Management of Acute Glenohumeral Dislocations

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Abstract

The glenohumeral joint is the most commonly dislocated joint in the human body. Glenohumeral joint dislocations account for a large number of orthopedic consultations in inpatient and outpatient settings. A thorough workup is required for accurate diagnosis and appropriate treatment of this injury. Complete history and physical examination and radiographic studies are essential, and reduction should always be attempted.

In this article, we review the literature for each phase of the workup for glenohumeral dislocation and describe the anatomy, biomechanics, and basic science of the injury. Featured is a detailed synopsis of the more commonly used reduction maneuvers plus their risks and success rates.

The first description of a glenohumeral joint dislocation appeared in the Edwin Smith Papyrus, circa 3000–2500 BC. Hippocrates gave a detailed description of glenohumeral instability and has been credited with one of the earliest descriptions of closed reduction. Two thousand years later, there is a large amount of literature on glenohumeral instability, with approximately 200 papers on the subject in 2007 alone.

The contemporary literature includes articles on a multitude of methods for managing acute shoulder dislocations. In the present article, we provide a thorough account of the more commonly used reduction techniques along with a review of the relevant anatomy, biomechanics, and basic science.

Anatomy

The glenohumeral joint is stabilized by its intrinsic anatomical structures, which can be divided functionally into dynamic and static restraints.

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The *dynamic* stabilizers of the glenohumeral joint include the 4 tendons of the rotator cuff as well as the long head of the biceps, which function mainly during active motion (Figure 1). In the middle range of motion, the rotator cuff provides stability by compressing the humeral head into the glenoid[1] (Figure 2). The supraspinatus contributes to this compression at lower degrees of humeral abduction.

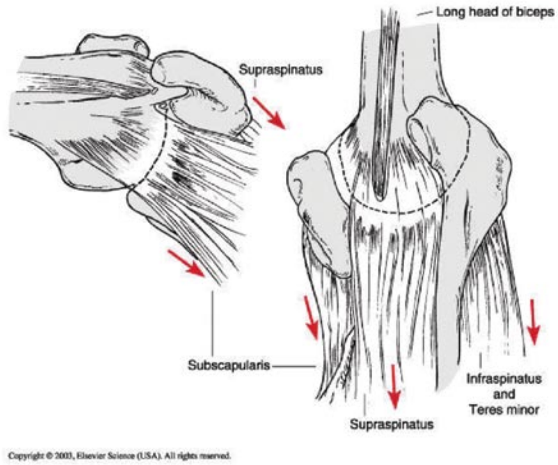

Figure 1. The dynamic stabilizers of the glenohumeral joint. This figure was published in *Skeletal Trauma,* Vol. 2, Browner B, Jupiter J, Levine A, Trafton P, Green N, Swiontkowski M, Chapter 44: Proximal humerus fractures and glenohumeral dislocations, 1515-1516, Copyright Elsevier 2003.

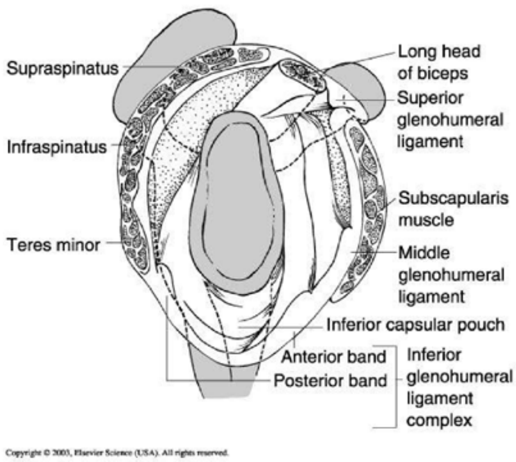

Figure 2. The rotator cuff as a compressive force. This figure was published in *Skeletal Trauma,* Vol. 2, Browner B, Jupiter J, Levine A, Trafton P, Green N, Swiontkowski M, Chapter 44: Proximal humerus fractures and glenohumeral dislocations, 1515-1516, Copyright Elsevier 2003.

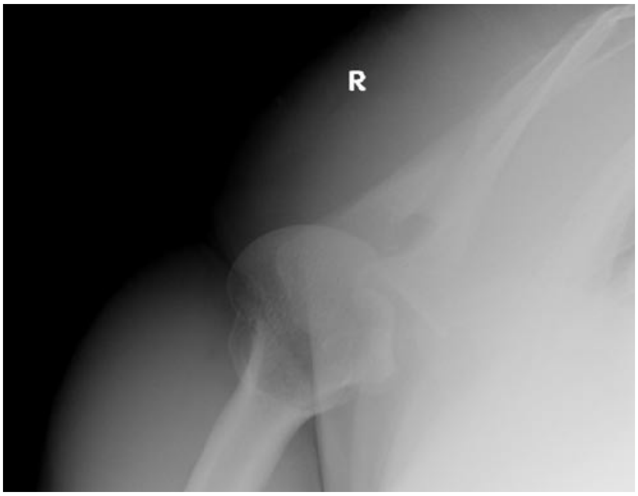

Figure 3. Posterior dislocation with reverse Hill-Sachs lesion.

Figure 4. Anteroposterior radiograph of anterior dislocation.

The long head of the biceps tendon, which anchors to the posterosuperior labrum, contributes additional stability in the more extreme ranges of motion. Additional stability may be provided by barrier effects of the muscles and by passive tension from the muscles themselves.

The *static* restraints to dislocation include the negative intra-articular pressure of the glenohumeral joint, the bony glenoid architecture, the glenoid labrum, and the joint capsule, which includes the coracohumeral and glenohumeral ligaments. Intra-articular pressure stabilizes the shoulder not only inferiorly but in all the other positions as well. The labrum functions by deepening the concavity of the glenoid, acting as a "chock block" to humeral head translation. The humeral head must override the labrum to dislocate. In increasing the depth and the surface area of the joint, the labrum is vital in providing stability.

The major glenohumeral ligaments consist of 4 distinct thickenings of the joint capsule—the superior (SGHL), middle (MGHL), and anterior and posterior portions of the inferior glenohumeral ligament (IGHL) complex (Figure 1). The IGHL complex is a hammock-like structure that consists of an anterior band, a posterior band, and an axillary pouch. The anterior band of the IGHL functions as the primary stabilizer of the glenohumeral joint and prevents anterior translation of the humeral head at 90° of humeral abduction. The anterosuperior portion of the IGHL functions as the main stabilizer at 45° of abduction along with the MGHL and subscapularis. Alone, the MGHL limits external rotation in the adducted shoulder.

Of the glenohumeral ligaments, the SGHL provides the least amount of static stability. It functions mainly along with the coracohumeral ligament in providing passive resistance to inferior translation of the humeral head with the arm adducted at the side. The SGHL and coracohumeral ligament make up the rotator interval capsule.

Dislocation Types

Dislocations are classified according to position of the humeral head in relation to the glenoid. *Anterior* glenohumeral dislocations, which comprise 85% to 98% of all shoulder dislocations,[2,3] are further subdivided into *subcoracoid, subclavicular, subglenoid,* and *intrathoracic* dislocations, with subcoracoid being the most common. *Posterior* glenohumeral dislocations, which make up 2% to 3% of glenohumeral dislocations,[2] are most commonly *subacromial*. *Posterior* dislocations are most common in patients between 35 and 55 years old, and up to 15% of these injuries are bilateral.[4] *Inferior* glenohumeral dislocations are also named *luxatio erecta* because of their association with abduction of the humerus. They are uncommon, comprising only 0.5% of glenohumeral dislocations.[5] First recorded by Langier in 1834, *superior* glenohumeral dislocations continue to be extremely rare.[6] Fractures and neurovascular injuries are common with these dislocations because of their association with high-energy trauma and industrial accidents.

History

A comprehensive history is vital to classifying a glenohumeral dislocation. Although some patients with recurrent or multidirectional instability may have atraumatic dislocations, 96% of all glenohumeral dislocations are post-traumatic and anterior.[7] Mechanism of injury, number of previous dislocations, and history of dislocations of other joints or of the contralateral shoulder are also important in the workup.

Patients with an anteriorly dislocated shoulder will typically recount an abduction or external rotation mechanism, as occurs during an "arm tackle," or when a player is hit while throwing a ball. The examining physician should also look for a distraction component, as a posterior-to-anterior–directed force may be associated with anterior dislocation. Posterior dislocations are classically associated with seizures, electrocutions, or head-on collisions with the driver gripping the steering wheel. During seizure or electrocution, the pull of the subscapularis overpowers the other muscles and forces the humeral head into extreme internal rotation. Inferior dislocations typically result from a hyperabduction force or a direct blow to the abducted

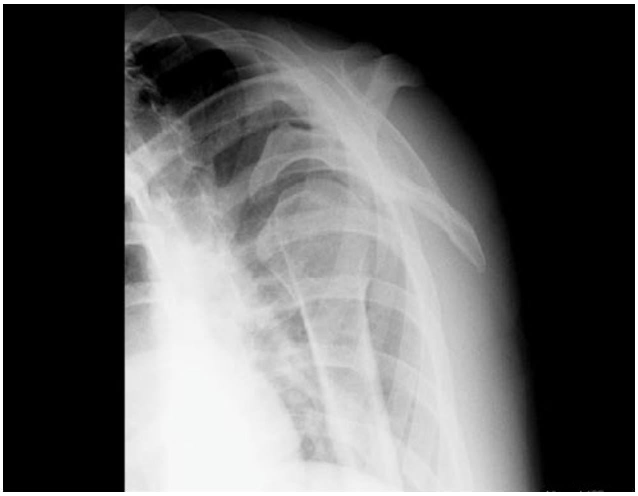

Figure 5. Scapular "Y" radiograph of anterior dislocation.

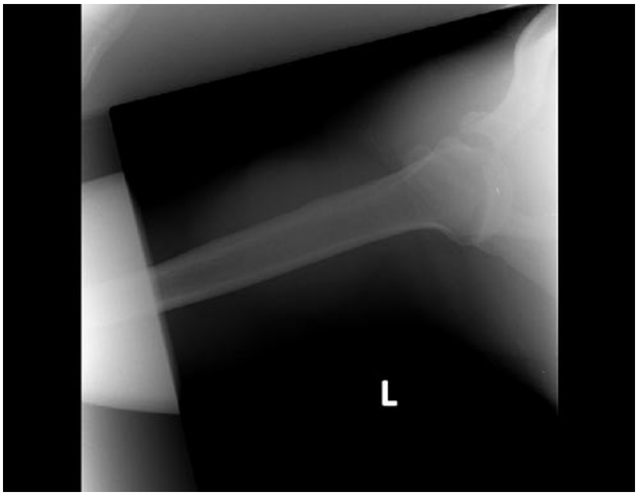

Figure 6. Axillary radiograph of anterior dislocation.

shoulder with the elbow extended and forearm pronated. This levers the proximal humerus on the acromion, forcing the humeral head inferiorly.

Physical Examination

Regardless of the specific etiology, patients who sustain a glenohumeral dislocation are often uncomfortable and quite anxious. Fortunately, the examiner can acquire a great deal of information with minimal provocation. Additional radiographic studies allow for more accurate decisions regarding treatment.

Patients with an anterior dislocation commonly hold the arm in slight abduction, and the humeral head may be palpable anteriorly. These patients are often incapable of placing their elbow at their side because of a lack of adduction. In contrast, patients with recurrent anterior dislocations may be strikingly at ease; in addition, these patients often state that they have a dislocation.

Patients with a posterior dislocation commonly lack gross deformity of the shoulder. The arm is typically held in the "sling" position—adducted and internally rotated. Classic features of a posterior dislocation include lack of external rotation (<0°), limited elevation of arm (<90°), prominence of coracoid process, posterior fullness, rounding of shoulder, and anterior flattening. Although there is pain with a posterior dislocation, it is not a distinguishing feature and therefore contributes to approximately 50% of these injuries being missed when patients first seek medical evaluation.[8,9] Missed posterior glenohumeral dislocations are more common in the elderly because of lack of clinical suspicion or lack of appropriate radiographs. Associated fractures are common (Figure 3). In a series of 41 locked posterior dislocations, Hawkins and colleagues[10] found that 20 dislocations had associated nondisplaced fractures of the proximal humerus. Robinson and Aderinto[4] found that most commonly the humeral anatomical neck was fractured with these injuries.

Mallon and colleagues[11] found that 27 (37%) of 86 inferior glenohumeral dislocations had an associated fracture, most commonly of the greater tuberosity. In addition, they found that 12% of patients with an inferior dislocation may sustain a tear of the rotator cuff. There have been case reports of luxatio erecta with surgical neck fractures,[5] bilateral inferior glenohumeral dislocations,[12] and open dislocations.[13] Vascular injuries are most common with inferior glenohumeral dislocations. In a series of inferior glenohumeral dislocations, Wirth and Rockwood[14] found that each of their 19 patients had brachial plexus pathology or vascular compromise before reduction.

The axillary nerve is the nerve that is most commonly injured. It is injured in up to 35% of first-time dislocations and is less common in recurrent dislocations.[15] Axillary nerve function can be quickly determined by assessing light touch sensitivity in the "sergeant's patch" area. This region can most reliably be found by measuring 5 to 10 cm from the lateral edge of the acromion along a line drawn directly lateral on the humerus. The patient should always be blinded when objectively assessing sensation. Subjective comparison with the contralateral extremity is essential. Motor testing of the deltoid is quite difficult, particularly in an extremity that is functionally incompetent. We recommend deep palpation of the deltoid muscle bulk just off the anterior, lateral, and posterior acromion followed by having the patient contract the deltoid. Again, contraction should always be compared with that on the contralateral side.

Careful documentation of what is directly observed is essential, and full strength of the deltoid cannot be ascertained from palpation alone. Although the technique of a detailed distal neurovascular examination is outside the scope of this article, the physical examination should be focused both on the nerve root (because of risk for avulsion injuries) and on peripheral nerve function. In addition, a thorough and accurate vascular examination is critical; axillary artery injury, though rare,[16] can have devastating consequences, including amputation and worse.

Figure 7. Milch technique.

Imaging

Radiographic evaluation of the glenohumeral joint must include a standard anteroposterior view (Figure 4), the scapula "Y" view (Figure 5), and the axillary view (Figure 6). The axillary view is the most useful for evaluating the direction of glenohumeral dislocation. The West Point or Velpeau view may be useful in patients who cannot tolerate a standard abducted axillary view. Alternative views, including an apical oblique view, the 45° lateral view, the 45° caudal view, and the Stryker notch view, can be of additional use, but their practical use is limited during acute management of these conditions.

When adequate radiographs cannot be obtained, computed tomography (CT) can provide definitive proof of joint integrity. Many institutions routinely pursue CT, as humeral head defects are found in up to 38% of acute glenohumeral dislocations.[17] At our institution, CT is performed whenever a humeral head or glenoid fracture is suspected. Whether to perform CT before and/or after reduction is worthy of discussion. When a radiograph shows a fracture of the articular surface, in centers where scanning can be done efficiently and expeditiously, prereduction imaging is reasonable; however, routine preoperative and postoperative CT scanning of all dislocations is not always indicated.

Reduction Techniques

Reduction should be attempted for all acute glenohumeral dislocations. Intravenous (IV) sedation can be used in the emergency department with appropriate monitoring. Some authors have recommended use of intra-articular lidocaine for pain control, as it is more easily accessible and does not require patient monitoring. Lippitt and colleagues[18] found that IV analgesia (muscle relaxants) was 75% successful and had a 37% complication rate, whereas intra-articular lidocaine was 100% successful and had no complications. Miller and colleagues,[19] in a randomized, prospective study, compared IV sedation (midazolam 2 mg, fentanyl 100 µg) with intra-articular lidocaine (20 mL of 1%). With the modified Stimson technique, no difference was found with regard to pain or success of reduction. Patients injected with lidocaine spent less time in the emergency department, and cost was significantly reduced.

Many techniques have been described for reduction of anterior shoulder dislocations. In perhaps the oldest, the Hippocratic technique, longitudinal traction was applied on the dislocated upper extremity with counterforce against the humeral head in the axilla. Typically, a ball or the physician's heel was used for countertraction. However, given numerous accounts of neurovascular complications and traumatic injuries, this technique fell out of favor.

Anterior Dislocations

Milch Technique

The Milch[20] technique, first described in 1938, uses the "anatomical position" of the shoulder musculature to aid in reduction. With the humerus at the side, the direction of various muscles around the shoulder girdle is haphazard. With the humerus in 180° of abduction, the shoulder musculature runs directly upward along the axis of the humerus. This is the only position of the humerus in which a single force applied to the humerus may overcome all the muscles about the shoulder girdle.

The patient is placed supine with the surgeon standing on the side of the dislocation. Should the dislocated shoulder be the right side, the surgeon's right hand is placed on the patient's shoulder, with the fingers on top of the shoulder and the thumb on the dislocated humeral head. Some surgeons allow the patient to then place the hand of the dislocated upper extremity behind the head (Figure 7). This can be done by the patient without assistance, and most patients find this surprisingly tolerable. If assistance is needed, the left hand then gently abducts the arm to the overhead position, while the right hand holds the head of the humerus in the dislocated position. Once the arm is in complete abduction, the humeral head can be gently pushed over the rim of the glenoid.

The success of the Milch technique is well documented. Beattie and colleagues[21] found a 72% initial success rate with this technique and noted that it is a less traumatic method of closed reduction. However, they also noted less success with the Milch technique when the dislocation was older than 4 hours. Janecki and Shahcheragh[22] reviewed 50 consecutive anterior dislocations reduced with the Milch technique. Seventeen patients required no analgesia. The authors reported no neurovascular injuries or fracture complications and again commented on the atraumatic nature of this technique. Russell and colleagues[23] reviewed 76 acute anterior shoulder dislocations reduced using the Milch technique. Sixty-eight cases (89%) were reduced on the initial attempt. Of the 68 patients, only 31% required analgesics or muscle relaxants. Again, the authors noted no complications with this reduction technique.

Kocher Technique

The Kocher technique of reduction requires that the physician stand at the side of the supine patient.

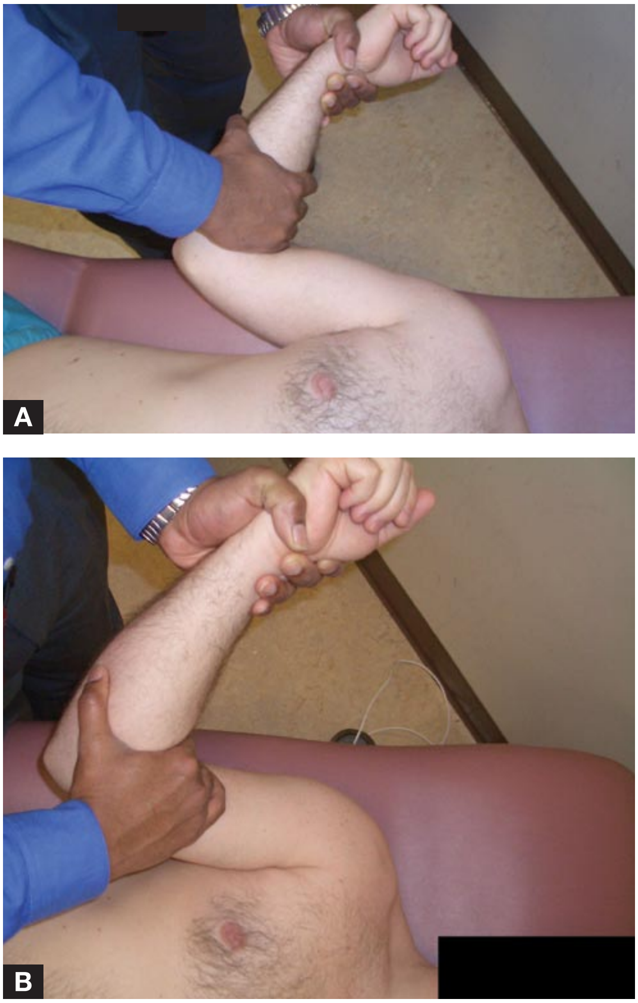

Figure 8. (A, B) Kocher technique.

Traction is applied to the patient's arm by holding the elbow (injured right extremity of patient held by right arm of surgeon) (Figure 8A). The humerus is rotated externally while the elbow is moved up toward the patient's chest (Figure 8B). This maneuver should reduce the humeral head into the glenoid fossa. After reduction, the hand of the patient on the injured side is brought to the contralateral shoulder.

Berkenblit and colleagues[24] reviewed 28 skiers and snowboarders treated with the Kocher method during a single ski season. All reductions were attempted within 1 hour of acute injury. The Kocher method was successful in 83% of cases. In the successful cases, reduction time was less than 5 minutes. In this series, only 1 patient required analgesia, and no one required sedation. The authors reported that 1 patient had hyperesthesia in the axillary nerve distribution. Manes[25] associated this technique with fracture of the humeral head or shaft in patients with osteoporosis, as well as damage to the axillary vessels and nerve. In Manes's experience, this maneuver can be performed safely and effectively when the desired adduction and external rotation are achieved in a deliberate, stepwise fashion (ie, advance 15°, relax 5°, etc).

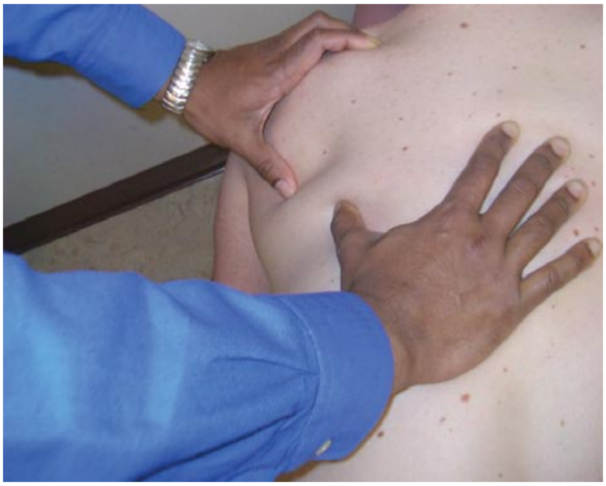

Figure 9. Scapular manipulation technique.

Scapular Manipulation

The scapular manipulation technique is a minimally traumatic technique that is similar in principle to the Milch technique, but with the patient in the prone position. Rather than the humerus being externally rotated, the scapula and glenoid are effectively internally rotated to disengage the humeral head. The patient is placed prone, and traction of 5 to 15 pounds is applied to the affected arm. The weight must be secured to the wrist in a way that does not compromise the vascularity of the hand and does not in any way require the patient to physically hold the weight. The patient simply can be left this way and can be encouraged to relax, but many feel it is more effective to manually raise and rotate the inferior angle of the scapula medially while the superior aspect of the scapula is manipulated laterally (Figure 9). This technique has a reported 92% success rate at initial reduction, with a limited need for analgesia and no complications reported.[26] The prone position excludes its use in patients with multiple injuries or with airway compromise.

Stimson Method

The Stimson method of closed reduction works on the principle that fatigue of the muscles of the shoulder girdle will allow for eventual reduction of the glenohumeral joint. The patient is placed prone, and the arm is allowed to hang over the edge of the examination table. Weight of 10 to 15 pounds is applied to the wrist as traction, typically by strapping the weight around the patient's wrist (Figure 10). Occasionally, gentle external rotation of the upper extremity may facilitate reduction. This technique may take several minutes to work and may require sedation. Should sedation be required, the patient must not be left unattended in the prone position.

Traction-Countertraction Technique

The traction–countertraction technique requires 2 people for reduction. The patient is supine on the examination table. A sheet is placed around the thorax, with the loose ends on the side opposite the shoulder dislocation. These ends are held by the assistant. The elbow of the dislocated shoulder

Figure 10. Stimson technique.

is flexed to 90°, which helps to relax the neurovascular structures. Traction is then applied in line with the humerus (Figure 11A). Steady traction with gentle rocking of the arm in internal and external rotation can be used to "walk" the humeral head over the glenoid rim (Figures 11B, 11C).

External Rotation Technique

The external rotation technique of glenohumeral dislocations applies gentle external rotation of the affected extremity to achieve reduction. With the patient supine, the physician stands on the side of the affected extremity. One hand is placed on the affected extremity at the wrist, and the other is placed on the elbow (Figure 12A). The elbow is flexed to 90°, and the arm is adducted to the side of the chest (Figure 12B). The shoulder is slowly flexed forward to 20°, and, with the grasped wrist used as a guide, the shoulder is gently externally rotated until the forearm is in the coronal plane (Figure 12C). Reduction typically is achieved between 70° and 110° of external rotation. Once reduction is obtained, the arm is internally rotated and the forearm rested across the chest.

Eachempati and colleagues[27] conducted a prospective study of 40 anterior shoulder dislocations reduced using the external rotation method. The authors noted that 36 of the 40 dislocations were successfully reduced using this technique on the first attempt. In addition, 29 of the 36 required no premedication. Of the 4 failures, 2 had associated greater tuberosity fractures. No short-term complications were noted with this technique.

Eskimo Technique

The Eskimo technique, originally described by Poulsen[28] in 1988 and first observed in Greenland, is a simple reduction technique. The patient is placed on the ground lying on the

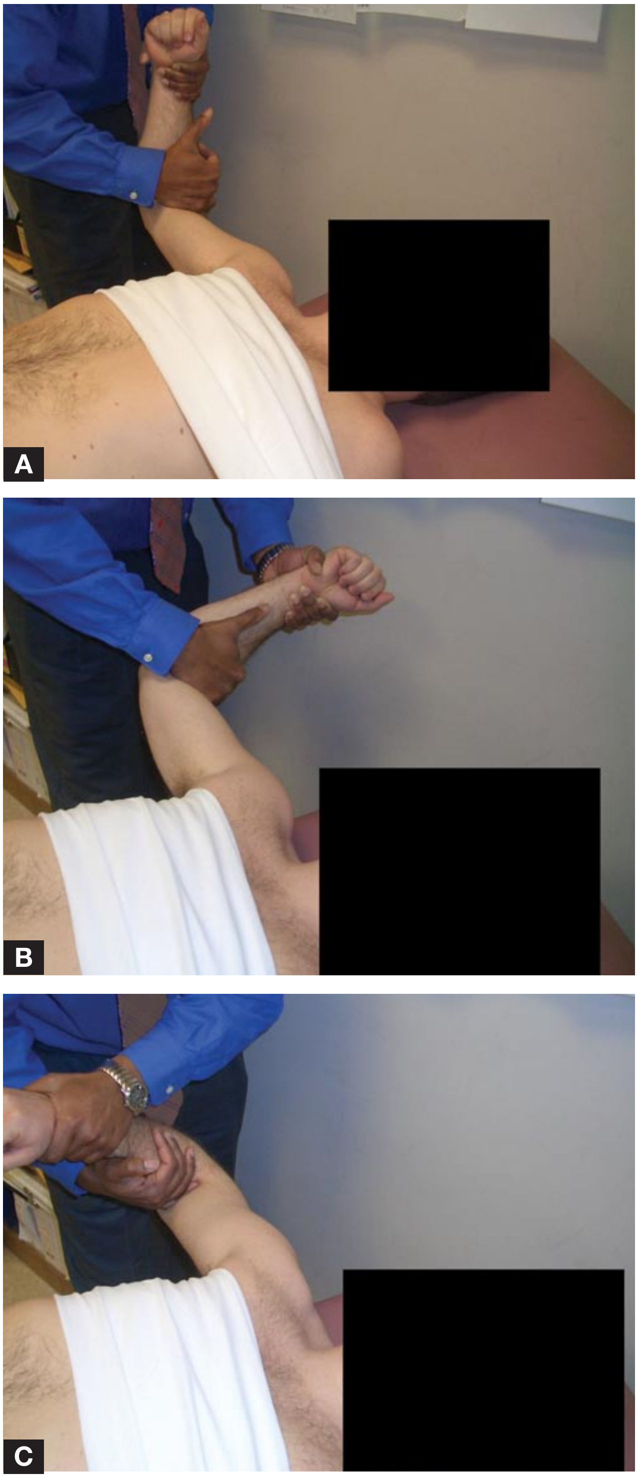

Figure 11. (A-C) Traction–countertraction technique.

nondislocated shoulder. Two people lift the patient by the dislocated arm, keeping the opposite shoulder suspended a couple of centimeters off the ground (Figure 13). Occasionally, gentle manipulation of the humeral head over the glenoid rim may be necessary.

Poulsen[28] studied 23 consecutive patients with anterior glenohumeral shoulder dislocations. Seventeen (74%) of the 23 patients were reduced on the first attempt using this technique. However, the author noted that

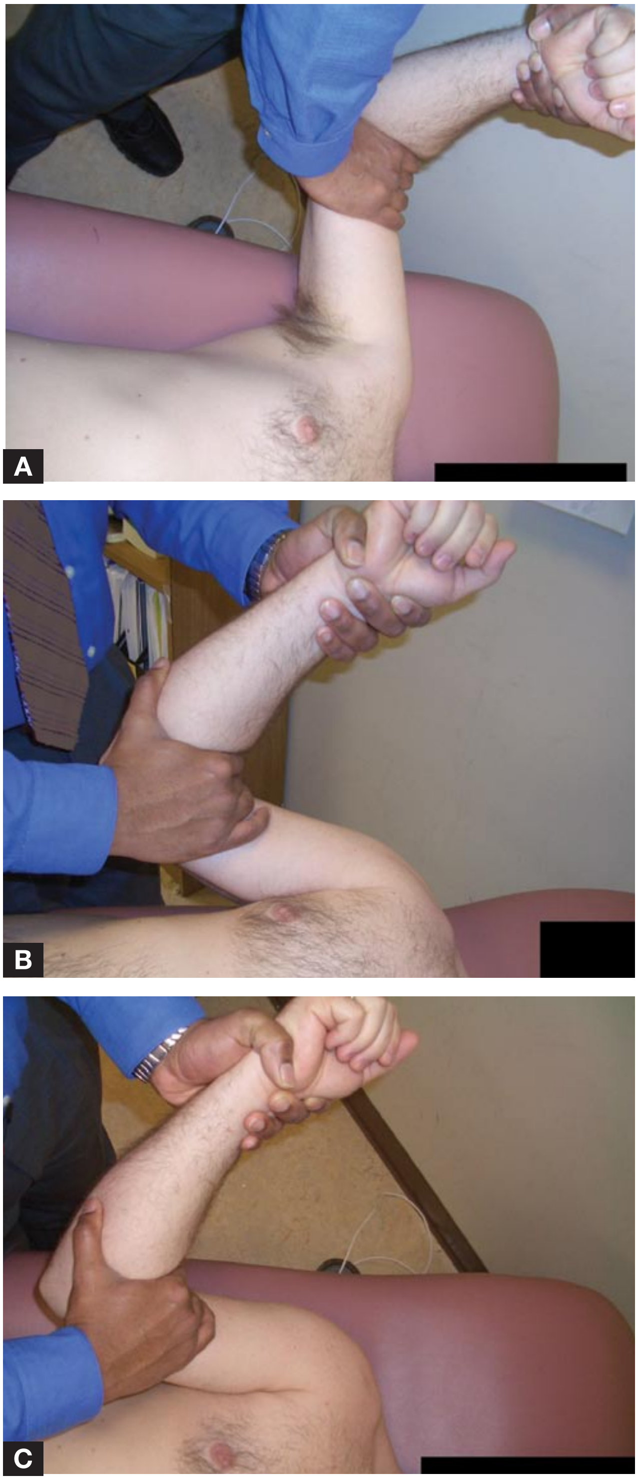

Figure 12. (A-C) External rotation technique.

this technique may place undue stress on the brachial plexus and axillary vessels, and he recommended further investigation.

Posterior Dislocations

The diagnosis of patients with posterior glenohumeral dislocations is more difficult, and it is essential to obtain a good history to assess chronicity. Given the high frequency of concomitant injuries in acute dislocations and fixed deformities in chronic dislocations, general anesthesia is often required for reduction. The patient is placed supine. Longitudinal and lateral traction is applied to the arm with gentle external rotation in a deliberate, stepwise fashion. Maximal internal rotation may be necessary to stretch out the posterior rotator cuff initially to unlock a bony deformity. Fluoroscopy is often important, as there is no clear visual or palpable feedback to ensure successful reduction. Postreduction care often requires immobilization in external rotation. A custom abduction sling is helpful in maintaining the shoulder in external rotation. When a chronic dislocation is presented, it is important to be prepared for open reduction. Hawkins and colleagues[10] reviewed 41 patients with locked posterior shoulder dislocations. Mean interval between injury and diagnosis was almost 1 year, and closed reductions were successful in only 6 of 12 attempted.

Figure 13. Eskimo technique.

Luxatio Erecta

This rare dislocation is best reduced with the patient supine. Countertraction is applied by an assistant using a sheet folded across the superior aspect of the shoulder and neck. Traction is initially applied upward, and then gradually the arm is brought into less abduction. The arm should be brought down to the patient's side; once this is accomplished, the deformity should be treated like an anterior dislocation.

Postreduction Management

A repeat thorough physical examination after closed reduction of a glenohumeral dislocation is critical. Particular attention should be paid to the motor and sensory function of the axillary, radial, ulnar, and musculocutaneous nerves. A vascular examination, noting the presence or absence of a pulse, hematomas, and bruits, is expected.

Postreduction management of all patients who undergo closed reduction of a glenohumeral dislocation should include an anteroposterior view in the plane of the scapula, a lateral view in the plane of the scapula, and an axillary view.

These allow the treating physician not only to confirm reduction but to diagnose any associated bony injuries. As mentioned, CT is useful in evaluating the humeral head, specifically in looking for a Hill-Sachs lesion, a reverse Hill-Sachs lesion, or a bony Bankart injury. Magnetic resonance imaging (MRI) has a limited roll in the emergency/acute setting. In the outpatient setting, MRI can show a labral tear, a rotator cuff tear, or other associated injuries.

Traditionally, after confirmed reduction, anterior dislocations are placed in a sling with the arm in adduction and internal rotation. However, there is minimal evidence-based data to support this practice.[29] In fact, results from an MRI shoulder study conducted by Itoi and colleagues[30] suggested that external rotation of the humerus better approximates Bankart lesions to the glenoid neck when compared with traditional internal rotation. Stable posterior dislocations can be placed in a sling. However, unstable posterior dislocations should be placed in a brace that maintains external rotation, abduction, and extension.[31]

Early follow-up with an attending orthopedic surgeon is of utmost importance. Patients expect to be uncomfortable after having a dislocation treated and may not realize that they have sustained a redislocation, which can have long-term implications. In our medicolegal climate, MRI is often ordered after the first outpatient consultation in order to assess the glenohumeral joint for associated injuries. Questions regarding initiation of therapy and range-of-motion exercises are subjects of controversy and beyond the scope of this article.

Surgical Indications

Indications for surgical treatment of acute glenohumeral dislocations include open dislocations, irreducible dislocations, dislocations that are unstable after reduction, displaced fractures of the greater and lesser tuberosity, glenoid rim fractures, and dislocations with humeral head fractures.

At our institution, the recommendation is 2 reduction attempts with either intra-articular lidocaine or sedation. When the dislocation remains unreduced, the next step is general anesthesia. Irreducible fractures are typically blocked by soft-tissue interposition, which should be further assessed with MRI. When soft tissue is found in the glenohumeral joint, early open reduction is recommended.[32,33]

Possible associated bony lesions that may block reduction or result in postreduction morbidity can be better assessed with CT. Greater tuberosity fractures displaced more than 0.5 mm and lesser tuberosity fractures displaced more than 1 cm, or 45° of angulation, are associated with residual functional deficits. These associated injuries require operative intervention.

Large posterior glenoid rim fractures, or fractures that result in glenohumeral incongruity, are likewise associated with poor results. These fractures require open reduction and internal fixation to restore congruity as well as stability.[34] Reverse Hill-Sachs lesions involving more than 20% to 40% of the articular surface may require a modified McLaughlin procedure, or humeral head resurfacing.

In an isolated glenohumeral dislocation, patient age and mechanism of injury play a role in determining surgical intervention to restore stability. There is still much controversy regarding early or late surgical intervention. Furthermore, long-term studies are still needed. However, a young patient who is functioning at a high level may benefit from early primary stabilization.[35-37]

Prognosis

Recurrent instability of the glenohumeral joint is the most common complication of glenohumeral dislocation. Patient age at time of initial dislocation is the most important prognostic factor, but severity of initial trauma plays a real (but poorly quantified) role as well. Patients younger than 20 at time of initial dislocation have up to a 90% chance of recurrent instability,[7,38] whereas patients older than 40 at time of initial dislocation have a 6% chance of recurrent instability but a clinically significant high incidence of rotator cuff tears.[39] The vast majority of recurrent dislocations occurs within the first 2 years after initial dislocation. Dominance of the affected shoulder seems not to have a major effect on recurrence.[39,40]

Conclusions

The glenohumeral joint is the most commonly dislocated joint in the human body. A thorough history and physical examination and appropriate radiographic studies are essential both before and after reduction of an acute dislocation. Reduction should be attempted for appropriate glenohumeral dislocations. Coexisting injuries are common and must be acutely diagnosed and appropriately treated. The treating physician should have a complete understanding of the likelihood of recurrence given the patient's demographics and injury specifics. Rehabilitation must be coordinated with a therapist to optimize the chances for success with physiotherapy. Although rehabilitation programs can be successful, a recent trend toward surgical stabilization in younger patients has been reported but remains controversial.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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This paper will be judged for the Resident Writer's Award.