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Contents lists available at ScienceDirect

JSES International

journal homepage: www.jseinternational.org

Comparing clinical outcomes between rotator cuff repairs, SLAP repairs, and combined repairs

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ARTICLE INFO

Keywords:

SLAP
arthroscopic rotator cuff repair
arthroscopic
shoulder strength
pain
arthroscopic stabilization
superior labral tear

Level of evidence: Level III, Retrospective Cohort Design, Treatment Study

Background: Superior labrum lesion from anterior to posterior (SLAP) often presents together with other shoulder pathologies such as rotator cuff tear (RCT), but it is uncertain if repairing both SLAP and RCT has superior clinical outcomes over isolated repairs of SLAP and RCT.

Materials and methods: This was a retrospective cohort study with prospectively collected data, reviewing 157 patients who underwent arthroscopic repair of either RCT, SLAP (type II lesion), or both. Before surgery and after 6 weeks, 12 weeks, and 24 weeks, shoulder objective range of motion and strength were measured, patient-reported function and pain was assessed by the modified L'Insalata questionnaire with a Likert scale, and complications after each repair were examined.

Results: At 24 weeks after surgery, the combined group ($n = 22$) and SLAP group ($n = 47$) had significantly higher forward flexion ($165^\circ \pm 4^\circ$ and $167^\circ \pm 4^\circ$ vs. $154^\circ \pm 3^\circ$, $P = .01$ and $P = .01$), external rotation strength (82 ± 6 N, 81 ± 6 N vs. 61 ± 3 N, $P = .01$ and $P = .01$), and abduction strength (94 ± 14 N, 78 ± 8 N vs. 53 ± 3 N, $P = .001$ and $P = .02$) compared with the rotator cuff tear repair (RCT) group ($n = 88$). The combined group also had stronger internal rotation than the RCT group (107 ± 12 N vs. 72 ± 4 N, $P = .02$). Function and pain improved from “severe-moderate” to “moderate-mild” in all groups after surgery.

Conclusion: Repairing RCT and SLAP tears together results in significant clinical benefits compared to repairing just RCT and analogous results against SLAP-only repair.

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Shoulder pathologies commonly present to emergency and general practice with shoulder pain, loss of strength, and loss of range of motion (ROM).^{36,52} They can be separated into extra-articular (rotator cuff tears [RCT], impingement, adhesive capsulitis) and intra-articular (superior labrum lesion from anterior to posterior [SLAP] tear, Bankart lesions, osteoarthritis). These conditions are often associated with each other. For example, SLAP lesions are often concomitant with RCT, Bankart lesion, or glenohumeral arthritis.^{17,30,43} In particular, concomitant RCT in type II SLAP lesions are considered to be a confounding factor influencing clinical outcomes.

A SLAP tear is typically diagnosed and categorized arthroscopically according to Snyder classification.⁴⁴ It can be managed

nonoperatively with a combination of oral nonsteroidal anti-inflammatory drugs, intra-articular steroid injections, and physiotherapy and/or via arthroscopic surgery involving débridement, biceps tenodesis, or SLAP repair.^{6,42} It is a heterogeneous condition where the extent of lesions does not always associate well with clinical symptoms and signs nor with postoperative complications such as re-dislocation and re-subluxation.³⁵ For isolated SLAP repairs, our group has been using the transrotator cuff technique described by O'Brien et al³³ and have reported a re-dislocation rate of 18% and re-subluxation rate of 12% between 3.7 and 6.5 years after surgery.²² The frequency of pain and overall activities improve over time from “Daily” to “Monthly” and from “Bad” to “Fair,” respectively.²²

RCT is the most common shoulder pathology in patients older than 60 years.^{5,26,27,34} Full-thickness rotator cuff tears occur in 25% of individuals above 60 year old and 50% above 80 years old.⁴⁵ Arthroscopic surgery aims to restore anatomical structures by reattaching torn tendons to the humeral head and in turn function. In addition to adhesive capsulitis, retear is the most distressing

Ethics approval was obtained from the South-Eastern Health Service Human Research Committee (HREC#: 09/STG/85).

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<https://doi.org/10.1016/j.jseint.2020.07.014>

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complication with variable rates estimated to be 15%–90% depending on studies.^{4,14,18,38} For rotator cuff tear repairs (RCR), we have been using the undersurface technique for over 10 years. It is an arthroscopic technique, which has the benefits of shorter operative time, quicker improvement of function, and less post-operative pain compared with a bursal side RCR.⁴⁹ The retear rates in our group have been on the lower end of what has been described so far, and in the range of 9%–28% depending on preoperative tear size.^{24,29,39–41,48}

When patients suffer from both SLAP lesions and RCT, it is unclear whether repairing both shoulder injuries at the same time improves clinical outcomes and prognosis. In earlier studies, Snyder et al⁴⁴ show that repairing an isolated SLAP type II lesion results in improvement of pain and function. Voos et al⁴⁷ and Oh et al³⁵ describe improved functional outcomes after surgically repairing SLAP and associated RCT; however, to our knowledge, direct comparisons of clinical outcomes between RCR, SLAP repairs, and combined SLAP + RCR repairs in the same patient cohort have not been made so far. Therefore, the aim of this study was to investigate the clinical outcomes of isolated SLAP repair, isolated RCR, and combined RCR and SLAP repairs. We hypothesize that repairing both injuries at the same time has clinical benefits over correcting RCR or SLAP alone.

Material and methods

Patient selection

Informed consent was obtained from the patients, and the participants were anonymized in this study. This was a retrospective cohort study with prospectively collected data of 157 patients who met the inclusion criteria and were able to complete a follow-up at 24 weeks. The indications for surgeries were shoulder pain, loss of strength, and loss of ROM from RCT and/or SLAP. We selected the cohort by reviewing all operative reports from January 2007 to August 2013. The inclusion criteria for the study were: (1) arthroscopic repair using a knotless PEEK 2.9 mm suture anchor (PushLock; Arthrex, Naples, FL, USA) for SLAP, and/or (2) arthroscopic repair using Opus Magnum 2 (Arthrocare; Smith and Nephew, London, UK) for RCR, (3) a minimum of 24 weeks' postsurgical follow-up period. Patients were excluded if they had revision surgery of the affected shoulder, a capsular shift without labral repair, posterior or anterior labral repair, an associated fracture, or osteoarthritis grade 2 or more.

A SLAP (SLAP II) was defined as a superior labrum tear from anterior to posterior lesion with a detached biceps anchor from 11 to 1 o'clock.⁴⁴ A full-thickness RCT was defined as either a tear of the infraspinatus or the supraspinatus tendon. A partial-thickness RCT was defined as a percentage of the thickness of tendinous insertion of the rotator cuff. (Only partial-thickness tears greater than 50% thickness of the tendon were included in this study; these partial-thickness tears were converted to a full-thickness tear intraoperatively and repaired as per full-thickness tear.) In order to match the tear sizes, the RCR group was selected by matching the average size and within 2 standard deviation of the RCT from the combined SLAP and RCT group's operative reports (1.3 ± 0.6 cm from anterior to posterior and 1.4 ± 0.6 cm from lateral to medial).

Arthroscopic surgery

All surgeries were performed by 1 surgeon using interscalene nerve blocks with sedation in a beach chair position. The procedure was initiated by inserting an arthroscope into the glenohumeral joint via a posterior portal, just posterior from the biceps tendon and medial from the rotator cuff ligament. An anterior superior

portal and a transrotator cuff portal were established under direct vision with the use of a spinal needle just anterior to the long head of the biceps in the rotator cuff interval.

SLAP was repaired via the transrotator cuff technique.³³ 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 nylon 3.0 suture was passed through the labrum. A grabber was used to pick up the wire, and a Suture Lasso (Arthrex) was tied to the nylon suture and shuttled through the labrum. A hole was drilled using a 2.9 mm PushLock drill on the edge of the glenoid at an angle of 30°–45° just anterior of the posterior border of the SLAP. The FiberWire, 38" blue was connected to the suture anchor and inserted. As many suture anchors as necessary were used to create a stable labrum and biceps anchor. The number and position of suture anchors were documented.

For RCT, the undersurface technique was used.^{21,49} A torn tendon was visualized from its undersurface, and a shaver was inserted to débride the edge of the RCT and the landing site for suture anchors. Anchors were inserted on the lateral margin of the landing site on the greater tuberosity. Sutures were passed through the tendon using the Opus Smartstitch Suture Device (Smith and Nephew, London, UK) to create an inverted mattress configuration resulting in a tension band effect, and the tendon was reduced to the bone.

Rehabilitation protocol

Patients were discharged with a sling for SLAP or an ultrasling for RCR. All patients received a detailed rehabilitation guideline with specific exercises with 2 or 3 phases. Phases 2 and 3 of the rehabilitation protocol were checked and instructed by a physiotherapist. At 6 months' follow-up, all patients were allowed to return to full work and regular sports. Patients with a SLAP repair had the following protocol. For phase I, day 1 after surgery, patients started with pendulum of the arm and scapular strengthening. On the second week, patients were allowed to passively flex the shoulder followed by passive horizontal flexion stretch and from week 3 to 6 extend shoulder. In phase II, from 6 weeks to 3 months after surgery, actively supported external rotation was initiated together with isometric strengthening exercises. From 3 to 6 months, phase III exercises commenced with active theraband exercises consisting of rowing, external rotation, internal rotation, adduction, and shoulder extension as well as straight-arm lifts. The rotator cuff repair rehabilitation protocol was in 2 phases. Phase I was the same as the SLAP rehabilitation protocol with additional passive internal and external rotation exercises after the first week. In phase II, active supported external rotation and isometric strengthening exercises were commenced.

Outcome assessments

The primary outcome of this study was passive ROM and strength at 24 weeks after surgery. Before surgery and at 6-week, 12-week, and 24-week follow-up consultations, ROM and strength of shoulder motions were measured by a registered clinician using previously validated standardized techniques.^{11,12} Passive range of movements of the shoulder, forward flexion, abduction, and external and internal rotation were measured visually. Muscle strength was measured for internal rotation, external rotation, liftoff, abduction, and adduction of the shoulder in the scapular plane using a Hand Held Force Gauge (HFG-45; Transducer Techniques, Temecula, CA, USA).

The secondary outcomes were patient assessed satisfaction, function, and pain. At each clinical visit, patients completed the modified L'Insalata questionnaire with Likert scales for evaluating both pain and function, with separately scored domains for global

Table 1
Patient demographics

Study group (n = 157)	RCR (n = 88)	SLAP (n = 47)	Combined (n = 22)	P values
Age	57 ± 11 (22-84)	43 ± 10 (19-61)	43 ± 11 (24-57)	.0891
Male	38	40	20	–
Female	50	7	2	–
Left shoulder	32	20	8	.7896
Right shoulder	56	27	14	.7896
Lesion size SLAP (cm ²)		2 ± 0.6 (1-3)	1.7 ± 0.5 (1-2.5)	<.02
Rotator cuff tear size area (cm ²)	1.6 ± 1.8 (0.4-4)	–	2.1 ± 0.5 (1.3-6.2)	.10
Full-thickness tears	22	4	–	.5864
Partial-thickness tears	66	18	–	.5864
Retear	0	1	–	.99
Number of anchors for SLAP	–	2 ± 0.6 (1-4)	2 ± 1 (1-3)	<.03
Number of anchors for RCR	1 ± 1 (1-4)	–	1 ± 1 (1-3)	.6553

RCR, rotator cuff tear repair; SLAP, superior labrum lesion from anterior to posterior.

assessment, pain, daily activities, recreational and athletic activities, work, and satisfaction.²³

Statistics

For the primary outcomes, 1-way analysis of variance with Holm-Sidak corrections for multiple comparisons was performed. The primary outcome was assessed using Student’s *t*-test for parametric data and the Mann-Whitney *U*-test for non-parametric data. Multiple linear regression analysis was performed to identify significant contributing factors (sex, age, insurance type, tear size, and type of RCT [partial- or full-thickness]) influencing primary outcomes.

Results

Study groups

Between January 2007 and August 2013, there were 198 patients with either an RCR or SLAP repair. Forty patients were excluded because of a coexisting anterior labrum repair. One patient was excluded because of the presence of moderate osteoarthritis ending up with 157 patients in the study group. Among these, 88 patients had RCR, 47 patients had SLAP repair, and 22 patients had combined SLAP and RCR. There was 1 patient who had a bilateral RCR in the RCR group.

Patient demographics

In the RCR group, there were 38 (43%) males and 50 (57%) females, with a mean age of 57 years (range, 22-84 years). Of the 88 shoulders, 32 (36%) were on the left and 56 (64%) were on the right. There were 40 males (85%) and 7 females (15%). The SLAP group had a mean age of 41 years (range, 19-61 years), with 20 (43%) on the left and 27 (57%) on the right. The combined group consisted of 20 (91%) male and 2 (9%) female patients with a mean age of 43 (24 to 57 ± 2). Among these, 8 (36%) were on the left and 14 (64%) were on the right. The RCR group was significantly older compared with the other groups (*P* = .0001). There was no significant difference between the groups regarding age. There was an equal distribution in left and right shoulders in all groups (Table 1).

There were 22 (25%) full-thickness and 66 (75%) partial-thickness RCT in the RCR group compared with 4 (18%) full-thickness and 18 (82%) partial-thickness RCT in the combined group. The mean RCT size in the RCR group and that in the combined group were similar with a surface tear area of 1.6 cm² (range, 0.36-4 cm²) and 2.1 cm² (range, 1.2-6.2 cm²), respectively. The mean SLAP lesion size (clock face) in the SLAP group was 2.1 cm

(range, 1-4 cm) larger than the combined group with a mean of 1.7 cm (range, 1-2.5 cm; *P* = .02). A mean of 1 anchor (1-4 ± 1, range ± SD) was used in the RCR group, and 1 anchor (1-3 ± 1, range ± SD) was used in the combined group for RCR. In the SLAP group, a mean of 2 anchors (range, 1-3) were used, which were statistically more than the combined group of 1.7 anchors (range, 1-3; *P* = .03).

Range of motion and muscle strength

No significant differences were identified at any time points between SLAP and combined SLAP and RCR group before and after surgery in ROM and strength measurements. The combined group started out with higher strengths before surgery compared with the RCR group and at all time points after surgery. At 24 weeks after surgery, patients in the SLAP group and combined group had significantly increased forward flexion compared with the RCR group (165° ± 4° and 167° ± 4° vs. 154° ± 3°; *P* = .01; Fig. 1, A). All 3 groups had improved strength in external rotation, internal rotation, and abduction by 24 weeks after surgery. Patients in both SLAP group and combined group had significantly increased external rotation strength compared with the RCR group at 24 weeks (82 ± 6 N, 81 ± 6 N vs. 61 ± 3 N, *P* = .01 and *P* = .01, Fig. 1, B). The combined group had statistically higher internal rotation force than the RCR group at 24 weeks’ follow-up with 107 ± 12 N vs. 72 ± 4 N (*P* = .02, Fig. 1, C). For abduction strength, both SLAP (78 ± 8 N) and combined group (94 ± 14 N) had stronger abduction compared with the RCR group (53 ± 3 N, *P* = .001 and *P* = .02, Fig. 1, D).

Patient-determined outcomes

No significant differences were identified between the groups before and after surgery for patient-determined outcomes. In all groups, patient satisfaction improved from “poor” preoperatively to “fair” 24 weeks after surgery (*P* = .01, Fig. 2, A). Compared with before surgery, both difficulty with overhead activities and pain with overhead activities improved from “severe” to “moderate” at 24 weeks’ follow-up in the RCR and SLAP groups and from “severe” to “mild” in the combined group (*P* = .001, Fig. 2, B and C). Similarly, level of shoulder stiffness decreased from “moderate” to slightly above “a little,” but it was not statistically significant from preoperative levels (Fig. 2, D). No significant differences in changes to the level of activities at work or sporting activities were identified.

Complications

In the RCR group, there were 5 patients with postoperative frozen shoulder that was resolved with supervised neglect. A frozen shoulder was defined as a stiff shoulder with external rotation less

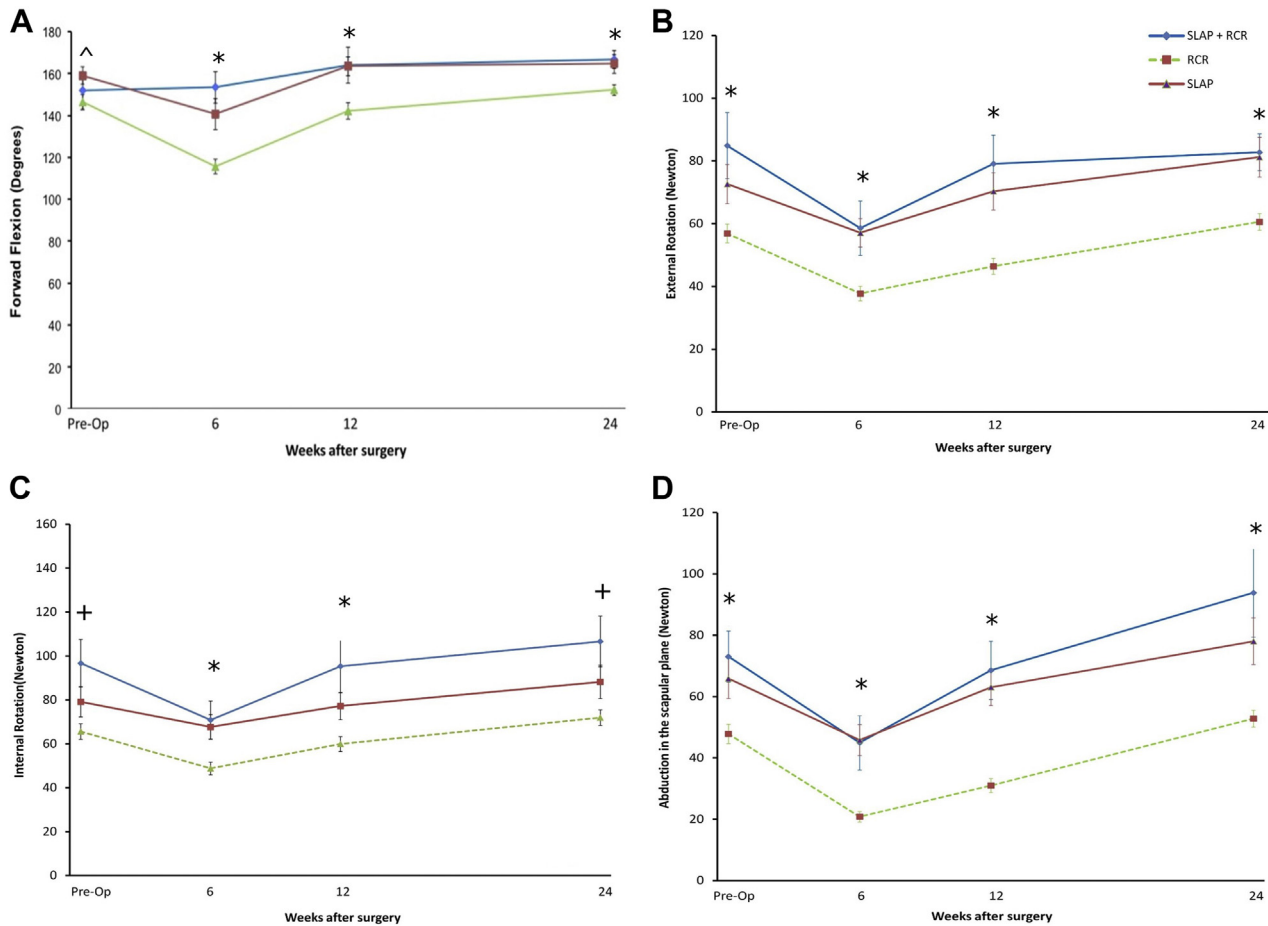


Figure 1 Range of motion and strength in the scapular plane. (A) Examiner-determined assessments of forward flexion range of motion. (Compared with the RCR group, the SLAP group had significantly higher forward flexion before surgery. At 6, 12, and 24 weeks, both SLAP and combined group had statistically increased forward flexion.) (B) External rotation strength. (Both SLAP and combined group had higher external rotation strength before and at 6, 12, and 24 weeks after surgery than RCR.) (C) Internal rotation strength. (Combined group had stronger internal rotation at preop and 24 weeks. Also the combined and SLAP group had greater internal rotation at 6 and 12 weeks.) (D) Abduction strength. (Both SLAP and combined group had superior abduction at all time points compared with RCR.) Results shown as mean ± standard error (*SLAP vs. RCR, $P < .05$; *Combined and SLAP vs. RCR, $P < .05$; +Combined vs. RCR, $P < .05$). RCR, rotator cuff tear repair; SLAP, superior labrum lesion from anterior to posterior.

than 20°, abduction less than 90°, forward flexion less than 90°, and internal rotation below L3. Two patients had persistent postoperative pain and 4 patients suffered from pain due to impingement that were remitted without further intervention (Table II). After a SLAP repair, 1 patient had positive impingement signs leading to arthroscopic subacromial decompression after a failed trial of conservative treatment and 1 patient had a frozen shoulder, which was successfully treated with supervised neglect without further surgery. One retear of the rotator cuff was identified and surgically revised in the combined group, leading to no other long-term complications. There were 2 patients with persistent postoperative pain. Four patients were identified with pain due to impingement with remission without operative intervention (Table II).

Multiple logistic regressions

Multiple linear regression analyses showed male gender to be a contributing factor with better forward flexion ($P = .04$), higher strength in external rotation and abduction in the scapular plane after 6 months ($P = .04$ and $P = .02$). Specifically, age, insurance type, tear size, and type of RCT (partial- or full-thickness) were not identified as contributing factors.

Discussion

In this retrospective cohort study, we show that the combined SLAP and RCR group has increased ROM in forward flexion and increased strength in external rotation, internal rotation, and abduction. The SLAP group has improved abduction strength compared with the RCR group. The contributing factor for increased forward flexion and external rotation and abduction is being a male. These findings indicate that there are clinically functional benefits for repairing SLAP and rotator cuff injury together compared with RCR alone. However, the benefits of combined repair are marginal when compared with SLAP repair alone, demonstrating that SLAP repair is likely contributing more to the clinical outcomes of the combined repair than RCR. To our knowledge, there has been no study that directly compared outcomes of RCR, SLAP, and combined RCR and SLAP repairs in the same patient cohort. Until now, most studies compared various combinations of 2 injuries from RCT or SLAP and associated pathologies.

Because of low interexaminer reliabilities with qualitative muscle strength testing and for objective assessment of the patient's postsurgical progress, we elected to quantitatively measure ROM and strengths in the scapular planes using a hand-held force gauge. It is not commonly used for tracking postoperative progress; however, hand-held dynamometry to measure strength has been

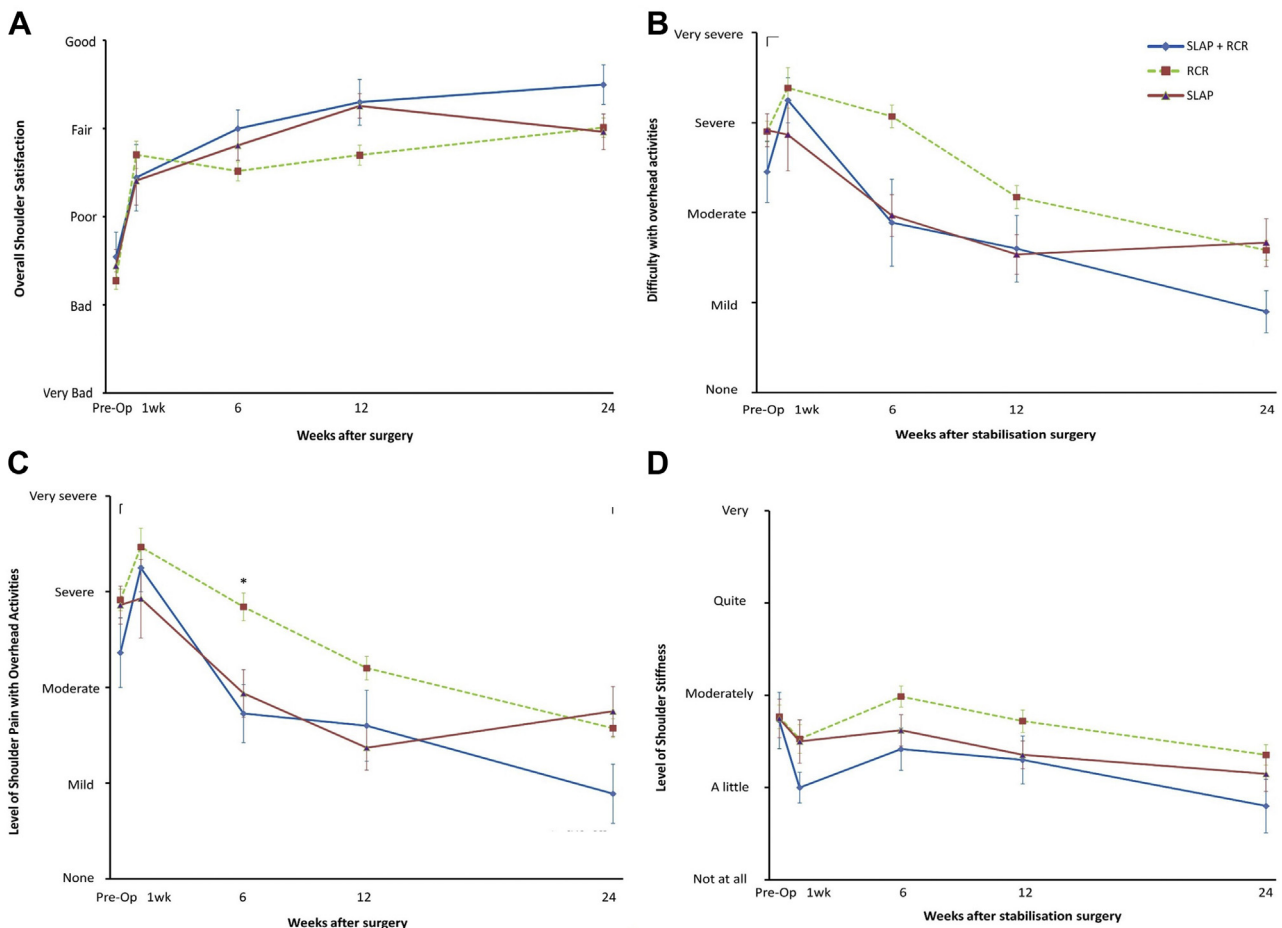


Figure 2 Patient-determined functional scores. There were significant improvements after surgery, but no statistically significant difference between groups after surgery. (A) Overall satisfaction. (B) Level of difficulty with overhead activities. (C) Level of pain with overhead activities (at 6 weeks after surgery in the RCR group, there was an increased level of shoulder pain with overhead activities, but this difference did not continue on subsequent 12 and 24 weeks). (D) Level of shoulder stiffness. Results shown as mean ± standard error (*Combined and SLAP vs. RCR). RCR, rotator cuff tear repair; SLAP, superior labrum lesion from anterior to posterior.

shown to be a useful tool to measure shoulder strength and to screen patients with different RCT sizes for supraspinatus muscle pathology.^{13,19,20} Lee et al²² used dynamometry to assess external and internal rotation and abduction for SLAP and Bankart lesions and at 24 weeks after surgery, reported forces to be 79 N, 56 N, and 75 N, respectively. In our study, the SLAP group strengths were 81 N, 88 N, and 78 N, which are analogous. For RCT, Klironomos et al¹⁹ studied over 1747 patients and reported an average external rotation force of 55 N, an internal rotation force of 65 N, and an abduction force of 45 N for RCT between 1 and <3 cm² that parallel strengths to our study. In a prospective long-term study with a minimum follow-up period of 2 years after a type II SLAP repair, the external rotation strength is shown to be 86 N, which is slightly higher than this study.⁹

Yang et al⁵¹ reported forward flexion ROM for vertical knot and horizontal mattress repairs for SLAP to be 139° and 143° at

2 months and 170° and 170° at a mean follow-up of 32 months, respectively. In prospective studies by Friel et al⁹ and Provencher et al,³⁷ forward flexion ROM after surgically repairing type II SLAP lesions was 151° at 40 months and 180° at 3.4 years. Kanatli et al¹⁵ examined clinical outcomes after SLAP and showed forward flexion to be 172°. In our study, forward flexion in the SLAP group was 140° at 6 weeks, which is similar to the Yang et al⁵¹ study, and 165° at 24 weeks’ follow-up, which is between the range of Yang’s study at 2 months and Friel’s study at 40 months, indicating that SLAP injuries continue to progressively recover over time. Kanatli et al¹⁵ also evaluated RCR combined with the SLAP group with the forward flexion of 169° with a minimum 2 years of follow-up. Kim et al¹⁶ reported in a combined RCR and SLAP group that the forward flexion ROM was 133° at 2-year follow-up, improved from 119° in a large and massive RCT. The forward flexion from our study in the combined group was 167°, which is similar to Kanatli et al’s study.¹⁵

It is difficult to correspond patient-determined outcomes of our patient cohort to what has been published so far, as every study uses a different scoring system. Shoulder stiffness, difficulty with overhead activities, and variable pain are known complications in both shoulder injuries. There is evidence of neoinnervation in the labrum and tendinopathy that could be a cause for pain.^{1–3,10,28,50} Arthroscopic repair of RCT results in a healing response with a thickened posterior capsule and a thickened subacromial bursa, and increases vascularization of the tendon footprint.⁴⁶ For these reasons, we decided to report individual components of the

Table 2 Complications after surgery

Complications	RCR, n (%)	SLAP, n (%)	RCR + SLAP combined, n (%)
Frozen shoulder	5 (6)	1 (2)	1 (5)
Impingement	4 (5)	1 (2)	1 (5)
Persistent pain	2 (2)	0	0
Retear	0	-	1 (5)

RCR, rotator cuff tear repair; SLAP, superior labrum lesion from anterior to posterior.

modified L'Insalata questionnaire and examined scored domains separately, in order to report the components of improvement or deterioration.²³ Tham et al⁴⁶ showed that there is a significant improvement in frequency and severity of pain and shoulder stiffness after RCR. For SLAP-only repairs, a previous study from our research group by Lee et al²² used individual components of the modified L'Insalata questionnaire and examined scored domains separately. Both this study and that by Lee et al²² report comparable shoulder stiffness improvements from “moderate” before surgery to “a little” 24 weeks after surgery. Shoulder pain with overhead activities and difficulty with overhead activities in the study by Lee et al start slightly above “moderate,” increase to “severe” at 1 week after surgery, and recover to just above “mild” at 24 weeks, which follows the same pattern as in this study. Among the studies that compared SLAP repairs and combined RCR and SLAP repairs, a study by Forsythe et al⁸ reported improved Constant score in the combined group, although the demographics of the 2 groups started out different from baseline, whereas there was no difference in The American Shoulder and Elbow Surgeons (ASES) scores at 41–43 months after surgery. We report no differences between SLAP and combined repairs, but a previous study by Enad et al⁷ showed that the combined group had better outcomes than the SLAP-only group, as evident by higher ASES scores at mean 31 months. Between the RCR and combined repairs, the patient outcomes seem to be dependent on the size of the RCT. Large to massive RCT have lower ASES scores than partial-thickness RCT (ASES: 80 vs. 96).^{16,32}

With regard to complications, our patient cohort had relatively low complications. Both SLAP and combined groups had minimal frozen shoulder, impingement, and persistent pain, whereas the RCR group had higher complication numbers in contrast to the other 2 groups. For rotator cuff complications, there was 1 rotator cuff retear in the combined group. The rotator cuff retear rate in literature is 15%–90%, less for partial tears and higher for full-thickness tears.^{4,14,18,21,25,31,37} The rotator cuff retear rate of 5% in our study using the undersurface technique was very low compared with other studies.²¹ This is likely due to the selected patient cohort of predominant partial-thickness RCT and the undersurface technique that we use for RCR.

Some of the advantages of this study are relatively higher reliability and reduced variability. This investigation was conducted on a cohort that was operated by 1 surgeon with the relatively low complication rate in a fairly constant community, which makes the study more robust and dependable. The data set consists of both objective and subjective outcome measures. We report both patient-determined and objective assessments before and after surgery. The objective data enable reproducibility of clinical findings and make comparison of the outcomes of RCR, SLAP, and combined shoulder pathologies easier for future studies. For patient-determined outcomes, describing each component of the scoring system rather than 1 summed score, although qualitative, enables more accurate differentiation of the patient's functions and satisfactions after surgery. A direct head-to-head evaluation of the RCR group, SLAP group, and combined RCR and SLAP group is another advantage of this study. Although there are many studies comparing one shoulder injury with another, there are no studies that directly compared RCR, SLAP repair, and combined in the same patient population, which makes this study distinctive.

The limitations of this study should also be considered. As the study was conducted retrospectively, there was an absence of a proper control group. Although valuable and informative comparisons were made between RCR, SLAP, and combined RCR and SLAP, we did not examine a group with a sham surgery group, as with known improvements after surgical intervention, it would be unethical to include a sham group of patients who are symptomatic. Other shoulder pathologies without RCR or SLAP could have been

investigated as a control group, but it would not be a true representation as a control group. Therefore, we cannot comment on the natural history of the injury conditions in our cohort. This study had a small number of patients and a short length of follow-up of 24 weeks. We recommend that subsequent studies investigate a large number of patients and have a longer period of time of follow-up for the purpose of ascertaining long-term outcomes of these 3 groups. Lastly, regarding the strength assessments, the RCR group generally had lower strength before surgery compared with the SLAP and combined group. After surgery, the RCR group not only resulted in lower external rotation, internal rotation, and abduction forces, but also lower strength in adduction and liftoff as well. It is possible that the RCR group ended up with a patient with low strength and the global baseline differences contributed to the significant differences in external rotation, internal rotation, and abduction strength for the SLAP or combined group postoperatively; however, this difference was not present in the adduction strength at 6 weeks' follow-up between the 3 groups. At this single time point, there could have been a transient improvement of the RCR group or a temporary deterioration of the SLAP and combined groups, but it is more likely that it is an indication that preoperative discrepancies contribute less to the findings of this study.

Conclusion

This study showed that although the RCR, SLAP, and combined repair groups all recover significantly after surgery with equal patient-determined clinical outcomes, combined RCR and SLAP repairs have improved forward flexion ROM and strength for external rotation, internal rotation, and abduction after surgery. Taken together, there are clinical benefits and no detriments at 24 weeks to surgically repairing both SLAP and RCT.

Disclaimer

This study was supported by the Orthopaedic Research Institute of the St. George Hospital (research and infrastructure support) and Premier Specialists (data collection).

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Acknowledgments

The authors thank Stefanie Janssens for support in selecting the rotator cuff repair group.

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