Do Vented Suture Anchors Make a Difference in Rotator Cuff Healing

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Abstract

**Purpose:** Ultrasound is well documented as an accurate tool to assess rotator cuff (RC) thickness, a proven marker of healing. There are no studies to date that compare healing in primary RC repairs between vented and non-vented suture anchors. The hypothesis is that vents allow stem cells and growth factors to assist healing in the rotator cuff.

**Methods:** Patients who had undergone primary RC repair were reviewed and divided into groups by those who received vented versus non-vented suture anchors. Healing was assessed by RC thickness as viewed on ultrasound at each patient’s routine six week post-operative appointment.

**Results:** Forty patients were in the vented group and thirty patients were in the non-vented suture anchor group. One-third of patients in the vented anchor group were female (37.5%), and half of the patients in the non-vented group were female. The average days between surgery and follow up in the vented group and non-vented group were 42.1 and 40.8 respectively. The average age of the vented group was 55.0 years vs. 62.5 in the non-vented cohort. The average thickness for the vented group was 0.59 centimeters and for the non-vented group was 0.48 centimeters (p-value 0.0074). Rotator cuff thickness was significantly associated with implant type, patient’s age (r = -0.42, p = 0.0003), and days post-op (r = 0.34, p = 0.0043).

**Conclusions:** The results of this study show that vented suture anchors provide greater healing potential for patients at six weeks post-operatively. We recommend continued investigation into this topic, with follow up at six months to evaluate rotator cuff healing at its full potential.

INTRODUCTION

Rotator cuff tears are a common condition affecting greater than half of those over the age of 60, and upwards of 80% of those above age 80 [1-7]. The rotator cuff and muscles are important anatomic structures that provide dynamic stabilization of the glenohumeral joint, and when injured can produce pain, functional impairment and sleep disturbances [8]. Rotator cuff injuries are thought to be caused by a combination of a vascular nature of the structure, age-related changes in the collagen makeup, as well as mechanical trauma [7,9,10].

The surgical approach to the rotator cuff has changed over time, although results have remained relatively unchanged [4,11-14]. In the initial open techniques, transosseous tunnels were utilized, with failure, when it occurred, often occurring by suture moving through the bone tunnels [5,15]. The development of suture anchors led to their use in rotator cuff repair, with this technology continuing to evolve over time in order to improve the results of rotator cuff repair [2,15]. Suture anchor technology and techniques have continued to advance over time, including double- and triple-loaded suture anchors, threaded suture anchors, knotless anchors, bio-absorbable anchors, and double and triple row technique, with the ultimate goal of fixation that withstands rehabilitation, allows for increased healing, and decreases failure [4,10,12-17].

A recent advance in suture technology was the development of vented anchors. The theoretical advantage of these anchors is to allow access of the bone marrow and associated stem cells to the repaired tendon to promote healing. This study compared the use of a vented suture anchor versus a non-vented anchor with the ultimate goal of determining which anchor produces better healing.

The hypothesis is vented anchors will improve tendon healing as compared to non-vented anchors as measured on six week ultrasound testing. Testing this hypothesis determines if the vent contributes to an increased rotator cuff healing post-operatively. The theory behind this hypothesis is that the vent allows blood and stem cells to contribute to the healing process of the rotator cuff [15]. To our knowledge, to date, there has been no studies...
performed comparing healing between vented and non-vented suture anchors.

**MATERIALS AND METHODS**

A review was performed on patients who received vented or non-vented suture anchors in the operative arthroscopic repair of rotator cuff tears by senior authors Felix H. Savoie III (FHS) and Michael J. O’Brien (MJOB) after approval was obtained from the International Review Board. Patients were selected based on surgical logs from surgeons FHS and MJOB, who performed all of the reviewed operations. Six week post-operative ultrasound images had been collected on all patients prior to beginning physical therapy, and rotator cuff thickness had been measured at the medial anchor site. All operations were performed between January 2014 and October 2014. Inclusion criteria were those undergoing primary (non-revision) rotator cuff repair with either a vented anchor (Smith and Nephew, HEALICOIL REGENSORB Suture Anchor, Andover, MA) or a non-vented anchor (Depuy Mitek, HEALIX ADVANCE Suture Anchor, Norwood, MA). Vented versus non-vented suture anchors were selected randomly for surgical candidates, and there were no clinical indications to use one anchor versus the other. Each surgeon performed surgery with both implant types in a randomly selected basis. Patients were blinded to the type of suture anchor they received. Patients who received concomitant biceps tenotomy or tenodesis, and/or subacromial decompression were included. Exclusion criteria included: revision surgery for recurrent rotator cuff tear, any other previous ipsilateral shoulder surgery, and those whose six week post-operative ultrasound fell outside of the 28-56 post-op day time range.

For operative technique, surgeries were performed in either lateral decubitus or beach chair position. After patients had obtained interscalene blocks in the pre-operative holding area, patients were placed under general anesthesia, and all surgeries were performed arthroscopically. A posterior portal was established for initial assessment of the glenohumeral joint. Bursectomy and subacromial decompression were performed if needed. The greater tuberosity was lightly debrided and micro fracture trephination tunnels created to improve the healing response in all cases. The torn rotator cuffs were then mobilized, and double and triple row repair were used for rotator cuff fixation to the greater tuberosity. Patients were kept in an abduction pillow sling for six weeks post-operatively, with home, pain free passive range of motion exercises started one week post-operatively. Patients were evaluated in clinic at 1-2 weeks post-operatively for wound checks and at their six week appointment for re-evaluation with ultrasound imaging. The physician performing the ultrasound was blinded as to whether a vented or non-vented anchor was utilized in the case. Thickness was measured at the medial anchor site in the coronal plane, just lateral to the articular margin.

Operative reports and intra operative photographs were reviewed, determining each patient’s suture anchor. Routine post-operative ultrasound images (SonoSite, Bothell, WA) at patient’s six week follow up appointments were collected and the thicknesses of insertion of the repaired rotator cuffs were measured. To quantify healing, the thickness of the rotator cuff was used as the variable for assessment. Previous studies have correlated tendon thickness and radiographic signs of healing with functional status [18]. Measuring the thickness of the rotator cuff was performed using ultrasound, a proven method for accurate radiographic assessment of this anatomic structure [1,19,20-22].

Data was collect and compiled with Microsoft Excel (Redmond, WA) and statistical analysis was performed with SAS Version 9.3 software (Cary, NC). Student’s t-tests were used to assess the univariate relationships between implant type, rotator cuff width, and key covariates (age, days post-op, gender, and dominant hand).

**RESULTS**

There were forty patients who had undergone rotator cuff repair with vented anchors and thirty patients who had undergone repair with non-vented anchors. Sample characteristics of the implant groups are shown in (Table 1). The vented anchor group was significantly younger than the non-vented anchor group, but there were no differences between the groups in terms of days post-op, handedness, or gender.

Patients in the vented group had an average rotator cuff thickness of 0.59 cm and the non-vented group had an average thickness of 0.48 cm (p-value 0.0074) (Table 2). Rotator cuff thickness was also significantly related to gender, age, and days post-op.

**DISCUSSION**

This study suggests a statistically significant advantage of vented over non-vented suture anchors (p-value 0.0074). At the six week post-operative visit, the vented anchor group has a thicker rotator cuff, which corresponds with an improved healing potential from the venting of the suture anchor.

Table 1: Sample characteristics (N = 70).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Vented (n = 40)</th>
<th>Non-vented (n = 30)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days Post-Op</td>
<td>42.1 + 5.1</td>
<td>40.8 + 6.2</td>
<td>0.3194</td>
</tr>
<tr>
<td>Age</td>
<td>55.0 + 10.1</td>
<td>62.5 + 10.7</td>
<td>0.0035</td>
</tr>
<tr>
<td>% Female</td>
<td>37.5</td>
<td>50</td>
<td>0.2956</td>
</tr>
<tr>
<td>% Left</td>
<td>45</td>
<td>43.33</td>
<td>0.8895</td>
</tr>
</tbody>
</table>

Table 2: Rotator Cuff Thickness Outcomes.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rotator cuff thickness</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant type</td>
<td>Vented</td>
<td>0.59 + 0.18</td>
</tr>
<tr>
<td></td>
<td>Non-vented</td>
<td>0.49 + 0.17</td>
</tr>
<tr>
<td>Gender</td>
<td>Female (n=30)</td>
<td>0.59 + 0.18</td>
</tr>
<tr>
<td></td>
<td>Male (n = 40)</td>
<td>0.49 + 0.17</td>
</tr>
<tr>
<td>Age</td>
<td>r = -0.42</td>
<td>0.34</td>
</tr>
<tr>
<td>Days post-op</td>
<td>r = 0.34</td>
<td>0.57 + 0.19</td>
</tr>
</tbody>
</table>
Double row trans-osseous equivalent repair has been shown to be biomechanically superior to most fixation techniques. Current issues are tension, not addressed in this study, and biology. Vented anchors are thought to provide a biologic advantage, promoting improved healing by allowing narrow stem cell access to the enthesiopathic distal rotator cuff tendon [23]. Recent studies utilizing Plasma Rich Protein and other methods to improve tendon healing were unsuccessful [24]. Our current thinking is that a vented anchor would allow better stem cell access via the marrow, and thereby improve healing over non-vented anchors. The present study shows increased thickness of the rotator cuff over the site of the vented anchor as compared to the non-vented anchor.

Rotator cuff tears will continue to be problematic for a majority of the aging patient population, requiring physicians to continue to find techniques, materials, and protocols that improve patient outcomes [21]. It is known that operating on younger patients, patients with smaller tears, patients without signs of advanced muscle atrophy, and using new biomechanical principles have provided orthopedists with improved results [13,21]. An ideal repair should incorporate strong initial fixation strength, maintain mechanical stability until appropriate healing, and allow minimal gap formation [13,14, 25].

Cummins study on revision arthroscopy reported the predominant mode of failure for rotator cuff surgery was tendon pulling through suture (19/22 with a p value < 0.001). Problems with revision surgery in nude larger tears encountered decreased tendon quality, and decreased tendon mobility, highlighting the importance of successful initial rotator cuff repairs [6].

This study did have several limitations, one being that the majority of patients in the non-vented group were performed by a single surgeon, MJOB, whereas the vented group had a smaller ratio between operating surgeons. Also, post-operative ultrasounds were performed by the operating surgeon, so inter-observer error between ultrasounds could affect the data. This study compares one type of vented suture anchor (Smith and Nephew, HEALICOIL REGENSORB Suture Anchor, Andover, MA) to a different single kind of non-vented suture anchor (DepuyMitek, HEALIX ADVANCE Suture Anchor, Norwood, MA), and differences between the suture anchor, apart from the vents, may affect results. Factors not accounted for in this study were smoking status, corticosteroid use, or any other medical condition which affects rotator cuff healing, which could affect final results of healing potential. Finally, the results are only those at patient’s six week appointments; other studies have denoted rotator cuff healing at its full potential.

CONCLUSION

Vented suture anchors provide increased healing potential in patients undergoing rotator cuff repair, seen as the difference in tendon healing at six weeks between each group. We recommend continued investigation into this topic, with follow up at six months to evaluate rotator cuff healing at its full potential.

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CONFLICT OF INTEREST

Michael O’Brien, MD: Consultancy for DepuyMitek and Smith and Nephew
Felix H Savoie, III, MD: Speakers Bureau for DepuyMitek and Smith and Nephew

REFERENCES


