University of Basel
Department of
Biomedical Engineering

University of Basel, Department of Biomedical Engineering, Gewerbestrasse 14, 4123 Allschwil

Master of Science – Biomedical Engineering
Thesis Proposal

Master Thesis: Additive manufacturing of patient-specific bone grafts at the Point of Care

The global market potential of bone substitutes is growing annually. Dental bone grafting alone was valued at approx. 663.2 million USD in the year 2020 and the demand is prospected to increase annually [1]. With the use of 3D printing, the Swiss Medical Additive Manufacturing Research Group (Swiss MAM) would like to explore the possibility of manufacturing patient-specific bone grafts using 3D printing at the hospital to improve bone regeneration. We would like to investigate the potential of using a biocompatible and biodegradable calcium phosphate and polymer composite (Poly(L-lactide-co-D,L-lactide) with 30% β-tricalcium phosphate) to manufacture microporous lattice structures with optimal osseointegrative, osseoconductive and mechanical properties. The aim of the Master Thesis is to investigate current methods of bone regeneration and to design self-supported lattice structures with functionally graded, biomimetic properties to optimize regeneration of the mandibular bone. Please contact us if you are interested or have any questions related to this MSc. Thesis.

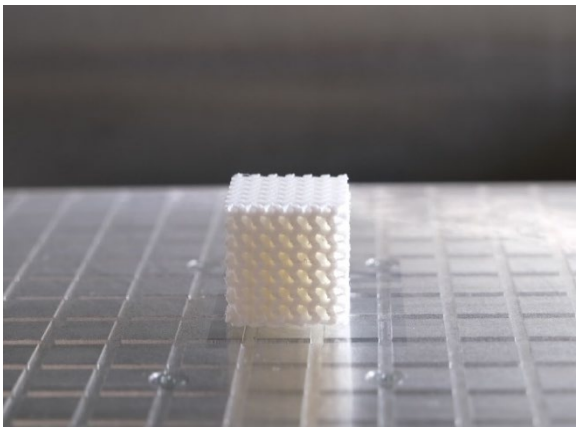

Figure 1 Cubic and macroporous 3D printed scaffold © Swiss MAM

Nature of the Thesis
Experimental: 70%
Programming: 0%
Documentation: 30%

Specific Requirements
- Basic, fundamental knowledge of biomaterials and implants
- Good English skills
- Strong interest in the use of 3D printing for medical applications
- Basic knowledge of 3D printing is advantageous
- Basic knowledge of Computer-Aided Design and Finite Element Analysis is advantageous

Supervisor
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Medical Additive Manufacturing Research Group (Swiss MAM)

Collaborators
- MIRACLE Smart Implants Research Group, Department of Biomedical Engineering, University of Basel
- Swiss Medical Additive Manufacturing Research Group, Department of Biomedical Engineering, University of Basel

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- 3D Print Lab at the University Hospital Basel
- University of Applied Sciences and Arts Northwestern Switzerland

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Suggested literature/references:

[1] Dental Bone Graft And Substitutes Market Size, Share & Trends Analysis Report By End-use (Dental Clinics, Hospitals), By Material Type (Xenograft, Synthetic), By Application, By Region, And Segment Forecasts, 2021 - 2028. Available online. https://www.grandviewresearch.com/industry-analysis/dental-bone-grafts-substitutes-market#:~:text=Report%20Overview,is%20propelling%20the%20market%20growth. (accessed on 22 March 2022).

[2] Zhao, Rusin, et al. "Bone grafts and substitutes in dentistry: A review of current trends and developments." *Molecules* 26.10 (2021): 3007.

[3] Geven, Mike A., and Dirk W. Grijpma. "Additive manufacturing of composite structures for the restoration of bone tissue." *Multifunctional materials* 2.2 (2019): 024003.