Humeral Head Resurfacing for Glenohumeral Arthritis Associated With Dysplasia

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Abstract

Humeral head resurfacing is indicated for the treatment of glenohumeral arthrosis in a variety of well-described situations, including humeral shaft abnormalities and obstructing hardware. This report of 2 cases emphasizes the benefit of this stemless device in situations in which dislocation of the humeral head and access to the humeral canal is not possible. In these 2 patients with developmental dysplasia and secondary glenohumeral arthrosis, humeral head resurfacing arthroplasty resulted in successful improvement of severe preoperative pain. In cases in which the humeral head cannot be dislocated due to severe dysplastic changes and joint line medialization, humeral resurfacing arthroplasty allows prosthetic placement through nontraditional exposures and results in high patient satisfaction and excellent pain relief.

Humeral head resurfacing is recommended and utilized to treat almost all forms of glenohumeral arthritis in which there is enough bone in the proximal humerus to support the prosthesis.[1] In many of these cases, such as osteoarthritis, the surgeon has the option of using a stemmed prosthesis without clear cut advantage of one system over another.[2] There are several well-described indications where using a resurfacing prosthesis offers significant advantages over a stemmed prosthesis. These include situations in which the humeral canal is abnormal, as in malunion, or when it is otherwise obstructed by hardware. In most cases, access to the humeral canal is gained by dislocating the glenohumeral joint and placing the arm in an extended and externally rotated position. This position allows for reaming of the canal and insertion of the prosthetic humeral stem. Situations in which this is not possible pose a challenge to the use of a stemmed humeral component.

Patients with glenohumeral dysplasia may progress to debilitating and painful arthritis; shoulder arthroplasty is often indicated in these cases. Glenohumeral joint dysplasia can be associated with syndromes such as multiple epiphyseal dysplasia and Apert's syndrome.[3,4] Congenital dislocation of the shoulder has been associated with Erb's palsy and Holt-Oram syndrome, and also results in joint dysplasia due to the abnormal relationship between the humeral head and glenoid during the growing years.[5] These dysplasias are often associated with significant medialization of the glenohumeral joint, prominence of the acromion, and a hatchet-shaped proximal humerus.[3,4] Dislocation of the glenohumeral joint and placement of the humeral shaft into the extended/externally rotated position necessary for reaming and stem insertion is often impossible without greater tuberosity osteotomy. This deformity is a significant challenge to the insertion of a traditional stemmed humeral component. The 2 case reports presented here demonstrate the advantage of humeral resurfacing in the management of these complex cases of arthritis associated with glenohumeral dysplasia. The patients provided written informed consent for print and electronic publication of these case reports.

Case Reports

Case 1

A 32-year-old right-hand dominant man with Apert's syndrome presented to our clinic with a 4 year history of progressive left shoulder pain. He had 26 prior surgeries associated with Apert's syndrome, mostly on his hands, face, and feet. Pain began with repetitive use of the arm stocking shelves in a grocery store. He did not respond to a prolonged course of physical therapy and 2 years prior to presentation to our facility had undergone arthroscopic acromioplasty, distal clavicle resection, and glenohumeral debridement. Grade III chondromalacia of the humeral head and glenoid was documented by the operating surgeon. The patient obtained no relief from these treatments.

On presentation to our clinic, he rated his pain as an "11" on the 10 point visual analog scale (VAS). In terms of function, he could perform only 2 tasks on the American Shoulder and Elbow Surgeons (ASES) questionnaire and both of these could be done only with great difficulty.[6] These included putting on a coat and doing his usual work.

His shoulder range of motion was active forward elevation of 45°, external rotation at the side of 45°,

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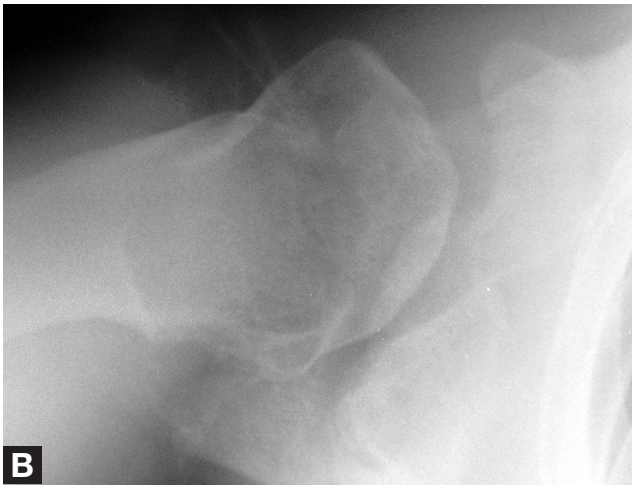

Figure 1. Case 1: (A) anteroposterior x-ray of the left shoulder of the patient with Apert's syndrome demonstrating the typical hatchet deformity. Note the severe glenoid dysplasia. (B) Axillary view of the left shoulder of the patient. Note the significant joint medialization.

and internal rotation to posterior superior iliac spine. Forward elevation strength and internal rotation strength was 4+/5 and external rotation strength was 5/5. This was fairly symmetrical with the contralateral side. He had diffuse tenderness about the left shoulder girdle. His ASES score was 3/100; a score lower than 70 is considered poor. Radiographic evaluation of the shoulder revealed severe dysplasia affecting both the glenoid and humeral head (Figure 1A, 1B). The patient had multiple deformities of the hands consistent with Apert's syndrome and subsequent reconstructive surgery as well as a congenital C5-6 fusion. Computed tomography (CT) scan of the shoulder confirmed severe glenoid and humeral head deformity. Intra-articular xylocaine injection resulted in near complete relief of shoulder pain. Due to severe and progressive left shoulder pain, humeral resurfacing arthroplasty was offered to the patient.

Figure 2. Active forward postoperative elevation of the patient in case 1. Note the multiple hand deformities.

Operative Technique

Under general and interscalene block anesthesia, the patient was placed in the beach chair position and a standard deltopectoral incision was made. The subscapularis tendon was released from the lesser tuberosity and mobilized. The glenohumeral joint capsule was released from the medial humerus. Severe medialization of the glenohumeral joint was noted and the axillary nerve was directly in the operative field because the joint line was so medial. The humeral head had an undulating surface with peripheral osteophytes with Grade III to IV chondromalacia. Dislocation of the joint was impossible because of severe medialization of the joint and acromial overhang.

The coracoid was predrilled and tapped and then osteotomized. The tip of the coracoid and attached conjoined tendons were reflected distally. The arm was held in an externally rotated and slightly extended position and peripheral osteophytes were removed from the humeral head with a rongeur. This allowed adequate visualization of the humeral head for resurfacing. A central guide pin was placed through the anatomic axis of the humeral head, which was more varus than usual. Placement of this guide pin was not possible without osteotomy of the coracoid because it blocked direct access to the head for pin placement and reaming. The humeral head was measured and a 41 mm reamer was selected. The anteroposterior distance between the rotator cuff posteriorly and the lesser tuberosity anteriorly was used as a gauge in determining head size as the head was markedly deformed. The humeral head was reamed and a 41x15 mm press fit humeral resurfacing head (Aequelis, Stafford, Texas) was impacted into place. The subscapularis was repaired using a combination of bone-to-tendon and tendon-to-tendon sutures and the coracoid was repaired with a

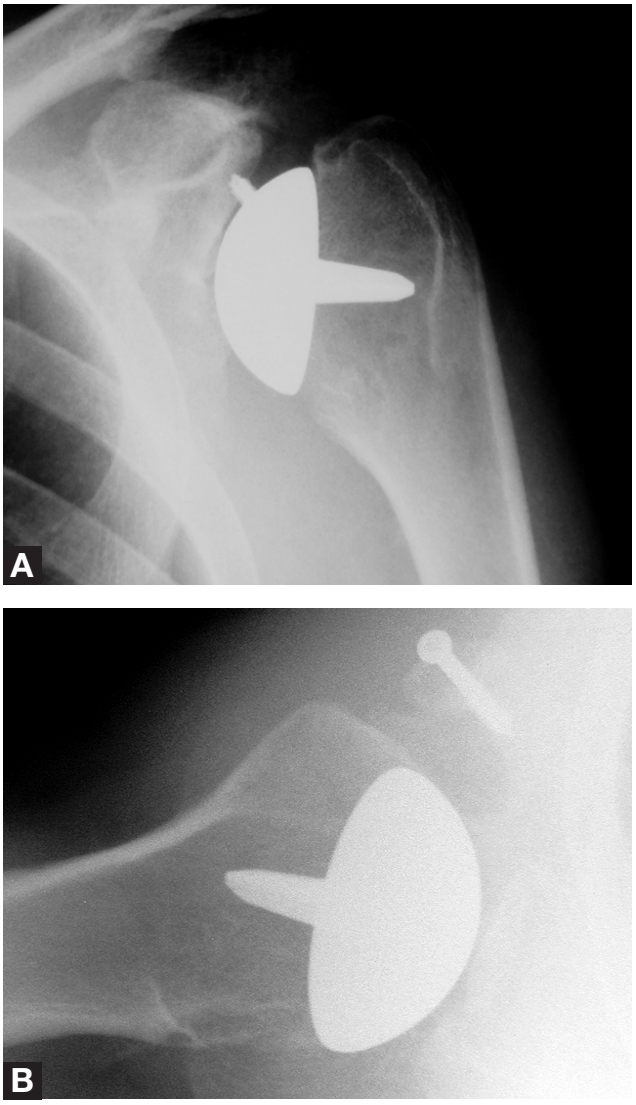

Figure 3. Case 1: (A) anteroposterior view of the left shoulder of the patient, post-humeral head resurfacing. Note that the position of the prosthesis was adapted to fit the patient's anatomy. (B) Axillary view of the left shoulder of the patient, post-humeral head resurfacing. Note the screw in the coracoids following osteotomy for prosthetic placement.

cannulated 4.0 mm screw. The wound was closed over suction drains and a standard postarthroplasty protocol for physical therapy was followed.

Three years postoperatively, the patient notes his pain as a 1 out of 10 on the VAS and is extremely satisfied with the results of surgery. He reports no restrictions in activities of daily living and has an ASES score of 95/100. Range of motion is active forward elevation of 80°, external rotation at the side of 50°, and internal rotation to L4 (Figure 2). He has 4+/5 strength diffusely. X-rays reveal a well-seated humeral resurfacing arthroplasty and union of the coracoid osteotomy (Figure 3A, 3B).

Case 2

A 72-year-old left-hand dominant woman suffered chronic right shoulder disability due to an Erb's palsy from birth. She had been followed 7 years previously for problems related to a massive contralateral left shoulder rotator cuff tear at which point this shoulder had limited function but was pain free. She did not develop right shoulder pain until 2 months prior to this most recent presentation. There was no history of trauma or overuse. She rated her pain as an 8 out of 10 on the VAS. Function had always been limited but was deteriorating. She could no longer sleep on that side which she had done without problems at her previous visit with me 7 years prior. Her preoperative ASES score was 31.7 out of 100. On examination she had moderate atrophy of the shoulder girdle with posterior joint line tenderness at the right glenohumeral joint. Range of motion was active forward elevation of 80°, external rotation at the side of -30°, and internal rotation to the side. Strength was diffusely 3/5 throughout. X-rays revealed chronic posterior dislocation of the humeral head with severe glenoid retroversion and wear (Figure 4). They were otherwise very difficult to interpret. CT scan confirmed this deformity and demonstrated that the glenoid vault consisted of little more than a concavity on the posterior table of the scapular body (Figure 5). It also demonstrated arthritic changes in the humeral head and bone on bone contact between the humeral head and the glenoid. Humeral resurfacing arthroplasty was recommended because of severe unrelenting pain,

Operative Technique

Under general and interscalene block anesthesia, the patient was placed in the beach chair position. A deltopectoral incision was made and the dissection was carried down to the anterior glenohumeral joint and subscapularis tendon. Dissection was difficult due to

Figure 4. Anteroposterior x-ray of the right shoulder in the patient with Erb's palsy (Case 2). Note the severe medialization with acromial overhang and severe glenoid dysplasia.

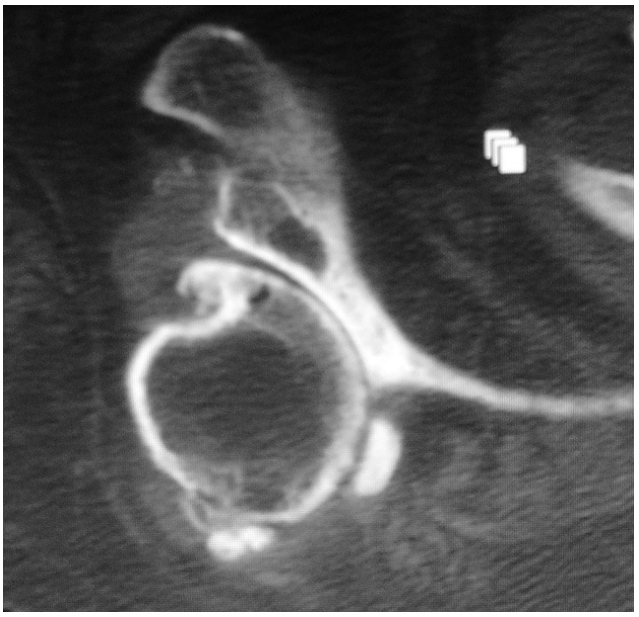

Figure 5. CT scan of the right shoulder of the patient in case 2. The glenoid consists of a slight indentation on the posterior wall of the scapula. Note the severe medialization with lateral prominence of the coracoid.

Figure 6. Postoperative active forward elevation in the patient in case 2. The range of motion did not change significantly but pain improved remarkably following shoulder arthroplasty.

deformities associated with the Erb's palsy and posterior dislocation. The subscapularis was released from the lesser tuberosity. Severe retroversion of both the proximal humerus and glenoid were noted and the humeral head could not be completely visualized from the anterior approach. Dislocation of the humeral head anteriorly was impossible despite multiple attempts.

The decision was made to proceed through a posterior approach to the shoulder. The operating table was tilted to the left and a 10 cm skin incision was made from the posterior corner of the acromion to the axillary skin fold. The deltoid muscle was very atrophic and a split was made in the posterior raphe. The axillary nerve was identified in the quadrilateral space and was protected. The infraspinatus and teres minor muscles were released from the greater tuberosity and reflected medially to expose the humeral head. The arm was held in marked internal rotation and slight flexion and the humeral head was delivered into the wound. A guide pin was placed centrally in the head although anatomy was very distorted. A 37x13.5 mm head (Aequelis) was selected and the humeral head was reamed over the guide wire. Large cysts in the head required cancellous allografting. The resurfacing implant was impacted and the posterior capsule was repaired along with the posterior cuff tendons. The subscapularis was similarly repaired. The patient's arm was held in a neutral rotation brace for 6 weeks after which active-assisted exercises were started. Passive range of motion exercises in the mid range were allowed to protect the rotator cuff and no active use of the arm was allowed until 6 weeks postoperatively. At 1 year postoperatively, she rates her pain as a 0 out of 10 on the VAS and her active range of motion in forward elevation was 90°, external rotation -10°, and internal rotation to T12 (Figure 6). Her ASES score is 70. She is very satisfied with the results of surgery. X-rays reveal stable alignment of the prosthesis relative to the humerus (Figure 7).

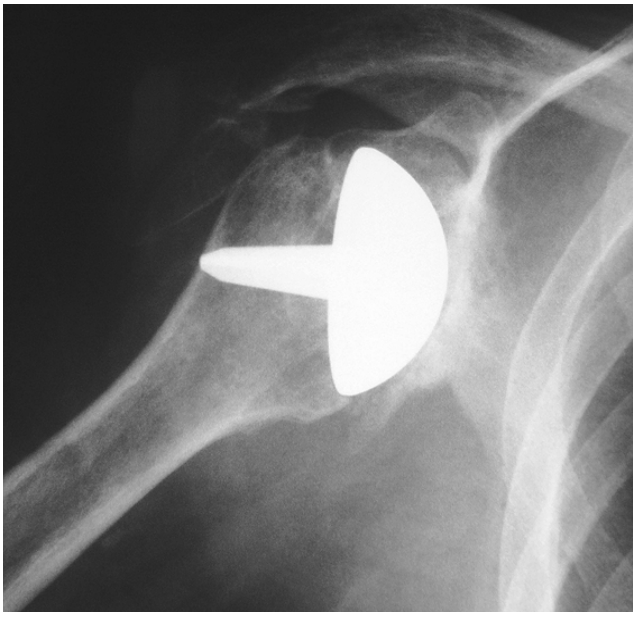

Figure 7. Anteroposterior view of the right shoulder in the patient in case 2, post-humeral head resurfacing. The shoulder remains well located in the patient's native hypoplastic glenoid.

Discussion

A major added benefit of the humeral resurfacing arthroplasty is the ability to perform this procedure through a limited approach without having to gain access to the humeral intramedullary canal. This aspect

of the resurfacing arthroplasty is especially helpful in cases of arthritis associated with glenohumeral dysplasia. In these cases, the glenohumeral joint is medialized and covered by a relatively long overhanging acromion.[3] Anatomic distortion often precludes dislocation and access to humeral canal. Similar circumstances may occur in patients with distorted anatomy due to posttraumatic malunion. Greater tuberosity osteotomy during shoulder arthroplasty is associated with significant morbidity and results of surgery are better if this can be avoided.[7]

Glenohumeral joint dysplasia presents with variable amounts of retroversion due to glenoid hypoplasia. The glenoid bone stock is typically insufficient to support a glenoid prosthesis. One challenge in the use of the humeral resurfacing arthroplasty in more standard cases is the increased difficulty it affords in accessing and preparing the glenoid for resurfacing. This aspect of the resurfacing arthroplasty does not play a role in cases of dysplasia as glenoid work is typically not possible. In many cases of Erb's palsy, access to the humeral head can be gained from an anterior approach and in those cases we would recommend resurfacing in-situ with forced external rotation of the arm and possible coracoid osteotomy. Otherwise, in cases of severe glenoid retroversion and chronic posterior dislocation, the posterior approach becomes an option. In these cases, protection of the rotator cuff will be required postoperatively as in a massive rotator cuff repair.

The major goal in the management of the 2 cases presented here was pain relief. Patients with glenohumeral dysplasia present with limited range of motion and function.[4] Humeral resurfacing did not significantly increase range of motion in either of these cases and functional improvement was primarily due to pain relief. The patient with Apert's syndrome's high ASES score (Case 1) is reflective of his satisfaction in the procedure, although his perception of functional limitations is different from someone with normal anatomy. We do not recommend this procedure for functional limitations alone without significant pain.

There are a growing number of prosthetic designs utilizing short stems that require access only to the metaphysis. These prosthetic designs may function in a similar fashion to the resurfacing arthroplasty used here, but we have no experience with them. Poor bone quality in the humeral head can be an issue in terms of support of the resurfacing arthroplasty, as seen in the Erb's palsy case here (Case 2). Generally, 60% support of the prosthesis is recommended and bone grafting may help.[1] Short metaphyseal stems may be indicated in this setting.

There are definite indications in which the resurfacing arthroplasty is clearly superior to a stemmed prosthesis, including cases in which the humeral intramedullary canal is abnormal, such as malunion or hardware blockage. Patients with well-compensated cuff tear arthropathy are good candidates for resurfacing arthroplasty, because potential revision to a reverse total shoulder prosthesis in the future is much easier with this prosthesis than with a well-fixed stemmed prosthesis. Use of the resurfacing prosthesis in younger patients for bone stock preservation is reasonable, but is not clearly superior to a well-placed stemmed humeral component, which is just as easily revised to a total shoulder replacement in the future.

Conclusion

Using a resurfacing prosthesis in cases of glenohumeral arthritis associated with dysplasia is clearly superior to using a stemmed prosthesis as these cases demonstrate and can be added to the list of definite indications for the humeral resurfacing arthroplasty.

Author's Disclosure Statement

The author reports no actual or potential conflict of interest in relation to this article.

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