In vivo characterisation of designated magnesium materials by µCT and fluorescence imaging in rats

Summary

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Supervisor:	Prof. Dr. Annelie-Martina Weinberg
Availability:	This position is available.
Offered by:	Medical University of Graz
Application deadline:	Applications are accepted between August 01, 2018 00:00 and September 23, 2018 23:59 (CEST)

Description

Background: In the last decades, biomedical imaging has gained a significant technological push – a development that is of high relevance in practically all fields of medicine. For instance, computed Tomography (CT) or hybrid technologies (e.g. PET-CT, PET-MRI) are the mainstay of diagnosis and therapy monitoring. Amazing progress in computational tools, sophisticated image fusion approaches and explorations into big data management are the catalysts for the advancement of biomedical imaging. Ageing populations, an ever-increasing incidence of obesity and a rapid rise in osteoporosis-related fractures, along with increasing high-risk sport activities make improvements in implants used in orthopedic interventions imperative.

Conventional alloying systems including titanium or stainless steel are currently used for orthopedic and trauma surgery. However, drawbacks associated with conventional alloys including “stress-shielding” or refractures, increase the need for novel strategies. In the last decade, resorbable magnesium (Mg)-based implants have been demonstrated as an interesting alternative with good biocompatibility and mechanical properties. Several studies have demonstrated the osteoinductive properties of Mg implants, which promote callus formation and reduce complications associated with bone fractures. Mg ions released by Mg-based alloys have been demonstrated to influence bone formation, osteoblast proliferation and adhesion (1, 2).

Overall aim of the PhD project: Establishing and combining of imaging techniques to evaluation of Mg-based implants by in young and old rats.

Objectives: (i) Quantification of implant degradation and bone response *in vivo* together with molecular activities of osteoblast, osteoclast and inflammatory cells, (ii) histological correlation with fluorescence signal of osteoblast, osteoclast and inflammatory response, (iii) *ex vivo* NMR-based metabolic phenotyping of bone and surrounding tissue, (iv) delivery of data, explants and tissue to network partners.

Methods: (i) surgical implantation into femur of rats; (ii) *in vivo* and *ex vivo* microCT; (iii) biocompatibility assays; (iv) serum/plasma characteristics; (v) RNA/protein isolation; (vi) qRT-PCR; (vi) western blot and/or ELISA; (vii) NMR-based metabolomics phenotyping; (viii) histological evaluation

Planned and obligatory academic/industrial training: (i) HZG, R. Willumeit-Römer, 1 month, training in implant alloying and manufacturing process and in surface observation and characterization; (ii) UGOT, P. Thomsen, 3 months, training in molecular analysis; (iii) CNR-IFC, L. Menichetti, 1 month, training PET, µCT, etc.; (iv) Bri.Tech, N. Grün, 2 months, Quality management and certification in industry; (v) HZG, R. Willumeit-Römer, 2 months, synchrotron tomography and SAXS measurements.

References:

1. Cai YL, et al., Osteoblastic cell response on fluoridated hydroxyapatite coatings: the effect of magnesium incorporation. *Biomed Mater.* 2010;5(5):054114

2. Park J-W, et al., Osteoblast response to magnesium ion-incorporated nanoporous titanium oxide surfaces. *Clin Oral Implants Res*. 2010;21(11):1278–87

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