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Slap Tears Of Shoulder

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The shoulder joint with its extensive range of movements is vulnerable to instability. Although avulsions of the anterinferior and posterior glenoid labrum are well known and commonly identified as 'Bankart lesions'and 'reverse Bankart lesions', superior labral tears are recognised by clinicians only occasionally.

Superior glenoid labral tears were first reported in high level throwing athletes by James Andrews in 1985 [1]. Subsequently Stephen Snyder in 1990 described similar tears extending from the anterior superior part of the labrum to the posterior superior aspect of it posterior to biceps tendon and involving the biceps labral complex [2]. This tear was termed as SLAP lesion (Superior Labrum Anterior and Posterior). Initially believed not to be very common, it is now frequently seen not only in overhead sportsmen such as cricket bowlers, volleyball players, swimmers and tennis players, but also in non-athletes with overhead shoulder injuries.

This instructional course lecture attempts to impart a complete understanding on SLAP tears and focuses on their clinical and radiological identification and current trends of treatment.

❖ Glenoid Labrum Anatomy & Biomechanics ❖

The glenoid labrum is a fibrocartilaginous structure attached to the glenoid rim and consists of dense fibrous tissue with elastic fibres. The inner surface is continuous with the glenoid articular cartilage while the outer surface extends into the glenohumeral joint capsule. The vascularity is limited to the periphery of the labrum. The main function of the glenoid labrum is to deepen the glenoid fossa facilitating glenohumeral stability [3].

The fibres of the long head of the biceps tendon blend with the posterior and superior aspect of the labrum forming a biceps labrum complex (BLC) which attaches to the superior pole of the glenoid [Fig.1]. This attachment of the biceps labrum complex to the superior glenoid may be of three types [4]. In type I the BLC attaches firmly to glenoid rim and there is no sublabral recess. In type II a small sulcus is present between the labrum and glenoid rim. In type III a deep sulcus is present between the labrum and glenoid rim and forms a sublabral recess at the 12 o'clock position. Other variants have also been reported where a sublabral foramen is found anterosuperiorly and anterior to the biceps tendon attachment.

A Buford complex is also found in 1.5% of individuals and consists of a cord like thickening of the middle glenohumeral ligament with absence of the anterosuperior labrum. In this group the middle middle glenohumeral ligament attaches directly to the anterosuperior glenoid rim.

The biceps labral complex and long head of the biceps play an important role in the anterior stability of the glenohumeral joint by increasing the shoulder resistance to any tortional forces in the position of abduction and external rotation. Detachment of the superior glenoid labrum leads to increased stress on the inferior glenohumeral ligament and subsequent damage to this important stabilising structure may lead to anterior instability [5]. An isolated lesion of the superior portion of the labrum not involving the insertion of the biceps brachii has no significant effect on anteroposterior and superoinferior glenohumeral translations, however a lesion of the superior labrum which destabilises the insertion of the biceps, results in

significant increase of glenohumeral translation at middle and lower elevation angles [6].

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Two types of injury mechanisms have been postulated for superior labral tears.

1. Traction injury : Chronic repetitive microtrauma caused by traction, or an acute traction force may lead to superior labral tears. Andrews postulated that the labral injury is a deceleration injury which occurs in the follow through phase of throwing [1]. On the other hand, Burkhart suggested that an acceleration injury with the shoulder in abduction and external rotation resulted in the tear [7]. He reported that a tortional force peels back the biceps and posterior labrum as the shoulder goes into extreme abduction and external rotation. This position can also cause an acute avulsion of the biceps labral complex. Posterior capsule tightness with marked decrease in the internal rotation has been attributed as a cause for SLAP tears in throwers.

2. Compression injury : Snyder described a mechanism in which a fall on the out stretched arm with shoulder in abduction and slight forward flexion leads to this injury.

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Snyder [2] described SLAP tears as lesions that began posterior to and extended anterior to the biceps tendon stopping at or above the midglenoid notch, and classified them into 4 distinct types. Later Maffet [7] added three more types.

SLAP Type I : Only fraying and degeneration of the superior labrum with no labral detachment and a normal biceps tendon anchor are present [Fig.2].

SLAP Type II : Pathological detachment of the labrum and the biceps anchor from the superior glenoid exists [Fig.3]. Morgan further divided these into 3 subtypes II-A, II-B and II-C, according to anterior, posterior or anterior and posterior combined involvement [8].

SLAP Type III : A vertical tear in the superior labrum with the free edge hanging in the joint space (bucket handle tear) is present while the remaining part of the superior labrum and the biceps are firmly attached to glenoid [Fig.4].

SLAP Type IV : A vertical or bucket handle tear in the superior labrum with the tear extending into the biceps tendon as a wedge upto a variable degree [Fig.5]. The torn biceps tendon tends to displace with the labral flap into the joint.

SLAP Type V : There is superior extension of the anteroinferior Bankert lesion [Fig.6].

SLAP Type VI : Disruption of biceps tendon with unstable flap tear of labrum [Fig.7].

SLAP Type VII : Extension of the SLAP tear anteriorly to involve area inferior to middle glenohumeral ligament.

Snyder reported that type II tears were most common (55%) followed by type I (21%) and then type IV and type III (10% and 9% respectively). 5% were complex tears (type V toVII).

SLAC Lesion : When the anterior superior labral tear is associated with a partial supraspinatus tear it is called a superior labral anterior cuff lesion (SLAC termed by Savoie) [9].

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History

Patients present with shoulder pain, which may be anterior, posterior or even ill defined. 45% of patients have an associated history of mechanical symptoms like locking, catching, popping or snapping in their shoulders. The commonest history of injury is a fall on the outstretched hand or a direct blow to the shoulder, however, some patients may give history of a traumatic dislocation or subluxation. Some persons feel pain only on lifting heavy weights, while others on overhead throwing activities. A few patients may have insidious onset of pain. Some overhead athletes may present with a dead-arm syndrome with decreased efficiency to perform sporting activities.

Examination

Various tests have been described to diagnose superior labral tears :

1. O'Briens active compression test [10] [Fig.8] : The standing patient is asked to keep his arm in 90° of forward flexion with full internal rotation and the thumb pointing downward with 10-15° of adduction, medial to the sagittal plane of body, keeping the elbow in full extension. The examiner stands behind the patient and applies a uniform downward force on the arm, while the patient resists this. Now with the arm in the same position the palm is fully supinated and the manoeuvre is repeated. The test is considered positive for superior labral tears if there is pain in the first manoeuvre and much decreased or absent in the second manoeuvre.

2. Biceps tension test (Speed test) [8] : The patient flexes the arm against resistance while the shoulder is flexed 90°, the elbow is fully extended and forearm is supinated. The test is positive when there is anterior shoulder pain in the region of the bicipital groove during the manoeuver.

3. Anterior slide test Of Kibler [11] : With the patient standing and keeping his hand on the hip with the thumb pointing posteriorly the examiner holds the affected shoulder by one hand in such a way the index finger extends over the anterior aspect of the acromion at the glenohumeral joint. The examiner then places the other hand behind the patient's elbow and pushes forward and slightly upward, while the patient resists. The test is positive for SLAP tears if there is pain or a click at the front of the shoulder, beneath the examiner's hand.

4. Compression Rotation Test [2] : The supine patient abducts his shoulder 90°, keeping the elbow flexed 90°. A compression force is applied along the long axis of humerus while rotations are performed. The test is positive if there is painful catching or snapping or grinding in the shoulder. A similar test performed with the patient in upright position and arm elevated to 160° in the scapular plane is termed the crank test.

5. Biceps load test [12] : This test is useful when SLAP lesions are associated with recurrent anterior dislocation. The supine patient abducts his arm 90° with full external rotation of shoulder. When the patient feels apprehensive of shoulder dislocation he is asked to flex the forearm against resistance. If his pain increases or remains same the test is positive for a SLAP tear.

These tests have varying degrees of sensitivity and specificity in the diagnosis of superior labral injuries. The standard test for SLAP tears is the O'Briens test, and is reported to have a 100% sensitivity with 98.5% specificity [10].

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Conventional MRI often fails to give an accurate diagnosis of capsulolabral lesions, however MRI-arthrography using intra-articular gadolinium contrast clearly defines these tears and has 89% sensitivity and 91% specificity for SLAP tears [Fig.9 & 10]. The MRI-arthrogram features for SLAP tears include :

1. A high signal intensity between the labrum and the glenoid in the posterior third of the superior glenoid.

2. Two high signal intensity lines in the superior labrum. One line represents the sublabral recess whereas the second defines the labral tear.

3. An irregular or laterally curved area of high signal intensity in the posterior third of the labrum. Laterally curved and posterior high signal intensities are specific signs for distinguishing a SLAP tear from a normal variant sublabral recess.

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Despite advances in imaging, the definite diagnosis of a SLAP tear is often made only after diagnostic arthroscopy. Besides a thorough examination of the superior glenoid labrum, it is important to look for various anatomical variations like sublabral recess and Buford complex. The dynamic peel back sign [Fig. 11] is the prime arthroscopic indicator of dysfunction of the biceps labral complex and is performed with the shoulder in abduction and external rotation position.

The typical arthroscopic findings in Type II A (anterior) tears are uncovered glenoid for 5 mm or more medial to the corner of glenoid under the

biceps root. There is also a displaceable vertex of the biceps root.

In Type II B (posterior) tears there is a peel back sign with the shoulder in 60° abduction and full external rotation. Here the posterior superior labrum rotates medially over the scapular neck. There is also a positive drive through sign in which the scope sheath can easily be passed superior to inferior.

In combined anterior and posterior lesions (Type II C) the biceps root also shifts medially during the peel back.

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The treatment of SLAP tears depends on the type of lesion. With Types II and IV tears, the goal is to restore stability to the labrum and biceps anchor and achieve healing to the glenoid. Suture repair with anchors is currently the repair technique of choice [Fig.12].

In patients with Type I tears the torn and frayed labral tissue is debrided back to intact labrum, carefully preserving the attachment of labrum and biceps tendon to the glenoid. Management of Type III tears depends on the size and the tissue quality of the bucket handle fragment. If it is thin, degenerative and devoid of vascularity, it is debrided back to stable tissue [Fig.13]. On the contrary large robust and vascular fragments can be abraded and repaired with sutures by all inside repair technique. Type IV lesions are treated according to the size of the biceps tendon tear. Small and unstable fragments are debrided while larger (>50% thickness) are repaired with fixation techniques.

The basic aim of Type II treatment is reattachment of BLC to the superior glenoid neck.

This was initially achieved using staples, and is presently performed using arthroscopically inserted suture anchors. This method needs demanding surgical skills but gives excellent results.

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1.Establish the 3 standard anterior and posterior arthroscopic portals (antero-superior just behind the biceps tendon, and mid-anterior just above subscapularis tendon). Proper placement of the antero-superior portal is critical to the success and ease of the procedure because both suture placement and drill positioning are performed through this portal. A spinal needle is used to test the portal position before establishment of this access site. When proper position is determined, an outside-in technique is used to establish this portal. 6.0 mm operating cannulae with diaphragms are inserted into the two anterior portals.

2. Debride degenerative labral and biceps tissue to expose the superior glenoid neck.

3. Lightly abrade superior rim of glenoid neck adjacent to the articular cartilage and freshen the bone below biceps labral complex.

4. Through the antero-superior cannula a suture anchor is inserted in the superior glenoid tubercle just below the biceps tendon.

5. One limb of the suture is retrieved out of the mid-anterior cannula with a crochet hook.

6. A birdbeak type of tissue penetrating cum suture retrieving instrument is inserted through the superior labrum just posterior to the biceps tendon. The suture limb retrieved out of the mid-anterior cannula is grasped with this instrument and retrieved through the labrum and out of the antero-superior cannula. Either a simple suture configuration or mattress suture configuration may be used.

7. A sliding knot is tied and using a loop handle knot pusher this knot is tightened. 3 additional alternating half hitches are tied together and locked so as to complete the repair.

8. Often SLAP II tears will require 2 suture anchors for repair. My preference often is a simple suture posterior to the biceps tendon first, followed by a mattress suture at the biceps tendon region.

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The patient is placed in a sling that he can remove for full extension of elbow. Patients are instructed to avoid external rotation of shoulder beyond neutral and extension of arm behind the body,

with the elbow extended for a period of 4 weeks. The shoulder sling is discontinued after 4 weeks and physiotherapy with gentle active and passive exercises restricted to 90° of flexion, 70° of adduction and 0° external rotation. From the 7 th week postoperatively exercises without restriction are allowed. Strengthening and posterior capsular stretching exercises continue indefinitely. Usually patients take 6 months postoperatively to involve in their sports activities.

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In a prospective study conducted at King Edward VII Memorial Hospital, 50 consecutive patients with SLAP lesions of the shoulder were managed by arthroscopic suture anchor repair or arthroscopic debridement. The series included 42 male and 8 female patients. The average follow-up for these patients was 37 months (range, 12 to 60 months). This group had 3 patients with symptomatic type I SLAP lesions, 26 patients with type II superior labral detachment lesions, 7 with Type III SLAP tears (4 classical, 3 variants), 5 with type IV lesions, and 9 complex SLAP tears of which 6 were associated with Bankart lesions. The average age of the patients was 29 years (range, 18 to 41), and the symptom time before diagnosis and arthroscopic management averaged 15 months (range, 1 month to 4 years).

The mechanism of injury was an acute traumatic event in 19 patients, repetitive microtrauma and overhead sports in 28 patients, whereas no specific incident or injury could be elicited in 3 patients. Of the 19 patients with known traumatic etiologies, 10 developed symptoms after a compression force to the shoulder, most often from a fall on an outstretched and abducted arm. Of the 9 remaining patients with traumatic etiologies, 7 resulted from a specific acute traction-type injury, often with the forearm supinated. The other 2 patients developed symptoms after the direct impact of a heavy object falling on the lateral aspect of the shoulder.

Symptoms consisted primarily of nonspecific posterior shoulder pain, which often increased during overhead activities. 23 patients also noticed mechanical symptoms including clicking, painful "popping", and locking in the overhead position. Athletes involved in overhead sports complained of decreased performance while throwing, serving, swimmimg. Cricketers especially noted that they were unable to throw the ball overhead from the boundary line, but were perfectly capable of underhand throws from near or far. Amongst cricket bowlers, spin bowlers were significantly more predominant than pace bowlers. The O'Brien's test was positive for 42 patients preoperatively. A variation of the apprehension test in which the humeral head is subluxated antero-superiorly on the glenoid also was positive for pain or crepitation in all patients.

Preoperative MRI was performed in 13 and MRI-arthrogram in 26 of the 50 shoulders. Definitive diagnosis of superior labral lesion was positive in only 4 shoulders with MRI and 19 shoulders with MRI-arthrogram.

All patients were managed by diagnostic arthroscopy followed by arthroscopic debridement or suture anchor repair of the SLAP tear at the same stage. 6 patients underwent a concurrent arthroscopic Bankart repair. 1 patient underwent a concurrent arthroscopic repair for a PASTA lesion (partial articular surface rotator cuff tear).

The superior labral lesion was defined and arthroscopic management was accomplished as below :

Type I	3	Debridement of the invaginated frayed superior labral tissue causing impingement. 1 concurrent PASTA lesion repair.
Type II	26	Suture anchor repair
Type III	7	Excision of bucket-handle tear in 3, excision of bucket-handle tear + suture anchor repair of remnant biceps-labral complex in 1, excision of anterior and posterior flaps of incomplete bucket-handle tear in 3.

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Type IV	5	Excision of bucket-handle tear and small biceps tendon tear + suture anchor repair
Complex	9	Individualised treatment depending upon extent of injury to superior labrum, intra-articular long head of biceps tendon, anterior labrum. 6 concurrent Bankart's repair.

All 50 patients were evaluated using the ASES (American Shoulder and Elbow Surgeons') shoulder evaluation system and the Rowe rating scale. Results of these examinations were compared with the preoperative evaluations to determine the efficacy of arthroscopic management. The ASES shoulder evaluation form is divided into separate parameters of pain, motion, strength, stability, and function. These parameters are scored independently, and an overall total score is omitted. The Rowe rating scale also was used to assess results in these 50 patients. This scale is based on the same parameters and components of evaluation as the ASES shoulder evaluation form, but individual parameter scores are also added to reveal an overall score. Patients were reassessed 12 to 60 months postoperatively (average, 37 months).

All preoperative scores increased postoperatively using the ASES evaluation system. Statistically significant gains ($P < 0.05$) were made in the categories of pain (score improved from 2.3 to 4.6) and of function (score improved from 2.1 to 3.8). The other parameters of motion, strength, and stability improved over preoperative levels but were not statistically significant. Using the Rowe scale, all scores improved postoperatively, and all patients achieved either good or excellent results at follow-up evaluation. All patients reported significant improvements in the shoulder pain that was present preoperatively, and no patient complained of any persistent mechanical symptoms after arthroscopic management. The specific tests used preoperatively for evaluation of the superior labral injury were all negative on postoperative evaluation. 21 patients were involved in sports and returned to their sports 3 to 10 months after reconstruction without limitation. 9 patients sustained work-related injuries; all of them returned to their preinjury occupations, although some initially had restrictions that gradually were lifted as they became more confident with their reconstruction. There was one complication in this series of patients (2%). Stiffness developed postoperatively in a 36-year-old male patient after repair of a Type II lesion. This was managed successfully by arthroscopic capsular release with good results at final followup.

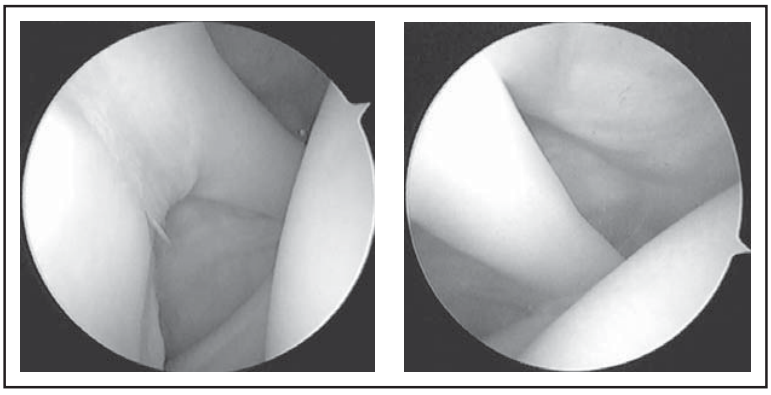

Fig. 1 : Arthroscopic images of the normal biceps labral complex

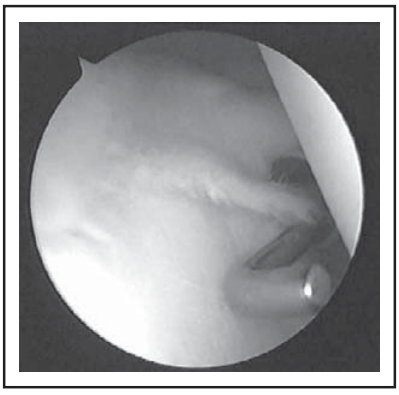

Fig. 2 : Type I SLAP tear

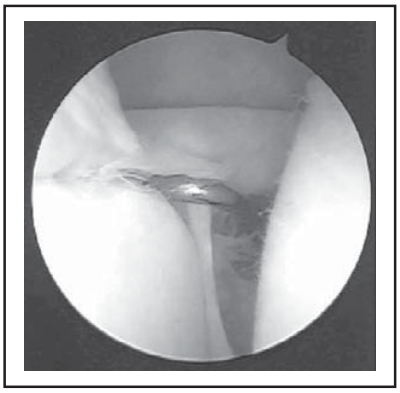

Fig. 3 : Type II SLAP tear

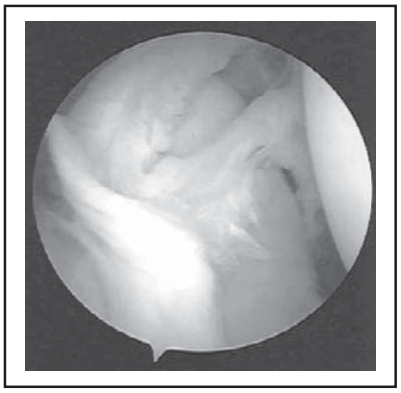

Fig. 4 : Type III SLAP tear

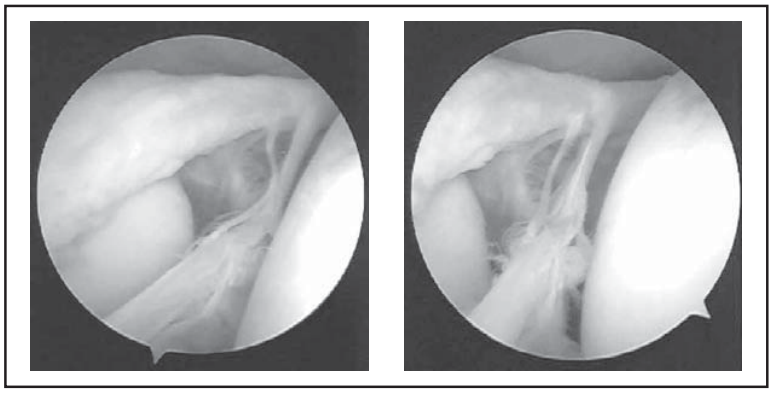

Fig. 5 : Type IV SLAP tear

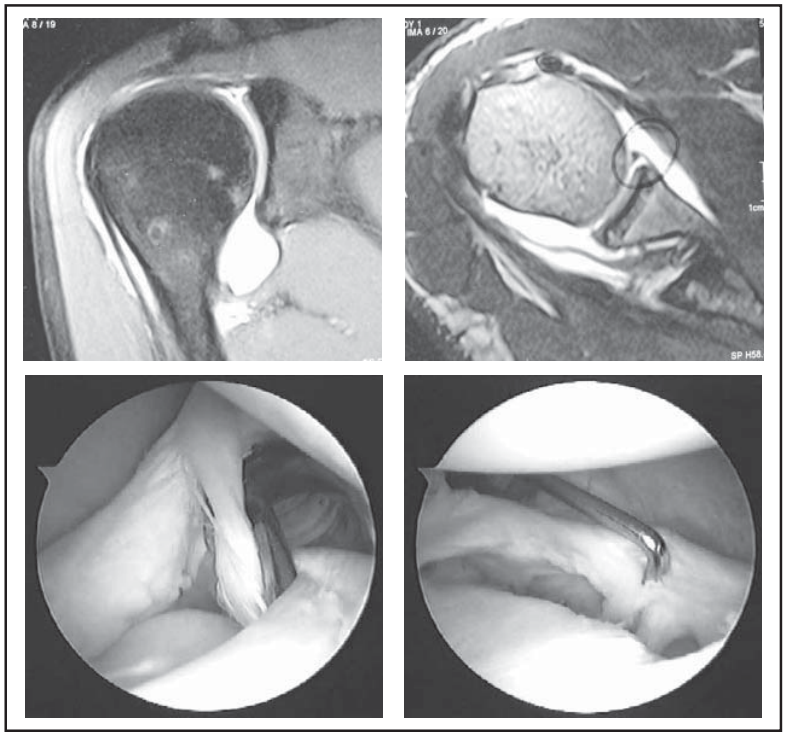

Fig. 6 : Type V SLAP tear : MRI-arthrogram and arthroscopic images (patient in lateral position)

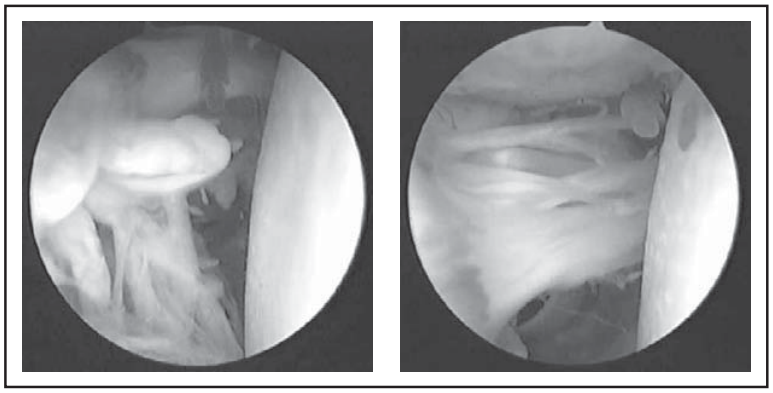

Fig. 7 : Complex SLAP tear with severe damage to intraarticular long head of biceps tendon

Fig. 8 : O'Briens active compression test : The standing patient is asked to keep his arm in 90° of forward flexion with full internal rotation and the thumb pointing downward with 10-15° of adduction, medial to the sagittal plane of body, keeping the elbow in full extension. A uniform downward force is applied on the arm, while the patient resists this. Now with the arm in the same position the palm is fully supinated and the manoeuvre is repeated. The test is considered positive for superior labral tears if there is pain in the first manoeuvre and much decreased or absent in the second manoeuvre

Fig. 9 : MRI-arthrogram images demonstrating a Type II SLAP tear. Note the irregular, laterally curved area of high signal intensity in the superior labrum

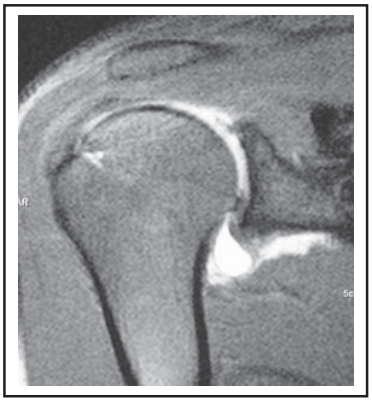

Fig. 10 : MRI-arthrogram images demonstrating a complex SLAP tear. Note the irregular, almost absent superior labrum

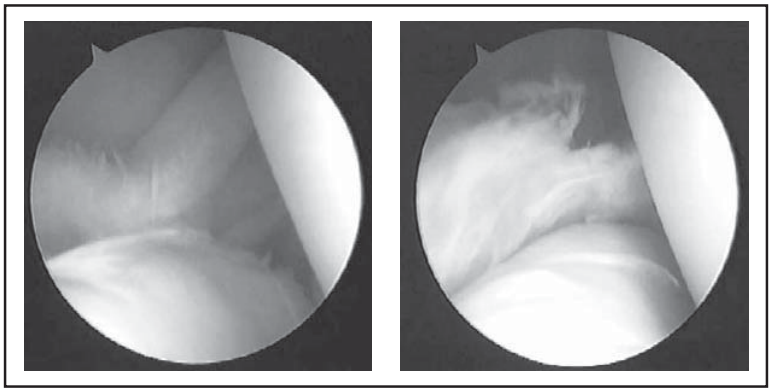

Fig. 11 : Arthroscopic images of the dynamic "peel-back" test for SLAP lesions. Note that when the arm is taken into abduction and external rotation, instability of the biceps-labral complex is revealed

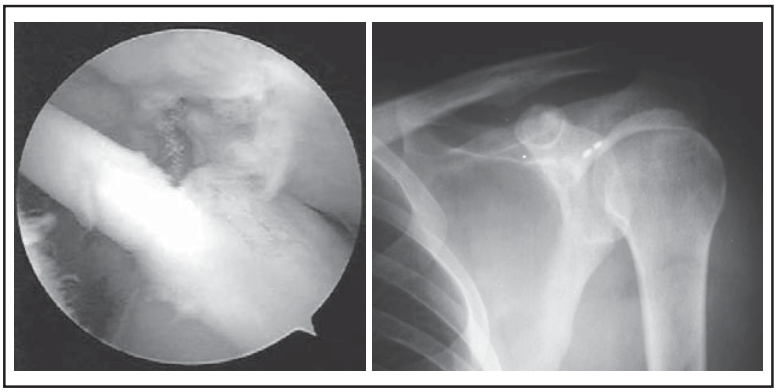

Fig. 12 : Type II SLAP tear suture anchor repair – arthroscopic image & postoperative radiograph

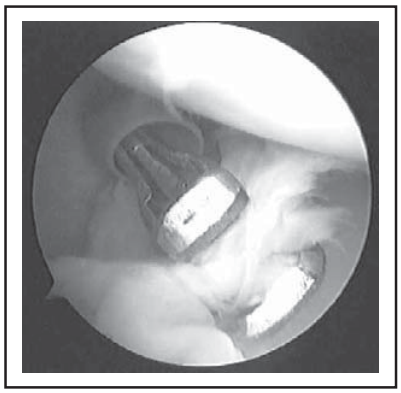

Fig. 13 : Excision of the bucket handle flap in a Type III SLAP tear

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