ARTHROSCOPIC BANKART REPAIR USING SUTURE ANCHORS

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Arthroscopic Bankart procedures have been well described, and their results have produced a significant improvement over those of other arthroscopic capsulorrhaphy techniques. Nonetheless, objections to these arthroscopic Bankart techniques persist. The primary objections are the drilling of transscapular pins out the posterior scapular neck in proximity to the suprascapular nerve and the tying of sutures over the muscle belly and fascia of the infraspinatus. The arthroscopic Bankart procedure using suture anchors nullifies these objections by the fixation of sutures, placed in the detached ligament labral complex, directly to the anterior glenoid rim without transscapular drilling. The procedure was performed in 14 patients with anterior inferior instability. The instability was confirmed by examination under anesthesia, and the intra-articular pathology was evaluated arthroscopically. Two or three sutures and anchors were used to reattach and retention the inferior glenohumeral ligament labral complex. The procedure requires the use of two anterior portals and intra-articular knot-tying techniques. Although the follow-up is short, there have been no complications and no recurrences of the symptoms of instability. This new approach offers distinct advantages over existing arthroscopic Bankart techniques without altering the basic principles of the procedure. Suture anchors, initially designed to facilitate traditional open Bankart procedures, can also be used arthroscopically, thus avoiding transscapular drilling and risk to posterior structures.

KEY WORDS: arthroscopic Bankart procedure, suture anchors, transscapular drilling

In an effort to treat the unstable shoulder, orthopaedic surgeons have described more than 100 different operations that may help to prevent recurrent subluxation or dislocation. Theories regarding the etiology of recurrent anterior instability of the shoulder center around three concepts: (1) a capsular and/or labral defect described by Bankart; (2) muscular insufficiency described by Symeonesides, Magnuson and Stack, and dePalma et al; or (3) bony abnormalities of the glenoid cavity or humeral head. Numerous studies have documented the functional significance of the anterior-inferior capsular labral structures in maintaining stability of the glenohumeral joint throughout ranges of motion. These studies emphasize the importance of the inferior glenohumeral ligament/labral complex (IGLLC) in providing a stabilizing force, especially in the abducted externally rotated position.

The standard approach to operative treatment of the unstable shoulder has been through an open procedure, with numerous techniques having been proposed by many surgeons. Follow-up studies have shown significant variability of results depending upon the procedure used. An extensive review of the literature is beyond the scope of this article; however, several techniques have emerged as reliable alternatives in treating recurrent anterior instability of the shoulder. The Bristow-Latarjet, Bankart, Putti-Platt, and Magnuson-Stack procedures enjoy popularity in this country, with an almost regional preference for a specific approach.

There have been several modifications of the Bristow-Latarjet procedure; however, the recurrence rate in two large series has been between 8.5% and 13%. Other problems with this repair have been limitations in external rotation and muscle weakness. The Putti-Platt procedure has a reported recurrence rate ranging from 0% to 12.5%, and a recent report by Hawkins revealed that glenohumeral osteoarthrosis can develop as a late complication in patients undergoing this procedure. The functional results of the Magnuson-Stack procedure have been less satisfactory, a common complaint being loss of external rotation and, thus, limitations in returning to overhead activities.

Bankart repair restores stability by reattaching the labrum or capsule directly to the anterior glenoid cavity. The procedure has a failure rate of between 2% and 10%, depending on the series reviewed. Bankart repair is a technically difficult procedure, especially with respect to dissection of the subscapularis from the capsule and the creation of suture holes in the anterior glenoid cavity needed to complete the repair. There have been several approaches to this step of the procedure, initially using forceps, curved awls, angled drills, and more recently the Midas Rex. In an attempt to simplify the Bankart repair, a suture anchor (MITEK, Norwood, MA) was designed to allow for secure fixation of tissue to the anterior glenoid cavity with minimal difficulty.
The suture anchor consists of a titanium body and a nitinol arc with a memory property that allows for insertion through a small drill hole, enabling the arc to anchor securely in the subcortical bone. The open technique is thereby simplified with a calibrated drill and drill guide, along with a quick insertion device to allow accurate and predictable placement of the anchor. Bench studies have been performed on cadaver scapulae comparing the pull-out strength of the suture anchor with that of a plain suture placed through a curved suture hole with satisfactory results. Using a no. 2 polyester suture, the suture anchor was found to be slightly weaker than the suture alone (82.5 N vs 135 N); however, the suture anchor was strong enough to provide stability in reattaching the anterior glenoid labrum or capsular complex. A review of 17 patients with greater than 1 year follow-up (of a total of 32 patients) undergoing open Bankart repair using a suture anchor, found 1 dislocation, which occurred in a football player 1 year postoperatively during an arm tackle. Recently, a second-generation suture anchor has been developed that uses a double-armed device with even stronger fixation strength than the original anchor. Testing of the newer anchor with no. 2 polyester suture showed almost comparable strength to the suture alone (90.1 N vs 98.4 N), confirming the suitability of a suture anchor in securing soft tissue to bone.

**Background**

A technique of arthroscopic Bankart suture repair has been successfully used by Morgan and Bodenstab, with preliminary results showing no recurrent instability and no complications. More recent data have revealed a 5.2% traumatic redislocation rate, and 7 of the 8 recurrences involved collision athletic injuries. Morgan has used a transglenoid suture technique that requires the drilling of suture pins through the scapular neck and out the back of the shoulder. The sutures are tied over facia and muscle where they exit posteriorly. This procedure has been performed only in cases in which a clear-cut Bankart lesion was found arthroscopically. The transglenoid techniques risk injury to the suprascapular nerve, and tying the suture over muscle and facia that is often distended with extravasated fluid can be less than reassuring.

We have attempted to restore the anatomic integrity of the IGLLC through an arthroscopic Bankart repair using the suture anchor. Our enthusiasm for this technique was fostered by our early results of open Bankart repair using the suture anchor. Using an arthroscopic approach with an anterior inferior portal, we have been able to place the suture anchors in the anterior inferior quadrant of the glenoid cavity and suture the labrum back to its normal position. With this technique, we have eliminated the objections to, and the potential complications of, the transglenoid suturing approach.

**Surgical Technique**

**Patient Selection**

A careful assessment of the patient must be made preoperatively in an effort to clarify the direction and degree of instability. The patient with radiographic evidence of re-
current anterior dislocation or clinical evidence of recurrent subluxation is ideal for this procedure. An effort to document the direction and amount of instability should be made through the history and reinforced through the physical examination, although the physical examination in the office is often of limited value. The arthroscopic Bankart repair using the suture anchor is not indicated in multidirectional instability.

Setup and Positioning

We perform shoulder arthroscopy with the patient on a bean bag in the lateral decubitus position because we feel this provides optimum exposure for instrument placement and allows for distraction of the glenohumeral joint. Our technique involves patient positioning and portals described by Wolf.26 The operating table is positioned to provide 180° of access to the shoulder by placing the anesthesia team at the level of the patient’s abdomen (Figs 2 and 3). The twin-traction setup is used to maintain distraction with the shoulder in a slightly abducted and internally rotated position. The internal rotation helps to relax the anterior capsule and increase the working space anteriorly. Modification of the weights and the angles of the traction devices during the operation can alter the position of the shoulder as needed.

Examination Under Anesthesia

Once the patient is intubated and positioned, an examination of the shoulder is performed to assess the direction and degree of instability (Fig 4).

The examination under anesthesia must be performed in a systematic fashion to ensure that this examination is accurate and reproducible; this is critical because its results will be used in conjunction with arthroscopic find-

Fig 2. Patient set-up and positioning with twin traction units, allowing adjustments during surgery. After prep and drape the arm is adducted and the underarm traction sling is applied. Ten to 15 lb is used for this underarm sling, depending on the size of the patient, and 10 lb is used distally. (Reprinted with permission.26)

Fig 3. The table is rotated 90° so that the anesthesia team is out of the way. This allows 180° of access to the shoulder. (Reprinted with permission.26)

ings to decide on the eventual surgical approach used to treat the patient’s instability. For this examination to be most accurate, it must be carried out (1) bilaterally, (2) in a lateral decubitus position, (3) with external rotation and abduction to 90°, (4) with axial compression of the hum-

Fig 4. The examination under anesthesia must be bilateral, in the lateral decubitus position, with 90° of abduction and external rotation, axial compression of the humeral head on the glenoid cavity, and stabilization of the scapula.

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eral head on the glenoid surface, and (5) with stabilization of the scapula.

All the above steps of the examination under anesthesia are essential to properly assess shoulder instability. This examination is, in some respects, similar to Barlow’s test of the congenital hip in which the pelvis is stabilized and the hip dislocated. There are also analogies to Lachman’s test in that to appreciate the anterior translation of the tibia on the femur, the femur must be stabilized when anterior force is applied to the posterior aspect of the tibia. To appreciate the instability (or lack thereof) in the glenohumeral joint, the scapula must be stabilized and the humerus abducted to 90° and externally rotated. With compression of the humeral head on the glenoid cavity, we can clearly appreciate when the convexity of the humeral head goes beyond the glenoid rim in any direction. Once this information is obtained, we then proceed with the arthroscopic examination and decide on a surgical approach based on the combined findings of the examination under anesthesia and the arthroscopic findings.

Portals

There are two anterior portals, the anterior superior (ASP) and the anterior inferior (AIP), and there are two posterior portals, the posterior superior (PSP) and the posterior inferior (PIP) (Fig 5).

After marking out the surface landmarks, in particular the posterior lateral edge of the acromion and the coracoid, we proceed to make the PSP at the posterior bony margin of the acromion at the level of the joint line. This joint line is easily palpated with the patient in traction by rotating the arm, while pressure of the thumb allows us to palpate the posterior level of the glenohumeral joint. With a blunt obturator in the arthroscope cannula, it is inserted and passed through the deltoid and infraspinatus muscle bellies to palpate the bony contours of the humeral head and the posterior superior rim of the glenoid cavity. It is not necessary to attempt to fill the joint cavity with saline, which, in fact, might prevent an adequate assessment of the anatomy with the blunt obturator in the arthroscope sheath. There are no sharp trocars on a shoulder arthroscopy set. Once the interval between the humeral head and glenoid is palpated, the blunt trocar is easily popped through the thin posterior superior capsule, entering the joint. The arthroscopic cannula, with its blunt trocar, is advanced anteriorly to palpate the coracoid process, which lies within the safe triangle created by the superior edge of the subscapularis, the inferior border of the biceps tendon, and the anterior superior edge of the glenoid cavity. Once the coracoid process is palpated, the blunt tip is allowed to slip off the inferior edge of the coracoid process and is advanced through the capsule and the deltoid and then tented the skin just inferior to the coracoid tip. A no. 15 blade is used to open the AIP. A cannula is then retrogressed back into the joint, where it is held for entry of a shaver, burr, and other instrumentation used during the course of the procedure.

A PIP is created 3 cm distal to the PSP, and this PIP is used to place the combination cannula of a 3M arthroscopy pump (3M, St Paul, MN) that is most helpful in distending the joint during this procedure.

An anterior superior portal is then created with an “outside-in” technique. The ASP is created under direct arthroscopic visualization by inserting a needle at the inferior border of the coracoacromial ligament into the rotator cuff interval. In essence, this ASP enters the joint behind the biceps tendon. This portal can be used for anterior visualization with the scope and can also be used to insert a grasper. This grasper can be used to place tension on the IGLLC while sutures are passed via the anterior inferior portal.

The surgeon must be familiar with the use of switching sticks and frequent changes in instrument and scope configurations. Often the surgeon has excellent visualization of the suturing process with the scope in the ASP, but as sutures are placed from inferior to superior, it is often preferable to switch to a 70° scope in the PSP to gain better visualization. (Fig 5C).

The preparation of the fibroblastic bed via debridement and abrasion of the anterior rim of the glenoid cavity and scapula neck is best accomplished with the scope in the ASP and the burr in the AIP.

In summary, there are two posterior portals, the PSP, at the posterior border of the acromion at the level of the joint line, and the PIP, at the level of the joint line 3 cm distal to the ASP. There are two anterior portals: the ASP

Fig 5. (A) The Bankart lesion among otherwise normal intraarticular shoulder anatomy. (B) This working configuration uses two anterior portals. The arthroscope is in the ASP and the large Concept cannula is in the AIP. A drill bit is making the drill holes in the glenoid rim. The transduction outflow cannula is in the posterior inferior portal. (C) After preparation and drilling of the glenoid rim, it is often advantageous to switch to a 70° scope in a PSP.
is used for visualization purposes, and the AIP is used to allow introduction of the transduction outflow cannula.

Arthroscopic Examination

Arthroscopic Bankart repair using suture anchors most often requires these four portals, which can be created as described. For even the most experienced arthroscopic surgeons performing this procedure initially, I would choose to begin the procedure with the creation of the most commonly used portals and those that most surgeons are familiar with, ie, the ASP and PIP. As described above, the ASP is located a little more anterior and superior than what is generally used in shoulder arthroscopy. The PIP is 3 cm from the inferior border of the acromion; thus, it is slightly more distal than the "soft spot" most commonly used. Thus, the surgeon enters the joint with the arthroscope via the PIP and can distend the joint and then visualize the area of the ASP, with the spinal needle coming in the region of the most superior part of the rotator cuff interval. This will allow establishment of flow and allow for the arthroscopic evaluation of the joint to begin. This procedure, performed with the standard 30° scope from the PIP, will generally allow the identification of a classic Bankart lesion. A 70° scope further facilitates the inspection from the posterior portal. The surgeon can view from the posterior portal and use the anterior cannula to probe the anterior ligament labral complex.

The arthroscopic examination is not complete until the structures are visualized from the ASP; thus, with switching sticks, the outflow cannula is placed in the PIP and the arthroscope in the ASP to allow the best possible evaluation of the anterior inferior structures; a 30° scope is more than adequate to allow this. The combination cannula can be pushed across the joint from a posterior direction and used to palpate the anterior structures.

If the patient has already undergone examination that clearly shows anterior inferior instability and if significant pathology of the glenohumeral ligament labral complex has been noted arthroscopically, the surgeon then needs to proceed to create the AIP and the PSP.

It is critical to maintain these portals at all times with a cannula in place. If this is done carefully and the portals are always maintained with cannulas within them, extravasation will be minimized. This careful technique, plus the use of a pump that allows control of intra-articular pressure and distention while maintaining flow, will minimize extravasation. When completed, these procedures result in remarkably little soft tissue dissection.

AIP

The key to obtaining access to the anterior inferior aspect of the glenoid cavity, where the pathology generally exists in recurrent anterior dislocations or subluxations, lies in the creation of the AIP. A cadaver study and clinical trial by Wolf has proven the safety of using such a portal in arthroscopic stabilization procedures. This portal is created using an inside-out technique, as already noted in the discussion of the posterior portals. This AIP is created with the blunt obturator in the arthroscope sheath. After entering the joint through the PSP the surgeon identifies the tip of the coracoid process by palpation with the blunt obturator. The obturator and sheath are advanced and slip off the inferior border of the tip of the coracoid process and are pushed out through the soft tissues and generally at the angle created by the conjoined tendon and the pectoralis minor. An incision is made carefully in this area because of the proximity of the cephalic vein. It is important to retrograde a cannula of choice back into the joint over the tip of the obturator, ensuring that both tips are positioned within the joint, before allowing contact of the cannula and obturator to be released.

There may be some trepidation in using this portal for fear of damaging the musculocutaneous nerve, but the safety of this approach has been documented (Fig 6). Wolf has shown that this portal remains between 1.5 and 4.0 cm (average, 2.9 cm) from the musculocutaneous nerve, and in no dissection or clinical case was there any damage to any neurovascular structure, in particular, the musculocutaneous nerve.

Preparation of the Anterior Glenoid Rim and Scapular Neck

After all the portals have been created, the next step is to prepare the anterior glenoid rim and scapular neck for creation of the fibroblastic bed and drill holes. The arthroscope is repositioned in the ASP to best visualize the anterior glenoid rim and scapula neck. The detached labrum is visualized, and an aggressive full-radius resector is used in the AIP with minimal or intermittent suction to clear the field. Care should be taken not to suction into a full-radius resector any viable tissues of the IGLLC needed for repair. An aggressive full-radius resector will allow excellent dissection along the scapula neck and glenoid rim to enlarge and complete the Bankart lesion.

Fig 6. Anatomy of the anterior inferior portal (P). This portal is always created with an inside-out technique at the junction of the conjoined tendon (CT) and the pectoralis minor (PM). The musculocutaneous nerve (arrow) is 2 to 4 cm from this portal. (Reprinted with permission.)
This will allow advancement and retensioning of the ligament labral complex. Once the soft tissue has been removed from the scapula neck, a motorized burr is used to decorticate the glenoid rim and scapula neck to bleeding bone.

Creating Drill Holes

At this point, it is necessary to switch cannulas in the AIP and place a large Concept arthroscopic cannula (Concept Surgical, Largo, FL) that will accommodate the drill guide, the drill bits, the suture hook, and anchors.

Once the cannula is inserted, the Mitek drill guide and drill are inserted, and three drill holes are spaced as far as possible from each other on the anterior glenoid rim. A drill hole is created as inferiorly as possible on the glenoid rim and another as far superiorly as possible within the lesion on the glenoid rim. The third hole is created between the two previously drilled holes.

It is important to check the direction of the drill bit and drill guide to ensure that the angle of the drill bit is at approximately 15 to 20°, angling medially to the plane of the glenoid surface, ie, going under the glenoid surface, avoiding potential damage to this articular surface.

To insert the suture, while still viewing through the ASP with the large arthroscopic cannula in the AIP, place a suture hook through the most inferior portion of the detached IGLLC (Fig 7). For cases in which there is a very cleanly detached IGLLC, this configuration with the scope in the ASP and the cannula in the AIP is sufficient. There are occasions when the ligament labral complex is nothing more than a scarred remnant of fibrous tissue that must be dissected free from the scapular neck. In such cases, it is best to place the scope in the PSP, place a grasper in the ASP to stabilize the remnants of tissue, and place the suture through the cannula in the AIP. A 70° scope in the PSP provides a good view of the drill holes and the tissue to be sutured and avoids crowding in the anterior aspect of the joint (Fig 5B).

The suture hook will feed a 0 PDS suture into the joint a sufficient distance so that the suture hook can be withdrawn, leaving the suture through the detached IGLLC. A suture grasper is then inserted, pulling out the end of the inserted suture, thus creating a loop going down through the cannula, through the ligament, and back out.

An anchor is then mounted on the inserter and fixed to the inserter with a security stitch of 0 suture that is tied over the handle of the inserter. This avoids losing the anchor within the joint should excessive pressures be placed on the anchor and it be tipped off the inserter. With the suture anchor mounted, it is slid down the "inside limb" of the suture, ie, that end of the suture that came through the avulsed surface to be applied to the glenoid rim. It passes down through the cannula, sliding over the suture to enter the first drill hole (Fig 8A and B).

The anchor is then inserted into the first drill hole, and the security suture used to fixate the anchor to the inserter is cut. The inserter is pulled out, thus leaving a loop of suture going down through the cannula, through the detached IGLLC into the hole, through the base of the anchor, back out the hole, and out the cannula (Fig 8C).

The Generation II Mitek anchor allows the suture to slide within the anchor and within its drill hole. The loop is closed, using a slipknot that is tied outside of the cannula, tightened outside the cannula, and slid down the

Fig 7. The first stitch is inserted in the detached inferior ligament labral complex. The scope is in the ASP, and the suture hook is passed through cannula in the AIP.

Fig 8. A suture anchor is slid down the inside limb of the suture (A) and inserted into the most inferior hole (B). A sliding loop is thus created that passes down the cannula, through the ligament, through the anchor and out the cannula (C).
cannula, tightening the loop and approximating the most inferior part of the IGLLC (Fig 9).

In general, three anchors and sutures are inserted, but two may be sufficient in some cases. The more proximal anchors and sutures often have to be inserted with the scope in the PSP. This avoids crowding in the anterior superior aspect of the joint and still permits, with a 70° scope, visualization of the drill holes and allows the insertion of suture and anchors.

Before closing the wound, the shoulder is filled with 20 mL of 0.25% bupivacaine with epinephrine. Once the repair is complete (Fig 10), all arthroscopic equipment is withdrawn, and the portals are closed with simple nylon sutures. A compressive dressing and immobilizer are applied.

**POSTOPERATIVE REGIMEN**

The patients wear the immobilizer almost continuously for 3 weeks postoperatively, except during bathing. Patients are advised that they may remove the dressings after 48 hours and apply adhesive bandages. The sutures are removed in 5 days. After 3 weeks, the patients are allowed to come out of the immobilizer gradually, but they are advised to wear it at night for a total of 6 weeks.

At 6 weeks, the patients are advanced to a more aggressive phase of therapy with full-range-of-motion exercises. A basic home therapy program suffices in the majority of cases; rarely does the patient need a formal physical therapy program. Only the most apprehensive and pain-intolerant patients have difficulty regaining motion, and most have full motion at 12 weeks.

**RESULTS**

This procedure has been performed in over 20 patients since September 1989. There have been no complications and no recurrences. Obviously the follow-up is short, and the results will have to be assessed in 2 to 3 years, but this arthroscopic Bankart repair does restore the IGLLC as physiologically and anatomically as possible without the morbidity of an arthrotomy.

This technique also allows for a degree of capsular plication. The suture hook passes not only through the labrum but through approximately 1 cm of capsule distal to the labrum. With capsular plication, as well as labral advancement, the patients have a sensation of stability as soon as they begin their rehabilitation.

**PITFALLS**

As with many arthroscopic techniques and shoulder surgery, this procedure is extremely demanding and should be performed only by surgeons with superior arthroscopic skills. For even the most experienced surgeons, there is a difficult learning curve in this technique. The technique described here has evolved to some extent, with the addition and modification of portal placement, but the basic principles remain the same.
CONCLUSION

As orthopaedic surgeons, we have the benefit (or the curse) of numerous methods to treat the multitude of problems that may need to be addressed in caring for a patient with a disorder of the musculoskeletal system. Throughout modern times, surgeons have attempted to develop techniques offering the highest chance of success with the lowest possibility of complication or failure. Our experience in treating shoulder pathology has been aided by the advent of arthroscopic techniques, which allow for better visualization of the anatomic structures associated with the various problems that involve the shoulder. At the same time, experienced arthroscopists have refined their skills and devised new instruments and techniques to allow for surgical repair of injured tissues of the shoulder. As with most areas of orthopaedic surgery, the physician must have a broad knowledge base to allow for proper decision making when planning the care of an orthopaedic problem. Throughout this journal, the authors have presented different arthroscopic approaches to the diagnosis and treatment of disorders of the shoulder. We are in varying stages of development of these techniques, and the ultimate success of any technique will have to stand the test of time.

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