ANALYZING THE INFLUENCE OF DRIVING PHYSICO-CHEMICAL CHARACTERISTICS IN INTRA-ORAL BONE REGENERATION USING A PREDICTIVE EMPIRICAL MODEL

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1. INTRODUCTION

Bone grafts that support alveolar augmentation have key role to ensure the success of bone regeneration process. There are many screening studies about the alveolar bone grafts, but little has been done on the multiple physico-chemical aspects in the intra-oral bone regeneration. Despite the large set of empirical data available on the characteristics, there is still lack of understanding their importance and contribution in the intra-oral bone regeneration. The purpose of this study was to implement multivariate statistical analysis to investigate the weighted value of driving biomaterials properties in the bone regeneration process, potentially giving directions of the design of a new generation of intra-oral bone biomaterials.

2. MATERIALS AND METHODS

A quantitative data set was built composed of morphological characteristics of 7 commercially available intra-oral bone biomaterials (BioOss®, BioOss®-Collagen, BoneCeramic®, Cerasorb®, MP3®, Natix® and Ostim®) and their in vivo response when implanted in a sinus augmentation model in rabbits [1-3]. The morphological properties include chemical composition, micro-porosity and surface roughness parameters. To acquire the surface profile of bone grafts for surface roughness evaluation, we used an in-house developed protocol that allows non-destructive assessment of the micro-scale roughness of porous materials using high-resolution SEM images [4]. A partial least square regression (PLSR) model was applied to the data set in order to gain find out which (combination of) morphological characteristics would allow to predict the bone regenerative response after in vivo implantation, quantified by the bone to material contact evaluated from histomorphometry at 6 months.

3. RESULTS AND DISCUSSION

The empirical model based on the aforementioned data set, allowed identification of the construct parameters driving optimized bone formation i.e. (a) the percentage of chemical components, (b) micro-porosity and (c) surface roughness.

The presented model provides a better understanding on the influence of driving biomaterial properties in the bone healing process as well as predicting the bone regeneration potential of new biomaterials based on their physico-chemical characteristics. This method appears a robust tool for the design of (3D printable) bone biomaterials with more controlled and custom-made structure.

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