Regenerated bone tissue and human tooth tissue studied with high resolution synchrotron-tomography

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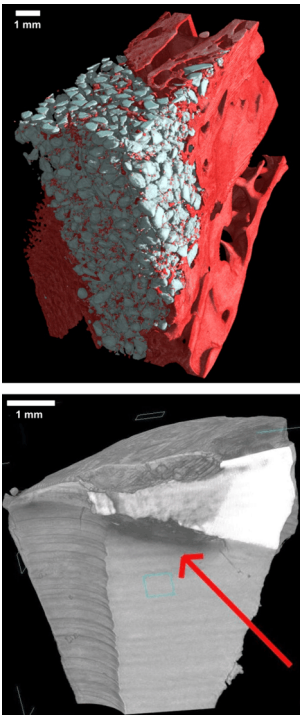

Fig. 1: Top: ceramic particles (Bioglass, white) as bone substitutes within upper jaw (red, sinus) of a sheep; 12 weeks after implantation. Bottom: deep carious lesion (red arrow) inside a human tooth - dentine in light gray, dental enamel in white.

High resolution synchrotron-tomography investigations on novel rapidly resorbable bone substitutes (ceramics like Bioglass, Cerasorb) and demineralised tooth tissue are reported. The measurements were performed with high spatial resolutions at the storage ring BESSY (BAM*line*). The use of monochromatic radiation and the application of subsequent 3d image analysis [1] enables us to separate different material phases in the volume data sets, e.g. tissue and ceramics in a reshaping jawbone (fig. 1, top). Quantitative determination of the formation and the structural changes of the bony tissue in a given defect plus the biodegradation of the bone substitute materials within animal and human biopsies 3, 4 and 6 months after implantation were performed. Parallel human tooth samples in different demineralisation stages were imaged as an loss of mineralized tissues (bone and tooth) is the first stage of caries and periodontitis (fig. 1, bottom). The demineralized tissue can be detected in the volume images due to it's lower density. By quantitative analysis of the data one obtains information about the disease growing's time-dependence. A comparison of non-treated infected teeth with treated ones (e.g. fluoridation) delivers information about the quality of different regeneration approaches. The aim of current and future research projects is to develop regenerative strategies by means of tissue engineering.

[1] J. Ohser and F. Mücklich, *Statistical Analysis of Microstructures in Materials Science*, John Wiley & Sons, 2000