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The Effect of Surface Modified Nano-Hydroxyapatite Incorporation into Polymethylmethacrylate Cement on Biocompatibility and Mechanical Properties

Authors : Yu-Shan Wu, Po-Liang Lai, I-Ming Chu

Abstract : Poly(methylmethacrylate)(PMMA) is the most frequently used bone void filler for vertebral augmentation in osteoporotic fracture. PMMA bone cement not only exhibits strong mechanical properties but also can fabricate according to the shape of bone defect. However, the adhesion between the PMMA-based cement and the adjacent bone is usually weak and as PMMA bone cement is inherently bioinert. The combination of bioceramics and polymers as composites may increase cell adhesion and improve biocompatibility. The nano-hydroxyapatite(HAP) not only plays a significant role in maintaining the properties of the natural bone but also offers a favorable environment for osteoconduction, protein adhesion, and osteoblast proliferation. However, defects and cracks can form at the polymer/ceramics interface, resulting in uneven distribution of stress and subsequent inferior mechanical strength. Surface-modified HAP nano-crystals were prepared by chemically grafting poly(ε-caprolactone)(PCL) on surface-modified nano-HAP surface to increase the affinity of polymer/ceramic phases .Thus, incorporation of surface-modified nano-hydroxyapatite (EC-HAP) may not only improve the interfacial adhesion between cement and bone and between nanoparticles and cement, but also increase biocompatibility. In this research, PMMA mixing with 0, 5, 10, 15, 20, 25 and 30 wt% EC-HAP were examined. MC3T3-E1 cells were used for the biological evaluation of the response to the cements in vitro. Morphology was observed using scanning electron microscopy (SEM). Mechanical properties of HAP/PMMA and EC-HAP/PMMA cement were investigated by compression test. Surface wettability of the cements was measured by contact angles.

Keywords : bone cement, biocompatibility, nano-hydroxyapatite, polycaprolactone, PMMA, surface grafting
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