Technical Note

Arthroscopic Low-Profile Knotless Repair of SLAP Tears With Suture Tape

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Abstract: SLAP tears have been a controversial topic in shoulder surgery for decades. The indications for repair of SLAP tears, as well as the methods of repair, have undergone a recent evolution. The use of intra-articular knots for SLAP repair has fallen out of favor because of potential abrasive damage to the rotator cuff and glenohumeral articular cartilage due to knot migration and prominence. In response to this potential iatrogenic injury, arthroscopic techniques have undergone an evolution using advanced techniques with low-profile knotless repairs. We describe our preferred low-profile knotless technique for SLAP repair using LabralTape (Arthrex) in a horizontal mattress configuration.

SLAP tears were first described by Andrews et al.1 in 1985 and were later classified into 4 distinct tear patterns by Snyder et al.2 Maffet et al.3 and Morgan et al.4 subsequently expanded this classification to include additional tear types. Surgical techniques were revolutionized with the introduction of the suture anchor and arthroscopic knot tying, but reports of abrasive damage to the rotator cuff and glenohumeral articular cartilage after knotted SLAP repairs due to knot prominence and knot migration5-8 have led to increased interest in knotless fixation techniques. Knotless fixation offers the potential advantage of a low-profile construct with biomechanically equivalent strength to traditional knot-tying methods.9 Furthermore, the use of a suture tape in a horizontal mattress configuration may more accurately restore the anatomy of the superior labrum and provide superior strength to the repair.10-13 We describe a knotless repair technique for SLAP lesions using LabralTape (Arthrex, Naples, FL) in a horizontal mattress configuration.

Surgical Technique

Our technique uses the traditional lateral decubitus position with a bolster under the arm for optimal visualization (Video 1, Table 1). A standard posterior portal is created, and diagnostic arthroscopy of the glenohumeral joint is performed. Concomitant pathology may be addressed in the same setting. Once the SLAP tear has been evaluated through the posterior portal, an 18-gauge spinal needle is used to localize an anterior-superior portal within the rotator interval, and an 8-mm clear cannula (Smith & Nephew, Andover, MA) is inserted using a standard surgical technique. A probe is used to determine the extent of the superior labral tear (Fig 1). A 4.5-mm shaver (Smith & Nephew) is used to debride any degenerative labral tissue and lightly decorticate the glenoid rim to a bleeding bed in preparation for repair (Fig 2). The arthroscope and working portal may be interchanged to adequately prepare the superior glenoid rim.

After bone bed preparation, a 45° left crescent-shaped suture passer (Linvatec, Largo, FL) is initially used to pass a PDS suture (Ethicon, Somerville, NJ) through the labrum (Fig 3). As opposed to traditional fixation techniques in which the suture is passed under the inferior aspect of the labrum, our technique passes the suture through the middle of the labrum to allow...
Table 1. Key Steps of Arthroscopic Knotless Repair of Superior Labrum Using LabralTape

1. Light Decortication of Glenoid rim in Preparation for Repair
2. Careful passage of sutures through middle of labrum
3. Suture management to ensure mattress configuration
4. Percutaneous entry of anchor inserter for proper drilling angle
5. Careful tensioning of LabralTape during anchor insertion to provide labral compression
6. Careful cutting of suture flush with chondral surface

the horizontal mattress configuration to better restore the anatomy and to create greater compression. We traditionally begin our repair posteriorly and progress anteriorly to aid in suture management and visibility. A standard suture-shuttling technique is used to pass a 1.5-mm flat, braided, high-strength polyethylene LabralTape suture (Arthrex) through the labrum in preparation for repair. Owing to the thickness of the LabralTape and the acute angle of shuttling, a knot pusher (Smith & Nephew) is used as a pulley to prevent abrasion of the labrum during this process (Fig 4). Suture management and organization are vital at this stage of the surgical procedure, and we recommend using multiple hemostats outside the portals to mark the suture tails to aid in tracking the separate ends of the sutures being passed. Special attention during the second shuttling step of each mattress stitch is critical to ensure that the end of the LabralTape that is behind the labrum is passed from behind the labrum to the front of the labrum to create a mattress configuration with both tails in front of the labrum (Table 2).

In preparation for anchor placement, a small percutaneous trans–rotator cuff portal is created using a percutaneous insertion kit (Arthrex) (Fig 5). This portal is also beneficial in suture management. We normally pass 2 horizontal mattress sutures posterior to the biceps and have found that sutures and anchors anterior to the biceps are unnecessary for an adequate repair. Once the mattress sutures have been passed, an offset drill guide (Arthrex) is positioned 2 mm onto the edge of the glenoid articular surface to avoid lateralizing the labral tissue. A hard bone drill (Arthrex) is used to drill a standard hole for a short, 2.9-mm × 12.5-mm BioComposite PushLock anchor (Arthrex). The previously shuttled LabralTape is then threaded through the eyelet of the anchor, and the eyelet is inserted into the previously drilled hole at the same trajectory (Fig 6). Great care is taken to leave enough slack in the tape prior to anchor insertion to avoid over-tightening or tearing through the labrum during insertion of the anchor. The anchor is then tapped with a mallet over the eyelet to secure the LabralTape over the labrum using press-fit fixation. Once the anchor has been inserted into the bone, additional adjustments in the tension of the tape may not be applied. The free ends of the LabralTape are cut flush with the chondrolabral surface using a Mini Suture Cutter (Arthrex) to avoid chondral abrasion or suture irritation. The process is then repeated, working from a posterior-to-anterior direction on the glenoid. A probe is used to verify a secure repair of the superior labrum (Fig 7).

Postoperatively, the patient is immobilized in an abduction pillow sling (DonJoy, Lewisville, TX). A home exercise program is started at 1 week and includes scapular retraction exercises, pendulums, and active elbow and wrist range of motion. The pillow portion of the sling is removed at 1 month postoperatively, and the patient begins formal physical therapy with passive range-of-motion exercises and soft-tissue mobilization. The sling is removed completely at 2 months, and physical therapy is progressed to active range of motion. Resistance exercises are started at 3 months postoperatively, and return to sports is permitted at 6 months postoperatively.

Discussion

The optimal treatment of SLAP lesions is predicated on multiple factors including patient age, level of activity, and type of sport, as well as tear morphology. Knotless fixation techniques offer a secure repair with both mechanical and clinical advantages (Table 3). The optimal treatment of SLAP lesions is predicated on multiple factors including patient age, level of activity, and type of sport, as well as tear morphology. Knotless fixation techniques offer a secure repair with both mechanical and clinical advantages (Table 3). Mechanically, a knotless technique diminishes the potential for knot migration, and the lower profile of the construct reduces the risk of abrasive wear on the rotator cuff and glenohumeral articular cartilage that has been previously reported with knot-tying techniques. Clinically, Park et al. clinically observed significant pain reduction and improved outcomes after arthroscopic knot removal in a small cohort of patients who had previously undergone SLAP repair. They postulated that the

Fig 1. Arthroscopic view of a left shoulder in the lateral decubitus position from the posterior portal. A probe, visualized from the anterosuperior portal, is used to lift the SLAP tear (arrow) in preparation for repair.
presence of suture knots alone could be a source of persistent shoulder pain. Our preference is to use a technique that limits the amount of exposed suture material to avoid these potential risks.

Several studies have reported on the potential clinical benefits of knotless fixation. Yang et al. \(^1\) compared the outcomes of 46 patients who underwent repair of type II SLAP tears with either a conventional vertical knot or knotless horizontal mattress suture. The knotless fixation group showed significantly greater amounts of external rotation at the side, internal rotation at abduction, and total range of motion at final follow-up. However, the differences in functional outcome scores did not reach statistical significance. Similarly, Reinig et al. \(^1\) found that athletes who underwent knotless repair of type II SLAP lesions achieved a significantly greater amount of external rotation in high abduction compared with those who underwent a knot-tying technique. As a result of their findings, the authors

### Table 2. Pearls and Pitfalls of Arthroscopic Knotless Repair of Superior Labrum Using LabralTape

| Pearls                                                                 | Pitfalls                                                                 |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------|
| Positioning of the anterosuperior portal to optimize suture passage   | Shutting of the suture tape at an acute angle without a knot pusher and  |
| and retrieval                                                         | “sawing” through the labrum                                              |
| Use of a covered or hooded shaver or burr to prepare the glenoid      | Poor suture management with tangling of sutures during passage           |
| Penetration of the labrum with a small passing device to minimize labral damage | Not using a hard bone drill, which may lead to breaking of the anchor during insertion |
| Penetration of the labrum in the middle to allow for a horizontal mattress technique | Placing a large cannula through the rotator cuff, which may lead to a tear |
| Use of a knot pusher to minimize suture abrasion to the labrum during shuttling | Over-tensioning the labrum during anchor insertion, causing suture cutout and tissue tearing |
| Leaving a small amount of slack in the suture during anchor insertion to avoid over-tensioning | Leaving a tail of suture after cutting, which may lead to chondral abrasion |
|                                                                        | Placing anchors anterior to the biceps tendon, which may lead to overconstraint and postoperative stiffness |
recommended the use of knotless fixation in type II SLAP repairs in overhead athletes. In a recent retrospective cohort, de Groot et al.\textsuperscript{18} examined the results of 74 patients with type IIb SLAP tears that were treated with SLAP repair using either knotted or knotless anchors. Although not statistically significant, their results showed a trend toward a decreased likelihood of revision surgery, higher rate of return to play, and improved outcome scores with knotless fixation.

The geometry of the suture used for SLAP repair may also play a pivotal role in achieving improved outcomes. Sileo et al.\textsuperscript{20} compared knotted horizontal mattress sutures with knotless fixation for SLAP repair in a cadaveric model using traditional round sutures for all repairs. They found that 80% of the SLAP repair constructs failed via intact suture cutting through repaired labral tissue at the suture—soft tissue interface. LabralTape not only offers the advantage of being an all-polyethylene, low-profile tape suture, but the flat geometry also provides a broader surface area for improved force distribution. In biomechanical testing, 1.5-mm LabralTape was found to be 37% more resistant to tearing through cadaveric labral tissue than traditional No. 2 FiberWire (Arthrex),\textsuperscript{13} which may improve the mechanical properties at the weakest point of the SLAP repair construct. Furthermore, the horizontal mattress configuration may provide a stronger construct than a vertical mattress configuration\textsuperscript{9} and more accurately restore the normal anatomy of the superior labrum.\textsuperscript{10}

Although numerous similar knotless techniques for SLAP repair have been described in the literature,\textsuperscript{10,17,21-23} our technique combines knotless fixation with a tape suture in a horizontal mattress configuration. This technique allows for a low-profile construct that reduces the risk of abrasive damage to the labrum.

| Table 3. Advantages of Arthroscopic Knotless Repair of Superior Labrum Using LabralTape |
|---------------------------------|---------------------------------|
| Standard arthroscopic Shoulder Setup and Portals | Similar to standard procedures |
| Familiar arthroscopic passing and shuttling techniques | Similar to standard procedures |
| Knotless, low-profile repair, minimizing risk of suture migration or irritation | Similar to standard procedures |
| Secure fixation with small BioComposite anchors | Similar to standard procedures |
| Broad, smooth compression of labrum with less risk of chondral abrasion | Similar to standard procedures |
| Potential for early rehabilitation with greater resistance to labral pull through | Similar to standard procedures |
the articular surface and rotator cuff from prominent or migrated suture material with the additional potential benefits of superior fixation strength and a more anatomic reduction of the glenoid labrum.

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