

JUL 15 2004

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188		
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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 14.Jul.04	3. REPORT TYPE AND DATES COVERED MAJOR REPORT		
4. TITLE AND SUBTITLE SUTURE ANCHOR ARTHROPLASTY FOR THUMB CARPOMETACARPAL OSTEOARTHRITIS			5. FUNDING NUMBERS		
6. AUTHOR(S) MAJ TAYLOR NATHAN L					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) COLUMBIA UNIVERSITY			8. PERFORMING ORGANIZATION REPORT NUMBER CI04-422		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) THE DEPARTMENT OF THE AIR FORCE AFIT/CIA, BLDG 125 2950 P STREET WPAFB OH 45433			10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION AVAILABILITY STATEMENT Unlimited distribution In Accordance With AFI 35-205/AFIT Sup 1			12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words)					
<p>DISTRIBUTION STATEMENT A Approved for Public Release Distribution Unlimited</p> <p>20040720 084</p>					
14. SUBJECT TERMS			15. NUMBER OF PAGES 14		
			16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT		

'Suture Anchor Arthroplasty' for Thumb Carpometacarpal Osteoarthritis

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Acknowledgement:

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Running Title: Suture Anchor Arthroplasty

Purpose: To describe a technique termed 'Suture Anchor Arthroplasty' (SAA), for thumb carpometacarpal joint osteoarthritis and to report the clinical results.

Methods: SAA is a surgical technique similar to 'Ligament Reconstruction Tendon Interposition' (LRTI) Arthroplasty, except that the entire flexor carpi radialis tendon is secured to the thumb metacarpal base using suture anchors instead of a bone tunnel. Temporary pin fixation is not used. Seventeen consecutive patients (20 hands) underwent SAA. Patients were assessed with a standardized questionnaire, physical exam, and x-rays at most recent follow-up.

Results: At an average follow-up period of 24 months (range 7-74 months), all patients had excellent pain relief. All patients were satisfied with 15 being very satisfied and 2 somewhat satisfied. All patients would have the surgery again if given the choice. Grip strength improved by 68% and key pinch strength increased by 35% compared to preoperative values. Loss of the trapezial space height averaged 28% by radiographs. No suture anchors pulled out and no patients required reoperation.

Conclusions: SAA provides clinical results similar to LRTI arthroplasty for thumb carpometacarpal osteoarthritis during the period studied. The use of suture anchors eliminates the need for a transosseous bone tunnel, simplifying the procedure.

Key words: arthroplasty, basal joint arthritis, osteoarthritis, thumb carpometacarpal joint

Introduction

Osteoarthritis of the thumb carpometacarpal (CMC) joint is a common, painful condition. Ligament Reconstruction Tendon Interposition Arthroplasty (LRTI), as described by Burton in 1983, is a well-proven surgical technique with a history of excellent results.^{1,2,3,4,5,6,7,8,9} Many surgeons now routinely harvest the entire flexor carpi radialis (FCR) tendon for the procedure.^{10,11,12} Threading the entire FCR tendon through the transosseous tunnel at the base of the first metacarpal can be difficult at times, as Tomaino has noted.¹³

The senior author (R.S.) has routinely employed a single incision anterior approach for distal biceps tendon repairs using suture anchors for the past 10 years with excellent results and no ruptures. Eliminating the transosseous drill hole for biceps tendon repair simplifies that technique and the concept seemed applicable to thumb CMC arthroplasty. Therefore, since 1997, the senior author (R.S.) has employed a modification of the LRTI technique that eliminates the need for passage of the FCR through a bone tunnel by utilizing suture anchors in the first metacarpal base to secure the FCR tendon. This technique obviates the need for exposure of the thumb metacarpal base dorsal to the insertion of the abductor pollicis longus tendon (APL), thereby reducing risk of injury to the radial artery and superficial nerves. The purpose of our study was to present the technique of 'Suture Anchor Arthroplasty' (SAA), and to report the subjective and objective clinical results in a consecutive group of patients.

Materials and Methods

We performed a retrospective study of patients who had undergone SAA. Between 1997 and 2002, the senior author (R.S.) performed SAA on 20 hands in 17 patients. These patients represent the first 20 consecutive hands to undergo this procedure. All patients had the preoperative diagnosis of painful, symptomatic Stage III or IV thumb CMC osteoarthritis (Figure 1). All patients had exhausted non-operative treatment and had symptoms for a minimum of one year.

The average age of the patients at the time of operation was 61 years. The dominant hand was involved in 13 of 17 patients. Five of the 20 hands also had symptomatic carpal tunnel syndrome which required release at the time of the SAA. Three hands required volar capsulodesis of the thumb metacarpophalangeal (MP) joint at the time of SAA due to thumb MP hyperextension, and one patient had a concomitant trigger finger release. Eight of the 17 patients were retired at the time of operation. Occupations of the other patients included dog handling, nursing, office administration, homemaker, and nutritionist.

Approval by the institutional review board (IRB # 3507) was obtained for this study, all patients provided informed consent, and all necessary HIPAA guidelines were followed.

Subjective Evaluation

At follow-up, each patient completed a written questionnaire evaluating subjective factors including satisfaction (very satisfied, somewhat satisfied, somewhat dissatisfied, or very dissatisfied), amount of pain (none, mild, moderate, or severe), ability to perform activities of

daily living (open jars, turn keys, open car doors, button shirts, or use scissors), and whether they would undergo the surgery again if given the choice.

Objective Evaluation

The physical examination for all patients included sensation, stability of the CMC joint, active range of motion (flexion, extension, adduction, abduction), and mobility (thumb to base or tip of little finger). Grip strength (Jamar dynamometer) and key pinch strength (pinch gauge) were measured preoperatively and at follow-up. Each hand was assessed with standard posteroanterior, oblique, and lateral radiographs of the hand and thumb preoperatively, postoperatively, and at follow-up. Stress radiographs of the thumb, as described by Tomaino, were not routinely performed.^{8,14} Proximal migration of the metacarpal was determined as percent diminution of the height of the arthroplasty space at follow-up compared to the early post-operative height.^{7,8} The arthroplasty space was defined as the distance between the thumb metacarpal base and the distal pole of the scaphoid on the thumb radiographs.^{7,8}

Surgical Technique

The operation was performed under axillary block anesthesia with tourniquet control. A Wagner incision was made overlying the thumb CMC joint (Figure 2). The volar branch of the superficial radial nerve and other superficial nerve branches were preserved. The radial artery was not exposed. The thenar muscles were elevated off the palmar capsule of the first metacarpal and CMC joint and the CMC joint capsule was incised longitudinally. The trapeziometacarpal and scaphotrapezoidal joints were identified. A 3.0 mm threaded Kirschner wire or Apex pin (Howmedica) was inserted into the trapezium for use as a 'joystick' and the trapezium was then

removed in toto by elevating the attached soft tissue and ligaments (Figure 3). The FCR tendon was identified and left intact during trapezium excision. The base of the thumb metacarpal was then prepared for the suture anchors. The remaining articular cartilage on the volar third of the thumb metacarpal was removed down to bleeding bone using a rongeur or burr to enhance tendon to bone healing. The remaining articular cartilage and/or subchondral bone should *not* be removed in the area of suture anchor application to provide for better suture anchor fixation. One or two 2.5mm suture anchors with "0" braided polyester suture attached were placed in the thumb metacarpal base usually in the middle or dorsal third of the thumb metacarpal (Figure 4a&b), though if cysts were found, the strongest appearing area of bone was used. Larger thumb metacarpals received 2 suture anchors as opposed to a single anchor for the smaller thumbs. The scaphotrapezoid joint was inspected and the proximal portion of the trapezoid was resected if arthritic changes were noted. The FCR tendon was identified and transected approximately 10cm proximal to the volar wrist crease via a 1.5 cm transverse incision. The FCR tendon was then delivered into the distal incision (Figure 5). The tendon was freed up to its insertion on the index metacarpal base. The thumb metacarpal was then pulled to its normal height while the FCR tendon was draped across the metacarpal base from volar to dorsal and affixed to the thumb metacarpal using the suture anchor sutures at the appropriate point on the tendon (Figure 6). A buried horizontal mattress (3-0 absorbable) suture was then used to secure the FCR to the insertion of the APL tendon on the thumb metacarpal base. The remainder of the FCR was then rolled into an 'anchovy' ball and secured with 3-0 absorbable sutures. The anchovy ball was inserted into the space left by the removed trapezium and secured with the remainder of the suture anchor sutures (Figure 7a&b). Kirschner wire fixation was *not* used to stabilize the thumb metacarpal. The trapeziometacarpal joint capsule was closed over the FCR anchovy ball with

3-0 absorbable sutures that also captured the anchovy to prevent motion of the tendon ball. The skin was closed with 5-0 nylon. A thumb spica splint was applied in the operating room.

Approximately 10-14 days after surgery the sutures were removed and a thumb spica cast with the interphalangeal joint free was applied. At 4 weeks postoperatively, a removable thumb spica splint was made by a hand therapist and gentle wrist and thumb range of motion exercises were begun. The splint was discontinued as tolerated, usually by 8 weeks postoperatively. Forceful pinching was avoided for 3 months postoperatively. Full use and strengthening was permitted at 3 months.

Results

No patients were lost to follow-up. Average follow-up was 24 months (range 7-74 months). One suture anchor was used in six thumbs, two anchors were used in thirteen thumbs, and three anchors were used in one thumb.

Subjective Evaluation

All patients were satisfied with 88% (15/17) being very satisfied and 12% (2/17) being somewhat satisfied. All patients reported relief of pain with one (6%) recording moderate pain, six (36%) mild pain, and thirteen (58%) no pain. Four patients (24%) noted difficulty opening jars occasionally and two (12%) patients found using keys or opening car doors difficult at times. All patients would have the surgery again if given the choice. All patients who worked preoperatively were able to return to their occupation.

Objective Evaluation

Every patient was examined at follow-up by the senior author (R.S.). All thumbs had normal sensation and stable thumb CMC joints to manual dorsal-volar and radioulnar stressing. All thumbs were mobile enough to touch either the small finger base or tip. Grip strength improved by an average of 68% and key pinch strength improved 35% on average compared to preoperative values. These improvements were statistically significantly greater than preoperative values ($p < .05$, students t-test, Table 1). Proximal migration of the thumb metacarpal averaged 28% (Figure 8).

There were no suture anchor pull-outs or loosening and no patients required reoperation. No infections, hematomas, or nerve problems occurred in this series.

Discussion

The results of SAA to date are comparable to past clinical studies of the LRTI arthroplasty for thumb carpometacarpal osteoarthritis.^{2,3,4,5,6,7,8,9} All patients in this series had relief of pain and all were satisfied at an average of 24 months follow-up.

As found in other studies, our patient's grip strength improvement exceeded any improvement in pinch strength.^{3,5,7,8} An unexpected finding at this early stage of follow-up (24 months) was an improvement in pinch strength. Tomaino et. al. in 1995 found a decline in pinch strength at 2 years and found that it took at least 6 years for key pinch strength to equal preoperative values.⁸ Rayan in 1997 showed a 13% increase in grip strength but 27% decline in key pinch strength at an average follow-up of 3.2 years.⁷ However, Lins in 1996 found an

increase in grip (50%) and key pinch (43%) strength at 42 months follow-up, Downing in 2001 found an increase in key pinch (exact percent not reported) strength at one year, and DeSmet in 2002 found an increase in grip (73%) and key pinch (8%) strength at 25 months follow-up.^{3,4,5} As evidenced by these studies, the increase in grip and pinch strengths are inherently variable.

Proximal migration of the metacarpal base was within the range of past reports.^{4,5,7,8,14} Previous studies have shown that slight or significant proximal migration of the thumb metacarpal does not correlate with objective or subjective outcome.^{4,5,7,8} Stress radiographs of the thumb metacarpal may have improved our ability to assess stability at the metacarpal base, although in 2003 Bhat showed that standard radiographs were equivalent to stress radiographs when comparing trapezial space at one year follow-up.^{8,14}

In conclusion, 'suture anchor arthroplasty' for thumb carpometacarpal joint osteoarthritis is an effective technique for relieving pain and improving thumb strength during the period of our study.

ACKNOWLEDGEMENTS:

We would like to acknowledge Dr. Jeffrey Greenberg and Dr. Rick Ahmad of the Indiana Hand Center for devising the patient questionnaire used in this study.

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Figure Legends

Figure 1. Preoperative x-ray showing thumb CMC osteoarthritis.

Figure 2. Wagner skin incision and proximal forearm incisions. This patient underwent concomitant carpal tunnel release.

Figure 3. Trapezial space after trapezium removal.

Figure 4. (A) Suture anchors placed in thumb metacarpal.

(B) Diagram of suture anchor placement in thumb metacarpal.

Figure 5. FCR withdrawn into trapezial space.

Figure 6. FCR anchored to thumb metacarpal with suture anchors.

Figure 7. (A) FCR "anchovy" inserted into trapezial space.

(B) Diagram of FCR "anchovy" inserted into trapezial space.

Figure 8. Two year follow-up x-ray with suture anchors in place.

Table 1. Grip and Key Pinch Strengths Pre-operatively and at Follow-up

	<u>Preop</u>	<u>Follow-up</u>	<u>%change</u>
Grip (lb)	32 (10-70)	46 (20-75)	+68
Pinch (lb)	10.8 (4-13)	13 (5-22)	+35

Numbers shown are means (range).