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Influence of cortical canal architecture on lacunocanalicular pore pressure and fluid flow.

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Abstract
Bone is a dynamic tissue that undergoes structural modification in response to its mechanical environment, but how bone cells sense and respond to loading conditions remains incompletely understood. Current theories focus on strain-induced fluid flow for the primary means of mechanotransduction. To examine the influence of age-related cortical rarefaction on lacunocanalicular fluid characteristics, coupled fluid flow and mechanical computational models of bone specimens representing young, mid-age and aged samples were derived artificially from the same original micro-computed tomography image data. Simulated mechanical loading was applied to the bone models to induce pressure-driven interstitial fluid flow. Results demonstrated a decrease in pore pressure and fluid velocity magnitudes with age as a result of increased cortical porosity. Mean canal separation, as opposed to canal size, was implicated as a primary factor affecting age-related fluid dynamics. Future investigations through refinement of the model may implicate fluid stasis or inadequate nutrient transport experienced by osteocytes as a key factor in the initiation of cortical remodelling events.

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