Traumatic Anterior Glenohumeral Instability: The Role of Arthroscopy

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Abstract

The static and dynamic stabilizers of the glenohumeral joint act together to ensure joint stability throughout the wide range of normal shoulder motion. These structures are functionally altered after a traumatic anterior shoulder dislocation, often resulting in recurrent instability. The arthroscope has enhanced the surgeon's ability to examine and repair the unstable glenohumeral joint. The rate of recurrence of instability after arthroscopic stabilization has historically been unacceptably high compared with that after open stabilization techniques. The authors offer a treatment algorithm and suggest guidelines for the use of arthroscopic techniques in the treatment of the unstable shoulder.

J Am Acad Orthop Surg 1997;5:233-239

Glenohumeral joint stability is dependent on the functioning of both static and dynamic stabilizing structures. The primary static stabilizer limiting anterior movement of the shoulder in 90 degrees of abduction is the inferior glenohumeral ligament (IGHL) complex.[1] O'Brien et al[2,3] identified the constituent structures of the IGHL complex as anterior and posterior bands separated by an intervening pouch, with the anterior band serving as the primary static stabilizer.

The role of the rotator cuff as a dynamic stabilizer is less clear. Turkel et al[4] reported that the subscapularis muscle provides stability at lower degrees of abduction but contributes little when the shoulder is in 90 degrees of abduction. However, DePalma et al,[5] Moseley and Övergaard,[6] and Symeonides[7] concluded that the subscapularis is the true stabilizer resisting anterior translation. The rotator cuff compresses the humeral head into the glenolabral socket, contributing stability, especially in the middle range of motion, when the ligaments are lax. Matsen et al[8] estimated the efficiency of this mechanism to be approximately 40% (e.g., if the compressive force into the glenoid is 100 units, the force resisting translation is 40 units). If the labrum is removed, the efficiency of this mechanism is decreased by 50%. Furthermore, Cain et al[9] have shown that the posterior cuff structures reduce the anterior capsular strains in abduction and external rotation.

Epidemiology and Natural History

The incidence of traumatic anterior glenohumeral dislocations in the general population has been estimated to be 1.7%.[10] McLaughlin and Cavallaro[11] reviewed the data on 573 patients and reported a recurrence rate of 90% in patients less than 20 years old, 60% in patients 20 to 40 years old, and only 10% in patients more than 40 years old. This is similar to the experience of others. Rowe[12] found that 94% of patients aged less than 20 years and 74% of patients between 20 and 40 years old had recurrent dislocations. Henry and Genung[13] analyzed the data on 121 patients and found a recurrence rate of 88% regardless of the type of nonoperative treatment provided. Simonet and Cofield[14] followed up 116 patients and found a recurrence rate of 66% in patients younger than 20 years old and 40% in patients aged 20 to 40 years. Arciero et al[15] found an 80% recurrence rate in 15 student-athletes with an average age of 20 years.

Recurrent anterior shoulder instability results in a functional disability. This disability is more

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profound when it involves the dominant extremity and when it occurs in very active individuals. Tsai et al[16] found that almost 60% of patients with unresolved anterior instability complained of poor strength and range of motion and increased pain after conservative treatment. The average Rowe shoulder score in this group of patients was 68 out of 100.

Pathoanatomy

Bankart maintained that the lesion responsible for recurrent anterior shoulder instability was detachment of the glenohumeral capsule and labrum from the glenoid rim.[17,18] Intrasubstance capsular tears have also been proposed as the mechanism for recurrent instability after a dislocation.[7,19,20] Even Bankart noted that capsular injury occurs with an anterior dislocation.[18] He maintained, however, that the "rent in the fibrous capsule heals readily and soundly." Injury to or deformation of the subscapularis tendon has also been implicated in the etiology of recurrent instability.[4,6,7] Despite these reports, the essential pathoanatomic lesion or pattern of lesions occurring with an anterior shoulder dislocation remains unclear. Clinical and biomechanical studies have been performed to elucidate this issue.

Arthroscopy and noninvasive imaging studies have been used to examine the pathoanatomic findings after an anterior dislocation. In a literature review of studies of anterior shoulder instability in which arthroscopic or radiologic techniques were used for evaluation,[15,21-29] the predominant lesion was detachment of the anteroinferior capsulolabral complex, or Bankart lesion (Table 1). However, inasmuch as this lesion was found in only 400 of 472 patients (85%), it cannot be considered the essential lesion.

Table 1
Findings in Studies of Anterior Shoulder Dislocation*

Study	Diagnostic Modality	No. of Patients	Mean Patient Age, yr	No. of Patients With Specific Injuries: Labral and Capsular Detatchment	IGHL Injury	Rotator Cuff Injury	Other Labral Injury	Radiographic Findings Noted
Adolfsson and Lysholm[21]	Arthroscopy	39	26	34	5	6	3	...
Arciero et al[15]	Arthroscopy	21	20	21	...	0	2†	5 glenoid avulsions
Baker et al[22]	Arthroscopy	45	21	28	6	5	11	...
Hintermann and Gachter[23]	Arthroscopy	178	35	152	97	51	9†	71 Hill-Sachs lesions
Norlin[24]	Arthroscopy	24	22	24	24	...	...	2 glenoid avulsions
Taylor and Arciero[25]	Arthroscopy	63	20	61	61	0	6†	14 glenoid avulsions
Kieft et al[26]	MRI	13	NA	8	2	...	...	8 Hill-Sachs lesions
	CTA	10	NA	7	6	...	...	1 glenoid avulsion
Rafii et al[27]	CTA	19	29	12	7	...	4	...
Ribbans et al[28]	CTA	33	NA	29	29	10	...	...
Seeger et al[29]	MRI	27	NA	24	...	...	...	...
Total		**472**		**400**	**237**	**72**	**35**	

*Abbreviations: CTA = computed tomographic arthrography; MRI = magnetic resonance imaging; NA = not available.
†Labral injuries described as superior labrum anterior-to-posterior, or SLAP, lesions.

Speer et al[30] simulated a Bankart lesion in a cadaver model by sharply elevating the anteroinferior labrum and capsule from the glenoid rim. A 50-N anterior load was then applied at various shoulder joint positions. A maximum increase in anterior translation of 2.3 mm was identified at 0 degrees of abduction. At 90 degrees of abduction, the decrease was 1.4 mm. They concluded that a Bankart lesion alone does not produce the amount of pathologic anterior translation necessary for anterior dislocation to occur.

Others have pursued the hypothesis that an injury to the anterior shoulder capsule and ligaments is causative. Bigliani et al[31] illustrated the ability of individual regions of the IGHL complex to stretch considerably before failure. They performed tensile testing after dividing the IGHL complex into three anatomic regions: the superior band and the anterior and posterior axillary pouch regions. The anterior pouch specimens were shown to fail at higher strain levels than specimens from the other two regions. However, the peak stress at failure was similar in all three regions tested. The glenoid insertion failed most commonly (40%), followed by the ligament substance (35%) and the humeral insertion (25%). Midsubstance strain was only 35% to 45% of the total specimen strain. They therefore concluded that considerable strain must be present at the ligament insertion sites. They also concluded that the IGHL complex can stretch a great deal before failure, but they did not attempt to differentiate between plastic and elastic deformation.

These studies indicate that a stretch injury to the anterior shoulder capsule and ligaments may occur with an anterior shoulder dislocation. This capsular injury may be plastic and thus would be likely to remain after reduction of the glenohumeral joint, contributing to recurrent instability. Repetitive insults to the capsule with recurrent anterior instability may produce further capsular laxity and deformation of this major glenohumeral stabilizer.

Diagnostic Arthroscopy

The arthroscope permits direct visualization of the glenohumeral joint and the surrounding periarticular structures. There are characteristic arthroscopic findings associated with anterior instability that are identified after a dislocation. The clear magnified view obtained arthroscopically provides an improved method of assessment of these structures compared with visualization during open techniques.

In approximately 85% of dislocations, the labrum and capsule are detached from the glenoid rim (Bankart lesion)(Fig. 1). Although variable in severity and extent, any such lesion effectively renders the

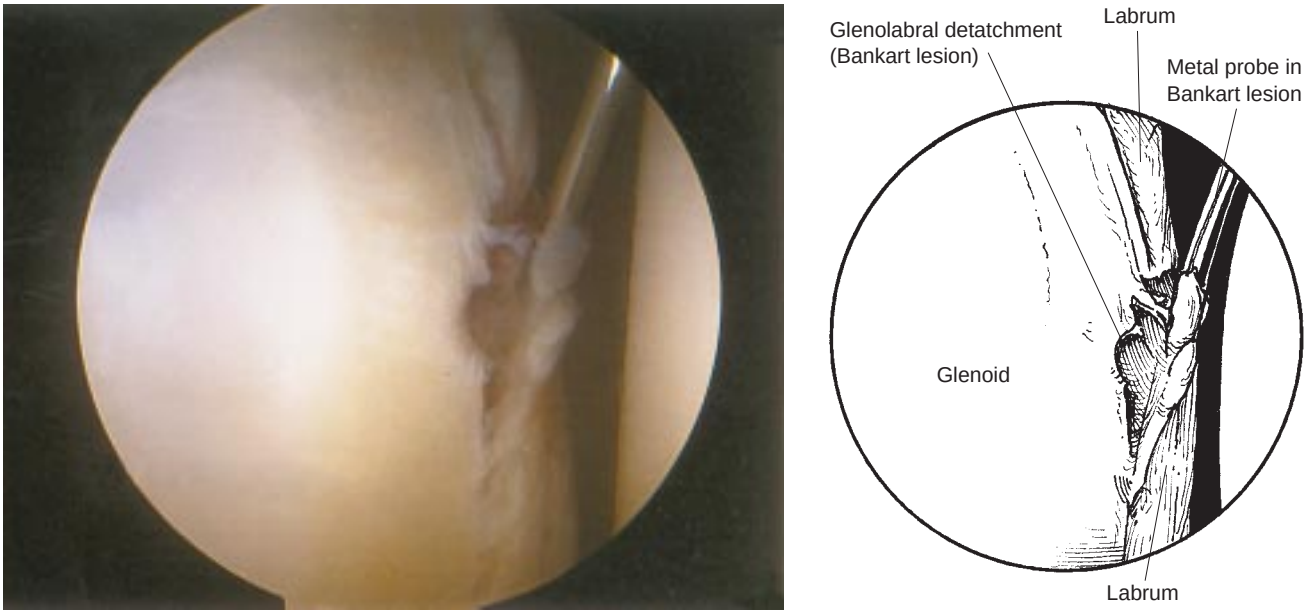

Fig. 1 Arthroscopic view from the posterior portal shows a classic Bankart lesion with detachment of the labrum from the underlying glenoid.

IGHL complex incompetent. Only the anteroinferior quadrant may be involved, or a capsulolabral lesion may extend superiorly and involve the anterosuperior labrum or even the biceps anchor. Labral detachment is usually present in conjunction with stripping of the capsule off the medial glenoid rim and neck, a finding usually identified with magnetic resonance imaging (Fig. 2). An osseous or osteochondral avulsion off the glenoid rim may also be present. The integrity of the periarticular tissues can be assessed arthroscopically. Whereas the detached labrum and capsule are often thick and robust after the initial dislocation, in chronic instability the detached capsulolabral complex may appear attenuated or degenerated due to repetitive trauma (Fig. 3).

The anteroinferior glenoid articular surface should be inspected for signs of damage. In cases of chronic subluxation, chondral scuffing or delamination may be the only pathologic lesion evident in this area.

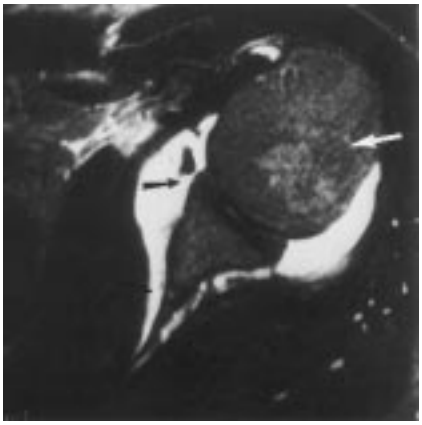

Fig. 2 An axial T2-weighted magnetic resonance image obtained after an acute primary dislocation. White arrow indicates marrow edema (Hill-Sachs lesion). Black arrows indicate an anterior labral tear with capsular stripping along the glenoid neck (Bankart lesion).

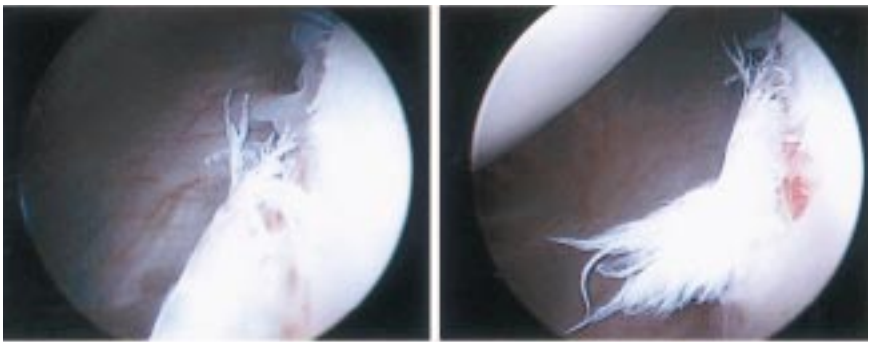

Fig. 3 Poor-quality labral tissue that is most likely not amenable to arthroscopic repair.

The posterior superior humeral head should also be inspected. A Hill-Sachs lesion is very common and can be easily distinguished from the normal bare area (Fig. 4). This lesion, while causing no damage to the glenohumeral stabilizers, is indicative of the magnitude of pathologic anterior translation that has occurred.

After arthroscopically inspecting the anterior capsulolabral structures and the anteroinferior glenoid, the preferred technique for operative stabilization can be selected. A thick, robust capsulolabral complex that has detached is ideal for arthroscopic reattachment. This is most common after a single traumatic dislocation. Recurrent instability often causes so much deformation of the anterior capsule and the anterior labrum that arthroscopic stabilization techniques are inadequate to achieve a repair. Even after a single dislocation, the injured tissues may be damaged to such a degree that open reconstruction is the best treatment option.

Hintermann and Gachter[23] arthroscopically examined 212 shoulders after anterior shoulder dislocation. It was the initial dislocation for 111 patients; the other 101 patients had had at least two dislocations. Of the patients with a first-time dislocation, 89% had an anterior glenolabral tear, 30% had an anterior glenoid osteochondral lesion, 67% had a Hill-Sachs lesion, and 7% had a superior labral anterior-to-posterior (SLAP) lesion. The observations in patients with recurrent dislocations were similar: 84% had an anterior glenolabral tear, 25% had an anterior glenoid osteochondral lesion, 69% had a Hill-Sachs lesion, and 5% had a SLAP lesion.

Repair of Recurrent Dislocation

The goals of the reconstructive stabilization procedure are to prevent recurrent instability, maintain normal glenohumeral joint motion and mechanics, minimize postoperative morbidity, prevent complications, return the patient to the preinjury level of activity, and give reproducible results.

Arthroscopic Repair

We believe the ideal patient for arthroscopic stabilization is one with a traumatic unidirectional dislocation with a Bankart lesion whose glenoid labral and capsular tissues are of good quality (i.e., repairable). An important determinant is the number of episodes of instability. The fewer the disloca-

tions, the more likely it is that the injured tissues will be of good quality and less permanent deformation of the capsular ligaments will be present. If these prerequisites are not met on the basis of the history or the clinical and arthroscopic examinations, consideration should be given to proceeding with an open repair (Fig. 5).

The chosen technique should be as technically easy to perform as possible. All current techniques of arthroscopic stabilization focus on reattaching the avulsed capsulolabral structures. Both the surgical techniques and the results vary with the mode of fixation used.

Staples

Staple fixation of the capsule was first described by Perthes in 1906.[32] This technique has been modified for arthroscopy with the use of smaller staples and cannulated systems. The results of staple capsulorrhaphy have been disappointing, with high rates of recurrence and complications.[33] Cook and Richardson[34] reported a 46% failure rate; in addition, 38% of their patients had complications that were related to staple placement. Matthews et al[35] identified a lower risk; reoperation was required in 20% of cases, and 7% of their patients had staple complications. Because of these unpredictable results, this procedure has largely been abandoned.

Sutures

The use of sutures for reattachment of the anterior structures has become increasingly common. Morgan and Bodenstab[36] described a technique of passing transglenoid sutures with a Beath pin. These sutures are then used to reapproximate the Bankart lesion and the glenoid rim. The authors reported a 100% success rate in a cohort study of 25 patients with an average follow-up period of 17 months. McIntyre and Caspari[37] reported on a similar technique in which multiple sutures are passed through the glenoid and then tied posteriorly over the infraspinatous fascia. They reported an 8% rate of recurrent instability after an average follow-up interval of 33 months.

Other results have been less impressive. In a study by Grana et al,[38] of 27 patients who underwent an arthroscopic Bankart suture repair, 44% had recurrence at follow-up an average of 36 months postoperatively. Failure was associated with a shorter period of immobilization and a history of multiple dislocations. The experience of Grana et al is similar to that of Green and Christensen,[39] whose patients had a recurrence rate at 2 to 5 years of 42%. They found a direct correlation between surgical failure and poor anterior tissue integrity.

Suture Anchors

Suture anchors allow the avulsed structures to be repaired without the need to pass instruments across the glenoid. This technique avoids the potential complication of injuring the suprascapular nerve when drilling through the glenoid. Wolf[40] reported a recurrence rate of only 2% at short-term follow-up in the more than 50 patients treated with this technique.

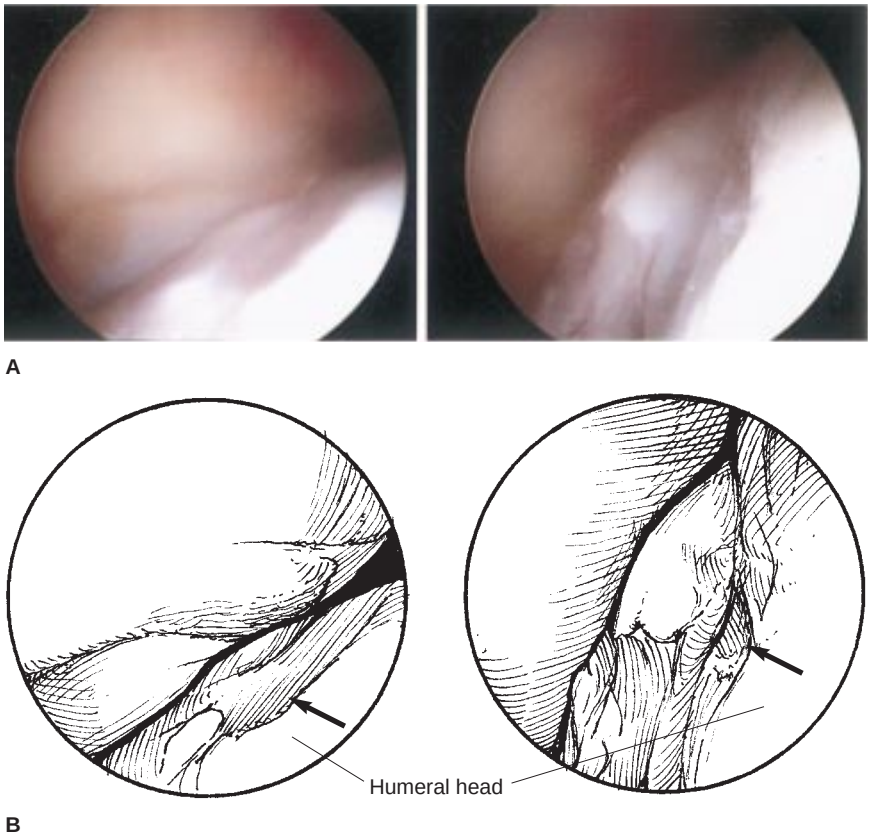

Fig. 4 **A,** Arthroscopic images of the posterosuperior aspect of a humeral head with a classic osteochondral Hill-Sachs lesion. **B,** Drawings depicting same views (arrows indicate Hill-Sachs lesion).

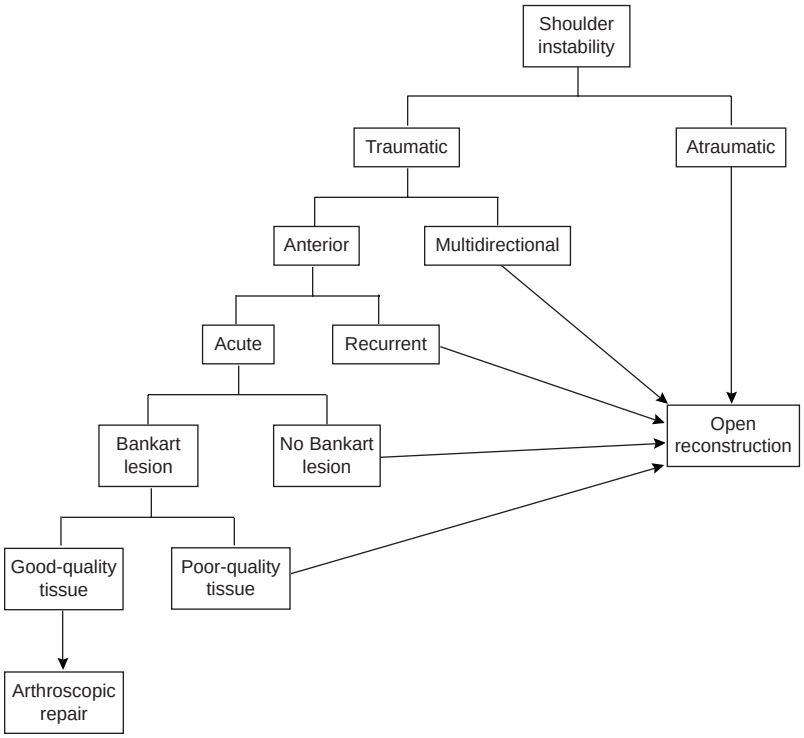

Fig. 5 Algorithm depicting the authors' recommendations for arthroscopic management of anterior shoulder instability.

Absorbable Tacks

Speer et al[41] have reported on a newer technique for arthroscopic capsular repair utilizing a bioabsorbable tack as an alternative to staples. Instability recurred in 21% of 52 patients followed up for an average of 42 months. There were no complications related to use of the tacks, probably because of their bioabsorbability. In 7 of the 8 patients who underwent an open capsulorrhaphy after the tack failure, the Bankart lesion was found to be healed. All 8 patients had patulous anterior capsules that were not visualized arthroscopically. Five patients were found to have open rotator-cuff interval defects.

Open Repair

It is clear from the above-mentioned cumulative results that arthroscopic methods for the most part have not met with the success that open methods have provided. Rockwood[42] reviewed data culled from the world literature on 2,300 patients who underwent open anterior stabilization procedures. Various methods and procedures were used, but the overall average recurrence rate was 3%, which is comparable to the 3.5% recurrence rate after open Bankart repair reported by Rowe et al.[43]

Although the available data indicate that the results of repair of Bankart lesions with the use of arthroscopic techniques are consistently reproducible,[41] the rate of recurrence of instability remains unacceptably high. It would seem, therefore, that in an open Bankart repair other pathoanatomic components are being addressed besides the avulsed anterior labrum. Still at issue is how much of an open procedure is a "hot poker" acting to inadvertently tighten the damaged anterior capsule. Arthroscopic procedures, by nature of their minimal invasiveness, leave the capsule essentially undisturbed. We postulate that this allows the plastic deformation injury in the anterior capsule to remain, which may be a factor contributing to the high failure rate of arthroscopic techniques. Many of these plastic deformations are not evident with imaging or arthroscopic techniques. Furthermore, the capsular injury may be magnified and additive with each episode of instability. On the basis of these data, we recommend that arthroscopic stabilization techniques be performed only in a select group of patients who meet strict historical, clinical, and anatomic criteria.

Summary

Arthroscopic shoulder stabilization has produced good results in carefully selected patients. However, there have also been reports of unacceptably high rates of recurrence and complications with arthroscopic stabilization techniques. To best ensure a favorable outcome with arthroscopic techniques, we recommend adherence to stringent preoperative patient selection criteria.

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