DOCTORAL THESIS ABSTRACT

Contributions to the posibilities of obtaining masive tridimensional structures from powdered materials with biomedical applications

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This thesis includes a literature review and several experimental studies performed for developing an integrated technological solution for manufacturing personalized biomimetic implants for filling large bone defects. The key-research problems that were addressed in the thesis are the main limitations of current alloplastic products for bone reconstruction: a) size and shape are inadequate for filling complex bone defects, b) various side effects and complications may arise after implantation and c) bone substitution products are sold with high prices. The thesis objectives were defined based on the main requirements of an ideal bone substitution product: avoiding bone necrosis by ensuring adequate vascularization; ensuring bone stability during regeneration and enhancing bone regeneration by ostoconduction mechanisms.

Bovine bone-derived hydroxyapatite was proposed as biomaterial due to its high availability, low cost and proven clinical performance. A strictly thermal route for processing bovine bone was refined in this project, in close agreement with European regulations for animal-derived medical devices. The challenges related to tissue vascularization and mechanical stability were addressed by innovative methods of ensuring an equilibrium between the macro/microporosity and mechanical properties of the implants by creatively using low-cost, natural, and biocompatible sintering additives. Various three-dimensional biomimetic test samples from pastes, powders and mechanical processing of massive components were evaluated in the final stages of the experimetal research with good perspectives for clinical application

Keywords: bone scaffolds, bovine bone, calcium phosphates, hydroxyapatite, customized implants