[Orthopaedic Surgery]

Evaluation and Management of Posterior Shoulder Instability

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Context: Posterior shoulder instability is a commonly misdiagnosed disorder in many competitive athletes.

Type of Study: Clinical review.

Evidence Acquisition: Relevant studies on posterior shoulder instability from 1950 to 2010 in PubMed and Cochrane databases were reviewed.

Results: A total of 107 studies were reviewed.

Conclusion: Patients who have undergone at least 6 months of physical therapy and still experience instability symptoms should be considered for surgical stabilization directed at their underlying pathology.

Keywords: posterior shoulder; instability; subluxation; laxity; dislocation; management

Glenohumeral instability is a relatively common condition affecting 2% of the general population,[2] with posterior instability being much less common (2% to 10% of all unstable shoulders).[4,11,49] Competitive athletes are among the most common patients owing to overuse or a single traumatic episode resulting in posterior subluxation or dislocation. McLaughlin[48] described the distinction between a fixed (or locked) posterior dislocation and recurrent posterior subluxation. Recurrent posterior subluxation is the most common type of posterior instability, whereas frank posterior dislocation is rarely seen. The pathoanatomy involving the capsule, rotator interval, labrum, or bony architecture of the shoulder has made diagnosis and treatment extremely challenging. Recent improvements in diagnostic tests, imaging, and surgical techniques have minimized misdiagnosis and enabled physicians to treat posterior shoulder instability more effectively.

ANATOMY: COMPONENTS OF POSTERIOR SHOULDER STABILITY

With less than one-third of the humeral head articulating with the glenoid fossa, the shoulder is the least stable joint in the body. Static stabilization is collectively provided by the articular cartilage surfaces, glenoid labrum, capsular ligaments, and intra-articular pressure.[83] In addition, glenoid version, humeral retrotorsion, and joint congruency help contribute to static stability. Structural irregularities such as posterior glenoid erosion and glenoid retroversion may predispose patients to posterior instability.[1]

The labrum is a ring of densely packed fibrocartilage at the margin of the glenoid cavity that stabilizes the joint by increasing glenoid depth, concavity, and surface area. The labrum is a stable fibrocartilaginous anchor for the capsular ligaments (superior, middle, and inferior) that stabilize the glenohumeral joint at the extremes of motion by resisting joint translation.[43,46,82] The most important structure responsible for preventing posterior translation is the posterior capsule, between the intra-articular portion of the biceps tendon and the posterior band of the inferior glenohumeral ligament complex.[61] It restricts posterior translation when the arm is flexed, adducted, and internally rotated.[50] Unfortunately, this portion of the capsule is also the thinnest and weakest.

The rotator interval is a triangular space between the subscapularis and the supraspinatus tendons, which prevents excessive inferior and posterior translation.[15,24] Deficiencies in the rotator interval may contribute to instability. Sectioning the rotator interval capsule can increase posterior and inferior translation, resulting in dislocation.[24] However, recent studies have shown no significant difference in the overall size of the

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rotator interval between patients with shoulder instability and controls.[63] Posterior or inferior instability did not improve after arthroscopic rotator interval closure, whereas anterior stability did.[52]

Posterior translation is resisted dynamically, most so by the subscapularis.[35,41] The infraspinatus and teres minor also play a significant role in stabilization at extreme ranges of motion.[31] Lippitt and Matsen[43] described 2 main dynamic stabilizing mechanisms: scapulohumeral balance and concavity compression. A larger glenoid arc provides stability for a larger range of joint force angles. Contraction of the rotator cuff across the joint increases joint stability through the concavity compression effect on the humeral head within the glenoid socket.[41,42,46,76,79] Glenohumeral joint stability is markedly reduced under tangential forces when the glenoid rim is partially resected.[32] Sekiya et al[70] showed that loss of this concavity compression mechanism increases instability of the glenohumeral joint. The pathoanatomy of anterior shoulder instability differs from posterior shoulder instability. The posterior capsule, posterior band of the inferior glenohumeral ligament, and posterior labrum provide the greatest support posteriorly.[7,8,57,61,82] An isolated lesion in any one of these posterior structures often results in unidirectional posterior instability.

CLASSIFICATION AND PATHOGENESIS

Many classifications of posterior shoulder instability have been described, including degree, direction, mechanism of injury, and volition.[6,40,77] Hawkins and McCormack[27] discussed acute posterior dislocations, chronic (fixed/locked) posterior dislocations, and recurrent posterior subluxation. Of these, recurrent posterior subluxation is the most common.

Posterior shoulder instability can be further divided dimensionally: unidirectionally (posterior), bidirectionally (posteroinferior),[4,21] and multidirectionally (posterior, inferior, and anterior).[4,51,54] Bidirectional and multidirectional instability are much more common than unidirectional instability. Specific pathoanatomic lesions, such as a reverse Bankart lesion, are often observed in patients with posterior instability caused by trauma. Multidirectional instability may have an inciting traumatic event, but it is due to preexisting global capsular laxity.[69]

Trauma may be macro or micro. Macrotrauma is a single event[20,25] of an axial load to the arm while the shoulder is flexed. Microtrauma is a repetitive injury, such as straight-arm pass blocking in football or bench pressing.[62,67] Trauma may injure the rotator cuff, labrum, and/or glenoid, contributing to posterior subluxation. Isolated sectioning of the posterior rotator cuff musculature does not increase posterior translation.[59,66] A posterior labral and capsular injury allows posterior translation and subluxation of the humeral head; however, an injury to the anterior capsule is necessary for complete posterior dislocation (circle concept).[55,58,60,67,75,78,84]

Atraumatic instability may be due to soft tissue abnormalities (ie, Marfan and Ehlers-Danlos) or glenohumeral dysplasia. Excessive glenoid retroversion may be a predisposing factor to posterior shoulder instability.[16,66,88] In the normal population, glenoid version varies significantly[14,19] and is difficult to measure radiographically.[13,17] Gerber et al[22] reported no correlation between altered glenoid version and instability. More recent studies have shown that increased glenoid retroversion is associated with a higher risk for posterior instability.[29,57] In a study of 33 shoulders with posteroinferior instability, greater glenoid retroversion and a more shallow glenoid were found when compared with age-matched controls.[37] Thus, excessive glenoid retroversion may be a contributory factor, but it is not likely a primary cause of posterior instability.[85,88] Patients with undetected retroversion who undergo a soft tissue capsulorrhaphy will have an abnormally high failure rate if bony abnormalities are not corrected. Exercise and physical therapy are mainstays for atraumatic injury but are unlikely to provide significant benefit in trauma.[11]

Last, posterior shoulder instability can be described on the basis of volition. A subset of patients habitually subluxate their shoulders using patterns of muscle activity.[65] These patients are different because of their abnormal psychological urge to subluxate their shoulders. It is important to identify these patients because their treatment plans differ significantly.

PATIENT ASSESSMENT

History and Physical Examination

There is an at-risk population of individuals who overuse their shoulders, causing symptoms of instability. Overhead throwers; volleyball, football, and tennis players; swimmers; and weight lifters are among the athletes at highest risk.[12,80] Linemen and defensive backs in football seem to also be at risk. A study of 336 collegiate football players reported that 14% of offensive linemen, 8.1% of defensive linemen, and 4.5% of defensive backs experience posterior shoulder instability.[34] Athletes commonly report intensifying shoulder pain in the later stages of their sporting events when dynamic stability decreases because of muscle fatigue.[50]

Patients with posterior shoulder instability primarily complain of aching pain and weakness along the posterior joint line, biceps tendon, or superior aspect of the rotator cuff. Symptoms intensify with the arm in 90° forward flexion, adduction, and internal rotation.[80] Mechanical symptoms are uncommon.[50]

Posterior instability tests differentiate shoulder instability from glenohumeral joint laxity. Instability is defined as symptomatic translation of the shoulder joint. The patient must have both a subjective feeling of discomfort and a feeling of joint laxity or slipping.[40] Excessive translation does not confirm shoulder instability, and not all patients with posterior instability present with excessive translation.[74]

Figure 1. Posterior drawer test: The examiner stabilizes the shoulder with 1 hand (between the clavicle and the coracoid [anteriorly] and the spine of the scapula [posteriorly]) and holds the humeral head with the other hand. The examiner presses the humeral head medially into the center of the glenoid to evaluate the neutral position of the joint. Posterior stress is then applied and the degree of passive translation determined. Reprinted with permission from Bahk et al.[5]

Specific Tests

Posterior drawer test. (Figure 1).[47]

Posterior stress test. The examiner stabilizes the shoulder with 1 hand and pushes the 90° flexed, adducted, and internally rotated shoulder posteriorly by the elbow. If the patient experiences pain and symptoms of instability, the test result is positive.

Kim test for posteroinferior instability. (Figure 2).

Jerk test. (Figure 3).

IMAGING

Radiographic Imaging

Plain radiographs often show normal bony anatomy; however, defects such as a reverse Hill-Sachs lesion may be found in the anterior humeral head on the Stryker notch or axillary lateral view (Figure 4).

Axillary stress radiographs are helpful in understanding the direction and degree of shoulder instability, and they are especially useful in diagnosing patients with a volitional component. West Point axillary view optimally detects osseous Bankart defects on the posterior glenoid rim (Figure 5).

Computed Tomography and Magnetic Resonance Imaging

Computed tomography and magnetic resonance imaging (MRI) are extremely helpful in determining the version and morphology of the glenoid. Computed tomography is most useful for determining the orientation of articular surfaces (Figure 6). Computed tomography is also useful in defining the size and orientation of a reverse Hill-Sachs lesion, a reverse Bankart lesion, posterior glenoid bone loss, or bony Bankart lesion (Figure 7). MRI is much more useful in evaluating soft tissue pathology (Figure 8).

Magnetic resonance arthrograms are the most sensitive examination of the posterior capsulolabral complex. Using magnetic resonance arthrogram imaging, Tung and Hou[81] found the location of the humeral head in the glenoid more posterior in patients with posterior labral tears. MRI is 90%

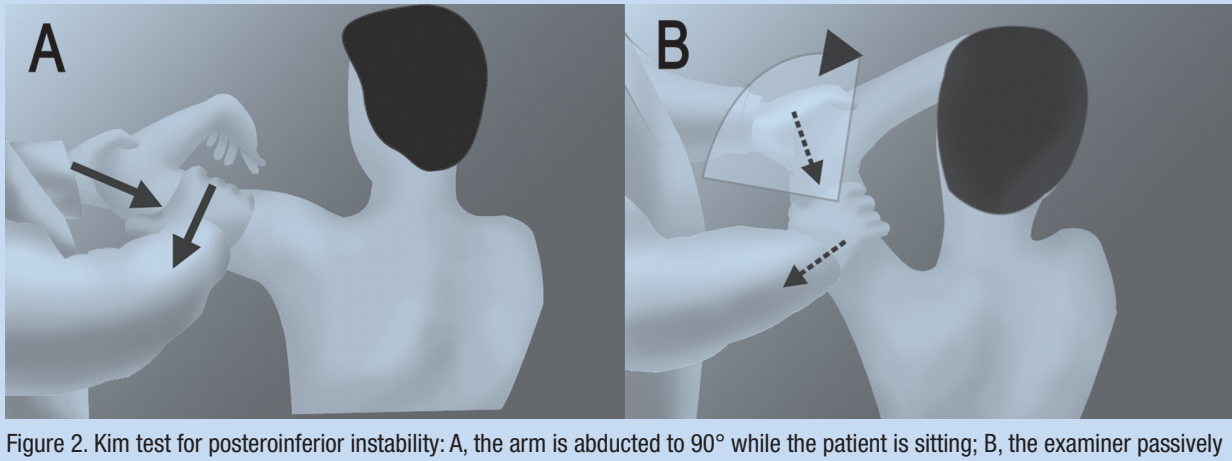

Figure 2. Kim test for posteroinferior instability: A, the arm is abducted to 90° while the patient is sitting; B, the examiner passively elevates the arm an additional 45° while applying a downward and posterior force to the upper arm, with an axial load to the elbow. Posterior subluxation with pain indicates a positive test result. Reprinted with permission from Kim et al.[39]

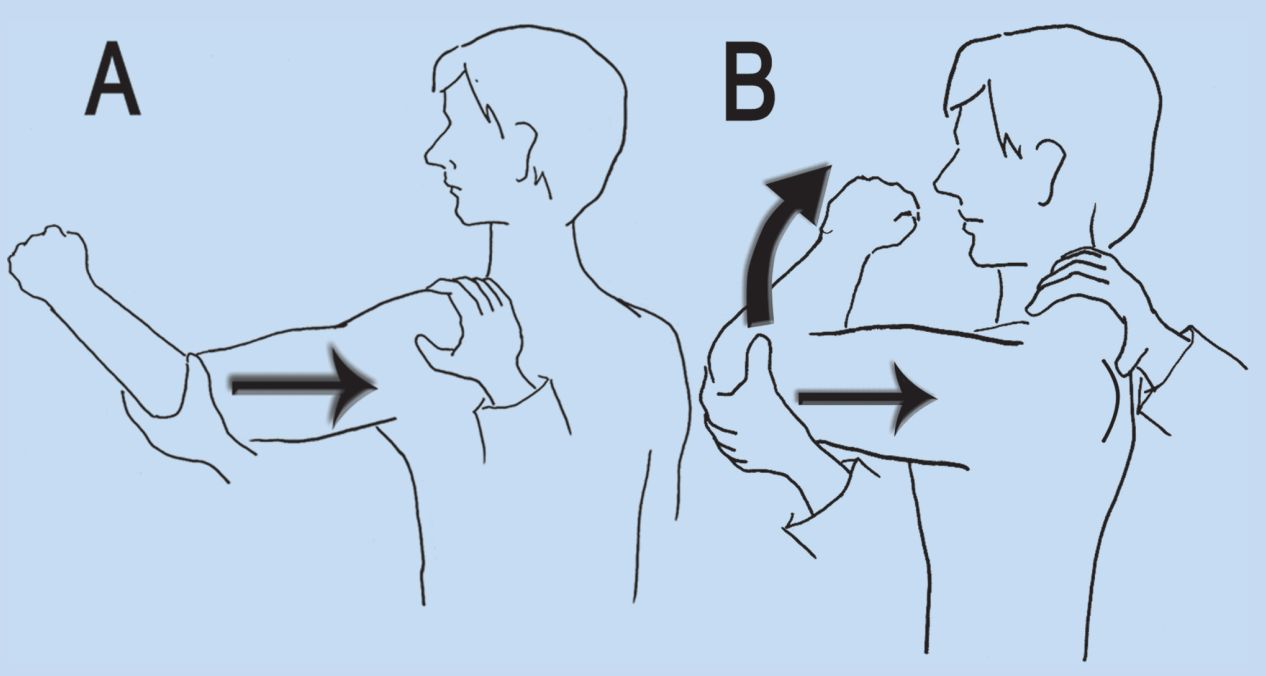

Figure 3. Jerk test: A, the examiner grasps the scapular spine and the clavicle with 1 hand while holding the elbow with the other. With the arm flexed 90° and internally rotated with the elbow flexed 90°, the shoulder girdle is pressed anteriorly with 1 hand and the elbow pushed posteriorly with the other, causing posterior subluxation of the humeral head. B, the arm is then abducted as it is pushed posteriorly. If the patient experiences a sudden painful jerk as the humeral head relocates, this is considered a positive test result. Reprinted with permission from Kim et al.[38]

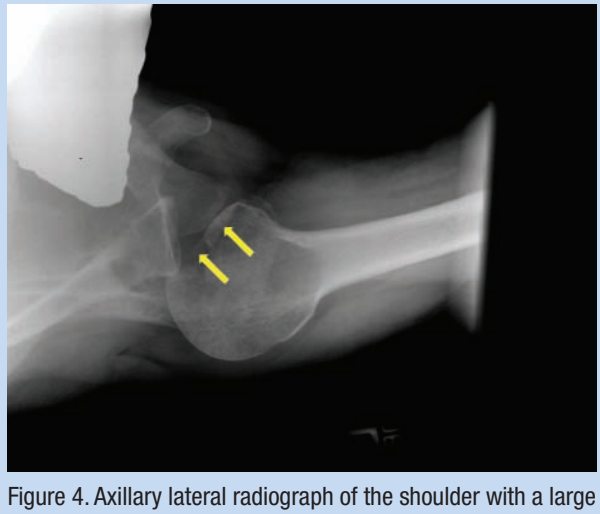

Figure 4. Axillary lateral radiograph of the shoulder with a large reverse Hill-Sachs defect (arrows).

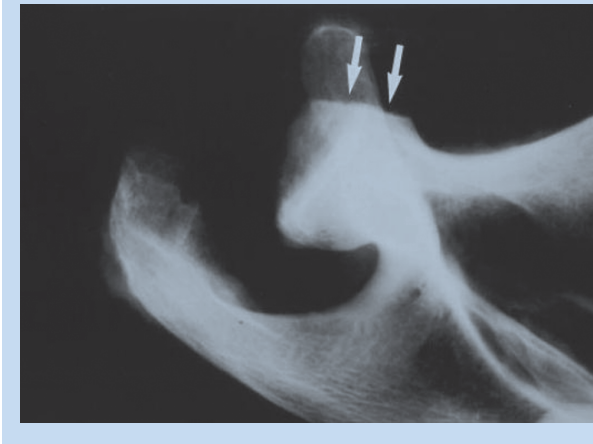

Figure 5. West Point axillary view showing glenoid bone loss (arrows). Reprinted with permission from Itoi et al.[30]

to 94% accurate for labral pathology when the imaging corresponds to the clinical examination.[23,31]

NONSURGICAL MANAGEMENT

Activity modification and a conservative physical therapy protocol usually form the first-line treatment.[14,20,25,56,61,80] The optimum duration of nonsurgical management is not based on scientific evidence, but at least 6 months of therapy is common before consideration for surgical repair.[11,16,21] Several exceptions exist, including evidence of bony pathology of the glenohumeral joint and traumatic instability. Both conditions are associated with poor outcomes with nonsurgical treatment.[11]

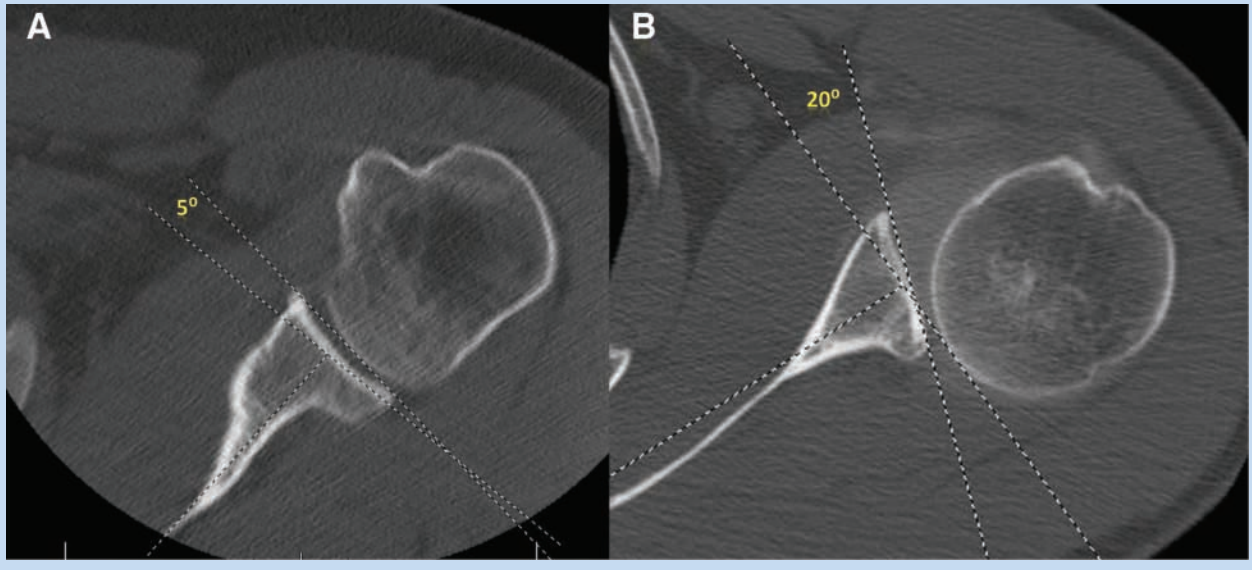

Figure 6. A, computed tomography scan of the shoulder showing normal glenoid version; B, retroversion of the glenoid.

Figure 7. Computed tomography scan of the shoulder showing a reverse bony Bankart lesion (arrow).

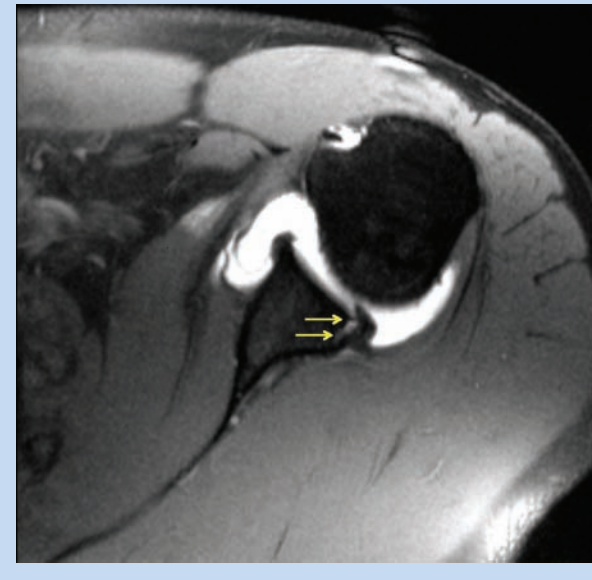

Figure 8. Magnetic resonance image of the shoulder showing a posterior labral tear (arrows).

The exercise protocol focuses on strengthening the rotator cuff and the scapular stabilizers through resisted external rotation exercises. It is important to balance the strengthening program with internal rotation exercises to reestablish synchronous scapulohumeral rhythm.[53] During conservative treatment, patients should modify their activity levels to prevent further injury. Biofeedback may also be helpful.[6,50,77] Conservative treatment is less successful for instability that occurred after a single injury to the shoulder.[20,56]

SURGICAL OPTIONS AND CONSIDERATIONS

Patients who have undergone at least 6 months of conservative treatment and still experience instability symptoms may be surgical candidates (Table 1).[14,20,25] Surgery is contraindicated for habitual instability because of psychological problems leading to a high failure rate[29]; these patients rarely comply with physical therapy regimens and are refractory to standard treatment.[65] Patients with seizures causing dislocations must

Table 1. Surgical considerations.[a]

Procedure	Consideration
Soft tissue	
Reverse Bankart repair (open or arthroscopic)	Often performed in combination with an arthroscopic capsular plication, posterior-inferior capsular shift, or reverse Putti-Platt
Arthroscopic capsular plication	Performed on patients with isolated unidirectional posterior instability without a true labral tear
Open posterior-inferior capsular shift	Surgical option for patient with posterior-inferior subluxation with no anterior component and a functionally intact rotator interval
Reverse Putti-Platt	Often reduces range of motion and is thus generally not recommended for athletes requiring full range of motion
Thermal capsulorrhaphy	Not recommended because of high recurrence rates
Osseous	
Posterior bone block or posterior wedge osteotomy	Generally indicated for patients presenting with a failed capsular plication, glenoid hypoplasia, increased glenoid retroversion, or an osteochondral fracture of the glenoid cavity vs posterior glenoid bone loss
McLaughlin's procedure or Neer's modification of McLaughlin's	Performed on patients with locked posterior shoulder dislocation resulting from reverse Hill-Sachs lesions encompassing 25% to 50% of the humeral head
Humeral head allograft	Alternative option to McLaughlin's or Neer's procedures based on the surgeon's preference/experience; our preference as the most anatomic way to reconstruct large engaging reverse Hill-Sachs lesions

[a]This table represents a general overview of the surgical options; surgical decisions must be made on a case-by-case basis

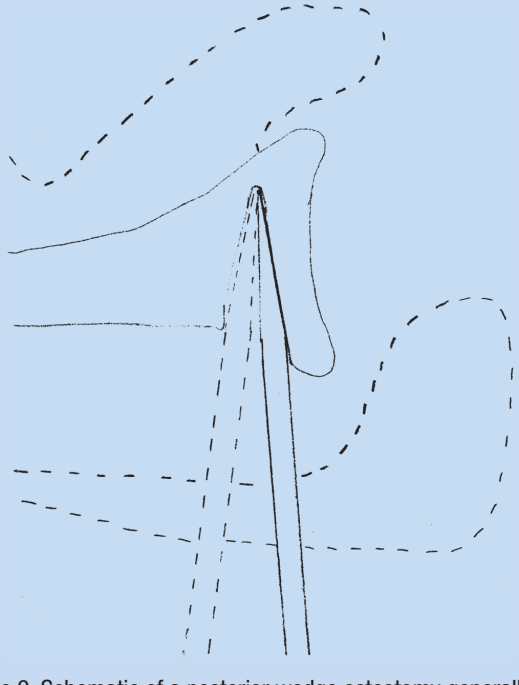

Figure 9. Schematic of a posterior wedge osteotomy generally indicated for patients presenting with failed capsular plication, glenoid hypoplasia, increased glenoid retroversion (version > 20°), or an osteochondral fracture of the glenoid cavity.

have their medications adjusted and seizure risks stabilized before surgical options are considered.

Surgical options can be divided into soft tissue and osseous procedures. Common soft tissue procedures include posterior labral repair and/or tightening of the posterior capsule (open posterior-inferior capsular shift, arthroscopic capsular plication, or a reverse Putti-Platt procedure). The osseous procedures include the posterior bone block, posterior opening wedge osteotomy of the glenoid neck (Figure 9), or posterior glenoid osteochondral allografting (Figure 10).[2,32] Procedures for correcting a reverse Hill-Sachs lesion include McLaughlin's procedure, Neer's modification of McLaughlin's procedure, and allograft reconstruction of the humeral head (Figure 11).[9,18,70] A recent meta-analysis comparing open and arthroscopic surgical approaches showed no statistical difference in clinical outcomes[33] or recovery time.[3]

Posterior capsule redundancy is the most common pathologic lesion (Figure 12). For patients with isolated unidirectional posterior instability without a true labral tear, posterior capsular plication is recommended.[10,36,87,89] Seventeen patients who underwent posterior capsulorrhaphy for isolated posterior shoulder instability reported function at 81% of the nonoperative shoulder at a mean follow-up of 3.8 years.[73] Posterior capsulorrhaphy has a 91% success rate when performed on isolated posterior subluxation.[20]

A posterior-inferior capsular shift should be performed for posterior-inferior subluxation with no anterior component

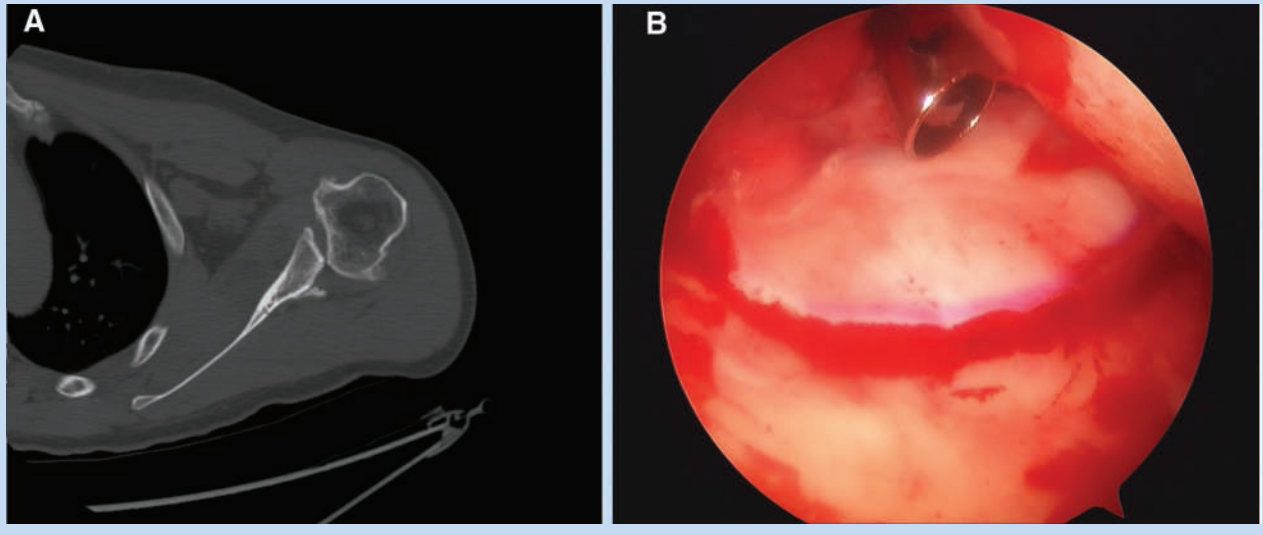

Figure 10. A, computed tomography scan of a chronic posterior instability patient with significant loss of posterior glenoid bone from chronic subluxations; B, arthroscopic view of osteochondral allograft reconstruction of the posterior glenoid bone loss.

and an intact rotator interval. The posterior aspect of the glenohumeral capsule is opened via a T-shaped incision creating medial caudal and cranial flaps, which are then drawn together and overlapped to reduce the volume of the glenohumeral capsule. This technique has a long-term success rate of 96%, excluding revision cases, and an 80% success rate with revision cases.[62] When a reverse Bankart lesion (posterior labral tear) coexists with a redundant posterior capsule, the labrum must be repaired along with the posterior capsular plication (Figure 13). Procedures focusing on restoring the labrum after a reverse Bankart lesion and eliminating capsular redundancy are more successful.[28,45]

Thermal capsulorrhaphy is currently not advocated because of highly variable results[44]—specifically, failure rates as high as 43%,[26] with capsular insufficiency occurring in up to 33% of cases.[90] Complications include capsular necrosis and capsular rupture.[90]

A posterior glenoid osteotomy or a posterior bone block is generally indicated for patients presenting with failed capsular plication, glenoid hypoplasia, increased glenoid retroversion (version > 20°), or osteochondral fracture of the glenoid cavity.[25,68,86] The goal of posterior wedge osteotomy is to decrease the retroversion of the glenoid fossa.[2,32] Osseous procedures are technically demanding and less successful than soft tissue procedures,[56] with high complication rates.[25] For instance, the posterior glenoid osteotomy has relatively poor outcomes, with a high complication rate of 41%.[25] Norwood and Terry[56] reported that 47% of patients experience some form of instability following a posterior glenoid osteotomy procedure. In addition, multiple studies show coracoid impingement and anterior dislocation following a posterior glenoid osteotomy procedure.[22,56,68] Nonetheless, in cases of bone deficiency or failed surgery, these types of procedures may be required to ultimately obtain clinical stability.

GENERAL POSTOPERATIVE REHABILITATION GUIDELINES

For the first month, the shoulder should be kept in relative external or neutral rotation to relax the posterior capsule and antevert itself. Between the first and second months' postsurgery, passive and active assisted range of motion can begin in a protected fashion while still limiting end ranges of motion in positions that maximally stress the posterior capsule. The sling use may be discontinued around 6 weeks.

Between 2 and 5 months, strengthening can begin with isometrics for the rotator cuff and periscapular muscles. Full motion should be achieved between 2 and 3 months. Between months 5 and 8, patients may begin gradual return to previous sports, activities, and work duties but under controlled conditions. Full return depends on full functional range of motion, no pain or tenderness, good strength, and satisfactory clinical examination.

CONCLUSION

Glenohumeral instability is a multifaceted disorder with varying causes, degrees, and directions of instability. Conservative physiotherapy management is recommended as the primary option for treatment. If conservative treatment is unsuccessful after a 6-month course, surgery may be considered.[64]

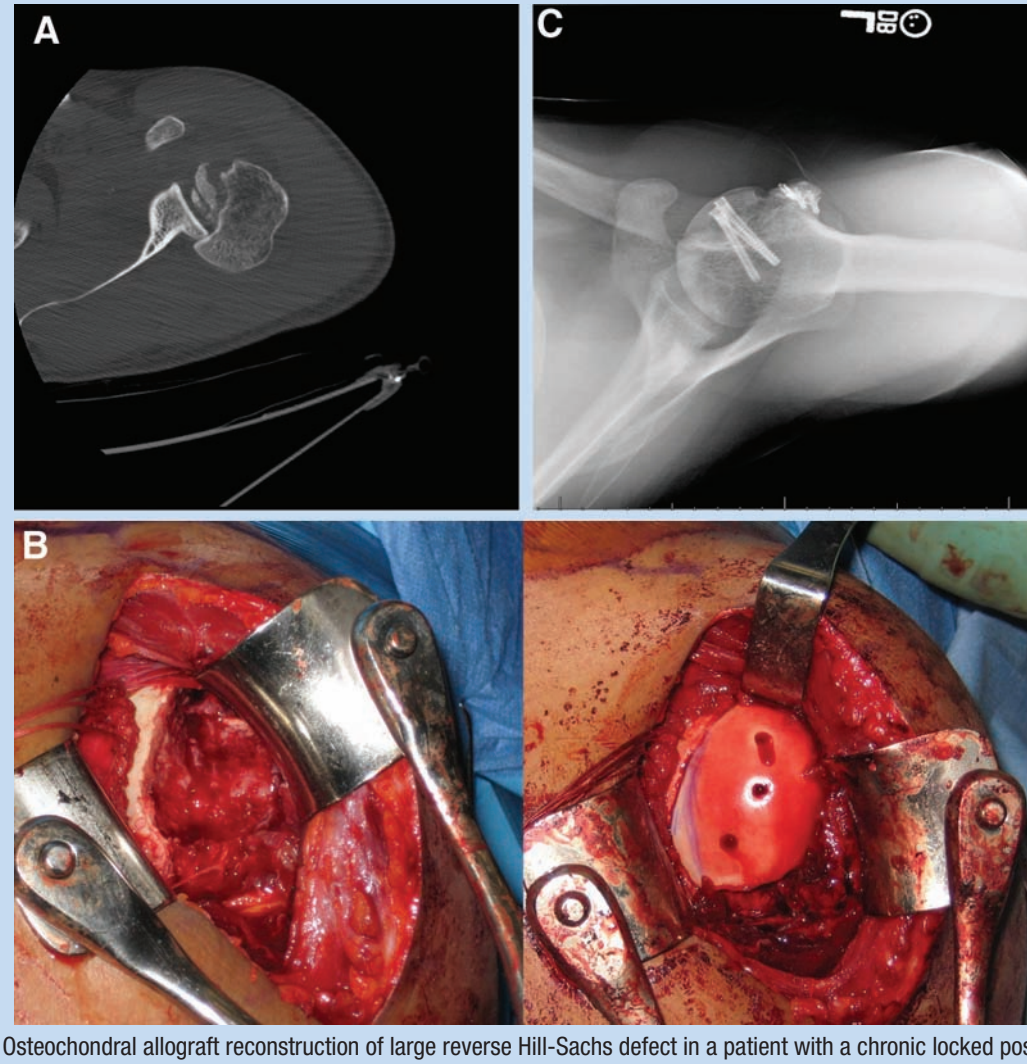

Figure 11. Osteochondral allograft reconstruction of large reverse Hill-Sachs defect in a patient with a chronic locked posterior dislocation following a seizure. A, computed tomography scan of a chronic locked posterior dislocation in a patient following a seizure. B, large reverse Hill-Sachs defect exposed during surgical approach before and after osteochondral allograft reconstruction. C, 10-month follow-up showing healing and integration of the allograft.

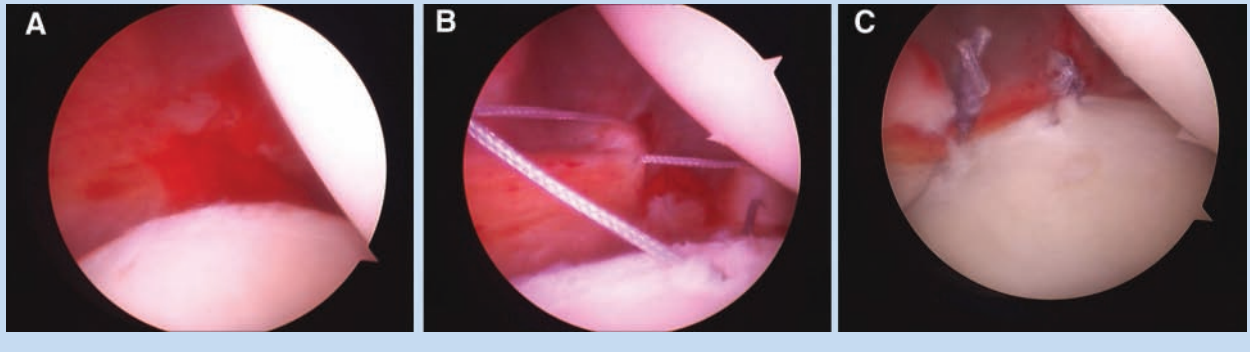

Figure 12. Arthroscopic posterior inferior capsulorrhaphy for bidirectional posterior inferior shoulder instability without labral tear. A, arthroscopic view of severe posterior inferior capsular stretching and laxity without a labral tear. B, arthroscopic posterior inferior capsular plication using a suture anchor. C, restoration of capsular tension following arthroscopic posterior inferior capsulorrhaphy.[71,72]

Figure 13. Chronic posterior instability in a veteran National Football League offensive lineman. A, detached posterior labral tear and degeneration of the glenoid with chronic posterior subluxation. B, sequential posterior labral repair and posterior capsulorrhaphy. C, posterior suture capsulorrhaphy.

Clinical Recommendations

SORT: Strength of Recommendation Taxonomy
A: consistent, good-quality patient-oriented evidence
B: inconsistent or limited-quality patient-oriented evidence
C: consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
Conservative physical therapy treatment is recommended as the initial form of treatment for patients presenting with posterior shoulder instability.[14,20,25,56,61,80]	B
An open or arthroscopic posterior capsulorrhaphy is recommended for patients with unidirectional recurrent posterior instability who fail conservative treatment after 6 months.[10,36,87,89]	B
A posterior bone block or glenoid osteotomy is recommended for patients with glenoid hypoplasia, increased glenoid retroversion, or an osteochondral fracture of the glenoid cavity.[25,68,86]	B
Arthroscopic thermal capsulorrhaphy is not recommended to treat patients with recurrent posterior shoulder instability.[26,90]	B

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