Surgical Treatment of Symptomatic Superior Labrum Anterior-Posterior Tears in Patients Older Than 40 Years

CME

A Systematic Review

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Background: Successful arthroscopic repair of symptomatic superior labral tears in young athletes has been well documented. Superior labral repair in patients older than 40 years is controversial, with concerns for residual postoperative pain, stiffness, and higher rates of revision surgery.

Purpose: To analyze the published data on the surgical treatment of superior labral injuries in patients aged ≥40 years, including those with concomitant injuries to the rotator cuff.

Study Design: Systematic review.

Methods: A systematic review of the literature was performed using the Preferred Reporting Items of Systematic Reviews and Meta-Analysis (PRISMA) guidelines. The MEDLINE database via PubMed and the Cochrane Database of Systematic Reviews were searched for articles related to superior labrum anterior-posterior (SLAP) tears. Studies were included if they met the following criteria: the study contained at least 1 group of patients who had undergone arthroscopic repair of a type II or IV SLAP lesion with a minimum 2-year follow-up, objective and/or functional scoring systems were used to evaluate postoperative outcomes, and the mean patient age was ≥40 years for at least 1 treatment arm or subgroup analysis. Studies were excluded if the article was a review or if the article included data for SLAP type I, III, or V to X tears or Bankart lesions.

Results: While several authors reported equivalent outcomes of SLAP repair in patients both older than 40 years and younger than 40 years, others demonstrated significantly higher failure rates in the older cohort. Decreased patient satisfaction and increasing complications, including postoperative stiffness and reoperations, occur at higher rates as the patient age increases. The literature demonstrates that biceps tenotomy and tenodesis are reliable alternatives to SLAP repair and that biceps tenotomy is a viable revision procedure for failed SLAP repair. With concomitant rotator cuff tears, the evidence favors debridement or biceps tenotomy over SLAP repair.

Conclusion: While studies show that good outcomes can be obtained with SLAP repair in an older cohort of patients, age older than 40 years and workers' compensation status are independent risk factors for increased surgical complications. The cumulative evidence supports labral debridement or biceps tenotomy over labral repair when an associated rotator cuff injury is present.

Keywords: shoulder; SLAP tear; labrum; biceps tendon

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Initially described by Andrews et al,[3] injuries to the superior glenoid labrum and biceps origin are a well-recognized cause of shoulder pain and dysfunction. In the nearly 3 decades since their description, our understanding of the anatomy, pathogenesis, diagnosis, and treatment of superior labrum anterior-posterior (SLAP) lesions has evolved together with widespread advances in shoulder arthroscopic surgery.

Snyder et al[36] provided the first classification of SLAP tears based on arthroscopic intraoperative findings. This scheme has subsequently been expanded but is still

TABLE 1
Description of Studies[a]

Study	Level of Evidence	Cohort Type	Patients, Male: Female, n	Group 1 n	Group 1 Age, Mean (Range), y	Group 2 n	Group 2 Age, Mean (Range), y	Mean Follow-up, mo	Interventions (All Arthroscopic)
Abbot et al[1]	2	P	NR	20	51.2 (47-60)	18	52.6 (45-60)	24	Group 1: SLAP II tears debrided; group 2: SLAP II tears repaired via anchors
Alpert et al[2]	3	R	NR	21	32 (17-39)	31	55 (43-67)	24	Group 1: >40 y; group 2: <40 y; all SLAP tears repaired with 2 single-loaded 3.5-mm Lupine suture anchors and PDS suture knots
Boileau et al[4]	3	P	19:6	10	37 (19-57)	15	52 (24-69)	35	Group 1: SLAP II tears repaired with suture anchors; group 2: underwent biceps tenodesis
Coleman et al[6]	4	R	47:3	34	34 (16-56)	16	42 (33-71)	39	Group 1: SLAP tears repaired with 1-4 tacks using SureTac; group 2: SLAP repair and concomitant subacromial decompression
Denard et al[8]	4	R	43:12	23	<40 (17-39)	32	>40 (40-65)	77	All repairs performed with double-loaded suture anchors (BioSutureTak or BioFastak); mean of 1.9 anchors used
Forsythe et al[9]	3	R	36:26	34	56.9 (NR)	28	59 (NR)	42	Group 1: RCR and SLAP repair; group 2: RCR only (no SLAP tear present)
Franceschi et al[10]	1	P	33:30	31	61 (51-79)	32	65 (53-81)	35	Group 1: SLAP repair using suture anchors via anterosuperior approach and arthroscopic cuff repair; group 2: biceps tenotomy and arthroscopic cuff repair
Kanatli et al[13]	3	P	9:22	15	58 (46-72)	16	57 (47-70)	30	Group 1: arthroscopic SLAP repair via 1 or 2 metal suture anchors; group 2: arthroscopic cuff repair with single-/double-row configurations with arthroscopic SLAP repair
Katz et al[14]	4	R	28:12	NA	NA	40	43 (16-58)	9	Nonoperative
Kim et al[15]	2	P	16:20	16	61 (±5.1)	20	63 (±6.0)	24	Group 1: arthroscopic cuff and SLAP repair; group 2: arthroscopic cuff repair and biceps tenotomy
Mok and Wang[20]	4	R	38:34	NA	NA	72	53 (19-75)	26	Arthroscopic SLAP repair and RCR in 27 patients
Neri et al[22]	3	R	49:1	25	23 (19-38)	25	47 (40-55)	36	All arthroscopic SLAP repairs with suture anchors via anterosuperior and trans–rotator cuff approaches
Provencher et al[31]	3	P	144:35	NA	NA	179	31.6 (18-45)	40	Arthroscopic SLAP repair with suture anchors and vertical suture construct
Schroeder et al[34]	4	P	71:36	NA	NA	107	43.8 (20-68)	60	Labral tears treated with glenoid rim debridement and fixed with resorbable tacks

[a]NA, not applicable; NR, not recorded; P, prospective; PDS, polydioxanone; R, retrospective; RCR, rotator cuff repair; SLAP, superior labrum anterior-posterior.

and concomitant rotator cuff tears. Five of 7 articles used the University of California, Los Angeles (UCLA) and/or American Shoulder and Elbow Surgeons (ASES) functional scores to evaluate their patients. Four were prospective and 3 retrospective. The weighted mean age of the SLAP and rotator cuff repair cohort was 57.9 years. After SLAP repair, mean UCLA scores improved from 14.15 ± 3.28 preoperatively to 28.98 ± 2.46 postoperatively. Mean ASES scores improved from 31.65 ± 12.80 to 88.40 ± 11.31. The weighted mean age of the SLAP debridement/tenotomy group was 60.61 years. When patients underwent labral debridement and biceps tenotomy, mean UCLA scores improved from 14.27 ± 3.76 to 31.90 ± 2.21, while mean ASES scores improved from 38.70 to 88.60. Across all studies, improvement in the UCLA and ASES scores from preoperatively to postoperatively was statistically significant. Differences between groups' preoperative and postoperative UCLA and ASES scores were not statistically significant (UCLA: $P = .857$ preoperatively and .229 postoperatively; ASES: $P > .999$ preoperatively and postoperatively) (Table 2).

The single level 1 study by Franceschi et al[10] prospectively evaluated SLAP repair versus biceps tenotomy in patients older than 50 years undergoing rotator cuff repair. While both groups demonstrated significant improvements, patients in the tenotomy cohort had significantly better UCLA scores (32.1 vs 27.9, respectively; $P < .05$) and range of motion when compared with those in the SLAP repair group (forward flexion: 166° vs 133°, respectively; external rotation: 134.3° vs 121.4°, respectively; internal rotation: 40° vs 34.3°, respectively; $P < .05$ for all). These authors concluded that there are no advantages to repairing a type II SLAP lesion with concomitant rotator cuff repair in the age group older than 50 years and that patients are better treated with biceps tenotomy.

Abbot et al[1] and Kim et al[15] similarly reported better outcomes with debridement and biceps tenotomy compared with SLAP repair. Abbot et al[1] prospectively evaluated 38 patients with type II SLAP lesions undergoing rotator cuff repair. At 24-month follow-up, those who underwent debridement and tenotomy showed significantly improved results over those with SLAP repair in UCLA scores, function, pain, and range of motion (UCLA: 34.0 vs 31.0, respectively; $P < .001$). In a similar population of 36 patients, Kim et al[15] conducted a study in which the decision for repair versus biceps tenotomy was nonrandomized

TABLE 2
Outcomes Data[a]

	Mean UCLA Score		Mean ASES Score		Mean L'Insalata Score		% Patients Returned to Normal Sport/Activity
	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative	
SLAP tears with concomitant rotator cuff tears							
Abbot et al[1]							
Group 1: SLAP debridement and RC repair	17.40	34.00					
Group 2: SLAP and RC repair	17.90	31.00					
Forsythe et al[9]							
Group 1: SLAP and RC repair			22.60	96.40			
Group 2: RC repair only			34.30	92.30			
Franceschi et al[10]							
Group 1: SLAP and RC repair	10.40	27.90					
Group 2: biceps tenotomy and RC repair	10.10	32.10					
Kanatli et al[13]							
Group 2: SLAP and RC repair	12.70	31.00					
Kim et al[15]							
Group 1: SLAP and RC repair	15.60	26.00	40.70	80.40			
Group 2: biceps tenotomy and RC repair	15.30	29.60	38.70	88.60			
Mok and Wang[20]: SLAP and RC repair	OSS						
Katz et al[14]: collection of postoperative complications	No functional scoring system						
Mean ± standard deviation							
Tenotomy/debridement	14.27 ± 3.76	31.90 ± 2.21	38.70 ± NA	88.60 ± NA			
SLAP repair	14.15 ± 3.28	28.98 ± 2.46	31.65 ± 12.80	88.40 ± 11.31			
P Value	.857	.229	>.999	>.999			
SLAP tears only							
Alpert et al[2]							
Group 1: SLAP repair <40 y (mean age, 32 y)				93.12			
Group 2: SLAP repair >40 y (mean age, 55 y)				86.03			
Boileau et al[4]							
Group 1: SLAP repair	VAS and Constant scores						
Group 2: biceps tenodesis							
Coleman et al[6]							
Group 1: SLAP repair (mean age, 34 y)				85.80		87.10	
Group 2: SLAP repair and subacromial decompression (mean age, 42 y)				86.50		85.10	
Denard et al[8]							
Group 1: SLAP repair <40 y (mean age, NR)	19.30	32.40	45.60	90.40			
Group 2: SLAP repair >40 y (mean age, NR)	19.00	30.30	43.10	83.10			
Subgroup 1: workers' compensation	17.00	28.50	31.30	76.50			64
Subgroup 2: non–workers' compensation	19.90	32.10	48.70	89.40			
Subgroup 3: all patients (mean age, 39.7 y)	19.10	31.20	44.10	86.20			82
Kanatli et al[13]							
Group 1: isolated SLAP repair >40 y (mean age, 58 y)	11.50	31.20					
Neri et al[22]							
Group 1: SLAP repair <40 y (mean age, 23 y)			59.04	91.42			50
Group 2: SLAP repair >40 y (mean age, 47 y)			54.56	87.16			
Provencher et al[31]							
Group 1: NA							
Group 2: SLAP repair (all patients: mean age, 31.6 y)			64.30	88.20			
Subgroup 1: successes (mean age, 27.9 y)				93.40			
Subgroup 2: failures (mean age, 39.6 y)				83.00			
Schroeder et al[34]	Rowe score						
Mean ± standard deviation							
SLAP repair <40 y[b]	19.30 ± NA	32.40 ± NA	52.32 ± 9.50	90.39 ± 2.95	NA	87.10 ± NA	
SLAP repair >40 y	15.25 ± 5.30	30.75 ± 0.64	50.08 ± 8.10	84.56 ± 2.87	NA	85.10 ± NA	
Tenodesis/debridement	NA	NA	NA	NA	NA	NA	
P value (SLAP repair <40 y vs >40 y)	.667	.667	.400	.056		NA	

[a]ASES, American Shoulder and Elbow Surgeons; NA, not applicable; NR, not recorded; OSS, Oxford Shoulder Score; RC, rotator cuff; SLAP, superior labrum anterior-posterior; UCLA, University of California, Los Angeles; VAS, visual analog scale.
[b]Includes Provencher et al.[31]

and made based on intraoperative assessment of biceps tendon quality. At 2-year follow-up, both groups exhibited significant improvements, but outcomes were superior in the tenotomy group (UCLA: 29.6 vs 26.0, respectively [P = .007]; ASES: 88.6 vs 80.4, respectively [P = .009]). The authors advocated biceps tenotomy over repair when addressing SLAP lesions with concomitant rotator cuff repair, although they recognized the potential biases inherent in their nonrandomized study design.

Kanatli et al[13] prospectively evaluated 35 patients over the age of 45 years who underwent arthroscopic repair of type II SLAP lesions with or without concomitant rotator

cuff repair. Both cohorts had significant improvements in the overall UCLA score with no difference between groups. No differences were seen with regard to postoperative pain, range of motion, or strength. Patients who underwent isolated SLAP repair had significantly better postoperative scores in the subcomponent areas of function (9.47 vs 8.63, respectively; $P < .045$) and satisfaction (4.93 vs 4.50, respectively; $P < .039$). The authors concluded that excellent results are obtained after the repair of type II SLAP lesions in patients over 45 years of age; however, less optimal outcomes can be expected with simultaneous SLAP and rotator cuff repair in this population.

Mok and Wang[20] retrospectively reviewed the outcomes of 71 patients (mean age, 53 years) who had undergone repair of type II SLAP lesions with a mean follow-up of 26 months. Twenty-seven patients had concomitant rotator cuff tears, and 9 had evidence of chondral disease of the humeral head. Good or excellent results were reported in 94%, with no difference in the Oxford Shoulder Score (OSS) in patients older than 50 years and those younger than 50 years.

SLAP Tears Without Concomitant Rotator Cuff Tears

Eight studies (evidence level: 5 level 3, 3 level 4) meeting our inclusion criteria examined patients with SLAP lesions without concomitant rotator cuff tears. Four were prospective, while 4 were retrospective analyses. Five used ASES functional scores to evaluate their patients. The weighted mean age for patients younger than 40 years was 29.9 years. For patients younger than 40 years, ASES scores averaged 52.32 ± 9.50 and 90.39 ± 2.95 before and after repair, respectively. For patients older than 40 years, the weighted mean age was 44.93 years, and mean ASES scores improved from 50.08 ± 8.10 to 84.56 ± 2.87 after repair. The difference in preoperative and postoperative ASES scores trended toward better outcomes in patients younger than 40 years but was just shy of statistical significance ($P = .056$). Four studies evaluated SLAP repair outcomes in older patients compared with younger patients. Two of these studies, Alpert et al[2] and Neri et al,[22] reported no significant difference in outcomes based on age. Provencher et al[31] will be reviewed in the Complications subsection. Alpert et al[2] prospectively compared the outcomes of isolated repair of type II SLAP lesions in patients both younger than 40 years and older than 40 years. There were no statistically significant differences in ASES, Short Form–12 (SF-12), Simple Shoulder Test (SST), or visual analog scale (VAS) for pain scores between the groups, although the younger group trended toward a higher satisfaction rate (95% vs 84%, respectively). These authors concluded that arthroscopic repair of type II SLAP lesions can yield excellent results regardless of age.

Similarly, Neri et al[22] reported no statistically significant differences in ASES scores in the repair of type II lesions between 2 age-based cohorts. The rate of return to the previous level of activity was also comparable. Intraoperative evidence of osteoarthritis, seen in 32% of the older cohort, was associated with lower ASES scores and a less likely return to the previous level of activity. The authors concluded that good or excellent results are obtained with the repair of type II SLAP lesions regardless of age; however, they warned that less optimal outcomes could be expected in patients with evidence of chondral disease. Only 1 level 4 study showed a trend toward better outcomes after SLAP repair in patients younger than 40 years. Denard et al[8] reviewed the results of repair in patients aged <40 years (range, 17-39 years) and those aged ≥40 years (range, 40-65 years). Trends toward better outcomes were seen in the under-40 cohort, with 97% achieving good or excellent outcomes compared with 81% in the over-40 group ($P = .219$). However, 6 of 7 patients with fair or poor results had workers' compensation status; if these patients are removed from the analysis, 96% of the over-40 cohort would have good or excellent UCLA scores.

Another level 4 study, Schroeder et al,[34] reviewed 171 patients thought to have isolated SLAP tears based on history, physical examination, and imaging who underwent arthroscopic surgery. Sixty-three were subsequently excluded from the study because of additional pathological changes found at the time of surgery. The remaining 108 patients (mean age, 43.8 years; range, 20-68 years) underwent repair and were followed prospectively. At 5-year follow-up, patients aged ≥40 years had nearly equivalent good or excellent results compared with those in the younger cohort (88.1% and 88.3%, respectively).

Only 1 study directly compared biceps tenodesis with SLAP repair. Boileau et al[4] compared primary arthroscopic biceps tenodesis with arthroscopic repair of type II SLAP lesions. In this nonrandomized study, patients were selected for biceps tenodesis at the discretion of the surgeon. This resulted in a statistically significant trend toward older patients, with 10 patients (mean age, 37 years; range, 19-57 years) undergoing repair and 15 (mean age, 52 years; range, 24-69 years) undergoing tenodesis. At 35-month follow-up, no difference in the overall Constant score was found, although there was a significantly higher activity subscore in the tenodesis group (19.50 ± 2.50 vs 16.30 ± 3.00, respectively; $P = .023$). In the tenodesis group, 87% of patients returned to their previous level of sport compared with a 40% rate of return to sport in the repair group. Only 20% of patients in the latter group returned to the previous level of sport.

Complications

Table 3 shows complications and patient satisfaction results for the included studies. Alpert et al[2] reported that 5 patients (16.1%) in their over-40 cohort would not undergo the operation again. These 5 patients presented with complaints including postoperative acromioclavicular joint tenderness requiring steroid injections, subjective instability, and shoulder stiffness. This postoperative stiffness was reported as "transient" but not specifically defined in terms of range of motion or duration. One of the 5 patients was involved in a workers' compensation claim.

TABLE 3
Complications and Patient Satisfaction[a]

Study	Injuries Included: Biceps Tendinopathy	Injuries Included: Chronic Subacromial Impingement	Injuries Included: Partial-Thickness RCT	Injuries Included: Full-Thickness RCT	Mechanism: Traumatic vs Atraumatic	Outcome Measures	Patients With WC	Complications and Patient Satisfaction	Disclosures
Abbot et al[1]	Excluded	Included	NA	Included	NR	Tegner, UCLA, ROM	NA	NR	None
Alpert et al[2]	NR	Included	Excluded	Excluded	NR	ASES, SF-12, SST, VAS	NA	Group 1: 5 patients unwilling to undergo surgery again, 3 stiffness, 1 acromioclavicular joint pain, 1 instability; group 2: 1 patient <40 y unwilling to undergo procedure again despite being "mostly satisfied," 2 patients with WC unsatisfied and would not undergo again	None
Boileau et al[4]	Excluded	Excluded	Excluded	Excluded	14 (60%) T	Constant, patient satisfaction survey, VAS, forearm pronation/supination strength testing	NA	4 revision surgeries of 10 total patients (40%), residual pain led to 3 tenodeses and then return to same level of sport; 6/10 dissatisfied with results	None
Coleman et al[6]	NR	Excluded	Included	Excluded	NR	L'Insalata, ASES	NA	Group 1: 2 revisions in SLAP only group, 1 hardware failure, 1 lack of compliance	≥1 authors with conflict of interest, royalty from Acufex
Denard et al[8]	Excluded	Excluded	Excluded	Excluded	NR	ASES, UCLA, patient satisfaction survey, return to sport/work	14	3 capsular releases for persistent postoperative stiffness (poorly defined) (ages 48, 38, 48 y), 2/3 with WC	Arthrex royalties
Forsythe et al[9]	NA	Included	NA	Included	34 T/28 A	ASES, Constant, strength testing/ROM	NA	Group 1: 1 DVT; group 2: 2-cm rerupture of rotator cuff	Funded by NIH, none
Franceschi et al[10]	Included	Included	NA	Included	NR	UCLA	NA	NR	None
Kanatli et al[13]	NR	Excluded	NA	Included	33/35 patients T (only 31 available for follow-up)	UCLA	NA	NR	None
Katz et al[14]	Included	Included	Included	Included	15 T/25 A	SST, patient satisfaction survey	20	Shoulders with complications (n = 40), pain, decreased ROM, mechanical symptoms (see review)	None
Kim et al[15]	Included	Included	NA	Included	NR	ASES, SST, UCLA, forward flexion/ROM	NA	NA	None
Mok and Wang[20]	NR	Included	Included	Included	17 T/55 A	OSS	NA	95% patient satisfaction (would undergo operation again)	None
Neri et al[22]	NR	Excluded	Included	Excluded	18 T/32 A	ASES	NA	NR	None
Provencher et al[31]	Excluded	Excluded	Excluded	Excluded	85 T/94 A	ASES, SANE, WOSI, ROM	NA	36.9% of all cases failed in highly active military population	None
Schroeder et al[34]	Excluded	Excluded	Excluded	Excluded	71 T/36 A	Rowe	NA	Postoperative stiffness in 13.1% (60° of abduction, <50% external rotation)	Public health grant

[a]A, atraumatic; ASES, American Shoulder and Elbow Surgeons; DVT, deep vein thrombosis; NA, not applicable; NIH, National Institutes of Health; NR, not recorded; OSS, Oxford Shoulder Score; RCT, rotator cuff tear; ROM, range of motion; SANE, Single Assessment Numeric Evaluation; SF-12, Short Form–12; SLAP, superior labrum anterior-posterior; SST, Simple Shoulder Test; T, traumatic; UCLA, University of California, Los Angeles; VAS, visual analog scale; WC, workers' compensation; WOSI, Western Ontario Shoulder Instability Index.

Neri et al[22] reported significant losses in range of motion in both age groups. These losses were not significant enough clinically to affect the ASES scores (Table 3) and did not appear to affect a return to activities. The younger patient cohort lacked a mean of 5.5° of internal rotation. The older cohort (age >40 years) lacked a mean of 8° of forward elevation.

Schroeder et al[34] documented a 13.1% rate of postoperative stiffness, defined to be greater than 60° of abduction and a 50% loss of preoperative external rotation. The mean age of the 13 patients with postoperative stiffness was 47.9 years, and only 2 patients were younger than 36 years. At 5-year follow-up, 9 of the 13 patients were managed successfully without surgery, although many required intra-articular steroid injections.

Denard et al[8] found a delay in full range of motion in their over-40 cohort by approximately 1 month. Three capsular releases were performed for persistent stiffness (which was poorly defined) in patients aged 48, 38, and 48 years. Two of the 3 patients had workers' compensation insurance. A fourth patient in this cohort required a second unknown operative procedure at another institution.

In a prospective level 3 study, Provencher et al[31] evaluated the results of type II SLAP repair in a military population with high activity demands. The authors found a trend toward decreased postoperative range of motion in all patients, with statistically significant decreases in forward flexion (164° vs 159°, respectively; $P < .042$) and abduction (166° vs 151°, respectively; $P < .039$). Subgroup analyses were conducted to identify factors associated with surgical failure, defined to be reoperation or a final ASES score of less than 70. Sixty-six (36.9%) met the authors' criteria for failure, with 28% of patients undergoing revision surgery. Age was the only factor statistically associated with failure; patients with failures had a mean age of 39.2 years (range, 29-45 years) compared with 29.7 years in those considered to have successful surgical outcomes. The relative risk for failure in patients over 36 years of age was calculated to be 3.45. These authors concluded that a reliable return to prior high-level activities in patients older than 36 years is limited with arthroscopic SLAP repair.

Katz et al[14] sought to identify causes for failure and dissatisfaction after SLAP repair. Forty shoulders in 39 patients (mean age, 43 years; range, 16-58 years) with persistent postoperative pain, stiffness, and/or mechanical symptoms were identified over a 9-year period on average. Twenty-one shoulders had undergone isolated type II SLAP repair, while 19 underwent repair with concomitant procedures, including rotator cuff repair, subacromial decompression, Bankart repair, or distal clavicle resection. Thirty-four shoulders were available for follow-up. Ten of these 34 shoulders ultimately achieved good or excellent results with continued nonoperative interventions after a period of postoperative dissatisfaction. Twenty-one underwent additional surgeries, including revision SLAP repair, total shoulder arthroplasty, rotator cuff repair, biceps tenodesis, subacromial decompression, glenohumeral debridement, capsular release, and removal of hardware. Age older than 40 years was found to be a risk factor, as was untreated acromioclavicular injuries. The authors recommended the judicious use of SLAP repair in patients over 40 years of age, with care to first rule out any additional shoulder pathological disorders in this population.

Boileau et al[4] reported that of the 10 patients in their SLAP repair group, 4 underwent revision surgery because of residual pain that precluded a return to sport. The mean age of the SLAP revision cohort was 37 years. Three of 4 patients who underwent revisions also underwent biceps tenodesis and subsequently returned to sport. No revision surgery was required in the tenodesis cohort despite having a mean age of 52 years. Franceschi et al[10] showed that despite the tenotomy cohort having better UCLA scores and range of motion compared with the SLAP repair group, 19 patients in the tenotomy group reported a "popeye" deformity during elbow flexion postoperatively.

DISCUSSION

Once thought to be unique to overhead athletes, SLAP lesions are increasingly being diagnosed and surgically treated in an older cohort of patients. In a recent analysis, Onyekwelu and colleagues[28] demonstrated a 458% increase in arthroscopic SLAP repairs from 2002 to 2010 in New York State. The authors also noted that the mean patient age increased significantly in this 8-year span (37 ± 14 years [range, 13-83 years] vs 40 ± 14 years [range, 13-87 years], respectively). Kim et al[16] found a 26% prevalence of superior labral tears in 544 shoulder arthroscopic procedures. Of the 139 SLAP lesions, 123 (88.5%) were associated with additional intra-articular injuries at the time of arthroscopic surgery.

As SLAP lesions are increasingly recognized, decisions regarding their treatment can be difficult. The ideal treatment of a symptomatic superior labral tear in the patient over 40 years of age is not clearly defined. Residual postoperative pain and stiffness after SLAP repair in this population have been reported.[2,15,31,34] Others have questioned whether a SLAP lesion is the true symptom generator in these shoulders, which frequently possess concomitant pathological disorders such as arthrosis and rotator cuff disease.[10,21,35] It has been suggested that degenerative SLAP tears may be expected with the aging process and should not be repaired.[1] Finally, other surgeons have recognized the symptomatic SLAP lesion in the older patient but advocated biceps tenotomy or tenodesis instead of repair.[4,10,16]

Given the growing controversy regarding their treatment, we conducted a systematic review of the literature examining the available evidence for treating SLAP lesions in patients over 40 years of age. Fourteen studies met our inclusion criteria.

Several studies directly compared the results of SLAP repair based on age. The majority revealed comparable outcomes for SLAP repair in older patients when compared with their younger counterparts. In 2 similar level 3 retrospective studies, Alpert et al[2] and Neri et al[22] reported equivalent results for the repair of type II lesions in patients both older than 40 years and younger than 40 years. Likewise, the

level 4 study by Schroeder et al[34] reported comparable results in these patient populations in a nonrandomized prospective cohort study. However, despite similar outcomes, it appears that the risk of complications is greater as age increases. Complication rates range from 10% to 16% in these articles, with a trend toward a higher complication rate as the mean age increases.

Other authors reported conflicting evidence. In a retrospective review of the repair of type II lesions, Denard et al[8] demonstrated trends toward poorer outcomes in their over-40 group. Provencher et al[31] conducted a prospective longitudinal analysis of 179 isolated SLAP repairs in a military population. Subgroup analysis demonstrated that increased age was the only factor associated with surgical failure, with a mean age in the failure group of 39.2 years. The relative risk for surgical failure in patients older than 36 years was 3.45. Katz et al[14] showed that patients with failed SLAP repairs had a mean age of 43 years, and all but 17.5% were aged $\geq$37 years.

The evidence for performing SLAP repair in the setting of rotator cuff repair is also mixed. Forsythe et al[9] demonstrated equivalent results with combined arthroscopic SLAP and rotator cuff repair compared with rotator cuff repair alone in a population older than 50 years. Abbot and colleagues[1] randomized patients to debridement or repair of type II SLAP lesions in the setting of rotator cuff repair. Those who underwent debridement outperformed patients in the repair group in terms of the postoperative UCLA score and range of motion at 2-year follow-up. Overall, the literature favors debridement or biceps tenotomy over SLAP repair when concomitant rotator cuff tears are present in the middle-aged patient population.

Several studies have examined the results of biceps procedures as an alternative to SLAP repair. In a randomized controlled trial, Franceschi et al[10] found biceps tenotomy to have improved outcomes compared with SLAP repair in patients undergoing simultaneous rotator cuff repair. Kim et al[15] and Boileau et al[4] both demonstrated consistent results with biceps tenotomy and tenodesis, respectively, in 2 similar but lower level nonrandomized studies.

This systematic review revealed a heterogeneous group of studies that examined various aspects of the treatment of SLAP lesions in an older cohort of patients. Despite equivalent and good results reported by several authors with SLAP repair in an active, middle-aged population, we continue to be cautious about repairing SLAP lesions in this age group, as some surgeons have reported age as the primary risk factor for increased postoperative stiffness and surgical failure. Concomitant intra-articular disorders, particularly rotator cuff disease and chondral disease, must be considered and treated appropriately. If rotator cuff repair is performed, available evidence suggests that biceps tenotomy or tenodesis provides superior results to labral repair if the disease is present at the bicipital origin. Decisions in treating SLAP tears in patients over 40 years of age must be individualized with the judicious use of SLAP repair and patient education regarding the risk of postoperative complications.

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