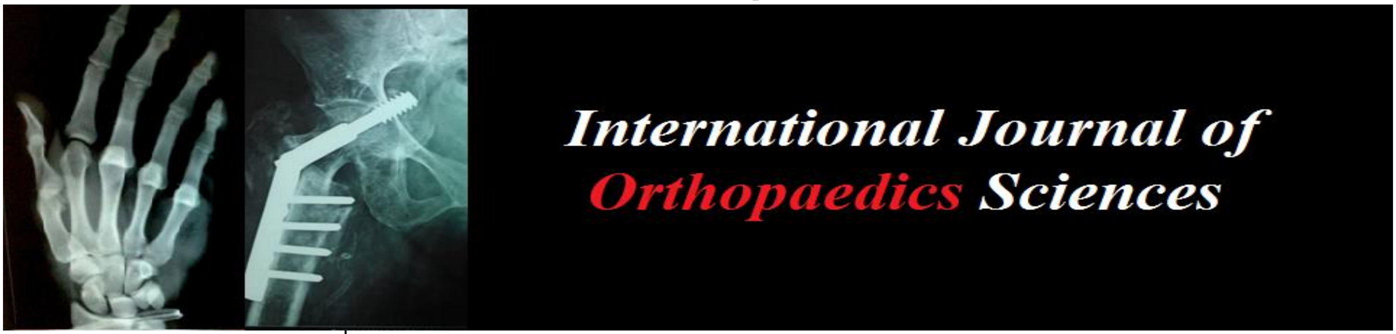

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Ahmed F Mekky
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Osama A Seleem
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Tarek I Abo El-Noor
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Tarek A El-Sheikh
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Corresponding Author:
Ahmed F Mekky
Department of Orthopedic Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Recurrent anterior Gleno-humeral instability: A review of latarjet procedure and its complications

Ahmed F Mekky, Osama A Seleem, Tarek I Abo El-Noor and Tarek A El-Sheikh

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Abstract
The shoulder is the most mobile joint whose stability requires the interaction of both dynamic and static stabilizers. Its wide range of movement predisposes to a high susceptibility to dislocation accounting for nearly 50% of all dislocations. This trauma typically results in ligament injury (e.g., labral tear, capsular strain) or bony fracture (e.g., loss of glenoid or humeral head bone), which frequently causes recurrent instability. Patients with significant glenoid defect may require Latarjet procedure which involves transferring the coracoid to the antero-inferior glenoid rim. In spite of outstanding results, 15 to 30% of cases suffer complications. In this article, we discuss the diagnosis of recurrent shoulder instability, the surgical technique and various complications of Latarjet procedure.

Keywords: Recurrent, anterior gleno-humeral instability, latarjet, unstable shoulder

Introduction

Anterior gleno-humeral (GH) dislocation after trauma is a common disorder that affects young male athletes at a rate of 24 per 100,000 individuals each year [1]. It may have several origins, including labroligamentous tear and glenoid or humeral head bone loss [2]. After anterior shoulder dislocation, the Bankart lesion, an antero-inferior labro-ligamentous avulsion from the glenoid, is the most common injury [3]. Moreover, humeral head and glenoid fractures are common. Hill-Sachs lesion, an impaction damage to the lateral side of head of humerous on the postero superior aspect resulting from contact with the anteroinferior glenoid occurs in up to eighty percent of 1st dislocations and up to ninety-three percent of individuals with repeated dislocations [4]. Up to twenty- two percent of first-time dislocations and up to ninety percent of cases with recurring dislocation have been discovered to have glenoid bone abnormalities known as bony Bankart [5].

The lower bone defect threshold value for which capsulo-labral restoration is advised is still a matter of debate. Burkhart SS, De Beer JF [6] and Bigliani *et al.* [7] determined that the tolerable glenoid defect limit for arthroscopic repair was 20% and 25%, respectively. For bigger deformities, described as an inverted pear-shaped glenoid, a bone graft must be placed at the defect location to restore the glenoid cavity [8]. According to Itoi *et al.* [9], the force required to dislocate the shoulder in the presence of a glenoid defect more than 21 percent was 50 percent less than the effort necessary in the absence of such erosion. Shin *et al.* [10] determined that glenoid bone loss of 17.3% was the key value for recurrent instability after arthroscopic Bankart repair. 43% of patients with higher than 17.3% glenoid bone loss experienced surgical failure, in comparison to 3.7% of patients with less than 17.3% glenoid bone loss. They indicated that bone augmentation is appropriate for high-demand contact athletes with subcritical bone loss between 13.5% and 17.3% because it may lead to a more favorable outcome and a reduced risk of failure [10].

The treatment of recurrent anterior GH instability is contingent on the total damage architecture. In the absence of severe glenoid bone loss, soft tissue treatments, such as an arthroscopic Bankart repair, may be suitable. In situations of significant glenoid bone loss, however, a soft tissue surgery alone is likely to result in a high risk of recurring dislocation [2].

Many treatment methods with better outcomes evolved slowly. Previously these fractures were managed conservatively with the assumption that the functions of the patient won't be affected [5]. Chances of subtalar arthritis are more during the conservative management of displaced calcaneal fractures. Most surgeons employ a large surgical exposure for open reduction and plate fixation, which allows for anatomical firm internal apposition of the pieces [6].
However, infections and skin necrosis have led surgeons to pursue minimally invasive techniques. Less intrusive techniques may have fewer problems, a shorter hospital stay, and a shorter period between first admission and operation. However, possible drawbacks include lower reduction quality and a poor functional result. Therefore, there is a trend towards open reduction and fixation for displaced intra-articular fractures of the calcaneum. Among the various techniques, open reduction with plating has been the gold standard for treating a displaced intra-articular calcaneal Many treatment options have been described in the literature for reconstructing the glenoid defects including fixation of fracture fragment to the glenoid rim in acute bone lesion [11] or augmentation by autogenous tri- cortical iliac crest graft, coracoid transfer (Latarjet) [12], distal tibial allograft [13] and fresh frozen osteo-chondoral glenoid allograft in chronic glenoid bone deficiency [14]. Surgical options to manage the humeral head defects include osteo-chondoral allograft, infraspinatus transfer (Remplissage), de-rotation osteotomy, humeroplasty and prosthesis replacement [15].

History
Participants should be questioned about the situation surrounding the initial trauma, the arm's position prior to dislocation, subsequent dislocations, the force required to dislocate, the frequency of dislocation, the mode of reduction of the initial dislocation (Manual reduction or general anaesthesia), and the length of time since the initial dislocation. In the context of an initial trauma and recurrent instability episodes occurring with moderate effort or in the half way of shoulder motion, a bone insufficiency may be indicated [16].

Physical examination
Both shoulders should be inspected for asymmetry, muscle atrophy especially deltoid muscle, scapular winging and any previous scars. Palpation is done for tenderness and muscle strength assessment. The range of motion of both shoulders is examined actively and passively. The generalized ligamentous laxity should be evaluated through shoulder dislocation, thumb flexibility, hyperextension of the knees, elbows and metacarpo-phalangeal joints. Neuro-vascular status of the affected limb should be checked to exclude post dislocation axillary nerve injury [17].
Anterior apprehension, Jobe relocation and load shift tests are performed to diagnose the recurrent anterior shoulder dislocation. Shoulder laxity is assessed anteriorly by anterior drawer test and inferiorly by sulcus sign [18].

Imaging
Routine radiographic evaluation including antero-posterior, axillary and lateral scapular Y views is needed to demonstrate the bony defects and to exclude the associated neglected fractures [19]. West Point and Bernageau views are used to more accurately assess the glenoid bony architecture [20]. Stryker notch and Hill-sachs views can be used to identify Hill-Sachs lesion [21] (fig. 1).

Fig 1: (a) Antero-posterior, (b) Stryker notch, (c) West point, (d) Bernageau views showing glenoid and humeral bone loss.

The examination of a patient with anterior glenohumeral dislocation might potentially benefit from the use of computed tomography (CT) and magnetic resonance imaging (MRI). A CT scan can be used to evaluate the skeletal architecture, measure bone loss, and detect tiny fracture pieces. A 3-D CT with subtraction of the humeral head permits direct view of the glenoid and more precise assessment of the degree of bone loss, which facilitates preoperative planning [7]. MRI and magnetic resonance arthrography (MRA) are utilised to assess soft tissue injuries including anterior inferior labral rips and capsular avulsions (fig. 2).
Using either CT or MRI, there are two main approaches for measuring glenoid bone loss: width measures, such as Griffith's index, and surface area measurements, such as the Pico method [22]. These techniques include removing the humeral head and obtaining a CT glenoid en face image. The inferior two-thirds of the glenoid resembles a real circle, the size of which may be determined using either the contralateral normal glenoid or the intact postero-inferior borders of the wounded glenoid. The bone loss might be depicted as the lost circle area or the anterior-posterior width loss [23].

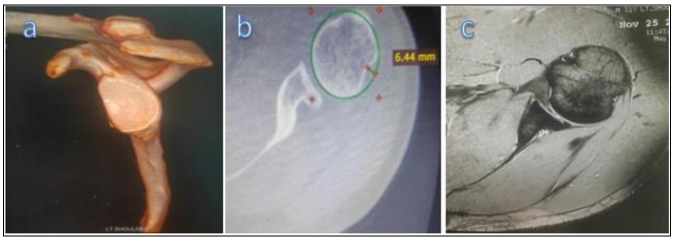

Fig 2: (a) 3-D CT glenoid en face view showing glenoid bone defect; (b) Axial CT, (c) Axial MRI showing humeral bone defects.

Management
The treatment of a persistently unstable shoulder should take into account the general health and function of the patient in addition to evaluating the shoulder pathology. The presence of any substantial medical co-morbidities or neurological abnormalities, the evaluation of overall functional needs, and the degree of predicted patient compliance are patient considerations to consider. The chronicity of dislocation, the functional restriction arising from dislocation, the measurement of glenoid and humeral bone loss, and the evaluation of articular cartilage should be evaluated in relation to the specific shoulder disease [24].

Non-operative Treatment
It is often reserved for patients who are medically ineligible for surgery, have modest functional needs, and have poor adherence to post-operative rehabilitation guidelines. Patients with a history of seizures or volitional dislocations should be identified since the conventional surgery technique entails a significant failure risk [25].
It consists of a supervised rehabilitation approach that stresses progressive range of motion based on the degree of bone loss.

Displacement-vulnerable positions should be avoided. Enforcing the rotator cuff, deltoid, and scapulo-thoracic stabilisers improves shoulder function overall and reduces the likelihood of subsequent displacement [25].

Operative treatment

It is the treatment of choice to restore the shoulder function and minimize the risk of recurrence in the setting of significant bone loss. It aims to address both soft tissue and bony pathology that are the cause of recurrent dislocation [25]. A Bankart repair (Open or arthroscopic) is commonly used to treat patients with recurrent dislocation especially if glenoid defects measuring < 20%. Bony procedures (Bristow latarjet) are recommended for patients with significant antero-inferior bone loss > 20% [26].

Bristow procedure

In 1958, Helfet documented and named this technique after his instructor, W. Rowely Bristow, who had introduced it almost two decades before. It entails transplanting the terminal 1/2" of the tip of coracoid immediately distal to the pectoralis minor insertion, with a tendon linked to the anterior-inferior glenoid rim. The coracoid tip offers a bone block to cover the glenoid deficiency, whereas the conjoined tendon enhances the anterior buttress effect in abduction and external rotation [27].

Latarjet procedure

In 1954, Latarjet described this procedure which involves transplantation of a much larger piece of the coracoid (2-3 cm) with attached conjoined tendon to the antero-inferior glenoid rim secured by two screws [28]. Recently, Lafosse *et al*. [29] described an arthroscopic Latarjet procedure.

With a "triple-blocking" effect, it was suggested that the Latarjet technique would treat both bone and soft tissue deficits. First, the coracoid graft restores the antero-posterior diameter of the glenoid, creating a "bony impression." The conjoined tendon provides a so-called "sling effect" by reinforcing the lower SS fibres and the antero-inferior joint capsule. Repair of the anterior capsule to the coracoacromial ligament stump concludes the triple blocking effect. This mechanism is crucial for abduction and external rotation [30].

Surgical technique

The patient is positioned in a position like a beach chair. The typical delto-pectoral technique involves a 4 to 5 cm long skin incision beginning at the coracoid tip and running distally through the delto-pectoral interval to the superior side of the axilla, while protecting the cephalic vein. The coracoid is exposed, the coraco-acromial (CAL) and coraco-humeral (CH) ligaments are cut, and the pectoralis minor is detached from the coracoid. A saw or osteotome is used to conduct an osteotomy at the "knee" (base) of the coracoid. Two drill holes are set 1 cm apart along the middle axis of the coracoid component. Because the graft's blood supply enters immediately medial to the conjoint tendon insertion, care must be given not to release beyond the coracoid tip (fig. 3).

Fig 3: (a) Coracoid harvesting from pectoralis minor medially and CAL laterally; (b) Coracoid osteotomy; (c) Grasping the coracoid by coracoid drill guide and drilling two parallel holes centered on the graft.

On abduction and external rotation, the SS muscle is divided horizontally at the 3 o'clock position at the junction between its upper third and rest of the muscle on the neck of the glenoid and a capsulotomy is done. The glenoid is made visible, as well as the anterior inferior labrum and periosteum. Using an osteotome, curette, or burr, the underlying anterior glenoid surface is decorticated with care to retain as much of the natural glenoid bone as possible in order to generate a smooth surface of bleeding cancellous bone.

There are three offsets (4, 6, and 8 mm) available to suit various graft sizes. The pegs are drawn into with the pre-drilled holes on the coracoid graft, allowing the graft to sit tightly against the overhanging offset bar for easy insertion on the glenoid. The optimal site for the coracoid graft is between 3 and 5 o'clock or slightly medial (1-2 mm), and below the equator of the glenoid with its inferior portion not too inferiorly overlying the bone. Two partly threaded, 4 mm cannulated screws are alternately tightened with two fingers over the guide wires. To prevent graft breakage, it is necessary to avoid overtightening (fig. 4).

Fig 4: (a) Anterior glenoid rim preparation to create flat bleeding cancellous bone surface; (b) The coracoid is engaged within the suitable offset to ensure to be flushed with the glenoid face; (c) The screws are placed over the guide wires and tightened alternatively.

The capsule is reconnected to the CAL stump using No. 1 absorbable suture while the shoulder is in adduction and external rotation to allow for rapid post-operative ROM and minimize shoulder stiffness. The SS muscle is sutured over the conjoined tendon, which remains linked to the coracoid graft that exits anteriorly via the split.

The delto-pectoral interval is approximated in an interrupted fashion with No. 0 Vicryl and both subcutaneous layer and skin are then closed with interrupted No. 2-0 Vicryl and No. 2-0 Prolene respectively. A post-operative dressing is applied in a sterile fashion followed by a pouch arm sling (fig. 5).

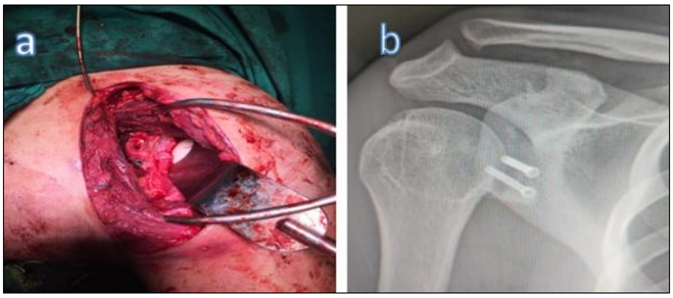

Fig 5: (a) Final coracoid fixation to the glenoid with its conjoined tendon exiting through the SS split; (b) Post-operative x-ray following Latarjet procedure.

Complications

Reportedly, the risk of recurrent dislocation after Latarjet treatment is around 1% [31]. Concerns have been raised, however, about a greater likelihood of surgical complications connected with the Latarjet operation. The open Latarjet operation has an overall complication rate of 15%, according to a recent major systematic study [32]. Others reported operative complications in 25 to 30 percent of the cases [33]. It is essential to emphasise that excellent surgical technique and a thorough awareness of local anatomy aid in minimising Latarjet treatment problems.

1. Graft malposition

Too high graft located above the equator leads to recurrent dislocation and superior screw malposition with increased risk of iatrogenic supra-scapular nerve injury [34]. Too low graft predisposes to insufficient space for the lower screw to be driven into the glenoid, leading to a fibrous nonunion, the single upper screw cannot provide stability with rotation, leading to poor biomechanical construction [35] this leads to a fibrous nonunion. A graft that is too medial will eliminate the bone-blocking action, resulting in repeated dislocation, whereas a graft that is too lateral is a risk factor for secondary GH arthritis [36] (fig. 6).

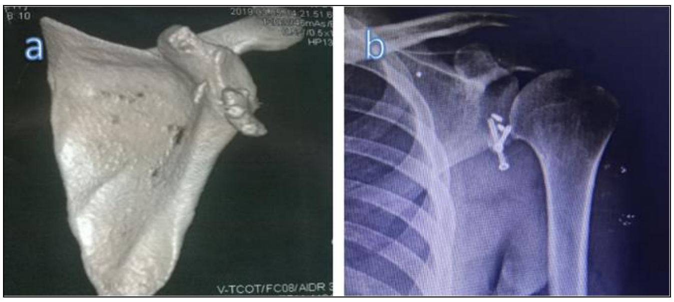

Fig 6: (a) 3D CT showing too low and lateral coracoid graft; (b) A/P x-ray showing more inferior graft and mal-directed screws

2. Graft fracture

Excessive decortication of the coracoid, over-tightening of the screws and older age with poor bone quality can lead to graft fracture. It can be reduced by employing a two-finger screw tightening method, prepping the graft with correctly sized holes, and spreading the drill drills wide enough of about 1 cm in the graft, tapping before insertion of the definitive screws and placing a washer or a plate in osteoporotic bone [37].

If the graft fracture is transverse with good bone quality, the available bone piece is fixed by a single screw and may be augmented by suture anchor. For a longitudinal fracture with osteoporotic bone, a tri-cortical iliac crest graft is an option. If the screw hole is blowout, a buttress plate or washers can be used to provide compression [38].

3. Neuro-vascular injury

The relatively long operation time may be a co-factor leading to prolonged nerve traction. The risk of nerve injury can be decreased by avoiding the extensive dissection around the coracoid and staying lateral to the conjoined tendon without exposing its medial border. If a nerve deficit is noted 2 weeks post-operatively, A CT scan is performed to check the precise placement of screws and grafts. If there is no abnormalities, the patient is comforted and monitored for three months; otherwise, an EMG is performed to determine the specific nature of the damage [38].

4. Implant related complications

The use of screws close to the GH joint can cause many problems including screw loosening, breakage, impingement and intra- articular prominence which can lead to GH arthritis. Anterior shoulder pain and focal tenderness may occur due to screw head rubbing against the Subscapularis (SS) muscle whereas too long screws can cause posterior shoulder pain which can be managed by screw removal via either an open or arthroscopic technique [39].

5. Post-operative complications

a. Hematoma

It can be avoided by meticulous hemostasis or using a drain or bone wax at the osteotomy site. If a patient presented with hematoma, reassurance with cold packs and oral analgesia is required. Rarely, a progressively enlarging hematoma requires surgical drainage [40].

b. Infection

If the infection is superficial, antibiotic therapy with or without debridement is enough. In cases of deep infection, it may be necessary to remove the screws with prolonged course of intravenous antibiotics to facilitate complete eradication of the infection then revision procedure to restore the stability when it is resolved [41].

c. Neuropraxia

The musculo-cutaneous nerve palsy may occur due to elongation of the nerve or change in the penetration angle into the conjoined tendon while mal-directed screws (towards the scapular spine) especially the superior one may cause entrapment of the infraspinatus branch of supra-scapular nerve [38].

d. Non-union

It is usually related to uni-cortical or single screw fixation and older patients with poor bone quality. It can be avoided by decorticating the coracoid surface slightly obliquely and the antero-inferior glenoid rim to get a flat surface of bleeding cancellous bone and placing two bi-cortical compression screws parallel to the glenoid face [37] (fig. 7).

e. Osteolysis

It occurs most frequently in the superficial portion of the proximal coracoid, whereas the deep portion of the distal coracoid is the least affected and exhibits the highest bone healing rates because the blood supply of the coracoid graft originates from the coraco-brachialis attachment, which is located in the inferior region of the graft, thereby promoting its healing. It can be reduced by preventing total devascularization of the graft by restricting soft tissue release beyond the coracoid tip. Typically, it is a radiographic finding with limited clinical importance in terms of recurring dislocation and is only related with persistent anxiety, therefore it does not require particular surgery unless it causes implant complications such as conspicuous screws [39] (fig. 7).

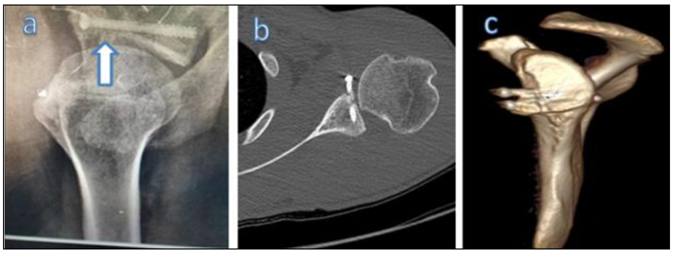

Fig 7: (a) Axial x-ray showing un-united displaced graft; (b) Axial CT, (c) 3-D CT glenoid en face view showing flushed partially resorbed coracoid graft

f. Recurrent instability

Recurrent dislocation after a Latarjet operation may be attributable to technical error on the part of the surgeon, such as graft malposition and iatrogenic graft fracture, patient factors, such as ligamentous laxity and seizures, SS failure, graft avulsion, osteolysis, and post-operative trauma. Its treatment frequently entails a technically complex salvage technique that is complicated due to the revision nature of the operation and scarring from a prior operation, such as a tri-cortical iliac crest bone transplant [42].

g. Gleno-humeral arthritis

The precise etiology of post-operative GH arthritis is still unknown. It may be related to pre-existing factors as increased age at first dislocation, long time elapsed between the first dislocation and surgery, increased number of dislocation episodes, pre-existing arthritis before surgery, severe HS lesions and technical errors such as laterally overhanging coracoid graft. It can be minimized by placing the graft flushed to the glenoid surface and avoiding intra-articular screw placement [43]. Some modifications such as congruent arc technique and extra-articular graft placement can potentially reduce the risk of GH arthritis [44].

h. Stiffness and loss of external rotation

About 10° external rotation loss occurs mainly due to SS tenotomy and repair. It can be minimized by using a horizontal SS splitting approach, repair of the CAL stump to the capsule with the arm in external rotation and immediate post-operative rehabilitation through self- stretching exercises [45].

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