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Application of β-1,3-glucan in production of ceramics-based elastic composite for bone repair

Research Article

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Abstract: Background: Unsatisfactory surgical handiness is a commonly known disadvantage of implantable granular bioceramics. To overcome this problem, β-1,3-glucan, biotechnologically derived polysaccharide, has been proposed as a joining agent to combine granular ceramics into novel compact and elastic composite. Hydroxyapatite/glucan elastic material was processed and evaluated as a potential bone void filler Methodology: The procedure of composite formation was based on gelling properties of glucan. Its properties were studied using X-ray microtomography, SEM-EDS, FTIR spectroscopy, compression test and ultrasonic method. Sorption index was determined in phosphate buffered saline; bioactivity in simulated body fluid; sterility in growth broth and human blood plasma; implantation procedure in dog model. Results: HAp/glucan composite is sterilizable, flexible and self-adapting to defect shape. It exhibits bioactivity, good surgical handiness, high sorption index and profitable mechanical properties, resembling those of spongy bone. Results of pilot clinical experiment on animal (dog) patients of a local clinic of animal surgery suggested good healing properties of the composite and its transformation into new bone tissue within critical-size defect. Conclusions: The results obtained in this study confirm that flexible HAp/glucan composite has potential as a bone-substituting material. Promising results of pilot clinical experiment suggest that further *in vivo* experiments should be performed.

Keywords: *Hydroxyapatite ceramics • Bone filler • Sorption index • Sterility • Bioactivity*

1. Introduction

Hydroxyapatite (HAp), especially in a porous form, is appreciated as a bone filler due to its biocompatibility, bioactivity, osteoconductivity, minimal risk of appearance of allergic reactions, lack of carcinogenic properties and lack of sensitivity to sterilization processes [1-3]. There are numerous commercially available bone graft materials based on biologic and synthetic HAp, including ProOsteon® (Interpore Cross International, USA), Endobon (BIOMET Orthopaedics, Switzerland), Cerapatite (Ceraver Osteal, France), Synatite (SBM, France) and others. HAp may serve not only as a bone filler but also as a carrier of active substances: antibiotics, chemiotherapeutics, growth factors, *etc.* [4-9]; it can also be used in composites, as a factor increasing their cytocompatibility, bioactivity, osteoconductivity, adhesion of coatings and compression modulus [10-14]. On the other hand, HAp application is often limited due to its relatively poor resorption and slow replacement by the host bone after implantation, substantially high Young modulus, and low fracture toughness [15,16], although these properties may be improved by addition of elasticity-increasing polymers. It is considered that polymer-ceramic composites reveal superior properties (at least in some aspects) over polymer and ceramic

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