# AI-Designed Synthetic Bones Could Change Orthopedic Surgery

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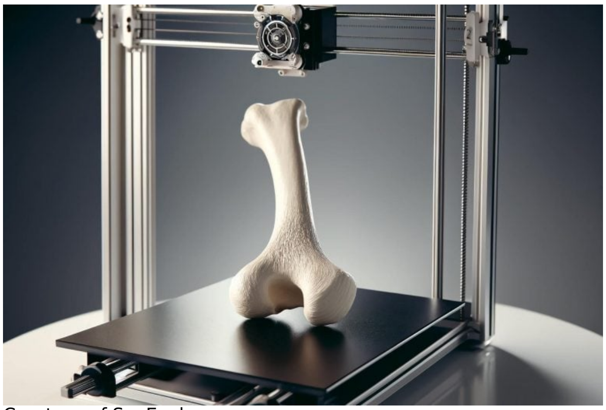


Courtesy of SynEvol

Credit: Fred Zwicky

Natural materials with uneven structures, such as bones and bird feathers, are incredibly effective in distributing physical stress. Scientists have long been puzzled by the precise connection between stress modulation and their architecture, though. In order to create a material that mimics the functions of human bone for orthopedic femur replacement, researchers recently combined machine learning, optimization, 3D printing, and stress trials. This work sheds light on this intricate interaction.

Courtesy of SynEvol
Credit: Fred Zwicky

Human femur fractures, which affect the long bone in the upper leg, are common and especially common in the elderly. The fracture is more likely to lengthen because of the concentrated stress at the crack tip caused by the fractured edges. The traditional approach to treating a femur fracture is surgery to place screws around the fracture and secure a metal plate, which can lead to loosening, long-term pain, and more damage.

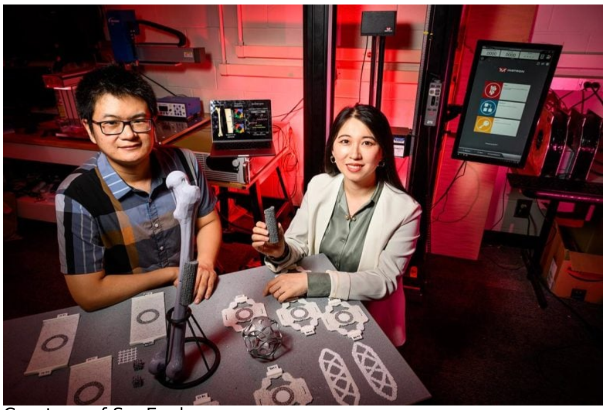
Leading the research team were graduate student Yingqi Jia, professor Ke Liu from Peking University, and Shelly Zhang, a professor of civil and environmental engineering at the University of Illinois Urbana-Champaign. Their work, which was published in Nature Communications, presents a novel strategy for orthopedic repair that creates a material that resembles bone by using a fully programmable computational framework.

"We began with a materials database and learned the relationship between its structure and physical properties by generating a virtual material using a virtual growth stimulator and machine learning algorithms," Zhang explained. "We went above and beyond by creating a computational optimization algorithm to maximize both the architecture and stress distribution we can control, which sets this work apart from previous studies."

Zhang's team created a full-scale resin prototype of the novel bio-inspired material in the lab using 3D printing, and they affixed it to a man-made replica of a fracturing femur.

Zhang stated, "Having a physical model allowed us to conduct practical tests, evaluate its effectiveness, and establish that it is feasible to grow a synthetic material in a manner similar to how biological systems are constructed." "We hope that this work will contribute to the development of materials that, by offering optimal support and defense against external forces, will stimulate bone repair."

Zhang claimed that anywhere stress manipulation is required, this technology can be used with a variety of biological implants. "The technique is highly versatile and can be utilized with almost any kind of material, including metals and polymers," the spokesperson stated. "There are practically infinite applications because the geometry, local architecture, and corresponding mechanical properties are key."



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