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Comparison of two xenograft materials used in sinus lift procedures: material characterization and in vivo behavior

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ABSTRACT

Loss of teeth in the posterior maxillary area can lead to severe maxillary sinus pneumatization, and in this anatomical situation, it can be very difficult to obtain a suitable primary stability of implants. Maxillary sinus augmentation is a predictable method to increase posterior maxillary bone height, allowing to place dental implants in case of a residual alveolar ridge with a reduced bone volume. In sinus lift procedures, several types of graft materials can be used. The aim of this study was to characterize the physico-chemical properties of two xenografts deproteinized at different temperatures and compare how the physico-chemical properties influence the material's performance in vivo by a histomorphometric study in retrieved bone biopsies following maxillary sinus augmentation in 10 clinical cases. The two materials were a bovine HAs scaffold (BBM) consisting of a highly porous network with an average pore size of 0.5 mm, and a porcine HAS scaffold (PBM) formed by small grains of 500 μm on average. The X-ray diffraction analysis revealed the typical structure of hydroxyapatite (HA) for both materials. Both xenografts were porous, with intraparticle pores. Strong differences were observed in terms of porosity, crystallinity, and calcium/phosphate ratio. Histomorphometric measurements on the bone biopsies showed statistically significant differences. Both xenografts showed to be characterized by an excellent biocompatibility, with similar characteristics to natural bone. At the 6 months follow-up, the success rate of the 10 partially edentulous patients was 100%. By the end of the healing period, the increased bone volumes were stable and it was evident a bone gain for both xenografts. At the moment of implant insertion, the augmented sites treated with PBM showed less dense new bone than BBM. The sintered HA xenografts exhibited greater osteoconductivity, but were not completely resorbable. The non-sintered HA xenografts induced about 25.92 ± 1.61% of new bone and a high level of degradation after six months of implantation. Differences in the physico-chemical characteristics (porosity, crystallinity and composition) found between the two HA xenografts determined a different behaviour for this material.

CONCLUSIONS

At the end of the study and after the evaluation of the results, the Authors concluded that "*the HAs assessed herein are shown to be biocompatible and osteoconductive when used for maxillary sinus elevation purposes. PBM displayed a high level of degradation over the study period*". Anyway, more histological and histomorphometrical studies are needed to better understand the resorption times of these biomaterials.

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LABORATORY TESTS

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SEM-EDX study of the degradation process of two xenograft materials used in sinus lift procedures

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ABSTRACT

In case of an implant rehabilitation in the upper jaw, maxillary sinus grafting, combined with Schneiderian membrane elevation, has been proposed to re-establish the ideal quantity and quality of bone prior to implant placement. In order to ensure positive results, the grafting material should provide good mechanical support, while maintaining bioactivity, and must biodegrade later at a tailorable rate. Therefore, the grafting material is an important determinant of bone augmentation procedures being a success or a failure. The objective of this study was to compare the physico-chemical properties of two deproteinized HA materials, assessing their influence on the degradation process of the materials' performance in retrieved bone biopsies following their use in maxillary sinus augmentation. The raw materials employed in this study were two different types of commercial deproteinized HA materials used in dentistry: OsteoBiol® (Tecnoss®, Giaveno, Italy), a deproteinized porcine hydroxyapatite (DPHa) processed at 130 C, and Endobon®, a deproteinized bovine hydroxyapatite (DBHa) processed with pyrolysis at 900 C following ceramization at 1200 C. Ten partially edentulous patients (six women and four men), whose ages ranged from 41 to 71 years, were subjected to maxillary sinus augmentation with a split-mouth design. Six months after the healing period, a biopsy was taken for histology purposes at the time of implant placement. From the results of the analysis, the fastest resorption rate of the material was in DPHa group and was related to physico-chemical characteristic of this xenograft. A significant difference in resorption time and stability of the material was found in DBHa, which showed greater stability and less resorption than the DBHa group. The HA of porcine origin is non-sintered presents high porosity, low crystallinity, low density, high surface area, and low calcium/phosphate ratio, low stability and high resorption rate.

CONCLUSIONS

In their conclusions, the Authors affirm that their study demonstrates that variations in the physical properties of a bone substitute material clearly influence the degradation process and, as a consequence, biomaterials can be chosen depending on the resorption rate, dimensional stability, and handling needed for each case. Anyway, further studies are required to establish to what extent the rate of resorption affects the capacity of the augmented area to receive and integrate dental implants.

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