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Defence announcement Public Defence on 22 September 2023

Materials for 3D Printing Personalized Bone Implants

Title of the doctoral thesis	Bioactive Patient-Specific Implants for Regeneration of Critical Size Bone Defects
Content of the doctoral thesis	Imagine needing to have your jaw replaced. Injury or diseases such as cancer can lead to a bone defect, a lack of bone where it should normally exist. Bone possesses the ability to spontaneously heal itself, however, if volume of the bone defect is substantial the body needs help to effectively heal. In such cases bone harvested for example from the hip of the patient can be used to fill the defect and assist the healing. Nevertheless, this method is limited considering for example the amount of native bone available. Therefore, synthetic bioactive materials resembling native bone can provide an alternative approach. Synthetic materials possess the advantage, that they can be engineered to have exactly the desired physico-chemical characteristics while being adaptable to fit the patient perfectly. This thesis studied composite materials for 3D printing of so-called patient-specific bone implants for healing large bone defects. Such implants are manufactured individually for the patient according to their anatomy based on computer imaging. Reconstruction of the lower jaw was chosen as case example. Of the four publications included in the work, three focus on the material development, upscaling and finally biological testing of one material and implants thereof. The encouraging results showed that the implants provide a surface upon implantation that stimulates bone growth within the bone defect. These results were confirmed in a large animal study, but the materials were also associated with an elevated incidence of infection. This thesis showed successful technical implementation of a complete production workflow from materials synthesis and materials characterization to manufacturing of large patient-specific bone reconstruction implants. At the same time the thesis highlights the challenge of product design from lab to clinic, while bringing substantial knowledge to the field about the studied materials and components.
Field of the doctoral thesis	Polymer Technology
Doctoral candidate and contact information	M.Sc. (Tech.) Kasper Dienel kasper.dienel@gmail.com
Public defence date and time	22 September 2023 at 13 o'clock (in Finnish time)
Remote defence	https://aalto.zoom.us/j/67964246636
Place of public defence	Aalto University School of Chemical Engineering, Lecture hall Ke1, Kemistintie 1, (main door at Biologinkuja) Espoo
Opponent(s)	Professor Anna Finne-Wistrand, KTH Royal Institute of Technology, Sweden
Custos	Professor Jukka Seppälä, Aalto University School of Chemical Engineering
Link to electronic thesis	https://aaltodoc.aalto.fi/handle/123456789/51
Keywords	patient-specific, bone regeneration, 3D printing, materials science, polymer technology, composite, medical materials

Dissertation will be on public display at https://aaltodoc.aalto.fi/doc_public/eonly/riiputus/