Basal joint osteoarthritis of the thumb: comparison of suture button versus abductor pollicis longus suspensionplasty

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Abstract

Background Our purpose was to compare the outcomes of patients with severe basilar thumb osteoarthritis treated with trapeziectomy and suspensionplasty using abductor pollicis longus (APL) tendon versus a suture button device.

Methods A retrospective study was performed for patients undergoing trapeziectomy and suspensionplasty with APL tendon or suture button fixation. Outcome measures included disabilities of the arm, shoulder, and hand (DASH); visual analog score (VAS); grip strength; key pinch; tip pinch; and thumb opposition. Radiographic measurements, surgical times, and complications were recorded.

Results Thirty-three patients in the APL tendon group and 27 patients in the suture button group had a minimum 6-month follow-up. VAS, DASH, and functional measurements improved after surgery for both groups. Mean operative time was 68 min for the APL tendon group and 48 min for the suture button group. Complications were similar between groups.

Conclusions The use of suture button fixation when compared to APL tendon suspensionplasty offers similar clinical outcomes.

Type of study/level of evidence: Therapeutic III

Keywords Thumb arthritis • Suture button • Suspensionplasty

Introduction

Osteoarthritis of the thumb carpometacarpal joint is a common condition that requires treatment when associated with pain and decreased function. Initial treatment modalities include activity modification, splinting, therapy, nonsteroidal anti-inflammatory drugs, and corticosteroid injections [14, 26]. Surgery is reserved for patients with persistent pain and progression of disability. Numerous surgical options have been described and include arthrodesis, trapeziectomy, trapeziectomy, and ligament reconstruction with or without tendon interposition, silicone arthroplasty, total joint arthroplasty, hematoma distraction arthroplasty, and suture button suspensionplasty [1–3, 5, 12, 13, 15, 16, 22, 25, 27].

Suspension arthroplasty provides stability to the thumb, counteracts radial displacement forces, and prevents axial shortening of the thumb metacarpal [21]. Several techniques of suspension arthroplasty have been described. Pellegrini and Burton described a technique that involved excision of the trapezium with reconstruction of the anterior oblique ligament using the flexor carpi radialis tendon [20]. The anterior oblique ligament is felt to play a role in the pathology of osteoarthritis at the thumb carpometacarpal (CMC) joint, and reconstruction is felt to be fundamental to the maintenance of a stable, pain-free, mobile basal joint [18, 19]. While excellent long-term results have been reported with this technique [3, 21, 29], there have also been reports of associated weakness in wrist flexion and torsion [17]. As a result, several

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techniques have been described that avoid the morbidity associated with flexor carpi radialis tendon harvest.

One such technique described by Thompson involves the use of the abductor pollicis longus (APL) tendon to recreate the intermetacarpal ligament [27, 28]. While this technique was initially described as a salvage procedure, it has shown excellent long-term results for the treatment of primary thumb CMC osteoarthritis [11].

The absence of ligament reconstruction after trapeziectomy has been shown in multiple studies demonstrating acceptable results of trapeziectomy alone (hematoma distraction arthroplasty) without tendon suspension arthroplasty [3, 6, 7, 24]. A novel suspension arthroplasty technique described involves the use of a suture button device as an alternative to Kirchner wire fixation for hematoma distraction arthroplasty [2, 30, 31]. A cadaver study demonstrated the efficacy of a suture button device in the maintenance of posttrapeziectomy height and prevention of thumb metacarpal subsidence following trapeziectomy for thumb CMC osteoarthritis [31]. As a result of this stability, the use of a suture button device may offer the advantage of early mobilization, early recovery, potential decreased morbidity, and decreased time away from work and activities of daily living [2, 30, 31]. The purpose of this study is to compare the outcomes of patients with severe basilar thumb osteoarthritis treated with trapeziectomy and suspensionplasty using APL tendon versus a suture button device.

Methods

After institutional review board approval, a retrospective chart review was performed to identify all patients treated for basal joint arthritis of the thumb at one institution between 2007 and 2012. Patients who received either APL tendon or suture button suspensionplasty with a minimum 6-month follow-up were eligible. All patients that underwent surgical intervention had failed nonoperative management and demonstrated radiographic evidence of Eaton grades III and IV trapeziometacarpal osteoarthritis [4]. Fifty-two patients who received APL tendon suspensionplasty and 41 patients who underwent suture button suspensionplasty were identified. A single surgeon performed all APL tendon suspensionplasties, while two separate surgeons performed suture button suspensionplasties.

APL tendon suspensionplasty was performed according to the technique described by Thompson [27]. A dorsal slip of the APL tendon is detached proximally after trapeziectomy. The tendon slip is passed through drill holes within the thumb metacarpal base and second metacarpal base. It is then weaved into the extensor carpi radialis longus. Kirschner wires were not placed for temporary immobilization. Postoperative immobilization involved a thumb spica plaster splint for 2 weeks followed by 2 weeks in a short arm thumb spica fiberglass

cast. Hand therapy was started at 4 weeks postoperatively. The hand therapist fashioned a custom hand-based thumb rigid splint for use at rest over the next 4 weeks.

Suture button suspensionplasty was performed via a complete trapeziectomy using a volar curvilinear Wagner approach. The trapezium and thumb metacarpal base is first exposed. Then, a small longitudinal incision is made over the dorsal aspect of the second metacarpal base prior to guidewire placement for proper visualization. The guidewire is passed from the thumb metacarpal base to the proximal second metacarpal and placement confirmed with fluoroscopy. The Mini-Tightrope (Arthrex, Naples, FL) is passed prior to trapeziectomy. The suture button is then gently tied over the ulnar aspect of the second metacarpal after trapeziectomy was completed. Postoperative immobilization involved a thumb spica plaster splint for 2 weeks followed by 4 weeks of a custom hand-based thumb rigid splint. Hand therapy was started at 2 weeks postoperatively. Once initiated, hand therapy for both groups included a gentle thumb active range of motion and soft tissue modalities. Patients were instructed to wear custom splint unless performing hand therapy or showering.

Subjective and functional outcome measures were obtained pre- and postoperatively. Functional outcomes were measured through a series of strength examinations by a certified hand therapist including grip strength, key pinch, tip pinch, and thumb opposition. Grip strength was measured using a Jamar dynamometer (Asimov Engineering Co., Los Angeles, CA), and pinch strength was measured using a pinch gauge (B&L Engineering, Tustin, CA). For each strength test, three successive measurements were obtained, and the average of these values was used for analysis. Range of motion was measured using the Kapandji test [9], which evaluates the ability to oppose the thumb to the small finger base, proximal or distal interphalangeal joint crease, or tip of small finger. Subjective functional outcomes were measured by the use of the disabilities of the arm, shoulder, and hand (DASH) outcome measure and visual analog score (VAS) for pain. Postoperative radiographs were evaluated at most recent follow-up, and the thumb metacarpal base to distal scaphoid space was measured. Surgical times, defined as start to end time, were recorded from the operative record. Complications were documented during chart review.

Statistical analysis was performed using the Student's *t* test for the patient questionnaires and the clinical measurements.

Results

There were 33/52 patients in the APL tendon group and 27/41 patients in the suture button group with a minimum 6-month follow-up. We excluded patients with less than 6-month follow-up for evaluation. Mean age was 62 years for both

APL tendon and suture button groups. Female patients made up 73 % of the APL tendon group and 75 % of the suture button group. The mean follow-up was 17.6 (6–63) months for the APL tendon group and 9.5 (6–28) months for the suture button group. Results of the patient outcome questionnaires are shown in Table 1. There was no statistical significance found between APL tendon or suture button groups regarding DASH or VAS scores. The clinical measurements did not demonstrate any statistically significant difference between the two groups (Table 2). Range of motion was reported as what percentage of the cohort was able to fully oppose to the base of the small finger. All patients without opposition to base were able to oppose to the proximal interphalangeal joint crease of the small finger.

Postoperative radiographic thumb metacarpal base to distal scaphoid distance was recorded at the latest clinical visit. The mean distance was 0.55 cm for the APL tendon group and 0.71 cm for the suture button group, $p=0.49$. Mean surgical time was 68.0 min for the APL tendon group and 48.1 min for the suture button group, $p=0.01$.

Two patients in the APL tendon group had postoperative complications. One superficial infection was resolved uneventfully with a course of oral antibiotics and local wound care. One patient suffered a second metacarpal fracture at 6 weeks postoperatively. She required revision arthroplasty after treatment of her fracture.

Three patients in the suture button group had a postoperative complication. One patient had a superficial infection that resolved with oral antibiotics. Two patients complained of palpable hardware over the dorsal aspect of the second metacarpal related to the placement of the suture button and knot. Over several months, both of these patients' symptoms resolved and did not require any additional procedures. The suture buttons in these two patients were more dorsally located within the second metacarpal compared to the more ideal ulnar position. There were no metacarpal fractures observed within the suture button group.

Discussion

Our results compare similarly with those previously published. In regards to pain relief, Gray and Meals [6] have

Table 1 Clinical outcome scores for APL and suture button groups

	APL	Suture button	<i>p</i> value
Preop VAS	7	7	0.49
Preop DASH	56	45	0.32
Postop VAS	2	2	0.44
Postop DASH	40	37	0.44

Table 2 Functional outcomes for APL and suture button groups

	APL	Suture button	<i>p</i> value
Preop grip strength (kg)	14	12	0.38
Preop tip pinch (kg)	4	4	0.19
Preop key pinch (kg)	5	5	0.41
Postop grip strength (kg)	20	17	0.27
Postop tip pinch (kg)	3	4	0.19
Postop key pinch (kg)	5	5	0.39
Thumb motion (% opposition to small finger base)	78 %	80 %	0.46

reported that 18 of their 22 patients undergoing hematoma distraction arthroplasty had complete relief of pain at an average follow-up of 6.5 years. The suture button suspensionplasty utilizes hematoma distraction arthroplasty while substituting suture button fixation instead of Kirschner wires. Yao et al. retrospectively reported favorable 2-year follow-up results for 21 patients that received suture button suspensionplasty [30].

In addition, excellent pain relief and high degrees of patient satisfaction have been demonstrated with ligament reconstruction tendon interposition (LRTI) and APL tendon suspensionplasty. Tomaino et al. [29] reported that 20 of 22 patients were satisfied with LRTI at 9-year follow-up, and Kochevar et al. [11] reported that 17 of 18 patients had excellent or good relief of pain with APL tendon suspensionplasty at a 5.5-year follow-up.

Imaeda et al. [8] demonstrated the importance of the anterior oblique and intermetacarpal ligaments as stabilizers of the trapeziometacarpal joint, and Rayan and Young [21] felt that reinforcing the intermetacarpal ligament creates a strong sling to counteract the APL tendon pull and has a favorable effect on lateral subluxation. Suture button suspensionplasty for basal joint arthritis aims to recreate these ligaments and maintain posttrapeziectomy space height and prevent thumb metacarpal subsidence without the need for application of Kirschner wires. A recent biomechanical study by Yao et al. demonstrated that a suture button device was comparable to K-wire fixation in regards to maintenance of posttrapeziectomy space height for 10,000 cycles of one third maximum lateral pinch loading [31].

Our patients undergoing suture button suspensionplasty also had similar results to previously reported studies in regards to strength. These results compare favorably to those reported for APL suspensionplasty [11] but are slightly lower than those reported for LRTI [29] and hematoma distraction arthroplasty [6, 7, 12, 24]. However, the reported studies for LRTI and hematoma distraction arthroplasty include a 6-year follow-up, and previous reports in the literature have demonstrated continued improvement in strength for as long as 6 years

postoperatively [6, 11, 29]. Longer follow-up studies regarding suture button suspensionplasty will need to be conducted to document its long-term success when compared to more traditional techniques. A prospective study comparing Kirschner wires versus a suture button for postoperative hematoma distraction arthroplasty immobilization would further answer questions on the potential benefit or unnecessary use of a suture button.

The additional implant cost may be offset by shorter operative times if long-term clinical outcomes are equivalent. Operating room time is estimated at \$10–30 per min [23]. The mean time difference of 20 min observed in our study would closely equal the implant cost of \$495 [30].

Our complications related to the palpable hardware support the importance of correct placement of the button and smaller size of the current button. We have had no other complaints with placement along the dorsal ulnar aspect of the second metacarpal. We reported no metacarpal fractures from the suture button device, although this is a potential risk as reported by Khalid et al. [10]. The current device uses a 1.1-mm suture passing wire compared to the previous version, which used a 2.7-mm cannulated drill. Use of the smaller diameter wire, avoiding the second metacarpal shaft and avoiding eccentric wire placement, should minimize the risk of fracture. We prefer to pass and tie the tightrope prior to trapeziectomy. We feel that this prevents over tightening and simplifies thumb position.

There are several weaknesses of our study including lack of long-term follow-up, retrospective study design, patients lost to follow-up, and the inclusion of different surgeons performing the procedures. Also, DASH and VAS may not accurately evaluate clinical outcomes for trapeziectomy, as they are more general measures of pain and extremity function. However, we attempted to best assess function with strength measurements. Also, the suture button group patients were immobilized differently between weeks 2 and 4 and started hand therapy 2 weeks earlier.

The short-term data demonstrates no statistically significant difference between APL tendon and suture button suspensionplasty for the treatment of advanced basal joint osteoarthritis with regard to patient satisfaction and grip strengths. Tomaino et al. demonstrated that grip and tip pinch strength continues to increase steadily for up to 6 years postoperatively before reaching a plateau [29]. This demonstrates the importance for prolonged evaluation for both of these patient cohorts in order to suggest what may provide the better functional outcome.

Suture button suspensionplasty may offer similar short-term clinical outcomes when compared to APL tendon suspensionplasty. Suture button fixation is an alternative

option with the potential ability of early range of motion and function.

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Conflict of Interest Kristopher R. Avant declares that he has no conflict of interest.

Jason A. Nydick declares that he has no conflict of interest.

Brian D. White declares that he has no conflict of interest.

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Statement of Human and Animal Rights All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Statement of Informed Consent Patients have a right to privacy that should not be infringed without informed consent. Identifying information, including patients' names, initials, or hospital numbers, should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes, and the patient (or parent or guardian) gives written informed consent for publication. Informed consent for this purpose requires that a patient who is identifiable be shown the manuscript to be published. Authors should identify individuals who provide writing assistance and disclose the funding source for this assistance. Identifying details should be omitted if they are not essential. Complete anonymity is difficult to achieve, however, and informed consent should be obtained if there is any doubt. For example, masking the eye region in photographs of patients is an inadequate protection of anonymity. If identifying characteristics are altered to protect anonymity, such as in genetic pedigrees, authors should provide assurance that alterations do not distort scientific meaning, and editors should so note. Informed consent was obtained from all patients for being included in the study.

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