Greater Return to Sport and Lower Recurrences With the Latarjet Procedure Versus Bankart Repair Without Remplissage in Martial Art Contact Athletes With Glenohumeral Instability and Glenoid Bone Loss Less Than 20%

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Purpose: To compare return to sport, functional outcomes, and complications between the arthroscopic Bankart repair without remplissage and the Latarjet procedure in competitive martial arts (MA) athletes with glenohumeral instability. **Methods:** Between January 2008 and February 2021, competitive MA athletes with anterior shoulder instability were operated in our institution. The first group of patients were operated on with the arthroscopic isolated Bankart procedure and the other with an open Latarjet procedure. Return to sports, range of motion, the Rowe score, the visual analog scale, and the Athletic Shoulder Outcome Scoring System (ASOSS) were used to assess functional outcomes using the minimal clinically important difference for Rowe and the patient acceptable symptomatic state (PASS) for the Rowe and ASOSS score. Recurrences, reoperations, and complications also were evaluated with a minimum follow-up of 36 months. **Results:** The mean follow-up was 68.7 months (range, 36-96 months) and the mean age was 24.2 years (range, 16-33 years). Ninety-two percent of patients were able to return to sports, 88% at their preinjury level of play. Sixty-one percent of patients in the Bankart group and 81% in the Latarjet group returned to compete at the same level ($P = .021$). No significant difference in functional scores and shoulder range of motion were found between the groups. In addition, the percentage of patients who surpassed the PASS threshold was similar. For the Bankart group, 92% achieved the PASS for Rowe scores and 85% for ASOSS scores. In the Latarjet group, the corresponding percentages were 88% and 81%. Nine recurrences and 7 reoperations were recorded. The rate of recurrences was 25% (7/28) in the Bankart group and 6% (2/32) in the Latarjet group ($P = .01$). The rate of reoperations was 18% (5/28) in the Bankart group and 6% (2/32) in the Latarjet group ($P = .07$). The rate of complications was 7% (2/28) in the Bankart group and 13% (4/32) in the Latarjet group ($P = .14$). these included biceps tendinitis and subacromial bursitis in the Bankart group (both resolved with conservative management), asymptomatic graft nonconsolidation in 3 patients who underwent Latarjet and resumed sports, and 1 patient who underwent Latarjet who developed a hematoma successfully treated with sling immobilization. **Conclusions:** In competitive MA athletes with glenohumeral instability and a glenoid bone loss <20%, both, the arthroscopic Bankart repair and the Latarjet procedure, produced excellent functional outcomes with most athletes returning to sports. However, the Bankart repair without remplissage was associated with a greater rate of recurrences and reoperations, as well as lower rates of return to the same level of competition than the Latarjet procedure. **Level of Evidence:** Level III, retrospective cohort study.

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Martial arts (MAs) have gained significant popularity over the last 20 years. It has been reported that there are approximately 8 million practitioners of these disciplines in the United States alone.[1] Although multiple types of MAs are described, a general categorization into 3 groups can be made according to whether striking, grappling, or a combination of both is predominant.[2] Striking involves attacking and blocking using any body part, but primarily one's upper or lower extremities. Examples of MAs that emphasize striking include karate, Taekwondo, boxing, and kickboxing. Grappling involves throwing, joint locks, submission, and choking.[2] Examples of MA that emphasize grappling include judo, jiujitsu, aikido, and wrestling.[2] Finally, there is a third category that is very popular nowadays called mixed martial arts (MMA), which integrates effective fighting techniques from multiple styles of striking and grappling.[1] With the rise of that discipline and its increased media exposure after the establishment of the first Ultimate Fighting Championship in the United States in 1993, the popularity of this sport has experienced exponential growth. It has transitioned from a professional sport to a widely practiced activity among amateur athletes who use it as physical training.[1,3]

Regarding shoulder injuries, in a survey on upper-extremity injuries among 758 martial arts participants, Diesselhorst et al.[4] reported that the shoulder was the second most affected joint in 27% of the cases, with dislocations being the most frequent injuries in 47% of the cases. With regard to the treatment, some authors have reported comparable rates of return to sport at the same level of competition among patients engaged in MAs and rugby, relative to other sports, regardless of the stabilization method employed (either arthroscopic Bankart repair or Latarjet procedure).[5,6] However, in a previous study, we observed a high recurrence rate in patients treated with arthroscopic Bankart repair without remplissage, increasing to 20% of the cases.[7] Since then, and because of the fact that the Latarjet procedure has proven to be effective in other collision sports such as rugby, we decided to start treating these patients with the Latarjet procedure.[5,8-11]

The purpose of this study was to compare return to sport, functional outcomes, and complications between the arthroscopic Bankart repair and the Latarjet procedure in competitive MAA with glenohumeral instability. The hypothesis of our study was that in competitive MAA with glenohumeral instability, the Bankart procedure would be associated with a significantly greater rate of recurrence and lower rates of return to sports at the same level than the Latarjet surgery.

Methods

This was a retrospective comparative cohort study. Between June 2008 and February 2021, 60 competitive MAA with anterior glenohumeral instability were operated in our institution. An arthroscopic Bankart repair without remplissage was performed in 28 patients early in the study period (January 2008 to December 2015), followed by a transition to the Latarjet procedure for 32 patients later in the study period (January 2016 to February 2021). The reason for this transition was attributable to the high rate of recurrences and the low rate of return to sport at the same level observed in MAA operated with the arthroscopic Bankart repair.

All the included patients were competitive MAA athletes with anterior glenohumeral instability without glenoid bone defects or who had a glenoid bone defect $<20\%$ and a minimum 3 years follow-up.

Inclusion criteria were MA athletes who had anterior shoulder instability and who participated at a competitive level (regular sport with competitions and practices >2 times/wk).[12] Exclusion criteria were large acute bony Bankart lesions (bony defects of $>20\%$ on the anterior portion of the glenoid), engaging Hill-Sachs lesions, humeral avulsion of the glenohumeral ligament lesions, associated SLAP lesions, posterior labral tears, and rotator cuff injuries. We also excluded patients who had other types of instability (e.g., posterior, voluntary, multidirectional), or in whom clinical or radiographic evaluations were absent at final follow-up. The ethics committee of our institution approved this study (institutional review board no. 11038).

Evaluation

Preoperative and postoperative evaluation consisted of a patient-based questionnaire and the physical examination performed by a shoulder fellow. On preoperative examination, all patients had positive anterior apprehension and relocation tests. Anterior hyperlaxity was defined as external rotation of $>90^\circ$ with arms at the side (reaching the frontal plane), and inferior laxity was determined through use of the Gagey hyperabduction test.[10,13] All patients were contacted and examined at a minimum 36 months follow-up.

All patients were studied before surgery with anteroposterior views and axillary glenohumeral views and magnetic resonance imaging (MRI). The preoperative glenoid bone loss was measured in the MRI with the glenoid index method according to Chuang et al.[13] In patients in whom the radiographs or the MRI findings suggested greater degrees of glenoid or humeral head bone loss and/or bipolar lesions we completed the assessment with a 3-dimensional computed tomography (3DCT) scan to further evaluate the bone loss.

Engaging Hill-Sachs lesions were assessed with dynamic examination after the Bankart repair. If the Hill-Sachs lesion engaged after the Bankart procedure, a remplissage was performed in addition to the Bankart repair.

Patients were asked the type of MA discipline they had practiced if they had been able to practice sports again and if they had been able to perform it at the same level they had before the injury. The Rowe score was used as a global outcome measure.[14] Shoulder-dependent sport ability was measured with the Athletic Shoulder Outcome Scoring System (ASOSS).[12] Clinical outcomes also were assessed using the patient acceptable symptomatic state (PASS) for the Rowe and ASOSS score. The PASS threshold for Rowe, and ASOSS were $\geq$80 and $\geq$90, respectively. In addition, in each group, the percentage of patients who surpassed the minimal clinically important difference for the Rowe score was evaluated, which was the primary functional outcome of the study. The range of motion was objectively recorded with a goniometer. In the Latarjet group, the postoperative bone block position and consolidation were assessed with 3DCT 3 months postoperatively by a shoulder fellowship-trained surgeon (R.B.). All surgery-related complications and reoperations were documented. We defined recurrence as the presence of a dislocation, subluxation, or apprehension during the follow-up physical examination.

Surgical Technique

The operations were performed by 3 surgeons (M.R., I.T., and L.R.). All the arthroscopic Bankart repairs were performed with the patient in the lateral decubitus position with combined general endotracheal and regional anesthesia administered. In all athletes, we used a knotted anchor technique with simple sliding knots. After complete liberation and release of the capsulolabral ligament beyond the 6-o'clock position, the labral edge was debrided. Then, the anterior and inferior glenoid rim and neck were abraded with a shaver. While viewing from the posterior portal, the drill guide for the double suture anchor (SutureTac biocomposite 3 mm 14.5 mm; Arthrex, Naples, FL) was introduced through the anterior portal and was positioned onto the face of the glenoid as close to the 6-o'clock position as possible. A suture passer with polydioxanone sutures was used to perform a capsular plication and labrum repair. Knots were tied arthroscopically using low-profile sliding locking Westin knots followed by half hitches with care to keep the knots away from the glenoid face, in an effort to prevent articular cartilage injury from the suture. Subsequent anchors were placed in similar fashion, working superiorly on the glenoid. Anchors were placed as close to each other as possible without compromising fixation of the previous anchor.

Typically, 3 anchors were placed on the cartilage edge of the glenoid surface. No patients in this series were treated with a posterior-inferior capsulolabral repair or rotator interval closure. Patients with a concomitant SLAP repair or remplissage were excluded from the study.

In patients operated with the Latarjet procedure, we used a deltopectoral approach. The coracoid process underwent osteotomy at the junction between the horizontal part and the vertical part. The subscapularis muscle was divided in line with the fibers at the two-thirds superior—one-third inferior junction to expose the anterior capsule that was divided in the same manner. The anterior glenoid neck was then prepared with a saw blade to be the recipient bed for the coracoid bone graft. The coracoid bone graft was positioned against the glenoid neck and was temporarily stabilized with 2-mm pins. The inferior hole was drilled through the graft and through the glenoid, and the coracoid was fixed with a single screw so that it lay flush with the glenoid joint line. This step was facilitated using specialized guides (South American implants). The pegs on the parallel drill guide mate the predrilled holes on the coracoid graft facilitating easy control and positioning of the coracoid graft onto the glenoid.

A second screw 1 cm proximal from the inferior screw was used to complete graft fixation. In all cases, 2 partially threaded cannulated, stainless steel, cortical screws (3.5-mm diameter) were used. We did not attempt to repair the capsulolabral complex. We did not perform any remplissage or other procedure in the presence of a concomitant Hill-Sachs lesion.

Postoperative Rehabilitation

All patients followed a standard postoperative rehabilitation protocol supervised by one of the authors. The rehabilitation protocol was the same for both techniques. The arm was supported in a sling for 4 weeks. After one week, supervised physical therapy consisting of passive pendulum and gradual passive range of motion (ROM) was begun. Active-assisted ROM exercises were started 2 weeks after surgery. When the patient could perform active forward elevation above the shoulder level, strengthening exercises were started. Running was authorized at 8 weeks. Return to sport criteria were standardized across both groups, necessitating pain-free status, restoration of full shoulder ROM, and reestablishment of preinjury shoulder strength. The average time was around 6 months.

Statistical Methodology

Given the fixed sample size, we performed a consecutive sampling of all patients. A power

calculation was made for a fixed sample size of 60, with a size of 28 of 32 with a recurrence rate of 0.04 and 0.2, and an alpha of 0.05, the power was 0.74. Pre- and postoperative scores were compared with the paired *t* test for independent samples. Continuous variables were presented as means ± standard deviations, whereas categorical variables as absolute and relative frequencies. Statistical analysis was performed using independent Student *t* test with a 95% confidence interval to calculate the differences between the groups in ROM and functional scores. Patients demographics were compared between Bankart and Latarjet with χ^2 test and Mann-Whitney test for categorical and continuous variables, respectively.

Pre- and postoperative functional outcomes were compared with the mean comparison test for paired data. The statistical analysis was performed using the software STATA, version 18 (Stata Corporation, College Station, TX). A *P* value less than .05 was considered statistically significant

Results

A total of 73 martial arts athletes with anterior glenohumeral instability were operated on during the study period. Ten patients were excluded; (6 patients underwent associated procedures and 4 had a glenoid bone loss >20%) (Fig 1). Three patients were lost to follow-up. Thus, the final analysis entailed 60 patients (95% follow-up). An arthroscopic isolated Bankart repair was performed in 28 patients early in the study period (January 2008 to December 2015), followed by a transition to the Latarjet procedure performed in 32 patients later in the study period (January 2016 to February 2021). The types of MAs that use grappling maneuvers were more frequent than striking (53.4% vs 46.6% respectively) (Fig 2).

The mean follow-up was 68.7 months (range, 36-96 months). There were 49 men (82%) and 11 women (18%). There were no significant differences between groups regarding patient and injury characteristics (including average bone loss) (Table 1).

A total of 54 patients (90%) were able to return to MA, and 43 (71%) returned at the same level they had played before the injury (Table 2). Significantly more patients operated with the Latarjet procedure than with the Bankart repair returned to MA at the same level after the operation (Latarjet procedure : 81%; Bankart repair: 61% $P = .021$) (Table 3).

The mean interval between surgery and return to competition was 6.1 months (±0.8), without significant differences between the groups (Table 3). No significant difference in shoulder ROM was found between preoperative and postoperative results (Table 2). The Rowe, ASSOS, and visual analog scale scores showed statistical improvement after operation ($P < .001$). No significant difference in shoulder ROM and functional scores was found between groups (Table 3). No significant differences were found in the percentage of patients who surpassed the minimal clinically important difference for the Rowe score in each group, which was 89% (25/28) in the Bankart group and 87% (28/32) in the Latarjet group ($P = .256$). There were not significant differences between the groups in the percentage of patients who surpassed the PASS threshold for the Rowe and ASOSS scores (Table 4).

Imaging Results

All the patients operated on with the Latarjet procedure were evaluated with 3DCT. The postoperative 3DCT was performed at a mean of 3.5 months (range, 3-5 months) after surgery. The bone block had healed in 90% (29/32 patients) of the cases. At the final follow-up, the rate of postoperative osteoarthritis was 7% (2/28 patients) in the Bankart group and 9% (3/32 patients) in the Latarjet group ($P = .55$). The 5 shoulders with postoperative osteoarthritis were graded as mild (stage 1) osteoarthritis.

Recurrences, Complications, and Reoperations

There were 9 recurrences (15%). The rates of recurrence were 25% in the Bankart group and 6% in the Latarjet group ($P = .001$) (Table 5). Regarding the type of recurrence, in the Bankart group, 3 patients had a dislocation, 3 patients had a painful apprehension that limited their sports activities and 1 patient had a subluxation, In the Latarjet group 2 patients had a painful apprehension that limited their sports activities and no patient experienced a dislocation or subluxation. There were 6 reoperations (10%). The rates of reoperation were 18% in the Bankart group (n = 5) and 6% in the Latarjet group (n = 1) ($P = 0.14$) (Table 5). There were 6 complications (10%). The rates

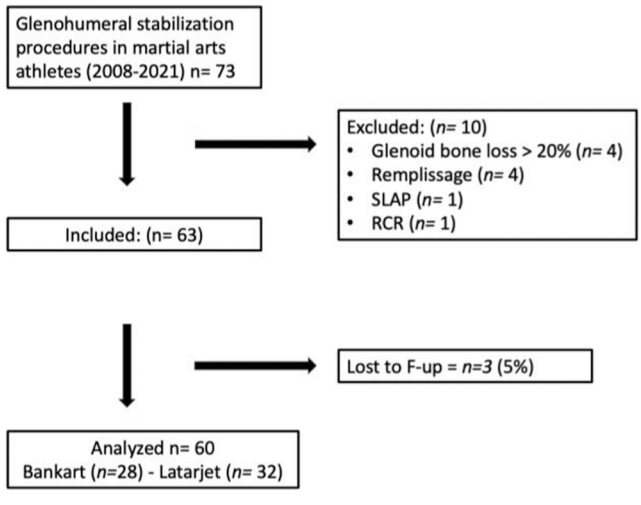

Fig 1. Flow chart of the included patients. (RCR, rotator cuff repair.)

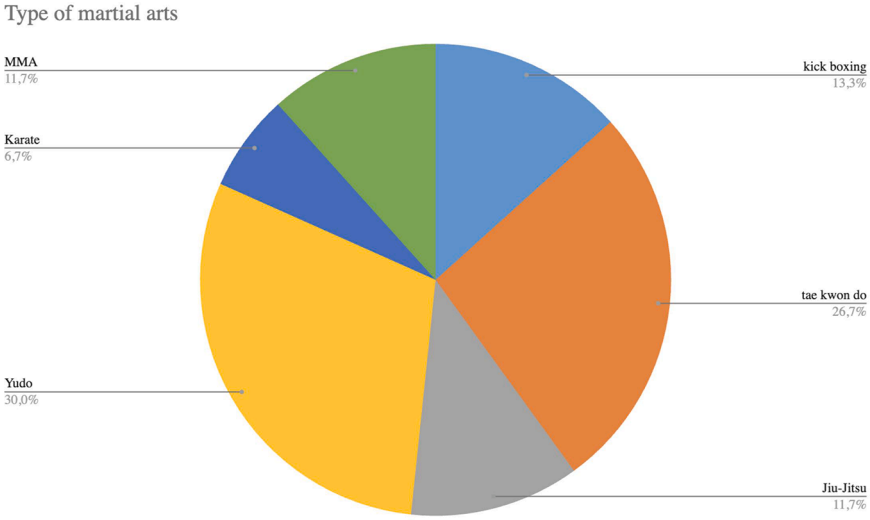

Fig 2. Distribution according to the type of martial arts. (MMA, mixed martial arts.)

of complications were 7% in the Bankart group (n = 2) and 13% in the Latarjet group (n = 3) (P = .072) (Table 5). One patient in the Bankart group developed a biceps tendinitis and 1 patient a subacromial bursitis. Both responded favorably with anti-inflammatory drugs and physical therapy. In the Latarjet group, 3 patients had no evidence of complete consolidation between graft and glenoid. The 3 were asymptomatic and resumed sports. Finally, 1 patient developed a hematoma and was treated favorably with sling immobilization.

Discussion

This study found that competitive MAA athletes with glenohumeral instability and a glenoid bone loss <20% treated with the Bankart procedure were associated with a greater rate of recurrences (25% vs 6%) and reoperations (18% vs 6%) than those treated with Latarjet. In addition, even though both groups obtained similar functional results, the rate of return to the same level of competition was significantly greater in the second group (61% vs 81% P = .021).

In MA, because the shoulder is actively involved not only in grappling maneuvers but also in striking, it is one of the joints with the greatest injury rate in the upper limb. In a survey on upper limb injuries in MAA, Diesselhorst et al.[4] reported that the shoulder was the second most affected joint, involved in 27% of the cases, only surpassed by the hand, which accounted for 53% of the total. Interestingly, although hand injuries were more frequently associated with karate and Taekwondo, shoulder injuries were more frequently associated with MMA. This finding could be explained by the fact that one of the main combat maneuvers in this discipline is grappling.[4] These results agree with ours because grappling disciplines in our series were more frequent, accounting for 53.4%, with judo in the first place, representing 30% of the cases.

The most effective treatment for MAA with shoulder instability continues to be a subject of debate. Although Blonna et al.[5] did not specifically focus on this

Table 1. Patient Characteristics

Variable	Bankart Repair (n = 28)	Latarjet (n = 32)	P Value
Age at the time of surgery, yr, mean (range)	24.9 ± 4.3	24.0 ± 4.3	.39
Dominant involvement, n (%)	20 (71%)	22 (69%)	.15
Average preop episodes, n (range)	1.5 (1-3)	1.4 (1-3)	.48
Follow-up, mo	69.6 ± 14.4	67.8 ± 9.3	.43
Percentage of glenoid bone loss %	2.5 ± 3.9	3.0 ± 5.4	.69
Preop Rowe	44.3 ± 15.9	44.5 ± 13.4	.90
Preop ASOSS	47.6 ± 8.0	47.1 ± 6.6	.71
Preop VAS	2.8 ± 1.2	2.3 ± 1.2	.10
Preop flexion anterior, °	164.6 ± 8.4	164.1 ± 8.4	.79
Preop external rotation, °	61.1 ± 9.6	58.4 ± 10.2	.25

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.
ASOSS, Athletic Shoulder Outcome Scoring System; preop, preoperative; VAS, visual analog scale.

Table 2. Summary of Functional Outcomes and Return to Sport Regardless of Type of Surgery

Variable	Preoperative	Postoperative	*P* Value
Rowe score	44.4 ± 14.5	92.2 ± 8.8	<.001
ASOSS score	47.4 ± 7.2	80.1 ± 11.6	<.001
VAS score	2.6 ± 1.2	1.2 ± 1.1	<.001
Forward flexion	164.3 ± 8.3	167.8 ± 9.0	.19
ER in adduction	61.1 ± 9.6	58.2 ± 9.6	.13
Return to sport	51/60 (85%)		
Return to same level of sport	43/60 (72%)		
Time to return to sports, mo	6.1 ± 0.8		

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.

ASOSS, Athletic Shoulder Outcome Scoring System; ER, external rotation; preop, preoperative; postop, postoperative; VAS, visual analog scale.

subgroup of patients, they compared the rate of return to sport and level of competition achieved of 30 athletes treated with arthroscopic Bankart repair and 30 with Latarjet surgery. In their bicentric retrospective study, the Bankart group obtained overall better results in terms of return to sport (with SPORTS score 8 for Bankart and 6 for Latarjet) and similar functional outcomes (Western Ontario Shoulder Instability Index score). However, within a subgroup of athletes with high upper-extremity involvement (swimming, rugby, and martial arts), the results regarding return to sport and level of competition were similar. In addition, although both groups showed no significant differences in redislocation rates (probably due to low statistical power), the Bankart group had 10% of patients with recurrence vs 0% for the Latarjet group. Furthermore, the patients treated with the Latarjet procedure were those with a glenoid bone defect greater than 20% and revision cases; nevertheless, they had no cases of recurrence. Taking only the aforementioned subgroup into account, our study showed similar results in terms of functional outcomes and return to sport rates. However, the recurrence rate was significantly higher in the group of patients treated with the Bankart procedure (25% vs 6%, $P = .01$).

In a recent study by Marigi et al.,[15] the authors exclusively analyzed 104 wrestlers who underwent surgery for shoulder instability, the majority receiving either arthroscopic or open soft tissue stabilization (97.1%), thus showing similarities to our study in terms of recurrence rates. In their study, cases of recurrent instability after surgery increased to 17.3%, whereas in our Bankart repair group, they rose to 25%. The reason why their recurrence rate was lower than ours could be due to the fact that they did not discriminate between cases of stabilization with soft tissues and with bone block procedures, which could have a selection bias since those techniques are different in terms of recurrence.

The main reason for revision surgery after a primary shoulder stabilization is recurrence. If we consider the time out of competition after the first surgery and add the time necessary to return to the sport after revision, the time out of competition would be between 8 and 12 months, which would mean one or two seasons of absence, as Lau et al. reported in their systematic review of return to play after revision anterior shoulder stabilization.[16] With regard to MAAs, the average length of a professional career is 10 seasons, which means an absence of 20% of their professional career due to shoulder instability.[17] Since we consider that it is crucial to minimize the chances of recurrence after primary shoulder stabilization surgery, and according to our findings in our previous study with MAA athletes treated with arthroscopic Bankart repair (when we had a recurrence rate of 20% after 71 months of follow up), we turned to Latarjet surgery as our gold standard to treat these subgroup of athletes.[7]

Table 3. Comparative Outcomes Between the Bankart and Latarjet Procedures: Functional Outcomes and Return to Sport

	Bankart (n = 28)			Latarjet (n = 32)			
Variable	Preop	Postop	Delta	Preop	Postop	Delta	*P* Value
Rowe score	44.3 ± 15	93.2 ± 9	48.9 ± 19	44.5 ± 13	91.2 ± 8	46.7 ± 16	.64
ASOSS score	47.6 ± 8	80.4 ± 10	32.8 ± 12	47.1 ± 6	79.8 ± 12	32.7 ± 13	.93
Forward flexion, °	164.6 ± 8	168.5 ± 9	3.9 ± 12	164.1 ± 8	169.1 ± 8	5.0 ± 11	.73
ER in adduction	61.1 ± 9	62.2 ± 6	1.1 ± 11	58.4 ± 10	62.8 ± 6	4.4 ± 11	.23
Return to sports n (%)			23/28 (82%)			28/32 (88%)	.58
Return to the same level n (%)			17/28 (61%)			26/32 (81%)	.021
Time to return, mo			6.3 ± 0.7			5.9 ± 0.8	.142

NOTE. Data are presented as mean ± standard deviation unless otherwise indicated.

ASOSS, Athletic Shoulder Outcome Scoring System; ER, external rotation; preop, preoperative; postop, postoperative.

Table 4. Percentage of Patients Who Achieved the PASS Threshold

	Bankart (n = 28)	Latarjet (n = 32)	*P* Value
Rowe score	92% (26/28)	88% (28/32)	.43
ASOSS score	85% (24/28)	81% (26/32)	.25

ASOSS, Athletic Shoulder Outcome Scoring System; PASS, patient acceptable symptomatic state.

Limitations

First, because of its retrospective nature, we did not record the reason why the MAA did not return to play at the same level, neither the time from the injury to surgery. In addition, because of the fixed number of cases in each group, our power analysis was 0.74 and some of our results might be different if we had a greater sample size. Also, we did not add a remplissage to the labral repair because at that time there was insufficient evidence of the benefits of this technique.

Finally, because of the limited number of patients, we were not able to analyze the sample according to the fighting techniques of each type of martial arts discipline in order to determine whether grappling types were more associated with a higher rate of recurrences. Also, another limitation of this study is the imbalance in our patient cohort regarding sex distribution, with 49 men and only 11 women. Although disaggregating results by sex could provide valuable insights into potential differences in outcomes for shoulder instability surgery, our limited sample size for female patients precluded a statistically powered analysis of this variable. Consequently, drawing definitive conclusions regarding sex-specific outcomes was not feasible, and our findings primarily reflect the overall cohort. Future research with a larger, more balanced representation of both sexes is warranted to explore these potential disparities.

Conclusions

In competitive MAA with glenohumeral instability and a glenoid bone loss <20%, both, the arthroscopic Bankart repair and the Latarjet procedure, produced excellent functional outcomes, with most athletes returning to sports. However, the Bankart repair without remplissage was associated with a greater rate of recurrences and reoperations as well as lower rates of return to the same level of competition than the Latarjet procedure.

Table 5. Comparative Outcomes Between Bankart and Latarjet Procedures: Recurrences, Complications, and Reoperations

	Bankart, n = 28	Latarjet, n = 32	*P* Value
Recurrences	7/28 (25%)	2/32 (6%)	.01
Complications	2/28 (7%)	4/32 (13%)	.14
Reoperations	5/28 (18%)	2/32 (6%)	.07

NOTE. Data are presented as n (%).

Disclosures

All authors (L.A.R., R.B., I.P., O.T., C.L., I.T., M.R.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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