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Long-term survival analysis of 191 MAÏA® prostheses for trapeziometacarpal arthritis

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Abstract

Surgery for trapeziometacarpal osteoarthritis after failure of medical treatment remains controversial. The aim of this study was to determine the long-term results of the MAÏA® trapeziometacarpal prosthesis (Lépine, Genay, France). This was a retrospective clinical and radiographic study of 191 MAÏA® trapeziometacarpal prostheses implanted between 2001 and 2016 from a single centre. The survival rate of the implants at the final follow-up of 12 years (range 17 days to 140 months) was 88%. Median pain score was 1/10. The median Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score was 20. The rate of major complications was 9% (5% dislocations and 4% loosening) with all dislocations needing revision surgery. The risk of prosthetic dislocation was highest during the first 3 years, most often related to malposition of the trapezium implant. The MAÏA trapeziometacarpal prosthesis represents a long-term solution for surgical treatment of thumb rhizarthrosis.

Level of evidence: IV

Keywords

Trapeziometacarpal arthroplasty, prosthesis revision, survival curve, thumb osteoarthritis

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Introduction

Trapeziometacarpal (TM) joint is the second most common location of osteoarthritis in the hand (Wilder et al., 2006). From 14% to 36% of patients are symptomatic (Dahaghin, 2005; Zhang et al., 2002). Various surgical options for pain relief have been recommended when medical treatment becomes unsuccessful. Since its introduction by De La Caffinière in 1971, use of TM prosthesis to address arthritis pain gained in popularity, particularly in Europe (de la Caffiniere and Aucouturier, 1979; Wajon et al., 2015).

The MAÏA® TM prosthesis (Groupe Lépine, Lyon, France) is a modular uncemented ball-and-socket prosthesis. It has a hemispheric cup implanted in the trapezium, a modular neck and an anatomical metacarpal stem. Both implanted parts have a bilayer coating of porous titanium and hydroxyapatite for cementless fixation. The prosthesis has shown very good results, with a failure rate of about 8% (Bricout and Rezzouk, 2016; Toffoli and Teissier, 2017).

A few studies published on TM prosthesis have included postoperative setbacks, with survival curves beyond 10 years (Apard and Saint-Cast, 2007; Dumartinet-Gibaud et al., 2020; Martin-Ferrero et al., 2020; Tchurukdichian et al., 2020). Survival studies of the MAÏA® TM prosthesis are limited and include fewer than 100 patients with 5 to 6 years follow-up (Andrzejewski and Ledoux, 2019; Toffoli and Teissier, 2017). The objective of this

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retrospective cohort study was to determine the long-term survival of the MAÏA® TM prosthesis at 10 years and beyond.

Materials and methods

Patients

All patients undergoing surgery with a MAÏA modular cementless prosthesis for TM joint arthritis from 2003 to 2016 were reviewed for this study. The clinical indication for surgery was painful TM osteoarthritis affecting activities of daily living and failure of conservative treatment. Preoperative radiographs were used to assess the TM osteoarthritis according to the classification of Dell et al. (1978) and scaphotrapeziotrapezoid (STT) arthritis according to the classification of Crosby et al. (1978). Irrespective of the radiological stage, asymptomatic STT arthritis was not considered a contraindication for TM replacement in this series.

Surgical technique

All procedures were performed by a surgeon with the level of experience of a specialist (Tang and Giddins, 2016). Surgery was done under locoregional anaesthesia and with the aid of a pneumatic tourniquet, except in cases of previous axillary lymph node clearance when tourniquet use was avoided. An anterior or lateral approach was used, protecting the superficial branches of the radial nerve. Abductor pollicis longus (APL) tendon was released during capsulotomy. Preparation included a saw cut of the base of the first metacarpal and resection of the osteophytes. After bone preparation and placement of the trapezial and metacarpal implants, a straight or offset prosthetic neck of appropriate length was selected based on implant stability, TM joint mobility and the correction of metacarpophalangeal hyperextension by lengthening of the thumb (Figure 1). The APL tendon was reinserted during closure.

Postoperatively, the thumb and wrist were immobilized for 3 weeks, followed by a self-directed rehabilitation programme without supervised physiotherapy input.

Functional evaluation

All patients gave informed consent for both surgery and use of data for the study. The clinical evaluation was performed retrospectively by means of a clinically validated self-reporting questionnaire, including a visual analogue scale (VAS) for pain (scores from 0 to 10), a global satisfaction score from 0 to 10, a cosmetic satisfaction score from 0 to 10, delay in returning to work or to leisure activities in the event of retirement, the desire to undergo the same type of surgery on the contralateral side in the event of a similar pathology, a Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score in French (Fayad et al., 2008) and a Kapandji thumb opposition score (Kapandji, 1986). Those patients who had ongoing pain or discomfort were seen for a face-to-face assessment by one surgeon (LC).

Figure 1. Postoperative radiograph showing MAÏA® prosthesis.

All radiographs were reviewed for radiolucency around the implant or other signs of implant loosening, a trapezium fracture and periarticular ossifications. Implant loosening was defined by the association of a Stage 2 or 3 implant subsidence and Stage 2 or 3 radiolucency around the implant according to the classification of Semere et al. (2015).

Statistical analysis

Quantitative variables were reported as mean (range) and categorical variables were expressed as number (percentage) of participants in each category. We analysed the survival rate of the prosthesis based on both the revision, as well as revision and theoretical indications for revision (asymptomatic loosening) as our end points. Patients who did not experience either of the two end points were censored at the

time of the last follow-up. Kaplan–Meier curves were used to estimate the survival rate against time, with 95% confidence interval (CI). The survivorship curves were compared using a log rank test to look for factors affecting implant survival. A p-value <0.05 was considered statistically significant.

Results

During the study period from March 2003 to November 2016, 293 TM prostheses were implanted in 251 patients in our centre. Of these 251 patients, nine patients (nine TM prostheses) died between the surgery and the last follow-up; 67 patients (74 TM prostheses) could not be contacted or did not answer to the questionnaire and were considered as lost to follow-up. We excluded 18 patients (19 prostheses) because of incomplete data, such as no radiographs available. Therefore, 191 MAÏA prostheses in 157 patients were available for the final analysis. Of these 191 prostheses, 12 had already undergone revision surgery at the time of the study (Figure 2). The median follow-up was 69 months (range 17 days to 140 months). The demographic characteristics of the patient group is shown in Table 1.

Clinical results

Of the 191 TM prostheses, the mean overall satisfaction score was 9/10 (range 2–10). Eighty-five per cent of the participants were satisfied with the appearance of the thumb with the mean cosmetic score of 9/10 (range 8–10). The mean VAS was 2/10 (range 0–8) with 79% of patients scoring 0 to 2. The mean QuickDASH score was 25 (range 0–82), and the mean Kapandji opposition score was 9 (range 3–10). The mean time to return to work or leisure activities was 3 months (range 1–18). Overall, 90% of patients would undergo the same procedure if they had the same condition on the contralateral side.

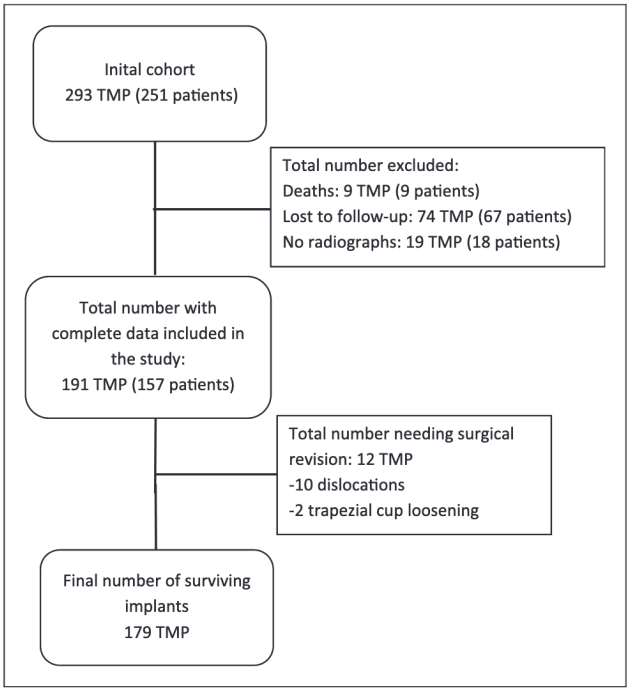

Figure 2. Flow chart with patient and implant numbers.

Survival rates

Twelve prostheses required revision surgery, two of which were for symptomatic loosening of the trapezial cup and the other 10 for dislocations. All these 12 were included in the survivorship study. At a final follow-up of 12 years (140 months), the survival rate of the implants according to the 'revision' criterion was 88% (95% CI, 79–97%). This survival rate was 97% (95% CI, 94–99%) at 3 years, 95% (95% CI, 91–98%) at 5 years, 93% (95% CI, 89–98%) at 8 years and 88% (95% CI, 79–97%) at 10 years (Figure 3). There was no difference in the survival rates between those patients who were still at work or had retired ($p = 0.49$).

In addition to the 12 implants that required revision, a further four implants that showed asymptomatic loosening on radiographs taken at the last follow-up were considered as 'indication for revision'. The overall survival rate according to the indication for revision criterion was 97% (95% CI, 94–99%) at 3 years, 95% (95% CI, 91–98%) at 5 years, 92% (95% CI, 87–97%) at 8 years and 82% (95% CI, 71–93%) at 10 years. At a final follow-up of 12 years (140 months), the survival rate of the implants according to the 'indication for revision' criterion was 54% (95% CI, 24–100%) (Figure 4).

Complications

The overall complications are summarized in Table 2. Nine of the 13 postoperative De Quervain's tenosynovitis patients were successfully treated with non-operative management, but the remaining four required surgical release following failed medical treatment. All patients with Type 1 complex regional pain syndromes had resolution of symptoms within 3 months with hand physiotherapy. There was no sepsis or loosening of the metacarpal implant.

All 10 dislocations required revision surgery. Five occurred in the first year without significant trauma. Intraoperative exploration in these five patients revealed excessive anteversion of the trapezial cup but with no loosening. Revision procedures

Table 1. Clinical and demographic characteristics of 191 MAIA prostheses.

Variables	$n = 191$
Age (years)[a]	65 (50–86)
Men/women	25/166
Dominant/non-dominant side	93/98
Working/retired	32/159
Trapezio metacarpal arthritis grade	
Dell 2	52
Dell 3	101
Dell 4	38
Scaphotrapeziotrapezoid joint arthritis grade	
Crosby 0	120
Crosby 1	46
Crosby 2	24
Crosby 3	1
Surgical approach	
Anterior	141
Lateral	50

[a]Median (range).

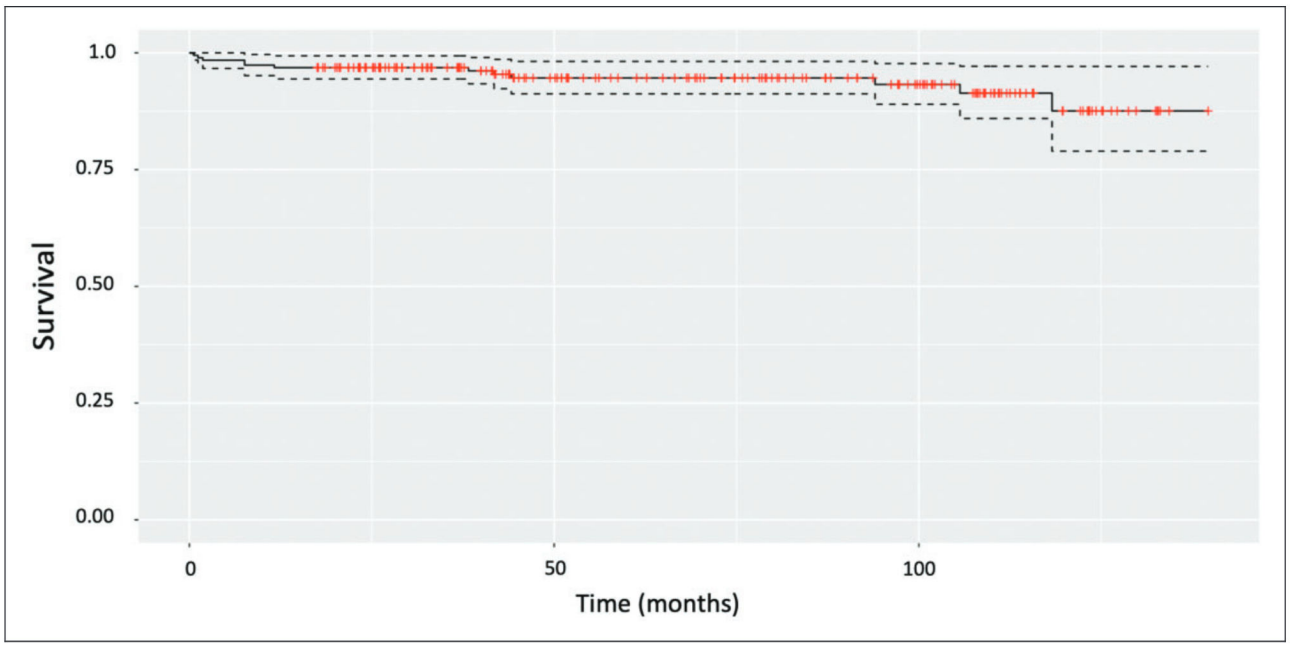

Figure 3. Survival rate according to the 'revision' criterion (event of a surgical revision of the prosthesis).

undertaken included modification of the neck, and modification of the trapezial implant with the insertion of a new larger cup (10 mm diameter) in three patients who had persistent intraoperative instability. One patient with a neck size of extra large (XL) required a trapeziectomy and flexor carpi radialis ligamentoplasty. Three palmar dislocations occurred in the third postoperative year. One patient with dislocation secondary to subsidence of the metacarpal implant was corrected by lengthening of the neck. Another patient with dislocation secondary to a Z-shaped deformity of the thumb was treated with lengthening of the neck along with centralization of the extensor hood. Third patient who presented with disassembly of the polyethylene from the metal cup required changing of the polyethylene and the neck. The other two remaining dislocations occurred at 9 and 10 years after the primary procedure. Both these revealed polyethylene wear without loosening during surgical revision. In one patient the polyethylene was replaced, and in the other excision of trapezium with ligamentoplasty was performed.

At the last follow up, seven implants showed radiological evidence of loosening of the trapezial

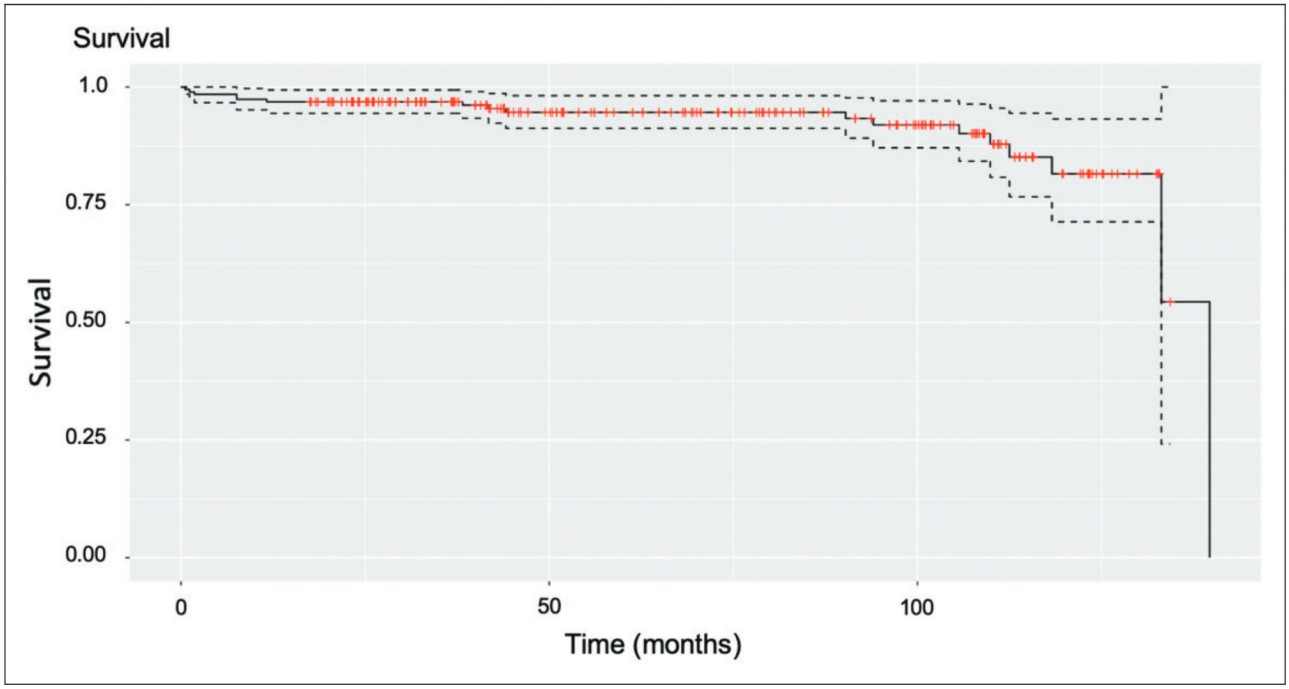

Figure 4. Survival rate according to the 'revision indication' criterion (event of a surgical revision of the implant but also theoretical indications for revision).

Table 2. Complications following trapeziometacarpal arthroplasty using MAIA prosthesis.

Complication	*n* (%)	Time between initial surgery to complication (range)	Surgical treatment (%)	Implant removal (%)
Dislocation	10 (5)	37 (0.6–106)	10 (100)	1 (10)
Trapezial cup loosening	7 (4)	118 (76–140)	2 (29)	2 (29)
De Quervain's tenosynovitis	13 (7)	2 (1–3)	4 (31)	0
Thumb trigger finger	2 (1)	2 (0.7–3)	1 (50)	0
Complex regional pain syndrome	10 (5)	1 (1–2)	0	0

Time between initial surgery to complication presented as months.

cup out of which only two were symptomatic. These two patients required further surgery to address their pain. The 73-year-old male who developed symptoms 6 years after initial surgery was treated with trapeziectomy and ligamentoplasty and the 63-year-old female who turned symptomatic 11 years after initial surgery required isolated trapeziectomy. Metacarpal implant was left in situ in both. Both patients showed good outcome after the second surgery. The remaining five asymptomatic loosening of the cup were discovered incidentally during the routine radiologic evaluation, and these patients have not undergone any further operations to date.

Discussion

Previous studies on MAIA prosthesis have noted a survival rate between 90% to 93% at an average of 5 or 6 years (Andrzejewski and Ledoux, 2019; Bricout and Rezzouk, 2016; Toffoli and Teissier, 2017). There are only seven recent studies looking at the survivorship of ball-and-socket TM joint prostheses beyond 10 years (Table S1). The 10-year survival rate of 88% with revision as the end point in this series is comparable with other published studies. However, the survival rate in our series according to the 'indication for revision' criterion fell significantly at maximum follow-up compared with the figure at 8 years (54% at 11 years). This finding could be due to a combination of factors. First, the gradual reduction of number of patients with complete radiographic records at longer follow-up may result in the survival curve to fall rapidly with each 'event' off the curve. In addition, the median time for radiological evidence of trapezoidal cup loosening was 112 months (range 90–140) in this series and therefore it is likely that

more implants may show evidence of radiological loosening with longer follow up compared with previous studies.

Our dislocation rate of 10 out of 191 prosthesis was comparable with other series of the MAÏA prosthesis reported in literature, with rates from 1% to 10% (Andrzejewski and Ledoux, 2019; Bricout and Rezzouk, 2016; Toffoli and Teissier, 2017). Half of the dislocation cases occurred during the first year and were due to malposition of the trapezial cup. Although all the implants in our series were the semi retaining cup, the position of the cup seems to be of primary importance for prosthesis stability. This series included only the first generation of MAÏA prostheses with simple mobility. Newer generations of the dual mobility prosthesis might solve the problem of early post-operative instability, but further studies are needed to confirm this (Tchurudkichian et al., 2021).

The second complication we encountered was loosening of the trapezium implant. although only two patients out of the seven implants that showed loosening were symptomatic and required revision. Previous studies using MAÏA series have shown loosening rates of 2% to 5%, which is comparable with our series (Bricout and Rezzouk, 2016; Martin-Ferrero et al., 2020; Toffoli and Teissier, 2017). These reported loosening rates are much lower than those reported for the De La Caffiniere-type prostheses with a cemented cup, with the over 20% loosening rate (De Smet et al., 2004; Johnston et al., 2012; Van Cappelle et al., 1999; Wachtl et al., 1998). In cases of symptomatic loosening and inability to re-implant a prosthesis, recent studies have shown that secondary trapeziectomy can provide the same results as first-line trapeziectomy (Kaszap et al., 2013; Lenoir et al., 2016).

Routine release of the first compartment during implantation of the TM prosthesis has been advocated by some surgeons to prevent postoperative De Quervain's tenosynovitis (Jager et al., 2013). Because majority of the patients who developed this complication postoperatvely in our series improved with non-surgical treatment, we do not recommend this approach.

We did not find any difference in prosthesis survival between those patients who were working and non-working, which agrees with the findings reported by Kirkeby et al. (2021).

The number of patients in the study group and the duration of follow-up are main strengths of this study. However, there are several limitations. This is a retrospective study with a heterogeneous follow-up time. Twenty-two patients were lost to follow-up and 45 did not answer the self-evaluation questionnaire. Eighteen patients also did not have follow-up radiographs. We have taken the assumption that all patients lost for follow-up may have had a worse outcome and hence an underestimation of complications may be possible (Murray et al., 1997). The clinical assessment was subjective and performed by a self-reporting questionnaire. Even when the questionnaire contains only scientifically validated items, it cannot claim to have the quality of a rigorous clinical assessment by an independent examiner (Fayad et al., 2008; Kapandji, 1986). Furthermore, force measurements, including grip and pinch strengths, are not possible with the self-reported evaluation. The retrospective nature of the study and the absence of a large amount of preoperative data did not allow for adequate comparison of the pre- and postoperative clinical data. Similarly, the absence of regular radiological and clinical evaluation over time did not allow for events such as complications or the appearance of radiological changes to be precisely dated, but rather only noted at the last visit or in the event of surgical revision. This series mostly included patients who have retired from work. Although we differentiated patients who were still working at the time of surgery and those who were retired from work, we did not take into account the difference in manual activity, and this could constitute a selection bias. Indeed, an active retiree may have a much higher manual activity than a sedentary worker and vice versa.

Despite these limitations, the survival curve at a final follow-up of 12 years (median 5.8 years) suggests MAIA total TM arthroplasty to be a reliable long-term solution for the surgical treatment of thumb osteoarthrosis after failure of medical treatment. However, these data warrant further analysis with survival curve studies beyond 10 years.

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References

Andrzejewski A, Ledoux P. Maïa trapeziometacarpal joint arthroplasty: survival and clinical outcomes at 5 years' follow-up. Hand Surg Rehabil. 2019, 38: 169–73.

Apard T, Saint-Cast Y. Results of a 5 years follow-up of Arpe prosthesis for the basal thumb osteoarthritis. Chir Main. 2007, 26: 88–94.

Bricout M, Rezzouk J. Complications and failures of the trapeziometacarpal Maia prosthesis: a series of 156 cases. Hand Surg Rehabil. 2016, 35: 190–8.

Crosby EB, Linscheid RL, Dobyns JH. Scaphotrapezial trapezoidal arthrosis. J Hand Surg Am. 1978, 3: 223–34.

Dahaghin S. Prevalence and pattern of radiographic hand osteoarthritis and association with pain and disability (the Rotterdam study). Ann Rheum Dis. 2005, 64: 682–7.

De la Caffiniere JY, Aucouturier P. Trapezio-metacarpal arthroplasty by total prosthesis. The Hand. 1979, 11: 41–6.

De Smet L, Sioen W, Spaepen D, Van Ransbeeck H. Total joint arthroplasty for osteoarthritis of the thumb basal joint. Acta Orthop Belg. 2004, 70: 19–24.

Dell PC, Brushart TM, Smith RJ. Treatment of trapeziometacarpal arthritis: results of resection arthroplasty. J Hand Surg Am. 1978, 3: 243–9.

Dumartinet-Gibaud R, Bigorre N, Raimbeau G, Jeudy J, Saint Cast Y. Arpe total joint arthroplasty for trapeziometacarpal osteoarthritis: 80 thumbs in 63 patients with a minimum of 10 years follow-up. J Hand Surg Eur. 2020, 45: 465–9.

Fayad F, Lefevre-Colau M-M, Macé Y et al. Validation of the French version of the Disability of the Arm, Shoulder and Hand questionnaire (F-DASH). Joint Bone Spine. 2008, 75: 195–200.

Jager T, Barbary S, Dap F, Dautel G. Evaluation of postoperative pain and early functional results in the treatment of carpometacarpal joint arthritis. Comparative prospective study of trapeziectomy vs. MAIA() prosthesis in 74 female patients. Chir Main. 2013, 32: 55–62.

Johnston P, Getgood A, Larson D, Chojnowski AJ, Chakrabarti AJ, Chapman PG. De la Caffinière thumb trapeziometacarpal joint arthroplasty: 16–26 year follow-up. J Hand Surg Eur. 2012, 37: 621–4.

Kapandji A. Clinical test of apposition and counter-apposition of the thumb. Ann Chir Main. 1986, 5: 67–73.

Kaszap B, Daecke W, Jung M. Outcome comparison of primary trapeziectomy versus secondary trapeziectomy following failed total trapeziometacarpal joint replacement. J Hand Surg Am. 2013, 38: 863–71.

Kirkeby L, Frost P, Svendsen SW, Hansen TB. Revision rates of trapeziometacarpal total joint arthroplasty in relation to occupational hand force requirements. J Hand Surg Eur. 2021, 46: 968–74

Lenoir H, Erbland A, Lumens D, Coulet B, Chammas M. Trapeziectomy and ligament reconstruction tendon interposition after failed trapeziometacarpal joint replacement. Hand Surg Rehabil. 2016, 35: 21–6.

Murray DW, Britton AR, Bulstrode CJK. Loss to follow-up matters. J Bone Joint Surg Br. 1997, 79-B: 254–7.

Semere A, Vuillerme N, Corcella D, Forli A, Moutet F. Results with the Roseland HAC trapeziometacarpal prosthesis after more than 10 years. Chir Main. 2015, 34: 59–66.

Tang JB, Giddins G. Why and how to report surgeons' levels of expertise. J Hand Surg Eur. 2016, 41: 365–6.

Tchurukdichian A, Guillier D, Moris V, See L-A, Macheboeuf Y. Results of 110 IVORY prostheses for trapeziometacarpal osteoarthritis with a minimum follow-up of 10 years. J Hand Surg Eur. 2020, 45:458–64.

Toffoli A, Teissier J. MAÏA trapeziometacarpal joint arthroplasty: clinical and radiological outcomes of 80 patients with more than 6 years of follow-up. J Hand Surg. 2017, 42: 838.e1–8.

Van Cappelle HGJ, Elzenga P, van Horn JR. Long-term results and loosening analysis of de la Caffinière replacements of the trapeziometacarpal joint. J Hand Surg. 1999, 24: 476–82.

Wachtl SW, Guggenheim PR, Sennwald GR. Cemented and noncemented replacements of the trapeziometacarpal joint. J Bone Joint Surg Br. 1998, 80: 121–5.

Wilder FV, Barrett JP, Farina EJ. Joint-specific prevalence of osteoarthritis of the hand. Osteoarthritis Cart. 2006, 14: 953–7.

Zhang Y, Niu J, Kelly-Hayes M, Chaisson C, Aliabadi P, Felson D. Prevalence of symptomatic hand osteoarthritis and its impact on functional status among the elderly: The Framingham Study. Am J Epidemiol. 2002, 156: 1021–7.

Dehl M, Chelli M, Lippmann S, Benaissa S, Rotari V, Moughabghab M. Results of 115 Rubis II reverse thumb carpometacarpal joint prostheses with a mean follow-up of 10 years. J Hand Surg Eur. 2017, 42: 592–8.

Martin-Ferrero M. Ten-year long-term results of total joint arthroplasties with ARPE implant in the treatment of trapeziometacarpal osteoarthritis. J Hand Surg Eur. 2014, 39: 826–32.

Martin-Ferrero M, Simón-Pérez C, Coco-Martín MB, Vega-Castrillo A, Aguado-Hernández H, Mayo-Iscar A. Trapeziometacarpal total joint arthroplasty for osteoarthritis: 199 patients with a minimum of 10 years follow-up. J Hand Surg Eur. 2020, 45: 443–51.

Tchurukdichian A, Gerenton B, Moris V, See L-A, Stivala A, Guillier D. Outcomes of double-mobility prosthesis in trapeziometacarpal joint arthritis with a minimal 3 years of follow-up: an advantage for implant stability. Hand. 2021, 16: 368–74.

Vissers G, Goorens CK, Vanmierlo B et al. Ivory arthroplasty for trapeziometacarpal osteoarthritis: 10-year follow-up. J Hand Surg Eur. 2019, 44: 138–45.

Wajon A, Vinycomb T, Carr E, Edmunds I, Ada L. Surgery for thumb (trapeziometacarpal joint) osteoarthritis. Cochrane Database Syst Rev. 2015, 2015: CD004631.