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ORIGINAL ARTICLE

Risk factors for recurrent shoulder dislocation after arthroscopic Bankart repair: The role of age, lesion type, and middle glenohumeral ligament variations

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ABSTRACT

Objectives: The aim of this study was to evaluate the effect of patient characteristics, including middle glenohumeral ligament (MGHL) morphological types, on the risk of redislocation following arthroscopic labral repair.

Patients and methods: Between February 2018 and May 2020, a total of 138 patients (105 males, 33 females; mean age: 26.5±9.8 years; range, 13 to 65 years) who underwent arthroscopic Bankart repair for traumatic anterior shoulder instability were retrospectively analyzed. Demographic data, the presence of an anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion, and information regarding the morphology of the MGHL were collected. Clinical outcomes were assessed using the Oxford Shoulder Instability Score (OSIS) and the Visual Analog Scale (VAS). The morphology of MGHL was classified through the analysis of surgical video recordings.

Results: Among the patients, ALPSA lesions were observed in 40% of cases. Redislocation occurred in 18% of patients and was significantly associated with younger age and ALPSA lesions. Multivariate logistic regression revealed that younger age at the time of surgery (odds ratio [OR]=0.936, $p=0.047$) and the presence of ALPSA lesions (OR=2.953, $p=0.027$) were independent predictors of redislocation. The morphology of MGHL showed no significant association with recurrence. The OSIS and VAS scores improved significantly postoperatively ($p<.001$), and stable patients had more favorable final patient-reported outcome measures compared to those with redislocation.

Conclusion: Although variations in MGHL morphology did not independently influence outcomes, younger age and presence of ALPSA lesions were identified as predictors of postoperative instability following arthroscopic Bankart repair. Based on these findings, the increased risk of redislocation in younger patients and those with ALPSA lesions should be carefully considered during treatment planning.

Keywords: Anterior shoulder instability, middle glenohumeral ligament, labroligamentous sleeve avulsion lesion, recurrence, labrum repair, shoulder arthroscopy.

Anterior shoulder instability is a clinical condition which requires patient-specific treatment planning.[1] If inadequately managed, it can lead to recurrent dislocations, functional impairment, and a marked reduction in quality of life.[2-5] Therefore, it is essential to accurately determine the most appropriate treatment strategy for individuals presenting with symptoms of instability.

Among surgical options, arthroscopic Bankart repair is widely preferred and has demonstrated high clinical success rates.[6] However, the

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effectiveness of this procedure largely depends on appropriate patient selection.[7] Several factors, such as age, lesion type, level of sports activity, glenoid bone loss, and number of preoperative dislocations, significantly influence surgical outcomes.[8-10] Evaluating these parameters requires consideration of not only demographic variables, but also the anatomical characteristics of the lesion. To illustrate, the presence of an anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion is associated with a significantly increased risk of redislocation.[8,9,11] In addition, several studies have suggested that the middle glenohumeral ligament (MGHL) has a key role in contributing to anterior stability of the glenohumeral joint.[12] Nevertheless, its clinical significance still remains debatable due to the substantial inter-individual variability in the presence, morphology, and thickness.[13] Considering these points, studies evaluating MGHL morphology and patient-specific factors in relation to the risk of redislocation after arthroscopic Bankart repair could provide valuable insights to the surgical decision-making process for anterior shoulder instability.

In the present study, we hypothesized that the presence of an ALPSA lesion would increase the risk of redislocation, while a thicker MGHL would be a protective factor. We, therefore, aimed to evaluate the effect of patient characteristics, including MGHL morphological types, on the risk of redislocation following arthroscopic labral repair.

PATIENTS AND METHODS

This single-center, retrospective cohort study was conducted at Gazi University Faculty of Medicine, Department of Orthopedics and Traumatology between February 2018 and May 2020. Patients who underwent arthroscopic Bankart repair of the anterior labrum for anterior shoulder instability by a single surgeon were included. Data were collected through a retrospective review of the patients' medical records and surgical video recordings, and clinical outcomes were assessed through examinations conducted during the final follow-up visit after the patients were invited. Records were fully anonymized, and procedures were conducted in compliance with patient confidentiality standards. Only patients who underwent arthroscopic labral repair for traumatic anterior shoulder instability and had complete data including preoperative patient-reported outcome measures (PROMs), clinical history, computed tomography (CT) scans, and surgical video recordings were enrolled in the study. Those with a glenoid defect greater than 25%, off-track lesions, hyperlaxity, glenohumeral arthritis, concomitant shoulder pathologies (rotator cuff tears or long head of biceps pathology), perthes lesion, revision surgery, missing data, loss to follow-up, or those who declined to participate in the final evaluation were excluded from the study. Finally, a total of 138 patients (105 males, 33 females; mean age: 26.5±9.8 years; range, 13 to 65 years) who met the inclusion criteria were recruited. The study flowchart is shown in Figure 1. Written informed consent was obtained from each patient. The study protocol was approved by the Gazi University Faculty of Medicine Ethics Committee (Date: 26.12.2023, No: 2023-1578). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Surgical technique and rehabilitation protocol

All procedures were performed under general anesthesia or an interscalene block with the patient in the lateral decubitus position and traction applied to the joint.[14] Diagnostic arthroscopy was performed using the standard posterior portal. The anterosuperior and anteroinferior portals were established. The glenoid rim was decorticated using a shaver, when an anterior labral tear was identified. The labrum was then repositioned and secured in its anatomical position on the glenoid using double-loaded suture anchors (2.9 mm GRYPHON, DePuy Mitek, Raynham, MA, USA). The first anchor was placed at the 5:30 position, followed by the placement of an additional 2 to 3 anchors at 8 to 10 mm intervals, depending on the size of the lesion. To achieve optimal stability, both vertical and mattress sutures were applied to each anchor. Repair was considered complete once the entire labrum was firmly secured along the glenoid rim.

After surgery, the injured arm was placed in a sling for a duration of six weeks. Passive shoulder range of motion (ROM) exercises were initiated between the postoperative Days 3 and 5; however, during the initial phase, passive external rotation was limited to a maximum of 30°. Active shoulder ROM exercises commenced between Weeks 4 and 6. Strengthening exercises and gradual return to daily living activities began after the third month.

Data collection and definitions

The medical charts of patients included in the study were reviewed to collect data on age, sex, dominant arm involvement, symptom

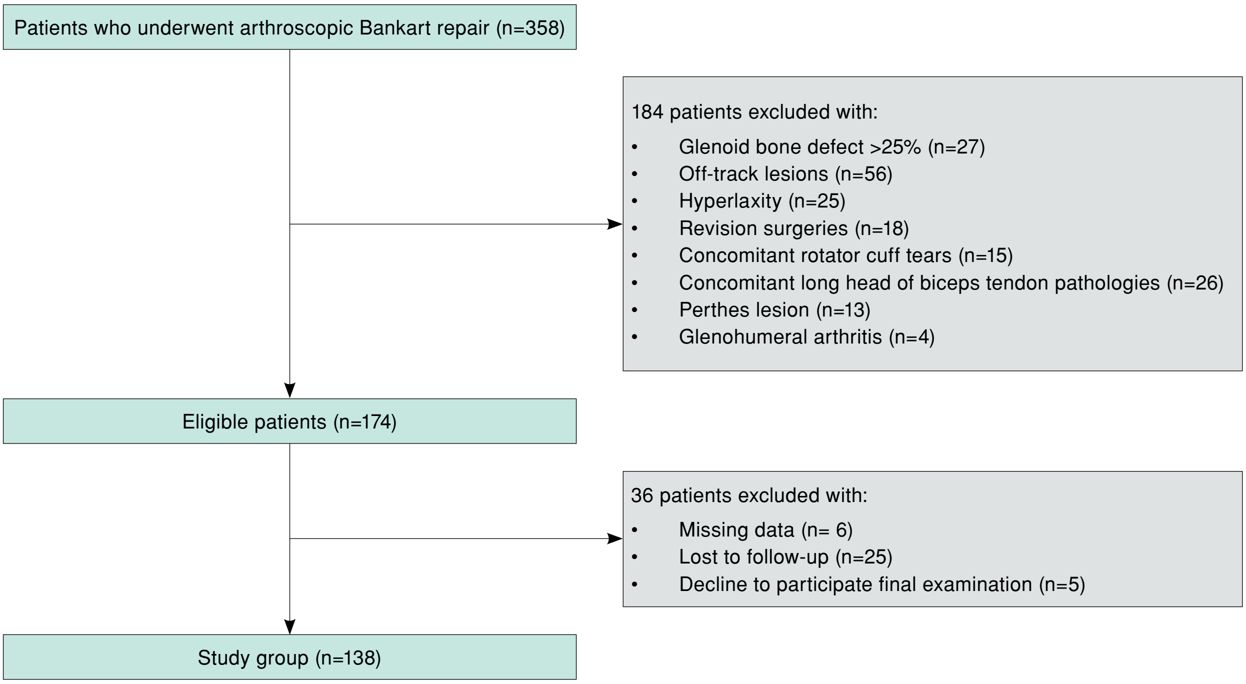

FIGURE 1. Study flowchart.

duration, number of preoperative dislocations, and preoperative PROMs (Oxford Shoulder Instability Score [OSIS] and Visual Analog Scale [VAS]). A blinded author conducted the final follow-up evaluation of the patients who agreed to participate in the study. During this evaluation, patients were first asked whether they previously experienced any postoperative redislocation or underwent revision surgery. The National Health Database was reviewed to confirm this statement for those who reported redislocation. If confirmation could not be obtained, the case was classified as having missing data. Labral lesion types were determined by reviewing intraoperative arthroscopic video recordings by a senior surgeon. Classic Bankart lesions were defined as detachment of the anteroinferior labrum from the glenoid rim, along with associated disruption of the periosteum. In addition, ALPSA lesions were characterized by medial displacement of the labrum, which remained attached to an intact but stripped periosteal sleeve that healed on the glenoid neck. Perthes lesions were identified when the labrum was detached from the glenoid cartilage but the overlying periosteum remained intact and undisrupted, resulting in a labrum that appeared to be in its normal position. Furthermore, MGHL morphology was evaluated arthroscopically using a 3-mm hook probe to determine the thickness, texture, and relationship with the labrum. Typically, MGHL agenesis was classified as Type 1; thin cord-like (<3 mm) as Type 2; gauze-like (>3 mm) as Type 3 (3A with labral attachment, 3B without); thin but obstructive as Type 4; thick obstructive as Type 5 (5A attached, 5B unattached); and cord-shaped without anterosuperior labrum (Buford complex) as Type 6.[13] To achieve more consistent results in identifying this classification, analyses of intra- and inter-observer reliability were conducted. For intra-observer reliability, one investigator reexamined all video recordings at intervals exceeding two weeks from the initial assessment. To determine inter-observer reliability, another investigator, who was blinded to the assessments or the patients' clinical outcomes, independently reviewed all surgical videos in a random sequence.

Statistical analysis

Power analysis and sample size calculation was performed using the G*Power version 3.1.9.7 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). Accordingly, a minimum sample size of 28 patients (14 per group) would be required to achieve 95% statistical power.

TABLE I
Patients characteristics

	n	%	Mean±SD	Min-Max
Age (year)			26.5±9.8	13-65
Sex				
Male	105	76		
Female	33	24		
Extremity involved				
Dominant	100	72		
Nondominant	38	28		
Symptom duration			9.5±10.0	1-60
Follow-up (mo)			71.3±7.1	60-84
Sports activity level				
None	44	32		
Recreational	54	39		
Competitive	40	29		
Preoperative number of dislocation			5.2±4.9	1-40
Lesion type				
Bankart	83	60		
ALPSA	55	40		
MGHL classification				
Type 1	13	9		
Type 2	14	10		
Type 3A	10	7		
Type 3B	20	15		
Type 4	20	15		
Type 5A	43	31		
Type 5B	10	7		
Type 6	8	6		

SD: Standard deviation; ALPSA: Anterior labroligamentous periosteal sleeve avulsion; MGHL: Middle glenohumeral ligament.

Statistical analysis was performed using the IBM SPSS version 28.0 software (IBM Corp., Armonk, NY, USA). The Shapiro-Wilk test was used to assess the normality of the dataset. Descriptive data were presented in mean ± standard deviation (SD), median (min-max) or number and frequency, where applicable. For data that did not follow a normal distribution, the Mann-Whitney U test was used to compare parameters, whereas the independent t-test was used for data with a normal distribution. Categorical variables were analyzed using the chi-square test or Fisher exact test. The pre- and postoperative scores were compared using the Wilcoxon signed-rank test. Multivariate logistic regression analysis was performed to determine the independent risk factors for dislocation after surgery. Variables with a p value of <0.25 in the univariate analysis were included in the multivariate regression analysis. The kappa (κ) statistic was employed to evaluate both inter- and intra-observer reliabilities, with values exceeding 0.8 signifying excellent agreement. A p value of <0.05 was considered statistically significant.

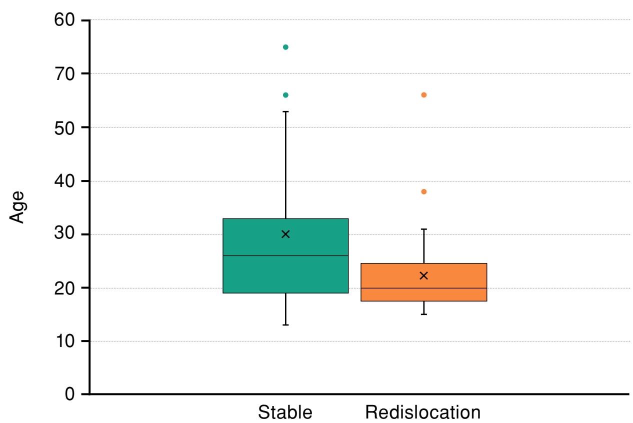

FIGURE 2. Age comparison between the redislocation and stable groups.

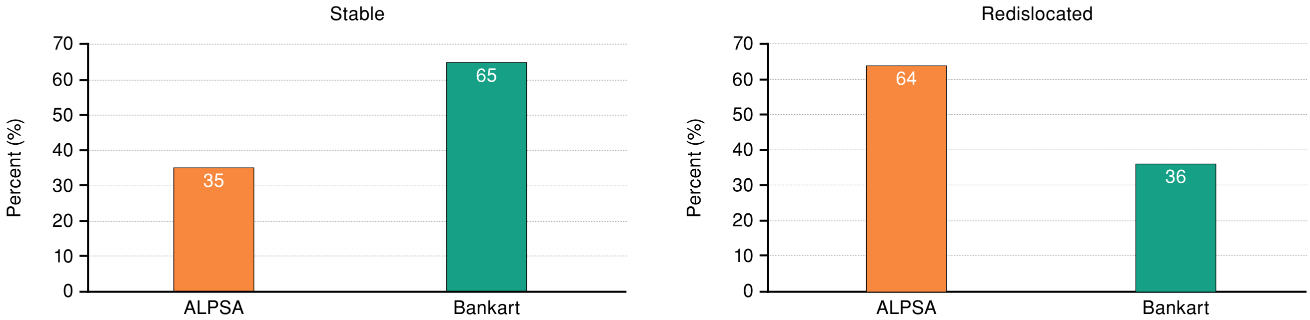

FIGURE 3. Comparison of ALPSA lesion distribution between groups.
ALPSA: Anterior labroligamentous periosteal sleeve avulsion.

RESULTS

The majority of the patients underwent surgery on their dominant arm (n=100, 72%). The mean duration of preoperative symptoms was 9.5±10.0 months, and the mean follow-up was 71.3±7.1 months. A Bankart lesion was identified in 60% of the patients (n=83), while 40% (n=55) had an ALPSA lesion. Among patients in whom MGHL morphology could be

TABLE II
Patient characteristics based on redislocation status

	Stable (n=113)				Redislocation (n=25)				
	n	%	Mean±SD	Min-Max	n	%	Mean±SD	Min-Max	*p*
Age (year)			27.3±9.8	13-65			22.6±8.8	15-56	**0.010**
Sex									0.226
Male	84	74			21	84			
Female	29	26			4	16			
Extremity involved									0.566
Dominant	82	73			18	72			
Nondominant	31	27			7	28			
Symptom duration			9.1±10.1	1-60			11.0±9.7	1-46	0.127
Follow-up (mo)			71.4±7.1	60-84			70.9±7.1	60-83	0.721
Sports activity level									0.884
None	37	33			7	28			
Recreational	44	39			10	40			
Competitive	42	28			8	20			
Preoperative number of dislocation			4.8±4.2	1-20			7.2±7.1	1-30	0.144
Lesion type									**0.007**
Bankart	74	65			9	36			
ALPSA	39	35			16	64			
MGHL classification									0.765
Type 1	10	9			3	12			
Type 2	11	10			3	12			
Type 3A	8	7			2	8			
Type 3B	16	14			4	16			
Type 4	14	12			6	24			
Type 5A	38	34			5	20			
Type 5B	9	8			1	4			
Type 6	7	6			1	4			

SD: Standard deviation; ALPSA: Anterior labroligamentous periosteal sleeve avulsion; MGHL: Middle glenohumeral ligament; * Boldface indicates significance p<0.05.

TABLE III
Logistic regression model assessing redislocation based on patient characteristics

			Multivariate		
Variables	Reference category	Analyzed category	Odds ratio (Exp(B))	95% CI for Exp(B)	*p**
Age at surgery	-	-	0.936	0.877-0.999	**0.047**
Sex	Male	Female	0.657	0.188-2.303	0.512
Symptom duration	-	-	0.984	0.921-1.050	0.620
Preoperative number of dislocation	-	-	1.083	0.957-1.227	0.207
Lesion type	Bankart	ALPSA	2.953	1.135-7.686	**0.027**

ALPSA: Anterior labroligamentous periosteal sleeve avulsion; CI: Confidence interval; Exp(B): Exponentiated regression; * Boldface indicates significance p<0.05.

assessed, the most common variant was Type 5A (31%), whereas the least common was Type 6 (Buford complex), observed in 6% of cases (Table I).

Postoperative redislocation was observed in 25 patients (18%). Patients in the redislocation group were younger (22.6±8.8 *vs.* 27.3±9.8, p=0.010) (Figure 2) and had a higher incidence of ALPSA lesions (64% *vs.* 35%, p=0.007) (Figure 3) compared to the stable group. However, the MGHL classification did not differ significantly between the two groups (p=0.765) (Table II). At the final follow-up visit, both OSIS (from 29.3±7.1 to 42.8±6.0, p<0.001) and VAS (from 4.5±2.1 to 1.6±1.6, p<0.001) scores demonstrated a significant improvement compared to baseline. While comparing patients with and without redislocation, no significant differences were found in preoperative scores (OSIS: 29.2±4.6 *vs.* 29.3±7.5, p=0.682; VAS: 5.1±2.5 *vs.* 4.3±2.1, p=0.124). However, postoperative PROMs were significantly more favorable in the stable group (OSIS: 32.2±5.7 *vs.* 45.1±3.2, p<0.001; VAS: 3.4±2.2 *vs.* 1.2±1.2, p<0.001). According to the multivariate logistic regression analysis, younger age at the time of surgery (odds ratio [OR]=0.936, p=0.047) and the presence of ALPSA lesions (OR=2.953, p=0.027) were independently associated with postoperative redislocation. Other variables included in the model, including sex (p=0.512), symptom duration (p=0.620), and the number of preoperative dislocations (p=0.207), were not significantly associated with redislocation (Table III). Intra- and inter-observer agreements for the MGHL classification demonstrated excellent reliability (κ=0.904 and κ=0.861, respectively).

DISCUSSION

In the present study, we evaluated the effect of patient characteristics, including MGHL morphological types, on the risk of redislocation following arthroscopic labral repair. Our study results demonstrated that younger age at the time of surgery and the presence of an ALPSA lesion were significantly associated with an increased risk of postoperative redislocation following arthroscopic labral repair, whereas variations in the MGHL did not independently influence this risk. These findings suggest that the increased risk of redislocation in younger patients and those with ALPSA lesions should be carefully considered during treatment planning.

High rates of redislocation have been reported in long-term follow-up studies of arthroscopic labral repair procedures,[9,15,16] casting doubt on the long-term efficacy of this technique. Taken together, identifying the risk factors contributing to redislocation is a critical step in evaluating the effectiveness of labral repair. Among these, age ≤20 years at the time of surgery has been widely recognized in literature as a significant predictor of recurrence.[9,10,17,18] Verweij et al.[8] reported a markedly increased risk of recurrence in patients aged ≤20 years (risk ratio: 2.02), with this trend extending to patients aged ≤30 years compared to older cohorts (risk ratio: 2.62). In the present study, younger age at the time of surgery was similarly found to be significantly associated with higher redislocation rates, which is consistent with the existing literature. This may be attributed to the younger population's lower compliance with postoperative rehabilitation protocols, their tendency to return to full activity prematurely, and the presence of a more elastic joint capsule.[19]

Another risk factor that influenced the likelihood of redislocation in the conducted study was the presence of an ALPSA lesion. In the present cohort, patients with ALPSA lesions had a

2.95-fold increased risk of redislocation compared to those without lesions. Of note, ALPSA lesions differ from classical Bankart lesions in several aspects. In ALPSA, the labroligamentous structures are completely detached from the glenoid rim and displaced inferomedially. Numerous studies have identified ALPSA as an independent risk factor for recurrent instability following labral repair.[8,9,20] In a large cohort study, Verweij et al.[8] demonstrated that patients with ALPSA lesions were at nearly twice the risk of redislocation compared to those without such lesions. Similarly, in a long-term follow-up study, Okutan et al.[9] reported that ALPSA was a significant predictor of recurrence over a 10-year period. These lesions are frequently accompanied by other structural abnormalities. Several studies have shown that ALPSA lesions commonly coexist with Hill-Sachs defects and glenoid bone loss, which collectively compound the risk of recurrent instability.[11,21] Given their anatomical characteristics and frequent association with additional structural lesions, patient education and counseling are particularly important in individuals with ALPSA lesions to address the elevated risk of redislocation.

Based on the biomechanical roles of the MGHL, we hypothesized that a thicker morphology might serve as a protective factor for shoulder stability. However, our clinical data did not support this assumption. Several biomechanical studies in the literature have suggested that the MGHL plays a role particularly in the anterosuperior stabilization of the shoulder joint.[12,17] Early biomechanical investigations emphasized its stabilizing function, particularly at abduction angles less than 45°, acting in coordination with the inferior glenohumeral ligament. Moreover, its contribution to shoulder stability has also been proposed in the 70° to 90° range of abduction.[22,23] Nonetheless, MGHL alone does not appear to play a consistent stabilizing role throughout the full ROM, but rather acts in conjunction with other glenohumeral ligaments.[24] Several clinical studies have reported that variations in MGHL do not significantly influence the risk of shoulder instability. In a cohort of 3,129 patients, Özer et al.[25] found no significant association between the thick, cord-like Buford complex (a variant of the MGHL) and shoulder instability; however, patients with a Buford complex showed a lower incidence of instability. Similarly, Kaptan et al.[13] reported no significant correlation between MGHL subtypes and anterior instability in their classification study of MGHL variants. Many studies focusing on MGHL have instead emphasized a strong association between the Type 6 MGHL variant, known as the Buford complex, and superior labrum anterior to posterior lesions.[13,25-27] Based on these findings, while the MGHL contributes to glenohumeral joint stability in conjunction with other ligaments, its isolated role in anterior shoulder stability seems to be limited. The association between various MGHL variants and instability has not been found to be statistically significant. In the present study, a novel comparison was carried out between MGHL subtypes and recurrence rates among patients with recurrent dislocation, and no statistically significant difference was observed. However, the recurrence rate was calculated as 23% for Type 1 MGHL and 12% for Type 6 MGHL, suggesting a trend toward decreased recurrence with increased ligament thickness. Although the MGHL subtypes did not show a statistically significant impact on redislocation in the current study, this finding may provide a basis for future investigations.

Nonetheless, this study has several limitations. First, the single-center, retrospective design carries an inherent risk of selection bias and missing data within the cohort. To minimize this risk, strict and well-defined inclusion and exclusion criteria were applied. Second, the classification of the MGHL was based solely on the review of arthroscopic video recordings. To minimize the potential for error, intra- and inter-observer reliability analyses were conducted. Third, potential confounding pathologies such as off-track lesions and bony Bankart lesions, which are known to contribute to recurrent dislocation, were excluded. Only patients who underwent isolated Bankart repair were included, with the aim of creating a more homogeneous cohort for better identification of risk factors associated with recurrence. Finally, patients with glenolabral articular disruption lesions were not excluded from the study.

In conclusion, although variations in MGHL morphology did not independently influence outcomes, younger age and presence of ALPSA lesions were identified as predictors of postoperative instability following arthroscopic Bankart repair. In the light of these data, the increased risk of redislocation in younger patients and those with ALPSA lesions should be carefully considered during treatment planning. Further multi-center, large-scale, prospective studies are warranted to confirm these findings.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/Concept: T.E., A.Y.K., U.K.; Design: A.Y.K., M.Ş.Ç.; Control/supervision, critical review: A.Y.K., U.K..; Data collection and/or interpretation: E.B.O., M.Ş.Ç., R.D.; Literature review: R.D., M.Ş.Ç., T.E.; Writing the article: T.E., E.B.O., M.Ş.Ç.; References and fundings, materials: T.E., E.B.O.

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