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CLINICAL STUDY

Mid-term outcomes of arthroscopic Latarjet procedure in chronic anterior shoulder instability after failed Bankart surgery or with significant glenoid bone loss

Krajcsovics N[1], VajczikovA S[2], Svec A[1], Pasiar J[1]

1st Department of Orthopaedics and Traumatology, Faculty of Medicine Comenius University and University Hospital in Ruzinov, Bratislava, Slovakia. **norbertkrajcsovics@gmail.com**

ABSTRACT

INTRODUCTION: Arthroscopic Latarjet surgery is a technique developed to minimize invasive surgical treatment of anterior shoulder instability. However, compared to an open Latarjet operation, it is considered more technically demanding. The aim of our study was to assess its mid-term success rate in the hands of a surgeon with sufficient experience.

PATIENTS AND METHODS: We included 32 patients with recurrent anterior shoulder instability in the analysed cohort who had undergone arthroscopic intervention according to Latarjet as a revision after a previous failed Bankart operation or in the case of the significant bone loss of the glenoid. Patients were followed-up according to a defined protocol for an average of 30.2 months (range 12–60 months). In this study, we present clinical and radiological results of a long-term follow-up evaluated using Rowe, UCLA, and SST scoring systems, comparing ranges of motion, and thorough analysis of CT examinations performed no earlier than 6 months after surgery. Rowe, UCLA and SST scores were determined pre- and postoperatively; the range of motion was compared to the contralateral side.

RESULTS: The postoperative score was significantly improved in accordance with the clinical finding in the followed-up group (Rowe: preOP 22.1 points – postOP 97.6 points, UCLA: preOP 19.50 points – postOP 33.30 points, SST: preOP 8.2 points – postOP 11.5). However, the postoperative external rotation remains significantly smaller as compared to the contralateral side. The feared neurovascular damage did not occur in our cohort; one patient (3 %) had an infection in the access portal, which was managed conservatively; one patient (3 %) required revision surgery.

CONCLUSION: Our results demonstrated that when in the hands of experienced surgeon, the arthroscopic Latarjet surgery is an effective surgical method with a low incidence of complications and excellent mid-term clinical outcomes *(Fig. 17, Ref. 25)*. Text in PDF *www.elis.sk*

KEY WORDS: arthroscopic Latarjet, anterior shoulder instability, failed Bankart, significant glenoid bone loss.

Introduction

Latarjet arthroscopic surgery is one of the most demanding surgical techniques in the shoulder area and is typically reserved for severe cases of anterior instability. The treatment of traumatic anterior shoulder instability in young patients requires a strictly individual approach. Bankart surgery performed arthroscopically produces good acute results, but according to the available data, approximately 50 % of patients presented a recurrence within two years after surgery (1). In patients who have ventral glenoid bone loss or humeral avulsion of the glenohumeral ligaments (HAGL), Bankart surgery does not produce the desired effect and does not prevent recurrent instability (3). In such cases, we are forced to choose another type of surgical technique, most often a technique aimed at restoring the bone margin of the glenoid – this is a so-called bone block procedure (2).

From a biomechanical point of view, Latarjet surgery increases the articulatory area of the glenoid by supplementing the bone loss of the ventral part. Dynamic stability is ensured by a so-called "*conjoined tendon*". It is a combined tendon of *m. coracobrachialis* and *caput breve m. bicipitis brachii*, which prevents dislocation of the humeral head in abduction and external rotation.

To achieve the above mentioned aim an osteotomy of the coracoid process in the horizontal area distally to *lig. coracoclaviculare* attachments is performed during Latarjet surgery. Subsequently, the graft is transferred through the split of *m. subscapularis* and fixed to the ventral glenoid region. The graft is positioned subequatorially at the level of the glenoid articulation surface. The fixation is performed using two cannulated screws (4). This type of operation provides excellent results with a low incidence of recurrences (5, 6).

[1]1st Department of Orthopaedics and Traumatology, Faculty of Medicine Comenius University and University Hospital in Ruzinov, Bratislava, Slovakia, and [2]2nd Department of Orthopaedics and Traumatology, Faculty of Medicine Comenius University and University Hospital Bratislava, Hospital of St. Cyril and Methodius, Bratislava, Slovakia

Address for correspondence: N. Krajcsovics, MD, UNB Ružinov, 1st Department of Orthopaedics and Traumatology, Pažítková 4, SK-821 01 Bratislava, Slovakia.
Phone: +421.915378565

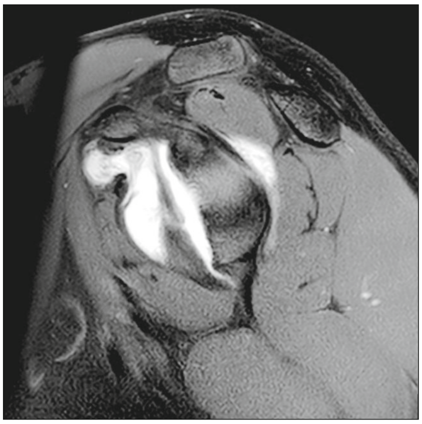

Fig. 1. MRI of a bone Bankart lesion (sagittal plane) shows a significant bone loss in the ventral glenoid region.

Fig. 2. MRI of a bone Bankart lesion (transverse plane). A large Hill Sachs lesion visible in the posterior superior region of the humeral head.

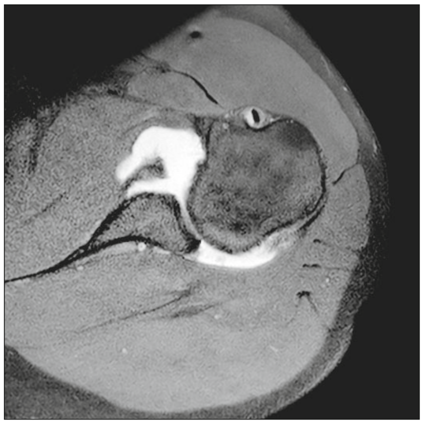

Fig. 3. MRI of a bone Bankart lesion (transverse plane) shows the significant bone loss in the ventral glenoid region.

By gradual improving of the arthroscopic techniques, an arthroscopic approach was also developed for Latarjet surgery. The excellent visualization of individual structures provides precise control during graft positioning and preparation of neurovascular structures (8,9,14,15). In addition, it allows the surgeon to treat concomitant lesions such as SLAP (superior labral anterior to posterior) or rupture of the rotator cuff (10,11).

Patient selection

Patients indicated for Latarjet surgery had significant ventral glenoid bone loss, HAGL lesion, or failed previous Bankart surgery. We included 32 patients who underwent surgery from February 2012 to March 2018. Latarjet surgery was performed arthroscopically in all patients. Patients with the history of another shoulder surgery were also included in the cohort. The data collection was performed both retrospectively and prospectively. All patients were postoperatively managed according to an identical rehabilitation protocol. Part of the prospective follow-up of patients was the completion of questionnaires focused on shoulder function, physical examination, X-ray scans in a standard AP projection, CT or MRI examination performed preoperatively and CT examination 3 months after surgery (Figs 1, 2, 3). Based on the CT examination, the following parameters were evaluated:

- Graft position in the horizontal and vertical planes
- Screw insertion angle and
- Graft healing.

Postoperative evaluation was performed by a single physician (N. K.). The range of motion (ROM) was measured using a goniometer. External rotation was evaluated in two ways:

- ER1 – extrarotation in shoulder adduction and 90° elbow flexion and
- ER2 – 90° abduction in the shoulder and 90˚ flexion in the elbow.

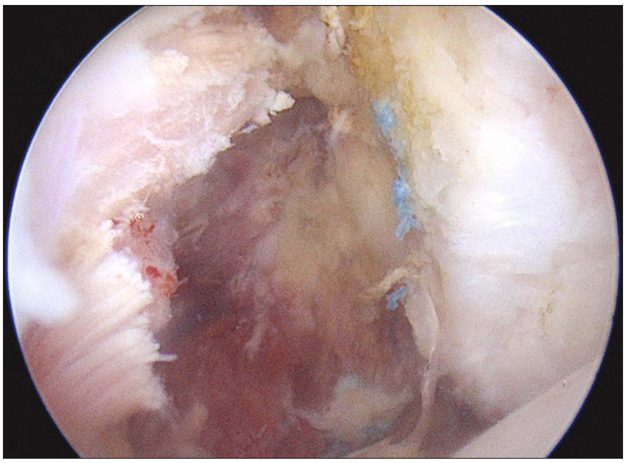

Fig. 4. A view of a glenoid bone lesion from the anterior inferior portal. Visible sutures after previous stabilization operation.

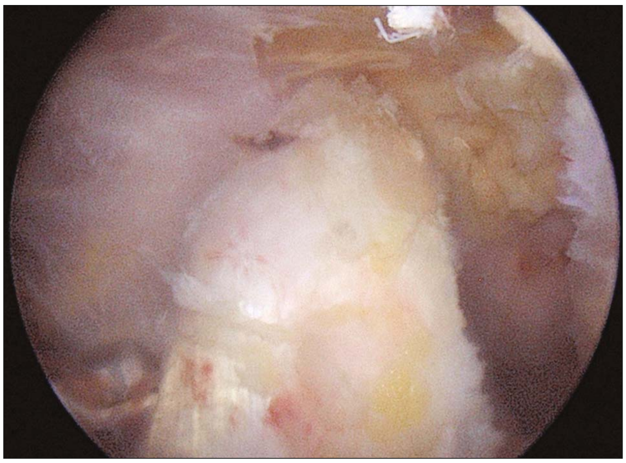

Fig. 5. The coracoid process and conjoint tendon (a view from J portal). Disconnected tendon of *m. pectoralis minor* and *lig. coracoacromiale*.

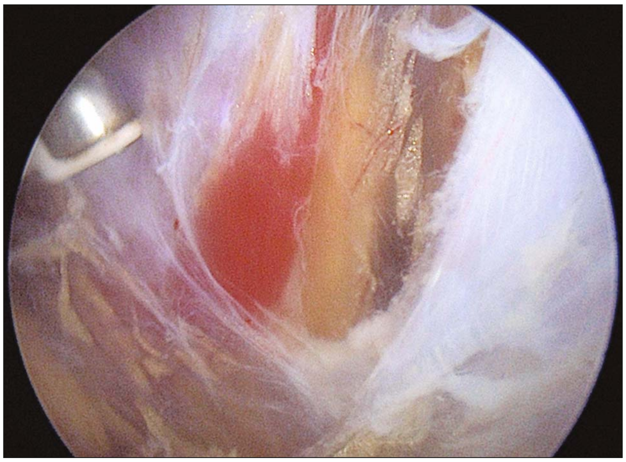

Fig. 6. Interval between the conjoint tendon (right) and *m. pectoralis minor* (left). *N. musculocutaneus* visible in the interval.

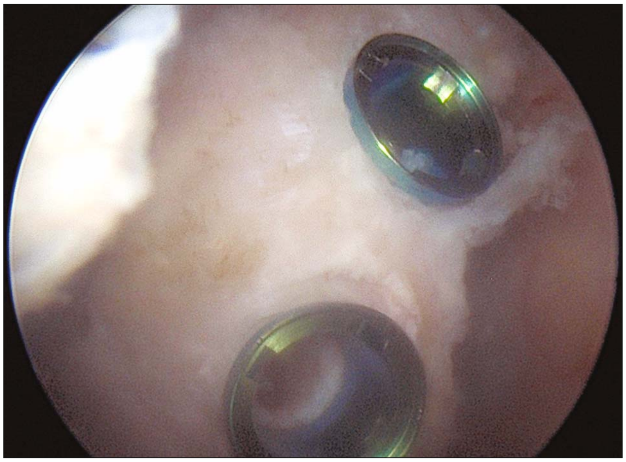

Fig. 7. Top Hats inserted into the coracoid process.

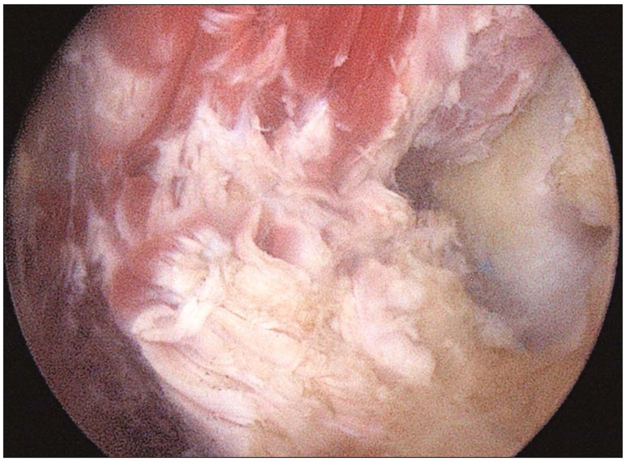

Fig. 8. The split of *m. subscapularis*. A Bankart's lesion visible in depth.

All parameters found on the operated extremity were compared with the contralateral side, which was intact in all patients.

Rowe score was used to measure ranges of motion, function, and stability, both preoperatively and postoperatively. The maximum score achieved is 100. A lower number of points means poorer joint function. A modified UCLA test (University of California Los Angeles) was used to assess pain, function, strength, flexion, and overall patient satisfaction. The maximum is 35 points, and the results were interpreted as follows: excellent (34–35 points), good (28–33 points), fair (21–27 points), and poor (0–20 points).

Simple shoulder test – SST – was used to evaluate the function and effect of shoulder function on activities of daily living. The maximum number of points is 12. The lower the score, the worse the monitored parameters (23).

Fig. 9. *M. subscapularis* (a view from the anterior inferior portal). The axillary nerve visible at the bottom left.

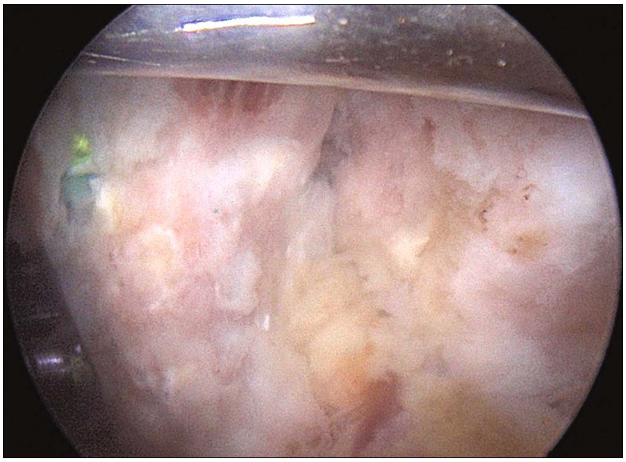

Fig. 10. Positioning of the graft of the coracoid process (left) into the area of a Bankart lesion (right).

Imaging assessment

Diagnostic imaging was performed in all patients as follows:

- Radiographic scan preoperatively, postoperative day 1, after 6 and after 12 weeks
- CT or MRI imaging preoperatively. In the period of 3 months after the operation, we already indicated only a CT examination.

We evaluated the graft position, graft healing, and screw angle relative to the plane of the articulation surface. The graft position in the axial plane was evaluated according to Boileau's classification (7). There are 3 categories:

- 1 – correct position – the graft is at the level of the articulation area,
- 2 – medial position – the graft is > 5 mm medial to the glenoid rim
- 3 – lateral position – the graft is > 5 mm lateral to the glenoid rim

Graft positioning in the coronal plane was assessed according to the relation to the equatorial plane of the glenoid. We observed 3 types: above the level, at the level, and below the level of the equatorial plane (12).

Surgical technique

All patients were operated by a single experienced surgeon (N. K.). The surgical procedure can be divided into 5 stages:

1. Comprehensive examination of intra-articular structures through the posterior portal. Following identification of the apex of the coracoid process, we resect the rotator interval and release the *ligamentum coracoacromiale*.
2. Through the anterior-lateral portal, we visualize the ventral aspect of the shoulder and move outside the intra-articular space, i.e., it is an endoscopy. We thoroughly visualize the Bankart lesion, while we can remove the sutures after the previous operation and revive the medial aspect of the lesion (Fig. 4). We gradually establish the medial portal (using a "switching stick" inserted through the posterior portal in the glenoid plane, we penetrate *m. pectoralis major* and the skin. We continue to establish the "J" portal, which is in front of the tip of the coracoid. Then we shift the camera into the "J" portal and visualize the area in front of the coracoid process (Fig. 5). We gradually release *m. pectoralis minor*, while respecting the natural interval between it and the conjoint tendon. *Nervus musculocutaneus* is in this interval (Fig. 6). Then, we establish the far-medial transpectoral "M" portal. This is used for preparation of the medial side of coracoid process. Care must be taken to the close neurovascular structures (13).
3. After preparation of the coracoid at the distance of *lig. coracoclaviculare*, using the drill guide, we introduce two Kirschner wires, with the help of which we drill holes leading craniocaudally. We introduce Top Hats, which serve to decompose compressive forces and to manipulate the graft during positioning (Fig.7). The osteotomy of the coracoid process is performed by a chisel through the superior portal (above the base of the coracoid at the level of the distance of *lig. coracoclaviculare*).
4. The split of the subscapularis muscle is performed using a radiofrequency probe at the interface of the middle and distal third of the muscle (Fig. 8). It is crucial to know the anatomical structures that we must protect – especially the axillary nerve. This nerve must be visualized all the time (Fig. 9).
5. Fixation of the graft follows its thorough processing with a bone cutter into an ideal shape in order to achieve an adequate contact area between the ventral glenoid and the graft. Subsequently, using the manipulation handle, we position the graft in the ideal position in front of the ventral glenoid while checking the horizontal and vertical planes. We fix it with Kirschner wires. After the final check of graft positioning from several points of view, we proceed to the graft fixation using two 3.5 mm screws (Fig. 10).

Postoperative rehabilitation

Postoperatively we prefer postoperative fixation for 4 weeks in an abduction orthosis, thus ensuring a neutral rotation of the extremity in the shoulder and 15˚ of abduction. We indicate passive (Codman) exercises as early as on the first postoperative day. Overhead stretches and exercises with a pulley are allowed in the 4th postoperative week. Isometric exercises focused on the rotator cuff, deltoid, and scapular stabilizers are allowed in the 6th week, postoperatively. We allow a full load in terms of contact and high-risk sports in the 4th to 5th postoperative month.

Results

Clinical outcomes

The followed-up cohort included 32 patients (32 operated shoulders); of these 28 males (87 %) and 4 females (13 %). The mean age of patients was 25.1 years (range 16–44 years). The right shoulder was involved in 20 (63 %) patients, and the left shoulder in 12 (37 %) patients; 18 patients (56 %) had undergone prior arthroscopic Bankart repair and 1 patient (3 %) was treated with open Bankart repair. One patient (3 %) experienced infection in the ventromedial portal. No patient experienced neuro-vascular injury. Recurrence occurred in 2 patients (6 %) due to an injury to the operated joint, but only in one case reoperation was indicated (filling the Hill–Sachs defect).

All patients were clinically examined postoperatively by the operating surgeon; the average time after surgery was 30.2 months (range 12–60 months). The UCLA, Rowe, and SST scoring systems were administered preoperatively and at the last postoperative follow-up. Postoperative flexion averaged 174.7˚ (range 150–180°) on the operated side and 176.3° (range 160–180°) on the contralateral side ($p=0.125$). Abduction was 168.1° (range 150–180°) and 169.6° (range 160–180°), postoperatively on the contralateral side ($p=0.125$). External rotation with the extremity at the body (ER1) was 60.5° (range 40–90°) on the operated side and 75.4° (range 60–90°) on the contralateral side ($p < 0.001$). External rotation in abduction (ER2) 76.1° (range 65–90°) on the operated side and 90° (range 85–95°) on the contralateral side ($p < 0.001$). Postoperative intrarotation reached 79.6° (range 75–85°) and 81.2° (range 75–85°) on the contralateral side ($p=0.284$) (Fig.11).

The preoperative Rowe score was 22.1 points (range 15–50 points) and the postoperative 97.6 points (range 50–100 points) ($p < 0.001$).

The UCLA score was 19.50 points (range 18–24 points) preoperatively and 33.30 points (range 27–35 points) postoperatively

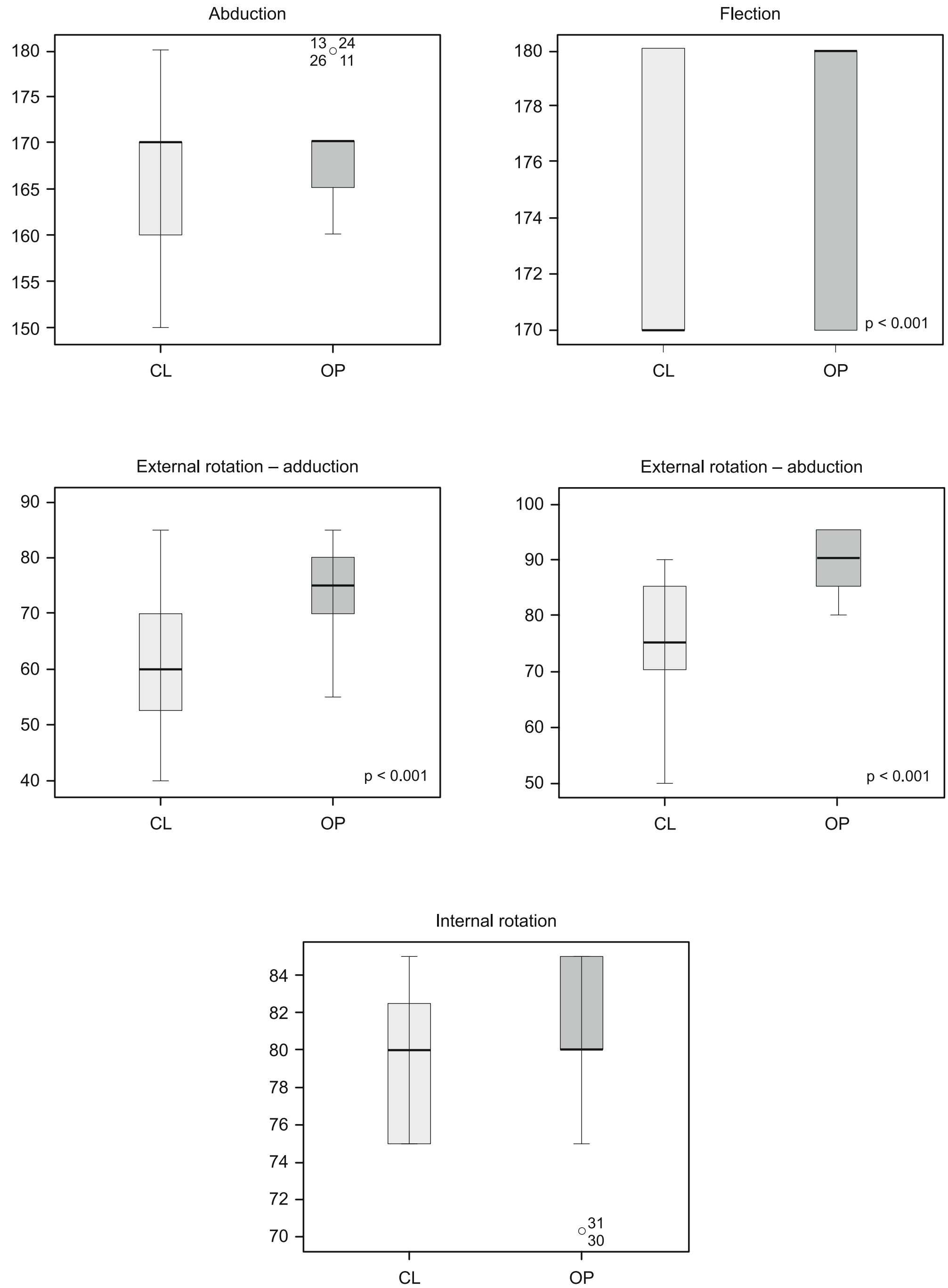

Fig. 11. The box plots showing the difference between range of motion in flexion, abduction, external rotation (in adduction and abduction) and internal rotation in operated shoulder (OP) versus contralateral shoulder (CL).

($p < 0.001$). Based on the UCLA score scale, 13 patients (40 %) were rated as excellent, and 19 patients (60 %) as good.

The average SST was 8.2 points (range 7–10 points) preoperatively and 11.5 points (range 9–12 points) postoperatively (p= 0 <.001). Twenty-four patients (75 %) were very satisfied, seven patients (22 %) were satisfied, and one patient (3 %) was dissatisfied with the mid-term outcome of the operation (Fig. 12).

Imaging outcomes

Graft healing

Graft healing was assessed by CT scanning in all patients 3 months after surgery:

- 29 patients (91 %) showed signs of complete healing of the graft
- 3 patients (9 %) showed fibrous graft healing.

Graft positioning

Graft positioning was assessed with CT scans in the coronal and axial planes. In the coronal plane, in 25 patients (78 %), the graft was in the optimal subequatorial position, in 6 patients (19 %), it was lower than the optimal position, and in 1 patient (3 %), the graft was higher than the optimal position (Fig. 13). In the axial plane, the graft was in the optimal position (flush with the glenoid surface) in 27 patients (84 %); in 5 patients (16 %), the graft was too medial to the ideal position (Fig. 14).

Screw's angle

The angle between the screws and the glenoid articulation surface was assessed with CT scanning. Based on our findings, the angle was 11.1° (0–25°). No screw migration occurred, and no screw penetrated the articulation surface (Fig. 15).

Discussion

A significant increase in the prevalence of shoulder instability, especially in young people, represents an unmet need to develop

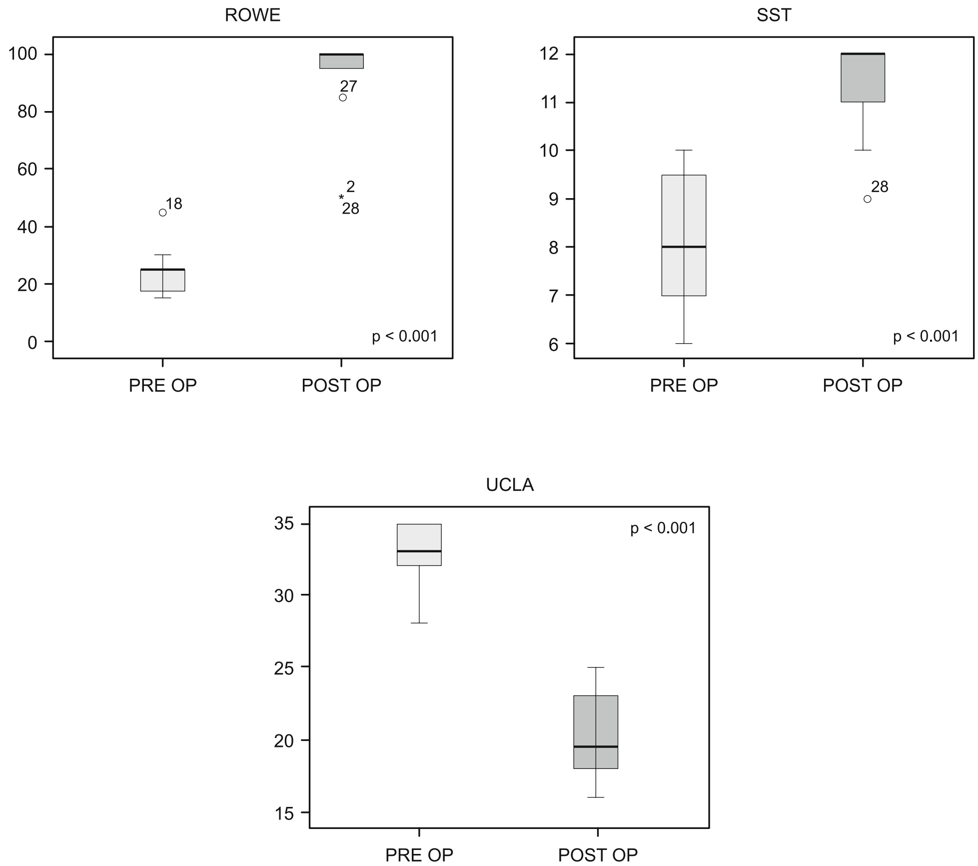

Fig. 12. The box plots showing the difference between ROWE, Simple shoulder test (SST) and University of Carolina at Los Angeles shoulder test (UCLA) at preoperative examination (PRE OP) and postoperative examination (POST OP). versus contralateral shoulder (CL).

Fig. 13. Postoperative CT (sagittal plane), graft position in the equatorial plane.

Fig. 14. Postoperative CT (coronal plane), graft position at the level of the joint surface of the glenoid.

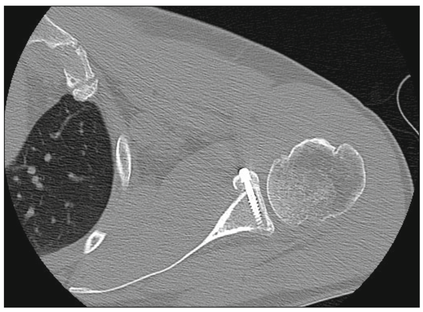

Fig. 15. Postoperative CT (transverse plane), the direction of the screws is parallel to the joint surface.

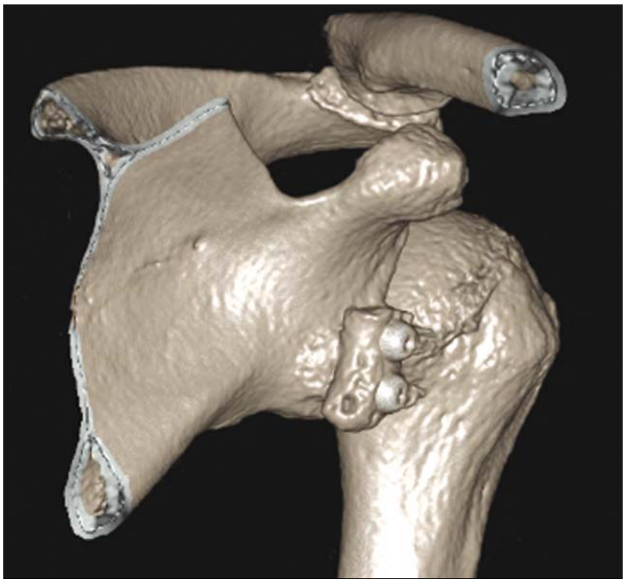

Fig. 16. Postoperative 3D CT, a view of the antero-medial area of the scapula.

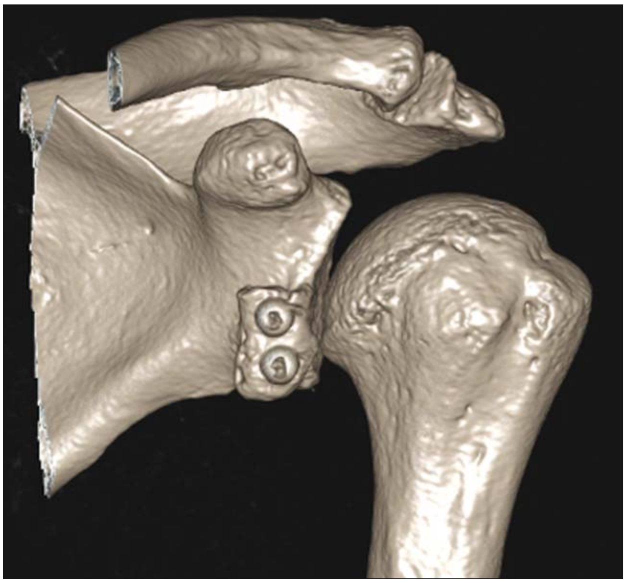

Fig. 17. Postoperative 3D CT, a view of the ventral area of the scapula.

long-term effective surgical solutions. Although the original Latarjet surgery has been used for more than half a century, its minimally invasive arthroscopic variant represents a method in development (20, 21, 22, 23, 24). Our study aimed to assess mid-term outcomes of this minimally invasive surgical approach with an emphasis on achieving optimal perioperative anatomical parameters.

For this purpose, the study evaluates the mid-term results of arthroscopic Latarjet surgery in young patients with recurrent shoulder instability through clinical scoring systems and imaging examinations. Thirty months postoperatively, we have verified a significant improvement in clinical presentation expressed by Rowe, UCLA, and SST scores. According to the UCLA score, the resulting postoperative condition was rated as excellent in 40% and as good in 60%. In 2 patients, surgery did not prevent the recurrence of instability; one of them expressed dissatisfaction with the treatment outcome in the questionnaire.

Arthroscopic Latarjet is a procedure which should be performed by an experienced surgeon. According to the study of Valsamis, a high-volume surgeon requires from 30 to 50 cases to achieve a steady-state operative efficiency (25).

A great advantage of the arthroscopic approach is the possibility of a safe identification and protection of the axillary nerve as well as other neurovascular structures. In one case, we recorded a graft fracture, which we treated with a fixation loop using a fibre made of non-absorbable material (Orthocord); no deterioration of parameters was found in the evaluation of imaging examinations. In one case, reoperation was indicated in the patient with recurrence of dislocation of traumatic aetiology with the finding of a marked Hill–Sachs defect, which was treated with a filling (so-called *remplissage*) with the tendon of *m. infraspinatus*.

In our group of patients, the graft healed in 29 patients (91 %) by bone healing. In the coronal plane, the graft was in the optimal subequatorial position in 25 patients (78 % of cases). In the axial plane, the graft was positioned correctly (at the level of the joint surface of the glenoid) in 84 % of cases. Boileau (8) published a group of patients where 89 % of the grafts were in a good position in the equatorial plane at the level of the joint surface of the glenoid.

Hovelius (10) published a cohort of 85 patients, in whom the coracoid process was located too proximally in almost half (49 %) of patients. According to Walch et al (18), in 27 % of patients the coracoid was too lateral and in 12 % too medial. Proper positioning of the graft in both the axial and coronal planes is crucial to achieve excellent clinical outcomes. If the graft is too high or too medial, the likelihood of recurrent instability increases (18). On the other hand, if the bone block is too lateral, the likelihood of late glenohumeral osteoarthritis increases (16, 17). In the case of the open Bristow–Latarjet surgery, the graft and screw malpositioning occurred in up to a half of the cases (19).

In the studied patient cohort, we have fixed the coracoid graft with two 3.5-mm cannulated screws. The mean angle between the screws and the glenoid surface was 11.1° (range 0–25°). The arthroscopic technique allows precise positioning of the graft and insertion of the screws, while the aim is to insert the screws as parallel as possible to the joint surface of the glenoid. Arthroscopy also offers the possibility to manage concomitant lesions in the area of the rotator cuff or pathology of the long head of the biceps tendon – SLAP (2, 8, 12).

Main limitation of our study is its retrospective character, but we believe it is clinically reasonably offset with strict adherence to a standardized surgical protocol and postoperative follow-up. On the other hand, the strengths of the study can be summarized as follows:

- All operations and the entire postoperative follow-up were performed by a single surgeon (N.K.)
- Detailed quantitative evaluation of CT imaging by the operator focused on close monitoring of graft position, angle of transfixation screws, and graft healing. 3D CT imaging was used for a comprehensive evaluation of individual bone structures (Figs 16, 17).
- Sufficient duration of postoperative follow-up (mean 30.2 months, minimum 12 months, maximum 60 months).

Based on these results, we conclude that adequate knowledge and experience with Latarjet arthroscopic surgery is a technique of choice for anterior shoulder instability, especially for in-patients.

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