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Is timing of superior labrum anterior to posterior (SLAP) repair important? A cohort study evaluating the effect of the duration of symptoms prior to surgery on the outcomes of patients who underwent type II SLAP repair

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Abstract

Background: The management of superior labrum anterior to posterior (SLAP) tears is somewhat controversial. It is unclear if the length of time between symptom onset and surgery affects SLAP repair outcomes.

Methods: Sixty-one SLAP repairs were retrospectively reviewed pre-operatively and post-operatively at 1, 6, 24 weeks, and > 2 years post-surgery. Patients were allocated to an 'early repair' or 'late repair' group based on time between symptom onset and surgery.

Results: Of the 61 patients, 22 patients had surgery within six months of symptom onset. Pre-operatively, 'late repair' patients played a higher level of sport than 'early repair' patients prior to injury. Post-operatively, both groups had similar outcomes up to six months, though at six months 'early repair' patients reported a higher level of work than 'late repair' patients ($p = 0.01$). At > 2 years after surgery, 'early repair' patients had reduced pain and difficulty with overhead activities ($p = 0.002$), less stiffness ($p = 0.001$) and were more satisfied than 'late repair' patients ($p = 0.04$).

Conclusions: Up to six months post-operatively, the time between symptom onset and surgery has limited effect on functional outcomes. However, at > 2 years after surgery, earlier repairs (< 6 months) are interestingly associated with better functional outcomes. Further studies are required to determine if this is a causal relationship.

Keywords

Shoulder, glenoid labrum, superior labrum anterior to posterior, repair

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Introduction

First described by Andrews et al., superior labrum anterior to posterior (SLAP) tears are a cause of significant pain and disability.[1] The Snyder classification system categorises SLAP tears based on the degree of labral tearing and bicipital tendon involvement. Type II tears are the most common. They involve fraying of the superior labrum and the detachment of the biceps anchor from the superior glenoid.[2–4]

A period of 3–6 months of non-operative treatment is often advocated for SLAP lesions.[5,6] In a prospective case series of 46 patients, Shin et al. found that three months of non-operative treatment improved patient's American shoulder and elbow surgeons (ASES) scores and Constant scores from baseline by two years after commencement of non-operative treatment.[7] Similarly, Edwards et al., in a case series of 19 patients, found that 3–6 months of non-operative treatment significantly

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improved patient ASES scores compared with prior to treatment.[8] However, in both studies, several patients (15% and 51%, respectively) still required surgery after this period of non-operative treatment.[7,8]

SLAP repair is a commonly advocated surgical treatment for SLAP tears. It involves the reattachment of the superior labra to the glenoid rim. SLAP repair results have generally been reported as significantly improving patients shoulder function and reduce pain.[4,9,10] In recent times, several studies have questioned the efficacy of this surgery.[11,12] To our knowledge, there has been no study that has analysed if the duration of time from symptom onset to surgery affects patient outcomes.

The purpose of this current study therefore was to determine the benefit or not of having an early SLAP repair. We hypothesised that early SLAP repairs would be associated with improved functional outcomes.

Materials and methods

Following ethics approval (09/STG/85), we performed a retrospective cohort study at our institution using prospectively collected data comparing early repair and late repair type II SLAP repair cases between January 2007 and May 2017 by the senior author. Patients who met the inclusion criteria were contacted via letter and telephone at the start of the study (May 2019) and asked to complete a > 2-year assessment either at the clinic or via telephone if they were unable to attend a clinic appointment.

Inclusion and exclusion criteria

Patients were included in this study if they underwent arthroscopic repair of a type II SLAP lesion between January 2007 and May 2017. Patients were excluded if it was a revision surgery or they had: no onset of symptoms date, glenohumeral arthritis (of grade II or greater as per Outerbridge classification);[13] concurrent anterior or posterior labral stabilisation; fracture of the humerus, scapula or clavicle; biceps tenodesis, calcific debridement, and rotator cuff repair or rotator cuff repair with polytetrafluorethylene patch.

Patient assessment

At presentation, each patient completed a questionnaire asking when the problem began, whether it was related to a specific injury and whether it was work related.

Shoulder function

Pre-operatively and at 1 week, 6 weeks, 6 months and more than 2 years post-operatively, patients answered a standardised questionnaire that was based on the L'Insalata Shoulder Rating Questionnaire using a five-point Likert scale.[14] The questions appraised: frequency of shoulder pain, level of shoulder pain, level of shoulder stiffness, difficulty with reaching the back, difficulty with overhead activities and overall shoulder satisfaction.

Sport and work level

Pre-operatively and at 1 week, 6 weeks, 6 months and more than 2 years post-operatively, patients answered questions regarding their level of activity at work and level of sporting participation using a four-point Likert scale.

Range of motion

Examiners measured passive shoulder range of motion pre-operatively and at 6 weeks, 6 months and > 2 years post-operatively. The ranges of external rotation, forward flexion, abduction, and internal rotation were determined visually, according to a previously validated protocol.[15] Patients who were unable to attend a clinic appointment at > 2 years post-operatively did not have their range of shoulder motion examined at > 2 years post-operatively.

Shoulder strength

Examiners tested the strength of shoulder external rotation, internal rotation, adduction, lift-off and abduction in the scapular plane (supraspinatus) with a handheld dynamometer according to validated protocols pre-operatively and at 6, 24 weeks and > 2 years post-operatively.[15]

Operative procedure

All operations were performed by the senior author. Surgeries were performed with the patient in the beach chair position under general anaesthesia and local interscalene nerve block. A standard posterior viewing portal was established followed by a routine diagnostic examination of the joint.

Type II SLAP lesions were repaired via the trans-rotator cuff technique described by O'Brien et al.[16] An anterior superior portal and a trans rotator cuff portal were established under direct vision with the use of a spinal needle (outside-in technique). After skin incision, a 5.5-mm disposable cannula was inserted. The superior anterior portal was created anterior of the long head of the biceps in the rotator cuff interval. The trans-rotator cuff portal was created posterior from the biceps tendon, medial from the

rotator cuff ligament. Next, a stab incision was made longitudinal to the supraspinatus tendon and the trocar was introduced.

A probe was used to determine the amount of labrum detachment and documented clockwise. Scar tissue was detached and the outer edge of the glenoid rim was roughened using an arthroscopic rasp. A Spectrum suture passer was used to pass a nylon 3.0 suture through the labrum. An arthroscopic grabber was used to pick up the wire through the second portal. Next, a FiberWire, 38″blue (Arthrex) was tied to the nylon suture and shuttled through the labrum. An arthroscopic drill guide was inserted (Arthrex) and positioned on the edge of the glenoid in a 30–45° angle anterior of the posterior border of the SLAP. A hole was drilled using a 2.9-mm PushLock drill. The FiberWire, 38″blue was connected to the suture anchor followed by insertion of the anchor according to the manufacturer's manual. As many suture anchors as necessary were used to create a stable labrum and biceps anchor. The amount of suture anchors used was noted, as well as each anchors position in relation to the glenoid. After fixation of the labrum, the cannulas were removed.

Post-operative management

All patients with a labral repair underwent a standardised rehabilitation programme. The patients were asked to wear a sling for six weeks. On day one, patients started with pendulum of the arm exercises and scapular strengthening. The second week, patients could passively flex the shoulder. This was followed by passive horizontal flexion stretch and shoulder extension from three to six weeks post-operative. They were checked and instructed by a physical therapist for the phase II of our rehabilitation protocol from six weeks to three months post-operative. In phase II, actively supported external rotation was initiated together with isometric strengthening exercises. At three months post-operative patients were seen by a physical therapist and were instructed to start phase III exercises until six months post-operative. Phase III consisted of active theraband exercises consisting of rowing, external rotation, internal rotation, adduction and shoulder extension as well as straight arm lifts. The rehabilitation protocol concluded at six months.

Statistical analysis

All statistical analyses were performed on an intent-to-treat basis. A post hoc subgroup analysis of SLAP repair cases was performed based on the time between patient reported onset of symptoms and the date of surgery. Patients were allocated to an 'early repair' group if they had surgery in less than or equal to six months after the onset of symptoms. They were allocated to the 'late repair' group if it took longer than six months to have surgery after the onset of symptoms. The rationale for this grouping was based on the recommendation of current literature to trial up to six months of non-operative treatment prior to considering surgery.[5,6]

The respective 'early repair' and 'late repair' groups were compared at each time point using unpaired Student's t tests for parametric data and Mann–Whitney U tests for non-parametric data. Bivariate Spearman's tests for correlation were conducted to determine a relationship between duration of symptoms prior to surgery and >2-year post-operative patient reported outcomes, work status and sporting status.

Results

Between January 2007 and May 2017, a single surgeon performed 157 type II SLAP repairs. Of these, 6 were excluded for being SLAP repair revisions, 66 for concurrent anterior stabilisation, 3 for concurrent posterior stabilisation, 3 for the presence of glenohumeral arthritis that was grade II or greater, 14 for concurrent rotator cuff repair and 2 for concurrent calcific debridement. Two patients did not specify when their symptoms began. This left a study cohort of 61 shoulders (61 patients) outlined in Figure 1 who underwent an isolated type II SLAP repair.

Demographics

There were 22 patients in the 'early repair' group (surgery within six months or less of symptom onset) and 39 in the 'late repair' group (surgery after at least six months of symptoms). The rationale for this grouping was based on the recommendation of current literature to trial up to six months of non-operative treatment prior to considering surgery.[5,6] Table 1 outlines the two groups demographics. The 'early repair' group had a significantly shorter time from symptom onset to surgery (mean 4 vs. 39 months, $p < 0.05$). The combined median duration of symptoms of our cohort was 10 months (range 1–259). There were otherwise no significant differences between groups. Prior to injury, 36 (59%) patients played hobby sport or higher, with 6 playing at a national level.

Functional assessment

There were no differences in any functional outcomes between the 'early repair' and 'late repair' groups prior to surgery ($p > 0.05$).

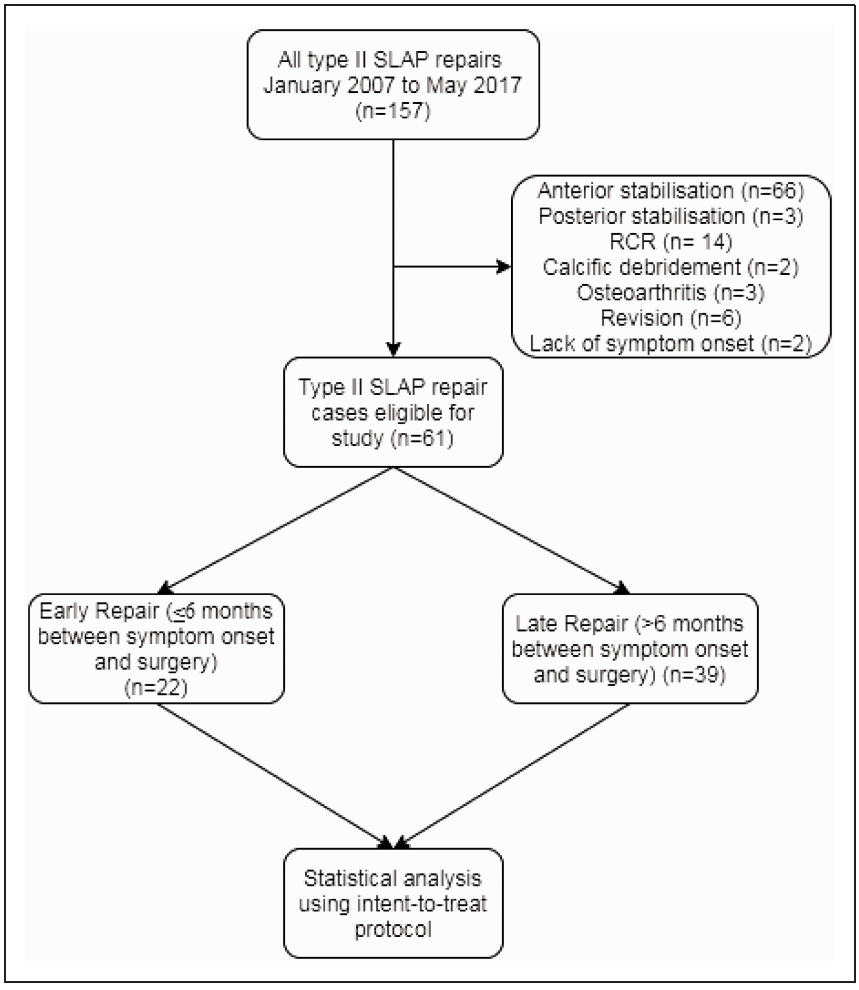

Figure 1. Patient selection flow chart. RCR: rotator cuff repair.

Table 1. Group cohort characteristics.*

	Early repair group	Late repair group	p-Value
Sex, male:female, n	20:2	34:5	>0.9
Age at surgery, y, mean (range)	39 (20–53)	37 (18–57)	0.7
Time from symptom onset to surgery, month, median (IQR)	4 (2)	21 (24)	0.004
Affected shoulder left:right, n	7:15	16:23	0.5
Follow-up, y, mean ± SEM (range)	5 ± 0.5 (3–6)	4 ± 0.4 (2–11)	0.9
No. of anchors used, mean (range)	2 (1–4)	2 (1–5)	0.4
Operation time, min, mean ± SEM (range)	25 ± 2 (9–50)	27 ± 2 (10–51)	0.6
Work cover, %	20%	24%	0.8
Injection prior to surgery	36%	36%	0.97

*Groups defined by time from symptom onset to date of surgery.

Post-operatively, both groups improved at a similar rate up to six months. At > 2 years after repair, the 'early repair' patients had reduced level of pain and reduced difficulty with overhead activities than the 'late repair' patients ($p = 0.002$). The 'early repair' group were less stiff and had less difficulty reaching behind their back than the 'late repair' group at more than two years after surgery (none vs. a little, $p = 0.001$ and none vs. mild, $p = 0.04$, respectively). 'Early repair' patients were significantly more satisfied with their shoulders than 'late repair' patients at > 2 years post-operatively ($p = 0.04$) (Figure 2).

Range of motion

Prior to surgery, there were no differences in range of motion between 'early repair' and 'late repair' patients.

After surgery, 'early repair' patients had less range of external rotation shoulder motion than 'late repair' patients (32° vs. 45°, $p = 0.01$) but by six months, there was no longer a difference between the two groups ($p = 0.5$). At more than two years after surgery, the 'early repair' group had more abduction and internal rotation than the 'late repair' group ($p = 0.03$ and $p = 0.04$, respectively) (Table 2).

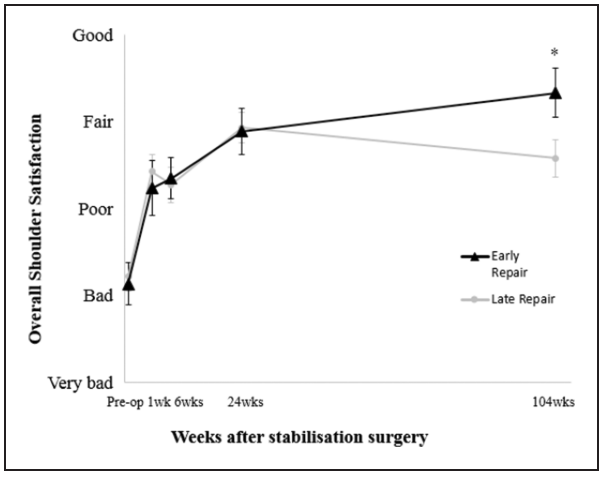

Figure 2. Overall shoulder satisfaction in SLAP repair patients who had surgery within six months of symptom onset and those that did not. Analysed with a Student's t test. *p < 0.05.

Strength

Pre-operatively, 'early repair' patients had less strength in lift off than 'late repair' patients (38 N vs. 56 N $p = 0.04$). After surgery, this difference disappeared. There were no other differences in strength ($p > 0.05$).

Return to work

Prior to injury and prior to surgery, there were no differences between 'early repair' and 'late repair' patients in level of activity at work. Post-operatively, 'early repair' patients returned to a higher level of activity at work earlier than 'late repair' patients ($p = 0.01$) (Figure 3). By > 2 years post-operatively, the 'late repair' group had improved and equalled the 'early repair' groups level of activity at work.

Return to sport

'Late repair' patients were more likely to have played at a higher level of sport prior to injury than the 'early repair' group ($p = 0.02$). However, once injured and after surgery there were no differences between 'early repair' and 'late repair' patients' level of sport.

Subgroup analysis

SLAP repair is often encouraged for young patients, with biceps tenodesis advocated for older patients.[12,17,18] Consequently, we performed a subgroup analysis of our cohort, analysing patients under the age of 40. Thirty-five patients were under the age of

Table 2. Range of shoulder motion in 'early repair' and 'late repair' SLAP repair patients (mean (SEM)).

	Pre-operatively		6 Weeks post-operatively		6 Months post-operatively		> 2 Years post-operatively	
	Early repair	Late repair	Early repair	Late repair	Early repair	Late repair	Early repair	Late repair
FF	152 (7)	159 (4)	131 (8)	135 (6)	162 (6)	165 (3)	180 (0)	145 (12)
ABD	134 (9)	140 (6)	105 (8)	113 (7)	151 (8)	149 (7)	180* (0)	128* (16)
ER	51 (5)	58 (3)	32* (4)	45* (3)	57 (5)	52 (4)	60 (15.3)	45 (7)
IR	L1 (1)	T12 (1)	L2 (1)	L2 (1)	T11 (1)	T12 (1)	T10* (2)	L5* (2)

*p < 0.05. FF: forward flexion; ABD: abduction; ER: external rotation; IR: internal rotation.

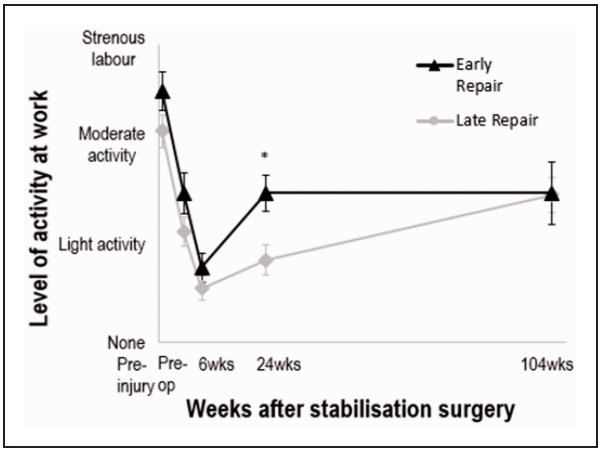

Figure 3. Level of activity at work in SLAP repair patients who had surgery within six months of symptom onset and those that did not using Student's t test. *$p < 0.05$.

40, with 12 (34%) undergoing an SLAP repair within six months of symptom onset. The remaining 23 were allocated to the 'late repair' group. Twenty-six patients were excluded for subgroup analyse.

There was a similar age at time of repair between the 'early repair' and 'late repair' subgroups (32 vs. 30 years, $p = 0.5$). There were also no differences in demographics between the two groups with regard to gender, level of work or sport prior to injury, length of operation time, number of anchors used or if they had received a steroid injection prior to surgery ($p > 0.05$). Pre-operatively, there were no differences in any functional outcomes or range of motion between the 'early repair' and 'late repair' subgroups ($p > 0.05$).

At more than two years after surgery, similar to the overall cohort, patients under 40 who underwent SLAP repair within six months of symptom onset reported decreased pain and difficulty with overhead activities (none vs. moderate, $p < 0.05$) and were more satisfied with their shoulders (good vs. fair, $p = 0.005$) than patients in the 'late repair' group.

Duration of symptoms' associations

We found that the length of symptoms prior to surgery was positively associated with increased level of pain with activity ($r = 0.31$, $p = 0.05$), level of pain with overhead activities ($r = 0.41$, $p = 0.008$), patient reported stiffness ($r = 0.4$, $p = 0.008$), difficulty reaching behind the back ($r = 0.33$, $p = 0.03$) and difficulty with overhead activities ($r = 0.41$, $p = 0.007$) at more than two years after repair (Table 3). Length of symptoms prior to surgery was negatively associated with overall shoulder satisfaction ($r = -0.31$, $p = 0.048$).

Table 3. Correlation of duration of symptoms with functional outcomes at more than two years after surgery.

Functional outcomes	Absolute correlation (R value)	p-Value
Difficulty with overhead activities	0.41*	0.007*
Patient reported shoulder stiffness	0.40*	0.008*
Level of pain with overhead activities	0.41*	0.008*
Difficulty reaching behind the back	0.33*	0.03*
Overall shoulder satisfaction	−0.31*	0.048*
Frequency of pain with activity	0.31*	0.05*
Level of pain at rest	0.3	0.054
Frequency of extreme pain	0.3	0.057

Completed using a bivariate Spearman correlation. *$p < 0.05$.

Discussion

This study showed that patients who underwent SLAP repair within six months of symptom onset had an earlier return to a higher level of activity at work at six months post-operatively and at two years after surgery had less pain and less difficulty with overhead activities and were more satisfied with their shoulders.

Of the 61 patients, 22 patients (36%) had surgery within six months of symptom onset. What caused the other 39 patients (64%) to have a delayed surgery is unclear and likely multifactorial. The 'late repair' SLAP repair group prior to surgery played a higher level of sport pre-injury than 'early repair' SLAP repair group. Consequently, these patients may have attempted to continue playing sports and tried to avoid surgery to avoid taking time off sport. This may have contributed to their long-term poorer outcomes after SLAP repair, though prior to surgery there were no differences between the two groups with respect to functional outcomes or shoulder range of motion. Additionally, the delay in surgery may have been due to the difficulty of SLAP diagnosis, which has been reported in several studies.[19,20]

In our study, the overall median time of surgery after symptom onset was 10 months. This is comparable to other studies analysing the outcomes of type II SLAP repair which have ranged from 8 to 14 months of time between symptom onset and surgery.[21–23] In comparison, a recent randomised control trial comparing SLAP repair with sham surgery and biceps tenodesis had a significantly longer time between symptom onset and surgery (median 24 months).[11] In the randomised control trial, there was

no difference in patient outcomes between sham surgery, biceps tenodesis or SLAP repair at two years after surgery. This potentially suggests that the benefits of surgery are lost if repair is significantly delayed.

In our study, patients who underwent SLAP repair within six months of symptom onset had both improved functional outcomes in the long term and an earlier return to a higher level of work. There were moderate correlations ($r = 0.33–0.41$) between a longer time between surgery and symptom onset, and worse functional outcomes. The earlier return to a higher level of work in our cohort contrasts with a recent randomised control trial comparing SLAP repair with sham surgery by Brox et al., that found that neither the duration of symptoms prior to surgery nor the method of surgery had any effect on number of days of sick leave taken by a patient up to two years after the surgery. Instead, a patient's sick leave at baseline and pre-operatively reporting symptoms of anxiety or depression were predictive of post-operative sick leave. However, in Brox et al.'s study, 80% of sham surgery patients and 70% of labral repair patients underwent surgery after reporting more than a year of shoulder symptoms. In comparison in our cohort, only 49% of patients reported symptoms for more than a year prior to surgery. In addition to the differing demographics, our dichotomous analysis of duration of symptoms prior to surgery varied to the study performed by Brox et al.[24] Brox et al. compared more than one year of symptoms prior to surgery and less than one year, while we compared more than six months and less than six months.[24] These differences may account for the contrasting results. When analysing our cohort based on more than one year of symptoms prior to surgery and less than one year, the differences in level of activity at work between the early repair and late repair group was no longer significant, suggesting that SLAP repairs performed more than a year after symptom onset have minimal effect on a patient's return to work and number of sick leave days.

The 'early repair' group had significantly less range of external rotation at six weeks post-repair compared with 'late repair' patients (32° vs. 45°). Early post-operative stiffness after SLAP repair; measured via external rotation at six weeks after surgery has previously been reported to be associated with improved outcomes.[25] It is also consistent with a study on rotator cuff repair, where early loss of range of motion in rotator cuff repair patients was associated with less re-tears on ultrasound at six months after surgery.[26] We hypothesise that the earlier repair, the greater the inflammatory response present. Upon repair, the increased inflammation causes an exuberant healing response manifesting as post-operative shoulder stiffness and in the long term improved functional outcomes.

A strength of this study was its clear inclusion and exclusion criteria. The study also has high internal validity, with all labral tears being diagnosed and repaired by the same surgeon, though this may limit its applicability to external settings. Furthermore, all pre-operative and post-operative patient data to six months was collected prospectively.

There were several potential limitations of this study that should be considered. There is a risk of recall bias with patients recalling when their symptoms began, especially amongst those with no clear precipitating injury. We also were unable to take into account potential confounding variables such as length of prior non-operative treatment. We were not able to determine if length of symptoms prior to surgery influenced repair integrity as no imaging analysis was used in this study. There was also no randomisation into repair vs. no repair or delayed surgery vs. no delay.

This study suggests that up to six months post-operatively, the time between SLAP repair and symptom onset has limited effect on patient-reported functional outcomes or range of shoulder motion, only affecting level of activity at work. However, by two years after surgery, patients who undergo SLAP repair within six months of symptom onset report better functional outcomes. Further studies are required to determine if this is a causal relationship between a shorter duration of symptoms prior to SLAP repair surgery and improved patient outcomes at more than two years post-surgery.

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Declaration of Conflicting Interest

GACM is a paid consultant and has research funding (products) from Smith and Nephew; and is a financial stakeholder with the facility (Kogarah Private Hospital – formerly known as National Day Surgery – Sydney) and is also on the Editorial Board of the following publications: Journal of Shoulder and Elbow Surgery; Shoulder and Elbow; Techniques in Shoulder and Elbow Surgery.

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Ethical Review and Patient Consent

Ethical approval for this study was obtained South East Sydney Local Health District HREC 09/STG/85. Verbal informed consent was obtained from all subjects before the study. Written informed consent was not obtained because follow-up was organised over the phone at >2 years after surgery.

Trial Registration

Not applicable because this was a restrospective analysis.

Guarantor

GACM.

Contributorship

GM and GACM researched literature and conceived the study. GM was involved in patient recruitment and data collection. GM and PHL were involved in data analysis. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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