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Durability Assessment of Nanocomposite-Based Bone Fixation Device Consisting of Bioabsorbable Polymer and Ceramic Nanoparticles

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Abstract : Effects of ceramic nanoparticles on the improvement of durability of bone fixation devices have been investigated by assessing the durability of nanocomposite materials consisting of bioabsorbable polymer and ceramic nanoparticles, which could be applied for bone fixation devices such as plates and screws. Various composite ratios were used for the synthesis of nanocomposite materials by blending polylactic acid (PLA) and polyglycolic acid (PGA) as bioabsorbable polymer, and hydroxyapatite (HA) and tri-calcium phosphate (TCP) as ceramic nanoparticles. It was found that the addition of ceramic nanoparticles significantly enhanced the mechanical properties of the bone fixation devices compared to those fabricated with pure biopolymers. Particularly, the layer-by-layer approach for the fabrication of nanocomposites also had an effect on the improvement of bending strength. Durability tests were performed by measuring the changes in the bending strength of nanocomposite samples under varied temperature conditions for the accelerated degradation tests. It was found that Weibull distribution was the most proper one for describing the life distribution of devices in the present study. The mean lifetime was predicted by adopting Arrhenius Eq. Model for Stress-Life relationship.

Keywords : bioabsorbable, bone fixation device, ceramic nanoparticles, durability assessment, nanocomposite
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