New research reveals how our skeleton is a lot like our brain

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Researchers from Monash University and St Vincent's Institute of Medical Research in Melbourne have used mathematical modelling combined with advanced imaging technology to calculate, for the first time, the number and connectivity of the osteocyte network in the human skeleton.

The findings could contribute towards finding better treatments for skeletal disorders such as osteoporosis.

Osteocytes are the living cells within bones that make up a living network through the skeleton; their long, dendritic fingers infiltrate the tissue and interconnect with each other. They play an important role in sensing mechanical strain, orchestrating bone tissue renewal and regulating calcium levels in the bloodstream. Until now they have been difficult to study because they live in hard, mineralised bone.

Researcher Dr Pascal Buenzli from the School of Mathematical Sciences at Monash University commented that the findings, published in the journal *Bone*, have exceeded all expectations.

"Taking recent imaging data, we calculated that the human skeleton contains about 42 million osteocytes. That's about six times the Earth's population. In comparison, the human brain contains 86 billion neurons, packed in a volume (1.2L) comparable with that of the skeleton (1.75L)," Dr Buenzli said.

"We then used a mathematical model of dendritic finger branching and, feeding this model with data on the network, we calculated that a remarkable 23 trillion cell–cell connections exist in the osteocyte network of the human body. This is impressive in view of the estimated 150 trillion synapses in the human neural cortex."

"In a similar way to the 86 billion neurons in the human brain, osteocytes exchange information with each other about, for example, where the skeleton is weak and needs to be repaired," he said.

Co-researcher Associate Professor Natalie Sims from St Vincent's Institute explained the significance of the findings.: "These measurements indicate that the skeleton is a lot like the brain, with a similar number of cells interconnected in a similar sized space. While we know little about why our skeletons need such a complex network and how osteocytes communicate, these findings mark a significant step in the journey towards finding better treatments for skeletal disorders such as osteoporosis and osteogenesis imperfect," Associate Professor Sims said.

More information: "Quantifying the osteocyte network in the human skeleton." *Bone*, 75, 144–150. DOI: 10.1016/j.bone.2015.02.016

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