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Outcomes of type II superior labrum, anterior to posterior (SLAP) repair: Prospective evaluation at a minimum two-year follow-up

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Hypothesis: Patients with type II superior labrum, anterior to posterior (SLAP) lesions will have improved function and decreased pain at a minimum of 2 years after arthroscopic SLAP repair using bioabsorbable suture anchor fixation.

Materials and methods: The study population consisted of 48 patients who underwent arthroscopic SLAP repair. Subjective shoulder scores, range of motion, and strength (postoperative only) were assessed preoperatively and at a minimum of 2 years postoperatively.

Results: At an average of 3.4 years after surgery, statistically significant improvement was seen in American Shoulder and Elbow Surgeons score, University of California, Los Angeles score, Simple Shoulder Test scores, Constant activities of daily living, visual analog scale for pain, and Short Form-12 Health Survey physical outcome scores. Improvements were made in forward flexion, abduction, external rotation, and internal rotation. Subgroup analysis of nonathletes, nonoverhead athletes, recreational overhead athletes, and collegiate overhead athletes showed preoperative to postoperative improvements in subjective outcomes scores. Overhead laborers and nonlaborers also showed preoperative to postoperative improvements in subjective shoulder scores.

Discussion: No differences were seen between the outcomes of nonathletes, nonoverhead athletes, recreational overhead athletes, and collegiate overhead athletes, suggesting that SLAP type II repair is successful independent of the patient's vocation or sport.

Conclusion: These results show that arthroscopic SLAP repair of type II lesions with bioabsorbable suture anchors provides a significant improvement in functional capacity and pain relief.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Labrum; SLAP lesion; shoulder arthroscopy; superior labrum anterior to posterior

Superior labral, anterior to posterior (SLAP) lesions, originally classified by Snyder et al,[17] have been commonly associated with trauma and overhead athletics. Typical mechanisms that produce SLAP lesions include traction, compression of the labrum from a fall onto an outstretched

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arm, and chronic acceleration/deceleration of the shoulder that often occurs in overhead throwing athletes and laborers who constantly use their arm above shoulder level.[14]

Historically, SLAP lesions have been treated with a variety of methods, including débridement, tenotomy, and labral reattachment. Labral reattachment has been performed with a variety of different constructs, including sutures, staples, tacks and bioabsorbable anchors.[9,10,16] Multiple authors have reported successful outcomes after SLAP repair, and reattachment of the labrum to the glenoid with bioabsorbable suture anchors for treatment of type II lesions is considered the current standard of care.[5]

Recently, however, the outcomes of SLAP repair have been reported as less than ideal, especially in overhead athletes, and biceps tenodesis[1] and tenotomy[8] have been suggested as options for better outcome. The purpose of this study was to subjectively and objectively evaluate the outcomes of SLAP type II repairs. We hypothesized that patients with type II SLAP lesions would have improved function and decreased pain at a minimum of 2 years after arthroscopic SLAP repair with bioabsorbable suture anchor fixation.

Materials and methods

This study was approved by the Institutional Review Board at the Rush University Medical Center (ORA #08042903).

Study design (patient selection)

Between December 2002 and April 2007, 136 consecutive patients who underwent arthroscopic SLAP treatment were enrolled in our prospective database. Lesions included type I, II, III, and IV SLAP tears, as well as associated pathologies, including Bankart lesions and rotator cuff tears. A review of patient records found 60 with type II SLAP tears that were treated with labral repair, and they were included for analysis. Exclusion criteria included (1) patients undergoing rotator cuff repair, (2) SLAP type I, III, or IV lesions, (3) prior surgical procedures on the ipsilateral shoulder, and (4) patients undergoing concomitant tenodesis or tenotomy. The study included patients with Bankart tears and those undergoing subacromial decompression, distal clavicle excision, and intra-articular débridement.

Patients with these diagnoses were included in this study (not just isolated SLAP tears) when the preoperative examination and history indicated the main pathology was the SLAP tear. For example, in patients with instability and SLAP tears, these patients had pain from their SLAP lesions not associated spatially with their dislocation events. Even though instability was a component of the patients' complaints and physical examination, their physical examination and history indicated pathology from their SLAP could not be attributed to instability; pain was a main component of the patients' complaints. Kim et al[12] have shown that nearly 89% of SLAP tears are associated with other pathology, specifically type II lesions are associated with Bankart lesions. The inclusion of these patients with concomitant pathology was permitted to be consistent with the varied pathology that surgeons encounter in patients with SLAP lesions.

Preoperative examination

Patients were clinically diagnosed with a SLAP tear by the senior author (B. J. C.) by the presence of a consistent history, positive result on the O'Brien test, and positive pain with abduction/external rotation. Subjective data on the University of California Los Angeles (UCLA) shoulder test, American Shoulder and Elbow Surgeons (ASES) shoulder score, Simple Shoulder Test (SST), Cumulative Activities of Daily Living (CADL) score, visual analog scale (VAS) for pain, and Short Form-12 (SF-12) Health Survey, as well as the range of motion (ROM), were recorded preoperatively and at postoperative follow-up visits. All surveys were completed by the patient.

Surgical procedure and perioperative management

All patients who had a type II SLAP repair underwent an examination under anesthesia and diagnostic arthroscopy first to confirm the diagnosis of a SLAP tear (using criteria based on Synder et al[17]) and to exclude other pathology such as rotator cuff tears and biceps tendinopathy. SLAP repair was performed with the patient in the beach chair position and under general anesthesia and local interscalene nerve block. All operations were performed by the senior surgeon (B. J. C.).

SLAP lesions were confirmed by the presence of separation of the cartilage/labrum junction with a tear extending medial to the glenoid in which a peel back of the biceps complex was exhibited with abduction and external rotation. Additional degenerative changes of the cartilage adjacent to the biceps insertion confirmed the presence of a SLAP tear. An 8.25-mm cannula was inserted through 1 anterior portal into in the anterior-superior rotator interval. The superior glenoid was prepared with an arthroscopic elevator and then a burr to expose bleeding cancellous bone as the repair bed.

Most commonly, 2 single-loaded 3.0-mm BioSuture tack (Arthrex, Naples, FL) anchors were then placed percutaneously just off the anterior-lateral edge of the acromion, penetrating the rotator cuff at the musculotendinous junction. The first anchor was placed directly under the biceps insertion, and the second was placed at the 11 o'clock position (right shoulder). For each anchor, 1 suture limb was passed through the labrum with a 45° curved spectrum (ConMed Linvatec, Largo, FL), and knots were tied behind the biceps and medial to the labral tissue to avoid prominence of the knot adjacent to articular cartilage. Double-loaded anchors with 1 limb anterior and 1 posterior to the biceps were avoided to prevent strangulation of the biceps.

Postoperative management

Patients wore a shoulder immobilizer for 4 weeks, and physical therapy was initiated after the first postoperative visit. Initially, passive range of motion and active assisted motion, including closed chain scapular strengthening were implemented. Active motion began at 4 weeks and strengthening was allowed at 8 weeks. At 3 months patients, were allowed to initiate a sport-specific regimen of strengthening and conditioning. Return to overhead activities was allowed at 5 to 6 months.

Postoperative testing

Forty-eight patients were evaluated using the same preoperative questionnaire, with the addition of questions on return to sport and work. A thorough physical examination was also completed at follow-up, which included ROM and strength testing using a Isobex dynamometer (Medical Device Solutions, Oberburg, Switzerland). In addition, patients were asked if they would repeat the surgery again based on the current state of their shoulder.

Statistical analyses

Statistical analysis was performed using paired *t* tests to compare preoperative and postoperative scores. Patients were further categorized as nonathletes, nonoverhead athletes, recreational overhead athletes, and collegiate overhead athletes for sports-related subgroup analysis, and as overhead laborers vs nonlaborer for work-related subgroup analysis. Sport subgroup analysis compared postoperative outcomes using Kruskal-Wallis with the Dunn multiple comparison test for nonparametric data and also evaluated the degree of improvement in scores preoperatively to postoperatively using one-way analysis of variance and post hoc Newman-Keuls multiple comparison test. Work subgroup analysis compared postoperative outcomes using independent sample *t* tests. Significance level was set at 0.05. Statistical analysis was performed using Prism 5.0 software (GraphPad, La Jolla, CA).

Results

Patient hemographics

Completed survey data were available for 48 (39 men, 9 women) of the 60 patients (80%) who met the inclusion criteria. The average patient age was 33.1 years (range, 16.1-58.9 years) at the time of surgery, with a mean delay between injury and SLAP repair of 11.2 months (range, 1.1-47.1 months). Patients were followed-up at a mean of 3.4 years (range, 2.0 -5.7 years) after surgery. Forty-two were right handed, and 60% had surgery on their dominant shoulder. At the time of surgery, 13 (27%) were receiving worker's compensation. A single traumatic incident caused the injury in 29 patients (60%), and 19 (40%) noted symptoms after chronic overuse. Ten patients were nonathletes, 15 were nonoverhead athletes (ie, gymnastics, wrestling, etc), 10 were overhead athletes (ie, baseball, volleyball, tennis) at a recreational level, and 13 were overhead athletes at a collegiate level. Thirteen were overhead laborers, and 35 described nonlaboring work.

In patients indicated for surgery, conservative treatment, consisting of rest, anti-inflammatory medications, and activity modifications, had failed. Before surgery, 24 (48%) previously had an injection, and 28 patients (56%) had at least 4 weeks of physical therapy.

Concomitant procedures at the time of SLAP repair included Bankart repair in 10, subacromial decompression in 5, distal clavicle excision in 2, labral cyst decompression in 2, microfracture of the humeral head in 1, capsular release in 1, and acromioplasty in 1; Table I).

Table I Demographic data of the 48 patients that met the inclusion criteria

Demographics	Result
Patients, No.	48
Age, y*	33.1 ± 12.1 (16.1-58.9)
Gender, No. (%)	
Male	39 (80)
Female	9 (20)
Dominant hand, No. (%)	
Right	42 (88)
Left	6 (12)
Injured side, No. (%)	
Right	23 (48)
Left	25 (52)
Injured on dominant hand, No. (%)	60.4
Worker's compensation, No. (%)	13 (27)
Preinjury activity level, No. (%)	
Overhead athletes	11 (23)
Nonoverhead athletes	16 (33)
Nonathletes/nonlaborers	17 (35)
Overhead laborers	4 (8)
Mechanism of injury, No. (%)	
Traumatic	24 (50)
Chronic	24 (50)
Symptom duration before repair, mon*	11.2 ± 10.0
Anchors, No.*	1.9 ± 0.51 (1-3)
Concomitant procedures, No.	
Bankart repair	10
Subacromial decompression	5
Distal clavicle excision	2
Cystic decompression	2
Microfracture of the humeral head	1
Capsular release	1
Acromioplasty	1

* Continuous data are presented as the mean ± standard deviation (range).

Outcomes assessment

Four patients underwent subsequent surgery on the index shoulder. Two patients had a revision SLAP repair and were included in outcome analysis; 2 patients underwent subsequent biceps tenodesis and biceps tenotomy, respectively, and although their failures are reported, these patients were not included in the outcomes analysis.

At an average of 3.4 years (range, 2.0-5.7 years) after surgery, statistically significant improvement was seen in ASES, UCLA, SST, CADL, VAS, and SF-12 physical outcome scores. No significant improvement was seen in the SF-12 mental component (Table II). Improvements in ROM

Table II Preoperative and postoperative results on subjective shoulder surveys

Assessment	Scores			*P* (*t* test)
	Max	Pre-op	Post-op	
SST	12	7.28	10.20	<.0001
ASES	100	59.49	83.37	<.0001
VAS	10	3.98	1.52	<.0001
CADL	20	11.85	17.52	<.0001
Short Form-12				
Physical	100	41.09	45.72	.0035
Mental	100	53.28	54.22	.6296

ASES, American Shoulder and Elbow Surgeons; *CADL,* Constant Activities of Daily Living; *SST,* Simple Shoulder Test; *VAS,* visual analog scale for pain.

Table III Range of motion

Range of motion	Pre-op	Post-op	*P* (*t* test)
Forward flexion	160°	180°	.0008
Abduction	156°	179°	.0003
External rotation	67°	73°	.0487
Internal rotation*	7.9	9.6	.0002

* Values correspond to the level of internal rotation: dorsum of hand to interscapular region (T7) or higher—10; dorsum of hand to 12th dorsal vertebrae—8; dorsum of hand to waist (L3)—6; dorsum of hand to lumbosacral junction—4; dorsum of hand to buttock—2; dorsum of hand to lateral thigh or less—0.

were found in forward flexion, abduction, external rotation, and internal rotation (Table III). Preoperative strength scores were not available for all patients. Postoperative strength of the operated shoulder did not reach that of the contralateral shoulder at a minimum of 2 years postoperatively (Table IV). UCLA scores averaged 30.9, corresponding to 10 excellent (23%), 25 good (57%), 8 fair (18%), and 1 poor (2%) outcomes (Fig. 1). Of the 46 patients, 41 (89%) responded that they would have the surgery again.

Subgroup analysis of nonathletes, nonoverhead athletes, recreational overhead athletes, and collegiate overhead athletes showed preoperative to postoperative improvements in subjective outcomes scores (Table V). ROM improved significantly for nonathletes, whereas the other 3 groups generally had good ROM preoperatively, so large improvements were not seen. Comparison of postoperative subjective scores, ROM, and strength did not reveal any significant differences among the groups. However, statistically significant differences were seen when comparing the degree of improvement from preoperative to postoperative subjective outcome scores and ROM (Table V).

Of the 13 overhead collegiate overhead athletes, 7 (54%) returned to their previous level of sport, with 5 of the 6 athletes who did not return citing shoulder injury as the reason. Interestingly, 6 of 7 baseball players returned to their previous level of sport, whereas only 1 in 4 of the tennis players returned to their previous level (Table VI).

Table IV Postoperative strength scores at minimum of 2 years postoperatively*

Variable	Operated	Contralateral	*P* (*t* test)
Forward flexion, kg	8.3	9.0	.0267
External rotation, kg	8.8	9.4	.0152

* Scores were measured using dynamometer. Forward flexion and external rotation were both stronger in the contralateral (unoperated) shoulder than in the operated shoulder. Preoperative strength scores were not available.

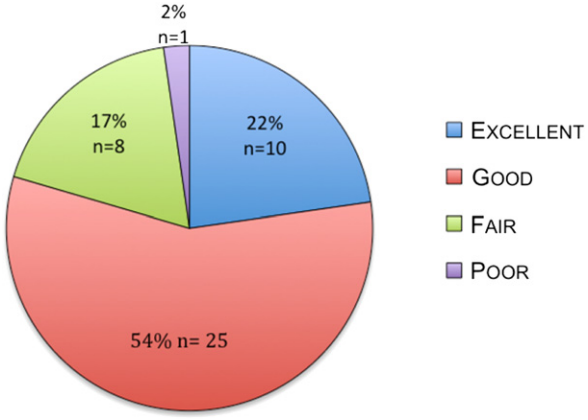

Figure 1 Postoperative University of California, Los Angeles Shoulder scores: excellent (34-35), good (28-33), fair (21-27), and poor (0-20).

Subgroup analysis of overhead laborers vs nonlaborers showed preoperative to postoperative improvements in subjective outcomes scores, with significant improvements in ROM only for the overhead laborers, primarily due to the good ROM preoperatively for the nonlaborers. Comparison of postoperative subjective scores showed better results in the overhead laborers in SST, ASES, and CADL scores, whereas postoperative pain was lower in the nonlaborer group. Postoperative ROM and strength did not reveal any significant differences between the groups. However, statistically significant differences were seen when comparing the degree of improvement from preoperative to postop ROM (Table VII).

Reoperations

Four patients needed additional procedures after their SLAP repair. One patient, an overhead athlete, reported a popping sound and sudden onset of pain during physical therapy at 8 weeks postoperatively. Revision SLAP repair was performed 7 months after the index procedure. The second patient, also an overhead athlete, had undergone repair of SLAP and Bankart lesions at the index procedure. He recovered well for 7 months before a traumatic event that led to a dislocation. At 1 year after the initial SLAP procedure, the patient underwent revision anteroinferior stabilization; of note, the superior labral repair remained intact. The third patient, an overhead laborer, described an aching pain in his shoulder after

Table V Scores for outcome assessments, range of motion, and strength testing results for each subgroup

Variable	Nonathletes	Nonoverhead athletes	Overhead athletes		Comparisons of scores across subgroups		
			Recreational	Collegiate	Pre-op	Post-op	Improvement: pre-op to post-op
Number of patients	9	15	9	13			
Age (at DOS)	41.8	33.7	36.1	23.5	.0027		
DOS-DOI	0.6	1.2	0.6	1.0	.0602		
Follow-up, y	3.0	3.6	3.5	3.5	.4963		
Would repeat the surgery	6	14	9	12			
Return to pre-injury level	N/A	10 (67%)	6 (67%)	7 (54%)			
Simple Shoulder Test							
Pre-op	3.1	9.0	7.7	7.9	**.0024***,†		
Post-op	9.0	10.4	10.0	10.9		.5677	
Improvement	5.9	1.6	2.4	3.0			**.0383***
P	**.0012**	.0537	**.0430**	**.0043**			
ASES Shoulder Score							
Pre-op	35.9	66.1	62.8	65.9	**.0022***,†,‡		
Post-op	78.3	85.2	78.0	88.5		.5237	
Improvement	42.4	19.1	15.2	22.6			.0758
P	**.0021**	**.0081**	.0712	**.0045**			
Visual Analog Pain Scale							
Pre-op	6.0	3.7	3.6	3.2	**.032**†		
Post-op	2.3	1.4	1.8	1.0		.6892	
Improvement	−3.7	−2.6	−1.4	−2.2			.4243
P	**.0137**	**.0028**	0.1806	**.0158**			
Constant ADL Score							
Pre-op	7.7	15.1	11.4	11.3	**.011***		
Post-op	16.8	18.1	16.3	18.2		.6101	
Improvement	9.1	3.4	5.1	6.9			.0880
P	**.0005**	**.0034**	**.0310**	**.0011**			
Forward flexion							
Pre-op	124	160	171	179	**.0012***,†,‡		
Post-op	180	179	179	180		.5446	
Improvement	6	19	8	1			**.001***,‡,†
P	**.0034**	.1050	.1930	.3409			
Abduction							
Pre-op	124	155	159	179	**.0132**†		
Post-op	180	179	180	179		.7215	
Improvement	56	24	21	−1			**.0082**†
P	**.0034**	.0633	.0878	.6761			
External rotation							
Pre-op	53	67	69	78	**.0003**†		
Post-op	78	74	67	72		.0563	
Improvement	24	7	−3	−6			**.0005**‡,†
P	**.0021**	**.0449**	.4161	.1422			
Internal rotation							
Pre-op	4.9	8.6	7.9	9.5	**.0024***,†		
Post-op	9.8	9.6	8.9	9.8		.3401	
Improvement	4.9	1.0	1.0	0.4			**.0005***,‡,†
P	**.0003**	.0682	.3198	.3409			
Strength in Forward flexion							
Operated-on	7.9	8.8	7.3	8.8	.7978		
Contralateral	7.9	10.1	7.8	9.2		.5644	
P	0.9773	**.0393**	.4072	.1996			
External rotation							
Operated-on	8.2	9.7	7.8	8.7	.6342		

(*continued on next page*)

Table V (*continued*)

Variable	Nonathletes	Nonoverhead athletes	Overhead athletes		Comparisons of scores across subgroups		
			Recreational	Collegiate	Pre-op	Post-op	Improvement: pre-op to post-op
Contralateral	8.8	11.0	7.7	9.2		.1357	
P	0.4498	**.0254**	.6331	.1979			
UCLA							
Post-op	28.9	31.6	32.0	30.9		.6166	
Excellent	22%	29%	38%	8%			
Good	44%	50%	63%	69%			
Fair	22%	21%	0%	23%			
Poor	11%	0%	0%	0%			

ADL, Activities of daily living; *ASES,* American Shoulder and Elbow Surgeons; *DOS*, date of surgery; *DOI*, date of injury; *UCLA,* University of California, Los Angeles.
Statistical difference between *nonathlete vs nonoverhead athlete; †nonathlete vs collegiate overhead athlete, ‡nonathlete vs recreation overhead athlete.

Table VI Collegiate overhead athletes who did and did not return to their previous level of sports and if not, whether this was due to their shoulder

Athlete	Sport(s)	Return to preinjury level of sport?	If no, was this due to your affected shoulder?
1	Baseball, racquetball	Yes	…
2	Baseball	Yes	…
3	Softball, volleyball	No	Yes
4	Tennis	No	Yes
5	Baseball	Yes	…
6	Softball	No	Yes
7	Tennis	No	Yes
8	Baseball	Yes	…
9	Baseball	Yes	…
10	Tennis	No	No
11	Baseball, football	No	Yes
12	Baseball, basketball, football	Yes	…
13	Tennis	Yes	…

surgery. Arthroscopy 1 year after the index procedure showed an intact labrum, but biceps tenodesis and subacromial bursectomy were performed secondary to recalcitrant biceps tendonitis. The fourth patient, a nonathlete, had pain out of proportion to her clinical symptoms after reporting a fall onto an outstretched arm. At surgery almost 3 years after the index SLAP repair, a loose body and labral fraying was found along with an intact superior labrum. The patient underwent biceps tenotomy and bursectomy. The third and fourth reoperations mentioned were not included in the outcome analysis because these patients underwent biceps tenodesis and tenotomy, respectively.

Discussion

This study evaluated the outcomes of arthroscopic type II SLAP repair with suture anchor fixation. Our results showed that arthroscopic treatment of type II SLAP tears resulted in good to excellent results in 79% of patients, with 89% of patients reporting that they would repeat the surgery again. Subjective shoulder outcomes improved, and patients had improved range of motion at a minimum of 2 years postoperatively.

Outcomes of repair for type II lesions are successful, with good to excellent results ranging from 65% to 97%.[3-6,11,13-16,18,19] Inclusion criteria for each of these studies had a wide range, from isolated type II SLAP repairs to mixed combinations of pathologies associated with the SLAP tear. Field and Savoie[7] first described outcomes of arthroscopic type II and IV SLAP repairs, with improvement in the 20 patients involved in the study, including10 athletes.

Voos et al[18] assessed concomitant rotator cuff repair plus a labral repair procedure in which 16 patients had Bankart lesions and 14 patients had SLAP lesions. Of these patients, 90% reported good to excellent results, and 77% returned to

Table VII Scores on outcome assessments, range of motion, and strength testing for the overhead laborer and nonlaborer work subgroups

Variable	Overhead laborer	Nonlaborer	Comparison of post-op scores
Patients, No.	12	34	
Age (at DOS)	40.40	30.22	**.0124**
DOS-DOI	0.62	1.04	.1407
Follow-up, years	3.08	3.56	.1543
Traumatic, %	0.67	0.62	
Returned to work			***.0138***
Yes	0.67	0.83	
No	0.33	0.17	
If no, was this due to your shoulder?			**< .0001**
Yes	1.00	0.25	
No	0.00	0.75	
Simple Shoulder Test			
Pre-op	3.5	8.6	
Post-op	8.5	10.8	**.0018**
P	**.00004**	**.00001**	
ASES Shoulder Score			
Pre-op	38.1	67.1	
Post-op	71.7	87.5	**.0070**
P	**.00009**	**< .00001**	
Visual Analog Pain Scale			
Pre-op	5.6	3.4	
Post-op	2.6	1.2	**.0166**
P	**.00090**	**< .00001**	
Constant ADL Score			
Pre-op	6.7	13.7	
Post-op	15.8	18.1	**.0381**
P	**< .00001**	**< .00001**	
Forward flexion			
Pre-op	133	170	
Post-op	179	180	.4423
P	**.00024**	.00723	
Abduction			
Pre-op	123	168	
Post-op	180	179	N/A
P	**.00001**	.00776	
External rotation			
Pre-op	57	72	
Post-op	75	72	.3318
P	**.00063**	.09462	
Internal rotation			
Pre-op	4.9	9.0	
Post-op	9.5	9.6	.8157
P	**< .00001**	.00882	
Strength in forward flexion			
Operated-on	7.0	8.8	
Contralateral	7.9	9.4	.2729
P	.01768	.00892	
Strength in external rotation			
Operated-on	8.1	9.0	
Contralateral	8.8	9.7	.4508
P	.03496	**.00144**	
UCLA			

(*continued on next page*)

Table VII (*continued*)

Variable	Overhead laborer	Nonlaborer	Comparison of post-op scores
Post-op	28.6	31.7	**.0186**
Excellent	18%	24%	
Good	46%	61%	
Fair	27%	15%	
Poor	9%	0%	

ADL, Activities of daily living; *ASES,* American Shoulder and Elbow Surgeons; *DOS*, date of surgery; *DOI*, date of injury; *UCLA,* University of California, Los Angeles.

their preinjury athletic status. The authors concluded that combined treatment for rotator cuff and labrum pathology yields good outcomes, restoration of range of motion, and a high degree of patient satisfaction.

Coleman et al[4] reported the outcomes of patients undergoing type II SLAP repair, with or without concomitant acromioplasty. They noted 65% and 81% good to excellent results in SLAP only and SLAP plus acromioplasty, respectively. They recommended that acromioplasty be added to SLAP repair to improve outcomes and to decrease the incidence of impingement after surgery.

Further, Enad et al,[5] in a mixed population of isolated type II SLAP repairs and SLAP repairs with concomitant procedures, found 89% good to excellent UCLA scores and 77% return of patients to their preinjury level of sport. The results of these studies are comparable to our results, with 77% of patients attaining good to excellent results when undergoing SLAP repairs and concomitant procedures and 62% returning to their preinjury level of sport.

Isolated SLAP repair has also been associated with good results. Rhee et al[15] noted 86% good to excellent results in a study including types II, III, and IV SLAP lesions. Cohen et al[3] found only 69% good to excellent results in 39 patients with an isolated type II SLAP lesion at 3.7 years postoperatively. They noted that poorer outcomes might be attributed to the high expectations and demands of overhead athletes (74% of the study population), but overall, type II SLAP lesions are difficult to treat. Most recently, Yung et al[19] evaluated the outcomes of isolated type II SLAP repairs with bioknotless suture anchors. Patients had improvements in UCLA (18.1 to 31.3) and all returned to preinjury sport level.

The effectiveness of SLAP repair in athletes has been questioned due to the low percentage of athletes returning to their preinjury level of sport, which is particularly important given that a large percentage of the tears are found in athletes. Kim et al[11] found that 22% of overhead athletes returned to their preinjury sport level compared with 63% in nonoverhead and nonathletes. Cohen et al,[3] in a study of isolated type II SLAP repairs, found only 38% good to excellent outcomes in throwing athletes ($n = 8$) compared with 71% in a nonthrowing group ($n = 21$; $P < .04$). Yung et al[19] reported 16 patients with SLAP lesions, 13 of whom participated in overhead sports, and 87.5% of patients reported good to excellent results. The authors pointed out that elite throwing athletes, although able to return to their preinjury level, had a longer rehabilitation period before return to sport. Interestingly, Rhee et al[15] noted that athletes had higher outcomes UCLA scores than nonathletes (32.7 vs 31.3), and even more surprising, throwing athletes did significantly better than non-throwing athletes (33.9 vs 31.7; $P < .011$). The authors noted that the low outcome scores of the nonthrowers may be attributed to gymnasts, who have a higher rate of repetitive injuries, comprising more than half of the nonthrowing athlete group. Their study was confounded because in addition to the 21 type II lesions, 9 type III and 4 type IV lesions were included.

Most recently, Brockmeier et al[2] noted that 74% of athletes who underwent arthroscopic SLAP repair, including 71% of overhead athletes, were able to return to their previous level of sport. Our results show that overall, 83% of athletes had good to excellent results; overhead athletes even had 86% good to excellent outcomes, indicating that satisfactory results can be obtained in athletes treated with SLAP repair. Further, 62% of all athletes and 59% of overhead athletes (67% recreational and 54% collegiate) returned to their preinjury level of sport. Interestingly, of the collegiate overhead athletes, 6 of 7 baseball players returned to their previous level, compared with only 1 of 4 who played tennis. Brockmeier et al[2] also showed that although 71% of all athletes returned to their previous level, only 4 of 8 tennis players returned to preinjury level of sport.

Recently, Boileau et al[1] suggested that biceps tenodesis may be superior to SLAP repair for the treatment of type II SLAP tears, especially in an athletic population. The authors noted that although both groups had improvements in the Constant shoulder score (SLAP: 63 to 83; biceps: 59 to 89), 60% of the patients in the SLAP group were disappointed and only 20% returned to the previous sport. This was compared to the biceps tenodesis group, in which 93% were satisfied or very satisfied and 87% returned to their previous level of sport. Their study, however, focused on overhead athletes (9 collegiate and 11 professional), and the patient age was statistically different between each of the groups (SLAP: 37, range 19-59; tenodesis: 52, range 28-64). Therefore, although tenodesis may be beneficial in this small population of throwing athletes, it is questionable whether these outcomes can be applied to the general population.

The present study showed significant improvements from preoperative to postoperative scores in the population as a whole and also for each of the sport and work subgroups. No differences were evident when postoperative scores were compared for each of the 4 sports subgroups. Generally, nonathletes showed larger preoperative to postoperative improvement scores, especially in ROM; however, this was likely due to lower preoperative scores rather than better postoperative outcomes. Subgroup analysis of overhead laborer vs nonlaborer showed preoperative to postoperative improvements in both groups, with overhead laborers achieving better functional outcomes and nonlaborers achieving greater reduction in pain.

Weaknesses of the current study include the lack of preoperative strength scores, making preoperative to postoperative strength comparisons difficult. Although patients showed good strength after surgery, the operated-on shoulder had less strength than the contralateral shoulder. Because 60% of the patients had surgery on the dominant arm, the operated vs contralateral shoulder strength measurements may be confounded by baseline variations in dominant vs nondominant hand strength.

This study is further limited by the subgroup analysis, in which the small sample size for each group may have confounded the interpretation of results. In addition, reoperations on the ipsilateral shoulder were not included in the outcomes analysis for 1 patient undergoing biceps tenodesis and another undergoing biceps tenotomy.

Conclusions

These data indicate that arthroscopic SLAP repair of type II lesions with bioabsorbable suture anchors provides a significant improvement in functional capacity and pain relief. No differences were seen between the outcomes of nonathletes, nonoverhead athletes, recreational overhead athletes, and collegiate overhead athletes, suggesting that SLAP type II repair is successful independent of the patient's activity level. In addition, although overhead laborers and nonlaborers both showed preoperative to postoperative improvements, overhead laborers achieved better functional outcomes and nonlaborers achieved greater reduction in pain.

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