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Arthroscopic Treatment of Anterior Glenohumeral Instability: Indications and Techniques

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Abstract

The arthroscopic treatment of anterior glenohumeral instability is becoming increasingly accepted as a viable treatment option because reported success rates parallel those of open stabilization techniques. This improved success rate is largely the result of advances in surgical techniques and technology. An improved understanding of the pathoanatomy associated with shoulder instability and continuing education initiatives have also been instrumental in expanding the indications for arthroscopic stabilization of the unstable shoulder. Important considerations during arthroscopy include identifying all pathology, mobilizing soft tissue, enhancing the local biology to promote soft-tissue healing to bone or to itself, securing anatomic fixation, and respecting the healing period during postoperative rehabilitation efforts. Principal contraindications include significant bone deficits and the inability to repair capsular avulsions or rupture. Adherence to these basic principles should lead to excellent results with arthroscopic stabilization of the unstable shoulder.

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Arthroscopy is becoming increasingly accepted as a viable treatment option for anterior glenohumeral instability. Despite early reports of variable recurrence rates, arthroscopic techniques have now evolved significantly largely as a result of improved understanding of the associated pathoanatomy, improved patient selection, simplified techniques, and advanced technology. The major advantages of arthroscopic repair over traditional open repair include the ability to identify and treat concomitant pathology, lower morbidity and decreased pain, shorter surgical time, and improved cosmesis. Some surgeons believe that patients who undergo arthroscopic repair of anterior glenohumeral instability have an easier functional recovery with greater returns in motion compared with patients undergoing traditional open repair. Finally, some of the inherent risks of open repair procedures, such as postoperative subscapularis rupture, are virtually eliminated.

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Anatomy of Shoulder Stability

Although the diverse stabilizing structures of the glenohumeral joint have been previously described in detail elsewhere,[1] a brief review here will provide a foundation for the discussion to follow. Because the large spherical head of the humerus articulates with the relatively small and shallow glenoid, the glenohumeral joint requires several mechanisms that maintain stability and allow for a large range of motion. Static and dynamic stability are provided by the combined effects of the capsuloligamentous structures, the rotator cuff, the scapular stabilizers, and the biceps muscle. In the midrange of motion, the principal stabilizers are the rotator cuff and biceps tendons, which dynamically stabilize the humeral head through concavity-compression within the glenoid socket. The ligamentous structures function at the extremes of rotation, preventing excessive rotation and translation.

The labrum increases the depth and surface area of the bony glenoid. Its principal function is to increase the depth of the glenoid socket and to act as a "chock block" to prevent the head from rolling over the anterior edge of the glenoid. It consists of a fibrocartilaginous ring that attaches to the glenoid articular cartilage.[2] Above the glenoid equator, the labrum is relatively mobile; below the glenoid equator, the labrum is more tightly attached to the glenoid articular cartilage. The labrum also provides an attachment site for the glenohumeral ligaments and the tendon of the long head of the biceps. Virtually all labral lesions, especially those below the glenoid equator, are thought to be associated with glenohumeral instability.

The role of the capsule and ligaments in shoulder stability is complex and depends on the position of the joint and the direction of the applied force. The inferior glenohumeral ligament complex is the primary static check against anterior, posterior, and inferior translation between 45° and 90° of glenohumeral elevation. The superior and middle glenohumeral ligaments limit anteroposterior and inferior translation in the middle and lower ranges of elevation as the arm approaches the adducted position.

The rotator interval region between the supraspinatus and subscapularis tendons provides stability against inferior and posterior translations, particularly when the arm is adducted and externally rotated. Evidence suggests that this may be a normal variant present at birth and is only a relative contributor to instability in the symptomatic patient with excessive inferior or posterior translation that is not eliminated despite correction of other existing pathology.[3]

The rotator cuff and long head of the biceps brachii enhance stability by increasing compression across the glenohumeral joint, thereby increasing the loads required to translate the humeral head. This is particularly apparent in the midranges of motion where the capsuloligamentous structures are more lax. The scapulothoracic stabilizers help to position the glenoid beneath the humeral head. Dysfunction in any of these stabilizers can lead to symptoms of instability. Proprioceptive mechanisms help to coordinate and time this system and are restored after instability surgery.

The articular surfaces also play a key role in stability. Articular version, negative intra-articular pressure, and adhesion-cohesion all enhance shoulder stability. In general, each of these factors plays a relatively small role in the pathogenesis of shoulder instability, although bone loss, particularly on the glenoid, can be significant enough to warrant surgical correction and remains the principal contraindication to arthroscopic shoulder stabilization.

Pathoanatomy

Labrum

Disruption between the anterior labrum and the glenoid below the equator is termed a Bankart lesion. Because the inferior glenohumeral ligament complex is the major static stabilizer when the shoulder is positioned in abduction and external rotation, a capsulolabral separation in this area effectively destabilizes the glenohumeral joint. Furthermore, the normal stabilizing effect of the rotator cuff compressing the humeral head into the glenoid socket is diminished when the labrum is separated from the glenoid rim. The Bankart lesion, which is considered the essential pathoanatomic lesion, is present in about 90% of all traumatic anterior shoulder dislocations. Because of its essential stabilizing functions, the labrum must be anatomically restored in patients with instability.

In some patients, the labrum heals in a medialized position (anterior labrum periosteal sleeve avulsion lesion).[4] When this occurs, the labroligamentous complex must be mobilized surgically and released from the glenoid and underlying subscapularis so that it can be reattached at its correct anatomic insertion. When the labrum is repaired to the glenoid, the suture anchors should be placed 1 to 2 mm onto the "face" of the glenoid to restore the concavity and to ensure that the labrum can perform its essential biomechanical functions.[5,6] Currently, the use of multiple anchors (ie, three to four) with multiple sutures providing multiple fixation points is preferred. It is also important that the anchors are placed at least down to the 5 o'clock position. This sometimes necessitates a "5 o'clock portal" to give a proper angle of approach for insertion of the anchors.[7] At the conclusion of the repair, the glenoid concavity should be visibly extended and a buttress or "bumper" effect should be achieved, as is present in the uninjured shoulder.

Above the glenoid equator, labral

anatomy may be quite variable, and a loose attachment below the biceps tendon may be a normal variant (ie, a sublabral foramen). Injuries to the superior labrum with associated destabilization of the biceps insertion may occur with shoulder instability. Both experimental and clinical studies have provided a rationale for arthroscopic repair of these superior labral injuries when treating instability.[8,9] The variations in superior labral anatomy may pose challenges in determining whether a patient's anatomy is a variant of normal or an abnormal labral detachment. In general, a loosely attached superior labrum with a smooth cartilage transition is a variant of normal and not a labral separation. True labral injury is associated with failure of the origin fibers of the superior labrum, cartilage injury at the margin of the labral attachment, synovitis, and/or extension of the tear into the biceps tendon itself. In the setting of shoulder instability, such tears of the superior labrum should always be repaired.

Ligaments

In addition to the Bankart lesion, recurrent dislocations can also cause stretching of the glenohumeral capsule and ligaments. This plastic deformation occurs from repetitive loading. Although identification of this stretch injury or laxity of the ligaments may be difficult, failure to address this component of the instability when performing an arthroscopic repair may contribute to failure of the procedure. Indeed, in some series, higher failure rates have been attributed to this error. If the middle or inferior glenohumeral ligament complex is stretched, then the joint volume will be increased, and the joint will be susceptible to instability on that basis even with an intact labrum.[6,10]

Actual macroscopic midsubstance failure of the capsule or failure at the humeral insertion (humeral avulsion of glenohumeral ligament) is uncommon but appears to constitute a relative contraindication to arthroscopic repair because of the technical difficulty associated with repairing such an injury. Although it is technically possible to repair this condition arthroscopically, direct repair with capsule repair and reinsertion appears to be more reliable through an open approach.

Insufficiency of the rotator interval may be responsible for failures in some series. This interval is usually involved if there is a large inferior component to the instability, particularly when the arm is in adduction and external rotation.[11] Rowe and Sakellarides[12] originally pointed out that the capsule may be absent or deficient in this area, and these authors and others recommended closure at the time of open instability repair.[3,11] The defect may represent either an injury or, more likely, a relative dysplasia of the ligaments of this region. When the defect is recognized arthroscopically, repair by overlapping the capsular region between the anterior edge of the supraspinatus and proximal edge of the subscapularis is the preferred method.

Rotator Cuff

When the rotator cuff is injured, its concavity-compression effect is diminished. Rotator cuff injury in younger patients usually occurs in the setting of repetitive overload. In such patients, the tear results from eccentric overload of the tendon and represents a secondary injury to the tendon from the recurrent instability. Full-thickness tears of the rotator cuff after a traumatic dislocation are uncommon in patients younger than 40 years but should be suspected in those who continue to have weakness and pain 3 weeks after a traumatic anterior dislocation. In this setting, careful physical examination and early soft-tissue imaging studies will discern the presence and configuration of the rotator cuff tear. Generally, tears of the superior cuff can be repaired arthroscopically at the same time as the instability. Significant tears of the subscapularis can also be repaired arthroscopically, although this does require considerable technical skill, and a traditional open repair is certainly an acceptable option.

Bone

Bone deficiency is a significant cause for the failure of arthroscopic Bankart repairs. Burkhart and De Beer[13] reported on a group of 194 patients who had undergone arthroscopic Bankart repair of the shoulder. One hundred one of these patients were contact athletes. These authors found that when the patients had no significant bone defects (173 patients), the recurrence rate was 4%. However, when patients had significant bone defects (21 patients), the recurrence rate was 67%. Contact athletes with significant bone defects had an 87% recurrence rate, whereas contact athletes without bone defects had a 6.5% recurrence rate.

Three types of bone lesions are found in patients with anterior instability: (1) glenoid erosion (also known as inverted pear glenoid morphology) (Figure 1); (2) the engaging Hill-Sachs lesion (Figure 2); and (3) the nonengaging Hill-Sachs lesion[13] (Figure 3).

Glenoid Erosion The normal glenoid is broader inferiorly than superiorly (pear-shaped). Because the glenoid resists both axial and off-axis loads, significant bone loss results in a shorter arc through which the gle-

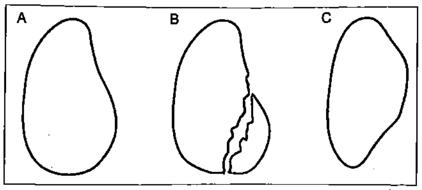

Figure 1 The normal glenoid and the inverted-pear glenoid morphology. **A,** The normal shape of the glenoid is that of a pear, larger inferiorly than superiorly. **B,** An acute bony Bankart fracture can create an "inverted pear" configuration. **C,** Erosion of the anterior glenoid can also create this configuration.

noid can resist these loads. Furthermore, the glenoid resists shear by rim loading. If part of the rim is lost (as the result of a labral tear, fracture, or erosion, for example), then it cannot effectively resist shear. 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 (Figure 1). Anatomic studies have shown that the inverted pear morphology always involves more than a 25% loss in diameter.[13,14]

Burkhart and associates[14] have also shown that the glenoid bare spot is the center of a circle defined by the margins of the anterior, posterior, and inferior glenoids, and therefore it is useful as a reference to gauge how much bone has been lost, particularly in a patient with erosive bone loss from chronic recurrent anterior dislocations. The bare spot is visible in virtually all patients and is best viewed through an anterosuperior viewing portal. Significant bone loss, with greater than a 25% loss of the inferior diameter of the glenoid, is a contraindication for arthroscopic repair because of an unacceptably high recurrence rate among such patients, particularly active individuals and contact athletes. In such cases, an open approach with bone grafting of the anteroinferior glenoid is preferred. Alternatively, coracoid transfer procedures offer acceptable treatment options.

Hill-Sachs Lesion When the glenohumeral joint dislocates, the Hill-Sachs defect can occur at a variety of angles as determined by the position of the humerus at the time of dislocation. 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[13] have described these as engaging Hill-Sachs lesions, in which the long axis of the humeral bone defects aligns parallel to the anterior glenoid rim when the shoulder is in a position of abduction and external rotation. Such fracture configurations have been found to be particularly prone to recurrent dislocation and subluxation after arthroscopic repair (Figure 2).

With the nonengaging Hill-Sachs lesion, the long axis of the Hill-Sachs defect diagonally crosses glenoid rim with the arm in abduction and external rotation so that it never "engages" the glenoid rim (Figure 3). In these types of defects, there is a continuous smooth articular contact throughout the range of motion. Such shoulders with nonengaging Hill-Sachs lesions are not at significant risk for recurrence when repaired arthroscopically, and therefore patients with these types of humeral lesions are good candidates for arthroscopic repair.

Evolution of Arthroscopic Repairs

The failure rate after open repair is generally less than 10%; this is benchmark against which arthroscopic repairs must be compared.[15-18] Historically, the literature has classified failures of instability repair as those that develop recurrent instability (ie, the shoulders of patients become too loose). However, there is scant mention in the literature of failures of instability repair that are too tight, resulting in stiffness, loss of motion, and late degenerative changes. It is important to remember that stiffness does not equal stability, and that there is significant danger in soft-tissue overconstraint. In addition, the early literature describing the results of open stabilization consists of largely retrospective series with relatively poor results in terms of returning athletes back to their original level of play. In addition, early reports fail to describe patients who have persistent apprehension or recurrent subluxation despite open stabilization procedure.

Variations in surgical indications, surgical techniques, and definitions of success and failure make comparisons across series difficult. Recent prospective studies of arthroscopic stabilization techniques have reported failure rates as low as those reported in the best open repair series, with a high rate of return to sporting activities[10,19-29] (Table 1).

Johnson[30] first introduced arthroscopic repair with metal staples in 1982; subsequent reports, however, demonstrated unacceptable recurrence rates as high as 33%. This technique has largely been abandoned because of the relatively high complication rates (between 5% and 10%) related principally to the hardware. Transglenoid sutures were introduced by Morgan and Bodenstab[31] and popularized by Caspari and Savoie.[7] Success rates of 90% have been reported,[32,33] but other authors do not report comparable success rates.[34-36] The major advantage of this technique was the multiple points of fixation for the labrum. It also allowed the surgeon to address capsular laxity by shifting the capsule

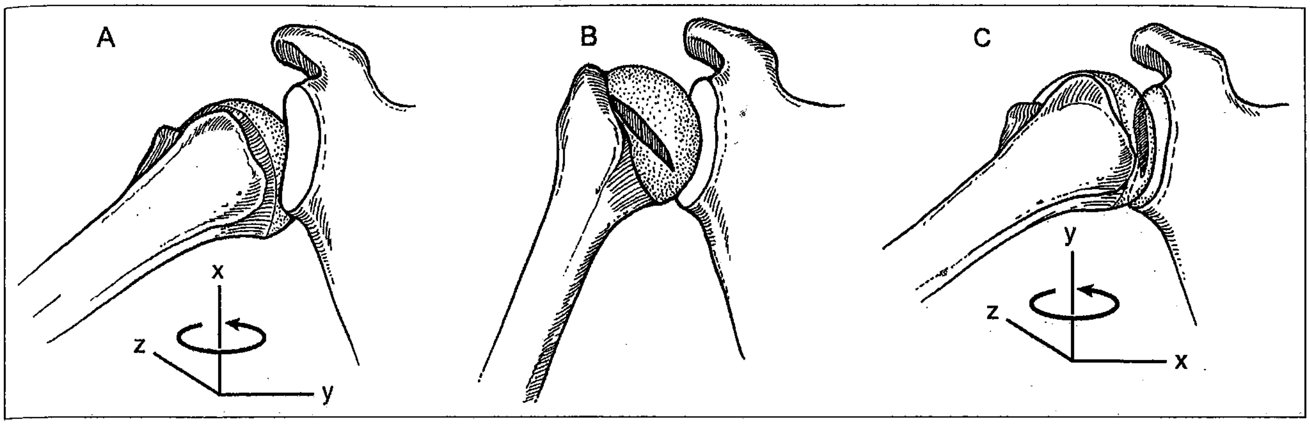

Figure 2 The engaging Hill-Sachs lesion. **A,** This impaction fracture is created when a glenohumeral dislocation occurs with the humerus in abduction and external rotation. **B,** Schematic showing the orientation of the osseous defect, which is more horizontal. **C,** Schematic showing the "engagement" of the defect on the anterior glenoid in a functional position of abduction and external rotation.

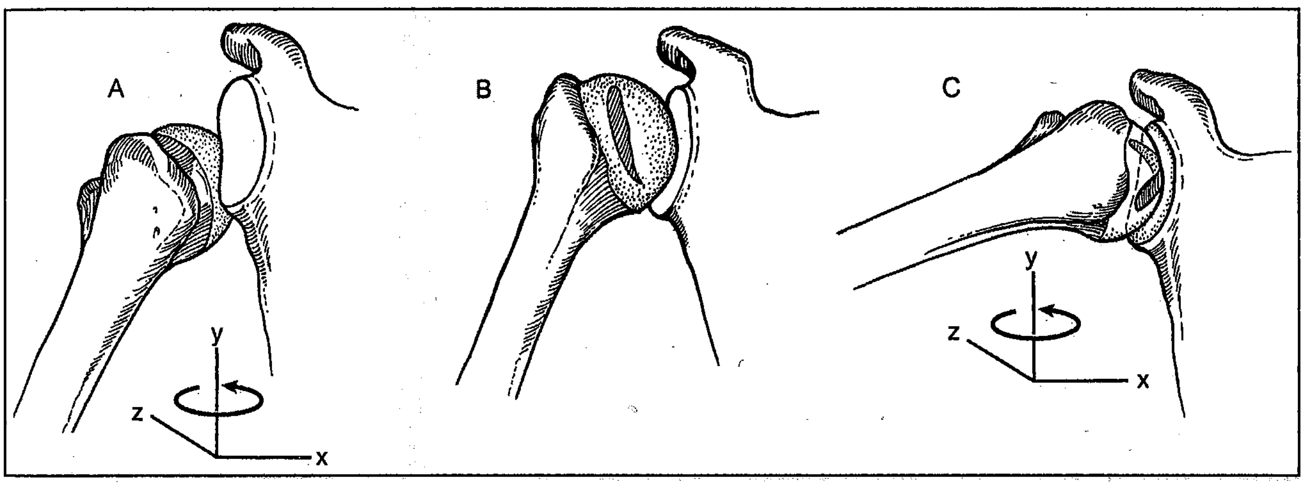

Figure 3 The nonengaging Hill-Sachs lesion. **A,** This impaction fracture is created when a glenohumeral dislocation occurs with the humerus in adduction. **B,** Schematic showing the orientation of the osseous defect on the humerus, which is more vertical. **C,** Schematic showing that the defect does not engage the anterior glenoid in a functional position of abduction and external rotation.

superiorly and medially on the glenoid rim. The major disadvantages were the technical difficulty and the transscapular drilling that placed the suprascapular nerve in jeopardy.

To obviate some of these concerns, Speer and associates[37] introduced a bioabsorbable (polyglycolic acid) single-point transfixing implant for intra-articular labral repair (Suretac, Acufex Microsurgical, Norwood, MA). Initial enthusiasm was tempered when recurrence rates up to 21% were reported. Recent experience has suggested that recurrence rates can be decreased to less than 10% if the procedure is limited to those with isolated Bankart lesions and no capsular injury.[38-41] Disadvantages of this technique include the inability to address concomitant capsular laxity and the potential for a synovial reaction to the polyglyconate of the implant, which may occur in up to 6% of patients.[42,43]

Modern Suture Anchor Repairs

Repair techniques that use suture anchors have become the most commonly used arthroscopic repair method. This is also the authors' preferred method of repair. The method was first described by Wolf,[10] who reported using a metal anchor and tying knots with absorbable sutures. In 1994, Snyder[44] mod-