ABSTRACT

The glenohumeral joint has the most mobility of any in the body, and contact between the humeral head and glenoid labrum contributes to its stability. Patients with recurrent dislocations may have bone defects in one or both of these surfaces, due to the presence of a Bankart lesion or an engaging Hill-Sachs lesion. We present a case of an adult whose left shoulder required intervention following a 10-year history of chronic, recurrent glenohumeral dislocation. Our assessment revealed a large Bankart lesion combined with a large Hill-Sachs lesion. We performed an open surgery with bone augmentation of the glenoid osseous defect using a tricortical autogenous bone graft harvested from the iliac crest. Intra-operative assessment showed adequate stability without intervention for the humeral head defect. The technical aspect of the surgery is described together with the clinical outcomes of the patient. We briefly review therapeutic options for glenohumeral osseous defects described in the literature.

ABBREVIATIONS

GHI: Glenohumeral Instability; IGHL: Inferior Glenohumeral Ligament; ROM: Range Of Motion; MRI: Magnetic Resonance Imaging; AP: Antero Posterior; CT: Computed Tomography

INTRODUCTION

The glenohumeral joint is a ball and socket joint. The articulation occurs between a rounded head of the humerus and the glenoid cavity of the scapula. The stability of the glenohumeral joint is highly dependent on its dynamic stabilizers (rotator cuff muscles, scapular muscle function, and biceps tendon) and static stabilizers (joint capsule, glenoid labrum, and the surrounding ligamentous complex), as well as the complex interaction between them [1-3]. Unlike the hip joint that has a deep socket, the glenoid cavity has a shallow socket. This may lead to instability if other stabilizers are compromised [4,5].

It is well established that glenohumeral instability (GHI) is associated with osseous defects on the glenoid or humeral head or both [6-10]. The most common defect of the glenoid following the first episode of dislocation is avulsion of the glenoid labrum and inferior glenohumeral ligament (IGHL) complex (Bankart lesion). Up to half of the cases had associated osseous defects [8,9]. Impaction of the humeral head against the glenoid rim during dislocation often leads to fracture involving the posterior-superior aspect of the head (Hill-Sachs lesion) [8,11]. Similar to bony Bankart, the frequency of Hill-Sachs lesions previously reported increases with the rate of recurrence dislocation. The osseous defect was observed in approximately 70% of cases following first episode of dislocation and up to 100% in cases of recurrences [6,11]. Significant correlation was also found between the rate of recurrence and the location of the osseous defect [12]. It is not uncommon to have osseous defects on both sides of the articulation following chronic or recurrent instability [7-9].

Many options of treatment have been described in the literature in reconstructing the glenoid defects including autogenous or allogeneic iliac crest grafts [13-16] and coracoid transfer [13,17-20]. Surgical options to manage osteochondral defect of the humeral head include osteochondral allograft [21-24], humeral head plasty [21-23,25,26], infraspinatus transfer [22, 23, 27-30], and rotational osteotomy [31-32], or other soft tissue procedures [21], although most of the outcomes reported were based on anecdotal or case series reports [4]. Successful arthroscopic management of GHI associated with osseous defects has been described, but open reconstruction is often indicated. Large osseous defects, especially with concurrent involvement of the glenoid and humeral head, can be challenging and preclude arthroscopic treatment [5,8,12,33]. We present a case of an adult who presented with chronic, recurrent unilateral glenohumeral...
instability with large bipolar (glenoid and humeral head) osseous defects. The patient was treated with reconstruction of the glenoid with a tricortical autogenous iliac graft. There was no surgical procedure performed to the humeral head.

**CASE PRESENTATION**

A 30-year-old right hand dominant male was referred to us for a chronic, recurrent left glenohumeral instability. His first dislocation occurred 10 years prior to presentation, as was secondary to a traumatic event. For the past ten years, he experienced multiple recurrences, each during low-energy daily activities involving overhead elevation or external rotation of the affected upper limb. Physiotherapy provided some alleviation of pain, but persistent instability, worsening and more frequent episodes of pain and limited range of motion (ROM) prompted him to seek for further advice and treatment.

On examination, his left deltoid and biceps were mildly wasted in comparison with the contralateral limb. He had 120° forward elevation, 30° of external rotation in adduction and T12 internal rotation. He displayed marked apprehension upon passive abduction and external rotation of his shoulder. Apart from these, there was no evidence of neurovascular deficit, assessment of his rotator cuff was relatively normal, and there were no hyperlaxity of joints.

Plain radiographs showed osseous deficits on both sides of the glenohumeral articulation with some arthritic changes. MR imaging revealed more extensive defects. A large defect estimated around 30% of the anteroinferior aspect of the glenoid and a large Hill Sachs lesion (Figure 1). In view of the estimated size of the defects, we opted for an open surgery utilizing the deltopectoral approach. Intra-operatively, the bony Bankart and Hill-Sachs lesions were visualized and measured (Figure 2). We proceeded with reduction and bone augmentation of the glenoid using a tricortical autogenous bone graft harvested from the iliac crest (Figure 3). The bone graft was shaped and trimmed accordingly to ensure a good contact with the glenoid before it was fixed to the anterior inferior aspect of the glenoid. We temporarily fixed the bone graft with Krischner wire and assessed the position before we finally fixed it with two cancellous screws (4.0 x 35mm) (Figure 4). Intra-operative assessment showed adequate stability of the glenohumeral joint without intervention for the humeral head defect. Hence, we decided no further procedure was required for the Hill-Sachs lesion.

The patient’s post-operative course and rehabilitation were uneventful. His operated limb was put on arm sling for six weeks but passive ROM exercises in elevation and external rotation was commenced on the third post-operative day. However, external rotation was limited to 60° to minimize overstress the glenoid reconstruction. Full active ROM was allowed at 6 weeks following surgery. Patient still had limited abduction and external rotation during assessment at three months (Figure 5) but his ROM improved to near full range at one-year follow-up. He achieved 120° of forward elevation, 30° of external rotation in abduction and T9 internal rotation (Figure 6). No further episode of dislocation was recorded.

**DISCUSSION**

The most common underlying cause of osseous instability of the glenohumeral joint is the bony Bankart lesion that can also occur even after the first episode of dislocation. Hill-Sachs lesions on the other hand are usually associated with recurrent anterior GHI [1]. During a dislocation, the cancellous bone of the humeral head is impacted against the glenoid rim.

Arthroscopic defect repair gained popularity due to its less invasive nature and lack of sub scapularis release and repair. Furthermore, it can be performed on a daycare basis leading to significantly lower cost in treatment making it more favourable [34,35]. Studies reported better functional outcomes and early
recovery compared to open Bankart repair [36-38]. However, higher rates of recurrence were observed following arthroscopic glenohumeral stabilization [39-42]. Recent reports claimed the recurrence rates following the two approaches are now comparable [36,37,39]. Hence, open Bankart repair has been consensually reserved for selected cases. Balg and Boileau [43] recommended avoidance of arthroscopic stabilization for patients with known risk factors for recurrent instability or failure of primary repair. These factors include age younger than 20 years, athletes involve in forced overhead or contact sports, evidence of glenohumeral hyperlaxity, presence of a Hill-Sachs lesion on an external rotation AP radiograph, and loss of the sclerotic inferior glenoid contour on an AP radiograph. Kropf et al. [34] suggested that the only absolute contraindication for an all-arthroscopic approach is a large osseous defect, with the definitive size remains debatable [1,8].

Significant osseous defect of the glenoid can be detected arthroscopically [5,18,33]. According to Bigliani et al. [18], glenoid osseous defect can be classified according to nature of the underlying pathology and the size of the defect. Burkhart et al. [33] further detailed the description by suggesting that the amount of osseous defect is quantified as a percentage of the glenoid width with the bare spot (center of the articular surface of the inferior glenoid below the level of the mid glenoid notch) used as a constant reference point. Similar to the classification by Bigliani et al., they also used 25% as the cutoff point of higher risk of instability and recommended bone grafting for any defect greater than the value [33]. In a cadaveric study, a glenoid defect of more than 21% required less translational force to dislocate the glenohumeral joint [9]. As for the humeral head defect, many studies suggested lesions with size greater than 20% to 40% have a higher risk of GHI [1,2,5,6,34,35,44] but a more recent laboratory results indicated defects as small as 13%, too, have biomechanical consequences of instability [24]. Another important factor that should be considered is the orientation of the defect. Hill-Sachs lesions with their long axis parallel to the anterior glenoid rim when the glenohumeral joint is abducted and externally rotated are more likely to be unstable. Burkhart and De Beer termed these defects as engaging Hill-Sachs lesions. On the contrary, non-engaging Hill-Sachs lesions carry less risk of instability hence suitable for isolated arthroscopic Bankart repair since they do not have “a functional articular-arc deficit” [5].

Pre-operative imaging can provide the necessary evaluation prior to any surgical intervention. Plain radiograph can detect significant osseous defect involving the glenoid and humeral head through specific views [8]. However, it could not objectively quantify the amount of defects as well as evaluating the surrounding soft tissues. MR is the imaging of choice to examine the surrounding soft tissues, especially the rotator cuff muscles, but has less specificity and sensitivity for juxta-articular structures such as the glenoid labrum and capsuloligamentous complex. Furthermore, it can give false-positive results and underestimate Hill-Sachs lesions [8,45]. MR arthrography provides better specificity and sensitivity but its relative invasiveness, cost, various contraindications and reported complications limit its wide application. CT scanning can evaluate osseous lesions better than other modalities [8,10,45]. In the current case discussed, pre-operative imaging performed was only plain radiographs and MR. The osseous defects were detected easily on plain radiographs. Considering the estimated size of the defects, we have opted for open method as the surgical approach of choice. MR was necessary to evaluate the surrounding soft tissues. Quantifying the defects can be performed under direct visualization intra-operatively. Nevertheless, CT scan remains the gold standard imaging to evaluate osseous defects of the glenoid and humeral head and its superiority is enhanced with advances such as the additional of 3D reconstructions [8].
Various surgical options for reconstructing glenoid defects have been described in the literature. Depending on the indications as well as interventions preferred, these procedures can be broadly classified into “anatomical” and “non-anatomical” procedures. Bone grafting using iliac tricortical graft and coracoid transfers are options available for oseous reconstruction of the glenoid. Reconstruction of the glenoid using iliac bone graft is widely accepted and used. By filling up the defects, the glenoid is restored to its anatomical morphology hence returning the stability of the joint. While several techniques in bone grafting have been reported [14-16], the use of autogenous bone graft carries the risk of donor site morbidities [4]. Coracoid transfers, such as the Latarjet procedure, increases the stability a bit more than required by the normal shoulder. This is achieved through combinations of bone block effect, with capsular and sling effects provided by the intact coracoclavicular ligament [20]. Latarjet procedure is preferred for athletes involved in contact sports with higher risk of recurrence [17,19,20]. In managing Hill-Sachs lesions, the aim of treatment is to avoid engagement between the lesions with the glenoid rim. This can be achieved by filling up the defects or limiting the range of motion in external rotation. Options to achieve the former include bone grafting [22], infraspinatus tenodesis into the defect [22,23,27-30], or percutaneous humeral head plasty [24-26]. The latter can be achieved with non-anatomical reconstruction as such rotational osteotomy [31,32]. Trivedi et al. [3] proposed the glenoid track concept to determine whether defects on both articular surfaces need to be addressed. The concept uses defects on both articular surfaces to predict subsequent risk of humeral head engagement and instability. They suggested restoring the track to its natural width should be the first priority in treating GHI. To date however, there are no validated preoperative guidelines for cases in which intervention for both are required.

In our case, considering the large defects of both glenoid and humeral head, we opted for augmentation of glenoid defect with autogenous tricortical iliac graft. We did not perform any procedure to the humeral head. Intra-operatively we managed to achieve a reasonable functional articular-arc. The stability was restored without intervening the humeral head defect. Follow up after one year showed no more dislocation and the patient was able to perform his daily activity without restriction.

CONCLUSION

Bone augmentation with a tricortical iliac autograft is an excellent option in the restoration of the large glenoid defect. Reconstructing of the glenoid defects alone may suitably treat cases with bipolar osseous deficits.

REFERENCES


