aus: Dental Implants, Carl Hanser Verlag 1980

2.3 Experimental and Clinical Experiences with a Blade Vent-Abutment of Al_2O_3-Ceramic in the Shortened Dental Row-Situation of the Mandible

P. A. Ehrl and G. Frenkel*

1 Summary

A blade vent implant of Al_2O_3-ceramic has been developed for the use in the premolar-molar area of the mandible. Photoelastic studies showed good stress distribution. The implanting procedure is described. First clinical experiences are very promising, but long-time studies still have to be made before reliable conclusions can be drawn.

2 Introduction

As described in earlier publications there are many indications for the use of Al_2O_3-ceramic as implant material (3, 6, 7, 8, 10, 16). This study deals with the development of a blade vent implant to be used as abutment in the shortened dental row situation of the mandible. This indication (defined as class-2-situation) has the best prognosis except for the "bridge with a wide span"-situation – the implant used as an additional middle abutment (class 3; 2). The use of the implant in the lower canine or incisor area is possible when the anatomical structure is adequate. Earlier developed forms of the implant proved to be too voluminous, the implanting procedure too complicated, too inexact and the post implantationem-situation too much favouring unhygienic conditions around the epithelium penetrating area of the abutment. So emphasis has been placed on

1. developing an implant shape,
   a) that needs a minimal wound of the mandibular bone,
   b) that is big enough to have no material-caused problems (braking),
   c) that has a good force distribution in its intraosseous part for mastication forces in all directions, and
   d) that has a vertical post with an easy access for plaque control and that requires no dressing after insertion and no intermediate crowns.

* Zentrum für Zahn-, Mund- und Kieferheilkunde an der Universitätsklinik Frankfurt.

2. developing an insertion technique,
   a) that is easy to perform and
   b) that gives the implant a primary stability.
3. developing a suprastructure,
   a) that is to be used immediately after abutment insertion,
   b) that is able to stabilize the implant,
   c) that sets no hygienic problems and
   d) that allows healing to proceed under functional stress.

3 Material and Shape

Aluminium oxide is known for its excellent biocompatibility and high strength (4, 8). Histological findings have been reported earlier (5, 6, 7). An indicator for the biocompatibility is the fact, that Al_2O_3 allows for a direct bone/ceramic contact without a soft tissue interlayer at least under biomechanically favourable conditions.

The shape of an implant has to be adequate to the anatomical structures into which it is to be placed. The premolar and molar area of the lower jaw is predisposed for a blade-shaped implant. The intraosseous horizontal extension of the implant should allow the cortical bone to unite over this part. Perforations in the implant body, which lead to penetration of the bone, increase that effect and produce an augmentation of the bearing surface. The extension of the implant within the cancellous bone leads to a better force distribution of the applied occlusal forces than single root implants do. The above mentioned criteria have led us to the implant shown in fig. 1. It has a constant thickness over its total length, needing for the insertion only a corresponding groove. It shows no sharp edges to avoid stress concentration. It has been demonstrated that there is a relation between the stress distribution and calcification, collagen synthesis and periimplant connective tissue capsule (10, 17). As *Riedmüller* et al. postulated (19), rounded edges and additional transmitting surfaces result in a even more load distribution. Evaluating these properties of the implant photoelastic methods have been used and confirmed the good stress distribution of the subcortically extended implant body.

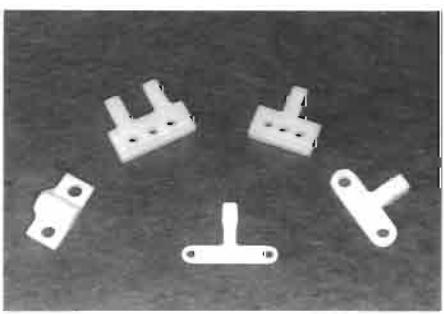

Fig. 1: Several designs in the development of a blade vent type Al_2O_3-implant. In the center the final form – now in clinical use.

4 Planning

After internal disease is excluded and the motivational behavior is proved, the local situation for the implantation has to be investigated. Necessary are: *inspection* (shape of the oral mucosa), *palpation* (shape of the mandible, esp. lingual overhang), a *panoramic radiograph* (evaluation of possible positioning in relation to anatomic structures – esp. mandibular canal – with a correspondingly enlarged drawing of the implant) and *models* of both jaws (proving the intermaxillary relation). These criteria serve to mark the implant's position which, finally, will be recorded in a pattern that can be used to reproduce this position on the patients' mucosa. With these plannings we are able to prefabricate a long-time temporary bridge from the prepared anterior teeth to the implant. Intermaxillary relation has to be carefully regarded, especially the occlusal surface must be shaped as to definitely avoid the creation of horizontal forces. Thus integration of the implant can happen under functional conditions.

5 Implantation

To be inserted, the implant needs a suited groove, which has the same width on its total length. For this purpose we use four radial milling cutters in enlarging sizes, the last one determining the insertion depth of the implant. The position of the groove is determined with the above mentioned pattern. Finally a cylinder drill is used to excavate the roundings of the groove's ends. Now the implant can be inserted.
For preparing the bone surface we use two methods: The straight incision over the implant's groove and the so-called poncho-flap (11). The perforated poncho-flap covers primary the operation wound and counteracts post-implantationem infection, so this method is preferable when possible.

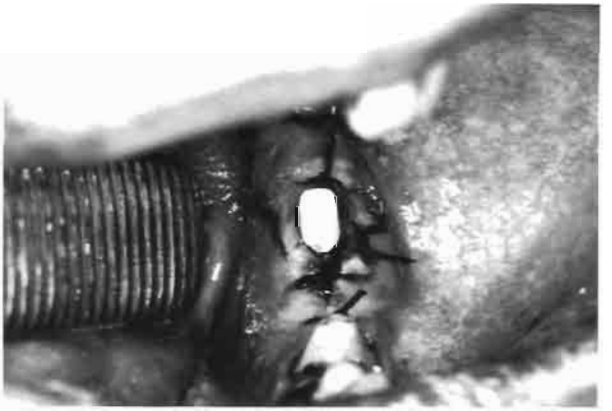

Fig. 2: The implant immediately after insertion. The wound is sutured and implant post and prepared anterior teeth are ready to receive the temporary bridge.

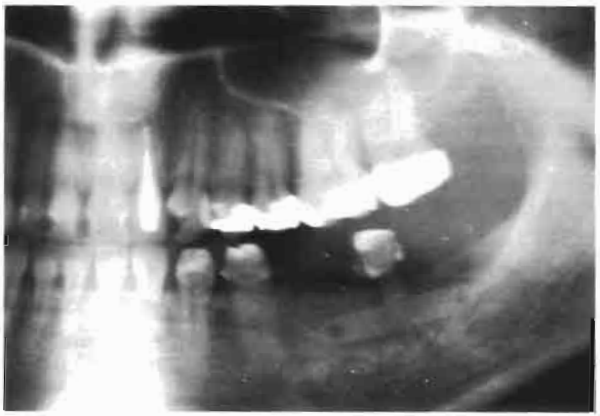

Fig. 3: Postoperative radiograph control shows position of the intraosseous part of the implant. Relation to the mandibular canal has been tested before implantation with a pattern and is sufficient to exclude irritation to the nerve.

6 Aftercare

The bridge fixed immediately after implantation should be left in during the healing period for 6–9 months. Even though after three months already the X-ray shows lamina dura-like structures around the implant – which may be considered as functional healed – the final suprastructure should not be inserted until at least six months. Clinical experiences have been good so far (20 implants, 3/79) and dates are collected for computer evaluation. The results over a long-time period should be waited for before concluding statements are possible.

7 References

1) *A. Baumhammers:* Custom modifications and specifications for blade vent implant designs to increase their biologic compatibility. Oral Implant., 2. (H. 4) 1972, 276–296.
2) *E. Brinkmann:* Indikation zur enossalen Implantation. Dtsch. zahnärztl. Z., 31 (7) 557–9/Jul 1976.
3) *T. D. Driskell, A. L. Heller:* Clinical use of aluminium oxide endosseous implants. Oral Implant., 7. (H 1) 1977, 53–76.
4) *D. F. Gibbons:* Biomedical materials. Annual review biophysics and bioengineering, 4. (H. 80), 1975, 367–375.
5) *G. Frenkel:* Zweieinhalbjährige Erfahrungen mit enossalen Implantaten. Dtsch. zahnärztl. Z., 28 (1), Jan. 1973, 30–5.
6) *G. Frenkel, K. Nowak, G. Schulz-Freywald, K. J. Bertram, W. Gruh, E. Dörre:* Untersuchungen mit nichtmetallischen Werkstoffen in der Zahn-, Mund- und Kieferchirurgie. Dtsch. zahnärztl. Z., 32, 1977, 295–297.
7) *G. Frenkel:* Klinische und histologische Aspekte bei der Verwendung nichtmetallischer Werkstoffe in der Zahn-, Mund- und Kieferheilkunde. Österr. Z. Stomat., H. 1, Jan. 1977, 2–9.
8) *G. E. Garrington* and *Ph. M. Lightbody:* Bioceramics and Dentistry. J. Biomed. Mater. Res. Symposium, 2, (part 1), 1972, 333–343.
9) *D. E. Grenoble:* Design criteria for dental implants. Oral Implant., Abington, Mass., 5, (H.1), 1974, 44–64.
10) *J. E. Hamner,* III and *O. M. Reed:* Implantable Ceramic Teeth. J. Biomed. Mater. Res. Symposium, Nr. 4, 1973, 217–234.
11) *D. L. Hoexter, S. B. Epstein:* The poncho-flap. Oral Implant., 5, (H. 4), 1975, 547–552.
11) *E. Jahn, C. Censi, C. Daehler, B. A. Rahn:* Bindegewebige Aufhängung bei Blattimplantaten. Vorläufige Mitteilung, Schweiz. Mschr. Zahnheilk., 85 (11), Nov. 1975, 1143–5.

13) *R. James:* A histopathological study of the nature of the epithelium surrounding implant posts, Part II. Oral Implant., (H. 3), 1973, 137–159.
14) *D. M. Keene:* Periodontal considerations for implant dentistry. Dental clinics of North America, 20. (H. 1), 1976, 155–179.
15) *S. Kubik:* Die Anatomie der Kieferknochen in Bezug auf die enossale Blattimplantation – I. Mandibula. ZWR, 85 (6), 1976, 264–71.
16) *E. Mutschelknauss* und *E. Dörre:* Extensions-Implantate aus Aluminiumoxidkeramik. Die Quintessenz, 7 u. 8, 1977.
17) *E. Privitzer:* Some Factors Affecting Dental Implant Design. J. Biomed. Mater. Res. Symposium, 6, 1975, 251–255.
18) *P. Rathgeb:* Die Transformation des Knochengewebes im Bereich eines CBS-Schraubenimplantates. Eine bioptische Untersuchung nach 10monatiger Implantationszeit mit Hilfe des Rasterelektronen-Mikroskopes Stereoscan. ZWR, 23/24, 1971, 1103–7.
19) *J. Riedmüller* und *U. Soltész:* Modelluntersuchungen zur Spannungsverteilung in der Umgebung von Zahnimplantaten. ZWR, 86, (17), 1977, 842–7.
20) *J. Randzio* und *E. Ficker:* Spannungsoptik in der Bewertung enossaler Dentalimplantate. ZWR, 86 (18), 1977, 894–900.
21) *P. Tetsch:* Experimentelle Untersuchungen zur primären Stabilität von Extensionsimplantaten. ZWR, 82 (13), 1973, 665–9.
22) *S. H. Wolfson, C. W. Svare* and *D. Weber:* Load-Bearing Capacity of Functioning Alumina Dental Endosseous Implants. J. Dent. Res., 55:22 (1967), 22–29.

Authors' address: Prof. Dr. Dr. G. Frenkel, Zentrum für Zahn-, Mund- und Kieferheilkunde an der Universitätsklinik Frankfurt; Theodor-Stern-Kai 7, Frankfurt/M., Germany