An implanted biomaterial to accelerate bone healing

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Unmet Need

A leading concept in regenerative medicine is transplantation of tissue-specific cells, often supported with biomaterials, to promote tissue repair. While this strategy has achieved some success, its broad clinical application is hindered by various challenges such as high costs, constraints associated with cell isolation and expansion, and limited in vivo engraftment of transplanted cells. Instead, harnessing endogenous cells and native biomolecules to augment the innate regenerative ability of tissues has been explored as an alternative. Notably, extracellular adenosine has been shown to play a key role in maintaining bone health and could potentially be used to treat bone loss. However, systemic administration of exogenous adenosine to treat bone disorders is challenging given the ubiquitous presence of adenosine receptors in different organs, the potential for off-target effects associated with its systemic administration, and the short half-life of adenosine in circulation. Accordingly, there exists a need in the art for therapeutic compounds and methods for the treatment and prevention of bone diseases that overcome these challenges.

Technology

Duke inventors have reported a biomaterial that is implanted to treat low bone mass, promote healing after a fracture, or enhance the outcome of orthopedic implant surgery. This biomaterial enables targeted delivery of adenosine to the site of bone loss. For example, the inventors copolymerized hyaluronic acid with phenylboronic acid, a reversible adenosine binding moiety, then conjugated this with alendronate, a bone-targeting moiety. The researchers then systemically administered the biomaterial to ovariectomized mice and observed attenuated bone loss. Additionally, this technology has also been demonstrated as a patch containing a PBA-functionalized polyethylene glycol network that could bind and release adenosine. This was implanted in mice following tibia fraction and resulted in accelerated healing.

Advantages

- Delivers adenosine to treat bone loss while mitigating the short half-life and off-target effects of systemic adenosine administration

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Links

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- Can be tailored using different combinations of polymers, osteoanabolic molecule binding moieties, and bone targeting moieties
- Mouse data demonstrates accelerated bone fracture healing

Publications

- Bone targeting nanocarrier-assisted delivery of adenosine to combat osteoporotic bone loss (Biomaterials, 2021)
- In vivo sequestration of innate small molecules to promote bone healing (Adv Mater, 2020)
- Published PCT App US2020/036012