The purpose of this study was to describe long-term outcomes of partial trapeziectomy with capsular interposition (PTCI) arthroplasty for patients with osteoarthritis of the basal joint of the thumb. A total of 27 patients (20 women, 7 men; 32 thumbs) with a mean age of 61 years (range, 47-74 years) agreed to return for follow-up and were included in the study. Mean postoperative follow-up was 64.3 months (range, 28-112 months). Evaluation included tests for grip and pinch strength; range of motion of the metacarpophalangeal joint; measurement of the first web space; completion of the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire; visual analog scale (VAS) measurements; and radiographic examination of the hand. A paired, 2-tailed $t$ test was used to determine statistical significance ($P<.05$) of pre- and postoperative values. Postoperative values for grip strength were significantly increased from preoperative values. No significant loss of pinch strength was noted. Excessive hyperextension of the metacarpophalangeal joint did not occur, and the first web space was maintained. The mean DASH questionnaire and VAS scores were 5.06 (range, 0-26.5) and 0.32, respectively. Use of PTCI arthroplasty resulted in minimal loss in thumb height (7%) and significantly reduced thumb metacarpal subluxation (13%). There were no reported complications. The low DASH questionnaire and VAS scores compare well with other studies and indicate good functional outcomes. In treating thumb basal joint osteoarthritis, use of PTCI arthroplasty may result in improved thumb stability and grip strength, minimal subsidence of the thumb metacarpal, and reduced joint subluxation. [Orthopedics. 2018; 41(2):e228-e233.]
thodesis, trapeziectomy, ligament reconstruction and tendon interposition (LRTI), hematoma distraction arthroplasty, and joint replacement arthroplasty. Satisfactory levels of pain relief and functional improvement have been reported for each technique. However, studies have also reported associated morbidity from non-union of arthrodesis, tendon harvest, loosening of prosthetics after arthroplasty, silicone synovitis, and subsidence of the first metacarpal. Few studies have found improved postoperative grip strength, and some have noted a decline in key pinch strength. Additionally, studies have infrequently described analysis of metacarpophalangeal (MCP) joint motion and outcomes of validated, pertinent clinical and radiological follow-up.

Partial trapeziectomy with capsular interposition (PTCI) arthroplasty was recently described as an alternative surgical technique for thumb basal joint arthritis. The procedure does not involve tendon harvest and may avoid its potential complications. This article describes long-term outcomes for a series of patients who underwent PTCI arthroplasty, specifically regarding pre- and postoperative measurements of grip strength; lateral pinch strength; first web-space distance; MCP joint flexion and extension; Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire; visual analog scale (VAS) measurements; and radiographically measured trapezial-space ratio and relative metacarpal subluxation.

**Materials and Methods**

The previously described surgical technique used for PTCI arthroplasty involved exposing the thumb basal joint using a dorsal approach between the extensor pollicis brevis and the abductor pollicis longus; elevating a perosteal sleeve, including the insertion of the abductor pollicis longus; and excising 2 mm from both the base of the first metacarpal and the distal trapezium. The proximally based capsular tissue was sutured to the volar capsule and thereby used as interposition material (Figure). The elevated periosteal flaps, including the tendon of the abductor pollicis longus proximally and all tissue covering the trapezium and dorsal metacarpal, were reed together to enhance the dorsal ligaments. A thumb spica splint was used to immobilize the thumb for 4 weeks postoperatively, after which occupational therapy was started, and a C-bar splint was applied for 2 to 3 weeks to maintain the first web space. The therapy progressively involved thumb stabilization, range of motion in all planes such as the MCP joint, scar mobilization, and intermittent splinting as needed. Thumb strengthening was started 8 weeks postoperatively. All exercises could be performed at home. The patients presented for follow-up 8 weeks postoperatively, with final evaluation at 4 to 6 months postoperatively.

Institutional review board approval was received for this study. The authors reviewed the electronic medical records of all patients who underwent PTCI for thumb OA between January 2006 and December 2012 and had a phone number for contacting. Exclusion criteria were a trauma to the hand and an upper extremity disorder other than carpometacarpal joint OA, including rheumatoid arthritis. A total of 66 patients met these criteria, and 44 responded to the authors’ phone calls. Seventeen patients did not attend the clinic visit owing to the following reasons: declined (n=12) and no show on the day of the visit (n=5). Of the 12 who declined, 7 lived out of town and 5 had scheduling conflicts. Ultimately, a total of 27 patients 47 to 74 years old (mean age, 61 years; 20 women, 7 men) returned for clinical and radiographic evaluation. Twenty-two patients did not return the authors’ calls and were lost to follow-up.

For all 27 patients included, initial non-operative treatment with splinting or injection was unsuccessful. Five patients underwent treatment for bilateral thumb OA (32 thumbs treated; 18 right, 14 left). Twenty patients were employed and 7 were retired at the time of operative treatment (Table 1). On arrival to the clinic, the patients signed a Health Insurance Portability and Accountability Act declaration form and an informed consent form to participate in the study. The patients agreed to clinical and radiographic examination of the hand. Thumb basal joint OA was classified as Eaton–Littler stage III in 28 thumbs and Eaton–Littler stage IV in 4 thumbs. Mean intraoperative time in a tourniquet was 60 minutes. Mean follow-up was 64.3 months (range, 28-112 months).

**Clinical, Self-Reported, and Radiographic Outcomes**

On physical examination, grip and pinch strengths were measured as a twice weekly mean of 3 trials. Pinch strengths were measured as a twice weekly mean of 3 trials. Radiographic outcomes were measured as a twice weekly mean of 3 trials. Radiographic outcomes were measured as a twice weekly mean of 3 trials. The procedure did not involve tendon harvest and may avoid its potential complications. This article describes long-term outcomes for a series of patients who underwent PTCI arthroplasty, specifically regarding pre- and postoperative measurements of grip strength; lateral pinch strength; first web-space distance; MCP joint flexion and extension; Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire; visual analog scale (VAS) measurements; and radiographically measured trapezial-space ratio and relative metacarpal subluxation.

**Materials and Methods**

The previously described surgical technique used for PTCI arthroplasty involved exposing the thumb basal joint using a dorsal approach between the extensor pollicis brevis and the abductor pollicis longus; elevating a perosteal sleeve, including the insertion of the abductor pollicis longus; and excising 2 mm from both the base of the first metacarpal and the distal trapezium. The proximally based capsular tissue was sutured to the volar capsule and thereby used as interposition material (Figure). The elevated periosteal flaps, including the tendon of the abductor pollicis longus proximally and all tissue covering the trapezium and dorsal metacarpal, were reed together to enhance the dorsal ligaments. A thumb spica splint was used to immobilize the thumb for 4 weeks postoperatively, after which occupational therapy was started, and a C-bar splint was applied for 2 to 3 weeks to maintain the first web space. The therapy progressively involved thumb stabilization, range of motion in all planes such as the MCP joint, scar mobilization, and intermittent splinting as needed. Thumb strengthening was started 8 weeks postoperatively. All exercises could be performed at home. The patients presented for follow-up 8 weeks postoperatively, with final evaluation at 4 to 6 months postoperatively.

Institutional review board approval was received for this study. The authors reviewed the electronic medical records of all patients who underwent PTCI for thumb OA between January 2006 and December 2012 and had a phone number for contacting. Exclusion criteria were a trauma to the hand and an upper extremity disorder other than carpometacarpal joint OA, including rheumatoid arthritis. A total of 66 patients met these criteria, and 44 responded to the authors’ phone calls. Seventeen patients did not attend the clinic visit owing to the following reasons: declined (n=12) and no show on the day of the visit (n=5). Of the 12 who declined, 7 lived out of town and 5 had scheduling conflicts. Ultimately, a total of 27 patients 47 to 74 years old (mean age, 61 years; 20 women, 7 men) returned for clinical and radiographic evaluation. Twenty-two patients did not return the authors’ calls and were lost to follow-up.

For all 27 patients included, initial non-operative treatment with splinting or injection was unsuccessful. Five patients underwent treatment for bilateral thumb OA (32 thumbs treated; 18 right, 14 left). Twenty patients were employed and 7 were retired at the time of operative treatment (Table 1). On arrival to the clinic, the patients signed a Health Insurance Portability and Accountability Act declaration form and an informed consent form to participate in the study. The patients agreed to clinical and radiographic examination of the hand. Thumb basal joint OA was classified as Eaton–Littler stage III in 28 thumbs and Eaton–Littler stage IV in 4 thumbs. Mean intraoperative time in a tourniquet was 60 minutes. Mean follow-up was 64.3 months (range, 28-112 months).

**Clinical, Self-Reported, and Radiographic Outcomes**

On physical examination, grip and pinch strengths were measured as a twice weekly mean of 3 trials. Pinch strengths were measured as a twice weekly mean of 3 trials. Radiographic outcomes were measured as a twice weekly mean of 3 trials. Radiographic outcomes were measured as a twice weekly mean of 3 trials. The procedure did not involve tendon harvest and may avoid its potential complications. This article describes long-term outcomes for a series of patients who underwent PTCI arthroplasty, specifically regarding pre- and postoperative measurements of grip strength; lateral pinch strength; first web-space distance; MCP joint flexion and extension; Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire; visual analog scale (VAS) measurements; and radiographically measured trapezial-space ratio and relative metacarpal subluxation.
Hand Dynamometer (Patterson Medical, Warrenville, Illinois) and Baseline hydraulic pinch gauge (NexGen Medical Systems, Pointe Claire, Quebec, Canada). Range of motion of the MCP joint was measured using a goniometer in flexion and extension positions, and the first web-space distance was measured between the thumb interphalangeal joint and palmar creases. In estimating the first web-space distance, the authors used linear rather than angle measurements to avoid potential inconsistency. Two surgeons in fellowship training for hand surgery (A.B.L., N.B.T.) performed all clinical measurements separately for each patient and did not participate in the initial operative treatment. A total of 14 patients underwent operative treatment on the dominant hand. Each patient completed a DASH questionnaire and a VAS survey.

Posteroanterior, oblique, and lateral radiographs were obtained for all 32 thumbs. All preoperative radiographs were available in the authors’ digital radiograph system. Pre- and postoperative measurements were independently evaluated by a doctoral research faculty member (C.S.) using iSite PACS R3.5 (Philips Medical Systems, Amsterdam, the Netherlands). Trapezial-space ratio and metacarpal subluxation measurement were obtained using the Lins et al18 and Trumble et al19 methods, respectively.

For the Lins et al18 measurement, the trapezial-space ratio was measured as the trapezial space height (distance from the subchondral surface of the metacarpal base to the most proximal articular surface of the trapezium) divided by the proximal phalanx height. The current authors slightly modified the technique, which originally measured to the most distal scaphoid. The authors found that the proximal trapezium was easily identified on the radiograph and accurately measured the space height. Using the Trumble et al19 method, the relative subluxation of the metacarpal was measured as the ratio of the distance between a line defining the ulnar border of the trapezium and the ulnar border of the metacarpal to the width of the subchondral surface of the metacarpal. Total thumb height was defined as the length from the distal end of the thumb metacarpal to the proximal surface of the trapezium.19

Statistical Analyses

A paired, 2-tailed t test was used to compare pre- and postoperative values for grip and pinch strengths, MCP joint flexion and extension, first web-space distance, trapezial-space ratio, and metacarpal subluxation. All analyses were performed by a doctoral-level statistician. P<.05 represented a statistically significant difference between groups.

RESULTS

Table 2 lists outcome measures for the 27 patients (32 thumbs). Hand dominance did not change for any patient. Pre- and postoperative measurements for grip strength, lateral pinch strength, first web-space distance, MCP flexion, and MCP extension were available for 25, 14, 15, 15, and 16 thumbs, respectively. Preoperative measurements were not recorded in the medical records for some patients. The number of data points for each outcome measure varied based on availability of preoperative measures. For postoperative employment, a total of 17 of 27 patients reported working. The remaining 10 patients had retired for reasons unrelated to the operative procedure (7 were ≥65 years old; 1 was 61 years old; 1 was 62 years old; and 1 was 54 years old and had recent onset of Meniere’s disease).

For grip strength, a significant increase was noted from preoperative to postoperative measurement (P=.01). For pinch strength, first web-space distance, and MCP flexion, no statistically significant difference was noted (P=.65, .10, and .53, respectively). Although an increase was found in MCP extension (P<.01), the measurement fell below the accepted 25° to 30° limit.20,21 The mean DASH questionnaire score was 5.06 (range, 0–26.5), and the mean VAS score was 0.32. Thumb height was reduced from 57 mm preoperatively to 53 mm postoperatively, for a total loss of 4 mm (7%). For trapezial-space ratio, the mean preoperative to postoperative values indicated no significant change (P=.65). Subluxation of the thumb metacarpal decreased significantly (13%; P=.01). No complications were noted.

DISCUSSION

In older patients, thumb basal joint OA is a common condition that can considerably affect activities of daily living.
Numerous operative procedures have been recommended; however, associated complications and unimproved grip strength have remained notable barriers to successful treatment. The authors have reported long-term results of using PTCI arthroplasty, a recently described alternative technique that may avoid problems relating to tendon harvest with LRTI.

A systematic review by Vermeulen et al13 concluded that LRTI was not superior to other described techniques. The authors found nonunion rates of 8% to 21% after arthrodesis of the joint and an increased rate of revision procedures. Additionally, a prospective long-term study by Gango-padhyay et al22 compared results of LRTI with trapezial excision and reported no benefits from using LRTI after a minimum follow-up of 5 years. A short-term study comparing the use of LRTI and hematoma distraction arthroplasty in 20 patients showed no difference in outcomes, with the LRTI operating time being 54 minutes longer.13 Furthermore, studies have reported on suspensionplasty of the first to second metacarpal using either tendon23 or suture buttons.24

However, the long-term outcomes of impingement between the 2 metacarpals are unknown. Most LRTI techniques involve using the flexor carpi radialis tendon, which inserts at the base of the second metacarpal and replaces the inter-metacarpal ligament rather than the volar oblique ligament. Yet recent understanding of the ligament complex of the thumb carpometacarpal joint indicates that the dorsal ligaments may be the most important joint-stabilizing structures.25,26 Use of the PTCI method may reinforce these ligaments by reefing the tissues on the dorsal aspect of the joint, including the adductor pollicis longus. Removing the base of the first metacarpal, which is always arthritic, and minimizing bony resection of the trapezium will enhance thumb stability. Studies have shown that partial excision of the trapezium can result in less subluxation and settling of the first metacarpal.13,27,31

The current authors observed a mean increase in grip strength of 6.3 kg at 64.3 months. A recent randomized controlled trial on thumbs treated using the Burton–Pellegrini or Weilby techniques found that grip strengths had increased by 4 kg and 3 kg, respectively, at 12 months.32 Similarly, reported use of an arthroscopic resection arthroplasty resulted in increased grip strength of 3 to 4 kg at 78 months.11 The current authors observed promising functional outcomes, indicated by low DASH questionnaire and VAS scores. The mean DASH questionnaire and VAS scores at long-term follow-up of patients treated with PTCI were 5.06 and 0.32, respectively. Other studies32,33 reported DASH questionnaire scores of 27 and 30 after LRTI and Weilby techniques, respectively. Use of ligament reconstruction with costochondral interposition allograft resulted in a DASH questionnaire score of 11.22. Notably, in the current study, available data indicated that no patient retired from employment owing to the treatment.

Use of joint capsular tissue as interposition material in conjunction with limited bony resection possibly helped maintain thumb height, indicated by the minimal loss of 4 mm (7%; from 57 to 53 mm). There was no significant change in the trapezial-space ratio. Studies using dermal matrix and the abductor pollicis longus have reported joint-space losses of 11% and 20%, respectively.34,35 Tomaino et al37 reported a mean loss of trapezial height of 13% in patients treated with LRTI at 9-year follow-up.

The current authors specifically addressed postoperative range of motion of the MCP joint to determine whether hyperextension at the joint affects the results of self-evaluation tests. Although the patients tended to develop hyperextension (mean, 22.4°), none who returned for follow-up required an additional procedure for treating the MCP joint. Only 1 patient had arthrodesis of this joint concurrently

### Table 2

<table>
<thead>
<tr>
<th>Variablea</th>
<th>No.</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grip strength, kg</td>
<td>25</td>
<td>22.64±8.54</td>
<td>28.89±9.28</td>
<td>.01</td>
</tr>
<tr>
<td>Pinch strength, kg</td>
<td>14</td>
<td>4.96±2.56</td>
<td>4.57±2.19</td>
<td>.65</td>
</tr>
<tr>
<td>First web-space distance, cm</td>
<td>15</td>
<td>3.94±0.79</td>
<td>4.43±0.63</td>
<td>.10</td>
</tr>
<tr>
<td>MCP flexion</td>
<td>15</td>
<td>42.33°±18.11°</td>
<td>36.67°±12.40°</td>
<td>.53</td>
</tr>
<tr>
<td>MCP extension</td>
<td>16</td>
<td>2.19°±6.57°</td>
<td>22.41°±10.04°</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>TSR, mm/mm</td>
<td>32</td>
<td>0.44±0.04</td>
<td>0.45±0.07</td>
<td>.65</td>
</tr>
<tr>
<td>Metacarpal subluxation, mm</td>
<td>32</td>
<td>0.53±0.11</td>
<td>0.46±0.15</td>
<td>.01</td>
</tr>
<tr>
<td>DASH questionnaire score</td>
<td>27</td>
<td>NA</td>
<td>5.06±6.73</td>
<td>NA</td>
</tr>
<tr>
<td>VAS score</td>
<td>27</td>
<td>NA</td>
<td>0.32±0.67</td>
<td>NA</td>
</tr>
<tr>
<td>Employed</td>
<td>17</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Abbreviations: DASH, Disabilities of the Arm, Shoulder and Hand; MCP, metacarpophalangeal; NA, not applicable; TSR, trapezial-space ratio; VAS, visual analog scale.

aAll variables except DASH questionnaire and VAS scores apply to number of thumbs (N=32).

bFor grip strength, pinch strength, first web-space distance, MCP flexion, and MCP extension, not all thumbs could be tested owing to lack of preoperative data.

bThe remaining 10 patients retired for reasons unrelated to the operative treatment.
due to considerable OA. On preoperative radiographs, a total of 4 thumbs showed scaphotrapezial trapezoidal joint involvement (Eaton–Littler stage IV). Two of these thumbs underwent limited resection of the distal scaphoid at the same time, owing to advanced degenerative changes at the scaphotrapezial trapezoidal joint. These results correspond with those of other studies, which indicate that some involvement of the scaphotrapezial trapezoidal joint may not progress if left untreated. Furthermore, the first web-space distance was well maintained postoperatively, allowing improved opposition of the thumb with the ability to touch the tip of the little finger. This measurement was not statistically significant. Current studies have found that, of the many surgical procedures available to treat this condition, no method results in improved postoperative outcomes. However, treatment with simple trapeziectomy has resulted in fewer complications.

The current study had several strengths. All procedures were performed by the same surgeon (M.S.M.) or under his direct supervision, leading to minimal variations in surgical technique. Additionally, none of the clinical evaluations were done by the surgeon. The authors evaluated only patients who had documented preoperative values for each outcome measure. Although clinical evaluation for all 27 patients was not available to obtain all measured values in the study, statistical significance was observed. Furthermore, the current study reported long-term clinical and radiographic evaluation for each patient. There were limitations to this study. This was a retrospective study, with no comparison to other techniques. The authors would have preferred to include more patients in the study; however, many patients who met inclusion criteria had had the procedure more than 5 years before the current investigation. These patients were discharged in 4 to 6 months, and the authors were not able to contact them. Their phone numbers had been disconnected, they did not return voice messages, or they lived out of town. Other long-term studies have reported similar difficulties.

**Conclusion**

Use of PTCI arthroplasty may result in significant postoperative improvements—clinically and radiologically—in patients with thumb basal joint OA. It is possible that radiographic appearance at follow-up was similar to that of a stable arthrofibrosis that results after asymptomatic nonunion of basal joint arthrodesis. Use of PTCI arthroplasty removes the need for harvesting a tendon graft or drilling holes in bones and helps reinforce the dorsal ligaments, which can enhance the stability of the thumb. Additionally, PTCI arthroplasty requires less technical expertise than complex ligament-reconstruction procedures, which decreases potential morbidity and may reduce operating time and simplify rehabilitation of patients. Other studies have indicated that simpler surgical procedures can result in good outcomes. Partial trapeziectomy with capsular interposition arthroplasty, used even in the presence of arthritic changes in the scaphotrapezial trapezoidal joint, may result in a stable thumb, minimal subsidence of the thumb metacarpal, and reduced subluxation.

**References**

19. Tribble TE, Rafijah G, Gilbert M, Allan CH, North E, McCallister WV. Thumb trapeziometacarpal joint arthritis: partial trapeziectomy with ligament reconstruction and inter-


