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*Research Article*

# Clinicoradiological Outcome in Midterm Follow-up After Subscapularis Repair Using Single Anterior Portal and Modified Mason Allen Stitch

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**Abstract**

Background: This study aims to evaluate the clinical and radiological outcomes following subscapularis tendon repair utilizing a single anterior portal and a modified Mason-Allen suture technique.

Methods: A prospective observational study was performed on 28 shoulders from patients undergoing subscapularis repair using a modified Mason-Allen single-row technique. All surgeries, performed through a single anterior portal, were conducted by the lead author between June 2017 and June 2021. Functional outcomes were assessed using the ASES, Constant-Murley and UCLA scoring systems at 6 weeks, 3 months, 6 months, 1 year and 2 years postoperatively. Additionally, subgroup analysis was conducted based on Lafosse grading, while radiological outcomes were interpreted using the KIMS and Sugaya criteria.

Results: Participants had a mean age of 56.74 years (±9.63), with equal representation of both sexes. Over half of the patients (57.1%) presented with Lafosse Grade 2 tears. All scoring systems (ASES, Constant-Murley and UCLA) demonstrated statistically significant improvements over time (Friedman test $p < 0.001$).

Conclusion: Subscapularis repair via a single anterior portal using the modified Mason-Allen technique yields favorable functional outcomes and effective tendon healing on midterm follow-up.

**Keywords:** Subscapularis Repair; Radiological Outcomes; Mason-Allen Suture Technique

## Introduction

The subscapularis is the largest muscle of the rotator cuff, attaching to the lesser tuberosity of the humerus, whereas the other rotator cuff muscles insert into the greater tuberosity [1-3]. Positioned anteriorly, the subscapularis, along with the infraspinatus, helps stabilize the shoulder by functioning as a force couple in the axial plane. A tear in the subscapularis tendon, even if isolated, can lead to significant shoulder pain and dysfunction [4-7]. These tears may occur alone or as part of a larger rotator cuff injury [1,8]. They often begin as articular surface tears, which may go unnoticed during open rotator cuff repairs, leading to a condition known as hidden lesions [2,9].

The Lafosse classification, established in 2007, is the most widely used system for grading subscapularis tears, with grades ranging from 1 to 5. The upper portion of the tendon is most frequently torn (Fig. 1) [10]. These tears are challenging to diagnose and treat, with clinical tests like the bear hug test showing higher sensitivity compared to the lift-off test [11,12]. Arthroscopic repair of subscapularis tears is technically demanding due to the need for multiple portals and difficulties in suture management and visualization [12,13]. The modified Mason-Allen stitch technique offers advantages by requiring less material for secure fixation (Fig. 1) and reducing the risk of tendon strangulation compared to other methods such as the double-row technique. This method is known for maintaining stability and minimizing tendon damage [14-19].

Despite its effectiveness, research on midterm outcomes following arthroscopic subscapularis repair using a single anterior portal

and the modified Mason-Allen technique is limited. This study aims to fill that gap by assessing clinical and radiological results over time.

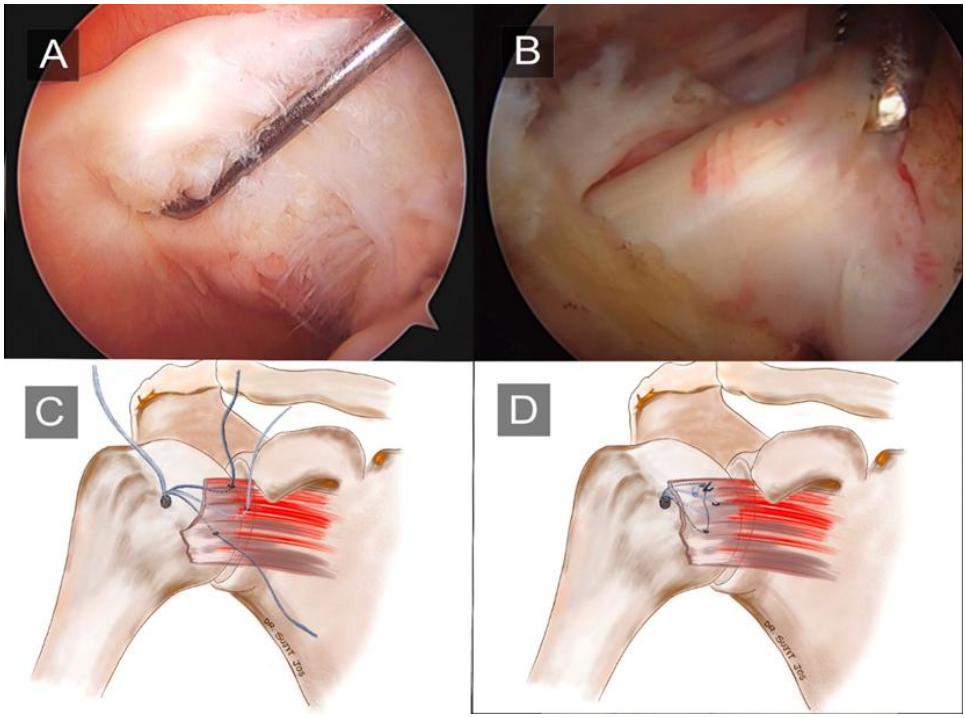


**Figure 1:** A) Arthroscopic image showing a Lafosse grade 3 subscapularis tear; B) A grasper was utilized to evaluate the tension in the subscapularis and its ability to move towards the footprint; C) Schematic diagram showing subscapularis muscle repair using a double loaded suture anchor with a horizontal mattress forming the 'rip stop stitch' and the vertical simple sutures which has the main holding power; D) final Modified Mason Allen configuration.

**Methodology**

This prospective observational study involved 28 shoulders from patients who visited our outpatient department and underwent arthroscopic subscapularis tendon repair using a single-row modified Mason-Allen technique. The repair was performed through a single anterior working portal along with a posterior viewing portal, between June 2017 and June 2021. A flowchart detailing patient selection is shown in Fig. 2.

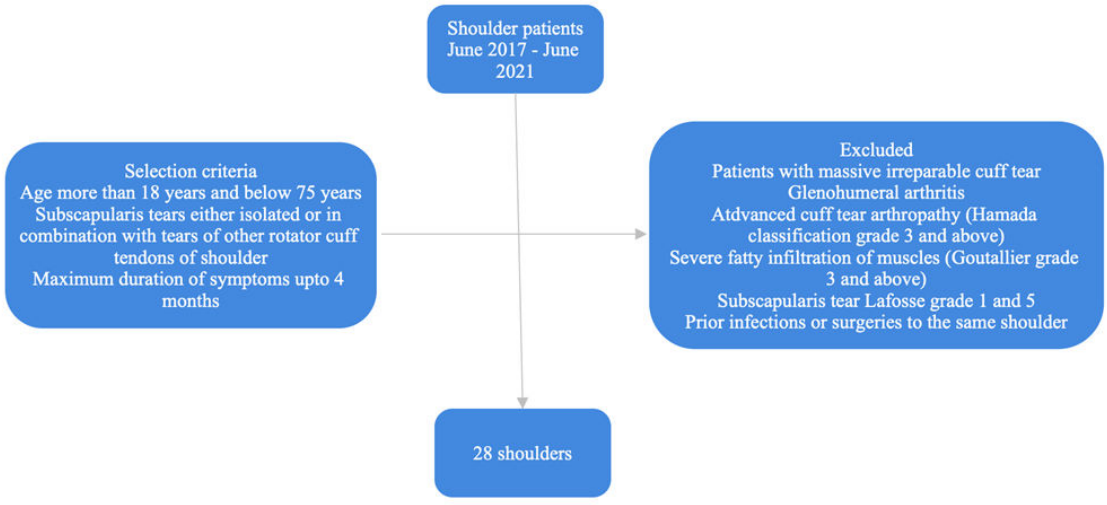


**Figure 2:** Patient selection flowchart.

Each patient was evaluated preoperatively using MRI and classified according to the Lafosse grading system. Patients with Lafosse Grades 2 and 3 underwent repair with a single suture anchor, while Grade 4 tears were treated using two anchors, all applied using the same single-row modified Mason-Allen configuration. If any pathology of the biceps tendon (such as tearing or displacement) was identified, a tenodesis was performed using an anchor in the bicipital groove to improve cosmetic and functional results.

All surgeries were performed by the lead author. Functional assessments were conducted using ASES, Constant-Murley and UCLA scoring tools at five postoperative intervals: 6 weeks, 3 months, 6 months, 1 year and 2 years. Radiological evaluation was done with MRI at 24 months post-surgery to assess tendon integrity, footprint coverage and the presence of perianchor cysts. Re-tears of the subscapularis were considered surgical failures. Data were analyzed using SPSS software for repeated measures, comparing functional scores before and after surgery.

All participants provided written informed consent and the study was conducted with prior approval from the institutional ethics committee.

*Surgical Technique*

Patients were positioned in a beach-chair setup, with the affected arm stabilized using a limb positioning system (Spider 2, Smith and Nephew, Andover, MA, USA). The shoulder was kept in slight internal rotation and forward flexion to optimally expose the subscapularis insertion site (Fig. 3). The surgical area was prepped and draped in a sterile manner and anatomical landmarks were marked using a skin pen (Fig. 3).

A posterior viewing portal was established approximately 3 cm inferior and medial to the posterolateral tip of the acromion. Using a 30-degree arthroscope, a diagnostic arthroscopy was initially performed. The anterior portal was then created by inserting an 18G spinal needle through the superior part of the rotator interval using the outside-in method. Minimal rotator interval clearance was performed using a radiofrequency ablation device. Internal rotation of the shoulder enabled visualization of the subscapularis tendon and its insertion site (Fig. 1). The extent, quality and retraction of the tear were evaluated.

The subscapularis tendon margins were debrided to remove unhealthy tissue. In some cases, the middle glenohumeral ligament was released to enhance visibility and mobility of the tendon. Retraction and tension of the tendon were assessed using a grasper (Fig 1B). Adhesions involving the coracohumeral ligament and anterior-superior subscapularis were released to facilitate tendon mobilization. The footprint on the lesser tuberosity was prepared using a Crimson Duvet technique with a Kirschner wire and a motorized burr, preserving the cortical bone at the planned anchor site.

A double-loaded suture anchor (Iconix 2.3 TT, Stryker, MA, USA) was inserted through the anterior portal into the upper third of the subscapularis footprint (Fig. 3). Using a direct suture-passing device (FirstPass ST, Smith and Nephew), full-thickness passes were made through the tendon from the articular to the bursal side (Fig. 3), approximately 5-10 mm below the superior margin of the tear and 5-10 mm medial to its lateral edge. The second pass was made 10 mm below the first and an additional pass was placed medially between the two.

The first pair of sutures was tied in a horizontal mattress configuration using sliding arthroscopic knots, forming a rip-stop for primary compression of the tendon to the bone (Fig. 3). This was followed by tying the second pair of sutures in a simple stitch pattern over the initial mattress stitch, resulting in the modified Mason-Allen construct on the tendon's anterior surface (Fig. 4). Stability of the repair was confirmed using a probe (Fig. 4).

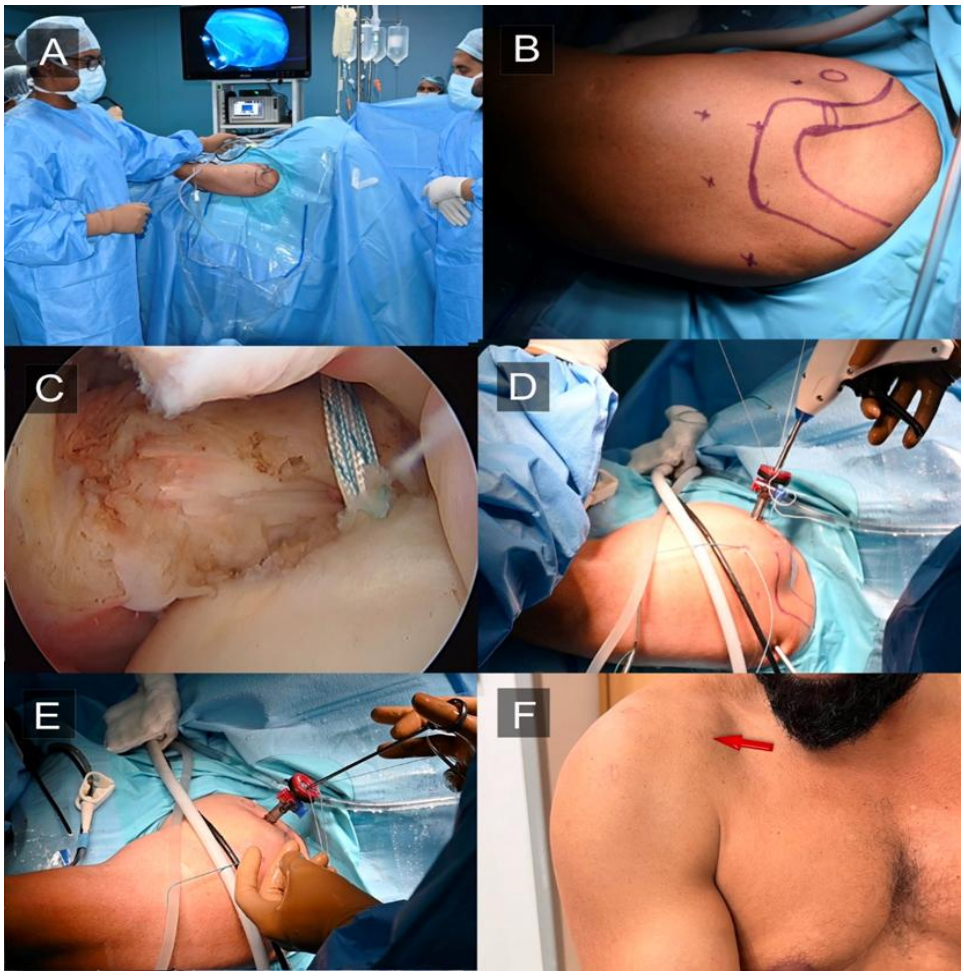


**Figure 3:** A) Patient is placed in a beach chair fashion with the limb secured to a limb positioning system; B) Bone landmarks were identified and marked using a skin marking pen; C) Through the anterior portal, a double loaded suture anchor was inserted at the upper third of subscapularis footprint on the lesser tuberosity; D) Full thickness penetration was done in the subscapularis tendon with the help of direct suture passing device; E) Knot tying through the anterior portal and creating a Mason Allen configuration over the anterior surface of subscapularis tendon. F) Anterior portal scar at 6 months follow-up (red arrow).

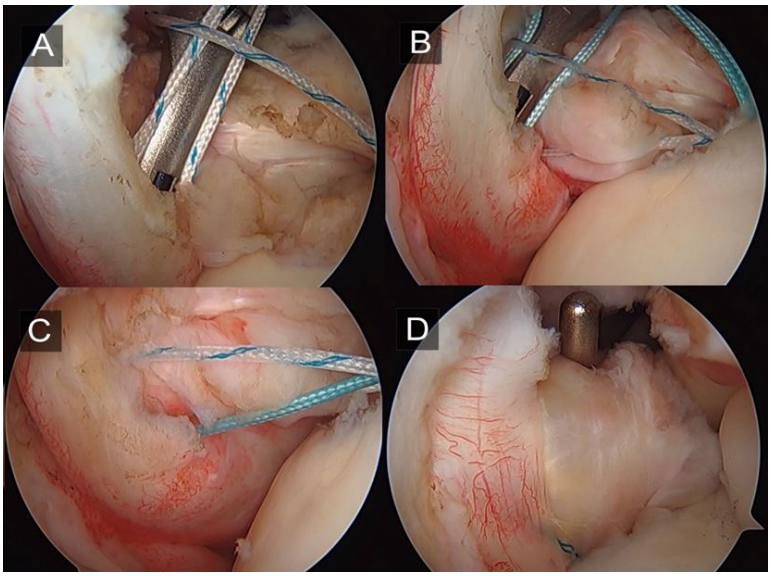


**Figure 4:** A) Modified Mason Allen first stitch; B) Modified Mason Allen third stitch; C) Final Modified Mason Allen configuration D) Probe used to confirm the strength of fixation.

*Post-Operative Care and Rehabilitation*

After surgery, the operated arm was supported in an arm sling for three weeks to enhance comfort. During this period, patients were instructed to perform pendulum exercises and passive mobilization of the elbow and wrist starting from the first postoperative day.

At the end of three weeks, passive external rotation exercises were introduced, with the range limited to 20 degrees until the six-week mark. From the sixth week onward, patients began active-assisted Range of Motion (ROM) exercises. Strengthening exercises using resistance bands were initiated at three months post-surgery.

**Results**

The study followed 28 patients for an average duration of 28.6 months. Demographic details of the participants are illustrated in Fig. 5.

| Patient demographics | Number of patients (N) |
|---|---|
| Sex<br>Male<br>Female | <br>14<br>14 |
| Mean age at surgery (years) | 56.74 ± 9.63 |
| Age of subscapularis tears (years)<br>Age of subscapularis tears with other rotator cuff tears (years) | 49.8<br>64.5 |
| Dominant hand | 20 |
| Duration of symptoms (months) | 3.2 ± 0.7 |

**Figure 5:** Patient demographics.

Patients were classified using the Lafosse grading system and the distribution across these grades is depicted in Fig. 6.

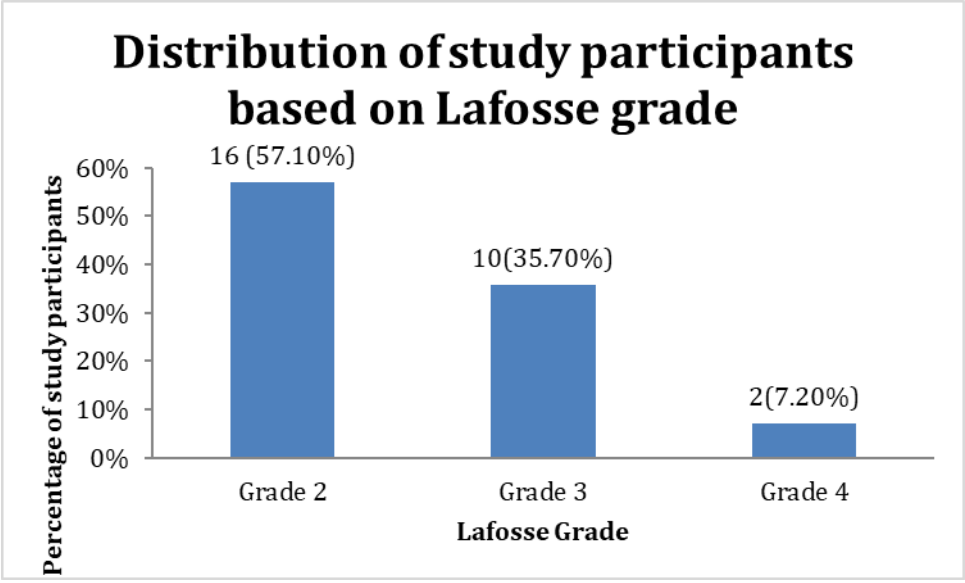


**Figure 6:** Distribution of study participants based on the Lafosse Grades.

A majority of patients (71%) had either torn, unstable or dislocated long head of the biceps tendons, which were managed with tenodesis.

Clinical and radiological progress was monitored using the ASES, Constant-Murley and UCLA scoring systems, recorded preoperatively and at five follow-up intervals: 6 weeks, 3 months, 6 months, 1 year and 2 years. To assess the distribution of the data, the Shapiro-Wilk test was applied and revealed non-normality ($p = 0.035$). Hence, the Friedman test-a non-parametric test for repeated measures-was used to compare scores across time points.

The test showed statistically significant improvements in mean ranks for all three scoring systems (ASES, Constant-Murley, UCLA), with p-values below 0.001, indicating notable progress over time (Fig. 7).

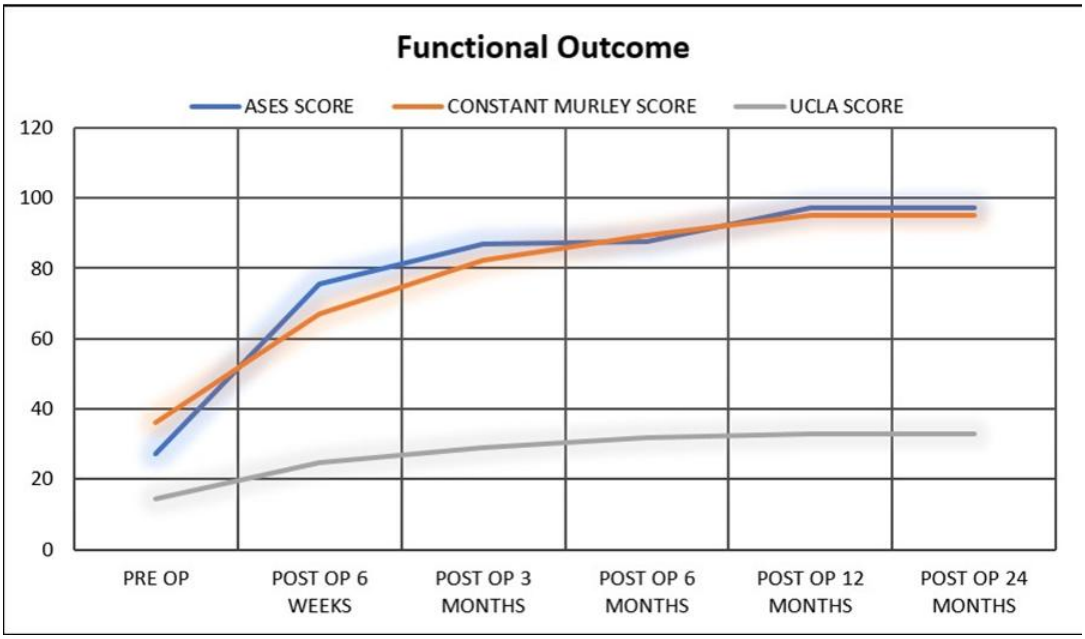


**Figure 7:** Functional outcome of patients assessed with ASES (Confidence interval 89.04 ±10.162), Constant Murley Score (Confidence interval 95.24 ±0.382) and UCLA (Confidence interval 33.08 ±5.239) score serially.

Subsequent pairwise comparisons using the Wilcoxon signed-rank test confirmed significant differences between various follow-up periods for each scoring system. All three outcome measures showed p-values < 0.001, reinforcing the presence of meaningful improvements (Fig 8).

| Rotator cuff tear patterns | Percentage prevalance | Post operative P value (ASES, Constant Murley scores, UCLA scores |
|---|---|---|
| Isolated subscapularis tear | 21.4% | <0.001 |
| Combined subscapularis and other rotator cuff tendon tears | 78.5% | <0.001 |
| Subscapularis tear with long head of biceps pathology which was tenodesesed | 71% | <0.001 |

**Figure 8:** Results of the examination and outcome measures.

Radiological assessments, conducted at the 24-month mark using the KIMS and Sugaya classifications, were evaluated by a single assessor (Fig. 9,10). All patients submitted imaging data for evaluation.

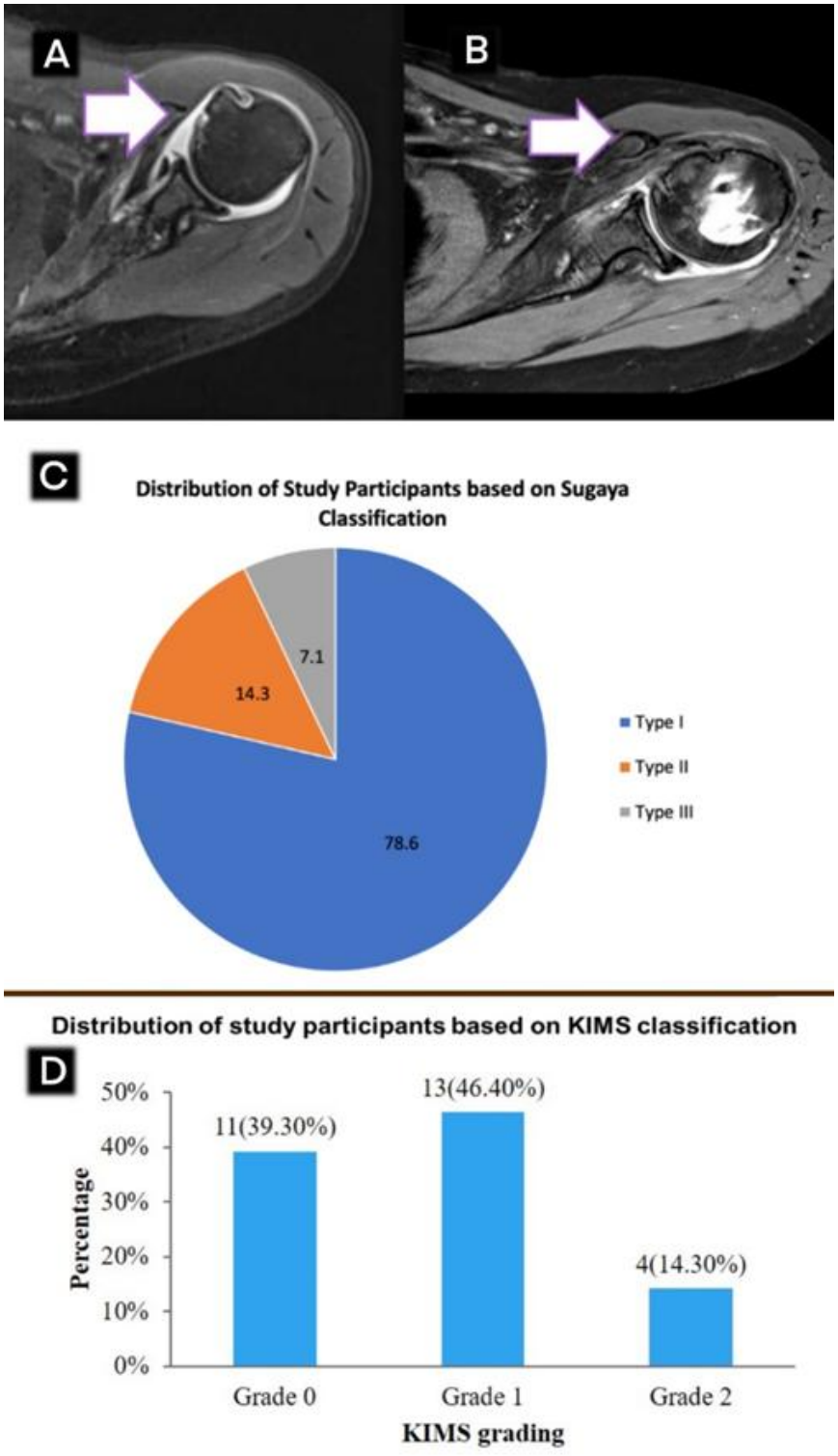


**Figure 9:** A) Pre-operative MRI axial view showing Lafosse grade 3 subscapularis tear; B) Post-operative MRI axial view showing subscapularis healing into footprint; C) Distribution of study participants based on Sugaya classification.

| Factors – MRI | | | | | |
|---|---|---|---|---|---|
| Acromiohumeral interval, mm | 9.0 ± 0.2 | | | | |
| Occupation ratio of supraspinatus, % | 82.8 ± 2.3 | | | | |
| Supraspinatus fatty infiltration, (n) | | Infraspinatus atty infiltration, (n) | | Subscapularis muscle atrophy, (n) | |
| Grade 0 | 4 | Grade 0 | 4 | Grade 0 | 0 |
| Grade 1 | 14 | Grade 1 | 14 | Grade 1 | 16 |
| Grade 2 | 10 | Grade 2 | 10 | Grade 2 | 10 |
| Grade 3 | 0 | Grade 3 | 0 | Grade 3 | 2 |
| Grade 4 | 0 | Grade 4 | 0 | Grade 4 | 0 |
| Radiological outcomes (24 months postoperative) n | | Sugaya classification (24 months postoperative) n | | | |
| KIMS classification | | Type 1 | 22 | | |
| Grade 1 | 11 | Type 2 | 4 | | |
| Grade 2 | 13 | Type 3 | 2 | | |
| Grade 3 | 4 | | | | |

**Figure 10:** Factors in MRI.

No significant difference in functional outcomes was observed between patients with isolated subscapularis tears and those with combined rotator cuff injuries at the 2-year follow-up. The p-values for ASES, Constant-Murley and UCLA scores between these groups were 0.23 and 0.12, respectively-indicating comparable postoperative recovery and tendon healing using the modified Mason-Allen repair via a single anterior portal.

*Clinical Outcome Analysis Based on Lafosse Grading*

The clinical recovery of patients-measured using ASES, Constant-Murley and UCLA scores was analyzed across different Lafosse grades at various postoperative intervals. Among these, only the ASES score at the 24-month follow-up showed a statistically significant correlation with the Lafosse classification, as determined by the Kruskal-Wallis test.

Neither the Constant-Murley nor UCLA scores demonstrated a significant relationship with the Lafosse grades. Further post-hoc analysis revealed that the significant difference in ASES scores was specifically observed between Lafosse Grade 3 and Grade 4 tears. Importantly, the outcomes did not correlate with structural failure of the repair or the Lafosse grade, suggesting that tendon healing and clinical improvement were not directly dependent on the severity grade of the tear.

**Discussion**

Subscapularis tendon tears can be managed through both open and arthroscopic approaches. Full-thickness tears are typically addressed using either single-row or double-row repair techniques [20-24]. In this study, substantial improvements in clinical outcome scores were observed over a 24-month follow-up after repair with the modified Mason-Allen technique through a single anterior working portal.

Pathology involving the long head of the biceps is a well-known contributor to shoulder pain, which is why tenotomy or tenodesis is frequently recommended [25]. Managing biceps pathology alongside rotator cuff repair has shown to positively impact patient outcomes findings that align with the results of our study [1].

Our data showed no significant difference in retear rates between isolated subscapularis tears and those associated with anterosuperior cuff involvement [13]. Meshram P, et al., demonstrated that patients with isolated Subscapularis (SSC) Rotator Cuff Tears (RCTs) were younger and had a similar incidence of trauma compared to those with combined Anterosuperior (AS) RCTs. Additionally, they exhibited worse tear characteristics, although clinical and radiological outcomes were similar between the two groups. These findings are consistent with those of our study [13].

Demographic patterns in our study also reflected these trends, with male predominance more evident in the isolated tear group, whereas the group with combined anterosuperior tears had a balanced male-to-female ratio consistent with prior findings by Kreuz, et al., [26]. Our comparative analysis indicates that male predominance was evident only in the isolated SSC group, while the combined AS group exhibited an approximately equal distribution of male and female patients [13].

In our surgical approach, we relied on a single anterior portal and straightforward instrumentation, including a direct suture-passing device. When paired with the modified Mason-Allen technique and double-loaded anchors, this method provided broad tendon-to-bone contact and evenly distributed pressure [29]. However, partial tears can be difficult to fully visualize through the posterior portal using a 30-degree arthroscope. Intra-articular findings such as biceps subluxation, the comma sign and the sentinel sign can serve as indirect indicators of subscapularis injury [2,30,31]. Tools like tissue graspers and traction sutures were employed to assess retraction and tear classification [2,32].

Postoperative immobilization for three to six weeks with restricted passive range of motion was consistent with rehabilitation protocols previously described by Adams, et al. [33]. The single-row modified Mason-Allen repair offers uniform pressure distribution across the footprint and reduces tissue trauma, balancing compression and stability through its hybrid stitch configuration [34].

Our findings are in line with prior evidence supporting favorable midterm outcomes after arthroscopic subscapularis tendon repair, particularly when combined with other rotator cuff repairs [1]. Since the superior edge of the subscapularis helps form the biceps pulley, tears in this region are often associated with biceps pathology [35].

Grueninger, et al., also reported excellent functional and healing outcomes in Lafosse type III and IV subscapularis tears, whether isolated or combined results that parallel our observations [36]. Although arthroscopic techniques have evolved to deliver reliable outcomes, their complexity due to the need for multiple portals and longer operating time can deter some surgeons [18]. The simplified technique presented in this study, using only a single anterior portal with a modified Mason-Allen stitch, offers a more efficient alternative without sacrificing repair quality.

Warner, et al., suggested that subscapularis tear size was a risk factor for poor clinical outcomes after combined anterosuperior cuff tears [37]. Grade 3 and 4 fatty degeneration of the subscapularis muscle on preoperative MRI is a significant risk factor for retear, hence assessing fatty infiltration of the subscapularis muscle and chronicity of tears prior to surgery in patients with subscapularis tears is of prognostic importance [38].

All repairs in our study were performed using single-row fixation, a method also supported by Balke, et al., as effective [39]. Yoon, et al., in their comparative analysis, reported no significant differences in function, motion or retear rates between single- and double-row techniques [40]. However, they noted that fatty infiltration beyond Goutallier grade 3 was linked to an increased risk of failure [41]. Strength of this study is less operation time also provides a possibility for treating associated injuries before fluids distend the shoulder joint and limit the visibility, simplified approach and lesser tissue handling [38]. One limitation of this study is the relatively small sample size and no comparison group with other techniques. However, primary aim was to introduce a novel technique for managing subscapularis tendon tears. In certain cases such as retracted or extensive tears or those involving poor-quality tendon tissue an accessory anterior portal and additional anchor fixation may be necessary.

Despite the literature describing a range of techniques for arthroscopic subscapularis repair, no clear consensus exists on the best approach. While the present study sheds light on potential improvements in clinical outcomes with this technique of subscapularis repair, further research involving a larger sample size is warranted.

**Conclusion**

Significant improvement in clinical outcome and better radiological outcomes following the subscapularis repair using single anterior portal and modified Mason Allen stitch are evident from present study. Adoption of such simpler techniques without compromising the outcome will aid surgeons in choosing better management options in rotator cuff repair along with ensuring a better experience with regard to functional outcome for the patients.

**Conflict of Interests**

The author declares no conflict of interest.

**Funding/Sponsorship**

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

**Patient Consent**

Written informed consent has been obtained from the patient or guardian for participation and publication.

**Ethics Statement**

Institutional review board approval for this study was obtained from Institutional Review Board of MOSC Medical College, Kolenchery, India.

**Author Contribution**

Sujit Jos: Conceptualization, Validation, formal analysis, investigation, data curation, writing original draft, supervision. Vyas Vijaya Kumar: Methodology, Validation, Formal analysis, Data curation, software and Writing original draft preparation. Bobby Paulose: Formal analysis, software, Writing- reviewing and editing. Rakshit J: Formal analysis, Writing- reviewing and editing. Shobith J Kunnamkottu: Formal analysis, Writing- reviewing and editing.

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