Purpose:The purpose was to take the first steps towards applying Non-Contact Ultrasound (NCU) to the in-vivo monitoring of osteoporosis and to skeletal quantitative ultrasound imaging (QUS) using cortical bone. The goals of this study focused on the possible advantages of NCU such as its lack of reliance on a technologist and a layer of acoustical coupling gel, its ability to use methods similar to those in x-ray imaging, and the likely reduction in statistical and systematic errors. This project pursued additional applications of NCU beyond its usage in assessing the severity of third degree burns.

Methods:An NCU imaging system, a pair of broadband, 1.5 MHz, non-contact transducers, and cortical bone phantoms were used to determine bone mineral density (BMD), speed of sound (SOS), integrated acoustical response (IR), and ultrasonic transmittance. Air gaps of greater than 3 cm, two transmission and reflection paths, and a digital signal processor were used to collect data from phantoms of nominal mass density and (BMD) from 1.17 g/cm3 to 2.25 g/cm3 and from 0 g/cm3 to 1.7 g/cm3.

Results:Good correlations between known BMD and measured SOS, IR, and transmittance were obtained for all 14 phantoms. Repeated measurements of the speed of sound (SOS), thickness, and IR for the phantom set show a small variation of plus or minus 1-2 %. These NCU data were shown to be in agreement with similar results from contact ultrasound to within 1-2%. Attenuation images of cortical bone phantoms showed discernible differences as a function of BMD.

Conclusions:The results suggest that NCU might find additional applications beyond burn assessment. Since the NCU and conventional gel-coupled measurements yield similar results, our air-coupled methods might be able to reach levels of accuracy close to those attained with gel, while avoiding the disadvantages of contact.

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