New understanding of bones could lead to stronger materials, osteoporosis treatment

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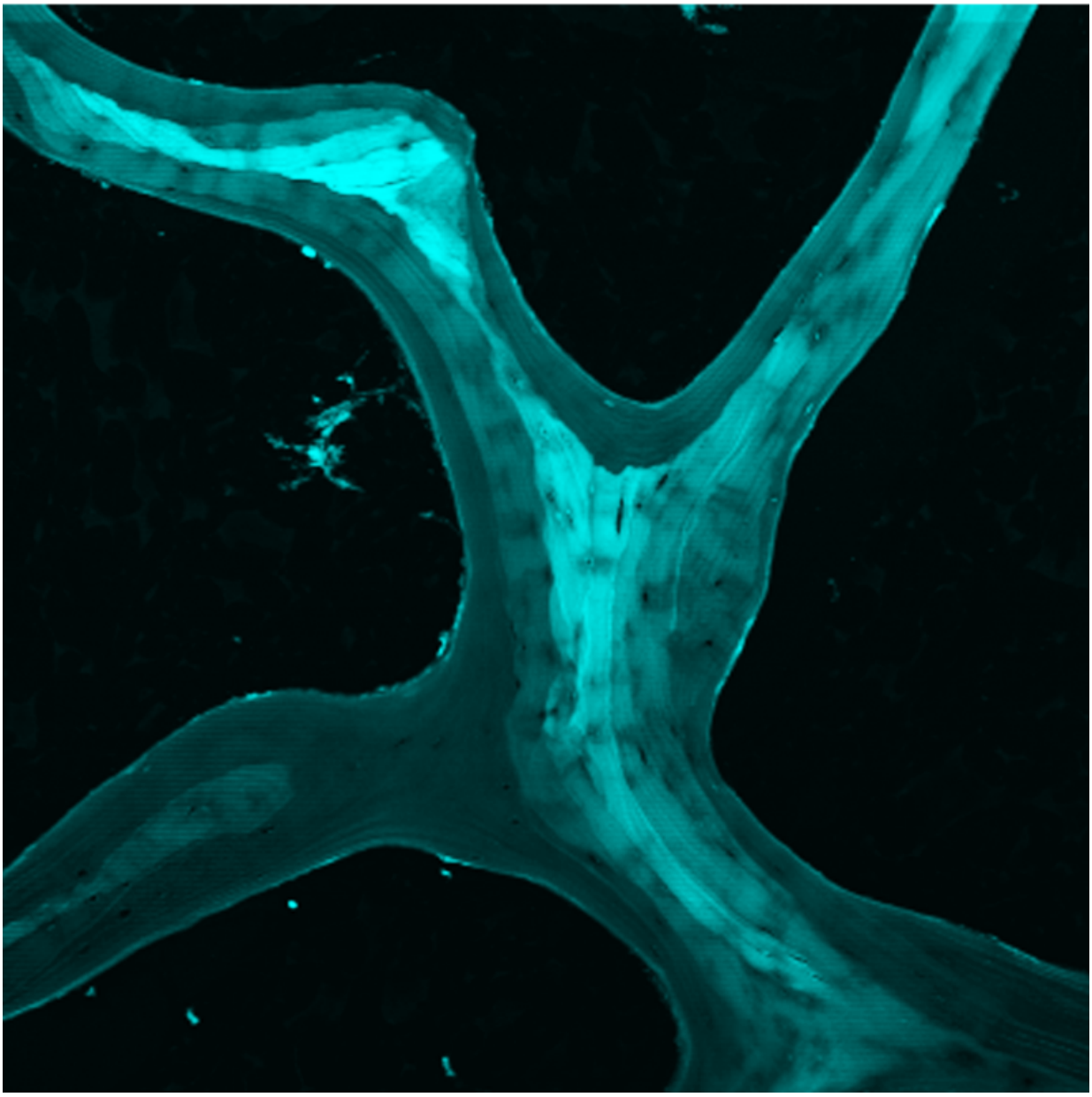

A microscopic slide showing a region of cancellous bone (blue). The brighter blue regions are more brittle where we found cracks more likely to grow. Credit: Cornell University

Researchers at Cornell University have discovered that bone does something better than most man-made materials: it bounces back after it breaks. In an article published in the *Proceedings of the National Academy of Sciences* this week Cornell scientists report that cancellous bone—the spongy foam-like type of bone found near joints and in the vertebrae that is involved in most osteoporosis-related fractures—displays unique material properties that allow it to recover shape after it breaks.

When most things break, they fall apart and lose their mechanical function. To help make car and aircraft parts last longer, engineers apply surface treatments that harden the surfaces to prevent cracks from starting.

"Cancellous bone does the opposite, it has softer surfaces with a more brittle interior," says Christopher Hernandez, Associate Professor of Mechanical and Aerospace Engineering and Biomedical Engineering and principal investigator on the project. The combination of softer surfaces and brittle interior allows cancellous bone to direct cracks to locations where they are less detrimental, allowing the structure to recover its shape—bounce back—after it breaks.

"That's totally not what we expected from an engineering standpoint," says Ashley Torres, a graduate student in biomedical engineering who was one of two individuals to lead the study. "But it allows the material able to continue to function after failure."

The discovery provides a compelling answer to the long-standing question as to why bones have foam-like regions. "We used to think that we had cancellous bone for the same reasons that we use foams in engineering, to absorb energy or make the structure more lightweight, but it turns out that cancellous bone does something different, the way cancellous bone breaks actually makes it heal better," says Hernandez.

"In the future, this could help in the design of new materials that can take advantage of this 'function after failure,'" says Jonathan Matheny the other graduate student leading the project. Material heterogeneity in structures, the group proposes, could help mitigate the effects of small structural flaws that are inevitable in manufacturing. Additionally, Matheny said these findings have implications for medicine, "to help us identify people at risk for an osteoporosis-related fracture and prescribe drug treatment."

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