Arthroscopic Bankart Repair Using Knot-Tying Versus Knotless Suture Anchors: Is There a Difference?

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**Purpose:** To compare the clinical outcome between the use of knotless sutures versus knot-tying sutures in arthroscopic Bankart repairs.

**Methods:** Between January 2007 and January 2011, 87 patients who underwent arthroscopic Bankart repair with the use of knot-tying suture anchors or knotless suture anchors were evaluated, with 45 patients in the knot-tying suture group and 42 patients in the knotless group. Patients were assigned to either group, with odd-numbered patients going to the knot-tying suture arm and even-numbered patients assigned to the knotless arm. Outcomes included the Constant score, the visual analog scale (VAS) score, patient satisfaction score, and range of motion in forward flexion and external rotation with the arm in adduction. Redislocations or subluxations with the 2 techniques was also studied. **Results:** Both groups showed a statistically significant improvement between the preoperative and postoperative VAS scores and Constant scores. In the knot-tying suture group, the VAS score improved from 2.5 to 0.7 (P < .05) and the Constant score improved from 64 to 10 (P < .05). In the knotless group, the VAS score improved from 2.8 to 0.9 (P < .05), and the Constant score improved from 62 to 89 (P < .05). The patient satisfaction scores were 6.9 and 7.1 for the knot tying and knotless groups, respectively. No statistically significant differences were found when comparing the outcomes between the 2 groups. The change in the range of forward flexion and external rotation was also similar in the 2 groups. There was also no difference in recurrence or redislocation rates. **Conclusions:** Both the knot-tying and knotless suture anchors groups showed statistically significant and similar improvement in VAS and Constant scores. Both anchors provided reasonable outcomes. The knotless suture anchor is a good alternative to knot-tying suture anchors so that arthroscopic Bankart repairs can be performed without knot tying. **Level of Evidence:** Level II, prospective comparative study.

Surgery is often performed for shoulder instability that affects the young and active individual. Open repair of the Bankart lesion has traditionally given good to excellent results. With the evolution of minimally invasive surgery, arthroscopic Bankart repair using suture anchors is now widely accepted as a method of restoring the labrum to the glenoid rim, with reported results similar to those of open stabilization. Benefits of arthroscopic surgery include the avoidance of subscapularis tenotomy, a faster return to normal activity, smaller surgical scars, an improved range of motion, and a shorter hospital stay.

Many arthroscopic repair studies describe the use of suture anchors with arthroscopic knot tying. Successful outcome with suture anchors is thus highly dependent on knot security. A good-quality arthroscopic knot-tying suture anchor repair is difficult to achieve technically, and significant practice is required. This process can take time to master. In view of this, concerns exist regarding the quality and consistency of arthroscopic knot tying. Hence, an inadequate technique is a potential cause of treatment failure and recurrent pain or dislocation.

Knotless anchors arose as a solution to the difficulty of tying secure knots with reliable tension arthroscopically. They offer the advantage of a secure low-profile repair without the technical challenges of tying knots arthroscopically. However, a late disengagement of a knotless anchor has been reported, and an in vitro comparison study of knot-tying versus knotless metal suture anchors has shown that knotless suture anchors may cause significantly greater gap formation.
between bone and soft tissue in comparison with knot-tying anchors.12 These concerns need to be addressed, and evidence in the form of outcome studies to support or reject the knotless suture as an option is required.

To date, there are only a few studies in the literature that have compared the clinical outcomes with the use of knotless sutures versus knot-tying sutures in arthroscopic Bankart repairs.13,14 The aim of this study was to compare the clinical outcomes between the 2 techniques. We hypothesized that there would be a significant improvement in outcomes with both techniques and that there would be no difference in outcomes between them.

**Methods**

Between January 2007 and January 2011, 95 consecutive patients who underwent arthroscopic Bankart repair with the use of knot-tying suture anchors or knotless suture anchors were evaluated. Preoperatively, patients were assigned to either group, with odd-numbered patients going to the knot-tying suture arm and even-numbered patients assigned to the knotless arm. Clinical records, intraoperative records, and intraoperative arthroscopic photographs were reviewed. The study received approval from the appropriate ethics committee and was performed in accordance with the ethical standards in the 1964 Declaration of Helsinki. It also received approval from the National Healthcare Group Disease-Specific Review Board.

All patients included in the study had a classic Bankart lesion caused by a traumatic anterior shoulder dislocation. All had at least 2 episodes of dislocation with persistent instability and conservative treatment had failed. Surgery was performed within 6 weeks of the last documented dislocation. No surgery was performed for patients who had a first episode of dislocation. Patients with (1) a bony Bankart lesion, (2) humeral avulsion of the glenohumeral ligament, (3) an associated SLAP tear, (4) a rotator cuff tear, or (5) an engaging Hill-Sachs lesion were excluded. A sample size of 40 participants in each group (80 in total) was sufficient to detect a standard difference of 0.65 (65% of the standard deviation) for the VAS score with a 2-sample t test at 80% power. Moreover, for within-group comparison, 40 participants was sufficient to detect a standard difference of 0.45 (45% of the standard deviation) for the VAS score with a paired t test at 80% power.

All procedures were performed by the senior author (V.P.K.). No additional procedure such as interval closure, posterior labral repair, or thermal capsulorrhaphy was performed. None of the cases involved an engaging Hill-Sachs lesion.

The mean follow-up period was 2.7 years (range, 2 to 3.7 years). Patients were evaluated both preoperatively and postoperatively with the visual analogue scale (VAS), Constant score, and patient satisfaction score (scale of 1 to 10). Preoperative and postoperative range of motion, particularly forward flexion and external rotation with the arm in adduction, were evaluated. Postoperatively, patients were also assessed for recurrence of dislocations or a positive apprehension test result. Clinical parameters such as the VAS score, Constant score, and patient satisfaction score were assessed by a nurse clinician not involved in the direct care of the patient. Patient satisfaction was evaluated on a scale of 1 to 10, with 1 being the worst satisfaction and 10 being the best. This assessment was done only in the postoperative review. Failure was defined as a non-traumatic redislocation or subluxation or a positive apprehension test result.

**Surgical Technique**

All surgery was performed with the patient in the beach chair position. Standard arthroscopic portals, were used, with a posterior portal as a viewing portal and anteroinferior and anterosuperior portals as working portals. The posterior portal was located approximately 3 cm inferior to the posterolateral corner of the acromion at the posterior soft spot. The arthroscope entered the joint in the interval between the infraspinatus and teres minor tendons. The anteroinferior portal was placed as close as possible to the superior edge of the subscapularis tendon to allow access to the anterior and inferior aspects of the glenoid rim. The anterosuperior portal was placed in the rotator interval just superior and anterior to the biceps tendon.9

After diagnostic arthroscopy, the anterior labrum was mobilized adequately, and a motorized shaver was used to debride the exposed labral edge to promote healing. An arthroscopic rasp and burr were used to decorticate the anterior glenoid neck.

**Knot-Tying Suture Group**

Anchor holes were created on the glenoid surface using a drill that was inserted through the anteroinferior portal at an angle of 50° to 70° to the plane of the glenoid and 1 to 2 mm from the glenoid rim. The first anchor was placed at the 5:30 o’clock position for the right shoulder and the 6:30 o’clock position for the left side. One end of the FiberWire (Arthrex, Naples, FL) was then retrieved through the anterosuperior portal. A 45° curved suture lasso (Lasso; Arthrex) was used to penetrate the labrum at the most inferior position about 1 cm lateral to the glenoid rim through the anteroinferior portal. The pulling suture loop was passed, retrieved through the anterosuperior portal, and tied to the end of the single anchor suture that lay outside the anterosuperior portal. The loaded pulling suture was then pulled back through the capsulolabral structure and out through the anteroinferior portal. A sliding hangman’s knot with alternating half-stitches was used to secure the capsulolabral structure to the glenoid articular margin. Additional anchors were
placed as necessary up to the 3 o'clock position for the right shoulder and the 9 o'clock position for the left shoulder. In all cases, an average of 4 suture anchors were used, with a range of 3 to 5 anchors.

**Knotless Group**
A 45° curved suture lasso (Lasso; Arthrex) through the anteroinferior portal was used to penetrate the labrum at the most inferior position about 1 cm lateral to the glenoid rim. The pulling suture loop was passed, retrieved through the anterosuperior portal, and tied to one end of a free FiberWire (Arthrex). The loaded pulling suture was then pulled back through the capsulolabral structure and out through the anteroinferior portal. The other end of the FiberWire (Arthrex) that lay outside the anterosuperior portal was subsequently retrieved through the anteroinferior portal as well. Drill holes were created on the glenoid surface at an angle of 50° to 70° to the plane of the glenoid and 1 to 2 mm from the glenoid rim. The first drill hole created was at the 5:30 o'clock position for the right shoulder and the 6:30 o'clock position for the left side. Both ends of the FiberWire (Arthrex) were passed through the distal ring of the PushLock (Arthrex) anchor, which was then inserted and tapped into a drill hole to the desired depth. Additional anchors were placed as necessary up to the 3 o'clock position for the right shoulder and the 9 o'clock position for the left shoulder. In all cases, an average of 4 suture anchors was used, with a range of 3 to 5 anchors.

**Postoperative Rehabilitation**
The postoperative rehabilitation protocol was similar for both groups. All patients were placed in a sling postoperatively. In the first postoperative week, they were taught pendulum exercises. The following week they were referred to a physiotherapist, who started passive range of movement exercises. Active mobilization was commenced after the third week. External rotation with the arm at the side beyond neutral was avoided for 6 weeks, and combined external mobilization and abduction was avoided for 12 weeks. Patients were also advised against contact sports and overhead activities for 5 months.

**Statistical Analysis**
The Wilcoxon signed rank test was used to analyze preoperative and postoperative pain and shoulder scores. The Mann-Whitney U test was used for comparison of results between the 2 groups. SPSS (SPSS Inc, Chicago, IL) was used for all analyses, with \( P < .05 \) considered significant.

**Results**
The mean age of patients at the time of surgery was 21 years (range, 17 to 31 years). There were 77 male patients and 10 female patients (Table 1). The minimum follow-up period was 2 years. None of the patients had a further episode of redislocation (Tables 1-3).

### Table 1. Demographic Data and Preoperative Status

<table>
<thead>
<tr>
<th>Variable</th>
<th>Knot-Tying Group (n = 45)</th>
<th>Knotless Group (n = 42)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>21.1 (17-29)</td>
<td>21.0 (18-31)</td>
<td>.93</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>40 (88.9)</td>
<td>37 (88.1)</td>
<td>.89</td>
</tr>
<tr>
<td>Preoperative assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS score</td>
<td>2.5 ± 2.3</td>
<td>2.8 ± 2.5</td>
<td>.87</td>
</tr>
<tr>
<td>Constant score</td>
<td>64 ± 7</td>
<td>62 ± 6</td>
<td>.94</td>
</tr>
<tr>
<td>Forward flexion (°)</td>
<td>169 ± 14</td>
<td>171 ± 15</td>
<td>.82</td>
</tr>
<tr>
<td>External rotation (°)</td>
<td>55 ± 10</td>
<td>54 ± 12</td>
<td>.96</td>
</tr>
</tbody>
</table>

NOTE. Values given as mean, with range in parentheses. VAS, visual analog scale.
minutes (range, 58 to 77 minutes). One patient experienced a redislocation after falling on his shoulder during a soccer game a year after the surgery. He experienced 2 further episodes of redislocations. The patient eventually underwent revision arthroscopic Bankart repair with a good result. The labrum was noted to be torn at the original repair site intraoperatively. None of the knotless anchors were dislodged (Tables 1-3).

There was no significant difference between the 2 groups in VAS scores, Constant scores, patient satisfaction scores, and the difference between the preoperative and postoperative range of movement.

**Discussion**

The Bankart repair aims to restore the detached capsulolabral complex back to the anteroinferior glenoid rim. The open Bankart repair has been shown to restore shoulder stability with good results.\(^1\) In recent years, the arthroscopic Bankart repair gained widespread acceptance with outcomes comparable to those of open repairs.\(^2,3\) Arthroscopic repairs started with the use of knot-tying suture anchors; lately, knotless anchors have been used. Some in vitro studies have implied that knotless anchors may not be as secure as knot-tying anchors in arthroscopic Bankart repairs.\(^1,2\)

Thus far, there are no well-conducted clinical studies to demonstrate the superiority or otherwise of one technique over the other.

Arthroscopic knot tying is technically challenging and can take significant practice to master, thereby raising concerns regarding the quality and consistency of arthroscopic knots in the hands of the beginner.\(^4,9\) Knotless anchors have thus been developed to overcome these difficulties while also providing a direct secure low-profile suture anchor repair.\(^9\) Although there is a learning curve, fewer steps are required before the labrum is secured to the glenoid. Despite these advantages, reports on the weaknesses of knotless anchors have emerged. Antonogiannakis et al.\(^12\) reported late disengagement of a knotless anchor. Zumstein et al.\(^12\) performed an in vitro comparison study of knot-tying and knotless metal suture anchors that showed knotless suture anchors may cause a significantly greater gap formation between bone and soft tissue than is produced by knot-tying metal anchors. The authors concluded that knotless suture anchors allowed significantly greater displacement under load than was permitted by knot-tying metal anchors, but they offered the advantage of a relatively easier application. In contrast, a biomechanical study by Leedle and Miller\(^13\) reported that knotless anchors resulted in a stronger construct than that produced with metal or absorbable knot-tying suture anchors. Thal\(^7\) also found superior suture strength with knotless suture anchors compared with knot-tying suture anchors on biomechanical testing.

Failure of Bankart repairs using a knot-tying suture anchor system have also been reported.\(^6,8\) These may occur at the suture knot, suture anchor, or bone. In most cases, the suture is the weakest link. A study on fatigue testing of suture anchors by Rupp et al.\(^16\) showed that most failures were the result of breakage of a knot or a suture at the eyelet.

Recent studies on arthroscopic Bankart repairs report recurrence rates between 7.5% and 15%.\(^6,17\) Gartsman et al.\(^17\) reported a failure rate of 7.5% with the use of knot-tying anchors for anterior-inferior shoulder instability at an average of 33 months. The Constant score was 91.8 points at final review. Our findings are similar except that we never supplemented our repairs with laser capsulorrhaphy, which was carried out on 48 of their 53 patients, or interval closure, which was used on 14 of their patients. Kim et al.\(^18\) reported a 4% recurrence rate with this technique of shoulder stabilization at 44 months. Recurrence was defined as when patients sustained frank dislocations or subluxations or had a positive apprehension test result. We used the same criteria for failures in our series. Further, loss of external rotation was 2° in their series and 3° in ours.

Hayashida et al.\(^3\) reported a recurrence rate of 6.4% in 47 patients with recurrent anterior instability who underwent arthroscopic Bankart repair with knotless suture anchors. The mean period of follow-up was 28 months. They reported a loss of external rotation of 8° with the shoulder adducted and 6° with the joint abducted 90°. The loss of external rotation in the neutral adducted position was 4° in our cases. They also

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**Table 2. Postoperative Results of Knot-Tying Versus Knotless Suture Anchors**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Knot-Tying Group (n = 45)</th>
<th>Knotless Group (n = 42)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS</td>
<td>0.7 ± 0.5</td>
<td>0.9 ± 0.6</td>
<td>.778</td>
</tr>
<tr>
<td>Constant score</td>
<td>92 ± 10</td>
<td>89 ± 9</td>
<td>.812</td>
</tr>
<tr>
<td>Difference in forward flexion (°)</td>
<td>2</td>
<td>3</td>
<td>.576</td>
</tr>
<tr>
<td>Difference in external rotation with arm in neutral position (°)</td>
<td>-3</td>
<td>-4</td>
<td>.647</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>74 ± 14</td>
<td>65 ± 12</td>
<td>.325</td>
</tr>
</tbody>
</table>

*VAS, visual analog scale.*

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**Table 3. Preoperative Versus Postoperative Results for Knot-Tying and Knotless Groups**

<table>
<thead>
<tr>
<th>Suture Anchor Group</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS</td>
<td>2.5 ± 2.3</td>
<td>0.7 ± 0.5</td>
<td>.017</td>
</tr>
<tr>
<td>Constant score</td>
<td>64 ± 7</td>
<td>92 ± 10</td>
<td>.024</td>
</tr>
<tr>
<td>Knotless group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>2.8 ± 2.5</td>
<td>0.9 ± 0.6</td>
<td>.011</td>
</tr>
<tr>
<td>Constant score</td>
<td>62 ± 6</td>
<td>89 ± 9</td>
<td>.019</td>
</tr>
</tbody>
</table>
cautioned on the use of knotless anchors, having had anchor problems in 3 of their cases. Perhaps this may be attributed to early experience with knotless anchors. They started using knotless anchors as early as 2000; the first report of the use of such anchors was made in 2001.\(^7\) Also, the anchor system they used required a few more steps than the system we report on. We had minimal issues with knotless anchor use. The Arthrex PushLock system that we report on is easy to use and involved a few uncomplicated steps. In another study by Garofalo et al.,\(^{19}\) 20 consecutive traumatic dislocations were repaired with knotless anchors. They showed a 5% redislocation rate at a mean follow-up of 43 months. The mean loss of external rotation of 3\(^\circ\) was similar to ours and like us, they found no cases of anchor dislodgement.

In a study using knotless versus knot-tying suture anchors by Cho et al.,\(^{13}\) 123 shoulders in 117 patients who underwent arthroscopic Bankart repair with either knot-tying or knotless suture anchors were retrospectively evaluated. There were 61 patients in the knot-tying suture group and 21 patients in the knotless group. The authors reported a significantly higher redislocation rate in the knotless group (23.8\%) than in the knot-tying suture group (4.9\%). However, there were potential issues with the study that could have accounted for the significantly higher redislocation rate in the knotless group. The surgical technique used for the knotless anchor insertion in their study was different from that described by the manufacturer. There was also no information regarding any additional procedures, such as a thermal capsulorrhaphy, that may have been performed. There was also a large difference in the number of patients in each group, which could have been a source of bias.

Another study by Kocaoglu et al.,\(^{14}\) compared the clinical results of knotless and knot-tying suture anchors in arthroscopic Bankart repair for collision athletes. Of the 38 patients who underwent surgery, knot-tying anchors were used in 18 patients and knotless anchors in 20 patients. After 40 months of follow-up, both groups had similar postoperative results in all variables, including redislocation rates.

In our study, the numbers were comparable in both groups. Both demonstrated a statistically significant improvement between the preoperative and postoperative VAS scores and Constant scores. There was no statistically significant difference when comparing the outcomes between the knot-tying and knotless groups. Also, no significant difference in postoperative range of motion was noted. There was a trend toward a shorter duration of surgery in the knotless group compared with the knot-tying suture group (65 minutes vs 74 minutes), although the difference was not statistically significant. Kocaoglu et al.,\(^{14}\) however, reported a significantly shorter time to insert a knotless anchor compared with a knot-tying anchor. In our study, both cases of redislocation were caused by retearing of the labrum at the site of the previous repair. Both patients had significant sports-related trauma as the cause for the dislocations. There was, however, no evidence at surgery of anchor pullout in these 2 patients.

The strengths of our study include the fairly equal number of patients in the 2 groups, a low dropout rate, and good compliance with follow-up. Demographic variables between the 2 groups were similar as well. All surgery was also performed by the same surgeon.

**Limitations**

Limitations of the study include only the use of the VAS and Constant scores to assess postoperative outcome besides ranges of flexion and external rotation. We also did not have sufficient data to look into postoperative return to sports. A larger number of patients with a longer follow-up period would have allowed a better comparison of results and confirmed the superiority or otherwise of one technique over the other.

**Conclusions**

Both the knot-tying and knotless suture anchor groups showed statistically significant and similar improvement in VAS and Constant scores. Both anchors provided reasonable outcomes. The knotless suture anchor is a good alternative to knot-tying suture anchors if avoiding knot tying is preferred for arthroscopic Bankart repairs.

**References**


