Bioglass fiber reinforced bone cements

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Abstract

The use of calcium phosphate-based bone cements, which are already well established on the market, is essential in the field of bone repair, mainly when bone defects occur. However, due to insufficient mechanical properties, the field of application is currently limited to non-load-bearing body areas, such as the top of the skull. In order to improve the bone cements' mechanical properties, we aim to investigate the influence of bioactive glass fibers as reinforcement agents. As a result, the bone cement and the bioactive glass fibers dissolve over time and promote bone growth.
Since after surgical fracture treatment, bacteria often cause infectious pseudarthrosis, a failure of the fracture to heal due to bacterial infestation, the glass fibers should have an antibacterial effect due to their dissolution and should therefore be doped with ions with an antibacterial effect; such as silver, copper and zinc. Moreover, infectious pseudarthrosis disease is promoted by circulatory disturbances. Therefore, another bioactive glass fiber-reinforced bone cements approach is to promote angiogenesis by adding ions to the glass fibers that promote the formation of new blood vessels (e.g., boron).
The advantage of bioactive glass fiber reinforcement is that these degradation kinetics and can be controlled by changing the chemical composition. For example, using a wide variety of glass fiber compositions in the bone cements, faster dissolution can promote angiogenesis, while slower dissolution of the glass fibers maintains mechanical reinforcement.

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