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Arthroscopic Stabilisation Techniques for Anterior Shoulder Instability

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Abstract

Traumatic anteroinferior dislocation of shoulder in young patients often results in recurrent instability and can be a challenging problem to solve surgically. Treatment of anterior shoulder instability continues to evolve. Arthroscopic shoulder stabilization has become a preferred method of treatment for shoulder instability because reported success rates are parallel to those of open stabilization techniques. This is due to continuing advancement in techniques, instrumentation, improved understanding of the associated pathoanatomy and proper patient selection. In addition to the typical capsulolabral disruptionsseen following a primary dislocation, patients with recurrent instability often have coexistent osseous injury to the humeral head and glenoid. Important considerations during arthroscopy include identifying all pathology, adequate mobilization of the capsulolabral sleeve, retensioning of glenohumeral sleeve and secure anatomic fixation. With advancements in technique and more accurate diagnoses, these outcomes will continue to rise, and patients will more reliably be able to return to prior functioning levels.

Keywords: disclocation of shoulder, pathoanatomy, capsulolabral sleeve.

Introduction

Recurrent anterior instability of the glenohumeral joint has long been an arduous problem to solve surgically owing to its difficulty to the need to restore both osseous and dynamic constraints in the unstable shoulder [1]. Arthroscopic shoulder reconstruction has become a preferred method for the treatment of shoulder instability for many surgeons [2]. Although, initial results from comparison studies between arthroscopic and open procedures indicated significantly higher rates of recurrence improvements in patient selection and operative technique have steadily decreased recurrence rates to match that of open procedures [3,4].

These improvements in the results of arthroscopic stabilization are related to the understanding that the Bankart lesion is not the "essential lesion" surgeons once thought. In addition to the Bankart lesion, the treating surgeon must be aware of other co-pathologies that can occur in concert with capsulolabral injury and present as potential barriers to successful outcome [5,6].

The major advantage of arthroscopic repair over traditional open repair includes the ability to identify and treat concomitant pathology, lower morbidity and decreased pain, shorter surgical time, and improved cosmesis [7].

In general, a successful operative outcome for patients with shoulder instability requires the surgeon to perform a complete preoperative evaluation, a thorough diagnostic arthroscopy to evaluate for concomitant co-pathology, and implement an effective postoperative therapy program tailored to the repair surgery.

Anatomy of Shoulder Stability

The bony architecture of the glenohumeral joint is often likened to that of a golf ball and tee. The joint restraints are normally divided into static stabilizers such as the glenoid fossa, the labrum, the joint capsule and the glenohumeral ligament, and dynamic stabilizers including the rotator cuff, the long head of biceps and the stabilizers of the scapula. There is a significant interaction between these restraints, and their relative importance alters with changing positions of the arm [8,9,10,11].

The ligaments responsible for glenohumeral stability include the superior glenohumeral ligament, the middle glenohumeral ligament (MGHL) and the inferior glenohumeral ligament (IGHL). The most important of the three is the IGHL, which is the primary restraint to anterior subluxation of the humeral head when the shoulder is abducted to 90° and externally rotated [12,13].

The glenoid labrum functions as an extension of the bony glenoid, increasing the depth and surface area of the glenohumeral articulation. The labrum also serves as a site of attachment for the IGHL complex and the biceps anchor [14].

The rotator cuff is critical to the normal biomechanics of the shoulder joint.The main function of these muscles is to compress the humeral head into the glenoid. This maximizes the lever arm of the deltoid

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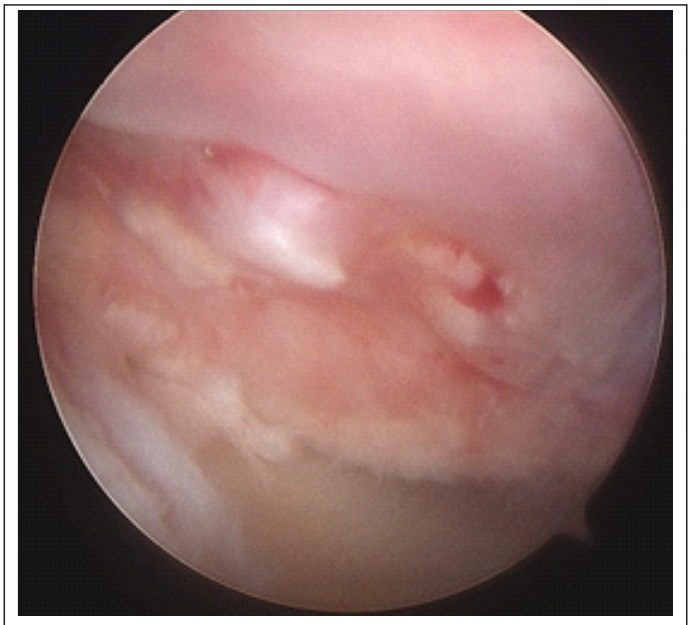

Figure 1: Arthroscopic view from posterior portal showing a Hill-Sach lesion.

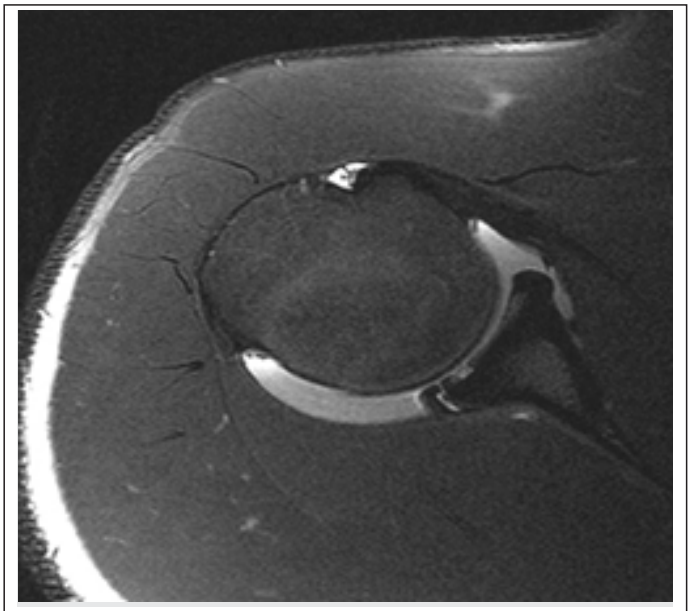

Figure 2: Axial T2 magnetic resonance imaging scan of a right shoulder showing a Bankart lesion or avulsion of the inferior capsulolabral complex from the glenoid rim.

while providing stability within the shoulder The rotator interval; which lies between the supraspinatus and subscapularis tendons, provides stability against inferior and posterior translations, particularly when the arm is adducted and externally rotated joint [15,16].

Pathoanatomy

Glenohumeral stability requires that the humeral head remain centered in the glenoid fossa. When the humeral head does not remaincentered, the patient has glenohumeral instability [16].

A spectrum of soft tissue and bony lesions can occur with instability. A detachment of the anteroinferior labrum with its attached anterior band of the IGHLcomplex (Bankart lesion) is the lesion most frequently encountered and is present in about 90% of all traumatic anterior shoulder dislocations. Plastic deformation of the anteroinferior capsule and IGHL complex becomes progressively more severe with recurrent episodes of instability.When the lesion involves a fracture of the anteroinferior glenoid rim in addition to the soft tissue avulsion, it is referred to as bony Bankart [17,18].

The humeral head is no longer stabilized by the deepening effect of the labrum,and thenormal stabilizing effect of the rotator cuff compressing the humeral head into the glenoid socket is diminished [7].

A number of variations from this typical pattern may be encountered: Superior labrum anterior and posterior detachment (SLAP) may occur in continuity with the inferior labral avulsion and is more common in throwing athletes [4]. Humeral avulsion of glenohumeral ligaments (HAGL) occurs when the capsuloligamentous structures are avulsed and torn off the humeral head and not the glenoid. The proposed mechanism of injury is a hyperabduction and external rotation force versus a hyperabduction and impaction force which would result in a Bankart lesion [17]. The incidence of HAGL lesions after a traumatic dislocation has been reported at 39%. A bony HAGL lesion occurs when the glenohumeral ligament is avulsed along with a bone fragment of the humeral head [19].

The Perthes and anterior labral periosteal sleeve avulsion (ALPSA) lesions are variants of the Bankart lesion. ALPSA is a soft-tissue or bony Bankart lesion that has healed in a medially displaced position on the glenoid rim and therefore does not restrain adequately the anterior translation of the humeral head. In this case, the avulsed periosteum has not raptured causing medial and inferior displacement of the labroligamentous structures [20,21,22,23].

Figure 3: Lateral decubitus position.

Figure 4: Surface marking showing portal positions.

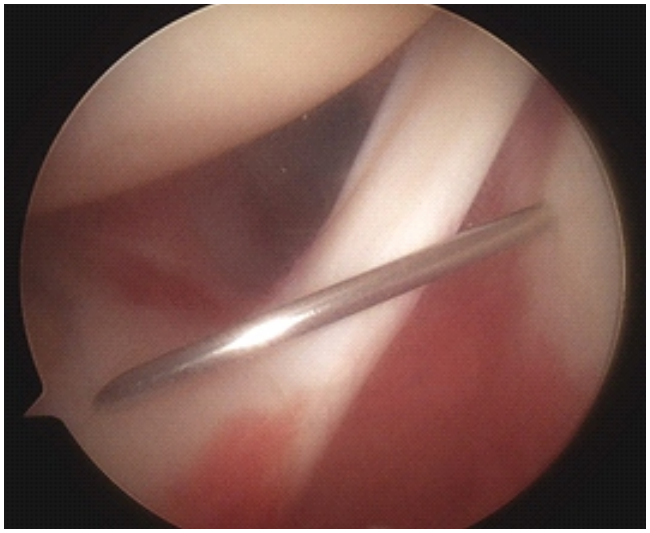

Figure 5: Arthroscopic view from theposterior portal with a spinal needle positioned between the biceps tendon and superior edge of subscapularis.

A Perthes lesion is characterized by an avulsion of the anterior labrum from the anterior-inferior glenoid which is attached to a stripped but still intact medial scapular periosteum. Another variant commonly referred to as a glenolabral articular disruption (GLAD lesion) is an anteroinferior labral tear along with an associated defect in the articular cartilage. In this injury, the torn labrum remains attached to the medial scapular periosteum; however, there is the addition of an adjacent articular cartilage injury [20,23,24].

Bone deficiency is a significant cause for the failure of arthroscopic Bankart repairs. Three types of bone lesions are found in patients with anterior instability: (1) Glenoid erosion (also known as inverted pear glenoid morphology, (2) the engaging Hill-Sachs lesion and, (3) non-engaging Hill-Sachs lesion.

The normal glenoid is broader inferiorly than superiorly (pear-shaped). When a large bony Bankart lesion is present or when glenoid erosion occurs from multiple dislocations, the glenoid loses its normal anatomic configuration and assumes the shape of an inverted pear. Anatomic studies have shown that the inverted pear morphology always involves more than a 25% loss in diameter. This is a contraindication for an arthroscopic repair due to their association with a high recurrence rate [25].

A Hill-Sachs Lesion is an impaction fracture on the posterolateral aspect of the humeral head (Fig. 1) and is present in 47-80% of anterior shoulder dislocations. Some Hill-Sachs lesions will "engage" the anterior glenoid rim when the glenohumeral joint is in a position of abduction and external rotation. Burkhart and De Beer described these as engaging Hill-Sachs lesions. Such fracture configurations have been found to be particularly prone to recurrent dislocation and subluxation after arthroscopic repair [17,26].

Imaging

Radiographic evaluation may include plain radiographs, magnetic resonance imaging (MRI), and computed tomography (CT). An appreciation for concomitant glenoid fractures, large Hill-Sachs lesions and other bony abnormalities will be helpful in determining whether arthroscopic or open stabilization is the appropriate surgical approach.

Imaging begins with plain radiography and should include anteroposterior, axillary, west point, and Stryker views to evaluate glenoid and humeral head bone loss. The modified axillary radiograph, "West Point" view, is specifically used to assess glenoid bone loss or rim fractures. Hill-Sachs lesions can be best appreciated on the anteroposterior view in internal rotation and the notch view [27,28].

A CT scan is the most accurate method of evaluating bone injuries of the glenoid or the humerus. A CT scan can effectively demonstrate the size of associated glenoid fractures or erosions and impression fractures of the humeral head. It is also useful to determine the orientation of the glenoid to exclude hypoplasia and version

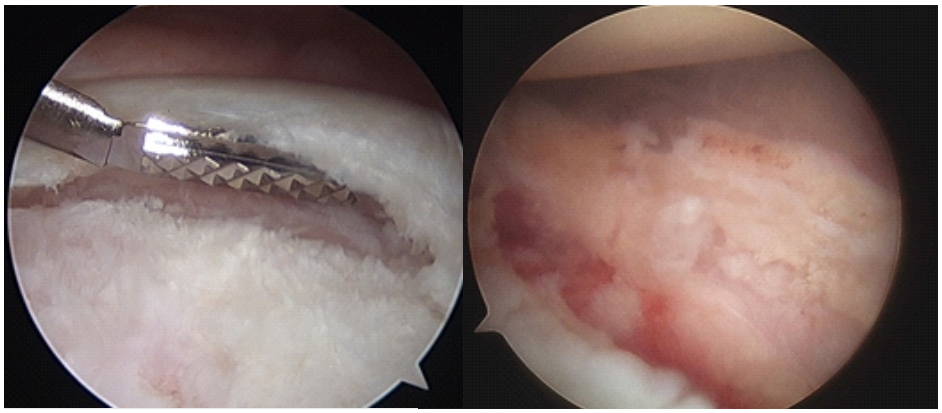

Figure 6: Arthroscopic view from posterior portal.(a)A perisosteal elevator being used to elevate and mobilize the capsulolabral sleeve,(b) release completed evident by visible underlying subscapularis muscle.

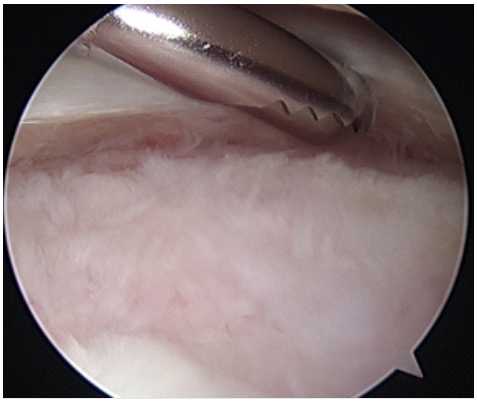

Figure 7: Arthroscopic view showing glenoid preparation with shaver.

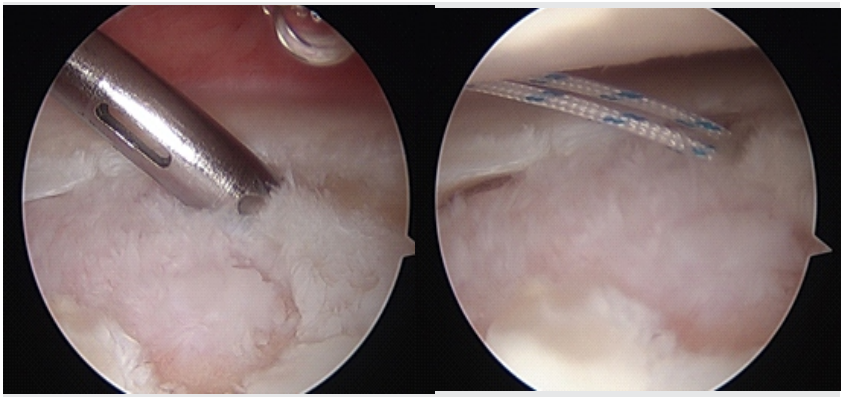

Figure 8: Arthroscopic view from posterior portal. (a) Positioning of drill guide at the glenoid rim for anchor placement, (b) anchor in poistion with nonabsorbable sutures.

abnormalities. CT arthrography can also be used to demonstrate soft- tissue pathology such as capsular or labral detachment and excessive redundancy [29]. Glenoid bone defects occur along a line parallel to its long axis. The inferior two-thirds of the glenoid have been described as a well-conserved circle and the amount of bone missing is assessedin respect to surface area loss of the circle. Glenoid bone loss between 6 and 8 mm of the anteroposterior diameter corresponds to 20-25% of the surface of the inferior glenoid. In a similar fashion, the extent and morphology of a Hill-Sachs lesion can be evaluated to assess the degree of engagement [30].

MRI is a gold standard for evaluating soft tissue recurrent Bankart lesions, HAGL lesions, SLAP tears, posterior labral tears, capsular redundancy and deficiency, chondrolysis, and rotator cuff pathology are just several entities that can be delineated with this imaging tool (Fig. 2). MR arthrography, however, has been found to present the highest sensitivity in detecting labral pathology compared with plain MRI and CT arthrography. It also achieved the best visualization of the IGHL and labrum [31,32].

Arthroscopic Repair

General principles

The basis for arthroscopic instability procedures is the reestablishment of normal glenoid labrum anatomy and retensioning of the IGHL in a manner that mirrors open procedures. Capsular laxity is addressed by thesuperior and medial shift of the capsule. If there appears to be aninsufficiency of the rotator interval region with persistent inferior laxity, then this region should be plicated as well. Finally, an associated tear of the superior labrum should also be repaired. At the conclusion of surgery, the labral complex should resemble a soft tissue buttress on the face of the glenoid, and the capsule should be appropriately tensioned.

Anesthesia and Positioning

Interscalene regional anesthesia, general anesthesia, or a combination of both may be used. Regional nerve blocks decrease narcotic requirements. The patient can be positioned in either the lateral decubitus or beach chair positions which is mainly based on surgeon preference.

The beach chair position is efficient, and conversion to an open approach is easier

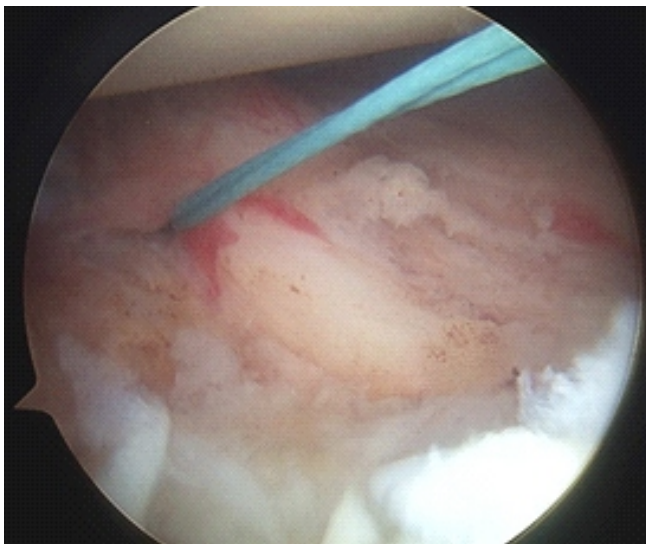

Figure 9: Arthroscopic view showing shuttling of the suture through the capsule and labrum.

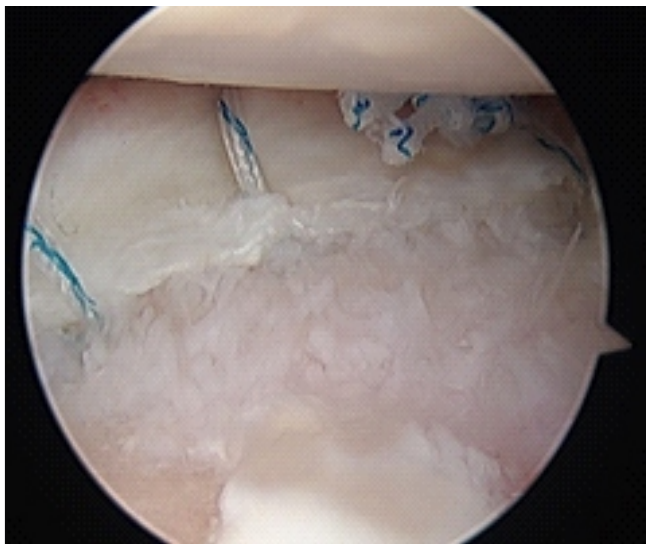

Figure 10: Arthroscopic view from the posterior portal after final repair showing 3 anchors with the head of humerus well centered on the glenoid.

with the patient in this position compared with the lateral decubitus position.
However, it is often easier to address the pathology at the anteroinferior capsulolabral complex with the patient in the lateral decubitus position, because it provides a wider distension of the glenohumeraljoint.
The arm is usually placed at 45°abduction and traction is applied both in the axial and lateral directions.
The authors prefer the lateral position.The patient is positioned on a long beanbag, and the arm is held in an armtraction device with 45° of abduction. A direct lateral traction to the proximal humerus is also applied with 2-5 kg of traction (Fig. 3).

Portals

Proper portal placement is essential in performing an accurate diagnostic arthroscopy, soft tissue mobilization, and anchor placement.
A standard posterior portal and two anterior portals (anterosuperior and anteroinferior) are usually required (Fig.4).
The posterior portal should be placed in line with the glenoid to allow the arthroscope angle to come into the joint slightly lateral to the glenoid face. This portal is made about 2 cm distal and directly in line with the posterior lateral edge of the acromion.This is slightly more lateral to the traditional posterior portal made 2 cm distal and 2 cm medial to the posterolateral corner of the acromion. A complete glenohumeral arthroscopy is performed. Once it is determined that the primary pathology is a detached anteroinferior capsule and labrum and that bone loss is not significant, the repair is initiated.
An anterior- superior portal is then created with an outside-in technique between the biceps tendon and superior edge of the subscapularis (Fig. 5).This portal is used for mobilization of the capsulolabral complex and subsequent suture management. It is always advisable to assess the intra-articular pathology through the anterior-superior portal as well to better evaluate the extent of labral tear posteriorly or glenoid bone loss and avoid missing a possible ALPSA lesion.
A second anterior-inferior portal is placed just inferior and lateral to the coracoid process to enter the joint above the superior edge of the subscapularis.This allows inferior placement of suture anchors on the lower aspect of the glenoid neck.These portals function as utility portals for instrument passage, glenoid preparation, suture management, and knot tying. It is important to separate these anterior cannulas widely so that access in the joint is not a problem.
Working cannulas are inserted into the two working portals to facilitate instrumentation handling. A wider (8mm) cannula is preferable for the anterior-inferior portal to allow for curved suture hooks, while a 5.5mm cannula is adequate for the superior portal for grasping instruments to be inserted.
Alternative portals have been described, such as a transubscapularis portal described by Davidson and Tibone or a 7-o-clock posteroinferior portal for accessing the most inferior aspect of the glenoid [18].

Glenoid and Labral Preparation

Proper labral preparation is imperative for successful anterior shoulder instability repair. A 30°arthroscope is placed in the posterior portal and sometimes in the anterosuperior portal which gives a better view of the anterior labrum.
Next, the anterior-inferior capsulolabral complex must be adequately mobilized from the glenoid neck as far inferiorly as the 6-o'clock position. Often the labrum is healed medially along the scapular neck. A combination of probes, rasps, motorized shavers and periosteal elevators are used to mobilize the medially displaced soft tissues from the glenoid neck. Care must be taken not to debride normal tissue needed for the repair. It is especially important to mobilize the capsulolabral sleeve so that it is freely mobile and can be shifted superiorly and laterally to the glenoid rim. The capsulolabral release is considered adequate when the muscular fibers of the subscapularis are visible under the labrum (Fig. 6a and b).
For final preparation, the glenoid must be roughened with a burr or bone rasp to encourage soft tissue healing. The abrasion of the juxta-articular scapula should continue approximately 1-1.5 cm medial to the articular cartilage and extend all the way to the inferior glenoid (6 o'clock) (Fig. 7).

Anchor Placement

The number and positioning of suture anchors used across the glenoid rim are still controversial. A standard arthroscopic Bankart repair typically requires three anchors. Others, however, have suggested the routine use of four anchors, because a three-anchor configuration was associated with increased failure rates [28].
Anchorsare placed at an angle of 45°relative to glenoid surface 2-3 mm inside the anterior glenoid rim. They should not be placed inadvertently along the medial scapular neck. 8-10 mm intervals between the anchor holes are considered to limit the stress risers for more secure fixation (Fig.8a and b) [33].
The first anchor is critical in establishing proper capsular tension. After mobilization of the capsulolabral periosteal sleeve as described above, the first anchor is placed at the articular margin at least as low as the 5 o'clock position.
Almost all techniques require shuttling of permanent non-absorbable suture, housed within the anchor, through the capsule and labrum. A soft-tissue penetration device (suture passer or suture hook) is used to pass the suture through the capsule medial and inferior to the lowest anchor so that the entire IGHLis shifted superiorly and laterally. The hook can be pulled when it is in the tissue to confirm the quality of the bite and the tension in the IGHL. The labrum should be included in this suture loop so that it will be repaired with the capsule (Fig. 9).
One limb of the suture from this anchor is retrieved through the superior cannula as this will be transported through the capsule with a device placed through the inferior cannula. After shuttling the non-absorbable suture, subsequent knot-tying will not only repair the labrum but also shift the labrum and capsule in a cephalad manner to begin retensioning of the IGHL. The suture limb that exits the anterosuperior cannula is the suture that will ultimately pass through the soft tissue. This is called the post suture because the sliding arthroscopic knot will move down this limb. It is important to choose this limb as the post because the knot will then sit on top of the tissue and not underneath it. It is preferable to have the knot on the capsulolabral side. The knot is cut leaving a 3-4mm tail. These steps are repeated for each subsequent anchor.

Rotator Interval

Rotator interval closure is advisable when residual inferior translation is evident after repair of the labrum and glenohumeral ligaments. Typical Bankart repair does not require RI closure but may benefit from it. One or two sutures are passed from the MGHL to the capsule anterior to the biceps tendon and tied. Consequently, the sides of this triangular interval are approximated. The arm should be placed in slight external rotation to avoid restriction of this motion postoperatively.

Associated SLAP tears are addressed simultaneously. Typical treatment of these lesions (type II and above) involves the placement of one or two suture anchors to reattach the superior labrum and biceps root to the glenoid rim. After debridement of the superior glenoid and labrum, suture anchors are properly placed at the superior margin of the articular cartilage and sutures are tied to restore all avulsed structures.

After all-suture anchors are placed, the repair is evaluated from both the posterior and anterior portals. The head should appear well centered on the glenoid and any Hill-Sachs lesion should rotate posteriorly. Ideally, this lesionshould not come in contact with the articular surface in any position of the shoulder (Fig. 10).

Avulsion of bony fragments from the ventral glenoid rim also referred to as a Bankart type 4 lesion occurs in 15-50% of cases of anterior instability. Larger fragments can and, if possible, should be reduced and fixed by open osteosynthesis. Smaller fragments require only refixation of the capsule and the labrum in the sense of a Bankart operation. In such a case, the fragment can either be ignored or integrated into the reconstruction of the soft tissue [2].

Postoperative Management and Rehabilitation

The armis immobilized in a sling for 4-6 weeks. Gentle pendulum exercises, active range of motion exercises of hand, wrist, and elbow, are begun immediately after surgery.Active and assisted range of motion exercisesare usually started at 4-6 weeks. Isotonic rotator cuff and scapular muscles strengthening are initiated after the 6th week. The return to unrestricted activity and full contact sports is determined on an individual basis and usually, is not anticipated until 4-6 months.

Anterior Instability Associated with Bone Loss

A critical decision on shoulder stabilization today focuses on the degree of bone loss and whether soft tissue reconstruction can be successful. Several studies have shown an increased failure rate after arthroscopic stabilization when bony defects were not addressed during surgery [10,19,25,34,35]. Bony defects of the glenoid and/or humeral head have been found to contribute to recurrent instability after arthroscopic stabilization. It is generally accepted that if the bony defect involves more than 25% of the glenoid width, a Latarjet or other bone-grafting procedures should be considered [18,36].

The Latarjet procedure which includes the transfer of the coracoid process has been advocated as a very popular method of treatment for anterior instability. Routinely, the Latarjet procedure is performed through a standard deltopectoral approach.

However, an all-arthroscopic alternative has been advocated recently as a consequence of the success of the open procedure and the advancements in arthroscopic instrumentation and techniques [2].

The arthroscopic technique is certainly advantageous in those cases in which the preoperative assessment fails to reveal an HAGL lesion or a large bony avulsion from the anterior rim, and it allows a surgeon to modify his or her plan intraoperatively. The technique, however, is a complex procedure and requires a degree of experience and expertise.

However, the treatment strategy for large Hill-Sachs lesions is still controversial. Burkhart and De Beer introduced the concept of the engaging Hill-Sachs lesion and proved that the failure rate after arthroscopic Bankart repair in patients with such lesions was significantly higher than those without it [35].

Recently, an arthroscopic “remplissage” technique was introduced consisting of an arthroscopic capsulotenodesis of the posterior capsule and infraspinatus tendon to fill the Hill-Sachs lesion [35]. Thus, with theadvent of these newer arthroscopic techniques, anterior shoulder instability associated with bone loss should no longer be considered an absolute contraindication for arthroscopic instability repair.

Conclusions

The arthroscopic management of recurrent glenohumeral instability continues to evolve. A thorough understanding of the pathoanatomy involved in shoulder instability allows us to address all injured structured responsible for the instability. Advanced imaging, CT or MRI may be necessary to adequately evaluate for associated glenohumeral pathology. Development of newer techniques and implants now make it possible to duplicate and perhaps even exceed the results of open stabilization procedures.

A variety of arthroscopic techniques is now available to restore anterior glenohumeral stability. The principal goal is to repair the capsulolabral sleeve carefully with appropriate tension. At present, suture anchor stabilization is the operation that best duplicates the time-tested open procedure and restores back the anatomy.

With advancements in technique and more accurate diagnoses, these outcomes will likely continue to rise, and patients will more reliably be able to return to prior functioning levels. However, arthroscopic techniques are demanding, and there is a steep learning curve. Bone loss issues, including Hill-Sachs and glenoid rim lesions, remain a concern and a challenge for arthroscopists to manage. An individualized treatment approach based on the patient's injury pattern and expectations, will likely lead to the most successful outcome.

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