

# Human histological 4 months findings using a combination of pure-phase beta tricalcium phosphate ( $\beta$ -TCP) and Platelet Rich Plasma (PRP) chair-side preparation in comparison with $\beta$ -TCP alone, autogenous bone graft, DFDBA and Bio-Oss

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## Introduction

The search for an effective regenerative biomaterial to restore bone, lost for instance as a consequence of periodontal disease, tooth extraction or traumatic impact has been a focal point for dental practitioners in implant dentistry. Different studies are present in literature to describe the improvement of filling materials like autogenous or homologous bone graft materials, xenogenous bone or different synthetic materials (Tricalciumphosphate, Hydroxyapatite i.e.). All of them have advantages and disadvantages.

The purpose of this study was a histological evaluation of bone formation after the treatment of comparable bone defects with a combination of pure-phase beta tricalcium phosphate (Cerasorb®, curasan AG, Germany) and Platelet Rich Plasma (PRP, curasan AG, Germany) compared to Cerasorb alone as well as autogenous bone graft, DFDBA and bovine bone graft (Bio-Oss®, Geistlich Pharma GmbH, Switzerland) as a control. In all cases biopsies were taken four months postoperatively when preparing the implant site.

### Case 1

A 51-year-old patient with an edentulous left maxilla with remaining unrestorable roots of #22, 23, 25, 26 and 27. Treatment with extraction of the roots, a ridge preservation and a lateral augmentation with 2,5g Cerasorb® and PRP(ad modum curasan).



Fig.1: Severely atrophied alveolar ridge in bicuspid region.



Fig.2: X-rays of the canine region (left), bicuspid and molar region (right) 3.5 months p.o. Cerasorb granules are visible, but already integrated in newly formed bone.



Fig.3: Biopsy 4 month p.o.: well formed mature lamellar bone and fatty marrow. Numerous osteocytes and osteoblasts are present. Mild fibrosis is seen in fatty marrow.

### Case 2

A 48-year-old woman with clinical symptoms of chronic apical root disease at #15. The tooth and the remaining root was carefully removed, the defect was filled level with Cerasorb, mixed with blood from the defect prior the application and covered with a resorbable membrane.



Fig.4: Displays traces of a former apicectomy treatment and inflamed tissue around the root apex

Fig.5: The defect was filled level with the Cerasorb-blood mixture

Fig.6: Biopsy 4 month p.o.: well formed mature trabecular bone with numerous osteocytes and mild osteoblastic activity. A dense fibrous tissue with fibroblast-like cells is seen.

### Case 3

A 33-year-old woman presented a vertical fracture of #47 and a undeveloped wisdom tooth. Radiographic and clinical evaluation revealed a unrestorable tooth. The second and third molar were carefully extracted. The extraction sockets were grafted with autogenous bone, harvested during the third molar's alveolectomy and in the ramous homolateral region and crushed in a bone mill.

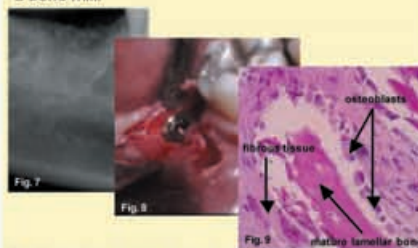


Fig.7: Defect region grafted with autogenous bone

Fig.8: Wide diameter implant placed in the grafted region

Fig.9: Biopsy 4 month p.o.: reveals mature trabecular bone lined with plumped osteoblasts. Vital osteocytes can easily be seen as well as a large amount of fibrous tissue.

### Case 4

In a 52-year-old woman a root fenestration was revealed resulting in a non-preservable tooth. Treatment with the extraction of the affected root and a single tooth implant restoration. As a consequence of the proximity of the sinus floor and the lack of primary stability for an implant a two-step procedure was indicated. The bony defect was filled with Bio-Oss corticalis, 0,5-1mm.



Fig.10 : Initial findings at #27

Fig.11: X-ray control shows correct position of the implant

Fig.12: Biopsy 4 month p.o.: The histological evaluation of this probe only shows fragments of dense fibrous tissue. Numerous elongated fibroblastic cells surround spiculae of altered bone. Inflammatory infiltrate is also present. Formation of mature bone cannot be observed after this four-month-period.

### Case 5

A 27-year-old woman with a pneumatization of the right sinus between #16 to #14. Treatment plan included orthodontic measures and a two-step sinus lift procedure. The sinus cavity was filled with DFDBA 500-850  $\mu$ m mixed with sterile saline. To prevent soft tissue migration and infections during the healing period the lateral window was covered with a resorbable membrane.

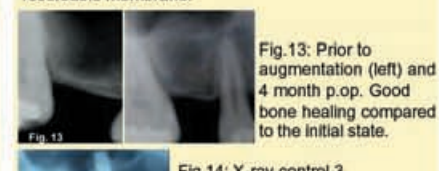


Fig.13: Prior to augmentation (left) and 4 month p.o. Good bone healing compared to the initial state.

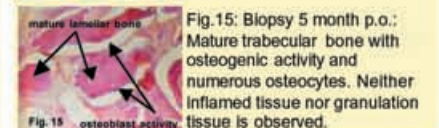
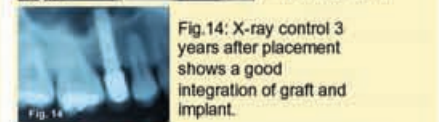


Fig.14: X-ray control 3 years after placement shows a good integration of graft and implant.

Fig.15: Biopsy 5 month p.o.: Mature trabecular bone with osteogenic activity and numerous osteocytes. Neither inflamed tissue nor granulation tissue is observed.

## Results

All filling materials demonstrated more or less the ability to create a new bone matrix. The histological findings revealed that in case 1 (Cerasorb + PRP) the highest rate of bone maturation was observed. Furthermore the highest number of osteoblasts and fibroblasts was detected, which was regarded as a sign of an increased cell differentiation and proliferation. The number was even higher than with autogenous bone graft.

According to literature, Cerasorb proved in both cases to be completely resorbed simultaneously with the formation of new bone. Bone formation and maturation in case 3 and 5 were less than in case 1 and comparable with case 2. In case 4 the bovine bone graft substitute as a non- or minimally resorbable material displayed the lowest rate of newly formed bone.

## Conclusion

The histological evaluation of the biopsies displayed significantly more mature bone formation for the sites treated with  $\beta$ -TCP and PRP and  $\beta$ -TCP alone, followed by autogenous bone graft. The two sites filled with DFDBA and bovine bone graft displayed decreasing amounts of bone formation in the order of mentioning.

Cerasorb provides the dentist or oral surgeon with a safe and predictable method to restore missing bone tissue. The implementation of PRP in implant dentistry and bone regeneration accelerates the maturation of new bone and allows an earlier implant placement or prosthetic supply.