

DENTALE IMPLANTOLOGIE

& Parodontologie

**Retrospective study of dental
implantation with sinus lift and
Cerasorb[®] augmentation**

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Fig. 1
Operative access to the floor of the maxillary sinus via a facial maxillary lid



Patients ask for optimal, and if possible fixed, prosthetic substitutes for their lost teeth.

This demand is all the greater in patients who have had negative experiences with removable dentures, especially when this is due to an atrophic mandible or a completely edentulous upper jaw.

Anatomical factors are of crucial importance in the insertion of implants in the maxilla.

Implantation in the posterior maxilla is regarded as difficult and demanding, as the vertical bone thickness in this area is generally insufficient to provide secure and lasting anchorage of the implant.

Successful implantation in this area calls for special surgical techniques and procedures such as a sinus lift, in which the floor of the maxillary sinus is augmented (1, 2).

For many years, reconstruction of bone defects has been achieved via a variety of bone replacement and bone regeneration materials of autologous, allogeneic, xenogeneic, or alloplastic origin (3–7). The question of what type of substrate is most suitable has been approached mostly from the point of view of smooth osseointegration (8, 9).

In the present study patients underwent internal augmentation of the posterior maxilla after a sinus lift procedure involving exclusive use of the bone regeneration material Cerasorb® (Curasan® Pharma GmbH, Kleinostheim), a fully synthetic, monophasic β -tricalcium phosphate material that undergoes complete resorption and is easy to handle (1–12).

Material and methods

In this randomized retrospective clinical study 50 patients were randomly chosen

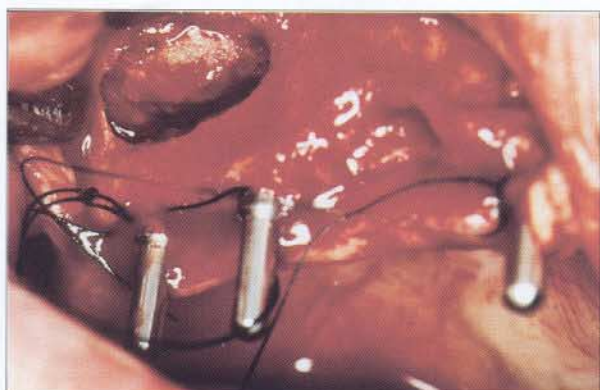


Fig. 2 Insertion of direction indicators in order to check for parallel orientation

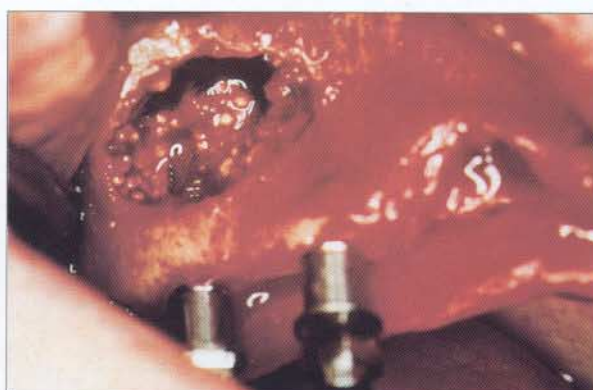


Fig. 3 Insertion of the implants

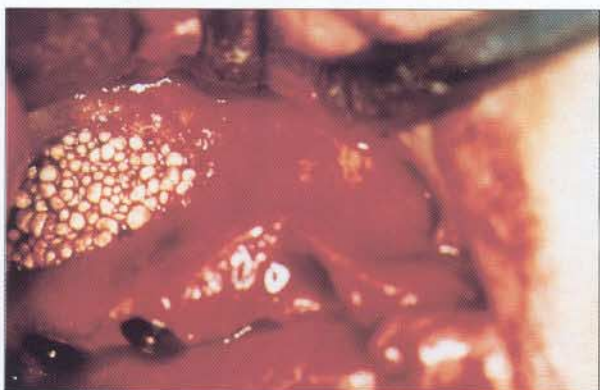


Fig. 4 Filling of the floor of the maxillary sinus with Cerasorb®

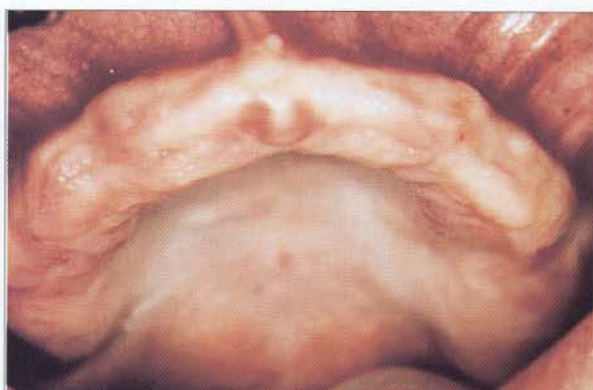


Fig. 5 Situation prior to uncovering of the implants after about eight months

from a group of 496 patients who underwent a surgery between 1996 and early 1999 (Table 1). The most recent follow-up of the patients was in July 1999.

The following criteria were investigated and subjected to statistical analysis:

- a) Was a one-stage or a two-stage procedure employed?
- b) What was the osseointegration time of the Cerasorb® material (in weeks)?
- c) In the case of two-stage procedures, what was the interval between the first stage and implantation (in weeks)?
- d) When were the implants uncovered (in weeks) in the one-stage and in the two-stage procedures?
- e) How many wound healing problems arose (in absolute figures)?
- f) What was the failure rate of the implants (in percentage and absolute figures)?

Listing of investigated and analyzed criteria

Year	1996	1997	1998	1999
N° of patients	12	38	33	18

Table 1: Patients operated on during the study period

Surgical techniques

One-stage procedure:

After a paracrestal incision, a trapezoidal mucoperiosteal flap is formed so as to expose the facial wall of the maxillary sinus. A circular cutter is used to fashion a bony lid which, after separation of the mucosa of the floor of the maxillary sinus, can be turned in a cranial direction (Fig. 1).

After preparation of the implant bed and checking for parallel orientation by means of direction indicators, the implant is inserted so as to achieve primary stability (Figs. 2 and 3) with its apical part resting on the cranially turned bony lid.

The periimplant space created by elevation of the floor of the sinus is filled with Cerasorb® (granule size 1000–2000 µm), allowance being made for slight condensation of the granules (Fig. 4) and care being taken to perfuse the bone regeneration material with autologous blood (from an antecubital vein). Implants are uncovered after an osseointegration period of about eight months (Fig. 5).

Where the vertical bone thickness of the implant bed is less than 4 mm, a two-stage procedure is performed

If the periosteum is intact, insertion of a membrane is not required

Special guidelines apply to the implantation of bone replacement materials

Two-stage procedure

A two-stage procedure is indicated where the vertical bone thickness of the implant bed is less than 4 mm and therefore primary stability of the implant cannot be achieved. For a classification of sinus lift operations on this basis, see Kreuzer and Jacobs (13).

Where the bone thickness is greater than 4 mm, primary stability is achievable and the operation can therefore be performed in a single stage.

After a vertical incision along the mucogingival junction, the facial wall of the maxillary sinus is exposed.

Preparation of the bony lid and elevation of the mucosa of the floor of the maxillary sinus are performed as in the one-stage procedure.

After insertion, the Cerasorb® material (granule size 1000 2000 µm) is perfused with autologous blood.

If the periosteum is intact, insertion of a membrane is not required (14).

Implantation is performed after an average osseointegration time of 35 weeks, depending on the individual patient.

Bone regeneration material and indications for its use

Bone replacement materials can be classified as either biological materials such as autologous, homologous, or heterologous bone, or synthetic, i.e. alloplastic, substitute materials.

A number of guidelines apply to the implantation of such materials.

For example, the material and its degradation products should be neither toxic nor carcinogenic in the recipient organism,

they should not induce any immunological or allergic reaction, and they should not increase the risk of infection.

Cerasorb® is a synthetic, mono phasic β-tricalcium phosphate material that satisfies these requirements.

Where the alveolar ridge is atrophic and edentulous, vertical bone thickness is insufficient because of the anatomical proximity of the generally very extensive and highly pneumatized distal region of the maxillary sinus.

Furthermore, the highly cancellous quality of the bone, which reaches D4 quality distally, makes it difficult to achieve stable long-term anchorage of the implant (Table 2). Augmentation of the bony deficits is therefore absolutely essential.

This situation calls for a sinus lift operation in which the floor of the maxillary sinus is augmented, using exclusively Cerasorb®.

The grain size of the bone regeneration material, in this case Cerasorb®, should be as large as possible but still smaller than the smallest depression in the defect to be filled.

By increasing the amount and quality of bone and preserving the vertical intermaxillary distance, this surgical procedure makes implantation possible.

Histological methods

A tissue specimen (diameter 2 mm, length 6 mm) obtained by means of a trephine was fixed for 24 hours in formaldehyde and then transferred to 70% alcohol. Masson-Goldner stain was applied to the sections.

Results

The decision as to whether implantation could be performed in a one-stage procedure with internal augmentation and a sinus lift or would be better performed via two separate operations was made on the basis of the vertical bone thickness in the area to be operated on. Where this was less than 4 mm, the

- D1 Equivalent to cortical bone structure
- D2 Equivalent to corticocancellous bone structure
- D3 Equivalent to slightly cancellous bone structure
- D4 Equivalent to highly cancellous bone structure

Table 2: Criteria for assessment of bone quality (15)

two-stage procedure was chosen. This was the case in eleven of the patients in the present study.

In the remaining 39 patients a one-stage procedure was performed. Wound healing was uneventful in nearly all the patients.

In the patients who underwent a two-stage procedure, implantation was performed after a mean interval of 35 weeks (range: 25–47 weeks). The bone quality found at implantation was D2 to D3, though the resistance encountered when preparing out the implant bed seemed if anything to be somewhat greater than that of fully grown bone.

Histological examination after six months showed that the rate of breakdown of β -tricalcium phosphate is the same as the rate of local bone regeneration (Figs. 6 and 7).

Fresh osteoid deposits are found on the fine trabecular structures. A great deal of neo-vascularization occurs, especially in the

formed, uninfamed yellow bone marrow (Fig. 7a). On the basis of histological criteria the reconstructed trabecular architecture was considered to be suitable for insertion of a dental implant.

After about nine months, Cerasorb® granules are scarcely recognizable any more in radiographs and considerable consolidation of the bone has occurred, the structure of the zone of augmentation closely resembling that of cancellous bone (Fig. 10).

The time allowed for healing of the implants varied according to whether a one-stage or a two-stage procedure had been performed.

In many patients the implant was uncovered using a CO₂ laser (NovaPulse, LX20, ESC Medical Systems), which permitted precise removal of the epithelium overlying the cover screws.

The implants inserted in a one-stage procedure were uncovered after a mean period of 33 weeks (range: 21–53 weeks). Premature failure of the implant occurred in one case (after five months). The implants inserted via a two-stage procedure were uncovered after a mean period of 24 weeks.

Only 6% of the 101 implantations performed in the posterior maxilla after augmentation with Cerasorb® alone were complicated by wound healing disturbances. These were short-lived and mild cases of sinusitis and wound dehiscence that were easily overcome by additional antibiotic therapy (one patient who had undergone a two-

The rate of breakdown of β -tricalcium phosphate is the same as the rate of local bone regeneration

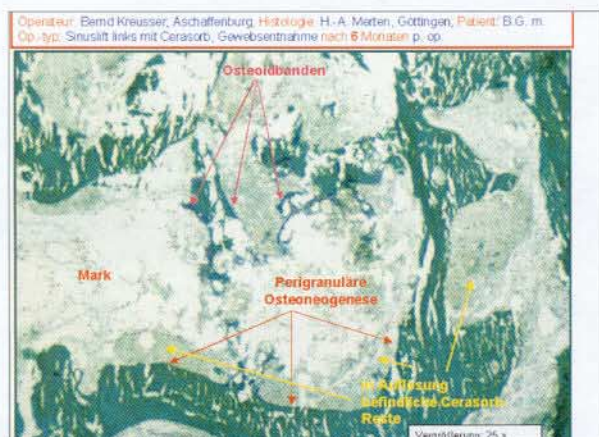


Fig. 6 Histological appearance of biopsy specimen taken after six months (magnification: 25x)

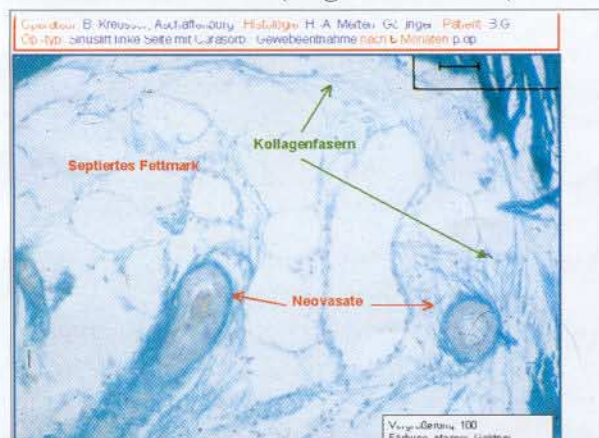
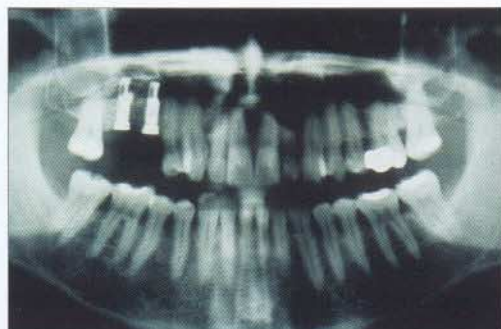


Fig. 7: Histological appearance of biopsy specimen taken after six months (magnification: 100x)

Fig. 8
Panoramic radiograph taken nine months after insertion of Cerasorb® (male patient, born 1950)



stage procedure and five cases patients who had undergone a one-stage procedure).

Thanks to the low rate of complications, there was only one case of premature failure of the implant (after five months) over a follow-up period of three and a half years. Osseointegration thus occurred in 100 of the 101 implants, i.e. the success rate was over 99% (Fig. 9).

Three different types of implant were used, namely Branemark, Frialit II, and ITI screws (Fig. 10). All the patients were fitted with supraconstructions. These were either removable prostheses borne on bars or secured via bolts, or else less easily removable bridges.

Discussion

Our experience with the sinus lift procedure using Cerasorb® alone calls into question the current gold standard of exclusive use of autologous bone (9).

Thanks to its high biocompatibility and the fact that to some extent it forms a template for bone regeneration, β -tricalcium phosphate in the form of Cerasorb® is in many

respects at least equal in value to autologous bone.

Similarly, the success rate of 99% that we achieved over the period of observation using Cerasorb® alone is comparable to that achieved with autologous bone.

In a meta-analysis of maxillary sinus implantations performed after augmentation with autologous bone, an implant survival rate of 90% was found after 6 to 60 months (16).

When autologous bone was used in combination with hydroxyapatite, an implant survival rate of 94% was found after 18 months. When only hydroxyapatite was used for augmentation, the implant survival rate was only 87% after 18 months.

Histological examination showed that neo-vascularization occurs in the Cerasorb® granulate and that the rate of breakdown of tricalcium phosphate is the same as the rate of local bone regeneration.

After about nine months, Cerasorb® granules are therefore scarcely recognizable any more in radiographs and considerable consolidation of the bone has occurred.

The only wound healing problems that occurred were a very small number of short-lived and mild cases of sinusitis and wound dehiscence that were easily overcome by additional short-term antibiotic therapy.

An additional advantage of this procedure is that it does not result in a second wound. In the case of operations employing autologous bone, by contrast, bone material has to be obtained from the mental or retromolar region of the mandible or even from the iliac crest.

Three different types of implant were used

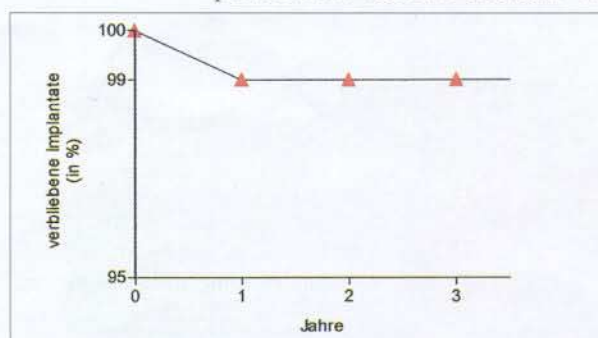


Fig. 9 Success rate of osseointegration of 101 implants in posterior maxilla with sinus lift and internal augmentation using Cerasorb® alone (period of observation: 3,5 years).

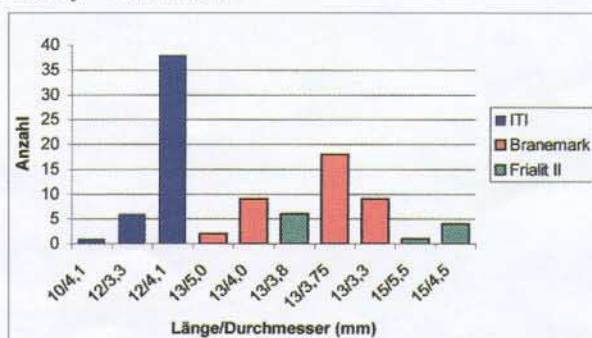


Fig. 10 Relative numbers of the various types of implant inserted

Summary

In this retrospective study, 101 implantations performed over a period of 3,5 years with exclusive use of the bone regeneration material Cerasorb®, a synthetic, monophasic tricalcium phosphate, were reviewed and statistically analyzed. In all cases, the bone regeneration material was combined with autologous blood after insertion. Implantation was performed via a one-stage procedure in 39 patients and via a two-stage procedure in 11 patients.

Three different implant systems were used. In the case of the two-stage procedure, implantation was performed after a mean interval of 35 weeks.

Only 6% of the implantations were complicated by wound healing problems. These were short-lived and mild and were easily overcome by short-term antibiotic therapy. The osseointegration of the β -tricalcium phosphate was investigated histologically and roentgenologically. The rate of resorption of Cerasorb® was found to be the same as the rate of local bone regeneration. After six months the reconstructed trabecular architecture was considered on the basis of histological criteria to be suitable for insertion of a dental implant. In the case of two-stage procedures we recommend that implantation be performed after 6–9 months. Only one implant failed during the period of observation. The success rate was thus over 99%. This figure is comparable to that achieved when autologous bone is used to lift the floor of the maxillary sinus.

The advantage of exclusive use of this bone regeneration material is that it avoids the need for a second operation. The surgical procedure described here can be recommended without reservation.

We wish to thank Dr. Dr. H. A. Merten for the histological examination of the specimens.

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After six months the reconstructed trabecular architecture was ready for insertion of a dental implant

The advantage of use of Cerasorb® alone is that it avoids the need for a second operation



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Born 1951

Studied medicine and dentistry at Freiburg and Würzburg universities. Graduated in medicine and dentistry in 1978 and 1979, respectively, from the University of Würzburg. 1978: Assistant, Department of Oral and Maxillofacial Surgery, University of Würzburg; Assistant, Department of Anaesthetics and Intensive Medicine, Aschaffenburg Municipal Clinics. 1979–1983: Scientific Assistant, Department of Oral and Maxillofacial Surgery, Hanover Medical School. Since 1983: member of group practice in oral and maxillofacial surgery with responsibility for care of patients in Aschaffenburg Municipal Clinics. Publications, lectures, and courses in Germany and abroad on preprosthetic surgery and implantology, therapeutic approaches in high-risk patients, intubational treatment of the handi-capped, and dental anaesthetics (deep sedation techniques).



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1988–1994: studied dentistry at Marburg. Awarded doctorate in pharmacology and toxicology by the University of Marburg. 1995–1998: general dental practice. Since 1999: oral and maxillofacial surgeon in the practice of Dr. B. Kreuzer, Aschaffenburg. Scientific lectures: 1995: SMYTE Congress, Prague 1996: SMYTE Congress, Bonn 1999: F.I.T. Congress, Frankfurt

Zusammenfassung

Nach dem Verlust der eigenen Zähne ist der Wunsch des Patienten nach einer optimalen Versorgung, wenn möglich mit festsitzendem Zahnersatz, umso größer, wenn bereits schlechte Erfahrungen mit herausnehmbarem Zahnersatz, besonders bei atrophischem Unterkiefer und absoluter Zahnlosigkeit im Oberkiefer vorausgingen. Bei einer geplanten Implantatversorgung im Oberkiefer spielen die anatomischen Verhältnisse eine besondere Rolle. Die Oberkiefer-Seitenzahnregion gilt als schwierig und anspruchsvoll, da hier die vertikale Knochenstärke meist nicht ausreicht, um eine dauerhaft sichere Verankerung des Implantates zu gewährleisten. Für eine erfolgreiche Implantation in diesen Bereichen sind besondere Operationstechniken und Verfahren wie der sogenannte Sinuslift angezeigt, bei dem der basale Anteil der Kieferhöhle augmentiert wird.

Résumé

Une fois ses dents perdues, le patient désire ardemment un traitement optimal, si possible avec prothèse fixe. Ce besoin est d'autant plus intense lorsqu'il a déjà eu une mauvaise expérience avec une prothèse amovible, particulièrement en cas de maxillaire inférieur atrophie et d'édentation totale du maxillaire supérieur. La situation anatomique joue un rôle important en cas d'un traitement par implant du maxillaire supérieur. La région des dents postérieures du maxillaire est réputée difficile et exigeante, parce que souvent l'épaisseur verticale de l'os n'est pas suffisante pour assurer un ancrage durablement fiable de l'implant. Des techniques opératoires et des procédés comme l'élévation du sinus, qui permet d'augmenter la partie basale du sinus maxillaire, sont indiqués pour une implantation réussie dans cette zone.

Riassunto

Después de la pérdida de los propios dientes, el principal deseo del paciente es recibir un tratamiento óptimo, si es posible, con prótesis dentarias fijas. Dicha necesidad es tanto mayor cuando ya han existido experiencias desagradables con prótesis removibles, especialmente precedidas de maxilar inferior atrófico y absoluta ausencia dentaria en el maxilar superior. Al planificar un implante en el maxilar superior, las relaciones anatómicas desempeñan un importante papel. La región de los flancos dentarios del maxilar superior se considera difícil y complicada, ya que aquí la fortaleza ósea vertical casi nunca es suficiente para garantizar un anclaje duradero y seguro del implante. Para un implante eficaz en dichas zonas están indicadas técnicas operatorias especiales y procedimientos como el llamado Sinus lift, en la que se aumenta la porción basal del seno maxilar.