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Subscapularis Repair

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Abstract

Subscapularis is largest muscle of the rotator cuff. It is important component of shoulder joint for necessary of unimpaired shoulder movements. Since past decade subscapularis tears are recognized as source of pain and dysfunction of shoulder joint. New diagnostic techniques and arthroscopic repair surgeries help to treat subscapularis tears. This article provides an overview of types of tear, diagnostic methods and treatment options.

Keywords: rotator cuff, subscapularis tendon tear, subscapularis repair

1. Introduction

Rotator cuff consists of four muscles supraspinatus, infraspinatus, teres minor and subscapularis. Subscapularis is largest of the four and is attached to the Lesser Tubercle. It constitutes 50–60% of the rotator cuff. It is one of the main anterior stabilizers of the shoulder.

The subscapularis muscle is the primary internal rotator of the shoulder joint. It also gives strong anterior stability along with capsulolabral tissues to prevent anterior dislocation. Recent studies have shown how the subscapularis works together with the infraspinatus muscle to create smooth balancing force couple and provides concentric compression effect.

Subscapularis tears are not as common as tears of the supraspinatus tendon. Subscapularis tendon tears may be isolated or in conjunction with supraspinatus and infraspinatus tendon tears or biceps tear/ subluxation (**Figure 1**).

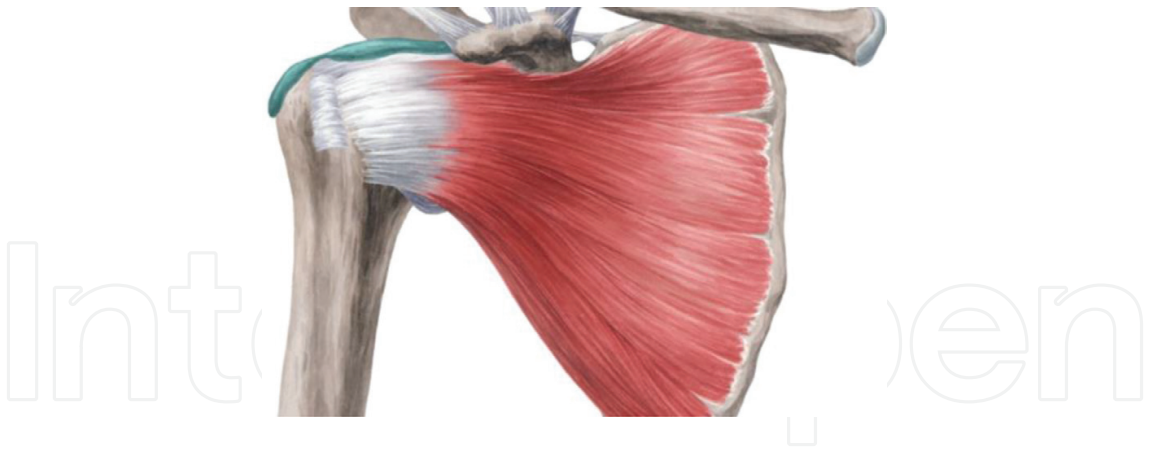


Figure 1. Subscapularis anatomy.

2. Overview

Subscapularis tendon tears have been firstly described by Smith [1] and Codman [2] Hauser reported in 1954 the first case of surgical repair of the subscapularis tendon [3].

Subscapularis tendon tears may be partial or full thickness. Chronic overload or acute trauma may cause tears. Traumatic tears are usually secondary to a forced external rotation or extension of the shoulder with the arm abducted. These tears are more prevalent in young patients as a consequence of a shoulder dislocation [4, 5]. In chronic tears due to repeated micro trauma degeneration, there is always an associated supraspinatus tear and biceps tendinosis or subluxation along with subscapularis tear. In tears of long duration, there can be severe retraction of the tendon underneath coracoids process. Sometimes it get tucked to superior capsule or glenohumeral ligaments forming a “Coma sign/tissue” as described by Burkhart [6].

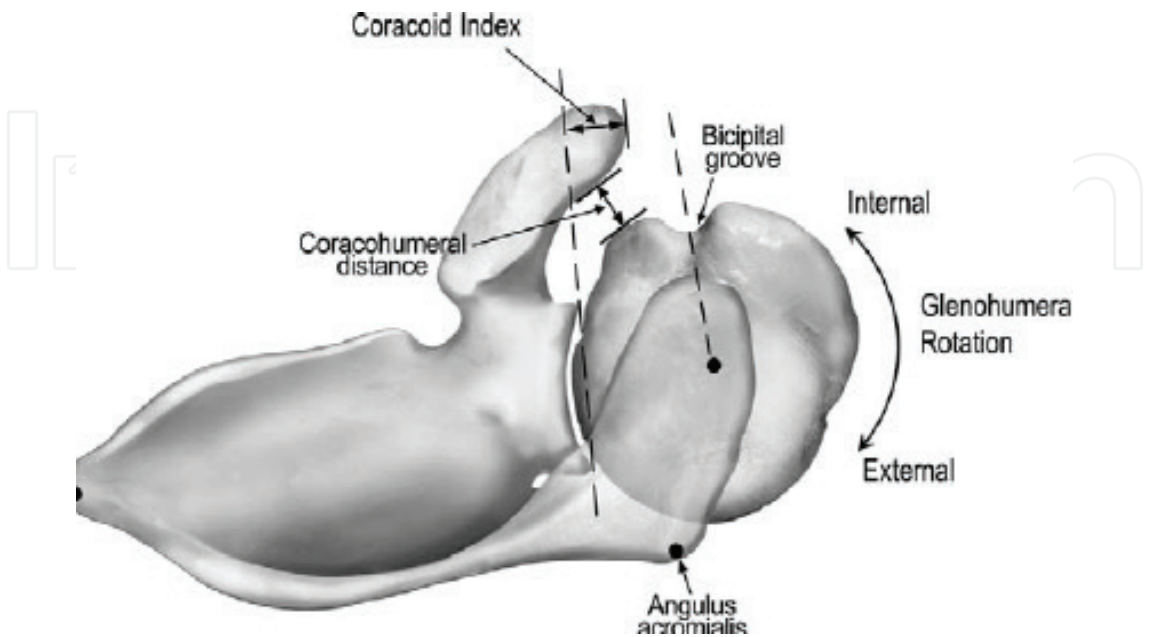


Figure 2. Coracoid impingement.

The main causes for subscapularis tear with or without other lesions is Sub coracoid impingement with reduced coracohumeral distance. Due to repeated friction in narrow canal beneath the coracoids process, attritional tear of subscapularis happens. When this distance, which normally ranges from 8.7 to 11 mm, is lower than 5 mm, the risk that the subscapularis tendon is torn is high [7, 8].

The coracoid impingement may be primary or acquired. Primary causes of sub coracoid impingement are lateralized coracoid process, calcifications or ossifications of the subscapularis tendon, subscapularis muscle hypertrophy, and ganglion cysts. Secondary causes are usually traumatic or degenerative like displaced humeral or scapular fractures, non-unions, posterior dislocation of the sternoclavicular joint, spur formation, etc., (Figure 2).

The subscapularis tendon is torn in 63% of patients in whom the biceps tendon is sub-luxated or dislocated as there is continuity between medial margin of pulley and the subscapularis tendon.

3. Symptoms

The shoulder pain related to a subscapularis tendon tear is more anterior compared to the typical pain observed in patients with rotator cuff tears. There is weakness in internal rotation and abduction like buttoning the shirt, adjusting the tie, tucking the shirt in the back etc. as these functions requires active internal rotation. Since in most of the cases anterior supraspinatus and biceps tendon is also involved, forward flexion, supination and abduction- external rotation can also be painful.

4. Clinical examination

On examination there will be increased passive external rotation, Loss of active internal rotation strength.

Lift-off, belly-press, Napoleon and bear-hug are specific tests to assess the subscapularis tendon.

The lift-off test: This test has 15–20% sensitivity and almost 100% specificity (Barth et al.) [9]. This test is carried out in sitting or in standing position. The patient's arm is kept in internal rotation with the hand is placed at the back at lumbar spine level. In this position patient tries to move the hand away from back by further extending arm and in internal rotation. Now if this movement is possible, examiner can check by providing resistance. The test is positive when the patient is unable to lift the hand away from back indicative of tear of subscapularis. The degree of weakness and pain are indicative of the degree of the lesion (Figure 3).

The belly-press test: It is one of the most commonly performed and accurate clinical test for subscapularis tear with sensitivity of 40% and specificity of 97.3%. It is also called as abdominal compression test, In this test patient attempts to press the hand against the belly with



Figure 3. Lift off test.

the arm rotated internally [10]. The examiner places hand on the abdomen so he can feel the how much pressure patient is applying. The test is considered positive if the pressing force is weaker or if the pressing movement of the hand against the belly is possible only with the elbow extension and shoulder extended. This indicates a deficiency of the subscapularis tendon tear or dysfunction (**Figure 4**).

The Napoleon test: It is similar to belly press test also called as modified belly press test. The patient hand is placed on abdomen with hand wrist and elbow in straight line. Now patient has to press down on the abdomen negative test indicates wrist at 0° suggestive of normal subscapularis. Positive test indicates patient can press on the belly by flexing wrist at 90° and intermediate result when wrist flexed $30\text{--}60^\circ$ suggestive of partial function of subscapularis. It has sensitivity of 25% and specificity of 97.3%.

The bear-hug test: This test is most sensitive (60%) and with specificity $>90\%$, can be considered single most accurate test for subscapularis injuries [11]. In this test patient has to place his hand on the opposite shoulder with the elbow anterior to the body. The examiner then applies an external rotation force while the patient attempts to maintain the hand on the shoulder. Positive test indicates patient cannot maintain the hand against the shoulder as examiner applies external rotation force (**Figure 5**).



Figure 4. Belly press test.



Figure 5. Bear hug test.

All these tests allow diagnosing a partial tear in 30% of cases. More than 50% of tendon thickness is torn when the Napoleon test is positive; more than 75% when the lift-off test is positive.

5. Imaging

X-Rays will demonstrate any coracoid pathology, associated acromial spur degenerative changes (**Figures 6 and 7**).

Ultrasonography (USG) is less reliable than MRI in diagnosing the Subscapularis tears.

USG is more preferred to assess the tendon repaired after shoulder arthroscopy (**Figure 8**).

MRI is the noninvasive procedure of choice to diagnose subscapularis tears. It provides higher diagnostic reliability. Arthro-MRI is even more perfect and accurate as compared to conventional MRI in patients with subscapularis tendon tears.

An indirect sign, often associated with partial subscapularis tears, is a medial dislocation of the long head of the biceps.

There are high chances of partial tears being missed on conventional MRI as compared to Contrast MRI. Fatty degeneration (fatty infiltration) is negative prognostic factor for full



Figure 6. X-ray rockwood view.



Figure 7. Coracoid impingement x-ray.

functional recovery of the shoulder. The percentage of fatty infiltration predictive of success after cuff repair is lower than 75%.

MR arthrography is accurate in the detection and grading of lesions in the subscapularis tendon. The specificity of findings on transverse images for this diagnosis can be improved by including ancillary signs and findings from parasagittal images (**Figures 9–11**).

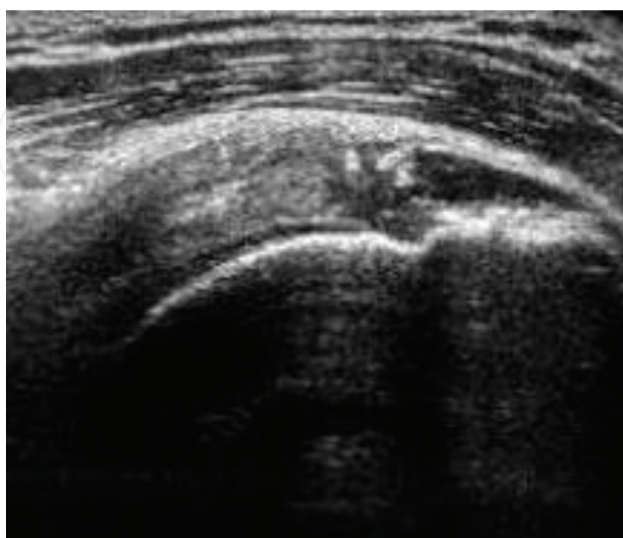


Figure 8. Ultrasonography of subscapularis tear.

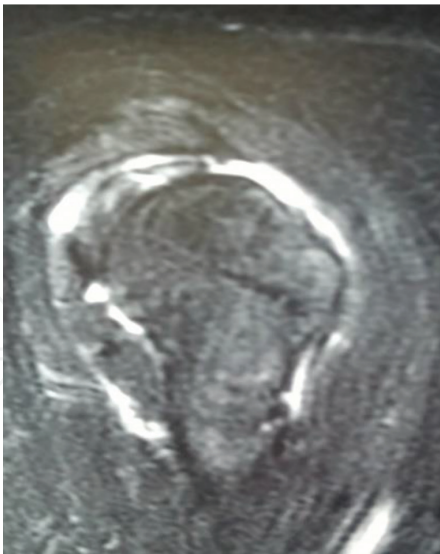


Figure 9. MRI axial view.

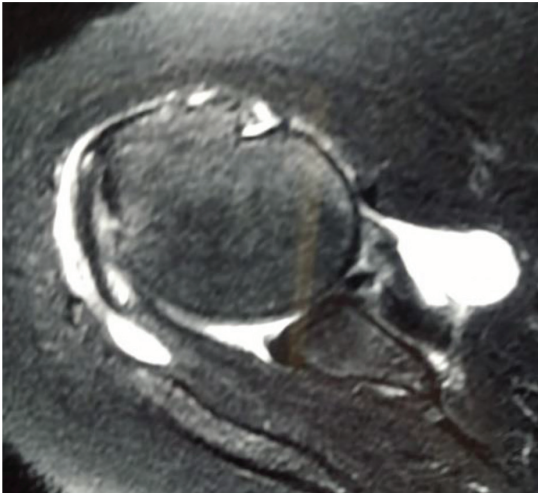


Figure 10. MRI coronal view.

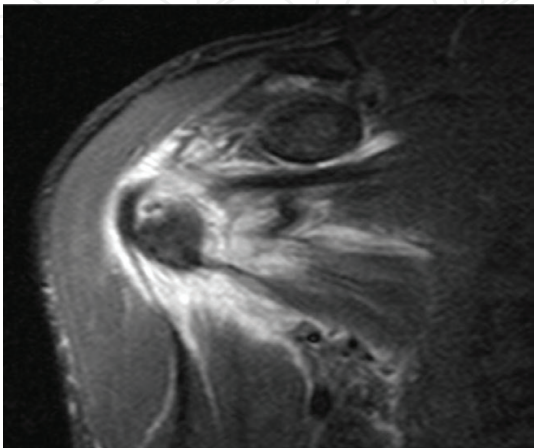


Figure 11. MRI showing rotator cuff muscles.

6. Types of subscapularis tears

In comparison with other rotator cuff tears, subscapularis tear is less common, it seems to have been underestimated. Because of recent attentions to subscapularis tendon, new types of such tendon's lesions have been identified and described. The subscapularis tendon tears may be classified as partial and complete, retracted and not retracted, superior involving the upper third and inferior (extended to the lower third). Lafosse described a five-type classification of subscapularis tendon lesions according to anatomic data and arthroscopic lesion-related findings.

The classification system by Lafosse:

II Complete lesion superior one third

III Complete lesion superior two-thirds

IV Complete lesion with head centered and fatty degeneration<stage3

V Complete lesion with eccentric head and fatty degeneration>stage3

A type I tear is a simple erosion of the upper third of the tendon without any disconnection to the bone (**Figure 12**).

In a type II is a frank detachment of the upper portion of the tendon (**Figure 13**).

A type III lesion is characterized by involvement of all the insertion of the tendon without detachment of the lower third of the muscular portion (**Figure 14**).

In type IV tears, the subscapularis tendon is completely detached from the lesser tuberosity and the humeral head is centered within the joint (**Figure 15**).

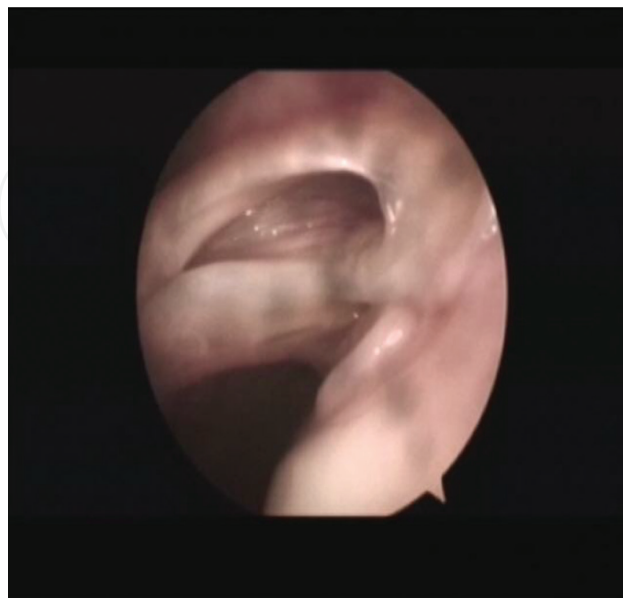


Figure 12. Type I tear.

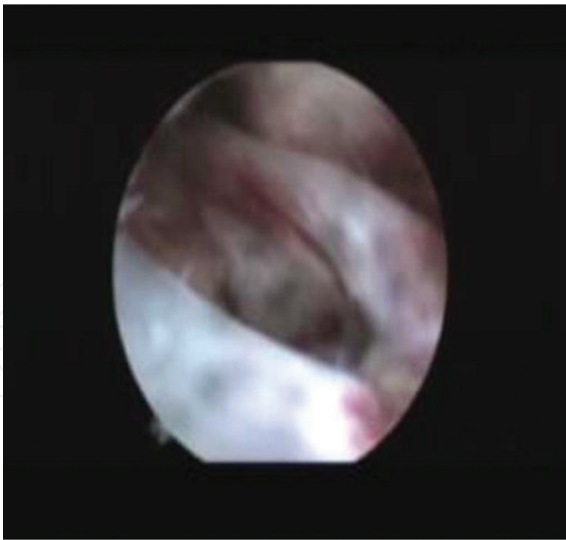


Figure 13. Type II tear.

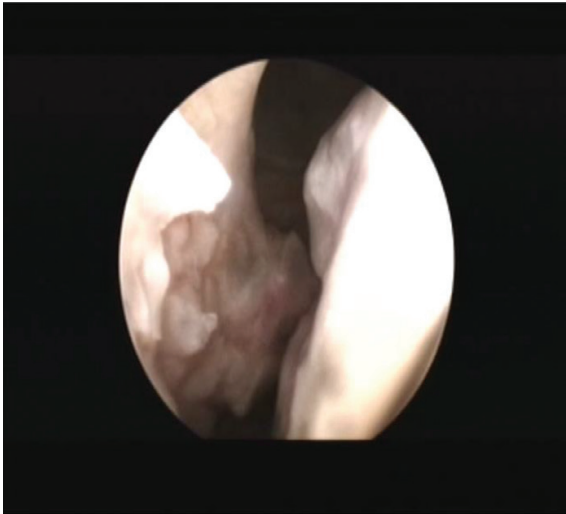


Figure 14. Type III tear.

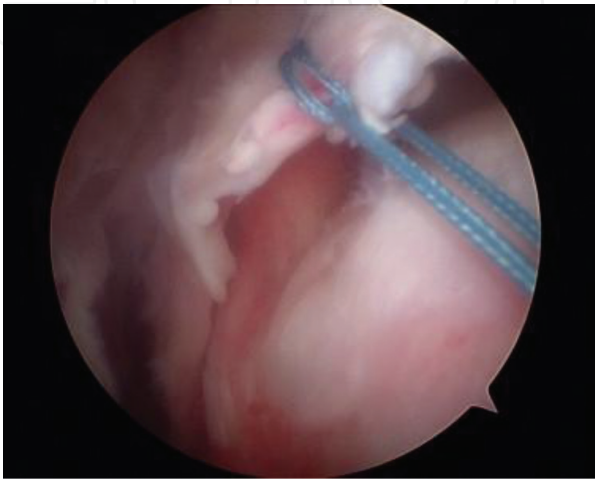


Figure 15. Type IV tear.

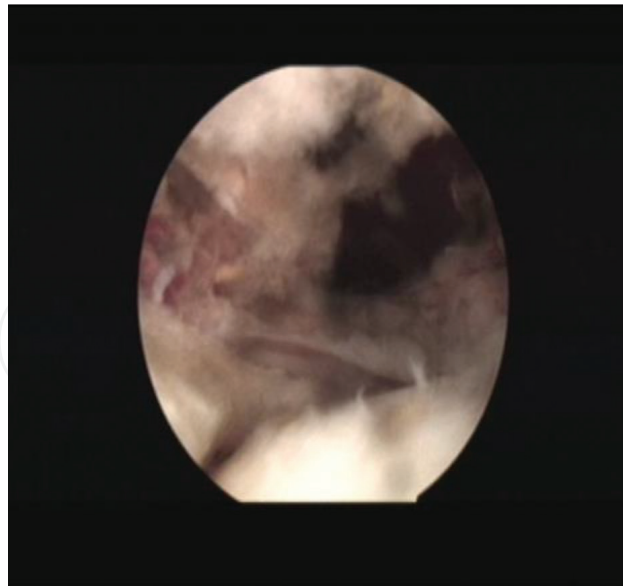


Figure 16. Type V tear.

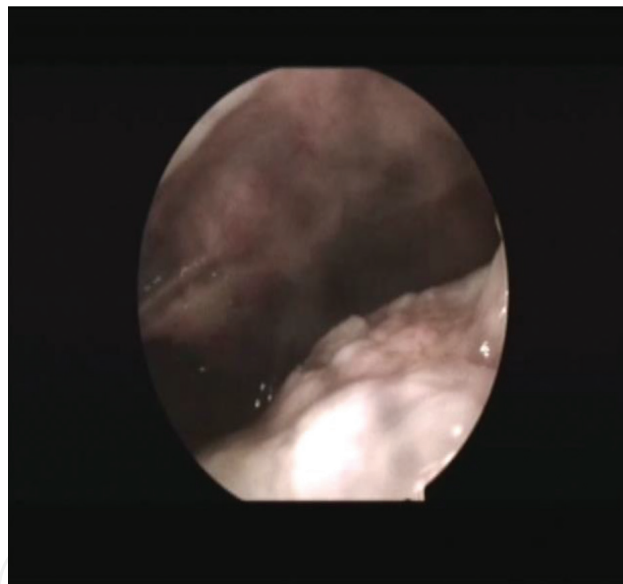


Figure 17. Type V tear Intra-articular view.

In a type V lesion, the lesion is complete, the humeral head is translated anteriorly and superiorly, with coracoid impingement and fatty degeneration of the muscle fibers of the subscapularis (**Figures 16 and 17**).

7. Treatment

There are multiple treatment options in the management of subscapularis tears, with non-operative care indicated in some. In older, inactive patients with smaller a traumatic tears a conservative treatment comprised of physical therapy, anti-inflammatories, and activity modification must be tried. Patients unresponsive to conservative treatment can be considered for surgical repair.

7.1. Open repair

Open repair surgery is performed by deltopectoral approach or anterior deltoid splitting approach in beach chair position. The anterior deltoid splitting approach is mainly used in subscapularis tear associated with supraspinatus or infraspinatus. The deltopectoral approach is used in isolated subscapularis tear. In deltopectoral approach advantage is deltoid is still intact and we can visualize retracted subscapularis tendon. Careful blunt dissection should be done to protect axillary nerve as it lies inferior border of subscapularis. In both approaches we have to open rotator interval from bicipital groove to glenoid. We should be careful for any bicep tendon or supraspinatus pathologies. "Bare bone" will be present between the lesser tuberosity and articular humeral head when there will be complete tear of subscapularis. To visualize the superior subscapular tendon margin, the humeral head must be pushed posteriorly and the tendon seen inside the glenohumeral joint. Tendon should be isolated and then released from its insertion site. In the bare area on the lesser tuberosity with the help of suture anchors or intraosseous sutures the detached tendon is fixed. To fully mobilize the torn tendon if the tendon is too much retracted then release of glenohumeral ligament on the articular side



Figure 18. Open subscap tear.



Figure 19. Open repair.

becomes very important step. Once the surgery is complete, the surgeon must assess the range of motion of the shoulder as well as the stability of the repair (**Figures 18 and 19**).

8. Arthroscopic repair

Arthroscopic subscapularis repair surgery can be done with the patient in lateral or beach-chair position. Arthroscopy allows a complete visualization of intraarticular aspects of the joint. In proper position the subscapularis footprint can be visualized that is arm in abduction and internal rotation. For improved visualization of the footprint, a new technique described by Burkhart that is “Posterior lever push.” In this technique, the elbow is grasped while a posterior force is applied on the humerus. This results into better visualization of subscapularis insertion site as the intact fibers are pulled away from footprint. This technique may increase the field of view by 5–10 mm. Another method is use of a 70° scope for better visualization of the footprint. The assessment of the tear depends upon the size, direction of the tear and the amount of retraction. It becomes highly impossible to distinguish from conjoint tendon when the tendon is totally retracted. In this situation, finding of “the comma sign,” an arc-shaped area of tissue at the superior-most aspect of the subscapularis becomes important. Fibers from the superior glenohumeral ligament as well as the medial head of the coracohumeral ligament comprise the “comma” which serves as a useful lighthouse for the tendon edge.

Biceps tendon pathology like medial subluxation, tears and even SLAP lesions are common with Subscapularis tears, it should be evaluated. The biceps tenotomy or tenodesis is required in order to enhance visualization and protect the repair in case of these pathologies. After a tear of the subscapularis has been identified, subsequent repair should be performed before other shoulder areas are addressed.

Mainly three portals are made to repair the subscapularis.

The posterior portal (P) is the primary viewing portal as commonly used in glenohumeral arthroscopy.

An anterosuperolateral portal (AL) is used to prepare the subscapularis footprint as well as for repair. It lies just anterior to the biceps tendon and anterolateral edge of the acromion.

An anterior portal (AI), is made on just lateral to the coracoid process and it is used for anchor placement.

It becomes very difficult to treat retracted subscapularis tears due to inadequate immobilization. Lo and Burkhart describe the “interval slide in continuity” in which part of the rotator interval and coracohumeral ligament are resected and released in order to increase mobility of the subscapularis tendon. The coracohumeral ligament is “peeled away” from the lateral coracoid, which provides the subscapularis with greater excursion. Preservation of the coracohumeral ligament also allows stable tissue for any associated posterior tears to be approximated via margin convergence.

In this procedure foot print is made by using the same principles that are used for rotator cuff surgery. When the lesions are retracted the bone surface is carefully decorticated, the foot print and subchondral bone exposure is medialised up to 7 mm. Healing process and biological response at the bone tendon interface is improved by micro fractures [12].

Depending upon choices absorbable or non-absorbable anchor sutures can be used in same manner like rotator cuff repair surgery. In almost all cases single anchor suture can be sufficiently used. It is advised that biomechanically one anchor for each square cm. of bare foot print area. It is advised that double row repair has advantages like in rotator cuff surgery in terms of strength and least failure rates. You can use bridging sutures or knotless anchors alternatively. To pass the sutures we can use same techniques that we are using in rotator cuff surgery, paying attention that the sub-coracoid space is far narrower than the sub-acromial space. By using small instruments which pass within the tendon without damaging lesion further, double layer and splitting tears need to be noted. Diagnostic arthroscopy can be used in partial tears thus allowing to undertake transtendineous repair similarly to repair of "PASTA" lesions of the rotator cuff [13] (**Figures 20–31**).

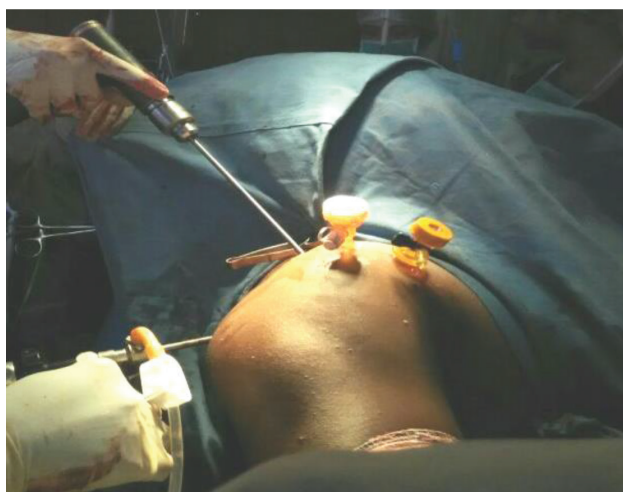


Figure 20. Arthroscopy positions and portals.

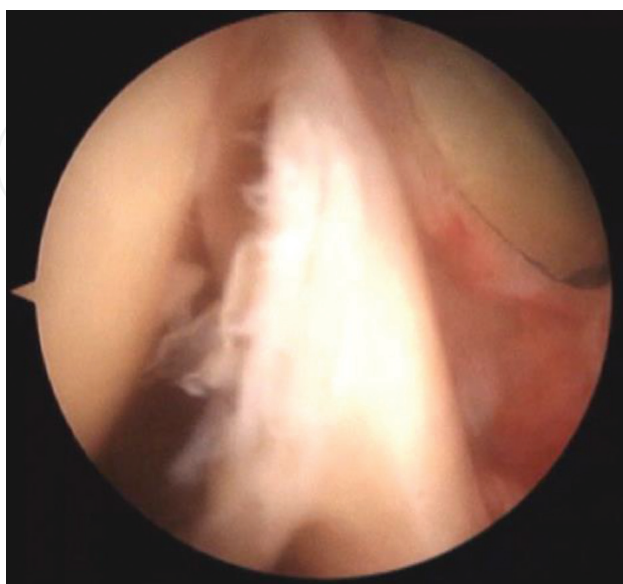


Figure 21. Arthroscopy glenohumeral view.



Figure 22. Anchor inserted.

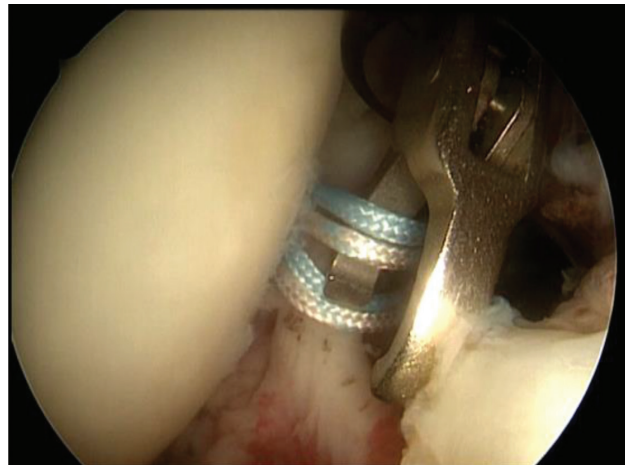


Figure 23. Sutures management.



Figure 24. Sutures passing through tendon.

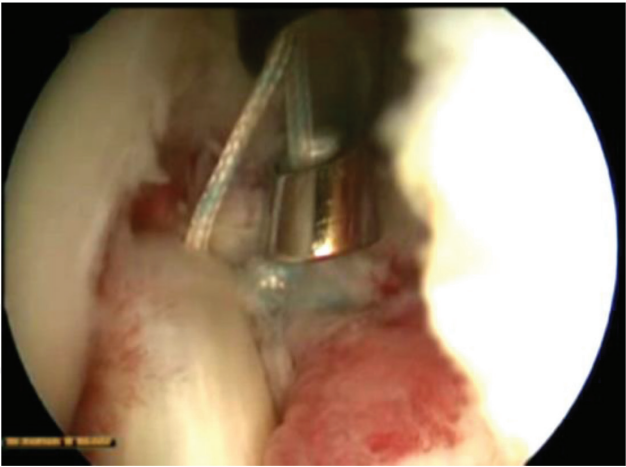


Figure 25. Completed repair.

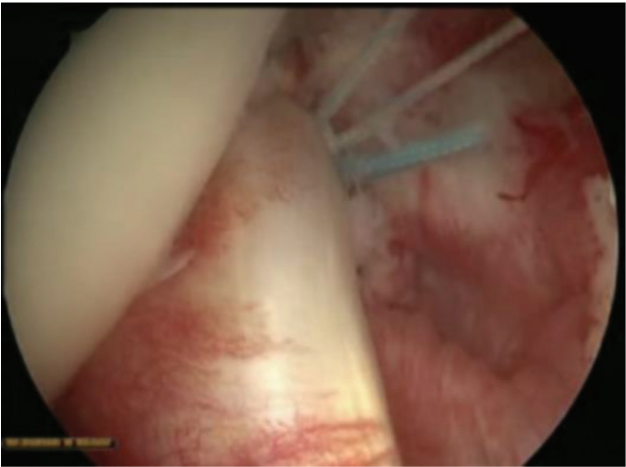


Figure 26. Tout tendon after repair.

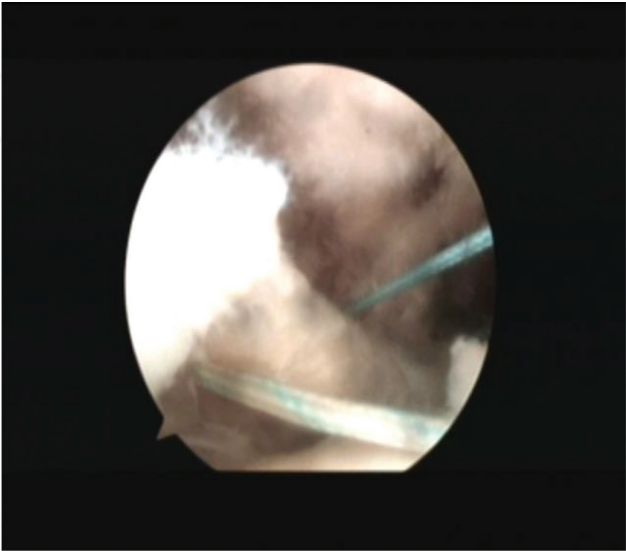


Figure 27. Full thickness tear sub acromial view.

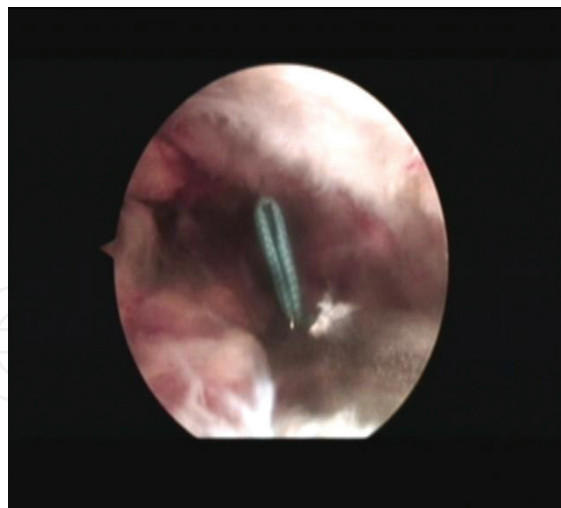


Figure 28. Suture passing through tendon.

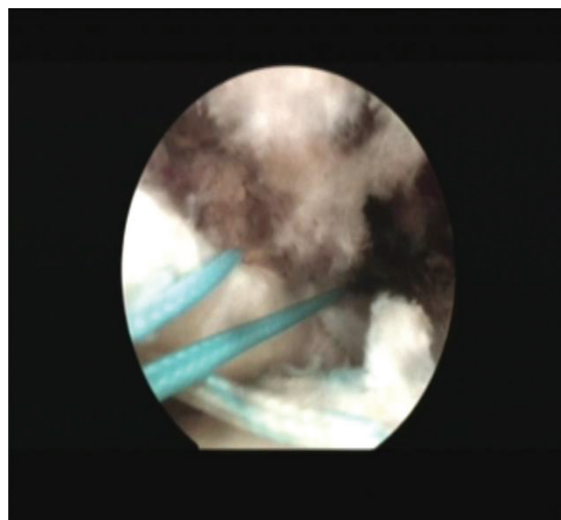


Figure 29. Special instrument for suture passing.



Figure 30. Suture management.

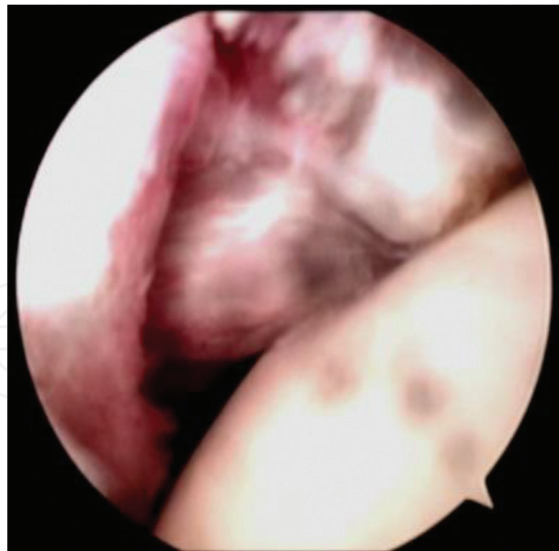


Figure 31. Final repair.

9. Rehabilitation

Physiotherapy protocol is usually individualized as per the Type of tear, Bone and tissue quality, Patients age and physical status and involvement of other Cuff muscles.

Day 0–Day 21:

- Arm pouch.
- Passive ROM as tolerated except external rotation and extension.
- Scapular retraction and rear deltoid exercises.

4th–6 week:

- Gradual full ROM.
- Start active assisted exercises.
- Arm pouch during travel and sleep.

7th–12 weeks:

- No sling.
- Start normal activities.
- Active Thera band exercises for rotator cuff and Scapular muscles.

4th–6 months:

- Weight training for deltopectoral and Biceps-Triceps muscles.
- Sports specific training (**Figures 32 and 33**).



Figure 32. Function post physiotherapy.



Figure 33. Excellent strength and functions.

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