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Original article

Maïa® trapeziometacarpal joint arthroplasty: Survival and clinical outcomes at 5 years' follow-up

Résultats cliniques et survie à 5 ans de la prothèse trapézo-métacarpienne Maïa®

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ABSTRACT

We sought to report the clinical and radiological outcomes and the survival of Maïa® trapeziometacarpal joint arthroplasty retrospectively at a mean 5 years' follow-up. We evaluated the implant survival and the clinical outcomes of 93 patients (113 prostheses). Patients were examined during a consultation and their mobility, key pinch strength and satisfaction were recorded. Patients also completed a QuickDASH evaluation. The 5-year survival rate was 92.2%. The mean QuickDASH Score was 26.7. The complication rate was 31% and the revision rate was 12.4%. The most common complication was dislocation and the most frequent cause of surgical revision was periprosthetic ossification. We identified two cases of aseptic loosening. This study shows the Maïa® prosthesis provides satisfactory medium-term results and has an excellent 5-year survival. However, the high complication and revision rates are still a major concern.

RÉSUMÉ

Nous rapportons dans une étude rétrospective les résultats cliniques et radiologiques et la survie de la prothèse trapézo-métacarpienne Maïa® à 5 ans de suivi moyen. Nous avons revu 93 patients (113 prothèses). Les mobilités articulaires, la force de pince et la satisfaction du patient ont été notées pour chaque implant. Les patients ont également été invités à remplir un questionnaire QuickDASH. La survie moyenne à 5 ans était de 92,2%. Le score QuickDASH moyen était de 26,7. Les taux de complications et de révision étaient respectivement de 31% et de 12,4%. La complication la plus fréquente était la luxation prothétique. La présence d'ossifications périprothétiques était la cause la plus fréquente de reprise chirurgicale. Nous avons trouvé deux cas de descellement aseptique. Cette étude montre des résultats satisfaisants à moyen terme pour la prothèse trapézo-métacarpienne Maïa® ainsi qu'une excellente survie à 5 ans. Cependant, les taux élevés de complications et de reprises chirurgicales sont encore un problème majeur.

1. Introduction

Trapeziometacarpal joint arthritis is a common disease that typically affects post-menopausal women. After the distal interphalangeal joint, it is the second most common location for degenerative arthritis in the hand [1]. The radiological prevalence in this population is 33% but only one-third have pain and restricted mobility and/or reduced strength [2]. Most patients can be treated conservatively with rest, painkillers and immobilization [3,4].

If this treatment fails, a surgical procedure can be proposed to restore thumb function with a pain-free, stable and mobile joint with preserved strength [5]. There are four types of surgical procedures: trapeziectomy with or without interposition, arthroplasty with interposition implant or resurfacing, trapeziometacarpal fusion and trapeziometacarpal prosthesis (TMP). There are many publications describing the results of these procedures [6–9]

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but no technique has been found to be superior to the others [10–13]. Despite trapeziectomy having been described long before the TMP, there are only a few studies reporting its long-term results and complications. Recent work demonstrated TMP was superior to trapeziectomy at a short follow-up [14,15].

Total trapeziometacarpal joint replacement was first described in 1973 [16]. Since then, several advances have been made in the anatomical design, cementless configuration and prosthesis modularity. TMP survival rates have progressively caught up with those of total hip arthroplasty. The main concerns are dislocation and long-term osteointegration of the cup. Only a few studies [17–20] have reported long-term results even though the TMP has existed for more than 40 years.

The Maïa® prosthesis (Groupe Lépine, Genay, France) has a ball-and-socket configuration and consists of two uncemented components – metacarpal stem and trapezial cup – and a neck with a metal-on-polyethylene bearing. There are two types of cup: retaining and non-retaining.

Our aim was to report the results and the survival of the Maïa prosthesis in a retrospective study at a mean 5 years' follow-up.

2. Patients and methods

2.1. Patients

From January 1, 2004 to December 31, 2013, 190 TMPs were implanted in 165 patients at our hospital. Conservative treatment had failed in these patients and Maïa® trapeziometacarpal arthroplasty was proposed to them. We did not propose other surgical options and we did not consider scaphotrapeziotrapezoidal (STT) arthritis to be a contraindication for TMP when the patient's STT was asymptomatic. In 2016, we invited them to take part in this retrospective study. The study was approved by our institutional ethics committee.

2.2. Surgical procedure

A senior surgeon (P.L.) carried out all the operations. The surgical technique was identical in all cases. Two important points in the technique need to be highlighted: the base of the first metacarpal bone was completely freed from its capsular and ligament attachments, and only standard non-retaining trapezial cups were used. Different neck sizes were tested to achieve the best thumb stability and circumferential motion. The wound was irrigated at the end of the procedure. After surgery, the thumb and wrist were immobilized in a cast for 1 week, then replaced by another cast for 4 additional weeks so the capsular elements could heal and the implant osteointegration could take effect.

2.3. Assessment

A single investigator (A.A.) reviewed all the patients. The clinical examination consisted of measuring the joint range of motion using a goniometer (3B Scientific®) and thumb opposition using the Kapandji Score [21]. We measured bilateral pinch strength using a pinch gauge (Saehan®). No preoperative measurements were available for comparison.

Patients were asked to fill out the French version of the Disabilities of the Arm, Shoulder, and Hand (DASH) Questionnaire. They also stated their satisfaction level with the outcome: very satisfied, satisfied, disappointed or dissatisfied.

Preoperative radiography was used to assess the trapeziometacarpal osteoarthritis stage based on the Eaton–Littler [22] and Dell classifications [23]. Anterior-posterior and lateral views of the thumb according to Kapandji et al. [24] were obtained and used to determine whether periprosthetic ossification, radiolucent lines and loosening were present.

Any complications were recorded from the patient's medical record. Every patient was also asked about the complications they encountered after the procedure.

2.4. Statistical analysis

The data are summarized by mean, standard deviation (SDs) and range (minimum–maximum) values. The data distribution was tested; Student's *t*-test was applied when a normal distribution was found. The Kaplan–Meier method was used to estimate survival probability.

3. Results

3.1. Population characteristics

In total, 93 patients were reviewed in the context of our study. Twenty-nine participants had a bilateral prosthesis; 20 were included in the study. This resulted in a cohort of 113 prostheses. Most patients were female (73 patients; 78%). The mean age at the time of surgery was 59.5 years (range, 38–79). Mean time to follow-up was 63 months (range, 32–143 months). Forty-nine prostheses (45%) had a follow-up of more than 5 years.

The majority of patients (58%) were not employed at the time of surgery: 44 were retired (47%), 6 were not able to work and 4 were housewives. Of the 39 patients who were employed, 31 (79%) were able to return to their job after a mean of 9 weeks and 6 days. Nineteen other procedures were performed at the same time: 11 carpal tunnel releases, 4 trigger thumb releases and 4 other hand surgeries.

3.2. Clinical outcomes

The clinical outcomes recorded here apply only to the patients in whom the prosthesis was still in place (109 prostheses). The trapeziometacarpal motion was excellent: mean abduction of 44° (SD 5, range 30–50) and mean antepulsion of 43° (SD 4, range 35–50). The mean Kapandji opposition was 8.9 (range 7–10). The key pinch measurements were compared to the other side in patients with a unilateral prosthesis ($n = 60$). The mean key pinch was 4.8 kg against 5.4 kg for the contralateral side ($P > 0.05$). In the subgroup of 20 male patients, the difference between the two sides was significant (7.7 kg vs. 9.4 kg; $P = 0.02$).

A majority of patients were either very satisfied (57.5%) or satisfied (34.5%). The mean DASH Score was 26.7 (range 0–85.3); it could not be compared with preoperative DASH Score since this information was not available.

3.3. Radiological outcomes

We first examined the preoperative radiographs. Based on the Eaton-Littler classification, 60% of joints were graded II, 38% were graded III and 2% were graded IV. Based on the Dell classification, 56% of joints were graded II, 43% were graded III and 1% were graded IV.

Post-operative radiographs were also examined (Fig. 1). Periprosthetic ossifications were observed in 43 cases and were judged severe (i.e. intra-articular with potential functional impairment) in 15 cases. It caused head–cup dissociation in two cases (Fig. 2) and spontaneous arthrodesis in two other cases. Surprisingly, these patients did not complain about their condition. All of them had bilateral prostheses with comparable functional results between the two sides. One case of polyethylene wear without functional

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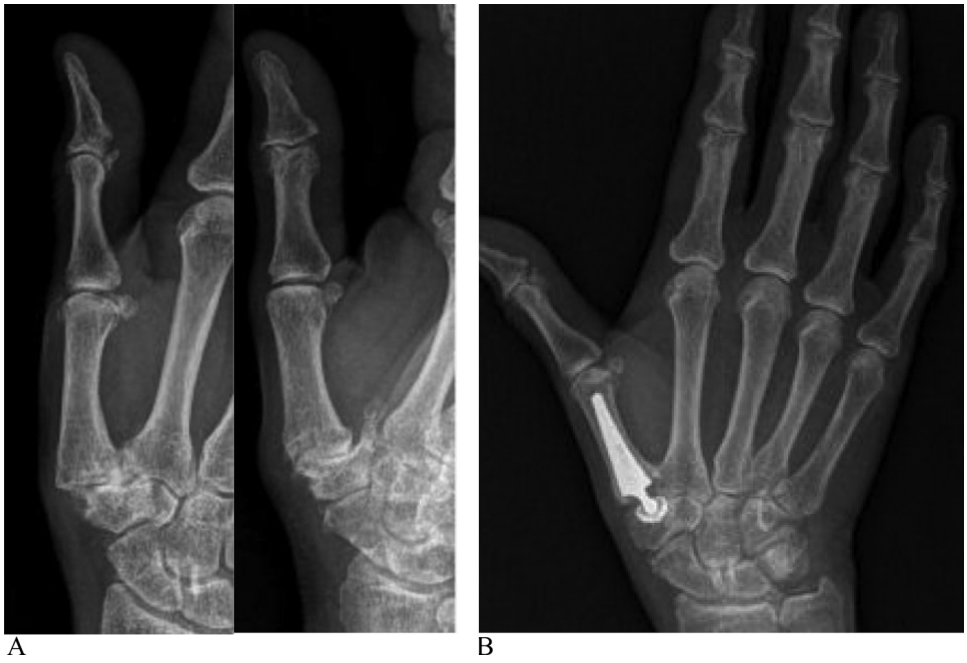

Fig. 1. TM prosthesis in a right-handed 75-year-old female patient. The preoperative radiographs showed severe trapeziometacarpal osteoarthritis (A). At 4 years' follow-up, the patient is very satisfied, has a Kapandji score of 9 and a key pinch strength of 5.5 kg; which identical to that of the unoperated opposite side; the radiographs have no abnormal findings (B).

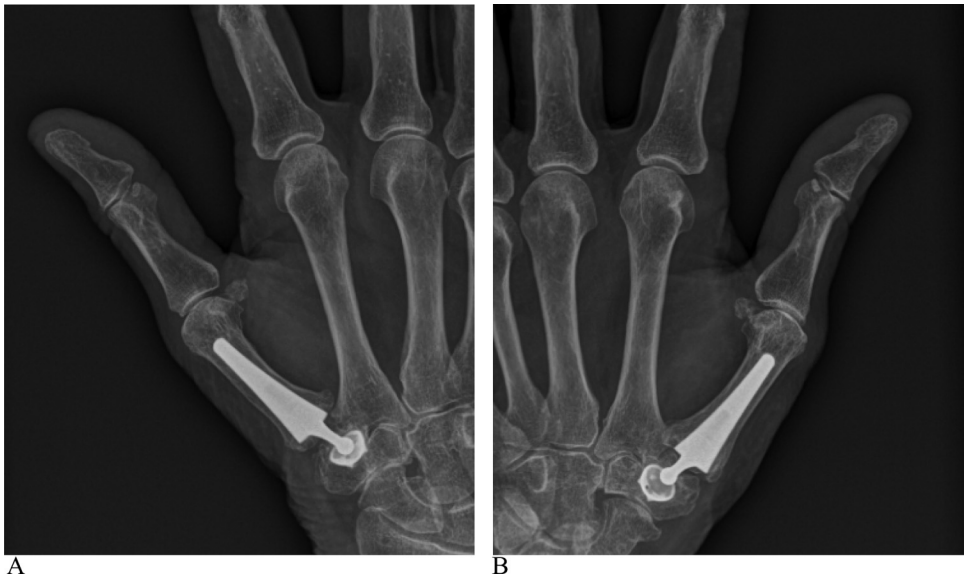

Fig. 2. Bilateral prosthesis in a 76-year-old female patient at 70 and 63 months of follow-up for the right (A) and left (B) implants, respectively. On the left side, the head is dissociated, and the joint has severe periprosthetic ossifications while the right side has a good radiological result. The clinical evaluation showed similar key pinch strength and a Kapandji score of 9 for both sides.

impairment was identified in a patient operated 4 years earlier. Five patients had radiolucent lines around the trapezial implant without migration. No case of fracture was found.

3.4. Complications and revisions

Dislocation was the most frequent complication in our series. There were 11 dislocations (9.7%) among our patients; 4 were recurrent dislocations that needed surgical reduction. One of them needed a change in neck length. Six dislocations happened during the first postoperative week when patients were wearing their cast. Closed reduction was performed, with two cases having a recurrence. The satisfaction amongst this subgroup of patients with dislocation was 72.7%, which is slightly under our overall satisfaction rate ($P < 0.05$). The functional results were close to those of the overall patient population.

Pain or functional impairment related to periprosthetic ossifications, trigger thumb and De Quervain tendinitis were, after dislocation, the most common complications (Table 1). We had to revise 14 prostheses (revision rate 12.4%). We performed four open reductions, six ossification removals and one change of the prosthesis neck. We found five prosthesis failures: one infection, one case of septic trapeziometacarpal loosening, two cases of trapezial loosening and one recurrent dislocation. One trapezial loosening case received a new implant. Four patients had a secondary trapeziectomy. Implants that had not been removed

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Table 1
Complications.

	Number of patients (*n*)	Percentage of patients (%)
Dislocation	7	6.2
associated to periprosthetic ossifications	2	1.8
not associated to periprosthetic ossification	5	4.4
Recurrent dislocation	4	3.5
Pain or functional impairment associated with periprosthetic ossification	6	5.3
Trapezial loosening	2	1.8
Metacarpal loosening	0	0
Trapeziometacarpal loosening due to infection	1	0.9
Infection without loosening	1	0.9
Complex regional pain syndrome	3	2.7
Radial neuralgia	0	0
Fracture	0	0
Allergic reaction	0	0
Total	24	21.3
Post-operative pathologies		
Trigger thumb	6	5.3
De Quervain tendinitis	5	4.4

were considered to be survivors. The survival rate of the prosthesis was 92.2% after a 5-year follow-up.

4. Discussion

Our aim was to report the medium-term clinical outcomes after Maïa® prosthesis implantation. The clinical results in terms of mobility, satisfaction and DASH Score at the final follow-up are good. The key pinch strength is comparable to the non-operated side in women but significantly inferior in men (82% of the non-operated side). However, it remains quite acceptable relative to normal values [25].

The five-year survival rate was 92.2%. This result is close to other published studies with the Maïa® prosthesis: 93% after 6 years [26] and 90.8% after 5 years [27]. It is also similar to the survival rate reported for other TMPs: 95% for the Ivory® [28], 96% for the Arpe® [29] and 93% for the Rubis II® [30]. The long-term survival rate of the TMP has only been reported in a few studies and ranges from 89% to 93.9% in a 10-year time frame [17,19,20]. The TMP's survival is one of the main concerns of hand surgeons. The uncertainty about survival can prompt surgeons to choose other surgical options for the treatment of basal thumb arthritis. However, TMP implantation does not compromise another surgical option: the outcomes of secondary trapeziectomy after failed TMP generally do not differ from primary trapeziectomy results [31]. Replacement of the implant after loosening is also an option [32].

The main complication encountered is prosthesis dislocation. Our dislocation rate is higher than that found in other studies about the Maïa® prosthesis: 1% for Toffoli and Teissier [26], 4.5% for Bricout et al. [27] and 0% for Jager et al. [14] in a prospective study comparing the Maïa® prosthesis and trapeziectomy after 1 year of follow-up. Semi-retaining cups were always used for the trapezial implant in those studies. Non-retaining cups were always used in our patients, but this cannot fully explain why our dislocation rate was higher. No case of dislocation was described in a study using non-retaining cups [33] and where the authors followed new guidelines they developed [34]. Compared to other unconstrained prostheses, our dislocation rate was also higher, whereas it is usually reported to be around 5% [7]. This is a concern for us and could be linked to the fact that our technique involves more extensive release of all the capsular and ligament attachments in order to prevent any constraint to the implant components. The extensive ligament release and the small diameter of the head (4 mm) may explain the high dislocation rate before periarticular scar formation. However, only half of the dislocation cases needed open reduction and dislocation was the cause of prosthesis failure in only one case.

In 2016, Bricout et al. [27] reported a 35.9% complication rate and an 11.5% revision rate with the Maïa® implant. Their most common complication was tendinopathy, which occurred in 16% of cases. We did not consider tendinopathy and trigger thumb as complications, but we reported it. These pathologies occurred after several months when patients resumed their activities after a long period of inactivity due to the pain caused by the basal thumb arthritis. One study focused on the occurrence of De Quervain tendinitis after TMP; it found no association between the increase in thumb length after arthroplasty and the occurrence of tendinitis [35].

The radiographs showed periprosthetic ossification in 43 cases (38%). This radiological finding is not reported systematically in studies about TMP but can often be associated with pain, malfunction of the prosthesis or dislocation [17,27,33]. Our rate of periprosthetic ossification is higher than that found in the literature – 5.8% to 27%. It could be related to the release of all the capsular attachments made during the surgical procedure. In our series, the majority of surgical revisions were performed because these ossifications were responsible for late dislocations (1.8%). Care must be taken in the future to diminish the rate of periprosthetic ossification and thus diminish the rate of surgical revision. We now take more time to lavage the wound properly. Moreover, we prescribe 1 week of indomethacin postoperatively for cases of revision due to periprosthetic ossification.

We reported two cases of aseptic loosening (1.8%). Toffoli and Teissier [26] reported a 4.2% rate, with all cases occurred in the first 40 months, suggesting that osteointegration failed. The main cause could be excessive loads applied to the implant and transmitted to the cup–bone interface, which prevents osteointegration. We believe it could be enhanced by the semi-retaining character of the cup used in our study. The higher loosening rate should be considered together with the dislocation rate. Indeed, they are inversely linked. There are two centers of rotation in the native trapeziometacarpal joint – one in the trapezium and one at the base of the metacarpal – while the TMP only has one center of rotation in the trapezium. To avoid loosening, the prosthesis has to be freed from the constraints of the attachments that could prevent osteointegration. But extensive soft tissue release seems to have increased the risk of dislocation in our study. This risk is high in the early postoperative period but diminishes over time. We believe it is more important to avoid loosening than dislocation, which can often be treated non-operatively in our study.

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We implanted a TMP in three patients who had radiological signs of STT arthritis. These patients did not have any postoperative complaints and did not undergo a revision procedure. However, some authors recommend performing STT joint replacement at the same time as the TMP implantation because the STT arthritis could cause residual pain and dissatisfaction in patients who undergo a TMP procedure only [27].

All the prostheses of our study were implanted by a single surgeon and the patients were reviewed by a single investigator different from the surgeon. This is both a strength and a limitation: while this guarantees the homogeneity of the case series, it can limit the generalizability of our study's conclusions. Other limitations include the study's retrospective design and the fact that all patients could not be reviewed. Moreover, a longer follow-up is mandatory to determine the survival rate of the Maïa® prosthesis.

5. Conclusion

The medium-term results with the Maïa® prosthesis are satisfactory. However, the high complication and revision rates are a major concern and care must be taken in the future to avoid early dislocations and periprosthetic ossifications.

Disclosure of interest

The authors declare that they have no competing interest.

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