

## Suspension arthroplasty in the treatment of thumb carpometacarpal osteoarthritis

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### Abstract

Literature presents several examples of surgical techniques for the treatment of carpometacarpal osteoarthritis. In our study we used a modified Ceruso's suspended arthroplasty technique. In this study, 53 patients from 2011 to 2017 underwent arthroplasty with trapezius excision and suture suspension between abductor *pollicis longus* and flexor *carpi radialis*. The average age at surgery was 69, the participants were 43 women and 10 men. The average total operation time was 59 minutes. The modified CMC suspension arthroplasty technique provides excellent results compared with those in the literature.

### Introduction

Carpometacarpal Osteoarthritis (CMC) is a common condition in adults with a long history of manual activities. Suspension arthroplasty of the first finger is the most frequent surgical reconstruction for arthrosis of the upper limb.<sup>1,2</sup> Every wrist pain symptoms join into differential diagnosis with fractures, especially in osteoporotic patients. The probability of low-trauma fracture increases with age in both sexes.<sup>3</sup> At 45 years old in Western Europe, the risk of a fracture is 47.3% for women and 23.8% in men.<sup>4</sup> It is essential to combine a suitable therapy to a correct diagnosis in order to treat osteoporotic patients conservatively or to correct surgically in the case of carpometacarpal arthrosis.<sup>5-7</sup> Cervical spine and shoulder pathologies need to be considered in the differential diagnosis when pain and functional impotence are present.<sup>8-10</sup> Depending on the stage of the disease, a conservative approach should be taken in consideration firstly. The use of bioactive

and bio stimulant substances can improve both the mechanics and the biology of the joint such as PRP or substances rich in growth factors.<sup>11-15</sup> Trapeziectomy is the gold standard for stages II to IV according to Brunelli.<sup>16-19</sup> This technique was introduced by Gervis and modified by others authors in 7 different variations, it proved to have excellent results in terms of resolution of pain, becoming the most commonly performed surgical treatments for carpometacarpal osteoarthritis of the first finger.<sup>20</sup> This generally happens for all the syntheses and is necessary in order to refine the technique and find the optimal solution.<sup>21-23</sup> In 1970, Froimson described a similar technique with the interposition of tendon tissue in place of trapezium, he intertwined the Flexor *Carpi Radialis* (FCR) tendon in the space left by trapezium to prevent a conflict between the first metacarpal and scaphoid.<sup>24</sup> Trapeziectomy alone eliminates carpometacarpal bone-to-bone contact but it does not resolve the instability due to ligamentous degeneration typical of CMC.<sup>25</sup> For this reason, trapeziectomy is usually performed with Ligament Reconstruction and Tendon Interposition (LRTI). Despite its frequent use and good results, the addition of LRTI to trapeziectomy did not improve results in some studies.<sup>26-28</sup> The literature described a relationship between the execution of LRTI using FCR and impaired kinematics of the wrist.<sup>29</sup> Compared to trapeziectomy alone, the addition of LRTI, protracts operation and recovery, it also develops the risk of migration and loosening.<sup>30</sup> A more efficient and less invasive stabilization method for the carpometacarpal joint after trapeziectomy is desirable. Del Signore *et al.* described a suspension arthroplasty with a braided, non-resorbable suture placed at the insertion of the Abductor *Pollicis Longus* (APL) and the FCR. This technique produces a sling suture to support the metacarpal base of the thumb, avoiding the use of holes, anchors, or Kirschner wires to reduce the tendon.<sup>31,32</sup> Suspension arthroplasty provided good results; however, follow-up data are still scarce. We develop a novel technique through trapeziectomy and transposition of the long abductor and radial flexor carpi tendons. We hypothesize that suspension arthroplasty, using the technique described in this study, gives better results than suspension arthroplasty with suture or implantable devices.

### Materials and Methods

We retrospectively reviewed the clinic

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reports and radiographs of patients undergoing suspension arthroplasty for CMC osteoarthritis. The procedures were carried out by 2 experienced hand surgeons who share similar approaches. The period study design is from 2006 to 2017 with a 2 years follow-up in the study. A total of 53 patients (43 women and 10 men) were enrolled for the final follow-up evaluation at one and two years. The inclusion criteria for this study were as follows: TM arthritis type 3 and 4 sec. the Brunelli classification; more than 18 years old. The exclusion criteria were as follows: be part of Brunelli type I or II; previous hand surgery; less than 18 years old. We excluded patients who had any sort of traumas resulting in tendon or ligament bone lesions and patients with an inadequate follow-up. The average onset of pain symptoms before surgery was 3 years (between 2-5 years). All of the patients underwent conservative therapy in other centers (general anti-inflammatories, local cortisone infiltration, day and night splints, and physical therapy, in any cases PRP was administered).<sup>33</sup> The average age at the time of surgery was 69 (between 52-88). Clinically, all the subjects had deformities, intense pain non responsive to therapy especially at night, a considerable reduction in strength and important functional limitation of the first finger.<sup>34,35</sup> Cervical myeloradicu-

lopathy joins into differential diagnosis with CMC because of nerve root compression and pain with weakness, hyporeflexia, and muscle atrophy.<sup>36</sup> The x-rays showed osteophytes, geodes, and disappearance of the joint line, with static subluxation. The Scapho-trapezial joint was always affected, while the trapezial-trapezoid was in 40% of the cases. In our study, there were 35 cases of stage III and 18 cases of stage IV arthritis. We collected the clinical data of the patients during the clinical examination or telephone interview. Radiological evaluation and measurements were conducted on radiographs at two years after surgery. We also used Brunelli classification,<sup>16</sup> as it refers to the whole clinical picture of the patient and not only to radiological findings that do not constitute an indication for surgery alone. All surgical operations were performed under axillary plexus anesthesia following the operative indications proposed by the author of the technique.<sup>37,38</sup> All patients, who underwent surgery, had no benefit from conservative therapy, FANS, splint, and corticosteroid injection. Osteoporosis has no role in CMC development, so treatment protocols for the control of osteoporosis are not implemented.<sup>39,40</sup> We evaluated: the patient's age, sex, duration of symptoms, Disabilities of the Arm, Shoulder and Hand (DASH), Kapandji scores, grip, pinch power, and waist flexion power, radial and volar abduction angle, hand dominance and the Visual Analog Scale (VAS) (0 for no pain and 10 for unbearable pain). The VAS score was described verbally. Radiographs were used for the evaluation of the preoperative stage of the disease and postoperative metacarpal depression (at 1 month and last follow-up).<sup>41</sup> Surgical reports were used to evaluate the duration of the procedure. the radiologic evaluation was based on the height of the trapezial space. We measured CMC space,

as the distance between the distal scaphoid and the base of the I metacarpal bone, in the anteroposterior view preoperatively and at 2 years follow-up. When the data evaluated satisfied criteria for normality and homogeneity of variance, statistical analysis between preoperative and final follow-up was performed using independent samples *t*-test. Statistical significance levels were  $P < 0.05$ .

### Surgical technique

The procedure is performed with the patient supine and the upper limb placed on dedicated support under axillary plexus anesthesia. We use the radial approach of Ceruso's technique, a cutaneous incision at the trapezium-metacarpal joint, slightly curved in a longitudinal direction, which falls into the most distal portion of the anatomical snuffbox (Figure 1).<sup>42</sup>

The *subcutis* is carefully dissected with the care of identifying the sensory branch of the radial nerve, it must be carefully protected to avoid injury. Tendons of the first extensor channel such as abductor *pollicis longus* and *extensors pollicis* are identified. They cross obliquely the terminal branch of the radial artery before that it engages in the first intermetacarpal space, going anteriorly, to form the deep palmar arch. Then a longitudinal capsulotomy, aiming trapezio-metacarpal joint, is completed by dissection of the De Quervain sheath and by a division of short extensor tendon and long abductor tendon. At this moment, trapeziectomy was done with a debridement of small osteophytes. The abductor *pollicis longus* tendon is now longitudinally splitted (Figure 2). The ulnar one third is detached from its distal insertion and passed through a loop at the most distal portion of the FRC tendon for the first time, then it is twisted around and fixed (Figure 3). Finally, the joint is covered by capsuloplasty with the residual

tendon tissue (Figure 4).

We are used to marking the distal portion of APL tendon before its partial section in reason of finding it easily under the extensor canal with the thumb in adduction. The articulation, at this point, appears to be more stable and freer to move in all directions. Finally, accurate hemostasis and suture are performed. Patients left the surgery room with a splint for the thumb that kept the trapezium-metacarpal joint in the resting position with the interphalangeal



Figure 1. Cutaneous incision at the trapezium-metacarpal joint, slightly curved in a longitudinal direction, radial approach.



Figure 2. Section of the abductor *pollicis longus*.

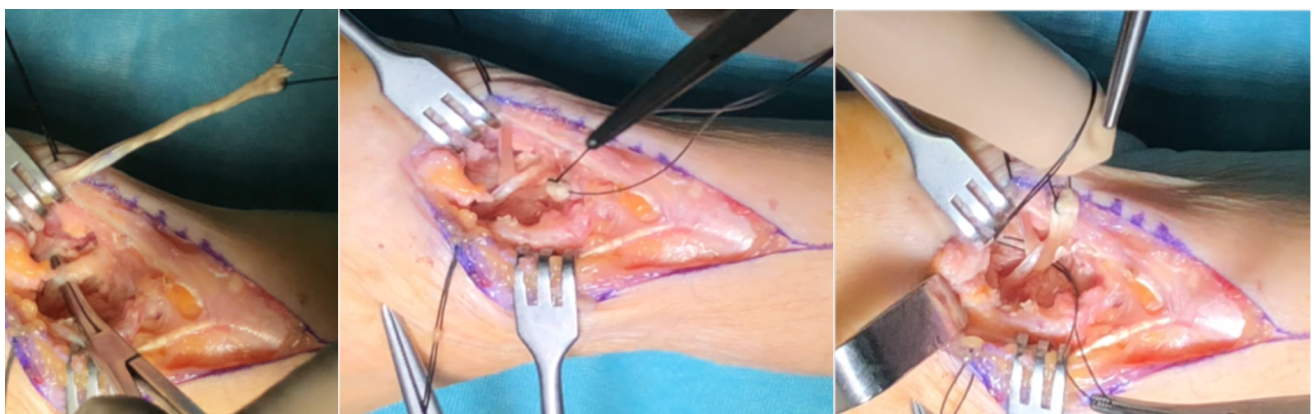


Figure 3. Abductor *pollicis longus* looped and twisted around flexor *carpi radialis*.

joint free to move. This procedure stabilizes the trapezium-metacarpal joint by redirection of the long abductor tendon split. The technique neutralizes dislocating forces on the first metacarpal base previously reduced and maintained by capsuloplasty. Surgical treatment was followed by cast immobilization of the wrist and the first finger for four weeks. Physiotherapy started 30 days after surgery with passive mobilization exercises. The postoperative evaluation included: subjective and objective conditions as well as pain at rest or during light and heavy activities; the ability to perform ADLs; the patient's opinion about the aesthetic aspect and functional results. We measured the palmar adduction, radial abduction, and opposition. Radiographic evaluations were performed up to 2 years postoperatively in all patients to measure the distance between the scaphoid and the base of the 1<sup>st</sup> metacarpal.

## Results

All patients, after surgery, reported no pain at rest and during light activities, while average pain intensity persisted only in three cases throughout heavy activities. All patients were able to return to their normal life. There were no complaints about the aesthetic appearance of the hand. The overall results were satisfying, in only 2 cases there was an unsatisfactory judgment dictated by the psychological situation of the patients who did not report pain or instability, but a different perception of the joint without any functional alterations. In no case, we found a reduction in the length of the thumb. Kapandji score, DASH, and VAS score for thumb pre-operative were 6.2, 51.6, and 7.5, respectively. The mean height of the trapezial space measured on the X-ray was 10 mm. Two years after surgery, all patients expressed their satisfaction with the improved appearance of the hand. Kapandji score and DASH improved to 20.8 and 7.8 points, respectively. VAS sig-

nificantly declined to 1.5. Waist flexion power was similar at the final follow-up. The trapezial space did not present any apparent depression. This type of procedure requires a biological response, but also adequate biomechanical support.<sup>43</sup> Regarding functional ability, all patients were able to

adduce the thumb against both the second metacarpal than the distal phalanx of the 5<sup>th</sup> metacarpus. All patients could lay their hands flat on the Table 1). The X-ray examination revealed no reduction of the distance between the scaphoid and the first metacarpal during the entire control period



Figure 4. Joint is covered by capsuloplasty with the residual tendon tissue.



Figure 5. Hand X-ray pre-op; hand X-ray post op showed that height of the trapezial space at 2 years follow-up.

Table 1. Preoperative and 2 years follow-up variables between 2 groups.

Variables	Pre-operation	2-year follow-up	P
Age	60.9 ± 16.5	60.9 ± 16.5	
Gender (female/male)	43/10	43/10	
VAS	7.5 ± 1.0	1.5 ± 0.5	<0.0001
DASH	51.6 ± 5.0	20.8 ± 4.0	<0.0001
Kapandji	6.2 ± 1.0	7.8 ± 1.0	<0.0001
ROM of radial abduction	60.2 ± 10.0	80.4 ± 7.0	<0.0001
ROM of volar abduction	59.8 ± 5.0	78.6 ± 5.0	<0.0001

DASH = Disabilities of the Arm, Shoulder and Hand, ROM = range of motion, VAS = visual analog scale.

(Figure 5). The main period to returning to daily activities was 4.3 months from surgery (2.8 - 5 months), and the oral anti-inflammatory total intake was not relevant except for the first month in 35% of the cases mainly due to the surgical trauma than to other factors. Patients with pain were administered paracetamol 1000mg 1 pill daily if needed and ibuprofen 600mg 1 pill to 2 times a day (8-20) for 5 days.

## Discussion

In our study, we described a novel technique that leads to satisfactory results in about 90% of cases regardless of the age of the subject. Most patients, before surgery, had limitations in common daily activities and manual works, while after treatment each patient was able to perform the same previous activities and progressively, they developed greater strength in grip hand. Contrary to literature about trapeziectomy,<sup>44,45</sup> we noticed a gradual recovery in strength without instability of the thumb. Ceruso's technique provides both stability, power grip, and lateral pinch strength to the first metacarpal. The use of the APL tendon allows performing surgery with single radial access, including trapeziectomy, preparation of the tendon band, and suspension arthroplasty. Furthermore, this technique permits the pronation of the fingertip as a result of the arthroplasty traction on the base of the 1st metacarpal. It also produces the interposition of biological tissues, constituted by the double passage of the APL on the FCR, between bone elements. This neo structure gives stability to the first metacarpus and acts as a biological spacer between it and the scaphoid.

## Conclusions

Our surgical technique demonstrated to fully comply with our reference parameters such as the simple execution and the short immobilization period (about 4 weeks). Therefore, we suggest this type of technique in reason of minimal complication risks, the low costs of surgery, and an early and optimal functional recovery. It could become the ideal solution for most forms of arthrosis of the trapeziometacarpal joint.

## References

1. Marshall M, van der Windt D, Nicholls E, et al. Radiographic thumb

osteoarthritis: frequency, patterns and associations with pain and clinical assessment findings in a community-dwelling population. *Rheumatology (Oxford)* 2011;50:735e739.

2. Pickrell BB, Eberlin KR. Thumb basal joint arthritis. *Clinics Plastic Surg* 2019;46:407–13.
3. Tarantino U, Iolascon G, Cianferotti L, et al. Clinical guidelines for the prevention and treatment of osteoporosis: summary statements and recommendations from the Italian Society for Orthopaedics and Traumatology. *J Orthop Traumatol* 2017;18:3–36.
4. Kanis JA, Johnell O, Oden A, et al. Long-term risk of osteoporotic fracture in Malmo. *Osteoporos Int* 2000;11:669–74.
5. Moretti A, De Sire A, Curci C, et al. Effectiveness of denosumab on back pain-related disability and quality-of-life in patients with vertebral fragility fractures. *Curr Med Res Opinion* 2019;35:151-5.
6. Conti V, Russomanno G, Corbi G, et al. A polymorphism at the translation start site of the vitamin D receptor gene is associated with the response to anti-osteoporotic therapy in postmenopausal women from Southern Italy. *Int J Mol Sci* 2015;16:5452-66.
7. Leali PT, Balsano M, Maestretti G, et al. Efficacy of teriparatide vs. neridronate in adults with osteogenesis imperfecta type I: a prospective randomized international clinical study. *Clin Cases Miner Bone Metab* 2017;14:153-6.
8. Doria C, Mosele GR, Badessi F, et al. Shoulder adhesive capsulitis in type 1 diabetes mellitus: A cross-sectional study on 943 cases in Sardinian people. *Joints* 2017;5:143-6.
9. Brockmeier SF, Werner BC. Shoulder arthritis in the young and active patient. *Clin Sports Med* 2018;37:13-4
10. Doria C, Mosele GR, Badessi F, et al. Pigmented villonodular synovitis in type 1 diabetes mellitus: A cross-sectional study in Sardinian people. *Int J Clin Rheumatol* 2016;11:15-20.
11. Toro G, Lepore F, Calabrò G, et al. Humeral shaft non-union in the elderly: Results with cortical graft plus stem cells. *Injury* 2019;50:S75-9.
12. Doria C, Mosele GR, Caggiari G, et al. Treatment of early hip osteoarthritis: ultrasound-guided platelet rich plasma versus hyaluronic acid injections in a randomized clinical trial. *Joints* 2017;5:152–5.
13. Steiner MM, Calandruccio JH. Biologic approaches to problems of the hand and wrist. *Orthop Clin North Am* 2017;48:343-9.
14. Manunta AF, Zedde P, Cudoni S, et al. Early joint degeneration and antagonism between growth factors and reactive oxygen species. Is non-surgical management possible? *Joints* 2015;3:123-8.
15. Loibl M, Lang S, Dendl LM, et al. Leukocyte-reduced platelet-rich plasma treatment of basal thumb arthritis: a pilot study. *Biomed Res Int* 2016; 9262909:2016.
16. Internullo G. Trapeziometacarpal joint osteoarthritis: Treatment with tendon interposition arthroplasty according to Ceruso in severe osteoarthritis. *Reumatismo* 2011;60:125-30.
17. Pellegrini VD Jr, Parentis M, Judkins A, Olmstead J, Olcott C. Extension metacarpal osteotomy in the treatment of trapeziometacarpal osteoarthritis: a biomechanical study. *J Hand Surg Am* 1996;21:16e23.
18. Tomaino M. Treatment of Eaton stage I trapeziometacarpal disease with thumb metacarpal extension osteotomy. *J Hand Surg Am* 2000;25:1100-6.
19. Eaton RG, Lane LB, Littler JW, Keyser JJ. Ligament reconstruction for the painful thumb carpometacarpal joint: a long-term assessment. *J Hand Surg Am* 1984;9:692-99
20. Gervis WH. Excision of the trapezium for osteoarthritis of the trapeziometacarpal joint. *J Bone Joint Surg Br* 1949;31B:537-9.
21. Matullo KS, Ilyas A, JJ Thoder. CMC Arthroplasty of the Thumb: A Review. *Hand* 2007;2:232–9.
22. Yuan F, Aliu O, Chung KC, Mahmoudi E. Evidence-based practice in the surgical treatment of thumb carpometacarpal joint arthritis. *J Hand Surg Am* 2017;42:104-12.e1.
23. Caggiari G, Ciurlia E, Ortu S, et al. Osteochondral avulsion fracture of the posteromedial tibial plateau. *Trauma Case Rep* 2020;25:100281.
24. Froimson AI. Tendon arthroplasty of the trapeziometacarpal joint. *Clin Orthop Relat Res* 1970;70:191-199.
25. Maes-Clavier C, Bellemère P, Gabrion A, et al. Anatomical study of the ligamentous attachments and articular surfaces of the trapeziometacarpal joint. Consequences on surgical management of its osteoarthrosis. *Chirurgie de la Main* 2014;33:118-23
26. Burton RI, Pellegrini VD. Surgical management of basal joint arthritis of the thumb. Part II. Ligament reconstruction with tendon interposition arthroplasty. *J Hand Surg Am* 1986;11:324-

- 32.
27. Vermeulen GM, Slijper H, Feitz R, et al. Surgical management of primary thumb carpometacarpal osteoarthritis: a systematic review. *J Hand Surg Am* 2011;36:157-69.
28. Bisaccia M, Rinonapoli G, Bisaccia O, et al. Articular fractures of distal radius: comparison of treatment and clinical and radiological outcomes with volar plate versus hoffmann bridging external fixator. *EuroMediterr Biomed J* 2017;12:023-8.
29. Naidu SH, Poole J, Horne A. Entire flexor carpi radialis tendon harvest for thumb carpometacarpal arthroplasty alters wrist kinetics. *J Hand Surg Am* 2006;31:1171-5.
30. Gray KV, Meals RA. Hematoma and distraction arthroplasty for thumb basal joint osteoarthritis: minimum 6.5-year follow-up evaluation. *J Hand Surg Am* 2007;32:23-9.
31. DelSignore JL, Accardi KZ. Suture suspension arthroplasty technique for basal joint arthritis reconstruction. *Tech Hand Up Extrem Surg* 2009;13:166-172.
32. DelSignore JL, Zambito-Accardi KL, Ballatori SE. Suture suspension arthroplasty for thumb carpometacarpal arthritis reconstruction: longterm outcome. *J Hand Surg Am* 2015;40:e29-30.
33. Caggiari G, Mosele GR, Puddu L, et al. Efficacy of platelet-rich plasma in experimental instrumented interbody spinal fusion. *EuroMediterr Biomed J* 2016;11:141-7.
34. Yuan F, Aliu O, Chung KC, Mahmoudi E. Evidence-based practice in the surgical treatment of thumb carpometacarpal joint arthritis. *J Hand Surg Am* 2017;42:104-12.e1.
35. Wajon A, Carr E, Edmunds I, Ada L. Surgery for thumb (trapeziometacarpal joint) osteoarthritis. *Cochrane Database Syst Rev* 2009;4:CD004631.
36. Doria C, Mosele GR, Balsano M, et al. Anterior decompression and plate fixation in treatment of cervical myelopathy: a multicentric retrospective review. *Acta Orthop Traumatol Turc* 2018;52:185-90.
37. Davis TRC, Brady O, Dias JJ. Excision of the trapezium for osteoarthritis of the trapeziometacarpal joint: a study of the benefit of ligament reconstruction or tendon interposition. *J Hand Surg Am* 2004;29:1069-77.
38. Davis T, Pace A. Trapeziectomy for trapeziometacarpal joint osteoarthritis: is ligament reconstruction and temporary stabilisation of the pseudarthrosis with a Kirschner wire important? *J Hand Surg Eur Vol* 2009;34:312-21.
39. Caggiari G, Leali PT, Mosele GR, et al. Safety and effectiveness of teriparatide vs alendronate in postmenopausal osteoporosis: A prospective non randomized clinical study. *Clin Cases Miner Bone Metabol* 2016;13:200-3.
40. Gangopadhyay S, McKenna H, Burke FD, Davis TRC. Five-to 18-year follow-up for treatment of trapeziometacarpal osteoarthritis: a prospective comparison of excision, tendon interposition, and ligament reconstruction and tendon interposition. *J Hand Surg Am* 2012;37:411-7.
41. Wajon A, Vinycomb T, Carr E, et al. Surgery for thumb (trapeziometacarpal joint) osteoarthritis. *Cochrane Database Syst Rev* 2015;2:CD004631.
42. Ceruso M, Delcroix L. Artroplastica tendinea in sospensione nel trattamento della rizoartrosi. Revisione di 80 casi operati. *Atti XXXIV Congr. SICM, Brescia: 1995.*
43. Ciurlia E, Puddu L, Caggiari G, et al. Peri-prosthetic humeral non-union: where biology meets bio-mechanic. a case report. *Int J Surg Case Rep* 2017;39:102-5.
44. Naidu SH, Poole J, Horne A. Entire flexor carpi radialis tendon harvest for thumb carpometacarpal arthroplasty alters wrist kinetics. *J Hand Surg Am* 2006;31:1171-5.
45. Iyer S, Pabari A, Khoo CT. Suture suspension arthroplasty technique for basal joint arthritis reconstruction. *Tech Hand Up Extrem Surg* 2010;14:200-1.