

LA PROTESI IN CERAMICA NELL' ARTROSI DELLA MANO

The ceramic prosthesis in osteoarthritis of the hand

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Summary

The authors describe their experience with the ceramic-ceramic coupling prostheses in osteoarthritis of hand (Fig.1). This implant is a non constrained, biocompatible system with biomechanical and biological favorable features.

Materials and methods

Between 2002 and 2008, 98 patients (59 female and 39 male) with the mean age of 62 years (range between 50-70 years) were treated in the Orthopedic Department of Pierangeli Hospital in Pescara. A total of 104 implants have been included in this study (55 in the right hand, 33 in the left hand and 8 in both hands). Seventy (70) patients were assessed with a follow-up range between 3 months to 5 years.

Results

The ceramic-ceramic coupling prosthesis showed favorable results in 90% of the cases in our series. Only 10% of the patients obtained poor results in terms of the implant survival. In the authors' opinion, this joint replacement system seems to give good outcomes in selected cases of osteoarthritis of the wrist and hand, due to intrinsic characteristic of its ceramic components, to the implant design and the minimal surgical invasiveness.

Conclusions

According to this series, the research of new materials has allowed to broaden new treatment opportunities in hand prosthetic surgery. The system used and developed in part by the authors needs to be further asses and must follow strict indications and a proper surgical technique. The biocompatibility and the osteointegration features of this system are particularly interesting along with its strong stability and minimal skeletal sacrifice. Riv Chir Mano 2011; 1:31-39

Key words

Ceramic prostheses, arthroses of hand

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The extreme differentiation and complexity of anatomical and functional condition of the wrist and hand treatment especially in degenerative osteoarticular pathologies, in which the main objective represented by the best functional recovery in the absence of pain and preservation of stability is a result difficult to prosecute (1, 2).

Over the years there have been proposed different treatment strategies for pursuing these objectives (2-4), and between these prosthetic surgery has developed various types of implants (2,5) different in form, biomechanics and material composition, implants which on the basis of the literature reviewed show positive results in 60-70% of cases and that recognize as the cause of the failures, precise mechanisms (1, 2, 6) in which the weak links of the system are represented by the biocompatibility of the systems, capacity of osteointegration, physical characteristics and design of implant that cause of the phenomena of wear, instability and aseptic loosening that determine precisely the failure of system (5-9).

These complications have given additional impulse in the research (5, 6, 9) for more reliable materials and techniques to achieve levels of success comparable to prosthetic surgery of the lower limbs.

And just taking a cue from the surgery of hip, our attention directed towards the bioceramic introduced by Boutin in the 1970s (Fig.1 and 2) (10).

Characteristics that gain interest to this material mainly are the following:

1) Mechanical resistance

There are material that have low module of elasticity, that don't deform and fatigue, don't break for wear but for sudden fracture when the applied forces exceed the elastic limit, which is about 2000-4000 mpa, have resistance to corrosion from 3 to 40 times better that metallic alloys, rigidity exceeds 300 times, burst strength up to 102 kn (twice the permissible value).

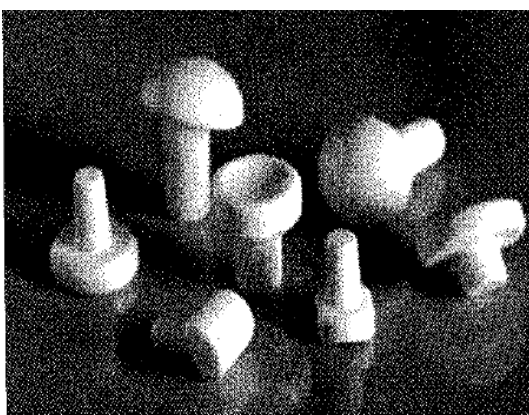


Fig. 1. Ceramic-on-ceramic coupling prostheses for osteoarthritis of hand

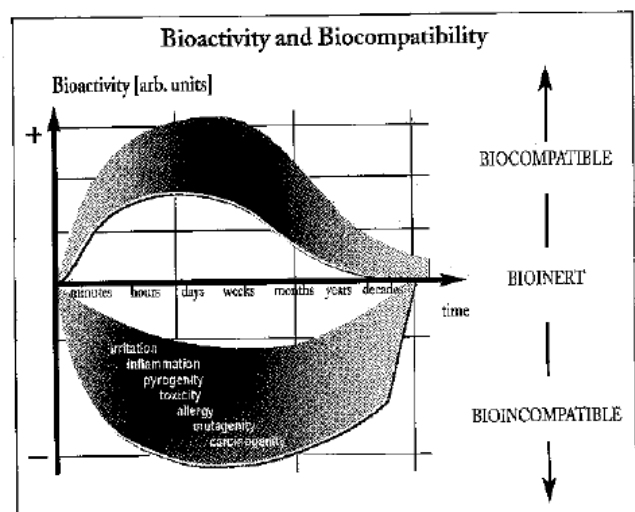


Fig. 2. Properties of bioceramic

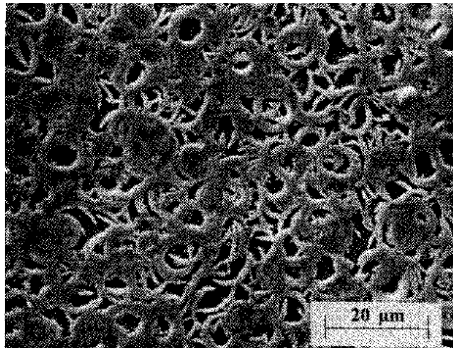


Fig. 3. Debris of polyethylene

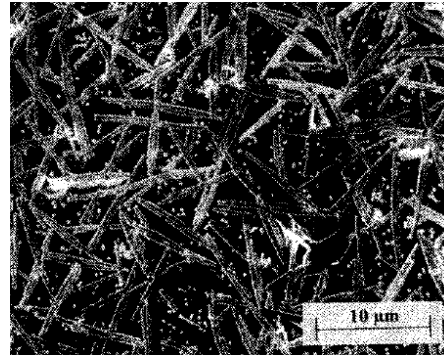


Fig. 4. Debris of ceramic

- 2) Capacity of osteointegration: have a high capacity of osteoconduction that allows the transformation of elements totipotent endothelial and mesenchymal elements of the blood stream as well as in osteoblasts, favoring the pressfit
- 3) Biocompatibility: have a high resistance to wear in contrast to common metal materials and polyethylene what apparently explains the almost total absence of synovial reaction to a foreign body, have a low coefficient of friction (0.6 compared to 0.1% of other alloys), a wear linear 0.02 / 0.5 mm (per year) versus 150/250 mm. Compared to other couplings volumetric values up to 250 times lower.
- 4) Self-lubrication : ability to form a fluid film that reduces friction between the articular surfaces, this capacity is intimately related to the difference in diameter of the articular surfaces of the system (tolerance) that must be minimal (low tolerance, high congruence, hydrodynamic lubrication) and from 'irregular surfaces (Fig.3-4).

These peculiarities have led us to try to find on the market a system that showcased a mix of these characteristics and the system that we identified as answered on paper meet the requirements: system pairing ceramic-ceramic, characterized by skeletal anchorage with pressfit technique, high consistency, and minimal skeletal resection (thus allowing salvage intervention).

The indications for treatment to us were those of a primary or secondary arthrosis of wrist and hand with an absolute contraindication of a poor bone quality (rheumatoid arthritis, severe osteoporosis) (Fig. 5).

Materials and methods

Convinced by the system since 2002 we have started our experience at the Department of Orthopaedics of Casa di cura Pierangeli in joint replacement surgery with ceramic implants for 98 patients with Osteoarthritis of the hand and wrist in which we felt there was indication for this method:

In our study, we treated (Fig. 6-10):

- 16 patients with wrist arthrosis
 - 8 cases of secondary arthrosis after SNAC/ SLAC
 - 4 cases of secondary arthrosis after Kienboech disease
 - 2 cases of idiopathic arthrosis
 - 2 cases of post fracture of the distal radius
- 63 patients with arthrosis of trapezio-metacarpal joint on stage $\frac{3}{4}$ according to Eaton excluding patients with STT arthrosis and height of trapezium $< \frac{7}{8}$ mm (Fig. 11-13).

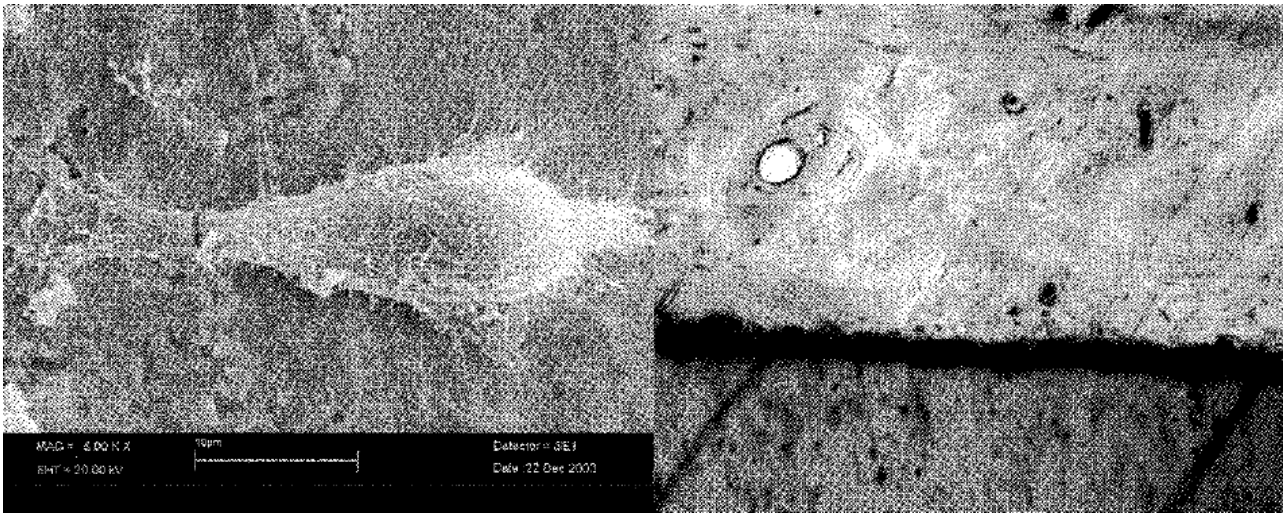


Fig. 5. Osteointegration capacity of ceramic

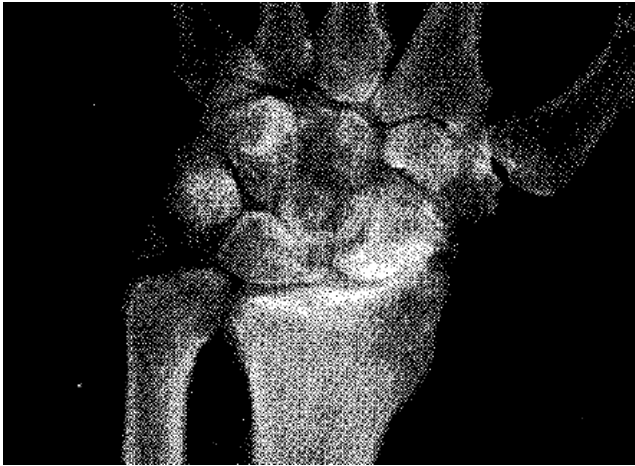


Fig. 6. Wrist pre AP



Fig. 7. Wrist pre L

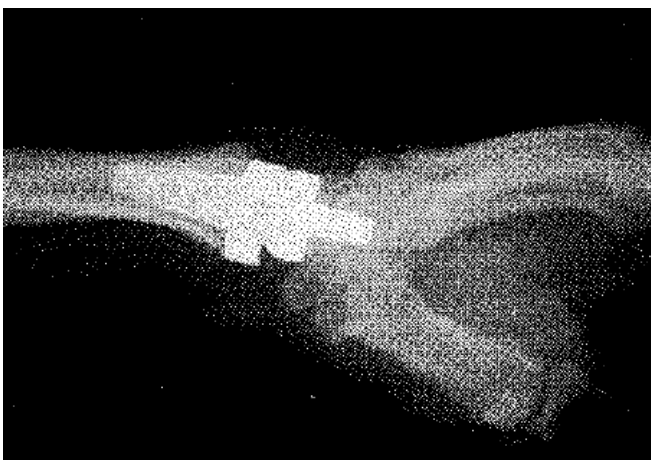


Fig. 8. Wrist post L



Fig. 9. Wrist post AP

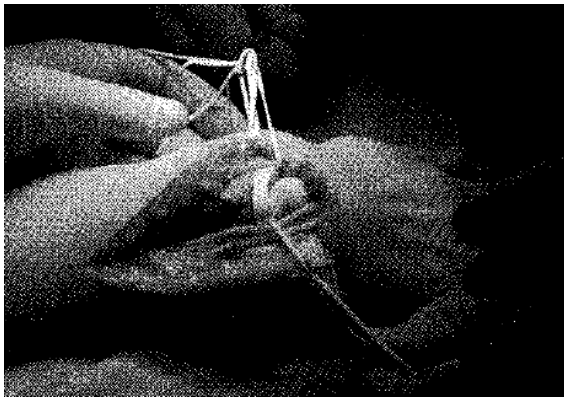


Fig. 10. For explanation see text



Fig. 11. TM pre. For explanation see text



Fig. 12. TM post. For explanation see text

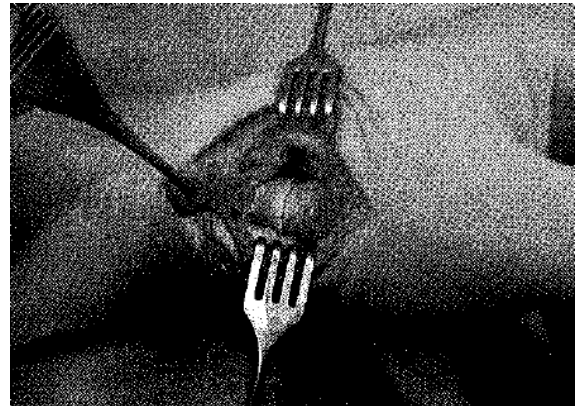


Fig. 13. TM intra. For explanation see text

Table 1. Evaluation parameters. VAS Scale for pain

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- Mayo Wrist Score
 - Radiographic parameters: height of the carpus, carpal ulnar deviation index, distal radial ulnar joint condition, signs of osteolysis, trapeziometacarpal axis and height, correction of digital axes.
 - Kapandj Scale for trapeziometacarpal
 - TAM Scale for distal articulation

Table 2. DASH Score

Disability of Arm-Shoulder-Hand

$\frac{\text{Score achieved} - 30 \text{ min. score}}{1, 20} = \text{DASH score}$

Ø= 40 (5-80)

0 points - excellent functional recovery

100 points – bad functional recovery

- 7 patients with degeneration of MCP joint
 - 1 patient with bilateral involvement for gouty arthropathy (Fig. 14-16)
- 12 patients with arthroses of proximal interphalangeal joints
 - 5 patients with post-traumatic arthrosis (Fig. 17)

After intervention followed: immobilization for 2 weeks, functional rehabilitation under control of specialist for a total period of three months which was followed by complete recovery to routine activities.

All patients entered in the series have been checked with follow-up from 3 months to 5 years, 73. The parameters of evaluation are shown in Table 1.

The Dash Score for evaluation of the global recovery of the hand and reported in Table 2. Analytically, we have examined:

- 48 patients operated trapeziometacarpal joint replacement
- 12 patients operated radiocarpal joint replacement
- 5 patients operated metacarpophalangeal joint replacement
- 8 patients operated interphalangeal joint replacement

Extrapolation of the data shows:

- 75% of the patients have achieved excellent results in terms of functional recovery and no pain
- in 15% of patients the results were sufficient for the presence of reduced strength and acceptable functional recovery and radiographic periprosthetic calcifications feature
- in 10% of cases we have observed the failure of the system and need for reoperation (Fig. 18-27).

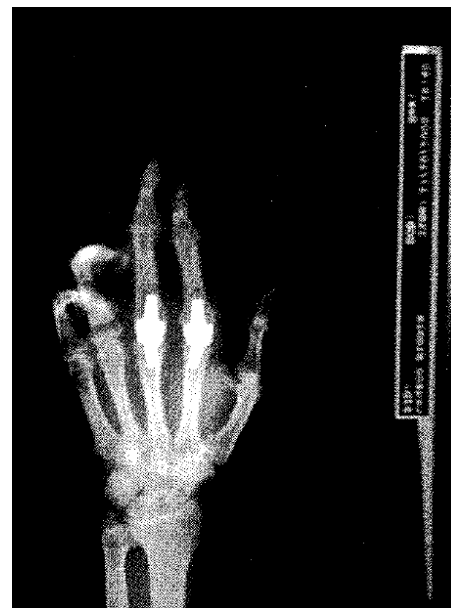


Fig. 14. MCP pre-op. For explanation see text

Fig. 15. MCP post-op. For explanation see text

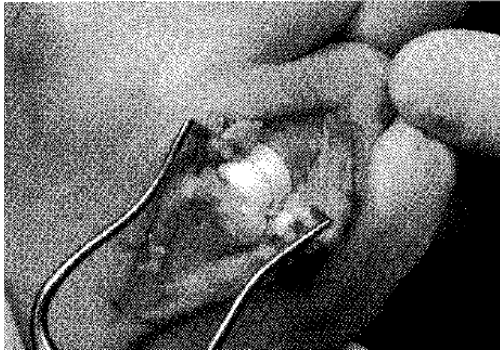


Fig. 16. MCP intraop.

For explanation see text

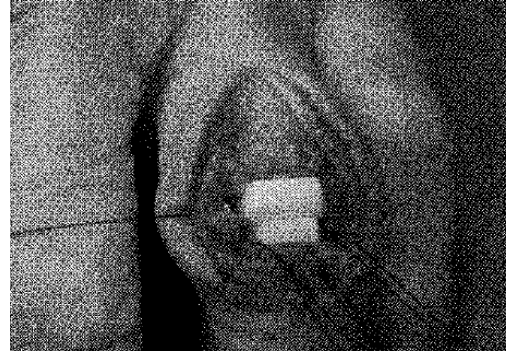


Fig. 17. PIP intraop.

For explanation see text



Fig. 18. MCP flexion

For explanation see text



Fig. 19. MCP extension

For explanation see text



Fig. 20. For explanation see text



Fig. 21. For explanation see text

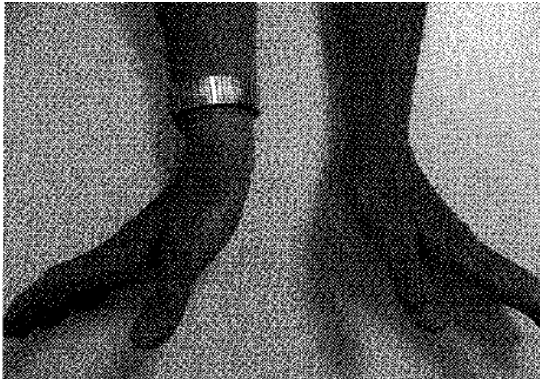


Fig. 22. Wrist function

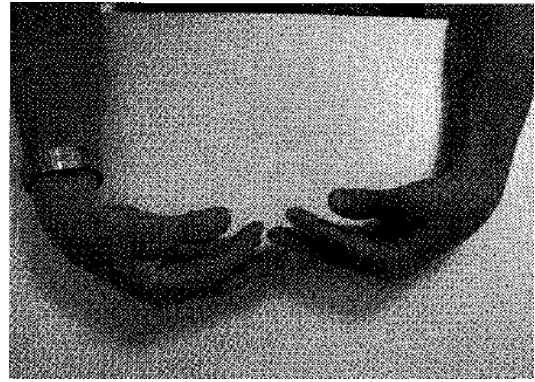


Fig. 23. Wrist function

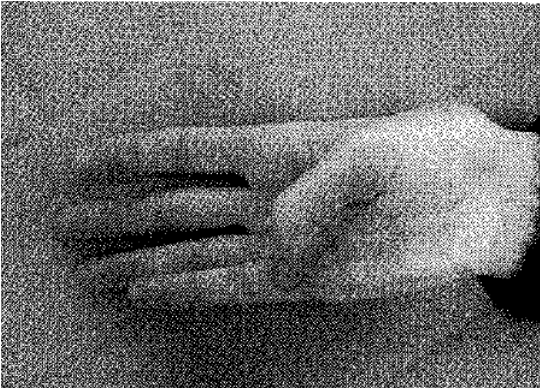


Fig. 24. TM post function (Kapandj 10)



Fig. 25. Unopposed pre int and deformity

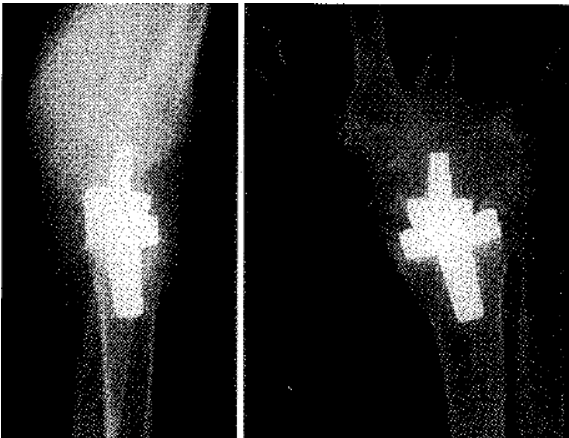


Fig. 26. Mobilization of implant

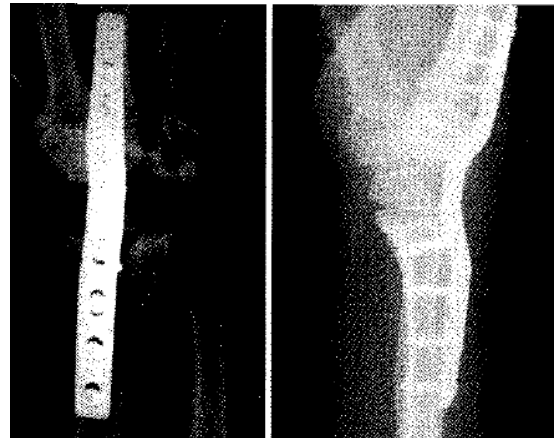


Fig. 27. Arthrodesis after wrist implant failure

Conclusions

Even in hand surgery introduction of new biomaterials has modified treatment planning for the serious consequences of degenerative osteoarticular pathologies with the introduction of new concepts of joint replacement.

In this context, and on this basis we seem to be able to support the reliability of the system we have adopted, in right indications, due to the intrinsic characteristics of ceramics, prosthetic design and mini-invasive technique.

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