J Shoulder Elbow Surg (2016) 25, 422-427

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Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

# Scapular dyskinesis after Latarjet procedure

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**Background:** Because of detachment of the pectoralis minor and variation of the vector of the conjoint tendons, we hypothesized that the Latarjet procedure may alter scapular position and motion. The purpose of this study was to evaluate scapular position and motion in patients who underwent a Latarjet or a modified iliac crest bone graft transfer (ICBGT) procedure (J-bone graft).

**Methods:** Forty-six consecutive patients treated for recurrent anterior shoulder dislocation between 2010 and 2012 were retrospectively enrolled. Twenty-three were treated with a Latarjet and 23 with an ICBGT procedure. Twenty Latarjet and 20 ICBGT patients were available at a mean follow-up of 20 months (min, 12; max, 60). We recorded the Western Ontario Instability Index, the Rowe Score, and the Subjective Shoulder Value. Scapulothoracic position was studied according to the dyskinesis yes/no method. Intraobserver and interobserver reliability of the dyskinesis assessment was assessed.

**Results:** Intraobserver and interobserver reliability of scapula dyskinesis assessment was high (Latarjet: intratester, $\kappa = 0.84$; intertester, $\kappa = 0.75$; ICBGT: intratester, $\kappa = 0.78$; intertester, $\kappa = 0.71$). Scapular dyskinesis was observed after 5 of 20 Latarjet and after 0 of 20 ICBGT procedures ($P = .047$). Patients with dyskinesis had lower scores (Western Ontario Instability Index, $P = .043$; Rowe, $P = .047$; Subjective Shoulder Value, $P = .046$), but no statistically significant difference was found between the Latarjet and ICBGT groups. Two of the 5 scapular dyskinesis patients reached the SICK (Scapular malposition, Inferior medial scapular winging, Coracoid tenderness, and scapular dysKinesis) scapula syndrome definition.

**Conclusions:** Scapular dyskinesis was found in 5 of 20 patients who underwent a Latarjet procedure. Dyskinesis may be related to the detachment of the pectoralis minor, and variation of the vector and the working length of the coracobrachialis and the short head of the biceps.

**Level of evidence:** Level III, Retrospective Cohort Design, Treatment Study.



**Keywords:** Scapular dyskinesis; Latarjet procedure; J-bone graft; Eden procedures; modified iliac crest bone graft transfer procedure; complications; scapular position

Investigational Review Board approval was not required for this study; however, respective institutions approved the human protocol for this investigation and all investigations were conducted in conformity with ethical principles of research.

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1058-2746/$ - see front matter © 2016 Journal of Shoulder and Elbow Surgery Board of Trustees.
http://dx.doi.org/10.1016/j.jse.2015.08.001

Glenoid bone loss is commonly observed in anterior glenohumeral instability and varies greatly in its extent and significance.[12,15,19] Arthroscopic soft tissue repairs for substantial glenoid bone defects result in failure rates of up to 67%,[6] whereas open capsule-labral reconstruction shows lower recurrence rates.[27] A number of techniques have been proposed and used for the reconstruction of substantial glenoid bone defects, including coracoid transfer to the anterior glenoid rim (eg, Latarjet procedure) or iliac crest bone-graft transfer (ICBCT; eg, Eden-Hybinette procedure).

Most bone restoration surgeries have generally demonstrated good results in shoulder stability.[2,7,16,18] The Latarjet procedure[24,33] is one of the most popular techniques and includes the transfer of the coracoid together with the coracobrachialis and short head of the biceps brachii tendons to the anteroinferior border of the glenoid to obtain a dynamic reinforcement of the inferior part of the capsule when the arm is abducted and externally rotated. At the same time, the pectoralis minor tendon is cut without being reattached. Consequently, the Latarjet procedure is a nonanatomic procedure. On the other side, the J-bone graft, with a J-shaped bicortical iliac crest bone graft anatomically modeled onto the glenoid rim and held in place without screw fixation, has demonstrated to be an anatomic valuable alternative, with good clinical results[2] and even with a physiologic remodeling process that molds the bone graft closely into the original shape of an uninjured anterior glenoid rim.[26]

A wide range of clinical results have been reported for both procedures, with good to excellent results, recurrence rates from 0% to 7%, and moderate long-term outcomes attributable to high rates of osteoarthritis and loss of motion.[2,7,17,18,26] In summary, the reported clinical results do not show a clear advantage for either procedure, even if a recent report about anatomic glenoid reconstruction showed a very low incidence of secondary arthrosis at a considerably long follow-up.[31]

To our knowledge, no study has analyzed scapular position and motion after a bony glenoid reconstruction procedure for glenohumeral instability with glenoid bone loss. Only Cerciello et al[11] investigated the effects of the Latarjet procedure on scapular position by means of a computed tomography (CT) scan analysis in the axial plane at 45 days and 6 months postoperatively. At this time, the scapular position was symmetric.[11] However, concerns remain regarding the potential negative effects induced by distorting the normal anatomy, in particular because of pectoralis minor detachment, coracoid transfer, and subscapularis split.[13] The function of the pectoralis minor is to assist the serratus anterior muscle in anterior tilt, internal rotation, and protraction; coupling with the lower trapezius muscle, these are the greatest contributors to scapular stability and mobility.[20,30] Accordingly, we hypothesized that the Latarjet procedure may modify scapular position and motion. This study evaluated and compared scapular position and motion in 2 groups of patients operated on for glenohumeral anterior instability and glenoid bone loss, one using an extra-anatomic technique (Latarjet) and the other an anatomic glenoid reconstruction technique (J-bone graft).

## Materials and methods

This was a retrospective case-control study of 46 consecutive patients with anterior recurrent (>1) shoulder dislocations enrolled between 2010 and 2012 in 2 different shoulder trauma centers. In the first hospital, 23 patients (group L) were treated according to the Latarjet procedure,[24] and in the second center, a modified Eden-Hybinette procedure, the J-bone graft,[2] was used for the same number of patients (group ICBGT). Demographic data were collected on all patients and included age, height, weight, body mass index, elapsed time from last dislocation to surgery, affected side, dominant side, and sport activity (sedentary, recreational, and professional).

Inclusion criteria were:

- Anterior recurrent shoulder dislocation, with glenoid bone loss $\geq$20% (assessed on CT scan using the Pico method)[3];
- No significant Hill-Sachs lesion and no hyperlaxity;
- Age between 18 and 60 years;
- Latarjet or J-bone graft as surgical treatment;
- A minimum of 12 months of follow-up; and
- Patients who followed a conventional postoperative rehabilitation program, with: (1) 3 weeks of immobilization in a neutral rotation sling; (2) passive exercises until recovery of full range of motion; (3) active range of motion allowed at 6 weeks; and (4) progressive return to sporting activities, including contact sports, allowed at 3 months after clinical and radiographic evaluation confirms satisfactory healing of the bone graft.

Exclusion criteria were:

- Previous shoulder surgery or instability unrelated injury;
- Recurrence of shoulder dislocation after surgery; and
- Body mass index >30 kg/m$^2$ (because of the difficulties of scapular skin land mark assessment).

At the time of clinical evaluation, author S.C. in group L and author P.M. in group ICBGT evaluated shoulder function with the use of Western Ontario Shoulder Instability Index (WOSI),[22] Rowe Score,[29] and Subjective Shoulder Value (SSV).[14] The researchers measured range of motion with the patient standing using a goniometer and shoulder abduction strength by the MicroFET3 dynamometer (Hoggan Health Industries, West Jordan, UT, USA). The evaluation of scapular position and kinesis was based on the protocol of Kibler et al[21] and Burkhart et al.[8] We analyzed scapular position with the patients standing and the arm at rest. We evaluated (1) the difference in height (in centimeters) of the superomedial scapular angle between the injured and contralateral scapulae, (scapular height), (2) the difference in the distance (in centimeters) of the superomedial scapular angle from the body midline between the injured and contralateral sides, (scapular translation), and (3) the difference in angular degrees, measured with a goniometer, of the medial scapular border from the plumb line between the injured and contralateral scapulae

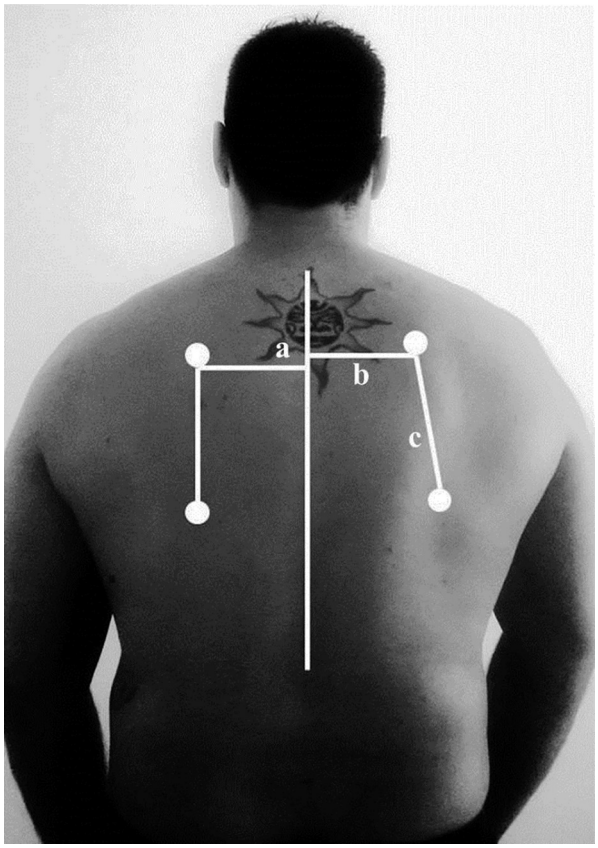


**Figure 1** Scapular height (a) (the difference in height in centimeters of the superomedial scapular angle between the injured and contralateral scapulae); scapular translation (b) (the difference in the distance in centimeters of the superomedial scapular angle from the body midline between the injured and contralateral sides); and scapular rotation (c) (the difference in angular degrees, measured with a goniometer, of the medial scapular border from the plumb line between the injured and contralateral scapulae) in a patient with dyskinesis after Latarjet procedure.

(scapular rotation; Fig. 1). The threshold after which an observed difference in measurement was considered abnormal was 1.5 cm or 5°.[8] If we noted malposition, it was ascribed to 1 of the 3 patterns of scapular dyskinesis described by Kibler and McMullen.[21] These dyskinetic patterns fall into 3 categories, characterized by the prominence of the inferomedial border of the scapula (type I), the entire medial border (type II), or the superomedial border (type III).[21] A history of coracoid pain was recorded, and the coracoid position was assessed. We applied the SICK (Scapular malposition, Inferior medial scapular winging, Coracoid tenderness, and scapular dysKinesis) Scapula Rating Scale to patients who had scapular malposition, inferior medial border prominence, coracoid pain, and dyskinesis.[8] This scale is based on measurements comparing the 2 scapula and investigating the subjective and objective pain of the injured shoulder. Clinical evaluation of scapular motion was performed with the dyskinesis yes/no method,[32] with the patient elevating the arm from 0° to 180° 3 times, with the physician standing behind (Video 1). The yes/no method allows multiple-plane asymmetries to be considered during shoulder anterior elevation and is considered a valuable screening tool to detect the presence of scapular dyskinesis.[32] Three physicians in each center performed a blinded evaluation of scapular motion with the dyskinesis yes/no method.[32]

All patients were informed of the purpose and content of the project and signed a written consent to participate in the study, according to the Declaration of Helsinki.

## Statistical analysis

Power calculation detected a significant difference in total WOSI Score of 255.3 ± 171.3 at follow-up. From this difference, assuming a 2-tailed $\alpha = 0.05$ (sensitivity 95%) and a $\beta = 0.95$ (study power 95%); we determined that at least 15 patients in each group were required at the follow-up evaluation (G*Power 3 power analysis program).

Intratester and intertester reliability of the dynamic clinical assessment method (dyskinesis yes/no method) were determined calculating intraclass correlation coefficients. Interpretation of the κ statistic was performed as described by Landis and Koch in 1977.[23] Agreement was considered excellent if κ fell between 0.81 and 1.0, high if κ was between 0.61 and 0.80, moderate if κ was 0.41 to 0.60, fair if κ was 0.21 to 0.40, and poor if κ was 0.20 or less.[23] Clinical measurement data are presented as means with standard deviations (SD) and were analyzed with the nonparametric Wilcoxon test. The Scores of patients with dyskinetic were compared with those without dyskinetic with the use of Mann-Whitney test. $P < .05$ was considered statistically significant.

## Results

At a mean follow-up of 20 months from surgery (SD, 8; range, 12-60 months), 20 patients who underwent a Latarjet and 20 who underwent a modified Eden-Hybinette procedure fulfilled the inclusion criteria. Three patients from each group were excluded: 2 patients in group L did not systematically follow the rehabilitation program and 1 was unreachable for clinical examination; 3 patients in group ICBGT were not reachable for clinical examination. The mean age was 24 years (SD, 8; range, 18-44 years) in group L and 26 years (SD, 17; range, 8-60 years) in group ICBGT ($P = .62$). The dominant side was involved in 16 of 20 patients (80%) in group L and in 14 of 20 patients (70%) cases in group ICBGT.

In group L, 5 patients were sedentary, 13 practiced recreational sport activity, and 2 were professional sportsmen. In group ICBGT, no patient was sedentary, 16 practiced recreational sport activity, and 4 were professional sportsmen. Morphometric data are reported in Table I. The mean WOSI score was 259 in group L (SD, 164; range, 30-528) and 252 (SD 182; range: 8-576) in group ICBGT ($P = 0.43$). The mean Rowe score was 87 in group L (SD, 8; range, 70-100) and 91 in group ICBGT (SD, 8; range, 73-100; $P = .09$). The mean SSV was 88 in group L (SD, 10; range, 70-100) and 90 in group ICBGT (SD, 9; range, 70-100; $P = .21$). When patients affected by dyskinesis

**Table I** Morphometric data in the Laterjet group and the iliac crest bone-graft transfer group

| Group | Height (cm) | Weight (kg) | BMI ($kg/m^2$) |
|---|---|---|---|
| Laterjet | 176 | 73 | 23.7 |
| SD | 8 | 10.3 | 2.6 |
| Range | 168-195 | 55-97 | 19.5-27 |
| Iliac crest bone-graft transfer | 178 | 78 | 24.3 |
| SD | 8 | 11 | 21 |
| Range | 164-191 | 63-94 | 20.5-28.9 |
| *P* value | .87 | .63 | .85 |

*BMI*, body mass index; *SD*, standard deviation.

**Table II** Scores in patients with and without dyskinesis

| Variable | WOSI score Mean (SD) | Rowe score Mean (SD) | SSV Mean (SD) |
|---|---|---|---|
| Dyskinesis | | | |
| Yes | 413 (65) | 82 (3) | 81 (3) |
| No | 229 (171) | 90 (8) | 90 (9) |
| *P* value | .043 | .047 | .046 |

*SD*, standard deviation; *SSV*, Subjective Shoulder Value; *WOSI*, Western Ontario Instability Index.

**Table III** Scapular static measurements in the Laterjet and iliac crest bone-graft transfer groups

| Group | Vertical height of superomedial angle Mean (SD) cm | Distance of superomedial angle from plumb line Mean (SD) cm | Angle between medial scapular margin and plumb line Mean (SD)° |
|---|---|---|---|
| Laterjet | 0 (0) | 1 (1) | 3 (3) |
| ICBGT | 0 (0) | 0 (0) | 1 (2) |
| *P* value | .046 | .039 | .64 |

*ICBGT*, iliac crest bone-graft transfer.

were compared with those who were not, the differences in the scores were significant (WOSI, $P = .043$; Rowe, $P = .047$; SSV, $P = 0.046$; Table II). Intratester and intertester reliability of the dyskinesis yes/no method was high in both group L and ICBGT (group L: intratester $\kappa = 0.84$, intertester $\kappa = 0.75$; group ICBGT: intratester $\kappa = 0.78$, intertester $\kappa = 0.71$). Considering the evaluation of the senior surgeon for both groups, 5 of 20 patients (25%) of the group L and 0 of 20 patients (0%) of the group ICBGT showed scapular dyskinesis ($P = .047$).

Results of scapular static measurements are reported in Table III. These results show that 5 of 20 patients in group L and 0 of 20 patients in group ICBGT reached the threshold for scapular malposition. The 5 group L patients had a type I malposition, and 2 of 5 fulfilled the criteria for a SICK Scapula Syndrome.[8] The SICK Scapular Rating Scale[8] in these 2 patients was 6 of 20 and 5 of 20.

## Discussion

This study addressed the potential development of scapular dyskinesis in patients who underwent anterior bony glenoid reconstruction. In the literature, only 1 study has investigated the position of the scapula with respect to the thorax assessed by CT scan at 45 days and 6 months after the procedure.[11] Cerciello et al[11] did not find any significant difference in a cohort of 20 patients who underwent a Latarjet procedure compared with a control group. In our study, 20% of the Latarjet patients had a type I dyskinesis after an average follow-up of 20 months. Dyskinetic patients had lower functional scores than those without dyskinesis. Nevertheless, the clinical outcome scores of the Latarjet patients with and without dyskinesis compared with the scores of the modified Eden-Hybinette patients did not show any significant differences. As reported, scapular dyskinesis is frequently associated with shoulder injuries, in particular instability, with rates ranging from 68% to 100% of patients.[34] That the preoperative prevalence of instability-induced scapular dyskinesis was the same in both groups can be assumed; however, there is no formal proof for this assumption. Postoperatively, we detected dyskinesis in 5 patients who were treated with a coracoid transfer procedure, including conjoint tendon transfer and detachment of the pectoralis minor.

One reason for scapular dyskinesis is an abnormally shortened pectoralis minor muscle.[25] Diminished pectoralis minor flexibility impedes optimal scapular kinematics, specifically in upward rotation, external rotation, and posterior tilting.[5] In the light of its functions, this muscle-tendon unit has been the objective of several investigations in relation to shoulder function and kinematics.[4,5,28] Considering our results, it is conceivable that detachment of the tendon did modify position and motion of the scapula.

Nonanatomic features of the Latarjet procedure were investigated because of possible effects on the morphology or function of the biceps muscle.[10] The authors of that study concluded that even if the procedure is ''non-anatomical,'' it does not modify the ''anatomy'' of the bulk of the biceps muscle.[10] Interestingly, a recent report about movement control in patients with shoulder instability has shown that open surgery stabilizes the shoulder, but at the same time, does not necessarily restore normal movement quality.[1] Even if both anatomic and nonanatomic procedures can restore shoulder stability, the shoulder may not get back to a normal movement quality, especially if nonanatomic procedures are performed.

The 5 patients with dyskinesis showed a type I pattern, which is characterized by the prominence of the inferior

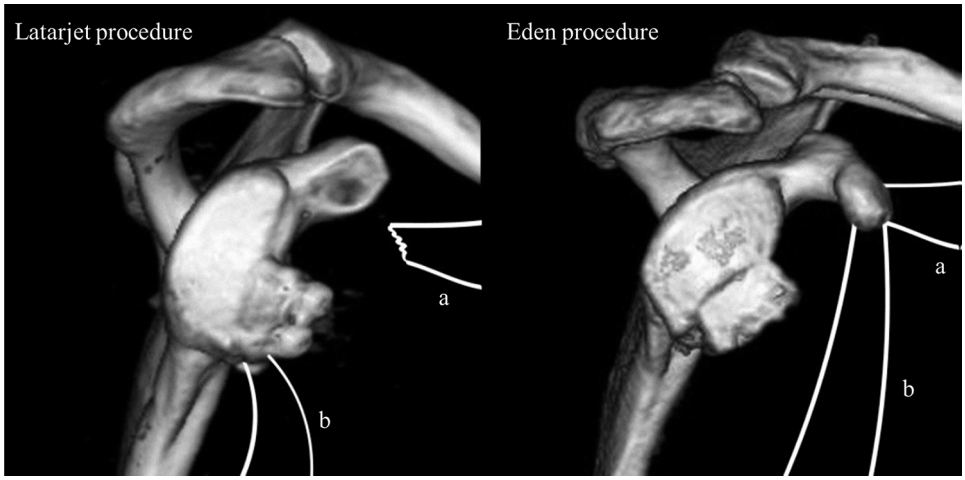


**Figure 2** (Left) The Latarjet procedure provides detachment of the pectoralis minor (a), and variation of the vector and the working length of the coracobrachialis and the short head of the biceps (b) compared with the (Right) Eden procedure.

medial scapular angle and is associated with excessive anterior tilting of the scapula.[21] Considering the function of pectoralis minor tendon and possible effects of its detachment (Fig. 2), we expected to find a different pattern of dyskinesis. In fact, detachment of the tendon would theoretically diminish anterior tilting with a resulting type III pattern, but, on the contrary, we observed an increased anterior tilting with a type I pattern. A possible explanation might be the shifted vector of the conjoint tendon toward lateral and inferior after the coracoid transfer (Fig. 2). After a Latarjet procedure, Cerciello et al[11] observed that, in the first postoperative period, the pectoralis minor detachment and variation of the vector of the coracobrachialis muscle may contribute to the loss of balance between groups of antagonist muscles, with a resulting increased scapular motion in the axial plane. At longer follow-up, when the rehabilitation program is concluded and once physical activities are resumed, they found a substantial symmetry in scapular position and concluded that the Latarjet procedure did not alter the scapular position.[11]

A major drawback of their study is that the authors measured only the inclination of the scapulae in relation to the thorax using CT scans with the patient immobilized in an unphysiologic position in the CT gantry. Furthermore, the CT was taken very early (at 45 postoperative days and 6 months of follow-up),[11] and therefore, it is not comparable to our study. Focusing on the clinical appearance, with static and dynamic measurement of the scapulae, we observed an alarmingly high prevalence of dyskinesis after Latarjet procedures. We believe that our study provides more insight on scapular position and especially motion compared with a mere CT evaluation of the scapulae in the axial plane.

Because of possible loss of balance between groups of antagonist muscles secondary to the detachment of the pectoralis minor and variation of vector of conjoint tendons, we suggest a postoperative rehabilitation program for patients who have undergone the Latarjet procedure aiming at stretching and strengthening of the periscapular muscles to improve scapular motion and control, as recently proposed.[9] Because of the alarming frequency of dyskinesis after shoulder stabilization surgery, we highlight the importance of observing scapular position and motion, especially in patients complaining of persisting pain after the rehabilitation program is completed.

Our study has an important drawback: we did not evaluate scapular position and motion before shoulder stabilization. Dyskinesis might have been present in some patients before surgery. A prospective randomized enrollment of patients before surgical treatment would have been necessary to prevent this limitation. Nevertheless, we suppose that dyskinesis was present in most patients of both groups, as reported in the literature for patients with anterior recurrent instability.[34]

## Conclusions

Scapular dyskinesis was found in 25% of patients who underwent a Latarjet procedure, with dyskinesis affecting the clinical result. We hypothesize that dyskinesis may be related to the detachment of the pectoralis minor, variation of the vector, and the working length of the coracobrachialis and the short head of the biceps.

## Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from

any commercial entity related to the subject of this article.

## Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jse.2015.08.001.

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