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The Hospital Physician Orthopaedic Sports Medicine Board Review Manual is a peer-reviewed study guide for orthopaedic sports medicine fellows and practicing orthopaedic surgeons. Each quarterly manual reviews a topic essential to the current practice of orthopaedic sports medicine.

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Anterior Instability of the Shoulder

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Table of Contents

Introduction ............................................ 2

Traumatic Anterior Instability ................. 2

Instability in the Overhead Throwing Athlete ...... 7

Conclusion ........................................... 10

References .......................................... 10

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www.turner-white.com Orthopaedic Sports Medicine Volume 1, Part 3 1
INTRODUCTION

Anterior instability of the glenohumeral joint accounts for 95% of shoulder instability in most series. Anterior shoulder instability represents a spectrum of disorders that can be classified by magnitude (subluxation versus dislocation), frequency and/or chronology (ie, acute, recurrent, or chronic), etiology (traumatic versus atraumatic), or the presence or absence of voluntary control. Each of these subgroups suggests varying pathologic anatomy and pathophysiology. Treatment should be directed toward the specific disorder suggested by a thorough history and physical examination and supported by radiographic findings and knowledge of the natural history. When surgery is indicated, management is further enhanced by arthroscopic examination of the glenohumeral joint under anesthesia to identify the pathology.

The most common types of anterior shoulder instability seen in orthopaedic surgery practice are traumatic anterior instability, subluxations due to trauma, and atraumatic (occult) instability in the overhead throwing athlete. This manual reviews the current knowledge on these topics and points out areas of continuing debate. Because traumatic anterior instability is most common, this type of shoulder instability is covered in more detail.

TRAUMATIC ANTERIOR INSTABILITY

INCIDENCE AND RECURRENCE RATES

The incidence of traumatic anterior shoulder instability is highest in patients younger than age 30 years, but is also increased in those older than 60 years. The etiology in younger patients is primarily traumatic, but subluxations may occur due to sports-related repetitive microtrauma. In older patients, shoulder instability may be the result of pre-existing rotator cuff disease that allows the humeral head to more easily dislocate with trauma. Studies show that the rotator cuff is an important stabilizer of the humeral head, and sectioning of the supraspinatus leads to large increases in anterior and inferior translation of the humeral head.

Several studies have associated age and activity level with rates of recurrent anterior shoulder dislocation. Hovelius et al studied patients from the general population who had an anterior dislocation reduced in the emergency department. At 2-year follow-up, the authors observed a recurrence rate of approximately 50% irrespective of the type and duration of postreduction immobilization. At 10-year follow-up, the recurrence rate was approximately 65% in patients aged 12 to 22 years, with 34% of these patients requiring surgery; patients aged 23 to 29 years had a recurrence rate of 56%, whereas those aged 30 to 40 years had a recurrence rate of 24%. Similarly, Simonet et al found that the recurrence rate was 82% in athletes younger than 30 years and 30% in nonathletic individuals of the same age. Taylor and Arciero studied a military population at West Point who returned to strenuous activity after a shoulder dislocation, in whom the recurrence rate was 95%; however, this study included athletes who may have been of higher caliber than those in other studies. Kirkley et al studied a group of amateur athletes who did not have surgery, in whom the recurrence rate after 2 years was 47%.

These findings have been used to suggest that patients with a first-time shoulder dislocation should be considered candidates for surgery to prevent an inevitable recurrence if they remain active. However, studies show that variables besides age may be important when considering surgery, including the dominance of the arm involved, the type of sport and timing during the sport season, the presence or absence of other injuries, and other activities performed. For example, Buss et al found that athletes who sustained a dislocation during the sport season and were treated with rehabilitation and a brace had a redislocation rate of only 37%, prompting the authors to conclude that surgery can be delayed until the end of the sport season in some cases. Most physicians believe each case should be evaluated individually for these factors and that a treatment decision should be based on informed consent with the patient.

PATHOLOGY

Static restraints to shoulder instability include the glenohumeral ligaments, glenoid labrum, glenoid, and...
anterior instability, Wheeler et al. found that 100% had a capsular tear and labral detachment in 64%. In a cohort of patients with a capsular tear with a partial labral detachment in 32%, www.turner-white.com Orthopaedic Sports Medicine

Anterior Instability of the Shoulder

rotator cuff. Dynamic restraints include the compressive force of the rotator cuff muscles and the “concavity compression” that results from interaction of the muscles with the static restraints.

The pathology of anterior shoulder instability has been extensively studied, and several potential lesions have been identified.

Major Lesions

The most frequent pathologies are detachment of the anterior labrum from the glenoid rim (Perthes or Bankart lesion) and injury to the inferior glenohumeral ligament (IGHL) complex. The IGHL complex consists of an anterior band (the portion most important in providing stability), a posterior band, and a thin capsular pouch between the 2 bands. The ligaments can be plastically deformed at the time of the dislocation or visibly torn midsubstance. The percentage of patients presenting with Bankart lesions varies depending on the population studied. In a study of patients with an acute dislocation using arthroscopic evaluation, Baker et al. found that 13% had capsular tears, 25% had mild Bankart lesions (partial labral detachments), and 62% had both Bankart lesions and capsular tears. Kirkley et al. found that 95% of patients who underwent surgery had a Bankart lesion. In a cohort of patients who underwent surgery for traumatic shoulder instability, Larrain et al. found a capsular tear in only 4%, a capsular tear with a partial labral detachment in 32%, and a capsular tear and labral detachment in 64%. In a cohort of 9 patients from West Point with traumatic anterior instability, Wheeler et al. found that 100% had a Bankart lesion at the time of surgery.

A less frequent pathology is a humeral avulsion of the glenohumeral ligaments (HAGL lesion). HAGL lesions are more difficult to diagnose without arthroscopic evaluation, but their incidence has been suggested to be as high as 10%. Other Lesions

Anterior glenoid rim fractures are known as bony Bankart lesions. Studies have shown that the humeral head can become unstable if 20% or more of the glenoid rim has been fractured or eroded by the instability. Anterior glenoid bone loss has been described as creating an “inverted pear” shape and is cited as a frequent cause of shoulder stabilization procedures when it is not addressed with a bone graft augmentation, particularly in the collision athlete.

When the capsule and labrum do not heal back to the glenoid rim, the capsule may detach from the anterior scapular neck. This detachment is believed to contribute to recurrent instability and is referred to as an anterior labroligamentous periosteal sleeve avulsion (ALPSA lesion). During surgical reconstruction, it is important to detach the capsulolabral complex and to reattach it directly to the glenoid rim to avoid recreating the ALPSA lesion. Another lesion described in the anterior and inferior glenoid is erosion of the anterior-inferior glenoid cartilage, a so-called glenolabral articular disruption (GLAD lesion).

The incidence of rotator cuff tears with anterior shoulder dislocation has been shown to mirror that in the general population. Tears of the supraspinatus tendon are most common, with an incidence as high as 30% in patients older than age 40. However, it is important to evaluate a patient with an anterior shoulder dislocation for a ruptured subscapularis tendon, since this tendon can tear when the arm is abducted, externally rotated, and extended. An important clue is that the initial pain caused by the trauma of dislocation does not subside in 2 to 4 weeks. This history should prompt an urgent assessment of the rotator cuff.

Damage to the humeral head results in cartilage loss or an impaction fracture on the posterior head of the humerus (Hill-Sachs lesion). Most studies of recurrent shoulder instability suggest that the size of the Hill-Sachs lesion does not correlate with recurrence. However, recent studies suggest that patients who fail surgery and who have very large Hill-Sachs lesions should be considered candidates for osteochondral allograft implantation in the humeral head. The exact size of the humeral head defect requiring this type of grafting has not been defined.

Greater tuberosity fractures may require operative intervention if they are displaced more than 5 mm. Humeral head anatomic neck fractures have been described after dislocations, and they should be considered when reducing a dislocation in an elderly patient with osteoporotic bone.

Associated Pathology

Nerve injury with anterior shoulder dislocations is more common than once assumed. A study using electromyography (EMG) found that 33% of patients had some nerve injury after an anterior instability episode. In most cases, the injury was not clinically significant and patients recovered without sequelae. The axillary nerve was the most common peripheral nerve injured, followed by the suprascapular and musculocutaneous nerves. Diffuse brachial plexus injury can occur but is not as common as single nerve injuries. The recommended treatment for nerve palsy after shoulder instability is to observe the injury for at least 4 to 6 weeks before
performing EMG. Surgical intervention for the nerve lesion should not be considered before 3 months.25

Osteoarthritis after shoulder dislocation remains controversial. In 1983, Samilson et al26 suggested that the number of dislocations did not correlate with subsequent development of osteoarthritis. A more recent study of patients who underwent shoulder stabilization found that the risk of osteoarthritis was associated with older age (35 years) and longer time from initial injury to surgery.27 Similarly, a recent multicenter study of patients who underwent surgery for shoulder instability found that osteoarthritis risk was increased by older age at the time of initial dislocation, increased time from initial dislocation to surgery, and the presence of glenoid rim lesions.28

Osteoarthritis has been associated with a loss of external rotation due to over-tightening of the anterior capsule of the shoulder.29,30 Such loss of external rotation has been seen after a Putti-Platt repair, in which the subscapularis tendon is imbricated over the top of a capsular repair, resulting in extreme shortening of the anterior structures of the glenohumeral joint.29 Biomechanical studies suggest that this procedure causes the center of the humeral head to be displaced posteriorly, so that posterior wear and erosions can occur over time.29 However, the theory that loss of external rotation alone can lead to arthritic changes has not been definitively proven. Some have suggested that loss of external rotation was a result and not the cause of the arthritis.26

EVALUATION

Physical Examination

In the patient with proven or suspected anterior shoulder instability, it is important to observe for atrophy anteriorly (deltoid, axillary nerve) and posteriorly (supraspinatus or infraspinatus, due to nerve injury or rotator cuff tear). Range of motion should be assessed, with full range expected in patients with a reduced shoulder dislocation after 3 to 4 weeks; if this is not the case, other injuries should be considered (e.g., redislocation, fracture, nerve or rotator cuff injury). Strength testing of the entire upper extremity is recommended to rule out nerve or rotator cuff injury. Sensory testing should accompany the examination, particularly in the lateral shoulder, where numbness may indicate an injury to the axillary nerve. Vascular testing, including pulses and capillary refill, should be tested in the acute dislocation before and after reduction.

Provocative maneuvers (e.g., the apprehension, relocation, and surprise tests) can provide information about the presence of anterior instability. Several studies have shown that these maneuvers are more accurate if they produce apprehension than when pain alone is used as the criterion for a positive test.30,31 For example, the anterior apprehension test has been found to have a sensitivity of 67% when apprehension is used as the criterion for a positive test for traumatic instability, but when pain is used as the criterion, the sensitivity is only 40%.30 The relocation maneuver also is helpful in confirming an anterior instability episode.31 This test is performed with the patient supine and the arm placed in an apprehension position. When the patient reports apprehension, the examiner stabilizes the humeral head, and the patient’s apprehension should subside. The surprise test begins by performing a relocation test, but after the humeral head is stabilized the arm is externally rotated a bit more. The stabilizing hand is then suddenly removed, “surprising” the patient with a sense of instability.

Imaging

The patient with an anterior shoulder instability episode should undergo radiography after the relocation maneuver is performed, including at least 1 anteroposterior (AP) view but preferably 2 AP views with the shoulder in internal and external rotation. An AP view in internal rotation has been shown to be better than an AP view in external rotation for detecting Hill-Sachs lesions. A scapular Y view has been shown to be as helpful in the emergency department setting as an axillary view for judging whether the humeral head is reduced. However, in the acute and chronic setting, an axillary view of the glenohumeral joint provides more information regarding the glenoid, coracoid, acromion, and proximal humerus than a scapular Y view (Figure 1).32

Other imaging studies can be used in circumstances when more information is needed. For example, a Stryker view can accentuate Hill-Sachs lesions and is considered more accurate for this entity than an axillary view.31 A West Point view can also be used for identifying bony Bankart lesions of the anterior-inferior glenoid.15,16,33 Computed tomography (CT) scanning is recommended for delineating fractures of the glenoid rim, the greater tuberosity, or the proximal humerus.35 CT scanning can also be used to evaluate the size of the glenoid rim defect in patients with bony Bankart lesions (Figure 2).15,16

Magnetic resonance imaging (MRI) can be helpful in evaluating patients with suspected instability or patients with proven instability who have signs of rotator cuff pathology. MRI can also show subtle humeral head edema, which confirms a Hill-Sachs injury to the proximal humerus (Figure 3). Although MRI is recommended for the evaluation of glenoid labral pathology, its accuracy remains in question and can vary significantly.
depending on the type of MRI obtained (closed versus open) and the experience of the radiologist and orthopaedic surgeon reading the films. Magnetic resonance arthrography has been shown to increase the accuracy for labral pathology in some series.36

TREATMENT

Nonoperative Treatment

After reduction, initial treatment of a traumatic dislocation is symptomatic and consists of a sling, pain medication, and range of motion exercises of the fingers, wrist, and elbow. Shoulder motion is begun as soon as the patient is comfortable, usually within a few days. The patient should be cautioned to avoid the extremes of abduction and external rotation. Once the patient is pain-free and motion is nearly normal, strengthening can begin.

The duration of immobilization is not a factor in recurrence.4,6,37 No difference in recurrence rates has been noted whether patients are treated with the regimen outlined above or with 6 weeks of immobilization. Recently, a protocol of immobilizing the arm in external rotation for 4 to 6 weeks has been suggested to decrease the recurrence of instability in patients with Bankart lesions.38,39 Ongoing international multicenter studies of this treatment approach may help define its future role.

One area of controversy is when to allow an athlete to return to sport after a traumatic dislocation.40 Typically, return to play should be delayed until range of motion and strength are attained. Athletes in contact sports can use a brace to prevent abduction and external rotation, so they may return to sports at least temporarily. Buss et al9 treated 30 adolescent athletes who had a traumatic anterior subluxation or dislocation with a rehabilitation program (100%) and a restrictive motion brace (70%); 90% of the athletes were able to compete in a portion or all of their sport season, but 53% went on to require surgical stabilization.

Surgical Treatment

Absolute indications for surgery for traumatic anterior shoulder instability include open injuries and dislocations.
that cannot be reduced closed. Other indications would be to repair associated fractures (eg, a displaced greater tuberosity fracture or a glenoid fracture over 20% of the glenoid surface) or a rotator cuff tear. The most common indication for surgery is recurrent episodes of instability (subluxations or dislocations) that are painful or limit activities of daily living or sports activity.

**Open versus arthroscopic technique.** Surgery for traumatic anterior instability involves several decisions, the first of which is whether to perform an all-arthroscopic or a traditional open technique. Surgical technique varies considerably among expert surgeons recommending an open or arthroscopic procedure or a combination of both procedures. Some physicians perform diagnostic arthroscopy first to address any superior labrum anterior-posterior (SLAP) lesions and then proceed to open surgery to address rotator cuff injuries, Bankart lesions, and capsular lesions. Open surgery has been considered by many to be the gold standard to which all arthroscopic procedures should be compared. However, there is increasing evidence that arthroscopic procedures performed by experienced surgeons can have a success rate similar to open procedures.

The ability to address capsular laxity is one area of controversy regarding surgery in the patient with a first-time dislocation. In the past, it has been suggested that all-arthroscopic procedures have less success in patients with a history of 2 or 3 dislocations, since multiple episodes of instability create greater capsular elongation. Several studies have demonstrated that arthroscopic surgery results in a significant reduction in recurrent instability following anterior shoulder dislocation compared with no surgery. A recent study compared open to arthroscopic stabilization in patients with traumatic shoulder instability who had isolated Bankart lesions and found that the results of surgery for the 2 groups were the same, with no recurrences in either group with minimum 2-year follow-up. However, the study excluded patients with ALPSA lesions, glenoid rim lesions, elongation or absence of the IGHL, rotator cuff interval lesions, or SLAP lesions.

**Further technical considerations.** Several important technical details can improve success when performing surgery for anterior shoulder instability. The first is to ensure that the detached labrum is sutured directly to the edge of the articular cartilage where it meets the glenoid rim. This recreates the normal anatomy and the compression-concavity mechanism that is helpful in shoulder stability. Any capsular stripping along the neck of the glenoid should be corrected in a similar manner to avoid a pouch where the humeral head can subluxate. Lastly, any large bony defect of the glenoid should be treated by a bone graft procedure (iliac crest or coracoid process).

Laxity of the anterior capsule can be addressed several ways. When using open techniques, the capsule can be advanced on the medial or glenoid side, or it can be performed on the humeral side. Closure of the rotator cuff interval can provide some capsular shifting superiorly in patients with increased inferior laxity of the superior glenohumeral or coracohumeral ligaments. This closure is indicated in patients who have an increased sulcus sign with the arm in external rotation compared with a sulcus sign in neutral rotation. Arthroscopic techniques for capsular tightening include advancing the capsule on the glenoid side with the labrum complex, capsular imbrication stitches, and rotator cuff interval closure. Thermal capsular shrinkage (capsulorrhaphy) has been described in patients who have had an arthroscopic Bankart repair, but this modality has not been proven to provide increased stability over other available techniques.

**Complications.** Complications after shoulder stabilization procedures include nerve or vessel injury, stiffness, reflex sympathetic dystrophy, and recurrent instability. Nerve injuries may occur in up to 8% of instability operations. The axillary nerve is the most commonly injured peripheral nerve. The axillary nerve runs next to the capsule of the inferior glenoid, at an average distance of 3.2 mm (range, 1–8 mm). Although some surgeons have recommended exposing the axillary nerve in open stabilization procedures, this is probably unnecessary if precautions are taken to protect the nerves in this area. The axillary nerve can be protected by placing the arm in some abduction and external rotation.

The next most common nerve injury after shoulder stabilization procedures is diffuse injury to the brachial plexus. These injuries can be minimized by properly positioning the patient’s head and neck and being aware of the proximity of the brachial plexus and brachial blood vessels to the anterior glenoid rim. If the subscapularis tendon and muscle are present, the brachial plexus has been found to be on average 2 cm from the glenoid rim. If the subscapularis is absent, portions of the brachial plexus can be scarred to the anterior capsule and may be very near the surgical dissection.

In most instances, a nerve injury occurring after surgery for anterior shoulder instability is a neuropraxia, and surgical exploration is not necessary. It is important to document the neurologic status preoperatively. Range of motion of the affected joints and pain management are recommended to prevent contracture until the nerves recover. An EMG can be performed 4 to 6 weeks later if necessary. If the nerve shows no sign
of recovery within 3 to 6 months, surgical exploration should be considered.25

INSTABILITY IN THE OVERHEAD THROWING ATHLETE

PATHOMECHANICS: HISTORICAL OVERVIEW

Rowe and Zarins44 were the first to describe anterior shoulder instability due to occult microtrauma. They described a group of athletes involved in overhead sports who complained of fatigue, pain, and a “dead arm” rather than symptoms of overt instability. In the late 1980s, Jobe et al54 further developed this concept to suggest that stretching of the anterior band of the IGHL resulted in laxity of the arm, and this “instability” created impingement of the rotator cuff upon the acromion. They hypothesized that this occult instability resulted in pain into the deltoid and prevented the athlete from full sports participation.

In the early 1990s, Walch et al55 described a phenomenon in the shoulder seen at the time of arthroscopy, suggesting another cause of pain in some overhead throwing athletes. When viewing the shoulder joint from a posterior arthroscopy portal, it was noted that if the arm was placed in abduction and external rotation similar to a cocking position of throwing or the overhead swing of a tennis racquet, there was internal impingement of the greater tuberosity of the humerus and of the rotator cuff upon the posterior, superior glenoid. The authors suggested that this phenomenon might explain the posterior and superior shoulder pain some athletes developed with overhead sports.

In 1985, Andrews et al56 noted superior labral abnormalities, which were later classified by Snyder et al57 into 4 types of SLAP lesions. Subsequent studies indicated that SLAP lesions, partial articular-sided rotator cuff tears, posterior capsular contracture, and in some cases, increased anterior laxity may play a role in the symptomatic shoulder of the overhead throwing athlete.58

More recently, it has been suggested that the throwing motion leads to superior labrum damage due to a windshield wiper effect of the biceps as it is alternately pushed and pulled by the throwing motion.58,59 SLAP lesions resulting from this proposed mechanism are primarily type II lesions, which can be further divided into 3 subtypes: an anterior, a posterior, and a combined type (Figure 4). Each of these subtypes has different etiologies and physical examination findings. Once the superior labrum becomes detached, a superior shoulder laxity pattern results, which appears similar to anterior instability.

A final observation in overhead throwing athletes is that the dominant, throwing arm often demonstrates increased external rotation with a corresponding loss of internal rotation compared with the non-throwing arm.58,59 This phenomenon has been called

Figure 4. Three subtypes of type II superior labrum anterior-posterior (SLAP) lesions shown by anatomic location: (A) anterior, (B) posterior, and (C) combined anterior-posterior. (Adapted from Burkhart SS, Morgan CD, Kibler WB. Shoulder injuries in overhead athletes. The “dead arm” revisited. Clin Sports Med 2000;19:125–58, with permission from Elsevier.)
Anterior Instability of the Shoulder

Table. Diagnostic Value of 3 Tests for Diagnosing SLAP Lesions

<table>
<thead>
<tr>
<th>Diagnostic Test</th>
<th>Control Group % (n)</th>
<th>SLAP Lesion Group % (n)</th>
<th>Sensitivity % (n)</th>
<th>Specificity % (n)</th>
<th>PPV % (n)</th>
<th>NPV % (n)</th>
<th>DA % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression rotation test</td>
<td>25(67/274)</td>
<td>24(7/29)</td>
<td>24(7/29)</td>
<td>76(207/274)</td>
<td>9(7/74)</td>
<td>90(207/229)</td>
<td>71(214/303)</td>
</tr>
<tr>
<td>Anterior slide test</td>
<td>16(62/381)</td>
<td>8(3/38)</td>
<td>8(3/38)</td>
<td>84(319/381)</td>
<td>5(3/65)</td>
<td>90(319/354)</td>
<td>77(322/419)</td>
</tr>
<tr>
<td>Active compression test</td>
<td>45(168/371)</td>
<td>47(18/38)</td>
<td>47(18/38)</td>
<td>55(203/371)</td>
<td>10(18/186)</td>
<td>91(203/223)</td>
<td>54(221/409)</td>
</tr>
</tbody>
</table>


*There were no significant differences between groups in terms of the percentage of patients with positive tests.

glenohumeral internal rotation deficit (GIRD). It has been suggested that GIRD is due to repetitive trauma from the deceleration phase of pitching, which results in scarring and tightening of the posterior capsule. Some have suggested that if this deficit in internal rotation exceeds 20° to 25°, the shoulder is at risk for further injury, specifically the development of a SLAP lesion with continued throwing. While some have suggested that GIRD is primarily due to soft tissue contracture, several studies demonstrate that some of the GIRD may be due to bony adaptations to throwing.

EVALUATION

The evaluation of the overhead athlete with shoulder pain should begin with a complete history of the onset of pain. A detailed history and examination should be done to rule out vascular compromise and thoracic outlet syndrome.

History

The timing of pain in relationship to the pitching motion (ie, early cocking versus follow-through) has been suggested to be helpful in determining pathology in the shoulder, but no study has substantiated that pain in one part of the cycle means a certain pathology will be found. The athlete should be questioned about dead arm symptoms of heaviness, fatigue, or paresthesia. Patients may occasionally say the arm feels loose, but they rarely say they feel it subluxate.

Physical Examination

Strength tests of the rotator cuff muscles should be performed to determine whether they elicit pain or weakness. Palpation of the greater tuberosity anteriorly for rotator cuff tenderness can be helpful, and palpation of the posterior and posterior-superior joint line may indicate a lesion of the superior labrum. However, all of these findings are nonspecific and should be incorporated into the entire clinical picture. Infraspinatus atrophy can be due to a traction injury or a spinoglenoid cyst compressing the infraspinatus branch of the suprascapular nerve.

Provocative maneuvers for SLAP lesions can be helpful, but the sensitivity, specificity, and clinical utility of these tests vary depending on the population studied. The active compression test described by O’Brien et al can be helpful for SLAP lesions in a target population (Table). Observing the shoulder motion with elevation has been suggested as a valuable method for detecting subtle abnormal scapular motions (so-called scapular dyskinesia), but no particular pathology in the painful throwing shoulder can be related to these patterns.

Imaging

Imaging should begin with plain radiographs. An axillary view can help to visualize an osteophyte off of the posterior glenoid (so-called Bennett lesion). The clinical importance of this lesion is controversial, since it may be an incidental finding. Some authors have suggested that it can be removed with good results, but its exact role in the painful shoulder is unknown. MRI may help to reveal labral pathology, particularly SLAP lesions. In patients with suspected SLAP lesions, intra-articular injection of contrast (eg, gadolinium, saline) prior to the MRI may increase the accuracy of the MRI for these lesions.

TREATMENT

Treatment of the painful shoulder in the overhead throwing athlete continues to evolve as our understanding of the pathomechanics improves.
Anterior Instability of the Shoulder

Nonoperative Treatment

The initial treatment for overhead throwing athletes with shoulder pain is rest, cryotherapy, pain medication, and physical therapy, including stretching of the posterior capsule when indicated. It is important to strengthen the rotator cuff and to correct scapular malpositioning with motion. Because the legs and trunk contribute to the generation of force in the upper extremity with the throwing motion, strengthening of the lower extremities and lower back also is indicated. The coaching staff should be consulted about mechanical changes that may help decrease stress on the patient’s shoulder. A gradual return to throwing should be closely monitored by the trainers and coaching staff to prevent recurrence of the pain.

Surgical Treatment

The main indication for surgery is failure of nonoperative treatment. Findings on physical examination and imaging studies should be used as adjuncts that may support earlier versus later surgical intervention. Other factors influencing the decision to perform surgery include the degree of symptoms, level of sport participation, timing during the sport season, and anticipated future sport participation.

The surgical intervention begins with an examination of both shoulders under anesthesia followed by diagnostic arthroscopy of the affected shoulder. Most patients under anesthesia can be translated over the rim anteriorly and posteriorly, so laxity testing alone should not be used to make the diagnosis of instability. In the symptomatic shoulder of an overhead throwing athlete, it is not unusual to find a SLAP lesion, a positive “drive-through sign,” and at times a partial articular-sided tear of the rotator cuff. A positive drive-through sign refers to the ability to pass the arthroscope easily between the humeral head and the anterior-inferior glenoid rim, but studies indicate that a drive-through sign correlates with laxity of the shoulder joint and not with instability.

Rotator cuff tears. Surgical options for rotator cuff tears in this group depend on depth of the tear, but little data support one form of treatment over another. Partial tears are commonly classified as grade I (< 3 mm), grade II (3–6 mm), or grade III (> 6 mm). Current opinion is that grade I and grade II tears can be debrided but that grade III tears should be repaired or converted to full thickness and then repaired. However, in a series of patients with surgically repaired SLAP lesions, Burkhart et al reported that patients with rotator cuff pathology had only good or fair results, whereas all patients with repair of an isolated SLAP lesion without cuff pathology had excellent results. The best method for addressing rotator cuff pathology in the overhead throwing athlete remains elusive, but partial articular-sided rotator cuff tears are likely best treated with debridement alone to maximize the possibility of return to overhead sport.

Capsular instability. If the patient is felt to be unstable, the laxity may be treated using arthroscopic or open techniques. The traditional operation for occult anterior instability in the overhead throwing athlete has been an open anterior capsular shift as described by Jobe et al. This procedure has been reported to return 70% of high-level throwers to their previous level of throwing. Rotator cuff interval closure via an open approach has been described by Field et al and more recently by Nobuhara et al. Postoperatively, a rigorous rehabilitation program is necessary to prevent loss of external rotation and to allow a gradual return to sports.

Arthroscopic options for stabilizing the anterior capsule in the athlete with presumed instability include capsular placation, rotator cuff interval closure, and thermal capsulorrhaphy. A variety of methods are available for imbricating the anterior and inferior capsule alone or stabilizing the capsule to the labrum or glenoid rim. Currently, no studies have evaluated the clinical results of these imbrication techniques as they relate to the throwing athlete. However, evidence from their use on patients with traumatic, anterior instability suggests that these techniques may be an effective alternative to open techniques in this patient population.

Thermal capsulorrhaphy has been used to tighten the anterior capsule of symptomatic overhead throwing athletes. Levitz et al, who recognized the SLAP lesion as part of the pathology, reported on 2 cohorts of patients who underwent SLAP repair with or without thermal shrinkage of the capsule. At 30-month follow-up, 93% of patients with thermal capsulorrhaphy versus 80% of patients without it were back to throwing at their previous level, suggesting that pathologic anterior capsular laxity does contribute to the problem. The value of adjunctive thermal capsulorrhaphy in other overhead athletes (eg, tennis players, swimmers) is unknown.

D’Alessandro et al studied patients with a variety of instability patterns and found that the failure rate depended on the type of shoulder instability. When thermal capsulorrhaphy was used in combination with arthroscopic stabilization of a Bankart lesion in patients with traumatic anterior instability, the failure rate at 2 years was 32%. However, in patients with multidirectional instability, which included many overhead athletes, the failure rate was 45%.

Other complications reported with the use of thermal energy for capsular tightening include complete
Ablation or thermal necrosis of the capsule so that the capsule is essentially destroyed. The axillary nerve is at risk for thermal injury due to its close proximity to the capsule at the inferior aspect of the glenohumeral joint. A recent study indicates that heating of the axillary nerve may occur during thermal capsulorrhaphy and temperatures can reach a level sufficient to cause neural tissue damage. Thermal energy has also been shown to be deleterious to chondrocytes at both the superficial and deep layers of the cartilage. Recently, cases of chondrolysis have been reported after thermal shifts, with the development of significant arthritic changes in the shoulder. Lastly, if the patient is immobilized too long after a thermal procedure, the shoulder may become too stiff and require further surgery to release adhesions.

The exact role of thermal capsular shrinkage continues to evolve and greater clarification is needed regarding which types of instability can be safely and successfully treated with this technique. Without question, the use of thermal capsulorrhaphy has decreased significantly over the past 5 years, with many surgeons favoring the reliability of suture techniques and the reduced risk of complications.

**CONCLUSION**

Management of the patient with anterior shoulder instability can be very rewarding for the practitioner, as patients generally do well with appropriate treatment. However, the evaluation and treatment should take into consideration the wide variety of pathologies that may exist in this patient population. An accurate diagnosis usually can be made with a history, physical examination, and radiologic imaging. Rehabilitation is most effective in occult or atraumatic varieties of anterior instability. Surgical interventions that adequately address the pathologies present can result in successful stabilization of the shoulder in most cases.

**REFERENCES**


Anterior Instability of the Shoulder