

# Chapter 7

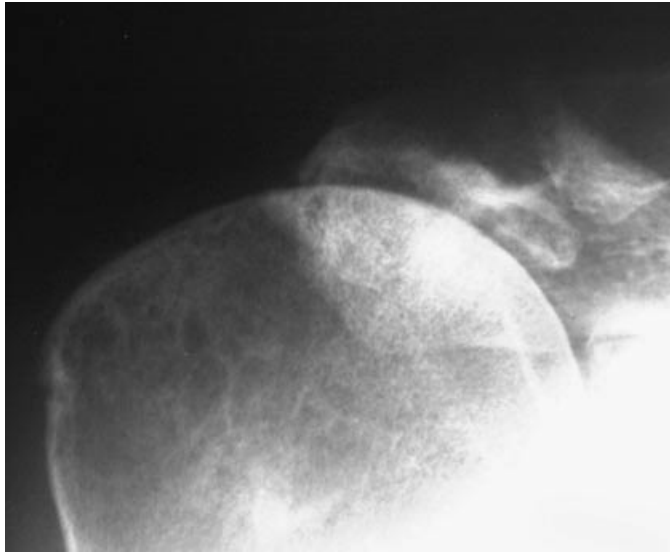
## Arthroplasty and Rotator Cuff Deficiency

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Rotator cuff deficient shoulders with degenerative joint disease are a treatment challenge. Most patients present primarily due to shoulder pain. Shoulder function can be variable even with significant chronic rotator cuff deficiency. The arthritic condition of the shoulder due to a chronic rotator cuff tear has been termed *cuff-tear arthropathy* [1]. This is characterized clinically by pain and poor active motion, but with near normal passive motion. Within the shoulder there is crepitus and occasional significant fluid production seen under the deltoid. On manual muscle testing, there is significant weakness of elevation and external rotation. Radiographically, this condition is characterized by elevation of the humeral head. There is loss of joint space at the glenohumeral joint and adaptive changes on the acromion and humeral heads. Typically a new *acromiohumeral* articulation has been formed (Figure 7.1). In advanced conditions, there can be collapse of the humeral head and significant incongruity between the humeral head and the superior glenoid, and between the humeral head and the undersurface of acromion.

Radiographically, there can be a pattern of more superior wear with significant adaptive changes and concavity of the acromion (Figure 7.2). There can be a centralized wear pattern between the humeral head and significant loss of glenoid bone stock (Figure 7.3). There can also be seen a more massive destructive arthropathy between the humeral head, glenoid and acromion (Figure 7.4A and 7.4B). It is unclear at this time if these are three different points on the time line of degeneration; or if the shoulder responds differently with differing degenerative patterns to the chronic cuff deficiency. There has been no staging or classification of these radiographic changes or of clinical function. To make matters more confusing, not every shoulder with an irreparable rotator cuff tear goes on to painful, symptomatic cuff tear arthropathy.

An attempt to classify the changes on the acromion and on the glenoid seen radiographically has recently been attempted [2]. This radiographic evaluation was performed in France to try to determine prognostic factors for treatment in the differing patterns of the degenerative change seen in cuff tear arthropathy. Patients were treated with



**Figure 7.1.** Characteristic adaptative changes in a right shoulder with cuff deficient arthritis. Note the concave acromion and the *new* acromiohumeral articulation. The greater tuberosity has *rounded off* also.



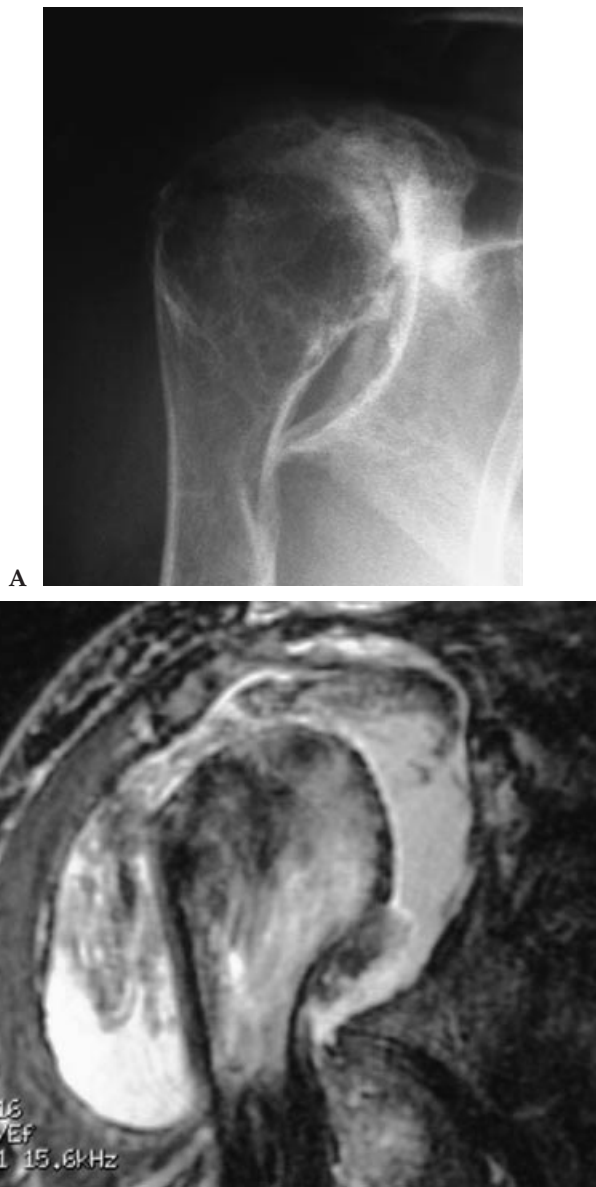
**Figure 7.2.** This shoulder exhibits a superior wear pattern. Note the extensive thinning of the acromion and the matching concave surfaces between the acromion and humeral head.



**Figure 7.3.** This shoulder exhibits a more central pattern of degenerative change. Note the narrowed acromiohumeral distance, but little concavity to the acromion. However, there are glenohumeral joint changes with irregularity, sclerosis, and glenoid bone erosion.

either hemi-arthroplasty or, then available only in Europe, a reverse prosthesis. Four differing patterns of wear of the acromion and four different patterns on the glenoid side were identified. Risk factors for a poor result were found in patients with a so-called E2 glenoid. This is a glenoid that has significant superior wear and thus, on an AP X-ray, shows significant superior slope (Figure 7.5). In both hemi-arthroplasty and reverse shoulder prosthesis, this superior slope glenoid had poor results. On the acromial side, significant thinning with either an impending fracture or evidence of an insufficiency fracture of the acromion led to very poor results with hemi-arthroplasty. This was the first type of any classification to determine any prognostic significance to the degenerative changes seen in cuff tear arthropathy. Certainly more detailed analyses and follow-up will be necessary to conclusively determine prognostic factors in this disease process.

As the population is getting older and staying more mentally and physically active, cuff deficiency with arthritis will be a problem that orthopedic surgeons will have to deal with, and the more detailed analysis and information on cuff tear arthropathy can only lead to better treatment. When evaluating an elderly patient with shoulder problems, a history and physical examination, as in any condition, is of paramount importance. History of previous surgery around the shoulder, especially earlier attempts at rotator cuff repair, is extremely important to know. A history of trauma such as previous falls, dislocations, or fractures needs to be known. Also the type of medication



**Figure 7.4.** Severe destructive arthropathy of a right shoulder. The AP radiograph shows superior and medial migration of the humeral head (A). The MRI reveals tremendous fluid accumulation under the deltoid (B).

the patient is on, especially anti-metabolites or corticosteroids, is extremely important to document.

### Physical Examination

On physical examination, one of the hallmarks of cuff tear arthropathy is the fact that passive motion of the shoulder is near normal but usually painful and has some crepitus associated with it. However, active motion of the shoulder is usually very restricted, and with



**Figure 7.5.** An example of the glenoid wear pattern categorized as E2, with significant superior glenoid bone erosion, creating a superior slope to the glenoid joint surface. Note that the medial humeral shaft is almost impacting on the inferior glenoid rim.

attempted active elevation, the scapula will shrug. In advanced arthropathy there will even be an internal rotation drop sign, with the forearm not being able to be held against gravity in external rotation. If viewed from the posterior aspect, most patients show atrophy of the supraspinatus and infraspinatus fossae. Typically, the deltoid is not atrophic but actually sometimes shows a bulge because of the fluid production and fluid collection under the deltoid that can occur (Figure 7.6). Occasionally, the shoulder seems very squared-off at the acromion because of the medialization of the glenohumeral joint line bringing the acromion into relief laterally. Careful evaluation on how the patient tends to elevate his or her arm is important. If with attempted active elevation there is anterior superior instability with the humeral head riding out from underneath the coracoacromial arch, either from previous coracoacromial arch surgery or significant loss of bone and soft tissue, this is a very poor prognostic sign for hemi-arthroplasty.

Imaging studies with plain X-rays are essential. The views obtained should be a true AP of the glenohumeral joint, an axillary view, and a scapular Y view. In patients without advanced osseous changes, a CT or MRI scan can be considered. This gives a quantitative and qualitative impression of the size and location of the rotator cuff tear and, more importantly, the status of the muscle bellies of the supraspinatus, infraspinatus, subscapularis, and teres minor. These studies can provide the surgeon with an assessment of the reparability of a rotator cuff tear with minimal degenerative changes as opposed to a long-standing rotator cuff tear with significant atrophy of the muscle bellies and fatty infiltration of the muscle bellies, which would indicate a technically challenging surgery and one in which functional restoration will not occur [3–7]. Most patients with advanced rotator



**Figure 7.6.** A right shoulder with an *inflated* appearance due to significant fluid accumulation under the deltoid.

cuff tear arthropathy with adaptive and degenerative changes seen on plain films do not require advanced imaging studies such as CT scan or MRI, however.

## Indications

Indications for surgical intervention in a patient with significant shoulder pain and advanced degenerative changes consistent with rotator cuff tear arthropathy are primarily for pain relief. As stated previously, the active forward elevation and shoulder function ability of patients in this disease process can be somewhat variable. Patients can have significant ability to raise the arm above horizontal and have dramatic radiographic changes and minimal pain. This patient should be treated conservatively. Some patients have almost no pain but extremely poor function with the inability to actively elevate above the horizontal or even use the hand away from the body at waist height. These patients are much more of a challenge because they have a painless *pseudoparalysis* of the shoulder. Hemi-arthroplasty does not restore active elevation ability in a patient who has pseudoparalysis. Prior to considering arthroplasty, an assessment of the patient's goals and needs should be made. Any surgery on cuff tear arthropathy is a limited goal procedure for pain relief and improved function of the shoulder for activities of daily living. The ability to actively elevate above the horizontal will be extremely unpredictable. Conservative

management would include a corticosteroid injection to decrease the inflammation and fluid production and to control the pain and allow the patient to rehabilitate. Physical therapy would have to focus on the structures that are left, which are typically some of the external rotators, some of the internal rotators, and the anterior deltoid. This can help patients gain another 5, 10, or 15 degrees of motion and stability. This can be a significant gain for these patients with regard to using the hand away from the body. If pain relief can be maintained, patients can be quite satisfied with these gains.

For the patient with cuff-tear arthropathy who has pain that is unresponsive to conservative management, no previous coracoacromial arch surgery, and no pseudoparalysis, hemi-arthroplasty is a reliable treatment. There appears to be no advantage to total shoulder arthroplasty (TSA) with resurfacing of the glenoid in an unconstrained shoulder design as there have been reports of longer operating room time, no advantage with regard to pain relief, and the risk of glenoid loosening because of the eccentric load of the humeral head on the glenoid component in rotator cuff-deficient patients [8, 9]. Bipolar shoulder hemi-arthroplasty has been advocated as a potential advancement for cuff tear arthropathy [10]. However, there has been no advantage to active forward elevation with the use of the bipolar and, in fact, in a published study, there was actually poorer active elevation ability than in other studies using hemi-arthroplasty.

Hemi-arthroplasty has shown the ability to predictably relieve pain in cuff tear arthropathy. Functional ability, specifically active elevation has been less predictable, however. At best, patients and surgeons should expect active elevation on the average to be approximately 90 degrees [9, 11–16]. It is unclear why some patients do better than others with regard to active elevation and shoulder function. No prognostic factor has been identified to correlate with a better functional result [11]. However, it is quite clear that poorer results are associated with those patients who had prior rotator cuff surgery, coracoacromial arch violation, or the use, as discussed earlier, of a total shoulder [9, 11, 13, 14].

## Operative Technique

The operative technique for arthroplasty in cuff tear arthropathy begins with a thorough preoperative evaluation. The vast majority of these patients are elderly, over the age of 62, and have comorbidities. These should be thoroughly evaluated by both the orthopedic surgeon and the patient's primary care physician. An anesthesia consult preoperatively can also be beneficial. We discuss the technical aspects of hemi-arthroplasty in this section.

Anesthesia can be provided with a scalene regional block. This provides excellent intraoperative pain relief and postoperative pain relief. The operation can be done completely under scalene regional anesthesia with sedation if desired or medically indicated. The procedure can also be done under a combined technique with a light general anes-



thetic in combination with the scalene regional block. This technique provides control of the airway and less requirement for intraoperative anesthesia because of the concomitant regional anesthetic and may be less stressful to the elderly patient.

Positioning is extremely important. The patient should be moved to the lateral edge of the operating room table. The operative arm should be able to be brought off the side of the table for gentle extension, external rotation, and adduction to dislocate the humeral head forward. The head and neck need to be supported. Because of the elderly nature of these patients, many of them have kyphosis of the thoracic spine and other cervical disease. A headrest that can extend or lengthen from the level of the back to the position on the occiput is helpful so as not to place these elderly patients in extension at the neck. A movable arm board, preferably a short arm board, is extremely important on the side of the table so that it can support the upper arm during the procedure but also slide down out of the way for the time when the arm needs to be dislocated off the side of the table. The shoulder and arm are draped free for maximum flexibility and position.

A deltopectoral approach is used so as not to violate the anterior deltoid (Figure 7.7). Typically the anterior deltoid is one of the few



**Figure 7.7.** A right shoulder with the deltopectoral incision marked out on the skin.



remaining functional muscles. Certainly before performing shoulder arthroplasty, an assessment of deltoid function needs to be made. If the deltoid has been denervated or is not functioning, hemi-arthroplasty is not indicated. The cephalic vein can be taken laterally with the deltoid or medially with the pectoralis major; it is a surgeon's choice. Typically after exploring the deltopectoral interval, extensive bursal material is encountered under the deltoid and under the clavipectoral fascia lateral to the strap muscles off the coracoid. This material can be quite extensive and can be found in an *onion skin* layering that can contain a significant volume of fluid in each layer. On first look the surgeon may think that they are cutting the subscapularis because of the robust nature of this material. With internal and external rotation of the humerus and forearm, the remnant of the subscapularis rotates with the humeral head. Thus, material that moves with shoulder and arm movement is the attached remnant of the subscapularis. Material that does not move is adaptive bursal material and this material should be debrided. Once the subscapularis is identified, the anterior circumflex vessels identify the inferior border of the subscapularis and are almost always present even in almost complete subscapularis deficiency. Whether there is significant subscapularis available or very minimal subscapularis available, the subscapularis should be incised off the lesser tuberosity. The author prefers a needle tip Bovie cautery and begins almost in the biceps groove and comes up over the top of the lesser tuberosity and takes the subscapularis off in a full thickness fashion in an attempt to preserve length.

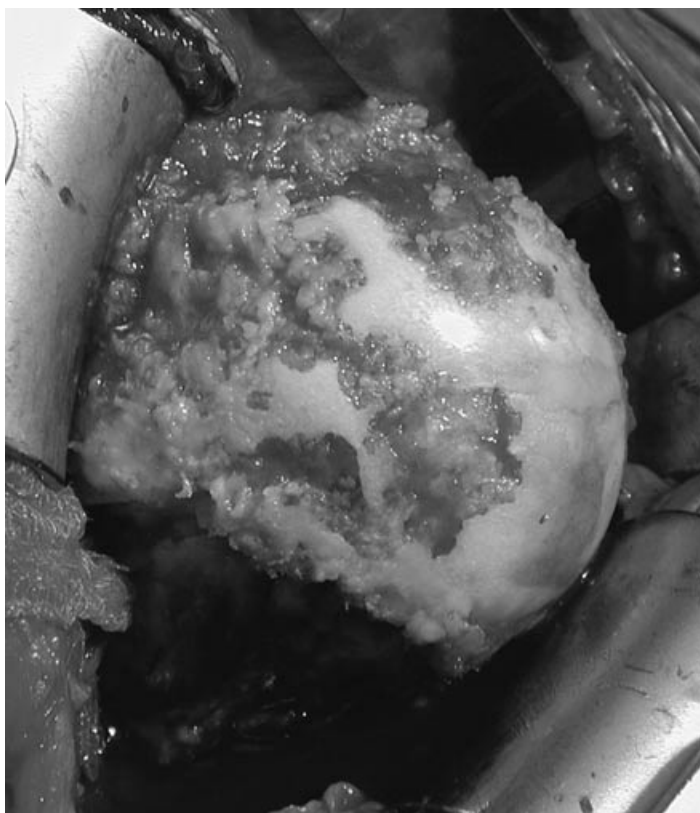
The humeral head most typically has found a new superior and medial location, and thus the subscapularis attachment is more superior within the shoulder and within the incision than seen in a typical shoulder operation. The axillary nerve should be palpated along the inferior border of the subscapularis and protected as the subscapularis is incised off the humerus. Placing the arm in adduction, external rotation brings the insertion of the subscapularis laterally away from the axillary nerve. Also, placing a Fukuda humeral head retractor within the glenohumeral joint places the axillary nerve on gentle stretch, allowing easier palpation and protection while incising the subscapularis.

Because of the superior location of the humeral head, the inferior capsule can be quite contracted. This inferior capsule needs to be released off the inferior neck of the humerus so that the humeral head can come down and be dislocated. This can be done safely with a blunt elevator and the capsule can be pushed off the inferior aspect of the neck of the humerus safely. The subscapularis should be tagged with sutures and reflected medially. There will be a variable quality to the subscapularis tendon and muscle belly in these patients. The subscapularis can be contracted to the anterior glenoid rim and the anterior capsule should be judiciously released from this area and the subscapularis also released from the undersurface of the base of the coracoid. This allows maximum excursion and a good *bounce* to the muscle belly. If the subscapularis is completely deficient, consideration can be given to a pectoralis major transfer. This can take the form of transferring the whole pectoralis major superiorly. Alternatively, the

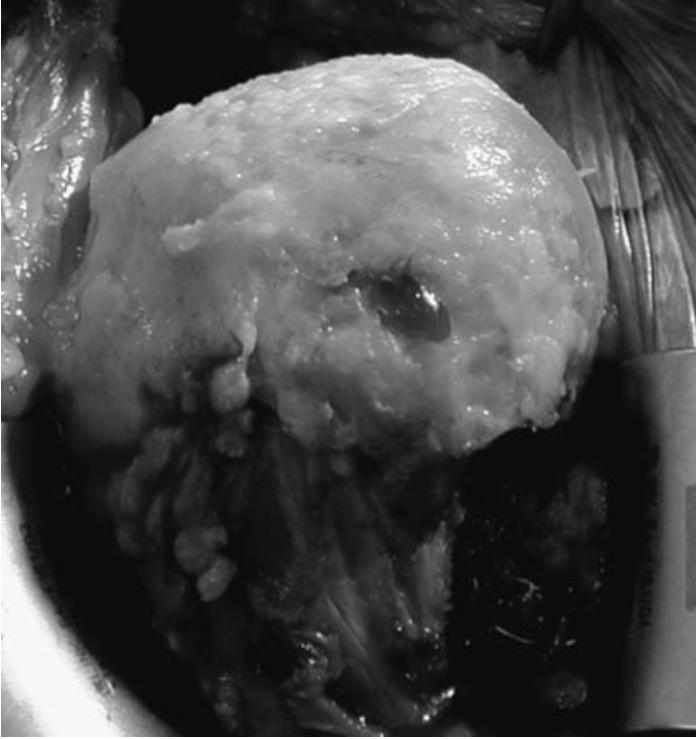
sternal head of the pectoralis major can be harvested and brought under the clavicular head and brought up, or the pectoralis major could be placed in a subcoracoid position for subscapularis substitution [17, 18].

Again, these are elderly patients and an assessment of the surgeon's ability to perform this part of the operation should be critically evaluated. Pectoralis major transfer in cuff tear arthropathy in addition to the utilization of a hemi-arthroplasty has not been a common combination. The advantage of pectoralis major transfer with hemi-arthroplasty has not been determined at this time.

At this point, the humeral head is gently dislocated. These patients have contracture as stated and are typically women over the age of 65 with osteopenic bone. Great care should be taken to gently distract the arm and put a flat retractor behind the humeral head. This should be the majority of the lever placed on the humerus, and then the arm carefully positioned in extension, adduction, and external rotation to bring the humeral head forward. It is hoped that these maneuvers will prevent any type of intraoperative fracture from occurring. The humeral head will be markedly deformed with a complete loss of supraspinatus tendon substance (Figure 7.8). Adaptive changes of the



**Figure 7.8.** An intraoperative photo of a right shoulder with cuff tear arthropathy. Note the severe deformity and erosions of the articular surface. Landmarks such as the biceps groove, greater and lesser tuberosities are not discernible.



**Figure 7.9.** This right shoulder is much more sclerotic, but so deformed it is difficult to determine medial or lateral orientation to the humeral head.

greater tuberosity that obscures the biceps groove and deforms the humeral head itself may leave no visible normal contour of the humeral head. The humeral head itself may look more like the ball on top of a flagpole than the more typical angled articular surface (Figure 7.9). Depending on what prosthetic system the surgeon is using, extra-medullary or intramedullary cutting guides can be used to mark humeral head osteotomy angle and location. The humeral head should be osteotomized with an oscillating saw with protection of the soft tissues. Once the humeral head has been osteotomized, the humeral canal is prepared with a selection of reamers and broaches as determined by the specific humeral implant that is being used. Careful reaming should be performed as again this can be very thin osteopenic bone. It is the author's preference to cement the humeral stem into place in the vast majority of these cases. The ability to get a press-fit within a very osteoporotic humerus with endosteal erosion can be difficult and can lead to intraoperative fracture. Also, cement stabilizes the proximal aspect of the humerus and supports sutures that are placed through the anterior anatomic neck for subscapularis reattachment without the risk of these sutures pulling through osteopenic bone.

One of the most problematic aspects of this operation for the surgeon is prosthetic humeral head size and position. Because the anatomy is so distorted, the restoration of normal glenohumeral joint relationships does not apply. General guidelines can be thought of as choosing a



**Figure 7.10.** The prosthetic head of the hemiarthroplasty has been sized to fit and fill the coracoacromial arch without overstuffing the joint. The sutures are for subscapularis reattachment.

humeral head size that will fill the existing coracoacromial arch. This should not be overstuffing, but should fill the coracoacromial arch because this is the new adaptive joint the patient has created (Figure 7.10). It is helpful to have a prosthetic head that allows approximately 50% of posterior translation on the glenoid. With the arm in approximately 70 degrees of abduction, at least 40 degrees of internal rotation of the arm should occur. This avoids overstuffing the glenohumeral joint cavity and creating the potential for posterior capsular tightness, anterior translation, and subsequent anterior and superior instability. This also avoids overstretching the subscapularis that needs to be repaired in some fashion at the end of the procedure. Thus, once the trial stem is in place and the trial humeral head in place, the surgeon should evaluate to make sure that the subscapularis can be repaired with the arm at approximately 30 degrees of external rotation, that the humeral head is stable underneath the coracoacromial arch, and that internal rotation is not significantly tethered. If there is adequate subscapularis material from superior to inferior, then the subscapularis can be translated superiorly to try to repair the upper centimeter of this to the anterior greater tuberosity. Any available posterior rotator cuff that can be identified and mobilized should be repaired to the greater tuberosity. However, no heroic repairs or tendon

transfers should be attempted. They show no advantage for pain relief or the restoration of active motion for the increased surgical time. All the soft tissue and rotator cuff mobilization should be done with the humeral trial head removed to maximize exposure and mobilization of this tissue.

Prior to cementing the hemi-arthroplasty stem in place, heavy non-absorbable sutures should be placed through the greater tuberosity if there is posterior rotator cuff to be repaired, and through the anatomic neck anteriorly for subscapularis reattachment. When cementing a cement restrictor plug should be used, the canal gently pulse lavaged of all fatty material, and poly methylmethacrylate cement mixed and placed down the canal. It is unnecessary and possibly dangerous to use a cement gun in the way that femurs are pressurized. Again, this is thin bone and, with pressurization, the cement can actually be pushed through a defect in the humerus. A Toomey syringe is an excellent way to place cement down the canal of the humerus, still provide an excellent cement mantle and control the cement technique. The humeral stem is then cemented into place in the determined position of height and retroversion. Depending on the system being used, the prosthetic humeral head may be placed on the stem before implantation or after the cement has hardened. Once the head is in place, the humerus is relocated in the glenohumeral joint cavity underneath the coracoacromial arch. The subscapularis is repaired to the lesser tuberosity. A drain may or may not be used underneath the deltoid. In many patients, because of the amount of bursal material and fluid production that needed to be debrided, there can be significant dead space. A drain for 24 hours may prevent a collection of a hematoma.

The deltopectoral interval is then tacked closed with absorbable sutures. The subcutaneous tissue is closed with absorbable sutures and then the skin closed by surgeon preference. A supportive sling and swathe device can be applied. If a scalene regional block has been used, the arm will have no muscle power and the swathe will control the arm at the side. It is also recommended that a pillow be placed behind the elbow postoperatively so that the arm, even though it is in a sling, cannot fall into an obligate extension position with the elbow at the level of the patient's back. It is much more comfortable to have the elbow at the level of the patient's anterior border along the stomach than having it fall back to the level of the back along the level of the mattress.

What about the glenoid? We had discussed that a superior sloping glenoid can be a cause for poorer results. With hemi-arthroplasty this allows the prosthetic head to slide superiorly and medially and continues significant bony erosion. Function is poor and the inferior aspect of the glenoid can actually impact the medial aspect of the humeral shaft. In these cases, with a severe superiorly sloped glenoid, consideration can be made for judiciously resculpting the glenoid with a reamer. The goal is to lessen the superior slope and try to provide a more concentric bearing surface on the glenoid side. This needs to be undertaken with great care as there can be very minimal bone stock in extremely soft bone. Authors have advocated superior glenoid bone

grafting but, in these elderly patients, it can be a difficult operation. Results of this type of procedure have been performed in a limited number of patients and a clear advantage has not been seen [19]. Hooded glenoid components to try to prevent this superior migration have been attempted but have universally failed due to loosening [20]. The best option is to identify the problem preoperatively with good radiographs and discuss with the patient that the goals of the surgery are pain relief, that function is going to be unpredictable, and that there can be progressive bony erosion from hemi-arthroplasty in these types of severe degenerative changes of the glenoid and acromion, which can lead to later pain and diminished function [14].

## Postoperative Care

Patients after hemi-arthroplasty for cuff tear arthropathy should be supported in a sling. Other co-morbidities such as lower extremity mobility problems from other types of arthritis need to be identified preoperatively. Many patients rely on their upper extremities to help support themselves during ambulation. This should be avoided in the early postoperative period. Passive range of motion should begin on the first postoperative day with pendulum exercises. Passive external rotation with a limit of 30 degrees, passive forward elevation with a limit of approximately 90 degrees and pulley exercises should be instituted. The patient is encouraged to use the hand, wrist, and elbow for activities of daily living within the sling. Aggressive stretching and attempts at improving range of motion are typically detrimental early on. After one month, the sling can be discontinued and active assisted range of motion can begin. The patient is encouraged to use the arm for activities of daily living and isometric strengthening for the muscle groups that are still workable are instituted. This would include the external rotators, all three heads of the deltoid and the scapular rotators. Any resistance to the internal rotators, specifically the subscapularis, should be avoided for approximately six weeks. At the end of two months, light resistive exercises with resistive exercise bands should be instituted for the external rotators, the internal rotators and all three heads of the deltoid. The patient should be informed both preoperatively and postoperatively that this will be a prolonged and slow rehabilitation. They will not reach their best or maximum potential for approximately six months after the operation.

## Results

Multiple studies have documented the predictable pain relief that hemi-arthroplasty can provide to patients who have unremitting pain from the degenerative changes of arthritis with cuff deficiency. This has also been shown to be the most consistent when there have not been previous attempts at rotator cuff repair or acromioplasty-coracoacromial arch violation type surgery. The average active forward



elevation that patients can expect from a hemi-arthroplasty for cuff tear arthropathy is approximately 90 degrees [9, 11–16, 21]. If patients have the so-called pseudoparalysis of the arm in which there is an extremely poor active elevation ability, a hemi-arthroplasty will not immediately restore active elevation. In these patients with poor preoperative active forward elevation, the hemi-arthroplasty provides pain relief, but the patient still may struggle with active elevation below the horizontal. It is extremely important that the surgeon reiterates to the patient and family, both preoperatively and postoperatively, realistic expectations for function. Once patients have obtained significant pain relief, they are typically disappointed that their active elevation and corresponding strength are still poor. Long-term results of hemi-arthroplasty have not been reported with regularity. Most studies have two-year follow-up, but longer term follow-up studies are being reported. These studies show that there is progressive bony erosion of the acromion and superior glenoid and that these erosions correlate with pain and decreasing function over the longer periods of time [14, 21].

Thus, it is extremely important to counsel the patients and the family about realistic expectations for pain relief, function, active elevation ability, and the fact that this is a limited goals procedure for pain relief and activities of daily living. It is also extremely important to counsel the patient that if he or she had previous acromioplasty surgery, hemi-arthroplasty, while the only option to restore concentric joint surface for the most part, will potentially be an ultimate failure because of the violation of the coracoacromial arch. In almost every report, those patients that have had previous acromioplasty surgery have gone on to anterior superior instability, poor active motion, and pain and have had a substantially worse result than those patients with no prior acromioplasty [11, 13, 14, 16]. The author does not recommend hemi-arthroplasty in those patients with prior acromioplasty surgery and evidence of anterior superior instability. Semiconstrained reverse shoulder arthroplasty is a better management option for patients with coracoacromial arch violation due to the predictable failure of hemi-arthroplasty in that clinical scenario. The reverse shoulder arthroplasty will eliminate anterosuperior instability and provide the potential for better active elevation.

## Complications

As discussed previously, the complications of hemi-arthroplasty for cuff deficiency begin with the fact that these are elderly patients and have co-morbidities. Cardiopulmonary side effects of the surgery can certainly occur. Medical problems can be exacerbated by surgery in the elderly. The unpredictable function results, especially with regard to strength and active forward elevation, make it imperative that a discussion occurs preoperatively and then postoperatively with the patient to avoid unrealistic expectations. One of the complications that has recently been seen after 4 to 5 year follow-up is the bone



erosion that is progressive at the superior glenoid and the under-surface of the acromion that correlates with increasing pain and decreasing function [14, 21]. Anterior superior instability, as discussed in the previous section, is a difficult problem. A hemi-arthroplasty will not solve this problem and actually will create a much more difficult problem to manage with resultant anterosuperior instability. Excessive retroversion of the humeral component and attempted coracoacromial arch reconstruction has not stopped the anterior superior instability [13, 14, 21–23]. Dynamic muscle transfer, such as pectoralis major transfer, have been advocated and, in small experience, have improved function of the hand away from the body at waist height [17].

If there is anterior superior instability for whatever reason and the coracoacromial arch has been violated, the best option at this particular time in these elderly patients would appear to be semiconstrained reverse shoulder arthroplasty. An update on the older concept of reverse shoulder arthroplasty was provided by Grammont and has been used in Europe for the past eight years [24]. Early results of the reverse prosthesis in elderly patients with cuff tear arthropathy have shown excellent pain relief, elimination of anterior superior instability, and superior motion for active elevation as compared with traditional hemi-arthroplasty [25, 26]. In a comparison study with follow-up greater than three years, patients with no prior shoulder surgery and cuff tear arthropathy were treated either with hemi-arthroplasty or reverse shoulder arthroplasty. The patients with reverse shoulder arthroplasty had 40 degrees greater active forward elevation for an average of 138 degrees; and the Constant Score was 20 points higher than those patients with hemi-arthroplasty [27]. There were no cases of glenoid loosening requiring revision. The hemi-arthroplasties had over one third of the cases with progressive bone erosion in the superior glenoid and acromion with increasing pain.

Reverse shoulder arthroplasty has been used on a custom basis for patients with anterior superior instability in the United States and has shown the ability to prevent anterior superior instability and provide shoulder stability with good active elevation (see Figure 6.19). The scapula is able to function in a much more normal ratio and provide the patients with consistent ability to use the hand away from the body between waist and shoulder height and, in most cases, above shoulder height [23, 28]. Reverse shoulder arthroplasty has just become available in the United States. Critical evaluation of the European experience allows us to say, while not a perfect solution, reverse shoulder arthroplasty certainly should be in the armamentarium of the shoulder surgeon to treat patients with cuff deficiency in advanced shoulder arthritis. This should primarily be reserved for those patients who have had multiple failed rotator cuff repair attempts with violation of the coracoacromial arch and anterior superior instability. It should also be considered in those patients with the pseudoparalysis and extremely poor active motion. Those patients with an extremely thin acromion or an acromial insufficiency fracture should also be considered candidates for reverse shoulder arthroplasty.

## Summary

Cuff tear arthroplasty is a disabling condition of the shoulder found in elderly patients. It is variable in its presentation with regard to the extent of degenerative osseous change in the glenoid, humeral head, and acromion. It is variable in its presentation with regard to preoperative active elevation ability and pain level. The overriding indication for hemi-arthroplasty in cuff tear arthropathy is pain relief. Reverse shoulder arthroplasty, now available in the United States, may provide improved active elevation in select patients.

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