

Several devices have been developed to make quantitative measurements of broadband ultrasonic attenuation (BUA) and speed of sound (SOS) in trabecular bone. Here we focus on cortical bone and use a simple contact setup for direct coupling to a water bath as well as a non-contact ultrasound analyzer and imager to make BUA and SOS measurements. As described in AAPM 03 a set of calibrated cortical bone test objects were formulated with values of Bone Mineral Density (BMD) that extend to 1250 mg/cc, within the range of healthy human subjects. We have also used several types of transducers with frequencies between .5 and 5 MHz in the contact mode and with a non-contact ultrasound system in both contact and non-contact mode. Transmission as well as reflection (pulse-echo) configurations were used.

The slope of the attenuation spectrum, measured with an NCU system for the test objects, was found to vary from 5-8 dB/ (MHz-cm), much lower than typical values of this quantity in normal trabecular bone of about 45 dB/ (MHz-cm) A correlation of $r^2 = .980$ was obtained for the slope of the attenuation spectrum in the linear region and the BMD of the test objects. Attenuation images of test objects were taken in non-contact mode at 2 MHz with a resolution of about .5 mm that graphically display correlation between BUA and BMD and resolve regions of inhomogeneity. Our results are being adapted to pursue human subject studies of BUA and SOS in cortical bone with contact and non-contact ultrasound.