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Recurrence of instability after Latarjet procedure: causes, results and treatment algorithm

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- Latarjet modifies the anatomy of the shoulder, and subsequent revision surgery is challenging.
- It is mandatory to determine the cause of recurrence in order to select the best treatment option. A CT scan is needed to measure glenoid track and evaluate coracoid graft status: position, degree of consolidation, and osteolysis.
- Conservative management can be advocated in selected patients in whom the instability level does not interfere with the activities they wish to perform. Surgical treatment is based on the glenoid track measurement and coracoid graft suitability.
- The coracoid graft is considered suitable if it preserves the conjoint tendon insertion, does not show osteolysis, and is large enough to reconstruct the glenoid surface. Adding a remplissage is recommended for those cases with a coracoid graft insufficient to convert large off-track Hill–Sachs lesions into on-track.
- If the coracoid graft is suitable to reconstruct bone defects in terms of size and viability but is poorly positioned or avulsed, graft repositioning can be a valid option.
- In patients with unsuitable coracoid bone graft, free bone graft is the revision technique of choice. The size of the graft should be large enough to restore the glenoid surface and to convert any off-track Hill–Sachs lesion into on-track.
- There is a small group of patients in whom bone defects were properly addressed but Latarjet failed due to hyperlaxity or poor soft tissue quality. Extraarticular capsular reinforcement is suggested in this population.

Keywords

- shoulder
- instability
- anterior
- Latarjet
- failure
- recurrence

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Introduction

The Latarjet procedure is a surgical technique especially recommended for patients with anterior recurrent instability in the presence of a critical glenoid bone loss (1, 2). It can also be considered the treatment of choice in patients without glenoid defect if they are deemed to have a high risk of dislocation if treated with soft tissue procedures (2, 3). As a result of these indications, the number of Latarjet procedures performed has increased exponentially in the last decades (4, 5).

Although the recurrence rate reported with Latarjet has been 0–18% in studies with a follow-up of less than 10 years, it may raise to 5–26% in those over 10 years (6, 7). Shoulder instability after Latarjet is a challenging situation. Since it is a non-anatomic technique, subsequent revision surgery can be seriously compromised not only by scar tissue obscuring normal tissue planes but also by alterations of anatomic stabilizing structures. Furthermore, the number of published studies reporting the results of revision surgery after failed shoulder stabilization using the Latarjet technique is very scant (8).

In this review, an update in the etiology, clinical and imaging assessment, and the surgical options of failed anterior instability after Latarjet procedure is presented, and an algorithm for its management is suggested.

Analysis of causes of recurrence and rationale

The causes potentially responsible for recurrence, considered as dislocation or subluxation, after anterior shoulder stabilization with the Latarjet technique should be identified to select the best revision option. First,

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there are unavoidable factors that rely on the patient´s characteristics. Recently, Di Giacomo *et al.* have reported a higher risk of recurrence in those patients with a traumatic mechanism for primary dislocation, bilateral instability, and female sex (9). On the contrary, Frank *et al.* did not find any differences in recurrence rate between genders (10). There can also be soft tissue problems related or not to collagen diseases such as generalized hyperlaxity or Ehlers–Danlos syndrome that may be related to postoperative recurrence after Latarjet (7). While epilepsy has been classically regarded as a risk factor for postoperative instability after Latarjet, Dzidzisvili *et al.* found no differences between epileptic and non-epileptic patients and sustained that the risk of recurrence after Latarjet was related to the severity of bony lesions commonly found in this population instead of the neurologic condition itself (11).

Second, the glenoid track before the index surgery and after recurrence should be thoroughly studied with CT scan when dealing with patients sustaining severe bipolar bone lesions, as some patients can remain off-track after a technically correct Latarjet since the width of the coracoid graft might not be enough to restore the glenoid track. Calvo *et al.* reported 11.8% of cases that remained off-track after undergoing a Latarjet procedure and they had a significantly higher rate of failure than those that converted to 'on-track' (12). In this clinical setting, some authors have suggested the congruent-arc technique as it provides approximately 5 mm more bone augmentation (13), while others might consider a better option addressing the Hill–Sachs lesion by adding a *remplissage* to the Latarjet procedure (14) or to increase the glenoid surface by means of a free bone graft (15, 16, 17, 18, 19, 20, 21, 22).

Not only are important the size of the glenoid bone and Hill–Sachs lesions but also the status of the transferred coracoid graft. CT scan is necessary not only to measure the glenoid track but also to evaluate the position of the graft as well as the degree of consolidation and/or potential osteolysis (18, 23). The ideal position of the graft should be below the glenoid equator and flush to the glenoid surface. A graft that is placed excessively medial, high, or low could be less effective in terms of achieving stability (7, 23). Whether or not fibrous union of the graft is related to a higher rate of complications is yet controversial, but it seems that it could be associated to a poorer recurrence rate a lower rate of return to sports (24). Tobacco use has been clearly related to non-union of the graft (25). Other causes have also been pointed out such as low contact area between the graft and the glenoid due to the shape of the glenoid neck or those cases without significant glenoid bony defect (26).

Osteolysis of the graft, especially at the superior part, has also raised interest. The cause of this phenomenon can be explained by Wolff´s law. The contact pressure of the humeral head in the graft as well as shear forces help in maintaining the osseous structure of the graft. The lack of mechanical stimuli in other areas results in osteopenia and bone resorption. Infection should always be considered in cases of severe osteolysis as well as other factors affecting the stability and positioning of the graft.

Lastly, technical errors can also be responsible for recurrence, such as medial or inferior graft placement.

Physical examination and imaging study

When approaching a patient who has had a recurrence after a Latarjet procedure, a physical examination should be conducted as in any other instability patient, especially if the first surgery was performed elsewhere. A complete interview is mandatory to record the patient´s details and confirm the symptoms as a true recurrence and no other type of complication, including persistent apprehension. A recurrence of the instability should only be considered in cases of dislocation or subluxation. Data regarding the mechanism of dislocation, time free of symptoms, and time from surgery should be included in the initial evaluation. Scars corresponding to surgeries should be noted as well as a complete neurological examination performed. In case of suspicion, electromyography studies should be arranged.

Range of motion, scapular rhythm, and degree of pain are also recorded. Although anterior dislocation is the most frequently encountered, posterior or multidirectional instability should also be examined together with any hyperlaxity component. General muscle status needs to be examined, and special attention should be paid to the anterior deltoid muscle in cases of previous open surgery and subscapularis muscle in the cases of previous tenotomy, prominent screws or repeated previous stabilization procedures. Some authors have pointed out that neurological damage could happen during surgery, fatty degeneration of the muscle, atrophy, or even a complete rupture can be present and can have an influence on instability recurrence (25). Scapular rhythm should always be evaluated as dyskinesia is not infrequent in patients with shoulder instability (26).

Conventional shoulder X-rays are useful to rule out degenerative changes as well as screw breakage or gross malposition. However, a CT scan is more precise to determine the position, consolidation degree, and presence of osteolysis of the graft (Fig. 1). Positioning of the graft should be studied in the axial, coronal, and sagittal planes. The height of the graft is determined by the percentage that is located above or under the equator of the glenoid. The major part of the graft should be subequatorial, with an optimal location at about 4 or 5 o'clock (4). The position with respect to the glenoid surface is determined in the axial plane and should be flush with the articular surface (7). It must be kept in mind that the depth of the cartilage

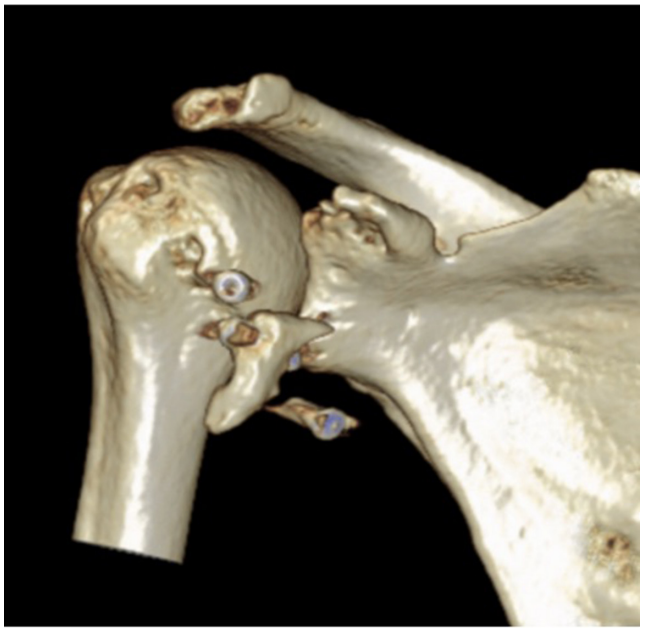

Figure 1
CT scan 3D reconstruction of a patient with a traumatic postoperative shoulder instability recurrence after a Latarjet procedure. The coracoid graft is avulsed, and the screws are broken.

is underestimated by the CT scan, and according to Kany *et al.*, the graft is considered accurately positioned when the medialization and lateralization were less than 5 and 3 mm to the glenoid subarticular bone, respectively (23). Different methods have been described to measure the osteolysis of the graft. (12, 27) The coracoid graft osseous union percentage is calculated as reported by Samim *et al.* (28) It is recommended to use 2-mm-thick sagittal multiplanar reformatted images and the percentage occupied by the screws is subtracted. Fusion of one segment is defined as trabeculation or ossification density crossing the glenoid graft space. Measurement of glenoid track once the graft is evaluated should be performed following Di Giacomo´s method (29) to confirm that any potential off-track Hill–Sachs lesion has failed to be converted into on-track after surgery (12). Additionally, magnetic resonance arthrogram can be useful to define soft tissue injuries, calculate glenoid track, and define any signs of fatty degeneration or atrophy of the muscles as well as cartilage status.

Treatment options and results

Treatment after a failed Latarjet is a challenging situation and indications should be studied thoroughly. It is crucial to identify the possible cause for recurrence although Flurin *et al.* in their series of 46 cases did not find a reasonable cause of failure in up to 56% of the cases (20).

There is still a role for conservative treatment in some infrequent cases of a single episode of postoperative instability that stabilizes over time (24). We should carefully analyze the CT scan to assure that the graft is well positioned, the hardware has not suffered any changes, and no other amenable causes of instability are identified. In these rare cases, the patient might have to minimize exposure to high-contact activities and commit himself to strengthening and proprioception training to avoid further episodes.

Surgical treatment is the gold standard and provides the most predictable results in patients with failed Latarjet procedure. However, surgery is technically difficult since Latarjet is a non-anatomic technique that significantly modifies the anatomy of the shoulder. The axillary nerve becomes more medial and the musculocutaneous nerve becomes more medial and more inferior (30). Routine neurolysis has not been recommended but traction should be avoided especially when working close to nerves (31). On the other hand, the conjoint tendon is lax and should be seen through the subscapularis split. Surgical steps typically include identification of the conjoint tendon and previous coracoid graft, hardware removal, preparation of the anterior glenoid neck, subscapularis release and arthrolysis and eventually a new subscapularis split and graft passage and fixation in the cases of bone block procedures.

Bone grafting techniques

Since Latarjet is aimed to increase the glenoid articular surface, several bone grafting techniques using auto- or allograft have been the most common techniques proposed to revise it. A recent systematic review by Buda *et al.* concluded that iliac crest autograft (Eden-Hybinette procedure) and techniques to plicate or reinforce the capsule are the most popular and safe procedures for failed Latarjet surgery with reported good to excellent outcomes in 67–89% of patients. Furthermore, the number of complications with these techniques was not higher than those reported in primary Latarjet surgery. The overall rate of complications was 17.2% and the recurrence rate was 8.6%. Only 51% of the patients returned to the previous sports level (8).

The main indication for bone graft techniques is a case with a critical glenoid bone or an off-track HS lesion that shows a non-suitable coracoid graft. It can be performed open or arthroscopically with the aid of medical devices specifically designed for the procedure. The fixation can be achieved with screws or buttons (Fig. 2). Bone grafting techniques offer the advantage that the graft can be tailored to the patient´s defect in size and shape.

Lunn *et al.* reported for the first time satisfactory long-term results in terms of recurrence rate and return to sports (68%) of the Eden-Hybinette operation as a

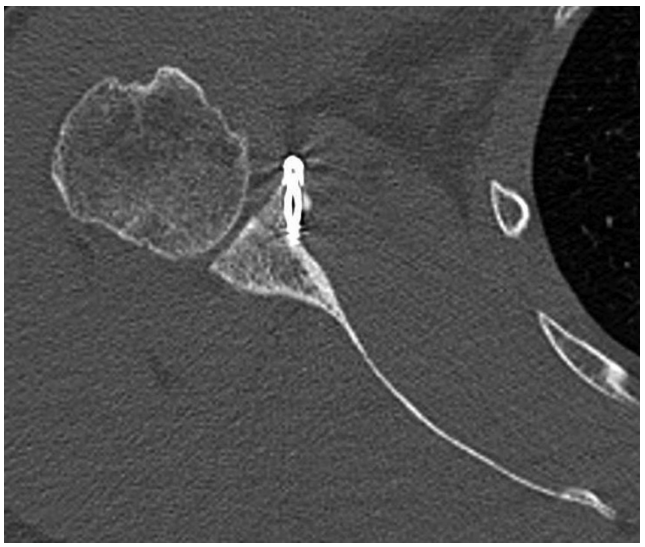

Figure 2
CT scan axial view of a failed Latarjet where the coracoid graft showed severe osteolysis. The glenoid bone defect has been reconstructed using an iliac crest bone graft.

salvage procedure after failure of an index Latarjet in 34 patients. However, the rate of complications was remarkable, including suscapularis rupture (17.4%) and osteoarthritis (11.8%) (15). Flurin *et al.* (20) published a multicentric series of 46 patients who underwent an open Eden-Hybinette procedure after a failed Latarjet. They reported satisfactory results in 80% of the patients, with 86% of stable shoulders, at a mean follow-up of 3 years. The rate of postoperative osteoarthritis was low (11%). Return to sports was related to age and the time elapsed between recurrence after the first surgery and the revision procedure. The results of the arthroscopic technique have also been recently published. (17, 19, 22) Giannakos *et al.* (17) studied 12 subjects of whom 10 had undergone a previous Latarjet revised with iliac crest bone graft fixed using screws and obtained satisfactory results in 67% of the patients, which was statistically associated with the consolidation of the graft. Boileau *et al.* (19) have also reported the results in a small series of patients using suture-button fixation and demonstrated that the fixation technique is reliable and permits optimal positioning and predictable healing of the new bone graft. The authors suggest this fixation system in cases where broken hardware is impossible to remove. Martinez-Catalan *et al.* (22) also published satisfactory results with good glenoid reconstruction in a series of 17 shoulders with critical bone defects. Iliac crest bone graft was incorporated successfully using double suture-button fixation. The distal clavicle is another potential source of autograft with the same advantages as the iliac crest, and it provides an osteochondral surface with less morbidity in the donor site, but no clinical outcomes have been reported using this technique (32).

Allografts from several donor sites have been used for the reconstruction of anterior glenoid defects including femoral or humeral head (19), glenoid (33), and distal tibia (18). Distal tibia has the advantage of being an osteochondral graft with a radius of curvature similar to that of the glenoid restoring in this way the native anatomy. It is obtained from the lateral third of the distal tibial surface and can be shaped as needed. The main disadvantage is its potential cost and availability. Provencher *et al.* (18) reported excellent results in 31 patients who underwent an arthroscopic iliac crest graft reconstruction with screw fixation after a failed Latarjet. There were no cases of recurrence at a minimum 3-year follow-up and clinical scores improved significantly. The overall union rate of the graft was 92%, which could be related to the fixation of the screws due to the excellent bone quality of the distal tibia as it is a weight-bearing surface.

On the other hand, in some cases where the Hill–Sachs lesion is very large, the Latarjet procedure might not be enough to correct the glenoid track. For these cases, there might be a role for allograft reconstruction of the humeral lesion (34).

Bone graft repositioning

Willemot *et al.* (35) reported a series of 26 patients with failed Bristow or Latarjet procedures and found a non-united or avulsed coracoid graft in six cases. The revision procedure consisted of repositioning the original graft with the addition of a structural bone graft in three of them. Clinical outcomes were satisfactory in terms of shoulder stability. The technique has been used by the senior author with satisfactory results (Fig. 3). The indication of bone graft osteotomy and reposition in failed Latarjet is a patient with suitable and large enough graft to reconstruct the glenoid track, but with avulsion or suboptimal position.

Soft tissue procedures

Several publications have found a small group of patients in whom the Latarjet had failed despite a correctly placed and healed coracoid graft (21, 36), Hyperlaxity was the hallmark of these patients and therefore can be managed with techniques of soft tissue stabilization whenever the graft shows no osteolysis and is consolidated in optimal position.

Capsulolabral reconstruction

Bankart repair together with the primary Latarjet technique is recommended to re-establish the capsulolabral complex useful for shoulder stabilization as well as for maintaining the graft extraarticular thus

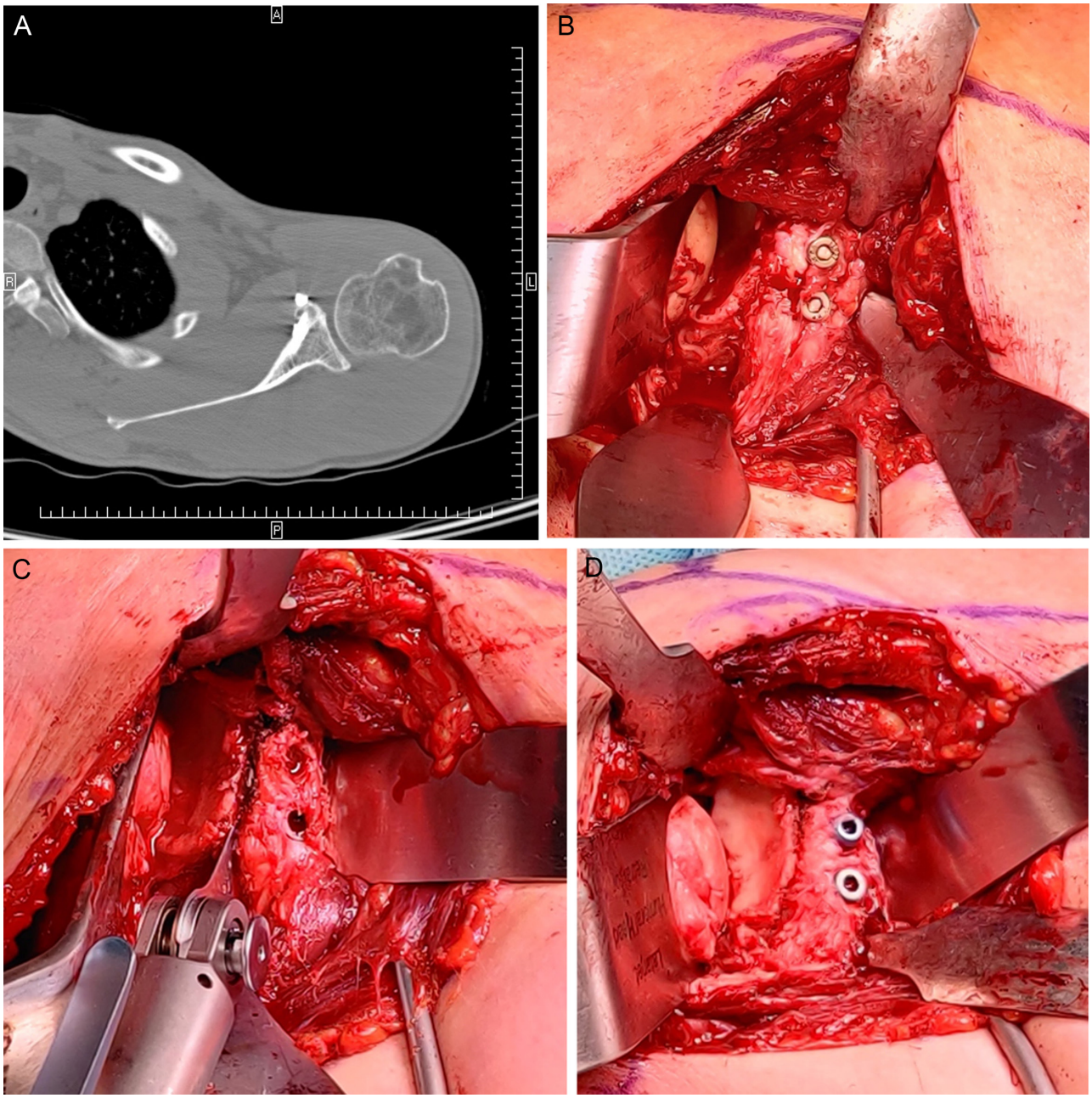

Figure 3
(A) CT scan axial view of case of postoperative instability after Latarjet. The bone graft is suitable and well consolidated, but it is in a medial position with regard the articular glenoid surface. Bone graft repositioning was planned. (B) Intraoperative imaging of the same case. Please note the medial position of the coracoid tip in relation to the glenoid rim. (C) Coracoid graft osteotomy at the union between the coracoid and the glenoid neck. (D) The coracoid is repositioned in a position flush with the articular surface.

preventing the potential future development of arthritis (1). Similarly, in revision cases when the glenoid track has been successfully restored but there has been a recurrence, the repair of the capsulolabral complex with the use of suture anchors has been considered as an option, especially in cases where the labrum was not adequately addressed in the previous surgery and the anterior glenoid rim does not present significant damage (1, 36). If the labrum was excised in the first surgery, the capsule can be used to recreate an anterior bumper. Cuéllar *et al.* (36) published a revision of 12 patients with capsular hyperlaxity and bone defect lower than 25% of the articular surface that had undergone a Latarjet surgery and presented with recurrence. An arthroscopic

capsular plication was performed with satisfactory results, including two cases of graft non-union and two cases of loose or broken screws. None of the patients in this series performed high-contact or professional sporting activities.

Extraarticular capsular reinforcement

In the cases of patients with generalized hyperlaxity or even cases in which the quality of the remaining soft tissues does not seem reliable to perform a capsular reparation, the use of tendon allograft to reinforce the anteroinferior glenohumeral ligament has been published in revision cases, whenever bone defects are not severe enough to justify postoperative instability (37). The rationale of these techniques is the reinforcement of the anatomical anteroinferior glenohumeral ligament with an allograft that acts as a restraint, preventing anteroinferior subluxation and dislocation of the humeral head and the tension of the muscle. The surgical technique consists of an extraarticular reinforcement of the native anterior capsule with an iliotibial allograft passed through a subscapularis split that is fixed on the inferior edge of the subscapularis insertion in the humeral side and at 3 o'clock position in the glenoid side. Interference screws are used for this purpose and the graft is tensioned in the position of abduction and external rotation contributing to shoulder stability. The author´s preferred technique is a modification of the one described by Sanchez *et al.* (38) that uses an iliotibial band allograft tensioned in abduction and external rotation. Following similar principles, the long head of biceps suspension has also been published by others as a potential dynamic anterior stabilization in cases of recalcitrant instability (39, 40). No data on the use of these dynamic stabilization techniques to treat failed Latarjet stabilizations have been reported.

Remplissage

In patients with a large or very medial off-track Hill–Sachs lesion in whom the width of the glenoid might not be enough to restore glenoid track adding a remplissage to the already performed Latarjet procedure might be a valid revision alternative. Lavoué *et al.* (14) studied a retrospective series of 41 patients with recurrent anterior shoulder instability after coracoid bone block procedures. Nineteen patients showed bipolar bone lesions that were managed successfully with a combined Bankart repair and a remplissage.

Salvage procedures

In cases with severe subscapularis damage or rupture, a pectoralis major transfer can be associated with a bone block procedure (41). Shoulder arthroplasty could be an option in older patients with persistent instability or in those cases of severe osteoarthritis (42). Arthrodesis might be an indication to eradicate pain and permanent subluxation in patients with neurological damage or severe hyperlaxity (43). The goal for the position is 25% of abduction, 25° of forward flexion, and 35° of internal rotation, In the series of Diaz *et al.* (43), the mean number of previous surgeries was seven. Seven of the eight patients suffered from generalized joint hyperlaxity and one of Ehlers-Danlos disease. Of them, only three had a traumatic onset of the instability. Although the overall satisfaction rate was 73%, five patients had subsequent surgery for hardware removal.

Conclusion and proposed algorithm

An increase in Latarjet revision surgeries is expected considering the procedure has expanded indications in the last decades. Since the Latarjet procedure significantly modifies the anatomy of the shoulder, subsequent revision surgery is difficult. Conservative management can be advocated in selected cases of a failed Latarjet with a degree of instability that does not interfere with the activities the patient wishes to perform. However, revision surgery is needed in most patients. An algorithm for the suggested treatment of failed Latarjet is shown in Fig. 4.

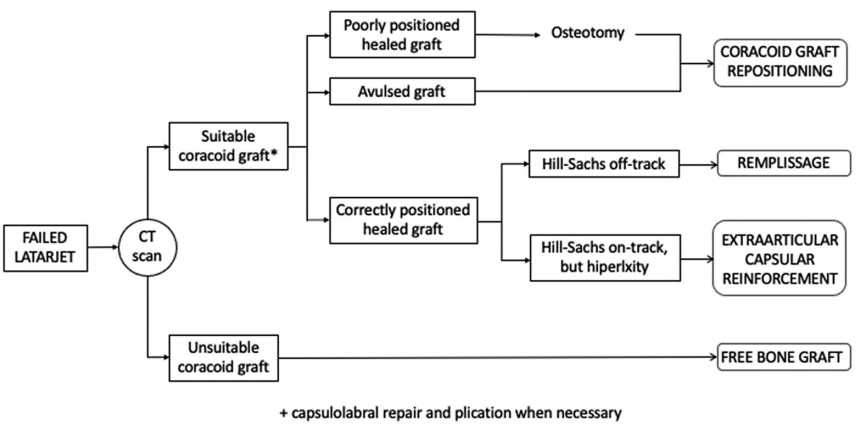

Figure 4
Flowchart showing the suggested algorithm to treat a patient with a failed Latarjet. *The coracoid graft is considered suitable if it preserves the conjoint tendon insertion, does not show osteolysis, and is large enough to reconstruct the glenoid surface as well as to convert any off-track Hill–Sachs lesion into on-track.

In revision surgery, it is mandatory to determine the cause of recurrence and the status of the coracoid graft to select the best treatment option. CT scan is needed to quantify glenoid track measuring bipolar bone defects and to evaluate the transferred coracoid graft concerning position, degree of consolidation, and osteolysis. The coracoid graft is considered suitable if it preserves the conjoint tendon insertion, does not show osteolysis, and is large enough to reconstruct the glenoid surface as well as to convert any off-track Hill–Sachs lesion into on-track. In patients with unsuitable coracoid bone graft, free bone graft – usually iliac crest autograft – is the revision technique of choice. If the coracoid graft is suitable but avulsed or poorly positioned, graft repositioning can be a valid option. Glenoid and coracoid surfaces should be carefully abraded and a stable fixation using screws or buttons is mandatory. Graft osteotomy will be required if it was healed. Adding a *remplissage* is recommended for those cases with correctly positioned coracoid graft but with a coracoid graft insufficient to convert large off-track Hill–Sachs lesions into on-track. Finally, there is a small group of patients in whom bone defects were properly addressed but Latarjet failed due to hyperlaxity or poor soft tissue quality. The extraarticular capsular reinforcement is suggested to stabilize the shoulder in this population.

ICMJE Conflict of Interest Statement

E Calvo receives research grants from Smith & Nephew, consulting fees from DePuy Synthes, and is paid presenter of DePuy Synthes, Smith&Nephew, and Stryker. A M Foruria is paid presenter of Zimmer and DePuy Synthes. M Valencia Mora and J Aguilar-Gonzalez report no conflict of interest.

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