

Posterior Labral Tear Extension Concomitant With Shoulder Bankart Injuries Is not Uncommon



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Purpose: To identify the rate and risk factors of posterior labral involvement in operatively managed Bankart lesions and assess the effectiveness of MRI arthrogram for preoperative identification of such injury patterns. **Methods:** A consecutive cohort of patients undergoing arthroscopic Bankart repair were retrospectively reviewed. All subjects underwent a prearthroscopy MRI arthrogram. Operative findings were used as the gold standard for posterior labral tear extension. Patient demographic and surgical data were then analyzed to identify independent factors associated with the presence of concomitant posterior labral injury. **Results:** Of 124 patients undergoing arthroscopic Bankart stabilization, 23 (19%) were noted to demonstrate posterior labral injury on arthroscopic evaluation. Factors associated with injury to the posterior labrum included those sustaining two or fewer dislocations events ($P = .001$), an earlier average presentation ($P = .001$), and a reported “contact” mechanism of dislocation ($P = .02$). Posterior labral involvement did not correlate with surgical positioning (beach-chair versus lateral) or the need for revision surgery. On the basis of review of preoperative imaging, MRI arthrogram demonstrated a sensitivity of 83% and a specificity of 95% for detection of posterior labral injury. **Conclusions:** Posterior propagation of Bankart lesions is relatively common following shoulder dislocations, with a rate of 18.5%. Risk factors for posterior labral extension include two or fewer dislocations, early presentation from the time of injury, and contact sports. On the basis of these findings, careful assessment of the posterior labrum on MRI arthrogram may reveal the majority, but not all, of these lesions. **Level of Evidence:** Level III, retrospective case-controlled study.

Introduction

An injury to the anterior inferior labrum, or a Bankart tear, is a well-described sequela of traumatic shoulder dislocation and occurs in the vast majority of anterior shoulder dislocations. The identification and repair of such injuries is a mainstay in the management of shoulder instability.

However, the prevalence of more extensive labral injury patterns, such as posterior labral or circumferential tear extension, remains relatively unclear. Burkhart et al. postulated that dislocations result in a 360° degree injury, with trauma to the anterior labrum, resulting in changes posteriorly, and vice versa.^{1,2} The potential for more extensive injury patterns is also supported by recent biomechanical data demonstrating increased strain in the posterior labrum following an anterior dislocation.³ Further, recent investigation^{4,5} has noted a far greater prevalence of posterior labral injury than the 2 to 6% that has been classically reported following traumatic dislocation,⁶⁻⁹ suggesting that a diagnosis of concomitant posterior labral injury may often be overlooked during Bankart repair.

Several descriptions of advanced patterns of labral injury have been described in the current literature, including Burkhart and Lo’s “Triple Lesion”¹⁰ and Mazzocca’s “270° Lesion”.¹¹

The prevalence and the clinical factors associated with such patterns is unknown.

The purpose of this study was to identify the rate and risk factors of posterior labral involvement in operatively managed Bankart lesions and assess the

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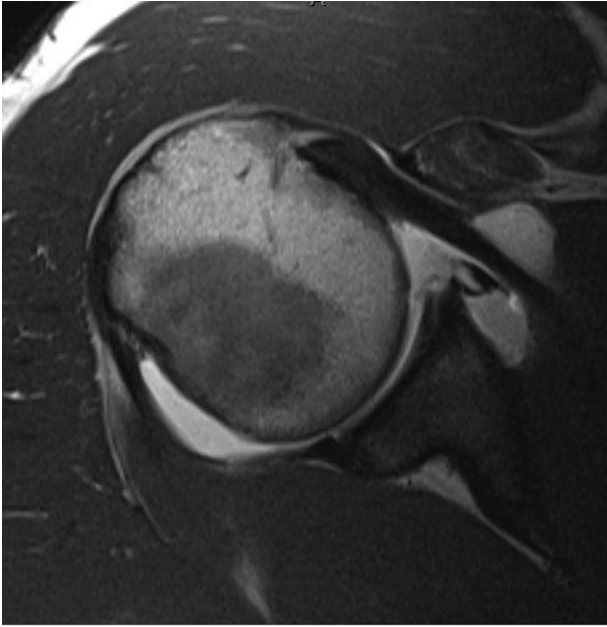


Fig 1. Magnetic resonance imaging arthrogram T1 axial view demonstrating combined anterior and posterior labrum involvement.

effectiveness of MRI arthrogram for preoperative identification of such injury patterns. The hypotheses were that posterior labral tears would have a relatively high prevalence in the context of Bankart injuries and that MRI arthrogram would have good sensitivity and specificity for identifying these lesions, particularly if scrutinized with a high degree of suspicion. In addition, delayed presentation, multiple dislocations, and contact sports are hypothesized to be risk factors for posterior labral tear extension.

Methods

Approval was obtained from the University of Pittsburgh Medical Center Institutional Review Board, and this study was conducted at the UPMC Department of Sports Medicine (Pittsburgh, PA). This was a retrospective cohort study that included all consecutive patients undergoing an arthroscopic shoulder stabilization for a diagnosis of Bankart injury with an available preoperative magnetic resonance imaging (MRI) arthrogram and operative report from January 2012 to December 2015. To establish baseline characteristics, individual patient data and medical histories for all included patients were reviewed and tabulated. In addition to baseline demographic information, recorded data included mechanism of injury, time to initial presentation, and reported number or prior dislocations, when available. Additionally, surgical factors such as the number of anchors employed for repair, positioning (beach-chair versus lateral), and need for further operation at final follow-up, were recorded. Exclusion criteria consisted of

patients with a history of ipsilateral shoulder surgery, connective tissue disorder, and patients noted to have atraumatic or multidirectional instability. Individuals with less than 2-year minimum follow-up, unavailable imaging, or operative report, as well as those receiving a no arthrogram MRI were excluded.

Once patients were identified, each preoperative arthrogram was first reviewed by a fellowship-trained orthopedic surgeon (E.G.) to assess for the presence of posterior extension or injury to the posterior labrum (Fig 1). All provided imaging was deidentified, with the reviewer blinded to operative course, radiology read, and final postoperative diagnosis. "Posterior Extension" was defined as injury visualized anywhere posterior to a vertical line connecting the 12 o'clock and 6 o'clock positions on the glenoid labrum (Fig 2). These findings were then compared to the final official radiology report for each included arthrogram. All included reports were read by attending radiologists with musculoskeletal (MSK) subspecialty training within the sports medicine division, with those lacking such a report excluded.

Next, both orthopedic and MSK radiology findings were then compared to the operative dictation, which served as the gold standard for the presence of injury to the posterior labrum in all subsequent calculations. All

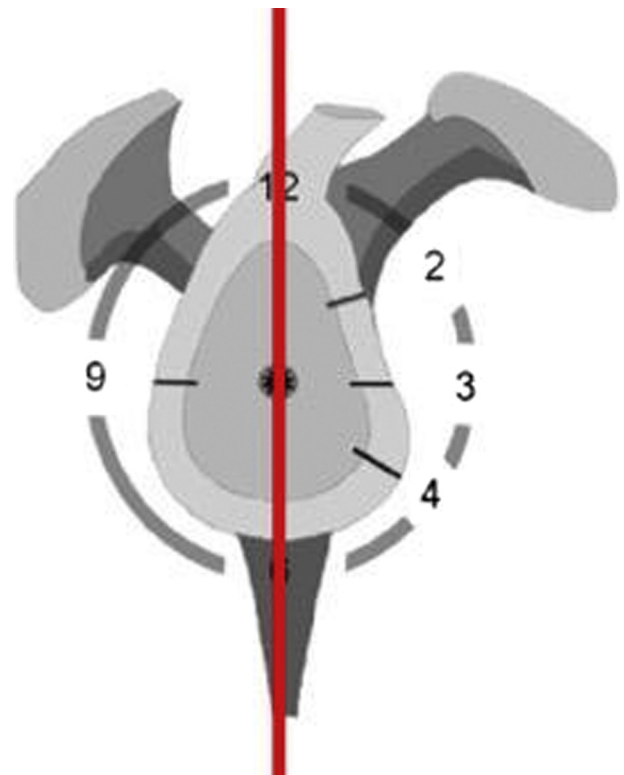


Fig 2. Depiction of a sagittal view of glenoid with vertical line representing the area in which posterior injury was defined. Any area of labral injury posterior to this line (6 to 12 o'clock) was considered to be positive for posterior extension.

Table 1. Orthopedic Surgeon MRI arthrogram Reading and Radiologic Report

Orthopedic Surgeon Reading	Posterior Labrum Involvement	No Posterior Labrum Involvement	Total
Positive	19/23 (82.6%)	5/101 (4.9%)	24
Negative	4/23 (17.4%)	96/101 (95.1%)	100
	23	101	124

Radiology report	Posterior labrum involvement	No posterior labrum involvement	Total
Positive	10/23 (43.5%)	6/101 (5.9%)	16
Negative	13/23 (56.5%)	95/101 (94.1%)	108
	23	101	124

Sensitivity 82.6%, Specificity 95.1%, Accuracy 93% Inter rater reliability (IRR) = .87. Sensitivity 43.5%, Specificity 94.1%, Accuracy 84% Inter rater reliability (IRR) = .87. MRI, magnetic resonance imaging.

cases in which posterior labral injury was present were then reviewed to determine if either type of radiology evaluation (MSK radiology or orthopedist) was able to correctly identify a confirmed posterior injury on imaging. For cases in which the posterior injury was detected by either read, it was determined that MRI arthrogram had been able to demonstrate the posterior pathology.

Next, employing these values, the sensitivity, specificity, and accuracy of preoperative arthrogram for the detection of posterior labral were determined. Additionally, κ-values were calculated to evaluate intra-rater and inter-rater reliability with regard to imaging assessment by MSK radiology and orthopedic practitioners, respectively. For patients in which posterior injury was noted, subgroup analysis was performed to assess patient and surgical factors that were independently predictive of posterior injury. Following data collection, normative values, including mean, median, and mode were tabulated for each subcategory. Descriptors in shoulders found to exhibit posterior injury were then compared to those noted to have an intact posterior labrum using both the Fischer exact and paired *t*-tests, as appropriate. Statistical significance was set at a *P* value of <.05.

Results

A total of 124 patients undergoing arthroscopic shoulder stabilization for traumatic shoulder dislocation were identified by chart review. Of these, 23 (18.5%) were noted to demonstrate injury to the posterior labrum on final operative dictation. When comparing arthroscopic findings to preoperative arthrogram read, the orthopedic read was found to correctly identify a concomitant posterior labral pathology in 19/23 (82.6%) cases, while final radiology dictation agreed

with operative dictation in 10/23 (43.5%) cases. The inter-rater reliability was calculated to be .87 (Table 1).

In combining both reads into an “overall composite read,” where one of the reviewers determined a posterior lesion to be present, a “false positive” posterior labral tear was called that was not encountered on arthroscopy in 6/124 (4.8%) of patients reviewed. Overall, preoperative arthrogram was able to detect 19/23 (82.6%) of arthroscopy-confirmed, concomitant posterior labral injuries. On the basis of the composite reads of both reviewers, MRI arthrogram demonstrated a sensitivity of 82.6%, specificity of 95% and accuracy of 93% for detection of posterior labral injury.

Regarding demographic risk factors, those sustaining two or fewer dislocations were more likely to experience concomitant posterior injury versus individuals sustaining multiple dislocations. Further, although a trend existed toward increased rates of posterior extension in those presenting following a first-time dislocation, this failed to reach statistical significance (*P* = .08). Those with combined anterior and posterior injury patterns were also noted to present earlier for orthopedic evaluation, at an average of 2.5 versus 11.0 months (*P* = .001). When such information was available, 17/23 (73.9%) individuals reported “contact” mechanism of dislocation and 2/12(8.7%) with a thrower mechanism were noted to have concomitant posterior injury at the time of arthroscopy (*P* = .01) (Table 2).

Regarding surgical factors, no difference was noted in the rate of posterior injury reported in stabilization procedures performed in the beach-chair versus lateral

Table 2. Demographic Data

Demographics	Isolated Bankart tear (n = 101)	Bankart + Posterior extension (n = 23)	<i>P</i> Value
Sex			
M	70 (69.3%)	19 (82.6%)	.01
F	31 (30.7%)	4 (17.4%)	
Age	18.6	18.5	.83
Dominant side involved	50 (49.5%)	12 (52.5%)	.66
Contact sports	63 (62.4%)	17 (73.9%)	.01
Thrower	10 (9.9%)	2 (8.7%)	.72
Operation position			
Lateral	29 (28.7%)	15 (65.2%)	.30
Beach chair	72 (71.3%)	8 (34.8%)	
Number of dislocations			
<2 episodes	66 (65.3%)	19 (82.6%)	.01
>2 episodes	35 (34.7%)	4 (17.4%)	
Anchors	3.7	4.7	.01
Presentation for orthopedic evaluation	2.5 months	11.0 months	.01



Fig 3. Left shoulder, lateral decubitus, and posterior view of a Bankart tear.

decubitus position. The identification of a posterior injury was noted to result in an increase in the number of anchors used to perform the labral repair, with an average of 4.7 anchors used in those with combined injury versus an average of 3.7 anchors used in those with isolated anterior pathology ($P = .02$). (Table 2) (Figs 3-7).

Discussion

One main finding of this study was that concomitant posterior labral injury occurred with a prevalence of 18.5% in patients undergoing operative stabilization for a Bankart tear. Also, potential risk factors for posterior labral extension were two or fewer dislocations, early presentation from the time of injury, and participation in contact sports. The relative frequency with which a concomitant posterior lesion was discovered, suggests that posterior injury resulting from traumatic dislocation may be more common than classically reported.⁶⁻⁹ This finding appears to be consistent with current literature, as a recent analysis of military recruits noted a rate of 18.6% combined anterior and posterior instability following a traumatic dislocation, a number nearly identical to the 18.5% reported in the current study.^{5,17}

This study also quantitatively assessed the ability of a preoperative arthrogram to identify concomitant posterior injury in shoulders requiring operative Bankart stabilization, with a noted overall sensitivity and specificity of 82.6% and 95%, respectively. Although encouraging, these numbers also highlight that 17% of concomitant posterior labral injuries were not initially identified on preoperative imaging. Further, the presence of a concomitant tear appeared to have a direct impact on management, as those with an identified posterior tear underwent a more extensive repair that required a greater number of anchors. On the basis of

these findings, a high level of suspicion should be maintained with a meticulous diagnostic arthroscopy to identify and treat these lesions at the time of surgery.

Our findings reinforce the importance of a high degree of clinical suspicion for secondary labral injury. Although the discrepancy between orthopedic and radiology reads was likely bolstered by the fact that the current study emphasized evaluation of the posterior labrum during the orthopedic read, the fact remains that such injuries can be easily missed if not specifically looked for. This assertion is supported by the recent work of Saqib et al., who reported similar results (sensitivity 53% and specificity 96%) in comparing the utility of preoperative arthrogram with arthroscopy in diagnosing isolated posterior labral tears.¹²⁻¹⁴

The presence of concomitant posterior injury was found to be associated with several patient factors in patients with known Bankart lesions. These included those suffering two or fewer dislocations with a higher rates following a first-time dislocation, an earlier time to presentation following traumatic dislocation, and a contact mechanism of injury. Interestingly, those with a concomitant posterior injury did not have a higher reoperation rate than patients with an isolated anterior-inferior pathology, perhaps highlighting that surgeons at our institution are keenly aware of evaluating the entire labrum at the time of surgery and addressing all tear extensions, as needed. There was also no difference in the rate of identified posterior pathology when comparing procedures performed in the beach-chair and lateral positions, an outcome consistent with prior authors' findings.¹³⁻¹⁵

Of particular interest, combined anterior and posterior lesions were more likely following two or fewer dislocations rather than in individuals that had suffered

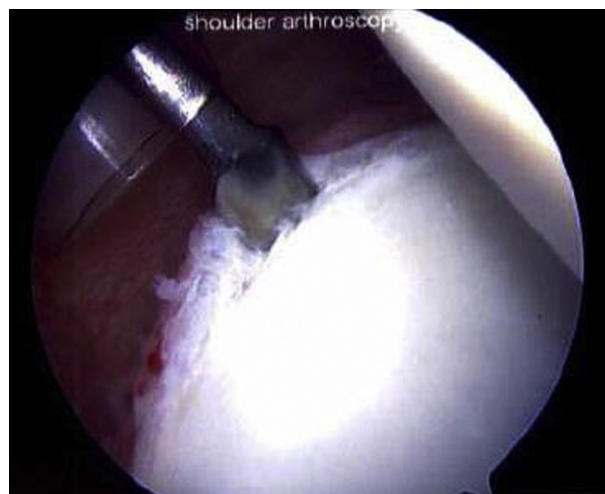


Fig 4. Left shoulder, lateral decubitus, and identification of the posterior labral extension tear.

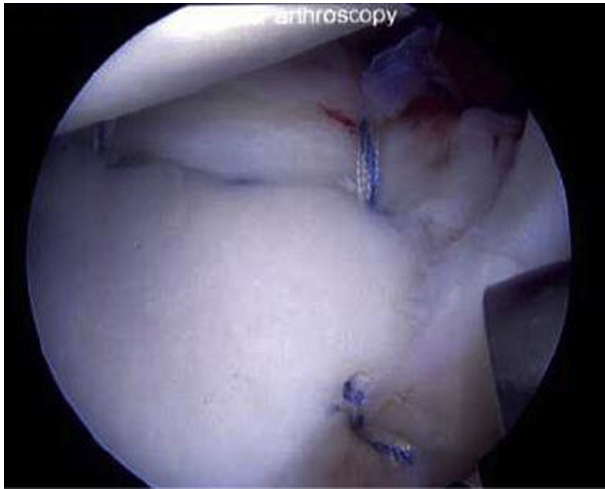


Fig 5. Left shoulder, lateral decubitus, posterior view of Bankart, and SLAP repair.

multiple prior instability events. One possible explanation for this finding is that the encountered posterior pathology may have occurred prior to traumatic dislocation. Especially given that a large portion of our cohort was active in sports, these individuals may have sustained a more attritional type of posterior labral injury that was present prior to a subsequent traumatic dislocation, which prompted orthopedic evaluation.

A second possibility is that the increased rate of combined injury in those with two or fewer dislocations may be representative of the severity of the initial injury, prompting an earlier evaluation. In patients experiencing a greater magnitude of force during initial dislocation, the supporting structures of the shoulder may have been unable to maintain normal biomechanics. In such situations, following the creation of an initial Bankart injury, increased force loads may have been dissipated by propagating posteriorly, resulting in the secondary posterior pathology encountered. This concept of posterior labral and capsular injury has been supported by recent biomechanical studies.¹⁶ This theory is also supported by our finding that posterior involvement was also more common in individuals reporting a "contact" mechanism of dislocation, suggesting a higher initial force-load at the time of injury. In contrast, those sustaining multiple dislocations may have experienced less overall compromise of their shoulder stabilizers, making it less likely for them to promptly seek orthopedic evaluation.

In several classic articles, Warren introduced the circle concept,¹⁷⁻¹⁹ whereby injury to the anterior labrum could result in posterior injury, a concept that has been advocated by several subsequent authors.^{1,2,10} This idea highlights the concept of a continuous, rather than discrete, pattern of labral injury. However, while authors have long described concomitant SLAP and

Bankart type injuries,¹⁹⁻²¹ the current literature contains relatively few descriptions of combined Bankart and concomitant posterior injury,^{10,11} as described in our study.

In one particular study by Burkart and Lo,¹⁰ 2.4% of 297 patients undergoing arthroscopy for shoulder instability were noted to have combined Bankart, type II SLAP, and posterior labral lesion. The authors deemed such injuries a "triple lesion," postulating that the injuries occurred simultaneously with the Bankart Injury, rather than due to secondary trauma. This theory was supported by several findings. First, all patients suffered an injury in the abducted and externally rotated position, resulting in anterior laxity. Second, although some patients demonstrated increased posterior translation, none demonstrated symptoms of posterior instability. Lastly, all patients denied a history of shoulder symptoms prior to sustaining a traumatic anterior dislocation. On the basis of these findings, the authors concluded that the more extensive triple lesion was a result of force propagation following the creation of the initial Bankart injury, a sentiment echoed by our findings.

Biomechanical data have also supported the idea of an anterior dislocation, resulting in posterior labral pathology. In a recent cadaveric study using a shoulder dislocation model, Takenaga et al. demonstrated increased rates of strain in the posterior capsule following anterior dislocations.³ Additionally, prior biomechanical work has noted that an isolated anterior injury alone should not result in frank anterior instability, with combined anterior and posterior injuries required to produce a frank dislocation on cadaveric testing.^{17,22}

In a recent review, Javed et al.⁴ investigated the incidence of isolated, as well as combined, posterior

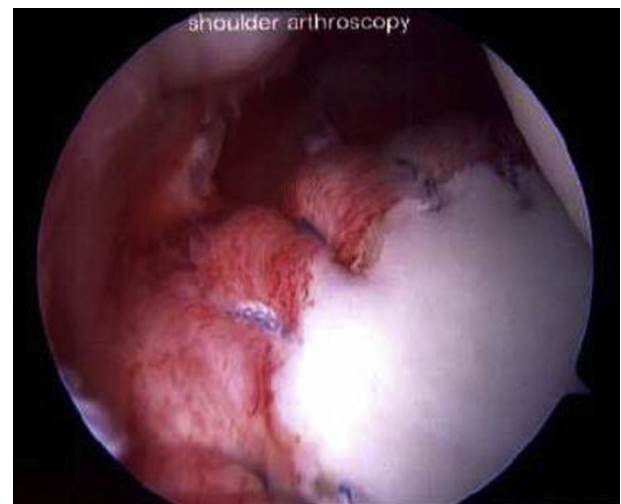


Fig 6. Left shoulder, lateral decubitus, anterior view of posterior labral extension repair.



Fig 7. Left shoulder, lateral decubitus, and anterior-superior view of the anterior and posterior labral repair.

labral injury in a cohort of patients undergoing arthroscopic shoulder stabilization. The authors noted a rate of 16.3% isolated posterior injury, with 30.8% of patients noted to have combined anteroposterior instability. In this study, “combined” injury was defined as any labral pathology lying both anterior and posterior to a vertical line drawn between the 6 and 12 o’clock positions. This discrepancy from our study is likely related to a difference in the definition of a combined injury, as all patients included in our study started with a confirmed, Bankart tear.

Limitations

Several limitations of the current study exist. First, there is no way of verifying that the posterior injury identified at arthroscopy did not exist prior to the patient’s Bankart injury. Many of the patients included in this series were athletes, participating in activities that may have predisposed them to prior posterior injury, which can often present with vague or no symptoms of instability. However, it is noteworthy that a majority of those found to have combined anterior and posterior pathology presented soon after their first dislocation, suggesting that this index traumatic event was the likely etiology of all pathology encountered.

Second, there may be variability introduced in the radiology reports available, as not all reports were read by the same radiologist. Nonetheless, all MRIs were read by trained MSK radiologists, with relatively similar years of experience.

As this is a retrospective chart review as well, certain data, which may be relevant to our findings was not readily available, including physical exam findings, and inconsistently reported patient-reported outcomes. One such example might be the presence of positive posterior instability maneuvers prior to surgery. Future prospectively collected data may help to eliminate these biases.

Conclusion

Posterior propagation of Bankart lesions is relatively common following shoulder dislocations, with a rate of 18.5%. Risk factors for posterior labral extension include two or fewer dislocations, early presentation from the time of injury, and contact sports. On the basis of these findings, careful assessment of the posterior labrum on MRI arthrogram may reveal the majority, but not all, of these lesions.

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