Latarjet procedure combined with inferior capsular shift for recurrent anterior shoulder instability in patients with hyperlaxity

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Background
Recurrent unidirectional anterior shoulder instability is a common disease especially among professional athletes. Open latarjet operation is a common surgical procedure used for the treatment of this condition, especially in cases associated with a high instability severity index score (ISIS) including cases with humeral bone loss (Hill–Sachs lesion) or anteroinferior glenoid bone loss. Persistent apprehension or recurrence of instability after the latarjet procedure might be attributed to associated anterior capsular laxity that was not addressed in the primary surgery.

Hypothesis
Combining coracoid bone transfer with capsulorraphy and capsular shift, and maintaining the sling effect of the conjoint tendon might be beneficial in patients with recurrent anterior shoulder instability associated with anterior capsular redundancy (ACR).

Patients and methods
A total of 30 patients with recurrent unilateral symptomatic involuntary unidirectional anterior shoulder instability were studied. All patients had an evidence of joint hyperlaxity with a Beighton score ranging from 6 to 9, mean 7.63±1.07. Evidence of ACR (Sulcus sign) was present. ISIS was superior than or equal to 4. In this study, the ISIS ranged from 6 to 10, with a mean of 8.38 and SD of 0.89. All of the patients underwent an open Latarjet procedure with superior capsular shift and capsulorraphy using Ethibond N:5 sutures wrapped around the serrations of the screw. All the patients were interrogated, examined clinically, and scored according to the Constant–Murley scoring system.

Results
The most important finding of this study is the marked improvement in the symptoms of instability as well as the level of function after surgery. There was a highly statistically significant difference between the preoperative and the postoperative Constant–Murley score.

Conclusion
In anterior shoulder instability with ACR, the Latarjet procedure associated with an anteroinferior capsulorrhaphy is an effective alternative to arthroscopic or open capsular shift and should help in reducing postoperative apprehension. The sooner the reconstructive surgery is performed, the better the functional outcome.

Keywords:
anterior capsular redundancy, joint hyperlaxity, latarjet, recurrent anterior shoulder instability

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Introduction

Recurrent unidirectional anterior shoulder instability is a common disease especially among professional athletes. Open latarjet operation is a common surgical procedure used for the treatment of this condition, especially in cases associated with a high instability severity index score (ISIS) including cases with humeral bone loss (Hill–Sachs lesion) or anteroinferior glenoid bone loss [1–5].

Persistent apprehension or recurrence of instability after the latarjet procedure might be attributed to associated anterior capsular laxity that was not addressed in the primary surgery. If patients suffering from instability and anterior capsular laxity were properly diagnosed (picked Up) pre-operatively, then they may be correctly treated by a combination of coracoid bone transfer and capsular shift capsulorraphy to optimize the functional outcome and minimize the post-operative recurrence of instability [6].

Isolated acquired [7] or constitutional [8–10] ACR has been reported in many series dealing with unidirectional anterior shoulder instability in patients without Multi directional instability (MDI) [11,12].

There is no simple method available to identify patients who present with an ACR [13,14], but the association of different criteria including instability history, sulcus sign, female sex, or increased generalized joint hypermobility Beighton score [15] should be considered as predisposing risk factors for ACR. Interestingly, Balg and Boileau [5] developed a 10-point preoperative ISIS to identify patients who may potentially develop recurrent anterior shoulder instability after an arthroscopic Bankart procedure and who would be better treated by a bone block procedure. In this score, among four other items, shoulder hyperlaxity is considered a risk factor for recurrence after arthroscopic stabilization of the shoulder. Patients with ISIS equal to or more than four would be better treated by a bone block procedure [16–18].

This research investigates the results of treatment of the ACR(+) population suffering from unidirectional recurrent anterior shoulder instability using a Latarjet procedure combined with inferior capsular shift using an innovated surgical technique by wrapping Ethibond N:5 sutures around the threads of the partially threaded cancellous 4.5 screws used for fixation of the coracoid fragment. The needle attached to the Ethibond suture is used for capsular shift capsulorraphy. The procedure is cost effective and can be totally performed through the split of the subscapularis without the need for complete detachment of the subscapularis tendon, such as what might be needed during conventional open capsular shift operations, thus maintaining the sling effect of the conjoint tendon and maximizing the postoperative functional outcome.

Patients and methods

A total of 30 patients with recurrent unilateral symptomatic involuntary unidirectional anterior shoulder instability were studied. All patients showed a positive anterior apprehension sign in maximal abduction and external rotation (Tables 1 and 2). Informed consent was obtained from all participants included in the study according to the ethical standards approved by our institution.

Inclusion criteria

(1) All patients had an evidence of joint hyperlaxity with a Beighton score ranging from 6 to 9, mean±SD of 7.63±1.07.
(2) Evidence of ACR (Sulcus sign).
(3) ISIS superior than or equal to four. In this study, the ISIS ranged from 6 to 10, with a mean of 8.38 and SD of 0.89 (Table 1).

Exclusion criteria

All of the patients who fulfilled the following criteria were excluded from the study:

(1) Patients with associated signs of posterior instability.
(2) Concomitant rotator cuff lesion.
(3) Voluntary or multidirectional instability.
(4) Previous anterior stabilization surgery.

History was taken from all patients,then they were examined clinically and scored according to the Constant–Murley (CM) scoring system [19]. The preoperative score ranged from 15 to 60, with a mean of 35.78 and SD of 12.37 (Table 1).

Table 1 Preoperative clinical variables

Variables	Minimum–maximum	Mean±SD
ISIS	6–10	8.38±0.89
Beighton score	6–9	7.63±1.07
Preoperative CM score	15–60	35.78±12.37

CM, Constant–Murley.

Table 2 Characteristic demographic features of the patient group studied

Variables	Number (%)
Age	
<20	6 (20.0)
20–23	14 (46.7)
>23	10 (33.3)
Range	17–30
Mean±SD	22.6±3.09
Sex	
Male	16 (53.3)
Female	14 (46.7)
Dominant side	
Right	24 (80.0)
Left	6 (20.0)
Affected side	
Dominant	21 (70.0)
Nondominant	9 (30.0)
Number of dislocations	
<10	8 (26.7)
10–15	15 (50.0)
>15	7 (23.3)
Range	7–20
Mean±SD	13.0±3.60
Energy	
Sport	14 (46.7)
High	2 (6.7)
Mild	10 (33.3)
Low	4 (13.3)
Sport type	
Noncontact	11 (36.7)
Contact	7 (23.3)
Forced overhead	6 (20.0)
Overhead	6 (20.0)

Radiography and computed tomography with 3D reconstruction were performed to evaluate the presence of and quantify any anteroinferior glenoid bone loss, as well as posterior humeral head bone defect (Hill–Sachs) lesion. Magnetic resonance Imaging (MRI) was also performed to assess the presence of associated humeral avulsion of the glenohumeral ligaments lesion, associated lesions as rotator cuff lesions or Superior Labrum Anterior & posterior (SLAP) lesions, and finally to assess the presence of capsular redundancy [20,21].

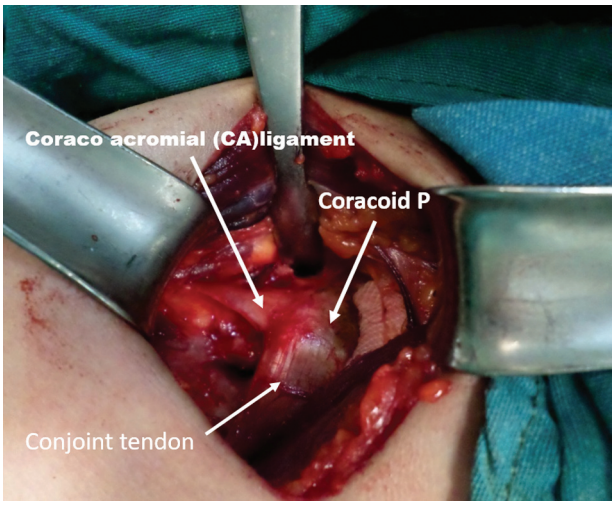
Surgical technique

All the patients were operated under general anesthesia in the beach chair position and the arm was draped free to allow motion intraoperatively. A 5–7 cm incision starting from the tip of the coracoid process (CP) directed downwards to the axillary fold. A deltopectoral approach was used, the deltopectoral interval was located, and the cephalic vein was identified (Fig. 1).

The arm was held in external rotation and abduction, and then the coracoacromial ligament, which is best exposed in this position, was incised from its coracoid attachment with electrocautery. The coracohumeral ligament, found beneath the coracoacromial ligament, was then released. The arm was then placed in adduction and internal rotation to improve exposure on the medial side of the coracoid and the pectoralis minor muscle was detached from the medial surface of the CP. A coracoid osteotomy was performed at a line just anterior to the coracoclavicular ligament insertion at the junction of the vertical and horizontal parts of the coracoid using an oscillating saw or a curved osteotome. Any remaining parts of coracohumeral ligament attachments were released. The arm was returned to the neutral position (Fig. 2). The soft tissue was removed from the inferior surface of the coracoid using electrocautery. The oscillating saw was then used to decorticate the inferior coracoid surface, exposing a broad flat cancellous bone.

Two drill holes were created for the 4 mm cannulated cancellous partially threaded screws on the undersurface of the coracoid using a 2.7 drill bit. The subscapularis muscle was split at the junction of the upper two-thirds and the lower one-third with the arm held by the side and externally rotated. The capsule was then exposed and bluntly dissected from the undersurface of the subscapularis, and then an oblique capsular incision was performed to allow later superior shift of the anteroinferior capsule (Fig. 3). Exposure of the anteroinferior glenoid surface was performed. The anteroinferior labrum and periosteum were excised with electrocautery. An osteotome and an oscillating burr were used to decorticate the anterior surface of the glenoid. The aim was to create a flat surface with bleeding cancellous bone on which the graft was placed. A 2.7 mm drill bit was used to drill the inferior hole in the glenoid. The second hole already made in the coracoid was used as a guide to place a preliminary mark on the glenoid for later insertion of the upper screw. Ethibond N:5 sutures wrapped around the serrations of the screws were used to suture the capsule in the new position after performing the capsulotomy and the upward capsular shift (Fig. 4).

Figure 1

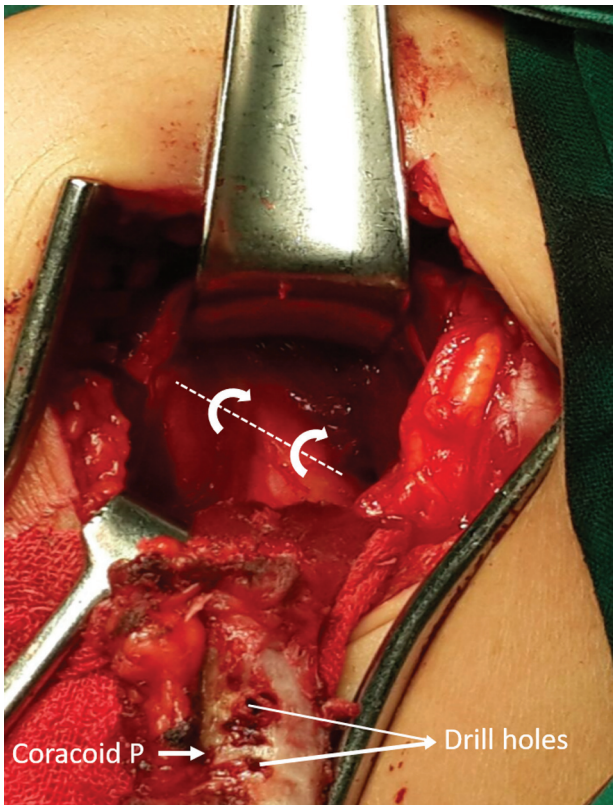


Deltopectoral approach. Detaching pectoralis minor and coracoacromial ligament from the coracoid process.

Figure 2

Osteotomy and reflection of the coracoid process with the attached conjoint tendon.

Figure 3

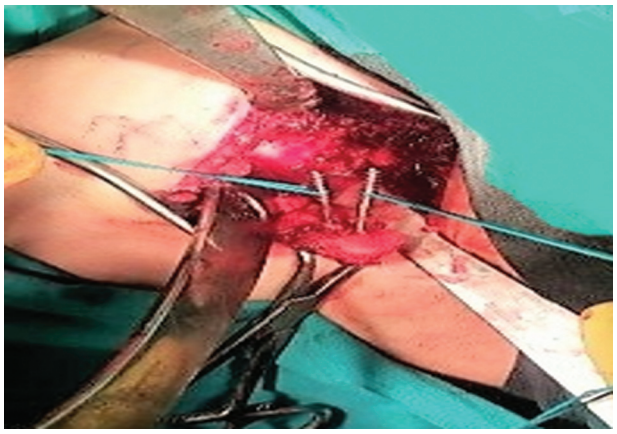


After proper decortication of the coracoid fragment and making drill holes for the 4 mm cannulated cancellous partially threaded screws on the undersurface of the coracoid, the subscapularis muscle was split at the junction of the upper two-thirds and the lower one-third. The capsule was then exposed, whereby an oblique capsular incision (dotted line) was performed to allow superior shift of the anteroinferior capsule (the direction of the shift is shown by arrows).

A partially threaded 4 mm cannulated cancellous screw was then fully inserted into the inferior hole in the coracoid graft (i.e. conjoint tendon end) after measuring its length. The screw was then placed into the already drilled hole in the glenoid and tightened into position, ensuring that the coracoid comes to lie parallel to the articular margin of the glenoid with no overhang. When the position of the coracoid was parallel to the glenoid, the second hole drilling was completed with the 2.7 mm drill bit through the glenoid using the preliminary mark that was placed on the glenoid by the diathermy as a guide. Fixation with another partially threaded 4.5 mm cancellous screw was performed. Both screws were tightened using a '2-finger' technique to avoid graft fracture.

After proper fixation of the coracoid graft, superior shift of the anteroinferior capsule was performed and capsulorraphy was performed using the Ethibond N:5 sutures that were wrapped around the serrations of the screws. Finally, closure was performed in layers and the wound was closed using subcuticular sutures without a suction drain after proper hemostasis.

Figure 4



The Ethibond N:5 sutures wrapped around the serrations of the screws were used for suturing the capsule in the new position after performing the capsulotomy and the upward capsular shift.

Postoperative rehabilitation

Postoperatively, all shoulders were routinely immobilized in a sling for 2 weeks with the arm in adduction and internal rotation. During that time, active exercises for the fingers, wrist, and elbow, as well as isometric exercises of the deltoid muscle were allowed.

After removal of the sling, gentle passive (pendulum) exercises and active assisted range-of-motion exercises were initiated. At 4 weeks, progressive active assisted range-of-motion exercises were begun and continued until a full range of motion was regained. Active resistance exercises with a light weight were started 6 weeks postoperatively.

Light sports activity, including overhead sports, was permitted 10 weeks after surgery, whereas contact sports were allowed 3 months postoperatively.

Methods of assessment of the results

All the patients were interrogated, examined clinically, and scored according to the CM scoring system [19], the Walch–Duplay score [12,22], and the Rowe score [11]. Clinical assessment was performed 1 and 6 months postoperatively. Glenohumeral arthritis was classified according to Samilson on the anteroposterior view [23]. The positioning of the CP and its fusion (lysis, pseudoarthrosis, fracture) were evaluated on both anteroposterior and profile views.

Statistical analysis

The data were collected and entered into a personal computer. Statistical analysis was carried out using the statistical package for social sciences (SPSS, version 20) software (IBM Corp., Released 2011, IBM SPSS Statistics for Windows, Version 20.0, Armonk, NY: IBM Corp.).

Arithmetic mean, SD, and for categorized parameters, the χ^2-test was used, whereas for numerical data, a *t*-test was used to compare two groups whereas for more than two groups, the analysis of variance test was used. To find the association between two variables, Spearman's correlation coefficient test was used. The level of significance was 0.05.

Results

There was a highly statistically significant difference between the preoperative and the postoperative CM score (Tables 3, 4 and Fig. 5). There was also a statistically significant difference between the preoperative CM score and other postoperative scoring systems, further emphasizing the marked improvement in the patients (Table 5 and Fig. 6).

It was found in our study that there was a correlation between the level of the sports and the final postoperative scores, with better results among patients who practiced sports occasionally on a recreational base (Table 6).

There was a statistically significant relation between the energy at the first dislocation and the number of instability episodes. In addition, patients practicing sports at the competitive level had significantly more instability episodes than others (Table 7).

There was also a statistically significant negative correlation between the number of instability episodes and the final outcome assessment scores (Table 8).

The coracoid fragment was fully united in all of the cases included in this study. There was no evidence of nonunion or lysis of the graft. In addition, there was no evidence of osteoarthritic changes at the end of follow-up.

Table 3 Descriptive statistics of the postoperative assessment scores

Postoperative assessment scores	Minimum–maximum	Mean±SD
Postoperative Rowe score	45–95	72.97±14.77
Postoperative CM score	40–95	71.56±16.16
Postoperative WD score	55–95	76.25±12.86

CM, Constant–Murley; WD, Walch–Duplay.

Table 4 Comparison between preoperative and postoperative Constant–Murley score

	Preoperative CM score	Postoperative CM score
Range	15–60	40–95
Mean	35.78	71.56
SD	12.37	16.16
t	6.25	
P	0.001*	

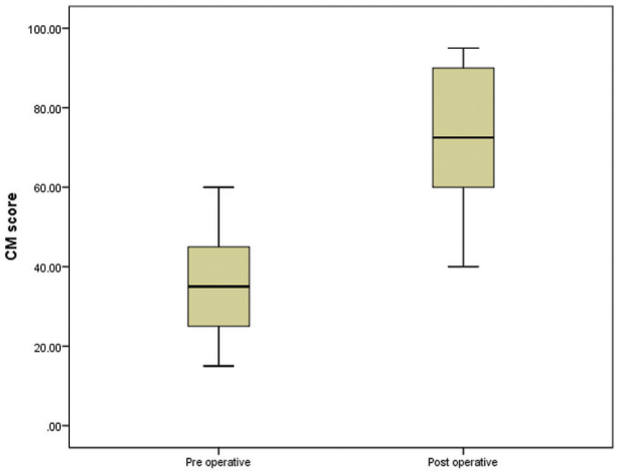
CM, Constant–Murley.

Discussion

The most important finding of this study is the marked improvement of the symptoms of instability as well as the level of function after surgery.

Patients with symptomatic unilateral involuntary anterior shoulder instability with clinically documented joint hyperlaxity as proven by a high Beighton score ranging from six to nine with an average of 7.63 were included in this study. Although Latarjet operation is a well-known reconstructive surgical procedure for the management of recurrent shoulder dislocation associated with humeral head defect (Hill–Sachs) lesion and/or anteroinferior glenoid bone loss, some patients reported having persistent apprehension following this kind of surgery, and on investigating these patients, most showed evidence of joint hyperlaxity. However, no evidence of multi-directional instability and the first dislocation was induced by a definite traumatic event. These patients, in addition to joint hyperlaxity, showed signs of ACR as evidenced clinically by a positive sulcus sign and by preoperative MRI [1–4,6,20,24].

Figure 5



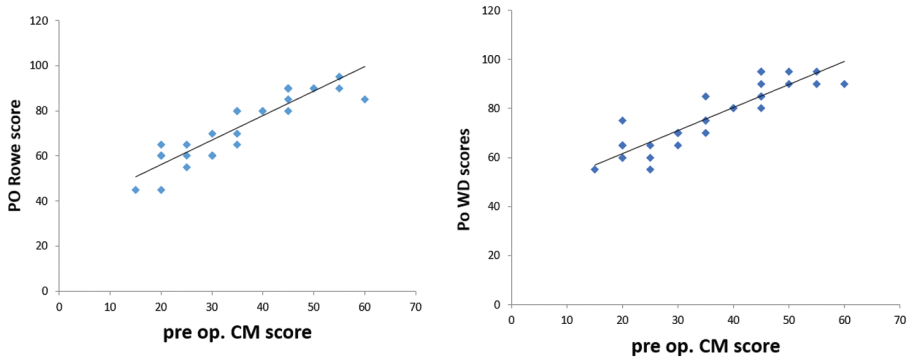
A box plot graph to compare between the preoperative and the postoperative Constant–Murley score showing a highly statistically significant difference between the preoperative and the postoperative Constant–Murley score.

Table 5 Correlation between preoperative Constant–Murley and postoperative Constant–Murley score in relation to the Rowe score and the Walch–Duplay (WD) score

Preoperative CM score	Pearson's correlation (*r*)	*P*
Preoperative Rowe score	0.908**	0.0001
Walch–Duplay (WD) score	0.899**	0.0001

CM, Constant–Murley; **P=0.01, significant.

Figure 6



The relation between the preoperative Constant–Murley score and the postoperative Rowe score and Walch–Duplay scores, respectively.

Table 6 Relation between the level of sport practice and the postoperative Walch–Duplay score

Sport level	Walch–Duplay (WD) score		ANOVA (*P*)
	Range	Mean±SD	
Competitive	55.00–95.00	72.19±11.54	3.45 (0.031*)
Occasional	75.00–95.00	87.50±8.02	
Recreational	60.00–90.00	73.00±15.65	

ANOVA, analysis of variance. *P=0.05, significant.

Table 7 Relation between number of instability episodes, the energy of the first dislocation, and sport level

	Number of instability episodes		ANOVA (*P*)
	Range	Mean±SD	
Energy of the first dislocation			
High	17–18	17.5±0.707	5.09 (0.007*)
Low	8–20	14.2±4.92	
Mild	7–17	10.2±3.39	
Sport	12–19	14.0±2.14	
Sport level			
Competitive	12–19	14.43±2.33	3.77 (0.023*)
Occasional	7–17	9.8±3.64	
Recreational	9–20	13.6±4.66	

*P=0.05, significant.

Table 8 Correlation between Rowe score and Walch–Duplay (WD) score and the number of instability episodes (*N*)

Number of instability episodes (*N*)	PO Rowe score	PO WD score
Pearson's correlation (*r*)	–0.768**	–0.748**
P	0.0001	0.0001

PO, post-operative; **P=0.01, significant.

Collin *et al.* [2] reported the results using an open coracoid bone block transfer for the treatment of anterior shoulder instability and highlighted a significant link between ACR and a persistent apprehension sign after an isolated Latarjet procedure.

The Latarjet procedure is usually considered in cases of glenoid bone loss and in situations with risk factors for recurrence following arthroscopic repair. The ISIS has been used as a guideline for the surgical management of recurrent shoulder instability, with patients with a score equal to or more than 4 points being candidates for a coracoid bone transfer reconstructive procedure. In our study, the ISIS ranged from 6 to 10, with an average 8.36; thus, all the patients were candidates for coracoid bone transfer reconstructive surgery [1–5].

Ahmad *et al.* [6] indicated that a redundancy of the anteromedial capsule of the shoulder persists despite proper tensioning of the capsule and repair of the Bankart lesion during anteroinferior capsular shift. Associated capsular laxity or redundancy may partially explain the variable outcome of arthroscopic procedures in terms of stability [25,26].

The combination of capsulorrhaphy and the Latarjet procedure was first reported by Walch *et al.* [12] in MDI patients with good results using an associated T-shaft capsulorrhaphy. In another study, Hovelius *et al.* [27] reported significantly reduced postoperative instability recurrence and subjective results improved when a horizontal modified capsular shift ('capsulopexy') was added to the coracoid transfer.

In our procedure, we used Ehibond sutures N:5 wrapped around the serrations of the screws used for fixation of the coracoid fragment. This allows us to use the needle mounted on the sutures to perform capsular repair and shift through the split of the subscapularis without the need to completely detach the muscle. This seems to achieve a double fold advantage by maintaining the sling effect of the conjoint tendon, thus maximizing the postoperative functional outcome and rehabilitation. Meanwhile, from the economic point of view, there is no need to use anchors to perform the capsular shift and capsulorraphy, thus reducing the burden on the healthcare facility provider.

The Rowe score was used for the postoperative assessment of the patients [11]; it is composed of four items and enables the assessment of pain and function, motion as well as stability. The CM score system [19] was also used for preoperative as well as postoperative clinical assessments. This score consists of four variables that are used to assess the function of the shoulder. Two variables are subjective and two are objective. The subjective variables have a maximum score of 35 and are composed of two items: pain, whereby absence of pain receives a maximum score of 15. The second item assesses limitation of activities of daily living (sleep, work, recreation/sport). No limitations receives a maximum score of 20. The objective variables have a maximum score of 65, with the range of motion having a maximum score of 40 and strength having a maximum score of 25. The Walch–Duplay score [12] was also used for postoperative assessment. Items for assessment include sport or daily activity, stability, pain as well as mobility. Clinical assessment of the patients in whom these scoring systems were used indicated significant improvement in the functional level with almost complete disappearance of pain and instability. None of our patients had persistent apprehension or recurrence of instability with resumption of sports activity or daily activities if no sport was practiced preoperatively.

It was found in our study that there was a correlation between the level of the sports and the final postoperative scores, with better results among patients who practiced sports occasionally on a recreational basis. There was a statistically significant relation between the energy at the first dislocation and the number of instability episodes. In addition, patients practicing sports at the competitive level had significantly more instability episodes than others. These findings might reflect a more severe injury to the capsule and soft tissue-stabilizing elements that subsequently reflect on the number of instability episodes and the functional outcome [9,28].

A limitation in this study is the relatively small number of patients and the relatively short duration of follow-up. Also, there was no control group for comparison, which should have included patients with recurrent anterior instability with anterior capsular laxity managed with Latarjet surgery alone without capsular shift to show and emphasize the effect of the latter in restoring shoulder stability.

Conclusion

In anterior shoulder instability with ACR, the Latarjet procedure associated with an anteroinferior capsulorrhaphy is an effective alternative to arthroscopic or open capsular shift and should help in reducing postoperative apprehension. The sooner the reconstructive surgery is performed, the better the functional outcome.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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