

***In vivo* and *in vitro* tomographic imaging of bone, implants and bioresorbable scaffolds**

[AE.Tami¹](#)

¹[AO Research Institute](#), AO Foundation, Davos, CH

INTRODUCTION: In the last two decades computed tomography has continuously increased its applications in basic research and in the healthcare field. With this technology, biological as well as non-biological structures can be visualized based on their ability to block the X-ray beam. From a series of two-dimensional cross-sectional images orthogonal to the scanning axis, 3D views of an object can be generated. This process enables subsequent volumetric representation of the structures and also the assessment of their morphological and densitometric properties.

The main goal of this article is to give a brief overview of experimental designs and evaluation methods used in our laboratories. The combination of standard protocols in computed tomography [1-3] with wide-ranging *in vivo* scanning capabilities and additional analytical methods (e.g. histology) underscores the remarkable potential of the technique.

***In vivo* and *In vitro* Imaging:** A peripheral clinical computer tomograph (XtremeCT) as well as a microCT system (uCT40, Scanco Medical, Brüttisellen, Switzerland) provide the raw data in a resolution range between 6 and 246 μ m. Several self-developed and custom-made adaptations have extended the spectrum of applications. *In vivo* scanning of sheep, rabbits and rats at different skeletal location have been carried out and longitudinal information was obtained. *In vitro* imaging was optimized and adjusted to allow scanning of bone samples with metallic implants and bioactive scaffolds.

Differentiated Evaluation: Repeatable and consistent data processing protocols are of key importance for results impact and relevance. New scripts and routines are continuously necessary to meet the demand of increasingly sophisticated experimental designs. Recent segmentation algorithms allow precise quantification of bone properties at different stages of healing as well as more accurate separation of biological and metallic resp. synthetic phase.



Fig. 1: Scout views of the regions of interest scanned in vivo (A, B) or in vitro (C, D). (A = critical radius defect in rabbit; B = calvarian defect in rabbit; C = implant osseointegration in ovariectomized rat; D = new bone formation with biomaterials in sheep)

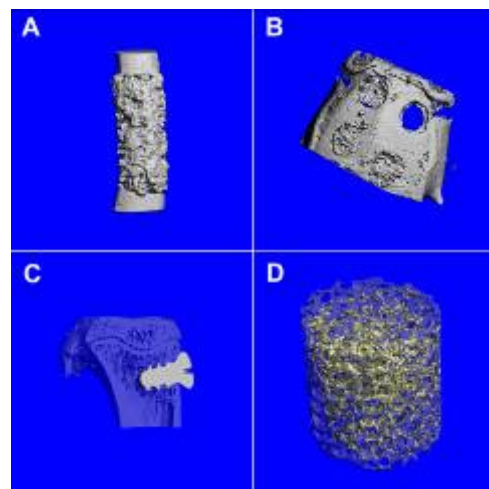


Fig. 2: 3D visualization of the samples shown in Figure 1. after appropriate data processing.

REFERENCES: ¹ A. Laib et al (2000) *Med Biol Eng Comput* **38**:326-332. ² J.A. Gasser et al (1995) *Bone* **17**:145-154. ³ G.H. van Lenthe et al (2007) *Biomaterials* **28**:2479-90.

ACKNOWLEDGEMENTS: The author would like to acknowledge the fruitful collaboration with AO-internal (Tissue Morphology Group, Experimental Surgery Group) as well as external groups (Institute for Biomechanics ETH Zurich).