AbstractID: 9748 Title: Ultrasound attenuation, attenuation spectra, and speed in cortical bone; New measurements and models

A number of techniques using ultrasound in bone diagnosis, proposed in the literature, or applied in clinical practice are based on broadband ultrasonic attenuation (BUA) or speed of sound (SOS). These methods usually focus on cancellous bone because of is high metabolic turn-over rate. However the axial skeleton and its mechanical properties are dominated by cortical bone. In this paper a new technique based on precision measurements of ultrasound attenuation, attenuation spectra, and SOS in cortical bone is described.

The pulse-echo technique was used at several frequencies and signal intensities and data was taken in the frequency as well as time domains. The ratio of intensities of signals, arriving from two parallel surfaces of the sample is proportional to attenuation and transmission coefficients at the interfaces. A study on test objects, made of Calcium-Hydroxyapatite embedded in an epoxy matrix, demonstrated a very strong dependence of the signal intensity ratio on mineral content that was most prominent at higher frequencies. Using the relative intensity of reflected signals and the time delay between signals, it is possible to estimate the product of the attenuation coefficient and the speed of sound. This quantity is proportional to bone mineral density but does not depend on the thickness of the sample. Human subject measurements were undertaken using our method in the distal radius and other cortical sites.