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Early Functional Outcomes after SLAP Repair with a Single Suture Anchor at the Superior Labral Insertion

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Abstract

Objective: Arthroscopic repair of superior labrum anterior to posterior (SLAP) type II lesions aims to restore the anatomy of the biceps-labrum complex. The objective of this study was to evaluate the early functional outcomes of arthroscopic repair using a single suture anchor placed at the 12 o'clock position. **Materials and Methods:** An observational, retrospective, case series study was conducted, including 37 patients operated on between 2023 and 2025. Functionality was evaluated using the ASES (American Shoulder and Elbow Surgeons) score, disability with the QuickDASH questionnaire, and pain via VAS (Visual Analogue Scale), with a minimum follow-up of 6 months. Pain was included among the clinical variables assessed; however, VAS values were not available in the final analytical database and therefore were not included in the statistical analysis. **Results:** The mean age was 44.08 ± 16.68 years (range 11 - 65 years). The mean postoperative ASES score was 92.93 ± 9.99 points (range 63.3 - 100), and the QuickDASH score was 6.69 ± 8.33 points (range 0 - 27.3). 48.6% of patients achieved an ASES score of 100. Pearson correlation analysis demonstrated an inverse association between age and postoperative ASES score ($r = -0.499$; 95% CI, −0.708 to −0.209; $p = 0.0017$). In an exploratory subgroup analysis, all seven patients younger than 25 years achieved an ASES score of 100 and a QuickDASH score of 0. No intraoperative or postoperative complications were recorded during the available follow-up. **Conclusions:** Arthroscopic repair of type II SLAP lesions using a single suture anchor at the 12 o'clock position was associated with favorable early postoperative functional scores in this retrospective series. The observed inverse association between age and ASES score and the findings in younger patients should be interpreted as exploratory and should not be considered evidence of an age-specific treatment effect.

Keywords

SLAP Lesion, Shoulder Arthroscopy, Suture Anchor, Labral Repair

1. Introduction

Superior labrum anterior to posterior (SLAP) lesions are a common cause of pain and altered shoulder functionality, particularly in young and active patients. Since their initial description by Snyder *et al.* [1], these lesions have been recognized as a complex entity due to the close anatomical and functional relationship between the superior labrum and the long head of the biceps brachii, which conditions their biomechanical behavior and response to surgical treatment.

In type II SLAP lesions, the detachment of the labral-bicipital complex from the superior glenoid rim alters glenohumeral stability. Burkhart and Morgan [2] described the peel-back mechanism, by which torsional forces exerted by the biceps promote lesion progression, especially in athletic patients. Although arthroscopic repair has proven to be an effective therapeutic option, the functional outcomes reported in the literature vary, with inconsistent rates of return to previous activity levels, leading to controversy when compared to alternatives such as biceps tenodesis (Boileau *et al.* [3]; Sayde *et al.* [4]).

Several clinical studies have evaluated functional outcomes following SLAP repair, showing significant clinical improvements, albeit with unpredictable results, particularly during early follow-up and in active populations (Provencher *et al.* [5]; Neri *et al.* [6]). These limitations have driven the development of surgical techniques that optimize anatomical fixation while minimizing tissue aggression.

In this context, optimizing the number of implants and the amount of suture material is fundamental to avoid overtensioning the complex and causing articular irritation. Biomechanical studies have demonstrated that adequate fixation of the superior labrum can be achieved with technical advantages and surgical reproducibility without overloading the glenoid footprint (Barber and Herbert [7]).

Anchor position represents a key factor in SLAP repair. Focusing on the direct fixation of the labrum-biceps complex at the 12 o'clock position allows for a more physiological anatomical restoration and optimizes labral-bone contact characteristics [8]. Previous biomechanical studies have supported that this location provides adequate stability and contact pressure at the superior labral footprint [9].

However, despite these theoretical and biomechanical advantages, there is limited clinical evidence specifically evaluating the early functional outcomes after SLAP lesion repair using a single suture anchor placed at the 12 o'clock position, which justifies the present study.

2. Materials and Methods

2.1. Study Design

An observational, analytical, and retrospective case series study was conducted.

The study population included patients undergoing arthroscopic surgical treatment for the repair of type II superior labrum anterior to posterior (SLAP) lesions. The recruitment period ranged from August 2023 to August 2025.

The research protocol was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by the Ethics Committee for Research of Hospital CEMA under approval reference number CEMA-356.

2.2. Patient Selection

The final analytical cohort consisted of 37 patients who met the predefined eligibility criteria and had complete postoperative ASES and QuickDASH data available for analysis. Patients were identified from the surgical records of Hospital CEMA during the study period.

Inclusion Criteria:

- Clinical and imaging (MRI) diagnosis of a SLAP lesion.
- Arthroscopic confirmation of a type II lesion according to Snyder's classification.
- Treatment via labral reinsertion with a single suture anchor.
- Minimum postoperative follow-up of 6 months.
- Complete medical records.

Exclusion Criteria:

- Type I, III, or IV SLAP lesions.
- Associated anterior or posterior glenohumeral instability (e.g., Bankart lesions).
- History of previous surgery on the ipsilateral shoulder.
- Patients with rheumatological or neurological pathology affecting the upper extremity.

2.3. Surgical Technique

All procedures were performed by the same surgical team. Under general anesthesia, with the patient in the beach chair position, standard posterior, lateral, and anterosuperior arthroscopic portals were established.

After diagnostic confirmation of the superior labral detachment (SLAP II), debridement of degenerative tissue and preparation of the bony footprint on the superior glenoid rim were performed using an arthroscopic rasp or a motorized shaver until a bleeding bone bed was obtained to promote biological healing.

Repair was carried out using a 1.9-mm all-suture anchor positioned at the 12 o'clock position. The intraosseous component consisted of Durabraid, composed of polyethylene terephthalate (PET), and the preloaded repair suture consisted of Ultrabraid, composed of ultra-high-molecular-weight polyethylene (UHMWPE). A percutaneous suture passer was used to capture the superior labrum posterior to the biceps tendon. Standard arthroscopic knot tying was subsequently performed to obtain anatomical fixation while avoiding excessive tension on the biceps-labral complex. The stability of the repair and the absence of mechanical impingement

were verified through dynamic intraoperative maneuvers.

The available analytical database did not contain a specific variable documenting concomitant procedures or detailed suture-limb configurations; therefore, no additional concomitant procedure is reported in the present analysis unless documented in the operative records.

2.4. Rehabilitation Protocol

All patients followed a standardized protocol consisting of:

- Phase 1 (0 - 4 weeks): Immobilization with a simple sling. Pendulum movements and active exercises of the elbow, wrist, and hand were allowed from the first day.
- Phase 2 (4 - 8 weeks): Sling removal. Initiation of progressive passive and active-assisted mobility, limiting external rotation and combined abduction to protect the repair.
- Phase 3 (8 - 12 weeks): Full recovery of range of motion (ROM), and scapular and isometric strengthening.
- Phase 4 (>12 weeks): Progressive strengthening and gradual return to specific sports activities, starting from the 4th to 6th month, depending on functional demand.

2.5. Outcome Evaluation

Functional evaluation was performed at the 6-month follow-up using two validated instruments:

- ASES Score (American Shoulder and Elbow Surgeons): A 0 to 100-point scale (50% pain/50% function) to evaluate specific shoulder function.
- QuickDASH (Disabilities of the Arm, Shoulder, and Hand): An abbreviated 11-item questionnaire to measure upper extremity disability, where 0 indicates no disability and 100 indicates total disability.

Pain intensity was also intended to be evaluated using the Visual Analogue Scale (VAS); however, VAS measurements were not available in the final analytical database and were therefore not included in the statistical analysis.

2.6. Statistical Analysis

Data were collected in an electronic database and analyzed using Python/Pandas. Quantitative variables (age, ASES, and QuickDASH) were expressed as mean ± standard deviation with ranges where appropriate. A Pearson correlation analysis was performed to evaluate the relationship between patient age and postoperative ASES score. The correlation coefficient was reported with its 95% confidence interval and p-value.

Age-stratified analyses were performed descriptively as exploratory analyses and were not prespecified as primary hypotheses. Patients younger than 25 years and patients older than 50 years were described separately. No preoperative ASES, QuickDASH, or VAS values were available in the final analytical database; there-

fore, preoperative to postoperative change scores were not calculated or imputed.

3. Results

A total of 37 patients diagnosed with type II SLAP lesions who underwent arthroscopic repair using a single suture anchor technique at the superior labral insertion were included. The average follow-up time was 6 months, and complete postoperative ASES and QuickDASH data were available for all 37 patients.

3.1. Demographic Data

The mean age of the cohort was 44.08 ± 16.68 years (range 11 - 65 years). Nineteen patients were male (51.4%) and 18 were female (48.6%). The right shoulder was affected in 23 patients (62.2%) and the left shoulder in 14 (37.8%). The affected shoulder was the dominant shoulder in 32 patients (86.5%) and the non-dominant shoulder in 5 (13.5%).

The mechanisms of presentation included falls onto an outstretched hand in 11 patients (29.7%), sudden traction in 10 (27.0%), chronic/repetitive onset in 8 (21.6%), direct trauma to the shoulder in 6 (16.2%), and eccentric traction associated with deceleration in 2 (5.4%).

In 24 patients (64.9%), participation in structured physical or sports activities was reported, including gym-based exercise, running, CrossFit, tennis, basketball, flag football, Pilates, volleyball, and charrería. In 13 patients (35.1%), no regular sports or exercise activity was reported.

The available clinical database documented systemic medical comorbidities in 14 patients (37.8%), including hypertension, diabetes mellitus, or both. Twenty-three patients (62.2%) had no documented systemic comorbidity. The database did not contain a dedicated variable for concomitant structural shoulder pathology.

No intraoperative or immediate postoperative complications, including infection, implant failure, or reintervention, were reported during the available follow-up period.

3.2. Functional Evaluation (ASES Score)

At the end of the 6-month follow-up, the mean postoperative ASES score was 92.93 ± 9.99 points (range 63.3 - 100). Eighteen of 37 patients (48.6%) achieved the maximum score of 100.

Because preoperative ASES scores were not available in the analytical database, the observed postoperative scores are presented descriptively and should not be interpreted as a quantitative improvement from baseline (**Figure 1**).

3.3. Perceived Disability (QuickDASH)

The mean postoperative QuickDASH score was 6.69 ± 8.33 points (range 0 - 27.3), indicating low reported upper-extremity disability at the 6-month assessment.

Because preoperative QuickDASH measurements were unavailable, no preoperative-to-postoperative change score was calculated.

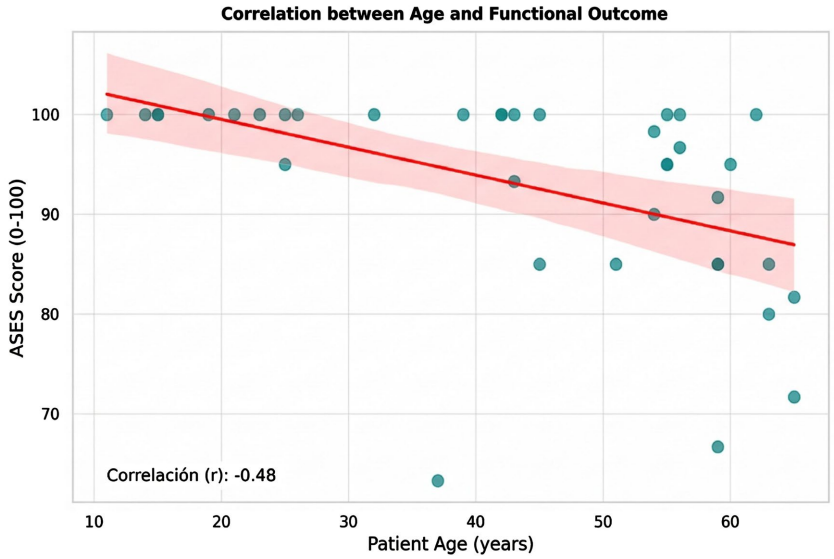


Figure 1. The score distribution presents a pronounced negative skew, with the vast majority of patients clustered in the range of excellence (>90 points).

3.4. Age Subgroup Analysis

Pearson correlation demonstrated an inverse association between age and postoperative ASES score (r = −0.499; 95% CI, −0.708 to −0.209; p = 0.0017).

The age-stratified analysis was exploratory and was not pre-specified as a primary hypothesis.

- Group < 25 years (n = 7): All patients in this group (range, 11 - 23 years) obtained an ASES score of 100.0 ± 0.0 and a QuickDASH score of 0.0 ± 0.0.
- Group > 50 years (n = 19): The mean ASES score was 88.78 ± 9.53, and the mean QuickDASH score was 10.28 ± 8.18.

These subgroup findings are presented descriptively and should not be interpreted as evidence of an age-specific treatment effect (Figure 2).

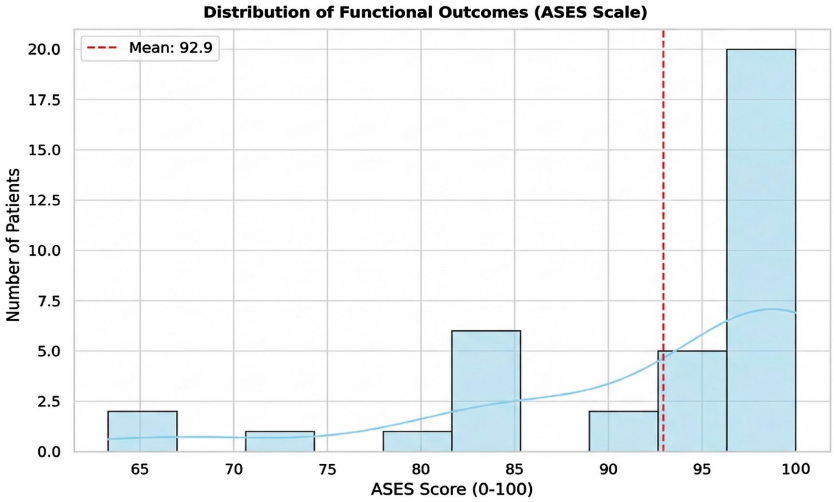


Figure 2. How return-to-normal scores are concentrated in the younger age groups, while variability increases slightly starting from the fifth decade of life.

4. Discussion

The results obtained in this series provide descriptive evidence of favorable early postoperative patient-reported outcomes after type II SLAP repair with a single suture anchor at the 12 o'clock position. In our cohort, the mean postoperative ASES was 92.93 ± 9.99 and the mean QuickDASH was 6.69 ± 8.33, with no recorded complications during the available six-month follow-up.

In 18 patients (48.6%), an ASES score of 100 was achieved. This finding indicates that a substantial proportion of the cohort reported a maximal postoperative ASES score; however, given the retrospective design and absence of preoperative scores, this should not be interpreted as proof of complete functional recovery attributable to the procedure.

Compared to historical series using multiple anchors and reporting average ASES scores between 82 and 89 points [5] [10], the postoperative scores observed in this series are within a favorable range; however, direct comparisons between studies should be interpreted cautiously because of differences in patient populations, study designs, surgical techniques, outcome timing, and baseline characteristics.

One exploratory finding was the inverse association between age and postoperative ASES score. The Pearson coefficient was r = −0.499 (95% CI, −0.708 to −0.209; p = 0.0017). Although this association suggests that age may be related to postoperative functional scores in this cohort, the observational design does not establish causality.

All 7 patients younger than 25 years achieved an ASES score of 100 and a QuickDASH score of 0. This finding is notable but should be interpreted cautiously because the subgroup was small and the analysis was exploratory rather than prespecified. Factors such as tissue quality, activity level, injury mechanism, and patient selection may contribute to the observed distribution.

In patients older than 40 - 50 years, contemporary discussion often leans toward biceps tenodesis as the preferred alternative, supported by studies such as Boileau *et al.* [3] and Werner *et al.* [11], which report rates of residual pain and failure following traditional SLAP repair. In the present series, patients older than 50 years had a mean ASES score of 88.78 ± 9.53. These findings indicate that satisfactory postoperative scores were also observed in older patients; however, because there was no comparison group undergoing biceps tenodesis, the present study cannot determine whether single-anchor repair is superior or equivalent to tenodesis in this population.

This suggests that the problem might not be the repair itself, but rather the overload of suture material in the joint. However, this mechanistic interpretation cannot be directly established by the present clinical data and should therefore be considered hypothesis-generating rather than demonstrated by this study.

From a biomechanical standpoint, choosing a single anchor at the 12 o'clock position might initially seem insufficient compared to more extensive constructs with anterior and posterior fixation. However, understanding the peel-back mechanism

described by Burkhart and Morgan [2] makes it logical to focus stabilization on the point of maximum tension of the biceps-labrum complex. The present clinical findings are compatible with the possibility that fixation at this position may provide satisfactory early functional outcomes, although biomechanical and comparative clinical studies are required to establish whether the single-anchor configuration provides equivalent stability to multi-anchor constructs.

Another aspect worth noting is technical simplicity. A single anchor may reduce the number of implants and the amount of intra-articular suture material compared with multi-anchor constructs [12]. However, the present study did not formally measure operative time, implant cost, or intra-articular suture burden, and these potential advantages therefore require confirmation in future comparative studies.

The principal limitations of this study include its retrospective design, relatively small sample size, lack of a comparison group, six-month follow-up, absence of preoperative ASES and QuickDASH measurements, and unavailability of VAS data in the final analytical database. These limitations prevent assessment of longitudinal change and limit conclusions regarding comparative effectiveness. In addition, the exploratory age-group analysis should be interpreted cautiously because of the small number of patients in the younger subgroup.

Despite these limitations, the study provides clinical data regarding a specific single-anchor technique and describes the early functional outcomes observed in a heterogeneous cohort that included both young and older patients. Prospective comparative studies with preoperative and postoperative patient-reported outcomes, pain measurements, longer follow-up, and standardized assessment of return to sport would be valuable to further evaluate this technique.

Overall, the findings suggest that type II SLAP repair with a single suture anchor at the 12 o'clock position can be associated with favorable early postoperative functional scores in selected patients. The results should be interpreted as preliminary clinical observations rather than as evidence of superiority over alternative treatment strategies.

5. Conclusions

The repair of type II SLAP lesions using a single 1.9-mm all-suture anchor at the 12 o'clock position was associated with favorable early postoperative functional scores in this retrospective series. The mean postoperative ASES score was 92.93 ± 9.99, and the mean QuickDASH score was 6.69 ± 8.33 at approximately 6 months.

An inverse association between age and postoperative ASES score was observed ($r = -0.499$; 95% CI, −0.708 to −0.209; $p = 0.0017$). All patients younger than 25 years achieved an ASES score of 100 in this small exploratory subgroup; however, these findings should not be interpreted as evidence of an age-specific treatment effect.

The observed results support further prospective investigation of single-anchor SLAP repair, particularly studies incorporating preoperative and postoperative

functional scores, pain measurements, comparison groups, and longer-term follow-up.

Author Contributions

José María Busto Villarreal: Conceptualization, methodology, investigation, resources, and supervision.

Eduardo Hernández Morales: Investigation, data curation, resources, review.

Jorge Joaquín Recio Valdes: Investigation, data curation, resources, review.

Juan Felipe Gómez Castillo: Investigation, data curation, resources, writing, review.

Jimena Guadalupe Prado Peláez: Conceptualization, methodology, formal analysis, review, and editing.

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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