Dislocation of the Upper Extremity: Diagnosis and Management

Xinning Li
Boston University

Antonio Cusano
Boston University

Josef K Eichinger
Medical University of South Carolina

9 DISLOCATIONS OF THE UPPER EXTREMITY: DIAGNOSIS AND MANAGEMENT

Xinning Li, MD; Antonio Cusano, BS; Josef K. Eichinger, MD

KEYWORDS: shoulder dislocation, elbow dislocation, acromioclavicular joint dislocation, sternoclavicular joint dislocation

Dr. Li or an immediate family member serves as a paid consultant to or is an employee of Mitek and Tornier. Dr. Eichinger or an immediate family member serves as a paid consultant to or is an employee of Acumed and serves as a board member, owner, officer, or committee member of the American Academy of Orthopaedic Surgeons. Neither Dr. Cusano nor any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this chapter.

INTRODUCTION

Shoulder dislocations are common and account for 50% of all joint dislocations.[1] Elbow dislocations are the second most prevalent major joint dislocation in adults.[2] Effective treatment of these injuries requires a thorough understanding of the anatomy and imaging techniques as well as how to safely and effectively perform timely reductions. Upper extremity dislocations are generally acute traumatic events because of supraphysiologic forces resulting from falls from a height or contact sport injury. These dislocations are typically associated with marked pain and restricted function, prompting emergency evaluation and treatment. This chapter discusses the functional anatomy, clinical and radiographic evaluation, indications, and management of shoulder and elbow dislocations, as well as other less commonly dislocated joints around the shoulder girdle.

EPIDEMIOLOGY OF SHOULDER AND ELBOW DISLOCATIONS

The overall incidence of shoulder dislocations has been reported to be between 23.1 and 26.9 per 100,000 person-years and is more commonly observed in young males.[3] Extrinsic risk factors include occupations that require extensive upper limb activity and movement above chest height, as well as active participation in collision sports. The shoulder has four different articulations: the scapulothoracic joint, the glenohumeral joint, the acromioclavicular (AC) joint, and the sternoclavicular (SC) joint. Elbow dislocation accounts for 10% to 25% of all elbow and shoulder injuries.[2] The elbow is extremely stable, given its bony anatomic configuration; as such, excessive force is required to damage or dislocate this joint. The rate of elbow dislocation is 6 to 13 cases per 100,000 people, and men tend to be at greater risk.[4] Athletic involvement is associated with 50% of elbow dislocations, most of which are posterior.

FUNCTIONAL ANATOMY

Shoulder

Anatomically, the shoulder joint is uniquely arranged, with a relative lack of articular bony contact that provides a wide range of motion with six degrees of freedom. However, this expansive motion advantage makes the joint more susceptible to dislocation and injury. The shoulder joint relies on both static and dynamic structures to collectively maintain stability through the mid and end ranges of motion. Static constraints, such as the coracoacromial arch and glenoid fossa, confer anterosuperior and posteroinferior stability, respectively; the joint capsule and glenohumeral ligaments (GHLs) also provide multidirectional stability. The superior GHL prevents inferior humeral translational movement, and the middle GHL, although absent in 30% of shoulders, protects against anterior translation in the mid ranges of abduction. Last, the inferior GHL, composed of three bands, is the strongest GHL and limits external rotation at 45° to 90° of abduction. Because only 25% to 30% of the humeral head contacts the glenoid at any time, the deltoid, rotator cuff, and periscapular musculature play a critical functional role in compression of the humeral head against the glenoid and stabilization of the scapula.[5]

Elbow

The two main arcs of motion that occur at the elbow joint are pronation-supination at the radiohumeral articulation and flexion-extension at the ulnohumeral articulation. The elbow joint is considered a uniaxial hinge joint, although biomechanical studies have revealed that at extreme ranges of motion, potential exists for 3° to 4° of valgus, varus, and axial laxity.[6] Elbow stability is due in part to the osseous anatomy of the proximal ulna and distal humerus, as well as the static and dynamic constraints along the joint capsule. Dynamic muscular stabilizers, including the anconeus, brachialis, and triceps brachii, provide stability through joint compression. In addition, the lateral wad muscles contribute to varus force resistance, and the flexor compartment muscles on the medial aspect contribute to valgus force resistance. The coronoid process contributes the most joint stability because its unique structure resists posteriorly directed forces from the brachioradialis, biceps, and triceps muscles.[7] Biomechanical studies indicate that the ulnohumeral joint requires at least 50% of the coronoid process to be intact for proper function and to maintain stability.[8]

AC Joint

The AC joint is a diarthrodial joint located between the lateral aspect of the clavicle and the medial facet of the acromion. Its stability is maintained by the coracoclavicular ligaments (the conoid and trapezoid) and the AC joint capsule. At lower loads, the AC joint capsule is responsible for approximately two-thirds of the constraining force to superior displacement; however, at higher stress and larger displacement values, the conoid ligament assumes much of this load. The conoid ligament insertion is located medially from the lateral edge of the clavicle, at an average of 42.8 mm in females and 47.1 mm in males.[9] Moreover, the trapezoid ligament attaches more laterally to the underside of the clavicle, which allows it to resist AC joint compression.[10] Together, the ligaments provide stability in the superior-inferior plane, and the AC joint capsule provides stability in the anterior-posterior plane.

SC Joint

SC joint stabilization is maintained through the costoclavicular ligament, the anterior and posterior SC ligaments, the intraclavicular ligament, and the intra-articular discoligamentous complex. The costoclavicular ligament is a short, strong ligament located between the costoclavicular tubercle and the costal cartilage of the first rib on the medial side of the clavicle. The costoclavicular ligament is the main contributor to SC joint stabilization in all planes of motion except for lateral depression.[11]

HISTORY AND PATIENT PRESENTATION

Shoulder

Shoulder dislocations are most commonly observed following anteriorly directed trauma to an externally rotated and abducted arm, especially in the setting of contact sports. Most shoulder dislocations are in the anterior direction (more than 90%). Patients will typically present with the arm in an abducted and externally rotated position. Concomitant shoulder girdle injuries are common. A review of one prospective trauma database identified 3,633 consecutive patients with shoulder dislocation: 1,215 (33.4%) had either a greater tuberosity fracture or a rotator cuff tear and 492 (13.5%) had an associated neurologic deficit following reduction.[12] The axillary nerve is most susceptible to damage given its proximity to the inferior capsule within the axilla. Axillary nerve injury presents as limited shoulder abduction because of absent deltoid function and diminishment or loss of sensation to the anterolateral aspect of the shoulder.

Elbow

Ninety percent of elbow dislocations occur posteriorly as a result of a hyperextension mechanism, most commonly after a fall on an outstretched hand or collision injury event in athletics.[13] Because of the amount of force required to cause dislocation, concomitant fractures or neurologic compromise can occur, particularly to the median and ulnar nerves. The second most common elbow dislocation pattern is a posterior elbow dislocation with a concomitant radial and ulnar divergence.

AC Joint

Local tenderness in the area of the clavicle or acromion process remains one of the best diagnostic signs for AC joint separation. Patients often present with the arm in an adducted, supported position and report localized pain and point tenderness around the AC joint. Although the pain level varies depending on the severity of the injury, it is exacerbated when the arm is moved through abduction or cross-body adduction.[14] In more extensive cases, such as in type V dislocations, associated skin tenting may be apparent along the distal clavicle.

SC Joint

Patients may present with their head tilted toward the affected side and with the injured arm supported across the trunk. SC joint dislocations are commonly caused by direct trauma to the anteromedial aspect of the clavicle, resulting in posterior displacement of the clavicle. Dislocations can also occur as a result of anterolateral or posterolateral shoulder compression. The force vector is directed along the long axis of the clavicle and can result in either an anterior or posterior dislocation, depending on the resultant vector and the direction the shoulder moves in response to such stress. Patients commonly report chest and shoulder pain that is accentuated when lying in a supine position or when moving the affected arm.[15] This pain tends to be more severe following posterior dislocation. Furthermore, posterior SC dislocation can also involve compression of adjacent structures and subsequent dysphagia, dyspnea, upper extremity swelling, and/or neurologic deficits. With anterior dislocation, the patient will have deformity and pain with palpation at the SC joint.

PHYSICAL EXAMINATION

Shoulder

Gross abnormalities and asymmetry can be identified on visual inspection. With anterior dislocations, patients usually resist any movement and preferentially guard the affected shoulder by placing the arm in an externally rotated and slightly abducted position. The humeral head and acromion process can be palpated anteriorly, especially in thin patients. A complete neurovascular examination of the upper extremity should be performed. Posterior dislocations are more difficult to diagnose by physical examination because deformities are not as conspicuous. Classic features of posterior shoulder dislocation consist of limited arm elevation and external rotation, in addition to a protruding coracoid process with a prominent posterior shoulder and anterior flattening. The patient may present with the arm held in internal rotation and adduction because of an inability to externally rotate the affected arm.

Elbow

The elbow should be inspected for swelling or gross abnormalities. Anterior elbow dislocations appear to have an elongated forearm; posterior elbow dislocations tend to have a prominent, palpable olecranon on examination. A comprehensive neurovascular evaluation should be performed to examine for potential ulnar nerve, median nerve, and/or brachial artery injuries. Sensation is assessed using light touch in the median, ulnar, and radial nerve distributions. In addition, to test for potential motor loss deficits, the patient should be examined for the ability to perform index finger–and–thumb opposition (median nerve), thumb extension (radial nerve), and abduction/adduction of the digits (ulnar nerve). Palpation of both the radial and ulnar arteries at the wrist is essential to determine the vascular status of the arm.

AC Joint

Type I and II AC joint injuries rarely have gross abnormalities; however, type III and V injuries are characterized by a prominent clavicle and ligamentous disruption surrounding the AC joint. In acute settings, patients will have limited range of motion and substantial pain when attempting to raise the arm. The most reliable and widely used physical examination test to assess AC joint integrity and stability is the cross-body adduction test. The patient raises his or her affected arm to 90° of forward flexion, and the examiner holds the elbow and adducts the suspected arm across the patient's body. Pain and discomfort is associated with a positive test result. A posterior deformity through the trapezius muscle can be noted in patients with type IV AC separation.

SC Joint

Special attention should be given to monitoring patient respiration with a posterior SC dislocation, which can potentially cause airway, great vessel, or esophageal compression. Patients should be evaluated for stridor or tachypnea, as well as for venous congestion, vascular deficits, and neurologic compromise to the neck and affected arm. The affected shoulder is frequently positioned anteriorly and looks shortened. Tenderness to touch and edema are commonly found over the SC joint, in addition to pain that is exacerbated with lateral compression to the shoulders.

RADIOGRAPHS

Shoulder

Radiographs must be obtained before and after reduction to ensure anatomic alignment. Although AP and Grashey views are helpful, axillary and/or scapular Y views are essential because they better depict the relationship between the glenoid and the humeral head. Silfverskiold et al[16] compared the accuracy of the scapular Y and axillary views and reported that the scapular Y view was more accurate in diagnosing shoulder dislocations and was associated with substantially higher patient satisfaction. Another useful image for diagnosing/evaluating glenohumeral disolocations is the Velpeau radiograph, which does not require shoulder abduction and can be obtained with the patient in the upright or supine position. MRI is an adjunctive postreduction study and is particularly useful for highlighting soft-tissue damage and rotator cuff tears. The presence of a coexistent hemarthrosis serves as contrast to highlight capsular and labral pathology, precluding the requirement for an arthrogram.

Elbow

Standard AP and lateral views are necessary to understand the direction of the dislocation. A postreduction oblique radial head–capitellum view is recommended to examine for fractures because it reduces osseous overlap in this area.[17]

AC Joint

To properly visualize the AC joint requires one-third to one-half of the x-ray penetration used for a typical shoulder radiograph.[9] Although AP, axial, and lateral views are commonly used to evaluate the shoulder, a bilateral, upright, single-cassette Zanca view is necessary to assess the grade of the AC joint injury and displacement.[18] The Zanca view directs an x-ray beam at a 10° to 15° cephalic tilt at 50% of the standard penetration strength for an AP shoulder view. A cross-body adduction radiograph can help identify dynamic instability. Radiographs obtained with the patient holding weights are inaccurate, painful, and may not be tolerated by the patient; therefore, their use is limited in clinical decision making. MRI can be obtained to evaluate AC and coracoclavicular ligamentous integrity more accurately and has been shown to identify concomitant intra-articular shoulder injuries.[19]

SC Joint

The serendipity view can be used to visualize the medial clavicle and is obtained by positioning the beam 40° from vertical and directed through the patient's manubrium while he or she is supine. With an anterior or posterior dislocation, the clavicle will be superior or inferior to the horizontal plane, respectively. The Hobbs view can also be used to visualize the SC joint: the patient sits on the patient positioned with the radiography table so that his or her anterior chest touches the film cassette. With elbows flexed and straddling the anteriorly positioned cassette, the x-ray beam is aimed directly down the cervical spine. However, CT scans have supplanted plain radiographs to evaluate this region because CT also identifies compression of posterior structures and distinguishes between physeal and nonphyseal injuries in younger adults. Three-dimensional reconstructions help identify chronic medial clavicular malunion associated with SC dislocations.[20]

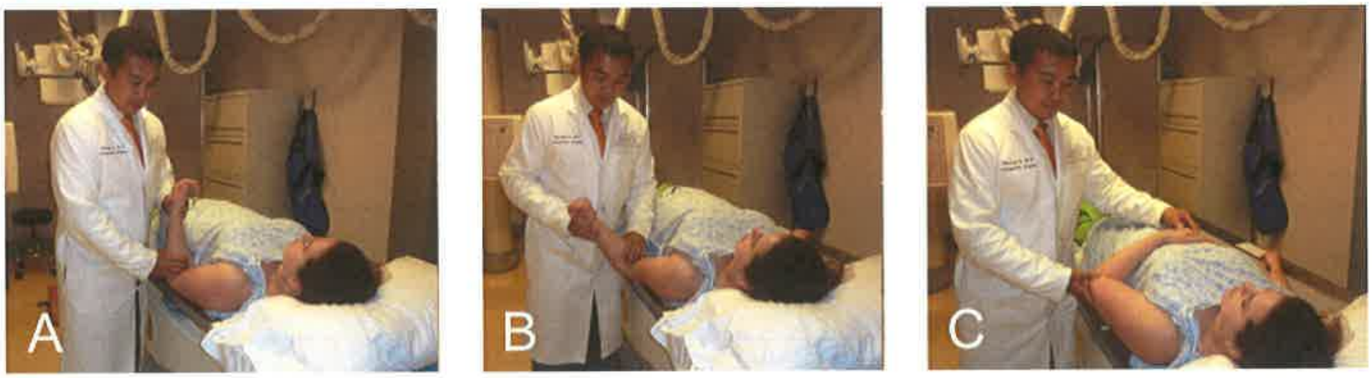

FIGURE 1 Photographs demonstrate the Kocher method for shoulder reduction. **A,** With the patient supine and the arm in neutral and adduction, the elbow is flexed to 90°. **B,** The arm is moved through gentle external rotation until resistance is felt, usually at 75°. **C,** The arm is slowly moved into abduction, and internal rotation is used to reduce the humeral head. After reduction, the arm is placed in adduction and internal rotation with a sling.

SHOULDER DISLOCATIONS

Acute, traumatic dislocations require prompt reduction irrespective of the direction of dislocation for both pain relief and to prevent further damage to surrounding structures such as the axillary nerve. The direction of dislocation (anterior, posterior, inferior) must be determined before attempting reduction as well as a plan for postreduction immobilization. The presence of a humeral neck or shaft fracture should also be ruled out using prereduction radiographs. Conscious sedation and manipulative reduction can be performed in the emergency department setting with or without the addition of a local anesthetic injected intra-articularly into the glenohumeral joint. Waterbrook and Paul[21] demonstrated that an intra-articular injection of 20 mL of 1% lidocaine alone with a manipulative reduction was as effective as and had lower complication rates compared with a manipulative reduction with intravenous sedation.

Reduction Technique for Anterior Dislocation

In the acute setting, closed reduction maneuvers are categorized depending on the use of countersupport on the axilla. The methods that do not rely on countersupport include the Hippocratic method (simple traction along the arm); the Kocher method (**Figure 1**); the Stimson method (**Figure 2**); and the Milch method, in which the

FIGURE 2 Photograph demonstrates the Stimson method for shoulder reduction. The patient is prone, with the affected arm hanging over the edge of the bed/stretcher; downward traction or hanging weight is applied; and reduction occurs with relatively little force after 15 to 20 minutes.

patient is supine or seated, the physician stabilizes the humeral head while the affected arm is slowly abducted while maintaining longitudinal traction, and with the arm in an abducted, overhead position, the cuff muscle is relaxed and the humeral head either self-reduces or can be glided back into the joint.[5] Conversely, maneuvers that use countersupport on the axilla are mostly variations of the original Hippocratic method and can include the use of the back of a chair or a sheet, as demonstrated with the Mitsen method.

In a randomized trial, Sayegh et al[22] compared a new method of shoulder reduction called the fast, reliable, and safe (FARES) method with the Hippocratic and Kocher methods. Reduction was achieved with the FARES method in 89% of patients, the Hipopocratic method in 73%, and the Kocher method in 68%. The time required for the

FIGURE 3 Photographs demonstrate the fast, reliable, and safe shoulder reduction method. **A,** With the arm at the side and extended, the hand is held with gentle longitudinal traction, neutral rotation is applied, and the arm is moved slowly into abduction. **B,** At the same time, brief, short-range vertical oscillating movements (5 cm superior and inferior to the horizontal level) are performed in all stages of the reduction. Beyond 90° of abduction, the arm is externally rotated with continued abduction and vertical oscillation. **C,** The shoulder is typically reduced at 120° of abduction and placed at the side with internal rotation and the forearm across the chest.

reduction was shorter and the amount of pain was substantially less with the FARES method. Maity et al[23] also reported that 95% of shoulders were successfully reduced with the FARES method, with less pain and time to reduction compared with the Eachempati method. No complications were reported in either study. The FARES reduction method (**Figure 3**) is performed without sedation, analgesics, or counter-traction, but with the patient as relaxed and comfortable as possible.

Reduction Technique for Posterior Dislocation

The reduction maneuver for a posterior dislocation is a combination of internal rotation to unlock the humeral head and translation of the head away from the glenoid to allow subsequent anterior translation and reduction to occur. For the Depalma method, the affected arm is first adducted and internally rotated, with caudal traction applied. Traction is maintained by using the medial side of the upper arm as a lever and internal rotation to disengage the humeral head from the glenoid fossa. The arm is extended and externally rotated to reduce the posterior dislocation[24] (**Figure 4**). A posterior locked shoulder dislocation can also occur with a lesser tuberosity fracture. The shoulder is reduced using the Depalma method under general anesthesia, and the lesser tuberosity fracture is repaired by open reduction and internal fixation (**Figure 5**).

FIGURE 4 **A,** AP radiograph demonstrates a posterior locked shoulder dislocation and a proximal humerus fracture. **B,** Grashy view radiograph demonstrates a congruent glenohumeral joint. **C,** Grashy view radiograph demonstrates a reverse Hill-Sachs lesion in the anterior aspect of the humeral head.

Not infrequently, posterior dislocations present in a delayed fashion due to misdiagnosis. Identifying subacute or chronic dislocations is important because a closed reduction may not be possible and an open surgical procedure is required. Persistent posterior shoulder dislocations are most commonly encountered in association with a reverse Hill-Sachs lesion or an anterior humeral head impaction fracture in which the humeral head is locked into the posterior glenoid rim (**Figure 5**). These bony injuries need to be treated during any open surgical procedure with a lesser tuberosity transfer, allograft reconstruction, or humeral head resurfacing, depending on the size of the lesion. Postoperative immobilization in external rotation is important to avoid subsequent dislocation.

Reduction Technique for Inferior Dislocation (Luxatio Erecta)

Inferior dislocation is uncommon and more often associated with neurologic and vascular injuries. Greater tuberosity fractures are also common but do not affect the reduction method. The arm should not be forced inferiorly; rather, all reduction maneuvers should be performed based on the position of presentation. One method is to use conscious sedation and place a closed fist in the axilla and push the humeral head superiorly while simultaneously providing axial traction followed by gentle arm adduction. Another reduction technique is to convert the luxatio erecta to an

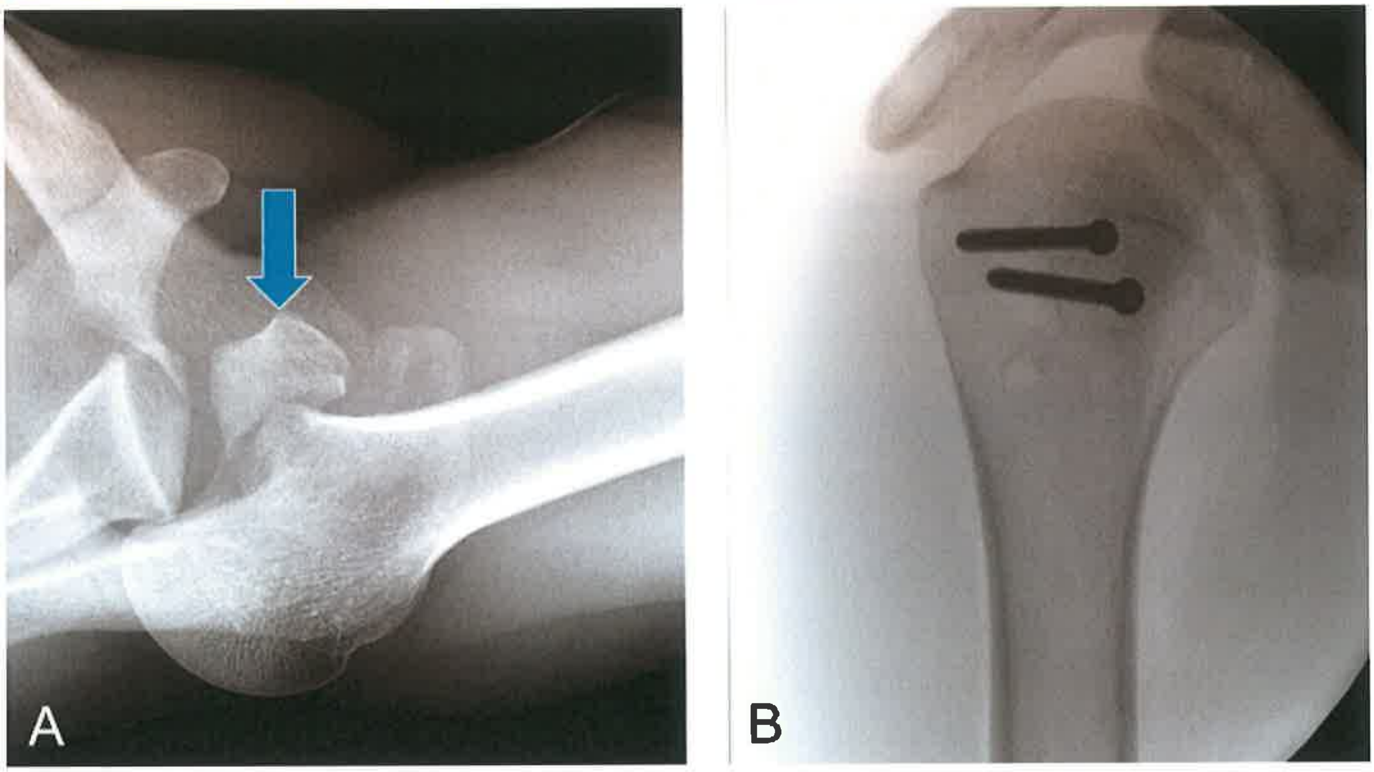

FIGURE 5 **A,** Axillary view radiograph demonstrates a posterior locked shoulder dislocation and lesser tuberosity fracture (arrow). **B,** Fluoroscopic view obtained following reduction using the Depalma method under general anesthesia; open reduction and internal fixation of the lesser tuberosity fracture was performed with an open deltopectoral approach and two screws.

anterior dislocation and use anterior maneuvers to reduce the shoulder: To do this, the elbow is pulled with one hand and the humerus is pushed with the other.[25] Any reduction technique listed previously for anterior shoulder dislocation can be used to reduce the shoulder. However, if the humeral head is buttonholed through the inferior glenohumeral capsule, conversion to an anterior dislocation is impossible and the reduction technique using the fist in the axilla is required. Given the challenging nature of this injury pattern, conscious sedation can be attempted, but a general anesthetic with muscular relaxation is frequently required.

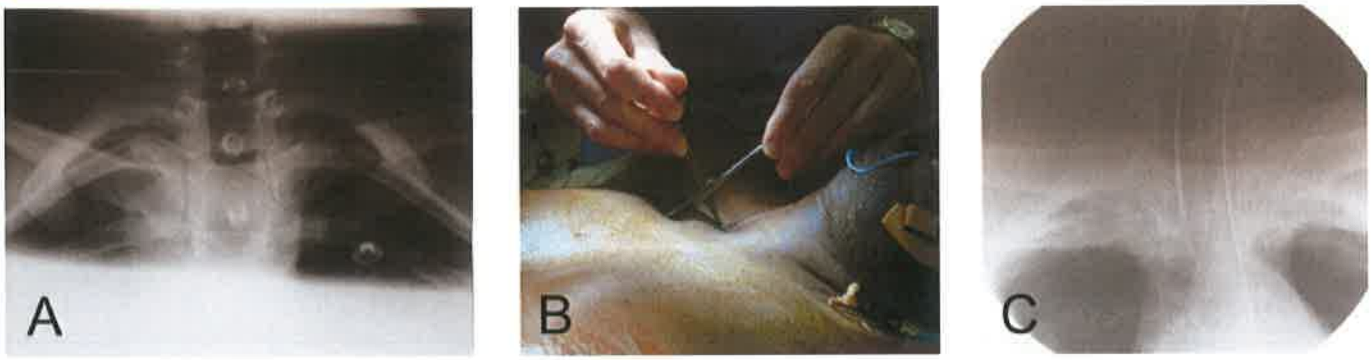

FIGURE 6 Images of a posterior sternoclavicular (SC) joint dislocation resulting from trauma. **A,** Preoperative serendipity view. **B,** Photograph demonstrates reduction performed with a towel clamp. **C,** Postreduction C-arm imaging demonstrates SC joint reduction. (Images courtesy of Paul Tornetta III, MD.)

Postreduction Treatment

Irrespective of which reduction maneuver is selected, postreduction AP and orthogonal radiographs need to be obtained to verify reduction. A Velpeau, axillary or scapular Y view is often preferred to avoid abducting the arm for a formal axillary view following reduction. Postreduction immobilization includes a sling for anterior shoulder dislocation and a sling with external rotation bracing for posterior shoulder dislocation. A comprehensive vascular and neurologic examination also should be performed and documented. Although vascular complications have been cited in less than 1% of patients,[26] nerve injury occurs in 21% to 45% of patients following shoulder reduction, typically involving the axillary nerve.[27] Examination for rotator cuff injuries should be performed in the clinic 6 to 8 weeks following closed reduction and physical therapy. If the patient has persistent weakness when testing for shoulder abduction or external rotation and a rotator cuff tear is suspected, MRI should be performed.

Special Circumstances

Glenohumeral dislocations can be complicated by concomitant fractures of the greater tuberosity, humeral neck, or glenoid. Generally, if only a tuberosity fracture is present, acute closed reduction is indicated and can be performed in the emergency department. However, a humeral neck fracture is a relative contraindication to closed manipulation. Decision making for this rare situation depends on patient age and the status of the neurovascular structures about the shoulder, specifically the axillary nerve.

In young patients, a fracture-dislocation is a surgical emergency requiring prompt reduction to relieve pressure/tension on the axillary nerve and theoretically reduce the risk of osteonecrosis. After reduction, the tuberosity fracture can be managed based on the amount of displacement and the expected activity level of the patient (**Figure 5**). In older (older than 70 years) and lower demand patients with fracture-dislocations and displaced three- or four-part proximal humerus fractures and poorer bone quality with an intact axillary nerve on examination, a delayed surgical approach can safely and prudently be undertaken. Often, a delayed surgical approach will require bone grafting and/or an arthroplasty procedure (total shoulder versus reverse shoulder arthroplasty, which can be approached in a delayed fashion when all required resources are available).

ELBOW DISLOCATIONS

Approximately 90% of elbow dislocations occur posteriorly.[13] Simple dislocations represent injuries that occur without fracture; complex dislocations also include osseous or soft-tissue injury.

Elbow Reduction Techniques

In the setting of simple dislocation, reduction can be performed in the supine position with sedation by stabilizing the humerus on the stretcher and flexing the elbow to 25° to 45°, applying longitudinal traction and forearm supination, and slowly flexing the elbow until reduction is achieved. This technique requires two people. Generally, the reduction is obvious and accompanied by a clunk. Alternatively, the patient can be placed in the prone position with the arm off the stretcher, facilitating a single-person reduction. Traction is applied with the arm in supination, and the other hand applies pressure to the posterior olecranon.

Before and after reduction, a thorough neurovascular examination must be performed and documented. The elbow is moved through range of motion to determine the stable arc of motion for therapy. Most dislocated elbows are too unstable to sustain valgus stress, and it is essential to evaluate the tendency for redislocation in extension that indicates an unstable joint. Postreduction orthogonal radiographs are obtained to document a concentric reduction. Joint space widening can indicate entrapped osteochondral fragments as well as the need for additional imaging.

Patients are placed on an immobilization protocol (using a posterior elbow splint at 90° of elbow flexion) for no more than 2 weeks followed by a hinged elbow brace for 4 weeks (open to allow motion within the stable arc) that controls both varus and valgus stability and physical therapy. Immobilization for more than 3 weeks has been associated with poor outcome and decreased range of motion.[28] Most patients with simple elbow dislocation will have excellent outcomes with functional therapy and without any further recurrence of elbow instability.[28]

Surgical Management of Complex Elbow Dislocations

Surgery is indicated in patients with subluxation or persistent instability of the elbow joint at greater than 30° of elbow flexion or when the elbow dislocation is associated with an unstable fracture pattern. The most common mechanism of elbow fracture-dislocation is a valgus posterolateral rotatory load, which results from an axial load with both valgus and supinating forces around the elbow. More extensive cases can involve a combination of radial head and coronoid fractures and injury to the lateral ulnar collateral ligament, termed the "terrible triad." These injuries require surgical intervention and are beyond the scope of this chapter.[29]

AC Joint Dislocation/Separation Injuries

Acute reduction is not performed for AC joint dislocation/separation injuries. Type I and II AC joint injuries are treated nonsurgically using anti-inflammatory medications, effective pain management, and activity modification. Type III injuries are most often treated nonsurgically. Nonurgent surgical treatment can be considered for some type III injuries in high-demand athletes. Type IV, V, and VI AC separations are treated with delayed surgical intervention.[9]

SC Joint Dislocations

Posterior SC dislocations require special attention because compression of the trachea, esophagus, and vascular structures can result in dysphagia, dyspnea, upper extremity swelling, and/or neurologic deficits requiring emergency treatment. In contradistinction, acute reduction of anterior SC dislocations is not necessary because most patients will have good to excellent outcomes with nonsurgical management.[30]

Reduction Technique for Posterior SC Joint Dislocation

Reduction of a posterior SC joint dislocation is performed in the operating room under general anesthesia and most often with a thoracic surgeon in the room or nearby. A bump is placed underneath the scapula with applied arm traction and extension. A towel clamp can be applied percutaneously to grasp the medial clavicle and apply anterior traction for reduction (**Figure 6**). Open reduction in symptomatic patients with chronically subluxated or dislocated SC joints has been described via several approaches, including tenodesis to the first rib, plate fixation, and medial clavicle resection with ligament reconstruction. Arthroscopic resection has also been described for symptomatic SC joint dislocations.[30]

SUMMARY

Upper extremity dislocations or injuries should receive immediate attention and intervention because prolonged treatment can result in neurovascular damage and difficulty in reduction. Adequate pain management is important to facilitate successful reduction. Prompt diagnosis can be aided using appropriate radiographic imaging, and subtle fractures or concomitant soft-tissue injury can be visualized using CT or MRI. Although closed reduction may be reliable in less severe dislocation injuries around the shoulder girdle, open reduction may be necessary to ensure joint stability and congruency.

KEY POINTS

- Accurate recognition and appropriate management of acute upper extremity dislocations is essential for patient outcome.
- Axillary or scapular Y views must be obtained in patients with shoulder dislocation for an accurate diagnosis.
- Adequate prereduction radiographs must be obtained to rule out associated fractures before closed reduction.
- Neurovascular status should be checked and documented before and after reduction.
- Intra-articular injection of lidocaine (20 mL of 1% solution) is a safe alternative method to intravenous sedation for closed reduction of anterior shoulder dislocations.
- FARES is a useful reduction method for anterior shoulder dislocation.

KEY POINTS *(continued)*

- In the setting of shoulder dislocation without fracture, MRI is useful for the diagnosis of labral tear.
- A stable arc of motion must be evaluated after every elbow reduction to determine therapy and the need for surgical intervention.
- In patients with symptomatic posterior SC joint dislocations, acute closed reduction is warranted.
- Anterior SC joint dislocations do not require closed reduction and management with nonsurgical methods.
- Most AC joint dislocations are managed nonsurgically.
- Patients with humeral head fracture-dislocations will need either open reduction and internal fixation or arthroplasty depending on the fracture pattern, patient age, and patient activity level.

SUGGESTED READING LIST

Li X, Ma R, Nielsen NM, Gulotta LV, Dines JS, Owens BD: Management of shoulder instability in the skeletally immature patients. *J Amer Acad Orthop Surg* 2013;21(9):529-537. Medline DOI

Li X, Ma R, Bedi A, Dines DM, Altchek DW, Dines JS: Management of acromioclavicular joint injuries. *J Bone Joint Surg Am* 2014:96(1):73-84. Medline DOI

Groh GI, Wirth MA: Management of traumatic sternoclavicular joint injuries. *J Amer Acad Orthop Surg* 2011;19(1):1-7. Medline

Wyrick JD, Dailey SK, Gunzenhaeuser JM, Casstevens EC: Management of complex elbow dislocations: A mechanistic approach. *J Amer Acad Orthop Surg* 2015;23(5):297-306. Medline DOI

Naranja RJ Jr, Iannotti JP: Displaced three- and four-part proximal humerus fractures: Evaluation and management. *J Amer Acad Orthop Surg* 2000;8(6):373-382. Medline

Jobin CM, Galdi B, Anakwenze OA, Ahmad CS, Levine WN: Reverse shoulder arthroplasty for the management of proximal humerus fractures. *J Amer Acad Orthop Surg* 2015;23(3):190-201. Medline DOI

SUGGESTED READING LIST (*continued*)

Martetschlager F, Warth RJ, Millett PJ: Instability and degenerative arthritis of the sternoclavicular joint: A current concepts review. *Am J Sports Med* 2014;42(4):999-1007. Medline DOI

REFERENCES

1. Blake R, Hoffman J: Emergency department evaluation and treatment of the shoulder and humerus. *Emerg Med Clin North Am* 1999;17(4):859-876, vi. Medline DOI
2. Kuhn MA, Ross G: Acute elbow dislocations. *Orthop Clin North Am* 2008;39(2):155-161, v. Medline DOI
3. Olds M, Ellis R, Donaldson K, Parmar P, Kersten P: Risk factors which predispose first-time traumatic anterior shoulder dislocations to recurrent instability in adults: A systematic review and meta-analysis. *Br J Sports Med* 2015;49(14):913-922. Medline DOI
4. Asadollahi S, Shepherd D, Hau RC: Elbow fracture-dislocation combined with Galeazzi fracture in adult: A case report and literature review. *Int J Surg Case Rep* 2013;4(8):748-752. Medline DOI
5. Youm T, Takemoto R, Park BK: Acute management of shoulder dislocations. *J Am Acad Orthop Surg* 2014;22(12):761-771. Medline DOI
6. Tanaka S, An K, Morrey B: Kinematics and laxity of the ulnohumeral joint under valgus-varus stress. *J Musculoskeletal Res* 1998;2(45-54. DOI
7. Morrey B, O'Driscoll S: *Complex Instability of the Elbow*, ed 3. Philadelphia, PA, WB Saunders, 2000.
8. Doornberg JN, van Duijn J, Ring D: Coronoid fracture height in terrible-triad injuries. *J Hand Surg Am* 2006;31(5):794-797. Medline DOI
9. Li X, Ma R, Bedi A, Dines DM, Altchek DW, Dines JS: Management of acromioclavicular joint injuries. *J Bone Joint Surg Am* 2014;96(1):73-84. Medline DOI
10. Rios CG, Arciero RA, Mazzocca AD: Anatomy of the clavicle and coracoid process for reconstruction of the coracoclavicular ligaments. *Am J Sports Med* 2007;35(5):811-817. Medline DOI
11. Bearn JG: Direct observations on the function of the capsule of the sternoclavicular joint in clavicular support. *J Anat* 1967;101(Pt 1):159-170. Medline
12. Robinson CM, Shur N, Sharpe T, Ray A, Murray IR: Injuries associated with traumatic anterior glenohumeral dislocations. *J Bone Joint Surg Am* 2012;94(1):18-26. Medline DOI
13. Ahmed I, Mistry J: The management of acute and chronic elbow instability. *Orthop Clin North Am* 2015;46(2):271-280. Medline DOI

14. Chronopoulos E, Kim TK, Park HB, Ashenbrenner D, McFarland EG: Diagnostic value of physical tests for isolated chronic acromioclavicular lesions. *Am J Sports Med* 2004;32(3):655-661. Medline DOI

15. Garretson RB III, Williams GR Jr: Clinical evaluation of injuries to the acromioclavicular and sternoclavicular joints. *Clin Sports Med* 2003;22(2):239-254. Medline DOI

16. Silfverskiold JP, Straehley DJ, Jones WW: Roentgenographic evaluation of suspected shoulder dislocation: A prospective study comparing the axillary view and the scapular 'Y' view. *Orthopedics* 1990;13(1):63-69. Medline

17. Greenspan A, Norman A: Radial head-capitellum view: An expanded imaging approach to elbow injury. *Radiology* 1987;164(1):272-274. Medline DOI

18. Saccomanno MF, DE Ieso C, Milano G: Acromioclavicular joint instability: Anatomy, biomechanics and evaluation. *Joints* 2014;2(2):87-92. Medline

19. Faria RS, Ribeiro FR, Amin Bde O, et al: Acromioclavicular dislocation: Postoperative evaluation of the coracoclavicular ligaments using magnetic resonance. *Rev Bras Ortop* 2015;50(2):195-199. Medline DOI

20. Ferri M, Finlay K, Popowich T, Jurriaans E, Friedman L: Sonographic examination of the acromioclavicular and sternoclavicular joints. *J Clin Ultrasound* 2005;33(7):345-355. Medline DOI

21. Waterbrook AL, Paul S: Intra-articular lidocaine injection for shoulder reductions: A clinical review. *Sports Health* 2011;3(6):556-559. Medline DOI

22. Sayegh FE, Kenanidis EI, Papavasiliou KA, Potoupnis ME, Kirkos JM, Kapetanos GA: Reduction of acute anterior dislocations: A prospective randomized study comparing a new technique with the Hippocratic and Kocher methods. *J Bone Joint Surg Am* 2009;91(12):2775-2782. Medline DOI

23. Maity A, Roy DS, Mondal BC: A prospective randomised clinical trial comparing FARES method with the Eachempati external rotation method for reduction of acute anterior dislocation of shoulder. *Injury* 2012;43(7):1066-1070. Medline DOI

24. Mimura T, Mori K, Matsusue Y, Tanaka N, Nishi Y, Kobayashi M: Closed reduction for traumatic posterior dislocation of the shoulder using the 'lever principle': Two case reports and a review of the literature. *J Orthop Surg (Hong Kong)* 2006;14(3):336-339. Medline

25. Nho SJ, Dodson CC, Bardzik KF, Brophy RH, Domb BG, MacGillivray JD: The two-step maneuver for closed reduction of inferior glenohumeral dislocation (luxatio erecta to anterior dislocation to reduction). *J Orthop Trauma* 2006;20(5):354-357. Medline DOI

26. Khiami F, Gérometta A, Loriaut P: Management of recent first-time anterior shoulder dislocations. *Orthop Traumatol Surg Res* 2015;101(1 suppl):S51-S57. Medline DOI

27. de Laat EA, Visser CP, Coene LN, Pahlplatz PV, Tavy DL: Nerve lesions in primary shoulder dislocations and humeral neck fractures: A prospective clinical and EMG study. *J Bone Joint Surg Br* 1994;76(3):381-383. Medline

28. Cohen MS, Hastings H II: Acute elbow dislocation: Evaluation and management. *J Am Acad Orthop Surg* 1998;6(1):15-23. Medline

29. Frankle MA, Herscovici D Jr, DiPasquale TG, Vasey MB, Sanders RW: A comparison of open reduction and internal fixation and primary total elbow arthroplasty in the treatment of intra-articular distal humerus fractures in women older than age 65. *J Orthop Trauma* 2003;17(7):473-480. Medline DOI

30. Martetschläger F, Warth RJ, Millett PJ: Instability and degenerative arthritis of the sterno-clavicular joint: A current concepts review. *Am J Sports Med* 2014;42(4):999-1007. Medline DOI

VIDEO REFERENCE

Li X, MD; N Orvets, MD: Video. *Dislocations of the Upper Extremity - Diagnosis and Management.* Worcester, MA, 2016. (4 minutes)

4:00

