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# Outcomes of the Dual Mobility Trapeziometacarpal Prosthesis versus Retentive Cup Prosthesis: Review of 118 Cases

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**Since its invention, the ball-and-socket prosthesis has played a significant role in treating carpometacarpal osteoarthritis of the thumb. One of the main postoperative complications remains prosthetic dislocation. To reduce this risk, engineers developed new designs — primarily the retentive cup and the dual-mobility cup.**

**The aim of this study was to compare the stability and outcomes of these two designs, focusing specifically on dislocation as the primary variable.**

**All Maia prostheses (n=118) implanted between 2019 and 2023 at a single institution by two surgeons using the same surgical technique were retrospectively reviewed. The type of implant, dislocation and complication rates, functional outcomes, and patient satisfaction were analyzed.**

**Although the overall complication rates did not differ significantly between groups, the retentive cup group had a slightly higher rate of dislocation (n=2; 3%) compared to the dual-mobility group (n=0; 0%) (p = 0.55).**

**Satisfaction rates, functional scores, QuickDASH results, and range of motion were similar between the two groups and comparable to those of the general age-matched population at midterm follow-up.**

**This study found a low postoperative dislocation rate in both groups, with no dislocations in the dual-mobility group. Although the difference was not statistically significant, the dual-mobility design may demonstrate superior stability in larger cohorts. Both implant types showed reliable performance and high survival rates at midterm follow-up.**

**Keywords:** Trapeziometacarpal prosthesis, dual-mobility, retentive cup, dislocation, Maïa prosthesis.

## INTRODUCTION

Trapeziometacarpal (TMC) joint osteoarthritis is a common manifestation of degenerative joint disease, with a high prevalence in the general population. It affects women more frequently than men, with the highest incidence occurring in the sixth decade of life[1]. Although trapeziectomy remains the most widely performed surgical procedure worldwide, the use of TMC joint prostheses is becoming increasingly common. Several studies have demonstrated that prosthetic replacement is associated with faster recovery and favorable functional outcomes compared to traditional techniques[2,3].

Since the first ball-and-socket prosthesis described by De La Caffinière in 1973, implant instability has remained one of the main complications following TMC arthroplasty. In response, various implant designs have been developed to reduce the risk of postoperative dislocation[4]. In addition to optimal implant positioning, two distinct design strategies are currently used to improve joint stability: the use of a retentive polyethylene insert, which restricts motion and blocks the prosthesis head to prevent dislocation[5,6], and the more recent dual-mobility concept, inspired by Bousquet's design in hip arthroplasty. The dual-mobility system increases both the range of motion and the critical distance required for the head to dislocate from the cup (jumping distance), theoretically offering greater resistance to dislocation[7-13].

While recent studies have reported promising results with dual-mobility implants, only a few have directly compared them to retentive designs using the same prosthetic system and surgical parameters[7-10].

Since 2015, the Lepine group has developed both a retentive and a dual-mobility cup for the MAIA prosthesis, allowing direct comparison between the two designs while keeping the rest of the implant and the surgical technique unchanged.

The primary objective of this study was to compare the incidence of dislocation between the retentive and dual-mobility versions of the MAIA prosthesis, implanted using the same surgical technique by the same surgeons. Secondary objectives were to assess the rate of other complications and to evaluate the functional outcomes associated with each implant design.

## MATERIALS AND METHODS

### *Patients*

This retrospective study analyzed all patients who underwent trapeziometacarpal (TMC) joint replacement between January 2019 and January 2023 in our institution. All procedures were performed using a standardized dorso-radial approach by two experienced surgeons (B.J., T.P.) who regularly used the MAIA prosthesis with both retentive and dual-mobility cup designs. The choice between cup types was based solely on implant availability and not influenced by patient characteristics. To minimize bias, we excluded patients who were operated on by surgeons using only one type of implant.

A total of 118 prostheses were included. All patients were contacted by telephone to obtain informed consent, report potential complications that may have been managed in other hospitals, and complete a standardized questionnaire. Among them, 55 patients were able to attend an in-person consultation, during which clinical outcomes were evaluated, including Kapandji score, thumb abduction angle, pinch strength, tip pinch strength, and grip strength.

### *Prosthesis description*

To isolate the cup design as the sole variable, the study focused exclusively on the two available versions of the MAIA prosthesis (Lepine group), a modular, press-fit ball-and-socket implant (Fig. 1). The titanium cup and stem are uncemented and feature a double coating of hydroxyapatite and porous titanium. The neck is available in three lengths (M, L, XL) and includes an anatomic offset. In the retentive design, the ultra-high molecular weight polyethylene (UHMWPE) insert is impacted into the trapezial cup, while in the dual-mobility design, the insert is mounted on the neck. Theoretical ranges of motion are 137° for the dual-mobility cup and 49° for the retentive cup.

### *Operative technique*

The surgical technique was identical for all patients. After placement of a pneumatic tourniquet inflated to 250 mmHg, a dorso-radial approach was made, taking care to preserve the superficial radial nerve branches. Following a longitudinal arthrotomy, a 5 mm resection of the metacarpal base and excision of the trapezial horns was performed to create a quadrangular working space. Manual reaming of the trapezium was carried out using a central guidewire inserted perpendicularly to the distal articular surface and centered both anteroposteriorly and mediolaterally. The definitive metacarpal stem was inserted first, followed by the cup, and the neck size was selected based on optimal tension and stability (Fig. 2, abcd). Intraoperative fluoroscopy was used to verify implant positioning, ensuring the cup was placed parallel to the proximal articular surface of the trapezium and centered along


*Fig. 1*

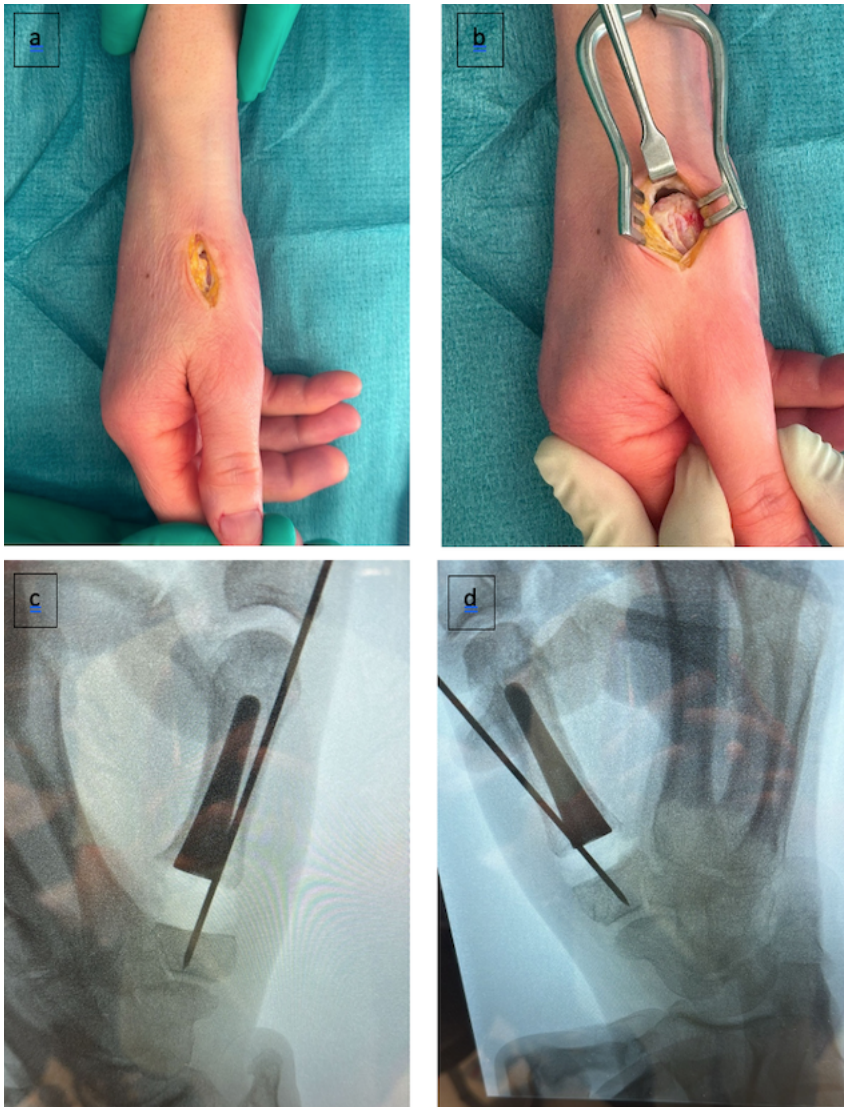


*Fig. 2 — a: Postero-lateral approach between extensor pollicis brevis and longus; b: Longitudinal arthrotomy; c,d: Trapezial stem in place. Central k-wire centered both anteroposteriorly and mediolaterally.*

its width. Closure was performed with Monoplus 4-0 sutures for the capsule and Vicryl Rapide 4-0 for the skin. A cast was applied for three weeks, after which patients began self-mobilization and resumed daily activities. Radiographs were obtained to confirm implant positioning at one day and six weeks postoperatively.

*Evaluation*

All patients (118/118) were evaluated by a single observer. Demographic data, including sex, age, occupational status, time since surgery, hand dominance, and smoking status, were collected. Postoperative complications were recorded, and patients were asked to complete a QuickDASH questionnaire, a pain score (0–10) at rest and during activity, and a satisfaction scale (0–10). In the subgroup of patients who attended follow-up consultations (55/118), additional clinical measurements were recorded. Hand strength was assessed using a JAMAR dynamometer, with each patient given three trials for familiarization. Only the best result was retained for analysis.

*Statistics*

Data were analyzed using SPSS SigmaPlot 13.0 software. Normality was assessed with the Shapiro-Wilk test, and homogeneity of variance with Fisher's test. When these assumptions were met, parametric tests (Student's t-test) were used, and results were expressed as means with standard deviations. When assumptions were not met, the Mann-Whitney U test

was used, and results were expressed as medians with interquartile ranges. For demographic data, age was compared using Student's t-test, while follow-up duration was analyzed with the Mann-Whitney U test. Proportional variables were compared using the chi-square test. For clinical outcomes such as pain, strength, QuickDASH score, and time to return to work, differences between the two groups were assessed using the Mann-Whitney U test. A p-value < 0.05 was considered statistically significant.

## RESULTS

A total of 118 implants were included in the study. Among them, 63 patients received the single-mobility prosthesis with a retentive cup, while 55 patients received the dual-mobility cup. Four patients were lost to follow-up but had no reported complications at six months in their medical records. Two patients could not respond due to cognitive impairment, and one patient declined to participate, although none of these patients reported any postoperative complications (Fig. 3).

There was no significant difference in baseline demographic characteristics between the two groups (Table I). The mean age was 60.1 years in the single-mobility group and 60.7 years in the dual-mobility group (p = 0.68). Female patients represented the majority in both groups, with a sex ratio of 82% and 84% respectively (p = 0.96). No significant differences were observed regarding occupational status (p = 0.24) or smoking habits (p = 0.23). However, the follow-up period differed significantly between the groups, with a mean duration of 17.4 months in the dual-mobility group and 37.2 months in the single-mobility group (p < 0.01).

Regarding complications, 21 of 63 patients (33.3%) in the single-mobility group experienced at least one complication, including two dislocations (3%). In comparison, 17 of 55 patients (30.1%) in the dual-mobility group experienced complications, but no dislocations were observed. The difference in dislocation rates was not statistically significant (p = 0.55), nor was the overall complication rate (p = 0.93). To better assess clinical relevance, complications were categorized as major (requiring surgical intervention) or minor. In the single-mobility group, four major complications occurred: two dislocations, one intraoperative trapezial fracture requiring revision and case of De Quervain's tenosynovitis that required surgical release. We didn't find any major complication in dual-mobility group (p = 0,164).

Prolonged pain was defined as persistent, intense pain lasting more than three months in the operative region, without evidence of underlying cause and which not met other criteria of complex regional pain syndrome (CRPS). Metal allergies were diagnosed postoperatively by independent dermatologists using patch testing and had not been identified prior to surgery.

In the single-mobility group, complications included five cases of radial dysesthesia, six cases of De Quervain's tenosynovitis (including one surgical case), four patients with prolonged pain, two cases of CRPS, and one metal allergy without the need for implant revision. One intraoperative trapezial

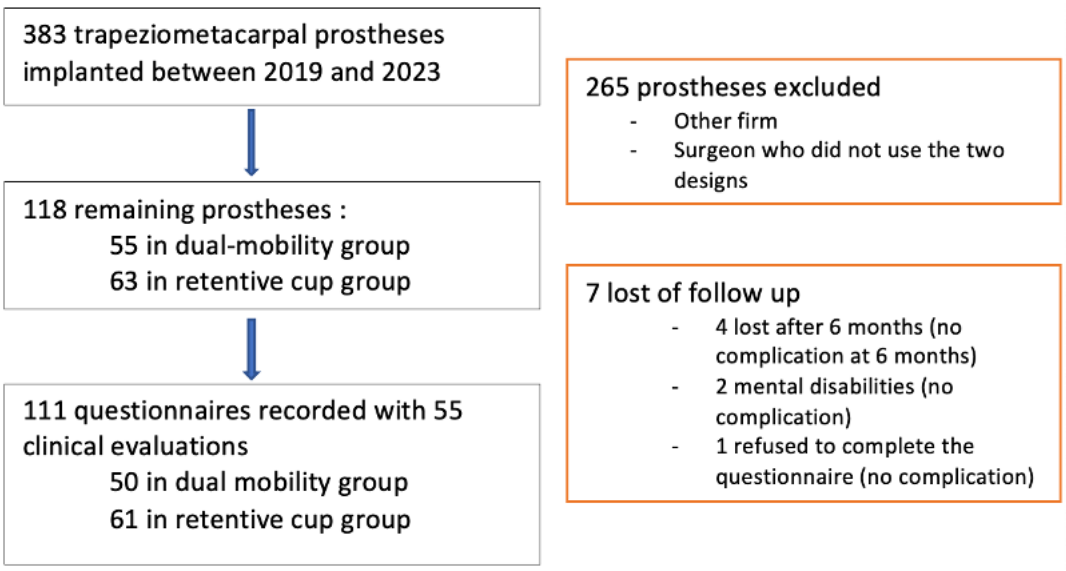


*Fig. 3 — Material and Method.*

**Table I.** — Demographic and clinical data.

| | Single mobility | Dual mobility | Pvalue |
|---|---|---|---|
| | n=63 | n=55 | |
| Sex (F/M) | 52/11 | 46/9 | 0,957 |
| Age (yrs) | 60,09 (7,4) | 60,72 (9,1) | 0,678 |
| Follow-up time (weeks) | 38 (28-47) | 16 (12-21) | **<0,0001** |
| Occupation | | | 0,243 |
| Manual | 22 | 12 | |
| Pensioner | 15 | 20 | |
| Office | 4 | 6 | |
| Free | 22 | 17 | |
| Tabacco | | | 0,229 |
| Yes | 8 | 14 | |
| No | 43 | 37 | |
| no response | 12 | 4 | |
| Complications | | | 0,93 |
| Yes | 21 | 17 | |
| No | 42 | 38 | |
| Major complications | | | 0,164 |
| | 4 | 0 | |
| | 59 | 55 | |
| Luxations | | | 0,554 |
| Yes | 2 | 0 | |
| No | 61 | 55 | |
| Implant revision | | | |
| Yes | 4 | 0 | |
| No | 59 | 55 | |

fracture occurred during manual drilling in a patient with low bone quality and required conversion to a cemented prosthesis. Of the two dislocations, one was caused by trauma while the other had no clearly identified cause. Additionally, five patients developed carpal tunnel syndrome (CTS) more than two years after surgery; these were considered more related to the naturel incidence of CTS than to implant. One implant was removed two years postoperatively due to symptomatic scaphotrapeziotrapezoid (STT) arthritis which had not been detected clinically or radiographically prior to the initial procedure.

In the dual-mobility group, complications included seven cases of De Quervain's tenosynovitis, four radial dysesthesias, three cases of prolonged pain, two CRPS, and one case of metal allergy without the need for implant removal. No dislocations occurred in this group.

All radial dysesthesias were transients and self-resolutive in both groups.

Overall, four implants were explanted in the single-mobility group—two due to dislocation, one due to trapezial fracture, and one due to STT arthritis—yielding a survival rate of 93.7%. No implant required removal in the dual-mobility group, resulting in a 100% survival rate.

No statistically significant association was found between smoking status and the incidence of complications (Table II). Functional outcomes were comparable between groups. The mean QuickDASH score was 14.9 in the single-mobility group and 14.2 in the dual-mobility group ($p = 0.3$). Pain and satisfaction scores were also similar between groups (Table III). The median time to return to work was eight weeks in both groups ($p = 0.56$). Among patients in the dual-mobility group, two never returned to work, compared to seven in the single-mobility group. Of the nine patients who did not return to full-time work, two switched to part-time work because of persistent pain, three were unable to work due to complications (dislocation, metal allergy, or chronic pain), and four stopped working for unrelated reasons.

In the subset of patients who underwent clinical evaluation (31 in the single-mobility group and 24 in the dual-mobility group), no statistically significant differences were found in clinical outcomes. However, grip strength tended to be slightly higher in the single-mobility group (mean 28 kg vs. 23 kg, $p = 0.059$), while the Kapandji score was slightly better in the dual-mobility group (mean 9.7 vs. 9.3, $p = 0.09$). These trends did not reach statistical significance (Table IV).

**Table II.**

| Complication in Dual Mobility group | |
|---|---|
| No | 38 |
| Radial dysesthesia | 4 |
| De Quervain | 7 |
| CRPS | 2 |
| Prolonged pain | 3 |
| Metal Allergy | 1 |
| Total | 55 |

| Complication in retentive cup group | |
|---|---|
| No | 42 |
| De Quervain | 6 |
| Radial Dysesthesia | 5 |
| Dislocation | 2 |
| CRPS | 4 |
| Metal allergy | 2 (same patient) |
| Trapezial fracture | 1 |
| Prolonged pain | 2 |
| Total général | 63 |

**Table III.** — Results of Mann Withney test in all patients.

| | Retentive cup | | Dual mobility | | Pvalue |
|---|---|---|---|---|---|
| | n=63 | | n=55 | | |
| | Median | (Q1-Q3) | Median | (Q1-Q3) | |
| Quick Dash | 5,27 | (0,57-21,98) | 10,68 | (4,5-22,16) | 0,311 |
| Satisfaction | 9,5 | (8-10) | 9 | (8-10) | 0,836 |
| Rest Pain | 0 | (0-1) | 0 | (0-0) | 0,373 |
| Pain on exertion | 1 | (0-3,75) | 1 | (0-3,75) | 0,75 |
| Return to work (weeks) | 8 | (6-12) | 8 | (6-12) | 0,561 |
| Complications in **smoking patients** | | | | | 0,59 |
| YES | 10 patients in 22 smoking | | | | |
| NO | 29 patients in 80 no smoking | | | | |

**Table IV.** — Results of Mann Withney test in the surveyed patients.

| | Retentive cup | | Dual mobility | | Pvalue |
|---|---|---|---|---|---|
| | n=31 | | n=24 | | |
| | Median | (Q1-Q3) | Median | (Q1-Q3) | |
| Pinch Strenght (Kg) | 6 | (5-7) | 6 | (4,125-7,375) | 0,55 |
| Tip Strenght (Kg) | 4 | (3-5) | 3,25 | (2,5-5) | 0,238 |
| Grip Strenght (Kg) | 28 | (20-32) | 21 | (16,875-28) | 0,059 |
| Abduction (°) | 58,4[$] | ±10,4[$] | 62,7[$] | ±11,8[$] | 0,154 |
| Kapandji | 9,5 | (9-10) | 10 | (9-10) | 0,096 |
| [$] Mean ± Standard deviation | | | | | |
| Grip Strenght by sex (Kg) | mean M (n=7) | mean F (n=24) | mean M (n=3) | mean F (n=21) | |
| | 44,86 | 23,3 | 38,67 | 21,24 | |

## DISCUSSION

This study confirms, in line with previous literature, that ball-and-socket trapeziometacarpal prostheses yield favorable functional outcomes in the treatment of thumb base osteoarthritis, despite a non-negligible complication rate. To our knowledge, this is the first study to directly compare the outcomes of two designs—retentive and dual-mobility—within the same prosthetic system, implanted using the same technique by the same surgeons. This approach minimizes confounding variables and allows a focused analysis of mobility design as the sole variable.

Our findings suggest a trend toward improved implant stability with the dual-mobility design. Although the difference in dislocation rates between groups did not reach statistical significance in this sample (3% vs. 0%, $p = 0.55$), the absence of dislocation in the dual-mobility group may be clinically relevant in larger cohorts. These results are consistent with those of Tchurukdichian et al., who reported a dislocation rate of 0.5% with the MOOVIS dual-mobility prosthesis compared to 7.3% with the IVORY single-mobility implant[8,14]. Similar findings were reported by Theyskens et al., with a reduction in dislocation rates from 9.7% to 1.4% with

the same implants[10]. In a multicenter study, Farkash et al. observed only two dislocations among 159 retentive MAIA implants (1.3%) and none among 222 dual-mobility prostheses (Touch and MAIA combined), reinforcing the notion that dual mobility enhances implant stability[7].

The increased theoretical range of motion—from 49° in the retentive design to 137° in the dual-mobility cup—combined with a greater critical distance to dislocation (jumping distance), likely contributes to improved stability[13].

However, dedicated instrumentation for perfect cup positioning is still lacking and despite intraoperative fluoroscopic control and radiographic alignment guidelines[15-17], cup positioning may vary slightly. It remains unclear whether the dual-mobility design has compensated for minor misalignments that might have otherwise led to dislocation in the retentive group.

Nevertheless, when considering that the physiological range of motion of the TMC joint is approximately 40–50°, as described by Crisco and Goubier[18,19], the functional necessity of the broader motion arc offered by the dual-mobility cup is debatable. In our series, excluding the one traumatic dislocation, only one atraumatic dislocation occurred among 63 retentive implants (1.6%), which aligns with results from other studies using retentive designs, including Toffoli and Teissier (1%)[5] and Jager et al. (0%)[6].

With respect to overall complications, our rates are comparable to those reported in similar MAIA series, including Bricout (35.9%), Andrzejewski (31%), and Farkash (31.4%)[7,20,21]. Importantly, the majority of complications were minor and self-limiting. Only four implants in our series required revision, yielding an implant survival rate of 96.6% at midterm follow-up. We did not observe any cases of aseptic loosening; however, radiographic evaluations were not systematically performed in asymptomatic patients, and subclinical loosening may have been missed.

While short-term survival appears excellent for both designs, long-term outcomes may differ due to differences in wear mechanisms. In hip arthroplasty, constrained implants have been associated with increased impingement and bone stress due to restricted motion, potentially leading to early loosening. Conversely, dual-mobility systems introduce an additional articulation, which may increase polyethylene wear over time[22,24]. Whether similar patterns apply to the TMC joint remains to be determined.

De Quervain's tenosynovitis emerged as the most frequent postoperative complication in our series. Although Theyskens et al. found a higher incidence in dual-mobility implants (12.2% vs. 6.4%)[10], our study did not confirm a statistically significant difference between groups (11.1% vs. 14.5%). Some authors, including Gonzalez-Espino[9] and Jager[6], have proposed systematically opening the first extensor compartment to prevent this complication, whereas others, such as Goubau and Duerinckx, who focused their works on this complication, remain cautious and have not advocated for this preventive measure[25,26]. In our series, all but one case resolved spontaneously without surgery, suggesting that further studies are needed to determine the necessity of prophylactic release.

Overall, our findings support the reliability of both implant designs in terms of pain relief and functional recovery. QuickDASH scores were comparable to those of the general population of similar age, and satisfaction scores were high in both groups.

The only near-significant difference observed in our study was in grip strength, which tended to be slightly greater in the single-mobility group (28 kg vs. 23 kg, $p = 0.059$). However, this trend was not mirrored in pinch or tip pinch strength, suggesting that it may be related to longer follow-up duration rather than implant design. When stratified by sex, grip strength in both groups remained comparable to normative values in the general population[27] (Table IV).

Regarding range of motion, abduction angle and Kapandji scores were slightly better in the dual-mobility group, but the differences did not reach statistical significance (Table IV). These differences could be significant in a larger cohort but remains small comparing to the theoretical design features of each implant and do not appear to translate into clear functional superiority at midterm follow-up. Given the natural range of motion of the TMC joint, it is reasonable to assume that the increased motion potential of the dual-mobility design may benefit stability more than function.

This study has several limitations. First, its retrospective design inherently carries a risk of bias. The dual-mobility cup was introduced in our hospital in 2020, resulting in a shorter follow-up period for that group. We attempted to mitigate this by including all implants from 2019 to early 2023 to provide a midterm perspective for each group (from six months to four years). Second, only 55 of the 118 patients attended a clinical evaluation, introducing potential selection bias. It is plausible that patients with severe disabilities were less likely to return, while those entirely satisfied with their outcome may have declined follow-up. These factors could skew both ends of

the clinical spectrum. Finally, no new radiographs were performed in asymptomatic patients during this study. Although the postoperative images available in the medical records showed satisfactory alignment, early signs of loosening or implant migration may have been missed. A longer-term follow-up study, including systematic radiographic evaluation, would be necessary to better compare both implant designs in terms of wear patterns and risk of loosening.

## CONCLUSION

This study confirms that trapeziometacarpal joint prostheses provide favorable functional outcomes and high patient satisfaction at midterm follow-up. Both the retentive and dual-mobility cup designs demonstrated reliable performance, with low complication and dislocation rates. Although no dislocations were observed in the dual-mobility group, the difference compared to the retentive design was not statistically significant in this sample. Nevertheless, the absence of dislocation in the dual-mobility group may suggest a potential advantage in terms of implant stability, which could become more evident in larger cohorts or with longer follow-up.

*Disclosure of interest:* The authors and co-authors declare that they have no conflict of interest.

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