Scientists optimize strontium content to improve bioactive bone cement

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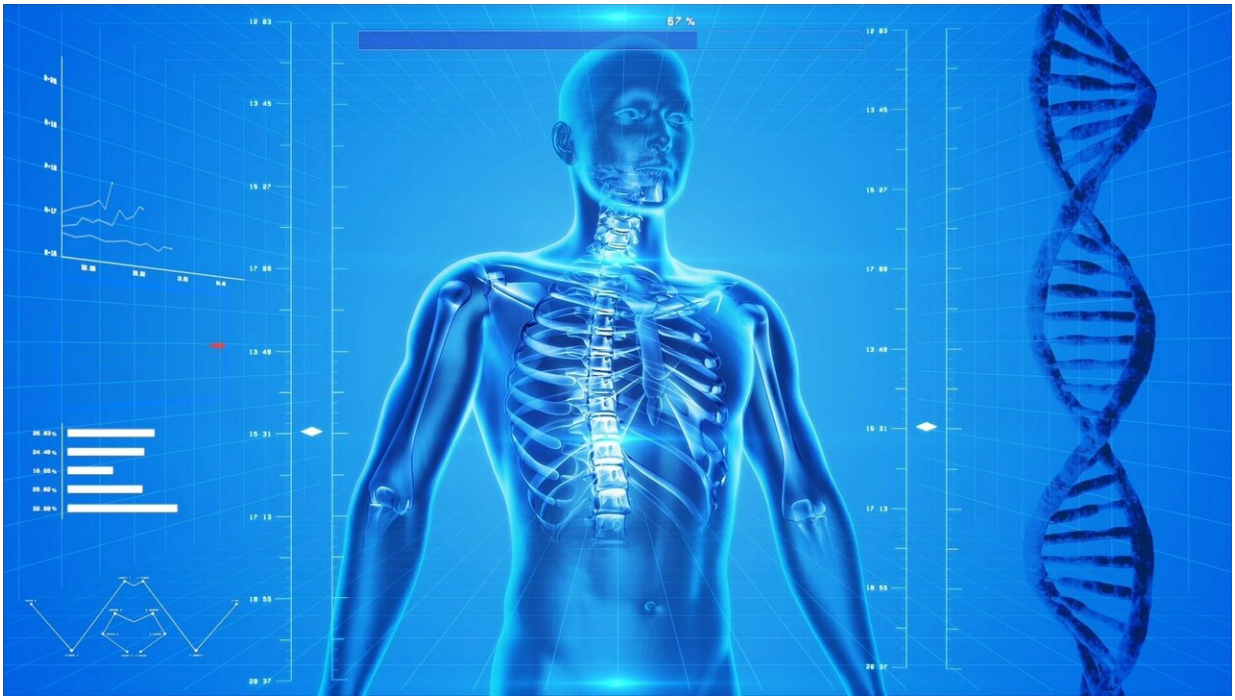

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Researchers from the Shenzhen Institutes of Advanced Technology (SIAT) of the Chinese Academy of Sciences have developed a new strontium-substituted bioactive glass (BG) bone cement that optimizes the concentration of strontium to improve peri-implant bone formation and bone-implant contact.

BG bone cement is a minimally invasive alternative to arduous and risky autologous bone grafts and allografts for the treatment of large bone defects.

Previous studies from SIAT found that adding strontium (Sr) to bioactive borate glass cement enhanced its osteogenic capacity in vivo. However, researchers didn't know how much Sr was needed to optimize the cement's physicochemical properties and capacity to stimulate bone regeneration. Likewise, they didn't clearly understand the molecular mechanism underlying this stimulation.

Their current research answers these questions.

In the present study, the scientists found that adding Sr to BGs could modulate the physicochemical properties and osteogenic activity of BG-based bone cements. For example, adding Sr sped up the setting reaction of bone cements and slowed down their degradation rate.

In order to determine an optimum level of Sr substitution, the researchers created bone cements composed of bioactive borosilicate glass particles substituted with varying amounts of Sr (0 mol% to 12 mol% SrO) and evaluated them in vitro and in vivo.

They discovered that osteogenic characteristics were optimally enhanced with a cement (designated BG6Sr) composed of particles substituted with 6 mol% SrO. When implanted in rabbit femoral condyle defects, the BG6Sr cement supported better peri-implant bone formation and bone-implant contact compared to cements substituted with 0 mol% or 9 mol% SrO.

The researchers also discovered that the underlying stimulation mechanism of Sr-containing bone cements involves the activation of the Wnt/β-catenin signaling pathway in the osteogenic differentiation of

human blood marrow mesenchymal stem cells (hBMSCs).

These results show that BG-based bone cements offer a promising combination of physicochemical properties and biological performance for the minimally invasive treatment of bone defects when Sr is appropriately added.

More information: Xu Cui et al, Strontium modulates osteogenic activity of bone cement composed of bioactive borosilicate glass particles by activating Wnt/β-catenin signaling pathway, *Bioactive Materials* (2020). DOI: 10.1016/j.bioactmat.2020.02.016

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