Arthroscopic single row repair of isolated subscapularis tear

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Abstract

Purpose
This study aims to evaluate the results of arthroscopic repair of isolated subscapularis tear
Patients and Methods
Arthroscopic repair of subscapularis tendon tear was performed in twenty patients. All patients were evaluated at a minimum of two-years follow up with a visual analog scale (VAS) score for pain, subjective shoulder value (SSV) was used for subjective evaluation of the affected shoulder as a percentage of the normal one, range of motion, the Constant score and the University of California at Los Angeles (UCLA) scores for clinical assessment. The Belly Press test (BPT) and lift-off test in particular back to hand distance (BHD) were used to evaluate subscapularis function.
Results
The mean age at the time of surgery was 49.2 ± 21.3 years. The rate of dominant arm involvement was 65 % of patients. At the final follow-up, the mean VAS score improved significantly to 0.40±0.03 points postoperatively ($p < 0.01$). The mean SSV improved from 41.6 ± 6.11 preoperatively to 91.1 ± 8.11 at the end of follow-up and this was significant ($p< 0.001$). The mean Constant score improved significantly to 83.0 ±8.11 at the final follow-up ($p<0.001$). The mean UCLA score improved significantly to 30.6 ± 3.81 at the end of follow-up ($P < .001$). Patients gained a significant reduction of Belly-press angle (BPA) from 35.8± 8.33 to 12.8 ± 2.97 ($p<0.0012$). Back-to-hand distance (BHD) has significantly improved from 2.95cm ± 0.61 to 6.0 ± 0.96 ($p<0.0011$).the mean active forward flexion and The mean active internal rotation significantly improved postoperatively, while the mean active external rotation was non significantly reduced.
Patients were satisfied with their repairs, with a mean subjective patient satisfaction score at final follow-up of 7.88±2.43.
Conclusion
Arthroscopic treatment of isolated subscapularis tear results in significant clinical improvements and excellent maintenance of muscle strength

Keywords
Arthroscopic repair, isolated subscapularis tear, subscapularis repair

Introduction

The subscapularis muscle is the dominant internal rotator of the arm. It acts as both a static stabilizer, dynamic stabilizer of the glenohumeral joint, forms the anterior segment of the transverse force couple, and is important for centering the humeral head and restoring normal glenohumeral joint biomechanics. [1-3]

Subscapularis tears can be isolated, part of the anterosuperior rotator cuff tear, or a continuum of large and massive rotator cuff involvement. [4-6]

Isolated subscapularis tears can occur following forced external rotation or extension of a partially abducted arm. [7]

The development of specific clinical tests and advanced imaging techniques improved our rate of accurate diagnosis of the often overlooked isolated subscapularis tendon tear. [8, 9]

Lafosse et al classified subscapularis tears into five types; type I partial superior one third, type II complete lesion superior one third, type III complete lesion superior two-thirds, type IV complete lesion with the head centered and fatty degeneration < stage 3, type V complete lesion with eccentric head and fatty degeneration > stage 3.[10]

For subscapularis tears in symptomatic patients at working age with a preserved subscapularis muscle belly, negligible osteoarthritis, and absence of capsulitis, operative repair is usually considered. [11-13]

Open repair of isolated subscapularis tendon tears achieves good clinical results, as shown in several

studies. Clinical outcomes after arthroscopic repair of isolated subscapularis tendon tears have been reported in a few studies with mainly small patient populations. [10,14-16]

The present study aimed to evaluate the functional outcomes after arthroscopic repair of isolated subscapularis tendon tears.

Patients and Methods

Between January 2016 and October 2017, twenty patients with an isolated subscapularis tendon tear were treated with an all arthroscopic repair. All patients were available for at least 2 years of follow-up. The local institutional review board approved the study, and all patients gave written informed consent. In all cases, the indication for operative repair was a clinically symptomatic subscapularis tendon tear with persistent pain and weakness of the shoulder.

The exclusion criteria included tears combined with the supraspinatus or infraspinatus tendon, fatty muscle infiltration of the subscapularis Goutallier [17] stage 3 or more, bony avulsion of the subscapularis, osteoarthritis, and patients with preoperative capsulitis with substantial loss of passive glenohumeral range of motion.

The study group consisted of 20 patients (14 men and 6 women) who had a mean age of 49.2±21.3 years (range, 28-67 years) at the time of operation. The dominant shoulder was involved in 13 (65%) patients. eighteen patients reported a traumatic onset of symptoms. In 9 cases, a traumatic rupture was caused by a forced abduction and external rotation of the shoulder, 7 patients reported a fall on the outstretched arm, and 2 patients reported a direct anterior blow against the shoulder.

Preoperative Assessments

A complete shoulder assessment, including history and physical examination, was performed in all patients.

Patient history included identifying the onset and duration of symptoms, any trauma to the affected shoulder, and the degree of physical demand, such as manual labor or level of sports involvement. The level of pain was determined using the visual analog scale (VAS). A standard shoulder examination was performed, which included inspection of muscle atrophy, determining the range of motion, both actively and passively. Forward flexion was checked in the scapular plane, external rotation was determined with the elbow at the side, and internal rotation was measured by determining the spinal segment that the patient could reach with his or her thumb. Neer [18] and Hawkins [19] impingement signs were performed. Tenderness on the lesser tuberosity and bicipital groove. Subscapularis power was tested and graded manually from 0-5 according to the Oxford scale [20]. Subscapularis function was tested by the lift-off test [21], in particular back–to-hand distance (BHD) [22], in which the distance (in cm) between the back and the back of the hand was measured and the belly press test, in particular, the belly-press angle (BPA) [23] was measured using a handheld goniometer. The belly-press angle was defined as the angle between the forearm and the hand in the belly-press test. The strength and range of motion of the contralateral shoulder were measured as a control.

All patients underwent objective shoulder evaluation using the University of California at Los Angeles (UCLA) score [24] and the Constant score [25]. A 10-point visual Analog Scale (VAS) was used for subjective pain assessment with 0 means no pain and 10 means maximal pain, and the Subjective Shoulder Value (SSV) was used to have a subjective evaluation of the affected shoulder as a percentage of the normal one [26].

Radiographic evaluation included true anteroposterior and axillary views of the shoulder and an MRI of the shoulder was done.

Operative technique

All patients received preoperative antibiotic prophylaxis within 30 minutes before the beginning of the procedure. Hypotensive general anesthesia was used in all the patients with interscalene block. Patients were placed in the beach-chair position. Bony landmarks of the shoulder joint (acromion, scapular spine, clavicle, coracoid, and acromioclavicular joint) were identified. 30 degrees 5.5 scope was used in all cases.

A posterior standard portal was created first (2 cm inferior and 2 cm medial to the posterolateral acromial angle) Diagnostic glenohumeral arthroscopy is done through this portal to evaluate the intra-articular lesions, then the anterior portal is developed under direct vision with the help of a spinal needle to choose the easiest axis to subscapularis footprint. The biceps tendon and its glenoid attachment are inspected and probed to evaluate if there are any SLAP lesions, subluxation, or dislocation of the tendon outside its groove. The articular surface of the posterosuperior cuff is then evaluated.

Visualization of the subscapularis and particularly its

footprint on the lesser tuberosity was performed with the arm in abduction and internal rotation. This maneuver allows excellent visualization of the footprint. Subscapularis tear size was classified according to the classification of Lafosse et al [10]: type II tears (complete lesion of the superior one-third of the tendon), type III tears (complete lesion of the upper 2 thirds of the tendon), and type IV tears (complete lesion .with centered head); type I tears, representing partial articular-sided tears of the upper third subscapularis and type V tears (complete tendon tear with ecenterec head) were not included in the study. Also, shoulders with other concomitant rotator cuff tears were excluded from the study

For a retracted tendon edge, a gradual release was made. A 270° tendon release was performed by freeing the upper tendon margin from the scars to the pulley sling with an electrothermal device and the shaver, resecting anterior adhesions to the coracoid process and also freeing the posterior aspect of the subscapularis from adhesions to the middle glenohumeral ligament and the scapular fossa, so that the tendon could be pulled tensionless to the lesser tuberosity. The axillary nerve must be identified and protected in the lower border of the subscapularis tendon.

Attention was then paid to the subscapularis repair, where the footprint was prepared through the anterior portal. No cannula was used to give more space to facilitate manipulation and release of the tendon. The tear was then repaired to its bony insertion using one or two 5mm double-loaded Arthrex corkscrew metal suture anchors (Arthrex Surgical Products, Naples, Florida) depending on the size of the tear. Anchors were placed from inferior to superior in the single-row technique. The sutures were then passed through the cuff with Rhino Suture Passer (Arthrex Surgical Products, Naples, Florida) through the anterior portal Lasso loop was used to improve tendon pressure at the footprint. Finally, arthroscopic knots were tied starting inferiorly with the arm in slight abduction and 20° of external rotation. (Fig.1a,b,c,d,e and f).

During diagnostic arthroscopy, the visible aspect of the long head of the biceps tendon (LHBT) was described and its stability tested. If the LHBT was either subluxated or inflamed, biceps tenotomy or tenodesis was performed before the subscapularis tendon repair. Based on clinical findings, an additional coracoplasty, acromioplasty, and/or AC joint resection was performed.

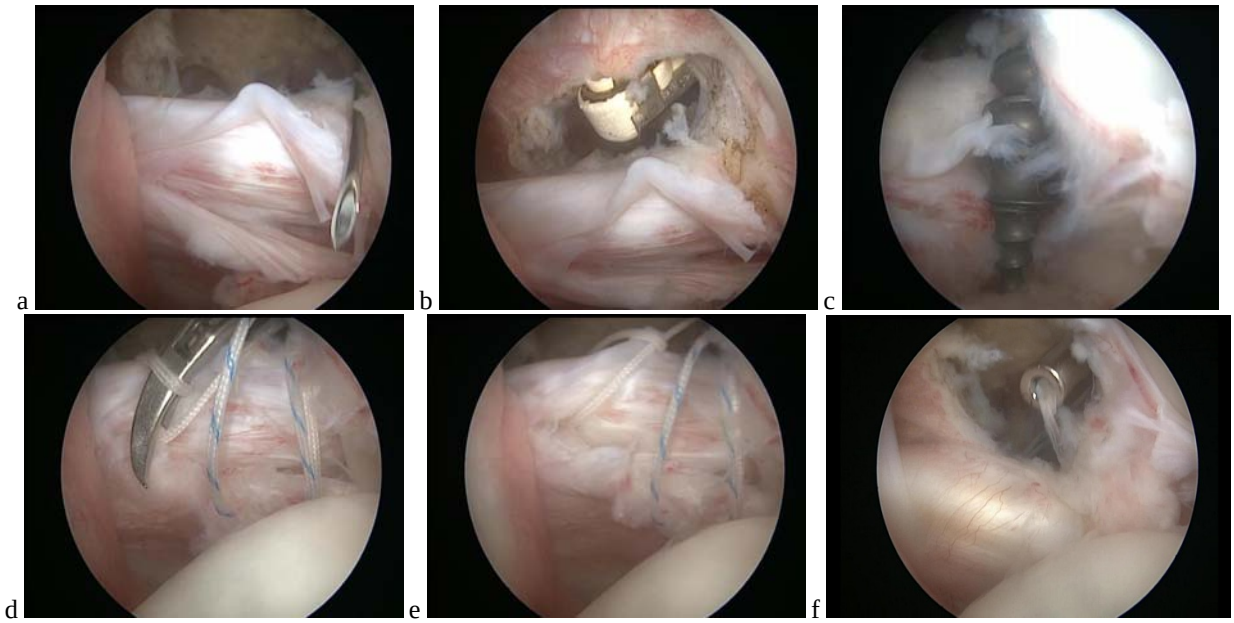

Figure 1: The procedure for subscapularis tendon repair. (a): subscapularis tendon tear. (b) Subscapularis tendon release (c) Anchor insertion in lesser tuberosity (d) suture passage by rhino suture passer (e) lasso loop (f) knot tying

Postoperative Rehabilitation

The affected arm was immobilized in an abduction brace for 6 weeks. Patients were asked to refrain from any active shoulder range of motion, and avoid active elbow flexion if biceps tenodesis was performed. On the first postoperative day, pendulum exercises and self-assisted circumduction exercises were encouraged. Before discharge, patients were educated about their rehabilitation protocol. Patients were followed up at two weeks, six weeks, three months, six months, and one year postoperatively. At six weeks postoperatively, patients were allowed to start active assisted exercises. Three months postoperatively, patients started an active range of motion and isotonic

strengthening exercises using elastic bands. Six months after surgery, patients were allowed to make a gradual return to their sporting activities.

Postoperative Assessment

All patients were evaluated at 3, 6,12, 18, and 24 months postoperatively applying the same preoperative assessment protocol. MRI was done for all patients at 12 months and the final follow up to evaluate the integrity of the repaired tendon.

Satisfactory Outcome Score

At the final follow-up, patients were asked via questionnaire to rate how satisfied they were with the rotator cuff repair on the ten-point scale with one being unhappy and ten being happy.

Statistical analysis:

The Data was collected and entered into the personal computer. Statistical analysis was done using Statistical Package for Social Sciences (SPSS/version 21) software.

The statistical test used as follow:

Athematic mean, standard deviation, For normally distributed data, comparison between two independent populations were done using independent t-test. The level of significance was 0.05.

Results

Patient demographic data

The studied group was composed of 14 men and 6 Women. The mean age at the time of surgery was 49.2 ± 21.3 years. The rate of dominant arm involvement was 65 % of patients. These patients were followed for a mean of 32.5±7.25 months (Table I).

Arthroscopic findings and concomitant procedures

According to Lafosse et al the subscapularis tears were type II tear seen in 7 patients (35%), type III tear was found in 9 patients (45%), and type IV subscapularis tear was encountered in 4 patients (20%). [10] (Table 2)

Concomitant biceps tenotomy was done in 8 patients (40%), biceps tenodesis was done in 7 patients (35%), Excision of the distal end of the clavicle was done in 4 patients (20%) and coracoplasty was done in 8 patients (40%). (Table 3)

Table 1: demographic and clinical data of the studied patients

	No.	%
Sex		
Male	14	70.0
Female	6	30.0
Age		
<50	9	24.0
>50	11	76.0
Range	28-67	
Mean±SD	49.2±21.3	
Median	48	
Affected side		
Right	12	60.0
Left	8	40.0
Dominant affected	13	65.0
Risk factors		
Smoker	12	48.0
DM	9	36.0
Duration of follow up		
Range	24-40	
Mean	32.5	
S.D.	7.25	

Table 2: Distribution of the studied group regarding the type of tear according to Laffose classification. (10)

	No.	%
Type II	7	35.0
Type III	9	45.0
Type IV	4	20.0

Table 3: Concomitant procedures in the studied group

	No.	%
Biceps tenotomy	8	40
Biceps tenodesis	7	35
Coracoplasty	8	40
Associated distal clavicle excision	4	20.0

Functional outcomes assessment

A statistically significant improvement was observed in all the clinical parameters measured.

The mean preoperative VAS score (± standard deviation) was 6.4 ± 1.22, while the mean postoperative VAS score significantly improved to 0.40 ± 0.03 ($p<0.001$) at the 2-years follow-up. The mean SSV improved from 41.6 ± 6.11 preoperatively to 91.1 ± 8.11 at the end of follow-up and this was significant ($p< 0.001$). (Table 4)

The mean Constant score improved significantly from 56.0 ± 7.0 preoperatively to 83.0 ±8.11 at the mean 2 years follow-up ($p<0.001$). The mean UCLA score improved significantly from 15.12 ± 2.33 preoperatively to 30.6 ± 3.813at the 2-years follow-up ($P < .001$). (Table 4)

Concerning the quantitative evaluation of the subscapularis function postoperatively, patients gained a significant reduction of Belly-press angle (BPA) from 35.8°± 8.33 to 12.8° ± 2.97 (p<0.0012). Back-to-hand distance (BHD) has significantly improved from 2.95cm ± 0.61 to 6.0 ± 0.96 (p<0.0011) (Table 5).

Furthermore, the modified belly-press test showed significant improvement of the subscapularis muscle strength at the final follow-up from 3.71 ± 0.43 to 4.88 ± 0.56 (p<0.0287). (Table 5).

The mean active forward flexion improved significantly from 155.0±12.3 preoperatively to 163.0±9.1at the final follow-up (p<0.008). The mean active external rotation was reduced from 57.6±9.2 preoperatively to 54.1± 6.99 at the final follow-up and this was not significant (p<0.107). The mean active internal rotation significantly improved from L1 (S1-T9) preoperatively to T10 (L3-T5) (p<0.021). (Table 5).

Overall, patients were satisfied with their repairs, with a mean subjective patient satisfaction score at final follow-up of 7.88±2.43 (range, 4-10). (Table 6). (Fig 2)

The clinical results were evaluated regarding the size of the tear. With the sample size, we did not find a correlation between tear size and clinical outcomes. (Table 7) (Fig 3)

Two patients (10%) showed postoperative complications in the form of a stiff shoulder. These patients showed lower functional scores, the worst pain, and lower improvement in range of motion. one patient (5%) improved by physiotherapy, and the second patient (5%) arthroscopic capsular release at 10 months postoperatively.

Table 4: Comparison between pre and post-operative at end of follow up regarding functional outcomes assessment

	Preoperative	**At end follow up**	**P**
VAS	6.4±1.22	0.40±0.03	0.001*
SSV	41.6±6.11	91.1±8.11	0.001*
Constant	56.0±7.0	83.0±8.11	0.001*
UCLA score	15.12±2.33	30.6±3.13	0.001*

Table 5: Quantitative evaluation of the subscapularis function postoperatively

	Preoperative	**At end follow up**	**P**
Belly-press angle (BPA)	35.8±8.33	12.8±2.97	0.0012*
Back-to-hand distance (BHD)	2.95±0.61	6.00±0.96	0.0011*
Subscapularis muscle strength	3.71±0.43	4.88±0.56	0.0287*
Active forward flexion	155.0±12.3	163.0±9.1	0.008*
Active external rotation	57.6±9.2	54.1±6.99	0.107
Active internal rotation (median vertebrae level)	L1 (S1-T9)	T10 (L3-T3)	0.021*

Table 6: Distribution of the studied patients regarding their satisfaction

Patients satisfaction	**No.**	**%**
4-6	2	10.0
6-8	4	20.0
8-10	14	70.0
Range	4-10	
Mean±S.D.	7.88±2.43	
Total	20	100.0

Table 7: Relation between tear size according to Laffose classification and clinical outcome

	Type II "n=7"		**Type III "n=9"**		**Type IV "n=4"**	
	Preoperative	At end of follow up	Preoperative	At end of follow up	Preoperative	At end of follow up
SSV (%)	42.1±4.69	92.3±6.11	40.2±5.20	90.1±9.32	39.6±4.12	89.1±7.98
P value	0.0013*		0.001*		0.004*	
Constant	60.1±6.03	83.9±8.65	57.2±5.11	82.0±9.01	54.8±6.62	80.7±7.96
P value	0.0021*		0.001*		0.003*	
VAS	6.0±1.03	0.32±0.02	6.3±1.08	0.41±0.040	7.0±1.66	0.55±0.03
P value	0.001*		0.001*		0.001*	

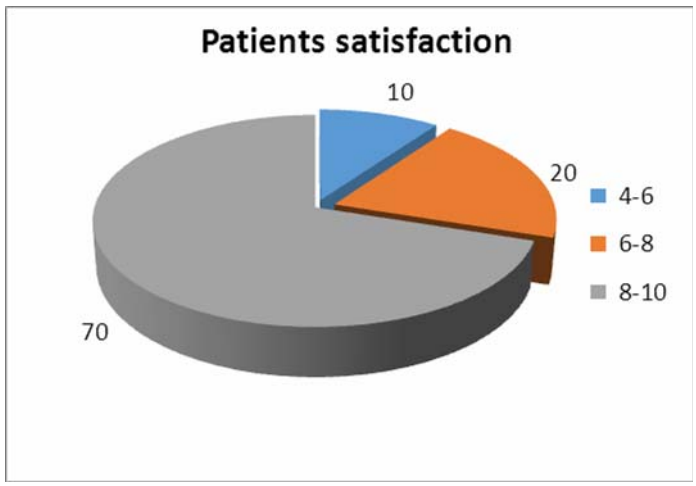

Figure 2: Distribution of the studied patients regarding their satisfaction

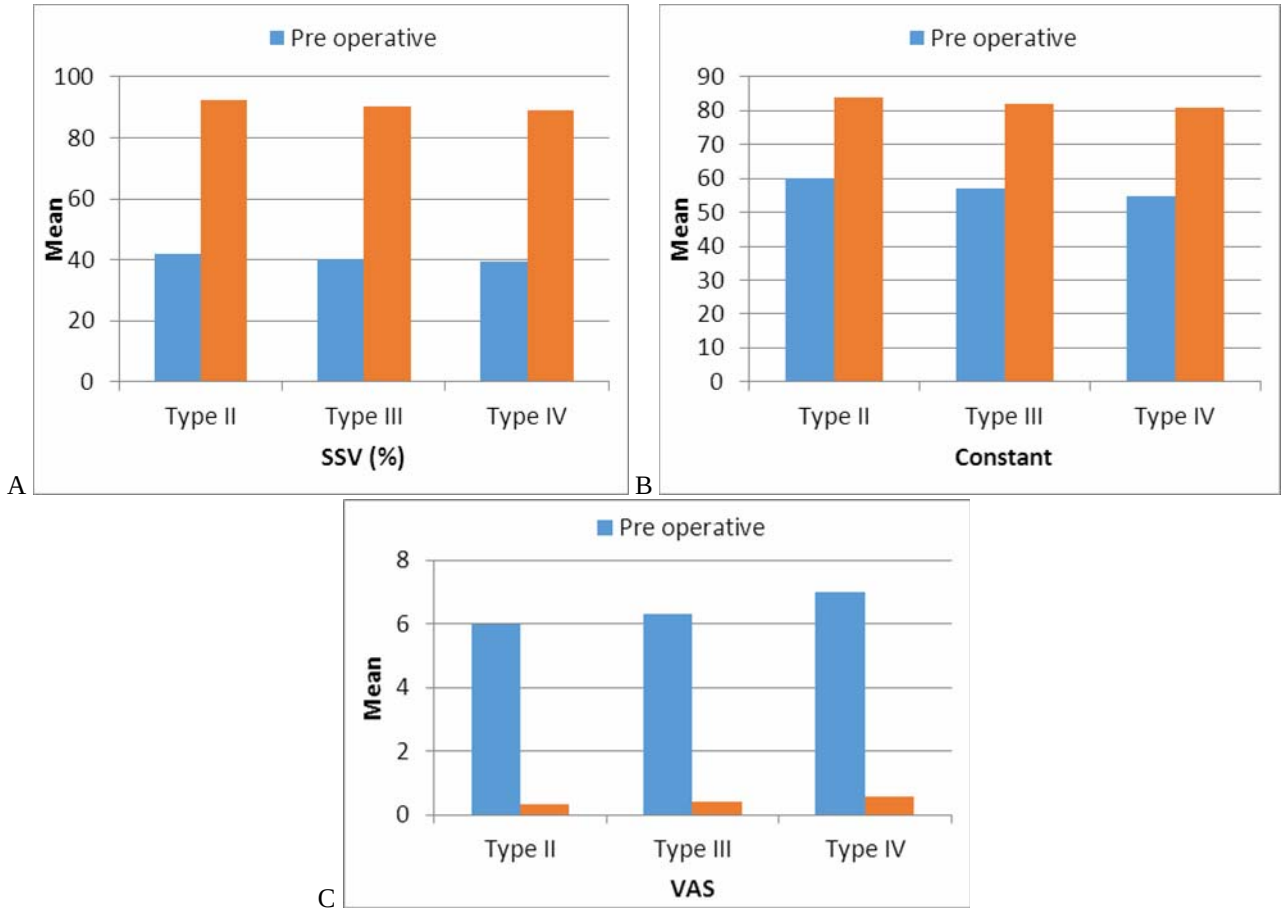

Fig. (3 A,B,C): Relation between tear size according to Laffose classification and clinical outcome

Discussion

Evaluation and detection of subscapularis tendon tears have improved due to developed arthroscopic skills and dynamic evaluation during shoulder arthroscopic surgery. The clinical and radiological diagnosis of subscapularis tendon complete tears is easy however the diagnosis of partial and smaller tears remains a challenge. The preoperative MRI interpretation did not reliably predict which patient had a small partial subscapularis tendon tear. The arthroscopic diagnosis is the gold standard for these lesions. Several reports have shown the incidence of the subscapularis tendon tear ranges from 2.1% to 10.5%. However, Sugaya et al reported the incidence was as high as 27.4%. [27-31]

Understanding the anatomy of the subscapularis footprint is crucial for an accurate diagnosis of these tears. Knowledge of the mean size of the footprint allows a proper evaluation of the partial tear size dimension.

The superior most insertion is also thought to have sufficient length to support the biceps tendon. These results highlight the importance of a clear investigation of the long head of the biceps tendon (LHB) in patients with subscapularis tears. [31,32]

In the biomechanical analysis, Yoo JC et al have shown that partial subscapularis tear might have an impact on glenohumeral joint kinematics. At 30 degrees of abduction, a ¼ subscapularis tear leads to significantly increased maximum external rotation and at maximum internal and external rotation, there was a significant superior shift in the humeral head apex position.[33]

The treatment of subscapularis tendon tears is multifold and recently developed further, ranging from simple debridement to single row and double row repairs.[27] Open repairs have been associated with good results in several studies.[11,13,34] In 2002 the technique of arthroscopic subscapularis tendon tears repairs was described by Bruckhart. [35]

The clinical and structural outcomes of arthroscopic repair are reliable. [36] Comparison with open surgery outcomes did not demonstrate a significant difference.[37] The currently available literatures show that repair of isolated partial subscapularis tendon lesions leads to successful clinical results. [10,38]

As the few available studies have however major flaws, due to either retrospective design, limited patient number, heterogenic subscapularis tendon tear pattern and short term follow up, as well as missing knowledge about the natural history of the partial subscapularis tendon lesions. In a study by Burkhart et al, the authors were the first to describe the technique and preliminary results of arthroscopic repair of the subscapularis tendon. The study evaluated 25 patients with a mean age of 61 years who had either anterosuperior or isolated subscapularis tendon tears repaired with an arthroscopic surgical technique. The mean follow-up in the study was 10.7 months with 23 good to excellent results, 1fair, and 1 poor result.[35]

Bennett et al. reported on a series of eight patients with isolated subscapularis repairs who were followed for a minimum of two years". The average postoperative Constant score was 74 points. However, the clinical evaluation of subscapularis function with the use of either the lift-off or belly press test was not reported. [15]

There have also been several articles published on the arthroscopic surgical treatment of subscapularis tendon tears. Kim et al. evaluated 29 patients with a mean age of 54 years who had isolated partial articular surface tears of the subscapularis tendon repaired with an arthroscopic surgical technique. The mean follow-up in their study was 2.3 years with 18 excellent, 10 good, and 1 fair result. [23]

Lafosse et al. published a prospective study on 17 patients with a mean age of 47 years who had isolated tears of the subscapularis tendon repaired with an arthroscopic surgical technique. The mean follow-up in his study was approximately 2.4 years with 12 patients very satisfied, 4 satisfied, and 1 not satisfied with the result at the latest follow-up examination. [10]

There have been few reports to date on the long-term results of surgical repair of isolated subscapularis tears. Hasler et al [39]on 36 patients and Seppel et al [38] on 17 patients discussed the long-term results of subscapularis tendon tear repair with single raw with a mean follow-up of 8.6 and 8.2 years respectively. Patient satisfaction was high with 97% of patients satisfied or very satisfied in Hasler et al [39],'s study and 88% in Seppel et al,'s [38]. the subjective shoulder value (SSV) was 91% in Hasler et al. and 80% in the Seppel study. The post-operative constant score was 81 in Hasler et al series and 74 in Seppel et al series. The gain after surgery ranged from 20 to 26 points.

Tear size was not predictive of overall clinical results in any of the studies. Sepple et al. found no significant difference in the range of motion between the injured and uninjured shoulder. [38]

However, the two studies show a persisting deficiency in clinical tests and /or residual strength deficit, which were unrelated to tendon healing or subjective and objective clinical outcomes. Subscapularis tendon tests are generally negative after surgery, but the litoff test and Jobe test remained positive for respectively and 6% of Hasler et al[39] patients and 17% of Seppel et al [35] patients. There was no association between shoulder strength and the size of the tear.

The clinical and anatomical outcomes are similar in the long term as in short term and medium term, clinical and anatomical outcomes are good and in the large majority of cases, the subscapularis tendon heals successfully regardless of the initial size of the tear.

Fatty infiltration of subscapularis muscle progress postoperatively even when the tendon heals successfully. This fatty infiltration predominantly in the superior deep part of the muscle seems to occur early then remains stable over time. [15]

The present study evaluated 20 patients with a mean age of 49.2+- 21.3 years who had isolated subscapularis tendon tears repaired with an arthroscopic surgical technique. According to Lafosse classification,

There were 7 patients type II, 9 patients type III, and 4 patients type IV. The mean follow-up in this study was 32.5+_7.25 months. There were statistically significant improvements in Constant score (56+_7to 83_+8.11) , UCLA score (15,12+_2.33 to 30.6+_3.81) and SSV (41.6 +_6.11 to 91.1+_8.11) at the latest follow-up evaluation. VAS significantly improved from 6.4+_1.22 to 0.40+_0.03. Patients were satisfied with their repairs, with a mean subjective patient satisfaction score of 7.88+_2.43.

Patients in this study gained a significant reduction of Belly press angle from 35.8 degrees to 12.8 and back to hand distance significantly improved from 2.95cm to 6 cm. the mean active forward flexion improved significantly from 155+_ 12.3 to 163 +_9. the mean external rotation was reduced from 57.6+_9.2 to 54.1+_ 6.99 and this was not significant. The mean internal rotation significantly improved from L1 to T10

We did not found any correlation between the size of the tear and clinical outcome

Two patients showed postoperative complications in the form of a stiff shoulder. These patients showed lower functional scores, worst pain, and lower improvement in range of motion. One patient improved by physiotherapy and the second patient had arthroscopic capsular release after 10 months of postoperative

Conclusion

Arthroscopic treatment of isolated subscapularis tear results in significant clinical improvements and excellent maintenance of muscle strength.

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