Anterior Shoulder Instability
A History of Arthroscopic Treatment

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Abstract

The glenohumeral joint is the most commonly dislocated joint in the body. The prevalence of this condition and the instability that may result from it has been a focus of diagnosis and treatment since the original description of the Bankart lesion in 1923. Now, with the introduction of MRI, lesions causing anterior shoulder instability can be diagnosed more accurately. This has led to improved understanding of the pathoanatomy that must be addressed and corrected during surgical repair. Initial attempts at arthroscopic treatment, including staple repair, transosseus suture repair, rivets, and thermal capsulorraphy were fraught with complications and unacceptably high recurrence rates. The development of arthroscopic suture anchors have revolutionized the treatment of anterior shoulder instability, such that arthroscopic management is now the standard of care. In the hands of experienced surgeons, outcomes for arthroscopic treatment of shoulder instability now approaches the success of open treatment.

The glenohumeral joint is the most commonly dislocated joint in the body, with an overall incidence of 17 per 100,000 per year.[1] Glenohumeral dislocation is classified in many ways, including duration (acute vs. chronic), degree (dislocation vs. subluxation), mechanism (traumatic vs. atraumatic), direction (anterior, posterior, vs. luxatio) and volitional. Anterior instability accounts for 95% of acute traumatic dislocations. There are two primary types of instability, the first being traumatic (T), unidirectional (U), generally associated with a Bankart lesion (B) and responds to surgery (S). This type has been given the acronym "TUBS."[2] The second is atraumatic (A), multidirectional (M), may be bilateral (B), and responds to rehabilitation (R). If surgery is required, it must include reconstruction of the rotator interval-capsule-coracohumeral ligament complex (I) with an associated tightening of the inferior capsule (I). This variant has been given the acronym "AMBRII." Both types do not exist in isolation but rather are part of a spectrum of disease.

The natural history of anterior shoulder instability has been studied extensively, and recurrence has been correlated with a younger age at the time of first dislocation.[3-6] Robinson and colleagues[7] prospectively evaluated 252 patients (225 males) with primary traumatic anterior dislocations treated initially in a sling for a period of 4 weeks, followed by physical therapy. They found that 55% of the patients had an additional instance of instability within 2 years of the initial traumatic dislocation. Furthermore, 66% of the patients had an episode of instability within 5 years.[7]

Anatomical Considerations

The glenohumeral joint is stabilized by dynamic and static structures. The dynamic stabilizers include the rotator cuff, the long head of the biceps, and the deltoid. The static stabilizers of the joint include the capsule, the glenohumeral ligaments, the labrum, negative pressure within the joint capsule, and the bony congruity of the joint. The superior glenohumeral ligament (SGHL) functions primarily to resist inferior translation and external rotation of the hu-

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Pope EJ, Ward JP, Rokito AS. Anterior shoulder instability: a history of arthroscopic treatment. Bull NYU Hosp Jt Dis. 2011;69(1):44-9.

meral head in the adducted arm. The middle glenohumeral ligament (MGHL) functions primarily to resist external rotation from 0° to 90° and provides anterior stability to the moderately abducted shoulder. The inferior glenohumeral ligament (IGHL) is composed of two bands, anterior and posterior, and the intervening capsule. The primary function of the anterior band of the IGHL is to resist anteroinferior translation.[8]

Type of Pathology

Bankart lesions are the most common sequelae of anterior shoulder instability with traumatic origins.[2] The lesion was first described, in 1923, as a shearing of the "fibrous capsule of the joint from its attachment to the fibro-cartilaginous glenoid ligament."[9] Presently, it is defined as a labral complex avulsion from the scapular periosteum. Bankart lesions may be purely soft tissue avulsions or may involve a fracture of the anteroinferior glenoid rim, termed a "bony Bankart."

Humeral avulsion of glenohumeral ligaments (HAGL) lesions are another known cause of anterior shoulder instability. 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.[10] An axillary view of the shoulder joint is necessary to distinguish this lesion from a Bankart lesion. HAGL lesions are an indication for open surgery as the pathology is difficult to address arthroscopically, which underscores the need for appropriate workup prior to operative treatment.[11]

An ALPSA (anterior labral periosteal sleeve avulsion) is a Bankart variant, however, in this lesion the avulsed periosteum remains intact. Because it is not ruptured, the labroligamentous structures will displace medially and rotate inferiorly on the scapular neck. Although these lesions eventually heal, the medialization of the labrum will result in reduced restraint to anterior translation of the humeral head and possible recurrent dislocation. ALPSA lesions have been successfully treated arthroscopically by mobilizing the tissue from the scapular neck and converting them into Bankart lesions with subsequent repair and capsulorrhaphy.[12]

A Perthes lesion is another Bankart variant in which there is an incomplete avulsion of the anteroinferior labrum with a medially stripped but intact periosteum.[13] This is differentiated from the ALPSA lesion by the lack of displacement of the avulsed labrum and is best viewed on MRI in the abducted and externally rotated (ABER) position.[14]

A GLAD lesion (glenoid labral articular disruption) is an anteroinferior labral tear along with an associated defect in the articular cartilage. In this injury, the torn labrum remains attached to the anterior scapular periosteum as is in the Perthes lesion; however, there is the addition of an articular cartilage injury. Pain is often the predominant clinical finding and anterior instability is absent. Relief of symptoms is noted with intra-articular lidocaine injection and is treated surgically with arthroscopic debridement.[15]

The Hill-Sachs lesion is an impression fracture that may occur in the posterosuperior aspect of the humeral head as the soft bone in this region impacts against the harder glenoid rim after an anterior dislocation. Defects are estimated to occur in 47% to 80% of anterior shoulder dislocations and approaches 100% in cases of recurrent instability. The factors involved in determining the likelihood of engagement of the lesion are the size of the Hill-Sachs defect and its location. There is debate on what size lesion requires treatment with bony reconstruction, with most studies reporting a threshold value ranging between 20% and 40% of the articular surface of the humeral head.[16] The location of the lesion is important if the long axis of the defect is parallel to the anterior glenoid when the shoulder is in a functional position, engaging the Hill-Sachs lesion with the anterior corner of the glenoid, thus promoting recurrent instability.[17]

Arthroscopic Techniques

Surgical techniques for the arthroscopic treatment of Bankart lesions have undergone many revisions and refinements as knowledge and equipment have improved. The earliest technique of Bankart lesion repair was the staple technique. This was first described by Johnson, in 1982, as a modification of the commonly performed open procedure. It was performed in the lateral position via a three portal approach. An abrasion arthroplasty was performed on the glenoid rim to produce bleeding cancellous bone. The staple arms were then used to engage the detached portion of the glenoid labrum, portions of the subscapularis tendon and the anterior capsule. A mallet was then used to drive the staple into the scapular neck.[18] This technique, however, was abandoned largely due to an unacceptably high complication rate.[19]

Hawkins retrospectively reviewed 50 cases of arthroscopic stapling for shoulder instability in 1989. He found a 16% recurrence rate of subluxation or redislocation, which he felt was due to failure to immobilize the shoulders for 3 weeks postoperatively. They also determined that a significant learning curve existed with the procedure and that good surgical technique and patient compliance were paramount for successful outcome.[20] In 1993, Lane and coworkers[21] retrospectively reviewed 54 patients who underwent arthroscopic staple capsulorrhaphy for stabilization. Their study found a 33% recurrence rate of instability along with an 18.5% rate of subsequent open reconstructive procedures. They also reported a 26% rate of staple loosening in the postoperative period. Of these, 42% were discovered due to recurrent instability of the shoulder, with the remaining being discovered on routine follow-up. One of the staples had migrated into the area of the brachial plexus, necessitating subsequent removal.

Hardware around the shoulder is not without inherent risk, as described by Zuckerman and Maatsen[19] in a review of 37 patients. They found that 16 of their patients had problems related to the use of staples for conditions including capsulorraphy, subscapularis advancement, or rotator cuff repair. The remaining 21 patients had problems related to screw fixation of transferred coracoid process to the glenoid. The most common patient complaint was pain, followed by decreased glenohumeral motion, and radiating paresthesias. Thirty-four of the 37 patients underwent additional surgical procedures for implant removal. Fourteen of these patients suffered permanent shoulder dysfunction because of damage to the articular cartilage imparted by the screws or staples.

The technique of arthroscopic transosseous suture repair was first described by Morgan and Bodenstab in 1987. They evaluated 25 patients who had traumatic unidirectional anterior shoulder instability that was stabilized arthroscopically using their suture technique. The patient is placed in the lateral decubitus position with the operative arm suspended. Once the lesion is identified, the glenoid rim and scapular neck are abraded to create a bleeding bed of cancellous bone in preparation for the repair of the Bankart lesion. Suture material in the form of #1 PDS is passed through the soft tissue of the Bankart lesion and glenoid bone from anterior to posterior with a modified Beath pin. Next, the pin is used to spear the IGHL near the attachment to the separated anterior glenoid labrum. This process is repeated once more to create a large horizontal mattress suture with tails that exit the scapular neck and skin posteriorly via two separate incisions. Care must be taken not to angle the pins in an extreme medial position, as this places the suprascapular nerve at risk. The PDS is then tensioned and tied over the posterior fascia in an effort to bring the Bankart and IGHL into an anatomic position. In a 17 month postoperative follow-up period, they rated all results as excellent with all patients achieving full and painless range of motion without instability.[22]

Others have attempted to reproduce these results with variable degrees of success. Benedetto and Glotzer[23] reported on 31 patients with no incidence of recurrence in a 2-year follow-up period. Grana and associates,[24] however, evaluated 27 patients over a 3-year follow-up and found a recurrence rate of 44%.[24] Disadvantages of the transosseus suture technique were the need to tie sutures over the posterior fascia, as well as possible iatrogenic injury to the suprascapular nerve while passing the suture. In a cadaveric study, Bigliani and colleagues[25] determined a "safe zone" for blind pin passing to avoid injury to the suprascapular nerve. They determined that inferiorly directed pins averaged 16 mm from the nerve, with none passing closer than 12 mm. This was in contrast to the medially directed pins that averaged a distance of 4 mm and pins parallel to the articular surface that averaged 6 mm. They determined the relative safe zone to be in the inferior and lateral portion of the posterior glenoid neck.[25] This technique has since been abandoned, due to variable success rates in follow-up studies as well as the advent of newer techniques.[26]

In 1988, Wiley[27] studied the effectiveness of arthroscopic rivets for use in the treatment of Bankart lesions. The rivet was designed as a removable metallic device for affixing the torn labrum and the inferior glenohumeral ligament (IGHL) to the glenoid margin. It was then removed after a period of 4 to 6 weeks. The rivet technique had the advantage of only penetrating the glenoid anteriorly, as opposed to through the glenoid neck with the transossesous suture technique, which decreases risk to the suprascapular nerve. Ten cases were presented and followed for a period of 6 months to 2 years with one recurrence reported. This case series was the only report regarding this technique and it never gained acceptance or widespread use.[27]

The Suretac cannulated bio-tack (Acufex Microsurgical, Mansfield, Massachusetts) had the advantages of avoiding posterior glenoid penetration and having a shorter learning curve. The lesion is identified and special attention is paid to stripping and mobilizing the IGHL superiorly and medially. The device is then placed as close as possible to the articular margin. Proper positioning was ensured by the anterosuperior arthroscopic portal.[28] The device was noted to be resorbed over a period of 4 weeks.[29] Small Bankart lesions were enlarged to allow for superomedial shift of the IGHL. The fixation of the IGHL was performed with two Suretac devices after obtaining a bleeding bed of cancellous bone on the scapular neck. Two additional Suretac devices were then used to repair the Bankart lesion.[29] Kartus and coworkers [30] reviewed their results using the Suretac device in 81 consecutive patients over a follow-up period of 107 months. They reported a postoperative complication rate of 38%, with 11 patients experiencing episodes of subluxation and 16 having recurrent dislocation. There was also an increase in the degenerative appearance of the glenohumeral joint on radiographs.[30] Negative aspects of this technique include the inability to address capsular laxity and a synovial reaction to the absorbable polyglyconate polymer.[29]

Suture anchors were the next technological advance in the treatment of anterior shoulder instability. They were first described by Wolf in 1993, who studied 50 patients with Bankart lesions treated arthroscopically. He reported promising results including no hardware complications and only one recurrence of dislocation. The advantages noted for this technique include multiple points of fixation, no posterior glenoid penetration and pullout strength approaching that of transosseous sutures, especially when using later generations of suture anchors. In this procedure, Wolf described the patient being placed in the lateral decubitus position. The debridement and preparation of the bleeding bed of cancellous bone is best accomplished via

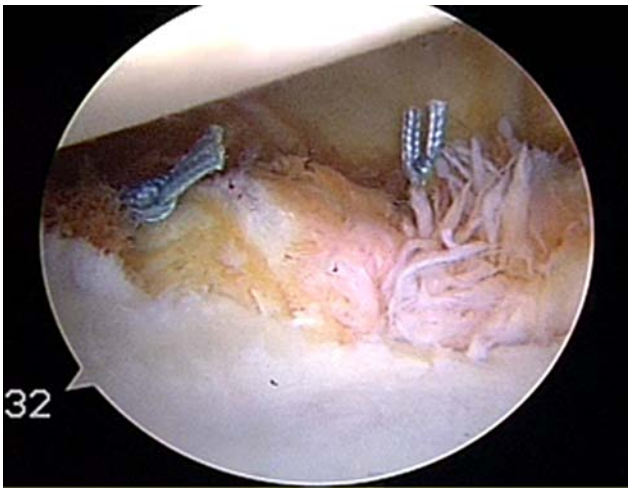

Figure 1 Suture anchor repair of Bankart lesion.

the anterosuperior portal. Insertion of the drill and drill guide is optimized through the anteroinferior portal, and the three drill holes should be placed as far apart from each other as possible on the glenoid rim. It is important to place the drill bit on the anterior border of the cartilaginous surface and not on the medial scapular neck. The suture material is then passed through the detached labral-ligament complex after the anchor is secured.[31] Various types of suture anchors are available including metal, bioabsorbable, and bioinert (Fig. 1).

Kim and associates[32] reviewed their results of arthroscopic repair of the Bankart lesion using suture anchors, retrospectively evaluating outcomes in 167 patients. They found that all patients had improved shoulder scores after surgery. There was a 4% rate of recurrence in the form of one patient dislocating, two subluxations, and four patients with positive apprehension tests postoperatively. Cole and Romeo[33] reviewed 45 patients with traumatic unidirectional anterior shoulder instability treated arthroscopically with suture anchor technique with 2-year follow-up. They found no recurrent dislocations in their patients and 96% good to excellent results. All athletes were able to return to contact sports.[33]

Capsular Volume Reduction Techniques

Thermal capsulorrhaphy is a procedure that uses a laser or monopolar radiofrequency probe to heat and denature the capsular collagen matrix. This in turn causes collagen molecules to unwind and shorten, thereby reducing capsular volume. Luke and colleagues[34] studied the technique in a cadaveric model, comparing standard anteroinferior capsular shift and the thermal capsulorrhaphy technique. They found that the capsular shrinkage procedure reduced capsular volume by only 30% compared to 50% for the open procedure.[34] Chen and coworkers[35] further evaluated this technique clinically in 66 patients that underwent anterior shoulder stabilization with the Suretac II anchor, with 38 patients also undergoing thermal capsulorrhaphy. They found no significant difference in the recurrence rate of the two groups, questioning the need for thermal capsulorrhaphy.

Complications of the technique include chondrolysis. In their case report, Good and associates[36] determined that the excessive heating of chondral tissue causes an inflammatory response with collagen fusion and a subsequent repair response, including synovial hyperplasia and fibroblast proliferation. Of the eight patients studied, none had evidence of chondrolysis prior to thermal capsulorrhaphy. Furthermore, the onset of chondrolysis was rapid, occurring approximately 8 months postoperatively. Four of the patients went on to either partial or total shoulder arthroplasty as a result of this complication.[36] Thermal capsulorrhaphy has been abandoned in light of this complication and unacceptably high recurrence rates.

Arthroscopic capsular plication via detachment and then capsular advancement and transosseous fixation was evaluated by Tauro in 1994. They evaluated four patients for a minimum of 6 months. They found that their technique allowed an additional 2 cm of capsular advancement, thereby providing greater reduction of the stretched and redundant capsule.[37] Wichman and colleagues[38] further evaluated the capsular plication technique in 24 patients with instability but without a Bankart lesion. The types of instability varied in these patients, with 10 having anterior instability, six having posterior instability, and the remaining eight having multidirectional instability. They experienced no complications and found an improvement in the ASES score from a preoperative value of 63.0 to a postoperative value of 86.2.[38]

Open versus Arthroscopic Stabilization Techniques

When comparing open versus arthroscopic techniques using suture anchors, only two randomized controlled trials have been performed. Fabbriciani and coworkers[39] evaluated 60 patients with isolated Bankart lesions. At a 2-year follow-up, they found no repeat dislocations in either group. Furthermore, they found a similar Constant score in both groups, although they noted an improved range of motion in the arthroscopic group. The Rowe score failed to find a significant difference between the two groups in terms of range of motion, function, pain, or stability. They concluded that there was no advantage to the open technique, compared with the arthroscopic technique.[39]

Bottoni and associates[40] studied 61 consecutive patients (29 open, 32 arthroscopic) for a minimum of 2 years with isolated anterior instability. They found no difference in the SANE, SST, Rowe, or WOSI scores in the two groups. There were no recurrent dislocations in either group. The arthroscopic group had a shorter operative time that was statistically significant. There was a trend towards improved

external rotation and forward flexion in the arthroscopic group. This led to the conclusion that arthroscopic repair was equivalent to open repair and could be recommended for patients with anterior instability.[40]

Conclusion and Summary

Arthroscopic treatment of anterior shoulder instability has evolved from the early initial use of large metal staples to the present widespread use of suture anchors with many variations in between. Outcomes have approached the success of open techniques in the hands of the experienced surgeon; however, there is still a role for primary open treatment. Most commonly, this is reserved for severe instabilities, revision surgery, and contact athletes.[41] While many improvements in arthroscopic technique have been made, further studies must be performed, particularly randomized, controlled trials comparing arthroscopic and open techniques.

Disclosure Statement

Andrew S. Rokito, M.D., is on the Scientific Advisory Board of Core Essence Orthopaedics, Inc. None of the other authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

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