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ORIGINAL STUDY

Clinical outcome of cementless semi-constrained trapeziometacarpal arthroplasty, and possible effect of Vitamin C on the occurrence of complex regional pain syndrome

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Patients with trapeziometacarpal joint arthritis stage II or III (according to Dell) and no benefit from non-operative therapy were selected to undergo joint arthroplasty. We performed 32 arthroplasties for first carpometacarpal arthritis in 27 patients using a cementless total trapeziometacarpal joint prosthesis. We undertook a prospective cohort study and evaluated the clinical results of total joint arthroplasty after an average of 39 months. Visual analogue scale (VAS) scores for pain, daily activities (ADL) and satisfaction were taken pre- and postoperatively, and the first web opening was measured. First web opening improved significantly as did pain, ADL and patient satisfaction.

Surgery of arthritis of the first carpometacarpal joint can be complicated by complex regional pain syndrome (CRPS) type I. In all our patients Vitamin C 500 mg daily was started two days before surgery and continued during 50 days. There were no cases of CRPS under vitamin C prophylaxis. These results justify further investigation in a randomised clinical trial.

Keywords : trapeziometacarpal arthritis ; arthroplasty ; joint replacement ; reflex sympathetic dystrophy ; complex regional pain syndrome ; ascorbic acid.

INTRODUCTION

Osteoarthritis of the trapeziometacarpal (TM) or first carpometacarpal joint (CMC I) is common. Treatment is usually conservative. Possible surgical solutions are resection-arthroplasty, interposition arthroplasty (*9*), fusion or arthrodesis (*1*) and prosthetic joint replacement (*6*). The complication rate of these surgical procedures is high and complex regional pain syndrome (CRPS) type I may occur (*11*). After wrist fracture a beneficial effect of vitamin C on the occurrence of CRPS has been described (*2,14,15*). We report our experiences with a total joint prosthesis under vitamin C prophylaxis in a prospective cohort study.

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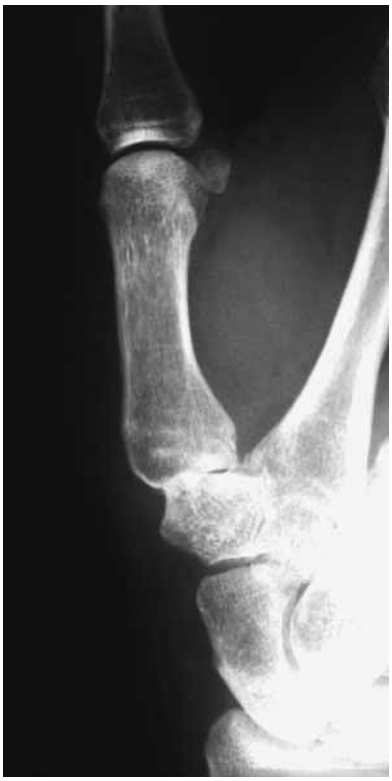

Fig. 1. — Mild arthritis of the first carpometacarpal joint : stage II according to Dell.

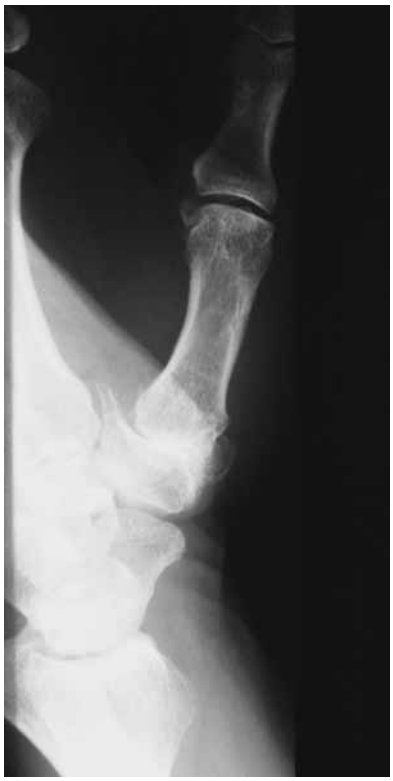

Fig. 2. — Arthritis of the first carpometacarpal joint : stage III according to Dell.

PATIENTS AND METHODS

Twenty seven patients (21 female and 6 male) with complaints of osteoarthritits of the trapeziometacarpal or first carpometacarpal (CMC I) joint were included in the study. Only patients with stage II or III arthritis according to Dell *(3)* were accepted in this protocol for prosthetic surgery (figs 1 and 2). They underwent 32 arthroplasties in total, after an unsuccessful trial of conservative treatment consisting in oral medication (non-steroidal anti-inflammatory drugs), injections (corticosteroids), physical therapy (intrinsic thenar musculature strengthening), casting or bracing, alone or in a combination. One surgeon (PEZ) implanted the Roseland prosthesis in all cases since 2002. The degree of osteoarthritis according to Dell was stage II in 13 cases and stage III in 18. One patient had a traumatic dislocation of the trapeziometacarpal joint. Her postoperative treatment consisted of plaster cast immobilisation for 6 weeks. We have reported on this particular case separately *(13)*.

The median duration of complaints was 42 months (interquartile range [IQR] =36), ranging from 5 (the dislocation case) to 156 months. The median time to surgery since the first complaints in patients with a Dell stage II problem was 24 months (IQR = 32, n = 13) and with a Dell stage III problem 48 months (IQR = 75, n = 18). The difference between the median delay of Dell stage II and III was significant (p = 0.008).

At the beginning of the study the following parameters were recorded : age, sex, side of CMC I arthritis, dominance, occupation, complaints and duration of complaints. Physical parameters were grind test, crepitus, subluxation, instability, thumb opposition, pinch grip test and first web opening.

We recorded the pre- and postoperative visual analogue scale (VAS) scores for pain, daily activities (ADL) and satisfaction, up to one year post-operatively *(5)*. In the score for pain, zero represents no pain and 10 means unbearable pain. In the ADL and satisfaction scores, zero means the worst imaginable outcome and 10 the best imaginable result.

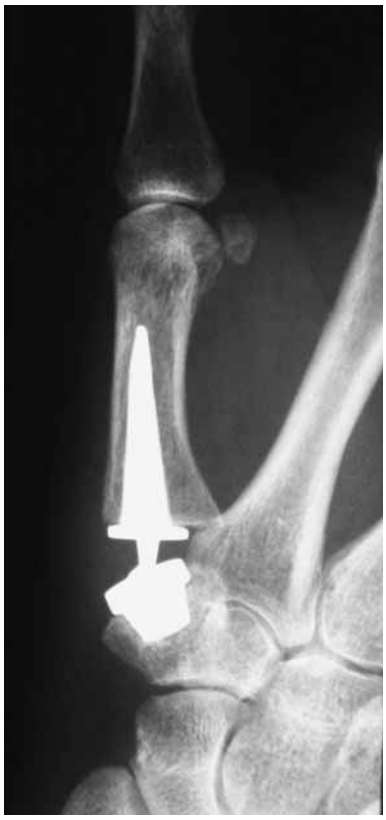

Fig. 3. — The same patient as in figure 1 ; after implantation of a semiconstrained hydroxyapatite coated trapeziometacarpal joint prosthesis (Roseland prosthesis ; DePuy, Leeds, England).

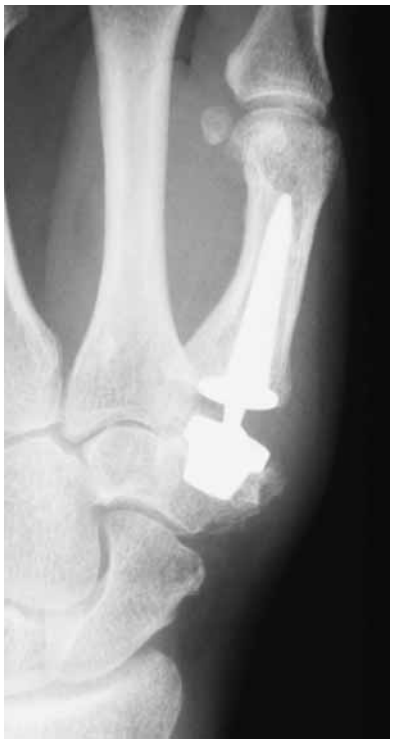

Fig. 4. — The same patient as in fig 2 ; after implantation of a semiconstrained hydroxyapatite coated trapeziometacarpal joint prosthesis (Roseland prosthesis ; Depuy Int. Leeds, England).

Two days prior to surgery oral vitamin C prophylaxis (500 mg daily for 50 days) was started, to diminish the chance for occurrence of complex regional pain syndrome (CRPS) type I, as described in a trauma protocol for wrist fractures by Zollinger *et al* (*15*).

Operation was performed as a day case or short stay (one night stay in the hospital) usually under plexus anaesthesia (30 times) or under general anaesthesia (2 times). A dorsoradial approach with a 'lazy Z' shaped incision was used in all cases.

In this study a cementless trapezio-metacarpal total joint prosthesis (Roseland prosthesis, DePuy, Leeds, England) was used (figs 3 and 4). This prosthesis made of titanium alloy has a partial hydroxyapatite coating and is semi-constrained as described by Moutet *et al* (*7*).

All patients received a single dose of intravenous cefazolin 1 g half an hour pre-operatively. A tourniquet was used routinely.

Postoperative treatment consisted of a bandage with collar and cuff for 5 days, NSAID and vitamin C. After 5 days the patients started circumduction and opposition exercises, without passive mobilisation. Two weeks post-operatively active physical therapy was started when necessary.

Follow-up visits were planned after 5 days, 2 weeks, 6 weeks with check radiographs, 3 months, 6 months and 12 months, again with radiographs and then yearly. Follow-up of our study group ranged from 7 to 66 months, with a mean of 39 months.

Complex regional pain syndrome type I was defined according to Veldman *et al* (*12*) and diagnosed when four of the following five symptoms were present and/or increased with activity :

1. unexplained diffuse pain ;
2. difference in skin colour compared with the other hand ;
3. diffuse oedema ;
4. difference in skin temperature compared with the other hand ;
5. limited active range of motion (*12*).

Table I. — Pre- and postoperative scores for the variables studied

	Mean (SD) preoperative	Mean (SD) postoperative	Difference (95% CI) (post-minus preoperative)	p value
First web opening (°)	58.0 (10.1)	76.1 (11.3)	18.1 (13.1 - 23.2)	0.000
VAS pain	7.4 (1.2)	1.2 (1.6)	-6.3 (-6.8 - -5.7)	0.000
VAS daily activities	4.2 (2.0)	8.5 (1.4)	4.4 (3.7 - 5.1)	0.000
VAS satisfaction	2.2 (82.0)	8.8 (2.0)	6.7 (5.7 - 7.6)	0.000

VAS = visual analogue scale
CI = confidence interval.

Table II. — Multiple regression of patient satisfaction (VAS : 0-10) on postoperative pain reduction (VAS : 0-10) and preoperative duration of complaints (months)

	Unstandardized coefficients Standard error		95% CI	Standardized coefficients Beta	P value
Improvement VAS pain score	0.907	0.234	0.428 - 1.386	0.546	0.001
Duration of complaints	0.020	0.009	0.002 - 0.039	0.312	0.035

VAS = visual analogue scale
CI = confidence interval.

Statistics

The statistical analysis was performed with SPSS (version 15.0.1) software on a personal computer.

The paired t-test, Wilcoxon signed rank test and the Mann-Whitney U test were used as applicable for univariate analysis.

The relationship between patient satisfaction and the other studied variables was estimated using multiple regressions. Non-significant variables were removed one by one, removing the largest p value first, until all remaining variables in the model were significant.

RESULTS

VAS scores for pain, daily functioning and satisfaction (table I) improved significantly after operation (p = 0.000, paired t-test). First web opening (table I) increased by 18° (p = 0.000, paired t-test).

Web opening increased less in Dell stage III (median = 15, IQR = 13.8) compared to Dell stage II (median = 25, IQR = 20), but the difference was not significant. The improvement for pain, ADL and satisfaction was equal for both stages of osteoarthritis.

Higher patient satisfaction was related to better postoperative pain reduction and longer duration of preoperative complaints (table II). No relation was found with the other outcome variables such as ADL and first web opening.

Complications occurred in 5 of 32 surgical procedures (15.6%).

In three cases a revision (9.5%) to a resection arthroplasty was performed once because of non union of a trapezium fracture occurred during operation (fig 5), and twice because of a trapezium implant dislocation.

One case of tendovaginitis of the thumb was treated successfully with a corticosteroid injection.

One case of a superficial radial nerve branch entrapment (complex regional pain syndrome type II) was relieved by open neural decompression.

We detected no cases of complex regional pain syndrome type I. There were no infections.

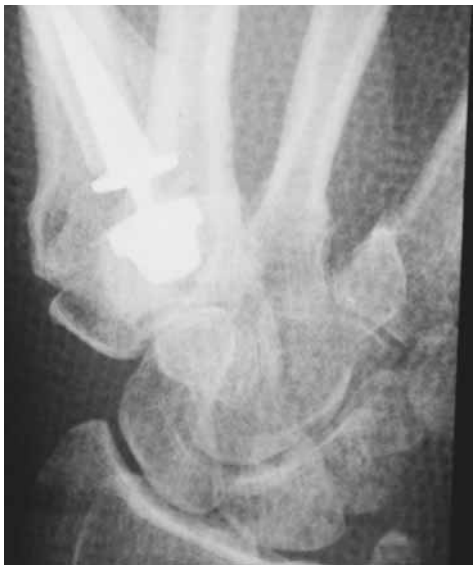

Fig. 5. — Fractured trapezium in cast

DISCUSSION

Surgery of the trapeziometacarpal joint is known to be demanding and the complication rate is high with different procedures (*6,9,10*).

Comparing arthrodesis with tendon interposition arthroplasty, the more favourable procedure is still unclear. Pinch grip seems stronger in arthrodesis, and range of motion is better after interposition arthroplasty (*4*). On the other hand the complication rate seems to be lower in the interposition arthroplasty group (27%) than in the arthrodesis group (39%) (*8*). Saehle *et al* (*9*) noted some loss of sensation on the dorsal aspect of the first ray in 8 of 55 (14.5%) tendon interpositions.

Takwale *et al* (*10*) report an incidence of 19% of complex regional pain syndrome (CRPS) in cases of post-traumatic instability of the trapeziometacarpal joint.

Torrededia *et al* (*11*) studied retrospectively 38 implantations in 34 patients with the same implant we used, the Roseland prosthesis. They immobilised the first column with a neoprene splint for one month and started physical therapy one week after surgery. Complication rate was 18.4%. Complex regional pain syndrome (CRPS) type I occurred in 5 patients (13%). They believe that lengthening of the first column might be the cause of CRPS in three of their 5 cases. The only difference with our aftercare is the early functional treatment we encourage and the administration of vitamin C.

MacDermid *et al* (*6*) report a high revision rate (23%) in their series. Revision rate to a resection arthroplasty in our series was 9.4%.

Our first experiences with this procedure seem encouraging. Patients have a satisfying pain relief and an improved and stable function. Patient satisfaction was strongly associated with the amount of pain reduction and the preoperative duration of the complaints. Patients with Dell stage III had a significant longer duration of symptoms than patients with Dell stage II before they were operated. This seems a logical consequence for a disease to become clinically worse in time.

Patients should be aware of the high complication and revision rate before they decide to undergo surgery. In case of failure of the procedure or the prosthesis, a resection arthroplasty or arthrodesis can be performed as a salvage procedure. We chose to perform a resection arthroplasty in those cases.

In contrast to Torrededia *et al* (*11*), we did not encounter CRPS in our patient group. The positive trend in this pilot cohort study in comparison with the study of Torrededia *et al* (*11*) confirms the results of two other randomised clinical trials (RCT) in wrist fractures (*14,15*), where a positive effect of vitamin C was noted on the occurrence of CRPS. A RCT in a larger population with long-term follow-up should clarify this.

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