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SLAP Repair or Isolated Biceps Tenodesis May Yield Similar Outcomes for SLAP Lesions in Females

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BACKGROUND: The purpose of this study was to report outcomes following Superior Labral Anterior to Posterior (SLAP) repair and biceps tenodesis (BT) for SLAP tears in females.
METHODS: Female patients who underwent SLAP repair or BT for treatment of isolated SLAP tears between 1/1/2014 and 9/1/2019 were retrospectively reviewed. Patients undergoing a concomitant procedure were excluded. Patients completed American Shoulder and Elbow Surgeons (ASES), single assessment numerical evaluation (SANE), and visual analog scale (VAS), and a custom return to activity surveys at a minimum 2 years post-operatively.
RESULTS: The study included 65 female patients; 38 (58.4%) underwent arthroscopic SLAP repair and 27 (41.5%) underwent open- or arthroscopic BT. There was no significant difference in laterality of procedure but patients in the repair group were significantly younger (36.7±8.44 years versus 44.4±10.4 years, P = .003). At minimum 2-year follow-up, both cohorts experienced ASES scores (SLAP: 78.3 versus BT: 80.0, P = .591), SANE scores (77.0 versus 80.1, P = .722) and VAS scores (26.4 versus 24.4, P = .530). Rates of participation in sports prior to surgery were higher for patients undergoing SLAP repair compared to BT (58.8% versus 37.0%, P = .152) and reported rates of return-to-sport after surgery (75.0% versus 80.0%, P = 1.000) were similar.
CONCLUSION: The findings of this study indicate that female patients undergoing surgical treatment of SLAP lesions with either SLAP repair or BT show acceptable patient-reported outcomes and return to sport at a minimum 2 years. However, due to the potential for selection bias and surgeon preference towards SLAP repair for patients of younger age and greater activity level, further controlled research is necessary in order to draw definitive conclusions regarding optimal surgical management of SLAP lesions in females.

INTRODUCTION

Superior labrum anterior and posterior (SLAP) tears were initially described by Andrews et al. in 1985 based on arthroscopic evaluation of overhead athletes[2] and were subsequently classified by Snyder et al into 4 types, with type II representing the most frequently encountered.[3] When patients fail a course of conservative treatment, SLAP tears have commonly been treated operatively in the form of arthroscopic SLAP repair (SR) with good clinical outcomes and improvement in functional scoring metrics.[4–6] Erickson et al. reported that >93% of major league baseball (MLB) orthopaedic surgeons would treat a type II SLAP tear with repair.[7] However, rates of return to previous level of sport after SR has been reported as low as 22% [31] and outcomes reported in overhead athletes have been suboptimal.[7,9,10]

Bicknell and Boileau et al. described biceps tenodesis (BT) as an alternative to repair in SLAP lesions.[8,11] Hurley et al demonstrated improved patient satisfaction and return to sport in patients treated with BT versus SLAP repair and subsequently revealed comparable results between repair and subpectoral BT in a particularly young and active population.[12,13] Furthermore, a recent systematic review similarly showed non-inferiority of BT to SR in surgical management of SLAP tears in overhead athletes, and even suggested a

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potentially lower complication rate in favor of BT—especially in those patients over age 35.[14–16]

While age and patient activity level have been examined in relation to this topic, these studies have focused primarily on male patients and overhead athletes. However, few studies have specifically focused on treatment of SLAP tears in females with existing literature for SLAP tears focusing predominantly on male cohorts. This is a topic that must be further explored specifically in female patients.

Given the lack of consensus regarding the optimal treatment strategy and high degree of heterogeneity with concomitant procedures found in previous studies on this topic, comparison of outcomes after these two procedures, specifically in female patients, may help to guide clinical decision making for the surgical management of SLAP lesions in females. Therefore, the purpose of this study was to retrospectively evaluate outcomes after SR and BT in females with isolated SLAP tears. The authors hypothesized that female patients undergoing SR or BT for surgical management of SLAP tears achieve comparable improvement with respect to patient-reported outcome scores and rate of return to sport participation upon final follow-up.

METHODS

Inclusion/Exclusion

This retrospective study was performed at a single institution between January 2014 and September 2019. The study was approved by our Institutional Review Board (Thomas Jefferson University Study #21E.965) prior to data collection. A query was performed on all female patients who underwent arthroscopic SLAP repair (CPT 29807) or arthroscopic/open BT (CPT 29828, 23430) for surgical management of an isolated SLAP lesion and were retrospectively identified from medical records. The query was performed between 1/1/2014 – 9/1/2019 in order to ensure a minimum of 2-year follow-up. Multiple surgeons were included within the retrospective review. Patients that resulted from the query were reviewed to verify that they met inclusion criteria. Inclusion criteria consisted of: Patients undergoing non-revision SLAP repair or BT procedures who were at least 18 years old at the time of surgery, had completed a trial of nonoperative treatment consisting of activity modification and physical therapy without symptom relief, could be reached for completion of outcome surveys were considered for study inclusion, and had a preoperatively identified SLAP lesion based on clinical examination and radiographic evaluation confirmed by both a musculoskeletal radiologist and attending orthopedic surgeon. Further, patients were only included if they completed outcome questioners at a minimum 2-year follow-up. Exclusion criteria consisted of: (1) Patients were < 18 years at the time of surgery, (2) had no clinical or radiographic evidence of SLAP lesion in medical records, (3) underwent concomitant procedures (distal clavicle excision/resection, non-SLAP labral repair, Bankart repair, remplissage, capsular plication, and/or rotator cuff repair), (4) had the following concomitant pathologies (Bankart lesion, Hill-Sachs lesion, adhesive capsulitis, significant glenohumeral joint disease including joint space narrowing, osteophyte formation, and subchondral sclerosis, and/or partial-thickness rotator cuff tears (Either bursal or articular-sided) which were felt to be clinically meaningful and ultimately required greater intervention than simple debridement or full-thickness rotator cuff tears requiring repair). All patients had clinical and radiographic evidence of a SLAP lesion preoperatively, with decision of treatment with SR versus BT being made between the operating surgeon and the patient following discussions related to risks, benefits, and potential outcomes.

Procedure Technique – SLAP Repair

Patients undergoing SLAP repair procedures were positioned in either the modified beach-chair or lateral decubitus position based on surgeon preference. A standard posterior portal was established for diagnostic arthroscopy, followed by establishment of an anterior portal in the rotator interval. The labrum was examined using an arthroscopic probe with confirmation of preoperative diagnosis of SLAP lesion. After preparation of the bony surface for anchor placement, knotless suture anchors (varying between 1 and 4) were utilized in order to repair the labrum.

Procedure Technique – Biceps Tenodesis

Patients undergoing arthroscopic BT were positioned in a modified beach chair or lateral decubitus position depending on surgeon preference. A posterior portal was established for diagnostic arthroscopy at which time the preoperatively identified SLAP lesion was confirmed. After creation of an anterior portal,

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biceps tenotomy was performed by release of the origin of the tendon at the superior glenoid. For the arthroscopic tenodesis, an additional portal after external rotation of the arm, the biceps tendon within the groove was visualized, captured with a grasper, and subsequently removed through the additional portal (often anterolateral). The tenodesis site within the biceps groove was prepared using electrocautery, and the biceps tendon was prepared with suture in locking fashion with subsequent removal of the remaining diseased articular portion of the tendon. Biceps tenodesis was performed with the use of tenodesis screw, anchor or button based on surgeon preference.

Patients undergoing open BT underwent the same technique for biceps tenotomy. The arthroscope was removed, the arm was externally rotated, and the incision site for the open subpectoral biceps tenodesis created just below the axilla at the inferior border of the pectoralis major. A longitudinal incision was made and blunt dissection towards the humeral shaft at the bicipital groove was performed. A retractor was placed proximal to the pectoralis insertion, exposing the biceps grove where the biceps tendon was extracted through the incision with a finger or right-angle retractor. Suture was placed in locking fashion beginning at the musculotendinous junction with excision of the proximal portion of the tendon. The periosteum overlying the anterior cortex of the proximal humerus in the bicipital groove was elevated in line with the bicipital groove and deep to the pectoralis major. The long head of the biceps tendon was secured to the proximal humerus in the bicipital groove with fixation either in the form of a unicortical button or tenodesis screw based on surgeon preference. Tenodesis screws were used in 7 of 14 (50.0%) patients in the arthroscopic BT group versus 6 of 13 patients (46.2%) in the open BT group (P=.841).

Rehabilitation Protocol

Postoperatively, patients were placed into a sling for 4 weeks with range of motion (ROM) goals of 90 degrees forward flexion and external rotation at the side by 4 weeks. Those in the BT group were instructed to progress biceps flexion and supination, beginning with passive motion followed by active assisted movement and finally active motion. At 4 weeks, both groups of patients discontinued the sling and gradually began increasing active ROM of the elbow and shoulder in all directions. At 4 weeks in the SR group and 6 weeks in the BT group, patients started scapular stabilizer strengthening, light isometric training, and shoulder strengthening exercises within ROM limitations. Between weeks 8 to 12, full shoulder ROM was achieved and strengthening exercises were advanced as tolerated. At 3 months, patients were allowed to progress towards eccentric upper extremity strengthening exercises and were to begin sports relate rehabilitation exercises, with the BT cohort return to throwing and swimming as tolerated at this time. At 4.5 months, patients were allowed to begin overhead activities such as throwing with return to contact sports by the 5 month mark.

Data Collection

Chart review was performed on all eligible patients to collect demographic information including age at time of surgery, height, weight, body mass index (BMI), race, hand dominance, participation in sports, as well as concomitant procedures and pathologies. Charts were also reviewed for revision procedures and non-revision procedures patients underwent involving the same shoulder. Two-year patient-reported follow-up was collected via patient reported outcome surveys through RedCap (Vanderbilt University, Nashville, Tennessee) including the American Shoulder and Elbow Surgeons (ASES) survey, Single Assessment Numeric Evaluation (SANE) survey, and Visual Analogue Scale (VAS) survey. ASES and SANE scores range from 0 (poor) to 100 (healthy). All the patients in the study received the surveys at the time of the retrospective review between May 2022 to August 2022. A custom survey was also included to collect return to sport information (Appendix 1). Of note, reports of revision procedures only pertain to those revisions performed at our institution and cannot account for patients undergoing treatment at an outside institution.

Statistical Analysis

Collected demographic and surgical information was compared between patients who underwent arthroscopic SR and arthroscopic or open BT for SLAP lesions. Self-reported outcomes were also reported between members of each cohort. These outcomes included mean ASES score, SANE score, and VAS score. Additionally, patient reported participation in sport prior to surgery and details on their return to sport after surgery were reported. No comparison between groups was performed due to lack of sufficient power between

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groups, which stemmed from our stringent exclusion criteria. Furthermore, outcomes after arthroscopic and open BT for SLAP tear were reported but comparisons were not made due to lack of sufficient power. Student t-tests were used to calculate P values for continuous data, and Fisher exact tests were used to calculate P values for categorical data. All statistical analysis was done using R studio (Version 3.6.3, Vienna, Austria). P values less than 0.05 were deemed significant.

RESULTS

Sixty-five patients were included in this study (SR: n = 38, BT: n =27) (Figure 1). There was no significant difference in race, height, laterality of procedure, hand dominance, or presence of concomitant procedures at the time of surgery, but patients in the SR group were significantly younger: 36.7 years (range: 18-50 years old) versus 44.4 years group (range: 20-68 years old), P = .003 (Table 1). Two patients within the SLAP repair group also underwent concomitant procedures, a synovectomy and capsulorrhaphy. One member of the BT cohort had a bursectomy performed on the same shoulder 15 years prior to undergoing open BT.

Mean ASES scores were 78.3 in the SLAP repair cohort and 80.0 in the BT cohort. Mean SANE scores were 77.0 and 80.1 and mean VAS was 26.4 and 24.4 at a minimum of 2 years following surgery. Thirty out of 65 patients (46.1%) reported that they participated in sports prior to surgery. The SLAP repair-treated cohort reported a 58.8% rate of participation in sport prior to surgery, and the BT-treated cohort reported a 37% rate of pre-surgical sport participation. Reported sport participation prior to SLAP repair included swimming (13.2%), followed by golf and volleyball (5.26% each), gymnastics, basketball and tennis (2.63% each), and other (21.1%). For those in the BT group who reported prior sport participation, softball and volleyball were the most popular sports (20% each), followed by golf and swimming (10% each), and other (40%). When asked if they returned to sport following surgery 75% of those in the SLAP repair cohort who reported sport participation prior to surgery and 80% of those in the BT cohort who reported sport participation prior to surgery reported doing so (Table 2).

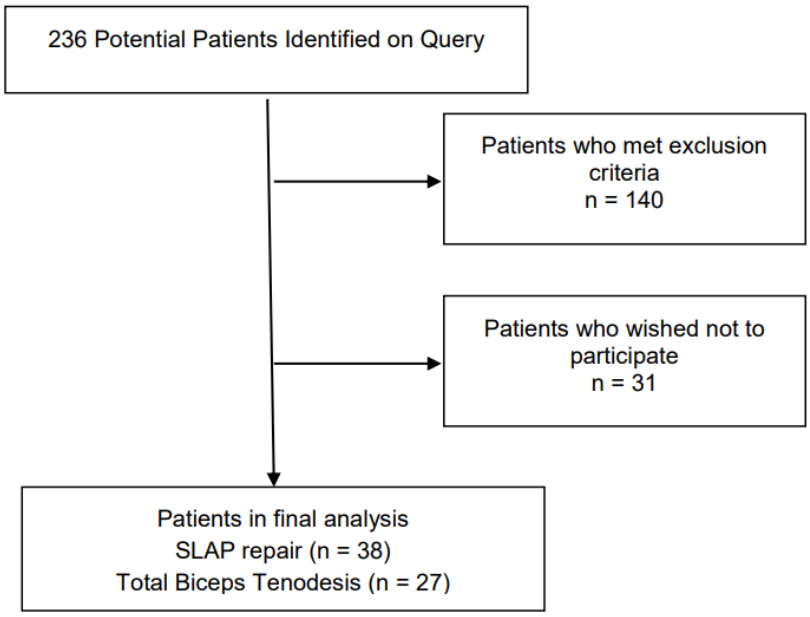

Figure 1. Flow diagram demonstrating patient selection

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Table 1. Demographic and surgery information SLAP repair and Biceps Tenodesis (bold indicates significance)

	SR	*BT*	*p-value*
	N=38	*N=27*	
Race:			.100
White	33 (86.8%)	18 (66.7%)	
Other	5 (13.2%)[a]	9 (33.3%)[+]	
Ethnicity:			.415
Not Hispanic or Latino	38 (100%)	26 (96.3%)	
Hispanic or Latino	0 (0.00%)	1 (3.70%)	
Age (years)	36.7 (8.44)	44.4 (10.4)	**.003***
BMI (kg/m^2)	27.4 (6.78)	28.9 (7.93)	.424
Height (in)	64.8 (2.75)	65.8 (3.03)	.178
Weight (lbs)	162 (36.5)	178 (52.5)	.174
Laterality:			.280
Right	22 (57.9%)	20 (74.1%)	
Left	16 (42.1%)	7 (25.9%)	
Hand Dominance:			.168
Right	25 (65.8%)	15 (55.6%)	
Left	5 (13.2%)	1 (3.70%)	
Unknown	8 (21.1%)	11 (40.7%)	
Surgery on dominant side:			**.031***
Yes	15 (39.5%)	13 (48.1%)	
No	15 (39.5%)	3 (11.1%)	
Unknown	8 (21.1%)	11 (40.7%)	

SR: SLAP repair; BT: Biceps tenodesis, Mean (SD), No (%)
[a] = includes 3 patents with unreported race and 2 Black/African American patients,
[+] = includes 5 Black/African American patients, 3 of unreported race, 1 native Hawaiian or Other Pacific Islander

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Table 2. Survey responses and surgery details comparing SLAP repair and biceps tenodesis

	SR	*BT*	*p-value*
	N=38	*N=27*	
ASES Score	78.3 (22.4)	80.0 (23.8)	.591
SANE	77.0 (25.2)	80.1 (22.2)	.722
VAS	26.4 (28.2)	24.4 (29.7)	.530
Participated in recreational sport prior to surgery			.152
Yes	20 (58.8%)	10 (37.0%)	
No	14 (41.2%)	17 (63.0%)	
Returned to Sport following surgery			1.000
Yes	15 (75.0%)	8 (80.0%)	
No	5 (25.0%)	2 (20.0%)	
How long after surgery until you returned to sport participation?			.663
Less than 6 months	9 (60%)	3 (37.5%)	
Between 6 months and 1 Year	3 (20%)	3 (37.5%)	
More than 1 year	3 (20%)	2 (25%)	
Revision:			1.000
Yes	1 (2.63%)	0 (0.00%)	
No	37 (97.4%)	27 (100%)	

SR: SLAP repair; BT: Biceps tenodesis, ASES = American Shoulder and Elbow Surgeons, SANE = Single Assessment Numeric Evaluation, VAS = Visual Analogue Scales SLAP = superior labrum anterior to posterior, Mean (SD), No (%)

Reasons for not returning to sport included 'participation in sport no longer available' reported by 2 members of the BT cohort (ages 21 and 48 years old). "Shoulder pain or dysfunction is too significant" was reported as the reason by 4 patients (age ranging from, 20-46 years old, with 3/5 patients over age 43), all of which underwent SLAP repair. One patient who underwent SLAP repair listed their reason as "other." One patient (1/38, 2.63%) in the SLAP repair cohort required re-operation in the form of capsular release for adhesive capsulitis. There were no additional reoperations or complications noted in either group within our practice, although reoperation at a different institution cannot be definitely determined due to inability to access outside medical records.

Arthroscopic and Open Biceps Tenodesis

Twenty-seven patients underwent BT, including 14 arthroscopic and 13 open. Patients in both cohorts were similar in race, ethnicity, age, height, laterality or procedure, hand dominance (Table 3). Tenodesis was performed with interference screws in 7/14 (50.0%) of patients in the arthroscopic BT group and 6/13 (46.2%) in the open BT cohort. No patients in either had any concomitant procedures performed at the time of surgery.

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Table 3. Demographic and surgery information of arthroscopic and open biceps tenodesis (BT), Mean (SD), No (%)

	Arthroscopic BT	*Open BT*
	N=14	*N=13*
Race:		
White	9 (64.3%)	9 (69.2%)
Other	5 (35.7%)[a]	4 (30.8%)[+]
Ethnicity:		
Not Hispanic or Latino	14 (100%)	12 (92.3%)
Hispanic or Latino	0 (0.00%)	1 (7.69%)
Age (years)	43.5 (9.48)	45.3 (11.6)
BMI (kg/m^2)	30.8 (9.60)	26.8 (5.22)
Height (in)	65.8 (3.29)	65.8 (2.86)
Weight (lbs)	190 (65.6)	165 (30.9)
Laterality:		
Right	11 (78.6%)	9 (69.2%)
Left	3 (21.4%)	4 (30.8%)
Hand Dominance:		
Left	0 (0.00%)	1 (7.69%)
Right	8 (57.1%)	7 (53.8%)
Unknown	6 (42.9%)	5 (38.5%)
Surgery on dominant side:		
Yes	7 (50.0%)	6 (46.2%)
No	1 (7.14%)	2 (15.4%)
Unknown	6 (42.9%)	5 (38.5%)

[a] = includes 4 Black/African American patients, 1 patient of unknown race.
[+] = includes 1 Black/African American patients, 2 of unreported race, 1 native Hawaiian or Other Pacific Islander

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Table 4. Survey responses and surgery details comparing arthroscopic versus open biceps tenodesis (BT)

	Arthroscopic BT	*Open BT*	*p-value*
	N=14	***N=13***	
ASES Score	85.9 (19.2)	73.6 (27.3)	.238
SANE	81.4 (22.5)	78.6 (22.6)	.922
VAS	16.8 (22.3)	32.5 (35.1)	.248
Participated in recreational sport prior to surgery	1.50 (0.52)	1.77 (0.44)	.236
Yes	7 (50.0%)	3 (23.1%)	
No	7 (50.0%)	10 (76.9%)	
Returned to Sport following surgery			1.000
Yes	5 (71.4%)	3 (100%)	
No	2 (28.6%)	0 (0.00%)	
How long after surgery until you returned to sport participation?			.915
Less than 6 months	2 (40%)	1 (33.3%)	
Between 6 months and 1 Year	2 (40%)	1 (33.3%)	
More than 1 year	1 (20%)	1 (33.3%)	

ASES = American Shoulder and Elbow Surgeons, SANE = Single Assessment Numeric Evaluation, VAS = Visual Analogue Scales, Mean (SD), No (%)

Mean reported ASES score was 85.9 in the arthroscopic cohort and 73.6 in the open cohort. Mean SANE scores were 81.4 and 78.6, respectively, and VAS was 16.8 and 32.4 at a minimum of 2 years following surgery (mean follow-up 5.58 years [range 2.63- 8.29] years in SLAP repair, and 4.78 [range 2.71-8.38] years in BT, P = .035). Groups also had similar rates of participation in sport prior to surgery (50.0% versus 23.1%, *P* = .236). Reported sport participation prior to surgery included baseball and volleyball (20% each), swimming and golf (10% each), and other (40%). When asked if they returned to sport following surgery 71.4% of those in the arthroscopic BT cohort and 100% of those in the open BT cohort reported doing so.(Table 4).

Reasons for not returning to sport included 'participation in sport no longer available' reported by 2 members of the arthroscopic BT cohort, both patients had reported playing baseball prior to surgery. No patients in either cohort underwent revision surgery or experienced any postoperative surgical complications.

DISCUSSION

This study found that female patients undergoing SLAP repair or BT for surgical management of SLAP tears experienced similar improvement in postoperative functional outcomes and return to sport. SLAP tears are common in both male and female athletes, although there have been limited studies evaluating the outcomes of SLAP repair and BT for surgical management of SLAP tears specifically in females. The authors' hypotheses were confirmed as female patients undergoing SLAP repair and BT experienced improvements in postoperative ASES scores, SANE scores, VAS pain and other functional outcome scores, and return to sport at a minimum of 2 years following surgery.

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Several studies have reported functional outcome measures after operative treatment of SLAP tears. Provencher et al. reported an average postoperative ASES score of 88.2 +/- 5.3 and SANE score of 85 +/- 6.1 at 40 months following anatomic repair of type 2 SLAP lesions in an active, predominantly male military population (144 versus 35 women).[15] Denard et al. subsequently reported an average postoperative ASES score of 87.4 for patients over 35 years of age with type 2 SLAP tears undergoing SLAP repair in comparison to 89.9 following BT at 2 year follow-up (P = .8719), though this was a substantially older, male (75%) population.[26] More recently, Hurley et al., reported 5-year ASES scores >90 after SLAP repair and BT in a predominantly male population (80%) with a mean age of 25.[13] However, all of these studies featured predominantly male patients. Rothermich et al. demonstrated comparable outcomes between SLAP repairs and biceps tenodesis procedures among fast-pitch female softball players, with no significant difference between return to play times between the 2 groups.[27] While our retrospective study design did not allow for collection of preoperative functional outcome scores like the previously mentioned studies, postoperative ASES scores at 2 years (78.3 in SR cohort versus 80.0 in BT cohort, P = .591) and lack of significant differences in ASES scores when BT was performed in arthroscopic versus. open fashion (85.9 versus 73.6, P = .238), demonstrate consistency in functional outcome measures in females compared to what is reported in predominantly male cohorts.[12,28]

In the current study, the mean age of females undergoing SLAP repair (36.7 years) was nearly 10 years younger than those patients undergoing BT (44.4 years, P = .003). Additionally, despite not achieving statistical significance, females in the SLAP repair cohort appear to be more involved in sports preoperatively compared to those receiving BT (58% versus. 37%, P = .152). These findings may be due to the younger age of patients included in the SLAP repair cohort, which could serve as a source of bias.[13,29] While some feel SLAP repair can be superior to biceps tenodesis in young, active patients, a recent clinical study by Hurley et al.[13] and in a meta-analysis by Shin et al. showed that young, overhead athletes had better ASES scores and rate of return to sport with lower complication profile when treated with BT compared with SR for SLAP tears.[16] Such findings may hold biomechanical merit, as Chalmers et al. compared 18 pitchers (including 7 controls, 6 playing after SR, and 5 playing after subpectoral BT) showing that *both* procedures can restore neuromuscular control to physiologic levels, though pitchers who had *BT*, not repair, had thoracic motion and EMG most similar to matching healthy controls.[30]

Rate of return to sport or full activity after surgical management of type 2 SLAP tears has been examined as an outcome measure in previous studies.[8,26] In one study, a 74% return was reported in an 83% male cohort (mean age of 36 years old) 3 years following SLAP repair.[4] Another study examining a 70.3% male cohort (mean age near 50 years old) reported an 86% return to play following SLAP repair and 100% return to sport following BT.[26] This is consistent with more recent studies by Hurley et al. and Shin et al. focused on young, active, overhead athletes which reported comparable results.[13,16] Despite not being specifically focused on athletes and having a cohort entirely composed of female patients (mean age 36.7 years old), the rate of return to sport in this study among those who reported prior participation (75% in SLAP repair cohort versus 80% in BT cohort) is comparable to previous studies. These findings further support the notion that alteration of the normal biceps tendon anatomy through BT may not have deleterious effects on return to sport.

It is important to consider the results of SLAP repair and BT with respect to their complications, need for reoperation, and differences in postoperative rehabilitation timelines. One patient from our study required reoperation for capsular release following SR while no patients undergoing BT required a reoperation. However, reports of complications and re-operations are much more frequent in the literature. In their systematic review of 13 studies including overhead athletes, Shin et al. found a 1.7% (1/58) complication rate in the BT cohort (traumatic tendon rupture) compared to 7% (9/129) in the SLAP repair group (retears), though this was not significantly different (P = .178).[16] 28% of patients undergoing SLAP repair required revision surgery in the form of BT according to Provencher et al. and Hurley et al. reported a revision rate of 11.5% following primary SLAP repair compared to 0.0% after BT.[14,15] In regard to postoperative rehabilitation, patients undergoing biceps tenodesis were progressed to full shoulder ROM without restrictions and full elbow motion without resistance by postoperative week 4 with return to throwing at 3 months and return to contact sports by 6 months. Patients undergoing repair

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were expected to achieve full shoulder ROM between postoperative weeks 8- 12 with return to throwing at 4.5 months and contact sports at 6 months postoperatively.

Limitations

First, the present study was not sufficiently powered to detect statistically significant differences in clinical outcomes between SLAP repair and BT cohorts. This lack of sufficient power likely stems from our attempt at setting strict exclusion criteria, as concomitant pathologies and procedures are highly prevalent amongst these cohorts. Similar to Provencher et al., we set these stringent criteria in attempt at clearly limiting the variable of associated pathology and distinguishing the true clinical effect of the two treatments in question. However, establishment of such benchmark data in a female cohort with stringent exclusion of concomitant procedures is imperative and thus the present study offers value. Second, some baseline characteristics, including age, preoperative sport participation, and mechanism of labral tear were not the same between the SR and BT groups. The mean age of patients treated with repair was significantly younger, additionally, while not statistically significant, the SLAP repair cohort appeared to be more active preoperatively. While traumatic versus atraumatic tears have not consistently been shown to affect outcomes of SLAP, the discrepancy in age between treatment groups could serve as a source of bias that must be considered.[15] Older patients may have been more likely to have degenerative tears and as such, surgeons may have been more likely to choose BT over repair in this instance. Third, as this study contains retrospectively collected data, preoperative functional outcome scores were not collected, therefore we cannot definitively conclude that either surgical intervention effects the natural history of the disease process from this study alone. However, all patients included in this study failed to improve after a trial of nonoperative management, and prior studies conducted in a prospective manner provide compelling evidence for improvement in ASES, VAS, and UCLA scores after either SLAP repair or BT.[15,26] Fourth, surgeries were carried out by multiple surgeons with varying degrees of expertise. Although institution treatment recommendations were followed when electing which procedure for patients to undergo, surgeons' own preferences, patient factors, and intraoperative findings may have also dictated which procedure was performed. The retrospective nature of the study did not allow for precise standardizations of procedures and postoperative rehab protocols, however surgeons included generally followed similar techniques to allow for analysis. Fifth, cosmesis was not considered in this present study in regard to open and arthroscopic biceps tenodesis. Lastly, reoperation at a different institution cannot be definitely determined.

CONCLUSION

The findings of this study suggest that female patients undergoing surgical treatment of SLAP lesions with either SLAP repair or biceps tenodesis show acceptable patient-reported outcomes and return to sport at a minimum 2 years. However, due to the potential for selection bias and surgeon preference towards SLAP repair for patients of younger age and greater activity level, further controlled research is necessary in order to draw definitive conclusions regarding optimal surgical management of SLAP lesions in females.

Conflict of Interest Statement

The authors declare no conflicts of interest with the contents of this study.

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Appendix 1. Custom return to sport survey

Were you participating in a recreational sport such as golf, tennis, swimming (or other) BEFORE your shoulder surgery? Select yes if you participated in this sport with some level of regularity at any point during the two years leading up to your surgery.	◯ Yes ◯ No
Which Sport did you participate in?	◯ Baseball ◯ Basketball ◯ Cross Country ◯ Field Hockey ◯ Football ◯ Golf ◯ Gymnastics ◯ Hockey ◯ Lacrosse ◯ Rowing ◯ Soccer ◯ Swimming ◯ Tennis ◯ Track and Field ◯ Volleyball ◯ Other
Did you return to ANY sports activity after your surgery?	◯ Yes ◯ No
What was the main reason?	◯ Not interested in returning to sport ◯ Participation in sport no longer available ◯ Shoulder pain or dysfunction is too significant ◯ Other
Following your shoulder surgery, how long was it until you were able to continue playing this sport?	◯ 1 month ◯ 2 months ◯ 3 months ◯ 4 months ◯ 5 months ◯ 6 months ◯ 7 months ◯ 8 months ◯ 9 months ◯ 10 months ◯ 11 months ◯ 1 year ◯ More than 1 year

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