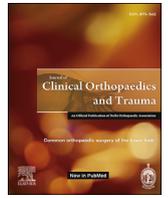




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Bone block procedures for glenohumeral joint instability

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ABSTRACT

Glenoid bone loss is a well established cause of instability and long term morbidity if not adequately addressed. Anterior glenohumeral instability due an anterior glenoid defect is significantly more common, and for many years has been well treated with open anterior bone block augmentation procedures, most commonly the Latarjet procedure. However, with refinement of this technique and some interest in reducing morbidity associated with iliac crest bone harvest, arthroscopic bone block procedures with allograft has become more popular. In this article we will review some of the key available evidence. We will also review management of the less common and more challenging posterior glenoid defects associated with posterior instability.

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1. Background

Traumatic dislocation of the shoulder is not an uncommon injury. When associated with bony defects of the glenoid or humeral head the congruency of the glenohumeral joint is altered and results in recurrent shoulder instability. The management of bone loss in traumatic shoulder dislocations can be extremely challenging.

Anteroinferior glenoid bone loss also known as a 'bony bankart' lesion is associated with anterior instability, and if left untreated will result in pain, persistent instability with secondary osteoarthritis, and poorer outcomes from delayed surgical intervention.

Historically an open Bankart repair was considered the gold standard for management of these injuries with good outcomes published^{1,2}. However there is now good biomechanical and clinical evidence to support non-atomic bony transfers in the presence of glenoid bone deficiency, or risk factors for recurrence including young age, high functional demands, contact sports and concomitant pathology such as a Hill-Sachs lesion.^{3–5}

In the presence of bone loss or significant risk factors for instability, the risk of recurrence is high if only soft tissue procedures are performed.^{3,5}

2. Anterior bone block procedures

Symptomatic anterior instability is a common cause of distress in young adults particularly athletes and military personnel. On review of recent literature there appears to be decreased utilization of open Bankart repair.

Although anterior arthroscopic stabilisation (capsulolabral repair) may have become the gold standard for the first time dislocator, there is a significant trend toward increased bone augmentation surgery with evolving indications.⁶

Primary arthroscopic Bankart repair has proven to be a successful operation.^{7–10} However more recently 'critical' anteroinferior bone loss, 'off track' Hill-Sachs lesions, contact sports, overhead athletes and inferior shoulder hyperlaxity have been identified as risk factors associated with failure.^{11–14}

2.1. Bone loss

In their seminal cadaveric study, Itoi et al. demonstrated that the critical glenoid defect size for biomechanical instability was 21%.¹⁵ A more recent cadaveric study from Yamamoto et al. demonstrated that the stability was significantly affected with a defect of greater than 26% of the glenoid with or 20% of the glenoid length.¹⁶ Yamamoto et al. also showed that shoulder stability after a Bankart repair was significantly reduced with a defect greater than 25% of the glenoid with and 19% of the glenoid length.¹⁷ These studies have indicated that there certainly is a 'critical' bone defect ratio after which it should be treated; and that it likely lies somewhere between 20 and 25%. Instability may also be affected by the location of the bone loss.

This evidence has led to a more focused assessment of the glenoid bone loss with three-dimensional CT imaging. Better recognition has likely lead to increased use of bone augmentation procedures.

2.2. Surgical management

Latarjet originally described his shoulder stabilisation technique

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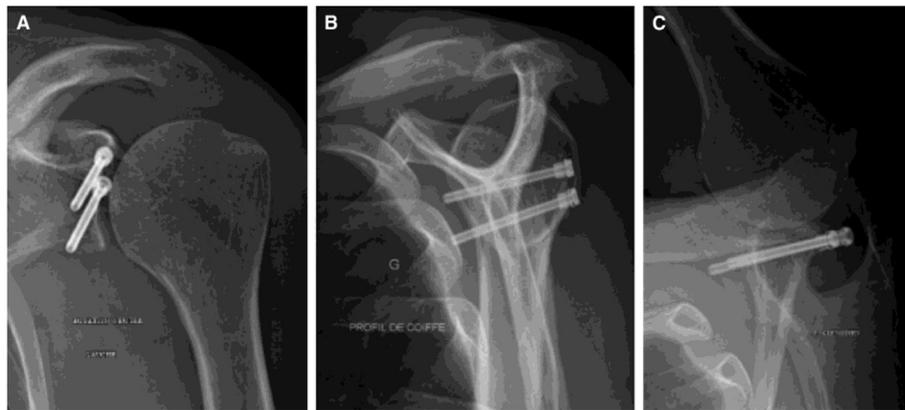
in 1958.¹⁸ In this procedure the corocoid is osteotomized with the attached coracobrachialis tendon and is transferred to the anteroinferior glenoid. This is said to have 3 effects: firstly it increases the anterior to posterior glenoid diameter. The conjoint tendon also stabilizes the joint when the arm is abducted and externally rotated by acting like a sling and re-inforcing the inferior subscapularis and anteroinferior capsule.³ The last effect comes from repairing the anteroinferior capsular wall.³

Epidemiological studies have shown a significant increased use of the Latarjet procedure over recent years.⁶ This likely represents the better recognition of bone loss through improved computed tomography with 3-dimensional reconstructions.

The Latarjet has been shown to have good results in patients with significant glenoid bone loss (>25%) and engaging Hill-Sachs lesions.^{4,19–21} Burkhart et al. report that it effectively increases

2.3. Arthroscopic Latarjet

Though more technically demanding, arthroscopic Latarjet is slowly gaining interest. It was originally described in 2007 by Lafosse.²⁹ As a new procedure available evidence and comparative data is somewhat limited. Boileau et al. in Nice published their results of 47 patients who had undergone arthroscopic Bankart-Bristow-Latarjet procedures for glenoid bone loss and capsular deficiency. They concluded that it is a safe and reproducible procedure.³⁰ Lafosse published a larger study in 2010, with 180 arthroscopic Latarjet procedures and reported that patient-reported outcomes were 91% excellent and 9% good at 26 months.³¹ Though there is a lack of long term data, the emerging studies have been promising indicating that outcomes are equivalent to the open Latarjet procedure.^{11,29,31}



the safe arc of glenohumeral motion. In Hantes et al.'s biomechanical cadaveric study they showed that defects up to 29% of the glenoid surface could be restored with the Latarjet procedure.²²

In 2012 Hovelius et al. reviewed 319 shoulders and concluded that the Bristow-Latarjet procedure yielded good and consistent results and 83% coracoid fusion, 5% redislocation and 1% revision surgery.²⁰ They also found that a position of the coracoid 1 cm or more medial to the rim was associated with significantly more recurrences. A number of studies found this procedure to not only be successful in athletes^{3,23} but also in elderly patients with instability.²⁴

In 2012 Schmid et al. published their retrospective case series which included 49 shoulders that has previously undergone at least one stabilisation procedure not including Latarjet. They concluded that the Latarjet procedure was a good revision option for recurrent anterior glenohumeral instability.²⁵ They also found that dissatisfaction was associated with pre-operative chronic pain, which was linked to a poorer subjective outcome.

Although rare there are some reports of suprascapular nerve injuries in up to 6% of shoulder instability surgery.²⁶ Longo et al. conducted a cadaveric study to identify the safe zone for screw placement in the coracoid graft to avoid injury to the suprascapular nerve. They concluded that the suprascapular nerve is furthest away from the glenoid with the shoulder at 90° of external rotation. Therefore, the placement of screws in external rotation of the humerus during glenoid bone block procedures likely reduces the risk of iatrogenic injuries of the suprascapular nerve.

Osteoarthritis is a common late finding after recurrent anterior dislocation and several medium and long term studies have shown high rates of osteoarthritis regardless of what stabilizing procedure was used.^{20,27,28}

Postoperative radiographs after arthroscopic posterior bone block: anteroposterior (A), scapular Y (B), and Bernageau (C) views.

2.4. Posterior bone block procedures

Posterior glenohumeral dislocation account for only 5% of shoulder dislocations,³³ and recurrent posterior instability is even rarer.

There is currently no consensus on the best surgical treatment, likely because posterior instability has a wide spectrum of clinical presentation. There is frequently subluxation rather than true dislocation, and can be voluntary or involuntary in nature. When conservative management fails or is not an option, surgical treatment is indicated and can be challenging.

Several surgical techniques have been described. These can be divided into soft tissue procedures such as open or arthroscopic capsulorrhaphy^{9,34,35} or labroplasty of a Kim's lesion³⁶; or procedures that address the bony anatomy. These can include glenoid osteotomy and bone block procedures. There are few surgical studies with low patient numbers.^{37–40}

Placement of a bone block on the posterior glenoid rim increases the glenoid surface area and increases stability. It was described as early as 1931 by Rocher using a rib graft.⁴¹ In 1943 Ilfield proposed using an iliac crest graft in patients who failed capsule stabilisation procedures.⁴² In 1976 Gosset proposed screw fixation with a larger, U-shaped graft projecting beyond the whole height of the glenoid,⁴³ and in 1989 Fronck advised combining with a procedure of the posterior capsule.³⁸ In 1993⁴⁴ famously described a bone block procedure using the posterior portion of the acromion with a deltoid flap, thereby providing triple posterior restraints, similar to Latarjet procedure for anterior instability.

More recently Clavert et al., report the findings from a multicenter retrospective study with 66 patients who had undergone an

iliac crest posterior bone block procedure with screw fixation, with or without capsulolabral reconstruction. They stated that this procedure was indicated in the following characteristics: male, age approximately 30 years, right handed, recreational athlete with post-traumatic involuntary instability.⁴⁵ They concluded that there was a good overall outcome with significant improvement in the constant and Walch-Duplay scores and a high satisfaction rate. This has been a consistent finding in several studies.^{30,32,46} However complications included a 12% recurrence rate and 18% persistent pain. This observation was similar to the by Servien et al., who reported persistent pain in 45%. Several reasons have been postulated. These include poor control of posterior translation (when the posterior capsule is not addressed), posterior chondral lesions, reverse Hill-Sachs lesion which alters joint kinetics and proprioception.

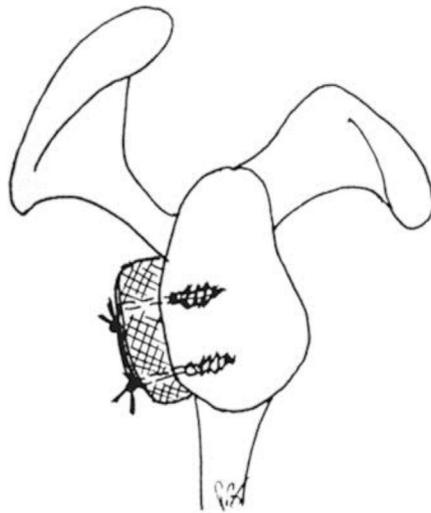
Meuffels et al. in the Netherlands report a long-term study of 11 patients with 18 years follow up. Subjectively, only 3 patients reported having a stable shoulder. Of the 8 that did not, 4 had recurrent instability and 2 underwent post-operative arthrodesis. 1 patient was subsequently diagnosed with Ehlers-Danlos syndrome. Outcome scoring was poor overall and far worse at 18 years than at 6 years. Furthermore at 18 years all patients had evidence of glenohumeral osteoarthritis.⁴⁷

Arthroscopic bone block procedure for posterior instability. Due to low incidence there are very few large studies assessing

the cited benefits include being able to diagnose any concomitant pathology, smaller surgical wounds and less soft tissue dissection.

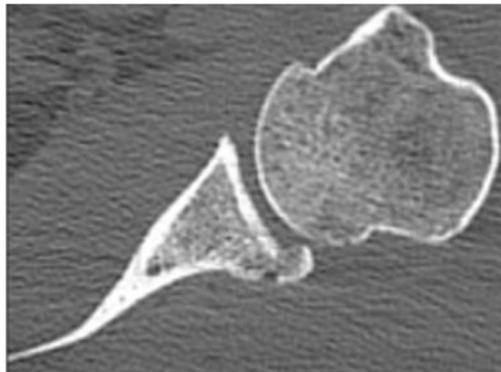
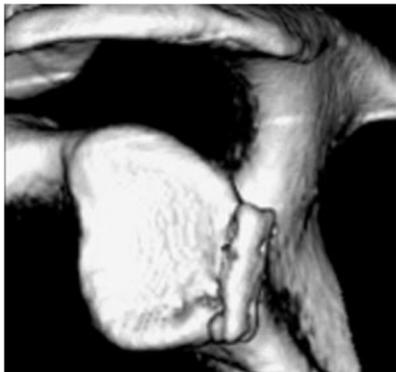
In 2013 Schwartz et al. published the first case series of arthroscopic posterior bone block augmentation with 19 shoulders. A 2 cm × 1 cm x 1 cm bone graft was harvested from the iliac crest and positioned against the posterior glenoid neck and flush with the glenoid articular surface, then fixed with two 3.5 mm partially threaded screws.³² The results were comparable to the results of open techniques. Sixteen of the 19 shoulders had good to excellent results after the index procedure. Complications requiring reoperation including hardware removal occurred in 7 of 19 shoulders. However the author partially attribute this to a steep learning curve. One patient underwent revision for complete lysis of the bone graft. There were no reports of donor site morbidity.³²

Boileau et al. also published a case series of 15 patients with a mean age of 27. They described an all-arthroscopic technique of posterior shoulder stabilisation using suture anchors for both bone block fixation and capsulolabral repair. They state that there is a reduced risk of neurovascular injury and chondral damage associated with drilling and screw insertion. Other reported benefits were reduced hardware complications requiring subsequent removal. No bone block non-unions were reported.³⁰ Graft remodelling on delayed CT imaging showed restoration of the glenoid pear shape.



outcomes of posterior bone block procedures, and at the time of writing this review there no comparative studies looking open versus arthroscopic techniques. Though technically demanding there is growing interest in arthroscopic bony stabilisation. Some of

Drawings from Boileau et al.,2013.³⁰ Drawings showing desired placement of bicortical bone graft on posterior aspect of glenoid and its extra-articular position after reattachment of posterior labrum.



Early CT images (at 2 weeks) showing correct bone graft positioning: in the vertical plane, the graft is subequatorial, whereas in the horizontal plane, it is flush or slightly overhanging laterally.

3. Conclusion

Significant glenoid bone loss is a risk factor for recurrent instability. Cases of anterior instability are significantly more common than posterior instability. The Latarjet procedure has been shown to produce good and consistent results in anterior glenoid defects greater than 25%. It is increasingly utilized to restore stability in patients without a glenoid defect, but with high risk of recurrent dislocation. A recent systematic review and meta-analysis of eight studies reported a significantly lower risk of recurrence and redislocation in the outcomes of open Latarjet compared to arthroscopic Bankart repairs.⁴⁸

As the technique is refined, there has been growing interest in arthroscopic bone block procedures either with iliac crest autograft or allograft. Though there have been few long-term studies, the available evidence suggests the outcomes are comparable to the traditional open techniques.

There remains some difficulty in the management of posterior glenoid bone defects. A comparative lack of evidence is largely down to the rarity of the problem. Only when functional non-operative treatment fails, should surgery be considered. Though a number of studies showed reasonable early results with low recurrence rates, long-term studies show poor outcomes with high rates of pain and glenohumeral osteoarthritis.

More recently authors have published data on arthroscopic bone block augmentation with iliac crest bone graft or allograft. Though current evidence is somewhat limited, some of the cited benefits include reduced surgical time, less soft tissue dissection and the ability to diagnose and treat associated pathologies. Though technically more demanding, it does seem to be growing in popularity, and early results are promising.

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