DOI: 10.7860/JCDR/2024/68078.19431

Original Article

Orthopaedics Section

Outcome of Modified Open Latarjet Operation in the Treatment of the Recurrent Anterior Shoulder Dislocation: A Cohort Study

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ABSTRACT

Introduction: Shoulder instability is defined as a symptomatic translation of the humeral head about the glenoid fossa during active shoulder motion. Anteroinferior glenoid bone loss or labrum avulsion is most often a consistent finding in recurrent dislocation. The modified open Latarjet procedure is one of the most effective methods of treatment for patients with recurrent shoulder instability with glenoid bone loss.

Aim: To determine the functional outcome of the congruent arc modification of the open Latarjet procedure.

Materials and Methods: This prospective cohort study was conducted at a tertiary healthcare centre in Bhopal, Madhya Pradesh, India between January 2018 and December 2020. A total of 25 patients with recurrent anterior shoulder dislocation underwent treatment using the modified open Latarjet procedure. Two patients were lost to follow-up, resulting in the evaluation of 23 patients. All patients underwent a 3D Computed Tomography (CT) scan to document glenoid bone loss. The intensity of pain, activity level, strength of abduction, and Range of Motion (ROM) were assessed to calculate the Constant Shoulder Score for pre- and postoperative evaluation of functional outcomes. Follow-ups were conducted at 3 months, 6 months, 1 year, and 2 years after surgery. The data was analysed using the Wilcoxon's signed-rank test, and Spearman's correlation coefficient was used to identify associations between various variables.

Results: A total of 23 male patients aged between 18 and 63 years were included. The average age of patients was 30.35±11.27 years. Preoperatively, only 3 patients (13.04%) had good to excellent Constant Shoulder Scores. However, no statistically significant variation in Constant Score was observed three months after surgery. Six months post-surgery, 17 patients (73.92%) showed good to excellent scores. Nearly one year after surgery, 21 patients (91.3%) had good to excellent outcomes. At the final follow-up, 22 patients (95.65%) demonstrated good to excellent outcomes. A statistically significant improvement in good to excellent scores was noted six months postoperatively (p-value <0.001). A total of 20 patients (86.96%) achieved full ROM, with only 3 patients (13.04%) reporting mild to moderate limitations in shoulder ROM. None of the patients experienced redislocation, and the apprehension test was positive in only one patient.

Conclusion: The modified open Latarjet procedure is a reliable method for providing stability and Self confidence to patients with recurrent shoulder instability and glenoid bone loss.

Keywords: Congruent arc latarjet technique, Constant shoulder score, Coracoid bone block, Coracoid transfer, Recurrent glenohumeral instability

INTRODUCTION

Shoulder instability is defined as a symptomatic translation of the humeral head around the glenoid fossa during active shoulder motion [1]. By its anatomy and biomechanics, the shoulder is one of the most unstable and frequently dislocated joints in the body, accounting for nearly 50% of all dislocations with a 2% incidence in the general population [1-3]. Previous studies have reported a very high recurrence within two years after the first episode of traumatic shoulder dislocation among males in younger age groups ranging from 15 to 35 years (72 to 90% for ages 13 to 20 years and 50% for ages 20 to 30 years) [4,5].

Recurrent anterior shoulder dislocation is commonly associated with substantial bone loss at the anteroinferior aspect of the glenoid rim. Bone loss can manifest as a classic bony Bankart's lesion [6] due to a traumatic event or attrition glenoid bone loss due to repetitive motion, as seen in overhead-throwing athletes. Traditionally, glenoid bone loss exceeding >20-25% is considered a "critical amount" and a contraindication for soft-tissue procedures alone due to the poor biomechanical environment and unsatisfactory clinical outcomes [7,8]. Similarly, cadaveric biomechanical studies have also indicated that a 19% to 21% loss of glenoid width significantly compromises the stability of soft-tissue repair alone [8]. Previous studies have established that >20% bone loss in the anteroinferior glenoid is critically high, with reports suggesting that lower percentages of "subcritical" bone loss after arthroscopic soft-tissue stabilisation do not necessarily result in a recurrence of dislocation but can lead to a poor functional outcome compared to those treated with bone augmentation procedures [9]. Some authors recommend treating shoulder instability with a primary Latarjet procedure regardless of glenoid bone loss [10].

A very high recurrence rate ranging from 0 to 37.5% has been reported after an arthroscopic Bankart repair in the presence of significant glenoid bone loss or an inverted pear-shaped glenoid with or without an engaging Hill-Sachs lesion [11,12]. This unacceptably high recurrence rate has led surgeons to opt for non anatomic repairs with a coracoid bone block, such as the Latarjet procedure. In 1954, Michel Latarjet first introduced the coracoid-transferring bone block procedure to treat recurrent anterior shoulder dislocation [13]. In 2009, De Beer J et al., described "The congruent arc modification" of the Latarjet procedure, involving a 90° rotation of the coracoid process [14]. As a result, the curved undersurface of the coracoid lies congruent with the glenoid cavity [15]. Rotation of the coracoid in such a manner has been shown to optimise glenohumeral contact forces in addition to the

triple blocking effect of the traditional Latarjet procedure [14]. The objective of the present study was to evaluate the outcome of the modified open Latarjet operation in the treatment of recurrent anterior shoulder dislocation.

MATERIALS AND METHODS

A prospective cohort study was conducted from January 2018 to December 2020 at the Department of Orthopaedics, Gandhi Medical College, Bhopal, Madhya Pradesh, India and the associated hospital in central India, after obtaining approval from the Institutional Ethical Committee (Letter No. 38062-08/MC//IEC/2018, Bhopal, Date: 30/01/2018). During the given study period, a total of 25 patients with recurrent anterior shoulder dislocation who consented to definitive treatment using the modified open Latarjet procedure were included. Two patients were later lost to follow-up, and the results of 23 patients were evaluated. A three-year study period was set between 2018 and 2020, ensuring a minimum follow-up of two years.

Sample size: For the present study, a purposive type of non probability sampling method was used.

Inclusion criteria:

- The consenting patient aged over 18 years with at least two episodes of recurrent anterior shoulder dislocation or subluxation episodes with or without hyperlaxity in the last two years.
- Clinically diagnosed recurrent anterior dislocation with a 3D CT scan documented Bankart's lesion of the glenoid with or without an engaging Hill-Sachs lesion.
- Patients who completed a two-year follow-up.

Exclusion criteria:

- An acute first-time anterior shoulder dislocation.
- Multidirectional atraumatic shoulder instability or posterior instability.
- Patients lost to follow-up.

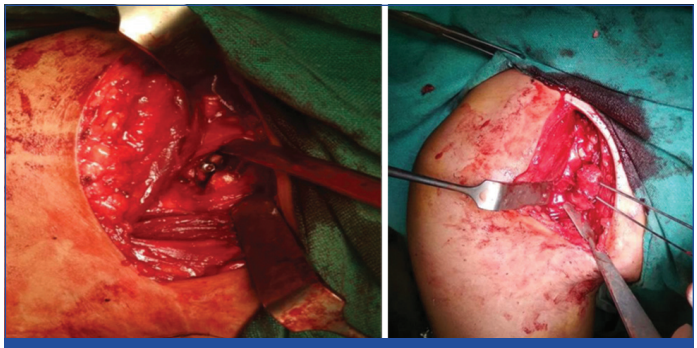
Study Procedure

In the present study, patients with any grade of glenoid bone loss (e.g., more or less than 20-25%) were subjected to the Latarjet operation. Those approaching 40% were excluded because larger glenoid defects are more appropriately treated by procedures that use larger autografts [16] or allografts [17]. Before proceeding to operative intervention, all patients underwent a complete physical examination of the bilateral shoulders in a standard fashion. A generalised ligamentous laxity assessment was conducted using the Beighton score [18]. A 3D CT scan of the shoulder joint was performed on all patients to evaluate the bony Bankart's lesion and quantify the Hill-Sachs lesion of the humeral head.

The en face view of the glenoid fossa in the 3D CT image was used for the measurement of glenoid bone loss as described by Huysmans PE et al., and Vopat BG et al., [19,20]. The surface area method was used for the assessment of glenoid bone loss, as the inferior part of the glenoid has the shape of a true circle [21,22].

Based on the quantity of glenoid bone loss, all the patients were categorised into three groups (Group A: <10%, Group B: 10%-20%, and Group C: >20% Glenoid bone loss).

Surgical technique: All surgeries were performed using a standard deltopectoral approach, and the coracoid graft transfer was done via a horizontal subscapularis split. The Latarjet procedure was performed following the Congruent Arc technique described by De Beer J et al., in 2009 [14]. The coracoid graft was rotated approximately 90° along its axis before being placed over the anteroinferior glenoid defect and fixed with two 4 mm cannulated cancellous screws [Table/Fig-1]. Two sutures were placed on the edge of the original glenoid around the screws and used to repair the capsule. The shoulder joint stability is provided by the triple blocking effect of the traditional Latarjet procedure. First, the coracoid bone block increases the inferior portion of the glenoid fossa's Anterioposterior (AP) diameter, making it more challenging for the humeral head to subluxate or dislocate. Second, the conjoined tendon acts as a sling reinforcing the inferior capsular ligamentous complex and the inferior portion of the subscapularis. Finally, repairing the inferior capsular ligamentous complex to the coracoacromial ligament's stump reconstructs the capsulolabral anatomy. Additionally, the Congruent Arc Latarjet is thought to improve glenoid reconstruction by providing better articular congruency, a larger surface to fill the glenoid defect, and a radius of curvature similar to that of the native glenoid, leading to increased anterior humeral head translation before reaching a non dislocated endpoint and decreased contact pressure across the glenohumeral joint.



[Table/Fig-1]: Showing intraoperative photograph of coracoid graft fixed with 4 mm cannulated screw.

Postoperative rehabilitation: Immediately postoperatively, patients were made to wear a shoulder arm pouch for support, and passive shoulder ROM only to the tolerance level was allowed with pendulum exercises until postoperative day 4. From postoperative day 5 to 2 weeks, gentle passive and active-assisted shoulder ROM in the scapular plane up to the tolerance level was permitted, e.g., door handle exercises. No resisted shoulder and elbow exercises were allowed for the first six weeks. Starting from seven weeks onwards, ROM gradually progressed to normal limits, optimum strength was gained by 5-6 months, and patients returned to their normal activities.

Postoperative functional outcome was assessed using the Constant shoulder score, which includes parameters like pain, activity level, arm positioning strength of abduction, and motion range [23]. All patients were followed-up at three months, six months, one year, and two years postoperatively, and the outcome was graded based on the scores obtained preoperatively and postoperatively at follow-ups as excellent (<11), good (11-20), fair (21-30), and poor (>30).

STATISTICAL ANALYSIS

The statistical analysis was performed using Epi Info 7.0 and Microsoft excel 2020 for tabulation and graphical data presentation. The data distribution was skewed, so non parametric tests, i.e., Wilcoxon's signed-rank test (for inter follow-up association) and Spearman's correlation coefficient (for statistical correlation between affected and unaffected Constant shoulder scores), were applied. The Friedman test for Chi-square value was performed to signify the mean and standard deviation values of the Constant shoulder score at each preoperative and postoperative follow-up assessment.

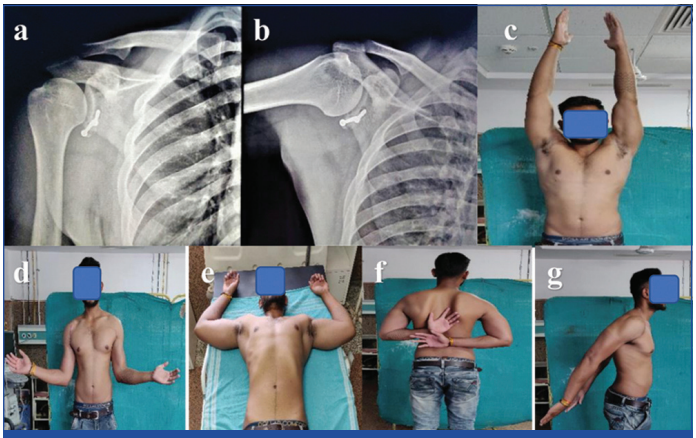
RESULTS

In the present study, the average age of patients was 30.35±11.27 years, ranging from 18 to 63 years. All the patients undergoing the operation were males. The right shoulder was affected in 16 cases (69.56%). None of the patients had ligamentous hyperlaxity. A total of 21 patients (91.3%) had bony Bankart's lesions, while 2 cases (8.7%) had soft Bankart's lesions. Concomitant Bankart's lesion and Hill-Sachs lesion were observed in 16 cases (69.56%). Glenoid bone loss was <10% in 4 cases (17.4%), 10-20% in 10 cases (43.5%), and more than 20% in 9 (39.1%) cases.

In the present study, 20 shoulders (86.96%) achieved full ROM in an average follow-up period of 677 days (1.86 years). When the patients were assessed for internal rotation, 16 patients (69.57%) could bring their hands up to the interscapular area. A total of 5 patients (21.74%) could bring their hand up to the T12 vertebrae level. A total of 2 patients (8.69%) reported moderately limited internal rotation up to the waist. External rotation was fully achieved in 20 cases (86.96%), and mild limitation was reported in 3 patients (13.04%). It was found that the mean lateral and forward elevation of 172.91±24.10 degrees and 172.74±24.12 degrees was achieved [Table/Fig-2,3a-g].

Range of Motion (ROM)			
Parameters	**Mean**	**Minimum**	**Maximum**
Lateral Elevation (LE)	172.913±24.10	65.0	180.0
Forward Elevation (FE)	172.739±24.12	65.0	180.0
Backward Extension (BE)	34.696±5.99	20.0	48.0
External Rotation (ER)	39.478±11.12	0.0	70.0

[Table/Fig-2]: Mean ROM showing LE, FE, BE and ER (in degrees).



[Table/Fig-3]: Radiographic and clinical photographs of 24 year male at final follow-up showing ROM of bilateral shoulder: a,b) Shoulder radiograph standard AP and AP view in 90 abduction; c) Lateral elevation; d) External rotation (Arm by the side); e) External rotation (Arm at 90° abduction); f) Internal rotation; g) Backward extension.

Constant shoulder score: The mean Constant shoulder scores significantly increased from 51.17±12.283 to 84.565±10.43 (p=0.001) from preoperative to final follow-up. The Constant shoulder score observed at the first follow-up was 58.31±12.89, in the second follow-up 78.12±11.56, and in the third follow-up 83.43±10.53. Preoperatively, there was a non significant (p=0.118) weak association (rs=0.335) between the affected and normal shoulder. At the final follow-up, a highly significant (p=0.01) extraordinarily strong correlation (rs=0.813) between the affected (84.565±10.43) and normal side (89.26±2.73) was found. It was observed that Group A patients with glenoid bone loss of <10% had a mean Constant score of 87.75±2.06, Group B patients with glenoid bone loss of 10-20% had a mean Constant score of 82.30±15.24, whereas Group C patients (with glenoid bone loss of >20%) had a mean score of 84.44±4.67.

Moreover, when a comparative analysis of Constant scores (mean and median) of the three groups categorised based on the percentage of glenoid bone loss was performed, no statistically significant difference was found by Analysis of Variance (F value=0.381, p-value=0.688) and Kruskal-Wallis test (Chi-square value=1.538, p-value=0.463) [Table/Fig-4]. Preoperatively, 16 patients (69.6%) had a poor grading of the constant score, and none of the patients achieved excellent grades. Postoperatively, at each follow-up, there was an improvement in the grading of the constant score, as shown in [Table/Fig-5]. At the final follow-up, 22 patients (95.65%) scored excellently, and only 1 patient (4.35%) reported a poor grade. Wilcoxon's signed-rank test was applied to calculate the paired difference of mean constant scores between preoperative versus postoperative scores. Initially, at the first follow-up, the paired difference was significantly less (p=0.876). Still, with successive follow-up evaluations, a statistically significant difference was found due to improvements in shoulder function and the constant score (p=0.001). The maximum paired difference was recorded between preoperative and final follow-up constant scores, which is highly significant (p=0.001) [Table/Fig-6]. No significant intraoperative or perioperative complications occurred. There were no surgical site infections, and no complications related to the use of screws. The apprehension test was positive in 1 patient (4.35%), mild pain was reported in 3 patients (43.04%) at the final follow-up of two years, but none of the patients had redislocation.

Groups	No. of patients	Affected side			Median
		Mean	SD	Std. Error	
A: <10%	4	87.750	2.06	1.03	87.50
B: 10-20%	10	82.300	15.24	4.82	82.30
C: >20%	9	84.444	4.67	1.56	84.44
Total	23	84.087	10.37	2.16	86.0

[Table/Fig-4]: Mean and median constant scores among three groups of patients with different quantity of glenoid bone loss (A; <10%, B; 10-20%, C; >20%).

Grade (D=N-A)	Preop; n (%)	1st follow-up at 3 month; n (%)	2nd follow-up at 6 month; n (%)	3rd follow-up at 1 year; n (%)	Final follow-update after 2 year
Poor (>30)	16 (69.57%)	17 (73.91%)	2 (8.70%)	2 (8.70%)	1 (4.35%)
Fair (21-30)	4 (17.39%)	3 (13.04%)	4 (17.39%)	0 (0%)	0
Good (11-20)	3 (13.04%)	2 (8.70%)	10 (43.48%)	1 (4.35%)	0
Excellent (<11)	0 (0%)	1(4.35%)	7 (30.44%)	20 (86.95%)	22 (95.65%)
Total	23 (100%)	23 (100%)	23 (100%)	23 (100%)	23 (100%)

[Table/Fig-5]: Improvement in grading of Constant shoulder score with follow-ups.
*D: Difference of mean Constant scores of normal and affected shoulder; N: Normal side score; A: Affected side score; n: Number

Constant score affected	Paired differences			Wilcoxon's Signed-rank test Z value	Significance p-value
	Mean	Std. Deviation	Std. Error		
Preoperative vs first follow-up	0.957	15.417	3.215	0.157	0.876 (NS)
Preoperative vs second follow-up	19.696	13.884	2.895	4.107	0.001 (HS)
Preoperative vs third follow-up	29.826	13.574	2.830	4.199	0.001 (HS)
Preoperative vs final follow-up	33.3913	11.6453	2.4282	4.200	0.001 (HS)
First follow-up vs second follow-up	18.739	8.598	1.793	4.11	0.001 (HS)
First follow-up vs third follow-up	28.870	9.720	2.027	4.202	0.001 (HS)
First vs final follow-up	32.4348	11.0939	2.3132	4.199	0.001 (HS)

[Table/Fig-6]: Affected side paired mean difference of the constant score with standard deviation between preoperative and postoperative follow-up values.
*Std: Standard; NS: Non significant; HS: Highly significant

DISCUSSION

The congruent Arc Latarjet technique restores a greater anterior-posterior diameter of the glenoid bone without compromising the

congruency of the articular surface of the shoulder joint. This may potentially decrease contact pressure across the glenohumeral joint and avoid degenerative changes in the long term [24]. As far as the outcome of the congruent arc Latarjet operation is concerned, the authors assessed the patients for pain, sleep disturbance, activity level, arm position, strength of abduction, and ROM in the form of a Constant shoulder score. With a strict rehabilitation protocol, the recovery of flexion, abduction, external rotation, and internal rotation in all planes was within normal limits in the majority of the patients. In the present study, the mean Constant score of the affected shoulders at the final follow-up was significantly comparable to the Constant scores of the normal shoulder of the same individual at the final follow-up. In a series by Bauer S et al., on more than 80 cases with a minimum 1-year follow-up (range: 1-5 years), demonstrated outcomes were good to excellent (subjective shoulder value >80% in 95% of cases; Constant score >90% and Rowe score >90%) [25].

The complication rate was low, with one early coracoid fracture (1.3%), no recurrent dislocation or neurological complications, and no new arthritis of the shoulder joint observed. A similar observation was found in a study by Mizuno N et al., on 68 patients [26]. The mean Rowe score increased from 37.9 preoperatively to 89.6 at the final follow-up ($p<0.001$). The mean subjective shoulder value was 90.9% at the final follow-up. The postoperative rate of recurrence of dislocation was 5.9%. In a study by Hurley ET et al., including 822 patients (845 shoulders), where 82% of patients were men with an average age of 27.4 years, and the mean follow-up was 199.2 months (16.6 years) [27], the rate of good/excellent outcomes was 86.1%. The recurrent instability rate was 8.5%, with 3.2% of patients having recurrent dislocations and arthritic changes seen in 38.2% of patients, and residual shoulder pain in 35.7% of patients. They concluded that the Latarjet procedure for anterior shoulder instability results in excellent functional outcomes in the long term and a high rate of return to sport among athletes.

Willemot L et al., concluded that the underlying failure mechanism of the Latarjet procedure was associated with non union in 42.3%, graft resorption in 23.1%, graft malpositioning in 15.4%, and trauma or graft fracture in 19.2% of cases [28]. They reported none of the recurrent dislocations after this procedure. A similar observation was found in a study by Bohu Y et al., on 217 patients, aged 26.8±7.3 years aimed to report the rate and time of Return To Play (RTP) during the first eight months following the Latarjet procedure [29]. They concluded that 158 patients (73%) resumed their main sports, at a mean of 5.1±1.5 months by eight-month follow-up. In a study by Menon A et al., a total of 280 patients were analysed in which 92.1% were athletes [30]. The recurrence of instability after the Latarjet procedure was observed only in 7 patients (2.5%), and radiological signs of the development of shoulder osteoarthritis were observed in 25.8% of the patients. The overhanging position of the bone graft resulted in a statistically significant onset or worsening of osteoarthritis. However, it was observed that the age of the patient at the time of surgery, the number of dislocations before surgery, and the presence of a Hill-Sachs lesion were not significantly associated with joint degeneration. The strength of the present study was that it was a prospective study and was performed at a single centre.

Limitation(s)

The main limitations of the present study were the small sample size and short follow-up period. Therefore, it is recommended that prolonged follow-up of all cases be conducted to evaluate long-term complications of the Latarjet operation, such as arthrosis of the shoulder joint and effects caused by graft resorption.

CONCLUSION(S)

The congruent arc modification of the Latarjet procedure is a reliable method for treating recurrent anterior shoulder dislocation in patients with minimal to more than 20% glenoid bone loss. The Latarjet procedure facilitates early recovery with regular compliance with the rehabilitation protocol. The present study established that this procedure ensures no further dislocation, early recovery, and adequate rehabilitation. Therefore, the Latarjet procedure is an excellent surgical intervention with satisfactory results for recurrent anterior shoulder instability.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Oct 16, 2023
- Manual Googling: Mar 27, 2024
- iThenticate Software: Mar 29, 2024 (23%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Oct 15, 2023**
Date of Peer Review: **Jan 18, 2024**
Date of Acceptance: **Apr 02, 2024**
Date of Publishing: **May 01, 2024**