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Complications associated with subpectoral biceps tenodesis: Low rates of incidence following surgery

Shane J. Nho, MD, MS[a], Stefanie N. Reiff[a], Nikhil N. Verma, MD[a], Mark A. Slabaugh, MD[a], Augustus D. Mazzocca, MD[b], Anthony A. Romeo, MD[a,*]

[a]*Section of Shoulder & Elbow Surgery, Division of Sports Medicine, Department of Orthopedic Surgery, Rush University Medical Center, Rush Medical College of Rush University, Chicago, IL*
[b]*Department of Orthopaedics, University of Connecticut Health Center, Farmington, CT*

Background: Tenodesis of the long head of the biceps tendon is a common procedure used to alleviate pain caused by instability or inflammation of the tendon. The purpose of this study is to report on the incidence and types of complications following an open subpectoral biceps tenodesis (OBT) procedure.
Hypothesis: Our hypothesis was that the rate of adverse events after OBT was low.
Methods: From January 2005 to December 2007, all patients that underwent an OBT with bioabsorbable interference screw fixation performed by 1 of the 2 senior authors for biceps tendonitis were reviewed, excluding tenotomy, revision cases, or fixation methods other than interference screw fixation.
Results: Over a 3-year period, 7 of 353 patients had complications with OBT with an incidence of 2.0%. The mean age of patients with complications was 44.67 years, with 57.1% males and 42.9% females. There were 2 patients (0.57%) with persistent bicipital pain. Two patients (0.57%) had failure of fixation resulting in a Popeye deformity. One patient (0.28%) presented with a deep postoperative wound infections that necessitated irrigation and debridement with intravenous antibiotics. Another patient (0.28%) developed a musculotaneous neuropathy. Another patient (0.28%) developed reflex sympathetic dystrophy necessitating pain management and stellate ganglion block.
Conclusion: The incidence of complications after subpectoral biceps tenodesis with interference screw fixation in a population of 353 patients over the course of 3years was 2.0%.
Level of evidence: IV, Case Series, Treatment Study.

Keywords: Biceps tendonitis; biceps tenodesis; biceps tenotomy; complications

Tenodesis of the long head of the biceps tendon is a common procedure used to alleviate pain caused by instability or inflammation of the tendon. While there are multiple fixation techniques for performing a biceps tenodesis, the complications for each procedure are similar. These include failure or rerupture of the tendon, hematoma, infection, persistent pain, reaction to a fixation device, nerve injury, cosmetic deformity, and fracture.[6,7,9,11]

An open subpectoral biceps tenodesis (OBT) using an interference screw technique has been reported advantageous due to its simplicity, the maintenance of muscle tendon and soft tissue units, the preservation of the length-tension

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*Reprint requests: Anthony A. Romeo, MD, 1726 W. Harrison St, Suite 1063, Chicago, IL 60612.
E-mail address: shoulderelbowdoc@aol.com (A.A. Romeo).

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relationship, the distal removal of the tendon from the bicipital groove and from the shoulder, and the biomechnical strength advantages of having an interference screw.[6,7,11] Numerous studies have reported improvement and excellent clinical outcome and pain relief after OBT.[7-9] Complications reported after OBT with interference screw fixation include failure of tenodesis, hematoma, seroma, infection, bioabsorbable screw reaction, persistent bicipital pain, neurovascular injury, or fracture.[7-9,11] These studies report on case series of less than 50 patients, and the rate of complications after OBT may be difficult to accurately determine. The purpose of the present study was to report on the incidence of complications after OBT and to describe the type of complications in a single institution with 2 orthopedic surgeons. Our hypothesis was that the rate of adverse events after OBT was low.

Material and methods

Between January 1, 2005 and December 31, 2007, all patients that underwent OBT through a subpectoral approach were reviewed. The study was approved by the Institutional Review Board. Two fellowship-trained orthopedic surgeons in either shoulder surgery or sports medicine performed all the surgeries in a high volume clinical practice. The inclusion criteria were patients who had undergone with either isolated subpectoral OBT with interference screw fixation or OBT combined with other arthroscopic shoulder procedures. All patients had a clinical examination that met the diagnostic criteria for biceps tendonitis, including tenderness over the biceps and/or positive Speed's, O'Brien's, and Yergason's tests. All patients had failed prior nonoperative management consisting of anti-inflammatories, physical therapy, and steroid injection.

The subpectoral biceps tenodesis technique has previously been described.[8] After arthroscopic tenotomy of the long head of the biceps, the patient positioning has to be adjusted so that the patient is supine with the head of the bed set at approximately 30°. The pectoralis major tendon is palpated from the muscle belly to its insertion on the proximal humerus. A 3-cm axillary incision is centered over the pectoralis tendon and the skin is injected with 10cc of 0.5% bupivicaine. The inferior pectoralis musculotendinous junction is identified, and the muscle is retracted superiorly and laterally with an Army-Navy retractor. The proximal biceps tendon is palpable immediately posterior to the pectoralis muscle, and the tendon should be easy to pull out of the surgical wound. Number 2 Fiberwire (Arthrex, Inc., Naples, FL) is locked onto the proximal tendon beginning at the musculotendinous junction and continued proximally. The proximal 2 cm of the tendon is excised. A Homan retractor is placed laterally under the deltoid and a Chandler is placed on the medial aspect of the humerus to retract the conjoined tendon and neurovascular structures. A guide wire is placed in the bicipital groove and 8-mm reamer is passed over the guide wire to create a bone tunnel in the anterior cortex proximal to the pectoralis tendon. An 8 x 12-mm Bio-Tenodesis interference screw (Arthrex, Inc., Naples, FL) is attached to the tendon and screwed into the bone tunnel until it is flush with the anterior cortex. The nonabsorbable suture is tied. The wound is copiously irrigated. A routine wound closure is performed.

To complete the study, all medical records of the 373 patients who underwent an OBT in the time period were reviewed. For patients identified with postoperative complications, the demographic information (age, gender), intraoperative data (date of index OBT, concomitant procedures that were performed with OBT), and data from the most recent follow-up appointment (type of postoperative complication, recognition of complication after index surgery, additional intervention) were recorded. The incidence of each specific complication and overall complications was calculated from this chart review.

Results

Over a 3-year period (January 2005 to December 2007), 373 patients underwent subpectoral biceps tenodesis by 2 senior physicians at a single institution. The average time until the chart review was 2.34 years after the surgical procedure (range, 1.03-4.01 years). The mean age of the entire study group was 53.6 ± 19.8 years at the time of surgery with 243 (65.1%) males and 130 (34.9%) females. Twenty patients were excluded due to nonarthroscopic concomitant procedures, including total shoulder arthroplasty and hemiarthroplasty. Arthroscopic concomitant procedures included rotator cuff repair, subacromial decompression, capsular release, debridement, distal clavicle resection, and SLAP repair with rotator cuff repair being the most prominent (44.9% of patients received one). Fifteen (4.2%) of patients had a biceps tenodesis only. The 2 surgeons performed a biceps tenodesis on 26% of their patients undergoing soft tissue procedures during this time period. Seven of 353 patients had complications after open subpectoral biceps tenodesis with an incidence of 2.0%. The mean age of patients with complications was 44.67 years, with 57.1% males and 42.9% females.

There were 2 patients (incidence, 0.57%) with persistent bicipital pain. At 6 months after surgery, 1 patient complained of persistent pain over the biceps with a positive Speed's test. An MRI was obtained and demonstrated that the biceps tenodesis site was intact. Another patient underwent revision repair of massive rotator cuff tear and OBT and had persistent bicipital pain and failure of rotator cuff repair at 12 months after surgery. The patient was ultimately revised to a reverse shoulder arthroplasty. Two patients (incidence, 0.57%) had failure of fixation resulting in a popeye deformity recognized at 4 and 6 months, respectively, after biceps tenodesis; but, only 1 elected to undergo revision biceps tenodesis.

One patient (incidence, 0.28%) presented with a deep postoperative wound infection that necessitated irrigation and debridement at 6 and 7 weeks, respectively, after the index procedure. After surgical debridement and 2 weeks of intravenous antibiotics, the patient symptoms resolved with the biceps tenodesis intact.

Another patient (incidence, 0.28%) presented with forearm numbness at 10 days postoperation and weakness in elbow flexion, and forearm supination at 6 weeks after

OBT. The patient underwent musculocutaneous nerve exploration 6 weeks after the index surgery, at which time the nerve was intact. The patient had complete resolution of the neurologic deficits by 6 months post-op. Another patient (incidence, 0.28%) developed reflex sympathetic dystrophy necessitating pain management and stellate ganglion block (see Table for complete summary).

Discussion

Open subpectoral biceps tenodesis utilizing an interference screw fixation technique was found to have a low incidence of complication at 2.0%. There were 7 patients with complications out of a total of 353 in the selected 3-year period. The present study represents the largest clinical series of patient who had undergone OBT in a single institution, and provides an accurate estimate of incidence and types of adverse events following OBT.

A number of smaller case series have also reported on complications after OBT. Millett et al[9] reviewed 34 patients who underwent OBT with interference screw fixation technique and reported no failures of fixation at an average of 13 months after surgery. Millett et al[9] also reported 1 patient with persistent bicipital groove tenderness, which represented 3% of the cohort. The findings of the present study reported 0.57% incidence of failure of fixation and 0.57% incidence of persistent bicipital pain.

Mazzocca et al[7] studied 41 patients at approximately 1 year after open subpectoral biceps tenodesis, using interference screw fixation. Seven percent of patients reported pain in the subpectoral triangle at follow-up with a mean of 1.1 on a 10- point pain-scale. There was 1 failure (2%) due to re-rupture of the tendon. Nevertheless, all patients, including the failed tenodesis, reported statistically significant improvement in ASES, Rowe, SST, CM, and SANE scores from baseline to final follow-up, and the OBT was able to restore biceps symmetry in 35 of 41 patients.

Other biceps tenodesis techniques have also been reported in the literature that vary in the location of the tenodesis (proximal or distal to the bicipital groove) and the type of fixation. Although the benefits associated with the location of tenodesis have not been clearly established, distal fixation removes the intra-articular portion of the long head of the biceps tendon with fixation distal to the bicipital groove, and, therefore, eliminates potential sources of pain from either the proximal portion of the tendon and surrounding tenosynovium and the bicipital groove.[6,11] Although there are no published rates of persistent pain following distal versus proximal fixation, Friedman et al[3] reports that OBT with fixation points proximal to the groove were revised (mostly due to continued pain) in 12% of cases after 2 years compared to a 2.7% revision rate in fixation sites distal to the groove. The rate of persistent bicipital pain and failure of fixation were low in the present series and may be attributed to the distal point of fixation with removal of the pathologic portion of the tendon and the strength of interference screw fixation with the OBT.

The type of fixation may also contribute to the potential complications related to failure of fixation and continued postoperative bicipital pain. Mazzocca et al[6] compared the cyclic displacement of open subpectoral bone tunnel and open subpectoral interference screw techniques to arthroscopic suture anchor and arthroscopic interference screw techniques in cadaver shoulders. The open bone tunnel technique had significantly greater displacement compared to the other 3 techniques, while the interference screw displaced the least; though this difference was not statistically significant from the 2 arthroscopic techniques. Kusma et al[5] reported that interference screw fixation had a significantly greater ultimate failure load to all others and the least displacement after 200 cycles when compared to suture anchor fixation, ligament washer fixation, the keyhole technique, and the bone tunnel technique in porcine humeri. Richards and Burkhart[12] demonstrated in

Table Description of complications associated with OBT

Age (Yr)	Sex	Concomitant procedures at index surgery	Complication	Recognition of complication after index surgery (mos.)	Additional intervention
51.3	Male	Acromioplasty, capsular release	Ruptured biceps	6	Revision open biceps tenodesis
33.1	Male	Acromioplasty, distal clavicle resection	Musculocutaneous neuropathy	1.5	Exploration of musculocutaneous Nerve
19.6	Female	None	Persistant bicipital pain	6	MRI tenodesis intact
64.4	Female	None	Deep wound infection	1	Irrigation and debridement
69.8	Female	Revision massive rotator cuff repair	Persistant bicipital pain	12	Reverse total shoulder arthroplasty
51.3	Male	Acromioplasty	Ruptured biceps	4	None
23.1	Male	None	Reflex sympathetic dystrophy	3	Stellate ganglion Block

cadveric shoulders that the interference screw had a greater resistance to pullout than did the suture anchor fixation technique. Ozalay et al[10] also supported the strength of the interference screw fixation by demonstrating that the screw has improved biomechanical strength compared to bone tunneling, suture anchors, and the keyhole technique, and may have the potential to improve clinical outcomes. Millet et al[9] found that 7% of their 54 patients who underwent an open subpectoral biceps tenodesis with suture anchor fixation had persistent pain compared to only 3% for the interference screw, although this difference was not significant. While the clinical outcomes were essentially equal for the 2 different techniques, the trend displays that suture anchors lead to greater possibility of continued pain after surgery. Millet et al[9] hypothesized that the screw provides smoother bone-tendon interface than suture anchors which leave a potentially irritating prominence of suture material.

The other complications that were also reported in the present study include include wound infection and neurologic injury. Due to the proximity of the brachial plexus, injury to the neurovascular structures can potentially occur with the deep surgical dissection; however, studies report a ''very low'' incidence of such injuries in both proximal and distal repair sites.[2] There was 1 isolated case of musculocutaneous neuropathy that completely resolved; however, the incidence of neurologic injury was still very low with only one incidence. The authors caution that the Chandler retractor should be positioned carefully and gentle medial retraction of the coracobrachialis and short head of the biceps should be performed only during necessary portions of the procedure.

The treatment of biceps tendonitis after failure of conservative measure has been debated. Biceps tenotomy has been considered to be a reasonable alternative with predictable pain relief and relative ease of surgical treatment.[1,4,11,13] The disadvantages of biceps tenotomy include a Popeye deformity and decreased elbow flexion and forearm supination. Biceps tenodesis has been thought to preserve the length-tension relationship of the biceps muscle by establishing a new origin at the appropriate length that prevents muscle atrophy, maintenance of elbow flexion, and supination strength to optimize elbow function and improved cosmesis by reproducing the biceps appearance.[8,11] Kelly et al[4] reports that up to 40% of tenotomy patients experience fatigue and pain in the affected arm, while our study reports a much lower incidence of pain with tenodesis.

The study has a number of strengths. The present study is the largest study population in the published literature to review the complications after subpectoral OBT, at a single institution with multiple orthopedic surgeons with fellowship training in either shoulder surgery or sports medicine. The study provided accurate information regarding the safety profile of OBT. Additionally, the study reported descriptive information on the types of complications, as well as epidemiological data on the incidence of overall complications and each specific complication.

There are a number of limitations of the present study. The study was a retrospective chart review that describes adverse events associated with subpectoral open biceps tenodesis. The study lacked a control group but provided comparisons with historical controls. Although the medical records of all patients that met the study criteria were reviewed, there may be patients with complications that did not return to the treating orthopedic surgeon, and the data would not be captured for analysis.

Conclusion

Open subpectoral biceps tenodesis using an interference screw technique has been reported advantageous because of its simplicity, the maintenance of muscle tendon and soft tissue units, the preservation of the length-tension relationship, the distal removal of the tendon from the bicipital groove and from the shoulder, and the biomechnical strength advantages of having an interference screw. Clinical series have demonstrated excellent pain relief, improvement in clinical outcome instruments, maintenance of biceps strength and function, and restoration of biceps muscle contour with an exceptionally low incidence of complications of 2.0%. The efficacy and safety of the OBT with interference screw fixation provides substantial support for subpectoral OBT with interference screw fixation for the treatment of biceps tendonitis.

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