Trapeziectomy With Ligament Reconstruction and Tendon Interposition Versus a Trapeziometacarpal Prosthesis for the Treatment of Thumb Basal Joint Osteoarthritis

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Numerous surgical procedures have been described to treat trapeziometacarpal osteoarthritis, but no approach is currently considered superior. Good long-term outcomes have been reported with multiple procedures. No studies have been published comparing outcomes of the Arpe joint replacement (Biomet, Valence, France) with those of ligament reconstruction and tendon interposition (LRTI) using the Burton–Pellegrini technique. The study objective was to compare clinical outcomes between these techniques. Sixty-five patients with Eaton stage III osteoarthritis of the thumb were included in this retrospective follow-up study. Patients were assigned to LRTI (LRTI group) or total joint replacement (Arpe group) and were followed for a mean of 4.8 years. The LRTI group included 34 patients and the Arpe group included 31. Clinical outcome variables were determined preoperatively and every 6 months postoperatively. Pain relief and functional improvement were similar between groups. Pinch strength and range of motion were superior in the Arpe group. Metacarpophalangeal hyperextension appeared to be prevented in the Arpe group but increased over the follow-up period in the LRTI group. However, the complication rate was higher in the Arpe group. Arthroplasty with the Arpe prosthesis can be considered in selected patients who require greater strength and range of motion, although it has been associated with a higher complications rate. [Orthopedics. 2017; 40(4):e681-e686.]
treatment of Eaton stage III trapeziometacarpal osteoarthritis between Arpe trapeziometacarpal prosthesis and LRTI by modified Burton–Pellegrini technique.

**Materials and Methods**

**Series**

A retrospective follow-up study was conducted in 65 patients with Eaton stage III carpometacarpal osteoarthritis of the thumb undergoing surgery between January 2006 and December 2011. The study was conducted in accordance with the principles of the Helsinki Declaration and was approved by the research ethics committee at the authors’ hospital. Written informed consent was obtained from all participants.

Patients received LTRI by Burton–Pellegrini technique (LRTI group) or joint replacement with the cementless Arpe prosthesis (Arpe group) according to patient preference after explanation of the risks and advantages of each method. Exclusion criteria were the following: radiographic findings of Eaton stage II or scaphotrapezial-trapezoid joint osteoarthritis (Eaton stage IV); bilateral cases; presence of upper limb lesion other than trapeziometacarpal osteoarthritis; and employment requiring heavy manual work. Participants’ functional status was evaluated preoperatively and every 6 months postoperatively, with a mean follow-up of 56 months.

The LRTI group included 34 patients, with a mean age of 60.48 years and mean follow-up of 59 months. The Arpe group included 31 patients, with a mean age of 56.37 years and mean follow-up of 56 months. No statistically significant between-group differences were found in characteristics or follow-up duration, as shown in Table 1.

**Surgical Technique**

All patients had locoregional anesthesia (axillary brachial plexus block) during surgery and received a single dose of 2 g cefazolin.

**Ligament Reconstruction and Tendon Interposition Arthroplasty.** A modification of the Burton–Pellegrini technique was performed, removing the trapezium via a lateral approach between the abductor pollicis longus and the extensor pollicis brevis tendons, using a Wagner approach with proximal extension to the first extensor compartment. Unlike in the original technique, the full thickness of the flexor carpi radialis tendon was used to suspend the first metacarpal through a bone tunnel, and no intermetacarpal stabilization with Kirschner wire was performed. The remaining tendon was sutured as “anchovy” and filled the trapezial defect as soft tissue spacer before wound closure.

**Arpe Prosthesis.** All prostheses were implanted using the Wagner anterolateral approach. The sensory radial nerve branch was identified and protected. The thenar muscles and the abductor pollicis longus tendon were partially detached from the first metacarpal, and the trapeziometacarpal capsulectomy was performed before metacarpal base and trapezial joint surface osteotomy. No examination of the scaphotrapezial-trapezoid joint was performed. Manual reaming of the medullary metacarpal canal and trapezial subchondral bone were performed to receive the prosthesis. After testing the tension, stability, and mobility, the trial components were replaced with the definitive prosthesis by press-fit fixation. The wound was closed in 2 layers after reattaching the abductor pollicis longus tendon to the first metacarpal with an absorbable bone anchor (Mitek MICROFIX 3.0; DePuy, Leeds, England) (Figure 2).

![Figure 1](image-url)
**Postoperative Care.** The thumb and wrist were immobilized in a cast splint for 4 weeks. The thumb was positioned in abduction and opposition at the same level as the second metacarpal in precisely the same manner in both treatment groups. After cast removal, an intermittent orthosis was prescribed for a further 2 weeks, and patients were referred to the rehabilitation department.

**Instruments and Measures**

**Variables.** Disability changes pre- and postoperatively were evaluated using the Disabilities of the Arm, Shoulder and Hand (QuickDASH) score, an 11-item questionnaire with a score ranging from 0 (no disability) to 100 (major disability).\(^2\) Pain was scored using a visual analogue scale (VAS) (0=no pain to 10=worst pain imaginable).

Range of motion was evaluated by applying the Kapandji opposition scheme and measuring thumb retropulsion.\(^2\) Retropulsion was evaluated as normal when patients, resting their hand on the table palm up, were able to touch it with the thumbnail of the same hand and as diminished when they were not able to do so. Metacarpophalangeal joint hyperextension was also assessed. Pinch strength was estimated as the mean of 3 measurements using the Jamar dynamometer (North Coast Medical, Morgan Hill, California). Data on all variables were gathered preoperatively and at the final follow-up postoperatively, and complications and reoperations were also recorded.

**Statistical Analysis.** SPSS version 20.0 software (IBM, Armonk, New York) was used for the statistical analysis. The paired Student’s \( t \) test was used for quantitative variables with normal distribution, according to the Kolmogorov–Smirnov test, and the Mann–Whitney \( U \) test for those with non-normal distribution. The chi-square test was used for qualitative variables. Spearman or Pearson correlation tests were used to compare variables according to their normal or non-normal distribution, respectively. A confidence interval (CI) of 95\% was considered statistically significant \((P<.05)\).

**RESULTS**

**Disability Changes**

No significant between-group differences were observed in the preoperative \((P=.748; \text{Mann–Whitney } U \text{ test})\) or postoperative \((P=.423; \text{Mann–Whitney } U \text{ test})\) mean QuickDASH scores. Mean improvement in QuickDASH score was 52.44±25.04 points for the LRTI group and 52.88±20.39 points for the Arpe group, with no statistically significant difference between them \((P=.735; \text{Mann–Whitney } U \text{ test})\) (Table 2).

**Pinch Strength**

Mean pinch strength values were similar between the groups preoperatively \((P=.215; \text{Student’s } t \text{ test})\) but significantly differed between groups postoperatively \((P=.000; \text{Student’s } t \text{ test})\) (Table 2).

**Postoperative Metacarpophalangeal Hyperextension Deformity**

No statistically significant difference between treatment groups in the preoperative degree of metacarpophalangeal hyperextension \((\text{Arpe: } 4.48°±9.67°, \text{LRTI: } 6.03°±10.89°; P=.469, \text{Mann–Whitney } U \text{ test})\). At the final follow-up session, hyperextension of the metacarpophalangeal joint was observed in 41.18\% of patients in the Arpe group and 39.39\% of the LRTI group, with no statistically significant difference between the groups \((P=.735; \text{Student’s } t \text{ test})\).

**Range of Motion**

Mean range of motion was wider in both opposition and retropulsion after Arpe trapeziometacarpal prosthesis than after interposition arthroplasty. Mean Kapandji score was higher in the Arpe group than in the LRTI group \((P=.032; \text{Mann–Whitney } U \text{ test})\). Thumb retropulsion was reduced in 39.39\% of the LRTI group and preserved in 100\% of the Arpe group \((P=.001; \chi^2\text{ test})\) (Table 2).

**Figure 2:** Preoperative anteroposterior radiograph in a case of Eaton stage III trapeziometacarpal osteoarthritis treated by arthroplasty with an Arpe prosthesis (Biomet, Valence, France) (A). Postoperative anteroposterior radiograph of the prosthesis (B). The base of first metacarpal appears to be distal to the second metacarpal base level, due to the previous osteotomy needed for stem implantation and the neck lengthening required for prosthesis stability.
This joint deformity was associated with lower pinch strength (Spearman correlation coefficient, -0.226). An increase in hyperextension deformity was observed after trapeziectomy, given that the mean metacarpophalangeal hyperextension angle was 6.03°±10.89° preoperatively vs 17.89°±15.39° postoperatively (\(P=.000\); Student’s \(t\) test). However, no significant change was found after the Arpe prosthetic procedure, with a mean hyperextension angle of 4.48°±9.67° preoperatively vs 3.5°±7.67° postoperatively (\(P=.507\); Student’s \(t\) test).

Surgical correction (metacarpophalangeal arthrodesis) was required for 2 patients in the LRTI group but no patients in the Arpe group (Table 2). The 2 patients who underwent metacarpophalangeal arthrodesis were analyzed before the metacarpophalangeal correction occurred, and the effect of the second operation was not evaluated.

Complications

In the Arpe group, 2 patients had dysesthesia of the superficial branch of the radial nerve and dislocations were observed in 3 prostheses, but there were no cases of infection, regional complex pain, or osteolysis with mobilization. The patients with prosthetic dislocation underwent surgical revision of the prosthesis by resection arthroplasty and flexor carpi radialis tenoplasty. The Weilby technique was used to avoid bone tunnels because of the impossibility of metacarpal stem removal. The reoperation rate was 9.67%.

In the LRTI group, there were no cases of infection or regional complex pain, but 2 patients had dysesthesia of the superficial branch of the radial nerve and required repeat surgery to correct metacarpophalangeal hyperextension. The reoperation rate was 5.88%.

**Discussion**

This study of patients with Eaton stage III osteoarthritis of the thumb suggests that the Arpe prosthesis provides postoperative pain relief, as measured by VAS, and functional improvement, as evaluated by the QuickDASH score, similar to the outcomes obtained with LRTI using the Burton–Pellegrini technique. However, mean pinch strength and range of motion were superior with the Arpe prosthesis. During the follow-up, patients who underwent trapeziectomy with LRTI showed an increase in metacarpophalangeal hyperextension, which required surgical correction in 2 cases. The Arpe prosthesis appears to prevent secondary deformity of the metacarpophalangeal joint.

Although good medium- and long-term outcomes have been reported after treatment of thumb basal joint osteoarthritis by trapeziometacarpal prosthesis and by LRTI, only 3 studies have compared these techniques.

A prospective study of 98 patients by Ulrich-Vinther et al compared Elektra prosthesis (Fixano, Péronnas, France) with LRTI using the Sigfusson and Lundborg technique at 1 year postoperatively and reported faster and better pain relief, stronger grip function, greater range of motion, and lesser convalescence time with the trapeziometacarpal joint prosthesis than with the tendon interposition arthroplasty.

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**Table 2**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Arpe(^a) (n=31)</th>
<th>LRTI (n=34)</th>
<th>Test</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative QuickDASH score, mean±SD</td>
<td>74.67±17.51</td>
<td>78.30±2.46</td>
<td>Mann–Whitney</td>
<td>.748</td>
</tr>
<tr>
<td>Postoperative QuickDASH score, mean±SD</td>
<td>21.79±19.03</td>
<td>25.86±2.66</td>
<td>Mann–Whitney</td>
<td>.423</td>
</tr>
<tr>
<td>QuickDASH score improvement, mean±SD</td>
<td>52.88±20.39</td>
<td>52.44±25.04</td>
<td>Mann–Whitney</td>
<td>.735</td>
</tr>
<tr>
<td>Preoperative VAS score, mean±SD</td>
<td>9.30±0.88</td>
<td>9.19±0.83</td>
<td>Student’s (t)</td>
<td>.607</td>
</tr>
<tr>
<td>Postoperative VAS score, mean±SD</td>
<td>1.33±1.54</td>
<td>1.38±2.09</td>
<td>Student’s (t)</td>
<td>.923</td>
</tr>
<tr>
<td>Kapandji score, mean±SD</td>
<td>9.52±0.95</td>
<td>9.03±1.21</td>
<td>Mann–Whitney</td>
<td>.032(^b)</td>
</tr>
</tbody>
</table>

Abbreviations: LRTI, ligament reconstruction and tendon interposition; MCP, metacarpophalangeal; QuickDASH, Disabilities of the Arm, Shoulder and Hand; VAS, visual analog scale.

\(^a\)Manufactured by Biomet, Valence, France.

\(^b\)Significant.
Vandenbergh et al.\textsuperscript{21} and De Smet et al.\textsuperscript{22} compared the long-term outcomes between cemented trapeziometacarpal prosthesis (De la Caffinière; Howmedica, Newbury, United Kingdom; and Roseland; DePuy) and LRTI (Burton–Pellegrini technique) in retrospective studies of 519 and 55 patients, respectively, after a mean follow-up of 5.4 and 9 years, respectively, based on the same initial series of patients. They found no differences in pain relief or functional improvement between the techniques.\textsuperscript{22}

To the authors’ best knowledge, the current study is the first to compare outcomes between LRTI and arthroplasty with the Arpe prosthesis. The current results are consistent with those published by Ulrich-Vinther et al.,\textsuperscript{20} observing greater mobility and strength in the Arpe prosthesis group.

In regard to pinch weakness, trapeziectomy with LRTI offers no benefit over trapeziectomy excision alone, and better outcomes have been reported with other techniques.\textsuperscript{1,28} Thus, a mean pinch strength of 6.51 kg (14.35 lb) was reported at 5 years in 41 patients undergoing hemitrapeziectomy and a mean of 5.6 kg (12 lb) at 2 years in 18 patients after trapeziometacarpal arthrodesis.\textsuperscript{29,30} However, comparisons with other studies are hampered by differences in evaluation methods and sample sizes and in the age, sex, and origin of study populations, among other variables.

No published study has considered the postoperative effect of the trapeziometacarpal prosthesis on metacarpophalangeal deformity of the thumb. The current authors observed a tendency for an increase in hyperextension deformity of the metacarpophalangeal joint among the patients undergoing trapeziectomy. This complication is associated with lower pinch strength and, in some cases, justifies repeat surgery of the metacarpophalangeal joint. In contrast, no significant secondary metacarpophalangeal deformity was observed in the patients who underwent treatment by Arpe prosthesis arthroplasty. The presence of hyperextension deformity in patients was not known until their outcomes had been evaluated and therefore could not have influenced their choice of procedure. The current authors consider that the superior mobility, pinch strength, and control of metacarpophalangeal deformity in the Arpe group are attributable to restoration of the thumb column length.

The main complication in the prosthesis group was prosthesis dislocation (9.67% in the current series). Ulrich-Vinther et al.\textsuperscript{20} reported no cases of prosthesis dislocation and found no differences between groups in complication rates. Vandenbergh et al.\textsuperscript{21} and De Smet et al.\textsuperscript{22} did not study the presence of complications during the follow-up. However, dislocation is a severe complication that usually requires revision surgery, increasing patient discomfort and costs, and it can be avoided by selecting other procedures such as trapeziectomy, with or without LRTI or trapeziometacarpal arthrodesis. The current results are consistent with previous findings of improved strength and earlier functional recovery with prostheses but a higher complication rate (especially dislocations).

Study limitations include the retrospective design, the small sample size, the short follow-up period, and the absence of randomization (patients were allocated according to their preference), which implies a possible selection bias. It should also be considered that the availability of certain prostheses is restricted in some health care settings (eg, non-FDA-approved prostheses in the United States).

One of the 3 previously published studies was prospective but only followed patients for 1 year.\textsuperscript{20} The study by Vandenbergh et al.\textsuperscript{21} had a large sample size but was retrospective and analyzed function (QuickDASH) and pain improvement (VAS) alone, without considering pinch strength, range of motion, hyperextension deformity, or complications. Prospective multicentric studies with a longer follow-up are required to elucidate the advantages of “ball and socket” prosthesis over trapeziectomy.

**Conclusion**

Ball and socket arthroplasty with Arpe prosthesis can be considered in selected patients in Eaton stage III because the benefits of improving pinch strength and preventing hyperextension deformity outweigh the risk of dislocation, which can be avoided by a ligament reconstruction and tendon interposition procedure.

**References**


