Arthroscopic Trapeziectomy With Suture Button Suspensionplasty: A Retrospective Review of 153 Cases

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Abstract

Background: Arthroscopic trapeziectomy with suture button suspensionplasty (ATBS) is a relatively new surgical option for the treatment of thumb carpometacarpal (CMC) osteoarthritis. Although ATBS has many potential benefits over alternative surgical treatments for CMC arthritis, little data exist regarding its safety and complication rates. The purpose of this study was to demonstrate that ATBS is associated with a low risk of complications within 1 year of surgery. **Methods:** A retrospective review of patients treated with ATBS by one senior hand surgeon over a span of 3 years was performed. **Results:** A total of 153 cases of ATBS were performed in 136 patients. Ninety-seven cases involved arthroscopic hemitrapeziectomies, and 56 involved arthroscopic complete trapeziectomies. There were 44 males and 92 females with a mean age of 62. Thirty-eight percent of the cases were graded as Eaton stage IV, 46% stage III, and 14% stage II CMC arthritis, while 3 cases (2%) were performed as revisions. Mean follow-up duration was 58 weeks. Mean preoperative key pinch strength of the affected versus the unaffected side was 92% compared with 95% postoperatively. Revision surgery was performed in 9 out of 153 cases (<6%). Of those 9 cases, 5 had additional minor bony debridement with subsequent improvement in pain, 3 had the implant repositioned due to button prominence, and 1 patient presented with osteomyelitis of the first and second metacarpals that was successfully treated with button removal and an antibiotic regimen. **Conclusions:** ATBS is a safe, minimally invasive procedure for treatment of symptomatic stages II through IV thumb CMC arthritis.

Keywords: carpometacarpal, osteoarthritis, thumb, trapeziectomy, suspensionplasty

Introduction

The thumb carpometacarpal (CMC) and scaphotrapezotrapezoidal (STT) joints are the most commonly involved arthritic joints in the hand and wrist, occurring in 25% of women and 8% of men.^{6,20,22} Once present, the symptoms of thumb CMC osteoarthritis (OA) are typically progressive and may lead to significant functional disability.

When nonoperative management fails to provide adequate relief, surgical options are numerous, though no consensus exists regarding the optimal treatment. As a result, surgical treatment is typically selected based on a variety of factors including surgeon preference, disease severity, and other patient-related factors. Generally, surgical treatment involves either partial or complete removal of the trapezium, while opinions differ on the best method (or need) for maintaining the relative alignment of the metacarpal, thus preventing subsidence into the trapezoidal void.

Within the past decade, arthroscopic approaches for the treatment of thumb CMC arthritis and particularly for trapeziectomy have gained popularity. Potential benefits include

sparing the joint capsule and important stabilizing ligaments that are sacrificed with open procedure, improved diagnostic ability, and the ability to convert to open procedure in the future if needed.^{1,2,3,7,11,13} Regarding metacarpal subsidence, options include ligament reconstruction with or without tendon interposition (LRTI), hematoma and distraction arthroplasty (HDA), suspensionplasty, and total or hemi-implant arthroplasty.^{5,6,8,9,14–16,19,21} However, these procedures have their own inherent potential complications that may include stiffness due to prolonged immobilization, prolonged recovery time, scar tenderness, tendon adhesion or rupture, sensory change, pin-related complications, and rarely complex regional pain syndrome (CRPS) type I.^{5,6,9,15}

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To address the downsides of both open trapeziectomy and the numerous procedures aimed at preservation of metacarpal height, arthroscopic trapeziectomy with suture button suspensionplasty (ATBS) has been proposed.¹⁰ This technique utilizes the Mini TightRope (TR) (Arthrex Inc, Naples, FL) device to maintain the relative alignment of the first and second metacarpals, thus preventing subsidence into the newly created trapezial void. Although a handful of studies in smaller cohorts have shown this technique to be comparable with others from a clinical and biomechanical standpoint,^{4,10,23,24} to date, there have been no studies to examine its relative safety in a large cohort of patients.

The present study seeks to analyze postoperative outcomes on patients who underwent ATBS for Eaton stages II to IV of symptomatic thumb OA. The study hypothesis was that this minimally invasive procedure is effective and poses minimal risk of complications requiring revision surgery.

Materials and Methods

This study was approved by our institutional review board. A retrospective review of all patients consecutively treated with partial or complete ATBS at one surgical center, from January 2010 to December 2012, was conducted. Inclusion criteria consisted of an established diagnosis of thumb CMC OA, failed trial of conservative management, and subsequent surgical treatment with either hemi-ATBS or complete ATBS. Patients who had prior surgery to address their thumb CMC OA before ATBS were *not* excluded. However, patients were excluded if any other procedures aimed at stabilizing the thumb basilar joint were performed simultaneously as ATBS. Data collected from chart review included patient demographics, medical history, work status, pertinent injury and surgical details, and preoperative and postoperative physical and radiologic exam findings. All surgeries were performed by one senior fellowship-trained hand surgeon. Primary outcomes assessed included postoperative key pinch strength, complications, and need for revision surgery. Secondary data collected included tourniquet time, and total time in the operating room were also collected. χ^2 analysis was used to compare the preoperative and postoperative values of the primary endpoints, and a one-way analysis of variance (ANOVA) was used to compare the means of tourniquet and operation room times over the 3 years of the study period.

Results

This study was approved by our institutional review board. One hundred fifty-three cases of ATBS performed in 136 patients met the criteria necessary for inclusion. Ninety-seven cases (63%) involved arthroscopic hemitrapeziectomies, and 56 (37%) involved complete arthroscopic

trapeziectomies. There were 44 males and 92 females with a mean age of 62 years (range: 44-92 years). Surgery was performed on the dominant hand (including 4 patients who were ambidextrous) in 89 cases (59%). Thirty-eight percent of the cases were graded as Eaton stage IV, 46% stage III, and 14% stage II CMC arthritis, while 3 cases (2%) were performed as revisions of prior failed surgical treatments and thus not assigned an Eaton stage preoperatively. (Figure 1). Sixty-two cases had at least 1 other procedure combined with the ATBS on the same hand, and the remaining 91 had only the ATBS performed.

Mean tourniquet and operating room times for the 90 patients who had only ATBS performed were 24 ± 10 minutes (range: 11-52 minutes) and 36 ± 14 minutes (range: 20-90 minutes), respectively. Tourniquet time means were also found to significantly decrease during the years of data collection, from 33 minutes in 2010 to 26 minutes in 2011 and then 19 minutes in 2012 ($P < .01$) (Figures 2 and 3).

Following surgery, all patients began active thumb motion 10 days postoperatively. The mean follow-up duration was 58 weeks. The mean preoperative percentage key pinch strength of the affected versus unaffected side for patients that did not have bilateral ATBS was 92%, compared with 95% postoperatively, though this difference was not found to be of statistical significance ($P = .77$). Seventeen patients (11.7%) underwent ATBS on both thumbs, including 1 patient who had both procedures performed simultaneously. Among those patients who underwent bilateral ATBS on separate dates ($n = 16$), the median duration between the two procedures was 26 weeks (range: 5-128 weeks). Three patients had TR placed for a prior failed CMC arthroplasty performed at another institution.

Repositioning of the arthroplasty was required in 3 out of 152 cases (2%), 1 of which was performed 11 months postoperatively in a patient with a prior failed CMC arthroplasty. Another patient had the implant moved volarly at 2 months, and a third patient had the button repositioned due to a palpable prominence on the dorsum of the index metacarpal 9 months postoperatively.

Five patients had additional bony debridement at a mean interval of 18 months (range: 7-41 months) from the date of the original surgery. Of those patients, 2 had the hemitrapeziectomy converted to a full trapeziectomy due to the progression of disease and subsequent involvement of the STT joints, 2 had an excision of an osteophyte on the first metacarpal after complaining of pain, and 1 patient had a hemitrapezoidectomy performed for persistent pain.

One patient presented with osteomyelitis of the first and second metacarpal bones and the tightrope was removed 6 weeks postoperatively. No patients developed CRPS. No fractures of the metacarpal bone of the thumb or index were observed during the follow-up period.

Figure 1. Preoperative radiographs of dominant right hand of 78-year-old female demonstrating stage IV CMC arthritis of her right thumb CMC joint.

Note. CMC, carpometacarpal.

Figure 2. Postoperative radiographs after arthroscopic trapeziectomy with suture button suspensionplasty using Mini TightRope® (Arthrex Inc, Naples, FL).

Figure 3. Evolution of mean tourniquet times over the 3-year period.

Discussion

The use of arthroscopy for the treatment of CMC OA poses numerous potential advantages over open methods including accurate staging of the disease and removal of bone while avoiding the morbidity associated with open trapeziectomy.¹⁻³ Hofmiester et al reported good outcomes at 7 years in 18 patients who underwent arthroscopic hemitrapeziectomy with

thermal capsular shrinkage.¹⁷ This was later supported by Edwards and Ramsey who prospectively reported on 23 patients who had arthroscopic hemitrapeziectomy and thermal capsular modification with overall excellent outcomes at 4 years.¹³ However, both studies involve temporary pinning of the CMC joint (though the pin is placed into the remaining trapezium, rather than the second metacarpal), and were thus subject to pin-related complications.^{13,16,17,19} Hofmiester et al reported 4 complications in 18 patients (22%): 2 cases of dorsal radial nerve neuritis, 1 rupture of the flexor pollicis longus, and 1 prolonged hematoma.¹⁷ Edwards and Ramsey reported 2 complications of note out of 23 cases (8.7%); one patient developed a painful neuroma related to pin placement and a second required conversion to LRTI due to persistent pain.¹³ Earp and colleagues reported on 15 cases of arthroscopic hemitrapeziectomy with tendon interposition with good results at just under 1 year of follow-up.¹² They reported 1 case of CRPS (6.7%) that developed postoperatively.

The TR device, when used in conjunction with arthroscopic trapeziectomy, offers some potential advantages than the aforementioned surgical options. The device utilizes 2 strands of No. 2 FiberWire anchored via buttons to the proximal first and second metacarpals to maintain their relationship, thus eliminating the need for pins. Yao and Song reported good outcomes in 21 patients treated with ATBS at 2 years, though 1 patient developed CRPS and subsequently fractured through the second metacarpal at the site of the button.²³ Khalid et al had also previously reported a case of fracture, though both reported fractures occurred with the first generation device that utilized a 2.7-mm drill to create the opening for the FiberWire as well as a larger 4-hole cortical button on the second metacarpal (Figure 4).¹⁸ As the implant and technique have been modified to use a 2-hole button and 1.1-mm tapered suture passing K-wire advanced under oscillation, no metacarpal fractures have been reported.

In the presented series, revision surgery was required in 9 of the 153, or less than 6% of cases. Of those 9 cases requiring additional surgery, 5 required simple excision of additional bone and were performed at an average interval of 1.5 years postoperatively. All 5 subsequently noted improvement in their pain. Of the remaining 4 cases requiring revision surgery, 3 patients underwent revision for prominence of the button on the index metacarpal, 1 patient had workers' compensation issues and requested TR repositioning, another patient had undergone revision ATBS for a failed LRTI at an outside institution, and a third patient had a prominence of the first generation (4-hole) button. This patient was a 67-year-old female with a body mass index (BMI) of 22.3. It is possible that the larger size of the 4-hole button, combined with the patient's diminished subcutaneous tissue, contributed to increased button prominence.

The final revision was performed in a patient who developed osteomyelitis of the right thumb and index metacarpal

Figure 4. First generation of the Mini TightRope® with the round 4-hole button for cortical fixation at the index metacarpal bone.

bones. This patient was a disabled 54-year-old right-hand-dominant female, who upon detailed review revealed an extensive medical history that included peripheral vascular disease, hypertension, Sjögren's syndrome (on immunomodulators), hypothyroidism, and anxiety/depression. The patient also reported a positive smoking history. At the patient's routine 2-week postoperative visit for suture removal, she was noted to have some erythema at the proximal dorsal incision without any drainage, and was placed on a 5-day course of oral antibiotics. It was later discovered that the patient had been noncompliant with both her antibiotic medication and her follow-up with therapy. When she was seen at the 6-week mark, purulence was noted emanating from the dorsal index wound. The wound was emergently debrided and the implant removed at that time. Intraoperative soft tissue and osseous cultures revealed Methicillin-Sensitive *Staphylococcus aureus*. An appropriate long-term antibiotic regimen was initiated under the guidance of infectious disease specialists and the infection ultimately resolved without further complication. Although only 1 out of 153 (0.7%) procedures resulted in an infection, the consequences of osteomyelitis can be devastating. The authors feel that while postoperative vigilance is critical, a thorough preoperative evaluation of patient risk factors is equally important. In the case of the presented patient, though no single factor alone would have precluded her from receiving this operation, the combination of factors

predisposing her to poor wound-healing and infection should have been more carefully scrutinized.

In this study, ATBS was associated with a low revision rate of 5.9%. One could argue that the 5 revisions that involved simply removing some additional bone represent the nature and progression of the disease versus true complications given that they were performed at a mean of 18 months postoperatively, with none performed earlier than at 7 months. Assuming that rationale, the true complication rate would be 4/152 or 2.6% of cases, which the authors feel is acceptable.

Understandably, a primary concern of performing ATBS using the TR device is its cost-effectiveness. The TR device itself is not inexpensive (\$495), especially when compared with the comparable techniques using pins or autograft tendon interposition. However, the present study demonstrates that it is associated with a low rate of revision surgery which may, in part, offset some of its cost. In addition, as a secondary outcome in this study, we found the mean tourniquet time to decrease over the years in which data were collected. This improvement over a 3-year period suggests the ability of the surgeon to become more functionally adept with the technique. In their study comparing suspension-plasty using abductor pollicis longus (APL) tendon versus TR, Avant and colleagues suggest that the improved operating room time using the TR may also offset some of the cost associated with the device itself.⁴

This study is not without limitations, which include the retrospective nature of data collection. Although no validated outcome scores were consistently collected in the study, we believe that maintenance of pinch strength and low risk of complications requiring additional surgery are sufficient outcomes for the purposes of showing the relative safety and efficacy in this large cohort of patients treated by a single surgeon. Another limitation of this study is that only early and mid-term outcomes are reported. However, as suture button suspensionplasty following hemitrapeziectomy or complete trapeziectomy is a relatively new technique, longer-term follow-up data are not yet available for our review. With no consensus existing as to the optimal treatment of CMC arthritis, it would be of great interest to conduct prospective randomized controlled trials to verify the benefit of suture button suspensionplasty following arthroscopic trapezium resection compared with arthroscopic resection alone or with other methods to maintain metacarpal height.

In conclusion, ATBS is a minimally invasive procedure used to treat symptomatic thumb CMC arthritis inclusive of Eaton stages II to IV. The presented study demonstrates that ATBS is associated with maintenance of pinch strength, with acceptable rates of complications and revision. Longer-term follow-up studies with well-defined outcome measures are necessary to evaluate both the longevity and efficacy of this procedure.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Informed consent was obtained from all individual participant included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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