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Effect of Poly(Vinyl Alcohol) Addition on the Properties of Hydrothermal Derived Calcium Phosphate Cement for Bone Filling Materials

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Abstract. The effect of addition of poly(vinyl alcohol) on hydrothermal derived calcium phosphate cement has been studied. The precursors used to prepare the cement were calcium oxide (CaO) and ammonium dihydrogen phosphate ($NH_4H_2PO_4$); the reaction was conducted in water at 80-100°C. To improve properties of CPC, poly(vinyl alcohol) (PVA) of 1wt% and 2wt% was added to the liquid phase of CPC and the results were compared to CPC without PVA addition. The addition of PVA was proved to bring remarkable effects on cohesion, setting time and mechanical strength of CPC which make it suitable physically for injectable bone filler applications.

1. Introduction

Calcium phosphate cements (CPC) has shown great interest as one of the materials for bone graft applications because of excellent biological behavior, non-toxicity, biocompatibility, and osteoconductivity[1]. CPC is generally produced by chemical reaction between two phases which are powder phase and liquid phase[2,3]. The preparation of cement using hydrothermal method is most favorable because its ability to produce highly crystalline cement with high yield, controlled morphology and stoichiometric Ca/P ratio[5].

Nevertheless, there are certain drawbacks that need to be considered which gives limitation to its clinical applications[2,6]. CPC has shown poor injectability and in certain cases, the phase separation between powder and liquid might occur[7]. The cements also have tendency to disintegrate after injected and contact with blood or other physiological solutions in body because of weak cohesion[7].

Numerous works have been reported to increase integrity of CPC by adding polymeric binder such as poly(vinyl alcohol) (PVA), poly(lactic-co-glycolic acid) (PLGA), chitosan fibers, polyamides and others to either powder or liquid phase of CPC paste with the aim to improve their handling and mechanical properties[6]. Among these polymers, PVA is of great interest from the viewpoint of improving cohesion and setting time of CPC. PVA is one of the hydrophilic biocompatible polymer that was widely used in biomedical applications. The high hydrophilicity and easy swelling when