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"LA GARANGOLA" PADOVA - ITALY

Medium term experience of the Moje Ceramic Implant for the Proximal Interphalangeal Joint

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Summary: Replacement of the proximal interphalangeal joints of the fingers is difficult and makes high demands on the bio-mechanics and stability of the prostheses (3). Previous products have frequently failed as a result of complications such as loosening of the prosthesis, instability and dislocation. As pure place-holders, the Swanson spacers used hitherto provided inadequate mobility and power (4,5). The Moje prosthesis is a development that imitates a real joint and should guarantee a durable, stable attachment. After a few weeks the prosthesis exhibits penetration by the bony tissue accompanied by firm incorporation of its components. It consists of a zirconium oxide ceramic coated with a bio-ceramic, Bioverit I. The most important property of this material is good bio-compatibility without inducing degenerative changes or foreign body reactions. Implantation is carried out without cement using a press-fit technique. Between November 1999 and December 2003 we implanted 26 Moje prostheses as the proximal interphalangeal joints of the fingers of 24 patients. Postoperatively very greatly improved mobility and gross power could be achieved. Follow-up examinations carried out as part of a study showed a statistically significant improvement in grasping power and average range of motion (ROM), and good subjective satisfaction in the patients. Long-term results have been lacking, but experience to date does, however, suggest that routine use in hand surgery can be expected.

Key words: Hand surgery and articular prosthesis.

INTRODUCTION

Because of the special anatomical circumstances, the development of a prosthesis for the proximal interphalangeal joint has turned out to be particularly difficult.

Over the last few decades many attempts have been made to introduce durable cemented and non-cemented prostheses. During this period a solution using silicone implants stood out and gave good results, especially in the metacarpal phalangeal joint. These implants act as a spacer and exhibit the side-effects of abrasion usually seen with silicone (2).

Many prostheses developed for the proximal interphalangeal joint failed, mainly as a result of loosening and dislocation. Thus the operation most commonly carried out on the proximal interphalangeal joint continues to be arthrodesis with tension banding, screw osteosynthesis or plating. Despite a carefully chosen angle of arthrodesis, this involves a definite restriction of movement and reduced clenching of the fist.

As before, the aim remains to produce a genuine joint with a stable and durable attachment.

The ceramic and pyrocarbon joint prostheses developed in recent years should prove more and more able to meet these demands (1).

In particular the Moje ceramic prosthesis should make it possible for cortical bone to grow into the jacket of the prosthesis without new bone formation at that point. Furthermore, the free play of the joint should be sufficiently great to keep the hand sound. It should be possible to rule out abrasion of the prosthesis (2).

As a consequence of the initial experience, the Moje ceramic implant underwent further modifications. The implanted bodies are kept flat in order to protect the insertions of the ligaments. The heads and cups of the joints are inclined towards the palmar surface and the components of the joint rounded off dorsally in order to achieve as much flexion and extension as possible. The design of the cup makes rolling and sliding possible. In order to provide improved

press-fit implantation, the surfaces are grooved so as to increase their area.

MATERIAL AND METHODS

Between December 1999 and December 2003, 26 Moje prostheses were implanted at our clinic as replacements for the Proximal interphalangeal (PIP) joint in 24 patients (Figure 5). PIP joint replacement was carried out six times on the index finger, nine on the middle finger and 11 on the ring finger. The male-female sex distribution was 8:16. The average age of the patients was 62.3 years ranging between 26 and 75 years (Table 1).

TABLE 1.

24 patients	26 prostheses	no.
Nov. 1999 - Dec. 2003	Index finger	6
16 females, 8 males	Middle finger	9
26-75 years (avg. 62.3)	Ring finger	11

Degenerative arthrosis was present in 17 proximal interphalangeal joints (Figures 3 and 4). Six patients exhibited destruction of the joints as a result of post-traumatic arthrosis (Figures 1 and 2). In one case there was destruction in the presence of chronic polyarthritis.

Patients with additional existing tendon damage or unsuitable soft tissue conditions in the area of the joint were excluded from the study. Conversely, severe deformity of the joints and pre-existing extensive exophyte formation were not excluded.

IMPLANTATION TECHNIQUE

The prosthesis used is a ceramic prosthesis consisting of a zirconium oxide ceramic coated with Bioverit I. The zirconium oxide ceramic was tested extensively in animal experiments. With the Bioverit coating as a bioactive glass-ceramic covering, good bio-compatibility was demonstrable. The coating makes it possible to have cement-free implantation by 'press-fit attachment' in the shaft of the proximal and middle phalanges. The size of the prosthesis can be determined preoperatively by lateral and antero-posterior preoperative X-ray examination.

Access was standardised in all patients. All procedures were carried out ischaemically under regional or intratracheal anaesthesia according to the patient's wishes. Special instru-

ments required were a cannulised drill set, an implant tool for intermedullary fixation of the shaft of the prosthesis and an impactor.

Access is obtained dorsally via a longitudinal incision in the region of the proximal interphalangeal joint. After longitudinal division of the central slip of the extensor tendon, the proximal interphalangeal joint is resected proximally and distally to correspond approximately with the volume of the prosthesis, the resection being at rather more than right angles proximally and rather less distally. The collateral ligaments remain in situ as far as possible. However, because of severe arthritic deformity of the joint, detachment of the insertion of the ligament is frequently necessary. This is later reconstructed and/or reattached. The surfaces of the resection are retracted, after which a Kirschner wire is inserted axially and drilled out with a cannulated drill. The site of the prosthesis is then prepared with the implant tool. Small irregularities in the cortical margin can be corrected with a sharp surgical spoon at the same time. There now follows preparation of the site of the prosthesis proximally by an analogous procedure. The prosthesis can then be inserted rotationally stable by the press-fit procedure using an impactor. By virtue of its design the shaft of the prosthesis exhibits an inclination toward the palmar surface proximally and distally.

On refixation of the collateral tendons, they are reinserted by means of an absorbable suture in the bone before the implant is introduced and gathering up of the ligaments is carried out. Drill holes are also used to reinsert the central slip of the extensor tendon at the base of the dorsal middle phalanx.

Once the Moje prosthesis has been implanted, suturing then takes place using the presenting sutures. X-ray fluoroscopy is carried out to check the exact seating of the implant. Longitudinal closure of the central slip of the extensor tendon is carried out using continuous or interrupted suturing. The finger is then splinted in a mid-flexion position using a palmar 2-finger splint.

Postoperatively the finger joints are immobilised with the fingers in mid-flexion for three weeks. During this time the proximal interphalangeal joints involved are thoroughly moved on changes of dressings. After three weeks active movement is commenced. A finger stall is worn

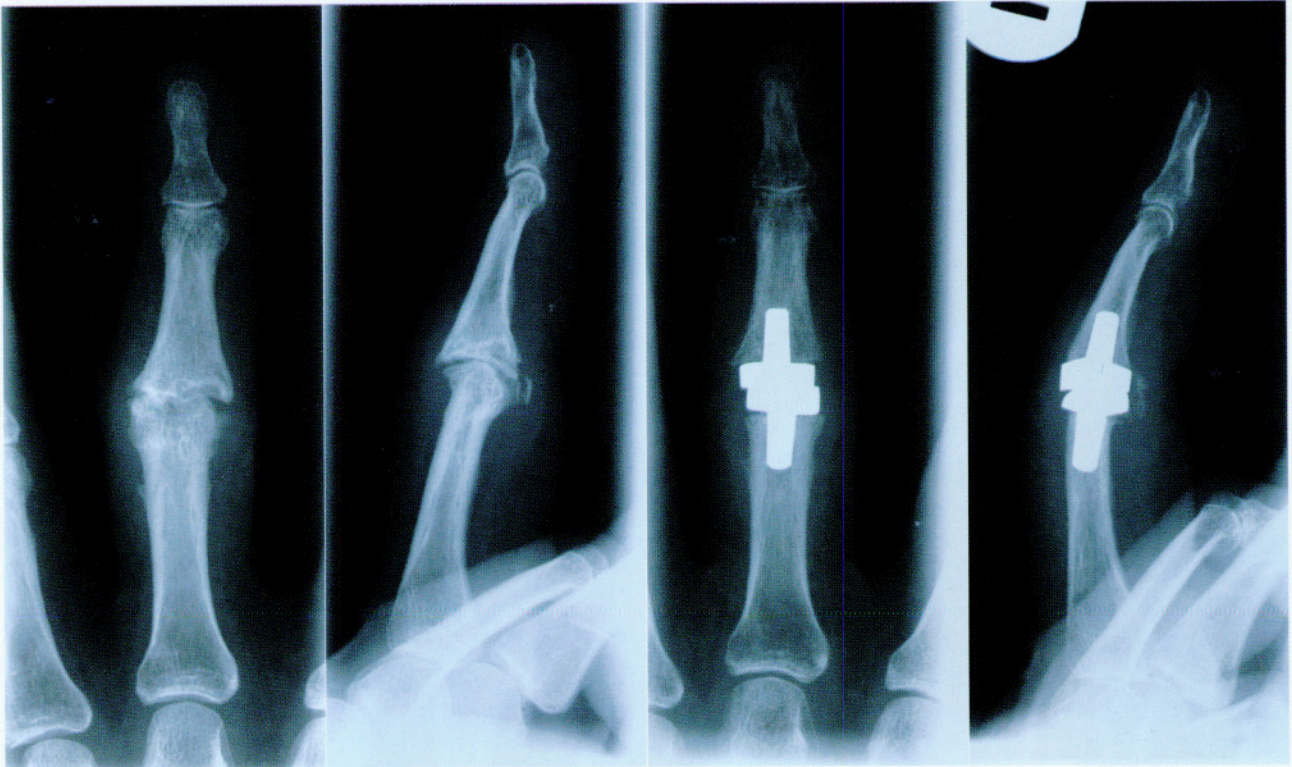


Figure 1. – A 62-year-old woman with a post-traumatic deformation of the PIP joint; pre op and 6 months after implantation of a MOJE prosthesis.

for a further two weeks. A twin bandage is applied until the 6th week after the operation.

RESULTS

It was possible to follow-up 23 patients with 25 proximal interphalangeal joint prostheses as part of the clinical study. The implant was removed from one patient because of a complication.

The period of follow-up varied between three and 48 months, with an average of 22.5 months. It was possible to compare the data obtained preoperatively with the postoperative results. Important measurements included the extent of pre- and postoperative mobility, grip in the power grasp and key grip, achievement of a clenched fist, assessment of pain and subjective satisfaction. Six patients exhibited a definite reduction in pain while

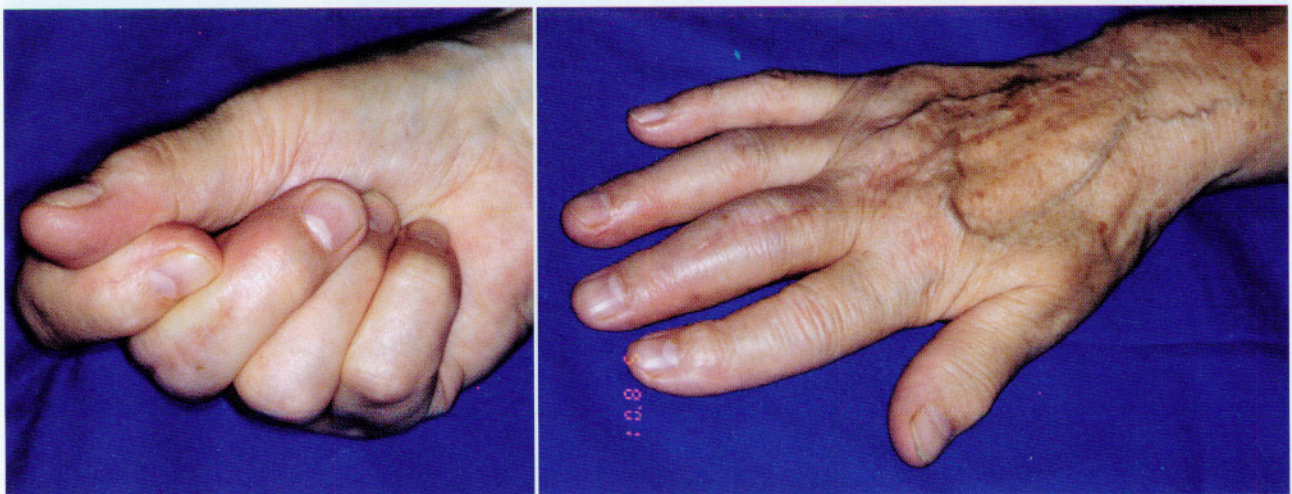


Figure 2. – Hand function six months after a PIP prosthesis.

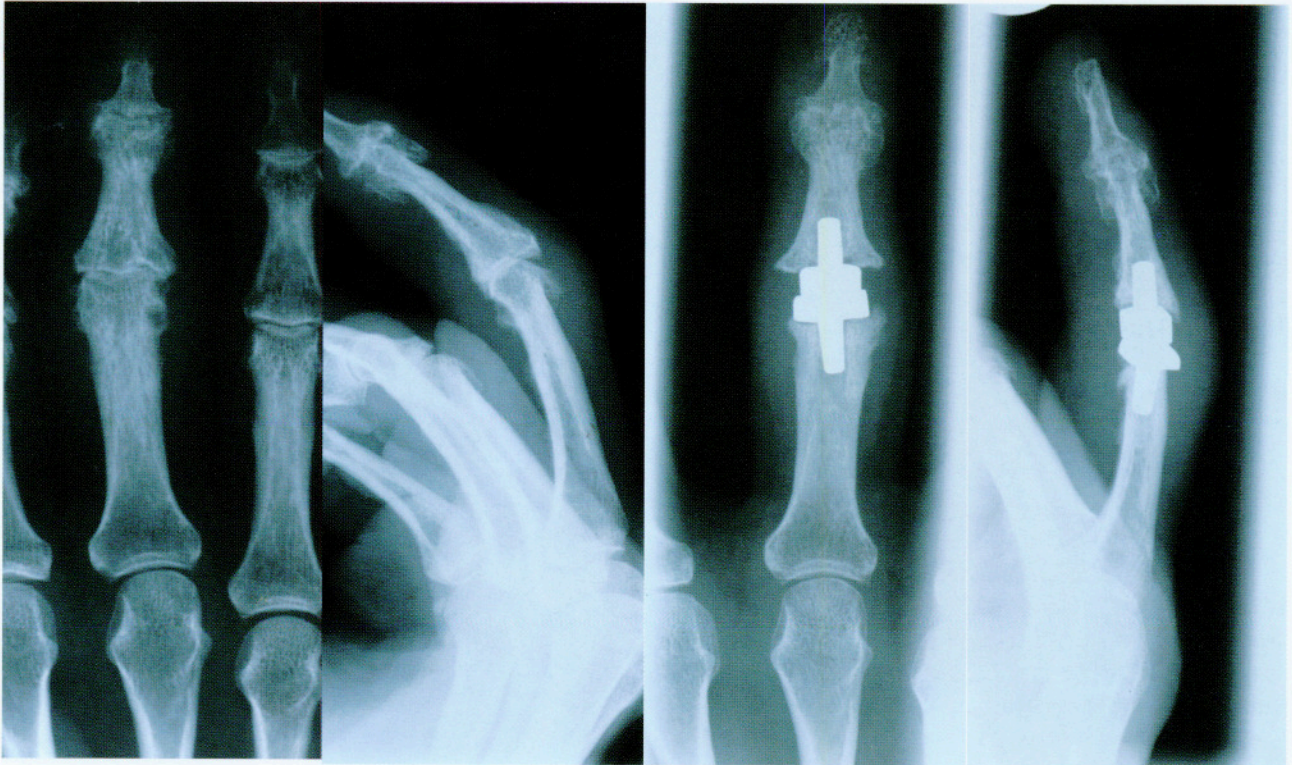


Figure 3. – A 73-year-old woman with degenerative arthritis of the PIP-joint middlefinger; pre op and one year after implantation of a MOJE prosthesis.

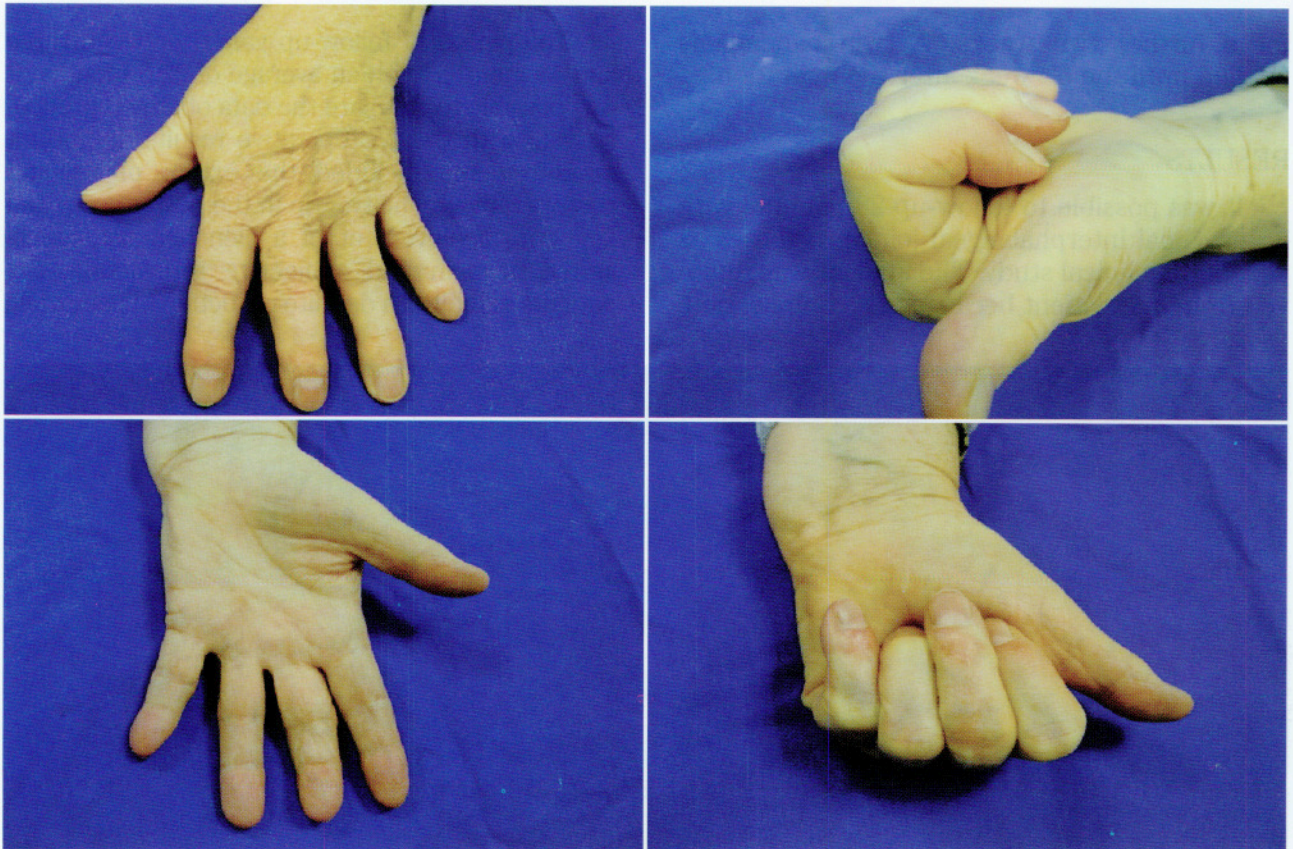


Figure 4. – Handfunction one year after PIP-joint arthroplasty.

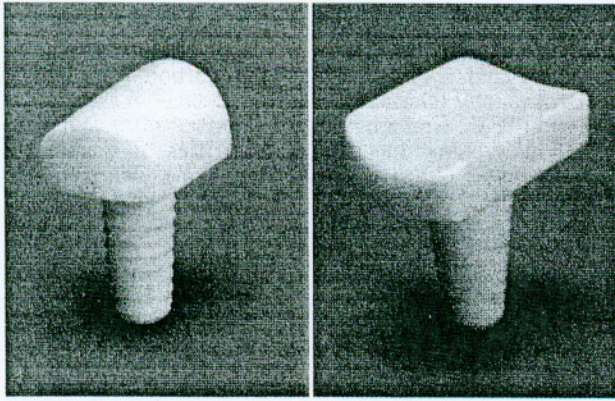


Figure 5. - Design of the ceramic prosthesis for the PIP-joint.

17 reported no pain. Stability was categorised as good by 18 patients and as satisfactory by five.

Radiologically, 23 implanted prostheses were revealed to be stable without signs of loosening while two exhibited slight sinking. A total of 16 proximal interphalangeal joints revealed ideal positioning of the prosthesis.

Postoperatively it was possible to achieve a good measure of mobility of the proximal interphalangeal joint. The preoperative mean value for flexion of the finger was 50.82° ($15-75^\circ$). Postoperatively the mean value was 75.12° ($65-95^\circ$). The average ROM was 25.25° preoperatively and 29.43° postoperatively. This value was statistically significant (Table 2).

TABLE 2.

PIP - flexion 25 fingers	preop: $15-75^\circ$ (avg. 50.82°) postop: $65-95^\circ$ (avg. 75.12°)
ROM 25 PIP - joints	preop: 25.25° postop: 29.43°

Grip on the dynamometer as a percentage of the opposite side rose on average from 52.3° to 70.26° .

This is also in keeping with improved fitness of the hand compared with preoperatively.

Subjective satisfaction on the visual analogue scale in relation to pain symptoms and function were assessed by the patients as follows: very good 11, good 10, satisfactory 2 and poor 0.

All patients would undergo the operation again.

COMPLICATIONS

So far as complications are concerned, we have to report a luxation of the implant. It was

possible to correct this by tightening the ligaments.

One patient, who was suffering from a rheumatic primary disease, exhibited disturbance of healing of the wound. Because of dehiscence of the wound, it was necessary to remove the prosthesis.

No incompatibility of the prosthesis or foreign body reaction was observed. In some patients a rubbing sound was audible that disappeared after some months. There was no disruption of the blood supply.

DISCUSSION

Overall we view the Moje prosthesis as a replacement joint well suited to the proximal interphalangeal joint. Although previous types of prostheses for the proximal interphalangeal joint were mostly unsuitable in the long run, we have here a sturdy joint that most probably meets the requirements for the use of the hand in terms of grip and its employment for fine movements. On the evidence of our follow-up to date, the hand can be used for fine work as well as for gross grasping and the application of force. Implantation of the prosthesis has also proved its worth with grossly deformed joints. The form of the joint surfaces of the total endoprosthesis guarantees adequate lateral stability and guidance. Since a non-coupled prosthesis is involved, the danger of loosening in the region of the shaft of the prosthesis is less than where its components are coupled.

The late X-ray results with slight sinking of the prosthesis after some years observed by us in two cases contrast with the very good clinical function in these patients. Further opinions on this cannot be given until several years have passed.

As to postoperative management, the rule is that the mobility achieved intraoperatively should not be exploited at first. With the press-fit procedure used, the prosthesis is firmly seated at the end of the operation so that moderate early mobilisation is possible. However, we prefer approximately three weeks immobilisation, followed by guided movements up to the 8th week. Only then may a solid attachment of the prosthesis to the bone be assumed. Furthermore, practice has shown that simultaneous fusion of the distal interphalangeal joint in the presence of advanced arthrosis there is

also possible. This combined operation was carried out in a total of three cases.

An indispensable condition of a good postoperative result is that the tensor and extensor ligaments of the proximal interphalangeal joint be intact while an intact and flexible capsule with sufficient elasticity of the membrane are essential. If these requirements were met, we could also achieve good results with post-traumatic changes. To summarise: from our experience to date, implantation of the Moje prosthesis may be regarded as an alternative to fusion of the joint. Long-term results will have to wait, however.

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