

Outcome of uncemented trapeziometacarpal prosthesis for treatment of thumb carpometacarpal joint arthritis

Manish Chug, Nicole Williams, David Benn, Stephen Brindley

ABSTRACT

Background: Osteoarthritis of the trapeziometacarpal joint of thumb occurs frequently and can be very disabling. Numerous surgical techniques including trapeziectomy with or without tendon interposition arthrodesis and partial or total joint arthroplasty with cemented and noncemented prosthesis have been described for the treatment of trapeziometacarpal joint osteoarthritis. Initial problems of osteolysis and implant loosening have been substantially reduced with improvement in implant design. The aim of this study is to demonstrate that trapeziometacarpal osteoarthritis of the thumb can be effectively treated with uncemented total joint replacement prosthesis.

Materials and Methods: We retrospectively collected data for 16 trapeziometacarpal joint replacements in 14 patients. One patient was excluded as they required revision with trapeziectomy and ligament reconstruction following fracture of Trapezium. The trapeziometacarpal joint prosthesis was used in all cases and all operations were carried out by one surgeon. Clinical outcome was determined by a pre and postoperative patient rated wrist evaluation (PRWE) and Michigan Hand Questionnaire Score. Range of motion, grip, tip pinch and key pinch strength were measured and compared with the unoperated hand. Radiological assessment was carried out by plain radiographs for preoperative staging of arthritis and postoperative radiographs at latest followup for evaluation of osteolysis and implant loosening. Average followup period was 26 months.

Results: There was an improvement in hand function and pain level based on PRWE and Michigan Hand outcome Questionnaire Score. One patient had intraoperative fracture of Trapezium and subsequent radiographs at 14 months followup showed loosening of the trapezium component due to nonunion of the fracture and complete disintegration of the trapezium. There were no cases of dislocation or implant loosening for the remaining 15 CMC joints at the latest followup.

Conclusion: The use of uncemented prosthesis in treatment of Questionnaire Score. Range of motion joint osteoarthritis gives excellent short term results in improving hand function in terms of strength and stability and achieving pain relief.

Key words: Carpometacarpal joint, osteoarthritis, thumb, trapeziometacarpal joint, uncemented trapeziometacarpal prosthesis

MeSH terms: Osteoarthritis, thumb, implant design, carpal bones, metacarpal bone

INTRODUCTION

Thumb carpometacarpal (CMC) joint is a saddle shape joint with biconcave-convex surfaces and has minimal bony constraints.¹ The peculiar shape of this joint allows a range of movement in various planes

and enables humans to perform a wide variety of tasks with the thumb including grip, grasp, opposition and pinch.² The trapeziometacarpal joint is a frequent site of osteoarthritis due to high compression loads thereby leading to pain, limitation of motion and weakness.

The various surgical techniques applied in the past with variable success and failure rates are, total trapeziectomy,³ ligament reconstruction,⁴ trapeziectomy with ligament reconstruction with or without tendon interposition,⁵⁻⁸ arthrodesis of the joint,⁹ metacarpal osteotomy¹⁰ and arthroplasty.

Trapeziectomy with ligament reconstruction has been considered to be the gold standard for the treatment of the thumb trapeziometacarpal joint osteoarthritis; however, proximal migration of the thumb metacarpal has been reported with this procedure resulting in reduction of pinch strength. Total arthrodesis is associated with decreased range of motion and transfer of forces to neighbouring joints. The

Department of Hand Surgery, John Hunter Hospital, Hunter New England Area Health Services, Lookout Road, New Lambton, Newcastle, NSW 2290, Australia

Address for correspondence: Dr. Manish Chug,
506/18-20, Smart Street, Sky Central Apartments, Charlestown,
Newcastle, NSW 2290, Australia.
E-mail: drchug_manish@yahoo.com

Access this article online	
Quick Response Code:	Website: www.ijonline.com
	DOI: 10.4103/0019-5413.136270

Swanson spacer implant has been associated with synovitis due to silicon wear.^{11,12} To counter these problems total joint arthroplasty in the form of a ball and socket type of implant was introduced by de la ca Caffiniere in 1971.¹³ Since, then there have been various modification in implant design to reduce the rate of aseptic loosening.¹³⁻¹⁹ The design of the trapeziometacarpal [Figures 1a and b] implant, manufactured by small bone innovations international, Peronnas, France, for the treatment of trapeziometacarpal joint osteoarthritis was introduced in 1996 and the results of the first 100 cases were published in 2006 with a mean followup of 54 months.¹⁵

The purpose of this article is to report excellent short term results of total joint replacement using the trapeziometacarpal implant for trapeziometacarpal osteoarthritis.

MATERIALS AND METHODS

Trapeziometacarpal joint replacement was performed on 16 thumbs in 14 patients for osteoarthritis between April 2007 and June 2009. Indication for surgery was a failure of conservative management to relieve pain with subsequent loss of function. Patients involved in strenuous labor work were not offered this surgery.

Average age of patients was 70 years (range 54-85 years); there were 10 women and four men in this group. There were two bilateral cases and 12 unilateral. Eight right and Eight left thumbs were involved. Out of 12 unilateral cases the dominant hand was involved in seven cases and nondominant in 5. Mean followup was 26 months (range 12-38 months). All patients had a positive grind test on physical examination. None of the patients had previous thumb surgery and in unilateral cases none of them had any complaints with the contralateral thumb. On radiological assessment three thumbs showed early stage IV Osteoarthritis (Eaton20) eight

thumbs showed stage III osteoarthritis and five thumbs stage II osteoarthritis. Additional procedures at the time of CMC joint replacement included first metacarpophalangeal joint fusion (one patient), Metacarpophalangeal joint Swanson arthroplasty of the ring finger (one patient) and first dorsal compartment release (one patient).

Range of motion was assessed using goniometry and the results were compared to the contralateral thumb. Similarly, results of grip strength using the Jamar dynamometer and tip pinch and key pinch strength using the Preston pinch gauge were compared to the contralateral hand postoperatively. All patients were asked to complete Pain related wrist evaluation and Michigan hand outcome questionnaires preoperatively and the data were compared to the postoperative scores of the two questionnaires.

Plain radiographs of the joint were taken preoperatively [Figure 2a] and at the latest followup [Figure 2b] for evaluation of osteolysis, migration of the cup or stem and evidence of joint subluxation or dislocation. All patients were clinically assessed by the clinicians participating in this study; however, all the radiographs were assessed by an independent observer.

An approval from the Institutional Research Body was not required for this study.

Operative procedure

The Elektra follows ball and socket joint design [Figure 2]. It is an unconstrained metal on metal joint prosthesis and consists of a titanium stem inserted into the first metacarpal after reaming with rasps. After preparing trapezium with a hand reamer and threading with a bone tap, a chrome-cobalt steel cup shaped like a truncated cone on the outside and comprising of a hydroxyapatite-coated deep thread, which screws into the trapezium was implanted using cementless, pressfit technique. A chrome cobalt steel head on a neck of variable length was inserted and assessed for stability and range of motion [Figure 2].

Postoperatively, the thumb was immobilised in a fiberglass thumb spica for one week and thermoplastic splint for another 3 weeks followed by hand therapy for active and passive range of motion.

RESULTS

The mean postoperative pain rated wrist evaluation score for pain was 5.3 and for function it was 12.4, which was a significant improvement from the preoperative scores [Table 1]. All the domains of Michigan Hand Questionnaire significantly improved after the surgery with

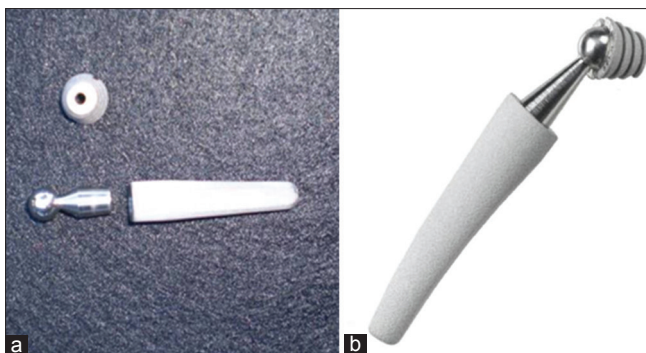


Figure 1: Clinical photograph showing (a) trapeziometacarpal prosthesis unconstrained metal on metal joint prosthesis consists of a titanium stem inserted into the first metacarpal, a chrome-cobalt steel cup shaped like a truncated cone on the outside and comprising a hydroxyapatite-coated deep thread which screws into the trapezium, a chrome-cobalt steel head on a neck of variable length (b) The Elektra follows ball and socket joint design



Figure 2: (a) Preoperative radiograph of Thumb anteroposterior and oblique views showing carpometacarpal joint for grading of osteoarthritis (b) Postoperative radiographs (anteroposterior and oblique views) for evaluation of osteolysis and loosening showing implant *in situ*.

Table 1a: Pain rated wrist evaluation pain score

PRWE score (Pain)	Sample size (n=15 thumbs in 13 patients)	
	Preoperative	Postoperative
Mean	34.2	5.4
Standard deviation	±16.2	±7.3
P value	<0.01	

PRWE=Pain rated wrist evaluation

Table 1b: Pain rated wrist evaluation function score

PRWE score (function)	Sample size (n=15 thumbs in 13 patients)	
	Preoperative	Postoperative
Mean	68.8	12.4
Standard deviation	±24.3	±17.3
P value	<0.01	

PRWE=Pain rated wrist evaluation

Table 1c: Pain rated wrist evaluation total score

PRWE score total	Sample size (n=15 thumbs in 13 patients)	
	Preoperative	Postoperative
	68.6	11.6
P value	<0.01	

**P value (P<0.01) is significant, PRWE=Pain rated wrist evaluation

all $P < 0.01$ [Table 2]. There was no significant difference in the mean grip, tip pinch and key pinch strengths in unilateral

cases as compared to the contralateral hand [Table 3]. Range of motion was excellent as compared to the contralateral hand [Table 4]. Opposition on Kapandji scale²¹ was measured as 8 in 13 thumbs, 9 and 10 in two thumbs respectively. There was no evidence of loosening of the cup or migration of the stem, subluxation or dislocation of the joint on radiographs at subsequent followup appointments.

We have presented results of only 15 thumbs out of 16 as one patient had intraoperative fracture of the trapezium, which was treated with immobilisation in a splint. Subsequent followup radiograph at 14 months showed a nonunion of the fracture and fragmentation of the trapezium. This patient underwent salvage with trapeziectomy and Weilby sling arthroplasty. This patient's scores and measurements were excluded from the study.

DISCUSSION

In this current series of 16 thumbs, treatment of trapeziometacarpal osteoarthritis with the Elektra implant has shown excellent short term results in terms of pain relief, range of motion, improvement in grip and pinch strengths and We had one revision (6.25%) with Weilby sling procedure, attributing to a nonunion of trapezium fracture.

Table 2: Michigan hand outcome questionnaire analysis

MHQ scale	Sample size (n=15 thumbs in 13 patients)		P value
	Mean preoperative±SD	Mean postoperative±SD	
Function	40.3±17.6	78.3±16.3	<0.01
Activity of daily living	38.0±27.6	88.7±14.6	<0.01
Work	45.0±17.0	76.7±17.4	<0.01
Pain	66.3±13.8	18.7±20.1	<0.01
Aesthetics	65.9±31.6	86.3±17.4	<0.01
Satisfaction	29.2±34.1	84.5±23.4	<0.01

MHQ=Michigan hand outcome questionnaire, **P value (P<0.01) is significant

Table 3: Strength analysis in unilateral cases

Unilateral cases (n=11)	Operated hand		Contralateral hand	
	Mean	Standard deviation	Mean	Standard deviation
Grip strength (in Kg)	27.0	11.0	28.0	9.0
Key pinch (in Kg)	3.6	1.5	3.9	1.4
Tip pinch (in Kg)	4.0	2.3	4.3	1.8

Table 4: Range of motion measured for thumbs in unilateral cases

Unilateral cases (n=11)	Operated hand		Contralateral hand	
	Mean	Standard deviation	Mean	Standard deviation
Radial abduction	47	6.11	50	5.61
Palmar abduction	40	9.45	41	9.06
Extension (in cm)	2.7	1.2	2.6	1.1

Regnard reported a 15% failure rate for the screwed cup due to lack of osteointegration into the trapezium. Ulrich-Vinther and Puggaard¹⁴ in a comparative study with abductor pollicis suspension arthroplasty showed better clinical results with Elektra. Out of 42 patients who received implant arthroplasty 36 came back for a followup at 1 year and the prosthesis components were well integrated and fixed on evaluation with plain radiographs. Hansen and Snerum reported a revision rate of 24% with Elektra in a case series of 17 thumb joint replacements.²² Hernandez-Cortes in a 2 year follow study in 19 implants reported 21% revision rate.²³ Klahn and Nygaard in a 39 consecutive case series reported a high failure rate of 44% after 72 months.

The results with other uncemented implants have been disappointing. Wachtl *et al.*¹⁶ reported a 59% survival rate in 45 patients after 16 months with Ledoux implant. Hansen and Vainorius reported migration of both implants with the use of Moje Acamo prosthesis in eight out of nine patients.

The cemented implants were introduced by de La Caffinier²⁴ in 1971. A high failure rate due to aseptic loosening has been observed with this prosthesis in most of the studies conducted in the past. A failure rate of 21% after 24 months was reported with the use of this implant in 1979. August *et al.* reported poor results with this prosthesis with a revision

rate of 24%, Sondergard *et al.* reported 18% failure rate and De Smet *et al.*²⁵ reported 44% loosening rate of the cup after 10 years with the De La Caffinier prosthesis. Results with Braun cutter cemented implant has been excellent in a study conducted by Badia *et al.*²⁶ with no aseptic loosening and one revision out of 24 cases at 59 months. Mixed results were observed by Braun with a revision rate of 10% and Cooney 19% respectively.

Aseptic loosening of the implants has been a problem with the use of a cemented prosthesis. However, with the use of uncemented cups, lack of osteointegration because of poor quality bone or fracture of osteointegration after intense or repetitive trauma has also been reported in the past.¹⁵ In a clinical study by Hansen *et al.*²⁷ it was seen that trapeziometacarpal implants can be evaluated by roentgen stereophotogrammetric analysis. Further to this Hansen *et al.*²⁸ in an experimental study suggested that threading of trapezium before insertion of Elektra uncemented screw cup weakens the primary fixation strength of the implant.

In a randomized clinical roentgen stereophotogrammetric analysis study with 2 year followup Hansen and Stilling²⁹ showed same results with cemented DLC all polyethylene cup and uncemented hydroxyapatitecoated chromium cobalt Elektra screw cup inserted without threading of the trapezium. The use of correct insertion technique for the trapezium cup, assessment of quality of trapezium for suitability for this procedure and correct selection of patients on the basis of the profession and lifestyle may decrease the incidence of this complication.

In conclusion, the results of Elektra uncemented prosthesis for the treatment of the thumb trapeziometacarpal joint osteoarthritis are consistent with significant improvement in pain and disability resulting in significant improvement in quality of life. Long term outcomes certainly need further evaluation so that survivorship of the implant can be better predicted.

REFERENCES

1. Kuczynski K. Carpometacarpal joint of the human thumb. *J Anat* 1974;118:119-26.
2. Koff MF, Zhao KD, Mierisch CM, Chen MY, An KN, Cooney WP 3rd. Joint kinematics after thumb carpometacarpal joint reconstruction: An *in vitro* comparison of various constructs. *J Hand Surg Am* 2007;32:688-96.
3. Taylor EJ, Desari K, D'Arcy JC, Bonnici AV. A comparison of fusion, trapeziectomy and silastic replacement for the treatment of osteoarthritis of the trapeziometacarpal joint. *J Hand Surg Br* 2005;30:45-9.
4. 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.

5. Roberts RA, Jabaley ME, Nick TG. Results following trapeziometacarpal arthroplasty of the thumb. *J Hand Ther* 2001;14:202-7.
6. Kriegs-Au G, Petje G, Fojtl E, Ganger R, Zachs I. Ligament reconstruction with or without tendon interposition to treat primary thumb carpometacarpal osteoarthritis. Surgical technique. *J Bone Joint Surg Am* 2005;87:78-85.
7. Sirotakova M, Figus A, Elliot D. A new abductor pollicis longus suspension arthroplasty. *J Hand Surg Am* 2007;32:12-22.
8. Budoff JE, Gordon L. Long term results of tendon shortening trapeziometacarpal arthroplasty. *Clin Orthop Relat Res* 2002;405:199-206.
9. Lanzetta M, Foucher G. A comparison of different surgical techniques in treating degenerative arthrosis of the carpometacarpal joint of the thumb. A retrospective study of 98 cases. *J Hand Surg Br* 1995;20:105-10.
10. Tomaino MM. Treatment of Eaton stage I trapeziometacarpal disease with thumb metacarpal extension osteotomy. *J Hand Surg Am* 2000;25:1100-6.
11. Lussiez B, Canovas F, Lenoble E, Allieu Y, Iselin F, Saffar P. Swanson's trapezius implants. Results of a multicenter study. *Ann Chir Main Memb Super* 1990;9:198-202.
12. Minami A, Iwasaki N, Kutsumi K, Suenaga N, Yasuda K. A long term followup of silicone-rubber interposition arthroplasty for osteoarthritis of the thumb carpometacarpal joint. *Hand Surg* 2005;10:77-82.
13. de la Caffiniere JY, Aucouturier P. Trapezio-metacarpal arthroplasty by total prosthesis. *Hand* 1979;11:41-6.
14. Ulrich-Vinther M, Puggaard H, Lange B. Prospective 1-year followup study comparing joint prosthesis with tendon interposition arthroplasty in treatment of trapeziometacarpal osteoarthritis. *J Hand Surg Am* 2008;33:1369-77.
15. Regnard PJ. Elektra trapezio metacarpal prosthesis: Results of the first 100 cases. *J Hand Surg Br* 2006;31:621-8.
16. Wachtl SW, Guggenheim PR, Sennwald GR. Cemented and noncemented replacements of the trapeziometacarpal joint. *J Bone Joint Surg Br* 1998;80:121-5.
17. Hansen TB, Vainorius D. High loosening rate of the Moje Acamo prosthesis for treating osteoarthritis of the trapeziometacarpal joint. *J Hand Surg Eur Vol* 2008;33:571-4.
18. Lemoine S, Wavreille G, Alnot JY, Fontaine C, Chantelot C, groupe GUEPAR. Second generation GUEPAR total arthroplasty of the thumb basal joint: 50 months followup in 84 cases. *Orthop Traumatol Surg Res* 2009;95:63-9.
19. Ferrari B, Steffee AD. Trapeziometacarpal total joint replacement using the Steffee prosthesis. *J Bone Joint Surg Am* 1986;68:1177-84.
20. Eaton RG, Littler JW. Ligament reconstruction for the painful thumb carpometacarpal joint. *J Bone Joint Surg Am* 1973;55:1655-66.
21. Kapandji AI. Clinical evaluation of the thumb's opposition. *Journal of Hand Therapy* 1992;5:102-6.
22. 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;42:316-9.
23. Hernández-Cortés P, Pajares-López M, Robles-Molina MJ, Gómez-Sánchez R, Toledo-Romero MA, De Torres-Urrea J. Two-year outcomes of Elektra prosthesis for trapeziometacarpal osteoarthritis: A longitudinal cohort study. *J Hand Surg Eur Vol* 2012;37:130-7.
24. Klahn A, Nygaard M, Gvozdenovic R, Boeckstyns ME. Elektra prosthesis for trapeziometacarpal osteoarthritis: A followup of 39 consecutive cases. *J Hand Surg Eur Vol* 2012;37:605-9.
25. De Smet L, Sioen W, Spaepen D, Van Ransbeeck H. Total joint arthroplasty for osteoarthritis of the thumb basal joint. *Acta Orthop Belg* 2004;70:19-24.
26. Badia A, Sambandam SN. Total joint arthroplasty in the treatment of advanced stages of thumb carpometacarpal joint osteoarthritis. *J Hand Surg Am* 2006;31:1605-14.
27. Hansen TB, Larsen K, Bjergelund L, Stilling M. Trapeziometacarpal joint implants can be evaluated by roentgen stereophotogrammetric analysis. *J Hand Surg Eur Vol* 2010;35:480-5.
28. Hansen TB, Meier M, Møller MC, Larsen K, Stilling M. Primary cup fixation with different designs of trapeziometacarpal total joint trapezium components: A radiostereometric analysis in a pig bone model. *J Hand Surg Eur Vol* 2011;36:285-90.
29. Hansen TB, Stilling M. Equally good fixation of cemented and uncemented cups in total trapeziometacarpal joint prostheses. *Acta Orthop* 2013;84:98-105.

How to cite this article: Chug M, Williams N, Benn D, Brindley S. Outcome of uncemented trapeziometacarpal prosthesis for treatment of thumb carpometacarpal joint arthritis. *Indian J Orthop* 2014;48:394-8.

Source of Support: Nil, **Conflict of Interest:** None.