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TECHNIQUE

Management of Posterior Glenohumeral Instability With Large Humeral Head Defects

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ABSTRACT

Traumatic posterior instability may occasionally cause a large osteochondral lesion when the anterior humeral head is compressed against the posterior glenoid rim. This is termed a reverse Hill–Sachs lesion. Such osteochondral defects may be very large in the case of chronic locked dislocations. Even in acute posterior disclocations, closed reduction may be difficult when the humeral head is locked posteriorly over the glenoid. In such cases closed or open reduction under general anesthesia with muscle relaxation may be necessary. In cases where the anterior humeral head defect is large, reconstruction may be necessary to maintain stability. Management must be tailored to the individual patient and depends on several factors, which include the size of the defect, the duration of the dislocation, the quality of the bone, the status of the articular cartilage, and the patient's overall health. Treatment options include skillful neglect, subscapularis-lesser tuberosity transfer into the humeral head defect, disimpaction and bone grafting, allograft reconstruction of the humeral articular surface, and arthroplasty.

HISTORICAL PERSPECTIVE

Posterior shoulder instability is a poorly understood clinical problem and includes a spectrum of disorders. This continuum of excessive posterior translation of the glenohumeral joint ranges from the more frequent recurrent posterior subluxation to the uncommon locked posterior dislocation. Posterior instability involving a large anteromedial humeral head impression defect, frequently called a reverse Hill–Sachs defect or a McLauglin impression lesion, is traumatic in etiology and typically includes chronic locked dislocations. The infrequent occurrence of a large anteromedial humeral head defect presents a significant technical challenge in the management of posterior shoulder instability.

Many classification schemes for posterior instability have been proposed which further confound treatment decision-making. There are 3 types of posterior instability. They include: acute posterior dislocation, chronic locked dislocation, and recurrent posterior subluxation or dislocation. In the literature the distinction between an acute and chronic dislocation ranges from as little as 24 hours to as late as 6 months.[1–3] As Rowe and Zarins proposed in 1982, we also define chronic dislocation as an unrecognized posterior dislocation more than 3 weeks old.[2] Success with closed reduction beyond this period dramatically decreases, and risk of iatrogenic proximal humerus fracture is significant.[4] While recurrent posterior subluxation is more common, traumatic acute and chronic dislocations are associated with significant anteromedial humeral head impression defects. The majority of posterior dislocations are not associated with sizeable humeral head lesions. This is especially true for dislocations that spontaneously reduce or in acutely reduced dislocations.

The duration of dislocation is important since up to 80% of posterior dislocations are missed upon initial evaluation and larger humeral head impression defects are associated with chronic dislocations.[1,2,5] The most common etiology of posterior dislocation is violent trauma such as a seizure, electrocution, motor vehicle collision, or fall upon an outstretched arm.[6–8] Nearly 50% of posterior dislocations are associated with fractures of the humeral surgical neck, one of the tuberosities or glenoid rim.[1,9,10]

The shoulder is the most mobile joint in the body, and this is due to a mismatch of surface area so that only one-third of the humeral head articulates with the glenoid.[11–17] The glenoid depth and breadth are enhanced by the labrum, and the capsule and ligaments provide static stability at the end-ranges of motion. Dynamic stability is afforded by the rotator cuff muscular envelope around the glenohumeral joint. When a posterior dislocation occurs, the capsuloligamentous structures must stretch and

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they may detach from the posterior glenoid rim (reverse Bankart lesion). With traumatic force of a posterior dislocation or with a chronic contact of the anterior humeral head against the posterior glenoid rim, a large osteochondral defect may be created in the anterior portion of the humeral head. In such cases, when the humeral head is reduced into the glenoid, posterior instability will occur with internal rotation since the articular defect will engage with the posterior glenoid rim. This lesion then becomes a relevant pathology that requires treatment. As this condition is rare, there is little literature on surgical management of this condition.[1,10,18–21]

CLINICAL PRESENTATION

The first step is to identify a patient with a posterior dislocation. Unfortunately, it is not uncommon for this diagnosis to be missed and the triad of: failure to recognize a typical mechanism, a poor physical examination, and inadequate radiographs, is responsible for this delay.

While highly variable, a finding of excessive pain may be the first identifier of a posterior dislocation on physical examination, as posterior shoulder dislocations are reported to be more painful than anterior shoulder dislocations.[22] Depending on the size of the patient, there may be a prominence of the coracoid process and flattening of the anterior shoulder along with a posterior fullness compared with the contralateral shoulder. The hallmark of a posterior dislocation is internal rotation of the arm and the lack of external shoulder rotation beyond 0 degrees on both active and passive examination with the elbow at the patient's side (Fig. 1). Another finding on examination is the inability for the patient to fully supinate the forearm with the arm in forward flexion.[23] Active forward flexion is present but frequently limited to less than 100 degrees. Nerve injuries following posterior dislocation have been reported to occur in nearly 30% of patients and necessitate careful evaluation during the physical examination.[3]

FIGURE 1. Clinical picture of locked posterior dislocation lacking external rotation.

RADIOGRAPHIC ASSESSMENT

Proper imaging is essential to confirm the diagnosis of a posterior shoulder dislocation and to quantify the size of the anteromedial humeral head impression defect. Initial radiographs including standard shoulder (plane of body), true shoulder (plane of scapula) anteroposterior, and axillary views are critical. An isolated anteroposterior radiograph is frequently not adequate to make the diagnosis. On the standard shoulder radiograph, the presence of a "light bulb" appearance of the proximal humerus along with a vacant appearing glenoid may suggest a posterior dislocation. The "vacant glenoid sign" is also called the "6 mm sign," where the loss of the elliptical shadow (normally caused by the overlapping of the glenoid and a reduced humeral head) gives a free space of 6 mm or more between the glenoid and humeral head. Even with these signs on an anteroposterior radiograph, the axillary view must be obtained. A properly performed axillary radiograph will clearly establish the relationship between the glenoid and humeral head and enable an estimation of the humeral head defect size to be made (Figs. 2 and 3). Visualization of glenoid rim and lesser tuberosity fractures are also permitted from the axillary radiograph.

Computerized tomography (CT) provides optimal 3-dimensional assessment of the glenohumeral joint, and we always use this imaging method. CT scan with or without 3-dimensional reconstruction will quantitatively document glenohumeral relationships, bony lesions of the glenoid, the size and location of the humeral head defect, quality of the bone, and fractures which may otherwise be unrecognized.[18] Although rotator cuff lesions have been reported with posterior shoulder dislocations, magnetic resonance imaging (MRI) is not routinely recommended and is not preferred to CT imaging.[18]

An electromyogram (EMG) or arthrogram should be obtained if there is concern for nerve or vascular injury.

TREATMENT OPTIONS

In acute, small lesions (those less than 20–25% of the articular surface or less than 1cm in craniocaudal length), closed reduction with immobilization may produce excellent results. In cases where a chronic dislocation does not significantly impair function or when patients are poor surgical candidates, cautious observation or skillful neglect may be successfully undertaken. However, if the lesion is larger than 20–25% of the articular surface, surgery may be necessary to restore function and stability. McLaughlin reported in 1952 on the importance of

FIGURE 2. Axillary and anteroposterior radiograph of locked posterior dislocation.

the size of the defect and recommended transferring the subscapularis tendon into the defect to restore stability.[5] Neer and Hughes later modified this technique to transfer the subscapularis with the lesser tuberosity into the humeral head defect.[24] Subscapularis transfer is typically recommended in humeral head defects involving 20–50% of the articular surface.[1,25] In 1996 Gerber and Lambert reported on the use of allograft to reconstruct chronic dislocations with humeral head defects up to 55% of the articular surface.[19] Gerber has also proposed elevation of the impression fracture with cancellous bone grafting in acute, small lesions as another humeral head sparing technique.[18] For defects larger than 45% of the articular surface, or in cases where severe osteopenia makes fixation prohibitive, arthroplasty may be recommended.[1,26]

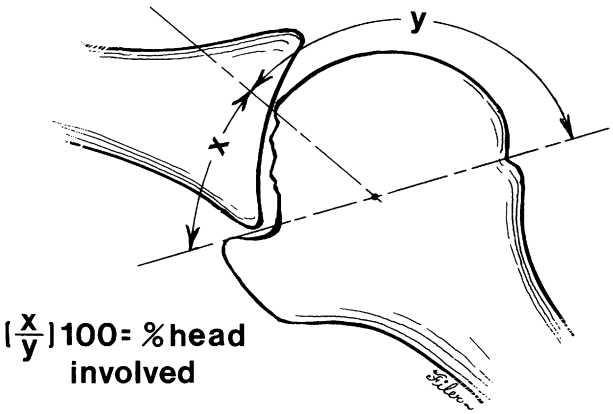

FIGURE 3. The size percentage of the humeral head defect can be calculated from dividing the arc of the intact humeral head by the arc of the impaction as measured from an axillary radiograph.

Rotation osteotomies have been performed for lesions greater than 50% of the articular surface but reported results were unsatisfactory; thus, this is not considered a treatment option by most surgeons.[1,25]

INDICATIONS AND CONTRAINDICATIONS

Indications for surgery depend on the size of the lesion, the quality of the bone, and the condition of the patient. Other surgical indications include: a displaced lesser tuberosity fracture, a sizeable posterior glenoid fracture, an irreducible or open dislocation, or persistent instability. If the dislocation is chronic, the bone may be severely osteopenic and could prohibit surgical fixation. Furthermore, if a humeral head allograft is performed, the humeral head may collapse once reduced into the glenoid since the bone strength will be reduced due to osteopenia. In these cases skillful neglect may be the favored procedure. Some additional contraindications to surgical intervention include: an uncontrolled seizure disorder, brachial plexopathy, suprascapular neuropathy, or poor medical status allowing instability to recur or prevent healing following surgical stabilization.

Acute and chronic dislocations are different conditions and may require different forms of treatment. The defects in chronic dislocations tend to be larger, the bone more osteopenic due to prolonged disuse, and the soft tissues less elastic preventing routine conscious sedation and attempted closed reduction. On the other hand, acute dislocations tend to not have severe articular injuries and the bone quality is more robust. Assuming there is not a large reverse Hill–Sachs lesion or an associated fracture,

closed reduction may be feasible. However, in our experience this is usually best accomplished in an operating room setting under general anesthesia with complete muscle relaxation. It is also important for the surgeon to understand the patient's expectations, perceived disability, health status, and ability to comply with postoperative rehabilitation prior to embarking on surgical management.

TECHNIQUE

Skillful Neglect

No discussion on the management of posterior instability with large humeral head defects would be complete without consideration of nonoperative care. In patients who have no or minimal pain with reasonable function, surgical treatment may not be warranted. Gerber recommends observation of chronically dislocated shoulders when the patient is advanced in age, has limited shoulder demands, is able to perform anterior activities of daily living (eating, combing hair, etc.), and has a normal contralateral shoulder.[18]

Closed Reduction

Once a posterior shoulder dislocation is diagnosed, closed reduction under conscious or general anesthesia may be attempted if the lesion is small (less than 20–25% of the articular surface), acutely diagnosed (less than 3 weeks), and no other fractures are identified. The reduction maneuver includes axial traction, flexion, adduction, and external rotation of the shoulder with direct pressure placed on the posterior shoulder. Following gentle and successful reduction, the shoulder should be ranged to assess stability. If redislocation does not occur with internal rotation of the ipsilateral hand to the chest, the shoulder is immobilized in neutral or external rotation for 4–6 weeks. A recent observation, however, has identified closer approximation of the reverse Bankart lesion to the posterior glenoid with internal rotation bringing into question the traditional position of immobilization.[27] During this period of immobilization, the patient is allowed unrestricted external rotation and can perform isometric shoulder girdle strengthening. Excessive internal rotation, such as with having the arm placed behind the back, is not permitted for a minimum of 6 weeks. Following immobilization, rehabilitation is advanced from passive stretching to active and resisted exercises. The majority of patients who continue to have symptoms following reduction of posterior dislocation fall into the recurrent posterior instability category and do not have recurrent shoulder dislocations. These patients typically have small anteromedial humeral head defects and their symptoms are secondary to soft tissue (reverse Bankart lesion, posterior capsular laxity, etc.) injuries. Multiple repairs have been described for these conditions.[28]

Open Reduction

If the duration of dislocation is greater than 3 weeks, if instability is present with internal rotation following reduction, or if the humeral head defect is larger than 20–25% of the articular surface (or greater than 1cm in craniocaudal length), surgical reconstruction of the humeral head impression defect may be necessary. Open reduction may be necessary to avoid fracture or further chondral injury. To do this the patient must be completely paralyzed. A deltopectoral incision is made, and the anatomic structures of the anterior shoulder should be defined. The anatomy is usually quite distorted as the soft-tissue structures are pulled posteriorly with the dislocated humerus. The coracoid process is a landmark, and the conjoined tendon should be separated from the subscapularis. The axillary nerve must be identified and it may be pulled tight against the inferior humerus as it courses over the subscapularis. We typically identify it and place a vessel loupe around it. The subscapularis is then detached according to the method selected depending on if a tendon transfer will be required. Reduction of a posteriorly locked humeral head may be difficult if it is engaged onto the posterior glenoid through a large reverse Hill–Sachs lesion that has been chronic. The soft-tissues in this case may actually shorten and contract, preventing lateral displacement of the humeral head away from the glenoid. In such cases, a complete inferior capsular release may be necessary after exposure and protection of the axillary nerve. Furthermore, it may occasionally be necessary to release the posterior capsule through the joint as well. Reduction is then facilitated by adducting and internally rotating the arm to relax the pectoralis. The humeral head may then be pulled laterally to disengage it from the posterior glenoid rim. The humerus is then externally rotated to bring the defect anteriorly when the humerus is reduced onto the glenoid

Reconstruction of Large Humeral Head Defects

Transfer of the Subscapularis Tendon (McLauglin Procedure) or Lesser Tuberosity

These transfers are recommended for lesions from 25–50% of the articular surface.[1,26] A standard deltopectoral approach is used. The subscapularis tendon is identified and released directly off the lesser tuberosity. In cases where the lesser tuberosity is to be removed and placed into the defect, the tuberosity is carefully osteotomized, tagged with suture, and elevated with the attached subscapularis and capsule to reveal the glenohumeral joint. When performing the lesser tuberosity osteotomy, care is

taken to avoid violating the bicipital groove and potentially causing subluxation of the tendon. In many patients, however, the biceps tendon is noted to be distorted or damaged and then it is tenotomized and subsequently tenodesed.

The impression defect on the anteromedial humeral head is roughened with an elevator or burr to create a cancellous bone bed and the tendon or tuberosity is secured within the defect. For the subscapularis tendon transfer, transosseous fixation with large non-absorbable sutures in a Mason–Allen configuration are used. In cases where the lesser tuberosity is transferred, it is rigidly secured with 1 or 2 cancellous lag screws with or without washers (Fig. 4). The disadvantage of transferring the subscapularis or tuberosity is that anatomy is altered making future surgery, including arthroplasty, more difficult.

Disimpaction With Bone Grafting

An alternative to subscapularis or lesser tuberosity transfer for acute, humeral head defects under 50% of the articular surface in patients with good bone stock is disimpaction and bone grafting.[18] Either allograft or autograft bone graft can be used. Our preference is to use allograft as it reduces morbidity to the patient and simplifies the procedure. When autograft is used, the ipsilateral iliac crest is prepped out with the patient remaining in the beach chair position.

A standard deltopectoral incision is used. The subscapularis is taken down 1 cm medial to its lesser tuberosity insertion and tagging sutures are placed to prevent medial retraction. A vertical capsulotomy allows visualization of the glenoid and humeral head. Following reduction, the condition of the cartilage of the humeral head should be assessed along with the glenoid for fractures and the posterior labrum and capsule for soft tissue injuries. If the cartilage is attached to the impacted humeral defect and in good condition, disimpaction with bone grafting may be performed.

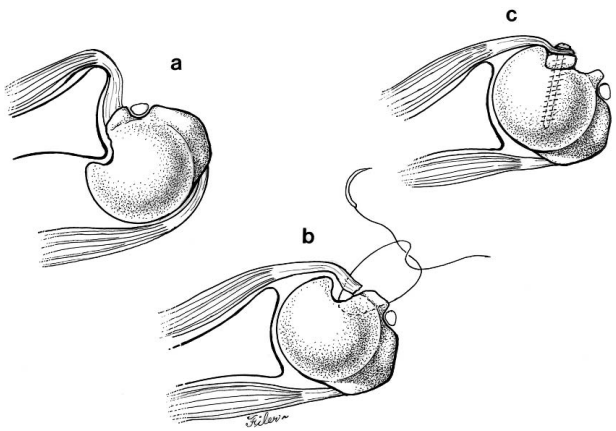

FIGURE 4. Diagram of (a) locked posterior dislocation and transfer of (b) subscapularis or (c) lesser tuberosity.

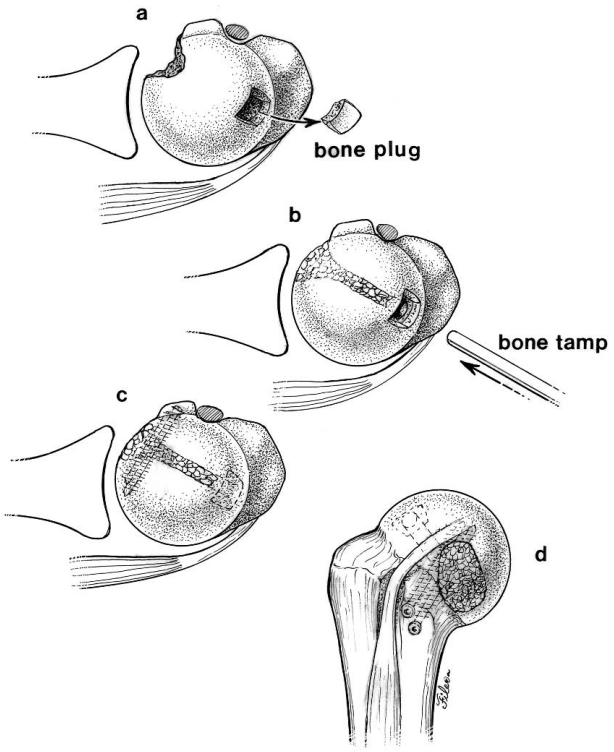

FIGURE 5. Diagram of disimpaction with bone grafting: a, Creation of bony window. b, Reduction of impact defect and filling with allograft. c, Screw scaffold to support the bone graft during healing and absorbable pin fixation of bony window.

A bone window is created near the greater tuberosity allowing a direct line for a bone tamp to disimpact the depressed area. Rotating the shoulder in internal rotation and external rotation will assist in identifying the window area. The humerus is internally rotated and the bone window is created with 1/4-3/8 inch osteotomes. Under direct visualization with a slender bone tamp and mallet, the humeral head contour is restored. It may be necessary to drill a starting canal if the bone stock is robust. Up to a size 10 mm drill can be used. Again, frequent external and internal rotation of the humerus will allow the progress in restoring the defect to be monitored. We fully elevate the depressed area and are not alarmed if there is slight over reduction to allow for normal settling of the restored defect once motion is permitted. Bone graft is now used to back fill the bone tamp tunnel and the cortical window is secured with absorbable K wires/pins. The reduced defect is maintained by 2 or 3 parallel 3.5 mm cortical screws (Synthes, Paoli, PA) to help serve as a scaffold to the bone grafting until healing occurs (Figs. 5 and 6). Next, the humerus is carefully internally rotated

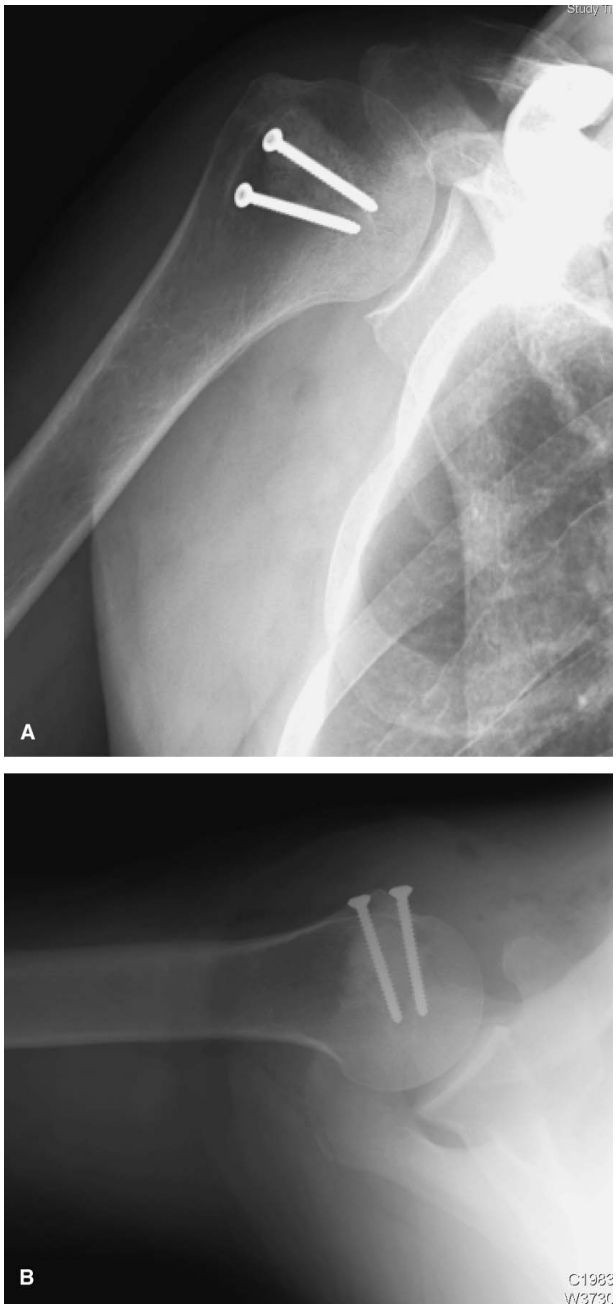

FIGURE 6. Anteroposterior (A) and axillary (B) radiograph of disimpaction with bone grafting.

to identify the "safe area" of where the disimpacted humerus begins to engage the glenoid. This is the maximum degree of internal rotation to be permitted during closure and early rehabilitation. The subscapularis is repaired with 4 Mason–Allen sutures and the degree of maximum external rotation able to be obtained without stressing the repair is documented. The patient is placed in an external rotation splint prior to leaving the operating room.

Allograft Reconstruction of Humeral Head Impression Defect

While the experience is limited in the shoulder, allograft reconstruction of joint surfaces has been successful in weight bearing joints.[29,30] This technique has been advocated for lesions up to 55% of the humeral articular surface.[19] Allograft humeral head reconstruction is Gerber's reconstruction technique of choice since it most closely restores the anatomy to the pre-injury state. He reports that maintaining the anatomy facilitates future procedures, such as arthroplasty, more than a subscapularis or lesser tuberosity transfer.[18] Use of this technique requires careful preoperative planning to ensure adequate bone stock is present for the fixation and an appropriately sized humerus allograft is available. We routinely obtain a radiograph of the contralateral normal shoulder and ask the bone bank to obtain a humeral head allograft matched to this size and radius of curvature. This ensures congruent reconstruction of the reverse Hill–Sachs lesion.

A standard deltopectoral approach is used. To assist exposure, the conjoined tendon may be partially released to reveal the internally rotated subscapularis insertion. The axillary nerve is identified and tagged with a vessel loupe tied to itself. The subscapularis is mobilized directly off the lesser tuberosity, and a vertical capsulotomy is performed. Effort is made to leave the superior glenohumeral ligament and the coracohumeral ligament intact. Adhesions are released and the dislocated head is reduced. While the posterior capsule is redundant from prolonged stretching by the dislocated humeral head, the capsule is not surgically addressed. Next, the reduced shoulder is internally rotated and stability is assessed. If minimal internal rotation is necessary to cause dislocation, allograft reconstruction of the humeral head defect is undertaken.

The humeral head defect is then prepared using a small oscillating saw to create a uniform defect that can then be measured. This measurement is then used to create a matching segment from the humeral allograft. This segment is slightly oversized and this allows the surgeon to shape the graft with a motorized burr to create a precise fit and obtain a smooth transition when restoring the convexity of the humeral head. A humeral head impactor from a shoulder arthroplasty set provides a broad surfaced impactor with a similar contour as the allograft. The graft is then secured with 3.5 mm partially threaded cancellous screws (Synthes, Paoli, PA) that are lagged and countersunk. Typically 2 screws are used (Fig. 7). Following repair, stability in internal rotation is reassessed.

During closure, the anterior capsule is not repaired but caution is taken to preserve the superior glenohumeral ligament because of its role in posterior shoulder

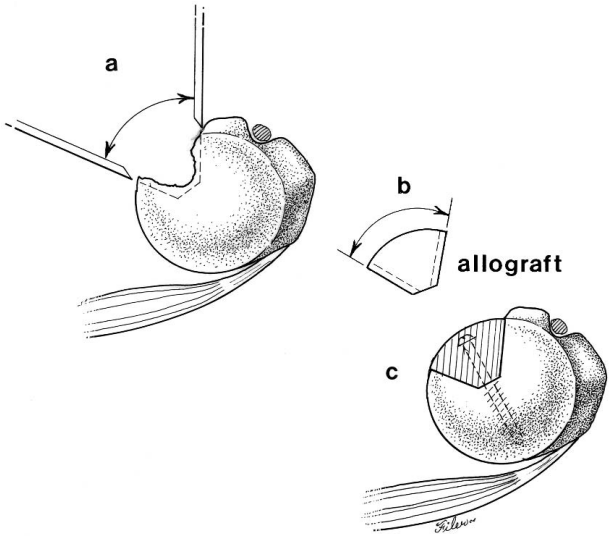

FIGURE 7. Diagram of allograft reconstruction of humeral head: a, Defect edges are sharply contoured. b, Allograft 1–2 mm larger than defect is prepared. c, Screw fixation of allograft.

stability.[17] The subscapularis is reattached to the lesser tuberosity with large transosseous sutures using 4 Mason–Allen stitches.

Arthroplasty

Arthroplasty is indicated if the dislocation is greater than 6 months duration or if the impression defect in the humeral head is greater than 45%.[1] Proximal humeral replacement is considerably more difficult in the setting of a chronic dislocation than for routine osteoarthritis. This is due to distortion of the soft tissues and also of the articular surfaces. Some surgeons have recommended total shoulder arthroplasty as it seems to be associated with more predictable pain relief; however, our approach is based on the condition of the glenoid articular surface.[1,18] In the case where the glenoid articular cartilage is intact, we perform a hemiarthroplasty. However, in almost all cases of chronic locked posterior dislocation there is significant damage to the articular surface of the glenoid and humeral head. In these cases we perform a total shoulder replacement.

It is mandatory in these cases to obtain a CT scan for preoperative planning as this will give insight into bone loss that may need to be addressed during surgery, and it may also quantify the degree of glenoid erosion and acquired retroversion that typically occur from chronic posterior dislocation of the humeral head. This then provides a guideline for the surgeon when reconstructing the glenoid by allowing him to anticipate the extent of glenoid reaming or bone grafting necessary to reorient the glenoid component into neutral version.

A standard deltopectoral incision is used; however, this is an extended incision. The anatomy is often distorted as the subscapularis and brachial plexus are pulled posterior along with the humeral head. We define the bicipital groove and rotator interval first and then perform the initial dissection and release as described above. The axillary nerve is always visualized and protected. We prefer to osteotomize the lesser tuberosity, although a traditional soft tissue release of the subscapularis can be performed. Once the lesser tuberosity and subscapularis are detached, the humeral head is released from tethering soft-tissues as previously described. In some cases there is so much distortion of anatomy that it may be possible to remove the humeral head piecemeal so that the proximal humeral metaphysic can then be delivered over the glenoid and anteriorly in the incision. Since the arthroplasty system we use (Anatomic, Zimmer, Warsaw, IN) allows us to position the humeral head on the stem in variable version, offset, and neck-shaft inclination, we can simply adapt the prosthesis to the remaining anatomy as we choose to restore proper orientation.

The glenoid is first reconstructed according to preoperative planning, which includes bone grafting as necessary or reshaping of the glenoid with a power reamer to reestablish orientation close to neutral version. The humerus is then reconstructed. Accurate orientation of the component is usually possible from the standpoint of head height, as the greater tuberosity remains as a landmark and the humeral head is positioned to be at the correct height relative to this bony landmark. The degree of retroversion is also important to control. We do not believe in adapting the humeral articular surface into excessive antiversion to compensate for acquired posterior glenoid erosion and retroversion. This will result in a biomechanically unsound reconstruction and may not prevent recurrence of posterior instability. Instead, we aim to achieve the mean of about 20° of retroversion. We do this using one of several mechanisms. First, the humeral anatomy may be a guide if the anatomic neck is not distorted severely by the impression fracture. If the humeral head is then resected along the anatomic neck, this will create the normal version in that patient when the humeral head is positioned on this resected surface. If, however, this landmark is distorted by the fracture, the humeral component is positioned so that when the shoulder is positioned in neutral rotation with the forearm forward, the humeral head points to the glenoid surface. This will achieve approximately 20° of retroversion.

If there remains excessive posterior capsular laxity and the humeral head tends to subluxate with internal rotation and flexion, we perform an internal capsular shift. This is done by removing the humeral component and then working through the joint. The humeral metaphisis is distracted from the glenoid with a humeral head

retractor or a bone hook. The capsule is then plicated by placing multiple purse string sutures through the capsule. We usually shorten the capsule by about 1cm. The humeral component is then fixed in place and the lesser tuberosity is reconstructed to the proximal humeral metaphysic using non-absorbable #5 braided sutures which have been placed into the metaphysis prior to press-fit or cemented insertion of the humeral stem (Fig. 8).

Table 1 summarizes the surgical treatments for large anteromedial humeral head impression defects.

RESULTS

Skillful Neglect

The natural history of chronic posterior dislocations is favorable and supports nonoperative treatment in situations where the patient is elderly or too medically ill to undergo surgery, or the patient has a chronic painfree locked dislocation and is willing to tolerate limited function.[1,18] In patients with chronically locked posterior dislocations, Gerber has reported minimal or no pain with good function having Constant scores between 60–85% of normal age matched individuals.[18,31,32]

Closed Reduction With Immobilization

The results of closed reduction and immobilization of acute dislocations are favorable when stability is present in internal rotation.[1,3] However, iatrogenic fracture is a concern and usually occurs when there is failure to recognize a non-displaced proximal humerus fracture or excessive force is applied to the humerus with insufficient muscle relaxation.[4] This is why most cases of locked posterior dislocation should be treated in an operating room with complete muscle paralysis and general anesthesia. Careful radiographic control can then be used along with gentle reduction attempts, and conversion to an open reduction is feasible.

Transfer of Subscapularis Tendon or Lesser Tuberosity

Satisfactory to excellent results have been reported for transfer of the subscapularis or lesser tuberosity.[1,2,5,25] There appears to be a more predictable improvement in pain relief and function with transfer of the lesser tuberosity.[1,33] Failures have been reported with transfers when the humeral head defect is greater than 50%.[25]

Disimpaction With Bone Grafting

Gerber has reported success with this procedure; however, no clinical series have been published in the English literature.[18]

Allograft Reconstruction

Three of 4 patients with allograft reconstruction of large humeral head defects (40–55%) in Gerber and Lambert's report had a Constant score 96% of age matched normal individuals at 5 years of follow-up.[19] The 1 poor result in this series was in a patient who developed avascular necrosis and collapse of the humeral head 6 years after surgery. More recently Gerber has reported similar success in an additional 5 patients with this technique.[18] This supports use of this surgical solution in individuals

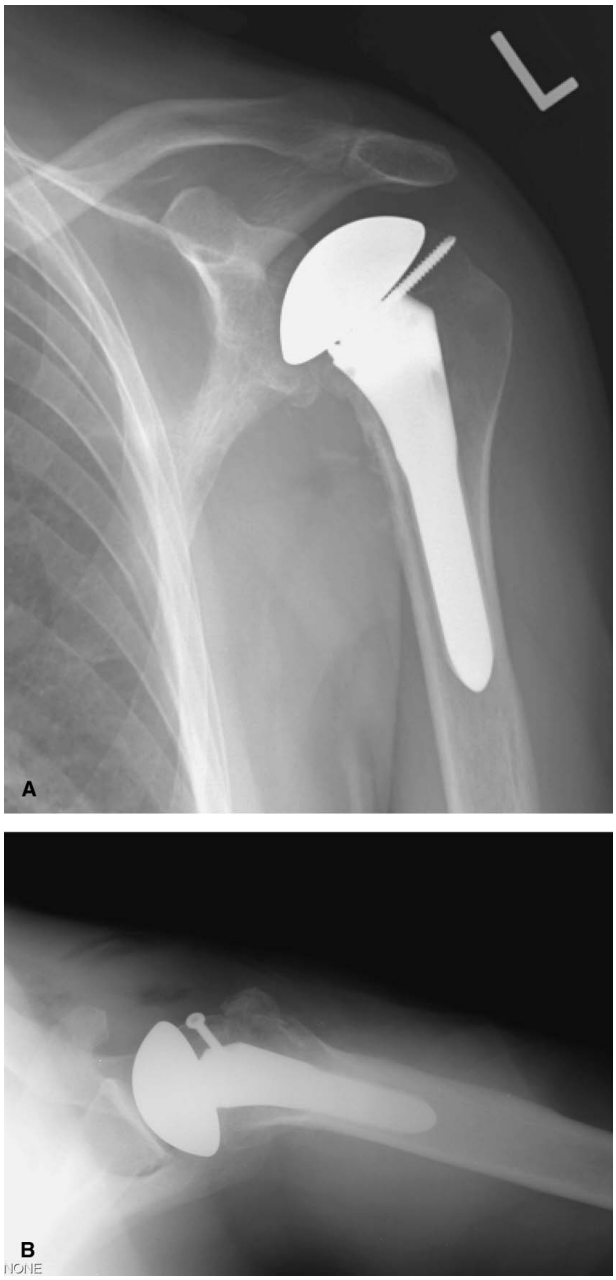

FIGURE 8. Anteroposterior and axillary radiograph of shoulder hemiarthroplasty for the treatment of a large, unreconstructable humeral head defect. Due to a sizeable defect that extended beyond the articular surface, autograft from the humeral head was used to graft around the prosthesis and was secured with a 3.5 mm screw.

TABLE 1. *Summary of surgical options for large reverse Hill–Sachs defects from acute posterior dislocations or chronic locked posterior dislocations*

Indication	*Surgical options*
20–25% humeral head defect	–Disimpaction with bone grafting –Subscapularis/lesser tuberosity transfer –Allograft reconstruction
20–50% humeral head defect	–Disimpaction with bone grafting –Subscapularis/lesser tuberosity transfer –Allograft reconstruction –Arthroplasty (hemi or total)
>45% humeral head defect	–Allograft reconstruction –Arthroplasty (hemi or total)

without longstanding, locked dislocations where the head defect is greater than 50%.

Arthroplasty

Few reports in the literature specifically consider arthroplasty in the case of chronic, locked posterior dislocations. Overall, it seems that total shoulder arthroplasty is more reliable at pain relief and restoration of function than hemiarthroplasty.[1] The 3 hemiarthroplasty failures (out of 9) in Hawkins and associates' study all had glenoid wear identified at the time of hemiarthroplasty but total shoulder arthroplasty was unavailable at that time. These patients had good pain relief upon conversion to a total arthroplasty. In this same study, 5 of 6 patients with a primary total arthroplasty had an excellent result. The 1 failure had recurrent instability.[1] Gerber also supports the use of total shoulder arthroplasty over hemiarthroplasty but has not published his clinical results.[17]

■ COMPLICATIONS

Persistent pain, poor function, and instability are potential complications with each technique. Failure of subscapularis tendon transfer has been associated with use in humeral head defects greater than 50%.[25] Potential allograft reconstruction failure from infection, fracture, nonunion, subsidence, or instability has not yet been reported.[18] Failure with hemiarthroplasty has been associated with glenoid wear.[1]

■ POSTOPERATIVE MANAGEMENT

Subscapularis Tendon or Lesser Tuberosity Transfer

With either a subscapularis tendon or lesser tuberosity transfer, the patient is immobilized in external rotation for 4–6 weeks. We usually use an orthosis that maintains the arm in extension and neutral rotation during this period. Following immobilization, rehabilitation is advanced from passive motion to active motion to strengthening exercises.

Disimpaction With Bone Grafting

After disimpaction with bone grafting, shoulder immobilization is as described above, with the arm in extension and external rotation, avoiding the predetermined maximum amount of internal rotation permitted, for 6 weeks. During this time gentle passive external rotation forward flexion and abduction may be permitted. After this period, active motion may be allowed. Strengthening and extreme internal rotation is avoided until 12 weeks postoperatively.

Allograft Reconstruction

Following allograft reconstruction, the shoulder is kept in neutral rotation for 6 weeks. During this time physical therapy is begun with passive external rotation exercise. No internal rotation beyond neutral is permitted. Active motion begins after 6 weeks and strengthening begins after 12 weeks.

Arthroplasty

Rehabilitation following arthroplasty depends on the condition of the soft tissues. If significant posterior capsule laxity was not present, routine postoperative physical therapy with passive motion avoiding excessive external rotation may be implemented immediately. Active motion begins at 6 weeks after surgery and strengthening at 12 weeks. Otherwise with intraoperative instability, the arm may need to be immobilized in neutral rotation for up to 6 weeks as described in the preceding text. This allows the soft tissues to adjust their tension and restore near normal physiologic conditions. During this time gentle, limited passive range of motion may be started.

■ POSSIBLE CONCERNS, FUTURE OF THE TECHNIQUE

Chronic locked posterior dislocation creates not only a difficult reconstructive problem for initial treatment, but the potential for subsequent need for surgical reconstruction. We believe it is imperative, if joint preservation techniques are used, to reestablish stability and proper anatomy so that if subsequent arthroplasty reconstruction is required, it can be more easily accomplished and motion improved. Distortion of humeral anatomy or chronic contracture of soft-tissues, can make subsequent reconstructive surgery difficult. Thus, in young patients we attempt to reconstruct articular surfaces and restore stability with this potential future need in mind.

■ SUMMARY

Chronic, locked posterior shoulder dislocation is a relatively rare condition and, therefore, may be at risk for

inadequate treatment. While few guidelines are described in prior literature, we feel that the principles of restoration of joint congruity, soft-tissue tension, and joint mobility are the principal goal of treatment. In select cases where the patient is too medically ill for surgical treatment, or there is no associated pain, skillful neglect may be in the best interest of the patient. Smaller, acute lesions may be managed by closed reduction with complete muscle relaxation in an operating room setting followed by immobilization with the arm in extension and external rotation. Occasionally, acute depression of the anterolateral humeral head may be elevated and bone graft can restore stability to this reconstruction. When the articular defect is <30% of the joint surface, transfer of the lesser tuberosity and subscapularis into the defect will provide stability with only modest loss of rotation. In the case of large defects less than 50% of the articular surface in active, young patients, reconstruction with a matched osteochondral allograft has been shown to provide predictable restoration of function and pain relief. When the size of the defect is greater than 50% of the humeral head, or osteopenia or chondral injury precludes humeral head salvage, reconstruction with an anatomic prosthesis can restore function and provide pain relief as well.

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