Article published online: 2024-06-07

Review of the Trapeciometacarpal Thumb Prosthesis of the Patella Type: Surgical Technique and Results of Secondary Trapeziectomy with Ligamentous Reconstruction

Revisión de la prótesis trapeciometacarpiana de pulgar tipo rótula: Técnica quirúrgica y resultados de la trapeciectomía secundaria con reconstrucción ligamentosa

Guillem Salva-Coll[1] Xavier Terrades-Cladera[2]

[1] Department of Hand and Wrist Surgery, Hospital Universitari Son Espases, Instituto IBACMA, Palma de Mallorca, Spain
[2] Hand Surgery, IBACMA Institute, Hospital Sant Joan de Déu and Mutua Balear, Palma de Mallorca, Spain

Address for correspondence Guillem Salvà Coll, MD, PhD, Department of Hand and Wrist Surgery, Hospital Universitari Son Espases, Instituto IBACMA, Palma de Mallorca, Spain (e-mail: gsalva@ibacma.com).

Rev Iberam Cir Mano 2024;52(1):e52–e61.

Abstract

Objective When revising a failed patella-type trapeziometacarpal (TMC) prosthesis, in some cases it may be necessary to remove the metacarpal stem. The purpose of this work is to present a new surgical technique to remove the metacarpal stem and present the results of secondary trapeziectomy after a failed TMC patella-type prosthesis.

Methods A retrospective review was conducted on a case series of 12 patients who underwent revision surgery for a failed TMC prosthesis between 2007 and 2019. Epidemiological and clinical data were recorded, including visual analog scale (VAS) and Quick DASH, and were statistically analyzed using SPSS® statistical software.

Results In all cases the stem could be removed without complications. The average prosthesis survival time was 32.3 months (range 11.5-53.2) and the average follow-up time after revision surgery was 34.9 months (range 14.4-55.4). The VAS mean was 4.0 (95% CI: 2.4-5.6) with a range of 0 to 8. The quick DASH mean was 52.1 (95% CI: 37.0-67.3).

Conclusion The presented surgical technique provides a useful resource to remove the stem if necessary. The results of secondary trapeziectomy may not be as good as expected.

Keywords
- trapeziometacarpal prosthesis
- ligamentoplasty
- joint replacement
- teview
- failure

received
March 1, 2024
accepted
April 8, 2024

DOI https://doi.org/10.1055/s-0044-1787298.
ISSN 1698-8396.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

Resumen

Objetivo Cuando se revisa una prótesis trapeciometacarpiana (TMC) fallida tipo rótula, en algunos casos puede ser necesario retirar el vástago metacarpiano. El propósito de este trabajo es presentar una nueva técnica quirúrgica para retirar el vástago metacarpiano y presentar los resultados de la trapeciectomía secundaria después de una prótesis TMC fallida tipo rótula.

Métodos Se llevó a cabo una revisión retrospectiva en una serie de casos de 12 pacientes que se sometieron a cirugía de revisión por una prótesis TMC fallida entre 2007 y 2019. Se registraron datos epidemiológicos y clínicos, incluyendo la escala visual analógica (VAS) y Quick DASH, y se analizaron estadísticamente mediante el software estadístico SPSS®.

Resultados En todos los casos se pudo retirar el vástago sin complicaciones. El tiempo promedio de supervivencia de la prótesis fue de 32.3 meses (rango 11.5-53.2) y el tiempo promedio de seguimiento después de la cirugía de revisión fue de 34.9 meses (rango 14.4-55.4). La media de la VAS fue de 4.0 (IC del 95%: 2.4-5.6) con un rango de 0 a 8. La media de Quick DASH fue de 52.1 (IC del 95%: 37.0-67.3).

Conclusiones La técnica quirúrgica presentada proporciona un recurso útil para retirar el vástago en caso de ser necesario. Los resultados de la trapeciectomía secundaria pueden no ser tan buenos como se esperaba.

Palabras clave

- prótesis trapeciometacarpiana
- ligamentoplastia
- reemplazo articular
- revisión
- fracaso

Introduction

Osteoarthritis of the base of the thumb is a disabling pathology, much more common in middle-aged women, with a ratio of 10:1 compared to men. The prevalence is high, affecting up to 10% of women in middle age[1]. The main goal of treatment for painful osteoarthritis of the thumb is the restoration of thumb function with a mobile, stable, pain-free, and stable joint. with a preserved force. When conservative measures fail, different surgical treatments have been used to achieve these objectives, but the vast majority are associated with a certain loss of length and strength in the thumb. For this reason, prosthetic replacement of the trapeziometacarpal (TMC) joint has increased in popularity in recent years due to an improvement in implant design, reproducible clinical results, and a 10-year prosthetic survival curve of up to 93%.[2,3] The recommendation for the use of prostheses in TMC osteoarthritis is made on the theoretical basis of faster recovery and greater strength compared to other treatments, but the long-term complications and cost of using implantation continue to be a matter of debate.[2] Herren et al. published that patients with TMC prostheses recover significantly faster in the first 3 postoperative months compared to patients in whom suspension arthroplasty with ligamentous reconstruction is performed[4] and that the postoperative results at 1 year are similar in almost all patient parameters evaluated for both groups, but patients with prostheses have greater clamp strength than patients treated with TMC suspension arthroplasty.

The most common prosthetic complications are related to dislocation and loosening of components (almost exclusively the trapezius component), requiring revision surgery to restore a pain-free hand with proper function. Implant failure rate and revision rates vary between different series and different implants: cemented Avanta® implants, from 7% to 20%, de la Caffinière® implants, from 12% to 23%, Elektra® implants, from 18% % to 35%, ceramic devices, 33%, and the ARPE® implant, 6% to 7%.[2,3,5,6] According to Kaszap et al., the results of secondary trapeziectomy after bone replacement arthroplasty of the failed trapeziometacarpal joint differ little from the primary cases but conclude that more studies are needed.[6] Regarding TMC prosthetic replacement, if the surgical technique is precise, the metacarpal stem is rarely a problem in these implants, since the integration is practically constant. The problem may arise during revision surgery. In cases where the metacarpal stem is not prominent, it can be left in place.[7] However, in some cases, it must be removed due to trapeziometacarpal or metacarpal-scaphoid conflict due to axial instability of the thumb, and it is a technically difficult step. difficult during revision surgery. The objective of this work is to present a new surgical technique to remove the metacarpal stem of the prosthesis and to review the clinical results of 17 patients in whom a secondary trapeziectomy with ligamentous reconstruction was performed because of a TMC prosthesis in the form of a patella (type "ball-and-socket") failed.

Material and Methods

We conducted a retrospective case series study that included 12 patients who underwent revision surgery due to a failed trapeziometacarpal (TMC) prosthesis between the years 2007 and 2019. Epidemiological and clinical data were recorded and analyzed (►**Table 1**). The inclusion criteria were a failed patella-shaped TMC prosthesis at least 12 months after the initial surgery since removal of the implants in the recent postoperative environment may be easier than in later stages due to osseointegration of the

Table 1 Table of frequencies, including type of prosthesis

GENDER		
	Frequency	Percentage
WOMAN	11	91,6
MEN	1	8,4
Total	12	100,0
AFFECTED SIDE		
	Frequency	Percentage
RIGHT	9	75
LEFT	3	25
Total	12	100,0
DOMINANT HAND		
	Frequency	Percentage
RIGHT	12	100
LEFT	0	0
Total	12	100,0
PROSTHESIS TYPE		
	Frequency	Percentage
ARPE	3	25,0
ELEKTRA	4	33,3
IVORY	2	16,7
MAIA	3	25,0
Total	12	100,0

implant. Seven patients came from other hospitals to our department to treat implant complications, while the rest were initially treated at our institution. All patients were treated using the same surgical technique. A descriptive statistical analysis was performed using SPSS® 20.0 software. The Wilcoxon test was used to compare groups.

Surgical Technique

A "V"-shaped dorsal approach is performed at the level of the TMC joint, with the apex at the junction between the palmar and dorsal skin. The sensory branches of the radial nerve and the radial artery are identified and protected in the anatomical snuffbox. The TMC joint is approached between the tendons of the extensor pollicis longus and extensor pollicis brevis muscles, along the axis of the first metacarpal. Next, a longitudinal capsulotomy and subperiosteal dissection of the base of the first metacarpal and trapezius is performed, exposing the implant (►**Figure 1**). It is very common to find a loss of capsular tissue replaced by a thick scar. It is recommended to preserve this tissue as a capsule, as it provides some degree of axial stability of the metacarpal at the end of the procedure. It is also common to observe bone resorption at the base of the metacarpal due to stress shielding, as occurs in other implants such as the stem of the radius head prosthesis or the distal ulna prosthesis,8 completely exposing the proximal part of the metacarpal stem.

Once the prosthesis is exposed, the first step consists of dorsal dislocation and removal of the neck of the prosthesis. When treating a chronic dislocation, we generally find the

Fig. 1 Exposure of the prosthesis through a dorsal approach.

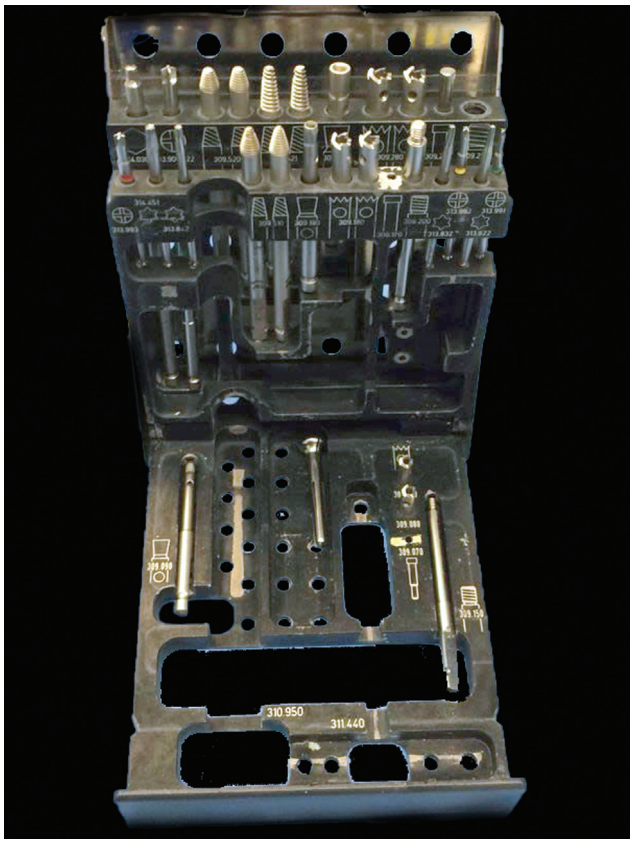

Fig. 2 Screw removal set.

head of the prosthesis dislocated dorsally, on the dorsoradial aspect of the trapezius, often associated with a bone defect in the trapezius.

The second step is to remove the trapezius while preserving the flexor carpi radialis (FCR) tendon. Trapeziectomy allows complete visualization of the stem and removal of fibrous tissue if necessary. Minimal exposure of the metacarpal base is done, just to allow the metacarpal base to move dorsally for good access to the stem. Preservation of the volar-ulnar scar tissue provides some degree of stability against the axial collapse of the metacarpal. A Hohmann retractor is placed in the volar cortex of the base of the metacarpal (►**Figure 1**).

At this point, a broken screw extraction set (Depuy Synthes® or similar) is used (►**Figure 2**). This set has different tools designed to remove screws with a damaged head. The tapered tip of the extraction screw (2.4 or 2.5 mm) engages the stem (►**Figure 3**).

With gentle rotary movements and with the other hand holding the thumb at the level of the first metacarpal, the rotary force breaks the bone bridges that fix the stem and can be removed by pulling and turning counterclockwise (►**Figure 4** and **5**). If this step is difficult due to stem integration, holding your thumb in your hand may not be enough to remove the stem. In this case, a reduction bone clamp (Setter type or similar) can be used at the base of the metacarpal to counteract the rotational force applied to the extraction tool. Care must be taken not to cause a fracture. If necessary,

Fig. 3 The frustoconical tip of the extraction screw (2.4 or 2.5 mm) engages the internal thread of the stem and engages by rotating the handle counterclockwise.

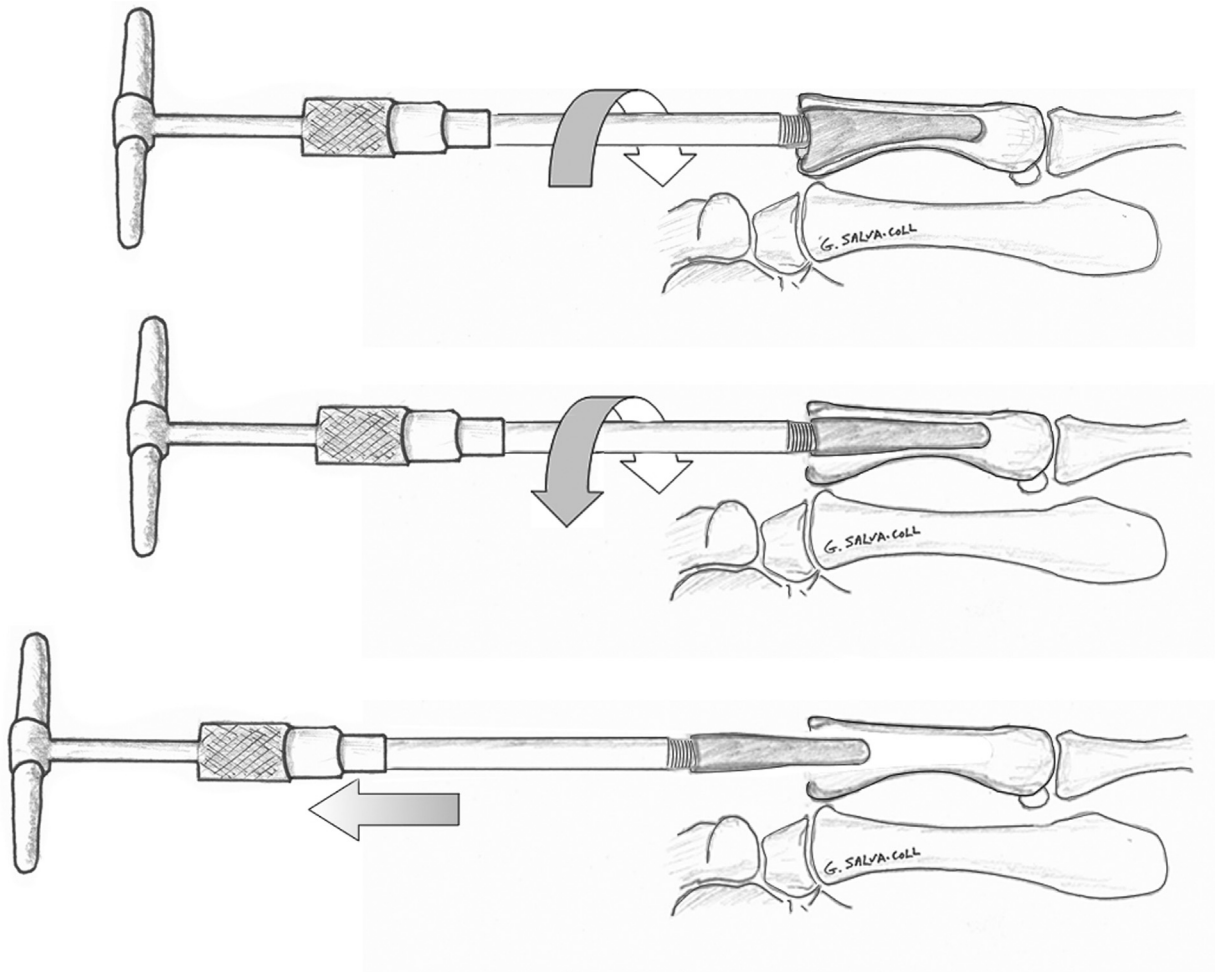

Fig. 4 Schematic representation of the stem extraction maneuver.

Fig. 5 Removal of the metacarpal stem by repeated rotations of the T-handle.

additional distal exposure of the metacarpal can be performed to apply the clamp to the cortical bone. In cases in which the metacarpal stem fills the metacarpal shaft and rotational movement is not allowed, it could cause a fracture of the metacarpal, although to date this has not happened to us on any occasion.

Once the stem is removed, tendon interposition and suspension arthroplasty are performed as in primary cases (►**Figure 6**). We use a suspension trapeziectomy technique and ligamentous reconstruction with abductor pollicis longus around the flexor carpi radialis tendon9 and reinforce with the capsule or scar tissue preserved during exposure. But, since the stem has been removed, any technique can be used. Finally, capsular closure is performed with a 3/0 absorbable suture, skin with 5/0 monofilament, and a plaster splint is placed. The stitches are removed after 8 days, and the plaster splint is maintained until 3 weeks. At this point, hand therapy is initiated, and an orthosis is worn part-time for 3 weeks, which can be removed during the day to begin progressive mobilization exercises.

Results

Twelve patients were reviewed, whose data are summarized in ►**Tables 1** and **2**. The average age of the patients at the time of surgery was 61 years (range 56-65). Eleven patients were women, and one was a man. Four different types of prostheses were reviewed: 3 Arpe®, 4 Elektra®, 2 Ivory®, and 3 Maia®. None of the Elektra® implant patients were initially treated at our institution. The average survival time of the prosthesis was 25.6 months (range 12-38), and the average follow-up time after revision surgery was 35.5 months (range 20-50). Two cases were due to late post-traumatic dislocation and the remaining cases were due to mobilization of the trapezius dome. The mean visual analog scale (VAS) score was 3.3 (95% CI: 1.8-4.7) with a range of 1 to 8. The mean Quick DASH questionnaire was 48.6 (95% CI: 35.0-62.2). The metacarpal stem was removed in all patients. Differences between pinch strength and fist strength with the contralateral side were compared using the Wilcoxon test. The average clamp force was 1.9 kg, representing 50% of the contralateral side, with a p-value <0.002. The mean fist force was 12.7 kg, which is 71.3% of the contralateral side, with a p-value <0.0001 (►**Table 2**).

Discussion

The most common complications of the prosthesis are related to dislocation and loosening of the components, which implies the need for revision surgery to restore a pain-free hand with adequate functionality.

The long-term results of trapeziometacarpal prostheses have not yet been established for large groups of patients. In Martin Ferrero's series of 69 TMC prostheses, the survival

Fig. 6 Preoperative x-ray of a patient with a painful prosthesis due to loosening of the trapezius cup and x-ray at 23-month follow-up after prosthesis removal.

Table 2 Descriptive analysis of the main variables

			Value	Error Std.
AGE (YEARS)	Mean		61,3	2,1
	95% CI	Lower limit	56,8	
		Upper limit	65,8	
	SD		8,1	
IMPLANT SURVIVAL (MONTHS)	Mean		25,6	6,2
	95% CI	Lower limit	12,3	
		Upper limit	38,8	
	SD		23,9	
FOLLOW-UP TIME (MONTHS)	Mean		35,5	6,9
	95% CI	Lower limit	20,7	
		Upper limit	50,2	
	SD		26,6	
VISUAL ANALOG SCALE	Mean		3,3	0,7
	95% CI	Lower limit	1,8	
		Upper limit	4,7	
	SD		2,7	
OPPOSITION (KAPANDJI SCALE)	Mean		7,9	0,4
	95% CI	Lower limit	7,0	
		Upper limit	8,8	
	SD		1,6	
QUICK DASH	Mean		48,6	6,3
	95% CI	Lower limit	35,0	
		Upper limit	62,2	
	SD		24,6	
CLAMP FORCE (Kg)	Mean		1,9	0,4
	95% CI	Lower limit	1,1	
		Upper limit	2,7	
	SD		1,4	
FIST STRENGTH (Kg)	Mean		12,7	1,8
	95% CI	Lower limit	8,8	
		Upper limit	16,6	
	SD		7,1	
CONTRALATERAL CLAMP FORCE (Kg)	Mean		3,8	0,4
	95% CI	Lower limit	2,9	
		Upper limit	4,7	
	SD		1,6	
CONTRALATERAL FIST STRENGTH (Kg)	Mean		17,8	1,6
	95% CI	Lower limit	14,3	
		Upper limit	21,2	
	SD		6,2	

CI, Confidence Interval for the mean; SD, Standard Deviation.

rate was 93% at 10 years with good mobility, pincer, and grip strength.[2,3] In the Apard and Saint-Cast series, the survival rate Survival of the ARPE prosthesis was less encouraging: 85% at 5 years and 79% at 11 years, but only 32 prostheses were available for evaluation.[10]

Few articles have been published on the complications of patella-type TMC prostheses. According to Bricout et al., the complication rate of the Maia® prosthesis in their series was 35.9%, ranging from minor complications that did not require treatment to major complications that required surgical

revisions. In total, 18 surgical revisions were performed on the 156 implanted prostheses.[11] Martin Ferrero, in his series of 64 patients with a follow-up of 10 years, 60 implants (92.3%) were functional and five were not (7.7%). The survival estimate for functional implants at 10 years was 93.9% (95% confidence interval: 82.3-97.9). Sinking of the dome of the trapezius was observed in 15.8%.[2]

Toffoli et al., in 80 patients treated with the Maia® implant, observed 5 failures (5.2%); of which, 4 loosening of the trapezius dome in the first 3 years requiring revision surgery. Two cases had a secondary trapeziectomy with ligamentous reconstruction, but the metacarpal stem was not removed. Although they reported that the clinical results of these 5 rescue procedures were satisfactory, the average postoperative value of the DASH scale was 39.[12] This DASH score is relatively high, considering that 0 represents no disability and 100 the most severe disability. Furthermore, preoperative DASH values were not evaluated, so clinical significance cannot be accurately assessed, although it does give an idea of the patient's clinical status.

Cootjans et al., in a series of 166 prostheses (in 156 patients, 10 bilateral) with an average follow-up of 80 months (median, 75 months), had 8 indications for revision. Two patients were asymptomatic and did not require treatment. The remaining 6 indications were made for review. The prosthesis was removed in only 1 patient (0.6%). A trapeziectomy with tendon interposition (flexor carpi radialis muscle, Weilby procedure) was performed, leaving the metacarpal stem in place.[13] There is no information on the results.

Although some characteristic complications such as loosening and/or sinking of the implant, periprosthetic fracture, or dislocation are not frequent, if they cause symptomatology they may require revision surgery. The revision strategy after a prosthetic TMC joint replacement includes implant revision, implant removal, and partial or total trapeziectomy with or without ligamentous reconstruction. During revision surgery, if implant removal is performed, the dome of the trapezius is not a problem. Trapeziectomy can be performed as in primary trapeziectomies. However, the metacarpal stem is usually completely integrated, and its removal can be difficult as well as challenging. For this reason, and because it is generally believed that removal of the stem is not necessary, the vast majority of authors leave the metacarpal stem in place.[2,12–14]

However, rigid fixation of the stem can cause proximal resorption of the bone at the base of the first metacarpal known as "stress shielding." Stress shielding is known to occur around rigidly fixed implants, as it can occur in other implants such as radial head prostheses, regardless of stem design. However, it is usually mild and non-progressive.[8] This stress shielding leaves the metal base of the stem exposed (►**Figure 7**). With thumb clamping, proximal displacement of the first metacarpal can occur and result in a painful thumb due to conflict between the first metacarpal and the trapezius. In this situation, stabilization of the first metacarpal is crucial and, with the metacarpal stem in place, two problems arise: protrusion of the metal base of the stem and conflict with the scaphoid or sometimes the trapezoid.

We have been using a useful technique to remove the metacarpal stem with a broken screw removal set (De Puy Synthes® or similar) (►**Figure 2**). This set has different tools designed to remove screws with damaged heads. The frustoconical tip of the extraction screw (2.4 or 2.5 mm) engages perfectly in the internal thread of the stem (►**Figure 3**). Since using this technique, we have been able to remove all but one case of the metacarpal stems. The case in which we were unable to remove the stem was in a patient who had had a previous revision surgery in which the metacarpal stem was replaced with the larger (size 10) Maïa® prosthesis. In this case, due to the risk of fracture, it was not removed.

The extraction of the stem allows any suspension arthroplasty technique to be performed with ligamentous reconstruction, and we believe that it also has a beneficial psychological impact for the patient, since, if pain persists in the event of non-extraction of the stem, it is easy to attribute the problem to the existence of the stem, although this is not always the case.

To date, there is little information available on whether the results of primary and secondary trapeziectomies might be similar. We present a series of 12 patients in whom salvage surgery was performed after a failed TMC prosthesis. The results indicate that although patients improved after revision surgery, the Quick DASH questionnaire mean was 48.6 (95% CI: 34.9-62.2). The average pinch force was 1.8 kg, which is 47% of the contralateral side with a value of $p < 0.002$, and the average fist force was 12.7 kg, which is 71.3% of the contralateral side with a value of $p < 0.0001$ (►**Table 2**). The results may not be as good as those reported by Kaszap et al.6 with an average DASH value of 17.2.

Limitations of the present study include its retrospective nature and the lack of information prior to the rescue surgery (VAS, Quick DASH, clamp force), which limits the interpretation of the results, and the small number of cases, although the follow-up is long enough. However, when compared with the study by Kaszap et al.,6 in which the mean Quick DASH score for secondary trapeziectomy was 16 (SD 4.3), in our series the results differ by more than 30 points, with a mean of 48.6 (95% CI 34.9-62.2), a very high value considering that the range is from 0 to 100, with 0 being the best possible value.

As a result of the present study, we can conclude that in cases of failure of ball-and-socket TMC prosthesis, secondary trapeziectomy with ligamentous reconstruction is a reproducible treatment option. Removal of the metacarpal stem, if necessary, can be performed in most cases with this relatively simple technique. However, the results of secondary trapeziectomy may be worse than those of trapeziectomy with primary ligamentous reconstruction.

Fig. 7 Stress shielding leaves the metal base of the stem exposed, which can cause conflict with the scaphoid or trapezoid.

Informed consent
Not applicable.

Authors' contribution
Guillem Salva-Coll researched the literature and conceived the study, participated in protocol development, recruited patients, and analyzed the data. Xavier Terrades-Cladera participated in patient recruitment and data analysis. Guillem Salva-Coll wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

Funding
The authors received no financial support for the research, authorship, and/or publication of this article.

Conflicts of interest
The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Acknowledgments
None.

References
1 Murray P. Thumb basal joint osteoartrithis. In: Wolfe SW, Hochtkiss RN, Pederson WC, Kozin SH, Cohen M, ed. Green's Operative Hand Surgery. 7th ed. Elsevier Churchill Livingstone; 2017:359–365
2 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 Vol 2014;39(08): 826–832. Doi: 10.1177/1753193413516244
3 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 Vol 2020;45(05): 443–451. Doi: 10.1177/1753193419871660
4 Herren DB, Marks M, Neumeister S, Schindele S. Short-term recovery after implant versus resection arthroplasty in trapeziometacarpal joint osteoarthritis. J Hand Surg Eur Vol 2023;48(10): 1048–1055. Doi: 10.1177/17531934231188407
5 Huang K, Hollevoet N, Giddins G. Thumb carpometacarpal joint total arthroplasty: a systematic review. J Hand Surg Eur Vol 2015; 40(04):338–350. Doi: 10.1177/1753193414563243
6 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(05):863–871.e3. Doi: 10.1016/j.jhsa.2013.01.030
7 Klahn A, Nygaard M, Gvozdenovic R, Boeckstyns MEH. Elektra prosthesis for trapeziometacarpal osteoarthritis: a follow-up of 39 consecutive cases. J Hand Surg Eur Vol 2012;37(07):605–609. Doi: 10.1177/1753193412443501
8 Chanlalit C, Shukla DR, Fitzsimmons JS, An KN, O'Driscoll SW. Stress shielding around radial head prostheses. J Hand Surg Am 2012;37(10):2118–2125. Doi: 10.1016/j.jhsa.2012.06.020
9 Harenberg PS, Jakubietz MG, Jakubietz RG, Schmidt K, Meffert RH. Treatment of osteoarthritis of the first carpometacarpal joint by resection-suspension-interposition arthoplasty using the split abductor pollicis longus tendon. Oper Orthop Traumatol 2013; 25(01):95–103. Doi: 10.1007/s00064-011-0082-2
10 Apard T, Saint-Cast Y. Les reprises de prothèses trapezométacarpiennes ARPE par trapézectomie. Ligamentoplastie selon la technique

de Jones: une étude homogène de six cas et revue de la littérature. Chir Main 2007;26(02):95–102. Doi: 10.1016/j.main.2006.12.002
11 Bricout M, Rezzouk J. Complications and failures of the trapeziometacarpal Maia® prosthesis: A series of 156 cases. Hand Surg Rehabil 2016;35(03):190–198. Doi: 10.1016/j.hansur.2016.02.005
12 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 Am 2017;42(10):838.e1–838.e8. Doi: 10.1016/j.jhsa.2017.06.008
13 Cootjans K, Vanhaecke J, Dezillie M, Barth J, Pottel H, Stockmans F. Joint Survival Analysis and Clinical Outcome of Total Joint Arthroplasties With the ARPE Implant in the Treatment of Trapeziometacarpal Osteoarthritis With a Minimal Follow-Up of 5 Years. J Hand Surg Am 2017;42(08):630–638. Doi: 10.1016/j.jhsa.2017.05.007
14 Hansen TB, Snerum L. Elektra trapeziometacarpal prosthesis for treatment of osteoarthrosis of the basal joint of the thumb. Scand J Plast Reconstr Surg Hand Surg 2008;42(06):316–319. Doi: 10.1080/02844310802393974

