Purpose:

This study compared two different graft materials, β-tricalciumphosphate (Cerasorb®, curasan AG) and autogenous bone, used in the same patient to determine whether donor site morbidity could be avoided by using pure-phase β-tricalcium phosphate (Cerasorb®).

Materials and Methods:

Bilateral sinus grafting was performed on 20 selected patients; Cerasorb® only was used on the experimental side, autogenous bone only was used on the control side. The experimental and control sides were chosen randomly. In 10/20 patients, the maxilla was atrophied to such an extent that the reconstruction included sinus grafting and onlay bone grafting. The procedure was followed by implant placement 6 month later. In addition to routine panoramic radiographs in 10/20 patients, 2- and 3-dimensional computed tomographic examinations were performed pre- and postoperatively and after implantation. A total of 80 bone biopsies were taken at the time of implant placement.

Results:

Clinical Observations: After sinus elevation, no postoperative complications occurred in any of the patients. Normal wound healing was observed after both, the first and the second operation.

Panoramic Radiograph: Three panoramic radiographs were compared for every patient; after surgery, at 6 and 12 months postoperatively. After 6 months, Cerasorb® had changed slightly in the radiographs: the contour of the bone around the graft became more defined. After 12 months, the graft was similar to bone, because the absorption of Cerasorb® and the simultaneous formation of new bone.

Histology: Experimental Side: Bone formation was preceded by the abundant proliferation of a cell-rich osteogenic mesenchyme and a new capillary network in the pores of the resorbing granules. Newly formed bone replaced the resorbing Cerasorb® particles continuously. Bone deposition characteristically occurred along the surface and in the pores of the disintegrated graft material.

Control side: The majority of the biopsy specimen contained mature lamellar bone. The bone trabeculae

Fig. 1: Preoperative radiologic assessment of patient H4.
Fig. 2: After sinus grafting: right Cerasorb, left autogenous bone.
Fig. 3: 12 months after the first surgery. The prosthetic rehabilitation is completed. Cerasorb was absorbed and simultaneously replaced by new bone.
contained osteocytes in their lacunae. Signs of dynamic bone formation with osteoblast activity or lacunar osteoclastic resorption were rare.

**Histomorphometry:** The mean percentage bone area for the 20 patients was $36.47 \pm 6.9\%$ on the experimental side and $38.34 \pm 7.4\%$ on the control side; the difference was not significant ($p=0.25$). In a majority of the patients (13 cases), the intensity of new bone formation was similar on both sides. When the volume occupied by the graft remnants was considered, these data suggest that the bone density was sufficient on both sides. The bone-forming capacity on the control side was more sluggish than on the experimental side in three cases. In two cases, the ossification process was uniformly weak in both sides; the respective percentages of newly formed bone were 27.5 and 25.6% on the experimental side, and 28.1% and 24.0% on the control side. In these two cases, the new bone trabeculae were uniformly thin, with no focal inflammatory lesion.

**Discussion:**

The comparison of the bone-forming activity of Cerasorb® and autogenous bone confirmed earlier findings. The new bone production was similar on both sides, and the difference was not significant. These results support the view that β-tricalciumphosphate is a satisfactory graft material, even without autogenous bone.

Several factors can influence new bone formation, in addition to the nature of the graft. In two cases there was a similar low rate of new bone formation on both sides. This might be the result of general factors, such as age, hormonal dysfunction, or disturbance in calcium metabolism. Such cases are also characterized by a low rate of graft resorption. In the introduction, the question was posed whether any bone substitute material is equivalent to the patient’s own spongiosa under certain conditions. These results suggest a positive answer of this question. In sinus elevation surgery, Cerasorb® can be as effective as autologous bone.

Regarding the question of spongiosa as the “gold standard”, this standard does have disadvantages. The most important of these are donor site morbidity, the relatively high number of complications, the need of general anaesthesia, and the higher costs of hospitalization. When all these factors are taken into consideration, it appears to be important to avoid the excision of autogenous bone whenever possible. The reason for the relatively small number of patients is that 2 working groups were forced to withdraw from participation in the investigation because patients did not agree to the excision of autogenous bone. This further demonstrates the importance of having a suitable bone-substitute material.

**Conclusion:**

Comparisons with other studies reveal that β-tricalciumphosphate (Cerasorb®) is a satisfactory graft material, even without autogenous bone. If remodelling is considered, this material used alone appears to be a suitable material for sinus floor augmentation. For this indication, Cerasorb® can be as effective as autogenous bone.