



Total joint arthroplasty for osteoarthritis of the thumb basal joint

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A survey of 43 cemented arthroplasties of the trapeziometacarpal joint with a la Caffinière prosthesis in 40 patients is presented. A 70% patient satisfaction rate was obtained, with a mean DASH score of 24.2. Good range of motion was preserved (opposition 9/10 on Kapandji's scale) and gripping force as well as key pinch force increased from 18 kg to 24 kg and from 5.3 to 6.0 kg respectively. However loosening was seen in 44% of the implants. Loosening was related to younger age. We conclude that despite good clinical outcome, radiographic loosening is a threat for the future of this implant.

INTRODUCTION

Patients with symptomatic osteoarthritis of the thumb basal joint or trapeziometacarpal (TM) joint often respond to rest, immobilisation, nonsteroidal anti-inflammatory drugs, or intra-articular injections of steroids. This conservative treatment may temporarily decrease the symptoms and give pain relief, but many patients remain significantly disabled (7), as was recently demonstrated by Damen *et al* (11).

When conservative treatments fail, there is a wide variety of surgical options to treat this condition : osteotomy (31), arthrodesis of the TM joint (4, 8), simple excision of the trapezium (19, 20, 29), trapeziectomy with soft-tissue interposition (18) and/or ligament reconstruction (16) and silicone arthroplasty (2, 25, 27).

de la Caffinière (12) developed a cemented total joint replacement for the TM joint. The proposed advantage of a prosthesis over other procedures is the rapid recovery of a painfree, stable and mobile joint with a normal thumb length.

We used this prosthesis since 1990 and a prospective survey was started in 1995, in order to evaluate the outcome.

PATIENTS AND METHODS

Patients

Patients with primary basal joint osteoarthritis of the thumb without involvement of the scaphotrapezoid joint were included in the study. Patients with rheumatoid arthritis and posttraumatic arthritis were excluded.

Forty patients could be enlisted for a prosthetic implant. They all had primary osteoarthritis of the TM joint. The predominant preoperative symptom was pain. The duration of pain was more than one year in 38 patients, six months to one year in three patients and less than six months in two patients.

Between August 1995 and May 2001, 43 de la Caffinière prostheses were implanted in 40 patients : 37 women and 3 men ; 23 were housewives, 9 were white collar workers, 3 had occupations involving heavy manual labour and 5 patients had other nonspecific activities.

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One man and two women underwent bilateral procedures. The mean age at operation was 54 years (range : 43 to 66 years). Twenty-three prostheses were implanted in the right hand, 20 in the left hand ; 22 operations were performed on the dominant hand and 21 on the non-dominant hand. No patient in the study had associated procedures as the time of the index operation. None had hyperextensibility of the ipsilateral metacarpophalangeal joint.

Surgical technique

The operation was performed by the senior author (LDS) as described by de la Caffinière (12). The prosthesis has a cobalt-chromium alloy metacarpal component comprising a stem, flange and ball, and a high density polyethylene cup which is slightly more than a hemisphere and has a circumferential wire marker ; it is implanted into the trapezium. The two components reduce with a snap fit. Only one size of cup is available and the metacarpal component come in two sizes. A short stem (PM – “Petit Modèle”) is usually required. The longer one (GM – “Grand Modèle”) is indicated in cases of failed trapeziectomy.

A curved radiopalmar incision is made over the trapezium. The thenar muscles are reflected. The capsule is opened and the metacarpal is prepared by resecting 3 mm of the articular surface with a small oscillating saw, then the medullary cavity is prepared with a rasp. A trial fit of the metacarpal component is made. The trapezium is then prepared : all osteophytes are removed ; a cavity is drilled out in the articular surface with a high speed burr to match the trapezial component. A small quantity of cement is introduced into the cavity and the cup on its introducer is pushed into the cement and positioned with its opening parallel to the joint surface. Cement is injected into the metacarpal cavity and the metacarpal component is inserted. The joint is reduced by snapping the ball and socket together. The thenar muscles are reattached and the skin is closed over a silicone drain.

The procedure can be done under general or regional anaesthesia in an outpatient setting. Mobilisation of the thumb is allowed and encouraged the day after the operation. Splints were not used in this series.

Evaluation

The 40 patients (with 43 prostheses) were reviewed at a mean of 26 months after operation (range : 15 to 69 months) by two independent observers (WS, DS).

Visual Analogue Scales (VAS) were used to assess patients' pain, function, dexterity and satisfaction. Patients were asked to mark the results on a horizontal line of 10 cm. A score of 5 cm represented no change with respect to the preoperative state, a score between 5 cm and 6 cm was fair, between 6 and 7.5 cm was a good result. Any score of more than 7.5 cm was considered as an excellent result.

All patients completed the DASH questionnaire (21). The raw score is transformed to a zero to 100 scale with zero reflecting no disability and 100 reflecting severe disability. Since the DASH score only recently became available in Dutch, this was filled out at follow-up, and not preoperatively

The web span was measured with the volar surface of the hand flat on the table with the thumb in maximal abduction (22). Opposition was assessed according to the method of Kapandji (23) and scored between 0 and 10. Both power and pinch grips were measured using a Jamar[®] dynamometer and a keypinch dynamometer. All these measurements were compared to the opposite side (in unilateral cases) and with the preoperative value (when available). Standard radiographs were performed and evaluated. Loosening was considered when a radiolucent line of 1 mm or more was present. Loosening was scored according to Chakrabati *et al* (9). Special interest was paid to the occurrence of osteoarthritis in the adjacent joints.

RESULTS

The mean postoperative DASH-score was 24.2 (SD, 19.32) (table I). This represents a low degree of overall disability. One patient had a score of zero reflecting no disability. The highest score was 67.4.

The Visual Analogue Scales showed good or excellent results in 70% of cases for pain, 81% for function, 67% for dexterity and 84% for satisfaction (table II). Only one patient was completely unsatisfied with the operation.

The correlation between visual analogue scores and the DASH scores was calculated. A high negative correlation was found between the DASH score and pain ($r = -0.72$; $p < 0.005$), function ($r = -0.81$; $p < 0.005$) or dexterity scores ($r = -0.86$; $p < 0.005$). There was a moderate negative correlation between the DASH and satisfaction scores ($r = -0.68$; $p < 0.005$) (Pearson correlation coefficient).

Table I

DASH-score	Number of patients
0-25 (none to mild disability)	26
26-50 (mild to moderate disability)	10
51-75 (moderate to severe disability)	7
76-100 (severe disability to unable)	0

Table II. — Results of the Visual Analogue Scales (percentage of thumbs)

	Pain	Function	Dexterity	Satisfaction
Poor results	11%	11%	26%	7%
No change	8%	8%	7%	12%
Good results	33%	37%	11%	19%
Excellent	48%	44%	56%	65%

Table III. — Mean values (with SD) of key pinch and grip strength of the affected side comparing before surgery to after surgery*

STRENGTH				
	No of thumbs	Before surgery		After surgery
Key pinch	32	5.32 (2.11)	p < 0,10	5.97 (2.66)
Grip strength	16	17.63 (12)	p < 0,05	23.81 (10.92)

* Measured in kilogram with the Jamar dynamometer (position 2).

Table IV. — Mean values (with SD) of key pinch and grip strength comparing the operated to the non-operated side*

STRENGTH				
	No. of thumbs	Operated side		Non-operated side
Key pinch strength	37	5.96 (2.44)	p < 0.01	6.96 (2.05)
Grip strength	37	23.78 (10)	p < 0.025	27.22 (10)

* Measured in kilogram with the Jamar dynamometer.

Mean opposition was equal in both the operated and unoperated sides. A mean Kapandji score of 9 (SD = range 6 to 10), i.e. touching the proximal crease of the little finger with the tip of the thumb, was obtained.

The mean first-web angle was 89° (SD = 16) on the operated side and 95° (SD = 13) on the opposite side in those who had unilateral surgery. Using Student's t-test, a statistically significant difference in web mobility was found (p < 0.025).

The pre- and post-operative key pinch strength measurements could be compared in 30 patients, the grip strength in 16 patients. There was a statistically significant increase in strength after surgery (Student's t-test) (table III).

Following unilateral operations (n = 37), both power grip and key pinch still demonstrated a statistically significant difference between the operat-

ed side and the contralateral side (Student's t-test) (table IV). The power grip on the operated side was on average 87% of the power grip on the contralateral side. The key pinch on the operated side was on average 86% of the pinch grip on the contralateral side.

The radiographs of all 43 thumbs could be evaluated. The position of the prosthetic components was unchanged at final follow-up in 19 of the 43 operated thumbs, four patients showed a cup fracture and one had perforation of the cortex of the metacarpal. Nineteen components showed radiological signs of loosening, affecting one metacarpal stem and 18 trapezial cups. Only five of these patients had symptoms. Only one patient was reoperated (resection of the implant and haematoma arthroplasty).

The mean age of patients with radiological loosening was 53 years (SD, 4.54). The mean age

Table V. — Comparison of implants with stable and unstable interface
(CL = contralateral, NS = not significant)

	Stable interface	Unstable interface	
Gripping postop./preop.	154%	109%	p < 0.05
Gripping postop./CL	92%	73%	p < 0.05
Key pinch postop./preop.	164%	184%	NS
Key pinch postop./CL	99%	78%	NS
DASH	20	29	NS

Table VI. — Mean values of the Visual Analogue Scales for each rank of the DASH-score

DASH-score	Visual Analogue Score			
	Pain	Function	Dexterity	Satisfaction
0-25	8	9	9	10
26-50	7	6	5	7
51-75	4	4	4	6

of patients without loosening was 56 years (SD, 6.38). A statistically significant difference in age was found between patients with and without loosening ($p < 0.01$). Radiological loosening was not correlated with time. The follow-up was 24 months (SD : 12.9) in patients with loosening and 28 months (SD : 13,1) ($p = 0.4$) in those without loosening.

We divided this cohort of patients into two groups. The first group included all patients without loosening or with only partial demarcation of cement ($n = 24$). The second group included patients with complete demarcation of cement and/or fracture of the cup ($n = 19$). A different outcome was observed (table V) : radiologically stable implants had a better gripping force. In none of the radiographs was osteoarthritis present in the adjacent joints.

DISCUSSION

The aim of total prosthetic replacement of the trapeziometacarpal joint is to create a painfree joint, combining the basic advantages of other methods : the stability offered by arthrodesis and the mobility and pain relief offered by resection and/or interposition procedures. Following total joint replacement, the thumb is neither shortened

nor destabilised. The results obtained indicate that this aim can be achieved, but not without complications.

There is an increase in key pinch and gripping power after surgery, but there still remains a significant difference between the operated and the non-operated side. With a grip strength improved to 87% of the opposite side, pinch strength improved to 86% of the opposite side, the goal of 60% of the opposite side for normal function is achieved (22).

Implant loosening is a matter for concern. Radiological loosening was present in 44% of the components. However, loosening of the prosthesis, in this series with 24 months of follow-up, did not necessarily lead to clinical failure. One case with loosening needed a revision. Only three patients with radiological loosening were not satisfied and only four complained of pain. Other series published in recent years by several authors have reported comparable outcomes (table VII) : pain relief ranged between 73 and 95%, but radiographic loosening was noted in 5 to 51%.

de la Caffinière and Rothe (14) considered the prosthesis to be indicated only in patients with restricted activity. Three of our patients had occupations involving heavy manual labour ; all three had good dexterity, satisfaction, pain and function results and two of them had no signs of loosening. Twelve of the housewives (48%), on the other hand, had loosening of their prosthesis (table VII).

Loosening was more common in younger patients (9, 28). The mean age of patients with loosening was significantly less than the mean age of patients without loosening. Six percent of the patients with loosening were older than 60 (table V), and 38% of the patients without loosening were older than 60. Of the patients older than

Table VII. — Review of some published series (NN : not noted, Fu = follow-up in months)

Author	Year	N patients	N thumbs	Age	Fu	% pain relief	% loosening
de la Caffinière and Aucouturier (13)	1979	29	34	NN	24	83	21
Braun (6)	1982	29	29	NN	12-84	76	10
August <i>et al</i> (3)	1984	20	21	57	15	95	48
Alnot and Saint-Laurent (1)	1985	15	17	56	36	76	NN
Ferrari and Steffee (17)	1986	38	45	61	51	73	51
Cooney <i>et al</i> (10)	1987	57	62	62	55	NN	51
Boecksteins (5)	1989	28	31	62	48	93	27
de la Caffinière (15)	1991	NN	13			69	61
Sondergaard <i>et al</i> (26)	1991	23	25	60	108	90	32
Nicholas and Calderwood (24)	1992	17	20	57	64	95	5
Chakrabati <i>et al</i> (9)	1997	71	93	57	72-192	93	24
Wachtl <i>et al</i> (30)	1998	NN	43	61	64	92	46
Van Cappelle <i>et al</i> (28)	1999	63	77	62	102	NN	44
This series	2004	40	43	54	26	84%	39.5%

60, 6% exhibited loosening, and 94% did not. Of the patients younger than 60, 50% showed loosening. We observed a 50% loosening rate in dominant hands, in contrast to 29% loosening in non-dominant hands (table V).

The DASH questionnaire proved to be a good tool for measuring the subjective impressions of the patients regarding activities of daily living. There are high correlations between the DASH scores and the visual analogue scores. When we look at the mean values of the visual analogue scales for each rank of the DASH score, we can conclude that a DASH score of more than 50 corresponds to unsatisfactory pain relief, poor function, and poor dexterity results (table VI).

We consider the la Caffinière prosthesis to be an acceptable treatment for trapeziometacarpal arthritis but the findings in this study caution that it might not be the right choice in younger patients or for the dominant hand.

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