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Augmentation Materials for Inserting Dental Implants in the Ambulatory Surgical Practise

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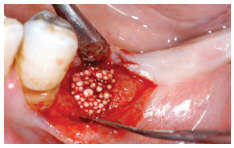
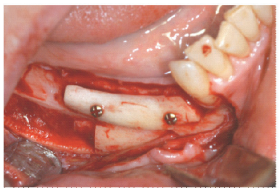
INTRODUCTION

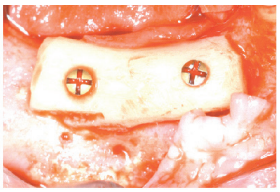


The insertion of dental implants is an established procedure performed in many offices. Successful osseo-integration of dental implants depends on sufficient bone-offer, but frequently, local bone defects result from tooth extraction or pathological resorption so that the insertion of an implant is impossible. In these cases, bone augmentation is required before or combined with inserting implants depending of the quantity of the bone. State-of-the-art bone augmentation methods are 2 stage procedures with autologous bone material for the restoration of large defects and one stage procedures with alloplastic bone substitutes, which are used when smaller defects are present, and can be carried out in ambulatory surgical practise under local anaesthesia. We inspect the possibility to restore large defects with alloplastic materials, thus allowing to avoid extended surgery to gather autologous bone.

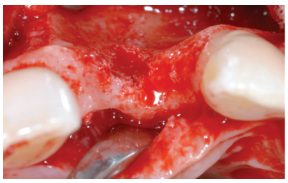
ONE VS. TWO STAGE BONE AUGMENTATION

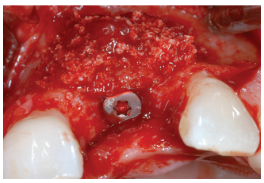
When the lack of bone offer is massive, bone augmentation for implant insertion is performed with autologous bone. In a first stage, autologous bone is implanted at the defect site. After the healing process, the implants are placed in a second stage. This procedure is often difficult for surgeon and patient, as the bone has to be gathered from intra- or extra-oral donor sites, implying extensive surgery.





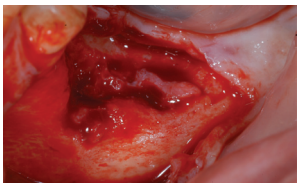
When less severe bone defects are present, bone augmentation is performed with alloplastic materials, which favor bone growth. Here, augmentation procedure and implant placement are performed in one session.

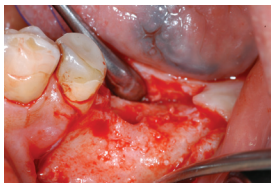




TWO STAGE WITH ALLOPLASTIC MATERIALS

Reconstruction of larger bone defects with alloplastic materials was performed in a two stage manner, analogous to restoration with autologous bone. The advantage of this approach is that no autologous bone has to be harvested.



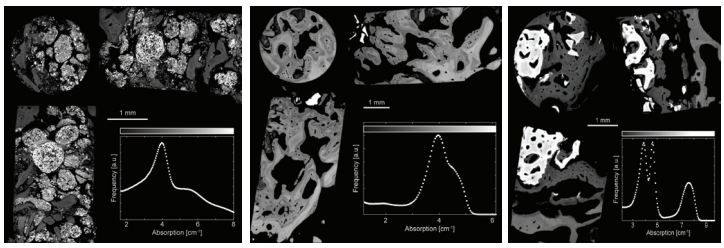


Because bone augmentation treatments using artificial calcium phosphate phases need months, one aims to identify the most effective biomaterials for bone augmentation. Here, we compare a set of specimens from patients, who obtained comparable treatments with different ceramic biomaterials, namely BoneCeramic (Straumann®, Basel, Switzerland), easy-graft™ (Degradable Solutions AG, Schlieren, Switzerland) and Bio-Oss® (Geistlich Pharma AG, Wolhusen, Switzerland). Before implant insertion, the oral surgeon prepares the hole for the implant by means of a hollow drill, which enables storing the specimens for detailed SRμCT-measurements and -analysis.

BONE INGROWTH ANALYSIS

Synchrotron radiation-based micro computed tomography (SRμCT) allows for the non-destructive 3-dimensional (3D) visualisation of bony structures and has thus been developed to a complementary method to histological sectioning. The high sensitivity to density changes allows distinguishing between bone in different stages of development and the augmentation material.

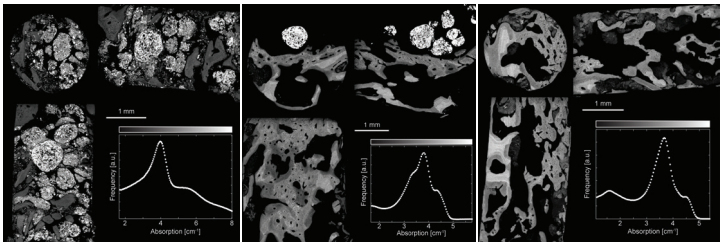
easy-graft™ | *BoneCeramic* | *Bio-Oss®*



Above, three orthogonal cuts through the dataset of three biopsies each restored with a different augmentation material are shown. Reasonable clinical results regarding bone ingrowth are reached in all three cases. However, residual augmentation material can be found in the easy-graft™ and Bio-Oss® specimens.

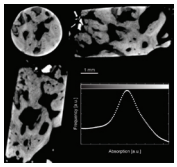
Below, the data of three easy-graft™ specimens is shown. A wide variety of bone volume and degree of resorption can be observed. The duration of the healing period and interpatient differences in metabolism activity and age are held responsible for these discrepancies.

8 months healing period | *4 months healing period* | *4 months healing period*



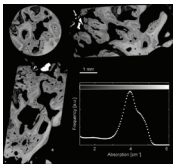
μCT vs. SRμCT

SkyScan 1174™ (SkyScan, Kontich, Belgium)



MicroCT (μCT) is a well established technique in materials science. Conventional tabletop scanners offer good availability allowing for a qualitative analysis. Fully quantitative data regarding bone density can be obtained at synchrotron radiation sources. However, limited beamtime availability makes the collection of statistically relevant data difficult.

SRμCT, HASYLAB (Hamburg, Germany)



CONCLUSION AND ACKNOWLEDGEMENT

The reconstruction with autologous bone, which is still the gold standard, is often difficult for surgeon and patient, as the bone has to be taken from intra- or extra-oral donor sites. Thus, bone substitutes are playing a more and more important role in augmentation surgery. SRμCT provides three-dimensional data that allow for the quantification of newly formed bone and resorbed augmentation material, therefore allowing for the identification of the best suited augmentation material under consideration.

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