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Original Research Article

EVALUATING CLINICAL AND FUNCTIONAL RECOVERY AFTER MINI-OPEN REPAIR OF ISOLATED SUPRASPINATUS TENDON TEARS: A 12-MONTH PROSPECTIVE STUDY

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ABSTRACT

Background: Isolated supraspinatus tendon tears are a common cause of shoulder dysfunction and pain, particularly in middle-aged and active populations. While arthroscopic techniques are widely used, the mini-open repair offers direct tendon visualization with favorable outcomes, especially in resource-constrained settings. This study aimed to assess the functional outcomes and recovery patterns following mini-open repair of isolated supraspinatus tendon tears over a 12-month postoperative period.

Materials and Methods: This prospective interventional study included 94 patients with MRI-confirmed isolated supraspinatus tears undergoing mini-open repair at a RAMA MEDICAL COLLEGE HAPUR tertiary care center in India. Patients were evaluated preoperatively and postoperatively at 6 weeks, 3 months, 6 months, and 12 months using the Visual Analog Scale (VAS), Constant-Murley Score (CMS), University of California Los Angeles (UCLA) Score, and range of motion (ROM) parameters. Functional grading, time to return to work, complications, and patient satisfaction were also recorded.

Results: The mean age of patients was 52.6 ± 8.3 years, with 61.7% being male and 70.2% having dominant-arm involvement. The mean CMS improved significantly from 41.5 ± 6.9 preoperatively to 88.5 ± 5.7 at 12 months ($p < 0.001$), and UCLA scores improved from 15.2 ± 3.4 to 32.1 ± 2.3 ($p < 0.001$). VAS scores decreased from 7.8 ± 1.2 to 1.3 ± 0.6. Range of motion improved markedly, with forward flexion increasing from 92.3° to 158.2°, and internal rotation improving from L5 to T10 level. At 12 months, 93.6% of patients were satisfied or very satisfied; 86.2% returned to pre-injury work levels within a mean of 9.1 ± 2.3 weeks. Complications were minimal, with tendon re-tear occurring in 2.1% of cases.

Conclusion: Mini-open repair of isolated supraspinatus tendon tears results in excellent functional outcomes, substantial pain relief, improved shoulder mobility, and high patient satisfaction. It remains a viable and effective option, particularly in Indian healthcare settings with limited arthroscopic resources.

Keywords: Supraspinatus tendon tear, Mini-open repair, Shoulder function, Rotator cuff, Constant-Murley Score, Postoperative outcomes.

INTRODUCTION

Rotator cuff tears are a leading cause of shoulder pain and disability, affecting up to 20% of the general population, with the prevalence increasing with age.[1] Among these, the supraspinatus tendon is the most commonly involved structure due to its anatomical position and biomechanical load during abduction and overhead activities.[2] Isolated

supraspinatus tendon tears, although sometimes asymptomatic, often result in functional impairment, limited range of motion, night pain, and reduced quality of life, especially in active individuals and laborers.[3]

In India, shoulder disorders account for approximately 16% of all musculoskeletal complaints in outpatient orthopedic settings, and supraspinatus involvement is frequently diagnosed among middle-aged adults involved in physical work.[4] Chronic degenerative tears are more common than acute tears, and early surgical intervention is often recommended in symptomatic patients to prevent irreversible changes such as fatty infiltration, tendon retraction, and muscle atrophy, which are known to compromise surgical outcomes.[5]

Surgical repair techniques for supraspinatus tears include arthroscopic, open, and mini-open approaches. The mini-open repair technique, introduced as a hybrid method, allows arthroscopic evaluation and decompression followed by a limited deltoid-splitting approach for tendon repair. This technique has shown comparable functional outcomes to arthroscopic repair, with the added advantage of improved visualization and handling of retracted tendons in isolated supraspinatus tears.[6,7] It is particularly useful in resource-limited settings where arthroscopic infrastructure or expertise may be lacking.

Postoperative outcomes of supraspinatus repair are typically assessed using functional scoring systems such as the Constant-Murley Score (CMS), the University of California Los Angeles (UCLA) Shoulder Score, and Visual Analogue Scale (VAS) for pain. Significant improvement in these scores was reported post-surgery, with average CMS improving from below 40 preoperatively to above 80 by 6–12 months in mini-open repairs.[8] Despite these improvements, recovery trajectories vary widely based on surgical technique, rehabilitation adherence, and patient-specific factors.

This prospective interventional study was conducted with an aim of assessing the functional outcomes following mini-open microscopic repair of isolated supraspinatus tendon tears, and progression of functional recovery throughout the postoperative healing period. By focusing exclusively on isolated tears, this study intends to provide a clearer understanding of the specific impact of mini-open repair, independent of other rotator cuff involvement, and contribute to evidence-based surgical decision-making in similar clinical settings

MATERIALS AND METHODS

Study Design and Setting

This was a prospective interventional study conducted in the Department of Orthopaedics RAMA MEDICAL COLLEGE HAPUR at a tertiary care center located in North India, over a period of 18 months from November 2023 to May 2025. The study received approval from the Institutional Ethics Committee, and informed written consent was obtained from all patients prior to inclusion.

Participant Selection

Patients aged between 30 and 65 years presenting with complaints of shoulder pain, reduced range of motion, and functional limitation were screened for eligibility. Those diagnosed with isolated full-thickness supraspinatus tendon tears confirmed by magnetic resonance imaging (MRI) were included in the study. Additional inclusion criteria were the presence of symptoms for more than three months despite conservative management including rest, physiotherapy, and non-steroidal anti-inflammatory drugs (NSAIDs), and willingness to undergo surgical repair with regular follow-up. Patients were excluded if they had partial-thickness tears, multiple tendon involvement, prior shoulder surgeries on the affected side, concurrent shoulder pathologies such as adhesive capsulitis, labral tears, osteoarthritis, or systemic diseases affecting wound healing (uncontrolled diabetes mellitus, rheumatoid arthritis). Individuals unable to comply with the postoperative rehabilitation protocol or follow-up visits were also excluded.

Sample Size Calculation

Based on previous study by Moorthy et al., indicating a mean improvement of 10 points in the Constant-Murley Score (CMS) following rotator cuff repair, and assuming a standard deviation of 15, the required sample size was calculated using the formula for comparison of means [8]. With a power of 80% and a two-sided significance level of 5%, the minimum sample size required to detect a clinically meaningful difference was estimated to be 78 patients. To account for a potential dropout rate of 20% due to follow-up loss or postoperative complications, the total sample size was increased to 94 patients, ensuring sufficient statistical power to evaluate the functional outcomes following mini-open supraspinatus tendon repair.

Preoperative Evaluation

All patients underwent a comprehensive preoperative assessment, including detailed history, physical examination, and functional evaluation using standardized scoring systems. The Constant-Murley Score, University of California Los Angeles (UCLA) Shoulder Score, and Visual Analogue Scale (VAS) for pain were used to establish baseline function and pain severity. MRI of the affected shoulder was reviewed to confirm the diagnosis and assess the degree of tendon retraction, muscle atrophy, and fatty infiltration using the Goutallier classification.

Surgical Technique

All surgeries were performed by a single senior orthopedic surgeon with experience in shoulder procedures. Under general anesthesia and interscalene block, the patient was placed in the beach-chair position. Initial diagnostic arthroscopy was performed to confirm the diagnosis of an

isolated supraspinatus tear and rule out additional intra-articular pathology. A 3–5 cm mini-open incision was made over the anterolateral aspect of the shoulder, and a deltoid-splitting approach was used to access the subacromial space. Subacromial decompression was performed when indicated. The torn supraspinatus tendon was mobilized, debrided, and repaired to the anatomical footprint on the greater tuberosity using double-loaded suture anchors with non-absorbable No. 2 Ethibond sutures. Magnification was achieved using 2.5x surgical loupes to enhance repair precision. Hemostasis was ensured, and the deltoid muscle was reapproximated before layered wound closure.

Postoperative Rehabilitation

Postoperatively, the arm was immobilized in an abduction brace for four weeks. Passive mobilization exercises, including pendulum and Codman exercises, were initiated on postoperative day two under the supervision of a trained physiotherapist. Active-assisted and active range of motion exercises were started after four weeks, followed by gradual introduction of strengthening exercises targeting the rotator cuff and scapular stabilizers between 6 to 10 weeks postoperatively. Patients were reviewed monthly to ensure compliance with rehabilitation and to assess clinical progress.

Outcome Measures and Follow-Up

Functional outcomes were assessed using the Constant-Murley Score, UCLA Score, and VAS for pain at five time points: preoperatively, and postoperatively at 6 weeks, 3 months, 6 months, and 12 months. Range of motion was also evaluated during each follow-up. Any complications, such as wound infection, postoperative stiffness, repair failure, or re-tear, were recorded and managed appropriately.

Statistical Analysis

All collected data were compiled and analyzed using IBM SPSS Statistics for Windows, Version 20.0. Continuous variables such as functional scores and range of motion were presented as mean ± standard deviation (SD), while categorical data were expressed as frequencies and percentages. Repeated measures analysis of variance (ANOVA) was employed to evaluate the changes in functional scores over time. Post hoc pairwise comparisons were performed using paired t-tests. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The mean age of the study participants (n = 94) was 52.6 ± 8.3 years, with a male predominance (61.7%). The right shoulder was more frequently involved (64.9%), and the dominant arm was affected in 70.2% of cases. The average duration of symptoms prior to surgery was 6.4 ± 2.1 months. Most patients were manual laborers (55.3%), followed by office workers (19.1%), homemakers (17.0%), and retirees (8.5%). The mean BMI was 26.3 ± 3.7 kg/m². Comorbidities included diabetes mellitus in 20.2% and hypertension in 14.9%, while 22.3% reported tobacco use. The mean preoperative VAS, Constant-Murley, and UCLA scores were 7.8 ± 1.2, 41.5 ± 6.9, and 15.2 ± 3.4, respectively. On MRI, Goutallier grade 1 fatty infiltration was the most common (56.4%), followed by grade 2 (24.5%) and grade 0 (19.1%) (Table 1).

Table 1: Baseline Demographic and Clinical Profile of Study Participants (N = 94)

Variable	Frequency (%)/Mean ± SD
Age (years)	52.6 ± 8.3
Sex	
Male	58 (61.7%)
Female	36 (38.3%)
Side involved	
Right	61 (64.9%)
Left	33 (35.1%)
Dominant arm involved	66 (70.2%)
Duration of symptoms (months)	6.4 ± 2.1
Occupation	
Manual labor	52 (55.3%)
Office work	18 (19.1%)
Homemaker	16 (17.0%)
Retired	8 (8.5%)
BMI (kg/m²)	26.3 ± 3.7
Diabetes mellitus	19 (20.2%)
Hypertension	14 (14.9%)
Smoking/Tobacco use	21 (22.3%)
Preoperative VAS Score	7.8 ± 1.2
Preoperative Constant-Murley Score	41.5 ± 6.9
Preoperative UCLA Score	15.2 ± 3.4
Goutallier Grade	
0	18 (19.1%)
1	53 (56.4%)
2	23 (24.5%)

There was a progressive and statistically significant improvement in all functional outcome scores following mini-open repair of isolated supraspinatus tendon tears. The mean Visual Analogue Scale (VAS) score decreased from 7.8 ± 1.2 preoperatively to 1.3 ± 0.6 at 12 months, indicating substantial pain relief. The Constant-Murley Score improved from 41.5 ± 6.9 preoperatively to 88.5 ± 5.7 at 12 months, reflecting enhanced shoulder function. Similarly, the UCLA shoulder score rose from 15.2 ± 3.4 to 32.1 ± 2.3 over the same period. Patient satisfaction also increased steadily, reaching a mean score of 9.2 ± 0.6 at one year. All improvements were statistically significant ($p < 0.001$) (Table 2).

Table 2: Serial Comparison of Functional Outcome Scores

Time Point	VAS Score	Constant-Murley Score	UCLA Score	Patient Satisfaction Score (0–10)
	Mean ± SD			
Preoperative	7.8 ± 1.2	41.5 ± 6.9	15.2 ± 3.4	—
6 weeks	5.3 ± 1.1	56.2 ± 7.4	20.8 ± 3.9	6.4 ± 1.1
3 months	3.4 ± 1.0	71.6 ± 6.5	25.9 ± 3.7	7.8 ± 1.0
6 months	2.1 ± 0.9	81.2 ± 6.2	29.8 ± 2.9	8.6 ± 0.9
12 months	1.3 ± 0.6	88.5 ± 5.7	32.1 ± 2.3	9.2 ± 0.6
P value	< 0.001	< 0.001	< 0.001	< 0.001

There was a marked improvement in shoulder range of motion following mini-open repair over the 12-month follow-up period. Mean forward flexion increased from 92.3° ± 14.7 preoperatively to 158.2° ± 10.4 at 12 months, while abduction improved from 85.2° ± 13.4 to 147.6° ± 9.8. External rotation at the side showed significant gain, rising from 38.1° ± 9.6 to 68.1° ± 7.4. Internal rotation, assessed by the vertebral level reached, improved from L5 to T10. Additionally, hand-behind-head reach increased from 12.4 ± 2.1 cm to 26.3 ± 1.9 cm. All these changes were clinically and statistically significant ($p < 0.001$) (Table 3).

Table 3: Extended Range of Motion (ROM) Over Time

Time Point	Forward Flexion (°)	Abduction (°)	External Rotation at Side (°)	Internal Rotation (Spinal Level)	Hand-Behind-Head Reach (cm)
	Mean ± SD				
Preoperative	92.3 ± 14.7	85.2 ± 13.4	38.1 ± 9.6	L5	12.4 ± 2.1
3 months	126.4 ± 15.2	120.3 ± 14.7	50.4 ± 8.9	L1	19.6 ± 2.5
6 months	142.6 ± 12.9	135.5 ± 11.2	59.7 ± 8.1	T12	23.2 ± 2.1
12 months	158.2 ± 10.4	147.6 ± 9.8	68.1 ± 7.4	T10	26.3 ± 1.9
P value	< 0.001	< 0.001	< 0.001	-	< 0.001

At the end of the 12-month follow-up, 70.2% of patients achieved an excellent outcome (Constant-Murley Score ≥85), while 21.3% had good outcomes, 6.4% fair, and only 2.1% had poor results. A significant proportion (86.2%) returned to their pre-injury work level within an average of 9.1 ± 2.3 weeks. Additionally, 59.6% resumed sports or overhead activities. Residual shoulder pain was reported in only 7.4% of cases, and overall satisfaction was high, with 93.6% of patients being satisfied or very satisfied with the surgical outcome (Table 4).

Table 4: Distribution of Functional Outcomes and Return to Activity (12-Month Evaluation)

Outcome Parameter	Frequency (%)
Constant-Murley Grade	
Excellent (≥85)	66 (70.2%)
Good (70–84)	20 (21.3%)
Fair (55–69)	6 (6.4%)
Poor (<55)	2 (2.1%)
Return to pre-injury work level	81 (86.2%)
Time to return to work (weeks)	9.1 ± 2.3
Return to sports or overhead activity	56 (59.6%)
Residual shoulder pain	7 (7.4%)
Satisfied or very satisfied patients	88 (93.6%)

Postoperative complications were observed in a small subset of patients. Superficial wound infections occurred in 3 patients (3.2%), primarily among diabetics, and were successfully managed with antibiotics. Shoulder stiffness developed in 5 patients (5.3%), predominantly among smokers, and showed improvement with aggressive physiotherapy. Two patients (2.1%) experienced tendon re-tear after six months; one underwent revision repair and regained full range of motion, while the other was managed conservatively with moderate functional limitation. Anchor irritation requiring removal was noted in one case (1.1%) and resolved post-extraction. Minor hematomas were

observed in 3 patients (3.2%), typically among hypertensives, and resolved with conservative management. No major complications or long-term morbidity were reported (Table 5).

Table 5: Extended Postoperative Complications and Adverse Events

Complication	Frequency (%)	Time of Onset	Risk Factor Present	Management	Outcome
Superficial wound infection	3 (3.2%)	Day 5–10	Diabetic (2)	Antibiotics	Resolved
Postoperative shoulder stiffness	5 (5.3%)	4–6 weeks	Smokers (3)	Aggressive physiotherapy	Improved
Tendon re-tear	2 (2.1%)	>6 months	Goutallier grade 2	One re-repair, one conservative	One full ROM, one moderate loss
Anchor irritation requiring removal	1 (1.1%)	2 months	—	Anchor removal	Resolved
Minor hematoma	3 (3.2%)	Post-op Day 1–3	Hypertensive (2)	Observation	Resolved

DISCUSSION

This prospective interventional study assessed the functional outcome of mini-open repair in patients with isolated supraspinatus tendon tears. The demographic characteristics of our cohort—mean age 52.6 years, male predominance (61.7%), and a high proportion of manual laborers (55.3%)—reflect the typical presentation pattern of rotator cuff pathology in India. These findings are in concordance with studies from Indian tertiary centers, such as that by Arora et al., who reported similar patient profiles in their study of rotator cuff repairs.[9] The dominant arm was affected in 70.2% of our cases, a finding supported by Babhulkar et al., who established a higher prevalence of symptomatic tears in the dominant limb due to repetitive overhead activity and biomechanical overuse.[10]

In terms of functional improvement, the Constant-Murley Score (CMS) improved from 41.5 ± 6.9 preoperatively to 88.5 ± 5.7 at 12 months ($p < 0.001$). This improvement is consistent with the findings of Jesalpura et al., who observed CMS improvements from 38.4 to 85.3 following mini-open repair.[11] Likewise, our study showed a significant rise in UCLA shoulder scores from 15.2 ± 3.4 to 32.1 ± 2.3, consistent with the results of Malavolta et al., who reported postoperative UCLA scores averaging 31.8 following mini-open rotator cuff repair.[12] These validated scoring systems holistically capture improvements in pain, strength, and function, and the gains seen in our cohort underscore the effectiveness of the mini-open approach even in physically demanding patient populations.

Pain relief, as assessed by the VAS, showed a significant decrease from 7.8 ± 1.2 to 1.3 ± 0.6 over 12 months, aligning with the results of Daga et al., who reported similar pain reduction trends following mini-open repair.[13] Notably, patient-reported satisfaction scores reached 9.2 ± 0.6 at 12 months, and 93.6% of patients expressed satisfaction or high satisfaction. These outcomes reinforce the clinical acceptability of this technique in settings where patient expectations of postoperative recovery are increasingly high.

Range of motion (ROM) significantly improved across all planes. Forward flexion increased from 92.3° to 158.2°, and abduction from 85.2° to 147.6°. External rotation improved from 38.1° to 68.1°, and internal rotation progressed from the L5 to T10 vertebral level. These results are comparable to those of Green et al., who reported forward flexion improvements from 90° to 150° and similar gains in abduction and rotation following mini-open repair.[14] Improved ROM in our study can be attributed to early and structured rehabilitation, tendon healing, and preservation of deltoid integrity—a key benefit of the mini-open technique. The hand-behind-head reach, an indirect but functional indicator of daily activity range, improved markedly from 12.4 ± 2.1 cm to 26.3 ± 1.9 cm.

In terms of return to work, 86.2% of patients resumed their pre-injury occupational level within an average of 9.1 ± 2.3 weeks. This is a crucial functional benchmark, especially in India where prolonged absenteeism can significantly impact socioeconomic status. Studies by Bagheri et al., and Vamsinath et al., similarly reported early return-to-work timelines of 8–12 weeks following mini-open repair in labor-intensive populations.[15,16] Return to sports or overhead activity was also favorable, achieved in 59.6% of patients, further supporting the functional robustness of the repair.

The Goutallier grading of fatty infiltration revealed that 56.4% of patients had grade 1 and 24.5% had grade 2 changes, which correlated well with postoperative outcomes. Both patients with tendon re-tears had Goutallier grade 2, reflecting the negative prognostic value of advanced fatty degeneration, as also reported in studies by Yoon et al., and Somerson et al., which documented higher failure rates and reduced strength recovery in patients with grade ≥2 infiltration.[17,18]

Complications were infrequent and manageable. Superficial infections (3.2%) resolved with antibiotics, and stiffness (5.3%), primarily in smokers, responded to physiotherapy. Our complication rates are comparable to those reported

by Savio et al., who noted a 6% overall complication rate for mini-open procedures.[19] Tendon re-tear (2.1%) in our study was notably lower than the 5–10% typically reported in arthroscopic repairs, possibly due to better visualization and secure suture placement in the mini-open technique.[20] One patient (1.1%) required anchor removal due to irritation, which is rare but documented in literature.[21] Minor hematomas (3.2%) were observed in hypertensive patients and resolved without intervention.

In comparison with arthroscopic repair, studies by Menekse et al., and Neviaser et al., have shown no significant differences in long-term functional outcomes between arthroscopic and mini-open approaches, although arthroscopy offers benefits like reduced soft tissue trauma and cosmesis.[22,23] However, mini-open repair provides direct tendon visualization, cost-effectiveness, and a shorter learning curve, making it an attractive alternative in resource-limited settings like ours.

Strengths of this study include a reasonably large sample size (n = 94), consistent follow-up, use of validated scoring tools, and comprehensive documentation of complications and rehabilitation timelines. However, it is limited by the lack of a control or comparison group (arthroscopic repair), and absence of long-term (>2 years) follow-up data on re-tear rates and degenerative changes.

CONCLUSION

The mini-open repair technique for isolated supraspinatus tendon tears demonstrated significant improvements in pain relief, shoulder function, and range of motion, with high patient satisfaction and a low complication rate. Functional scores such as Constant-Murley and UCLA showed consistent and sustained gains throughout the 12-month follow-up. Given its cost-effectiveness, direct tendon visualization, and suitability in resource-limited settings, mini-open repair remains a reliable surgical option. These findings support its continued use, especially in high-volume Indian healthcare settings where access to arthroscopy may be limited.

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