

# High Incidence of Anterior Shoulder Pain in Young Athletes Undergoing Arthroscopic Posterior Labral Repair for Posterior Shoulder Instability



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**Purpose:** The purposes of this study were to determine the incidence of anterior shoulder pain in young athletes undergoing arthroscopic posterior labral repair for symptomatic unidirectional posterior shoulder instability and in patients with preoperative anterior shoulder pain treated without biceps tenodesis at the time of arthroscopic posterior labral repair who underwent a revision biceps tenodesis procedure at short-term follow up. **Methods:** A retrospective review was performed at a single institution over a 24-month period. The study included young patients who underwent an arthroscopic posterior labral repair for symptomatic unidirectional posterior shoulder instability. The electronic medical record, magnetic resonance arthrograms, and arthroscopic images were reviewed to exclude patients with posterior labral tears with anterior labral tear or SLAP (superior labrum anterior-to-posterior) tear extension on advanced imaging and arthroscopic examination. Data collected included the presence of preoperative tenderness to palpation of the biceps tendon in the groove, the results of a preoperative Speed test, postoperative Subjective Shoulder Value, the presence of postoperative anterior shoulder pain, and the need for a secondary biceps tenodesis. **Results:** We identified 65 patients who underwent arthroscopic labral repair for posterior shoulder instability. From this cohort, 26 patients with symptomatic unidirectional posterior shoulder instability underwent an arthroscopic posterior labral repair. The incidence of preoperative anterior shoulder pain with Zone 2 biceps groove tenderness and a positive Speed test was identified in 20 of 26 patients (76.9%). Of 26 patients, 5 (19%) had concomitant biceps tenodesis. The median postoperative Subjective Shoulder Value was 80 (interquartile range, 60-90) at median follow-up of 2.1 years. Of the 20 patients with preoperative anterior shoulder pain, 8 of 20 (40%) reported persistent anterior pain. One patient (4.7%) underwent a secondary biceps tenodesis. **Conclusions:** There is a high incidence of anterior shoulder pain and Zone 2 biceps groove tenderness in patients undergoing isolated arthroscopic posterior labral repair for unidirectional posterior shoulder instability. At short-term follow-up, few patients required a secondary biceps tenodesis procedure; however, 30% of patients had persistent anterior shoulder pain. **Level of Evidence:** Level IV, retrospective diagnostic case series.

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Posterior glenohumeral instability has gained increasing attention as a cause of shoulder pain and dysfunction in a young, active population.<sup>1-7</sup> Posterior shoulder instability encompasses a spectrum of disorders ranging from frank traumatic dislocation, often associated with high-energy injuries or seizures, to chronic atraumatic recurrent posterior instability secondary to repetitive loading of the shoulder with posteriorly directed forces. Early understanding of posterior instability focused on single episodes of large physiologic posteriorly directed forces, but more recent research has demonstrated that chronic atraumatic repetitive posterior microtrauma commonly leads to posterior instability in shoulders with variations of scapular morphology, such as glenoid dysplasia, increased glenoid retroversion, increased posterior capsular area, and variations in posterior acromial

morphology.<sup>8-13</sup> Posteriorly directed axial forces from exercises such as push-ups and bench presses as well as repetitive microtrauma from contact collision sports all lead to degenerative attrition and tears of the posterior capsulolabral structures and resultant recurrent posterior shoulder instability.<sup>14</sup> These activities are common among rowers, weight lifters, overhead athletes, football lineman, and active-duty military service members.<sup>14,15</sup> Prior literature has shown that posterior shoulder instability comprised 24% of the instability population in a large cohort of young, active military athletes.<sup>7</sup>

Historically, long head biceps (LHB) dislocation has been associated with rotator cuff pathology and is accepted as pathognomonic for a subscapularis tendon tear.<sup>16-21</sup> However, LHB dislocation does not exclusively occur with rotator cuff tears. At least 2 case reports have documented medial LHB dislocation in association with a posterior labral tear and symptomatic posterior shoulder instability with the absence of rotator cuff pathology.<sup>22,23</sup> The proposed mechanism of biceps tendon dislocation occurs by disruption of the rotator interval sling created by the superior glenohumeral ligament, the coracohumeral ligament and, distally, the transverse humeral ligament.<sup>22</sup> The mechanism is thought to be a failure of the posterior and anterior capsulolabral structures under tension due to a posteriorly directed force. This can disrupt the rotator interval pulley with subsequent subluxation or dislocation of the LHB tendon. Biomechanical studies have validated the role of the biceps tendon in stabilizing the shoulder.<sup>24-27</sup> Additionally, prior studies attempting to objectively define rotator interval insufficiency in posterior shoulder instability demonstrated magnetic resonance arthrography (MRA) evidence of abnormality of the rotator interval. One study demonstrated that the LHB tendon assumes a more anterior position relative to the supraspinatus tendon in patients with posterior instability versus patients with anterior instability or those without clinical instability.<sup>28</sup>

Dislocation of the LHB is the terminal result of these supraphysiologic forces, so we postulate that posterior shoulder instability commonly leads to either acute or chronic disruption or attenuation of the rotator interval sling, and this entity exists short of frank LHB dislocation, which leads to anterior shoulder pain and, potentially, biceps tendinopathy. In addition, our institution has commonly identified patients with posterior instability and anterior shoulder bicipital groove pain. The purposes of this study were to determine the incidence of anterior shoulder pain in young athletes undergoing arthroscopic posterior labral repair for symptomatic unidirectional posterior shoulder instability and in patients with preoperative anterior shoulder pain treated without biceps tenodesis at the time of arthroscopic posterior labral repair who underwent a revision biceps tenodesis procedure at short-term

follow up. We hypothesized that there is a high incidence of anterior shoulder pain in patients undergoing isolated arthroscopic posterior labral repair for symptomatic unidirectional posterior shoulder instability, and that it is uncommon for patients to require a revision biceps tenodesis procedure for persistent anterior shoulder pain in the short term.

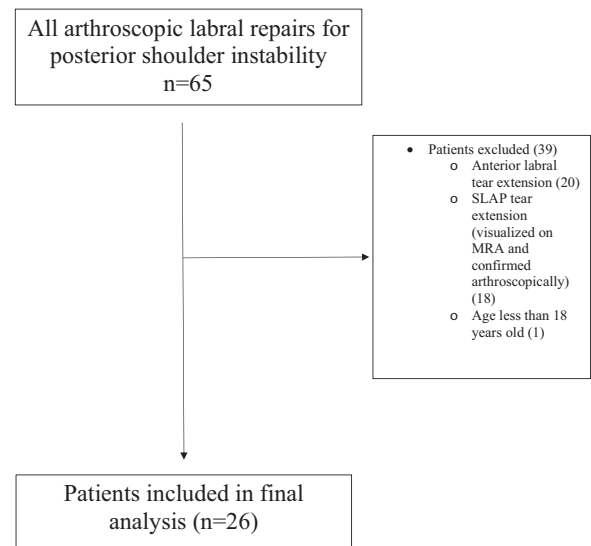
## Methods

After Institutional Review Board approval, we retrospectively reviewed 65 arthroscopic stabilization procedures performed for a diagnosis of posterior shoulder instability at a single academic institution over a 24-month period. Inclusion criteria were patients 18 to 45 years old who had undergone isolated arthroscopic posterior capsulolabral repair for symptomatic unidirectional posterior shoulder instability. All patients were active-duty military personnel. Through review of operative reports, arthroscopic images and the electronic medical records, we excluded patients younger than 18 or older than 45 years of age and patients with a posterior labral tear and with anterior labral tear extension or SLAP (superior labrum anterior to posterior) tear extension beyond 10 o'clock on a right shoulder or 2 o'clock on a left shoulder. Additionally, we excluded any patient with prior shoulder surgery on the ipsilateral shoulder, a diagnosis of multidirectional instability or a posterior glenoid fracture. A posterior glenoid fracture was defined as any posterior glenoid rim fracture noted on advanced imaging. Last, we excluded patients with physical examinations or advanced imaging demonstrating a subscapularis tear or rotator cuff tear. Additional data collected from the electronic medical records included documentation in the preoperative history and physical examination of preoperative biceps groove tenderness to palpation and results of a preoperative Speed test. Patients were considered positive for anterior shoulder pain and bicipital tendinopathy only if they had both anterior Zone 2 biceps groove tenderness to palpation and a positive Speed examination that replicated the anterior shoulder pain. This combination of examination maneuvers has been considered the gold standard for diagnosis of bicipital tendinopathy.<sup>29</sup> Arthroscopic examination of the intra-articular appearance of the biceps tendon was not used in the diagnosis of biceps tendinopathy because intra-articular inflammatory changes have not been shown to be reliable indicators of the clinical entity.<sup>30</sup> However, for patients with substantial preoperative Zone 2 biceps tenderness, we performed a preoperative ultrasound-guided biceps groove diagnostic injection of a combined mixture of local anesthetic and steroid. If patients had substantial pain relief following this injection, it confirmed the diagnosis, and those patients underwent concomitant biceps tenodesis. Additional data collected included the

patients' ages, laterality, histories of a traumatic posterior instability events, number of suture anchors, and whether the patients had undergone a concomitant biceps tenodesis at the time of arthroscopic posterior labral repair. Additionally, we collected the patients' postoperative subjective shoulder values (SSVs) at final follow-up and whether they had persistent postoperative anterior shoulder pain. Last, we determined whether they had undergone secondary surgeries for biceps tenodesis during the follow-up period.

Indications for surgery were history, physical examination and MRA findings consistent with an isolated posterior labral tear with symptomatic posterior shoulder instability and failure to respond to an appropriate trial of physical therapy and activity modification. All patients reported histories of shoulder pain and/or complained of shoulder instability or apprehension in the flexed, adducted and internally rotated position. Additionally, patients demonstrated physical examination findings consistent with symptomatic posterior shoulder instability, including a positive jerk test, 2+ posterior load and shift, and positive push-pull test.<sup>31,32</sup> Furthermore, examination under anesthesia demonstrated 2+ posterior load and shift according to the Antoniou classification.<sup>33</sup> MRA using a 3.0-T Siemens MRI scanner (Siemens Healthcare, Norwood, MA) showed evidence of a posterior labral tear in all patients. No patients had MRA evidence of a SLAP tear or an anterior extension of the posterior labral tear, as defined by extension beyond 6 o'clock on the face of the glenoid.

Arthroscopic posterior capsulolabral repair was performed in 24 patients in the lateral decubitus position, and 2 patients underwent surgery in the beach-chair position. After an examination under anesthesia and diagnostic arthroscopy, the isolated posterior labral repair was mobilized by a curved liberator through an anteroinferior cannula and then abraded with a shaver or rasp to create a bleeding bed of bone. Suture anchors were then sequentially placed from inferior to superior locations between the 6 o'clock and the 10 o'clock position on the face of the glenoid in a right shoulder and between the 6 o'clock and the 2 o'clock position on the face of the glenoid in a left shoulder. Arthroscopic percutaneous techniques were commonly used to place the suture anchors. Suture-shuttling devices were used to advance the posterior inferior glenohumeral ligament and to repair the posterior labrum. Both bio-composite and polyether ether ketone knotless and knotted anchors were used to secure the labrum. When knotted anchors were used, we utilized arthroscopic sliding locking knots with 3 alternating half hitches. One patient had a Kim lesion, and it was repaired with 1 double-loaded suture anchor,<sup>34</sup> and no patients had a posterior labrocapsular periosteal sleeve avulsion lesion. The median number of suture anchors was 3.0, range 1-5. The patient with the Kim lesion underwent



**Fig 1.** Flowchart depicting the selection of the patient cohort.

repair with a double-loaded single suture anchor and was the only patient who underwent repair with a single anchor.

Five patients underwent a concomitant biceps tenodesis at the time of arthroscopic posterior labral repair for significant Zone 2 biceps groove pain. The indication for performing a concomitant biceps tenodesis was at the discretion of the staff surgeon and was based on the patient's age, the magnitude of anterior shoulder pain symptoms and physical examination of significant preoperative groove pain. Additionally, all patients also had significant pain relief by means of a preoperative ultrasound-guided biceps groove diagnostic injection with a combined mixture of local anesthetic and steroid. All biceps tenodesis procedures were performed via an open subpectoral technique.

Descriptive statistics were determined for the study cohort's variables and for the rate of anterior shoulder pain and concomitant biceps tenodesis. Univariate analysis was performed for all variables. The Mann-Whitney nonparametric test for unpaired samples was used for continuous variables, and the 2-tailed Fisher exact test was used for categorical data. A post hoc power analysis was performed with an alpha error set at 0.05 and a power of at least 80%. There are no prior studies on which to base our assumptions, so we assumed that a high percentage (75%) of patients would have biceps groove pain. Our sample size of 26 patients achieved a power of 84.9%. The statistical significance was set to a *P* value of 0.05. All statistics were performed using online software (<https://www.easymedstat.com>).

## Results

In the final analysis, 26 patients with isolated arthroscopically confirmed posterior labral tears and

**Table 1.** Study Demographics

	Traumatic Instability N = 16	Atraumatic Instability N = 10	P Value
Age (years), median (IQR)	26 (24-28)	30 (26-34)	0.25
Sex: Male:Female	16:0	9:1	0.38
Laterality: Left:Right	9:7	2:8	0.11
Median number of suture anchors (IQR)	3.0 (2-3)	3.0 (3-4)	0.48

IQR, interquartile range.

with symptomatic posterior shoulder instability were included (Fig 1). The median age was 27 years, the interquartile range was 24-33 (range, 19-42) (Table 1). The incidence of preoperative anterior shoulder pain with positive biceps groove tenderness and a positive Speed test in patients undergoing arthroscopic isolated posterior capsulolabral repair was 77% (20 of 26). Of 26 patients, 5 (19%) had a concomitant biceps tenodesis at the time of arthroscopic posterior labral repair. The median number of suture anchors was 3.0 (range, 1-5). In only 1 patient was a single double-loaded suture anchor used for a Kim lesion. Suture anchors were placed between the 6 and 10 o'clock positions on the posterior glenoid in the right shoulders, and between the 6 and 2 o'clock positions on the posterior glenoid in the left shoulders. There was no significant difference in the incidence of biceps groove pain tenderness to palpation and preoperative positive Speed test between patients with traumatic and atraumatic mechanisms of posterior shoulder instability (Table 2).

The median postoperative SSV for the cohort was 80 (interquartile range, 60-90), (range, 40-100). Of 26 patients, 8 (30.7%) reported postoperative anterior shoulder pain. Of the 20 patients with preoperative anterior shoulder pain, 8 patients (of 20) (40%) had persistent postoperative anterior pain. One of the 5 patients (20%) who underwent a concomitant biceps tenodesis at the time of their initial arthroscopic posterior labral repair had postoperative anterior shoulder pain. In contrast, 7 of 15 patients (47%) with preoperative anterior shoulder pain who had isolated arthroscopic posterior labral repair (without concomitant biceps tenodesis) reported postoperative anterior shoulder pain. One patient had symptomatic recurrence of posterior shoulder instability (3.8%). Of the 21 patients who did not have primary biceps tenodesis as a component of their initial surgeries, 1 patient (1/21; 4.7%) underwent a secondary surgery for revision posterior labral repair and biceps tenodesis due to persistent postoperative anterior shoulder pain and posterior instability. The median follow-up for the cohort was 2.1 years.

There was no significant difference in the final patient-reported outcomes between patients with

preoperative anterior shoulder pain (n = 20) and those without preoperative anterior shoulder pain (n = 6), median SSV 80 versus SSV 77.5 ( $P = 0.96$ ), respectively. Additionally, there was no significant difference in outcomes between patients with and without postoperative anterior shoulder pain, median SSV 73 versus SSV 79 ( $P = 0.55$ ), respectively. Finally, there was no significant difference in median SSV between patients who underwent arthroscopic posterior labral repair versus arthroscopic posterior labral repair with concomitant biceps tenodesis, SSV 80 versus SSV 80 ( $P = 0.47$ , respectively) (Table 3).

## Discussion

In our cohort of 26 consecutive patients, we found a 77% rate of anterior shoulder pain in patients undergoing isolated arthroscopic posterior labral repair. At final follow-up, 8 of 20 patients (40%) with preoperative anterior shoulder pain reported persistent anterior pain, and 1 of 21 patients (4.7%) underwent a secondary biceps tenodesis procedure. Of 15 patients, 7 (47%) with preoperative anterior shoulder pain who underwent arthroscopic posterior labral repair without biceps tenodesis had persistent anterior pain, whereas 1 of 5 (20%) patients with preoperative anterior pain who underwent arthroscopic posterior labral repair with concomitant biceps tenodesis had postoperative anterior pain. There was no significant difference in final outcome as measured by the SSV for patients with and without preoperative anterior shoulder pain ( $P = 0.96$ ). Additionally, there was no significant difference ( $P = 0.47$ ) in median SSV between patients who underwent arthroscopic posterior labral repair versus arthroscopic posterior labral repair with concomitant biceps tenodesis.

In our practice, we have observed that young, active patients with physical examination and MRA evidence of a symptomatic posterior labral tear with unidirectional posterior shoulder instability commonly present with anterior shoulder pain and point with 1 finger to the biceps tendon in the groove as the location of the worst pain. In our experience, this presents a clinical challenge in the diagnosis of posterior shoulder

**Table 2.** Comparison of Presence of Preoperative Anterior Shoulder Pain and Biceps Tendinopathy Between Traumatic and Atraumatic Posterior Shoulder Instability

	Traumatic Instability N = 16	Atraumatic Instability N = 10	P Value
Preoperative biceps groove pain (Yes:No)	12:4	8:2	1.0
Preoperative positive Speed test	12:4	8:2	1.0
Concomitant biceps tenodesis procedure	3	2	1.0



**Table 3.** Comparison of Outcomes Between Patients Who Underwent Arthroscopic Posterior Labral Repair Versus Arthroscopic Posterior Labral Repair + Biceps Tenodesis

	Arthroscopic posterior Labral Repair N = 21	Arthroscopic posterior Labral Repair + Biceps Tenodesis N = 5	P Value
Age (years), median, IQR	26 (24-33)	27 (27-33)	0.53
Median number of suture anchors	3.0	3.0	0.97
Preoperative biceps groove pain (Yes:No)	15:6	5:0	1
Postoperative biceps groove pain (Yes:No)	7:14	1:4	1
Median Postoperative SSV, IQR	80 (60-90)	80 (80-100)	0.47
Revision surgery (biceps tenodesis)	1	0	N/A

IQR, interquartile range.

instability, especially if patients have concomitant posterior glenohumeral joint-line pain and no instability. This study attempted to determine the frequency with which anterior shoulder pain occurs in isolated posterior instability by rigorously excluding all entities other than isolated symptomatic posterior labral tears that underwent isolated arthroscopic posterior capsulolabral repair. Patients with SLAP tear extension as defined by tearing of the labrum from the 10 to 2 o'clock position or anterior labral tear extension past the 6 o'clock position could plausibly have anterior shoulder pain caused by these injuries and were, therefore, excluded from the current study.<sup>14</sup> We meticulously reviewed preoperative MRA imaging, operative reports and arthroscopic images to identify only truly isolated posterior labral repairs.

The cause of anterior shoulder pain in association with posterior shoulder instability is unclear; however, prior clinical and imaging studies have documented a link between posterior labral pathology and rotator interval sling disruption. Gambill and coauthors documented a case of posterior shoulder instability and medial biceps tendon dislocation in the setting of an intact rotator cuff.<sup>22</sup> The authors described the treatment of a young male patient with an isolated posterior labral tear and symptomatic posterior shoulder instability with a medially dislocated biceps tendon in the setting of an intact supraspinatus and subscapularis. The authors confirmed, through an open approach, the disruption of the superior glenohumeral ligament, coracohumeral ligament and transverse humeral ligament. They noted the association between posterior shoulder instability and rotator interval injury. Their patient was successfully treated with an arthroscopic posterior labral repair and open subpectoral biceps tenodesis. Similarly, Vopat et al. also reported a young male patient with a posterior labral tear who was treated with an arthroscopic posterior capsulolabral repair. The patient continued to have anterior shoulder pain postoperatively and later sustained a symptomatic medial biceps tendon dislocation with an intact rotator cuff due to a recurrent posterior shoulder subluxation

event.<sup>23</sup> Still further, Provencher et al. identified a link between posterior shoulder instability and rotator interval sling attenuation, which could be identified by advanced imaging.<sup>28</sup> The authors described the anatomic measurements of the rotator interval on MRAs in patients with shoulder instability versus a control group of patients without instability. They reported that the LHB tendon assumes a more anterior position in relation to the supraspinatus tendon in patients with posterior instability versus patients with anterior instability or a control group without instability. This more relative anterior position may be secondary to attenuation of the superior glenohumeral ligament, which is a key component of the rotator interval sling that prevents intra-articular subluxation of the biceps tendon over the superior border of the subscapularis.<sup>35</sup> We examined the MRA sagittal oblique sequences of our cohort and performed the same rotator interval measurements (rotator interval width and the position of the biceps tendon in relation to the anterior border of the supraspinatus tendon); however, we did not find a significant difference in measurements (rotator interval width,  $P = 0.56$ ) (anterior border supraspinatus to anterior border biceps tendon,  $P = 0.07$ ) between the patients with and without preoperative anterior shoulder pain. These prior case reports and the MRA imaging study highlight a potential cause for anterior shoulder pain in posterior instability. The mechanism may be a failure of the posterior and anterior capsulolabral structures under tension due to a posteriorly directed force. However, future clinical and imaging studies are needed for further evaluation.

The ideal surgical management of anterior shoulder pain in patients with isolated posterior labral tears is unknown. So far, in our clinical practice, the severity of the anterior shoulder pain complaints, the patient's age, the patient's response to a preoperative ultrasound-guided biceps groove diagnostic injection, the arthroscopic examination of the biceps tendon and rotator interval structures, and the surgeon's preference have dictated the treatment of the biceps. Older patients with significant anterior shoulder pain who have marked

improvement in anterior shoulder symptoms following a preoperative ultrasound-guided biceps groove injection in the setting of a symptomatic isolated posterior labral repair have an indication for arthroscopic posterior labral repair and biceps tenodesis.

### Limitations

There are several limitations in the study that should be considered. The study is retrospective in nature and has a unique and potentially nongeneralized military patient population. However, military athletes perform many of the same tasks as a similar young civilian patient cohort, including posterior instability, such as pushups, weight lifting and contact and noncontact recreational sports. Additionally, the incidence of anterior shoulder pain in the general military population and in patients without shoulder instability is unclear. It may be higher than in the general population. Another limitation of this study is the lack of a shoulder-instability outcome score. Last, the sample size is modest and there is only short-term follow-up.

### Conclusion

There is a high incidence of anterior shoulder pain and Zone 2 biceps groove tenderness in patients undergoing isolated arthroscopic posterior labral repair for unidirectional posterior shoulder instability. At short-term follow-up, few patients required a secondary biceps tenodesis procedure; however, 30% of patients had persistent anterior shoulder pain.

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