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Indications for reverse total shoulder arthroplasty in chronic locked shoulder dislocation: A case report and review of literature

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Abstract
Reverse total shoulder arthroplasty (rTSA) is typically indicated for severe glenohumeral disease with concomitant rotator cuff insufficiency, though sparse evidence suggests positive outcomes with its use in chronic shoulder dislocation as well. We present the case of a 51-year-old male with a chronic locked anterior glenohumeral dislocation for 7 months and associated rotator cuff tear, massive engaging Hill Sachs lesion, and Bankart lesion. Several attempts at both arthroscopic and open joint repair failed, and the patient was ultimately successfully treated with rTSA. The chronicity of this patient's dislocation and severity of concomitant articular defects put him at high risk of failing native joint repair, and while these operations were still attempted, the operative surgeon would recommend rTSA first if presented with this case again. The authors believe this case lends support to the use of rTSA as a primary operative intervention in patients with chronic locked glenohumeral dislocation, though further prospective research is needed to better support this recommendation.

Keywords: Shoulder, arthroplasty, replacement, shoulder, arthroplasty joints

Introduction
Reverse total shoulder arthroplasty (rTSA) is a procedure used to preserve range of motion and reduce pain in patients with advanced glenohumeral disease with concomitant severe rotator cuff deficiency [1-6]. While minimally invasive arthroscopic procedures have become commonplace for many shoulder surgeries, including rotator cuff repairs, remplissage, and bony resections, the demand for shoulder arthroplasty has been increasing in recent years and is projected to increase ninefold between 2011 and 2030 [7]. Furthermore, rTSA is expected to be used in an increasing proportion of shoulder arthroplasties compared to hemiarthroplasty [7, 8]. In addition to its indications in glenohumeral disease with rotator cuff insufficiency, rTSA has also been shown to be an effective treatment for less common etiologies of shoulder disease, including chronic glenohumeral instability and chronic locked shoulder dislocation [9, 10]. We describe the case of a patient with chronic anterior locked dislocation of the glenohumeral joint that failed numerous nonsurgical and less invasive surgical treatments, ultimately treated successfully with rTSA.

Case presentation
Operative reports
We present the case of a 51-year-old male patient that initially came to the outpatient clinic with a 7-month history of right anterior shoulder dislocation. He had recently obtained an MRI at another clinic demonstrating anterior dislocation of the right shoulder, an engaging Hill-Sachs lesion involving almost 50% of the humeral head, a large full-thickness tear of the rotator cuff with supraspinatus and infraspinatus retraction, and a Bankart lesion of the anterior labrum. Plain radiographs obtained at this visit supported the MRI findings, with additional evidence of a right sided incompletely healed, mildly displaced distal-third clavicle fracture and glenohumeral arthritis (Figure 1). He reported his shoulder had been anteriorly dislocated for the entire 7 months since his initial injury. He had tried NSAIDs and physical therapy for his shoulder pain and decreased range of motion, but these did not provide any relief. He had also failed several attempts at closed reduction of the shoulder. Physical exam showed visible deformity of the right shoulder, tenderness to palpation over the right coracohumeral ligament, severely limited range of motion in the right shoulder (pROM to 10 degrees of forward flexion, aROM to 0 degrees of forward flexion) and 1/5 and 1/5 strength of the right supraspinatus. He described his pain as mostly constant with a severity rated at 8/10.

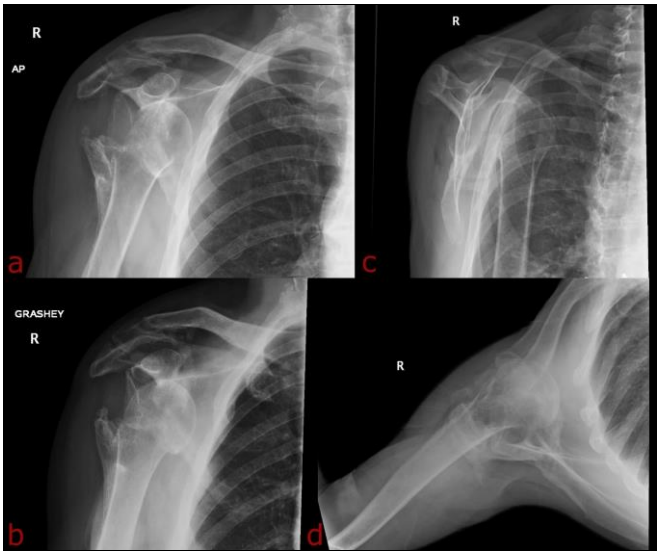

Fig 1: Right shoulder radiographs taken at the patient's initial visit to our clinic, demonstrating anterior shoulder dislocation. Views: (a) anterior-posterior [AP], (b) Grashey, (c) Scapular-Y, (d) Axillary.

Due to his numerous past failures of closed reduction, bony lesions, and significant rotator cuff pathology, an arthroscopic reduction with rotator cuff repair with bankart repair and remplissage was scheduled for this patient. Intraoperatively, reduction could not be achieved despite extensive release of adhesions and significant manipulation and traction. The patient had not wished for a conversion to open reduction at this time, and as such the surgery was ended and the arthroscopic incisions were closed. Upon further discussion with the patient postoperatively, an open reduction with rotator cuff repair and remplissage and excision of heterotopic ossification was scheduled for 6 weeks after the arthroscopic attempt. In this open surgery, significant scar tissue released and heterotopic ossification was excised from the glenoid, subacromial, and coracoid spaces. Only after the subscapularis was tenotomized was glenohumeral reduction successful. The anterior labrum and anterior joint capsule had completely degenerated and were not seen, and there was acetabularization of the anterior scapula medial to the glenoid fossa where the humeral head had been resting for many months. The reduced glenohumeral joint allowed direct visualization of the Hill-Sachs defect, and a teres minor remplissage was completed with Mitek Healix suture anchors [11]. The supraspinatus, infraspinatus, and subscapularis tendons were all repaired with the same suture anchors, and the skin was irrigated and closed.

Five weeks after the open reduction with remplissage and rotator cuff repair, the patient returned to clinic with anterior bulging at the operative shoulder. Plain radiographs demonstrated the right shoulder was dislocated yet again, without evidence of interval fracture (Figure 2). Due to recurrent dislocations, the Hill-Sachs lesion comprising over 50% of the humeral head articular surface, the massive Bankart lesion, recently reconstructed rotator cuff tears, and multiple failures of other surgical therapies, a reverse total shoulder arthroplasty was recommended. The patient was informed that the chronic nature of his shoulder injury and his history of multiple failed reconstructions indicated that he was at a higher risk of rTSA failure, in which case a Girdlestone resection arthroplasty would be the only remaining option for shoulder salvage. He understood and agreed to proceed with rTSA.

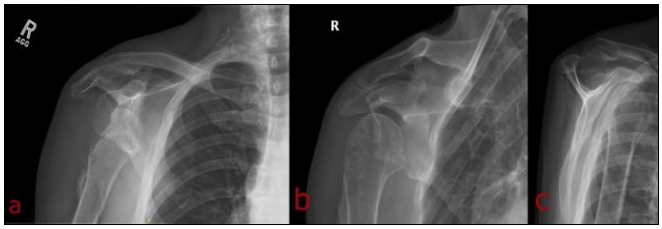

Fig 2: Right shoulder radiographs taken 5 weeks after attempted arthroscopic reconstruction, demonstrating a repeat anterior shoulder dislocation. Views: (a) anterior-posterior [AP], (b) Grashey, (c) Scapular-Y

At the start of the reverse total shoulder arthroplasty, the previous surgical incision at the deltopectoral interval was opened and the dislocated humeral head was immediately visualized. The humerus was reamed and broached, and then the humeral head was resected. The glenoid was then exposed, which was covered with and surrounded by scar tissue. All visible scar tissue, as well as the sutures and suture anchors from prior surgeries, were removed, and standard releases of the shoulder were completed. The glenoid was extremely small due to erosion anteriorly from the chronic dislocation and subsequent acetabularization, and there was additionally a new fracture of the anterior inferior glenoid. The rTSA was then completed using the Zimmer Biomet Comprehensive Reverse Shoulder System [12] with a 36mm glenosphere and constrained liner limiting the shoulder to 120 degrees of forward flexion. Stability and motion tests were satisfactory, and the tissues were irrigated and closed. Postoperative radiographs demonstrated prostheses in good alignment without hardware complication (Figure 3). The patient was observed overnight in the hospital and was discharged home the following day.

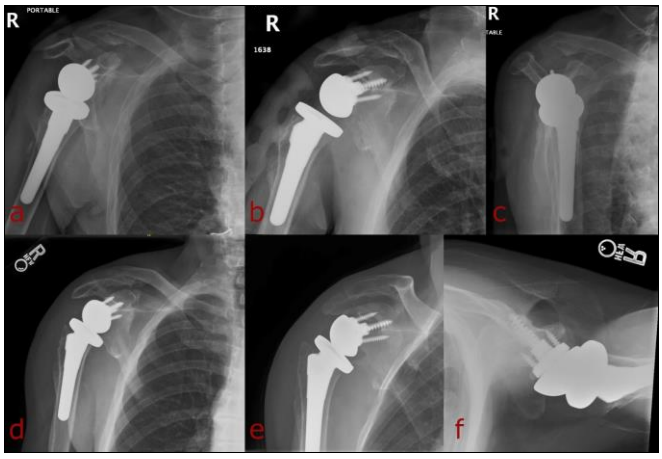

Fig 3: Right shoulder radiographs taken immediately (images a-c) and two weeks (images d-f) status post reverse total shoulder arthroplasty. Views: (a,d) anterior-posterior [AP], (b,e) Grashey, (c) Scapular-Y, (f) Axillary.

Post-operative treatment course

The patient returned to the clinic two weeks after the rTSA surgery for his first follow-up visit. Plain radiographs obtained at that time demonstrated well-seated prosthetic shoulder hardware in correct alignment without evidence of dislocation or periprosthetic fracture (Figure 3). The patient reported minimal pain and some numbness and tingling in

his right arm consistent with his preoperative baseline. He was referred to physical therapy at this time, and was advanced to full range of motion without the sling with a weight restriction of 10 pounds. He was instructed to follow up as needed after completing his physical therapy regimen.

Discussion

For over a century, arthroplasty has been used as a treatment for joint pain and diminished range of motion secondary to joint damage by arthritis, infection, trauma, or congenital defects [13]. The first documented use of an endoprosthetic shoulder replacement in a human took place in 1893, when French surgeon E.J. Péan implanted a proximal humerus prosthesis composed of platinum and rubber for a shoulder damaged by tuberculosis infection [14, 15]. Shoulder arthroplasty became more prevalent after Neer's 1955 article reporting favorable outcomes in patients who underwent proximal humerus arthroplasty after humerus fracture [16]. As shoulder prostheses and surgical arthroplasty techniques became more refined throughout the 1960s and 1970s, surgeons became increasingly aware of frequent complications with their use, including continued pain and instability after shoulder arthroplasty – particularly in patients with concomitant rotator cuff injury [17–19]. Without an intact rotator cuff to provide glenohumeral stability, these patients were prone to primary shoulder arthroplasty failure due to recurrent dislocations. Constrained (or fixed-fulcrum) shoulder arthroplasty was developed to address this problem of implant instability by removing the ability of the prosthetic proximal humerus to translate across the glenoid surface [20]. Constrained arthroplasty was often used as a salvage procedure in patients who had failed primary arthroplasty due to lack of rotator cuff integrity [21]. However, these constrained prostheses had high rates of failure, primarily due to glenoid component loosening in response to powerful forces directed on the glenoid implant and insufficient anchoring capacity of the scapula [15].

In 1985, Paul Grammont published a paradigm-shifting system for total shoulder arthroplasty that shifted the center of glenohumeral joint rotation medially and distally with respect to previous shoulder implant designs, allowing the deltoid to provide elevation and stability at the glenohumeral joint without the need for an intact rotator cuff [22, 23]. Grammont's design was further refined and released in 1991 as the Delta III shoulder implant, composed of a half-sphere implant at the glenoid (glenosphere) fixed by a central peg and two screws, a polyethylene cup, and a humeral stem [22]. This "reversal" of the native ball and socket locations on the humerus and glenoid led to Grammont's implant becoming known as the reverse total shoulder arthroplasty. Today, orthopedic surgeons typically use rTSAs for patients with severe glenohumeral arthritis, trauma, or other deformity and concomitant irreparable rotator cuff disruption, in addition to patients with intact rotator cuffs but failed prior surgical interventions [2–6, 24–26]. Occasionally, rTSA is used in patients presenting with other less common shoulder pathology, including glenohumeral instability and chronic locked dislocation [9, 27].

Chronic glenohumeral dislocation, especially locked dislocation, almost always requires surgical intervention as closed reduction is rarely successful [28]. Even with arthroscopic or open reduction, these cases have historically been associated with poor range of motion and pain outcomes postoperatively [29-32]. Several studies have reported positive outcomes with rTSA in the management of chronic locked shoulder dislocation, including both anterior and posterior dislocations [9, 24, 27, 28, 30, 32-34]. Reverse TSA has an added benefit in these patients as many will have concomitant rotator cuff disruption from traumatic primary or recurring dislocations, making them unlikely to benefit from standard TSA or other more conservative treatments [2, 5, 23, 25, 35]. Patients with shoulder dislocation have an associated Hill-Sachs lesions in 47-100% of cases, and hemi- or total arthroplasty has been recommended in patients with lesions involving more than 25-40% of humeral head [28, 36, 37]. Thus, the likelihood of significant bony damage in patients with chronic or recurrent shoulder dislocation with or without locking, especially those with long periods of dislocation (>6 months), together with the high probability of failed nonoperative and/or failed arthroscopic treatment in their disease course, makes these patients good candidates for rTSA [9, 26, 28, 37–39].

In this case of a patient with chronic locked shoulder dislocation with associated massive Hill-Sachs deformity, Bankart lesion, and rotator cuff tear, a reverse total shoulder arthroplasty successfully restored adequate range of motion and stability. The rTSA was used as a last resort to preserve motion at the shoulder and reduce pain from chronic recurrent shoulder dislocation after several failed attempts at non-prosthetic reconstruction. As of writing this manuscript, the patient is very happy with his new shoulder. He reports that he has not had any dislocations of the prosthetic shoulder, and has had significant improvements in range of motion, pain, and paresthesias of the right upper extremity with continued physical therapy and healing time. The positive outcomes seen in this case provide further evidence of chronic locked glenohumeral dislocation successfully treated with rTSA.

The authors also advocate for more prospective studies on the indications and outcomes for rTSA as a primary treatment for chronic glenohumeral instability and chronic locked glenohumeral dislocation; costs associated with failed surgical interventions might be avoided if reverse total shoulder arthroplasty is used as a first option for patients with a lower likelihood of response to minimally invasive or native joint conserving reconstructions. Several recent studies have found the use of rTSA as a primary treatment for proximal humerus fractures is associated with significantly higher measures function, lower rates of complications, and less need for further revision when compared to other surgical treatment plans like ORIF or hemiarthroplasty, even when those are later revised with rTSA [33, 40-43]. While there are several studies already cited above that examine the role of rTSA in chronic locked shoulder dislocation, very few have explored the use of rTSA as a primary treatment for this condition [9, 33, 34]. In agreement with the findings of those studies, the authors support the use of rTSA as a primary surgical treatment for chronic locked glenohumeral dislocation.

Conclusion

Reverse total shoulder arthroplasty is a procedure typically performed as a last option to preserve range of motion in patients with glenohumeral disease and rotator cuff insufficiency. Sparse data in the available research indicates rTSA can also be an effective treatment for chronic locked shoulder dislocations. The case presented here lends further

evidence of successful use of rTSA in chronic locked shoulder dislocation. The supervising author, who is also the operative surgeon, would likely use rTSA as a primary surgical intervention if presented with this case again. The authors advocate for further study on the differences in cost savings and outcomes when rTSA is used as a primary intervention for chronic locked shoulder dislocation compared to its use as a secondary or 'salvage' procedure in this demographic.

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