

Arthroscopic Bankart repair versus arthroscopic Latarjet for anterior shoulder instability in adolescents

a matched-pair study

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Aims

The Bankart and Latarjet procedures are two of the most common surgical techniques to treat anterior shoulder instability with satisfactory clinical and functional outcomes. However, the outcomes in the adolescent population remain unclear, and there is no information regarding the arthroscopic Latarjet in this population. The purpose of this study was to evaluate the outcomes of the arthroscopic Bankart and arthroscopic Latarjet procedures in the management of anterior shoulder instability in adolescents.

Methods

We present a retrospective, matched-pair study of teenagers with anterior glenohumeral instability treated with an arthroscopic Bankart repair (ABR) or an arthroscopic Latarjet (AL) procedure with a minimum two-year follow-up. Preoperative demographic and clinical features, factors associated with dislocation, and complications were collected. Recurrence, defined as dislocation or subluxation, was established as the primary outcome. Clinical and functional outcomes were analyzed using objective (Rowe), and subjective (Western Ontario Shoulder Instability Index (WOSI) and Single Assessment Numeric Evaluation (SANE)) scores. Additionally, the rate of return to sport was assessed.

Results

A total of 51 adolescents were included, of whom 46 (92%) were male, with 17 (33%) in the Latarjet group and 34 (66%) in the Bankart group. The mean age at time of surgery was 18 years (15 to 19). There were no intraoperative complications. At a median follow-up of nine years (IQR 2 to 18), recurrence was observed in 12 patients in the Bankart group (35.3%) and one patient in the Latarjet group (5.9%) ($p = 0.023$). Satisfactory postoperative outcomes were obtained, with mean Rowe, WOSI, and SANE scores noted at 95 (10 to 100), 325 (25 to 1,975), and 87.5 (10 to 100), respectively. Most patients (29 in the Bankart group (85.3%) and 16 in the Latarjet group (94.1%)) were able to return to sport ($p = 0.452$).

Conclusion

The ABR and AL procedures both obtain satisfactory clinical and functional outcomes in the treatment of anterior glenohumeral instability in adolescents with a low complication rate. However, the ABR is associated with a significantly higher recurrence rate.

Take home message

- The arthroscopic Bankart and the arthroscopic Latarjet have shown satisfactory clinical and functional outcomes in the treatment of anterior glenohumeral instability in teenagers.

Introduction

Anterior glenohumeral instability is becoming an increasingly common pathology among the teenage population, most likely related to an earlier and increasing enrolment in competitive sport.^{1,2} This condition can profoundly impact their athletic performance and quality of life.

No consensus exists on the treatment of shoulder instability in teenagers. First episodes were traditionally treated conservatively.³ However, delay in surgery may lead to the development of severe bony lesions,⁴ worse postoperative scores,⁵ curtailment in sports participation,⁶ and even a rise in the incidence of osteoarthritis (OA).⁷ In addition, better postoperative outcomes have been reported when surgery is performed after a single dislocation episode.⁸ As a result, there has been a trend towards surgery after a first dislocation episode.

The arthroscopic Bankart repair (ABR) is considered the treatment of choice for the management of traumatic anterior glenohumeral instability.^{9,10} Although good short-term outcomes have been reported, the recurrence rate is noticeably high in adolescents, with reported rates ranging between 30% and 50%.^{11,12} As a result, Bankart repair with remplissage, or bone-block procedures such as the arthroscopic Latarjet (AL), have been proposed as an initial surgery when treating anterior instability in teenagers, especially in those with associated bone loss.¹³ While the literature concerning adult patients shows good short- and long-term outcomes, with low recurrence and complication rates,^{14,15} little is known about the Latarjet in young patients, and nothing has been published regarding the arthroscopic Latarjet in this specific population.¹⁶ Latarjet has some limitations that have raised concerns about its use in adolescents (i.e. is it a non-anatomical technique?), and it has been attributed an increased risk of early glenohumeral OA, and potential complications.

The purpose of this study was to analyze rates of recurrence and return to sport, and clinical and functional results, of teenage patients with anterior shoulder instability treated with an ABR or an AL procedure. The null hypothesis was that no differences in terms of recurrence, postoperative reported outcomes, or return to sport exist between the two procedures.

Methods

The study was approved by the Institutional Review Board under act 10/21.

Study population

An observational, retrospective study of prospectively collected data of patients with anterior glenohumeral instability younger than 20 years at the time of surgery was conducted. Patients treated with an AL were match-paired in a 1:2 ratio, with patients treated with an ABR procedure according to preoperative patient characteristics, including epidemiologic data and risk factors, except for bone loss.

Patients aged 20 years or younger, with preoperative MRI or CT, a minimum follow-up of two years, and who had consented to participate in the study were included. The following patients were excluded: those who had undergone additional procedures (such as remplissage, posterior capsular plication, superior labrum anterior to posterior (SLAP) lesion repair, surgery on the biceps-labral complex, or rotator cuff repair); patients with posterior or multidirectional instability surgery, revision surgery, or involvement of the operated limb by any other pathology not related to the episode under study that could influence the results of the intervention (such as fractures or motor paralysis due to systemic or neurovascular diseases); and those who declined to participate in the study.

Surgical technique

All procedures were performed by the same senior surgeon (EC). The choice of the procedure was based on bone loss: an ABR was performed on patients with on-track Hill-Sachs lesions, with anterior bone loss lower than 15% or no bone loss; and in those with an off-track Hill-Sachs lesion or an anterior glenoid bone loss of 15% or more, an AL procedure was carried out following the technique described by Lafosse et al,¹⁷ using the Depuy Mitek arthroscopic Latarjet system (DePuy Mitek, USA).

Postoperatively, immobilization with a sling with the arm in a neutral position was maintained for three weeks after surgery, only being removed three times a day to maintain joint balance of the elbow and wrist. Self-assisted exercises in the supine position in forward flexion and abduction were allowed from the first postoperative week while avoiding external rotation until the sixth week after surgery, when muscle strengthening was also initiated.

Clinical evaluation

Medical records of all eligible patients were reviewed by a single observer (JMM-R). Preoperative characteristics of the patients, including demographic features (sex, history of epilepsy, side, dominance, age at first instability episode, mechanism of injury, preoperative degree of instability, number of previous instability episodes before surgery, and age at surgery), sports activity, and level of competition were recorded.

The primary outcome was recurrence at the time of follow-up, defined as subluxation or dislocation. Intraoperative and postoperative complications were also recorded.

Postoperative clinical and functional status were evaluated at the final follow-up using the degree of instability,¹⁸ the Rowe score,¹⁹ the Spanish validated version of the Western Ontario Shoulder Instability Index (WOSI),²⁰ and the Single Assessment Numeric Evaluation (SANE).²¹

Regarding sports activities, the type of sport and the level of competition were recorded. The type of sport was classified into five categories,²² as follows: 0) sedentary life without sporting activity; 1) non-contact sports; 2) sports which do not require overhead use of the arm; 3) sports requiring overhead use of the arm without forced abduction and external rotation (e.g. golf or weightlifting); and 4) sports involving overhead hitting movements or contact sports with a high risk of falls (e.g. basketball, tennis, or rugby). The level of competition was graded according to five categories:²² 0) no sporting activity; 1) recreational sport; 2) high school

team sport; 3) university team sport; and 4) professional sport. Finally, return to sport was recorded and classified as follows: 0) no return to sports activity; 1) partial recovery (less than 25% recovery); 2) subtotal recovery (between 25% and 50% recovery); and 3) complete recovery of previous sports activity.

Imaging study

Anteroposterior and scapular Y radiological views of the shoulder were performed in all patients. Bone loss and glenoid track evaluation were conducted by a previously trained shoulder and elbow surgeon (CD) using either CT scan (Siemens Somatom Definition Flash 128-slice CT Dual Energy; Siemens Healthcare, Germany) or MRI scan (Siemens Magnetom Verio 3T, A Tim+Dot System, Siemens Healthcare). Glenoid bone loss was expressed as a percentage of the circle's diameter following the formula $d/D \times 100$. Glenoid track measurements were performed as described by Calvo et al.²³ following the method described by Gyftopoulos et al.²⁴

Statistical analysis

Statistical analysis was performed using SPSS software v. 26 (IBM, USA) and Prims 5.0 (GraphPad, USA). The normal distribution of data was analyzed using the Kolmogorov-Smirnov test. Quantitative variables were expressed as mean (SD) or median (IQR). Comparison of quantitative data was conducted using independent-samples *t*-test for parametric data and the Mann-Whitney U test for non-parametric data. Categorical variables were depicted using frequencies and percentages and compared using the chi-squared test. Additionally, Kaplan-Meier survival analysis was employed to assess recurrence-free time, with survival times compared using the log-rank test. Multivariate logistic regression analysis was performed to explore significant associations between preoperative features and recurrence. Power analysis was conducted prior to data collection. Thus, with an α risk of 0.05 and β risk of 0.2 in a two-sided test, 17 subjects were deemed necessary in each group in order to detect a statistically significant difference equal to or greater than the established thresholds. The significance level was established at $p < 0.05$.

Results

Patient selection

Initially, 81 adolescent patients with anterior glenohumeral instability treated with an ABR (62 cases) or AL (19 patients) at our hospital were identified (Figure 1). Of these, ten patients were excluded: two in the AL group (one lost to follow-up and one revision surgery); and eight patients in the ABR group (five lost to follow-up, two due to additional surgical procedures performed, and one patient declined to participate). Thus, a final sample of 17 patients in the AL group was available and was matched with 34 of the 54 patients managed with an ABR (Figure 1).

The demographic characteristics of all participants are summarized in Table I.

Complications

No intraoperative or immediate postoperative complications were detected in either group. There was no statistically significant difference between the groups in rates of postoperative complications, with no complications detected in the AL group. Three patients in the ABR group (8.8%) experienced

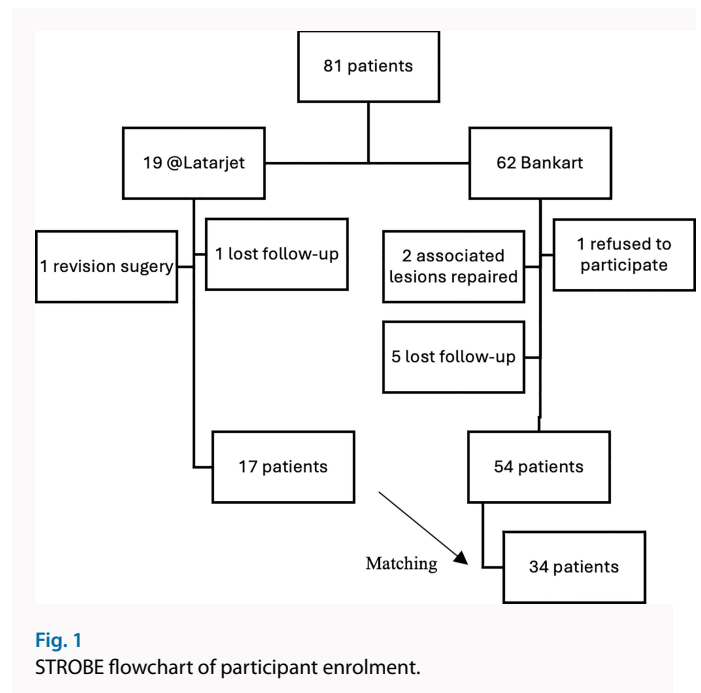


Fig. 1
STROBE flowchart of participant enrolment.

pain and limited range of motion that was fully restored with physiotherapy.

Recurrent instability

At a median follow-up of nine years (IQR 2 to 18), recurrence was observed in 12 patients in the ABR group (35.3%) and one patient in the AL group (5.9%) ($p = 0.023$). At eight years, survival free from recurrence was 64.7% in the ABR group and 94.1% in the AL group ($p = 0.049$) (Figure 2).

The multivariate and linear regression analysis showed no association between preoperative features and recurrence. Of the 12 patients with recurrence in the ABR group, eight underwent revision surgery: in two patients a new ABR was carried out, while in the remaining six patients an AL procedure was performed. In the AL group, revision surgery using iliac crest as a free graft was needed in the patient with recurrent instability. Revision surgery was also performed in a patient treated with a Latarjet who reported screw-related discomfort. Removal of the screws resulted in a complete resolution of symptoms.

Postoperative clinical and functional outcome measures

Postoperative subjective and objective outcomes are summarized in Table II. The mean Rowe, WOSI, and SANE scores were 95 (10 to 100), 325 (25 to 1,975), and 87.5 (10 to 100), respectively. No statistically significant differences between groups were found.

No significant differences in type or level of postoperative sports were found between the groups, with 29 patients in the ABR group (85.3%) and 16 patients in the AL group (94.1%) being able to return to sport ($p = 0.452$, chi-squared test).

Discussion

The main finding of this study is that both the ABR and AL procedures achieve excellent clinical and functional outcomes and high return-to-sport rates in the treatment of anterior glenohumeral instability in adolescents. However, the ABR

Table I. Demographics and preoperative clinical and radiological features of the two studied groups.

Variable	All (n = 51)	Arthroscopic Bankart (n = 34)	Arthroscopic Latarjet (n = 17)	p-value*
Sex, n (%)				
Male	47 (92.2)	30 (88.2)	17 (100.0)	0.141
Female	4 (7.8)	4 (11.8)	0 (0.0)	
Side, n (%)				
Right	19 (37.3)	12 (35.3)	7 (41.2)	0.682
Left	32 (62.7)	22 (64.7)	10 (58.8)	
Dominant side, n (%)				
Yes	24 (47.0)	15 (44.1)	6 (35.3)	0.133
No	27 (53.0)	19 (55.9)	11 (64.7)	
Mean age at first instability episode, yrs (range)	16 (11 to 19)	16 (11 to 18)	16 (14 to 19)	0.305
Mean no. of instability episodes (range)				
Dislocation	3 (0 to 25)	2.5 (0 to 20)	4 (0 to 25)	0.120
Subluxation	1 (0 to 100)	1 (0 to 8)	1 (0 to 100)	0.290
Type of sport, n (%)				
0	4 (7.8)	2 (5.9)	2 (11.8)	0.125
1	5 (9.8)	5 (14.7)	0 (0.0)	
2	9 (17.6)	7 (20.6)	2 (11.8)	
3	4 (7.8)	4 (11.8)	0 (0.0)	
4	29 (57.0)	16 (47.0)	13 (76.4)	
Sport level, n (%)				
0	5 (9.8)	2 (5.9)	3 (17.7)	0.657
1	16 (31.4)	12 (35.3)	4 (23.5)	
2	19 (37.2)	14 (41.1)	5 (29.4)	
3	8 (15.7)	4 (11.8)	4 (23.5)	
4	3 (5.9)	2 (5.9%)	1 (5.9)	
Epilepsy, n (%)				
Yes	1 (2.0)	0	1 (5.9)	0.159
No	50 (98.0)	34 (100.0)	16 (94.1)	
Mean age at surgery, yrs (range)	18 (15 to 19)	18 (15 to 19)	18 (15 to 19)	0.106
Preoperative degree of instability, n (%)				
0 Sedentary				0.452
1 Traumatic		11 (32.3)	3 (17.7)	
2 Sports		7 (20.6)	4 (23.5)	
3 Activities of daily living		7 (20.6)	2 (11.8)	
4 Sleeping/spontaneous		9 (26.5)	7 (41.2)	
Mean glenoid bone loss percentage (range)	4.6 (0 to 25.7)	2 (0 to 19.5)	11 (0 to 25.7)	0.020
Glenoid track, n (%)				
On-track	41 (80.4)	32 (94.1)	9 (52.9)	0.030
Off-track	10 (19.6)	2 (5.9)	8 (47.1)	

*Chi-squared test for qualitative data, and independent-samples t-test and Mann-Whitney U test for quantitative data.

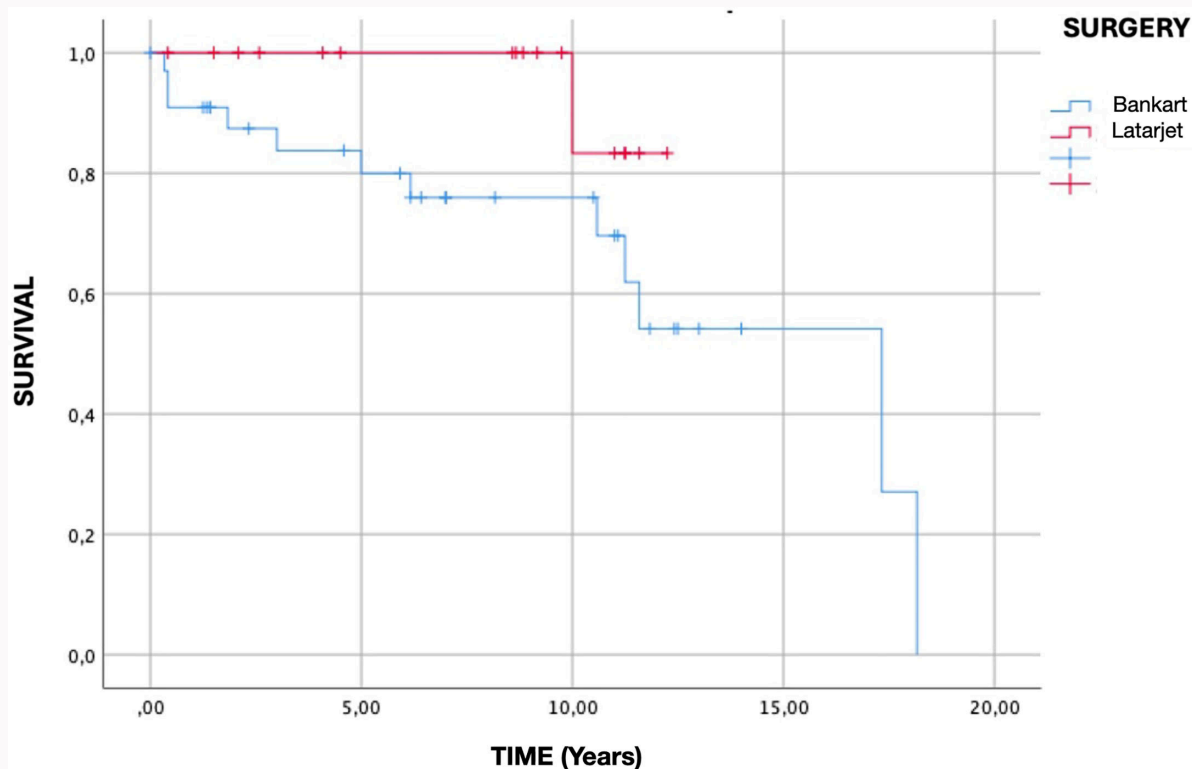


Fig. 2

Kaplan-Meier survival curve of recurrences for the Bankart and Latarjet groups over time showing an estimate for the cumulative proportion of stable shoulders of 0.65 for Bankart patients and 0.94 for patients with Latarjet. Log-rank test, $p = 0.049$.

is associated with a significantly higher recurrence rate compared with the AL procedure.

Young age has been proposed to be the main prognostic factor for recurrence: adolescents have the highest risk of developing glenohumeral instability after a first episode of traumatic anterior dislocation. Zachilli and Owens²⁵ revealed the highest incidence of dislocation in the group aged between ten and 19 years (39.7/100.000 person-years). Similarly, Roberts et al²⁶ reported a 76.7% recurrence rate in 133 patients aged 14 to 18 years. Young age has also been identified as a risk factor for the development of an off-track Hill-Sachs lesion.⁴ Variables related to persistent instability such as a higher number of instability episodes or increased time from first instability episode to surgery were also found to be risk factors for the development of off-track Hill-Sachs lesions in the Delgado et al⁴ series. These findings have led some authors to propose early stabilization procedures, especially in adolescents, the population at higher risk of recurrence and development of bone loss. In addition, better outcomes have been reported in those patients undergoing surgery after the first dislocation episode.^{8,27} Gigis et al⁸ showed a markedly higher recurrence rate of 70.3% in teenagers with glenohumeral instability managed conservatively, compared with patients who were initially treated surgically (13.1%). These results were further supported by the systematic review conducted by Longo et al,²⁷ which encompassed 15 studies with 705 shoulders of patients aged 18 years or younger. The recurrence rate of patients undergoing surgery after the first dislocation episode was noted at 17.5%, whereas patients treated surgically after the second or more dislocation episodes showed a significantly

higher recurrence rate, at 71.3%. Furthermore, patients who underwent surgery following their first dislocation episode showed superior outcomes in return to sport and better functional status.

The Bankart repair is still the most common technique for the treatment of anterior instability. Studies focused specifically on the outcomes of arthroscopic stabilization using the Bankart repair technique in teenagers report satisfactory clinical outcomes but high recurrence rates. In our series, a high recurrence rate of close to 35% has been observed, in line with that previously reported in the literature. In a cohort of 30 patients aged 11 to 18 years treated with an ABR, Jones et al²⁸ found an 18% rate of recurrence. Patients involved in sport do also have a high risk of recurrence. Torrance et al¹¹ described a recurrence rate of 51% in young professional collision sports athletes, whereas Kramer et al⁹ found a 33% recurrence rate in patients involved in contact sports. Despite these high recurrence rates, return to sport after the Bankart repair is common. An overall return-to-sport rate of close to 82% was described in the systematic review designed by Kasik et al²⁹ in 2019. Our results are consistent with the literature, showing a high return-to-sport rate following ABR of close to 86%, and satisfactory objective and subjective outcomes.

On the other hand, in our series, the AL procedure has been shown to be an effective technique with favourable clinical outcomes and minimal recurrence rates.¹⁴ The overall recurrence rate in the AL group in our study was 5.9%, significantly lower than that of the ABR. Similar recurrence rates have been reported previously in the literature. Domos et al¹⁶ examined the results of the open Latarjet procedure in

Table II. Postoperative clinical and functional outcomes and sports activity.

Variable	All (n = 51)	Arthroscopic Bankart (n = 34)	Arthroscopic Latarjet (n = 17)	p-value*
Median Rowe score (IQR)	95 (10 to 100)	95 (10 to 100)	95 (55 to 100)	0.294
Median WOSI score (IQR)	325 (25 to 1,975)	310 (15 to 1,975)	329 (25 to 1,405)	0.552
Median SSV score (IQR)	87.5 (10 to 100)	90 (10 to 100)	80 (70 to 100)	0.525
Type of sport, n (%)				
0	7 (13.7)	4 (11.8)	3 (17.6)	0.424
1	16 (31.4)	11 (32.4)	5 (29.4)	
2	7 (13.7)	6 (17.6)	1 (5.9)	
3	8 (15.7)	6 (17.6)	2 (11.8)	
4	13 (25.5)	7 (20.6)	6 (35.3)	
Sport level, n (%)				
0	7 (13.7)	4 (11.8)	3 (17.6)	0.160
1	16 (31.4)	15 (44.1)	1 (5.9)	
2	19 (37.3)	11 (32.4)	8 (47.1)	
3	7 (13.7)	3 (8.8)	4 (23.5)	
4	2 (3.9)	1 (2.9)	1 (5.9)	

*Independent-samples t-test for quantitative data, and chi-squared test for qualitative data. SSV, Subjective Shoulder Value; WOSI, Western Ontario Shoulder Instability Index.

45 patients aged 13 to 17 years and found a 4% recurrence rate. Similarly, Khan et al³⁰ showed a 7% recurrence rate in skeletally immature patients (aged younger than 16 years) treated with an open Latarjet procedure. These satisfactory results are also obtained in athletes, as demonstrated by Rossi et al,³¹ who found a 3.3% recurrence rate in competitive athletes aged younger than 20 years treated with an open Latarjet. Therefore, although our data are consistent with the literature, it is important to highlight that the present study reports, for the first time, on the AL whereas previous studies evaluated the open approach. Interestingly, in our study we did not encounter any intraoperative or postoperative complications in patients undergoing AL, in contrast with previous literature reporting a 30% complication rate following the open Latarjet procedure.³² Moreover, it is worth highlighting that there is some concern about the possibility of growth disturbance or glenoid deformities, especially in those aged 15 years or younger who present with incomplete ossification of the scapula. Similar to the literature, with studies such as the one by Domos et al,¹⁶ who examined a series of patients aged between 13 and 17 years and did not observe growth disturbances or glenoid deformities after 6.6 years postoperatively, our study included five skeletally immature patients in the AL group (29.4%), and we did not find any of these complications. This lower complication rate observed in our study may be related to the fact that the procedure was performed arthroscopically as suggested by previous literature.¹⁵ Interestingly, we have not found recurrence rates and postoperative outcomes to be related to preoperative features, contrary to those reported by Olds et al.³³

These findings have relevant clinical implications. First, there are limited data regarding glenohumeral instability

treatment in adolescents, despite teenagers being particularly at risk. Second, this is the first study reporting on arthroscopic Latarjet results on adolescents. It is important to note that patients up to 19 years old have been enrolled, in addition to younger adolescents. However, some patients aged 20 years still have an unfused coracoid ossification centre and could be considered as skeletally immature. On the other hand, it is important to stress the main finding of our study; the ABR has been shown to have a significantly higher failure rate in teenagers compared with the Latarjet. Given the high risk of developing large off-track Hill-Sachs lesions, risk of recurrence in young patients, and high failure rates of the Bankart repair, the Latarjet procedure would seem to be the ideal technique for managing glenohumeral instability in adolescents, especially in those with bone defects and recurrent episodes of dislocation.

There are several limitations to be acknowledged. First, this is a retrospective, non-randomized study. The AL group was small, compared with the ABR group, and that is why we have been compelled to conduct a matched-pair study. However, according to sample size predetermination, the number of patients enrolled in the study is enough for statistical analysis. On the other hand, we do not have long-term analysis of the glenohumeral arthritis development. Finally, other techniques that might be indicated in this specific subpopulation, for example Bankart with remplissage, have not been assessed. Nevertheless, this study has strengths. First, both samples were homogeneous for preoperative features. Moreover, all surgeries were performed by the same surgeon (EC) and the medical records were reviewed by the same single observer (JMM-R). Furthermore, although it is a retrospective study, data collection was conducted prospectively.

In conclusion, both the ABR and AL procedures achieve satisfactory clinical and functional outcomes, with low complication rates, in the treatment of anterior glenohumeral instability in teenagers. However, the ABR is associated with a significantly higher recurrence rate.

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