

Subpectoral Biceps Tenodesis for Treatment of Isolated Type II SLAP Lesions in a Young and Active Population

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Purpose: The purpose of this study was to evaluate outcomes following open subpectoral biceps tenodesis for the treatment of isolated type II SLAP lesions in patients 45 years of age or younger and evaluate the rate of return to sport. **Methods:** All patients included in the study were at least 2 years out from open subpectoral biceps tenodesis for treatment of an isolated type II SLAP lesion and were treated between December 2007 and March 2015. All patients older than 45, those who had prior surgery on the index shoulder, and those who had any concomitant reconstructive shoulder procedures were excluded. American Shoulder and Elbow Surgeons (ASES), Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH), Single Assessment Numeric Evaluation (SANE), and Short-Form 12 Physical Component Summary (SF-12 PCS) scores were collected pre- and postoperatively along with postoperative patient satisfaction. Patient return to sport was evaluated by questionnaire. **Results:** Twenty patients with a mean age of 38 years (range 21-45) were included, of which 16 were available for follow-up. There was significant improvement in median pre- to postoperative outcome scores (ASES, 66-94 points, $P = .001$; QuickDASH, 31-8, $P = .003$; SANE, 60-92, $P = .001$, SF-12 PCS, 41-52 points, $P = .002$), with a median patient satisfaction of 8.5 points (range 1-10) at a mean follow-up of 3.4 years (range, 2.0-6.3 years). At final follow-up, all patients had returned to sport, with 73% of patients indicating a return to their previous or comparable level of sports. Subgroup analysis showed 80% of overhead athletes returned to the same or a comparable level postoperatively. **Conclusions:** This study suggests that young patients around their 30s participating in sport at a recreational level may benefit from open subpectoral biceps tenodesis for a primary isolated SLAP II tear and would experience excellent outcomes, high satisfaction, and a high rate of return to sport. **Level of Evidence:** Level IV, therapeutic case study.

SLAP tears occur at the superior glenoid labrum-biceps anchor complex, and generally are attributed to either acute trauma or chronic overuse. SLAP tears were first described by Andrews et al.¹ and later classified into 4 distinct subtypes by Snyder et al.² Type II SLAP tears involve complete detachment of the biceps anchor from the superior glenoid, with the anterior and posterior labrum remaining intact.³ Although SLAP lesions are often associated with

concomitant shoulder pathology (e.g., Bankart lesions, rotator cuff tears, acromioclavicular joint arthritis, glenohumeral chondral injuries), they can occur as an isolated lesion that can cause pain, mechanical symptoms, instability, and loss of range of motion causing patients to not be able to perform at the preinjury athletic level.^{2,4-6}

Several factors have been shown to potentially influence the management and outcomes of type II

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SLAP lesions including patient age, activity level, quality of labral tissue, and concomitant pathology.⁷⁻¹² Initial management consists of activity modification, nonsteroidal anti-inflammatory drugs, physical therapy, or injections.¹³⁻¹⁶ Surgical treatment options involve either primary repair or biceps tenodesis (BT). Despite previous research, patient selection for repair versus BT is yet to be clearly delineated. Primary arthroscopic repair of type II SLAP lesions has traditionally been considered the gold standard in young patients with several studies reporting good to excellent results after repair.^{10,17,18} Conversely, BT has been favored in older patients because of lower failure rates, reduced pain, and higher rates of satisfaction and return to sport in comparison to repair.^{9,19-21} Recent work has shown that BT can be a reasonable option in younger patients who failed SLAP repair presenting the question whether younger patients should be managed with BT primarily.²²⁻²⁵

The purpose of this study was to evaluate outcomes following open subpectoral BT for the treatment of isolated type II SLAP lesions in patients 45 years of age or younger and evaluate the rate of return to sport. We hypothesized that open subpectoral BT in the young population would be an effective treatment with a low revision rate and significant improvement in postoperative outcomes scores with a high rate of return to sport near preinjury level.

Methods

Study Population

This was an institutional review board–approved Level IV retrospective outcomes study with prospectively collected data. Review of a single-surgeon series (P.J.M.) was performed to identify patients meeting the following inclusion criteria: all patients aged 45 years or younger who underwent open subpectoral BT for an arthroscopically-confirmed isolated type II SLAP lesion and were at least 2 years out from surgery. The age limit was chosen based on previous literature.^{21,26} An isolated type II SLAP tear was defined as one in which there was no additional repair or reconstructive surgery (e.g., Bankart lesion, rotator cuff tear, and acromioclavicular joint injury). Patients were excluded if they had additional or prior shoulder surgery unrelated to BT on the ipsilateral shoulder.

Subjective evaluations were obtained with the American Shoulder and Elbow Surgeons (ASES); Quick Disabilities of the Arm, Shoulder and Hand; Single Assessment Numeric Evaluation; Short-Form 12 Physical Component Summary; and satisfaction scores (10-point scale) preoperatively and at a minimum 2 years postoperatively. Additional questions on the evaluation form assessed preoperative time from onset of injury to surgery, preoperative physical therapy, type

of preoperative sports or activities, and postoperative return to sports or activities. Clinical failures were defined as revision BT surgery.

Pre- and postoperative outcomes scores were compared for all patients in the study population. The association between postoperative outcomes scores and type of sport or activity as well as participation in preoperative physical therapy were assessed.

Surgical Technique

All operations were performed using general anesthesia with an additional interscalene nerve block and with the patient placed in the beach-chair position. Following diagnostic arthroscopy and confirmation of the SLAP II lesion, a biceps tenotomy was performed at the tendon insertion using a radiofrequency device. If necessary, intra-articular debridement or synovectomy were performed using an arthroscopic mechanical shaver and radiofrequency device. If present, fraying of the labrum was also debrided. Subacromial decompression (SAD) with acromioplasty was subsequently performed in patients who revealed radiologic signs of a bursal-sided partial-thickness rotator cuff tear or who showed clinical signs and symptoms of subacromial impingement. In patients with an articular-sided partial-thickness rotator cuff tear, an isolated subacromial bursectomy to assess the tear was performed. The shoulder was then repped, and open subpectoral BT was performed following the technique described by Tahal et al.²⁶ using a PEEK (polyether ether ketone) tenodesis screw of either 7 × 10 mm or 8 × 12 mm diameter.

Postoperative rehabilitation consisted of sling immobilization for 2 weeks with immediate full passive and active range of motion. Resisted elbow flexion was avoided for the first 6 weeks.

Statistical Analysis

All statistical analyses were performed using SPSS, version 11.0 (SPSS, Chicago, IL). Because of the limited number of patients included, a formal post hoc power analysis was not appropriate. In this data set, all continuous variables were checked with the Kolmogorov-Smirnov test and were found to be nonnormally distributed. Therefore, the pre- and postoperative outcome scores of the study population were compared with a Wilcoxon signed-rank test. The association between categorical variables and outcome scores was assessed with a Mann-Whitney *U* test. All results were presented as median and range unless otherwise noted. The level of significance was set at $P < .05$.

Results

Between December 2007 and March 2015, the senior surgeon (P.J.M.) performed subpectoral BT for an arthroscopically confirmed isolated type II SLAP lesion

on 22 patients (Fig 1). One patient refused to participate, and another patient was excluded following arthroscopic lysis of adhesions for idiopathic frozen shoulder 1 year postoperatively. This left a final study population of 20 patients (10 women, 10 men) with an average age of 38.5 years (range 21-45, median 41), with 14 patients older than 35 years. Patient demographics are listed in Table 1. Postoperative surveys were obtained for 16 of 20 patients (80%) at a mean follow-up of 3.4 years (range 2.0-6.3). Despite our best efforts to contact the remaining 4 patients, they could not be reached for follow-up; the most recent follow-up was 6 weeks to 6 months for these 4 patients, and all were doing well except 1 gentleman who was experiencing mild shoulder pain 6 months postoperatively. Prior to injury, 16 of 20 patients participated in recreational sports, with 11 of the 16 patients participating in overhead sports (Table 2).

Six patients indicated injury due to sports participation, 5 patients indicated injury due to a fall upon the extended arm, and 9 patients indicated no specific injury preceding symptoms. In total, only 2 (13%) of the 16 injuries of patients available for outcome analysis were considered "acute" (less than 6 weeks from onset of the symptoms till surgery).²⁷

No patient in the study population required revision surgery; however, 1 patient suffered from adhesive capsulitis 6 weeks after surgery but could be treated nonoperatively. All patient-reported outcome scores significantly improved from pre- to postoperation (Table 3). Moreover, 13 (81%) of the 16 patients included underwent additional SAD.

There were no significant differences in postoperative outcomes scores between patients participating in overhead versus nonoverhead activities ($P > .05$,

Table 1. Study Population Demographics

Demographics	Study Population (n = 20)
Age at surgery	41 (21-45), 38.5 ± 6.4
Sex	10 M, 10 F
BMI	24 (18-34)
Hand dominance	R 19, L 1
Operative shoulder	R 16, L 4

NOTE. Continuous data are presented as median (range) or mean ± standard deviation.

BMI, body mass index; F, female; L, left; M, male; R, right.

Table 4). Postoperatively, all patients (100%) returned to their previous sport. More precisely, 39% of patients returned to their preinjury level or higher, and 31% patients returned to slightly below the preinjury level. The remaining 30% of patients were either moderately or significantly below their preinjury levels. Among patients participating in overhead activities, 80% returned to sports at the same level or slightly below compared with their preinjury level. The remaining 20% of patients returned at a lower level compared with their preoperative status. Reasons that were cited included pain, weakness, fear of reinjury or further surgery, lack of motion, and lifestyle changes.

Discussion

The most important finding of this study is that young patients around their thirties participating in sport at a recreational level experienced significant improvement in clinical outcome scores, high postoperative satisfaction, and a high rate of return to sports following open subpectoral BT for isolated type II SLAP tears. As such, we feel that open subpectoral BT is an appropriate

Fig 1. Flow chart visualizing the patient population for this study after accounting for inclusion criteria, exclusion criteria, clinical failures, and those lost to follow-up. (BT, biceps tenodesis.)

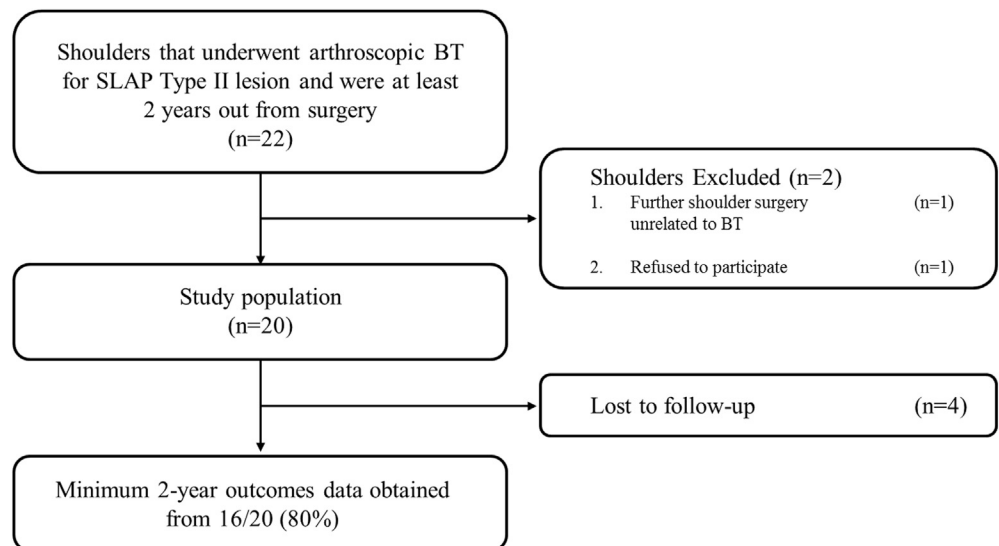


Table 2. Activity Participation for Each Patient in the Study, Categorized as Overhead Versus Nonoverhead Activities

Patient Activities	
Overhead Activities (n = 11)	Nonoverhead Activities (n = 5)
Baseball	Running
Basketball	Skiing
Golf, biking, fishing	Skiing
Martial arts	Snowboarding
Rock climbing	Soccer
Softball, rafting	
Volleyball	
Volleyball, kayaking	
Weight lifting	
Weight lifting	
Weight lifting, skiing, hiking	

surgical treatment option for those patients, which confirms our initial hypothesis.

To our knowledge, of the studies in the literature evaluating BT for SLAP tears, this study has the lowest mean patient age. Another strength of our study is that the confounding effect of concomitant pathologies is largely reduced, providing valuable clinical information to patients and surgeons. More precisely, the only concomitant treatment in our study group was SAD, which we do not believe to have a significant effect on outcomes. Several previous studies²⁸⁻³⁰ have shown that the presence or absence of concomitant SAD along with reconstructive procedures, most notably rotator cuff repair, does not alter clinical outcomes. Because BT is a reconstructive procedure, we do not feel that concomitant SAD likely influenced the outcome, though we do recognize it could have played a role. Additional evidence suggesting its minimal impact on outcomes is provided by Boileau and colleagues,¹⁹ who, without performing SADs, published BT outcomes that were comparable to our own.

In general, our findings concur with that of Boileau and colleagues,¹⁹ who directly compared outcomes between arthroscopic suprapectoral BT and SLAP repair

Table 3. Preoperative Versus Postoperative Outcomes Scores of the Study Population

Outcomes Scores	Preoperative Score	Postoperative Score	P Value
ASES	66 (45-80)	94 (53-100)	.001*
QuickDASH	31 (13-52)	8 (0-39)	.003*
SANE	60 (4-94)	92 (64-99)	.001*
SF-12 PCS	41 (26-56)	52 (29-61)	.002*
Satisfaction	—	8.5 (1-10)	—

NOTE. Continuous data are presented as median (range).

ASES, American Shoulder and Elbow Surgeons score; QuickDASH, Quick Disability of the Arm, Shoulder, and Hand; SANE, Single Assessment Numeric Evaluation; SF-12 PCS, Short Form 12 Physical Component Summary.

*Statistical significance.

Table 4. Postoperative Outcomes Scores Compared Among Patients Participating in Overhead Sports Versus Those Who Did Not

	Participate in Overhead Sports?		
	Yes (n = 11)	No (n = 5)	P Value
ASES	98 (80-100)	97 (73-100)	.933
QuickDASH	7 (0-39)	5 (0-34)	.833
SANE	95 (64-99)	94 (73-99)	.622
SF-12 PCS	54 (38-61)	55 (28-58)	.724
Satisfaction	9 (1-10)	8 (5-10)	.524

NOTE. Continuous data are presented as median (range).

ASES, American Shoulder and Elbow Surgeons score; QuickDASH, Quick Disability of the Arm, Shoulder, and Hand; SANE, Single Assessment Numeric Evaluation; SF-12 PCS, Short Form 12 Physical Component Summary.

with suture anchors for the treatment of isolated type II SLAP lesions at mean 35 months of follow-up. In the tenodesis group of 15 patients with a mean age of 52 years, the authors found that the Constant scores significantly improved from an average 59 points preoperatively to 89 points following surgery.¹⁹ In the tenodesis group, 87% of patients returned to sports at their preoperative levels with 67% of these patients practicing overhead or contact sports. Interestingly, though the 2 treatment groups did not statistically differ in outcomes scores, the tenodesis group had significantly higher postoperative satisfaction, and the return-to-sport rate in the SLAP repair group was only 20%.¹⁹ This gives further weight to the notion that BT may be a valuable treatment option for type II SLAP lesions in young, active patients. Furthermore, the comparable outcomes between Boileau's study and our study show that the technique of the BT may only play a minor role, which has been previously confirmed for other pathologies.³¹ In another recent study, Gottschalk and colleagues²¹ investigated outcomes in 36 shoulders treated with an open subpectoral BT for type II and IV SLAP lesions at an average follow-up of 40 months. Though the authors used the same surgical technique as in our study, their study population was older with an average age of 46.7 years. Overall, their results agreed with ours in that patients had significant improvements in the ASES score from 48 points preoperation to 88 points postoperation. The slight difference found in the postoperative ASES scores between the 2 studies may be due to the authors including nonisolated SLAP injuries, including patients with additional procedures such as repair of partial-thickness rotator cuff tears or revision cases.²¹ However, the 6-point difference in postoperative ASES scores is unlikely to be clinically relevant³²; more importantly, both studies revealed significant pre- to postoperative improvements in ASES scores that did exceed the minimum clinically important difference.³² Moreover, the authors reported a 90% rate of patients returning to

activity at their preoperative level, which is generally in line with our findings.²¹ Remarkably, we found a slightly higher return-to-sport rate to the preoperative level in patients practicing overhead sports compared with nonoverhead athletes. As our study size is limited, this finding may be due to the presence of a confounding effect; that is, those taking part in more demanding overhead sports may be more motivated to return to those sports.

Limitations

Although this study reveals interesting and useful findings, it is not without limitation. First, the strict inclusion and exclusion criteria used to isolate type II SLAP tears did result in a limited study size, making our statistical analysis less robust for false-negative results (type II, or beta error). Moreover, a follow-up rate of 80% of 20 patients does create potential selection bias and susceptibility to type II (beta, or false negative) errors and potential for false inflation of the observed results; however, this number is consistent with similar retrospective studies.^{9,33-35} Additionally, although in the orthopaedic literature several groups have already reported outcomes using 35 years as the cut-off, over which they favor BT,⁹ this study not only further validates previous work but suggests that tenodesis may be of some value below 35 years for selected patients. Finally, the senior surgeon treats patients at a referral clinic for sports medicine and patients are usually healthy and athletic, which may not be representative of the general population. Therefore, this potential bias could limit the generalizability of our findings.

Conclusions

This study suggests that young patients around their thirties participating in sport at a recreational level may benefit from open subpectoral BT for a primary isolated SLAP II tear and experience excellent outcomes, high satisfaction, and a high rate of return to sport.

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