New biomaterial regrows blood vessels and bone

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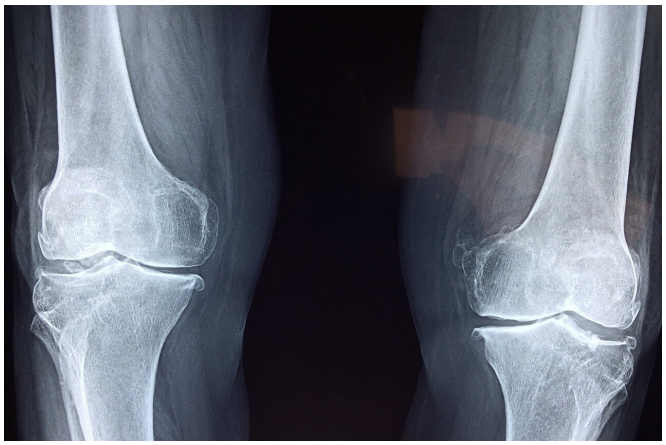

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Scientists have developed a new biomaterial that regrows blood vessels and bone, potentially providing a single-stage approach when repairing large bone defects.

The study, led by researchers from RCSI University of Medicine and Health Sciences and SFI AMBER Centre, is published in the *Journal of Controlled Release*.

Previous RCSI-led research had found that activating a mechanosensitive gene, called placental growth factor (PGF), at different doses promoted bone regeneration and grew new blood vessels. Using this knowledge, the researchers developed a biomaterial that delivers PGF at different concentrations.

Inspired by the natural way in which bone defects regenerate, the biomaterial first releases a high dose of PGF, promoting blood vessel growth, and follows it with a more sustained lower dose, which promotes bone regeneration. When tested in a pre-clinical model, the biomaterial successfully repaired large bone defects while also regrowing blood vessels.

Current biomaterials that promote both blood vessel and bone growth typically require using more than one therapeutic drug, which means designing a more complex system that faces more challenges. Furthermore, drugs that have been approved for use in the clinic have been controversially associated with dangerous side-effects, highlighting the need for new strategies.

"More testing is needed before we can begin clinical trials, but if proven successful, this biomaterial could benefit patients when repairing bone defects by providing an alternative to current systems," said Professor Fergal O'Brien, the study's principal investigator and RCSI's Director of Research and Innovation.

"In addition to repairing bone defects, our approach to regenerative medicine executed in the study provides a new framework for evaluating regenerative biomaterials for other tissue engineering applications. We are now applying this concept of 'mechanobiology informed regenerative medicine' to identify new therapeutics in other areas, including cartilage and spinal cord repair."

The biomaterial was developed by researchers from the Tissue Engineering Research Group (TERG) based at RCSI and the SFI AMBER Centre. Their work was supported by the Irish Research Council, the EU BlueHuman Interreg Atlantic Area Project, the European Community's Horizon 2020 research and innovation program under European Research Council Advanced Grant agreement n° 788753 (ReCaP) and the Health Research Board of Ireland under the Health Research Awards—Patient-Oriented Research Scheme.

"By using a mechanobiology-informed approach, we were able to identify a promising new therapeutic candidate for bone repair and also

determine the optimal concentrations required to promote both angiogenesis and osteogenesis within a single biomaterial," said Dr. Eamon Sheehy, the study's first author and researcher in TERG.

"The regeneration of large bone defects remains a significant clinical challenge, but hopefully our new biomaterial will continue to prove beneficial in further trials."

More information: Eamon J. Sheehy et al, Mechanobiology-informed regenerative medicine: Dose-controlled release of placental growth factor from a functionalized collagen-based scaffold promotes angiogenesis and accelerates bone defect healing, *Journal of Controlled Release* (2021). DOI: 10.1016/j.jconrel.2021.03.031

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