The Diagnosis and Management of Superior Labral (SLAP) Tears of the Shoulder: A Review Article

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Abstract

The labrum helps deepen the glenoid and serves as an attachment of the long head of biceps. Superior Labrum antero posterior (SLAP) tears are common in the overhead throwing athlete and is a common cause of shoulder pain in the younger population. Often its due to repetitive throwing action or may present after a single acute injury. The diagnosis can be challenging and hence a careful history and examination followed by investigation is key to clinch the diagnosis. The normal variants of the capsulo – labral complex can make the diagnosis difficult. A thorough understanding of the condition is hence essential. This article reviews the relevant anatomy, clinical diagnosis, investigations and management of the condition.

Keywords: Superior Labrum Antero Posterior, SLAP, Arthroscopy, Stabilization, Tenodesis

Introduction

Andrews et al first described superior labral anterior-posterior lesions (SLAP) of the shoulder in 1985 amongst overhead-throwing athletes [1]. Recent published studies have reported an incidence between 6% and 20% and are not exclusive to these athletes [2]. Pathogenesis can be related to trauma or part of a degenerative process. For the treating Orthopaedic surgeon, SLAP pathologies can be a challenging problem to manage due to ambiguity in clinical diagnosis, variation in normal labral anatomy and controversies in treatment.

Role and function

The labrum helps deepen the anatomically shallow glenoid, which in turn helps confer additional passive stability to the glenohumeral joint [3]. The superior aspect of the labrum also serves as points of attachment of the tendon for the long head of biceps, the superior and middle glenohumeral ligament (MGHL) and the posterior-superior aspect of the capsule, they have an important role in stabilizing the shoulder especially in the first half of shoulder elevation [4, 5].

Anatomy

Histologically, the superior labrum is a triangular structure and is composed of fibrous and fibrocartilaginous tissue [3, 6]. Vascular supply to this region of the labrum is from joint capsule via the branches of the suprascapular artery, the circumflex scapular branch of the subscapular artery and the posterior humeral circumflex artery [6]. Literature describes significant variability in the anatomy of the superior aspect of the glenoid labrum and the attachment of the long head of biceps, which can cloud the management of a SLAP pathology [3]. Williams et al retrospectively reviewed 200 consecutive shoulder arthroscopies to find a 12% incidence of a sublabral foramen [7]. When this variation was present, 75% of the patients had a 'cord-like' appearance of the MGHL that attaches directly to the labrum. The group also noted a rare variation, known as the Buford complex, which occurred in 1.5% of the arthroscopies they reviewed. This is described as a cord like MGHL with an anterior superior glenoid that is devoid of a labrum. Subsequent published studies have further confirmed the incidence rates of these normal anatomical variations [8, 9].

In addition, the labrum can appear meniscoid as it drapes over the superior glenoid articular cartilage, which may give an appearance of labral detachment [10]. The surgeon must be aware of these, as reattachment or repair of these normal variations can lead to a significant loss of range of motion of the shoulder [11].

Pathogenesis

SLAP lesions were first noted as a repetitive injury in overhead-throwing athletes [1]. Increased external rotation of the shoulder at the cocking phase of a throw displaces the labrum and biceps tendon medially and is thought to increase torsional force at the biceps

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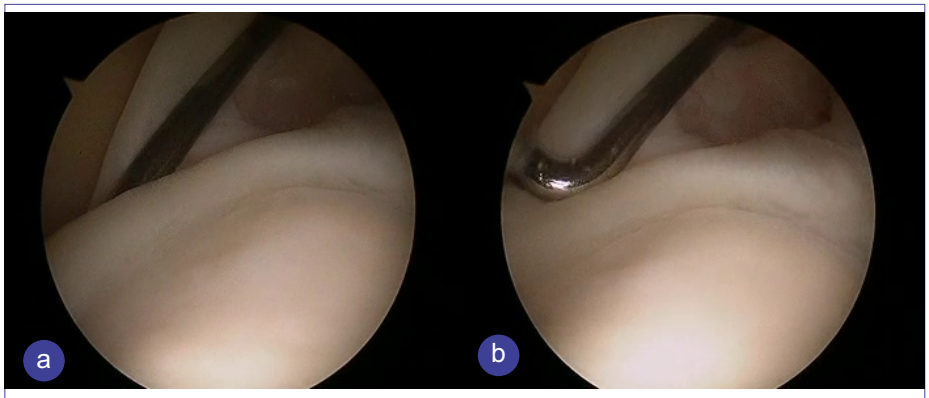

Figure 1 a-b : Arthroscopic images of normal superior anterior labrum

anchor. This results in a phenomenon known as 'peel-back' injury to the labrum [12]. These athletes also increase the forces at the superior labrum by adopting a reduced internal rotation motion while in the abducted position of a throw [12, 13]

SLAP tears can also occur due to forceful traction to the shoulder, direct compression injuries or fall on an abducted and externally rotated arm. The position of the shoulder at the point of impact loading is thought to be key and studies have shown SLAP tears are more likely to occur when the shoulder is forward flexed rather than extended [14]

Classification

In 1990, Snyder et al described four types of SLAP lesions based retrospective review of 700 shoulder arthroscopies [15]. Over the last 30 years, this classification has been expanded to include six more types but Synder's original classification is still the most recognized and widely used.

In Snyder's paper, he described Type I SLAP lesions as a superior labral fraying with localized degeneration. The superior labrum and the biceps anchor remain intact and patients are commonly middle-aged and clinically asymptomatic.

Type II lesions occur when there is detachment of the labrum and the biceps anchor from its attachment to the glenoid. This type of SLAP pathology is the most clinically significant variant.

Type III lesion is a bucket handle tear superior labrum with the biceps anchor still intact. This phenomenon is very similar to a bucket handle injury of the meniscus in the knee joint and if significantly unstable, it can displace into the glenohumeral joint to cause mechanical symptoms.

Type IV lesions differ form Type III lesions by having split in the biceps tendon itself and this split is included in the bucket handle component of the SLAP tear.

Clinical diagnosis

Making a clinical diagnosis of a SLAP lesion can be challenging for a myriad of reasons. Patients' history of preceding events can be variable and examination is often ambiguous and frequently reveals a variety of other co-existing pathologies.

History

Depending of the specific pathogenesis of the SLAP tear, symptoms can arise insidiously or acutely. Overhead throwing athletes are more likely to present with an insidious history due to the progressive nature of the tear and may complain of reduced throwing velocity and overhead movement. Acute trauma causing a SLAP lesion can be due to a traction injury can be due to unexpected weight shift of a heavy object or a compression injury from a fall on an outstretched limb.

The most common presenting complain in patients with a SLAP pathology is pain [16]. The location of pain can either be felt deep in the shoulder joint or a discomfort radiating to the anterior aspect of the shoulder. The nature of the pain can either be sharp or a dull ache that is often exacerbated by activities of pushing, heavy lifting or overhead actions. For patients with a Type III or IV SLAP pathology, they may complain of mechanical symptoms including sensation of giving way especially when performing overhead activities.

Patient may also complain of weakness to the affected limb. Ganglion cyst formation secondary to a chronic SLAP lesion can cause compression of the suprascapular nerve to result in this symptom.

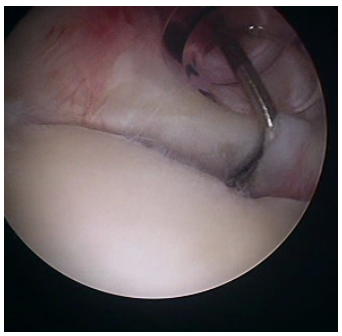

Figure 2 : Arthroscopic example of a Burford complex

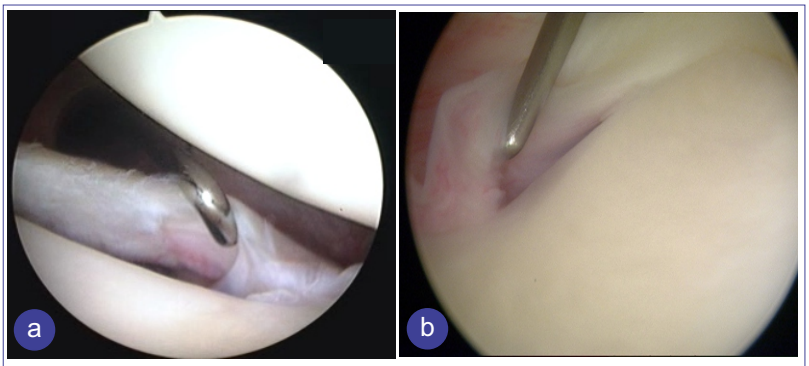

Figure 3a & 3b: Arthroscopic example of a sublabral foramen

Examination

Clinical examination of patients with suspected SLAP pathology can be unequivocal and

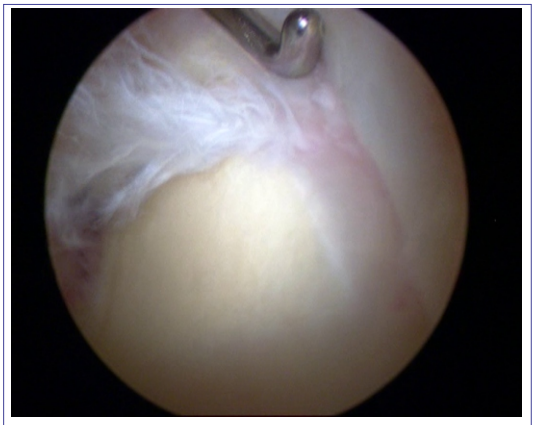

Figure 4: Arthroscopic example of a type II SLAP lesion

confusing as the numerous provocative tests to elicit SLAP lesions lack sensitivity or specificity. Patients also often present with co-existing shoulder pathology to further cloud the clinical picture. One study found 88% of patients with SLAP lesions found at arthroscopy had co-existing shoulder pathology ranging from subacromial impingement, rotator cuff pathology acromioclavicular joint arthritis [8].

When examining a patient with a possible SLAP lesion, pay particular attention to the symmetry of muscle around the shoulder girdle. Wasting of the supraspinatus and infraspinatus muscle may indicate the presence of a glenoid cyst impinging on the suprascapular nerve. In these patients, the active range of motions of the glenohumeral joints often remains normal but pain may be elicited in the position of internal impingement (external rotation of the abducted and externally rotated shoulder) [11]. Stability and apprehension tests of the joint should be tested but significant instability of the joint is rare in SLAP pathologies [16].

Table 1 shows the various tests used to clinically elicit a SLAP lesion. Of these, the O'Brien test is probably the most commonly utilized [17]. To perform this test, the shoulder is position at 90° of flexion, 15° of adduction, full internal rotation and pronation of the forearm. At this point, the patient is asked to flex against resistance. A positive test is declared if patient experiences a deep or anterior shoulder pain. Symptoms should not be reproduced with the shoulder in similar position but in external rotation. Due to the pc reproducibility, sensitivity and specificity the various special tests available, Arnander & Tennant suggested the combination of Kim's biceps load test II and the O'Brien's test gave the best likelihood of a positive result in identifying an isolated SLAP lesion [18].

Investigations

As a baseline, standard plain radiographs (anteroposterior view of shoulder, axillary and scapular 'Y' view) of the affected shoulder should be attained. Although this will not help with the diagnosis of SLAP pathology, this practice might highlight any co-existing pathology that will help in formulating a surgical management plan.

Magnetic resonance imaging (MRI) is the gold standard for imaging labral pathologies. When compared to arthroscopy, MRI is thought to have a sensitivity of 90%, specificity of 89.5% and accuracy of 98% [25]. Although there have been debates in the past, several studies have shown that introducing intra-articular contrast into the shoulder can help increase diagnostic sensitivity [26-28]. Despite this, and taking into consideration anatomical variations, interpretation of the MRI images can remain difficult. Identifying SLAP lesions on MRI scan is best done from the coronal oblique sequences and positioning the shoulder in abduction and external rotation is thought to further help with diagnosis.11 Applying axial traction to the arm has also been suggested as a

	Original Paper		Independent Papers		Comments
	Sensitivity	Specificity	Sensitivity	Specificity	
Speed's Test			47.8%[17]	67.4%[17]	Useful screening test for proximal biceps pathology. Not specific to SLAP lesions
O'Brien's Test	100%[19]	98.5%[19]	67%[20]	37%[20]	Common test for SLAP pathology but sensitivity suffers if there are concomitant shoulder pathologies
Compression Rotation (Crank) Test	> 90%[21]	> 90%[21]	13%-81%[18]	67%-88%[18]	[18] Helps localize location of labral pathology
Kim's Biceps Load Test II	89.7%[22]	96.9%[22]	30%-55%[18]	53%-78%[18]	SLAP lesion in absence of instability
Pain Provocation Test	100%[23]	90%[23]	< 20%[17]	90%[17]	Supination puts more tension on the SLAP lesion
Anterior Slide Test	78.4%[24]	91.5%[24]	17%[20]	86%[20]	Active resistance against anterior humeral translation

Table 1: Summary of chosen clinical examinations for SLAP lesions
[Numbers in superscript denote the reference numbers of the articles]

possible technique to increase contrast dissipation into the intra-articular space and hence improve sensitivity [29].

Arthroscopy

Arthroscopy remains the gold standard in diagnosing SLAP lesions [26, 28, 30]. Direct visualization and gentle probing of the labral-biceps complex often helps identify the lesion. Despite this, arthroscopic findings can be difficult to interpret and knowledge of patients' presenting history, examination findings, imaging results can help the clinician determine if the visualized labrum represents a pathological process. Awareness of the possible anatomical variations to the superior labrum will also prevent inadvertent repair of an otherwise normal biceps-labral complex.

Several authors have suggested dynamic testing the biceps attachment to the labrum can assist diagnosis by making subtle pathologies more obvious. This is achieved by placing the arm in abduction and external rotation which applies tension to the biceps and can cause the labrum to "peel-away" from the glenoid [12, 31]. Other signs of a pathological labrum-biceps complex include signs of reactive synovitis under the labrum, excessive sublabral recess beyond the edge of the glenoid cartilage and hypermobility of more than 5mm on biceps manipulation [32].

Treatment options

Non operative

Conservative treatment of SLAP pathology revolves mainly around physiotherapy, non-steroidal medications and steroid injections into the shoulder. Although there are no published studies on conservative management of SLAP lesions, authors have experienced poor long-term outcomes following conservative management. Patients are rarely satisfied with their function and ends up requiring surgical intervention an average of one or two years following initial presentation [33].

Surgical Treatment Controversies

The role of surgical treatment of SLAP tears is shrouded in controversy. The lack of clear guidelines and randomized control studies further compounds this issue. It is critical to note that not all SLAP lesions identified intra-operatively require repair. Meticulous patient selection taking into consideration patient age, levels of activity and co-existing shoulder pathology should guide the treating surgeon which is the best way to surgically treat a SLAP lesion.

Isolated SLAP Lesions

Type I

This subtype of SLAP lesions is often an incidental finding at arthroscopy as it is usually subclinical in terms of its symptoms. Thought to be secondary to degeneration, it is not usually picked up during MRI imaging and when encountered intraoperatively, it can be left alone. If significantly frayed, it is recommended that the lesion is debrided back to healthy labral tissue [30, 34-36]. Care should be taken to find other co-existing pathology such as subacromial impingement or rotator cuff pathology as a cause of symptoms.

Type II

This is the most common and clinically important subtype of SLAP lesions. It should be treated if patients' symptoms, clinical examination is suggestive of SLAP pathology and arthroscopic examination of the rest of the shoulder does not reveal any other co-existing shoulder pathology. Managing these isolated lesions can be achieved via various techniques and is again a source of much controversy.

Suture anchors are the most common method of repairing SLAP lesions with more predictable and favorable outcomes when compared to biodegradable tacks [31, 35, 36]. Patients from this treatment group report at least 94% good to excellent results post-operatively and about 74% of patients returned to their pre-injury sporting activities [8, 37] The ideal configuration in terms of the number of anchors and suturing technique; simple, dual simple or horizontal mattress, is again a subject of heated debate. Various studies have been published to support the use of each argument with good outcomes [35, 36, 38]. A prospective study by Bedi et al found similar clinical outcomes in patients independent of the number of suture anchors used for repairing of the SLAP lesion [39]. Despite several of these studies showing good outcomes with primary repair, Denard, in his study, noticed a trend of poor outcomes with increasing age [40]. Provencher et al carried out a large prospective study and agreed with Denard's findings and highlighted an increased rate of failure of SLAP repairs in patients above the age of 36 [41]. Boileau and his team were first to study the differences in outcome between primary repairs versus biceps tenodesis for SLAP injuries. His team found that 60% of patients who had a repair were dissatisfied or disappointed with their outcomes while 87% of patients in the tenodesis group were satisfied with their outcome with higher rates of return to sports [42]. He also went on to report 40% of patients from the repair cohort required revision surgery due to persistent pain and inability to participate in sports.

Findings of this study were replicated in several other studies and based on these recent evidence, a significant shift has taken place in the management of this subtype of SLAP lesions [10, 43]. It is now recommended that in patients with a isolated type II SLAP lesion, aged above 36 years old, low sporting demand and poor tissue repair quality, a biceps tenodesis is a viable surgical

option. This can be performed either arthroscopically or via a mini-open technique. The biceps tendon tenotomised, doubled on a suture and pulled into a humeral socket drilled at the proximal aspect of the bicipital groove. It is fixed in placed using a biodegradable interference screw. These patients had functional outcomes comparable to younger patients with primary repair of their lesions [10]. However, if the patient is under 36 years-old, active athlete with good tissue quality, the recommendation is to still perform a repair of the lesion using suture anchors [42, 44]. This option aims to restore normal anatomy and is most likely influenced by several studies suggesting a key role of the labral-biceps complex in maintaining glenohumeral stabilization [45, 46]. In the event of non-resolution of symptoms or poor overhead performance, biceps tenodesis can still be performed as a salvage procedure with good and predictable outcomes.

Type III

Management of this subtype requires resection of the unstable bucket-handle lesion. It is of upmost importance that the MGHL is not destabilized during the resection process as damage can cause significant anterior instability of the joint [34, 38, 39, 47]

Type IV

Management of Type IV lesions is determined by the extent of biceps tendon involvement and patients' age. When less than 30% of the biceps tendon is involved, both the labrum and the pathological biceps tendon is debrided and resected. If more than 30% of the biceps is involved, in a young patient, a biceps tenodesis and labral repair is carried out. However, in an older patient or if the labral tissue quality is poor, then a labral debridement is performed with either biceps tenotomy or tenodesis [16].

Type V to X

These subtypes of SLAP injuries often represent a more significant labral injury and are often associated with shoulder instability [11]. Treatment should not only address the labral-biceps complex but also the other parts of the labrum and the MGHL injury.

Slap with co-existing pathologies

Eighty-eight percent of patients with SLAP lesions diagnosed during arthroscopy have co-existing pathology [8]. In view of this, it is recommended to have a clear idea on how to manage these patients based on latest evidence.

SLAP tear with rotator cuff pathology

In patients with these pathologies, it is important to clinically determine which pathology is causing the clinical picture. If both structures are thought to be the generator of symptoms, surgical repair of both can be done at the same sitting with good outcomes [48, 49]. This treatment option is thought to help improve range of motion and patient satisfaction. However, another study looked at patients above the age of 50 with similar dual pathology and found that in this subgroup of patients, managing their pathology with a rotator cuff repair and a biceps tenotomy yielded a significantly better outcome compared to a SLAP and rotator cuff repair [50].

Subacromial Impingement

It is recommended that patients with symptoms of clinical signs of impingement in the shoulder have arthroscopic subacromial decompression during surgery for a SLAP repair. Coleman et al looked at this particular co-existing pathology in his study and concluded that although functional outcome measures were similar in both groups, patients who had an acromioplasty in the same sitting were more satisfied with their surgery [51].

Ganglion cysts

Ganglion cysts may develop secondary to chronic SLAP tears and if anatomically favorable, can cause suprascapular nerve palsy via impingement. Literature have described arthroscopic decompression with a probe, shaver and ever a spinal needle [52, 53]. However, if it occurs due to an isolated SLAP pathology, these cysts have been shows to resolve spontaneously following a SLAP repair. In Youm at al case series, even patients with clinical weakness due to compressive neuropathy of the suprascapular nerves have been shown to make a full recovery following SLAP repair [54].

Conclusions

Over the last 30 years, advancement in medical technology has not made the management of SLAP lesions any less challenging. An ever increasingly active society ensures a steady increase in incidence of SLAP injuries but their history remains as variable as before. Improvement in imaging techniques and advancement arthroscopic instruments may allow us to pick up subtle abnormalities, but careful interpretation has to be undertaken in order to provide the right treatment to the right patients. The gold standard repairing technique is to use suture anchors but the ideal anchor/suture configuration is still a highly debated topic. Co-existing pathologies in shoulders of our aging population further adds to the management dilemma. Having a clear algorithm in managing these pathologies based on latest evidence will help obtain best outcomes and return to activity for our patients.

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