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A NEW TISSUE-ENGINEERED PRODUCT INDICATED FOR BONE RECONSTRUCTION: PROOF OF CONCEPT

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Abstract

To design slow resorption patient-specific bone graft whose properties of bone regeneration are increased by its geometry and composition and to assess it in in-vitro and in-vivo models.

A graft composed by hydroxyapatite (HA) and β-TCP was designed as a cylinder with 3D gyroid porosities and 7 mm medullary space based on swine's anatomy. It was produced using a stereolithography 3D-printing machine (V6000, Prodways).

Sterile bone grafts impregnated with or without a 10µg/mL porcine BMP-2 (pBMP-2) solution were implanted into porcine femurs in a bone loss model. Bone defect was bi-weekly evaluated by X-ray during 3 months. After sacrifice, microscanner and non-decalcified histology analysis were conducted on biopsies.

Finally, osteoblasts were cultured inside the bone graft or in monolayer underneath the bone graft. Cell viability, proliferation, and gene expression were assessed after 7 and 14 days of cell culture (n=3 patients).

3D scaffolds were successfully manufactured with a composition of 80% HA and 20% β-TCP ±5% with indentation compressive strength of 4.14 MPa and bending strength of 11.8MPa.

In vivo study showed that bone regeneration was highly improved in presence of pBMP-2. Micro-CT shows a filling of the gyroid sinuses of the implant (*Figure 1*).

In vitro, the presence of BMP2 did not influence the viability of the osteoblasts and the mortality remained below 3%. After 7 days, the presence of BMP2 in the scaffold significantly increased by 85 and 65% the COL1A1 expression and by 8 and 33-fold the TNAP expression by osteoblasts in the monolayer or in the scaffold, respectively. This BMP2 effect was transient in monolayer and did not modify gene expression at day 14.

BMP2-impregnated bone graft is a promising patient-personalized 3D-printed solution for bone defect regeneration, by promoting neighboring host cells recruitment and solid new bon formation.

or any figures and tables, please contact the authors directly.

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