Posterior Instability of the Shoulder

CME

Diagnosis and Management

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Recurrent posterior instability of the shoulder can be difficult to diagnose and technically challenging to treat. Although not as common as anterior instability, recurrent posterior shoulder instability is prevalent among certain demographic and sporting groups, and may be overlooked if one is not aware of the typical examination and radiographic findings. The diagnosis itself can be difficult as patients typically present with vague or confusing symptoms, and treatment has evolved from open to arthroscopic surgical techniques. This article is intended to review the anatomy and biomechanics associated with posterior shoulder instability, to discuss the pathogenesis and presentation of posterior instability, and to describe the variety of treatment options and clinical results.

Keywords: posterior shoulder instability; glenohumeral joint; arthroscopic repair; thermal capsulorrhaphy; labral repair; posterior instability; posteroinferior instability

The diagnosis and management of posterior glenohumeral instability can be challenging. Posterior instability is less common among cases of shoulder instability, accounting for 2% to 10% of all cases,[1,8,40] although it is present frequently in certain demographic and sporting groups. This includes young athletic patients, football players, rugby players, weight lifters, paddling sport athletes, and climbers. The diagnosis itself may be easily overlooked as patients present relatively infrequently (vs anterior instability), with a confusing spectrum of clinical symptoms, and may have been referred with a diagnosis other than shoulder instability.[45] The causes vary from acute traumatic instability to atraumatic instability to repetitive microtrauma. As such, an accurate history and physical examination, as well as a thorough analysis of intraoperative pathologic changes, are vital for a successful outcome in the treatment of recurrent posterior shoulder instability.

Biomechanical and clinical work has improved our understanding of the pathophysiology of posterior shoulder instability and has helped correlate clinical symptoms and examination findings to the pathologic findings. Additionally, improved implants and advanced arthroscopic techniques have allowed the orthopaedic surgeon to provide relatively reliable surgical results in patients with posterior shoulder instability. This article will describe the anatomy, biomechanical function, and pathologic changes of recurrent posterior shoulder instability. In addition, treatment options, operative techniques, and clinical outcomes related to posterior shoulder instability repair will also be discussed.

ANATOMY AND BIOMECHANICAL CONSIDERATIONS

Recent advances in our understanding of the anatomic and biomechanical considerations of posterior instability have led to an improvement in both clinical diagnosis and recognition of pathologic abnormalities. The posterior capsule itself, which contains the posterior band of the inferior glenohumeral ligament (PIGHL), is relatively thin, unlike the thicker ligamentous composition of the anterior capsule (Figure 1).[4] In addition, the quality and biomechanical performance of the posteroinferior capsule is not as robust as that of the anterior capsule.[4] The bony anatomy and

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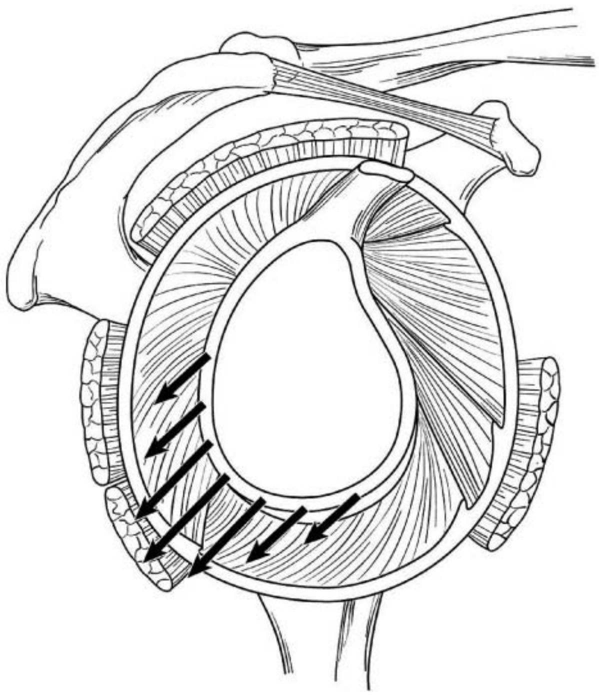

Figure 1. The posterior band of the inferior glenohumeral ligament (PIGHL) is under tension with the shoulder in flexion and internal rotation. The direction of posterior instability is in the 7-o'clock position as depicted by the black arrows.

capsulolabral structures are the primary static stabilizers in the shoulder joint,[36,48,50,64] and damage to these structures can result in instability. For example, posterior shoulder instability has been associated with not only bony glenoid retroversion, but also with chondrolabral retroversion,[33] and with increased posteroinferior capsular size.[14] However, also important in posterior shoulder instability are the dynamic stabilizers, especially the subscapularis muscle, and these should be carefully evaluated in any patient with posterior shoulder instability.

Dynamic Stabilizers

Similar to their role in preventing anterior shoulder instability, the rotator cuff muscles[13,64] are the most important dynamic stabilizers in preventing posterior shoulder instability. Previous studies have identified the subscapularis as the primary dynamic stabilizer preventing posterior translation[6,38,64]; however, all the rotator cuff and scapular muscles are important in providing concavity-compression of the shoulder joint.[6,10,37,38] Dynamic inferior stability of the shoulder joint is maintained by the supraspinatus muscle[6,62] and, potentially, the long head of the biceps,[62] while the infraspinatus and teres minor muscles serve as posterior compressors.[38,49] When a patient presents to the clinic with posterior instability, it is crucial to assess scapular rhythm and control, carefully assess the integrity of the subscapularis, and ensure that the scapula has a coordinated and synchronous motion.

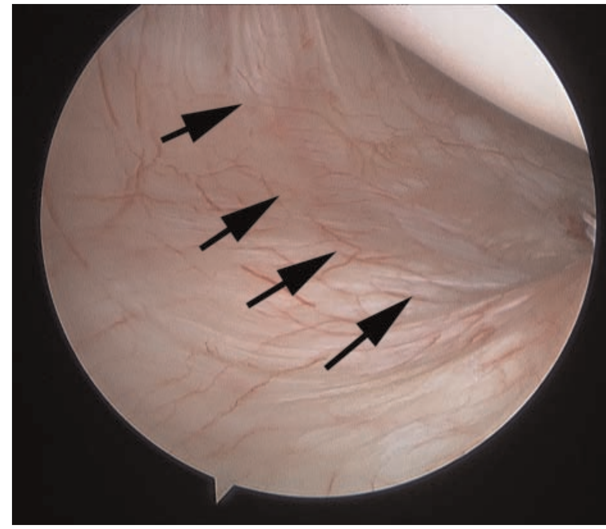

Figure 2. The posterior band of the inferior glenohumeral ligament (PIGHL) is visualized arthroscopically and is under tension with the arm in flexion and internal rotation.

Static Stabilizers

The bony anatomy and capsulolabral ligamentous complex are the primary static stabilizers of the glenohumeral joint.[38,49,64] In the posterior loading position of internal rotation and forward flexion, the most important ligamentous stabilizer is the PIGHL complex. In the common football lineman blocking injury, the arm is placed in a flexed (90°) and internally rotated position, which places the PIGHL in an anterior-posterior orientation and under tension (Figure 2).[6] Several studies have shown stretch of the capsule and PIGHL beyond the initial resting length as a potential cause of posterior and multidirectional instability.[38,52,64] During various ranges of motion, the middle glenohumeral ligament (MGHL) and superior glenohumeral ligament (SGHL) also play important roles in stabilization. Specifically, studies have shown that the MGHL and SGHL augment the PIGHL in prevention of posterior shoulder translation during midrange abduction and shoulder adduction, respectively.[5,10,46]

Other static stabilizers include the rotator interval as well as the SGHL. Although debatable, the rotator interval has been shown to be a stabilizer of the shoulder, as it limits inferior and posterior joint translation while the arm is in adduction, and likely plays a lesser role in a provocative shoulder position of flexion and internal rotation.[22] Some have demonstrated that the SGHL, while not a major static stabilizer, helps to oppose posterior translation when the shoulder is in flexion, adduction, and internal rotation.[47] However, others[44] have demonstrated that there is little importance of the rotator interval on posterior stability of the shoulder.

The labrum acts as a static stabilizer to the glenohumeral joint by increasing the concavity-compression mechanism of the humeral head in the glenoid socket and increasing the depth of the humeral articulation.[35,37,38] In patients with clinically documented recurrent posterior instability, a loss of chondrolabral containment, incorporating both an increase in bony retroversion as well as a loss of posteroinferior labral height, has been demonstrated.[33] Given the shallow depth of the bony glenoid, which is augmented by the glenoid labrum, chondrolabral containment is important when considering overall stability of the glenohumeral joint.[35,37] With regard to the capsular component of the capsulolabral complex, the posterior capsule and PIGHL are much less robust and are unable to sustain as much tensile force as the anterior capsular structures, underscoring how different posterior and anterior instability and their respective pathoanatomy actually are.[4]

There remains confusion regarding the location of the damage in a posterior shoulder dislocation. The "circle concept" was popularized after, in a cadaveric model,[67] it was demonstrated that in order for a shoulder to dislocate posteriorly, there has to be ligament and capsular damage on the opposite side (such as the rotator interval). However, this concept has been recently challenged with cadaveric studies that did not support an injury to anterior structures, including the rotator interval, in a posteriorly dislocated shoulder.[44,55,67,68]

Overall, the rotator cuff muscles, and in particular the subscapularis, are very important dynamic stabilizers of the posterior shoulder, while the capsulolabral structures and bony anatomy, especially the bony glenoid, are important static stabilizers. The PIGHL and glenoid labrum are also important static stabilizers as these structures resist posterior translation, especially in flexion and internal rotation. Damage to any of these structures may lead to posterior shoulder instability.

PATHOGENESIS

Three broad etiological categories have been implicated in posterior instability, including repetitive microtrauma to the shoulder, acute traumatic events, and purely atraumatic causes.[15,57,60] Overall, it is crucial to identify the correct pathogenesis of posterior shoulder instability so that treatment can be appropriately tailored to the patients' needs.

The most frequent cause of recurrent posterior shoulder instability is cumulative microtrauma to the posteroinferior shoulder complex. Repetitive bench press lifting, overhead weight lifting, rowing, swimming, blocking linemen in football, or other athletic activities that involve repetitive loading of the shoulder in front of the body can be sources of repetitive microtrauma. In these activities, the shoulder is repetitively placed in a flexed and internally rotated position. The resulting concomitant posterior load causes stretch and injury of the PIGHL and the nearby capsular structures,[9,15,57] as well as the posterior labrum. With repetitive posterior load on both the labrum and the capsule, the tissues experience repetitive injury and this leads to posterior laxity. The patient often presents with concomitant poor scapulothoracic mechanics due to an inability to optimize rotator cuff strength, particularly with regard to the subscapularis.

Patients with an acute traumatic posterior instability can usually recall an injury that immediately precedes the onset of symptoms. An example is a football lineman who sustains a blocking injury and posterior instability event with the arm forward flexed and internally rotated. Other traumatic instabilities might result from electrocution or seizures, or high-weight bench pressing. These types of acute, traumatic injuries may potentially predispose the patient to recurrent episodes of posterior instability in the future. These injuries are not as frequent as recurrent microtrauma, and unlike anterior shoulder instability, a posterior dislocation is usually not the most common initial injury in patients who present with recurrent posterior instability.[25,26]

The rarest cases of posterior instability are those that are atraumatic, and this type of injury is predisposed in patients with generalized ligamentous laxity. Gradually, pain and a sensation of instability will develop in these patients. Symptoms may only initially be present in higher demand activities or provocative positions; however, progression of symptoms may lead to instability while performing activities of daily living.

Other causes of posterior instability include excessive glenoid or humeral retroversion,[28,41] glenoid hypoplasia,[28,37,38] and loss of chondrolabral containment.[33] However, it is not currently known if glenoid bony changes, such as retroversion, precede the development of posterior instability or if instability itself causes bony changes.

PREOPERATIVE CONSIDERATIONS

Clinical Presentation

The most common complaint in a patient with posterior shoulder instability is generalized shoulder pain or pain deep within the posterior aspect of the shoulder.[25,43,54] The pain is often accompanied by decreased athletic performance and/or loss of strength.[9,30,57,66] Specifically, patients may describe a reduced bench press capacity, an inability to do the same number of push-ups, and an overall decreased athletic performance. Because the classic complaint is pain and reduction of activities, a patient with posterior shoulder instability may often be confused as having outlet impingement, biceps problems, or myofascial diagnoses. In the young patient (generally <30 years of age) with multiple vague shoulder complaints and a sports history to support the potential injury, it is incumbent upon the physician to rule out posterior shoulder instability until proven otherwise.

Patients with posterior shoulder instability may also describe an ability to "voluntarily" subluxate their glenohumeral joints posteriorly. Two types of voluntary glenohumeral instability have been described: voluntary positional and voluntary muscular.[43] Common in recurrent posterior instability, voluntary positional instability is defined by subluxation in a provocative position (flexion

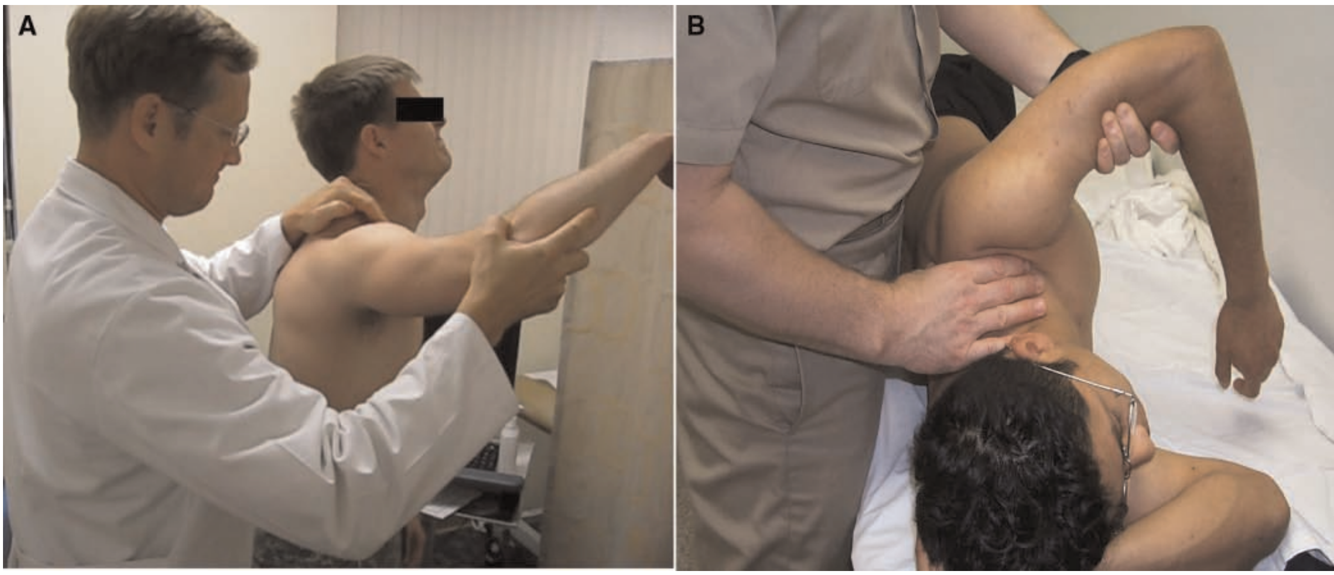

Figure 3. A, the jerk test is shown in a standing patient. The examiner stabilizes the scapula, and provides flexion and internal rotation with a posteriorly directed force at approximately the 7-o'clock direction. A positive test reproduces the patient's symptoms when the shoulder is provoked in this manner and is consistent with the diagnosis of posterior instability. B, an examination in the lateral decubitus position in clinic is performed to determine the amount of symptomatic instability in the posterior direction, while stabilizing the scapula and loading the shoulder in flexion and internal rotation toward the 7-o'clock position.

and internal rotation). Patients who can positionally (flexion and internal rotation) reproduce their instability should not be excluded from surgical treatment.[16] Further, these patients should not be associated with those who may be classified as having voluntary willful instability, as in a multidirectional instability patient. The reason is that this phenomenon is thought to be a learned event, and that patients who demonstrate positional posterior instability actually do not like their ability to subluxate the joint in a posteroinferior direction. In contrast, voluntary muscular (or habitual) instability occurs with the arm in an adducted (nonpositional-dependent) position and is more indicative of ligamentous laxity or an underlying muscular imbalance, and not true posterior instability. Patients with voluntary muscular instability are typically not good candidates for surgical treatment, as they do not represent the true spectrum of recurrent posterior instability.[43]

Physical Examination

A thorough physical examination is essential in patients with suspected posterior instability of the shoulder, especially because many patients only describe vague symptoms not specific for posterior shoulder instability. Both shoulders should be examined and any obvious dislocation, asymmetry, abnormal motion, muscle atrophy, swelling, and scapular winging and tracking should be noted. The key to diagnosis is eliciting symptoms of posterior instability in the clinic, which may be confirmed later during a translation examination under anesthesia.[12]

During examination, tenderness to palpation at the posterior glenohumeral joint line is common.[43] With regard to range of motion, while an increase in external rotation and mild loss of internal rotation is sometimes seen in patients with posterior instability, range of motion testing in these patients is most often normal and symmetrical.[15] Conversely, subjective apprehension in posterior instability is uncommon, except while performing certain posteroinferior provocative translation testing maneuvers as outlined below.[60]

To determine the degree and direction of instability, certain provocative maneuvers can be performed. The jerk test,[6] the Kim test,[34] the posterior stress test,[52] and the load and shift test[17] are all common examinations for posterior instability. The jerk test is performed while the examiner stands next to the affected shoulder, grasps the elbow in one hand, and the distal clavicle and scapular spine in the other. After placing the arm in a flexed and internal rotated position, the flexed elbow is pushed posteriorly while the shoulder girdle is pushed anteriorly. The test is positive when a sudden jerk associated with pain occurs as the subluxated humeral head relocates into the glenoid fossa (Figure 3).

Another useful test for recurrent posterior instability is the Kim test, which is performed with the patient seated and the arm in 90° of abduction. To perform this test, the clinician grasps the patient's elbow with one hand, while with his or her other hand, the clinician grasps the lateral aspect of the patient's proximal arm, applying an axial loading force. While elevating the patient's arm to 45°, the clinician applies a downward and posterior force to the upper arm. A sudden onset of pain signifies a positive test.[34] A combination of a positive Kim test and jerk test has been shown to have 97% sensitivity for posterior instability (Figure 4).[34]

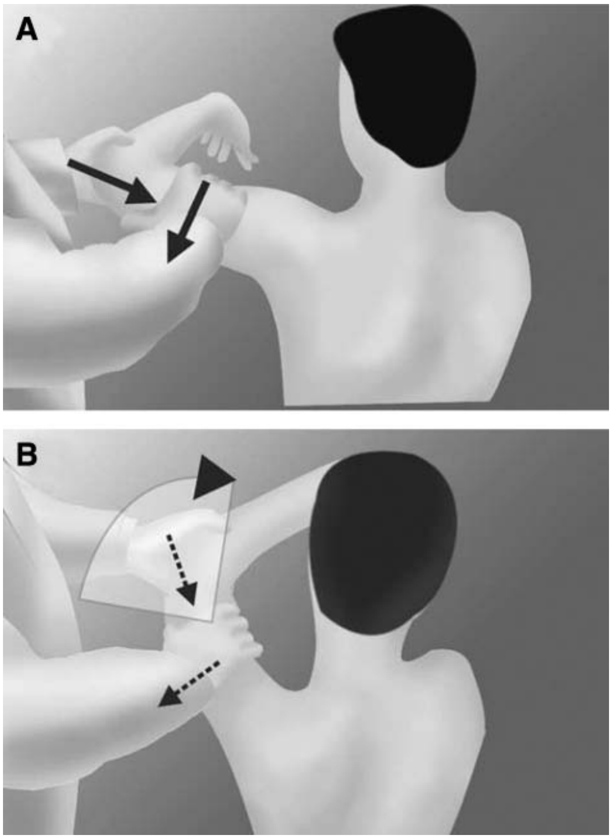

Figure 4. The Kim test is performed with the patient seated and the arm in 90° of abduction. To perform this test, the clinician grasps the patient's elbow with one hand, while with his or her other hand, the clinician grasps the lateral aspect of the proximal arm, applying an axial loading force. While elevating the patient's arm to 45°, the clinician applies a downward and posterior force to the upper arm. Pain signifies a positive test. (Reproduced with permission from Kim SH, Park JS, Jeong WK, Shin SK. The Kim test: a novel test for posteroinferior labral lesion of the shoulder—a comparison to the jerk test. *Am J Sports Med.* 2005;33(8):1188-1192.)

The posterior stress test is also performed with the patient in a seated position. While stabilizing the medial border of the scapula, the examiner uses his or her free hand to apply a posterior force to the arm while it is held in a 90° forward-flexed, adducted, and internally rotated position. A positive test occurs with subluxation or dislocation with reproduction of the patient's pain or apprehension.

The load and shift test can be performed with the patient supine and with the symptomatic arm in approximately 20° of forward flexion and abduction. The humeral head is then loaded while anterior and posterior stresses are applied. The direction and amount of translation can then be graded. Excessive inferior translation of the humerus on the glenoid is often associated with posterior subluxation[23,25] and may indicate bidirectional or multidirectional instability if the inferior sulcus test reproduces the patient's symptoms. The sulcus test is performed with the patient seated and the arm at the side in a neutral position. The clinician grasps the patient's elbow or wrist and applies downward traction while observing the shoulder for a sulcus (depression) lateral or inferior to the acromion. If present, this sulcus may suggest inferior glenohumeral instability.[1-3,25]

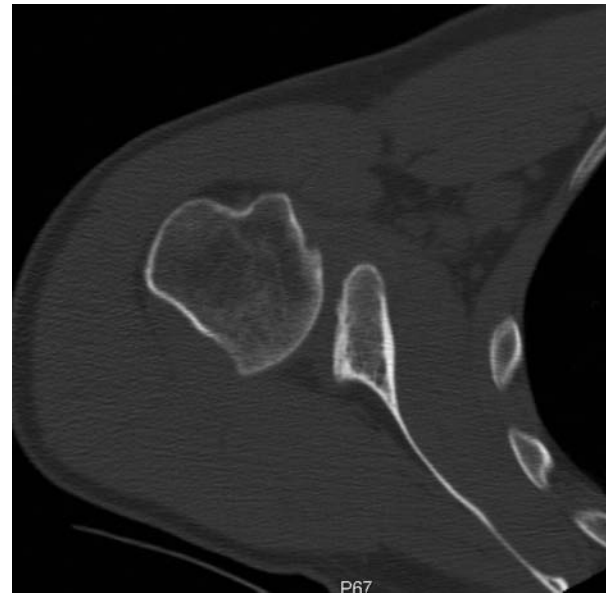

Figure 5. A CT scan demonstrating posterior glenoid bone erosion in a patient with recurrent shoulder instability secondary to glenoid hypoplasia posteriorly.

Diagnostic Imaging

Plain radiographs in posterior instability are typically normal, although the axillary radiograph should be inspected for osseous version changes, especially an increase in posterior version. Occasionally, a reverse Hill-Sachs lesion may be seen, which would be indicative of a prior posterior instability event. Axillary radiographs provide the most information with regard to diagnosing posterior dislocation or subluxation, including the direction and degree of displacement of the humeral head relative to the glenoid, the presence and size of humeral head compression fractures, and posterior glenoid rim defects and the associated potential for increased glenoid retroversion.

Computed tomography is useful in the visualization of the bony structures, and can be used to evaluate glenoid hypoplasia, glenoid bone loss, and/or glenoid retroversion (Figure 5). Magnetic resonance imaging and magnetic resonance arthrography (MRA) provide visualization of the posterior labrum and capsule as well as the inferior and posterior capsulolabral components, the biceps anchor, the rotator cuff, and the rotator interval, which can be used to aid in diagnosis and planning for surgical treatment (Figure 6). As in anterior instability, posterior instability may be associated with injury to the capsular insertion on the humerus (a posterior humeral avulsion of the glenohumeral

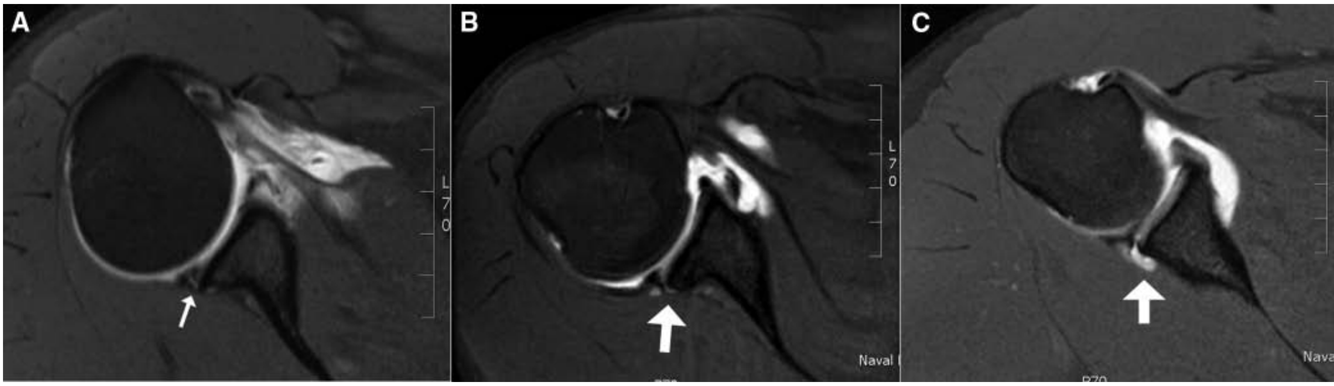

Figure 6. A, magnetic resonance arthrogram depicting a posterior shoulder labral marginal crack (''Kim lesion''; white arrow) on the axial images. B, another axial magnetic resonance arthrogram demonstrating a posterior labral tear (white arrows). C, another example of a labral tear with a paralabral cyst.

TABLE 1
Kim Classification System for Posterior Labral Tears

Type	Description
Type I	Incomplete detachment
Type II	Incomplete and concealed avulsion (Kim lesion)
Type III	Chondrolabral erosion
Type IV	Flap tear

ligament [PHAGL]); however, this is very rare. In addition, the posterior capsule may be enlarged on MRA in some patients with posterior instability, which underscores the biomechanical evidence that the posterior capsule is much weaker than the anterior capsule.[4,14]

Incomplete avulsion of the posterior labrum (“Kim lesion”) can also be seen on MRA as a marginal labral crack. This will appear as a loss of posterior labral height with incomplete extrusion of contrast into the posterior chondrolabral junction. These and other labrum tears, which have been associated with both acute trauma and repetitive microtrauma, are extremely important to recognize, as patients with labral injury typically have successful outcomes after appropriate surgical intervention.[7,9,30] The Kim classification system has been proposed to describe the complexity of posterior labral tears, as seen in Table 1.[32]

TREATMENT OPTIONS

Indications/Contraindications

All patients with posterior instability should be encouraged to start a comprehensive nonoperative treatment program. Surgical treatment may be a good option for patients with limited function secondary to symptoms of pain and/or instability. In addition, patients who have failed an adequate trial of nonoperative therapy may be candidates for surgical treatment.[15,60] As discussed above, positional voluntary instability should not necessarily be considered a contraindication to surgical treatment.[15]

Nonoperative Treatment

Nonoperative treatment, including physical therapy and rehabilitation, is the initial treatment of choice for posterior instability.[11,15] Appropriate strengthening and proprioception training programs have been shown to diminish pain and/or improve stability in approximately two-thirds of patients with posterior and multidirectional instability.[11,15] Such programs may be particularly beneficial for patients with generalized ligamentous laxity and repetitive microtrauma to the shoulder joint.[60] Nonoperative treatment, however, is less likely to be successful in patients with a history of a traumatic event.[11,15,60] Specifically, studies have shown from 70% to 89% success rates for rehabilitation in atraumatic subluxators,[11] with only 16% success in traumatic subluxators.[11] Patients who demonstrate a clear injury or a posterior labral tear are less responsive to nonoperative treatment.[54] If nonoperative therapy fails, or if the patient is an otherwise good candidate for surgery, every effort to strengthen the dynamic stabilizers of the scapula should be made via a preoperative strengthening program, to assist with postoperative rehabilitation. In addition, subscapularis muscle strength should be optimized as this is the most important dynamic posterior stabilizer of the glenohumeral joint.

Operative Treatment

If patients remain symptomatic after a trial of nonoperative treatment as described above, they are potential candidates for surgical intervention. While open procedures have traditionally been viewed as the gold standard for anterior instability (although arthroscopic techniques are now universally accepted as appropriate for management of anterior instability), open treatment of posterior instability has not been as successful, with a 30% to 70% failure rate. This is most likely attributable to the larger surgical dissection required to visualize and access the posterior shoulder structures and the inability to visualize all of the pathologic tissues associated with posterior instability, all of which are limited by the unique biomechanical properties of the posteroinferior capsule and labrum.[24,25,63,70]

Figure 7. The lateral decubitus position setup for shoulder arthroscopy. In this position the arm is abducted approximately 50° and flexed 15° via utilization of an overhead traction sleeve, supplemented by axillary or balanced suspension with a pillow bump to further open the posteroinferior aspect of the shoulder.

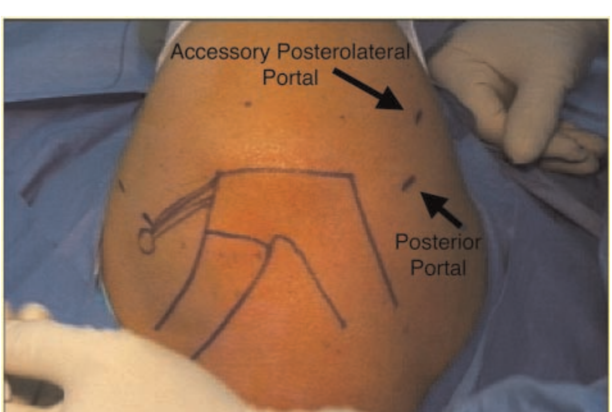

Figure 8. The arthroscopic portals are demonstrated, including the posterior portal, anterosuperior portal, anterior midglenoid portal, and posterolateral portal.

Arthroscopic treatment of posterior shoulder instability without significant posterior glenoid or anterior humeral head bone loss is becoming the treatment of choice. This is because of decreased operative dissection and the ability to address concomitant injury, as well as easier access to the posterior capsulolabral complex. Nevertheless, it is important to note that these procedures can be technically demanding, and a thorough understanding of the surgical anatomy and technique is crucial for success. When there is a substantial amount of bone loss, open procedures including glenoid osteotomy,[23] bone blocks,[61] or rotational osteotomy of the proximal humerus[8] may be utilized.

Arthroscopic Surgical Technique

Patient Positioning. Both the beach chair and lateral decubitus positions are appropriate; however, we believe that the lateral decubitus position more effectively opens up the inferior and posterior quadrants of the shoulder,[27] providing ease of access to the entire glenohumeral joint. In this position, the arm is abducted approximately 50° and flexed 15° via utilization of an overhead traction sleeve, supplemented by axillary or balanced suspension with a pillow bump to further open the posteroinferior aspect of the shoulder (Figure 7).

Portal Placement. Ease of access to the posteroinferior aspect of the glenohumeral joint is essential for a successful outcome. Upon completion of diagnostic arthroscopy from the posterior portal, an anterosuperior portal is made for the arthroscopic camera in the superior aspect of the rotator interval.[54] A midglenoid portal, important for labral tear evaluation and preparation, is also made just above the subscapularis and a 5- to 6-mm cannula inserted. Two posterior portals are used to address the posteroinferior structures: one from the original arthroscopic posterior portal and a second posterolateral portal. The posterolateral accessory portal, also referred to as the 7-o'clock portal, is 2 cm lateral and 1 cm anterior to the original posterior portal, or just 2 cm directly lateral to the posterior corner of the acromion (Figure 8). This portal is thought to be very important to the success of a posterior capsulolabral repair by permitting ease of access to the posteroinferior aspect of the glenohumeral joint for both anchor insertion and capsular repair devices.[20]

Treatment Techniques. While the repair is being performed, the posterior shoulder volume is progressively diminished after each capsulolabral repair stitch, and thus it becomes progressively more difficult to make further repairs because of a smaller working space. However, the decreased volume is important for the success of the procedure,[29] while avoiding overconstraining of the shoulder.[18] It is thus important to address the most inferior aspect of the glenohumeral joint first, followed by any remaining anterior and/or concomitant repairs such as superior labrum anterior and posterior (SLAP) tears, to leave enough room to complete any posterior instability–related repairs. In general, 3 to 4 suture anchors, placed approximately 5 mm apart on the posterior glenoid edge, are usually sufficient for isolated posterior labral and/or capsular injury. For

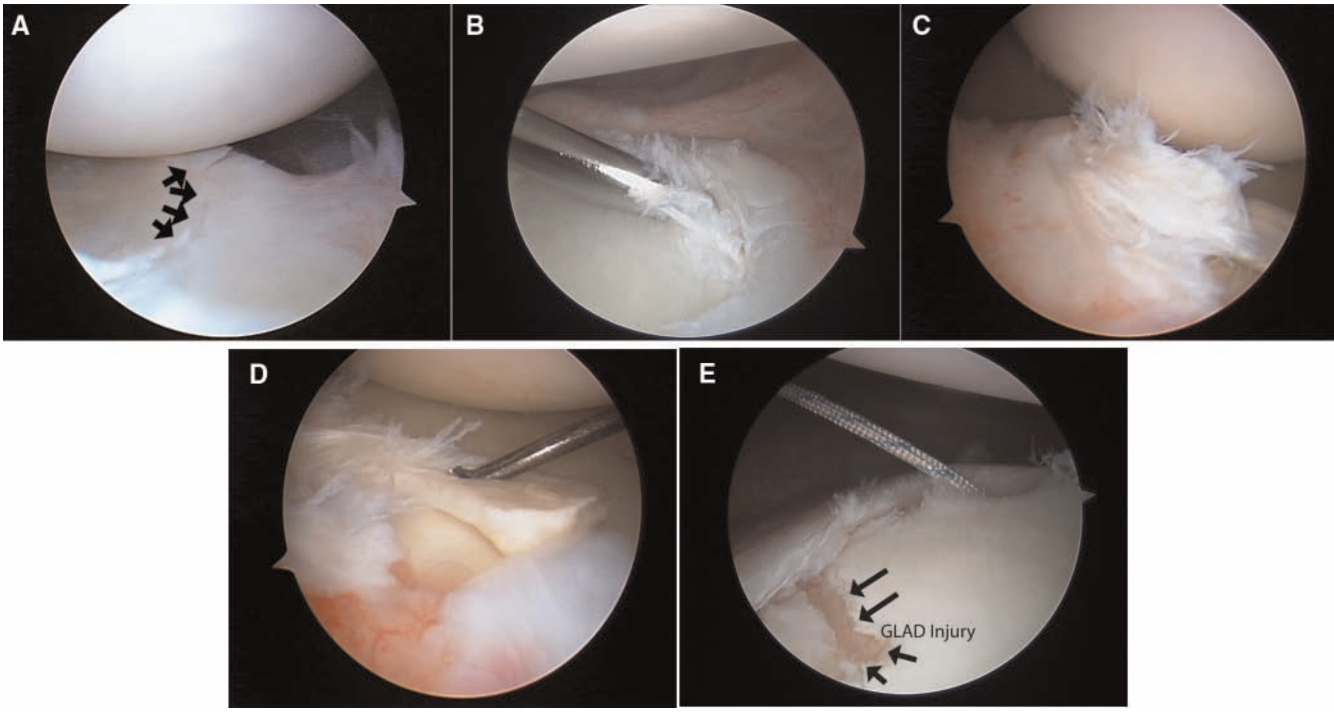

Figure 9. Examples of posterior labral tears as visualized arthroscopically include: A, a posterior labral crack Kim lesion (black arrows); B, a posterior labral tear from 3 to 6 o'clock; C and D, posterior labral tears with associated posterior labral flaps; and E, a posterior labral tear in association with a glenoid labrum articular disruption (GLAD) lesion (black arrows).

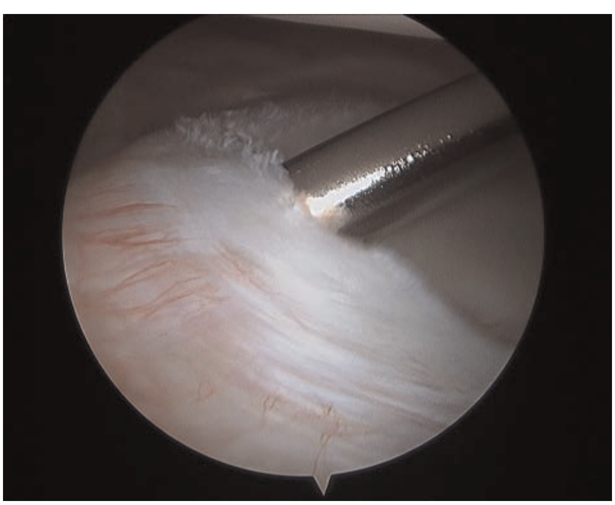

Figure 10. Preparation of the posterior and posteroinferior chondrolabral junction is performed more easily from the anterior portal.

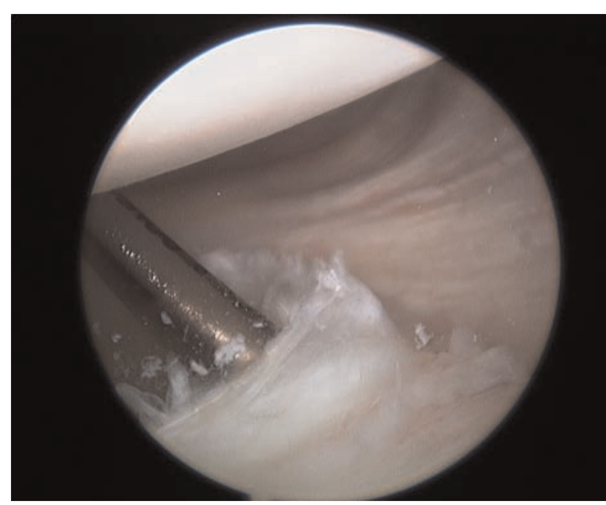

Figure 11. Other labrum and posterior glenoid bone preparation instruments may be brought in from the anterior portal to complete preparation before suture anchor repair.

more extensive tears, additional capsular plication and/or glenoid anchors may be necessary.

The posterior labral tear is initially visualized with the arthroscope in the posterior portal (Figure 9); however, it may be easier to see if the arthroscope is switched anteriorly to either the midglenoid portal or the anterosuperior portal. There may be many different types of posterior labral tears, including marginal cracks, complete tears, and also labral flaps and degenerative tears. Occasionally, a cartilage disruption may also be seen of the posteroinferior glenoid; the treatment and long-term significance of these focal cartilage injuries, known as glenoid labrum articular disruption (GLAD) lesions, remain largely unknown.

For treatment of a posteroinferior labral tear, with the arthroscope in the original posterior viewing portal, the tear is prepared with an elevator device inserted anteriorly from the midglenoid portal. While not necessarily intuitive, it is much easier to prepare the posterior labrum with an

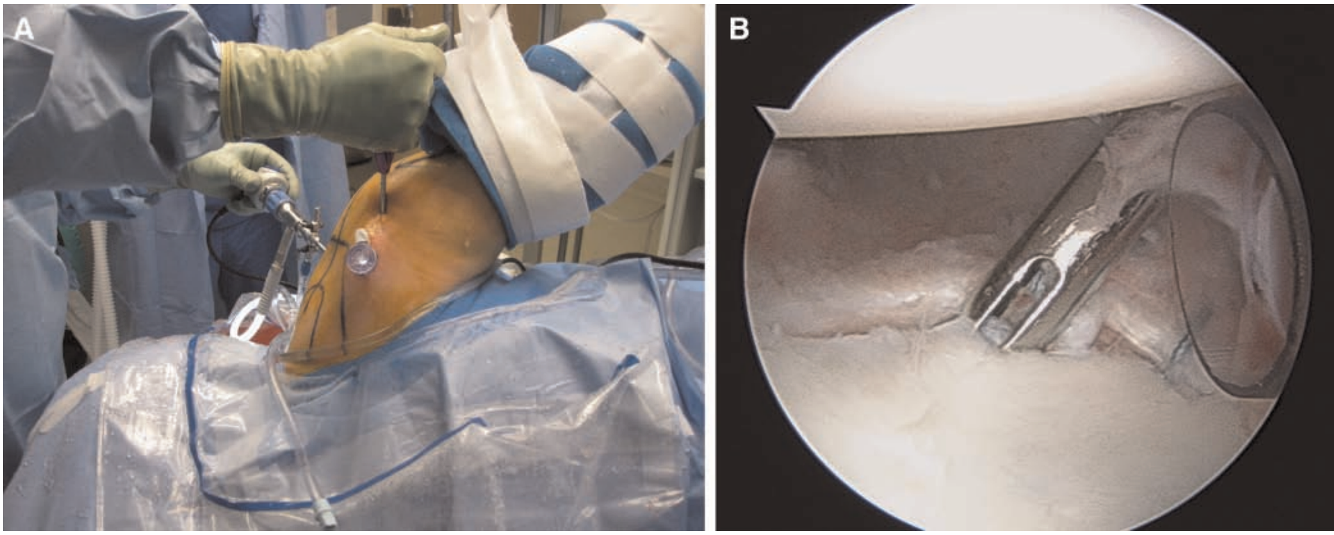

Figure 12. A, the posterolateral (7-o'clock) portal is visualized from the outer view, such that the glenoid drill guide is positioned superiorly and drilling at a viable trajectory back into the glenoid. B, only a small skin incision (2 to 3 mm) is necessary to accomplish anchor insertion.

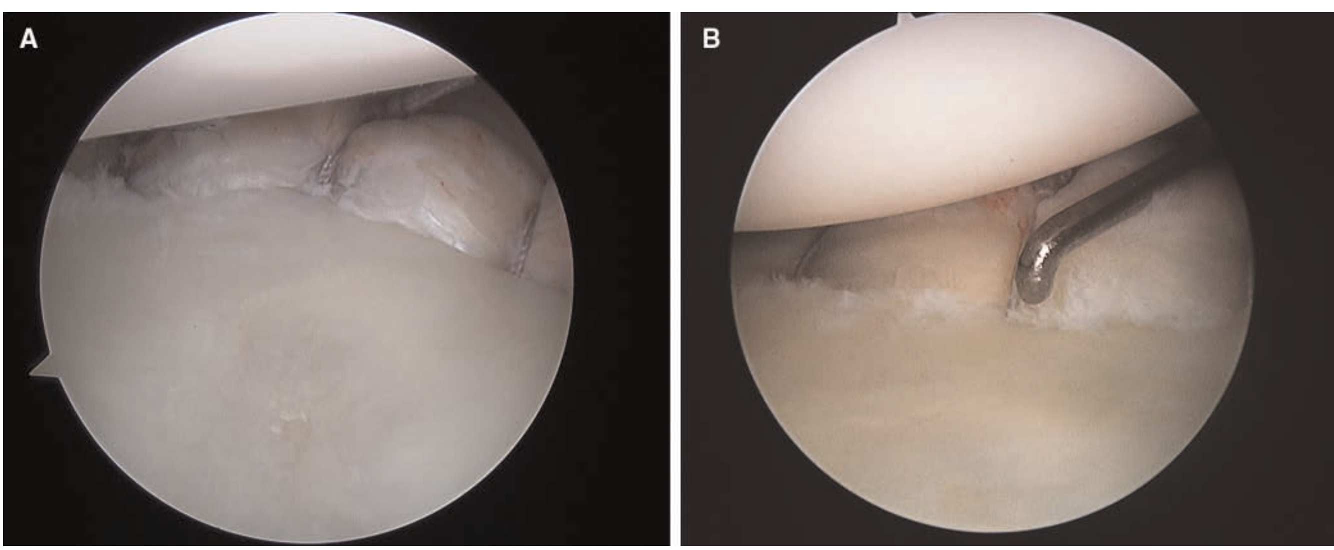

Figure 13. Final capsulolabral repair; both cases (A and B) utilized 3 anchors.

instrument inserted from the anterior midglenoid portal (Figure 10). Specifically, the posterior labrum is attached on the glenoid face and can be easily elevated from an anterior portal, whereas the use of sharp elevator instruments from posterior portals can more easily tear the labrum.[54] Additionally, the midglenoid portal affords a flat trajectory relative to the glenoid such that the instruments may be easily passed without damaging the glenohumeral chondral surfaces. A shaver or bur and capsular rasp may also be introduced from the anterior midglenoid portal to complete the capsulolabral and bony preparation before posterior labral repair (Figure 11).

To facilitate placement of anchors posteroinferiorly, the posterolateral portal (7-o'clock portal), as described above, is especially helpful as it provides excellent trajectory for optimal anchor insertion.[19,20] The 7-o'clock portal is made approximately 2 cm directly laterally off the posterolateral edge of the acromion with a spinal needle. Of note, numerical distances as previously described as well as skin markings serve only as the potential starting point because of the incredible variation in body habitus, musculature, and bony morphologic characteristics. The spinal needle itself is used to fine-tune the trajectory and placement of the portal. Care is taken to not plunge deep into the capsule inferior to the glenoid, but rather to "hug" the humeral head posteriorly. A sharp anchor inserter instrument is then placed when the spinal needle has been removed at the same trajectory. All of the posterior repair anchors (3 to 5 total) may be placed from this 7-o'clock portal by varying the trajectory of the anchor inserter device

(Figure 12). Use of the posterolateral portal, as described by Goubier et al,[19] is an excellent way to approach the posterior and posteroinferior aspects of the shoulder as the instrument is forced to enter the portal in a nearly oblique or vertical fashion, providing excellent accessibility. Furthermore, this portal is typically anatomically safe for surrounding neurovascular structures such as the axillary and musculocutaneous nerves.[19,42] Specifically, the musculocutaneous nerve is safe with this portal placement as it is quite anterior to the portal site, especially if the positioning is just off of the lateral edge of the posterolateral acromion. It is important to avoid an extremely deep placement with the spinal needle during creation of the portal to avoid potentially injuring the axillary nerve.

Capsular plication[27] is a technique that reduces redundancy of the stretched capsule with a suture (absorbable or nonabsorbable), typically using an intact glenoid labrum as the fixation point. In contrast, a capsulolabral repair with anchors utilizes the glenoid anchor as the fixation point. If it is clear that the posteroinferior glenoid labrum is completely intact, patients with an intact labrum may be amenable to capsular plication without anchors.[54] Nonetheless, while the labrum has been shown to be a solid fixation point, several lesions including an unrecognized Kim lesion,[31] suture breakage, small labral tear propagation, and/or shear stress are worrisome and may serve as indications for anchor fixation. Overall, in patients with posterior instability, one should have a low threshold for anchor repair given the high frequency of labral injury and pathologic changes present, which may compromise overall capsular repair strength.

Determining the amount of capsular plication remains one of the biggest challenges in surgical management of posterior instability. While there is currently some debate on the correct amount, it is generally accepted that a 1-cm plication results in adequate correction of the underlying pathologic abnormalities.[59] The important areas to address with a posterior instability repair are the posteroinferior aspects of the capsule. Typically, 3 to 5 capsular repair sutures are sufficient, anchored either to the intact labrum or to a glenoid bony anchor (Figure 13). It is important to note that while beneficial in tightening the capsule, plication can also result in postoperative decreases in range of motion, including internal rotation and abduction, which can be frustrating for the patient.

When repairing the posteroinferior capsule, it is crucial to make every attempt to avoid injury to the axillary nerve. When the arm is placed in abduction and external rotation with balanced suspension, the zone of safety during arthroscopic plication increases.[65] Anatomically, the closest point between the glenoid rim and the axillary nerve is approximately 12.5 to 15 mm between the 5:30 (anterior) position and the 6-o'clock position,[53] and thus care must be taken when positioning the arm. Further, the use of thermal devices should be avoided, as injuries to the axillary nerve attributable to these devices are well characterized in the literature.[21]

Rotator Interval Controversy

In addition to labral repairs and/or plication, the benefits of additional closure of the rotator interval remain controversial. While closure of the rotator interval has been reported to be a beneficial concomitant procedure in open rotator interval closure cases,[58] arthroscopic closure may not be as biomechanically strong and/or stable as an open closure with imbrication of the coracohumeral ligament.[22] In fact, many surgeons have not closed the rotator interval in conjunction with posterior instability[9,70] repairs and have obtained excellent results. Furthermore, recent biomechanical evidence[51] has suggested that arthroscopic rotator interval closure is not overly beneficial to posterior glenohumeral instability repair. The main issue with an arthroscopic rotator interval closure centers on the idea that arthroscopic closure imbricates different structures than in the open technique described by Harryman et al.[22] Specifically, most described arthroscopic techniques shift the MGHL to the superior rotator interval capsule (SGHL), and do not necessarily imbricate the coracohumeral ligament as described by Harryman et al[22] in an open approach. Thus, the results produced by open rotator interval closure are biomechanically much different than those produced by arthroscopic techniques, and therefore the data described by Harryman et al[22] cannot necessarily be used to support arthroscopic rotator interval closure. However, the decision to use a rotator interval closure as a supplement to stability repair in patients with posterior instability remains controversial, although the arthroscopic evidence that it is clinically beneficial is quite limited.

POSTOPERATIVE CONSIDERATIONS

After surgery, patients are immobilized in a 30° abduction pillow in neutral rotation for 4 to 6 weeks, and some have advocated an external rotation brace to prevent internal rotation during this time period to avoid stress on the posterior capsular repair.[30] During these initial 6 weeks, patients are encouraged to perform active elbow and wrist motion, passive pendulum exercises, and gentle passive scaption. Passive motion is started at postoperative day 2, with passive flexion to 120°, abduction to 90°, and avoidance of combined flexion and internal rotation. The magnitude of both the injury and repair determine when active motion of the glenohumeral joint and strengthening of the rotator cuff and scapular stabilizers can begin, which can be as early as 4 to 6 weeks postoperatively. Internal rotation and adduction are restricted for a total of 6 weeks. A progressive strengthening and motion program are instituted around 6 weeks. At the 4- to 6-month point, the majority of patients are allowed complete return to full activities after a sport-specific training program. It should be noted that since the posterior capsule is much less robust than the anterior capsule, rehabilitation programs for anterior instability might not be applicable.

CLINICAL OUTCOMES

The results of arthroscopic treatment of posterior shoulder instability repair,[¶] as presented in Table 2, have not been as encouraging as those treated for anterior instability,

[¶]References 1, 7, 9, 30, 39, 54, 56, 58, 69, 70.

TABLE 2
Posterior Instability Arthroscopic Results[a]

Year	Authors	Mean Age of Patients, y (Range)	Number of Shoulders	Mean Follow-up (Range)	Pathologic Abnormalities	Repair Type	Rotator Interval Closure?	Outcomes
2008	Savoie et al[58]	26 (15-59)	92	28 months (12-132)	51% reverse Bankart 67% stretched posterior capsule 16% combined reverse Bankart and stretched posterior capsule 61% RI damage	Multiple surgical techniques	Yes, in all but 5 patients (95%)	97% success (Neer-Foster) 2/92 failed 1 recurrent gross subluxation 1 recurrent dislocation
2008	Radkowski et al[56]	23	107 27 throwers (T) 80 nonthrowers (NT)	27 months (minimum 12 months)	Throwers: 52% patulous capsule 30% partial labral tear 19% complete labral tear Nonthrowers: 38% patulous capsule 29% partial labral tear 34% complete labral tear	Multiple surgical techniques	11% (T); 19% (NT)	ASES: 82.9 (T), 86.8 (NT) Pain: 2.4 (T), 1.5 (NT) Return to pre-injury sport level: 55% (T), 71% (NT) 1 ASES failure (T)
2006	Bradley et al[9]	23 (15-61)	100	27 months (12-77)	27% partial labral tear 30% complete labral tear 43% no tear (patulous)	44% CL plication 39% CL plication w/ anchors 17% CL plication and additional plication	None	ASES: 85.7 Stability: 1.9 out of 10 (0 most stable) Pain: 1.7 Function: 26.4 (out of 30)
2005	Provencher et al[54]	25 (19-34)	33	39 months (22-60)	52% labral tear 20% partial labral tear 28% no tear (patulous)	52% CL repair (anchors) 48% CL repair (no anchors)	Only in 2 of 33 (part of failure group)	ASES 94.6 SANE 87.5 Total 4/33 recurrent instability
2005	Bottoni et al[7]	23	31 19 open 12 arthroscopic	40 months (24-63)	Mix of labral tear and posteroinferior injury	12/19 CL repair w/ anchors 5/19 CL repair w/ tacks 2/19 thermal	100% of arthroscopic patients	Arthroscopic cases better (SANE=92; Rowe=92, SST=11.4) 2 recurrent instability (1 open, 1 arthroscopic)
2003	Kim et al[30]	21 (14-33)	27	39 months	Type I: 18 patients Type II: 4 patients Type III: 3 patients Type IV: 2 patients	CL repair with anchors in all patients	None	ASES = 94.6 UCLA=33.4 Pain score = 0.2 1/27: recurrent instability
2003	Williams et al[69]	28.7	27	60 months (24 - 252)	Posterior capsulolabral complex detached in all patients	27 with CL repair with tacks	None	3/27 with pain and instability; 2 required additional surgery; L'Insalata = 90.0
2000	Antoniou et al[1]	28	41 (mixed group with MDI) isolated posterior in 31	28 months (12-69)	Posterior and inferior capsular laxity	CL shift to labrum	In all 10 patients with MDI	41% had symptoms of instability postop 35/41 improved SST =8.1 Did not differentiate the 31 posterior instability patients from the 10 MDI patients
1998	Wolf and Eakin[70]	30.7	14 9 trauma 4 microtrauma 1 atraumatic	33 months (26-45)	Excessive posteroinferior laxity all 14, 12/14 with labral tears	Anchors if labral tears	None	11/14 returned to preinjury level of function 1 with recurrent posterior instability
1997	McIntyre et al[39]	22	20 shoulders	31 months (24-44)	12/20 labral tears 3 with excessive posterior laxity (no tears)	Multiple suture techniques	None	2 dislocations 3 recurrent subluxations (25% failure) Bankart tear in all recurrences

[a]MDI, multidirectional instability; T, throwers; NT, nonthrowers; RI, rotator interval; CL, capsulolabral; ASES, American Shoulder and Elbow Surgeons; SANE, Single Assessment Numeric Evaluation; SST, Simple Shoulder Test; UCLA, University of California, Los Angeles.

although recently reported outcomes are more promising. Studies with large cohorts of patients are limited, simply because of the low incidence of this type of injury, making clinical interpretation somewhat difficult. Further, no randomized clinical trials analyzing optimal posterior instability repair are available in the literature. However, the clinical studies that are available indicate that the arthroscopic treatment of posterior stability is an effective means to help even high-level, high-demand patients back to unrestricted activities and/or sports. In addition, the diagnosis and frequency of this condition seems to be on the increase, probably because of an improved awareness and more careful attention to history and examination.

In 1998, Wolf and Eakin[70] published a report on their outcomes after arthroscopic capsular plication with suture anchors for posterior shoulder instability in 14 patients, and reported only 1 patient with continued instability. Subsequent to this study, other authors have published equally encouraging outcomes, including a series of 33 patients by Provencher et al,[54] in which stability was achieved in 88% of patients at a mean follow-up of 39 months. Similarly, Bradley et al[9] published successful results in 100 athletes with 89% returning to full sport without recurrence of instability. Radkowski et al[56] followed 107 shoulders (98 athletes) and compared results between the dominant shoulders in throwing athletes and the dominant shoulders in nonthrowing athletes. Overall, good to excellent results were seen in 89% of throwers and 93% of nonthrowers; however, throwers were less likely to return to their preinjury levels of sport. Finally, Savoie et al[58] followed 92 patients and reported a 97% success rate at a mean of 28 months postoperatively, based on the Neer-Foster rating system.

CONCLUSION

Posterior instability of the shoulder is a diagnostic and clinical challenge. The relative infrequency of the condition, the minimal reports in the literature, and the lack of clear superiority of surgical techniques make it difficult to determine the best way to evaluate and treat these patients. It is critical to completely understand the origins, to perform careful patient selection, and to adhere to techniques designed to address the pathologic changes to obtain a successful outcome. The relatively young athletic patient who presents with vague complaints of shoulder pain and decreased athletic performance should be carefully assessed for posterior shoulder instability. Overall, as the knowledge and technical expertise regarding arthroscopic posterior shoulder stabilization procedures become more advanced, it follows that surgical techniques and postoperative outcomes will continue to improve.

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