High Rate of Return to Sports and Low Recurrences With the Latarjet Procedure in High-Risk Competitive Athletes With Glenohumeral Instability and a Glenoid Bone Loss <20%

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Purpose: To analyze return to sports, functional outcomes, and complications following the Latarjet procedure in competitive athletes with anterior glenohumeral instability and glenoid bone loss <20%. Methods: All the included patients were operated between 2010 and 2016. The inclusion criteria were competitive athletes with anterior glenohumeral instability, a glenoid bone defect <20% who participated in contact sports, forced overhead sports, or had a previous failed Bankart repair and had a minimum 2 years’ follow-up. Return to sports, range of motion (ROM), the Rowe score, and the Athletic Shoulder Outcome Scoring System score were used to assess functional outcomes. Complications and bone consolidation were also evaluated. Results: A total of 65 athletes were included in the study. The mean follow-up was 53 months (±13), and the mean age was 23.9 years (range, 16-31 years). Overall, 94% were able to return to sports and 84% returned at the same level. No significant difference in shoulder ROM was found between preoperative and postoperative results. The Rowe and Athletic Shoulder Outcome Scoring System scores showed statistical improvement after operation (P < .001). No significant difference in shoulder ROM and functional scores was found between primary and revision cases. The total complication rate was 11% and the revision rate was 1.5%. The recurrence rate was 4.6%. The bone block healed in 95% of the cases. Conclusions: In high-risk competitive athletes with anterior glenohumeral instability and glenoid bone loss <20%, the Latarjet procedure resulted in excellent functional outcomes, with most of the patients returning to sports and at the same level they had before injury with a low rate of recurrences.

Level of Evidence: Therapeutic case series; Level of evidence, IV.

Glenoid bone loss is a common finding in association with anterior shoulder instability and it has been identified as a predictor of failure after capsulolabral-stabilization procedures.1 Historically, 20% to 25% has been accepted as the “critical” cutoff value at which glenoid bone loss should be reconstructed during surgery.2,3 Due to the unsatisfactory results reported with isolated capsulolabral repair in athletes with recurrent glenohumeral instability and glenoid bone deficit >20%, most authors recommend glenoid reconstruction with bone grafting in these patients.2,3 However, some studies published in the last decade have shown that in some risk subgroups, the results with Bankart repair are even unfavorable when patients have a glenoid bone deficit of less than 20%.4-8 These risk subgroups mainly include contact and collision athletes, forced overhead athletes, and patients with previous failed Bankart repairs.2-8 The main problem in these high-risk patients is the high recurrence rate, which can vary between 15% and 51%.4-8 Furthermore, some authors have demonstrated a significant decrease in functional outcomes with isolated capsulolabral repair in athletes with only 13.5% to 20% glenoid bone deficit, even in patients who did not sustain a recurrence of their instability.9,10 Due to the high risk of recurrences and the possibility of obtaining...
suboptimal results with isolated Bankart repair, we have decided, since 2010, to treat high-risk patients in our institution by means of glenoid reconstruction with Latarjet surgery.

The purpose of this study was to analyze return to sports, functional outcomes, and complications following the Latarjet procedure in competitive athletes with anterior glenohumeral instability and glenoid bone loss <20%. We hypothesized that the Latarjet procedure would achieve a stable shoulder in high-risk competitive athletes with anterior glenohumeral instability and glenoid bone loss <20%, resulting in a high rate of return to play with a low rate of recurrences.

Methods

This was a retrospective comparative study. All the included patients were operated between 2010 and 2016. The inclusion criteria were competitive athletes according to Araujo et al.14, who participated in contact sports, forced overhead sports, or had a previous failed Bankart repair and had a minimum 2 years follow up. We excluded patients who had, other types of instability (e.g., posterior or voluntary), or in whom clinical or radiographic evaluations were absent at final follow-up. The congruent arc Latarjet11 was performed early in the study period (January 2010 to June 2015), followed by a transition to classic Latarjet technique12 later in the study period (July 2015 to December 2016). The ethics committee of our Institution approved this study (institutional review board: 00010193). The ethics committee of the Italian Hospital from Buenos Aires, Argentina, approved this study (institutional review board: 00010193, protocol number: 5395).

Evaluation

Preoperative and postoperative evaluation consisted of a patient-based questionnaire and the physical examination performed by a shoulder fellow who did not participate in the surgery. On preoperative examination, all patients had a preoperative examination consisting of apprehension and relocation testing. We also evaluated range of motion (ROM). Patients were contacted and examined at a minimum 3 years' follow-up.

All patients were studied before surgery with anteroposterior views and axillary glenohumeral views, magnetic resonance imaging, and computed tomography with 3-dimensional reconstruction (3DCT). Preoperative glenoid bone loss was measured with the glenoid index method according to Chuang et al.13 Patient sport level was divided into competitive and recreational sports. All included patients were competitive athletes according to Araujo et al.14

Sports were classified in an analog manner according to Allain et al.15: noncollision/nonoverhead shoulder sport (G1), high-impact/collision sport (G2), overhead sport with hitting movements (G3), and overhead sport with hitting movements and sudden stops (G4). Patients were asked 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. We also asked patients who did not return to sports the reasons for cessation. The Rowe score was used as a global outcome measure.16 Clinical outcome was also assessed using the minimal clinically important difference (MCID) for the Rowe score, defined as an increase from baseline in overall Rowe of at least 9.7 points.17 Shoulder-dependent sport ability was measured the Athletic Shoulder Outcome Scoring System (ASOSS).18 The ROM was objectively recorded with a goniometer. The postoperative bone block position and consolidation were assessed with 3DCT 3 months postoperatively. We considered accurate positioning of the bone block was reached when values of medialization and lateralization of the bone block were within −5 mm and +3 mm, respectively.19 Osteoarthritis was graded according to the classification of Samilson and Prieto.20 All surgery-related complications and reoperations were documented. We considered patients who had a dislocation, subluxation, or who had painful apprehension after surgery as recurrences. Lesions were defined as “on track/off track” according to Di Giacomo et al.21

Surgical Technique

During the surgical procedure, patients received combined anesthesia (regional blockade + general anesthesia) and were placed in the beach-chair position. We used a small 5-cm deltopectoral approach. The coracoid process underwent osteotomy at the junction between the horizontal part and vertical part. In patients in whom the congruent arc was performed, in this step the coracoid graft was rotated on its longitudinal axis by 90°, such that the original medial surface was facing the glenoid neck.11 The medial cortex of the graft was removed with a saw blade. Conversely, in patients were the classic Latarjet was performed, the inferior cortex of the graft was decorticated.12 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. Then the graft 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). A second screw 1 cm proximal from the inferior one was used to complete graft fixation. In all cases, 2 partially threaded cannulated cortical screws (3.5 mm diameter) were used. We did not do any 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

The arm was supported in a sling for 4 weeks. All patients followed a standard postoperative rehabilitation protocol supervised by one of the authors. After 1 week, supervised gentle physical therapy consisting of passive pendulum and gradual passive 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 sports was allowed when the patient was pain free, full shoulder ROM had been achieved, and shoulder strength was near the same as before the injury.

Statistical Methodology

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. The statistical analysis was performed using the software STATA, version 13 (Stata Corporation, College Station, TX). A P value less than .05 was considered statistically significant.

Results

Sixty-seven athletes who met the inclusion criteria were operated during the study period. Two patients were lost to follow-up, and thus the final analysis included 65 patients. The mean follow-up was 53 months (±13). The main characteristics of the involved patients and their injuries are shown in Table 1.

Return to Sports

Sixty-one (94%) patients were able to return to sports, and 84% returned at the same level they had previous to their injury (Table 2). The mean interval between surgery and return to competition was 5.6 months (range, 3-11 months). Four patients (6%) did not return to sports after the procedure. Regarding the reasons for cessation, 2 patients did not feel psychologically confident and 2 patients feared they would suffer the same injury again. No significant difference regarding return to sports was found between primary and revision cases (Table 3) and between patients operated with the classic and the congruent arc technique (Table 4).

ROM and Functional Scores

No significant difference in shoulder ROM was found between preoperative and postoperative results (Table 2). The Rowe and ASOSS scores showed statistical improvement after operation. Ninety-five percent of the athletes (62 of 65 patients) achieved a clinically significant improvement that exceeded the MCID for the Rowe score. No significant difference in shoulder ROM and functional scores was found between primary and revision cases (Table 3) and between patients operated with the classic or the congruent arc technique (Table 4). Finally, we did not find a significant difference in functional scores according to the type of sports practiced by the patients (Table 5).

Imaging Results

The bone block healed in 57 shoulders (95%). In 3 shoulders (5%), the bone block had not healed: One soccer player had pain 2 months after surgery and presented radiolucences around the inferior screw. It was interpreted as a nonunion secondary to the screw loosening. The screw was changed arthroscopically to a longer one. The graft consolidated 2 months after the reoperation and the patient returned to play soccer at the same level as before the injury. In 2 patients, no evidence of complete consolidation was observed. However, the patients were pain free, without

Table 1. Patients Demographics

| Variable                              | Preoperative | Postoperative | P Value |
|---------------------------------------|--------------|---------------|---------|
| Sex, men/women, n                     | 62/3         |               |         |
| Side, right, n (%)                    | 39 (60%)     |               |         |
| Dominant involvement, n (%)           | 39 (45%)     |               |         |
| Age at the time of surgery, y, mean (range) | 23.9 (16-31) |               |         |
| Type of surgery                       |              |               |         |
| Primary, n (%)                        | 29 (45%)     |               |         |
| Revision, n (%)                       | 36 (55%)     |               |         |
| Glenoid bone loss, % (range)          | 12% (0-18)   |               |         |
| On-track/off-track lesions*           |              |               |         |
| On track, n (%)                       | 40 (62%)     |               |         |
| Off-track, n (%)                      | 25 (38%)     |               |         |
| Follow-up, mo (range)                 | 53 (36-96)   |               |         |
| Type of sport,1 n                     |              |               |         |
| G1                                    | 12 (18%)     |               |         |
| G2                                    | 35 (54%)     |               |         |
| G3                                    | 9 (14%)      |               |         |
| G4                                    | 9 (14%)      |               |         |

*According to Di Giacomo et al.21
1According to Allain et al.15

NOTE. Values are expressed as mean ± SD unless otherwise indicated. paired rank test.

ASOSS, Athletic Shoulder Outcome Scoring System; ER, external rotation.

Table 2. Summary of Functional Outcomes and Return to Sport

| Variable                              | Preoperative | Postoperative | P Value |
|---------------------------------------|--------------|---------------|---------|
| Rowe score                            | 51 ± 15      | 95 ± 7.5      | <.01    |
| ASOSS                                 | 29 ± 7.9     | 92 ± 15       | <.01    |
| Forward flexion                       | 173 ± 6.1    | 171 ± 6.2     | .20     |
| ER in adduction                       | 67 ± 2.8     | 66 ± 3.6      | .99     |
| Return to sport, n (%)                |              | 61/65 (94%)   |         |
| Return to same level                  |              | 51/61 (84%)   |         |
apprehension. Both patients were treated conservatively with no evidence of screw loosening at last follow-up, which suggested a fibrous union between the graft and the glenoid.

In the axial view, 92% (60/65 cases) were positioned within the target range (−5 to +3 mm). In contrast, 3% (2/65 cases) were considered lateralized and 5% (3/65 cases) were considered medialized. On the preoperative imaging studies, 5 shoulders (7.6%) had mild (stage 1) glenohumeral osteoarthritis. At final follow-up, 7 shoulders (10.7%) were graded as mild (stage 1) osteoarthritis. Sixty shoulders (92.4%) were free of arthritis (stage 0). No cases of moderate or severe arthritis were observed in this study. All the lesions were “on-track” in the postoperative 3DCT evaluation 3 months after surgery.

Complications and Recurrences
The total complication rate was 10.8% (7/65 patients) and the revision rate was 1.5% (1/65 patients). A summary of the complications and their general management is shown in the Table 6.

Discussion
The main findings of this study were that in high-risk competitive athletes with anterior glenohumeral instability and glenoid bone loss <20%, the Latarjet procedure resulted in excellent functional outcomes, with most of the patients returning to sports and at the same level they had before injury with a low rate of recurrences. Moreover, outcomes were equally favorable in patients undergoing a primary or a revision procedure and in patients operated with the classic or the congruent-arc technique.

In general, the sports results reported after arthroscopic Bankart repair in athletes have been favorable. However, in competitive high-risk athletes (such as those included in our study), the results have not been so encouraging. Among these are collision athletes, those who practice forced overhead sports and athletes with a previous failed Bankart stabilization surgery. Trinh et al. recently reported the clinical outcomes of 49 overhead athletes undergoing primary arthroscopic anterior shoulder stabilization. At 2-year follow-up, only 63% of athletes returned to sports and only 45% were able to return to their previous levels of competition. Buckup et al. evaluated 20 athletes who underwent arthroscopic revision stabilization after failed primary arthroscopic Bankart repair. The authors reported that only 70% of the patients were able to return to their original sporting activities at the same level and 90% of the patients described a limitation in their shoulder when participating in their sports. Petrera et al. compared the return to sports rate after Bankart repair in collision versus noncollision athletes and reported that only 73% of collision athletes were able to return to sports at their preinjury levels compared with 81% of noncollision athletes. Other authors also reported low rates of return to preinjury levels of competition in collision athletes after arthroscopic Bankart repair, ranging between 25% and 40%.

In our study, 94% of the athletes returned to sports and 84% returned at the same level they had before injury. It is important to emphasize that 68% of the

Table 3. Comparative Outcomes Between Primary and Revision Procedures

|                     | Primary Procedures (n = 29) |                               |                      |                      | Revision Procedures (n = 36) |                               |                      |                      |
|---------------------|-----------------------------|-------------------------------|----------------------|----------------------|-----------------------------|-------------------------------|----------------------|----------------------|
|                     | Pre | Post | Delta | P Value | Pre | Post | Delta | P Value |
| Rowe                | 50.5 ± 2 | 95.9 ± 6 | −45.3 ± 13 | <.001 | 51.8 ± 17 | 93.7 ± 8 | −41.9 ± 19 | <.001 |
| ASOSS               | 28.1 ± 18 | 89.7 ± 18 | −61.6 ± 20 | <.001 | 29.1 ± 8 | 94.0 ± 11 | −64.9 ± 13 | <.001 |
| Forward flexion     | 170.76 ± 6 | 171.5 ± 6 | −0.76 ± 5 | .467 | 169.9 ± 6 | 170.3 ± 6 | −0.39 ± 5 | .667 |
| ER in adduction     | 65.8 ± 4 | 65.6 ± 4 | 0.17 ± 4 | .83 | 67.1 ± 1 | 67.1 ± 2 | 0.05 ± 2 | .878 |
| Return to sport, n (%) | 26/29 (90%) |                      |                      |                      | 35/36 (97%) |                      |                      | .207 |
| Return to same level| 21/26 (80%) |                      |                      |                      | 30/35 (86%) |                      |                      | .395 |

ASOSS, Athletic Shoulder Outcome Scoring System; ER, external rotation; pre, preoperative; post, postoperative.

Table 4. Comparative Outcomes Between Patients Operated With the Classic and the Congruent-Arc Procedures

|                     | Classic Latarjet (n = 26) |                               |                      |                      | Congruent-Arc Latarjet (n = 39) |                               |                      |                      |
|---------------------|-----------------------------|-------------------------------|----------------------|----------------------|-----------------------------|-------------------------------|----------------------|----------------------|
|                     | Pre | Post | Delta | P Value | Pre | Post | Delta | P Value |
| Rowe                | 50.3 ± 15 | 94.8 ± 7 | −44.5 ± 17 | <.001 | 52 ± 15 | 94.6 ± 7 | −42.5 ± 16 | <.001 |
| ASOSS               | 29.6 ± 9 | 95.0 ± 9 | −65.4 ± 14 | <.001 | 27.8 ± 6 | 89.6 ± 18 | −61.7 ± 18 | <.001 |
| Forward flexion     | 170.6 ± 5 | 170 ± 6 | 0.66 ± 6 | .55 | 169.9 ± 6 | 171.5 ± 6 | −1.6 ± 4 | .05 |
| ER in adduction     | 66.6 ± 2 | 66.6 ± 3 | −0.03 ± 2 | .9 | 66.5 ± 3 | 66.3 ± 3 | 35.22 ± 3 | .73 |
| Return to sport, n (%) | 28/30 (93%) |                      |                      |                      | 33/35 (94%) |                      |                      | .87 |
| Return to same level| 23/30 (77%) |                      |                      |                      | 28/35 (80%) |                      |                      | .74 |

ASOSS, Athletic Shoulder Outcome Scoring System; ER, external rotation; pre, preoperative; post, postoperative.
patients included in our series performed collision or forced overhead sports. We believe that this is a relevant finding of our study since although Latarjet surgery has shown high return to sport rates in patients with significant bone deficit,\textsuperscript{22,23} there is very little information in the literature addressing sports results of this technique in competitive high-risk athletes with a glenoid deficit <20%.

Another relevant finding of our study was that although 55% of patients had a previous surgery, when we compared primary and revision surgeries, we found no significant differences in the percentage of patients who returned to the same level they had before the injury (80% vs 86% respectively). In a recent systematic review, Abdul-Rassoul et al.\textsuperscript{22} evaluated the amount of time needed for athletes to return to sport after different surgical treatments for anterior shoulder instability. Return to sports occurred at a mean of 5.9 months after arthroscopic Bankart, 5 months after open Latarjet and 5.8 months after arthroscopic Latarjet. In our series, the mean interval between surgery and return to competition was 5.6 months. No significant difference regarding return to sport rates was found between primary and revision cases and between patients operated with the classic and the congruent arc technique.

Regarding functional outcomes, both open and arthroscopic Latarjet have shown excellent functional scores.\textsuperscript{29,30} In a recent systematic review, Hurley et al.\textsuperscript{31} evaluated the functional outcomes after the open Latarjet procedure at a minimum follow-up period of 10 years. The most commonly used functional outcome score was the Rowe score, with a weighted mean average of 88.5. Although this represents a very good clinical outcome, no study included patients without glenoid bone loss. In our study, the final Rowe score was 95, which is in line with the results reported in patients with severe bone deficit. Moreover, 95% of the patients achieved a clinically significant improvement that exceeded the MCID for the Rowe scores. We evaluated shoulder-dependent sport ability with the ASOSS score, which showed an excellent final performance of the patients’ shoulders after returning to sports. No significant difference in shoulder ROM and functional scores was found between primary and revision cases and between patients operated with the classic and the congruent arc technique. This is an important finding of this study, since glenoid bone loss as low as 13.5% has been associated with unacceptable clinical outcomes in a young, active population with the Bankart repair.\textsuperscript{9} Shaha et al.\textsuperscript{9} retrospectively evaluated 72 consecutive patients with anterior glenohumeral instability and glenoid bone loss <25% who underwent isolated anterior arthroscopic labral repair. The group was divided into quartiles based on bone loss. The authors reported that the mean Western Ontario Shoulder Instability Index score correlated with Single Assessment Numeric Evaluation scores and worsened as bone loss increased in each quartile. Specifically, in patients with glenoid bone loss >13.5%, the Western Ontario Shoulder Instability Index score increased to rates consistent with a poor clinical outcome.

The main problem facing competitive high-risk athletes undergoing an open or arthroscopic Bankart repair is the high recurrence rate.\textsuperscript{5-7,24-26} Recurrences not only generate new structural damage to the shoulder but also leave athletes between 5 and 7 months out of the competition.\textsuperscript{5-7,24-26} In a recent systematic review, Alkaduhimi et al.\textsuperscript{7} evaluated redislocation risk after the arthroscopic Bankart procedure and reported that collision athletes have an increased absolute risk of 8.0 for development of postoperative instability in comparison to noncollision athletes ($P = .001$). Specifically, the recurrence rates reported in risk athletes have been between 31% and 51% in collision sports, between 12.5% and 21.5% in forced overhead sports, and between 15% and 42% in patients with a previous failed Bankart repair.\textsuperscript{28,32-35}

As an alternative to reduce the rate of recurrences, some authors propose performing a remplissage in addition to the Bankart repair in patients presenting with an off-track Hill–Sachs lesion.\textsuperscript{36,37} Although remplissage has proven effective in the general population, there is very little information on the results of this procedure in young high-risk athletes such as those included in our study. Yang et al.\textsuperscript{38} compared remplissage with modified Latarjet for off-track Hill-Sachs lesions with subcritical glenoid bone loss. An arthroscopic Bankart procedure with remplissage (group A) was performed in 98 patients, and modified Latarjet

### Table 5. Results of Functional Scores by Type of Sports

| Type of Sports | Rowe | ASOSS |
|---------------|------|-------|
| G1            | 12 (18%) | 95 ± 5 | 90 ± 22 |
| G2            | 35 (54%) | 94 ± 8 | 92 ± 16 |
| G3            | 9 (14%) | 97 ± 7 | 97 ± 4 |
| G4            | 9 (14%) | 96 ± 9 | 91 ± 2 |
| $P$ value     | .55   | .04   |

ASOSS, Athletic Shoulder Outcome Scoring System.

### Table 6. Summary of Complications and Their Treatment

| Complications | Frequency | Management |
|---------------|-----------|------------|
| Recurrence    | 2/65 (3%) | Revised with autologous iliac bone graft |
| Dislocations  | 1/65 (1.5%) | Conservative treatment |
| Subluxations  | 1/65 (1.5%) | Oral antibiotics, 2 weeks |
| Superficial wound infection | 1/65 (1.5%) | Full recovery with conservative treatment |
| Musculocutaneous Neuropraxia | 1/65 (1.5%) | The 3 patients were asymptomatic so they were managed conservatively |

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significance studies included in the review evaluated patients with the Latarjet surgery in patients with significant recurrences (2 of 65 patients). With an average follow-up of 53 months, we had only 4.6% of recurrences between 3% and 7%, respectively. The rates of complications and revisions associated with the Latarjet surgery in patients with significant glenoid bone deficit vary between 7% and 30% and between 3% and 7%, respectively. The rates of complications and revisions in our series were 11% and 1.5% respectively. These were similar to those reported in the series with patients operated with major defects. A particular concern related to the Latarjet surgery performed in patients with glenoid bone deficit <20% is the possibility of resorption of the coracoid graft. The coracoid graft has been reported to suffer significantly more osteolysis in patients without previous minor glenoid bone defects compared to those with significant glenoid bone loss. One possible explanation for these findings is that according to Wolff’s law, bone that is not under load is reabsorbed due to lack of mechanical stimulation. However, different authors have shown that patients who presented greater resorption of the bone block did not present greater apprehension or recurrences than patients with less resorption. The authors argue that this could be due to the compensatory mechanism provided by the cojoint tendon. Therefore, partial lysis of the coracoid that occurs frequently only rarely leads to persistent apprehension and unsatisfactory results and is not considered a complication by most authors but an expected biological reaction of the bone consolidation process described by Wolff. Complete graft resorption is very rare and has been described in less than 1% of the cases. In our study, we had no resorption or fragmentation of any graft. We believe that this was due to the fact that, at the time of preparation of the anterior edge of the glenoid, we resected 2 to 4 mm of bone until we reached the bleeding spongy bone to achieve adequate bone consolidation between the coracoid graft and the anterior face of the glenoid. As the glenoid widens from anterior to posterior surface, this allowed us to achieve a suitable support surface for the coracoid graft. Consequently, we ensured that the entire graft would be in contact with the anterior face of the glenoid surface, thus maximizing the chances of consolidation.

Limitations

The present study has some limitations that should be mentioned. In the first place, we did not have a control group operated with another technique to compare our results. Second, although for the majority of the main variables evaluated we had an adequate follow-up, for others such as osteoarthritis, the follow-up of our series was limited. Third, we used 2 types of Latarjet surgery in the series. The first group of patients were operated with the congruent arch technique and the following with the classic technique. To avoid biases associated with the interpretation of the results according to the type of Latarjet used, we presented the comparative results between both types of Latarjet procedures.

Conclusions

In high-risk competitive athletes with anterior glenohumeral instability and glenoid bone loss <20%, the Latarjet procedure resulted in excellent functional outcomes, with most of the patients returning to sports and at the same level they had before injury with a low rate of recurrences.

References

1. Tokish JM, Lafosse L, Giacomo GD, Arciero R. Patients in whom arthroscopic bankart repair is not enough: Evaluation and management of complex anterior glenohumeral instability. Instr Course Lect 2017;66:79-89.
2. Provencher MT, Ferrari MB, Sanchez G, Anavian J, Akamefula R, LeBus GF. Current treatment options for glenohumeral instability and bone loss: A critical analysis review. JBJS Rev 2017;5:e6.
3. Willemsot LB, Elhassan BT, Verborgt O. Bony reconstruction of the anterior glenoid rim. J Am Acad Orthop Surg 2018;26:e207-e218.
4. Su F, Kowalczyk M, Ikpe S, Lee H, Sabzevari S, Lin A. Risk factors for failure of arthroscopic revision anterior shoulder stabilization. J Bone Joint Surg Am 2018;100:1319-1325.
5. Ranalletta M, Rossi LA, Alonso Hidalgo I, et al. Arthroscopic stabilization after a first-time dislocation: Collision versus contact athletes. Orthop J Sports Med 2017;5:2325967117729321.
6. Ranalletta M, Rossi LA, Sirio A, et al. Return to sports and recurrences after arthroscopic anterior shoulder stabilization in martial arts athletes. Orthop J Sports Med 2017;5:2325967117725031.
7. Alkaduhimi H, van der Linde JA, Willigenburg NW, et al. Redislocation risk after an arthroscopic Bankart procedure in collision athletes: A systematic review. J Shoulder Elbow Surg 2016;25:1549-1558.

8. Torrance E, Clarke CJ, Monga P, Funk L, Walton MJ. Recurrence after arthroscopic labral repair for traumatic anterior instability in adolescent rugby and contact athletes. Am J Sports Med 2018;46:2969-2974.

9. Shaha JS, Cook JB, Song DJ, et al. Redefining "critical" bone loss in shoulder instability: Functional outcomes worsen with "subcritical" bone loss. Am J Sports Med 2015;43:1719-1725.

10. Yamamoto N, Kawakami J, Hatta T, Itoi E. Effect of subcritical glenoid bone loss on activities of daily living in patients with anterior shoulder instability. Orthop Traumatol Surg Res 2019;105:1467-1470.

11. Burkhart SS, De Beer JF, Barth JRH, Criswell T, Roberts C, Richards DP. Results of modified Latarjet reconstruction in patients with anteroinferior instability and significant bone loss. Arthroscopy 2007;23:1033-1041.

12. Walch G, Boileau P. Latarjet-Bristow procedure for recurrent anterior instability. Tech Shoulder Elbow Surg 2000;1:256-261.

13. Chuang TY, Adams CR, Burkhart SS. Use of preoperative three-dimensional computed tomography to quantify glenoid bone loss in shoulder instability. Arthroscopy 2008;24:376-382.

14. Araújo CGS, Scharhag J. Athlete: a working definition for medical and health sciences research. Scand J Med Sci Sports 2016;26:4-7.

15. Allain J, Goutallier D, Glorion C. Long-term results of the Latarjet procedure for the treatment of anterior instability of the shoulder. J Bone Joint Surg Am 1998;80:841-852.

16. Rowe C, Patel D, Southmayd W. The Bankart procedure: A long-term end-result study. J Bone Joint Surg Am 1978;60:1-16.

17. Park I, Lee JH, Hyun HS, Lee TK, Shin SJ. Minimal clinically important differences in Rowe and Western Ontario Shoulder Instability Index scores after arthroscopic repair of anterior shoulder instability. J Shoulder Elbow Surg 2018;27:579-584.

18. Stein T, Linke RD, Buckup J, et al. Shoulder sport-specific impairments after arthroscopic Bankart repair: A prospective longitudinal assessment. Am J Sports Med 2011;39:2404-2414.

19. Kany J, Flamand O, Grimberg J, et al. Arthroscopic Latarjet procedure: is optimal positioning of the bone block and screws possible? A prospective computed tomography scan analysis. J Shoulder Elbow Surg 2016;25:69-77.

20. Samelson RL, Prieto V. Dislocation arthropathy of the shoulder. J Bone Joint Surg Am 1983;65:456-460.

21. Di Giacomo G, Itoi E, Burkhart SS. Evolving concept of bipolar bone loss and the Hill-Sachs lesion: From “engaging/non-engaging” lesion to “on-track/off-track” lesion. Arthroscopy 2014;30:90-98.

22. Abdul-Rassou1 H, Galvin JW, Curry EJ, Simon J, Li X. Return to sport after surgical treatment for anterior shoulder instability: a systematic review. Am J Sports Med 2019;47:1507-1515.

23. Ialenti MN, Mulvihill JD, Feinstein M, Zhang AL, Feeley BT. Return to play following shoulder stabilization: A systematic review and meta-analysis. Orthop J Sports Med 2017;5:2325967117726055.

24. Petrella M, Dwyer T, Tsuji MR, Theodoropoulos JS. Outcomes of arthroscopic Bankart repair in collision versus noncollision athletes. Orthopedics 2013;36:e621-e626.

25. Cho NS, Hwang JC, Rhee YG. Arthroscopic stabilization in anterior shoulder instability: Collision athletes versus noncollision athletes. Arthroscopy 2006;22:947-953.

26. Cordasco FA, Lin B, Heller M, Asaro LA, Ling D, Calcei JG. Arthroscopic shoulder stabilization in the young athlete: Return to sport and revision stabilization rates. J Shoulder Elbow Surg 2020;29:946-953.

27. Trinh TQ, Naimark MB, Bedi A, Carpenter JE, Robbins CB, MOON Shoulder Instability Group. Clinical outcomes after shoulder stabilization in overhead athletes: An analysis of the MOON Shoulder Instability Consortium. Am J Sports Med 2019;47:1404-1410.

28. Buckup J, Welsch F, Gramlich Y, et al. Back to sports after arthroscopic revision Bankart repair. Orthop J Sports Med 2018;6:2325967118755452.

29. Randelli P, Fossati C, Stoppani C, Evola FR, De Girolamo L. Open Latarjet versus arthroscopic Latarjet: Clinical results and cost analysis. Knee Surg Sports Traumatol Arthrosc 2016;24:526-532.

30. Horner NS, Moroz PA, Bhullar R, Habib A, Simunovic N, Wong I, Bedi A, Ayeni OR. Open versus arthroscopic Latarjet procedures for the treatment of shoulder instability: A systematic review of comparative studies. BMC Musculoskeletal Disord 2018;19:255.

31. Hurley ET, Jamal MS, Ali ZS, Montgomery C, Pauzenberger L, Mullett H. Long-term outcomes of the Latarjet procedure for anterior shoulder instability: A systematic review of studies at 10-year follow-up. J Shoulder Elbow Surg 2019;28:e33-e39.

32. Clesham K, Shannon FJ. Arthroscopic anterior shoulder stabilisation in overhead sport athletes: 5-year follow-up. Ir J Med Sci 2019;188:1233-1237.

33. Nakagawa S, Mae T, Sato S, Okimura S, Kuroda M. Risk factors for the postoperative recurrence of instability after arthroscopic bankart repair in athletes. Orthop J Sports Med 2017;5:2325967117726494.

34. Rose GD, Borroni M, Castagna A. The role of arthroscopic capsulolabral repair in unidirectional post-traumatic shoulder instability in adolescent athletes participating in overhead or contact sports. Joints 2014;1:108-111.

35. Kasik CS, Rosen MR, Saper MG, Zondervan RL. High rate of return to sport in adolescent athletes following anterior shoulder stabilisation: A systematic review. J ISAKOS 2019;4:33-40.

36. Alkaduhimi H, Verweij LPE, Willigenburg NW, van Deurzen DFP, van den Bekerom MPJ. Remplissage with Bankart repair in anterior shoulder instability: A systematic review of the clinical and cadaveric literature. Arthroscopy 2019;35:1257-1266.

37. Liu JN, Gowd AK, Garcia GH, Cvetanovich GL, Cabarcas BC, Verma NN. Recurrence rate of instability after remplissage for treatment of traumatic anterior shoulder instability: A systematic review in treatment of subcritical glenoid bone loss. Arthroscopy 2018;34:2894-2907.e2.
38. Yang JS, Mehran N, Mazzocca AD, Pearl ML, Chen VW, Arciero RA. Remplissage versus modified Latarjet for off-track Hill–Sachs lesions with subcritical glenoid bone loss. *Am J Sports Med* 2018;46:1885-1891.

39. Paulino Pereira NR, van der Linde JA, Alkaduhimi H, Longo UG, van den Bekerom MPJ. Are collision athletes at a higher risk of re-dislocation after an open Bristow-Latarjet procedure? A systematic review and meta-analysis. *Shoulder Elbow* 2018;10:75-86.

40. Griesser MJ, Harris JD, McCoy BW, Hussain WM, Jones MH, Bishop JY, Miniaci A. Complications and re-operations after Bristow-Latarjet shoulder stabilization: A systematic review. *J Shoulder Elbow Surg* 2013;22:286-292.

41. Williams HLM, Evans JP, Furness ND, Smith CD. It’s not all about redislocation: A systematic review of complications after anterior shoulder stabilization surgery. *Am J Sports Med* 2019;47:3277-3283.

42. Domos P, Lunini E, Walch G. Contraindications and complications of the Latarjet procedure. *Shoulder Elbow* 2018;10:15-24.

43. Di Giacomo G, Costantini A, De Gasperis N, De Vita A, Lin BKH, Francone M, et al. Coracoid graft osteolysis after the Latarjet procedure for anteroinferior shoulder instability: A computed tomography scan study of twenty-six patients. *J Shoulder Elbow Surg* 2011;20:989-995.

44. Di Giacomo G, de Gasperis N, Costantini A, De Vita A, Beccaglia MAR, Pouliart N. Does the presence of glenoid bone loss influence coracoid bone graft osteolysis after the Latarjet procedure? A computed tomography scan study in 2 groups of patients with and without glenoid bone loss. *J Shoulder Elbow Surg* 2014;23:514-518.

45. Ruff C, Holt B, Trinkaus E. Who’s afraid of the big bad Wolff? "Wolff’s law" and bone functional adaptation. *Am J Phys Anthropol* 2006;129:484-498.