

Seeing bone in three dimensions: AI-driven deep imaging and spatial omics of the human skeletal stem-cell niche

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TIME
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VENUE
B6-619, 6/F Yeung Kin Man Academic Building

ABSTRACT

The skeleton has long resisted high-resolution study because bone is opaque, mineralised and architecturally complex. My work builds an engineering pipeline (DeepBone) that renders human bone optically transparent, images it whole-mount by light-sheet microscopy, and reconstructs it in three dimensions at single-cell resolution using deep-learning segmentation. Coupled with single cell transcriptomics, this turns intact human biopsies into quantitative 3D maps of cells, vessels and signalling niches. Using this platform we showed that human mesenchymal stromal cells occupy a defined osteo-sinusoidal niche that remodels with age (Nature Biomedical Engineering, 2026), and built the first transcriptional atlas of the pubertal human growth plate, revealing that growth hormone acts directly on cartilage stem cells (Science Translational Medicine, 2026). Complementary mouse genetics defined how growth hormone controls the stem-cell pool (PNAS, 2025) and how MMP14 tunes PTH signalling during bone formation (eLife, 2023). Together these establish a translational, imaging-and-AI-centred approach to skeletal biology with direct application to osteoporosis, osteoarthritis and growth disorders.

BIOGRAPHY

Dr Nelson Tsz Long Chu is a researcher at the University of Gothenburg (Department of Rheumatology and Inflammation Research, Institute of Medicine). He obtained his PhD from the School of Biomedical Sciences, The University of Hong Kong, and trained as a postdoctoral researcher at Karolinska Institutet. His work develops AI-driven three-dimensional deep-tissue imaging and spatial transcriptomics to decode the human skeletal stem-cell niche, bridging biomedical engineering, computational biology and skeletal medicine. He is first or co-first author of recent papers in Science Translational Medicine, Nature Biomedical Engineering, PNAS and eLife, with work featured in the AAAS Science Press Package.