Abstracts: Metabolic Bone Disease

INVESTIGATION OF THREE-DIMENSIONAL STRUCTURE OF TRABECULAR BONE BY COMPUTED TOMOGRAPHY OF ILLIAC BIOPSY SAMPLES.

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The three-dimensional structure of trabecular bone has important pathogenetic and biomechanical implica-tions, but current methods of directly examining this structure cannot be combined with measurements relating to cells, mineralization or tetracycline uptake. We have demonstrated that the internal structure of methacrylate embedded transiliac bone biopsy cores is accessible to high resolution computed tomography. The developmental system consists of a microfocus x-ray source (beam current approx. 0.1 mA, 50 kV potential), a specimen rotational stage, x-ray image intensifier, TV camera, image memory and associated computer. Direct reconstruction from a series of two-dimensional projections enables a three-dimensional density profile to be generated. Cross-sections display a honeycomb-like structure; walls typically 100-200 µm thick enclosing void regions typically 600-1000 µm across are easily resolved. The method is non-destructive and fully compatible with normal bone histomorphometry. All the structural indices commonly determined micro-scopically such as trabecular bone volume, surface density, surface:volume ratio and mean trabecular thickness can be obtained with minimal intra-core sampling error, from multiple planes of section and with identification of regional heterogeneity of struc-ture. Additional three dimensional characteristics such as bone and marrow connectivity and trabecular plate perforation can be studied directly, eliminating the need for serial microscopic sections. The method also has the potential of providing data for finite element modeling of biomechanical properties such as resistance to fracture.

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