

Preparation and Characterization of Calcium Phosphate Bone Cements

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ABSTRACT

Calcium phosphate cement (CPC) is a biodegradable bioceramic that can be used as temporary scaffolds or defect fillers in bone tissue engineering. However, CPC is mechanically weak even in its dense form, needless to say in its porous form. In this study, both dense and porous CPCs were prepared. The dense CPC was prepared by mixing a CPC powder consisting of tetracalcium phosphate ($\text{Ca}_4(\text{PO}_4)_2\text{O}$) and dicalcium phosphate anhydrous (CaHPO_4), with an aqueous solution of sodium phosphate (Na_2HPO_4). The porous CPC was prepared by coating polyurethane foams of four pore sizes with a CPC slurry, followed by setting, and firing. In order to improve the mechanical properties of the porous CPC, fired or sintered CPC was coated with poly (lactic-co-glycolic) acid (PLGA). The dense and porous CPCs were characterized by density measurement, x-ray diffraction, scanning electron microscopy, compressive testing, etc. Both the as-set CPC and the fired CPC showed the hydroxyapatite phase but with different crystallinity. The true density, compressive strength, and three point bending strength of the dense CPC were 3.05 g/cm³, 9.22 MPa and 3.78 MPa, respectively. The porous pure CPCs had pore sizes of 4.92 to 1.13 mm, total porosities of 86.19 to 69.35 %, and compressive strengths of 0.03 to 0.29 MPa. The coated porous CPCs showed compressive strengths from 0.31 to 4.03 MPa, which were one order higher than those of uncoated CPCs. Since the sintered porous CPC contained both open macropores and open micropores, the PLGA phase was able to penetrate into the micropores to actually form porous PLGA/HA composites.

Keywords: Calcium phosphate cement, porosity, PLGA and coating