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Ultrasound simulation in the distal radius using clinical
high-resolution CT images

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The overall objective of this research is to develop an ultrasonic method for non-invasive assessment of the distal radius. The specific objective of this study was to examine the propagation of ultrasound through the distal radius and determine the relationships between bone mass and architecture and ultrasound parameters. Twenty-six high-resolution peripheral-CT clinical images were obtained from a set of subjects that were part of a larger study on secondary osteoporosis. A single mid-section binary slice from each image was selected and used in the 2D simulation of an ultrasound wave propagating from the anterior to the posterior surfaces of each radius. Mass and architectural parameters associated with each radius, including total bone mass, volume fraction, trabecular number, and trabecular thickness were computed. Ultrasound parameters, including net time delay (NTD), broadband ultrasound attenuation (BUA), and ultrasound velocity (UV) were also evaluated. Significant correlations were found between NTD and total bone mass ($R^2 = 0.92$), BUA and trabecular number ($R^2 = 0.78$), and UV and trabecular bone volume fraction ($R^2 = 0.82$). The study shows that ultrasound measurements are correlated with bone mass and architecture at the distal radius, and thus ultrasound may prove useful as a method for non-invasive assessment of osteoporosis and fracture risk.