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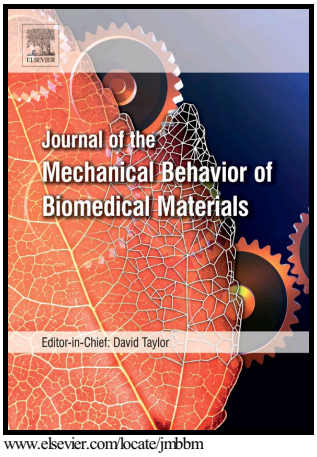

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Original article

How does tissue regeneration influence the mechanical behavior of additively manufactured porous biomaterials?

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Abstract

Although the initial mechanical properties of additively manufactured porous biomaterials are intensively studied during the last few years, almost no information is available regarding the evolution of the mechanical properties of implant-bone complex as the tissue regeneration progresses. In this paper, we studied the effects of tissue regeneration on the static and fatigue behavior of selective laser melted porous titanium structures with three different porosities (i.e. 77, 81, and 85%). The porous structures were filled with four different polymeric materials with mechanical properties in the range of those observed for *de novo* bone (0.7 GPa< E <1.5 GPa) to simulate bone tissue regeneration into their pores. The static mechanical properties and fatigue behavior (S-N) curves of as-manufactured and filled porous structures were then determined. The static mechanical properties and fatigue life (including endurance limit) of the porous structures were found to increase by factors 2-7, even when they were filled with polymeric materials with relatively low mechanical properties. The relative increase in the mechanical properties was much higher for the porous structures with lower porosities. Moreover, the increase in the fatigue life was more notable as compared to the increase in the static mechanical properties. Such large values of increase in the mechanical properties with the progress of bone