CHAPTER

10

Shoulder: Diagnosis and Decision Making

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Instability is defined as an inability to hold the humeral head centered on the glenoid, resulting in *unwanted* excessive translation. The patient's history and physical examination can determine the degree, direction, and frequency of unwanted excessive humeral head translation on the glenoid.

Classification schemes of shoulder instability have been based on the energy of the injury, whether it is atraumatic or traumatic, the compromised stability mechanism, and the direction of the resultant instability. Concomitantly, instability may be organized by the arm positions associated with excessive translation and therefore the direction of humeral translation on the glenoid, as well as whether the instability occurs with the arm at the extremes of motion or in the midrange.

In this chapter, the basic mechanisms of shoulder stability are detailed first. In the unstable shoulder, one or more of these mechanisms have failed. An understanding of the failed mechanism or mechanisms allows treatment to be directed, regardless of the specific surgical technique employed. Next, an instability-directed clinical evaluation is detailed. The final section summarizes the compromised stability mechanisms, physical examination and radiographic findings, and reconstruction techniques to restore stability.

Anatomy and Biomechanics

Glenohumeral stability combines both dynamic and static anatomic stabilizing factors that exist in combination and may be additive in failure, leading to instability or unwanted excessive translation of the humeral head on the glenoid.[11]

Balance

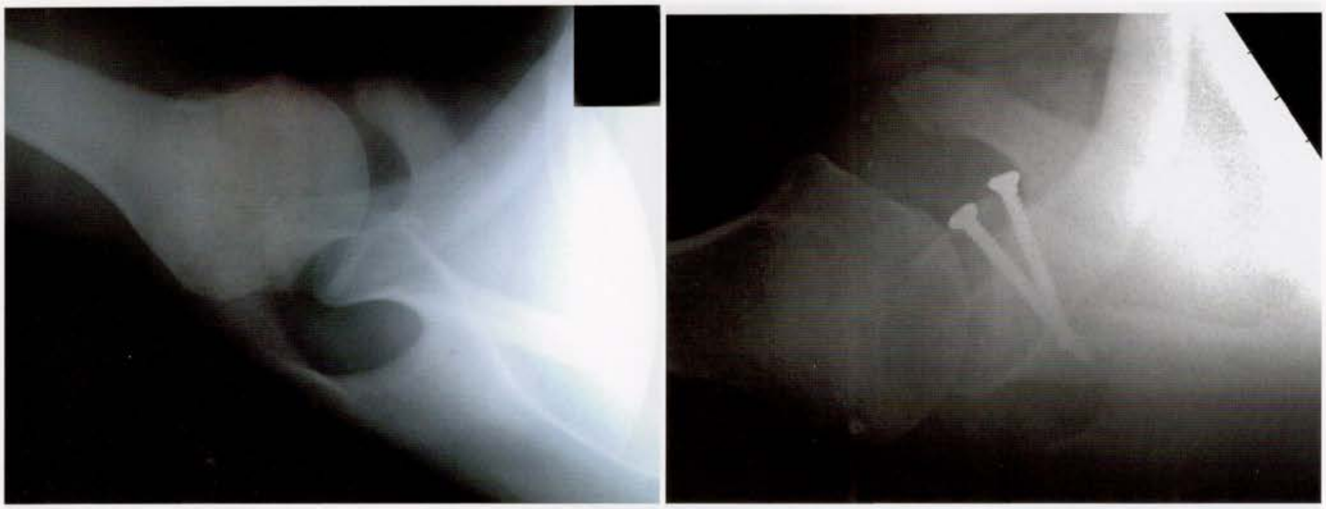
The glenoid can be positioned such that net humeral joint reaction forces pass through the glenoid fossa.[3] The alignment of joint reaction forces is determined by the position of the glenoid (scapula) relative to the humerus; greater stability is present if net forces pass closely through the glenoid centerline as opposed to near the edge. The greater the angle between the humeral shaft and the glenoid, the greater the tendency for instability, because the net joint reaction forces summate near the periphery of the glenoid.[10,12] Decreased glenoid length or depth decreases the "allowable" motion that is stable, because the joint reaction forces align beyond the glenoid support.

Balance requires neuromuscular control of the scapula and the humerus relative to the scapula.[13,17] The range of directions of force supported by the glenoid is directly related to the arc length of the glenoid.

A glenoid fracture can shorten the glenoid arc length, limiting the range of forces supported by the glenoid and therefore the arm positions that allow the humeral head to remain located (Fig. 10–1). Poor scapular control can result in inferior tilting of the scapula, leading to subluxation of the humerus (Fig. 10–2). Finally, muscle imbalance, such as that seen in Erb's palsy, in which internal rotation forces (subscapularis) are more powerful than external rotation forces (supraspinatus and infraspinatus), causes the humeral head to subluxate posteriorly. Similarly, diminished superior stability can exist in the context of rotator cuff disease due to muscle imbalance, as the superiorly directed forces of the deltoid overcome the compression of the diseased rotator cuff.

Concavity Compression

Compression of the convex humeral head into the concave glenoid resists translation forces. The rotator cuff compresses the humeral head into the glenoid throughout the range of motion. Stability is increased by increasing the depth of the concavity, which is accomplished by both the "hard tissue" anatomy (bone and



A B

Figure 10–1 *A*, Glenoid fracture limits the range of motion in which the humeral head remains stabilized against the glenoid due to the foreshortened arc length. *B*, Glenoid arc length has been restored by anterior extracapsular bone grafting, restoring stability without altering the capsular length.

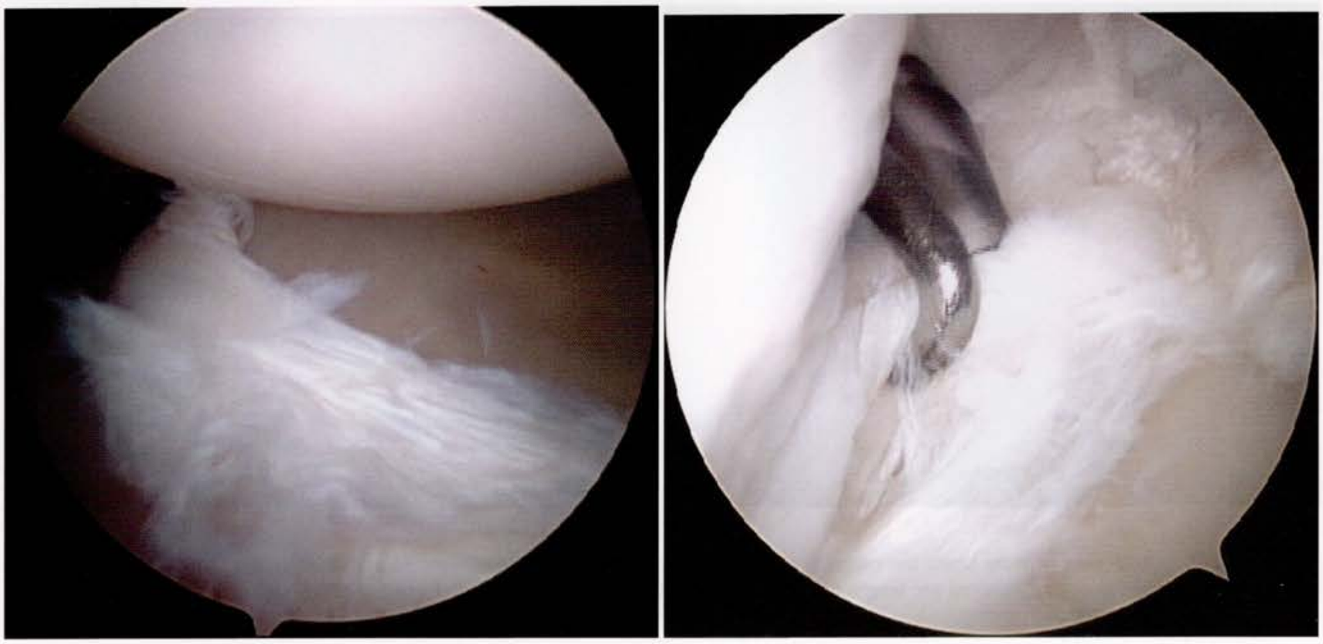
Figure 10–2 This patient's scapula is tilted inferiorly and is out of balance, resulting in inferior subluxation of the humeral head despite normal neurologic function. Interestingly, this patient failed six previous soft tissue operations designed to limit capsular length.

articular cartilage) and the soft tissue labrum. Theoretically, excessive unwanted translation of the humeral head on the glenoid can occur in any direction. Other anatomic factors such as the coracoacromial arch limit the magnitude of humeral displacement; therefore, certain directions of instability may be more subtle in their manifestations due to the minimal humeral translation.[16]

The bony anatomy of the glenoid is such that there is greater concavity in the superoinferior direction than in the anteroposterior direction. Further, the depth of articular cartilage increases toward the periphery, thus increasing the depth of the concavity. The capsulolabral complex, which attaches to the glenoid such that the labrum is on the surface of the glenoid fossa, increases the depth significantly at the periphery. The magnitude of compressive forces created by the rotator cuff increases glenohumeral stability.[18,20] However, the edge of the glenoid (cartilage and labrum) is deformable, and repeated excessive translation can decrease the height and minimize the concavity when the humeral head has excessively translated over the glenoid fossa edge[7,8,14,15] (Fig. 10–3).

After a patient suffers an anteroinferior dislocation of the shoulder, the capsulolabral complex typically avulses from the glenoid. If the anteroinferior labrum and capsule do not heal in their anatomic positions, the depth of concavity will be lost in that isolated area. When a patient's arm is placed in the abducted and externally rotated position, the summary forces across the glenoid align near the periphery. With a loss of concavity, excessive unwanted translation of the humeral head occurs, despite compression by the rotator cuff. The patient feels unwanted translation of the humeral head and reports "apprehension." Similarly, placing the arm in an adducted, internally rotated position places joint reaction forces at the posteroinferior portion of the glenoid. The adducted, internally rotated position may also result in apprehension due to unwanted, excessive posterior translation. Further, if there is a concomitant fracture of the glenoid bone, the arm position of abduction and external rotation tolerated by the patient would necessarily be less owing to the lack of support, because the joint reaction forces summate outside of the bone (see the earlier discussion of balance).

Another clinical example is the "load and shift" test. The patient relaxes to minimize the compressive effect of the rotator cuff. The examiner manually compresses the humeral head into the glenoid and then attempts to translate the humeral head (a tangential force).



A B

Figure 10–3 *A*, As seen from the posterior portal, the posterior labrum is flattened and attenuated in this patient with posterior instability. Also note the relative posteroinferior subluxation of the humeral head. *B*, In addition to rotator interval shortening, this patient underwent a capsulolabral augmentation by capsular plication. The first inferior suture (in this case, anchors were used) incorporates the patulous capsule and the split labrum. The probe demonstrates the split in the labrum.

Normally, to translate, the humeral head must move laterally over the glenoid edge and labrum. If the labrum has been avulsed or flattened, translation is easier due to the lost concavity. The deformable nature of the glenoid periphery serves to enhance stability when the humeral head is centered by a suction cup–like effect.

Suction Cup Effect

The labrum and capsule form a seal around the humeral head. Like a rubber suction cup, the glenoid is noncompliant in the center and increasingly compliant toward the periphery. The cartilage thickens toward the periphery, and the labrum and capsule at the periphery are more compliant. With compression, the interposed fluid is expressed to the periphery. Graduated flexibility allows the glenoid (cartilage, labrum, and capsule) to seal around the humeral head.

The suction cup effect helps center the humeral head independently of muscular forces and is significant in the midrange, where capsule and ligaments are not under tension. If the glenoid labrum is torn or the articular cartilage is eroded, the ability of the capsulolabral complex to "seal" around the humeral head is limited. Just as wetting a rubber suction cup often improves the compressive effect, in the shoulder, the synovial fluid in the glenohumeral joint facilitates stability by the "adhesion-cohesion" phenomenon.[12]

Adhesion-Cohesion

An adhesive fluid is one in which the molecules are attracted to like molecules. A cohesive surface is one to which fluid adheres. So when two cohesive surfaces (articular cartilage) come into contact with adhesive (synovial) fluid, the adhesion of the fluid and the cohesion of the surfaces tend to keep the surfaces together. This phenomenon is similar to the forces seen when two wet glass microscope slides are stuck together. Adhesion-cohesion functions in any joint position. The magnitude of the stabilizing force is predicated on the synovial fluid present, as well as the conformity of the contacting surfaces.

The loss of articular cartilage and labral tears limit both adhesion-cohesion and the suction cup effect. Articular cartilage irregularity diminishes the integrity of the contact surfaces, and labral tears do not allow a conforming seal to form around the humeral head (Fig. 10–4). Inflammatory changes in the synovial fluid alter the cohesive properties. Further, the volume of fluid and the volume of the glenohumeral joint (determined by capsular length) affect glenohumeral stability.[12]

Limited Joint Volume

The synovia removes free fluid and maintains the negative intra-articular pressure. The joint capsule is sealed, and the length is fixed. The humeral head is held with increasing force to the glenoid by the relative vacuum created as it is distracted away, increasing the negative pressure and adding to the resistance to displacement. Stability is enhanced by the close apposition of the joint surfaces, independent of muscular action.

Simply venting the glenohumeral capsule increases translation ease.[4] Glenohumeral venting is common in shoulder biomechanical studies to minimize the limited

Figure 10–4 Loss of cartilage on the anterior glenoid. This patient, a competitive baseball player, never dislocated his shoulder but rather had straight anterior instability. The detached labrum and middle glenohumeral ligament are present.

joint space effect. Stability is compromised by factors that increase the amount of fluid, such as the presence of a hemarthrosis after fractures of the proximal humerus. Not uncommonly, the humeral head is subluxated inferiorly after a fracture, and with fracture healing and hemarthrosis resolution, the humeral head centers on the glenoid. Furthermore, the amount of "drive-through" present during arthroscopy should be interpreted with caution because of the necessary venting and the instillation of arthroscopy fluid. The degree of separation is predicated on capsular length and the amount of traction present.

Patients vary in the degree of ligamentous laxity. A very compliant capsule may stretch and be pulled into the joint. This greater compliance minimizes the increase in the negative pressure with distraction. The capsule and ligaments may actually infold into the joint between the humerus and glenoid and diminish the stability mechanisms that rely on conformity, thus contributing to the lack of centering in the midrange. The capsular length also contributes to glenohumeral stability at the extremes of motion and has been referred to as the capsuloligamentous constraint mechanism.

Capsuloligamentous Constraint

The capsule and ligaments are checkreins to rotation and translation. The magnitude of rotation, elevation, and translation is predicated on capsular length and compliance.[16] The capsule and ligaments are in continuity with the glenoid articular surface and, under tension, provide a smooth continuation of the glenoid concavity.

The greater the angle between the humeral shaft and the glenoid, the greater the tendency for instability, owing to the fact that summating forces align near the periphery of the glenoid fossa as opposed to the center. Coincidentally, the positions that result in the joint reaction forces falling *outside* the glenoid concavity are those positions in which the capsuloligamentous structures become tight. This mechanism is not activated in the midrange of motion because no tension is present in the capsulolabral complex. At the extremes of motion, tension is rapidly generated to impart a stabilizing force to both limit rotation and exert a force on the humeral head to normalize joint reaction forces. The ligaments are well placed to tolerate the large torques encountered at the extremes of common motions such as overhead throwing.

After a dislocation, the capsule is detached (typically along with the labrum) and functionally lengthened, and it does not exert a centering force to minimize the restraint to translation (in addition to the loss of concavity due to the labral avulsion). With repeated trauma, the capsule may become lengthened[1,2,9,19] while attached to the labrum and glenoid. Independent of humeral version, excessive rotation of the humerus may occur and increase normal contact forces between the undersurface of the rotator cuff and the posterosuperior labrum. Shortening of the anterior capsule can limit rotation and minimize such contact.

One of the primary goals of the clinical evaluation is to differentiate between *mechanical laxity* and *clinical instability*. Laxity refers to the amount (distance) of translation of the humeral head on the glenoid away from the center and therefore reflects the length and compliance of the capsule. Translation requires lateral displacement of the humeral head over the intact labrum. A "normal" amount of laxity does not exist, and there is tremendous individual variation. Translation is limited at the extremes of motion by tension and shortening of the capsule as it wraps around the humeral head. Increased or decreased laxity does not *necessarily* imply instability or stability, respectively. Stable shoulders can be extremely lax, whereas unstable shoulders can be minimally lax. Typical laxity tests require the patient to relax (and therefore minimize concavity compression) and position the humerus in the midrange of motion (to maximize capsular length).[5]

In certain circumstances, increased laxity may allow the humeral head to be positioned in extremes before the stretched capsule tightens, limiting translation.

Rotator Interval Capsule

The rotator interval is a triangular structure whose base is the coracoid process; the coracohumeral ligament originates from the base, and the transverse humeral ligament is the apex. The structural contents of the rotator interval are the capsule, coracohumeral ligament, and superior glenohumeral ligament. The rotator interval capsule plays a major role in the range of certain motions, in obligate translation, and in allowed translation of the glenohumeral joint.[6,21]

Shortening of the rotator interval decreases posterior and inferior translation. The length of the rotator interval does *not* have a significant effect on anterior translation in the midrange and, interestingly, *augments* obligate anterior and superior translation at extremes of flexion. When repairing the rotator cuff, cutting the rotator interval can diminish the anterosuperior translation with elevation and minimize tension on the cuff repair.

Clinical Evaluation

History

The basic functions of the history are to determine the circumstances in which the problem began and that presently cause symptoms and to correlate the arm position or positions that produce symptoms. Other components of the history can refine the diagnosis and add to the understanding of the deficient stabilizing mechanism. Associated numbness or tingling of the arm should be ascertained.

Patient Age

Unwanted excessive humeral translation can occur at any age. For instance, the sequelae of a stroke may paralyze the shoulder girdle muscles and allow the humeral head to subluxate inferiorly on the glenoid. The most common age of presentation, however, is between 15 and 40 years. Patients with "atraumatic" or repetitive low-level injuries tend to be younger and are typically 10 to 30 years old, whereas patients with "traumatic" unidirectional instability tend to be 16 to 40 years old.

Injury

The type of trauma has been used to classify these injuries and to help understand patient characteristics and the underlying faulty stabilizing mechanisms. If the initial traumatic event was a fairly violent mechanism with large applied forces, the instability pattern can be classified as a "traumatic" type. The humeral head translates significantly, but the humerus does not necessarily dislocate. Some form of reduction maneuver is common. These traumatic types of injuries result in an instability in which the humerus translates excessively in a single direction and are associated with labral detachments; the instability pattern is duplicated by unique, typically singular arm positions. This common form of anteroinferior instability is referred to as the "TUBS" type (*t*raumatic *u*nidirectional instability *B*ankart lesion, often improving with *s*urgery). Should a posterior dislocation occur, the "B" of the acronym would refer to the labral detachment corresponding to the posteroinferior quadrant of the glenoid.

In other forms of instability, a clear-cut high-energy injury is not present in the history. Rather, the patient recounts a series of events that individually do not cause clinical instability but rather cause a number of stability mechanisms to eventually decompensate. The patient may recall a specific low-energy event, such as an awkward lift, as the decompensating injury and may report that "popping" the shoulder provides comfort. The clinical instability is such that the humeral head translates excessively in multiple directions. A reduction maneuver is almost never needed. Instability with multiple directions of excessive translation is referred to as the "AMBRII" type (*a*traumatic *m*ultidirectional instability with *b*ilateral findings, often improving with *r*ehabilitation, and should surgery be needed, a *r*otator interval capsule–coracohumeral ligament plication with tightening of the inferior capsule is needed).

Importantly, one should try to understand the instability in terms of the mechanisms of stability that have failed, so that treatment can be directed toward correcting each one. The broad classifications remain useful and highlight the fact that in certain instability patterns, rehabilitation is critical because associated muscular weakness and imbalance are typically present.

Arm Position

Arm position at the time of injury and the arm positions that reproduce the symptoms are critical to understanding the type of instability and the underlying failed mechanisms of stability.

In traumatic instability, a common mechanism of injury is an indirect loading to the capsulolabral complex, glenoid, and rotator cuff through the arm, which acts as a lever arm to transmit and augment energy to the structures. Commonly, the arm is at the extremes of elevation and rotation. Placing the humerus in abduction and external rotation tightens the anteroinferior glenohumeral ligament. The arm is forcefully extended and externally rotated, avulsing the anteroinferior labrum via the anteroinferior glenohumeral ligament.

In traumatic instability, the subsequent arm positions that provoke symptoms (instability) are typically similar to the position of the arm at the time of injury. The ease of translation and therefore symptoms of instability may increase with time, progressing to subluxation during sleep.

Patients with atraumatic or repetitive low-level instability often give a history of repetitive arm positions at extremes of motion in multiple positions. Common sport histories are swimming and volleyball. A patient may complain of mild symptoms that increase significantly after a seemingly trivial event.

In atraumatic or multidirectional instability, patients often (but not always) complain of symptoms with the arm in the midrange of motion, and sometimes in combination. The predominant arm positions that increase symptoms are in front of the body.

Physical Examination

The physical examination for shoulder instability is confirmatory or elaborative in nature based on the patient's history. A comprehensive musculoskeletal examination is also important. The following description is weighted primarily toward an instability examination.

Observation and Palpation

Observe the overall posture, with the patient both seated and standing, from posterior and anterior viewpoints. Look for shoulder girdle ptosis and scapular position asymmetry. In the chronic state, tenderness is unusual in patients with isolated instability.

Range of Motion

The range of motion of both shoulders should be measured, and it is typically symmetrical. Significantly greater range of motion than population norms may suggest the possibility of multidirectional instability, as capsular length is proportionate to elevation and rotation.

Provocative Positions

Observe as the patient demonstrates the arm positions that feel unstable, with special reference to associated faulty scapular mechanics. Following the demonstration, combine arm positions with force applications (rotation and translation) to produce or "threaten" instability (excessive unwanted translation).

The apprehension test places the arm in abduction and external rotation. A patient response of impending subluxation is positive and suggestive of anterior instability. In contrast, the jerk test, which places the arm in forward elevation, internal rotation, and adduction, can cause the humeral head to subluxate with reduction as the arm is abducted and externally rotated.

Translation

With the patient relaxed, the arm is positioned in the midrange of motion. The humerus is translated (tangential force to the glenoid) in the anterior, posterior, and inferior (sulcus test) directions to observe the magnitude of distance traveled. The mechanical laxity demonstrated by these translations is not specific for instability. One should observe the patient's response with each direction. A catch or a pop may be indicative of a torn labrum. Finally, the "feel" of the glenoid concavity can be appreciated, as can the accompanying lateral displacement of the humeral head, with translation in the anterior, posterior, and inferior directions.

Noting the ease of translation is also important. With the patient relaxed, the examiner compresses the humeral head medially to mimic the cuff and then translates the humeral head. With a competent labrum, translation is typically minimal. Without a labrum present to increase the concavity, the humeral head can be felt to move tangentially on the glenoid (translate) without appreciable lateral displacement.

Neuromuscular Examination

As described earlier, scapulothoracic motion and static scapular posture should be observed. A lateral "droop" or retraction with anterior elevation predisposing to excessive translation is typical in multidirectional instability. The periscapular muscles, including the protractors, elevators, and lower trapezius, should be tested.

Manual muscle testing of the rotator cuff can be done in external rotation at the side, in internal rotation at the side, and with the arm elevated 90 degrees in the scapular plane. Associated tears of the rotator cuff are unusual but become more common after a dislocation as patient age increases. Greater or lesser tuberosity fractures may occur and result in weakness.

Brachial plexus injuries are not uncommon but are typically minor and transient. Older age is associated with clinically observable sequelae of neural injury. In addition to examining peripheral pulses, signs of atrophy should be documented. Weakness without fracture or rotator cuff tendon tear raises the suspicion of neural injury.

Imaging

An anteroposterior view in the scapular plane and an axillary lateral view are the basic radiographs obtained. Specialized views, such as the apical oblique view, may be added based on the clinical situation.

Ancillary studies such as magnetic resonance imaging or computed tomography may be helpful but are not needed on a routine basis. Computed tomography is useful to evaluate the glenoid arc length after fracture. Magnetic resonance imaging with or without a gadolinium arthrogram is useful to determine subtle labral or capsular tearing, as well as the integrity of the rotator cuff tendons.

Summary

Traumatic Anterior Instability

History

1. Typically, the humerus is elevated beyond 90 degrees and externally rotated. The force is applied at a distance, such as when the forearm is trying to block a shot in basketball. The arm is forcefully externally rotated.
2. If the humerus dislocates, a reduction maneuver is often required.
3. The arm is stable at the side. Abduction and external rotation increase symptoms.

Physical Examination

1. Normal appearance in the chronic state.
2. Absence of rotator cuff weakness.
3. Apprehension with the arm in 90 degrees of abduction and 90 degrees of external rotation.
4. Load and shift test is positive (ease of translation).

Radiographs

1. Anteroposterior: observe for periosteal changes inferiorly, and ensure that the joint space is visible.
2. Axillary: observe for glenoid fracture and humeral fracture.
3. Apical oblique: observe for humeral impaction fracture and inferior glenoid avulsion fracture.

Primary Failed Stability Mechanisms

1. Concavity compression:
   a. Loss of concavity (labrum or cartilage).
   b. Compression by rotator cuff is typically normal.
2. Capsuloligamentous constraint.
3. Adhesion-cohesion and suction cup.
4. Balance if a fracture significantly shortens the arc length of the glenoid.

Treatment: Nonoperative

1. Sling for comfort.
2. Strengthening.
3. Avoid abducted, externally rotated arm position.

Treatment: Operative

1. Examination under anesthesia.
2. Labral repair to the peripheral margin of the glenoid fossa.
3. Capsulorrhaphy:
   a. If the capsule is significantly lengthened.
   b. If there is no labral avulsion, the capsule can be shifted and repaired to the labrum, which increases the depth of the glenoid and shortens the capsule.
4. Glenoid fracture:
   a. Acute: open reduction and internal fixation.
   b. Chronic glenoid deficiency: bone graft (Bristow-Laterjet or iliac crest) to lengthen glenoid arc.

Traumatic Posterior Instability

History

1. Humerus elevated to about 90 degrees and internally rotated (as in blocking in football).
2. If the humerus dislocates, a reduction may be needed.
3. Arm stable at the side; elevation, internal rotation, and adduction increase symptoms.

Physical Examination

1. Normal in chronic state.
2. Absence of rotator cuff problems.
3. Apprehension with arm elevated 90 degrees, internally rotated, and adducted across the chest.
4. Jerk test positive:
   a. The arm is subluxated in the position described for apprehension
   b. The arm is reduced with abduction and external rotation.

Radiographs

1. Anteroposterior: ensure joint space is present; overlap suggests chronic dislocation.
2. Axillary: observe for glenoid and humeral fracture.

Primary Failed Stability Mechanisms

1. Concavity compression:
   a. Concavity loss due to labral avulsion; more commonly, repeated humeral subluxations flatten the labrum.
   b. Compression by the rotator cuff is typically normal.
2. Capsuloligamentous constraint.
3. Adhesion-cohesion and suction cup.
4. Balance:
   a. Fracture significantly shortens the arc length of the glenoid.
   b. Abnormal scapular movement (tilting) with glenohumeral motion.

Treatment: Nonoperative

1. Sling for comfort.
2. Strengthening.
3. Avoid adducted, elevated, and internally rotated arm position.

Treatment: Operative

1. Labral repair similar to that for anterior instability.
2. Capsulorrhaphy—posterior instability typically has an attenuated labrum rather than avulsion of the capsule and labrum, as in traumatic anterior instability:
   a. Shortening of lengthened capsule.
   b. Capsule plicated to the labrum to shorten the capsule and increase the depth of the glenoid concavity.
3. Rotator interval plication:
   a. Reduces flexion, adduction, and external rotation.
   b. Minimizes posterior and inferior humeral translation.

Multidirectional "Atraumatic" Instability

History

1. Repetitive activities requiring excellent coordination, strength, endurance, and often extremes of motion, such as swimming or volleyball.
2. Pain, occasional paresthesias (commonly ulnar nerve distribution); if the humerus dislocates, a reduction may be needed.
3. Arm stable at the side.
4. Symptoms typically in the midrange of motion as well as at extremes.

Physical Examination

1. Poor shoulder posture and associated shoulder girdle ptosis.
2. Rotator cuff weakness.
3. Apprehension with arm elevated 90 degrees, internally rotated, and adducted across the chest.
4. Jerk test positive:
   a. The arm is subluxated in the position described for apprehension.
   b. The arm is reduced with abduction and external rotation.

Radiographs

1. Anteroposterior and axillary views are typically normal.

Primary Failed Stability Mechanisms

1. Concavity compression:
   a. Concavity loss due to repeated humeral subluxations that flatten the labrum.
   b. Compression by the rotator cuff is typically diminished.
2. Capsuloligamentous constraint: loose, stretchy capsular tissue is common and may predispose to lengthening.

3. Adhesion-cohesion and suction cup:
   a. Possible capsular inflolding between humeral head and glenoid due to increased capsular length and compliance.
   b. When infolded, the redundant capsule may act as a skid to facilitate humeral subluxation.
4. Limited joint volume: loose, stretchy capsule minimizes negative intra-articular pressure with distraction.
5. Balance: abnormal scapular movement (tilting) with glenohumeral motion.

Treatment: Nonoperative

1. Avoid provocative positions and inciting activities.
2. Strengthening:
   a. Scapular strengthening and positioning exercises.
   b. Postural exercises.
   c. Avoid rotator cuff strengthening until manual muscle testing is pain free.

Treatment: Operative

1. Labrum is typically attenuated but attached; if torn, repair to surface of glenoid periphery.
2. Capsulorrhaphy:
   a. Concentric shortening with repair to labrum.
   b. Symmetrically tighten anteriorly and posteriorly.
   c. Capsule plicated to labrum to shorten capsule and increase depth of glenoid concavity.
3. Rotator interval plication:
   a. Reduces flexion, adduction, and external rotation.
   b. Minimizes posterior and inferior humeral translation.

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