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Easy recipe to make bone and cartilage

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Scientists at The University of Texas Health Science Center at Houston (UTHealth), Monash University and RIKEN Centre for Developmental Biology have used a combination of small molecules to generate mouse cells that can form bone and cartilage. This new method is easily scalable, and hence is a promising approach for the repair of human bone and cartilage defects. The research has just been published at dev.biologists.org/ in the scientific journal *Development*.

Current strategies to regenerate bone and cartilage use adult stem cells that are committed to forming these tissues, but such strategies have shown limited success. The team led by Naoki Nakayama, Ph.D., holder of the Jerold B. Katz Distinguished Professorship in Stem Cell Research at the UTHealth Medical School, took a different approach, choosing to work with pluripotent stem cells from the early mouse embryo, which have the potential to become any cell type. To persuade these embryonic stem cells to become cells that can form cartilage (chondrocytes) and then bone, the team chose to use small molecules.

"Current cell generation strategies generally use proteins to direct the stem cells to give rise to functional cells of interest. Such proteins act on the target cells through multiple mechanisms, not all of which necessarily help to achieve the overall goal [of generating chondrocytes]. In addition, proteins are unstable and expensive to make, and the cost is one of the hurdles that limits the ability of scientists to make the amounts necessary for clinical purposes", said Nakayama, whose laboratory is housed in the Center for Stem Cell & Regenerative Medicine in the UTHealth Brown Foundation Institute of Molecular

Medicine for the Prevention of Human Diseases.

"In contrast, small molecules are generally longer-lasting than proteins in culture and also inexpensive to produce to a large scale. They can also allow a particular mechanism to be more precisely activated. Such strategies have already been used to replace protein factors with such small molecules to establish a better culture method for maintaining pluripotent embryonic stem cells and for induction of early neural precursor cells from them," he said.

Using embryonic stem cells and small molecules, the team was able to generate cells that look and behave like chondrocyte precursor cells e.g. paraxial mesoderm and sclerotome that are destined to form cartilage for the formation of backbone and disc. When such cartilage was transplanted into mice, they were able to form bone-like structures.

This team's strategy offers great potential in the repair of bone defects through cartilage or potentially of damaged cartilage itself in humans in the future, "because it can easily be scaled up to reproducibly produce large numbers of cartilage-forming chondrocyte precursors," he said.

More information: dev.biologists.org/content/141/20/3848

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