MENTORS IN ORTHOPEDICS

TREATMENT OF SHOULDER INSTABILITY WITH BIPOLAR LESIONS: THE ON-TRACK/OFF-TRACK CONCEPT

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SUMMARY

Background: The glenohumeral joint is the most frequently dislocated joint in the body, often resulting in bipolar bone loss characterized by concomitant anteroinferior glenoid defects and posterolateral humeral head compression fractures, known as Hill-Sachs lesions. While arthroscopic Bankart repair (ABR) is the standard treatment for soft tissue injuries with minimal bone loss, high recurrence rates are observed in patients with significant bipolar lesions, particularly athletes in contact sports.

Objective: This article aims to delineate the glenoid track concept and its application in surgical decision-making for bipolar shoulder instability, while detailing the technical execution of remplissage and the indications for alternative stabilization procedures.

Key Points: The glenoid track represents the contact zone between the glenoid and humeral head during end-range motion; lesions extending medially beyond this track are classified as "off-track" and carry a higher risk of engagement and recurrence. Quantification of bone loss via 3D computed tomography or arthroscopic measurement allows for categorization into four treatment groups. Management strategies include ABR alone for on-track lesions with less than 25% glenoid loss, and ABR augmented with remplissage (infraspinatus tenodesis) for off-track lesions. For glenoid defects exceeding 25%, the Latarjet procedure or iliac crest autografting is indicated to restore the articular arc and provide a dynamic sling effect.

Conclusion: Successful management of recurrent anterior shoulder instability requires precise quantification of bipolar bone loss. Utilizing the glenoid track concept to guide the selection between soft tissue augmentation and bone grafting procedures optimizes clinical outcomes and reduces the risk of postoperative recurrence.

KEYWORDS

Shoulder Dislocation; Joint Instability; Bankart Lesions; Arthroscopy; Latarjet Procedure

INTRODUCTION

The glenohumeral joint is the most dislocated joint in the body. Instability of the glenohumeral joint ranges from subtle increased laxity to recurrent dislocation. When glenohumeral joint dislocates, it causes both soft tissue and bony lesions. The two common lesions seen in such patients are Bankart's and Hill Sach's lesion. Bankart's lesion is defined as the detachment of anteroinferior labrum with periosteum. Griffith et al. [1] and Saito et al. [2] have described the glenoid osseous defect to be located at 3'o clock position in right shoulder. However, as the glenoid inclines anteriorly in the sagittal plane, the true location of the glenoid defect is anteroinferior, relative to the scapula. Hill Sach's lesion is described as compression fracture of posterolateral humeral head. Both these lesions usually occur in association with anterior dislocation of glenohumeral joint. Bipolar bone loss is a term coined for a combination of glenoid defect and a Hill-Sachs lesion in a shoulder with anterior glenohumeral instability.[3]

Anterior shoulder dislocation commonly results in recurrent shoulder instability in younger population. Recurrent instability occurs in 50%-96% of patients younger than 20 years and 40%-74% of those aged 20-40 years; this may be an indication for surgical treatment to avoid further instability and associated disability. [4],[5], [6] Arthroscopic Bankart repair is the gold standard of treatment in shoulder instability with soft tissue labral injury with glenoidal bone loss less than 25%. Consensus of the treatment is clear regarding the management of glenoid bone loss of more than 25%. These group of patients are successfully treated with anterior glenoid bone grafting either with coracoid bone transfer (Latarjet) or Iliac crest autograft. Management of shoulder instability in patients with bipolar lesions with varying bone loss at glenoid and humerus is challenging. Arthroscopic Bankart's repair (ABR) alone is associated with high rate of recurrent dislocation in patients with significant combined Bipolar lesions especially among athletes involved in collision/contact sports.[7],[8],[9]. Yamamoto et al. reported that the re-dislocation rate following ABR was three times higher among patients involved in contact sports and only 24% of athletes recovered to pre-injury activity levels, because of residual instability and restriction movements of shoulder.[10]

ABR requires to be combined with soft tissue augmentation procedures like remplissage (infraspinatus tenodesis in the Hill Sachs) in patients with moderate to large sized Hill Sachs lesion. Remplissage procedure as an adjunct to ABR has become popular for the management of such high-risk cases.[11] The Latarjet procedure, is also applicable in such patients. Though there is no difference in postoperative recurrence rate between Latarjet and remplissage procedures, there is a higher incidence of complications such as nerve injury, bone graft dislocation, and bone nonunion with Latarjet procedure. [12],[13]

We believe that arthroscopic Bankart's repair (ABR) augmented with other procedures like remplissage provides better outcome in young athletic patients. The type of surgical procedure required is guided by the glenoid track concept. In this article, we aim to explain the concept of glenoid track and its application to guide surgeons in deciding which procedure can be used to augment ABR. Additionally, we will explain the technique of remplissage and indications of other procedures in treatment of bipolar lesions of shoulder.

TRAUMATIC SHOULDER DISLOCATION AND BIPOLAR LESION

The shoulder joint is a ball-and-socket joint. The socket (glenoid) covers only one-quarter of the surface of the ball (humeral head)[21] and hence, the shoulder has greatest mobility among all joints in the body. When the arm

reaches to the limit of shoulder movement, it is defined as the 'end-range'. The track of the extended arm moved along the end-range creates a large circle around the shoulder joint. The area surrounded by this circle is known as 'mid-range' of movement. Mid-range stability is provided by the negative intra- articular pressure[22],[23] and the concavity-compression effect.[24] At the end-range of movement, a part of shoulder joint (like antero-inferior capsule and inferior glenohumeral ligament- IGHL in abduction, horizontal extension and external rotation) capsule becomes tight and prevents further movement of the arm. The tight capsulo- ligamentous structure functions as a stabilizer of the humeral head. If a force greater than the IGHL resistance is applied, the IGHL may get avulsed or ruptured and the humeral head dislocates.

Glenoid bony defect is related to mid-range instability as there is no protection from tight capsule or repaired antero-inferior labrum. (Figure 1). E. Itoi et.al. through their study concluded that 25% of glenoid defect is the critical size to cause anterior shoulder dislocation in mid-range.[25] The Hill Sach's lesion (HSL) is also most seen in shoulders with anterior instability along with soft tissue bankart lesion. The prevalence of HSL has been reported to be 65% to 67% after initial dislocation and 84% to 93% after recurrent dislocation.[26],[27] Quite often, a small HSL is located close to the greater tuberosity, whereas a large HSL extends more medially. (Figure 2). A HSL which is small and narrow but is located medially needs special attention for optimum treatment option (Figure 3).[28]

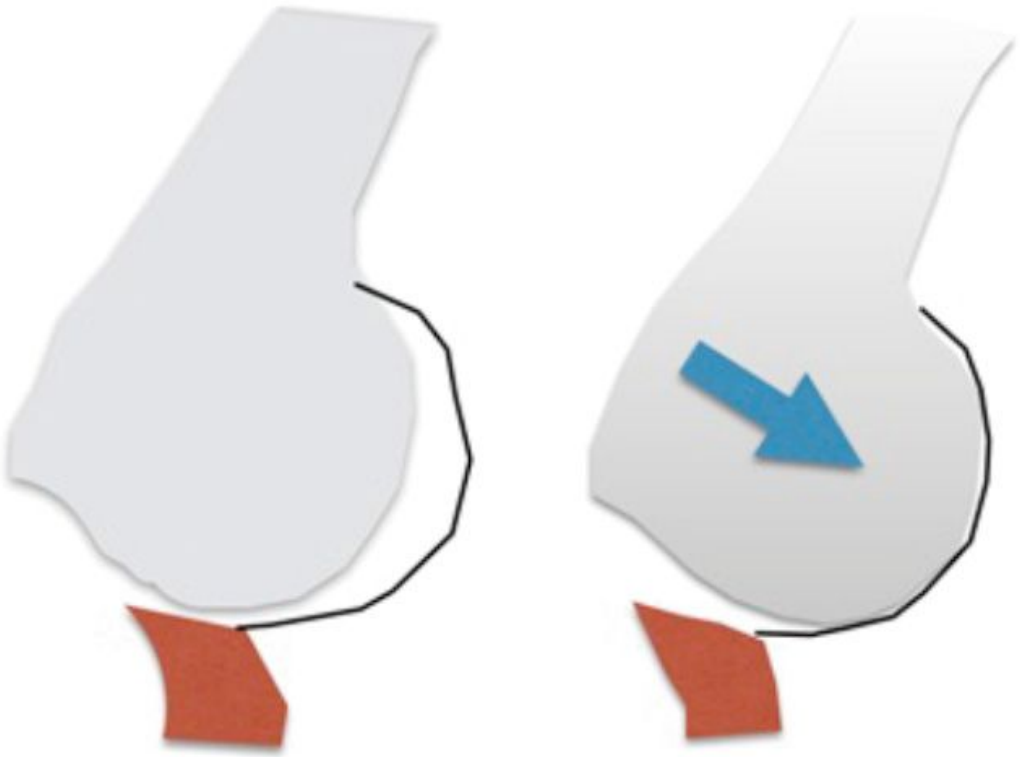

Figure 1: In midrange, the anterior capsule is lax and humeral dislocates, because the glenoid defect is large

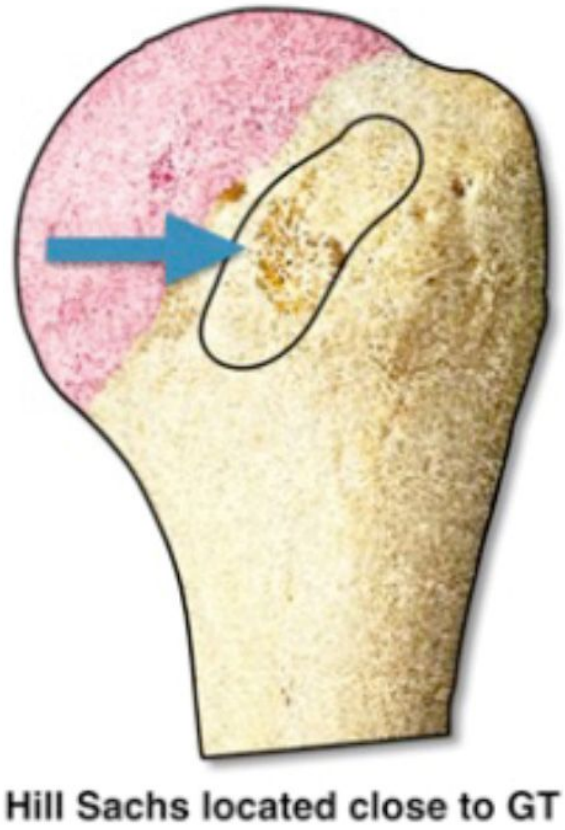

Figure 2: Hill Sach's lesion located close to greater tuberosity

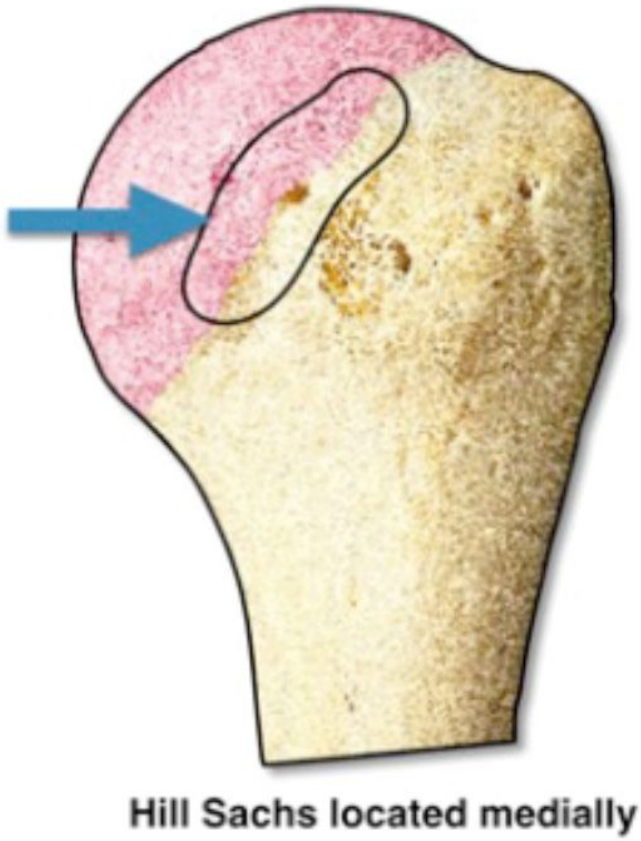

Figure 3: HSL is narrow but, located medial to greater tuberosity and has a high risk of being an off-track lesion

Clinically, the load and shift test should be used to evaluate anterior translation in three positions of glenohumeral elevation in the plane of the scapula: neutral, 45, and 90 degrees. All of these should be performed with the shoulder in mild external rotation. A gross shoulder deformity, positive shoulder apprehension in the midrange of abduction (30 to 90 degrees) with limited external rotation, and reproducible anterior translation of the humeral head are all suggestive of glenoid bone loss.[31]

A HSL is not related to the mid-range stability as it is located away from the glenoid in this range of movement. With the arm at the posterior end-range of movement, the glenoid comes to the posterolateral portion of the humeral head, where the HSL is located. If the HSL is entirely covered by the glenoid in this arm position, it will not cause instability. However, if it is out of the glenoid coverage, it may engage with the anterior rim and cause a dislocation (Figure 4).

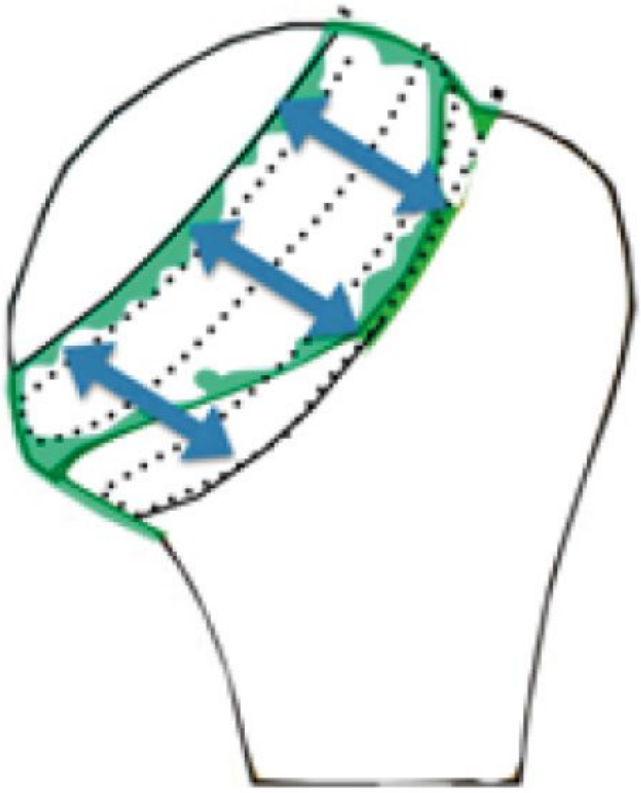

Figure 4: The glenoid track is the zone of contacts of the glenoid on the humeral head

GLENOID TRACK CONCEPT

The incidence of the glenoid bone loss is very high in patients with recurrent anterior dislocation of the shoulder. [14],[15] Recent clinical studies pointed out that these untreated bone losses cause residual post- surgery instability.[7],[8] Certain video studies have demonstrated that dislocation occurred in positions other than abduction and external rotation.[16],[17] Compression of humeral head against anterior margin of glenoid creates Hill Sachs lesion (HSL) and it increases in size as time lengthens. The patients who suffer dislocation come to an emergency room, their shoulders are adducted and internally rotated. Hence, HSL many times is created during the process of adduction and internal rotation after dislocation.[18]

Yamamoto et al. [19] in their cadaveric study found that the relative location of HSL to glenoid represents a very critical factor. The location of the glenoid was marked on the humeral head, and the arm was elevated along the end-range of glenohumeral motion. As the arm was elevated at 0°, 30°, and 60° with maximum external rotation and horizontal extension, the contact area of the glenoid shifted from inferomedial to superolateral portion of the humeral head, creating a zone of contact (Figure 4). The distance from the medial margin of the footprint of the rotator cuff to the medial margin of this contact area at 60° of abduction was 18.4 ± 2.5 mm, which was equivalent to 84% ± 14% of the glenoid width. Yamamoto et al. defined this contact zone as the glenoid track. Omori et al. measured the glenoid track in live shoulders. They demonstrated that the width of the glenoid track in live shoulders was 83% of the glenoid width at 90° of abduction.[20]If the HSL remains within the glenoid track, there is no risk of engagement between the HSL and the glenoid. However, if the HSL extends medially over the glenoid track, there is a risk of engagement. The engagement always occurs between the HSL and the glenoid rim. This

means both are responsible for the engagement. In fact, the engagement is more frequently if there is a large glenoid defect Hence, when considering the critical size of the HSL, treating physician needs to observe the glenoid bone loss as well.[7] This gives the concept of glenoid on track and off track lesion. Di Giacomo et al. developed a method (both radiographic and arthroscopic) that uses the concept of the glenoid track to determine whether a Hill-Sachs lesion will engage the anterior glenoid rim and there is concomitant anterior glenoid bone loss. If the Hill-Sachs lesion engages, it is called an “off-track” Hill-Sachs lesion; if it does not engage, it is an “on-track” lesion.[29] Cook et. al. validated this concept in anterior shoulder instability and concluded that osseous defect defined as on-track or off-track is a better predictor of failed arthroscopic stabilization than solely quantifying glenoid osseous defect.[30] The glenoid track concept enables us to take into consideration combined effect of bipolar lesion i.e. humeral and glenoid bone loss.

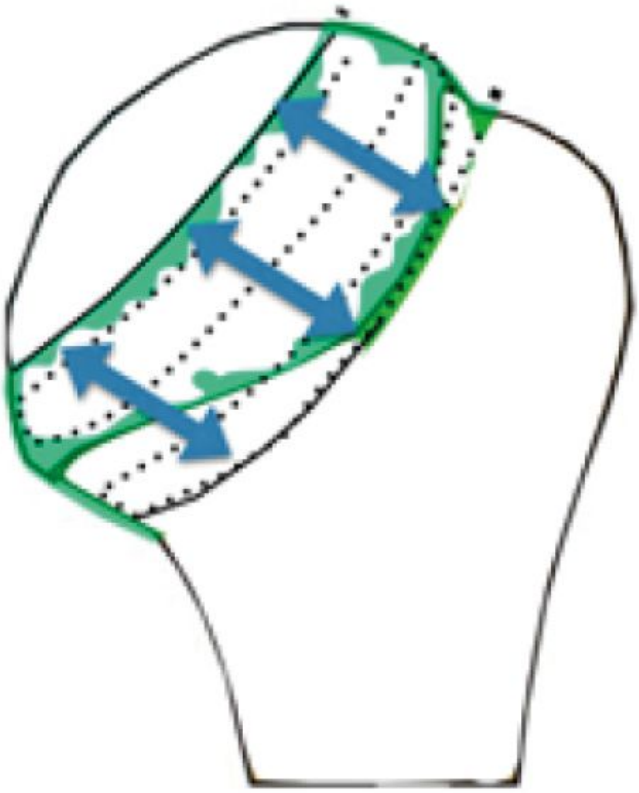

Figure 4: The glenoid track is the zone of contacts of the glenoid on the humeral head

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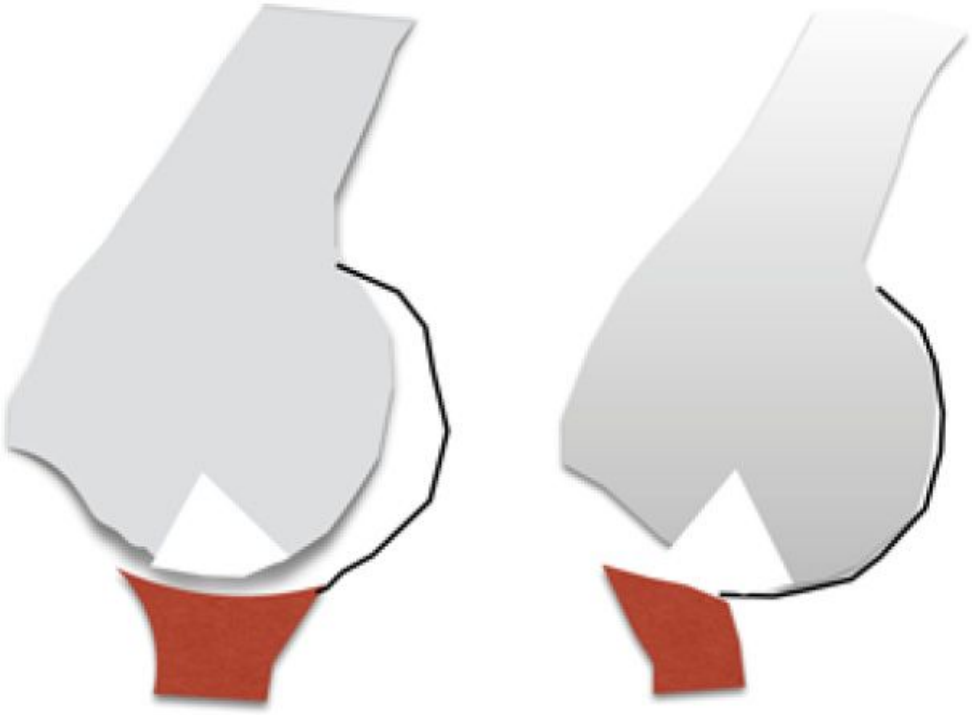

Figure 5: HSL entirely covered by glenoid in end-range and hence, stable shoulder. In case of glenoid defect; same size HSL is uncovered. Thus, the shoulder becomes unstable.

RADIOLOGICAL (CT) METHOD

Di Giacomo et. al. [29] in their study gave the method to evaluate the bipolar lesion both radiologically and arthroscopically. Using the 83% value as the mean glenoid track width, they developed a method to assess whether a Hill-Sachs lesion is on track or off track. Initially, glenoid and the humeral head are visualized using 3D CT. For a unilateral shoulder scan, the patient is placed in the CT gantry and both shoulders are placed in the scanning field. With a single scan, the data of both shoulders are recorded. First, an en face view of the glenoid is created. There are various methods to assess the size of the glenoid bony defect. Di Giacomo et. al. used the contralateral shoulder as a reference because the difference between the right and left sides is extremely small. Jeske et. al. observed that the average area difference between the left and right sides was only 1.8%.[32] The greatest horizontal distance of the glenoid (width) on both shoulders is measured and is the diameter of the intact glenoid (D). Then the defect size (d)is measured using intact glenoid as reference, as follows: d= Intact glenoid width (D) – injured glenoid width.

Next, using the posterior view of the humeral head, the medial margin of the footprint of the rotator cuff and the Hill-Sachs lesion is identified (Figures 6A and 6B). Following this, a line is set located at a distance equivalent to 83% of the glenoid width from the medial margin of the rotator cuff footprint. If there is no bony defect of the glenoid, this line represents the medial margin of the glenoid track (line G1 in Fig. 6A). If there is a bony defect of the glenoid (d), the distance d is subtracted from the 83% line to obtain the medial margin of the true glenoid track (line G2 in Fig 6B). If the Hill-Sachs lesion is located within the glenoid track, it is called an on-track Hill-Sachs

lesion (Fig 7A). If it extends more medially over the medial margin of the glenoid track, it is an off-track Hill-Sachs lesion (Fig 7B). In addition to this, there is typically an intact bone bridge between the rotator cuff attachments and the lateral margin of the Hill-Sachs lesion. This bone bridge width plus the width of the Hill-Sachs lesion is known as Hill Sach's interval (HSI). (Figure-7A and B) The medial margin of HSI is the critical point in determining whether a Hill-Sachs lesion is on track or off track.

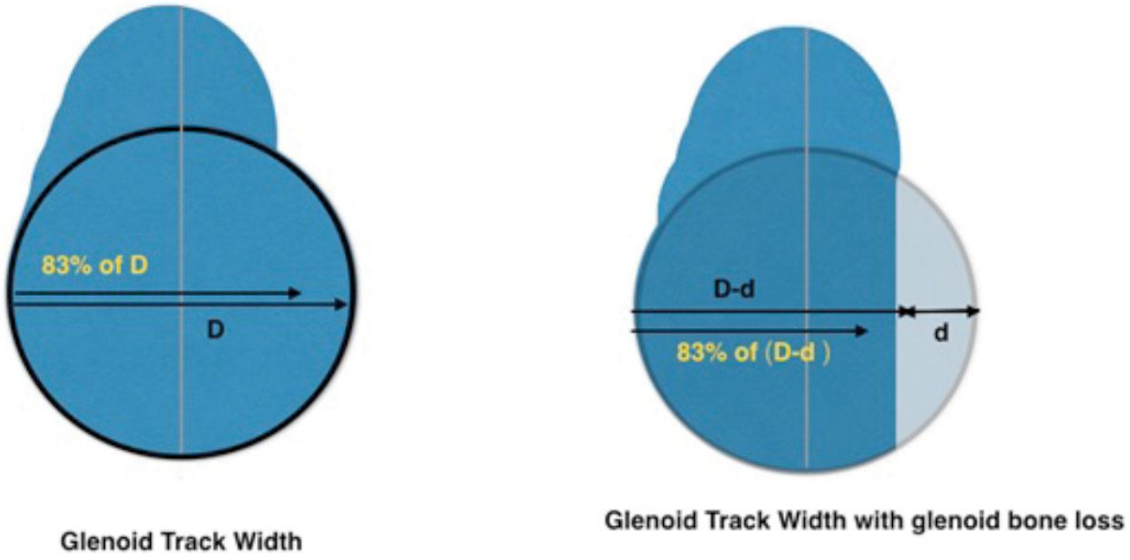

Figure 6: 6A Glenoid track calculation in intact glenoid (D). 6B Glenoid track calculation with anterior glenoid bone loss (d). The width of the glenoid track will be 83% of glenoid diameter minus d.

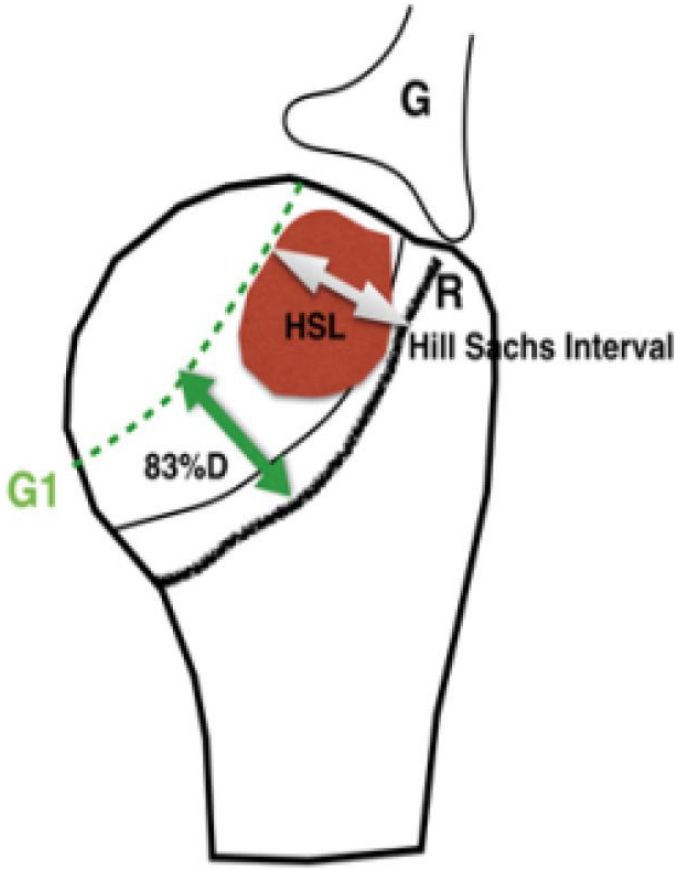

Figure 7A: medium size Hill Sachs lesion. Line G 1 represents medial margin on glenoid track and R line, medial border of footprint of attachment of rotator cuff. The HSL in on-track as it is within the glenoid track.

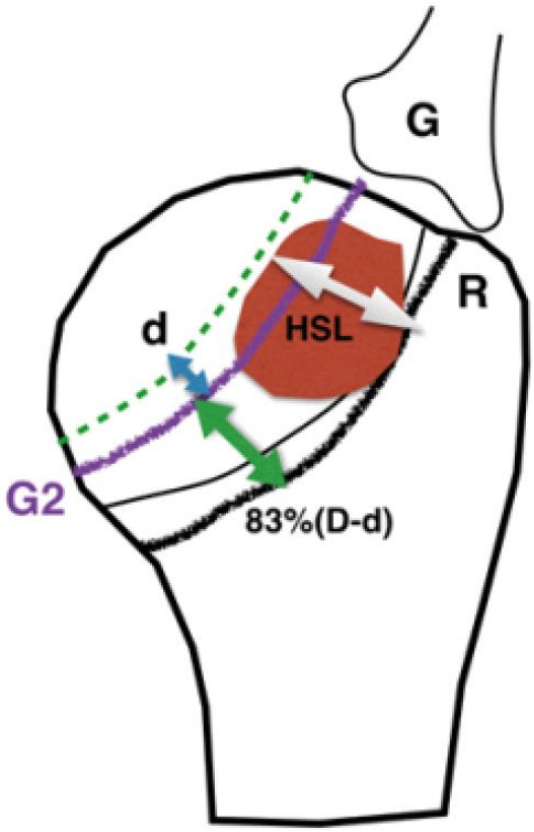

Figure 7B: Medium sized Hill Sach s lesion, same as case in Fig. 7 A. Line R-attachment of rotator cuff, Line G2-medial margin o fg lenoid track in the presence o fg lenoid defect. This is an ojf track HSL.

ARTHROSCOPIC METHOD

While viewing from an antero-superolateral portal, the radius of the inferior glenoid is measured by measuring the distance from the bare spot of the glenoid to the posterior glenoid rim (Figure 8). Then, one doubles the radius to obtain the inferior glenoid diameter (D). Then the distance from the anterior glenoid rim to the bare spot of the glenoid is measured. If there is no glenoid bone loss, this measurement should be the same as the posterior glenoid radius. If there is a glenoid bone loss (d), then the glenoid track measurement will be 0.83D-d. Now, the Hill Sach's interval (HSI) is measured. The HSI is the distance from the rotator cuff attachments to the medial rim of the Hill-Sachs lesion, and it is equal to the width of the Hill-Sachs lesion plus the width of the intact bone bridge between the rotator cuff and the Hill-Sachs lesion. After the measurements, if HSI is found to be more than glenoid track, then the Hill Sach's lesion will be an off-track engaging lesion.

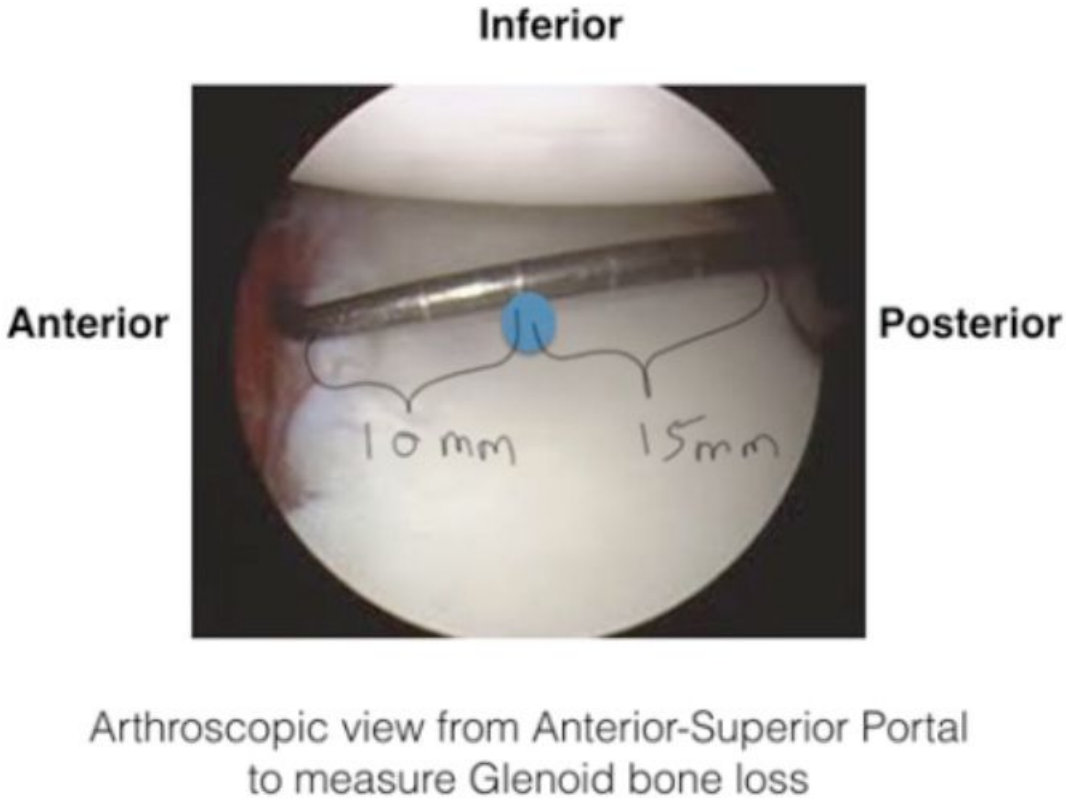

Figure 8: Right shoulder, anterosuperior viewing portal. The calibrated probe with 5 mm hash marks, has been introduced through the posterior portal. The radius of the glenoid is from the bare spot to posterior glenoid rim is 15mm in this case. However, the distance to anterior rim is only 10 mm, indicating 5mm glenoid bone loss in this case.

Recently conducted, some clinical studies have shown the validity of this on-track/off-track concept. Locher et. al. [33] retrospectively analyzed 100 patients who underwent arthroscopic Bankart repair. Among these patients, 88 of them had on-track HSLs and 12 had off-track HSLs. The patients with on-track and off-track lesions had a recurrence rate of 6% (5 out of 88) and 33 % (4 out of 12) respectively. Shaha et. al. also observed 57 patients who underwent arthroscopic Bankart repair. The recurrence rate was 8% in the on-track and 75% in the off-track patients. The positive predictive value of off-track concept to predict the recurrence was 75%, whereas that of the glenoid bone loss of > 20% was 43%.[34]

TREATMENT OF BIPOLAR LESIONS

Parke et. al. evaluated engagement before and after the Bankart repair. In their series of 983 shoulder stabilizations, 70 shoulders showed an engagement during dynamic examination. after the Bankart repair and they added remplissage in these cases.[35] Yamamoto et. el. performed a similar biomechanical study, taking the soft tissue contribution into consideration. They reported that the critical size of an anterior glenoid defect was the one with a thickness that was at least 25% of the glenoid width. Thus, in cases with a large glenoid defect (> 25% of the glenoid width), bone grafting is necessary as a surgical treatment.[36]

Kurokawa et. al. [28] reported in their series of 100 shoulders with recurrent anterior dislocation, 94 shoulders had HSL, and 7 of them (7.4%) were defined as off-track HSL. The study observed that there are two categories of

off-track HSL: the large and wide type, and the narrow but, medially located type. There is a positive relationship between the sizes of the glenoid defect and HSL: the larger the glenoid defect, the larger the HSL. Thus, if there occurs a large glenoid osseous defect, one needs to confirm whether the HSL is an on-track or off-track lesion. If the glenoid defect is less than 25%, only soft tissue repair is adequate with no need of glenoid bone grafting for this defect. Such cases are treated with adjunct procedure for HSL. For bipolar (engaging, off track HSL) lesions, if latarjet procedure is chosen the glenoid track can be enlarged by bone grafting. In the arthroscopic remplissage procedure, engagement can be avoided by filling the humeral head defect with the infraspinatus tendon.

Di Giacomo et. al.[29] categorized all the anterior instability patients into four categories. (Table 1)

Group	Lesion	Recommended treatment
1.	Less than 25% glenoid defect with an on-track Hill Sachs lesion	Recommended treatment
2.	Less than 25% glenoid defect with an off-track Hill Sachs lesion	Arthroscopic Bankart repair and filling
3.	Glenoid defect > 25% with on-track Hill Sachs lesion	Latarjet procedure
4.	Glenoid defect > 25% with an off-track Hill Sachs lesion	Latarjet procedure combined with a humeral procedure (humeral bone graft or filling) according to the degree of involvement of the Hill Sachs lesion at the end of the Latarjet procedure

Table 1

Nakagwa et.al.[37] from their study in 80 male athletes (85 shoulder) devised a scoring system for bipolar bone loss. This was useful to evaluate the influence on post-operative recurrence in male athletes. The sizes of both lesions were evaluated retrospectively in 80 male athletes (85 shoulders) using computed tomography. The glenoid defects and the dimensions of the Hill-Sachs lesions were classified into 5 size categories and were allocated scores from “0” for no defect to “4” for the largest defect. Patients were then classified into 5 classes according to the total score for both lesions. They concluded that the postoperative recurrence rate was influenced by extent of bipolar bone loss and the sporting category, regardless of the presence of off-track lesions.

We believe that the paradigm given by Di Giacomo et.al. is vital in guiding towards the management of shoulder instability with bipolar lesions. Arthroscopic Bankart's repair combined with remplissage is a promising surgical procedure with low rate of recurrent dislocation, clinically no significant loss of glenohumeral movements and a good functional outcome score.[38]

REMPLISSAGE

We describe here our technique of performing arthroscopic remplissage. This procedure converts Hill Sach's lesion into an extra-articular structure and acts as a checkrein against anterior translation. Patient is positioned in lateral decubitus. Posterior, antero-inferior and antero-superior portals are made. The antero-superior one is

the primary viewing portal and is made more posterior than usual. After adequate viewing of HSL, it is accessed through posterior portal. External rotation of humeral head positions HSL in front of posterior cannula. The bed of the lesion is abraded and an anchor (double or triple loaded) is placed. Putting an anchor in the center of the lesion, closer to the articular surface in mediolateral plane, avoids stiffness in external rotation, post operatively (Figure 9). While passing sutures, posterior cannula should be withdrawn just outside the infraspinatus and beneath the deltoid (Figure 10). Then the sutures are passed using bird beak suture passer, staying lateral to posterior portal avoid stiffness in external rotation. (Figure 11) Then, the knot tying is completed.

Figure 9: Fitting an anchor in the middle of the HSL

Figure 10: Removal of the posterior cannula outside the infraspinatus

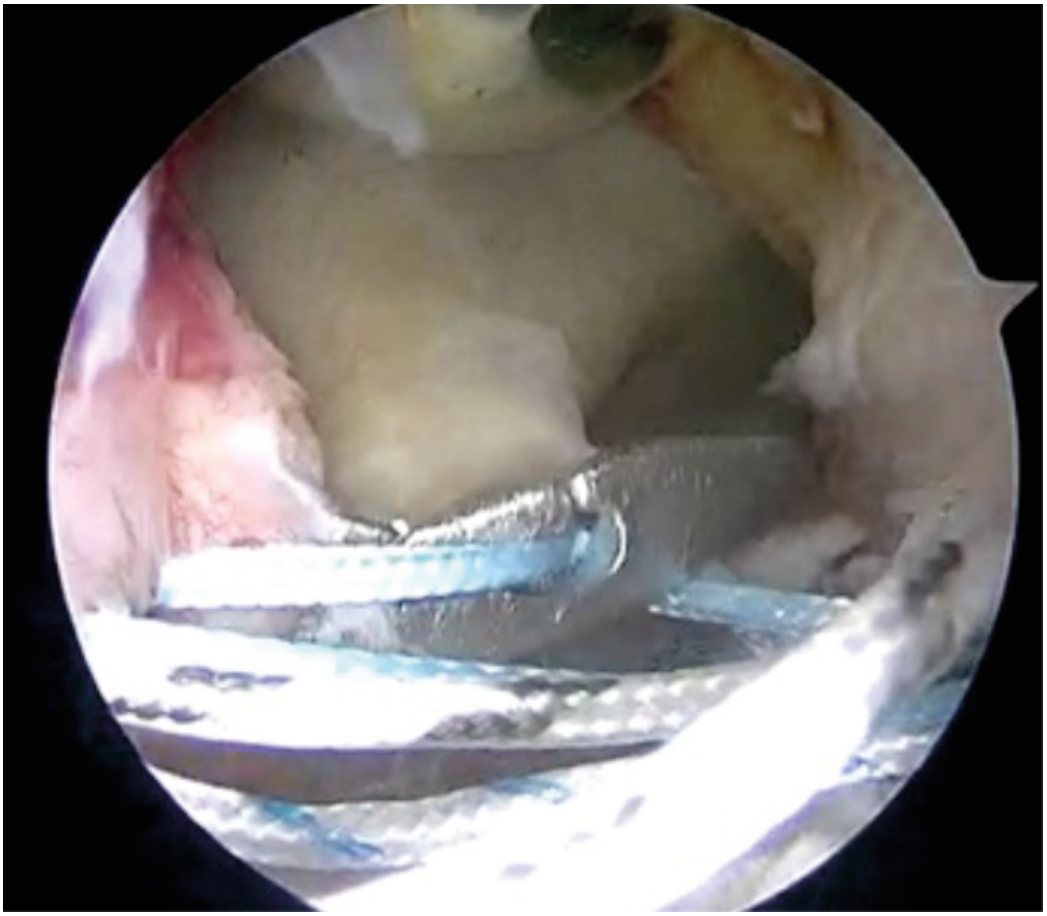

Figure 11: Use of a bird's beak suture pass-through to make punctures in the infraspinous and capsule.

For combined arthroscopic bankart repair and remplissage, we start with diagnostic arthroscopy, followed by mobilization of Bankart's lesion and preparation of the glenoid. Inferior labral suture and a 5 o'clock anchor is placed. Remplissage procedure is then performed except knot tying. Once the Bankart's repair is completed, knot tying is done for remplissage. (Figure 12)

Figure 12: Last image taken after the filling procedure

Post operatively, shoulder should be protected in a sling in neutral rotation for 4 weeks. Following this, the active assisted range of movements exercises were started and strengthening was initiated at 6 weeks, post-operatively. Zhyu Y.M. et.al. [39] from their study in 49 patients could not find any clinically significant loss in external rotation after arthroscopic Bankart's repair combined with remplissage for treatment of shoulder instability in engaging bipolar lesion. Purchase, Sahajpal et. al.[40] observed a recurrent instability rate of 7% at 2 years following combined bankart plus remplissage surgery with no significant loss in range of motion.

Procedures like latarjet, bone grafting and rotational osteotomy have specific indications. Latarjet procedure which involves the transfer of approximately 2.5 cm of coracoid process with attached conjoint tendon to the anterior glenoid. This is indicated when glenoid bone loss is more than 25 % and glenoid takes the shape of inverted pear shape.[41]

The rationale for the Latarjet procedure is that it provides a bone block effect to fill an anteroinferior glenoid defect and increases the contact surface area of the glenohumeral articulation. Secondly, a dynamic sling effect is created by conjoint tendon which supports the humeral head and provides increased stability in abduction and external rotation. Thirdly inferior glenohumeral ligament is reattached to glenoid rim to restore capsular integrity. The technique of coracoid transfer, first described by Latarjet in 1954, has undergone many modifications.

There are two most utilized techniques, the “classical” and “congruent arc” Latarjet. In the congruent arc technique, the coracoid graft is rotated about its long axis, and the concavity is lined up with the joint surface. This relatively increases the anteroposterior diameter and hence increases the surface area for anterior translation in comparison with the classic Latarjet technique. In the classic latarjet technique the inferior surface

of the coracoid sits on to the anterior inferior rim of glenoid. We follow classic conventional open surgical technique of Latarjet.

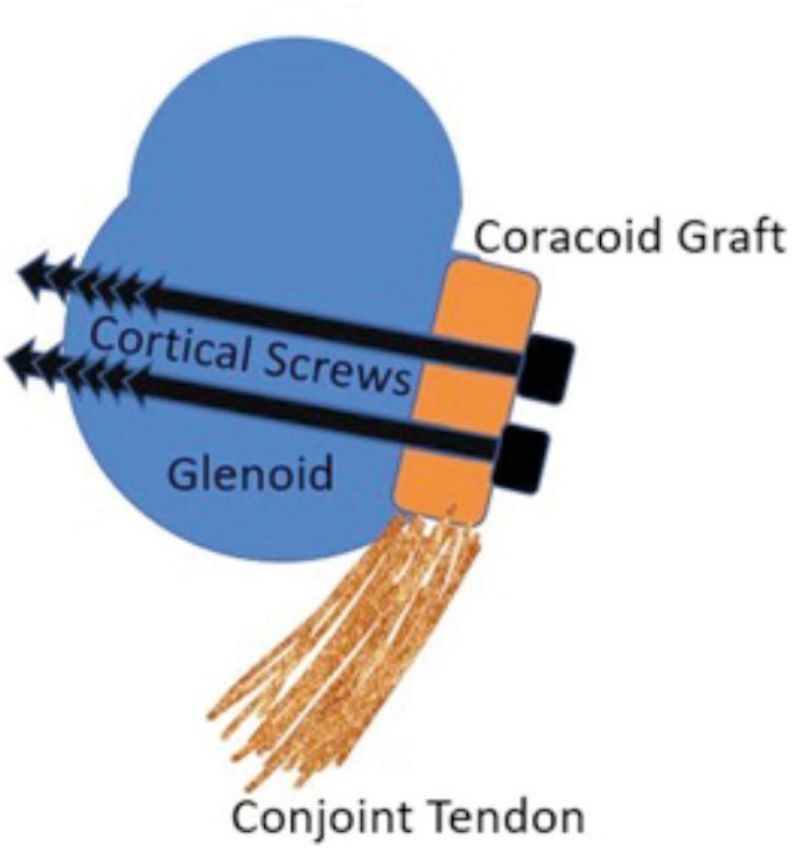

Figure 13: Principle of the Latarjet surgical technique using a coracoid graft fixed by cortical screws

Technical steps in Latarjet procedure [47]

Under regional and general anesthesia, patient is placed semi beach-chair position. Surgical parts are scrubbed, painted, and draped in standard fashion. Standard deltopectoral approach is used. A 5 to 7cm skin incision is taken from the tip of coracoid process to the superior aspect of axillary fold. Cephalic vein is protected throughout the procedure and is retracted laterally along with deltoid musculature. The coracoid process is exposed from the tip to the insertion of coracoclavicular (CC) ligament at its base. Now, the coracoacromial ligament (CAL) is divided approximately 1 cm from its insertion on coracoid process. With the shoulder in adduction and internal rotation, the pectoralis minor tendon is then released from the medial side of coracoid with periosteal elevator. The axillary and musculocutaneous nerve is protected throughout the procedure. A ruler is used to measure the appropriate length of bone graft required. A curved ostetome is used to perform a medial to lateral osteotomy to harvest the coracoid bone graft. During graft preparation, care must be taken to preserve CAL stump and conjoint tendon insertion.

Now, the glenoid surface should be prepared. For this, subscapularis muscle is sharply split with electrocautery at the junction of its superior two-third and inferior one-third. Vertical capsulotomy is done. After exposure, the anterior glenoid neck is abraded with a curette to prepare the bed for coracoid transfer.

Fukuda retractor is now placed in glenohumeral joint to improve visualization. The longitudinal axis of coracoid graft is positioned supero-inferiorly along the glenoid neck flush with articular surface. The optimal position is

between 3'O clock to 5'O clock position on glenoid. The graft is positioned and two Kirshner wires are passed for provisional fixation. Position is checked and confirmed under image intensifier. Definitive fixation is achieved with lag technique using either two 3.5 mm cortical screws or 4.0 mm cannulated cortical screws. Once the graft is fixed, the glenoid articular surface is assessed to ensure proper graft position. Following this, the capsular repair is performed and CAL remnant on coracoid is incorporated into the capsular repair to provide additional strength. Subscapularis split is closed. Closure is done for subcutaneous tissue and skin.

Post operatively, a sling is used for 4 weeks. Gentle passive, active and active assisted shoulder range of movements and scapular pain is permitted during this period. No resisted elbow flexion for 6 weeks post-operatively. Once radiological healing is seen, active strengthening is started. Patient can usually return to contact sports 4 months post-operatively.

Griffin et al. [42] has suggested that an autograft or allograft may be a used in cases of a failed Latarjet, in cases of concurrent coracoid fracture and in massive glenoid bone loss. The most described autograft has been the Eden-Hybinette procedure. This involves using the inner table of the iliac crest as an autologous graft to augment the glenoid defect.

For humeral side bone loss, 0 to 20% bone loss can be managed conservatively. A trail of immobilization followed by physiotherapy focusing on dynamic shoulder stabilizers is usually helpful. However, the demands of patients especially those involved in contact sports should be taken into consideration. For 20 to 40% bone loss, remplissage has become popular with promising results. Proximal rotational humeral osteotomy, described by Weber et. al. [43] in 1969, was used to treat young adults with moderate to severe Hill-Sachs lesions with aim of restoring stability. The procedure involved a sub capital osteotomy with medial rotation of humeral head by 25 degrees and imbrication of subscapularis tendon and anterior capsule. This prevented the engagement of humeral head in glenoid through the arc of motion. However, the procedure is associated with high complication rates and has fallen out of choice. [44],[45]

For humeral bone loss > 40% in young patients, osseous allograft reconstruction has been described as a useful strategy to avoid the need for prosthetic replacement. The data in the literature is very limited and further work is needed to evaluate the efficacy and limitations of this technique. An emerging technique in the treatment of young patients with bone loss > 40% has been the use of a partial resurfacing prosthesis such as the Hemi CAP® (Arthrosurface, Franklin, MA, United States). This uses a spherical cobalt chrome component to fill the Hill-Sachs defect and restore joint congruity. The technique requires patients to have at least 60% normal bone stock. The largest case series performed by Raiss et. al. [46] only involved 10 patients. They reported a Constant score of 41 points post-operatively with two re-operations.

Ramhamadany E. et. al.[41] recommend hemiarthroplasty in elderly individuals with off-track Hill Sach's lesion, with more than 40 % of humeral bone loss and less than 25 % glenoid bone loss. Reverse geometry shoulder arthroplasty is indicated in similar group of patients but, with those having more than 25% of glenoid bone loss.

We believe that patients with recurrent anterior shoulder instability require careful physical examination and imaging. Above-described methods of radiological and arthroscopic quantification of bipolar lesions with glenoid track concept guide the surgeon to offer the best possible treatment. Categorizing the patient in four groups, provides a paradigm to decide the optimal surgical procedure required. It is always the demands of each individual patient that governs the management pathway he/she will undergo.

The aim is to obtain a stable shoulder without any significant clinical loss of range of movements at glenohumeral joint.

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