Sutureless Anchors in Shoulder Surgery

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Since the introduction of sutureless anchors for shoulder surgery in the late 1980s, multiple reports of their success in shoulder surgery have been published. Current use of sutureless anchors in shoulder surgery include stabilization and rotator cuff surgeries. Techniques for rotator cuff repair and Bankart stabilization are described in this article. The overriding reason for their continued use is the simplicity of their insertion, making them a very attractive alternative for arthroscopic shoulder surgery. Usually a guide wire is inserted through the rotator cuff or the capsulolabral tissue and driven into the bone. The cannulated drill or tap is then inserted over the guide wire to the desired level and exchanged for the placement of the sutureless anchor. A review of the latest literature reveals that these procedures’ overall success is inferior to that of suture anchors. Furthermore, sutureless anchors have also been associated with possibly significant complications such as inflammatory reactions, intraarticular migration, and failure of reduction, although the relative incidence compared with suture anchors is unclear. However, there may still be a place for sutureless anchors in clinical practice.

KEYWORDS: Bankart, rotator cuff tear, SLAP, sutureless anchors, tack

In 1982, arthroscopic shoulder stabilization using metal staples was first introduced by Dr L.L. Johnson. This method was an arthroscopic adaptation of the Johannesburg stapling technique described by Du Toit and Roux in 1956. Potentially disastrous complications of metal staples such as lost fixation—resulting in these staples becoming loose bodies within the shoulder, leading to significant articular cartilage loss and posing difficult technique modification for future shoulder surgery—led to the development of other metallic anchors and absorbable anchors. When sutureless anchors (tacks) were first introduced, there was significant initial interest in them as they helped simplify procedures by avoiding the need to drill tunnels to suture soft tissue to bone and increase the ability and flexibility to perform procedures arthroscopically. Developing new anchors without suture is also of interest. The ease of not having to tie arthroscopic knots and dealing with multiple sutures for arthroscopic rotator cuff and Bankart surgeries are reasons many surgeons still prefer sutureless anchors. Many have found suture breakage to be the major mode of failure of rotator cuff repair. A sutureless anchor that does not require passing the suture through the tendon and avoids knot tying is appealing choice. There have been multiple publications since their introduction. Initial reports provided acceptable results, though the latest ones yielded less than optimal results when compared with suture anchors.

Literature Review

Stabilization Surgery

Initial literature reports concerning arthroscopic implantation of metal staples for Bankart lesions revealed a high rate of redislocation of 11-33%. More recently, however, reports of recurrence rates after arthroscopic shoulder stabilization of Bankart lesions with bioabsorbable tacks vary between 5-21%. Existing literature lacks prospective randomized clinical trials of arthroscopically implanted sutureless anchors with suture anchors or open techniques for shoulder instability. However, there are some studies that provide information about the success of sutureless anchors in the management of shoulder instability.

A multicenter prospective study of patients with recurrent shoulder instability after a primary dislocation compared arthroscopic labrum stabilization with tacks (Suretac; Smith & Nephew Endoscopy, Andover, MA) with the standard open technique. The study found a 23% recurrence rate with arthroscopic techniques as compared to 12% with the open procedure. The authors attribute this difference to patient selection, minor surgical technique differences between the different participating surgeons, and the difficulty to adequately access and address poor soft tissue quality of the capsule and labrum.

Segmüller et al published a review of 71 shoulders in pa-
tients who had arthroscopic stabilization with the Suretac device for Bankart, SLAP (superior labrum anterior-posterior), and other labral lesions. They noted a 12% recurrence of dislocation or subluxation in their unstable shoulder group (N = 42). Further analysis of the results for the true anteroinferior dislocator group (N = 31) revealed a recurrence rate of redislocation or only 3.2%. This discrepancy could be attributed to the difficulty to fully address the extent and relevance of additional capsuloligamentous laxity. They conclude that this type of repair should be limited to patients with Bankart lesions, SLAP lesions, and those patients with high quality tissue.

The basic principles of shoulder stabilization apply to open, arthroscopic with suture anchor, and sutureless anchors. To ensure successful results with stabilization procedures, one must avoid some common errors: inadequate abrasion of the glenoid rim; inadequate superior shift of the inferior glenohumeral ligament (IGHL); medial placement of the anchor; and insufficient capture, compression, and solid fixation of the capsular tissue. It has been suggested that due to the weak initial fixation strength of sutureless anchors, that patients treated with these tacks should have a prolonged period of immobilization to help ensure success.

**SLAP**

A recent publication biomechanically compared suture anchors with bioabsorbable tacks (Suretac II, Acufex; Smith & Nephew Endoscopy) for treatment of type II SLAP lesions. The authors found that the initial fixation strength between the groups was comparable in the superior glenoid, with a failure load of 163 and 161 N for the simple and mattress suture anchors, respectively, and 145 N for the tack group (not statistically significant).

Clinically, a subgroup analysis of a previously described study revealed that 82.3% of shoulders with SLAP II and IV lesions treated with arthroscopic bioabsorbable tacks (Suretac, Acufex) for SLAP repair had good-to-excellent Constant scores.

Samani et al reported, with a mean follow-up of 35 months, an overall success rate of 88% using bioabsorbable tacks (Suretac, Acufex) for repair of type II SLAP.

The authors are aware of no other clinical studies comparing sutureless anchors with other techniques in the treatment of SLAP lesions. Further discussion on recurrence of instability will follow in the complication section.

**Rotator Cuff Surgery**

Ideal rotator cuff repair should have high initial fixation strength, minimal gap formation, and high mechanical stability until completion of tendon-to-bone healing. Compared with shoulder stabilization, more research has been performed evaluating the use of arthroscopic implants in the treatment of rotator cuff tears as compared with the dearth of study for shoulder instability.

Cummins et al studied the failure load of 3 different bioabsorbable screws, suture anchors, and transosseous sutures. They also looked at clinical outcome from rotator cuff tears less than 4 cm² repaired with either bioabsorbable screws or metal suture anchors. Ex vivo results showed an inferior failure load with bioabsorbable screws (76 N for BioTwist RC anchor [Linvatec Corp, Largo, FL] and 100 N for Headed Bio-Corkscrew [Arthrex, Naples, FL]) as compared with suture anchors (140 N for Mitek QuickAnchor [Mitek Surgical Products, Norwood, MA]), transosseous sutures (147 N) and bioabsorbable screw with a washer (190 N for BioCuff, Bionx [Linvatec Corp]). Clinical outcomes were superior and there was no revision cases in metal suture anchors as compared with the bioabsorbable screw (Headed Bio-Corkscrew).

Whereas most of the biomechanical studies have employed an ultimate failure load model, Goradia et al have investigated cyclic loading of rotator cuff repairs with bioabsorbable tacks, metal suture anchors, and transosseous sutures. Using a human cadaveric model, they showed that smooth bioabsorbable 8-mm Suretacs had significantly higher number of cycles to failure for 10-mm gap as compared with transosseous sutures. There was no significant difference in the number of cycles to produce a 5-mm gap between the transosseous sutures, suture anchor (Mitek), Smooth Suretacs, and Spiked Suretacs. Similar results were obtained by Bicknell et al, comparing bioabsorbable anchors (BioTwist RC) with transosseous sutures using a stepwise cyclic loading model. They found no statistically significant difference between the 2 groups for loss of repair of 10 mm. However, they found the bioabsorbable anchor able to sustain significantly more cycles and load before failure for 50% (5 mm) loss of repair.

Pedowitz et al have also investigated failure to cyclic loading. They compared (in bovine models) a bioabsorbable poly-D-lactic acid (PDLA) screw and toothed washer (BioCuff, Bionx), with four commonly used suture anchor fixation methods: Mitek Super QuickAnchor Plus (G4) suture anchors (Mitek), either single- or double-loaded with different suture techniques (2 single-loaded suture anchors placed 1 cm apart in the defect and a simple suture technique, 2 double-loaded suture anchors and a simple suture technique consisting of a total of 4 suture limbs in the repair, 2 single-loaded suture anchors and a horizontal suture repair technique, and 2 single-loaded suture anchors and a repair employing the modified Mason-Allen technique). They found the PDLA screw and washer to have significantly better resistance to gap formation in a cyclic isometric contraction model than standard suture anchor techniques.

Another similar study showed different results. Comparing a poly-L-lactic acid (PLLA) bioabsorbable screw anchor (BioTwist RC) with a metallic suture anchor (Super QuickAnchor Plus) loaded with a No. 2 braided polyester suture, the authors reported a higher failure rate in the sutureless anchor repair group. The bioabsorbable screw group withstood an average of 41.2 cycles before 100% failure while the suture repair group lasted 734.2 cycles. The modes of failure for the bioabsorbable screw was either the screw slicing through the tendon substance or the screw breaking at the threaded-shaft interface. The authors hypothesized that the grip on the tendon was suboptimal and a screw with a larger head diameter or a rougher undersurface would possibly increase the surface area for grip on the tendon.

It appears from those multiple biomechanical studies that the larger head and washer anchors (such as the BioCuff) have stronger biomechanical properties.

There are no other clinical studies identified by these au-
thors comparing open or arthroscopically applied sutureless anchors with arthroscopic or open suture anchors or the transosseous suture technique.

Complications

Inflammatory Reaction

All current sutureless anchors are made of various composites of biodegradable material. Biodegradable materials, by design, are attacked by the body for resorption. Some have an excessive response, clinically seen as an inflammatory reaction. Biodegradable implant foreign-body reactions should be divided into osseous, intraarticular, and extraarticular inflammatory response. In a review of 2,528 patients operated for various conditions with polyglycolic or polyactic acid implants, Bostman and Pihlajamaki found a 4.3% incidence of significant local inflammation. This study was not specific for shoulder surgery and the majority of the cases were either malleolar fractures, chevron osteotomies for hallux valgus, or radial head fractures. One hundred seven of 108 of the inflammation cases were associated with polyglycolic acid reaction and only one was associated with a polyactic acid implant. Polyglycolic acid implants have been reported to cause significant foreign-body reactions, with clinical symptoms as early as 1 month after surgery, usually at an average time of 11 weeks postoperatively.

Freehill et al retrospectively studied a cohort of patients treated with PLLA tacks for stabilization of the shoulder. Nineteen percent of these patients had delayed onset of clinical symptoms at an average of 8 months postoperatively. The potential reasons for the delayed onset of symptoms were implant fragmentation with resultant mechanical irritation and an inflammatory foreign body reaction to the crystalline material released during degradation. Other authors have also reported foreign body reaction in shoulder surgeries with bioabsorbable tacks.

Mallik et al reported a case of intraarticular migration of a bioabsorbable rotator cuff tack device (CuffTack, Mitek) that required revision surgery. A case of intraarticular dislodgement of anchor is depicted in Figure 1.

Recurrence of Instability

In a series of 20 patients treated with a Suretac implant for arthroscopic Bankart stabilization, Warner et al reported a 20% recurrence rate at nearly 3 years. Laurencin et al, using

<table>
<thead>
<tr>
<th>Name Indication</th>
<th>Arthrex</th>
<th>Arthrotek</th>
<th>Linvatec</th>
<th>Linvatec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue Tak II Bankart &amp; SLAP</td>
<td>Arthro Rivet Rotator cuff, Bankart &amp; SLAP</td>
<td>Bio Twist RC Rotator cuff</td>
<td>Bio Cuff C Rotator cuff</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>PLDLA</td>
<td>82% PLLA 18% PGA</td>
<td>PLLA</td>
<td>PLA</td>
</tr>
<tr>
<td>Washer</td>
<td>No, 5 mm Oblong Straight or 30° Angled head</td>
<td>No, Spiked head</td>
<td>No, Flat head</td>
<td>Yes, Spiked washer</td>
</tr>
<tr>
<td>Technique sequence</td>
<td>• 1.5 mm guide wire • Drill • Mallet anchor</td>
<td>• Drill/bone punch • Gun inserter with anchor through ST into PH • Keep compression, pull trigger, expansion anchor</td>
<td>• 3.0 mm bone punch • Tip of inserter through ST into PH • Screw anchor</td>
<td>• 1.5 mm K-wire • 3.5 mm Drill • 6.1 mm or 6.3 mm Tap • Screw Anchor</td>
</tr>
<tr>
<td>Size</td>
<td>3.75 × 18 mm</td>
<td>10 or 15 mm length 3.55 to 4.85 mm expanded diameter</td>
<td>6.3 × 22 mm</td>
<td>6.0 × 22 mm</td>
</tr>
</tbody>
</table>

Abbreviations: ST, soft tissue; PH, pilot hole.
similar tack device, found a 10% recurrence rate.\textsuperscript{13} Their indications for the stabilization procedure using tacks were stricter than the Warner study and included only those patients with unidirectional anterior instability with a Bankart lesion, minimal bony erosion, and a traumatic etiology.

Cole and Warner compared bioabsorbable tacks with open stabilization procedure for shoulder instability.\textsuperscript{36} With an average follow-up of 55 months, they reported 16% recurrence of instability in the arthroscopic group versus 9% in the open group.

Thus, the failure rate with first generation tacks is higher than the historical reports with open stabilization. Initial reports of open suturing reveal a recurrence rate from 0-11%.\textsuperscript{37-40} This may be due to the lack of attention paid to capsular tension and/or not replacing the labrum onto the glenoid face, restoring concavity-compression.

**Surgical Technique**

**Stabilization Surgery**

After general anesthesia and interscalene block, the patient is placed in beach chair position. Posterior and anterosuperior portals are established initially. A diagnostic sweep of the glenohumeral joint is performed to rule out other pathology and to ensure proper diagnosis. A drive-through sign would be indicative of an injury to the inferior glenohumeral ligament.\textsuperscript{41} It is crucial to adequately prepare the glenoid rim as well as the anterior scapular neck to ensure an adequate surface for healing of the capsulolabral structures to bone. Mobilization is not complete until one can see subscapularis muscle. Using needle localization, the anteroinferior portal is established to allow for placement of a cannula followed by the guide wire on the glenoid rim at the 5 o’clock position. A detailed list of the different products available is provided in Tables 1 and 2. The guide wire is passed through the capsulolabral tissue and moved slightly superiorly to the optimal site of attachment on the glenoid rim to tension the capsule (Fig. 2). It is important to start with the most inferior anchor. Most manufacturers recommend the placement of 3 anchors, although this obviously depends on the size of the Bankart lesion. Anchors are placed approximately 1 cm apart. It is also important to push the tissue onto the glenoid face making sure the humeral head does not articulate on the anchor. The drill is then advanced to the laser mark and removed to allow for insertion of the anchor (Figs. 3 and 4). Once this is done, the guide wire is removed and the shoulder is examined arthroscopically to ensure the humeral head does not

**Table 2 Current Sutureless Anchor Specifications**

<table>
<thead>
<tr>
<th></th>
<th>Mitek/Depuy</th>
<th>Smith &amp; Nephew</th>
<th>USS Sports Medicine</th>
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</thead>
<tbody>
<tr>
<td>Name</td>
<td>Contack Labral Anchor</td>
<td>Suretac II &amp; III</td>
<td>E-Z Tack</td>
</tr>
<tr>
<td>Indication</td>
<td>Bankart &amp; SLAP</td>
<td>Bankart &amp; SLAP</td>
<td>Bankart</td>
</tr>
<tr>
<td>Material</td>
<td>L-PLA anchor with L/DL-PLA washer</td>
<td>PDLA</td>
<td>82% PLA</td>
</tr>
<tr>
<td>Washer</td>
<td>Yes</td>
<td>No, Straight or 18° Angled spiked head</td>
<td>No, Straight spiked head</td>
</tr>
<tr>
<td>Technique</td>
<td>Guide wire</td>
<td>Guide wire</td>
<td>ST placement Cannula</td>
</tr>
<tr>
<td>sequence</td>
<td>3.5 mm Drill</td>
<td>Drill</td>
<td>3.5 mm Drill or Bone Punch</td>
</tr>
<tr>
<td></td>
<td>Anchor insertion</td>
<td>Mallet anchor</td>
<td>Gun inserter with Anchor through ST into PH, pull handle</td>
</tr>
<tr>
<td>Size</td>
<td>3.5 × 11 mm</td>
<td>4.15 × 16.5 mm</td>
<td>4 × 9 mm</td>
</tr>
</tbody>
</table>

Abbreviations: ST, soft tissue; PH, pilot hole.
articulate with the anchor head, and the shoulder is examined to ensure shoulder stability.

Anchors with angled heads are preferred for anterior or posterior glenoid insertion since the angle of insertion is oblique and using the angled heads allows the head to be flush with the glenoid margin.

**SLAP Lesion Repair**

Using the same approach as with stabilization surgery, an accessory Wilmington portal is established to allow for insertion of the anchor at a favorable angle in the superior glenoid rim. Identification of the pathology is of crucial importance, as one should determine if the superior labrum should be fixed, debrided, or left alone. Flap and buckle handle tears of labrum are debrided. If an unstable superior labrum/biceps anchor is encountered, it should be fixed. The glenoid rim is abraded with a shaver to subchondral bone at the site of labral detachment. The guide wire is then introduced via the Wilmington portal and positioned at the site of labral detachment. The insertion of the drill and anchor is identical to that described previously in the instability section. Depending on the extent of the lesion, one to three anchors may be used (Fig. 5), although the authors have found one (and sometimes two) anchor(s) are most commonly needed. Regular sutureless anchors are appropriate here since the humeral head would not articulate with the anchor.

**Rotator Cuff Surgery**

We use similar positioning of the patient as that for the stabilization procedure. Standard posterior and anterosuperior arthroscopic portals are established. Following intraarticular glenohumeral arthroscopy, needle localization is performed while the scope is in the subacromial space. The lateral portal is established to optimize the mobilization and preparation of the rotator cuff tear as well as the greater tuberosity area. Once the bursectomy and subacromial decompression are completed, the rotator cuff is appropriately debrided and the

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**Figure 4** Once the drill has been removed, the anchor is inserted through the guide wire still anchored in the glenoid rim. (Image courtesy of Smith & Nephew Endoscopy.) (Color version of figure is available online.)

**Figure 5** Arthroscopic picture of sutureless anchors for the treatment of a SLAP lesion. (Color version of figure is available online.)

**Figure 6** Mobilization of rotator cuff using arthroscopic tissue grasper (white arrow). (Image courtesy of Linvatec.) (Color version of figure is available online.)

**Figure 7** Once the guide wire has been properly advanced and well seated into the bone, the drill shaft is inserted to the preset laser marks. It is then carefully removed, making sure the guide wire stays in the same position to allow for the sutureless screw placement. (Image courtesy of Smith & Nephew Endoscopy.) (Color version of figure is available online.)
tuberosity bone is abraded on the anatomical neck of the humerus, adjacent to the articular cartilage. Care is taken not to remove the full thickness of the cortical bone when preparing the anchor site. The rotator cuff is then mobilized laterally to assure proper apposition of the tissue to the bone (Fig. 6). With the arm at 15° of abduction, a 8.4 mm working cannula is used, perpendicular to the cuff, for anchor placement. Depending on the manufacturer, the initial use of a guide wire is suggested, followed by a drill to be advanced to a preset laser mark (Fig. 7). Others recommend different types of tap devices depending on bone quality. The obturator wire is then placed inside the selected tap and they are locked together by rotating the obturator in a clockwise direction (Fig. 8). The rotator cuff is then reduced in position for repair either with a tissue grasper or with the obturator (Fig. 9). The tap is then advanced until the laser mark reaches the surface of the rotator cuff. Keeping the reduction with the tap, still anchored in bone, the obturator is exchanged with a K-wire to allow for removal of the tap and placement of the sutureless anchor (Figs. 10 and 11). The K-wire is then removed after the insertion of the implant. Additional implants should be placed at least 1.5 cm apart from each other (Fig. 12).

Authors’ Preferred Method of Treatment

Over the past several years, we have transitioned our surgical technique to using suture anchors almost exclusively for arthroscopic rotator cuff, SLAP, and shoulder stabilization surgery. Our current use of sutureless anchors at this time is for salvage situations or as a bail-out.

Stabilization Surgery and SLAP

If the decision is made to proceed with sutureless anchors for a stabilization procedure, we will use anchors with an angled head to allow the anchor, which is introduced at an angle to the glenoid, to remain flat against the glenoid rim, such as the Suretac III anchor (Acufex, Smith & Nephew Endoscopy) or the angulated Tissue Tack II (Arthrex). An angled implant is not necessary for repair of SLAP lesions. It should be empha-
sized that preparation of the glenoid bone bed and the labrum is of critical importance regardless of whether open or arthroscopic suture anchor techniques are used. If we judge that insufficient labral tissue is available, because of poor tissue quality or chronicity of the lesion, we incorporate capsular tissue in the repair to recreate an appropriate buttress to help tension the capsule.

Rotator Cuff Surgery

If proceeding with a sutureless anchor, our preference for rotator cuff fixation is the BioCuff C anchor (Linvatec) because it has a sizeable head and a soft tissue washer that provides additional stability and due to its favorable in vitro biomechanical data. Based on different biomechanical studies, the sutureless anchors with some form of soft tissue washer have a lower failure rate due to better contact area between the implant and the rotator cuff. After surgery, patients should be allowed perform a passive range of motion (PROM) up to 140° forward elevation and 30° external rotation. Active motion and strengthening should be started after 6-8 weeks with emphasis initially on complete range of motion, then on strengthening of the rotator cuff and scapular stabilizer muscles.

Pearls

1. We recommend the use of a tissue grasper to appropriately tension and mobilize the rotator cuff or the capsulolabral complex.
2. If using spiked anchor heads or washers, we recommend the use of a cannula to facilitate passage of the anchor and prevent soft tissue damage and capture.

Conclusion

The ideal anchor should be easy to insert and provide adequate initial strength as well as sustained strength during the healing process. The authors find it appealing to use sutureless anchors for rotator cuff as well as for stabilization surgery mainly because of the simplicity of their use. However, one should be critical of their results in both in vitro and in vivo studies. Most of the literature shows that they are inferior, or at best equal, to suture anchors. Their use should be limited to bail-out situations or for surgeons not comfortable with suture management and arthroscopic knot tying techniques. The latest development of multiple arthroscopic devices to facilitate soft tissue mobilization and suture passage have made sutureless anchors less attractive.

References

sorbable sutureless screw anchor versus suture anchor fixation for rotator cuff repair. Arthroscopy (in press)


