

Synchrotron-tomography on regenerated bone tissue using rapidly resorbable bone substitute materials

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The current gold standard for bone reconstruction in implant dentistry is the use of autogenous bone grafts. But the concept of guided bone regeneration (GBR) has become a predictable and well-documented surgical approach using biomaterials (bioactive calcium phosphate ceramics) which qualify as bone substitutes for this kind of application as well. We applied high resolution synchrotron-tomography (S-CT) and subsequent 3d imaging in order to quantify bone formation and degradation of the bone substitute material in a three-dimensional manner.

An animal study has been performed in which these novel rapidly resorbable bone substitute materials are implanted in sheeps. In this study novel materials are compared to tricalcium phosphate and Bioglass. By using monochromatic synchrotron-radiation it is possible to separate the newly formed bone tissue and the implanted bone substitute materials within the resulting images. By means of 3D image analysis we then are able to quantify how the inserted bone substitute materials are supporting bone regeneration while characterizing the degradation of the bone substitute material at the same time (decrease of volume of bone substitute material). Furthermore, the degradation rate of the bone substitute materials will be characterized by quantifying the volume of the bone substitute materials still present after 3 and 6 months of implantation. Parallel to the animal study samples of human bone tissue 6 months after implantation of Cerasorb ceramic particles are investigated as well.

The synchrotron-tomography complements histologic data of the bone tissue in an ideal manner by yielding highly important information on (1) the amount of bone formed in the respective defects and how formation and mineralisation of the regenerated bony tissue progresses in a three-dimensional manner and (2) on the volume and size of the remaining bone substitute materials and on how the biodegradation of the bone substitute material particles progresses within the regenerated defects.