

A CLINICAL STUDY OF Al_2O_3 CERAMIC IMPLANTS FOR THE RECONSTRUCTION OF THE TERMINAL ENDENTULOUS MANDIBLE

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SUMMARY

Twenty seven Al_2O_3 -dental endosteal implants were clinically tested. The mean time of observation was 18.4 month, the longest 3.25 years. One of the implants was lost after three month. Photoelastic analysis was used to demonstrate stress distribution around the implant body. Clinical evaluation consisted of visual observation of the state of the oral mucosa, measurements of the pocket depth and gingival crevicular fluid. A radiological examination showed formation of bone around the implants.

INTRODUCTION

Dense Al_2O_3 ceramic has been in medical use since 1965. It has been used in the following medical applications: substitution of one tooth (Schulte & Heimke 1976, Sandhaus 1969, Mutschelknauss 1970); dental endosteal blade implants (Driskell & Meller 1977, Mutschelknauss & Dörre 1977); orbital floor repair (Iancu-Löbel 1979); canine fossa reconstruction (Geiger et al. 1980); temporo-mandibular-joint prosthesis (Frenkel & Niederdellmann 1977) and as a hip endoprosthesis (Heimke et al. 1974). An endosteal blade implant described previously (Ehrl & Frenkel 1979) was modified and this report-concerns our clinical experience with the implant in 27 patients.

MATERIAL AND METHODS

The implants used are made of high density multicristal-line aluminium oxide ($99.7\%Al_2O_3 + 0.25\% MgO$). Photo-elastic analyses led to an implant design in which rounded edges reduce stress concentration caused by the wedge effect (Fig. 1).

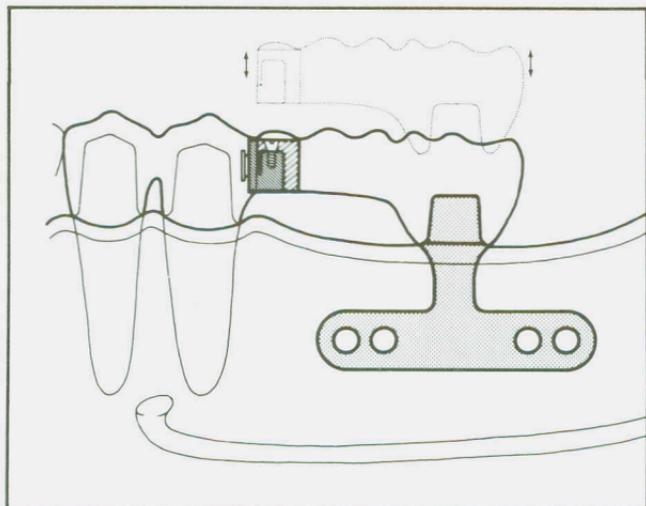


Fig. 1. Diagram of the implant and its position in the mandible. The crown on the implant and the attached bridge can be removed by opening a screw in a precision attachment element.

Twenty seven patients are included in this survey. Observation of the implants was during an average of 18.4 months, the implant incorporated the longest was 40 months old. In each case it was a second class situation, that is anterior teeth were present which could be attached to the implant by a bridge (Fig. 1).

Immediately after implantation temporary bridges were placed. Permanent bridges were placed after 6 to 9 months. Precision attachments were used to allow exact investigation and fabrication of removable prosthesis in the event of implant failure.

Clinical reexamination consisted in questioning the patients, clinical inspection of the peripheral mucosa

condition and measurement of periimplant pocket depth. The gingival crevicular fluid (GCF) was withdrawn from the sulcus according to the method of L oe and Holm-Pedersen (L oe et al. 1965) and measured with a periometer (Periotron, Harco). These results were also compared with results from natural teeth of the same individual. Apical and orthoradial x-ray pictures of the implant area were taken by standard method.

RESULTS

After surgery the wound usually ached, but the patients discomfort was less than had been expected. In all cases four analgesic pills (Noramidopyrinmethansulfonate 0.5) were given to the patients, only in seven cases did the patient ask for more. Suspected wound infection complaints were stilled by antibiotic treatment in 10 cases. After prosthetic restoration was completed only four patients complained about slight discomfort, and one patient about great discomfort. After correction of occlusal contacts three of these patients had no further complaints. In two cases the attached gingiva had to be widened. In one case inflammation of the tissue could be seen. Surprisingly enough the mean depth of the sulcus of the implant was 1.3 mm which was a better result than that of natural teeth with a mean depth of 1.8 mm (Fig. 2). The average quantity of GCF around implants was 0.037 ul and around natural teeth was 0.038 ul.

The radiographs show that in two thirds of the cases there is a structure similar to a lamina dura around the bone impacted implant. In the other cases no changes of the bone structure in the vicinity of the implant could be found. The formation of a crater around the implanted post could vaguely be interpreted in six cases, in two cases a crater was obvious. There was no correlation between these results and those of the gingival-implant junction.

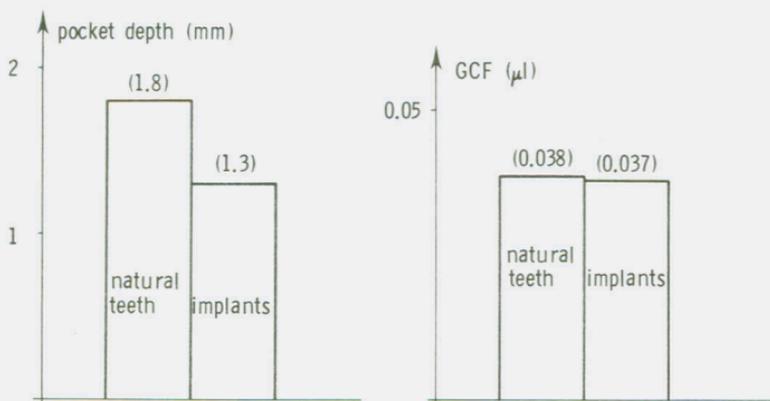


Fig. 2. a) The pocket was deeper in comparable natural teeth than in the implant. b) The gingival crevicular fluid (GCF) was almost the same in each group and was slight.

DISCUSSION

Twenty seven implants were not enough to give statistically valid information, yet useful observations were possible. Firstly all implants but one are still functioning correctly. Concerning the implant that was finally lost it must be mentioned that the implant was initially unstable and this could not be compensated by the temporary reconstruction. The precision of the fit which should provide a large contact area between implant and bone is decisive for an initial stable position of the implant and consequently for its life span (Tetsch 1973). This initial stability can be achieved for class 2 implants by connecting the implant with natural teeth.

The ability to maintain a healthy mucosa around the implant post depends on the ability of the patient to carry out good plaque control (see Fig. 3 a). The gingival collar must come in contact only with the implant-material. The danger spots in which plaque will accumu-

late must be easily accessible for the patient when he cleans his teeth. In five cases it could be shown that slight peripillary inflammation could be treated with success by periodontal methods.

The examination of the mucosa by visual inspection, measurement of the periodontal pockets and GCF measurements indicate that conditions around these ceramic implants were better than around comparable metal implants (Babbush et al. 1977, Smithloff et al. 1976, Brinkmann 1978). However, because of the many variables associated with a clinical investigation of this kind we do not have enough evidence to draw valid conclusions comparing the performance of different types of implants.

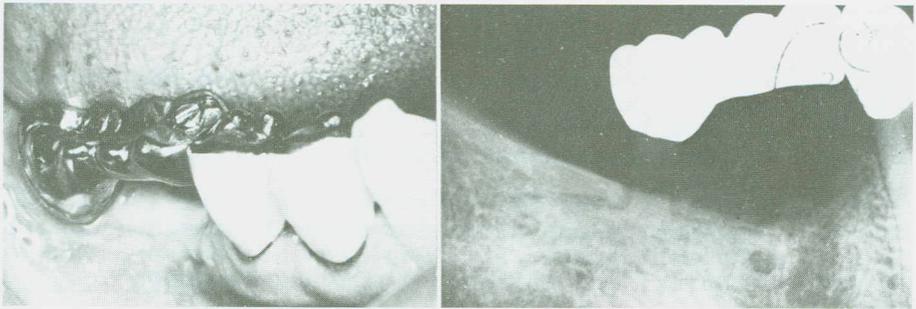


Fig. 3 a). A 30 months old implant. The gingiva is without irritation and at no point is the sulcus deeper than 1 mm. Plaque control is easy. b) The radiograph showing radiolucent zone and lamina dura around the implant.

The development of a lamina dura like structure around the implant body, as seen in radiographs, can be interpreted as an adaptation of the bone. We observed that these structures develop during the function of the implant. In the ideal case the lamina dura on implants has the same characteristics as on natural teeth (Fig.3b). At the moment a decision cannot be made about the interpretation of this zone, whether it is a functional adaptation or indicates an inflammatory reaction. We are

unable to explain, as yet, why the development of an bone crater around the implant post can be seen in a radiograph and suggests bone absorption does not correspond with clinical epithelial invagination.

REFERENCES

- Babbush, C., A. & GREENE, A. H. (1977) Implant dentistry: A long-term survey & comparative study with foxed bridgework, J. Oral Implantol., 7, 89-105.
- Brinkmann, E. (1978) Parodontalbefunde bei enossalen Implantaten, Dtsch. zahnärztl. Z., 33, 52-53.
- Driskell, T.D. & Meller, A. L. (1977) Clinical use of aluminium oxide endosseous implants, Oral Implantology, 7, 53-76.
- Ehrl, P. A. & Frenkel, G. (1979) Vorläufiger Bericht zur Entwicklung eines Extensionsimplantates. Quintess. zahn. Lit. I:30, Ref. 6015, 1-7, & II:31, Ref. 6015, 8-18.
- Frenkel, G. & Niederdellmann, H. (1977) The possibilities afforded by the use of dense aluminium oxide ceramics in the reconstruction of the temporomandibular joint. Quintess. Internat. 7, 295.
- Geiger, S.A. & Pesch, H. J. (1980) Langzeitverhalten von Aluminiumoxid-Keramik-Implantaten. Dtsch.zahnärztl.Z. 35, 57.
- Heimke, G., Andrian-Werburg, H. v., Krempien, B. & Griss, P. (1974) Endoprothesen aus Al_2O_3 -Keramik, Dtsch. Keram. Ges. 51, 29.
- Iancu-Löbel, R. (1979) Die Versorgung der Orbitabodenfraktur mit Implantaten aus Aluminium-Oxid-Keramik. Med.dent.Diss.
- Löe, E. & Holm-Pedersen, P. (1965) Absence and presence of fluid from normal and inflamed gingivae, Periodontics 3, 171-177.
- Mutschelknauss, E. (1970) Enossale Implantation von Porzellankörpern, Quintess. zahn. Lit. 21, No. 6, 17-23.
- Mutschelknauss, E. & Dörre, E. (1977) Extensions-Implantate aus Aluminium-Oxid-Keramik, Quintess. zahn. Lit. 21, Ref. 5623, I:7, 1-5 and II:8, 6-10.
- , (1978) Enossale Stiftimplantate aus Aluminium-Oxid-Keramik, Zahnärztl. Prax. 29, 362-366.
- Sandhaus, S. (1969) Nouveaux aspects de l'implantologie - L'implant CBS, Lausanne.
- Schulte, W. & Heimke, G. (1976) Das Tübinger Sofortimplantat, Quintess. zahn. Lit., Ref. 5456.
- Smithloff, M. & Fritz, M.E. (1976) The use of blade implants in a selected population of partially edentulous adults. A five-year-report, J. Periodontol., 47, 19-24.
- Tetsch, P. (1973) Experimentelle Untersuchungen zur primären Stabilität von Extensionsimplantaten, Zahnärztl. Welt Ref. 82, 665-669.