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Ten-year long-term results of total joint arthroplasties with ARPE® implant in the treatment of trapeziometacarpal osteoarthritis

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Abstract

Between May 1999 and April 2002 a total of 69 consecutive thumb carpometacarpal joint arthoplasties were performed in a total of 64 patients for carpometacarpal joint osteoarthritis using the cementless hydroxyapatite (HA)-coated unconstrained ARPE implant. Clinical, functional and radiological results at 10-year follow-up are presented. Survival analysis was performed using the Kaplan–Meier method. Of the 64 patients, four were lost to follow-up, 60 implants (92.3%) were functional and five (7.7%) were not (two dislocated, two were removed and one with aseptic loosening). Survival estimate for functional implants over 10 years was 93.9% (95% confidence interval 82.3–97.9). The radiographs were satisfactory in 82.4%. There was subsidence of the cup in 15.8%. Thumb carpometacarpal joint arthroplasty with the ARPE implant offers a reliable treatment alternative in patients with Eaton grade III or IV thumb carpometacarpal joint arthritis in the presence of good bone stock.

Keywords

ARPE, cementless arthroplasty, follow-up study, osteoarthritis, trapeziometacarpal joint replacement, thumb carpometacarpal joint arthroplasty, unconstrained arthroplasty

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Introduction

Since the first description of thumb carpometacarpal (CMC) joint replacement in 1973 (De la Caffinière, 1973), arthroplasty of this joint has become one of the established treatments for this condition. The ARPE CMC joint arthroplasty was introduced in 1991 (Comtet et al., 2000). This consists of an unconstrained uncemented arthroplasty with a cup inserted into the trapezium and a stemmed component inserted into the thumb metacarpal.

Trapezectomy remains the commonest surgical treatment for thumb CMC joint arthritis. Although some inconsistent results have been reported (Fischer et al., 2011), no other procedure has been demonstrated to be better (Gangopadhyay et al., 2012; Salem and Davis, 2012). A number of different joint replacements have been developed including spacers (Maru et al., 2012; Nilsson et al., 2005), hemiarthroplasties (Burke et al., 2012; Kaszap et al., 2012) and total joint replacements (Comtet et al., 2000; De la Caffiniere, 1973; Lebrun et al., 1996; Regnard, 2006). Some good results have been reported (Amillo et al., 2002; Apard and Saint Cast, 2009; Badía and Sambandam, 2006; Brutus and Kinnen, 2004; Chakrabarti et al., 1997; Johnston et al., 2012; Simón et al., 2007; Sondergaard et al., 1991), in particular the patients typically recover quicker compared with trapezectomy alone and may have a better pinch strength (Jonhston et al., 2012; Martín-Ferrero, 2002; Regnard, 2006; Simón et al., 2007). However, there have also been many reports of poor results (Hernandez-Cortes et al., 2012; Kaszap et al., 2012; Klahn et al., 2012; Maru et al., 2012). Studies have demonstrated failures, particularly in association with conical screw cups with

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reports of radiological implant failure of 47% at 2 years with 21% of these implants having been removed at 2 years giving an overall revision rate of 44% at 6 years. Similar results had been reported with threaded cups in hip surgery (Hendrich et al., 2006).

The aim of this study is to report the long-term results of a cohort of patients treated with the ARPE thumb CMC joint arthroplasty.

Methods

A follow-up study was done at the Hand Unit of the University Hospital of Valladolid (Spain) between May 1999 and April 2002. Patients included in the study had undergone thumb CMC joint arthroplasty for arthritis of this joint using the ARPE implant (BIOMET Spain Orthopedics SL, Valencia). Data on age and gender were recorded.

Operative technique

A single surgeon (M-F) performed all arthroplasties via a standard approach between the extensor pollicis brevis and abductor pollicis longus tendons. The capsule of the thumb CMC joint was opened longitudinally, and after release of the joint and removal of osteophytes, a saggital saw was used to remove the proximal 6–8 mm of the base of the thumb metacarpal. The geometric centre of the joint surface of the trapezium was easily identified and a hole was drilled by means of a surgical awl. This hole was enlarged with curettes and with the appropriate sized trapezium reamer. Power tools were not used. An awl was used to open the intramedullary canal of the thumb metacarpal and enlarged with rasps. The trapezial cup was implanted by means of a press fit, the cup resting on the edges of the subchondral bone to increase primary stability. The stem was implanted again by means of a press fit and the back of the stem was aligned with the nail of the thumb. A trial head was inserted and a trial reduction undertaken. The replacement was assessed for stability and impingement. If there was any suspicion of instability, the components of the prosthesis were reviewed with intraoperative fluoroscopy. Accurate neck length was calculated as follows: with the thumb extended the volar crease of the interphalangeal joint should match the proximal volar crease of the hand. The definitive head was then inserted and the joint reduced and reassessed. The capsule-periosteal flap was closed with an absorbable suture and the skin was closed with an absorbable suture. The thumb was dressed and patients were placed into a short plaster of Paris arm cast with the thumb in a functional position for 3 weeks (to reduce the risk of dislocation). Removal of the plaster and an exercise programme was undertaken after 3 weeks.

Assessments

Clinical and radiological assessment was made preoperatively, at 3 months, and at 5 and 10 years. Clinical examination consisted of the range of motion using the criteria of the International Federation of Societies for Surgery of the Hand (IFSSH, 2012), which considers the resting position of the thumb metacarpal to be 30° of abduction (i.e. palmar abduction) and 10° of extension (i.e. radial abduction), and thumb opposition using the Kapandji method (Kapandji, 1986). Key pinch strength was measured using the B&L Engineering mechanical pinch gauge (Alimed Inc, Dedham, MA).

The radiological examination consisted of posterior-anterior and oblique radiographs. Preoperative radiographs were classified by the Eaton criteria (Eaton and Litler, 1973), and postoperative radiographs were assessed with regard to implant alignment or loosening.

Pain was measured using a visual analogue scale (VAS) and patient satisfaction was measured using the DASH (disabilities of the arm, shoulder, and hand) questionnaire (Rosales et al., 2002).

Statistical analysis

Continuous variables were assessed by means of the mean and standard deviation (SD) or median and range of the data. Chi-square tests were used to compare frequencies among the patient subgroups. Nonparametric methods were used where appropriate (Snedecor and Cochran, 1989). The Kaplan–Meier method was used to estimate survival probability over time (Kaplan and Meier, 1958). Statistical analysis and determination of statistical significance ($P < 0.05$) were performed by means of the SPSS package (SPSS Inc., Chicago, IL).

The study was approved by the hospital Ethics committee. The patients gave their consent.

Results

Initially 64 consecutive patients were enrolled in the study, but four patients were subsequently excluded because incomplete information was available (i.e. three had died and one had been diagnosed as having Alzheimer's disease). The Eaton grades were as follows: Grade II in six cases, Grade III in 45 cases and Grade IV in 14 cases. A total of 65 arthroplasties (five bilateral) from 60 patients were included. The majority (57) were female. The median age at surgery was

Table 1. Clinical outcome. Distribution of prostheses by preoperative and postoperative range of motion based on IFSSH criteria (IFSSH, 2012).

Range of motion	Assessment	
Anteposition (palmar abduction)	Preoperative	Postoperative*
0º to 20º	72%	11%
20º to 40º	28%	89%
Retroposition		
<5º	49%	8%
>5º	51%	92%
Abduction (radial abduction)		
<10º	75%	18%
10º to 30º	25%	82%
Adduction		
0º to 10º	52%	11%
10º to 25º	48%	89%
Opposition		
1 to 5	25%	0%
6 to 8	52%	29%
9 and 10	23%	71%

(*) At 10-year follow-up ($P < 0.001$). IFSSH, International Federation of Societies for Surgery of the Hand.

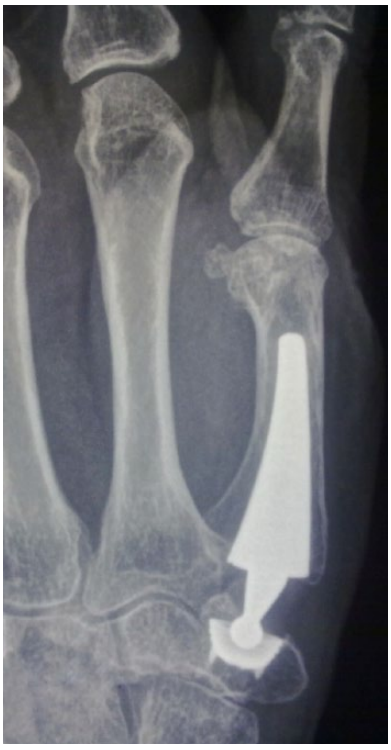

Figure 1. A 65-year-old female with left implant and subsidence of the cup at 10.6 years of follow-up.

58 years (range 45–75). Median time to follow up was 10.6 years (range 10–12.5). We treated 42 right thumbs and 23 left thumbs; 43 of the treated thumbs were dominant. The implant combinations were as follows: 63 number nine and two number ten cups were implanted in the trapezium, 39 number eight, 21 number nine and five number ten stems were implanted in the thumb metacarpal. An angulated neck was used in all but two cases. Fifty-eight patients (62 implants) undertook a complete clinical and radiological assessment, two patients (three prostheses) had telephone follow-up only. Thirty-six patients had formal physiotherapy and twenty-nine (44.6%) undertook their own comprehensive exercise programme.

Table 1 compares the ranges of movement preoperatively and at 10 year follow-up and shows a significant improvement in all movements ($P < 0.001$). All patients, excluding those whose prostheses failed, were able comfortably to hold medium-sized objects (e.g. bottles, cans and boxes) between their thumb and fingers. The mean key pinch strength significantly increased from 4.3 kg (SD 2.3) preoperatively to 5.6 kg (SD 2.6) at 10-year follow-up ($P = 0.005$).

The median VAS score at 10 years was 1.1 (range 0–5). The median preoperative score was 7.4. This represents a significant improvement ($P < 0.001$). Fifty-five thumbs (85%) were painless or painful only after intense use, seven (10%) had discomfort with some restriction and three (5%) had pain at rest. Fifty-seven patients (95%) reported that they were satisfied with the final cosmetic appearance. Function was measured using the DASH score. The median DASH score was 18.3 (range 5.6–36.8) at the 5-year follow-up and 20.1 (range 6.7–39.8) at the 10-year follow-up ($p = 0.62$).

Radiologically 78% demonstrated no evidence of loosening or subsidence, 14% demonstrated minor changes and 8% (five) had failed. Minor radiological abnormalities included: (a) slight mal-positioning of five components that was present from initial implantation and did not change over time (i.e. the cup was not placed perfectly in the middle of the trapezium or the stem was oblique with respect to the medullary cavity of the metacarpal); (b) the implant position changed over time (i.e. some subsidence of the cup into the trapezium in seven cases, Figure 1); (c) partial areas of well-demarcated radiolucency around the cup in two cases, which did not change from the immediate postoperative to end of follow-up (Figures 2(a) and 2(b)); (d) ectopic bone around the base of the stem in six cases (Figure 2(b)); and (e) alterations in the coupling of the components that caused subluxation in some thumb positions in four cases. In addition, there were some combinations of changes (i.e. cup subsidence, ectopic bone and/or minor axis alterations). Radiographs of the five prostheses that had failed showed dislocation in two case, cup

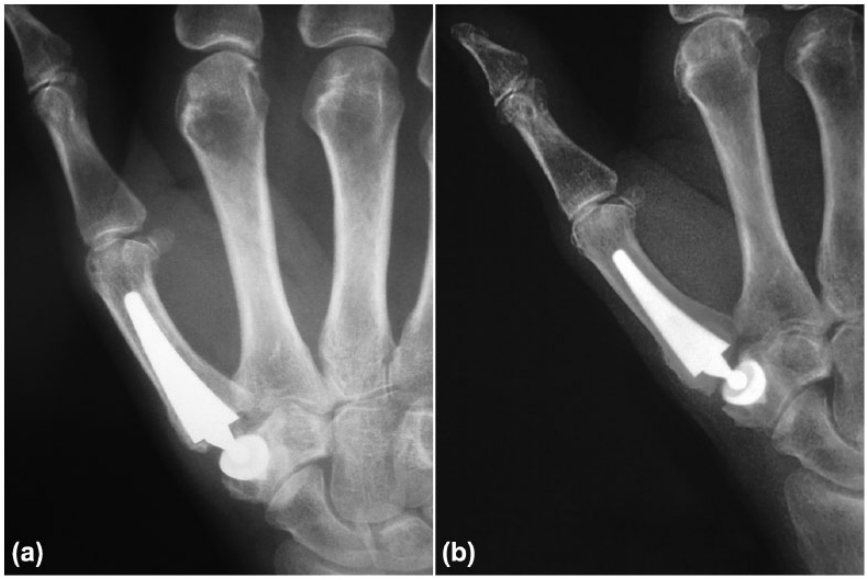

Figure 2. A 62-year-old woman with an implant in the right side. Partial areas of radiolucency well delimitated around the cup, without changes over the years: (a) at 5.3 years of follow-up; (b) at 11 years of follow-up.

loosening in two and loosening of both components in one.

Perioperative complications in this series included, a non-displaced trapezial fracture in two patients, one implant that had penetrated the cortex of the thumb metacarpal, four dislocations (three of them in the first 20 prostheses of the series, and one within the next 45) and soft tissue problems in eight patients. In the patients with trapezium fractures that occurred on impaction of the cup, immobilization was undertaken for 5 weeks and the trapezium healed without loosening. The implant that penetrated the cortex was left to remain functional in situ without evidence of loosening. Two dislocations were corrected with revision surgery and the other remained chronically dislocated and was labelled as failed prostheses. At 3-months review, eight patients complained of moderate paraesthesia or dysesthesia of the thumb owing to surgery, but only two of these patients still reported symptoms at the 10-year review. Two patients suffered complex regional pain syndrome (CRPS) Type I but resolved fully and there were four cases of intolerance to stitches. There was no evidence of infection.

Three prostheses (4.6%) required revision surgery. These were not excluded from the analysis because they were functional once the revision surgery had been undertaken and are reported separately. (1) Early dislocation of the implant seen at cast removal, this had been caused by a large osteophyte on the ulnar side of the trapezium impacting on the base of the metacarpal. Resection of the osteophyte was performed as part of an open reduction and the prosthesis remained stable thereafter. (2) Dislocation of the prosthesis following a fall on the hand 3 years postoperatively. This was revised using a larger cup and autologous bone graft. (3) Instability at 9 years postoperatively owing to chronic subsidence of the cup without loosening. In this case the head was exchanged to a longer neck (Figure 3).

Five implants (7.7%) failed. (1) One implant in a 58-year-old woman loosened at 6 years. This was associated with a diagnosis of hypocalcaemia of 2 mg, owing to inadvertent removal of the parathyroid glands during surgery on the thyroid gland. (2) A 59-year-old female had dislocation of the prosthesis diagnosed at cast removal, but she refused further surgical revision. (3) A 59-year-old female suffered a traumatic dislocation owing to a fall on her hand at 8 years after surgery, and although it was surgically revised it remained unstable and was dislocated at 10-year follow-up. (4) Two prostheses had to be removed because of a complete non-traumatic loosening of the cup, at 6 and 7 years, respectively. A trapezectomy and ligament reconstruction and the other tendon interposition (LRTI) was performed in both, one patient using the flexor carpi radialis (FCR) tendon and abductor pollicis longus (APL). The stems were completely incorporated and could not be removed in either patient. Both patients were pain free at 12 months.

At 10-year follow-up, five prostheses out of 65 were regarded as failures (two were removed, one was loose and two dislocated). Three more prostheses had been surgically revised; these were included in the analysis because they were functional after revision surgery. Therefore, Kaplan–Meier survival probability was 93.9% (95% CI 82.3–97.9) (Figure 4). Survival probability when

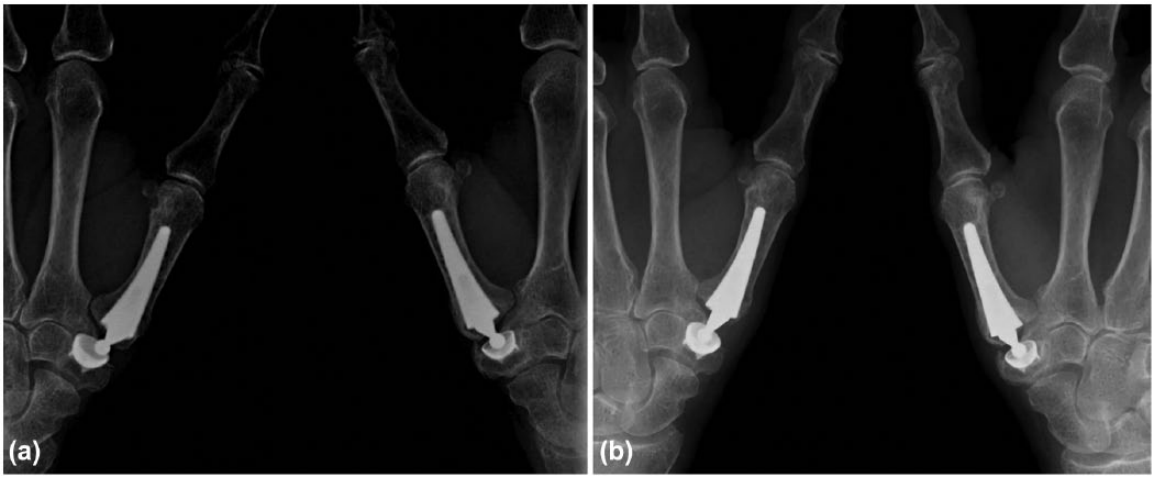

Figure 3. A 52-year-old female with bilateral implant: (a) instability on the left side owing to subsidence of the cup without loosening; (b) corrected after revision surgery and placement of a longer neck.

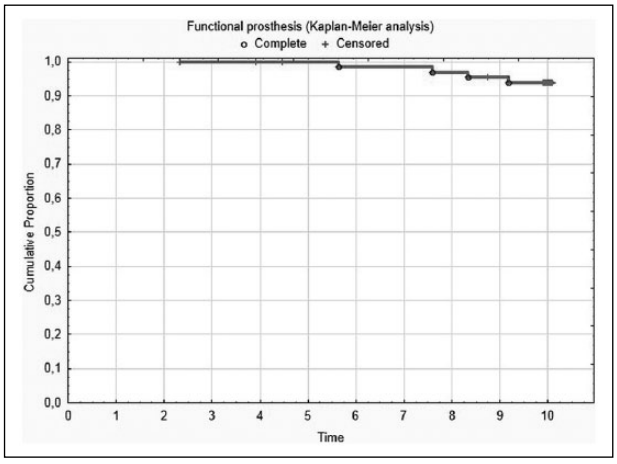

Figure 4. Kaplan–Meier survival analysis at 10-year follow-up, considering removed and failed implants (time in years).

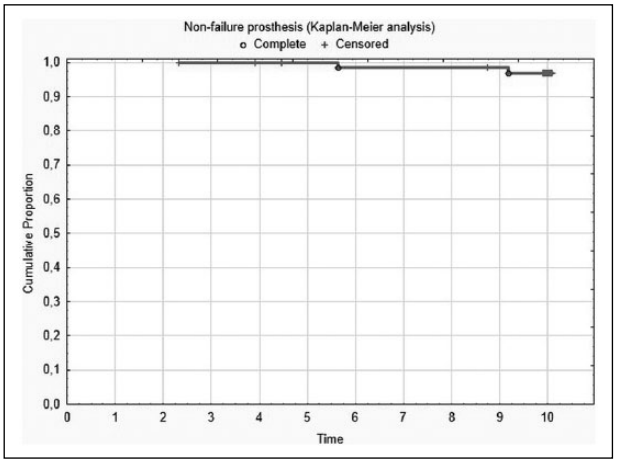

Figure 5. Kaplan–Meier survival analysis at 10-year follow-up, considering removed implants only (time in years).

only the removed implants was considered was 96.9 (95% CI 85.8–99.3) (Figure 5). There were no statistically significant differences by age or Eaton grading.

Discussion

Thumb carpomethacarpal (CMC) joint arthroplasty has been considered an unreliable surgical procedure with few long-term studies showing good results (Giddins, 2012). This may be owing to the fact that some arthroplasties do not attempt to restore the anatomy of the thumb (Hernandez-Cortes et al., 2012; Klahn et al., 2012), but even those that do, have not been successful (Pendse et al., 2009). Arthroplasties of ball and socket design have shown to give good results (Amillo et al., 2002; Apard and Saint Cast, 2009; Badía and Sambandam, 2006; Brutus and Kinnen, 2004; Chakrabarti et al., 1997; Johnston et al., 2012; Simón et al., 2007; Sondergaard et al., 1991).

Our experience with the ARPE thumb CMC joint replacement has been good. The survivorship rate at 10 years of the implants that remain functional was 93.9%. This result was better than the 82% and 89% published in series of the cemented Caffiniere prosthesis with similar follow-up (Amillo et al., 2002; Chakrabarti et al., 1997; Sondergaard et al., 1991), and better than the results at longer follow-up of 89% (16 years) and 73.9% (26 years) as expected (Johnston et al., 2012). The results of this study are close to that achieved with total hip arthroplasty (standard reference) of 93.1% (Allami et al., 2006).

The clinical outcomes of patients in this series with regard to key pinch strength, pain relief and

DASH score were similar or slightly better than those published in series of similar sample size and follow-up that had received trapezectomy alone or trapezectomy combined with LRTI (Salem and Davis, 2012). Although the failure rate (7.7%) was higher than the reported failure rate with trapezectomy (3.6%), the two removed prostheses converted into LRTI were not painful 1 year postoperatively. Of the remainder, 85% were painless or hurt only after intensive use, compared with 80% with trapezectomy alone, and 87% with trapezectomy and LRTI. Final key pinch strength was also better with this prostheses (5.6 kg) than with in trapezectomy alone (3.7 kg) or trapezectomy and LRTI (4.1 kg).

The sample size and the long follow-up of the present study allow some conclusions to be drawn even though the design of the study was not of a randomized clinical trial. A single surgeon (M-F) treated and assessed all patients so the potential for bias owing to inter-observer variability can be ruled out. The remaining pain level and patient satisfaction were measured using a VAS score and a validated Spanish version of the DASH questionnaire completed by the patients themselves. This study demonstrates that the ARPE thumb CMC joint prosthesis is a reliable option for patients with thumb CMC arthritis of Stage III and for some patients of Stage IV of the Eaton classification in patients with medium–high level of functional demand. As suggested by others (Johnston et al., 2012), it should also be emphasized that there is a need to create a joint registry to record implant failure and revision rates.

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Professor A. Mayo Iscar for support with statistical analysis and Dr C. Simón Pérez for assistance in gathering clinical data.

Conflict of interests

None declared.

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