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Arthroscopic vs. Open Repair of Subscapularis Tears: A Comparative Study on Functional Outcomes

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ABSTRACT

Background: Subscapularis tear repair can be achieved through arthroscopic or open surgical techniques.
Objectives: The current work aimed to compare the outcomes of both methods in patients with subscapularis tears.
Patients and methods: This prospective study included 30 patients with subscapularis tears requiring surgical intervention, conducted at Benha University Hospitals and Ahrar Teaching Hospital from November 2020 to February 2023. Patients were randomly assigned into two groups: Group I (arthroscopic repair, n=15) and Group II (open surgery, n=15). Functional outcomes were assessed using the Simple Shoulder Test, Constant scores, and UCLA Shoulder Score, while subscapularis function was evaluated with passive and active rotation measurements, belly-press, and lift-off tests. Postoperative follow-up occurred at 3, 6, and 12 months.
Results: The mean age of patients in the arthroscopic and open surgery groups was 45.33 and 45.93 years, respectively. Postoperative Constant scores improved significantly in both groups (arthroscopic: 87.06±7.8, open: 84.06±2.84, p=0.001). The arthroscopic group demonstrated better improvement in the lift-off test (14 patients with negative outcomes) compared to the open surgery group (8 patients, p=0.018). Forward elevation significantly improved in the arthroscopic group (175.66±10.49°) compared to the open surgery group (162.66±7.76°, p<0.001).
Conclusion: Arthroscopic repair of subscapularis tears results in comparable functional outcomes to open surgery, with superior improvements in specific functional measures like lift-off test and forward elevation. These findings suggest arthroscopic repair as a favorable option in selected patients.
Keywords: Subscapularis tear, Arthroscopic repair, Open surgery, Shoulder function, Randomized study

INTRODUCTION

Subscapularis tears are a common injury affecting the shoulder, often resulting from trauma or degenerative changes. These tears can cause significant pain, weakness, and reduced range of motion, particularly during internal rotation of the shoulder. Proper diagnosis and timely surgical intervention are crucial to restore shoulder function and improve patient outcomes. While both arthroscopic and open surgical techniques have been employed for subscapularis repair, the choice of method remains a subject of ongoing debate in the orthopedic community [1].

Arthroscopic repair has gained popularity due to its minimally invasive nature, which offers the potential for quicker recovery, reduced postoperative pain, and improved visualization of shoulder structures. This technique allows surgeons to address concomitant pathologies, such as biceps tendon injuries or other rotator cuff tears, through the same approach [2]. Despite these advantages, arthroscopic repair can be technically challenging, particularly in cases of large or retracted subscapularis tears, raising concerns about its long-term durability and effectiveness compared to open repair [3].

On the other hand, open repair has been a traditional approach, providing direct access to the subscapularis tendon and allowing precise reattachment. It is often favored in cases of more severe tears, where visualization and mobilization of the tendon are essential [4]. However, open surgery is associated with a longer recovery period, greater postoperative pain, and a higher risk of complications such as stiffness and scar formation [5]. Given the differences between these techniques, there is a need for comparative studies to determine which method offers better functional outcomes and fewer complications.

This study aimed to compare the outcomes of arthroscopic versus open surgical repair in patients with subscapularis tears, focusing on functional recovery, pain reduction, and overall shoulder function.

PATIENTS AND METHODS

This prospective study included 30 patients with subscapularis tears who needed repair and attended Benha University Hospitals and Ahrar Teaching Hospital from November 2020 to February 2023.

Inclusion criteria:
Patients aged 18-70 years of both sexes who had clinically symptomatic isolated ST tear, and concomitant other rotator cuff tear with persistent pain and weakness of shoulder.

Exclusion criteria:
Patients with massive rotator cuff tear with more than 5 cm retraction, previous shoulder surgery, pseudoparalysis, history of shoulder infection, arthrosis of glenohumral joint and rotator cuff arthropathy.

The included subjects were randomized using a computer-generated randomization table into two equal groups (each 15patients): Group I include patients who underwent arthroscopic surgery to repair subscapularis tear. Group II include patients who underwent open surgery to repair subscapularis tear.

All patients underwent a thorough evaluation, including a standard physical examination, medical

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history assessment, and comprehensive laboratory tests. Functional assessment was conducted using Simple Shoulder Test [6], using absolute and adjusted constant scores [7], and University of California, Los Angeles (UCLA) Shoulder Score [8]. Subscapularis function was tested via passive and active rotation measurements [9], and specific tests (lift-off and belly-press) [10, 11]. Radiographic evaluations included standard pre- and postoperative views, and preoperative MRI assessed tear characteristics and muscle condition.

Operative Technique

All patients (100%) received general anesthesia with an endotracheal intubation, in addition to antibiotic administration for Group II.

Group I (Arthroscopic operative technique)

Patients were positioned in a beach chair at 70° to facilitate shoulder manipulation, with scapula off table and arm hanging freely. surgeon stood beside patient's shoulder, identifying key bony landmarks, while a 30° 5.5-mm scope was utilized for procedure. A posterior standard portal was established, followed by diagnostic arthroscopy to assess intraarticular lesions and develop anterior portal for subscapularis manipulation. biceps tendon and supraspinatus were inspected for tears, with visualization of subscapularis footprint facilitated by arm positioning. tear was repaired using 5-mm double-loaded Mitek Fastin anchors, with sutures passed through cuff and arthroscopic knots tied. Subacromial decompression and lateral clavicle resection were performed, if necessary, followed by supraspinatus repair through lateral portals.

Group II (Surgical technique of open surgery)

Open repair surgery for subscapularis tears was performed using either a deltopectoral or anterior deltoid splitting approach, depending on the associated injuries. The deltopectoral approach preserves the deltoid, allowing better visualization of the retracted tendon, while care must be taken to protect the axillary nerve. Both approaches require opening rotator intervals and assessing for biceps tendon or supraspinatus issues. In cases of complete subscapularis tears, "bare bone" is visible between lesser tuberosity and humeral head. the tendon is isolated, released from its insertion, and reattached using suture anchors. If the tendon is significantly retracted, releasing the glenohumeral ligament is crucial for mobilization. Post-surgery, the surgeon evaluates the shoulder range of motion and repairs stability.

Outcome Measures

Postoperative rehabilitation involved immobilizing affected arm in an abduction brace for 6 weeks, during which patients avoided active shoulder motion and elbow flexion if biceps tenodesis was performed. On the first day post-surgery, pendulum and self-assisted circumduction exercises were introduced, and patients received education on their rehabilitation protocol before discharge. Follow-ups were scheduled at 2 weeks, 6 weeks, 3 months, 6 months, and 1 year, with active assisted exercises permitted at 6 weeks, and active range of motion and isotonic strengthening exercises starting at 3 months. By 6 months, patients could gradually resume sports activities. All patients were assessed at 3, 6, and 12 months using the same preoperative evaluation methods.

***Ethical Consideration*:**

This study was ethically approved by the Research Ethics Committees, Al Ahrar Teaching Hospital and Banha University Hospitals. Written informed consent of all the participants was obtained. The consent form explicitly outlined their agreement to participate in the study and to publicize the data, ensuring the protection of their confidentiality and privacy. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human testing.

Statistical methods

Data were carefully reviewed, encoded, and processed using IBM SPSS Statistics version 25.0. The Shapiro-Wilk test was employed to evaluate the normality of data distribution, with nonparametric findings considered significant when deviations were detected. For parametric data, descriptive metrics included the mean, standard deviation, and range, while frequencies and percentages summarized categorical data. Comparative analysis was conducted using the Student's t-test for mean differences between groups, with the Chi-square and Fisher's exact tests applied to qualitative variables. Paired t-tests were used to assess changes over time, and repeated measures ANOVA examined variations across multiple time points. Graphical representations featured column charts, with error bars indicating standard deviation values. A p-value of less than 0.05 was considered indicative of statistical significance within a 95% confidence interval.

RESULTS

The mean age in the arthroscopic group was 45.33 years (6 males, 9 females), while the open surgery group had a mean age of 45.93 years (9 males, 6 females). There were no significant differences in age, gender distribution, or medical history between the groups. In the arthroscopic group, 20% of patients were smokers, 33.4% had hypertension, and 13.3% had diabetes. In comparison, the open surgery group had 33.33% smokers, 20% with hypertension, and 26.7% with diabetes. Occupational backgrounds were comparable between the two groups **Table 1**

Table 1: Comparison of demographic data and medical history among studied groups.

	Total subjects n=30	Arthroscopic group n=15	Open surgery group n=15	Test	p
Age Mean ±SD	45.63±11.5	45.33±9.9	45.93±13.35	0.140	0.890
Gender					
Male, n (%)	15(50)	6(40)	9(60)	1.200	0.273
Female, n (%)	15(50)	9(60)	6(40)		
Special habits, n (%)					
Smoker	8(26.66)	3(20)	5(33.33)	0.68	0.409
Non-smoker	22(73.33)	12(80)	10(66.66)		
Hypertension, n (%)					
Hypertension	8(26.6)	5(33.4)	3(20)	0.68	0.409
Non hypertensive	22(73.4)	10(66.6)	12(80)		
Diabetes, n (%)					
Diabetic	6(20)	2(13.3)	4(26.7)	0.83	0.361
Non-diabetic	24(80)	13(86.7)	11(73.3)		
Occupation, n (%)					
Employer	13(43.3)	5(33.33)	8(53.3)	2.23	0.329
Housewife	12(40)	8(53.33)	4(26.7)		
Driver	5(16.7)	2(13.33)	3(20)		

SD: standard deviation.

In arthroscopic group, 86.6% had a history of trauma, with 13.4% isolated and 86.6% combined tears, while in open surgery group, 80% had trauma, with 53.3% isolated and 46.7% combined tears, showing a significant difference. Right-side tears were more common in both groups (73.3% arthroscopic, 60% open). Post-operative pain was mostly absent or mild, and complications were rare in both groups. Follow-up durations were similar, with no significant differences in complications or follow-up times. **Table 2**

Table 2: Comparison of tear characteristics and surgery complications among studied groups.

	Total subjects n=30	Arthroscopic group n=15	Open surgery group n=15	Test	p
History of trauma					
Yes	25(83.3)	13(86.6)	12(80)	0.240	0.624
No	5(16.7)	2(13.4)	3(20)		
Tendon tear					
Isolated	10(33.3)	2(13.4)	8(53.3)	5.400	0.02*
Combined	20(66.7)	13(86.6)	7(46.7)		
Side affected					
Right	20(66.7)	11(73.3)	9(60)	0.600	0.439
Left	10(33.3)	4(26.7)	6(40)		
Post-operative pain					
Mild pain	4(13.33)	0(0)	4(26.66)	5.360	0.069
Moderate	1(3.33)	1(6.66)	0(0)		
No pain	25(83.33)	14(93.33)	11(73.33)		
Complications					
No complications	25(83.3)	14(93.3)	11(73.3)	3.360	0.186
Superficial infection	3(10)	0(0)	3(20)		
Infection and rapture	2(6.7)	1(6.7)	1(6.7)		
Duration of follow up (months), M ±SD					
	20.26±3.24	20.06±3.91	20.46±2.53	0.332	0.742

Preoperative assessments showed significant differences in constant scores (arthroscopic: 54.36, open surgery: 51.4). Belly press and lift-off tests were mostly positive in both groups. Abduction, external rotation, and internal rotation levels were similar. Postoperatively, significant improvements were noted in constant scores (arthroscopic: 87.06, open surgery: 84.06) and UCLA scores, with better belly press and lift-off test outcomes in arthroscopic group. Postoperative abduction, forward elevation, and internal rotation also showed significant improvements, particularly in arthroscopic group, while external rotation showed no significant difference between two groups. **Table 3**

Table 3: Comparison between groups of study according to preoperative and post-operative data

	Total subjects(n=30)	**Arthroscopic group(n=15)**	**Open surgery groupn=(15)**	**Test**	**p**
Preoperative Constant score					
	54.36±4.93	57.33±3.82	51.4±4.11	Z=28.500	<0.001*
Preoperative belly press test					
negative	2(6.66)	0(0)	2(13.33)	2.143	0.143
Positive(no)	28(93.33)	15(100)	13(86.66)		
Preoperative lift off test					
negative	0(0)	0(0)	0(0)	-	-
Positive(no)	30(100)	15(100)	15(100)		
Preoperative abduction degree					
	111.5±6.45	112±6.49	111±6.6	102.500	.683
Preoperative external rotation					
	31±5.16	30.26±5.41	31.73±4.97	85.500	0.267
Preoperative internal rotation (level of spine)					
L3	17(56.66)	8(53.33)	9(60)	0.136	0.713
L4	13(43.33)	7(46.66)	6(40)		
Preoperative forward elevation					
	148.33±9.31	146±9.67	150.66±8.63	85.000	0.267
Post-operative Constant score					
	85.56±5.96	87.06±7.8	84.06±2.84	Z=35.500	0.001*
Post-operative UCLA score					
	30.2±2.2	30.8±2.83	29.6±1.12	Z=34.500	0.001*
Post-operative belly press test					
negative	24(80)	14(93.33)	10(66.66)	3.333	0.068
Positive(no)	6(20)	1(6.66)	5(33.33)		
Post-operative lift off test					
negative	22(73.33)	14(93.33)	8(53.33)	6.136	0.013*
Positive(no)	8(26.66)	1(6.66)	7(46.66)		
Post-operative abduction degree					
	164.5±13.79	166±19.01	163±5.27	48.000	0.007*
Post-operative internal rotation (level of spine)					
L2	27(90)	14(93.33)	13(86.66)	0.370	0.543
L3	3(10)	1(6.66)	2(13.33)		
Post-operative external rotation					
	45.06±6.78	45.13±7.94	45±5.66	110.000	0.935
Post-operative forward elevation					
	169.16±11.22	175.66±10.49	162.66±7.76	20.000	<0.001*

The arthroscopic group showed greater improvement in both lift-off and belly press tests, with 14 patients showing negative test changes, compared to 8 in open surgery group for both tests. **Table 4**

Table 4: Preoperative and post-operative lift off test and belly press

	Arthroscopic group (n=15)			**Open surgery group (n=15)**				
negative	**Pre**	**Post**	**Change**	**Pre**	**Post**	**Change**	**Test**	**p**
Lift off test	0	14	14	0	8	8	x=5.568	0.018*
negative	**Pre**	**Post**	**Change**	**Pre**	**Post**	**Change**	**Test**	**p**
Belly Press test	0	14	14	2	10	8	x=6.136	0.035*

Pre- and post-operative constant scores, abduction, and external rotation degrees showed significant differences in both groups, with near-equal post-operative mean levels. Forward elevation showed more significant improvement and better results in arthroscopic group compared to open surgery group. **Table 5, Figure 1.**

Table 5: Preoperative and post-operative constant score, abduction degree, external rotation and forword elevation

	Preoperative	Post-operative	Test	p
Arthroscopic gr. Constant score	57.33±3.82	87.06±7.8	-3.422	0.001*
Open surgery gr. Constant score	51.4±4.11	84.06±2.84	-3.430	0.001*
Arthroscopic gr. Abduction degree	112±6.49	166±19.01	-3.334	0.001*
Open surgery gr. Abduction degree	111±6.6	163±5.27	-3.424	0.001*
Arthroscopic gr. External rotation	30.26±5.41	45.13±7.94	-3.330	0.001*
Open surgery gr. External rotation	31.73±4.97	45±5.66	-3.420	0.001*
Arthroscopic gr. Forward elevation	146±9.67	175.66±10.49	-3.316	0.001*

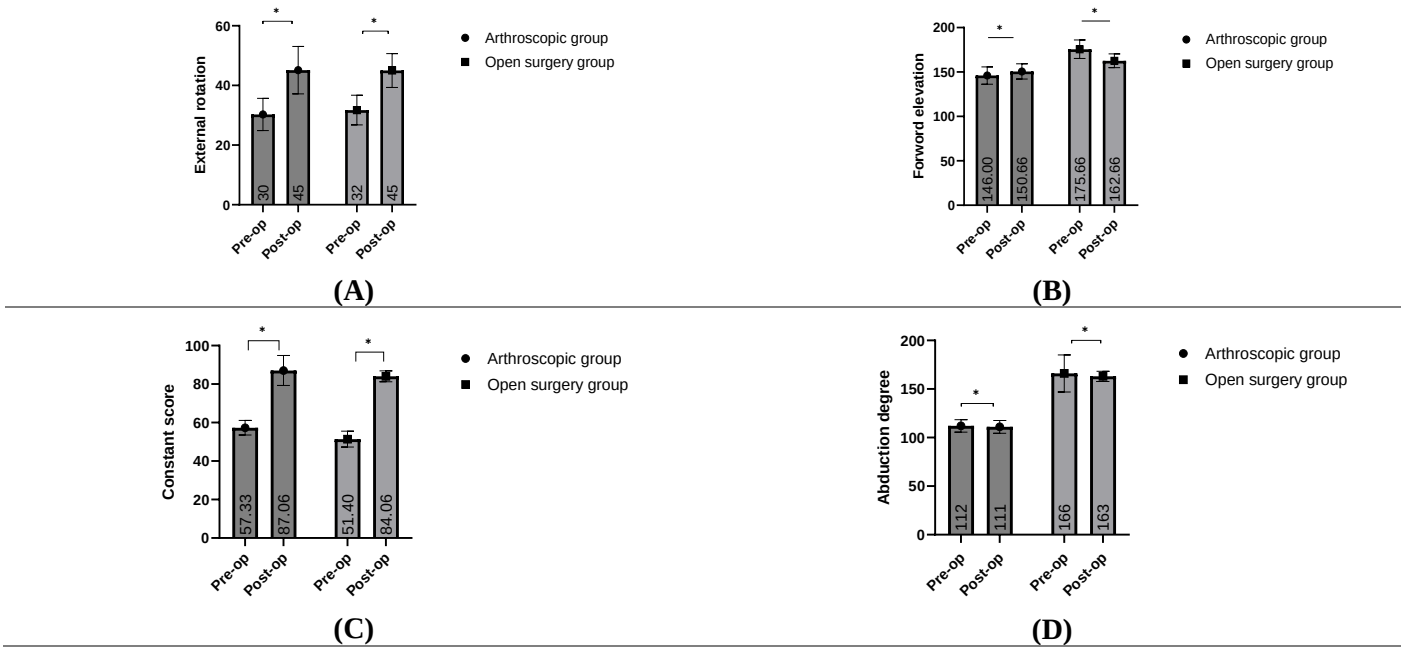

Figure 1: Preoperative and post-operative External rotation (A), forward elevation (B), constant score (C) and abduction degree (D)

DISCUSSION

Subscapularis tendon (ST) tears were first described in cadavers by Smith in 1834, with Hauser pioneering repair studies in 1954. Despite historical descriptions, research on ST repair remains limited due to tendon's proximity to critical neurovascular structures and its lower injury rate compared to other rotator cuff tendons [12]. Previously, ST tears were thought less common than other rotator cuff tears, but they are now recognized as prevalent as infraspinatus tears [13]. ST tears can lead to glenohumeral arthrosis, pain, and loss of internal rotation and stability [14]. repair is challenging due to significant retraction of chronic tears, difficulties in mobilizing tendon near critical structures, and restricted arthroscopic visibility in subcoracoid space [15, 16]. While open repair was once standard, arthroscopic repair has recently gained preference, though comparative studies are still lacking [12, 17]. Therefore, this study aimed to compare arthroscopic versus open techniques outcomes in subscapularis tear repair.

Significant improvements were observed in pre- and post-operative Constant Scores and specific functional tests, with better outcomes noted in arthroscopic group. Arthroscopic surgery showed more significant improvements in belly press and lift-off test results compared to open surgery. Both techniques showed similar mean levels of external rotation and

abduction post-operatively, with notable advantages in forward elevation in arthroscopic group.

Consistent with our results, **Gedikbas et al.** [12] performed a retrospective cohort study that compared the clinical outcomes of open and arthroscopic treatment for ST, with or without accompanying supraspinatus tendon injuries. This study involved 70 patients who underwent treatment for isolated subscapularis tears or combined subscapularis and supraspinatus tears at a single center between 2011 and 2019. Similarly, **Nové-Josserand et al.** conducted a detailed retrospective evaluation of subscapularis tendon healing following arthroscopic repair, correlating structural healing with clinical outcomes. Their study included 22 patients who underwent arthroscopic repair for isolated supraspinatus tears, with a mean follow-up of 36 months. Outcomes were assessed preoperatively and postoperatively using the Constant-Murley score, subjective shoulder value, lift-off test, belly-press test, and imaging through MRI or computed tomography arthrography. The results were then compared with a control group of 13 patients who received open repair for supraspinatus ruptures, revealing no significant differences in demographic data between the arthroscopic and open repair groups ($P > 0.05$) [18].

Contrary to our findings, **Gedikbas et al**. [12] observed that patients who underwent open surgery had a significantly higher Constant-Murley Score compared to those treated arthroscopically (53.7 ± 4.6 vs. 48.9 ± 6.8; $P = 0.001$). Additionally, **Nové-Josserand et al**. [18] reported no significant difference in preoperative Constant-Murley scores between the groups, with scores ranging from 48 to 81 (mean 66.4) in the arthroscopic group and 49 to 78 (mean 67.7) in the open surgery group. Their findings also indicated that, within the arthroscopic cohort, the Constant-Murley score improved significantly from a mean of 66 preoperatively to 85 postoperatively ($p < 0.05$) [18]. **Neviaser et al.** [19], further highlighted that the belly-press test outcomes significantly favored the arthroscopic repair group over the open repair group.

A comprehensive study by **Huang et al.,** which included 18 comparative studies and 4 randomized clinical trials, showed that patients undergoing mini-open repair had a notably better Constant-Murley functional score [20].

Furthermore, **Mall et al.** [21] conducted an extensive review of the literature on subscapularis repairs, comparing arthroscopic and open approaches when applicable. Their systematic search of the Cochrane, PubMed, and Embase databases identified studies focused on isolated subscapularis repairs. For studies that included both subscapularis and supraspinatus tears, subgroup analyses for isolated subscapularis repairs were required for inclusion. Additional criteria included a minimum follow-up of one year. Their review identified three studies on arthroscopic repair and six on open repair that met all inclusion criteria. The average patient age was 49.2 years, and the average duration from injury to surgery was 11.1 months. Postoperative outcomes were comparable between the two groups, with a mean score of 88.1. Pain relief after surgery was significant in both groups, with a mean score of 13.4 (out of 15, where 15 indicates no pain) in the arthroscopic group and 11.5 in the open repair group.

Our findings are consistent with those reported by **Gedikbas et al**. [12], who observed significantly better postoperative improvements in abduction ($P = 0.005$) and forward elevation ($P = 0.005$) in the arthroscopic repair group compared to the open surgery group. Additionally, they found only minor changes in internal and external rotation in both groups.
Similarly, **Nové-Josserand et al**. [18] noted that active forward elevation and active external rotation did not differ significantly between preoperative and postoperative evaluations for both groups ($P > 0.05$).

Other research on open repairs of subscapularis tears, with follow-up periods ranging from 12 to 46 months, reported improvements in Constant-Murley (CM) scores, forward elevation, and external rotation; however, the lift-off test results often remained negative [22-24]. **Nové-Josserand et al**. [22] highlighted that, while clinical assessments demonstrated significant progress, complete correction was not always achieved. Despite the fact that open repair offered higher subjective shoulder ratings and better strength outcomes, most other clinical tests, postoperative subscapularis evaluations, and structural healing results were similar between arthroscopic and open repair groups.

A comprehensive review supports our results where **Saltzman et al**. [25] conducted a detailed review of the literature to evaluate outcomes in patients with isolated subscapularis tears treated arthroscopically. The study aimed to (1) summarize findings from all repair types, (2) compare results across different arthroscopic techniques, and (3) examine the incidence and management of concomitant long head of the biceps pathology and its effect on outcomes following arthroscopic subscapularis repair. This review included eight studies and highlighted significant improvements in patient-reported outcomes following arthroscopic subscapularis repair. Consistent gains were observed in Total scores across all studies, ranging from Δ18.8 to Δ49.8 points. Substantial improvements were also seen in strength, pain, and range of motion, with variations from Δ1.3 to Δ13.7 points for strength, Δ7.6 to Δ8.9 points for pain, and Δ7.3 to Δ13.3 points for range of motion. Notable advancements were recorded in belly-press and lift-off strength (Δ24.3 N or Δ1.7 to Δ1.9 out of 5), forward flexion (29.1° to 37.0°), external rotation (10.3° to 16.0°), and internal rotation. Complications were infrequent, with five studies reporting no complications and three studies noting rerupture rates between 4.8% and 11.8%.

The study had several limitations, including a relatively small sample size, which may limit the

generalizability of the findings. The follow-up period of 12 months, while adequate for assessing short-term outcomes, may not fully capture long-term functional differences between the arthroscopic and open repair techniques. Additionally, the study was conducted at two centers, potentially introducing variability in surgical techniques and postoperative care. Finally, the absence of patient-reported outcome measures beyond standardized scoring systems may limit the assessment of patient satisfaction and quality of life after the procedures.

Conclusion

Arthroscopic repair of subscapularis tears results in comparable functional outcomes to open surgery, with superior improvements in specific functional measures like lift-off test and forward elevation. These findings suggest arthroscopic repair as a favorable option in selected patients.

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