**Orthopedic Assessment, Diagnosis and Treatment of Common Glenohumeral Pathologies**

**Introduction**

The shoulder is a complex joint with many different articulations and many different possibilities for tissue failure. For the average person, the shoulder complex is a highly functional set of joints designed to maximize an individual’s ability to complete daily tasks. This paper will focus on the glenohumeral joint, its structure and function, and common pathologies associated with it. It will also explore the evidence-based treatments, both conservative and surgical, that are recommended for each pathology.

**Glenohumeral Joint: Structure and Function**

The glenohumeral joint is a ball-and-socket joint designed to move with three degrees of freedom. It is formed where the convex humeral head meets the concave glenoid fossa of the scapula.1 Due to its structure, it favors mobility over stability. It gains the majority of its stability from musculature, ligamentous structures and the glenoid labrum.1 At its most basic structure; the glenohumeral joint is protected by the glenoid labrum. The glenoid functions to deepen the socket, providing more coverage of the spherical structure of the humeral head. It resists anterior-posterior movement and superior-inferior movement in both directions, and prevents subluxation or dislocation of the humeral head in any direction. The rotator cuff muscles attach from the scapula to the humeral head providing further stability. The biceps muscle tendon splits into a long head and a short head with the short head attaching to the coracoid, and the long head attaching to the glenoid.1,16 These muscles control the movement of the glenohumeral joint and provide stability to the joint when proper mechanics are observed. There are also a number of ligaments that protect the integrity of the glenohumeral joint. The superior, middle and inferior glenohumeral ligaments are the large ligamentous support in place to prevent excessive motion. The superior ligament resists inferior translation, external rotation and anterior translation. The middle ligament limits external rotation in abduction. The inferior ligament has a pouch or sling, which supports the humeral head in extreme abduction and limits inferior translation. The anterior band of the inferior ligament limits external rotation; while the posterior band limits internal rotation of the glenohumeral complex.1 These structures work cohesively to stabilize an exceptionally unstable joint.

The humeral head consists of articular cartilage that protects the subchondral bone. Since the shoulder is not generally a weight bearing structure, it is well protected from articular cartilage damage, and the articular cartilage effectively protects the surfaces of bone at the joint.1

The glenohumeral joint provides a highly functional joint for control of the upper extremity. It moves on three axes and with three degrees of freedom. It allows flexion, extension, internal rotation, external rotation, abduction and adduction movements, and often combines these motions into more functional positions. The resting position for the glenohumeral joint is in 40 to 55 degrees of abduction and 30 degrees of horizontal adduction. The close packed position, where joint surfaces are most congruent, is in full abduction and external rotation. The capsular pattern of restriction of the glenohumeral joint is external rotation, abduction, and internal rotation.1 There are a number of ways in which this joint can be injured. Biomechanically, it is highly susceptible to injury due to its large range of motion.1,16

**Conservative versus Surgical Treatments in the Shoulder**

In general, there are many different factors to consider when weighing the options between conservative treatment and surgical treatment for glenohumeral pathology. First, age is an important aspect to remember when considering the most appropriate treatment.8 Older individuals are at a higher risk for surgical complications than younger individuals. Also, age can determine level of function required to complete daily tasks. A younger individual may have more physically demanding tasks that require a higher level of function to be attained, while an older adult may be able to function sufficiently without surgical intervention and make modifications to current activity.8

 Surgical intervention has its inherent benefits, by structurally fixing the injury and restoring continuity of the tissues. However, side effects of surgery can be just as detrimental and can cause further damage of tissues. Surgery in any context can lead to excessive scar tissue formation, stiffness, risks of anesthesia, and nerve damage. Also, there is a possibility that extenuating factors could prevent the success of the surgical intervention such as normal biomechanics for the individual, level of activity, non-compliance, etc.8

 Conservative treatment can avoid the risks associated with surgery, but will often not result in a full functional return. It requires stringent activity modification as well as reduction in intensity, duration and frequency of said activities.8 Conservative treatment is often not appropriate for patients who require full or near-full function of the glenohumeral joint, and could also lead to a more severe tear or injury if unsuccessful.5

 For both surgical and conservative interventions, compliance is extremely important to maximize the benefit of treatment. Any one treatment will not be successful if the patient does not adhere to the treatment protocol.

**Impingement Syndrome**

*Pathology and Diagnosis*

Impingement syndrome is the result of repetitive motions, overhead work, chronic vibration in manual labor, and high work demands.15,16 In younger individuals impingement can occur with overhead sports such as tennis or baseball. In older individuals there is likely degeneration occurring under coracromial arch. The limited blood supply to the area can lead to cell death and a following inflammatory response, causing pain at the site. In junction with the inflammatory response, scar tissue may be laid down to “repair” the damaged area, causing a increasing volume of tissue with a constant available space.16 Impingement syndrome occurs when structures are compressed between the humeral head, coracoid process and acromion in the subacromial space.1 It can also occur when excessive translation of the humerus occurs secondary to weak rotator cuff muscles, compressing the structures under the coracoacromial arch.21 When the subacromial space or coracoacromial arch is narrowed it ceases to allow sufficient room for the rotator cuff tendons, bursa, and other tissues to coexist. It can be the result of outlet impingement, subacromial spurs, type 2 and 3 acromions, thickened coracromial ligaments, instability in the shoulder complex, adhesive capsulitis, and thickened or inflamed subacromial bursa.13 All of these pathologies serve to decrease the space in which the rotator cuff tendons reside. Individuals with types 2 and 3 acromion have a more curved or “beaked” bony prominence that can restrict available space (**See Figure 3**).13 Persons with impingement syndrome will likely present with a “painful arc” with pain between 60 and 120 degrees of active shoulder abduction as the compression of tissues is greatest in this range.1 The person will typically not experience pain at ranges outside this arc. The continuous compression of subacromial tissues can lead to microtrauma, ischemic injury and cell death, progressing the degradation that occurs in the rotator cuff tendons.15 If continued for a long period of time, they can eventually lead to a rotator cuff tear, as will be discussed below.

Impingement can be assessed with a combination of clinical tests. The most common ones are the Neer Impingement Test, Hawkins-Kennedy Test, and external rotation resistance test. All of these tests serve to put the shoulder in the extremes of internal or external rotation and abduction.1 According to a study conducted by Michener et al, painful arc, external rotation resistance and Neer Impingement test are all helpful in ruling out subacromial impingement, while painful arc, external rotation resistance and empty can test are helpful for ruling in subacromial impingement.18 However, most of these tests are unable to differentiate between the exact pathology causing shoulder impingement and X-ray or MRI may be necessary to pinpoint this.15 Subsequently, shoulder x-rays may exhibit a particular shape of the acromion, or bone spurs that have formed to cause or exacerbate the impingement.1

*Conservative Treatment*

Depending on the type and severity of impingement that is occurring, a conservative approach may be entirely appropriate for a patient presenting with impingement syndrome.15 According to a review conducted by Gebremariam et al, the presence of severe symptoms and symptoms persisting longer than one year are negative prognostic factors when coupled with conservative management.15

 Physical therapy treatment should begin with reducing inflammation and encouraging blood flow to the area for proper healing.16 This can be achieved by using modalities such as ultrasound or ice. Friction massage can help mobilize any scar tissue that may have formed to reduce adhesions, increase mobility of the shoulder and increase blood flow to the area.16 The therapist should encourage activity modification if possible, to avoid overhead activity, repetitive motions, and vibration. Once pain and inflammation have reduced a strengthening program can be started by with postural exercises to encourage a more regular glenohumeral rhythm.16 One study by Camargo et al19 had patients with subacromial impingement syndrome perform isokinetic eccentric shoulder abduction exercises (from 0 degrees to 60 degrees) with successful decreases in pain, improved scores in the Disabilities of the Shoulder and Hand (DASH) questionnaire, peak torque, total work and acceleration time. With this knowledge, it is clear that return of functional activity is possible with the adoption of activity modification and patient education.

*Surgical Treatment*

One of the most common forms of surgical intervention is subacromial decompression.14 This surgical procedure can be conducted either arthroscopically or openly. There are no clinical differences between the outcomes of both surgeries, though there is a slight advantage of arthroscopic being a less invasive procedure.15 The surgery serves to debride any scar tissue that has formed within the area, release the coracromial ligament and remove any bone spurs that are occupying space.17 Yel et al20 determined from a long-term follow-up of 51 shoulders, that the majority of individuals with subacromial decompression surgery rated the results as excellent (39%) or satisfactory (51%), with a select few being unsatisfied (10%) with their results. After surgery the patient is given a sling for short-term use, though it should be discarded quickly there after so range of motion is not lost.17 Physical therapy is typically used after surgical intervention to regain range of motion, strength and control.15,17

**Rotator Cuff Tears:**

*Pathology and Diagnosis*

The rotator cuff muscles are made up of four muscles that attach to the humerus and provide both mobility and stability for the glenohumeral joint.5 They consist of the supraspinatus, infraspinatus, and teres minor which attach to the greater tubercle of the humerus, and the subscapularis which inserts at the lesser tubercle of the humerus.1 These four muscles influence the movement of the humerus on the glenoid based on the orientation of their collagen fibers. **Figure 1**4 demonstrates the structure of these muscles in relation to the scapula and humerus.

Due to the structural relationship of the rotator cuff muscles and tendons to the humerus, rotator cuff tears occur frequently, especially in older adults. A tear most commonly occurs two ways, one from trauma, usually seen in the younger, more active population, and one from aging and degeneration of muscular and tendinous tissue.5 The older an individual, the greater the risk is for muscle tears with risk increasing around age 40.5 The overall weakening of the rotator cuff muscles and decrease in cross sectional area of the muscular complex leads to a decreased protection throughout the aging process.8 There are three typical causes behind rotator cuff tears in the older adult: repetitive stress, decrease in vascularization, and formation of bone spurs.5 These three factors are normal in the aging population and can strongly influence the integrity of muscle tendon units. In particular, the supraspinatus tendon has areas of hypovascularity, making it more susceptible to chronic degradation with aging and poor healing abilities.12

It is most frequently diagnosed by magnetic resonance imaging, but can also be observed through arthroscopy or injections.2 There are two different types of tears, partial thickness and full-thickness. A partial thickness tear still has some intact fibers, while a full-thickness tear is fully ruptured.5 **Figure 26** demonstrates the comparison between a normal supraspinatus tendon, and a torn one via magnetic resonance imaging. When this disruption of muscle-tendon continuity occurs, pain, weakness and instability can follow. Pain from a chronic tear usually presents when the individual is raising his or her arm overhead.5 The empty can test with the shoulder in 90 degrees abduction and full internal rotation (thumb down), can be utilized when a supraspinatus tear is suspected.1,16

*Conservative Treatment*

Conservative treatment consists of a combination of rest, over-the-counter medication, steroid injection, physical therapy, and activity modification. If activity modification truly occurs, pain can be readily managed with conservative treatment. In a longitudinal study by Kijima et al, 43 patients with conservative treatment of rotator cuff tear were contacted via telephone survey to determine level of pain 13 years after diagnosis. 88% of subjects reported no or slight pain in the affected shoulder.7

 Physical therapy treatments for rotator cuff tear begin by addressing pain and restoring a more functional motion through passive range of motion and active assistive range of motion exercises. The clinician also focuses on educating the patient on activity modification and the importance of body movement patterns on the rotator cuff complex.8 Pain can be addressed with a number of modalities including ice, ultrasound, massage, manual therapy, and heat.8 After a more functional range of motion is gained, therapy goals shift towards postural exercises and light shoulder strengthening exercises.8 Strengthening of the anterior deltoid also assists in stabilizing the humerus within the glenoid, since excessive motion within the glenoid is discouraged to protect the damaged tissue.8 After a continued passive range of motion and progressive resistive exercise program has been implemented, re-integration of activities can be gradually introduced as tolerated so the patient can do so under the supervision of a knowledgeable professional.8

 Another conservative approach is the use of corticosteroid injections. It is a risky one as it has been known to weaken collagenous material, and creates a false sense of structural improvement from decreased pain.8 It is generally recommended that no more than three injections be administered throughout a patient’s lifetime, as tissue atrophy and increased risk for tear are side effects.8

*Surgical Treatment*

Rotator cuff repair is often conducted with younger individuals who sustain an injury as a result of trauma. It can also be carried out for older individuals with more chronic rotator cuff issues.1 There are a number of different ways that surgical intervention can be carried out, but this review will outline the most prominent ones.

Open rotator cuff repair is one reliable surgery that is often used for large rotator cuff tears.11 A large incision is made and the deltoid attachment is removed to gain access to the underlying rotator cuff structures so they can be repaired.11 This is a highly invasive surgery that can lead to secondary complications, but has a high success rate in repairing traumatic rotator cuff tears.11

Arthroscopic surgical repair is one surgery that often has successful outcomes. It involves the use of a small camera that displays a large picture on a screen and repairs are carried out with small instruments magnified on the screen.11 There has been a recent shift from open rotator cuff repair to arthroscopic repair. Comparatively, arthroscopic and open repair have similar outcomes, but less invasive procedures may lead to a more functional return of range of motion, less scar tissue formation, and better quality of life.9 Arthroscopic repairs are conducted with suture anchors with number depending on the extent of the tear.10

Surgical interventions are commonly followed-up with physical therapy evaluations and treatments, to maximize range of motion, improve glenohumeral kinematics, strengthen postural muscles and educate patients on proper kinematics.

**SLAP Lesion**

*Pathology and Diagnosis*

 A superior labrum anterior and posterior (SLAP) lesion is the disruption of the labral tissue of the glenohumeral joint.1 The superior portion of the labrum is typically more loose and mobile than the inferior part which hugs the humerus more tightly, making it more susceptible for injury, especially in overhead athletes.23 It can lead to joint instability, pain, and limitations in range of motion. The injury typically occurs when a person falls on an outstretched hand (FOOSH) or during sudden traction from the biceps muscle.1 They can occur both suddenly or over time.22 New research has demonstrated that in overhead athletes SLAP lesions occur during the late cocking phase of throwing, rather than the previously thought deceleration phase.22

SLAP lesions fall into four categories. In type I injuries, the superior labrum is intact but frayed. In the most common type II injuries the superior labrum has a small tear and instability between the labrum and biceps is present. In a type III injury a bucket handle tear occurs with the biceps tendon still attached, but displacement into the joint space. Finally, a type IV injury involves a bucket-handle tear, which involves the biceps tendon as well causing it to sublux into the joint space.1 (See **Figure 4**)24

There are some clinical tests designed to diagnose SLAP lesions, though they are generally not reliable or consistent with arthroscopy findings. The most direct and accurate way to diagnose a SLAP lesion is through arthroscopic findings and direct visualization.22 In diagnosing this injury, history of the patient is important as there is almost always a mechanism of injury whether an acute FOOSH or chronic overhead throwing mechanism.23

*Conservative Treatment*

 Conservative treatment should be the initial approach for treating a SLAP lesion. It is attained through rest, ice, NSAIDS, and stretching.22 Physical therapy will focus on strengthening of rotator cuff and other scapular stabilizers, and maintaining capsular range of motion, especially in the posterior capsular region.23 According to Dr. Annie Hayashi22, if conservative treatment longer than three months does not remove or improve symptoms, surgery should be considered.

*Surgical Treatment*

The preferred method for surgical intervention is an arthroscopic one, since open surgery presents a difficult visualization and approach.23 For types I, III, and IV debridement of frayed tissue is completed and for types II and IV the biceps anchor is restored to protect its integrity and prevent further injury.23

A successful surgical intervention consists of proper anchoring of peel back with sutures and return to prior activity.22 There is a wide variation in post-surgical rehabilitation protocol depending on the type and severity of the SLAP lesion.23

**Conclusion**

From these findings, it is clear that glenohumeral pathology often involves the structures that help stabilize the joint, and can lead to further injury if left untreated. These injuries have varying outcomes with either conservative or surgical interventions. When treating a patient with a shoulder pathology, it is important to consider all factors that may play into a positive prognosis, and consider the patient’s goals as well.



**Figure 14**

Anatomy of rotator cuff complex



**Figure 26**

Visualization of rotator cuff tear on an MRI.



**Figure 313**

Types of Acromion shape. This can determine how susceptible an individual is to impingement syndrome.



**Figure 424**

Classification and treatments of SLAP lesions (courtesy of Beantownphysio.com)

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