Open Versus Arthroscopic Stabilization for Traumatic Anterior Shoulder Instability

Richard K. N. Ryu, MD

Summary: Symptomatic, recurrent anterior shoulder instability requires stabilization, open or arthroscopic. The arthroscopic approach has, in the past, been associated with a worrisome recurrence rate. By adhering to strict clinical and technical criteria including restoration of the proper resting length of the glenohumeral ligament as well as recreation of the labral "bumper," current arthroscopic techniques can offer success rates comparable to those reported with open techniques.

Key Words: anterior instability, shoulder dislocation, Bankart repair, labral tear

(*Sports Med Arthrosc Rev* 2004;12:90–98)

There is little doubt that those suffering from recurrent anterior shoulder instability benefit greatly from stabilization procedures. Historically, open stabilization surgery has yielded satisfactory results with recurrence rates usually under 10% and as low as 2%.[1–3] Unfortunately these same open procedures have been associated with numerous complications including late chondrolysis,[4] significant motion restriction,[3,5] hardware loosening and breakage, an arduous rehabilitation, and cosmetically disappointing incisions.

The application of arthroscopic techniques in the management of anterior instability has been used for nearly 2 decades, and the initial reasons remain compelling: (1) postoperative motion gains that are critical to the overhand athlete, (2) facilitated (although not shorter) rehabilitation, (3) an opportunity to completely evaluate and treat associated intra-articular pathology, (4) shorter operative time and potentially lower costs, and (5) enhanced cosmetic outcomes. However early optimism has been tempered with the historically lower success rates reported with the procedure, sometimes approaching 50% in skilled and experienced hands.[6–12]

This current dilemma begs the obvious question: "When confronted with recurrent, traumatic, anterior instability, should the procedure of choice be an open procedure or is arthroscopic stabilization the preferred solution?" This article attempts to answer this question by reviewing the pertinent pathoanatomy, the available clinical data, and the surgical techniques associated with a successful outcome. Recommendations, based on pathoanatomy and known risk factors, for both open and arthroscopic techniques are presented. When discussing stabilization surgery, it is critical to remember that the guidelines espoused in this article are specifically for those patients suffering from recurrent traumatic, anterior shoulder instability.

Private practice, Santa Barbara, California

Reprints: Dr. Richard K.N. Ryu, 533 E. Micheltorena Santa Barbara, CA 93103 (e-mail: famryu5@aol.com).

PATHOANATOMY

When discussing shoulder instability, several pertinent anatomic and biomechanical issues deserve emphasis. Instability is a pathologic condition of the capsuloligamentous complex whereas laxity is a physical finding. Physiologic laxity can become symptomatic over time and could, at that time, be considered "pathologic". Studies by Turkel[13] and O'Brien,[14] in selective cutting studies, have determined that with the shoulder in 90° of abduction, the anterior–inferior glenohumeral ligament remains the primary static restraint to anterior translation. Additionally, intrinsic shoulder stability depends on an intact inferior glenohumeral ligament–labral complex that deepens the glenoid and also provides a "bumper" effect to the glenoid rim.[15] Detachment of the labrum can decrease socket depth by nearly 50% whereas the resistance to translation can also be diminished by 20%.[16] Negative intra-articular pressure (the "suction effect") can contribute to joint stability. The concavity–compression effect is a critical one and relies on an intact labrum and a well-functioning rotator cuff. Dynamic stabilizers of the shoulder include the biceps[17] as well as the larger extrinsic shoulder musculature, which in combination with static stabilizers provides and maintains shoulder stability. Version of the glenoid can also be considered a static stabilizer in that variations of glenoid version can predispose to instability patterns.[18] Shoulder instability can arise if any or a combination of these forces is disrupted or is abnormal.

Sectioning and stress testing have also demonstrated that although considered the "essential" lesion, a Bankart lesion alone is not enough to permit recurrent instability.[19,20] Associated plastic deformation of the glenohumeral ligaments is a necessary factor in recurrent instability and must be ad-

dressed if successful stabilization is to be achieved arthroscopically.

Although the rotator interval has historically been implicated in the spectrum of pathologic changes associated with multidirectional instability,[21–23] the rotator interval may also contribute to recurrent, anterior shoulder instability. A persistent preoperative sulcus sign with the shoulder in adduction and external rotation should raise concern regarding the integrity of the rotator interval. Intra-operative findings of a patulous interval, ballooning out with increased intra-articular pressure, often in association with poorly defined glenohumeral ligaments should be recognized and must be considered in the treatment plan.[24]

LITERATURE REVIEW

Arthroscopic Stabilization

With the advent of arthroscopy, and with the rapid technical advances and improved implant choices, arthroscopic stabilization quickly became the "panacea" for traumatic shoulder instability. Early reports were encouraging,[25–28] citing the many advantages of the arthroscopic approach, including minimal surgical trauma, a facilitated rehabilitation with much less peri-operative morbidity in addition to the ability to recognize and treat associated pathology while sparing the subscapularis, and providing for a desirable cosmetic outcome.

However with longer-term follow-up, the initial success rates plummeted with recurrence rates approaching 50%.[6–12,29] Several risk factors were determined to be statistically significant for recurrent instability following arthroscopic stabilization. A short period of postoperative immobilization,[7,9] bony Bankart lesions leading to "inverted pear" configurations[6,30] associated generalized ligamentous laxity[6,12,31,32], large and engaging Hill-Sachs lesions,[1,30] contact or collision sports,[4,8,12,24,31,33] the younger patient,[34,35] as well as poor glenohumeral ligament quality[7,11,31,33] have all been implicated as risk factors for arthroscopic failure.

Although many cogent and timely articles focusing on the results of arthroscopic stabilization have been published, there are a few that merit closer attention. In 1993 Grana[8] was one of the first investigators to document a recurrent instability rate of nearly 45% in transglenoid Bankart repairs. An analysis of risk factors revealed a short immobilization period as a statistically significant risk factor while age, dislocation over subluxation, and contact sports trended toward significance. Walch[6] in 1995 reported a failure rate of nearly 50% in his transglenoid Bankart repair series, and noted that associated ligamentous laxity and the presence of a bony Bankart injury were 2 statistically significant risk factors for recurrent instability following arthroscopic stabilization. Pagnani et al[32] in 1997 reported a 19% failure rate in a series of 102 patients followed for over 2 years. Transglenoid stabilization was used in approximately 50% of the patients while the remaining patients were stabilized with a bio-tack technique. They identified 4 risk factors, namely generalized ligamentous laxity, poorly defined glenohumeral ligaments, the absence of a Bankart lesion, and participation in a contact sport. They concluded that these risk factors were also additive and that those with 3 of the risk factors had the highest recurrence rate of 43% compared with those without risk factors whose recurrence rate was only 3%. Torchia et al[34] in 1997, using multivariate analysis with a single surgeon and consecutive patients, determined that the presence of a Bankart lesion and a younger age, were 2 of the most significant risk factors for failed transglenoid stabilization. Burkhart and DeBeer[30] introduced the concepts of the glenoid "inverted pear" configuration as well as the "engaging Hill-Sachs lesion," both bony defects contributed to a failure rate approaching 70% in their series. It is noteworthy that in their patient population without significant bone loss, the recurrence rate was only 4%.

In contrast to these studies, there have been recent reports of a greater success rate following arthroscopic intervention. Bacilla and Savoie[36] in 1997, utilizing suture anchors and nonabsorbable suture, reported a failure rate of only 9% despite treating 40 consecutive young, high-demand athletes, 38 of whom were younger than 22 years of age. They concluded that there were no specific risk factors that could be identified or that were associated with a higher recurrence rate. O'Neill[37] in 1999 cited a recurrence rate of only 5% after treating high-demand athletes with a transglenoid stabilization for anterior instability. 40 of 41 patients returned to their previous level of competition with follow-up averaging over 4 years. Twenty-two of the 41 patients regained a full range of motion, and 2 patients reported a single subluxation episode postoperatively. Romeo,[38] reporting on a consecutive series of 30 patients treated with arthroscopic stabilization using a "5-o'clock" portal, experienced no recurrences with a minimum 2-year follow-up. Gartsman[39] in 2000 cited a success rate of 92.5% in the arthroscopic stabilization of chronic anterior instability using suture anchors and non-absorbable suture. Adjunctive capsular plication and closure of the rotator interval was implemented in conjunction with repair of the Bankart lesion. Mishra et al[40] in 2001 reported a failure rate of only 7% with greater than 2-year follow up in a group of patients treated with a Bankart repair and adjunctive thermal capsulorrhaphy. The thermal treatment was implemented as a means of shortening the glenohumeral ligaments in conjunction with a Bankart repair. Thirty-eight of 42 patients returned to their prior level of sports participation, 14 of whom were contact or collision athletes. Using not only dislocation and subluxation, but also positive apprehension as criteria for failure, Kim et al[41] in 2003 cited a 4.2% recurrence rate in 167 patients following arthroscopic stabilization with a 2- to 6-year follow-up. These results are very similar to the 3.4% recurrence rate previously published by Kim in a prospective study comparing open and

arthroscopic results.[35] It is noteworthy that only 1 patient out of the 167 in his study actually sustained a recurrent dislocation whereas 4 described apprehension.

Prospective Studies

Although results from prospective studies have been reported, none fully adhere to the randomized, blinded format that delivers the most reliable data. In 1991, Weber,[42] in a non-randomized study, described a failure rate of 16% for arthroscopic repairs versus 4% in the open group. As expected, the overhand athletes in his study exhibited a 3-fold greater likelihood of returning to their pre-morbid level of competition. Guanche[9] in 1996 revealed a failure rate of 33% compared with 8% in the open group. Mean follow-up averaged over 2 years for both groups although the overall sample size was small. Geiger[10] described a 43% failure rate with arthroscopic stabilization compared with 0% in the open stabilization cohort, both groups part of a non-randomized prospective study. He also concluded that the range of motion was not improved in the arthroscopic treatment group. Field[43] in 1999 cited a 0% recurrence rate utilizing an open technique in his prospective study whereas those treated with an arthroscopic stabilization exhibited a respectable 8% recurrence rate. Cole[44] in 2000 included apprehension as well as subluxation and frank dislocation to his study criteria comparing open and arthroscopic techniques and reported recurrence rates of 24% in the arthroscopic group compared with 18% in the open category, statistics noteworthy not so much for the higher rate in the arthroscopic group, but for the unexpected failure rate of 18% in those treated with an open stabilization. Sperber in 2001[45] also reported on his short-term results comparing open and arthroscopic techniques and although the arthroscopic technique was associated with a failure rate of 23%, the open technique was associated with a failure rate of 12%, again considerably higher than the traditional 3% to 4% recurrence rate historically associated with open techniques. Kim et al[35] in the most compelling prospective study, using stringent criteria, determined that there was no significant difference in outcome between the 2 groups with regard to recurrent instability rates. If apprehension is included as a criterion for failure, then a recurrence rate of 10% and 10.2% is reported for the open and arthroscopic groups respectively. In assessing recurrent dislocations, his open group fared worse with an incidence of 6.7% compared with 3.4% in those treated arthroscopically.

ANALYSIS OF FAILED ARTHROSCOPIC STABILIZATION

Because of the higher failure rate associated with arthroscopic stabilization procedures, opportunities to study possible causes are abundant. Mologne[46] evaluated 20 patients who developed recurrent anterior instability after arthroscopy. His analysis revealed healed Bankart lesions in 60% whereas 40% (8 patients) demonstrated recurrent Bankart lesions. Fifteen (75%) of the failures were noted to have capsular redundancy, and he concluded that recurrent Bankart lesions were an obvious source of failure, but that untreated or unrecognized capsular deformation was also a common cause for failure following an arthroscopic Bankart repair. Speer[47] and Warner[48] noted a high incidence of capsular laxity with intact Bankart repairs in their failed cases, again emphasizing the importance of capsular treatment in conjunction with the Bankart repair. Wolf[49] reported on 8 failures evaluated arthroscopically, and he noted that 2 post-surgery dislocations caused by major trauma were distinguished by recurrent Bankart pathology whereas the remaining 6 failures were all noted to exhibit capsular insufficiency. Kim[24] detailed his experience in arthroscopically revising failed Bankart procedures, both open and arthroscopic. He determined that although risk factors such as bone loss and contact sports remained relevant, technical errors were commonly encountered. Medialization and non-anatomic repair of the Bankart lesion, essentially creating an ALPSA (anterior labroligamentous periosteal sleeve avulsion) lesion,[50] accounted for several failures. Poor anchor placement and poor tensioning of the glenohumeral ligaments likewise contributed to a high recurrence rate. Interestingly, Torchia et al[34] in1997 cited a failure rate of 16% in his transglenoid stabilization series. In addition to a younger age, presence of a Bankart lesion was considered a statistically significant risk factor for recurrence. This factor seems counter-intuitive, yet a cogent explanation followed. With the primary goal of repairing the Bankart lesion, the unrecognized capsular deformation was not addressed as a surgical goal. By believing that the operation was simply one of restoring the labrum to its position on the glenoid, the need to adequately treat the associated capsular lengthening was under-appreciated, leading to the high failure rate in those with treatable Bankart injuries.

OPEN STABILIZATION

Rowe's[1] classic article from 1978 forms the basis for the 3.5% failure rate often cited when discussing the merits of open surgery. It is noteworthy that nearly 20% had non-Bankart pathology and that the activity level following surgery was not well documented. Gill et al[3] reported on their long-term results following open Bankart reconstruction with follow-up averaging over 11 years. Instability recurred in 3 of 60 patients whereas 93% were felt to have excellent or good outcomes. It should be noted that the average motion loss in external rotation was 12°. Kiss et al[4] reported on their long-term results with the Putti-Platt procedure. An acceptable redislocation rate of 9% was cited with an average follow-up of 9 years. Of considerable interest were the findings that 11% of patients had pain at rest while 35% described pain with activities. The average external rotation loss was 23°. Late arthritic change was moderate in 29% of the patient population and severe in 1%. Yoneda et al[5] in 1999 addressed the issue of open stabilization in the contact athlete. Eighty-three contact ath-

letes averaging 21 years of age were treated with a combined Bankart and coracoid transfer procedure. With an average follow-up of nearly 6 years, 88% returned to their contact sport while average external rotation loss with the elbow at the side was 15°. Pagnani[33] in 2002 authored what might be considered the definitive article on anterior stabilization for recurrent traumatic instability in the American football player. His study population averaged 18.2 years of age, and the procedure consisted of an open Bankart repair supplemented by a capsular shift with the shoulder positioned in 45° of abduction and external rotation. Fifty-two of 58 patients returned to competitive football. Two patients sustained a recurrent subluxation for a failure rate of 3.4%. Eighty-four percent of the study group achieved a range of motion within 5° of the contralateral side.

Recent data suggests that the long-term follow-up of open stabilization surgery may reveal recurrence rates that approximate the failure rate reported in the most current arthroscopic literature. Uhorchak in 2000,[51] detailing a military academy experience, reported a re-dislocation rate of 3%, a recurrent subluxation rate of 19% for a combined 22% failure rate. All patients were collision or contact athletes, averaging 19.5 years in age with follow-up averaging 4 years. Magnusson in 2002[52] evaluated 47 of 54 open Bankarts with follow-up exceeding 5 years. Sixty-six percent of these individuals were contact or overhead athletes. The combined recurrent dislocation or subluxation rate was 17%, nearly a 500% increase over the original results reported by Rowe.

The data garnered from a review of the literature is noteworthy for differing patient populations, varying surgical techniques, and results that at best would be considered "conflicting". Are we witnessing the maturation of a "technique in evolution", namely arthroscopic Bankart repair, and are the recent reports citing single digit recurrence rates an indication of what we can now expect from this intervention? Furthermore are we also witnessing a higher recurrence rate associated with open procedures as a result of longer-term follow-up?

With the identification of risk factors such as significant bone loss, contact sports, associated generalized ligamentous laxity, and the younger patient, the indications for arthroscopic stabilization for traumatic anterior instability have been refined and will be reflected in higher success rates as the higher risk patients are treated with alternative solutions.

The recent improvement in success rates also reflect the technical lessons that arthroscopic surgeons have discovered over the past decade regarding shoulder stabilization:

1. The damaged glenohumeral ligament must be sufficiently mobilized so that an inferior to superior shift can be accomplished and the capsule properly tensioned.
2. Placement of suture anchors must be on the glenoid face such that a labral "chock block" is re-established versus anchor placement on the glenoid neck (medialization).
3. At least 3 suture anchors must be used in the repair.
4. Associated ligamentous laxity must be addressed in the form of a capsular "tuck", possible adjunctive thermal treatment, and/or rotator interval closure.
5. Postoperative rehabilitation should be well supervised and individualized, especially if thermal energy is used concomitantly. A minimum period of 3 to 4 weeks of restricted motion should be implemented.

There may be an answer as to why the recurrence rates for open and arthroscopic stabilization seem to be converging. In addition to refinements in selection and improved surgical technique, pragmatic considerations such as the desire to improve postoperative external rotation, especially in the throwing athlete while performing an open procedure, may explain the convergence. Although an increase in external rotation becomes one of the primary surgical goals, the recurrence rate will surely increase with the open techniques because the shoulder can be placed in a more functional, but precarious position.

Surgical Technique for Arthroscopic Stabilization

The principles guiding stabilization surgery, whether open or arthroscopic, must be adhered to if a satisfying outcome is to be obtained. The sequence of these essential steps is outlined below:

1. Lateral decubitus or beach chair positioning with the ability to apply dual traction. Examination under anesthesia should confirm the preoperative diagnosis. Comparison with the contralateral side is recommended if the diagnosis is in doubt.
2. A dual anterior portal technique is recommended. A low anterior portal just above the intra-articular slip of the subscapularis is created as well as a high anterior portal, directly behind the biceps tendon, to facilitate anterior visualization (Fig. 1). Although viewing from a posterior portal with a 70° lens is an alternative, viewing from an anterior-superior portal provides the definitive view of labral pathology and the subsequent repair. The posterior portal is converted to a working portal to facilitate suture handling.
3. Once the joint is entered, all pathology is carefully evaluated. Associated rotator cuff or SLAP injuries may require concomitant treatment. The Bankart lesion should be easily identified from the anterior portal. The condition of the Bankart lesion (Fig. 2) should be assessed including tissue integrity, presence of a bony component as well as suspected capsular redundancy.
4. This step is the most critical one. The Bankart lesion must be completely freed from the neck of the glenoid. For the anterior ligamentous periosteal sleeve avulsion (ALPSA) lesion, this dissection can be tedious. Every attempt should be made to avoid thinning the glenohumeral ligament during the dissection. At the completion of this step, the sub-

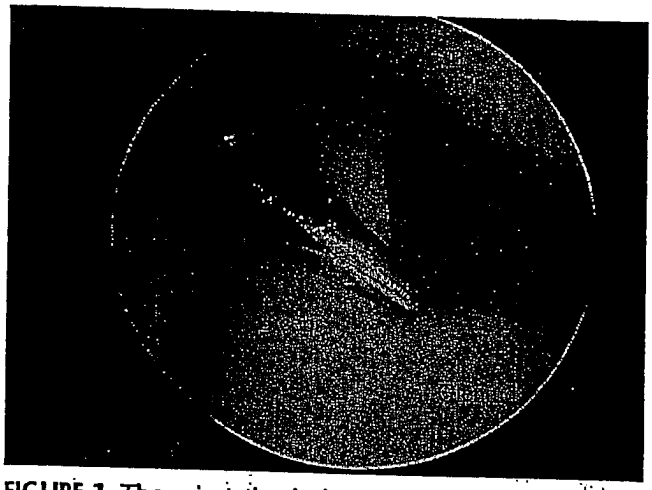

FIGURE 1. The orientation is that of the lateral decubitus position. The small arrow points to the anterior–superior viewing cannula, entering directly behind the biceps. The larger arrow indicates the low anterior working portal just superior to the intra-articular slip of the subscapularis tendon.

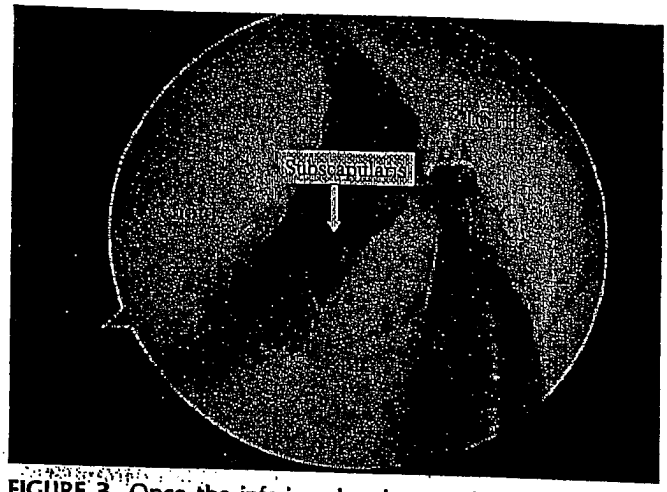

FIGURE 3. Once the inferior glenohumeral ligament (IGHL) has been released, the subscapularis tendon is easily visualized.

scapularis muscle should be clearly visible through the tear site (Fig. 3). Grasping tools can be used to evaluate how far the tissue can be shifted superiorly.

5. The anterior glenoid rim and neck are prepared with a ring curette and a shaver. Use of a motorized burr is rarely necessary, and may actually compromise bony purchase or exacerbate bone loss.
6. Through the low anterior portal, instrumentation for anchor placement is placed at the lowest anchor site first, approximately the 7:00-o'clock position in a left shoulder. The drill hole is made with the guide on the glenoid face by 2 or 3 mm (Fig. 4). This is essential for re-creating the labral bumper, but also ensures that the most inferior anchor will achieve adequate bony purchase.
7. The suture anchor is inserted and the sutures separated. One strand is brought through the posterior cannula. A suture hook device is then loaded with 0 PDS and with the arm internally rotated while in dual traction, the inferior glenohumeral ligament is penetrated approximately 1 to 2 cm inferior and lateral to the suture anchor. This allows for adequate tissue shifting both lateral to medial and inferior to superior. A pinch-tuck maneuver (Fig. 5) can also be implemented at this time for those individuals with severe capsular redundancy. This allows for an even greater degree of tissue shifting.
8. The 0 PDS suture is grasped through the posterior portal, and the suture strand from the anchor is brought through a

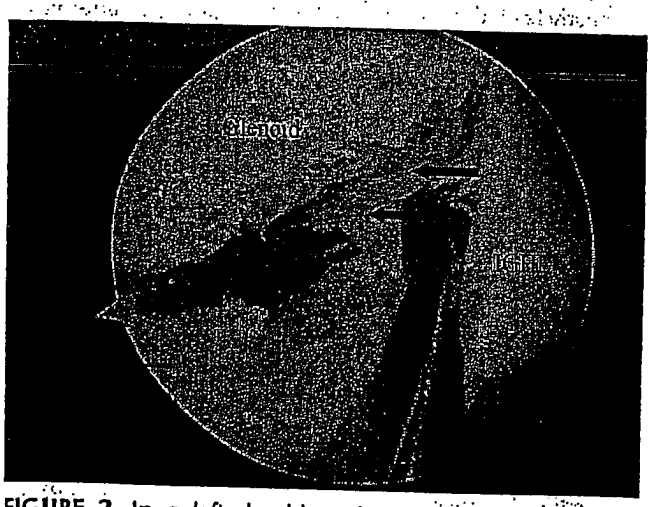

FIGURE 2. In a left shoulder, viewing from the anterior–superior portal, the Bankart lesion remains scarred to the anterior glenoid (arrows). A thorough dissection is needed to shift tissue superiorly.

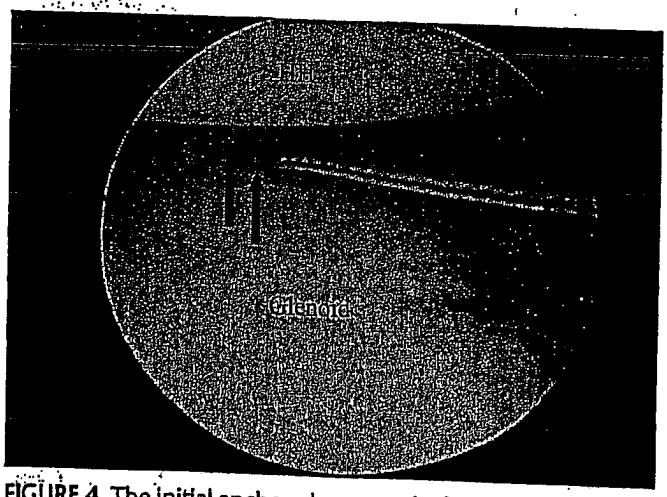

FIGURE 4. The initial anchor placement is the most inferior one and should remain 2 or 3 mm on the glenoid face (arrows). This permits adequate bony purchase and also allows re-creation of a labral "bumper".

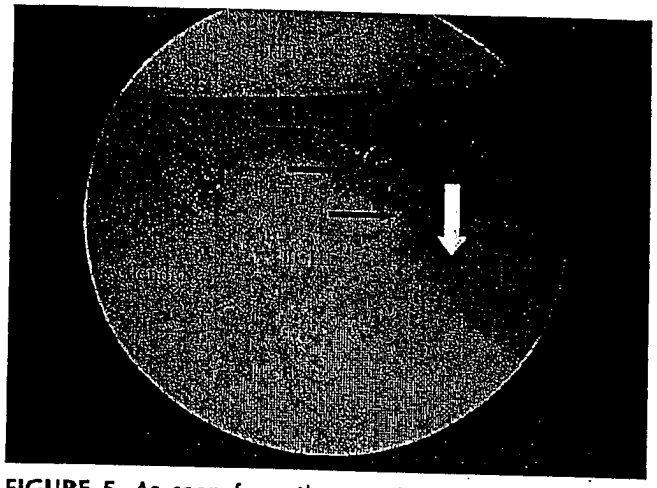

FIGURE 5. As seen from the anterior-superior portal, the "pinch-tuck" technique allows additional capsular shifting thereby reducing capsular volume. Arrows point to the "folding" of the "pinch-tuck" technique whereas the larger arrow depicts the sulcus created by "folding" a portion of the capsule into the anchor stitch.

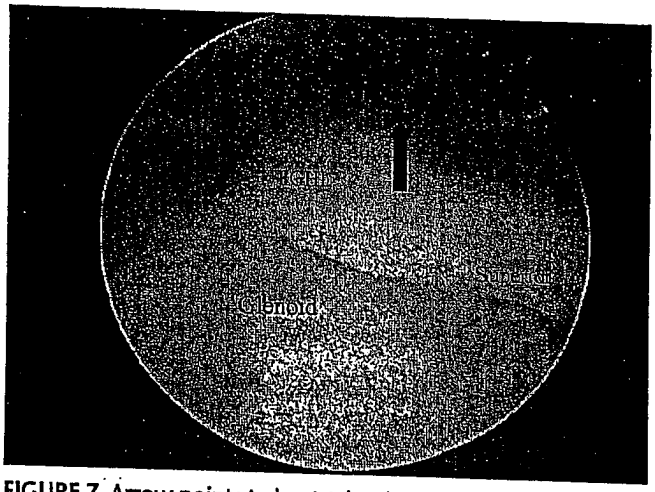

FIGURE 7. Arrow points to knot-tying instrument pushing knot down suture limb retrograded through the inferior glenohumeral ligament (IGHL). Pushing knot down this limb "rolls" labrum onto the glenoid face, helping to restore the "bumper" effect.

simple loop in the PDS and then retrograded through the labrum and retrieved from the low anterior portal (Fig. 6). Separating sutures before this maneuver prevents twisting of the sutures as they exit the same cannula.

9. When tying knots, the suture limb retrograded through the labrum must remain as the post. Whether tying sliding knots or alternating half-hitches, this sequence pushes the labrum onto the glenoid face (Fig. 7) re-creating the labral "bumper". If reversed, the knot pushes the labrum off the glenoid face. Knot-tying skills should be mastered before attempting this technique. Furthermore knot security and loop security should match the quality of knots tied in an open setting.
10. Steps 6 to 9 are repeated for the remaining anchors, carefully shifting tissue in a superior direction with each additional anchor. When completed, tension within the glenohumeral ligaments should be restored and a labral "bumper" created (Figs. 8A, 8B).
11. Once the Bankart lesion has been repaired, additional capsular plication stitches can be placed if deemed necessary for capsular redundancy.
12. If a patulous interval is noted at the time of the diagnostic portion of the arthroscopic procedure, on completion of the Bankart repair, a rotator interval closure is completed. My technique is one of placing two #1 PDS sutures through the most superior portion of the rotator interval and then retrieving each with an angled penetrating device that has been introduced through the low anterior cannula and has already pierced a portion of the middle glenohumeral ligament (Fig. 9). The two superior sutures are captured with a crochet hook and brought through the low anterior portal where the sutures are tied in an extracapsular fashion. My concern for over-constraining the interval and limiting rotation is reflected in the use of absorbable suture.
13. Postoperative care should be individualized, but should include immobilization for a minimum of 3 to 4 weeks, The combined abducted–externally rotated position should be avoided for at least 2 months. Range of motion goals should proceed cautiously with 90% of motion achieved at 3 months post operatively. A return to contact or collision sports is permitted 5 months following surgery.

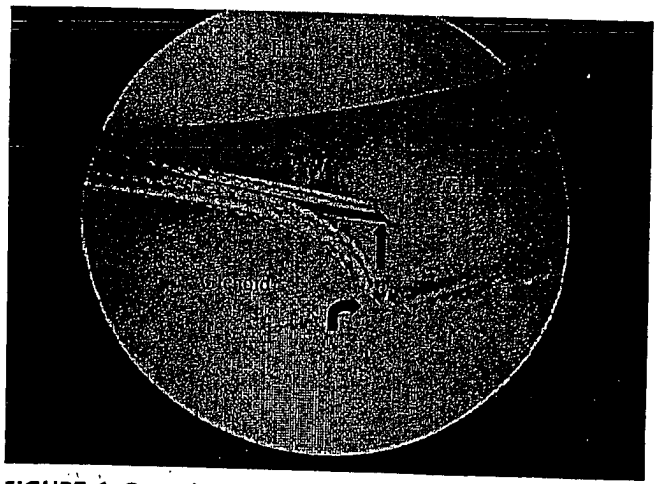

FIGURE 6. Curved arrow points to anchor placed on the glenoid face. Straight arrow depicts "poor man's shuttle" in which O PDS suture is used to retrograde a suture limb through the inferior glenohumeral ligament (IGHL)

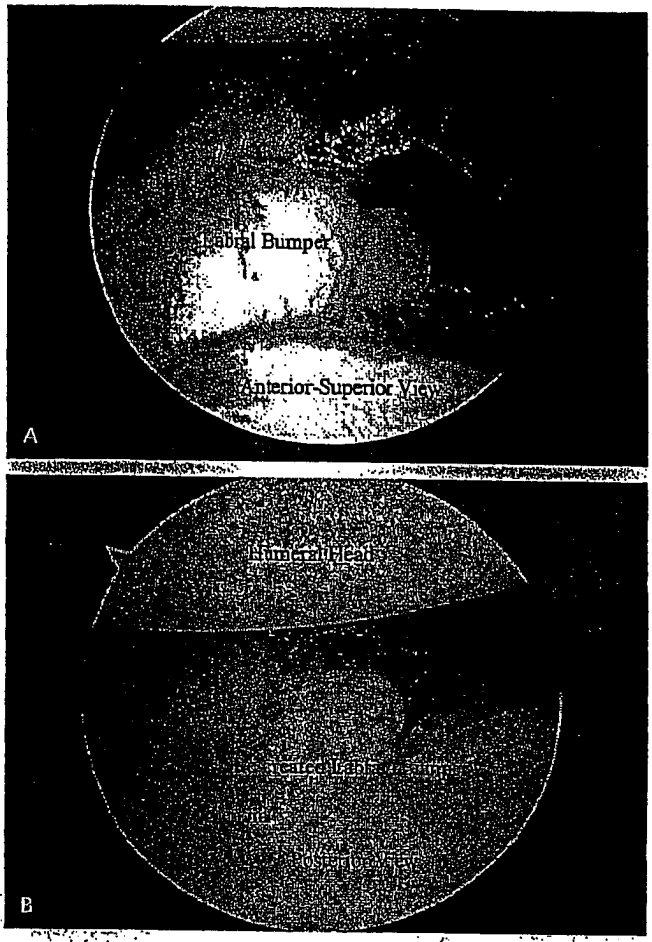

FIGURE 8. A, Re-created labral "bumper" viewed from the anterior-superior portal. Tension has been restored to the glenohumeral ligaments. B, Labral "bumper" viewing from the posterior portal.

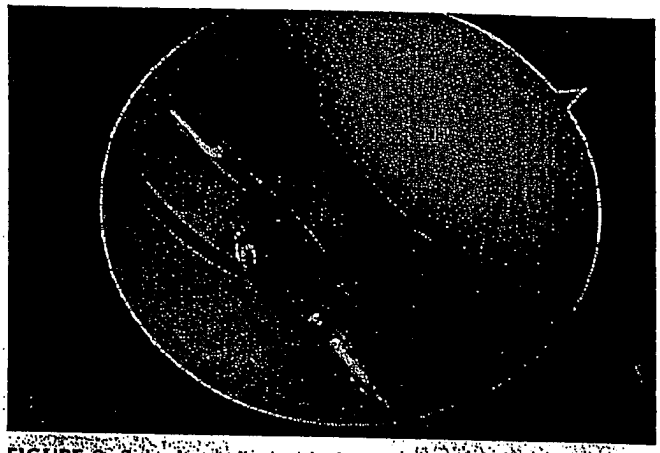

FIGURE 9. Spinal needle loaded with #1 PDS passed behind the biceps (B); grasper placed through low cannula, penetrating the middle glenohumeral ligament (MGHL). Knot tied extra-capsular.

CONCLUSION

Given the advantages of the arthroscopic approach, can current arthroscopic techniques, carefully detailed in the list, reliably overcome the multiple risk factors alluded to earlier? From 1984 to 2000, the literature did not support the routine use of arthroscopic stabilization for the general orthopedist because only a handful of clinicians could attain success rates comparable to the open techniques. Since 2000, with the advent of improved techniques in combination with a better appreciation for the pathoanatomy, one can reasonably conclude that arthroscopic stabilization is a valid alternative to open reconstruction in properly selected cases. Current literature supports the concept that recurrence rates for both open and arthroscopic stabilization procedures are converging and range from 5% to 10%.

When trying to decide between open and arthroscopic procedures, the most important question to be answered by the individual clinician is "What is an acceptable recurrence rate in my practice?" The answer will be different for all of us and will reflect the patient population we are treating. The orthopedist striving to maintain the highest level of skill and ability in a professional pitcher may have very different goals when treating instability in a classroom teacher. Each clinician must determine the risk factors facing each of their patients with shoulder instability, and should then candidly discuss these factors with the patient. Once all of the risk factors have been identified and discussed, both the surgeon and patient will be committed to the final surgical solution whether it be open or arthroscopic. If an acceptable recurrence rate is to be maintained utilizing arthroscopic techniques, several variables must be considered when making a decision of open versus arthroscopic:

1. Skill and experience of the operating surgeon
2. Expectations of the patient
3. Anatomic risk factors:
4. Significant bone loss
5. Generalized ligamentous laxity
6. IGHL quality
7. Non-anatomic risk factors
8. Younger age
9. Contact sports

For the younger contact athlete or for those with significant glenoid or humeral head bony deficiencies or severe associated ligamentous laxity, an open shoulder reconstruction may be the procedure of choice. Absent these risk factors, arthroscopic stabilization is a viable alternative to the open techniques. At the time of surgery, the goals achieved in open surgery must be duplicated during the arthroscopic approach, namely restoration of the appropriate resting length of the glenohumeral ligaments, closure of the Bankart lesion, and recreation of the labral "bumper", all of which can be accomplished by following meticulous technique.

On a final note, immediate arthroscopic stabilization of the first-time dislocator who is at the high risk for recurrence[53–55] may be the best circumstance for arthroscopic stabilization. The considerations are analogous to the acute anterior cruciate ligament injury.[56] Rarely do we advise our high-risk knee patients to compete and to experience a severe pivot shift episode, risking further damage to articular cartilage and menisci, before deciding to proceed with stabilization of the knee. In the high-risk shoulder instability group, the risk for further damage is present,[57,58] and the results following late reconstruction can be jeopardized. The surgical environment for healing is ideal following the initial dislocation, and the complex issue of capsular elongation can be avoided. By preventing further episodes of instability, capsular damage is obviated and, progressive bone loss from either the glenoid or humeral head is likewise precluded.

REFERENCES

1. Rowe CR, Patel D, Southmayd WW. The Bankart procedure: a long-term end result study *J Bone Joint Surg.* 1978;60A:1–16.
2. Wirth M, Blatter G, Rockwood C. The capsular imbrication procedure for recurrent anterior instability of the shoulder. *J Bone Joint Surg.* 1996;78: 246–259.
3. Gill TJ, Micheli LJ, Gebhard F, et al. Bankart repair for anterior instability of the shoulder: long-term outcome. *J Bone Joint Surg.* 1997;79:850–857.
4. Kiss J, Mersich I, Perlaky GY, et al. The results of the putti-platt operation with particular reference to arthritis: pain and limitation of external rotation. *J Shoulder Elbow Surg.* 1998;7:495–500.
5. Yoneda M, Hayashida K, Wakitani S, et al. Bankart procedure augmented by coracoid transfer for contact athletes with traumatic anterior shoulder instability. *Am J Sports Med.* 1999;27:21–26.
6. Walch G, Boileau P, Levigne C, et al. Arthroscopic stabilization for recurrent anterior shoulder dislocation: results of 59 cases. *Arthroscopy.* 1995;1:173–179.
7. Mologne TS, Lapoint JM, Morin WD, et al. Arthroscopic anterior labral reconstruction using a transglenoid suture technique: results in active-duty military patients. *Am J Sports Med.* 1996;24:268–274.
8. Grana WA, Buckley PD, Yates CK. Arthroscopic Bankart suture repair. *Am J Sports Med.* 1993;21:348–353.
9. Guanche CA, Quick DC, Sodergren KM, et al. Arthroscopic versus open reconstruction of the shoulder in patients with isolated bankart lesions. *Am J Sports Med.* 1996;24:144–148.
10. Geiger D, Herley J, Tovey J, et al. Results of arthroscopic versus open bankart suture repair. *Ortho Trans.* 1993;17:973.
11. Green MR, Christensen KP. Arthroscopic Bankart repair: two to five year follow-up with clinical corelation to severity of glenoid labral lesion. *Am J Sports Med.* 1995;23:276–281.
12. Manta JP, Organ S, Nirschl RP, et al. Arthroscopic transglenoid suture capsulolabral repair. *Am J Sports Med.* 1997;25:614–618.
13. Turkel SJ, Panio MW, Marshall JL, et al. Stabilizing mechanisms preventing anterior dislocation of the glenohumeral. *Joint J Bone Joint Surg.* 1981;63:1208–1217.
14. O'Brien S, Schwartz R, Warren RF, et al. Capsular restraints to anterior-posterior motion of the abducted shoulder: a biomechanical study. *J Shoulder Elbow Surg.* 1995;4:298–308.
15. Lazarus MD, Sidles JA, Harryman DT, et al. Effect of a chondral-labral defect on glenoid concavity and glenohumeral stability: a cadaveric model. *J Bone Joint Surg Am.* 1996;78:94–102.
16. Lippett SB, Vanderhooft JB, Harris SL, et al. Glenohumeral stability from concavity-compression: a quantitative analysis. *J Shoulder Elbow Surg.* 1993;2:27–35.
17. Pagnani MJ, Deng X, Warren RF, et al. Effect of lesions of the superior portion of the glenoid labrum on glenohumeral translation. *J Bone Joint Surg.* 1995;77:1003–1009.
18. Cole BJ, Warner JJP. Anatomy, biomechanics, and pathophysiology of glenohumeral instability. In: Iannotti J, Williams G, eds. *Disorders of the Shoulder: Diagnosis and Management.* Philadelphia: Lippincott-Raven; 1999:207–232.
19. Speer K, Deng X, Borrero S, et al. Biomechanical evaluation of a simulated Bankart lesion. *J Bone Joint Surg.* 1994;76A:1819–1826.
20. Bigliani LU, Pollock RG, Soslowsky U, et al. Tensile properties of the inferior glenohumeral ligament. *J Orthop Res.* 1992;10:187–197.
21. Field LD, Warren RF, O'Brien SJ, et al. Isolated closure of rotator interval defects for shoulder instability. *Am J Sports Med.* 1995;23:557–563.
22. Harryman DT, Sidles JA, Harris SL, et al. The role of the rotator interval capsule in passive motion and stability of the shoulder. *J Bone Joint Surg.* 1992;74:53–66.
23. Itoi E, Berglund LJ, Grabowski JJ, et al. Superior-inferior stability of the shoulder: role of the coracohumeral ligament and the rotator interval capsule. Mayo Clin Proc. 1998;73:508–515.
24. Kim S-H, Ha K-I, Kim Y-M. Arthroscopic revision bankart repair: a prospective outcome study. *Arthroscopy.* 2002;18:469–482.
25. Arciero RA, Taylor DC, Snyder RJ, et al. Arthroscopic bioabsorbable tack stabilization of initial anterior shoulder dislocations: a preliminary report. *Arthroscopy.* 1995;11:410–417.
26. Arciero RA, Wheeler JH, Ryan JB, et al. Arthroscopic Bankart repair versus non-operative treatment for acute initial anterior shoulder dislocations. *Am J Sports Med.* 1994;22:589–594.
27. Caspari R, Savoie FH. Arthroscopic reconstruction of the shoulder: the Bankart repair. In: McGinty J. ed. *Operative Arthroscopy.* New York: Raven Press; 1991:507–516.
28. Morgan CD, Bodenstab AB. Arthroscopic Bankart suture repair: technique and early results. *Arthroscopy.* 1987;3:111–122.
29. Youssef JA, Carr CF, Walther CE, et al. Arthroscopic Bankart suture repair for recurrent traumatic unidirectional anterior shoulder dislocations. *Arthroscopy.* 1995;11:561–563.
30. Burkhart SS, De Beer JF. Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repairs: significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion. *Arthroscopy.* 2000;16:677–694.
31. Hayashida K, Yoneda M, Nakagawa S, et al. Arthroscopic Bankart suture repair for traumatic anterior shoulder instability. *Arthroscopy.* 1998;14: 295–301.
32. Pagnani MJ, Warren RF, Altchek DW, et al. Arthroscopic shoulder stabilization using transglenoid sutures: a four-year minimum follow-up. *Am J Sports Med.* 1996;24:459–467.
33. Pagnani MJ, Dome DC. Surgical treatment of traumatic anterior shoulder instability in American football players. *J Bone Joint Surg Am.* 2002;84: 711–715.
34. Torchia ME, Caspari RB, Asselmaier MA, et al. Arthroscopic transglenoid suture repair: 2 to 8 year results in 150 shoulders. *Arthroscopy.* 1997; 13:609–619.
35. Kim S-Ho, Ha KI, Kim S-Hyun. Bankart repair in traumatic anterior shoulder instability: open versus arthroscopic technique. *Arthroscopy.* 2002;18:755–763.
36. Bacilla P, Field LD, Savoie FH. Arthroscopic Bankart repair in a high demand patient population. *Arthroscopy.* 1997;13:51–60.
37. O'Neill DB. Arthroscopic Bankart repair of anterior detachments of the glenoid labrum: a prospective study. *J Bone Joint Surg.* 1999;81:1357–1366.
38. Romeo AA, Carreira D. Outcome analysis of arthroscopic Bankart repair: minimum two-year follow-up, presented at the Annual Meeting of the Arthroscopy Association of North America, Miami, FL, 2000.
39. Gartsman GM, Roddey TS, Hammerman SM. Arthroscopic treatment of anterior-inferior glenohumeral instability. *J Bone Joint Surg.* 2000;82: 991–1003.
40. Mishra DK, Fanton GS. Two-year outcome of arthroscopic Bankart repair and electrothermal-assisted capsulorrhaphy for recurrent traumatic anterior shoulder instability. *Arthroscopy.* 2001;17:844–849.
41. Kim S-H, Ha K-I, Cho Y-B, et al. Arthroscopic anterior stabilization of the shoulder: two to six year follow-up. *J Bone Surg Am.* 2003;85:1511–1518.
42. Weber SC. A prospective evaluation comparing arthroscopic and open