Technical Note

Simplified Arthroscopic Rotator Interval Capsule Closure: An Alternative Technique

Yuri M. Lewicky, M.D., and Roman T. Lewicky, M.D.

Abstract: The anatomy of the "coracoid eclipse" of the rotator cuff, the rotator interval, has been studied extensively. Its importance in shoulder stability with respect to inferior and posterior translation has been described. Historically, open repairs for instability indirectly addressed interval lesions and closure based simply on the definition of the deltopectoral approach with its subscapularis advancement and capsular shift in a "pants-over-vest" manner. With results of arthroscopic repairs of glenohumeral instability approaching those of open procedures, the importance of simplification without sacrificing outcome has become a forefront in arthroscopic shoulder surgery. We present an alternative technique for interval closure by means of a 3/32-inch smooth Steinmann pin modified at its proximal and distal ends. A standard 3-portal technique consisting of the anterior superior portal, anterior mid-glenoid portal, and the posterior superior portal is used. The technique does not require the use of a suture shuttle nor does it require the placement of the arthroscope in the subacromial space for suture tying. A Tennessee slider knot is tied intra-articularly, thus allowing for tension modification before definitive alternate locking half-hitch placement. Intra-articular knot tying also allows for added security because suture slack is eliminated, thus avoiding air knots. **Key Words:** Rotator interval—Arthroscopic closure—Glenohumeral instability.

The "coracoid eclipse" of the rotator cuff with the superior glenohumeral ligament (SGHL) and coracohumeral ligament (CHL) contained within its umbra has been studied extensively. Its macroscopic and microscopic anatomy have been delineated[1-6] as has its histologic character.[3] Numerous studies have addressed its importance in restraint to shoulder subluxation and shoulder instability,[7-16] and a greater openness to interval capsule closure is evolving. Both open[7,16] and arthroscopic[10,17-19] procedures involving the rotator interval have been described and the advantages of arthroscopic shoulder surgery are now known.[8,20-23] We describe an alternative technique for arthroscopic interval capsule closure by means of a modified Steinmann pin.

STEINMANN PIN MODIFICATION

A 3/32-inch smooth Steinmann pin is modified at the proximal end with the placement of a 1-mm diameter hole, 5 mm from the sharp tip—hence the descriptive term "holey spear." The 1-mm hole easily allows the passage of a No. 2 Ethibond suture (Ethicon, Somerville, NJ), the authors' preferred suture choice for interval closure. Additionally, a longitudinal etch mark is placed between the spear tip and the newly fashioned hole. The etch mark facilitates suture management intra-articularly by preventing spear capture within the interval stitch. The distal end of the

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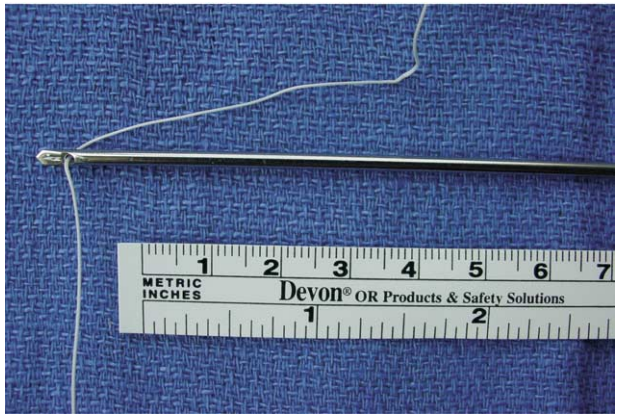

Figure 1. The modified 3/32-inch smooth Steinmann pin with an etched hole at the proximal end loaded with a No. 2 Ethibond suture.

spear is rounded off to a blunt tip to prevent inadvertent spearing of surgeons or assistants (Fig 1). Each spear can be resterilized, allowing for multiple procedures limited only by continued spear tip sharpness.

OPERATIVE TECHNIQUE

Initial patient positioning is supine on a bean bag. General endotracheal anesthesia is administered followed by a thorough shoulder examination of both the affected and unaffected sides. Particular attention is paid to excessive side-to-side differences with anterior translation and a sulcus sign with the arm in internal and external rotation. Repositioning of the patient into the 20° supinated lateral decubitus position with the proper placement of an axillary role at the level of the nipples is performed. The peroneal nerve is properly protected and the knees and hips are flexed with a pillow placed between them. The bean bag is inflated and the arm is placed in the shoulder holder (Dyonics, Smith & Nephew, Memphis, TN) in 60° of abduction and 15° of forward flexion with 10 lb of traction. Before interval closure, 5 lb of traction are removed to facilitate knot tying under decreased tension. Operative arthroscopy is performed with the creation of the standard posterior superior portal (PSP) and placement of the arthroscope. Anterior structures are assessed to determine desired anterior portal placement. If an interval lesion exists, its incorporation into a portal site is desirable to minimize further interval damage. If anterior reconstruction, superior labrum anterior to posterior (SLAP) lesion repair, or interval closure are anticipated, a high anterior superior portal (ASP) will be necessary in addition to the standard anterior midglenoid portal (AMGP). The AMGP is established by advancing the arthroscope into the triangle formed by the subscapularis and biceps tendons. Portal placement is just superior to the subscapularis tendon toward the triangle apex. If hidden interval lesions are suspected, placement of the cannula more medial and inferior in the interval is recommended so as not to obscure them.[1] An inside-out "obturator within scope cannula" technique is performed, making sure that the portal exit site is lateral to the coracoid process. A 15-step diagnostic arthroscopy of the shoulder is performed as described by Snyder.[24,25] Improved visualization of the interval can be obtained by retracting the biceps tendon intra-articularly with the elbow flexed and the shoulder elevated and internally rotated.[26,27]

The ASP is then established using an 18-gauge spinal needle and an outside-in technique. The needle is placed just off the anterolateral corner of the acromion, aiming for the superior margin of the interval just inferior to the biceps tendon. Both anterior portals are fitted with a 7-mm clear plastic cannula (Arthrex, Naples, FL). Other lesions allowing for glenohumeral instability are addressed first, with the rotator interval closure addressed last. Before closure, the arm is abducted 30° and externally rotated 30° to prevent external rotation loss. Closure is observed from the PSP. The holey spear is loaded with a No. 2 Ethibond suture until the suture ends are equally distant from the spear tip. The suture end that exits from the spear on the side without the etch mark is tagged with a mosquito clamp. When placing the spear, attention is paid to the orientation of the etch mark, with a lateral-facing orientation being optimal, but not required. The clear AMGP cannula is retracted until it is extracapsular; an optional modification is to use the AMGP cannula capsular entrance point as the first point of spear placement. Once extracapsular, the cannula can be used as a probe to push on the capsule, allowing for orientation for proper spear placement. Depending on structural integrity of the interval tissue, inferior spear placement can be just superior to the subscapularis tendon or through the superior border of the tendon. Similarly, a small portion of the supraspinatus tendon can be incorporated when placing the spear in the superior portion of the interval. The holey spear is advanced through the AMGP and the capsule is pierced at the desired location oriented parallel to the glenoid. Once intra-articular, the spear is slightly withdrawn so as to form a small amount of suture slack, thus facilitating suture grasping. A crochet hook is placed in the ASP (Fig 2), and the suture end exiting

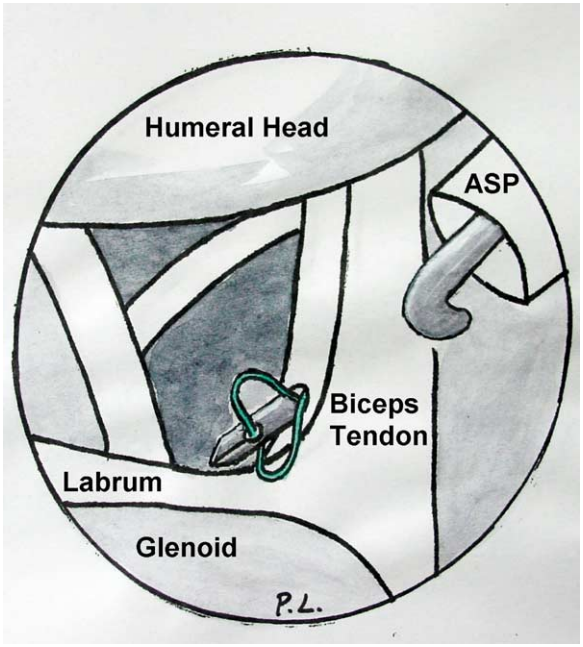

FIGURE 2. Arthroscopic view of the rotator interval of the left shoulder from the PSP. A loaded spear in the AMGP has pierced the superior portion of the interval and has been retracted slightly to produce suture slack for facilitated grasping. A crochet hook enters through the ASP.

from the etch mark side is hooked and pulled out the ASP and tagged with a mosquito clamp. Mild tension is maintained on the suture end exiting from the ASP while the spear is withdrawn to the level of the mid-portion of the clear cannula.

The cannula is now redirected against the capsule in a more inferior location and the spear is once again advanced through the capsule and withdrawn slightly for suture slack (Fig 3). The clamp on the suture end exiting from the AMGP is released. A crochet hook is then reinserted in the ASP and the suture end exiting from the etch mark side is hooked and pulled out of the ASP (Fig 4). Both ends are tagged together for later tying. Interval closure suture placement should proceed from the most medial aspect of the interval and from the supraspinatus tendon to the subscapularis tendon. Subsequent sutures should be placed more laterally toward the apex of the interval triangle. All tying should be performed last and proceed in a lateral to medial direction. By using a Tennessee slider knot, the range of motion of the shoulder can be evaluated with all sutures partially tied and loosened or tightened accordingly before half hitch locking. The authors choose to use at least 2 side-by-side stitches to distribute tensile forces (Fig 5). An additional step (the utility of which still remains to be determined) is that, before placing the inferiorly located suture, the interval is punctured in a sequential superior to inferior manner to initiate bleeding and improve the strength of the closure. Additional modifications of the above procedure include use of only a PSP and an ASP in isolated rotator interval lesions in which an AMGP is not necessary. In this situation, the spear suture complex can be passed percutaneously to the appropriate AMGP position within the interval with the subsequent passage of suture and associated tying. Final inspection of the joint is performed before arthroscope withdrawal.

DISCUSSION

The anatomy of the rotator interval has been extensively studied.[1-6] The interval is triangular in shape with its base formed by the perforation of the rotator cuff by the coracoid process and its apex defined by the transverse humeral ligament at the biceps intertubercular sulcus. The width of the interval capsule averages 1.7 to 2.0 mm[3] and consists of the CHL, the SGHL, and the glenohumeral joint capsule. The superior border of the interval is formed by the anterior border of the supraspinatus musculotendinous unit and the inferior border by that of the subscapularis. Volk

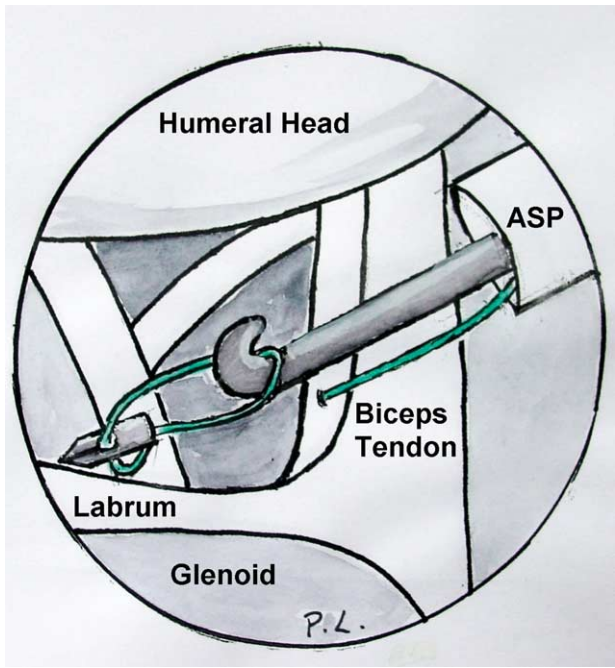

FIGURE 3. Piercing the inferior portion of the rotator interval.

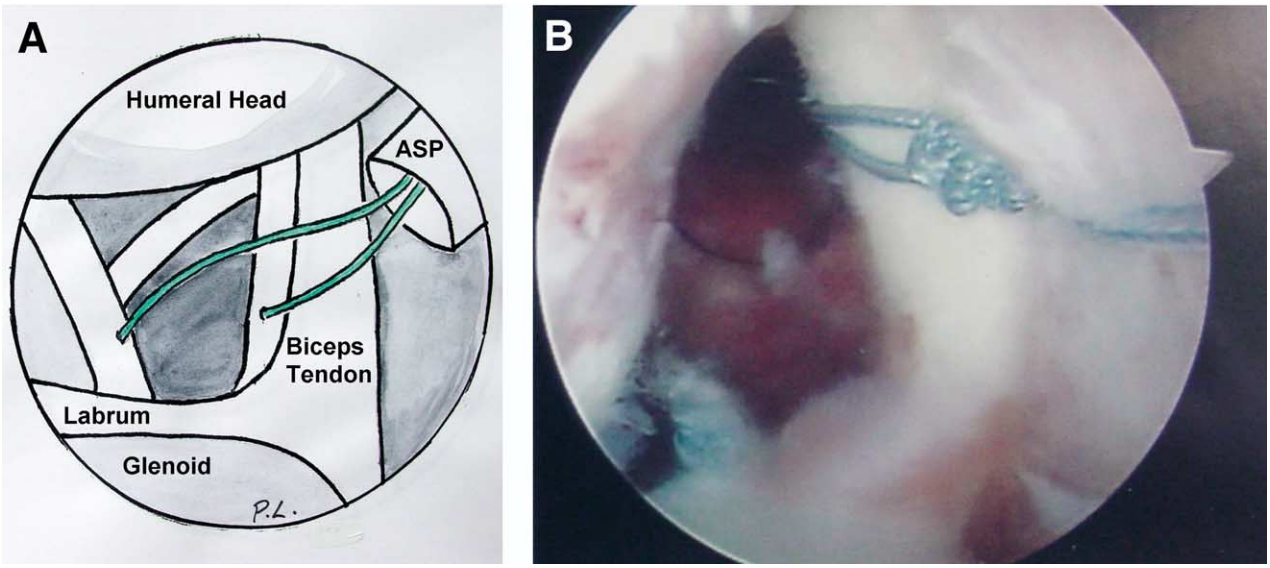

Figure 4. Interval closure with suture management through the ASP in preparation for tying. (A) Artistic rendition and (B) photograph.

and Vangsness[6] found in their study of 20 anatomic shoulder specimens that the anterior lateral portion of the supraspinatus contained more tendon than the posterior portion, thus suggesting its utility when closing the rotator interval or a rotator cuff tear. Similarly, the subscapularis was shown to have a specific superior medialized tendinous portion.[28,29] Jost et al.[4] distinguished 2 functional parts of the rotator interval, a medial component composed of 2 layers and a lateral component consisting of 4 layers. The medial portion, specifically the CHL component, was shown to mostly control inferior translation of the adducted arm and to a lesser extent external rotation. In contrast, the lateral component mainly influenced external rotation of the adducted arm.

Pathology of the "coracoid eclipse" of the rotator cuff, the rotator interval, recognized as a patulous interval capsule, fraying, or subluxation of the biceps tendon, SGHL tears, or injury to the superior margin of the subscapularis, has been implicated in shoulder instability.[11,12,15,17] Historically, arthroscopic stabilization of anterior shoulder instability centered on repair of the "essential lesion," formerly known as the Bankart lesion. Hintermann and Gachter[30] identified several pathologic lesions associated with glenohumeral instability in 212 patients with documented shoulder dislocations. The lesions included labral tears, anterior capsular deficiency, Hill-Sachs lesions, glenohumeral ligament disruption, rotator cuff tears, and SLAP lesions. Normal shoulder stability is dependent on both static and dynamic structures; these include the fitting of the humeral head into the glenoid socket, the glenoid labrum, intra-articular pressure with adhesion and cohesion, the superior, middle, and inferior glenohumeral ligaments, the rotator cuff and

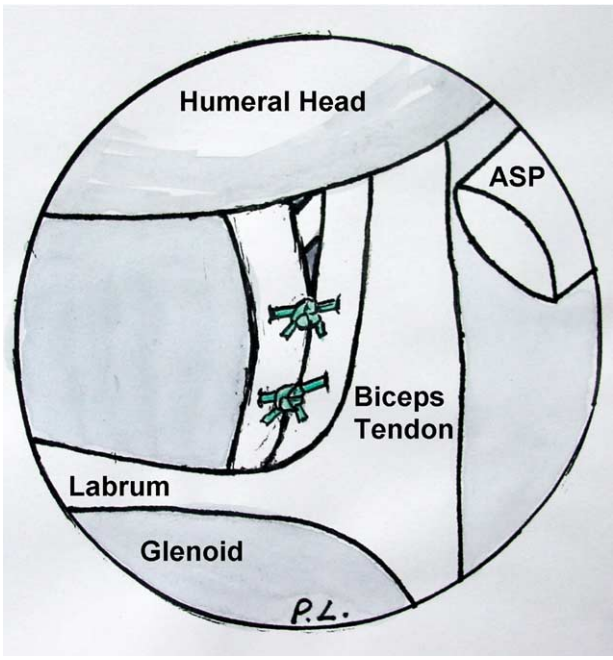

Figure 5. Rotator interval closure with placement of 2 side-by-side sutures.

associated scapular musculature, and the long biceps tendon and its intra-articular attachment.[10] The rotator interval serves as the only structure that maintains intra-articular pressure in the zone where the rotator cuff is absent, making it anatomically and functionally significant to shoulder stability.[13,31] The rotator interval is particularly susceptible to insult during arthroscopic shoulder procedures because of the placement of the AMGP within the interval itself. Frequently, large defects remain unaddressed and iatrogenic ones overlooked.

The popularity of arthroscopic shoulder stabilization is increasing. Open and arthroscopic interval capsule closure have been described in numerous reports of studies using varying techniques.[7,8,10,16-19,32] Gartsman et al.[8] studied 53 shoulders in 53 patients and concluded that anterior-inferior glenohumeral instability was associated with multiple lesions and that greater success was achieved by treating all lesions simultaneously. The benefits of arthroscopic procedures include less intraoperative bleeding, decreased postoperative pain medication, shorter hospital stays, less soft tissue violation, inspection and access to all areas of the glenohumeral joint, the ability to treat intra-articular lesions, and preservation of external rotation.[8,20-23]

The arthroscopic technique presented here is unique in that the use of a modified Steinmann pin greatly facilitates rotator interval capsule closure. Benefits include an accurate, efficient device that does not require a suture shuttle with its required suture transfers. Knots are tied intra-articularly, thus avoiding arthroscope transfer to the subacromial space. Additionally knots are placed directly onto the capsule, eliminating the possibility that they have been secured in subcutaneous tissue alone. Over the past year, the senior author (R.T.L.) has used this technique in 15 patients and has not incurred any complications. The holey spear technique serves as an adjunct to arthroscopic shoulder stabilization or as a primary means of addressing rotator interval lesions and can readily be used for anterior and posterior portal closure.

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