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ABSTRACT BOOK

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(BIO-P004-2019) Physicochemical and biological properties of bone cement made from bioactive borosilicate glass containing strontium

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To determine the optimal strontium content in glass particles, a kind of novel bone cements composed of the bioactive borosilicate glass particles containing different amounts of Sr (0 to 12 mol% SrO) and the chitosan solution was made in this work. The injectability, setting time, compressive strength, degradation rate and bioactivity of these cements were evaluated in vitro. The ability of Sr ions released from the cements to modulate the proliferation, differentiation and mineralization of human bone marrow stem cells (hBMSCs) was studied in vitro. After comparing the physicochemical and biological properties, some of these cements were implanted for up to 8 weeks in a rabbit femoral condyle defect model in vivo and evaluated for their capacity to stimulate the healing of bone defects. The evaluation was arrived by the Van Gieson's picrofuchsin stain to identify new bone formation at the bone-cement interface. From the results of osteogenic capacity of this kind of bone cements, the work was concluded that the cement (designated 2B6Sr) composed of glass particles containing 6 mol % SrO content, supported better peri-implant bone formation and significantly higher bone-implant contact area than the cements containing 0 or 9 mol % SrO content.

(BIO-P005-2019) Angiogenesis and full-Thickness wound healing efficiency of a copper-doped borate bioactive glass/poly (lactic-co-glycolic acid) dressing loaded with vitamin E in vitro and in vivo

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Cu-doped borate bioactive glass (BG) microfibers have been proven to stimulate the proliferation of endothelial cells and upregulate VEGF gene expression. However, the release of effective ions is uncontrolled in the degradation process, leading to initially burst release, being toxic to the surrounding cells. To solve the problem, a composite dressing of Cu-doped BG microfibers and poly (lactic-co-glycolic acid) (PLGA) with various concentrations of vitamin E (VE) (VE-Cu BG/PLGA) was fabricated, in which PLGA is adopted as a substitute matrix for controlling the ion release rate of Cu-doped BG microfibers and VE was loaded because of its anti-oxidant and anti-inflammatory properties. In vitro results showed that the dressing was an ideal interface for the organic–inorganic mixture and a controlled release system for Cu^{2+} and vitamin E. Cell culture was suggested that the ionic dissolution product of the dressing improved the cell migration, tubule formation, and vascular endothelial growth factor (VEGF) secretion in human umbilical vein endothelial cells (HUVECs) and expression levels of angiogenesis-related genes in fibroblasts in vitro. These results indicate that the VE-Cu BG/PLGA dressing is a promising wound dressing in the reconstruction of full-thickness skin injury.

(BIO-P006-2019) Stereolithography of osteoconductive elastic bone implants based on hydrogel and octacalcium phosphate

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Most of the modern bone implants (metal alloys, ceramics and polymers) require additional surgery and their full or part replacement during the usage. Also it usually is challenging to fill and restore hard-to-get defects with a complex shape. This study aims at the creation of the material with the following properties: a) elasticity; b) biocompatibility and biodegradability, led to complete substitution of the implant by native bone tissue; c) osteoconductivity, i.e the permeability of the implant for bone tissue growth, blood vessels, nutrients etc. through interconnected macropores (of about 500-1000 μm). Such complex property set determined by choosing of polyethylene glycol diacrylate (PEGDA)-hydrogel as elastic matrix, layered calcium phosphates like brushite and octacalcium phosphate as inorganic filler and stereolithography (DLP) 3D-printing as the accurate way of formation of macroporous materials with specific architectures (Kelvin structure, gyroid- and diamond-types). For these biocomposites the composition of suspesion for DLP-printing was revealed, rheological, mechanical and toxicological tests were carried out and preliminary in vivo study on the model of monocortical rat defect was done. The work was supported by RSF, grant #17-79-20427. The authors acknowledge partial support from Lomonosov Moscow State University Program of Development.

(BIO-P007-2019) Resorbable ceramic materials based on calcium magnesium phosphates for bone regeneration

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An ideal material for regeneration of bone tissue in reconstructive and corrective surgery and orthopedics, needs to be porous in order to allow the growth of blood vessels, nerve tissue and bone cells proliferation. Such materials compensating for the lost area of bone tissue should create necessary conditions for its regeneration. In this study, we are obtaining porous resorbable ceramic materials based on calcium magnesium phosphates. According to the laser granulometry of calcium magnesium phosphate, the nanoparticle are suitable for 3D printing where they have a dark gray color, due to the presence of decomposition products of ammonium acetate. The resulting composite (monomers/powder) structures in the form of a Kelvin structure were exposed to a temperature of up to 1200°C. The study of the metabolic activity of cells in the presence of extracts from the material showed that the materials are able to support the adhesion, spreading and proliferative activity of human mesenchymal stem cells. These samples of biomaterials are biocompatible and do not have a cytotoxic effect on mammalian cells. The resulting ceramic materials are suitable for the creation of resorbable bone implants, including individually designed inorganics bases for the treatment of bone defects. Acknowledgement: This work was supported by the RFBR, grant nos. 18-29-11079, 18-53-00034.

(BIO-P008-2019) Effect of fluorapatite (FAp) coating on transform reaction of dicalcium phosphate dihydrate (DCPD) to FAp

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A dicalcium phosphate dihydrate (DCPD) transforms to more stable calcium phosphate such as hydroxyapatite (HAp) and fluorapatite (FAp). This reaction have been applied to serf-setting calcium phosphate cements. We previously appeared that the transform reaction of DCPD requires the formation "nano-surface structure" on surface of the DCPD particle. In this research, we investigated effect of coating of nano-scaled hydroxyapatite (HAp) and FAp nano-particle on surface of theDCPD particle by soaking the DCPD into an aqueous solutions. HAp precursor was successfully induced by using simulated body fluid (SBF), however the solution containing only calcium and phosphate ions (Ca-P solution) did not induce any precursor. FAp precursor was successfully induced by addition of fluoride ion in the Ca-P solution (Ca-P-F solution). More FAp precursor successfully induced by renewing the Ca-P-F solution