in line with the previous incision. If needed, debridement can be performed with an arthroscopic shaver. A small Cobb elevator is inserted through the anterior portal and used to lever the polyethylene off the metal baseplate (Figure 1).

The anterior incision is then extended approximately 2 centimeters to allow for space for the implant. A radiofrequency ablation device can also be used to open the rotator interval to allow for ease of removal. An arthroscopic grasper is then used to remove the polyethylene from the shoulder. The new polyethylene implant is then inserted through the extended anterior portal (Figure 2). An arthroscopic probe is used to rotate the implant to the appropriate orientation (Figure 3). A Cobb elevator is then reintroduced through the anterior portal and medial pressure is applied to click the polyethylene into the metal baseplate. The elevator can then be used to gently try to elevate the polyethylene to ensure it is fully docked. The camera can also be moved to the anterior portal to visually confirm complete seating. Arthroscopic fluid can then be evacuated from the shoulder, and the portals closed.

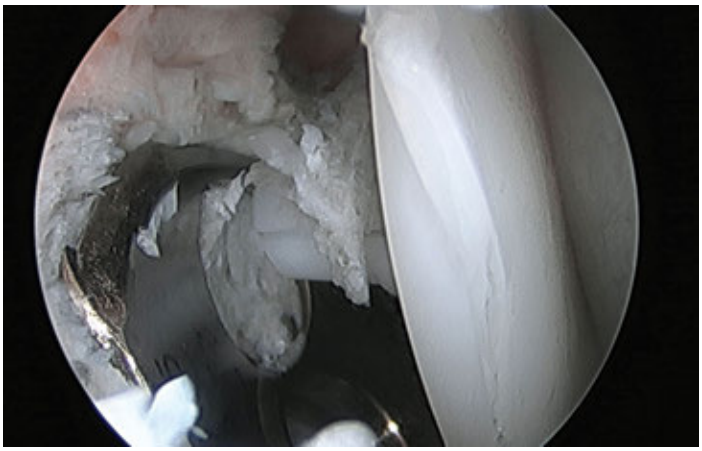

Figure 1. The polyethylene is disengaged from the metal baseplate using a Freer elevator or Cobb elevator and removed through the anterior portal.

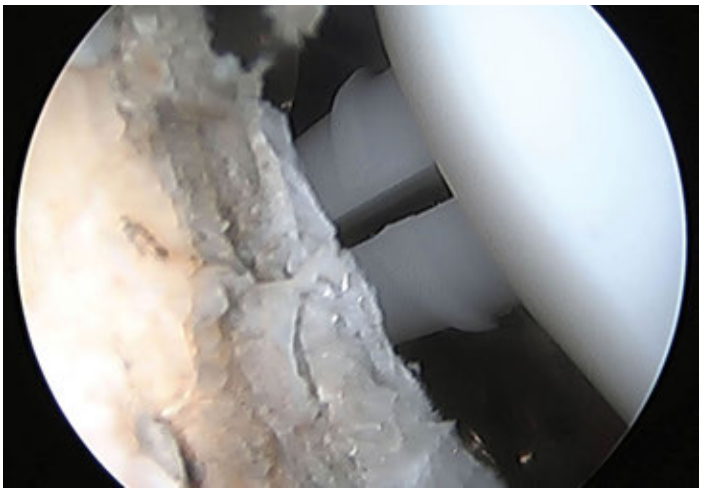

Figure 2. The new polyethylene liner is inserted through the anterior portal, rotated to the correct orientation, and snapped into place using a Cobb elevator.

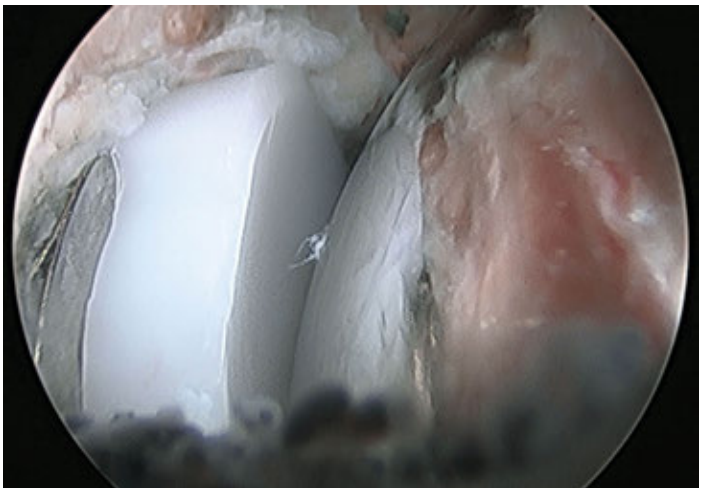

Figure 3. The scope can be used from the posterior and anterior portals to confirm complete seating of the liner.

Results

Patient 1

A 39-year-old male heavy equipment operator presented to clinic with complaints of left shoulder pain. He had a history of multiple left shoulder dislocations that was treated many years prior at an outside facility with an open capsular shift. MRI showed severe glenohumeral arthritis with 38 degrees of glenoid retroversion (Figures 4 and 5). After failing extensive conservative management, the patient elected to undergo a total shoulder arthroplasty. The procedure was performed

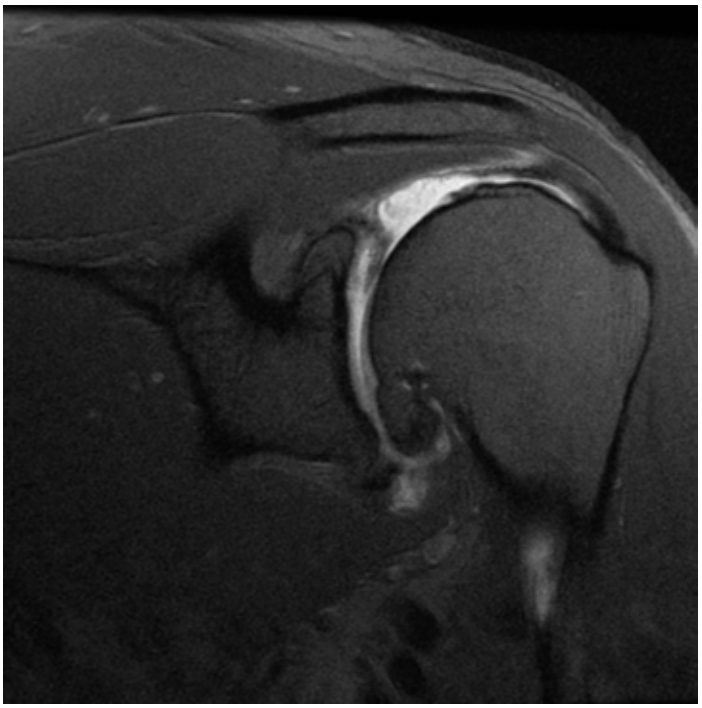

Figure 4. Coronal MRI demonstrating glenohumeral arthritis with a large inferior osteophyte.

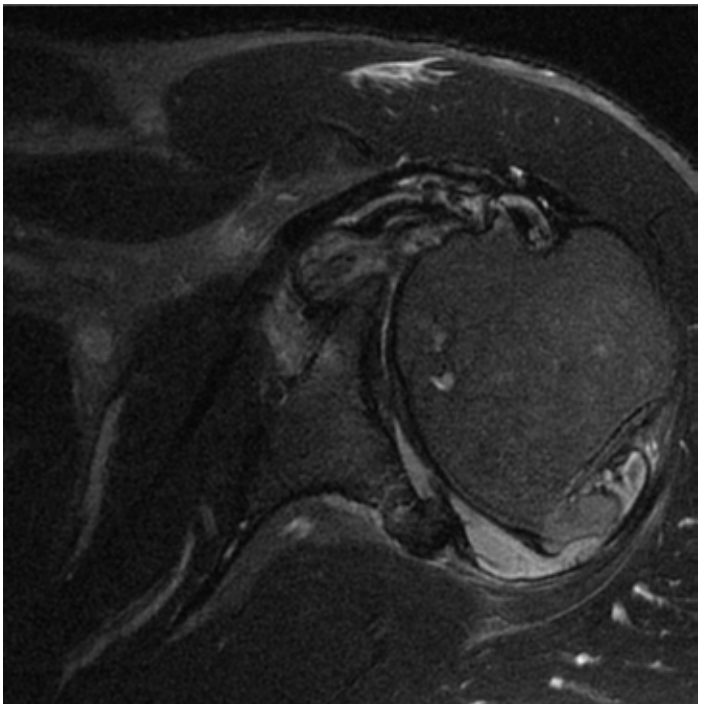

Figure 5. Axial MRI showing severe glenoid retroversion. This was likely due to overtightening of anterior structures after multiple previous surgeries for instability.

using a modular, metal-backed glenoid implant (SMR System, Lima Corporate, Villanova, Italy).

Patient did very well with his arthroplasty, with no pain and full range of motion at 1.5 years after surgery. Patient subsequently was lost to follow up until 5 years postoperatively, when he presented to clinic with complaints of left shoulder pain. Repeat radiographs showed evidence of asymmetric polyethylene wear, with some erosion of the metal baseplate (Figures 5 and 6). The patient underwent arthroscopic debridement and polyethylene exchange. At 9-month follow-up, he has no pain. He has active forward elevation to 170 degrees and external rotation to 40 degrees. Radiographs show appropriate position of the humeral component in relation to the glenoid (Figures 7 and 8). He is very satisfied, with a Subjective Shoulder Value of 90, American Shoulder and Elbow Surgeons score of 100, and a Penn Shoulder Score of 97.

Patient 2

A 46-year-old male attorney presented to clinic with complaints of chronic right shoulder pain. He had a history of traumatic posterior shoulder dislocation and instability that was treated with multiple arthroscopic procedures and an open posterior glenoid bone block augmentation at an outside facility. CT showed the prior bone block augmentation with two screws and washers and significant glenoid wear with humeral head flattening, consistent with post-traumatic glenohumeral osteoarthritis (Figure ± and 7). After failing extensive conservative management, the patient elected to undergo a total shoulder arthroplasty and removal of prior hardware. The procedure was performed using a modular, metal-backed glenoid implant (SMR System, Lima Corporate, Villanova, Italy).

At the 3-month follow-up, patient progressed well with his arthroplasty with active forwarded elevation to 150 degrees and no pain with external rotation to 45 degrees. At the 9-month follow-up, patient had some discomfort and impingement signs at extreme range of motions but was

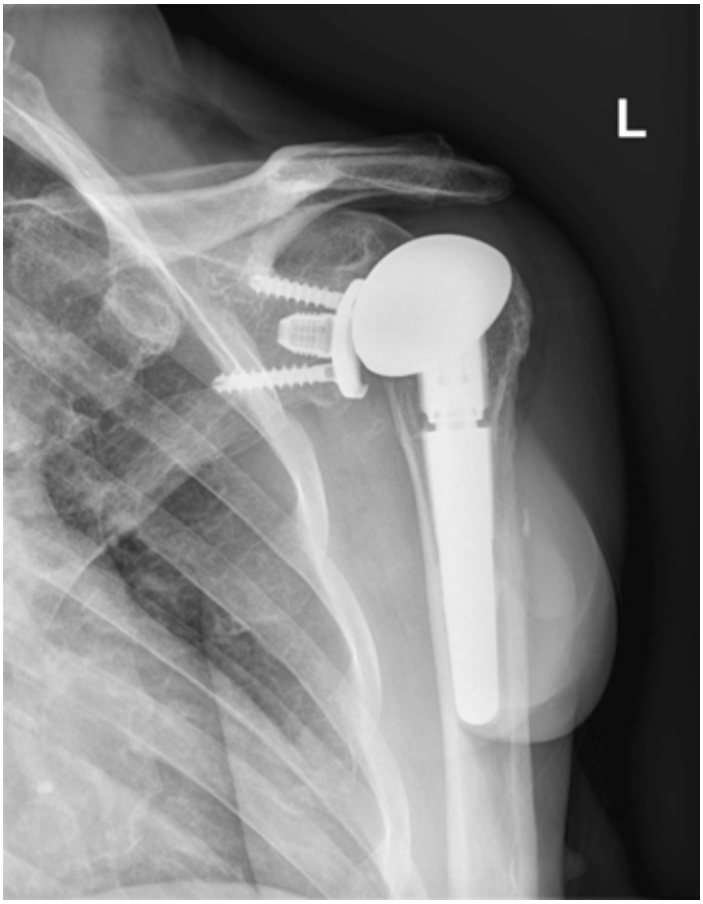

Figure 6. Grashey radiograph demonstrating narrowing of space between humeral and glenoid components, indicating excessive polyethylene wear.

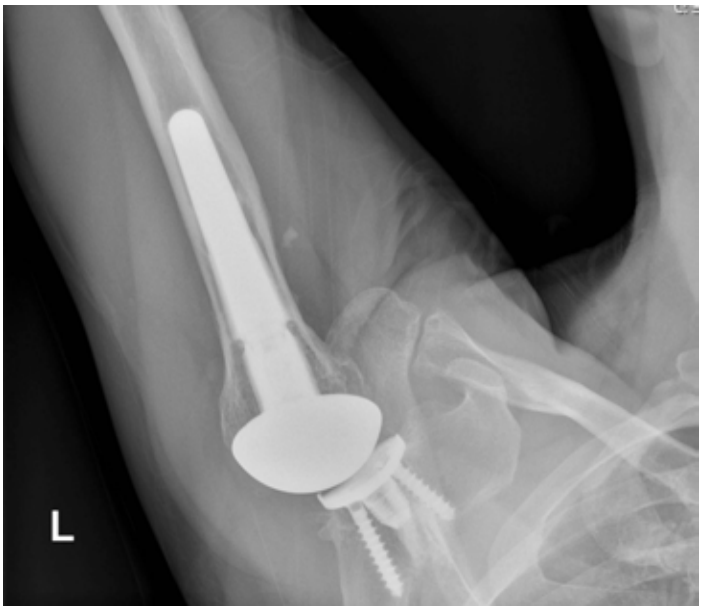

Figure 7. Axillary radiograph indicating polyethylene wear.

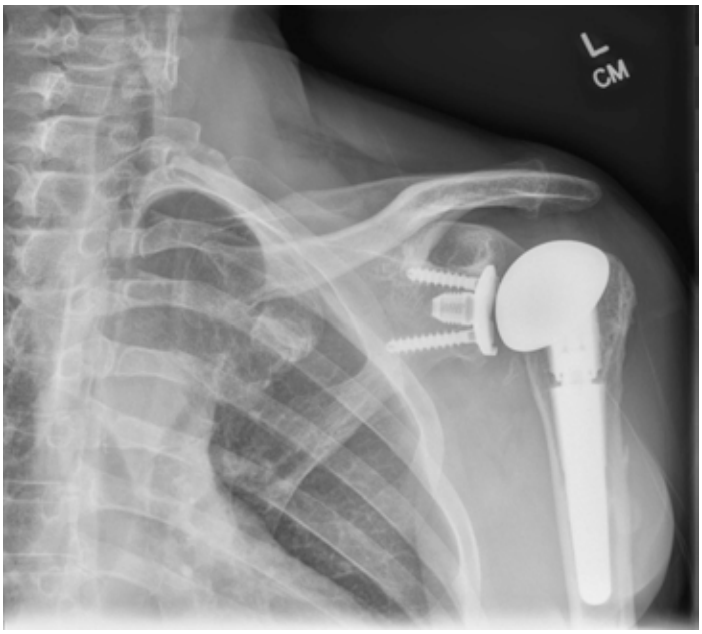

Figure 8. Grashey radiograph after APE procedure performed, demonstrating restoration of appropriate space between humeral and glenoid components.

able to perform his daily activities of living. At 1.5 years, patient had increasing right shoulder pain, but good range of motion. Repeat radiographs showed evidence of asymmetric polyethylene wear, and it appeared that the humeral head was beginning to subluxate posteriorly, potentially indicating rotator cuff imbalance (Figures 9 and 10). The patient underwent arthroscopic assessment, which showed that the subscapularis muscle was intact, but mildly attenuated. There also was a very small undersurface partial tear of the supraspinatus muscle. A debridement and APE was performed. At the 1-year follow-up since the liner exchange, patient continued to have shoulder pain with forward elevation to 90 degrees and external rotation to 40 degrees. He continued to have pain, and was converted to a reverse total shoulder arthroplasty at 3.5 years after the initial shoulder arthroplasty (Figure 11).

Discussion

Revision shoulder arthroplasty can be a very morbid procedure, especially in a younger patient. With revision of a traditional, cemented, all-polyethylene glenoid implant, component removal can compromise bone stock, as well as soft tissue quality, which can make each subsequent surgery progressively more difficult, and potentially necessitate revision to a reverse total shoulder arthroplasty (RTSA).

Sheth, et al. reported on revision of failed anatomic TSA to another anatomic TSA. Revisions were performed for a variety

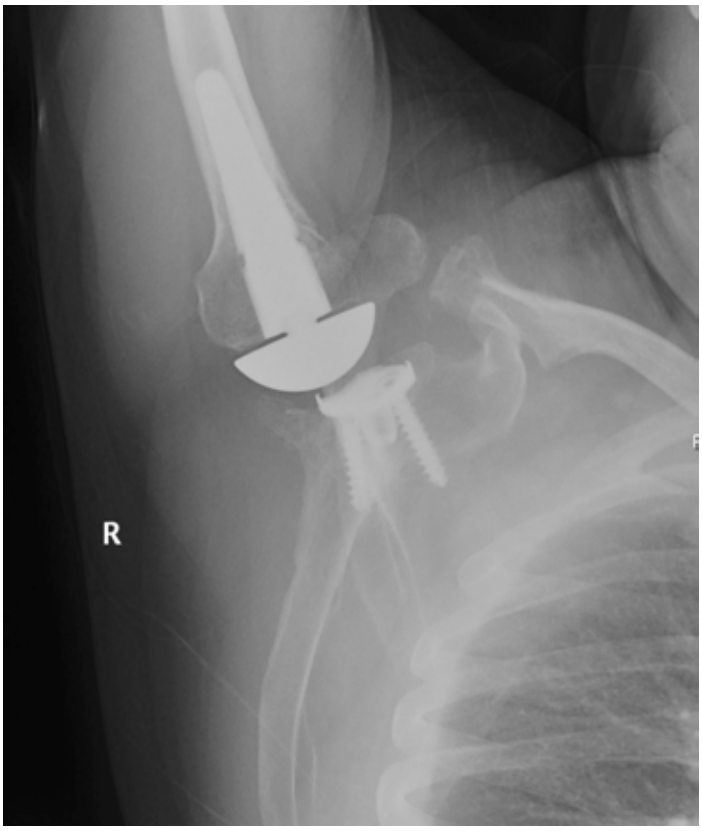

Figure 10. Axillary radiograph showing posterior subluxation of the humeral head. Likely due to soft tissue attenuation due to multiple previous procedures for posterior instability.

Figure 9. Axillary radiograph showing restoration of joint space, as well as appropriate rotator cuff balance, with the humeral head well-centered in the glenoid.

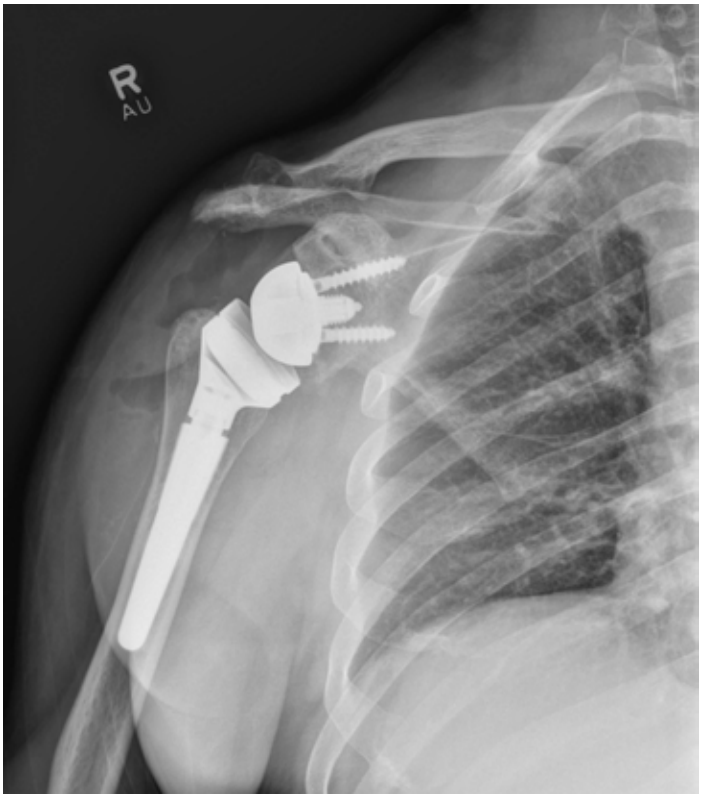

Figure 11. The patient was converted to a reverse shoulder arthroplasty after failing the APE procedure. This was likely due to rotator cuff imbalance causing persistent shoulder dysfunction.

of reasons. Outcome scores and range of motion values were inconsistent, and there was a survival rate of only 60% at 4 years.

Black and colleagues performed a retrospective review of patients aged 65 and younger of patients who underwent RTSA as a salvage for failed primary arthroplasty[23]. They found that these patients did well in terms of pain and functional improvement, but had lower subjective outcome scores compared to patients who underwent primary RTSA. They noted that the relatively high complication rate for revision surgery, and recommended setting appropriate expectations with patients before surgery.

Gauci, et al. reviewed revision shoulder arthroplasty performed over a 20-year period at two tertiary centers[24]. They found that 21% of their cohort required multiple reinterventions, mostly due to soft tissue insufficiency or infection. The final implant, regardless of number of procedures was a RTSA in 48% of cases.

Young, active patients with severe glenohumeral arthritis and glenoid deformity offer a significant challenge to the shoulder surgeon. These patients have a very high risk of revision during their lifetime, regardless of the type of implants used[25,26]. While modular metal-backed glenoid implants have the potential for accelerated polyethylene wear, they do offer the advantages of solid glenoid fixation and easy polyethylene exchange. It is our practice to closely monitor these patients, and to scrutinize radiographs for signs of polyethylene wear. With our novel APE technique, polyethylene implant exchange can be performed relatively quickly, with very little insult to the patient's soft tissue, and with very good results, as seen in our first patient. Patient selection is pivotal for this procedure. As demonstrated in our second patient, rotator cuff imbalance can predispose the shoulder to failure, and other revision options should be pursued in these cases.

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