

Researchers develop new biomaterial that helps bones heal faster

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Scientists have developed a new biomaterial that helps bones heal faster by enhancing adults' stem cell regenerative ability.

The study, led by researchers from RCSI University of Medicine and Health Sciences and CHI at Temple Street, is published in the current edition of *Biomaterials*, the highest ranked journal in the field of biomaterials science.

The researchers had previously discovered a molecule called JNK3, which is a key driver of children's stem cells being more sensitive to their environment and regenerating better than adults'. This explains, at least partially, why children's bones are able to heal more quickly. Building on this knowledge, they created a biomaterial that mimics the structure of bone tissue and incorporates nanoparticles that activate JNK3.

When tested in a pre-clinical model, the biomaterial quickly repaired large bone defects and reduced inflammation after a month of use. The biomaterial also proved to be safer and as effective as other drug-loaded biomaterials for bone repair whose

use has been controversially associated with dangerous side-effects, including cancer, infection or off-site bone formation.

"While more testing is needed before we can begin clinical trials, these results are very promising," said Professor Fergal O'Brien, the study's principal investigator and RCSI's Director of Research and Innovation.

"This study has shown that understanding stem cell mechanobiology can help identify alternative therapeutic molecules for repairing large defects in bone, and potentially other body tissues. In a broader sense, this project is a great example of how growing our understanding of mechanobiology can identify new treatments that directly benefit patients—a key goal of what we do here at RCSI."

The work was carried out by researchers from the Tissue Engineering Research Group (TERG) and SFI AMBER Centre based at RCSI in collaboration with a team from Children's Health Ireland (CHI) at Temple Street Hospital. The CHI at Temple Street team was led by Mr Dylan Murray, a lead consultant craniofacial, plastic and reconstructive surgeon at the National Paediatric Craniofacial Centre (NPCC), who has collaborated with the RCSI team for a number of years.

"It is very exciting to be part of this translational project in which the participation and consent of the patients of the NPCC at Temple Street -whom donated harvested bone cells- have contributed immensely to this success," said Mr Murray.

The research was funded by the Children's Health Foundation Temple Street (RPAC-2013-06), Health Research Board of Ireland under the Health Research Awards—Patient-Oriented Research scheme (HRA-POR-2014-569), European Research Council (ERC) under Horizon 2020 (ReCaP project #788753) and Science Foundation Ireland (SFI) through the Advanced Materials and

Bioengineering Research (AMBER) Centre
(SFI/12/RC/2278).

"We have now proven that identifying mechanobiology-inspired therapeutic targets can be used to engineer smart biomaterials that recreate children's superior healing capacity in adults' [stem cells](#)," said Dr. Arlyng Gonzalez Vazquez, the study's first author and a research fellow in TERG.

"We are using the same strategy to develop a novel biomaterial for cartilage repair in adults. A follow-up project recently funded by Children's Health Foundation Temple Street is also aiming to utilize a similar scientific approach to identify if the molecular mechanisms found in children diagnosed with craniosynostosis (a condition where the skull fuses to early and in his brain growth) could be used to develop a therapeutic [biomaterial](#) that accelerates bone formation and [bone](#) healing in adults."

More information: Arlyng González-Vázquez et al, Accelerating bone healing in vivo by harnessing the age-altered activation of c-Jun N-terminal kinase 3, *Biomaterials* (2020). [DOI: 10.1016/j.biomaterials.2020.120540](#)

Provided by RCSI

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