

Setting, Mechanical, Morphological, Degradation and Antibacterial Properties of Brushite cements.

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Aims:

This study aim was to develop high strength, antibacterial-releasing brushite cements with controllable setting and porosity for bone-filling.

Materials and Methods:

Monocalcium phosphate monohydrate (MCPM) was reacted with equimolar β -tricalcium phosphate (TCP) and 800mM aqueous citric acid (CA) containing 0, 20, or 40wt% of antibacterial ϵ -polylysine (PLS). The large MCPM monoclinic crystals (10x100x500 micron) were used as received or after grinding. The powder to liquid ratio was 3:1 or 4:1. Setting kinetics, mechanical strengths, fracture surface morphologies, degradation rates, and PLS release was undertaken. Additionally, MRSA colony forming units (CFU) on set material discs with 0 versus 40wt% PLS and in surrounding broth medium was compared.

Results

Use of smaller particles and increased PLS lead to formation of more stable intermediate complexes and slower Brushite formation. Formulations with intermediate MCPM particle size and higher powder content had significantly higher flexural strengths. Pores / channels with dimensions comparable with those of the original MCPM crystals were detected on the fracture surfaces. Dissolution rates were affected by MCPM particle size but not PLS content. PLS release occurred primarily in the first 24 hours of set disc immersion in water. Addition of PLS enabled MRSA growth to decline from 1.8×10^7 to 2.5×10^4 on a set disc and from 2.0×10^9 to 1.2×10^4 CFU in the surrounding medium.

Conclusion and significance

The above antibacterial Brushite cements could be employed in the treatment of infected bone (e.g. periodontitis, implantitis, osteomyelitis). Controlled setting is required to minimise leakage away from the required site of application. The channels in the cements and dissolution will allow bone cell penetration and provide

ions for new bone formation respectively. The higher strengths will enable application in greater load bearing clinical situations.

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