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ORIGINAL ARTICLE

Comparative Study Between Iliac Bone Grafting Versus the Latarjet Procedure for Surgical Management of Recurrent Anterior Shoulder Instability With Glenoid Bone Defect

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Abstract

Background and aim: **Anatomical glenoid restoration by iliac graft transplant versus latarjet surgery is competing as a management option for recurrent traumatic anterior dislocation of the shoulder associated with glenoid bone loss. All patients, who have recurrent traumatic anterior dislocation of the shoulder with loss of glenoid bone rime, will be assessed effectively for their responses to the Latarjet or the Iliac Graft Transfer.**

Patients and methods: **There were 40 patients presented with Anterior dislocation of the shoulder who had open Latarjet operation or ICBGT operation in this prospective random research. Rowe and ASES ratings, satisfaction level, evaluation of range of motion, and instability were all conducted before surgery and after 6, 12, and 24 months following surgery. All patients were followed up with radiographys and CT scans before and after surgery and over the time of follow-up and recorded.**

Results: **There is no statistically significant difference between both groups for management of recurrent traumatic anterior dislocation ($P < 0.05$).**

Conclusion: **It has been observed during the follow-up over this period, and as a result of the measurements or radiographs, that there is no difference between them except the Latarjet group's significantly decreased exterior rotation capacity.**

Keywords: Glenoid bone defect, Iliac-bone, Instability, Latarjet, Shoulder instability

1. Introduction

Commonly occurring traumatic anterior dislocation of the shoulder results in bone losses on both the humeral and glenoid surfaces of the shoulder joint, which is characteristic of this condition.[1] It has been shown that soft-tissue stabilization treatments for recurrent anterior shoulder destabilization are unsuccessful in people who have had significant glenoid bone loss. It is indicated that bone grafting methods be used in place of soft-tissue stabilization methods when there has been a severe loss of glenoid bone.[2,3] Bony lesions were discovered by Burkhart and De Beera[4] to be a major cause of arthroscopic Bankart repair failure. Therefore, a lot of research has been done and developed to restore the glenoid bone defect. When patients suffer from significant bone loss, a bone-replacement method is often well accepted. The recommendation for a bone supplementation operation for the glenoid defect is now widely accepted in patients who have had extensive bone loss compared to the past. There are two categories of competitors for bone grafting methods: coracoid or free iliac graft. The process of coracoid transfer involves moving bone from one location to another. Latarjet technique, which involves the division of the subscapularis muscle in a horizontal direction to

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move the coracoid bone and its connected conjoined tendons to glenoid rime, is a method performed in orthopedic surgery. The combination of bone grafting and Latarjet's sling effect is responsible for the majority of shoulder stabilization.[5] An intra-articular tricortical iliac bone crest transplant for the treatment of glenoid insufficiency is more anatomically acceptable in the therapy of recurrent traumatic anterior dislocation of the shoulder.[6] It's vital to restore normal anatomical length and breadth to the rim glenoid to achieve joint stability.[7]

With several numerous research on both surgical techniques' clinical results, the advantages of one over the other have long been debated and this study aims to reach a comparison between the two methods to try to reach the difference between them and which one is the best.

2. Patients and methods

This study was conducted on 40 patients attending AL Hussein University hospital and Nasser Institute Hospital from May 2019 to June 2021. The Ethical Research Authority of all clinical applications has signed off on this study from Al-Azhar University. Randomization of subjects was done by the Random Allocation Software V.4.5 (Asfahan, IR) randomization program.

Two equal groups were formed, 20 in group A (patients underwent ICBG) and the other 20 patients in group B (patients underwent Latarjet procedure). All selected patients met the following criteria, clinical examination suggestive of anterior shoulder instability in the age group (18–60) years old with radiological evidence with anterior glenohumeral instability associated with loss of glenoid bone >15% on CT scan with the 3D of the glenoid with AP distance method described by Skupiński et al.[8] And exclusion the following patients, if the radiological suggestive glenoid bone defect less than 15% on CT scan with the 3D glenoid, more than 40% of the head humerus is affected by the Hill–Sachs lesion with Flatow technique, collagen disease, glenohumeral arthritis, muscle disorders around the shoulder, associated fracture-dislocation or uncontrolled seizures.

The patients were evaluated according to the following: how many times they've been dislocated, how long it's been since they have had a dislocation, what caused it, and previous surgical stabilization. As a score of the American Shoulder and elbow surgeon's shoulder index and the score of Rowe is to determine the level of instability. Clinical examination is carried out using instability tests. All patients do radiographys, CT scans, and MRI before surgery.

2.1. Surgical technique

General anesthesia was induced, and the patient was placed in the beach-chair position with all bony prominences appropriately well padded (Fig. 1).

Preoperative physical examination of the shoulder with the patient under anesthesia is then performed to confirm the positions and degree of instability. When indicated, a standard diagnostic arthroscopy may first be performed with the patient to confirm the glenohumeral osseous deficiency. Patients were assigned to receive either an open Latarjet procedure or ICBG.

Latarjet procedure: Between coracoid to fold of axilla, a 4–6 cm arch-shaped incision is formed (Fig. 2).

The cephalic vein is identified by careful dissection and then maintained laterally in a proper manner. To improve the field and expose the coracoacromial ligament (CA), minor abduction with the arm rotated to the outside is performed. The CA ligament is cut 1 cm from its coracoid insertion, allowing it to be later reattached. The inferior surface of the coracoid should be cleaned from soft tissues by periosteal elevator, to be suitable for a replacement of a missing component when applied as the bone graft.

The axillary and musculocutaneous nerves should be identified and protected with digital palpation throughout the coracoid exposure. At this point, the coracoid process should be appropriately prepared for the graft harvest. And by an oscillating saw, cut the coracoid from the front to the coracoclavicular ligament. By rotating the arm externally, the subscapularis is stretched, allowing glenohumeral joint exposure and exploration after coracoid osteotomy. The superior and inferior margins of the muscle are identified. Mayo scissors are used to split and spread the muscle at the junction of its upper two-thirds to its lower one-third. A pedicled gauze is

Fig. 1. Intraoperative picture of a patient's left shoulder in the beach chair posture.

Fig. 2. Intraoperative photograph of incision.

inserted underneath the muscle, followed first by a Hohmann retractor and later by a Link retractor keeping contact with bone. This retractor is important to protect the passage of the axillary nerve. Preserving joint extension needs an incision approximately 1 cm medial to the glenoid margin. A clear and porous region should be created on the anterior glenoid neck by applying burr before transplant.8 The humeral head is forced back into position by the use of a retractor called Fukuda, during the drilling stage, this is placed into the joint (Figs. 3 and 4).

When the coracoid is applied to the surface of the glenoid, the long axis should be anteroinferior to the glenoid, which is the ideal position, After finding the perfect site, the procedure is performed by drilling two bilateral cortical holes equal to the articular surface at roughly 5 o'clock positions in the anteroposterior direction.[9]

Fixation with two 3.75-mm partially threaded, cannulated, self-tapping, titanium screws to hold

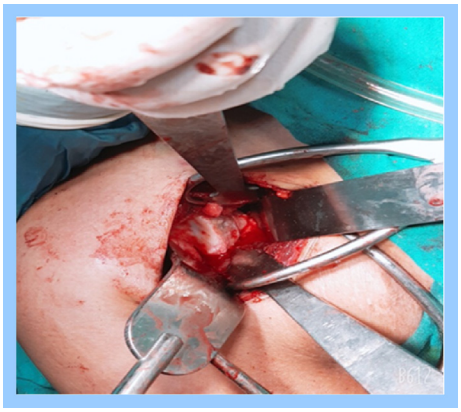

Fig. 3. Since the anterior glenoid had been exposed, a bone deficiency could be seen as a flat surface instead of the convex shape of a usual glenoid. The humeral head was pulled away from the soft tissues on the inside using a Fukuda retractor while the medial soft tissues were retracted using a curved blunt retractor.

the coracoid, over-tightening the screws can cause a coracoid fracture (Fig. 5).

Anatomical bone reconstruction with iliac bone graft: Iliac ridge was cleaned and covered sterilely in a classical way, using a routine method via the deltopectoral interval to the clavipectoral fascia. Between the upper two-thirds and lower one-third of the subscapularis, muscle fiber is split with scissors to reach the joint, and when exposed to the glenoid edge, Instead of the convex shape that would be observed in a classic anterior glenoid, the bone lesion appeared as a flat surface.[10] A medial retractor with a curved tip was used to withdraw soft tissues and uncover the glenoid, while the humeral head retractor was used to pull the glenoid. Make a 1–2 inch incision along the posterior superior iliac spine to reach the bone. Blunt retractors were applied to maintain exposure of the iliac crest from the inner and outer surfaces, an oscillating bone saw made a 3 cm long, 2 cm thick triangular wedge graft.[11] This graft was shaped to fit the glenoid rime using a small saw and bur, increasing the glenoid surface's breadth and depth, articulation was created by using a curved inner surface (Fig. 6).

The graft was secured with AO 4.0 mm cannulated screws threaded K-wires. To allow the screw heads to sit medially to the joint surface, wires were inserted in the center and equal to the surface, by using the standard technique, two cannulated screws were inserted over the wires to hold the graft in place. For a seamless transition to glenoid depth reconstruction, the contact between the glenoid and the graft which carefully examined and checked during the procedure.[12] Then the periosteal capsule sheath is attached to the edge of the graft by applying horizontally arranged braided material sutures No. 2 secured beneath each screw (Fig. 7).

Postoperative follow-up by a sling for 14 days, the sling can be avoided, passive and active rotation is allowed after 4 weeks, started active FF, ER at the side, ER at 90° abduction, and IR at 90° abduction were assessed, and documented, Rowe and ASES scores were calculated, anteroposterior plain radiography and C.T 3D of glenoid postoperative and follow-up examinations were performed.

2.2. Ethical approval

As required to perform the study, acceptance from the Ethical Research Board of the Faculty of Medicine at Al-Azhar University in Cairo, was obtained before beginning. After a full clarification of the operation and the possibility of side effects, a written agreement was obtained from all participants.

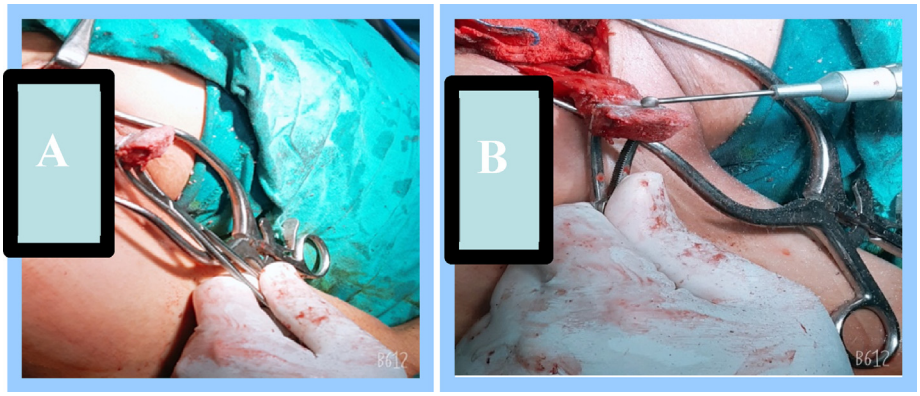

Fig. 4. (A) Coracoid osteotomy. (B) Coracoid preparation. (A)When performing osteotomy of the coracoid, an oscillating saw blade is applied. Osteotomies are most commonly performed just anterior to the point where the coracoclavicular ligaments attach to the coracoid's elbow. (B) It is at this following step that the coracohumeral ligament is dislodged from the automatized coracoid, although a tendon is still attached to it. The medial surface of the coracoid is Prepared by decortication with an oscillating saw and burr.

2.3. Statistical analysis

Follow-up was carried out over a period of two years All patients were followed up at six months and twelve months. Scores medians and means were analyzed and compared using IBM SPSS Statistics software v19 (IBM Corporation, Somers, NY, USA). Significances were tested using the Wilcoxon Signed Ranks Test for related samples, Mann–the Whitney test for independent samples, and Pearson's correlation test for bivariate variables. Results were considered significant at the 95% confidence interval level for all statistical analyses.

3. Results

There were 36 males (90%) and 4 females (10%) with a mean age of 25.9 years ± 5.6 (range 18–38 years) There was 28 Rt shoulder (70%) and 12 Lt shoulder (30%) The mean number of preoperative instability episodes was 11.95 ± 5.38 (range 5–21 times). The mean duration from the time of the first dislocation to surgery was 15.3 months ± 5.19 (range 8–24 months) The mean duration of follow up in our series was 16 months ± 3.4 (range, 8–24 months).

Preoperative range of motion (ROM): A clinical examination revealed that all of the patients tested positive for anterior instability tests such as anterior drawer test, apprehension test, relocation test, and load and shift test. The mean preoperative ROM of the 20 patients who underwent ICBG (group A) was as follows, external rotation (ER) at 90° abduction was 63°, ER at 0° abduction was 35°, forward flexion (FF) was 161° and internal rotation (IR) at 90° abduction was 76°. The mean preoperative ROM of the 20 patients who got Latarjet (group B) was as

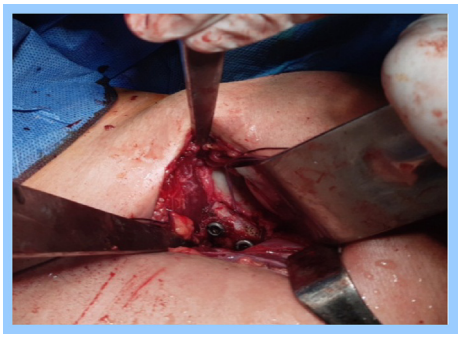

Fig. 5. (A) Intraoperative photograph of coracoid graft after fixation by screws.

Fig. 6. Preparation of the iliac crest, As part of a procedure to remove a tricortical wedge-shaped graft of approximately 3 cm in length and 2 cm in diameter, the surgeon utilized an oscillating saw.

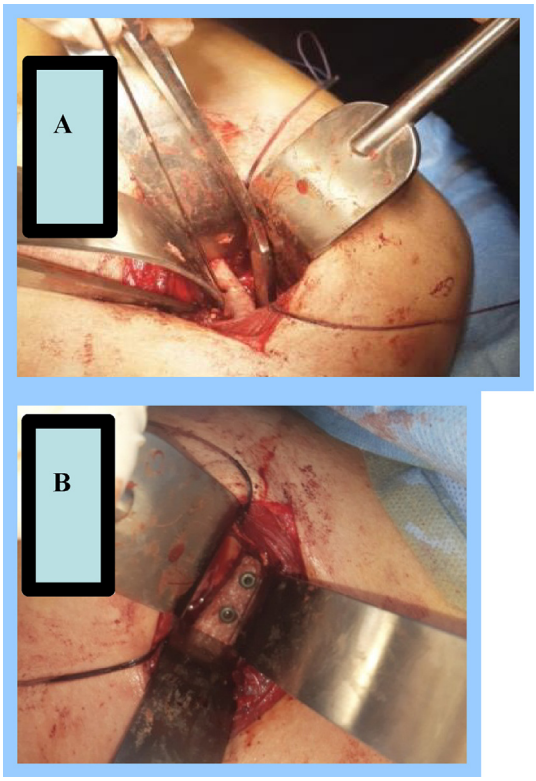

Fig. 7. (A) A temporary Kirschner was constructed with wires that were oriented medially and parallel to the joint surface so that the screw heads sat medially and the inner table was congruent with the glenoid articular surface, which was as far away from the humeral articular surface as was reasonably possible. (B) Two cannulated screws were subsequently put over these wires using a normal method.

follows, ER-90° abduction was 61°, and ER-0° abduction was 32. FF was 161° and IR-90° was 81° (Table 1).

Preoperative functional scores: Rowe and ASES mean scores were 18.5 and 40.2 respectively in patients with Latarjet procedure, and in patients with ICBG procedure were 23 and 35.93, respectively [Table 2].

Postoperative ROM: in group A, ER-90° abduction was 80°, ER-0° abduction was 44, FF was 172°, and IR-90° was 81°. In group B, ER-90° abduction was 75°, ER-0° abduction was 37. FF was 169° and IR-90° was 86° (Table 3).

Postoperative Functional scores: Patients who got Latarjet surgery had mean Rowe and ASES ratings of 87.8 and 91.1 at terminal follow-up, whereas patients undergo ICBG surgery had mean Rowe and ASES scores of 92 and 91.7 respectively (Table 4).

Results as regards the time of operation: When we compare them in terms of surgery time, we will find the time for the Latarjet procedure was 77.33 ± 10.19 (range, 60–90), and the mean operative time for ICBG operation was 73 ± 10.56 (range, 55–90). When comparing mean operative time (*P* value 0.183), there is no statistically expressive difference.

Results as regards ROM at ending follow-up: Statistically, there was the same result between mean postoperative forwarding flexion in the two groups when we compared them in terms of forwarding flexion (*P* value 0.17), at external rotation in 0° abduction we found the mean ER-0° after ICBG was higher than after Latarjet by 7.5°, and this was significant (*P* value 0.001), at external rotation at 90° abduction we found mean ER-90° after ICBG was higher than after Latarjet by 5°, and this was significant (*P* value 0.02), at IR at 90° abduction we found mean IR-90° after Latarjet was higher than after ICBG by 5°, and this was statistically expressive (*P* value 0.09).

In functional scores, the mean Rowe and ASES Scores showed better results with ICBG but with no statistically expressive (*P* value 0.14), (*P* value 0.54) respectively.

Postoperative pain after 4 weeks follows up: in two methods we found a mean increase of 0.6 of postoperative pain according to visual analog score (VAS Score) for patients who underwent ICBG operation than that for patients who underwent Latarjet operation and it was statistically expressive (*P* value 0.029).

As regards complications, we had two patients who developed numbness on the anterior portion of the thigh following iliac crest graft harvesting after ICBG reconstruction. It was discovered that the lateral cutaneous nerve of the thigh had been damaged when an EMG was performed three months after the

Table 1. Illustrates the preoperative ROM in group A and B.

	Forward flexion	ER at 0° abduction	ER at 90° abduction	IR at 90° abduction
Mean ± SD ICBG	161 ± 6	35 ± 6	63 ± 7	76 ± 8
Mean ± SD Latarjet	161 ± 7	32 ± 7	61 ± 7	81 ± 5
Range	150 – 170	25 – 45	50 – 75	55 – 85

Table 2. The preoperative functional scores.

	ICBG		Latarjet	
	Pre Rowe	Pre ASES	Pre Rowe	Pre ASES
Mean ± SD	23 ± 10	35 ± 11	18 ± 11	40 ± 11
Range	5 – 45	20 – 58	5 – 40	20 – 58

Table 3. Illustrates the postoperative ROM in group A and B.

	Forward flexion	ER at 0° abduction	ER at 90° abduction	IR at 90° abduction
Mean ± SD ICBG	172 ± 6	44 ± 7	80 ± 7	81 ± 6
Mean ± SD latarjet	169 ± 5	37 ± 5	75 ± 5	86 ± 2
Range	160 – 180	35 – 60	60 – 85	70 – 90

Table 4. Illustrates the postoperative functional scores.

ICBG			Latarjet	
	Post rowe	Post ASES	Post rowe	Post ASES
Mean ± SD	92 ± 10	91 ± 7	87 ± 10	91 ± 8
Range	70 – 100	78 – 100	75 – 100	78 – 98

first injury. After the Latarjet operation, another patient's MCA dislocated, the graft and screws were fractured, and autogenous iliac crest bone graft restoration was performed, with the patient reporting good functional scores and range of motion at 6 months. Another female patient experienced an intraoperative coracoid graft breakdown when tightening screws during a latarjet treatment. The transplant was transosseous fixed, and she was immobilized by an arm sling for four weeks. Postoperative limited range of motion in follow-up was noticed, the patient started physiotherapy for 12 sessions and an accepted range of motion was achieved. No case has been registered with non-union in both groups or recurrence instability.

Case presentation from group A:

Student male patient 20 years old with right anterior shoulder instability. The condition started 2 years ago. Recurrent right anterior shoulder dislocation 10 times within 11 months, dislocation is as a result of fits, no special sports activity with tramadol addict. Anterior apprehension, relocation, and anterior drawer were positive with an ISIS score were (6), range of motion of ER-90 was 45, ER-0 was 30, FF was 155, and IR-90 was 75.

Preoperative Plain radiography and CT Scan were done. Post-operative Plain radiography and CT Scan were done at 6 months and 12 months showing increased surface area and decreased glenoid defect and the union of the graft (Figs. 8–11).

After 12 months follow up ROM ER-90 was 80, ER-0 was 55, FF was 170, and IR-90 was 80 (Fig. 12). ASES Score preoperative and postoperative respectively was 20,90. Rowe Score preoperative and postoperative respectively was 35,90.

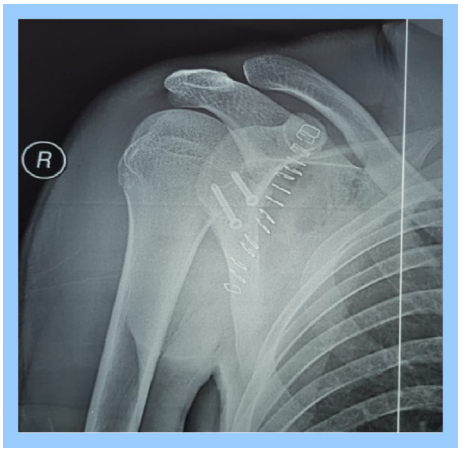

Fig. 9. Postoperative radiography.

Case presentation from group B:

Student male patient 19 years old with left anterior shoulder instability, the first dislocation from 3 years ago past history of arthroscopic banker repair with the anchors. Repetition of dislocation 9 times within 18 months after the operation, dislocation is a result of direct trauma and the dislocation, football as a special sports activity, and no smoker. Anterior apprehension, relocation, and anterior drawer were positive with an ISIS score were (8), range of motion of ER-90 was 65, ER-0 was 40, FF was 160 and IR-90 was 75. Preoperative plain radiography and CT scan were done. Postoperative plain radiography and CT scan were done at 6 months and 12 months showing increased surface area and decreased glenoid defect and the union of the graft (Figs. 13–15).

After a 12-months follow up ROM ER-90 was 75, ER-0 was 45, FF was 165 and IR-90 was 85. ASES Score preoperative and postoperative respectively was 36,98. Rowe Score preoperative and postoperative respectively was 25,90 (Fig. 16).

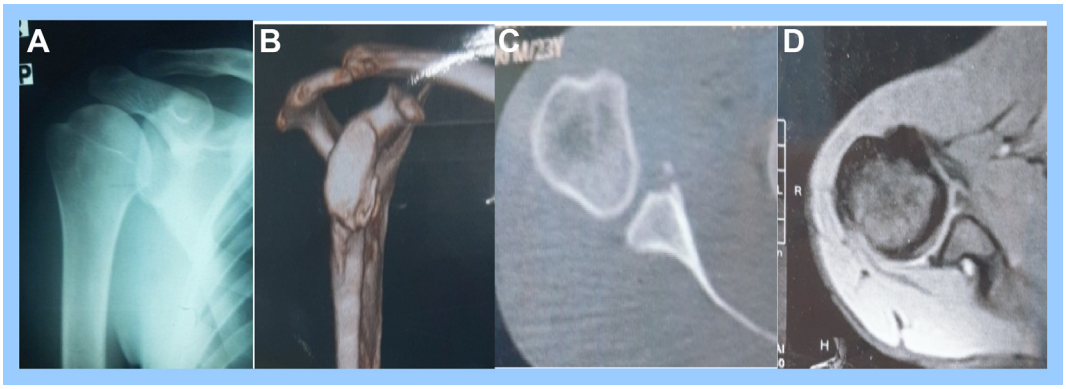

Fig. 8. Preoperative (A) Radiography A_P view. (B) Enface view (C) Axial cut show defect of gleniod rim. (D) Axial cut of MRI show Bankart lesion.

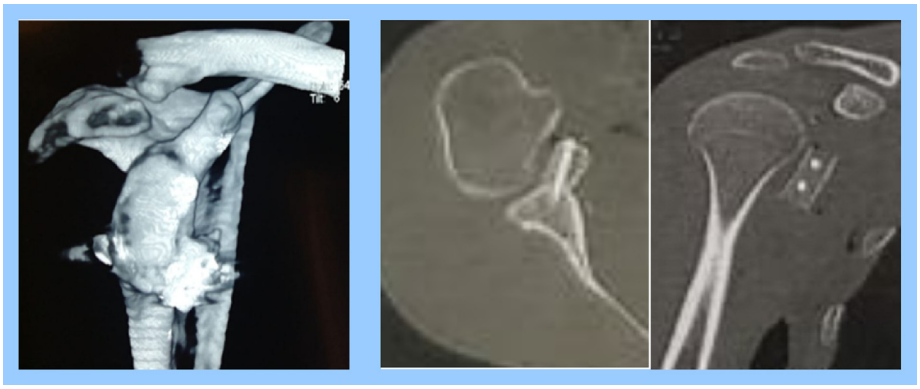

Fig. 10. C.T after 6 month follow-up.

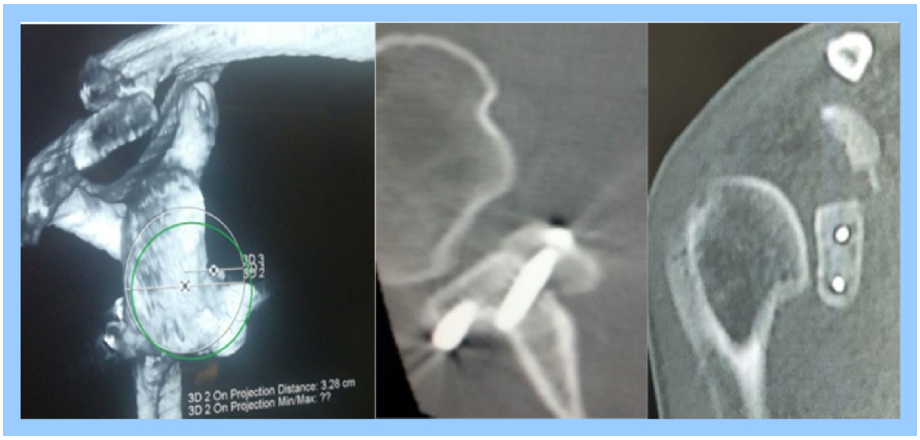

Fig. 11. C.T after 12 month follow-up.

4. Discussion

Our study's major finding is that the primary endpoint measurement did not show any significant variations (Rowe and ASES scores) between the ICBGT and the Latarjet technique at any of the observed periods following surgery. However, in the absence of more randomized comparison studies, identical results have been reported in two-level III matching group research: one comparing the Latarjet technique to the ICBGT, and another Latarjet technique with the distal tibia transplant technique (as a type of bone grafting).[13] Over the

Fig. 12. Shoulder ROM at final follow-up.

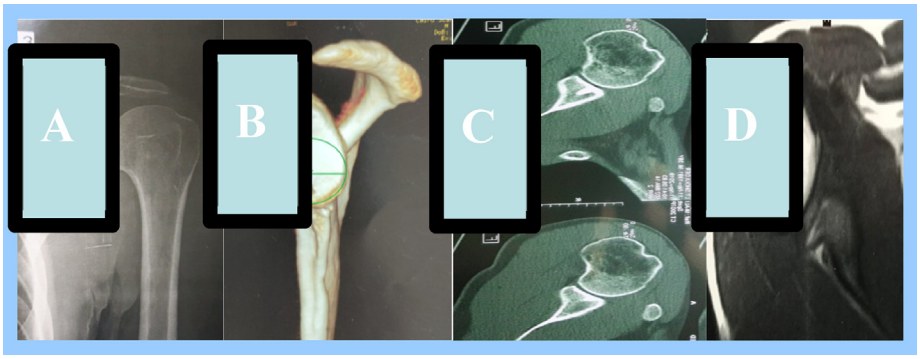

Fig. 13. Preoperative (A) radiography by AP view show the pervious a Bankart repair with the anchors. (B) Enface view. (C) Axial CT cut show the gleinoid bone loss and Hill Sachs defect. (D) Axial cut of MRI show Hill Sachs defect.

course of two years, recorded motion, abduction, and internal rotation were not different between the groups. However, external rotation; was considerably poorer following the Latarjet surgery than after ICBGT. Although the origins are unknown, one possibility is that the conjoined tendon completely splits the subscapularis, causing structural damage or dynamic limit to the muscle and tendon.[14]

The tensioning of the transferred conjoined tendon may explain the superior stabilizing effect of the Latarjet surgery, especially in higher degrees of abduction and external rotation. The sling action at the subglenoid level closes the glenoid defect's critical gap. These findings support those of Jiang et al.,[15,16] who reported that the transferred conjoined tendon has a strong stabilizing effect on shoulder stability. After rerouting the tip of the coracoid process under the subscapularis muscle, they noticed a marked decrease in glenohumeral translation and loading of the conjoined tendon (0 kg, 1.5 kg, 3.0 kg). The anterior glenohumeral translation was reduced from 9 mm to 5 mm with a 3 kg load. Halder et al.[17] found that the conjoined tendon had a considerable capability to translate the humeral head superiorly (2.8 mm; standard deviation, 1.3 mm). Wellmann et al.[6] performed anterior translational testing after a rerouting of the osteotomized coracoid process under the subscapularis muscle and consecutive bony reattachment to its anatomic location (Boytchev procedure). The position of the rerouted coracoid significantly differs from the transferred coracoid segment position at the anterolateral scapular neck in the Latarjet technique. Nevertheless, the short head of the biceps seems to have a relevant stabilizing function on the humeral head, if its course to the humerus has been surgically approximated to the anterior aspect of the glenohumeral joint.

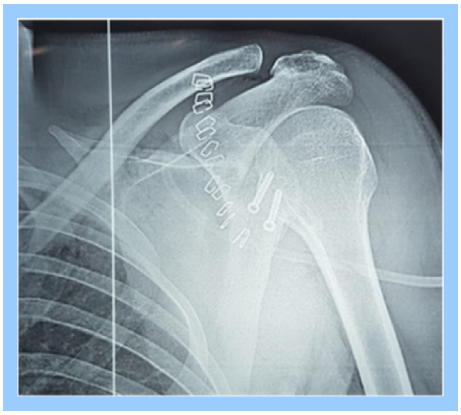

Fig. 14. Postoperative radiography.

When the conjoined tendon was loaded rather than unloaded, a reduction in the overall rotational capacity was seen at 90 degrees of abduction, founded on a biomechanics evaluation of the sling action after the Latarjet surgery. Given the same tendency for joint abduction, there observed was no statistically expressive difference between the groups. Another possibility is that the Latarjet group had more prior open Bankart repairs than the ICBGT group, which could have injured the subscapularis musculotendinous unit muscle.[18] Statistically, $P = .353$ indicates no difference between both groups, preoperative external rotation performance was nearly identical suggesting that this explanation is highly unlikely. During the study's conclusion, it was discovered that there was the same result between the Latarjet and ICBGT groups when strength assessments were conducted between the two groups.

An isometric muscle evaluation of the patient's capacity was performed following the Latarjet operation, researchers found that after a year after surgery, patients had less strength and capacity in both internal and external rotation compared to the normal side.[19] However, Edouard et al.[20] found the

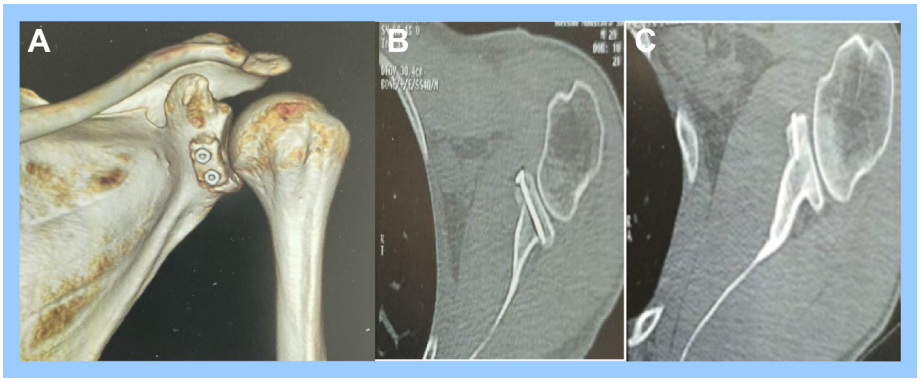

Fig. 15. (A) 3D computed tomography revealed coracoid graft after 6 month. (B) CT axial cut after 6 months. (C) CT axial cut after 12 months.

impairment may have existed before surgery and that individuals restore their preoperative rotation strength 6 months following the Latarjet procedure. Previous studies have demonstrated that the Latarjet technique, which employs a subscapularis division rather than cutting the muscle in the form of an L shape, results in no variation in external rotation strength between the operated and unoperated sides. According to Paldini et al.,[21] the variation in isometric subscapularis capacity following an L-shaped tenotomy and following a splitting muscle method. They highly recommended that the muscle division technique be used in protecting optimum subscapularis performance after surgery. External rotation limits and loss of internal rotation after surgery and subscapularis fatty degeneration can be explained by subscapularis muscle insufficiency. There was no clinical variation between the two categories on the basis of postoperative stability. Donor site-related adverse events, such as sensory anomalies surrounding the scar, were more common in the ICBGT group than shoulder-related potential complications, in which adverse risks are well-known. It is possible that complications related to fixation such as graft nonunion and screw irritation will develop, necessitating the removal of the implant, despite the fact that the Latarjet technique offers a clear benefit due to no additional morbidity at the donor site. In addition, the extra-anatomical nature of the Latarjet technique may produce scapular dyskinesis and require surgical intervention. When comparing the Latarjet procedure to the ICBGT with the size of the graft we find coracoid graft is limited in size and not suitable for a large defect on the glenoid or combined defect in the anterior and posterior rim in these cases, an iliac transplant is recommended.

Fig. 16. ROM at final follow-up.

4.1. Limitations

Our study had several limitations including a small number of fairly heterogeneous patient‟ populations with no high demand athletes, the short-term follow-up to assess O.A development and non-digital measuring of ROM. In addition, postoperative MRI and C.T follow-up were not done for all patients.

4.2. Conclusion

The Latarjet and ICBG reconstruction methods effectively manage anterior shoulder instability caused by loss of glenoid bone which restores the glenoid rim architecture. With the exception of much greater external rotation capability in the ICBGT group, there was no difference in clinical and radiologic results between the two groups. In contrast, the Latarjet treatment has the benefit of having a ‘sling effect,’ Which may mean a lower risk of recurrence with this surgical technique. However, it's a cause of a decrease in the external rotation range, in comparison to the anatomical bone reconstruction with ICBG.

We recommend early surgical intervention for recurrent shoulder instability as a late intervention with an increased number of Instability and time from first Instability to time of surgery are associated with lower functional scores.

In initial cases of recurrent traumatic anterior shoulder instability with loss of glenoid bone, we advocate both techniques (ICBG and Latarjet operation), which have the benefit of a practically unlimited range of motion and just 2 weeks of postoperative immobilization. There has been no nonunion and the clinical results have been excellent, as well as high patient satisfaction.

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No.

Conflicts of interest

There are no conflicts of interest.

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