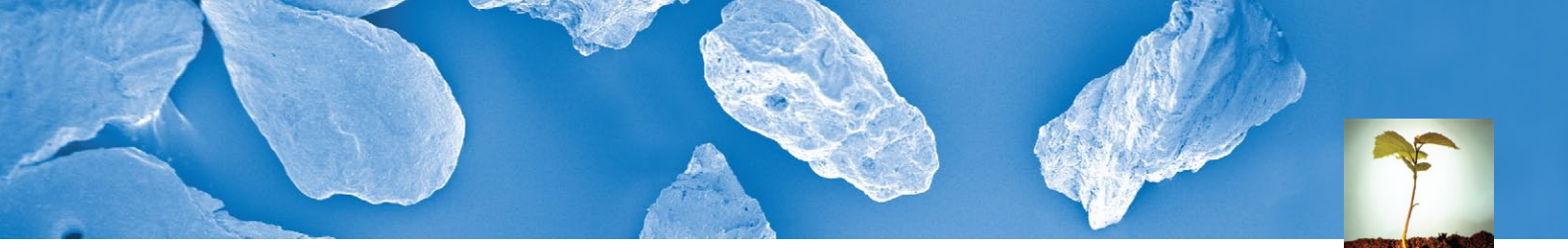
Laboratory tests

OsteoBiol®
by Tecnoss

REGENERATION SCIENCE

INSPIRED BY NATURE



OsteoBiol® by Tecnoss

Physicochemical characterization of biomaterials commonly used in dentistry as bone substitutes - comparison with human bone

LABORATORY TESTS

026

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ABSTRACT

Xenografts have been regarded as promising alternatives to autografts, thanks to their unlimited supply of available material and because they can reduce morbidity by eliminating the donor site. The main purpose of this study was the characterization of a variety of granulate mineral-based biomaterials, chosen to encompass materials of different origins (bovine, porcine and coralline) and different types (cortical and cancellous bone and mineral based). The biomaterials examined included grafting materials of different origins: bovine (BioOss® and PepGen P-15®), porcine (OsteoBiol® *Gen-Os*®, Tecnoss®, Giaveno, Italy) and coralline (Biocoral®). These samples were tested with no further treatment. The results obtained for these biomaterials were compared with those of human bone. Besides a classical rationalization of chemichal composition and crystallinity, a major emphasis was placed on the measurement of various morphostructural properties, specifically particle size, porosity, density, and surface area. Each material was used in a granular form (easier to accommodate and more quickly resorbed) with the lowest particle size range available, recommended for application in the treatment of oral, periodontal, and maxillo-facial bone defects. Mercury intrusion revealed a significant variation in the samples porosity: 33% for OsteoBiol®, 50% for PepGen P-15®, and 60% for BioOss®. Moreover, it showed that a significant percentage of that porosity corresponded to submicron pores. Biocoral® was not analyzed by this technique as it possesses larger pores than those of the porosimeter upper limit. The density values determined for the calcined samples were close to the theoretical values of hydroxyapatite. However, the values for the collagenated samples were lower, in accordance with their lower mineral content. The specific surface areas ranged from less than 1 m^2/g (Biocoral®) up to 60 m^2/g (BioOss®).
FTIR spectra of OsteoBiol® *Gen-Os*® and natural human bone showed collagen bands clearly visible in addition to those of hydroxyapatite, while diffractograms of these samples represent the dual-phase composition: hydroxyapatite (sharp peaks) and collagen (broad band).

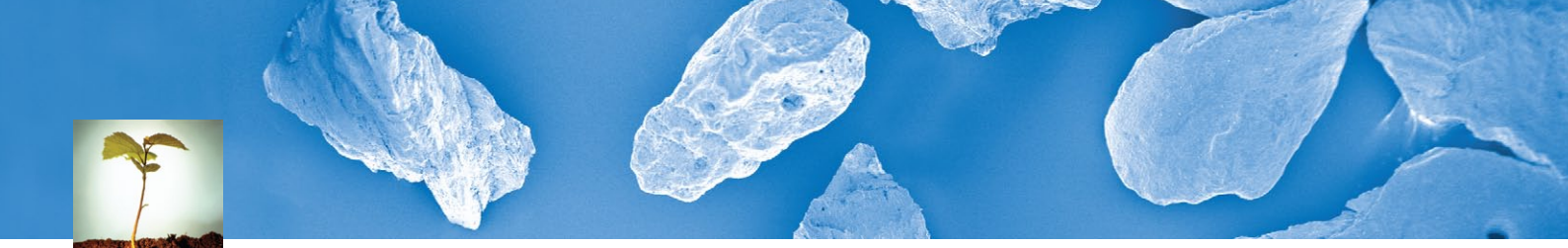
CONCLUSIONS

In evaluating these biomaterials, the Authors detected significant differences in terms of particle size, crystallinity, porosity and pore size distribution, surface area, and mineral content. Consequently, they concluded that *"although these morphological characteristics greatly influence the in vivo behavior of the samples, they are often not taken into consideration when the samples' biological performance is evaluated. This may be responsible for the conflicting results frequently found in the literature. It is believed that the results provided for the materials investigated will be most useful to fully interpret their clinical responses"*.

ORIGINAL ARTICLE
Journal of Biomedical Materials Research
2010 Feb;92(2):409-19

Material tested

BONE SUBSTITUTE
OsteoBiol® *Gen-Os*®



OsteoBiol® by Tecnoss

LABORATORY TESTS

070

Solid-state NMR and IR characterization of commercial xenogeneic biomaterials used as bone substitutes

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ORIGINAL ARTICLE
Journal of Pharmaceutical and Biomedical Analysis
2012 Mar 5;61:136-41

ABSTRACT

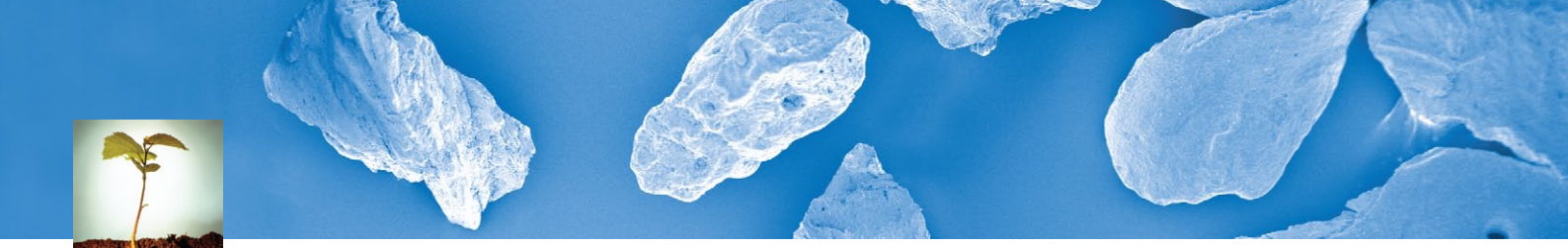
Thanks to their similarity to human bone tissue, xenogeneic biomaterials, mainly of bovine and porcine origin, are widely used as bone substitutes in the reconstructive surgery.
As in literature only a few works on commercial xenogeneic materials used for bone repair are available, the Authors decided to perform an elaborate characterization of three commercial xenogeneic biomaterials OsteoBiol® *Gen-Os*® (GO), *Apatos* Spongiosa (AS) and *Apatos Cortical* (AC), all from Tecnoss® srl (Giaveno, Italy) originated from porcine bone. Often used in dental surgery, AS and AC are produced from trabecular and cortical porcine bone, respectively. *Gen-Os*® is made of porcine bone, both cortical (25%) and trabecular (75%).
For the purpose of this study, these three xenogeneic biomaterials were characterized by various analytical methods, such as powder X-ray diffraction (XRD), thermogravimetry (TGA), high-resolution solid-state nuclear magnetic resonance (ssNMR) and infrared spectroscopy (FT-IR), focusing on their structural properties and chemical compositions.
The reported spectroscopic analyses are semi-quantitative and aimed at structural comparison of the examined materials. Moreover, as the samples do not require any chemical pre-treatment, those methods are not invasive and do not interfere with the material structure.

CONCLUSIONS

According to this study, it is evident that the main constituents of the analyzed biomaterials were nanocrystalline apatite mineral with the average crystal sizes similar to those in bone mineral. Moreover, they contain organic collagenous matrix composed mainly of collagenous proteins, but with the amino acid composition different than that in pure collagen type I. This difference in the protein structure may be a consequence of the manufacturing process of the raw bone.
The highest levels of water, organic matrix and apatite mineral were found in GO, AS and AC, respectively. The lowest levels of water, organic matrix and apatite mineral were found in AC, AS and GO, respectively.
The Authors conclude that *"solid-state NMR and FT-IR spectroscopies, applied together and accompanied by elaborate curve fitting analysis, provide valuable information on xenogeneic biomaterials"*.

Material tested

BONE SUBSTITUTE
OsteoBiol® *Gen-Os*®
OsteoBiol® *Apatos*



OsteoBiol® by Tecnoss

LABORATORY TESTS

100

Characterization and angiogenic potential of xenogeneic bone grafting materials: role of periodontal ligament cells

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ORIGINAL ARTICLE
Dental Materials Journal
2016 Dec 1;35(6):900-907

ABSTRACT

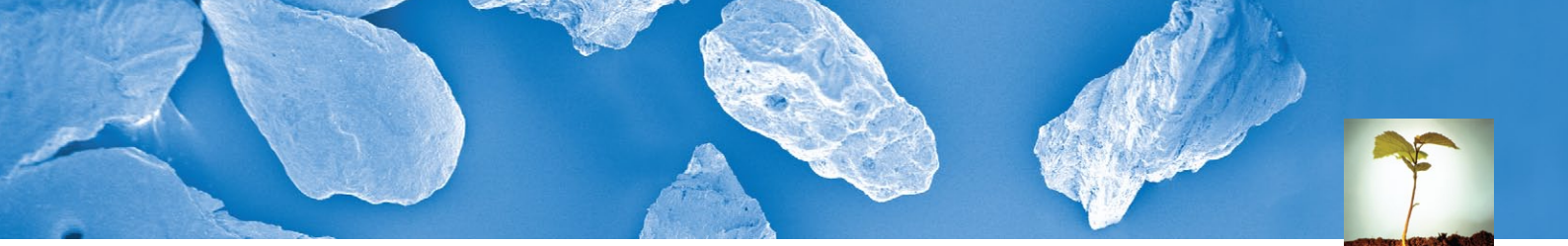
In case of intrabony defects, grafting materials are frequently applied in order to fill the defect and support bone regeneration, with the aim to favour the migration of bone forming cells into the bone defect. As an adequate revascularization is a prerequisite for successful healing of periodontal bone defects, it is necessary that the grafting material used is capable of promoting a rapid revascularization. In literature, there is a clear evidence that the use of bone grafting materials with an angiogenic potential for treatment of periodontal bone defects can improve the clinical outcome.
The aim of this study was to characterize three different xenogeneic bone grafting materials and evaluate their angiogenic potential: Bio-Oss® cancellous anorganic bovine bone grafting material (Geistlich Pharma, Wolhusen, CH); OsteoBiol® *Gen-Os®* (Tecnoss®, Giaveno, Italy) cortico-cancellous collagenated bone grafting material of equine origin, and OsteoBiol® *Gen-Os®* cortico-cancellous collagenated bone grafting material of porcine origin. The hypothesis of this study was that the material may influence periodontal ligament (PDL) cell angiogenic activity, which is a prerequisite for successful bone regeneration. The three bone grafting materials were characterized by scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), X-ray diffraction (XRD) analyses and Fourier transform infrared (FT-IR) spectroscopy. In this way, the precise material chemistry was determined, allowing the interpretation of the materials' effects on cellular behavior. With reference to the effect of bone grafting materials on VEGF secretion by PDL cells, results showed that all three bone grafting materials significantly increased VEGF secretion by PDL cells and that this increase was significantly higher with OsteoBiol® *Gen-Os®* from porcine and equine origins. A significant increase in endothelial cell proliferation was observed in cultures with both OsteoBiol® *Gen-Os®* conditioned media, but not with that of Bio-Oss®. Moreover, results showed that angiogenesis was stimulated by both OsteoBiol® *Gen-Os®* conditioned media as demonstrated by an increased formation of capillary-like structures.

CONCLUSIONS

As stated by the Authors, "Our results clearly indicate a significant increase in VEGF secretion and a higher angiogenic potential of both OsteoBiol® Gen-Os® materials from porcine and equine origins, compared to Bio-Oss®. Indeed, VEGF secretion by PDL cells increased when cultured in OsteoBiol® Gen-Os® conditioned media. This was associated with increased endothelial cell proliferation and formation of capillary-like structures. The formation of these structures reflects angiogenesis in vivo".
Consequently, their conclusion is that "Within the limits of this in vitro study, it was demonstrated that both OsteoBiol® Gen-Os® materials have a higher angiogenic potential compared to Bio-Oss®. Both OsteoBiol® Gen-Os® materials have the ability to induce VEGF secretion by PDL cells which is an interesting feature since it mitigates the need for exogenous growth factor delivery. Furthermore, angiogenesis was induced which suggests that the use of OsteoBiol® Gen-Os® materials will favour the bone regeneration process by stimulating early revascularization within the grafted material".

Material tested

BONE SUBSTITUTE
OsteoBiol® *Gen-Os®*



OsteoBiol® by Tecnoss

Porcine bone scaffolds adsorb growth factors secreted by MSCs and improve bone tissue repair

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ABSTRACT

When bone regeneration is needed, tissue engineering represents an ideal approach to restore critical-sized defects by means of biomaterials, cells, and biologicals. Biomaterials provide a three-dimensional (3D) substrate with specific engineered characteristics for cells to attach and proliferate and growth factors can be added in order to improve the migration and differentiation into the required tissue type. In order to improve or accelerate the bone healing process, new tools are offered to produce scaffolds that act as carriers for growth factors with bone-related biological properties, such as bone morphogenetic proteins (BMPs) and VEGF.
The aim of the present study was to elucidate whether bone substitutes adsorbed with growth factors secreted by stem cells could represent a good natural delivery system able to stimulate vascularization and promote bone repair. In the vast panorama of bone substitutes, porcine-derived scaffolds are showing great results in terms of human bone regeneration, as confirmed by several studies. In the present study, porcine-derived bone granules with dimensions of 250-1000 μm (OsteoBiol® *Gen-Os*®, Tecnoss®, Giaveno, Italy) were loaded with MSCs, in particular those isolated from human dental pulp in order to investigate the ability of the porcine-derived bone granules impregnated with growth factors to promote and facilitate bone tissue regeneration in critical-size calvaria defects in rats.

CONCLUSIONS

Based on the results, the Authors determined that *"bone tissue formation and markers for bone and vascularization were significantly increased by the growth factor-enriched bone granules after implantation. This suggests that the controlled release of active growth factors from porcine bone granules can enhance and promote bone regeneration"*.

ORIGINAL ARTICLE
Materials
2017 Sep 8;10(9)

Grafted with

BONE SUBSTITUTE
OsteoBiol® *Gen-Os*®