A103 Infant Bone Health: An Evaluation of Quantitative Ultrasound

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After attending this presentation, attendees will understand the value of Speed Of Sound (SOS) as a measure of infant bone health.

This presentation will impact the forensic science community by evaluating Quantitative Ultrasound (QUS) as an instrument to measure infant bone health. Evaluating pediatric bone health is an important component of a physical exam, especially when unexpected skeletal fractures are found. Research suggests that QUS is a promising tool for assessing infant bone health.

QUS is a technology which measures the speed (m/s) of an ultrasound wave (SOS) as it travels through bone. Studies have shown that physical and material properties that influence bone strength also influence SOS. Bone Mineral Density (BMD) and elastic modulus are positively correlated with SOS, indicating that greater SOS value is related to greater BMD and stronger bone. Cortical thickness, porosity, and anisotropy have also been shown to affect SOS. Furthermore, significant correlations have been reported between bone strength measured by mechanical testing and SOS. As a result of previous research, this study hypothesizes that SOS is associated with factors that affect bone strength, such as chronic illness and prematurity.

In order to test the hypothesis, a prospective study of infant decedents was conducted. During a nine-month period, all infants ranging from 30 weeks post-menstrual age to one year at the time of death that were autopsied by the Harris County Institute of Forensic Sciences and Texas Children's Hospital were included in the study. For each infant, the following measurements and imaging were collected: SOS measurement of the tibial midshaft, circumference of the leg, digital radiographs of the leg and arm, and a histological sample of an anterior rib and iliac crest. Several measurements were collected from the radiographs, including Tibial Midshaft Diameter (TD), total Cortical Thickness (CT), and Medullary Cavity Diameter (MD). Cortical Index (CI), the cortical thickness/tibial midshaft diameter, was calculated. Additionally, the medical histories and autopsy findings were recorded for each decedent.

Analysis of Variance (ANOVA) and linear regression analyses were used to test the relationship between SOS and bone dimensions and medical history (i.e., chronic illness and/or prematurity). The results show no statistically significant differences in SOS measurements between infants positive for traumatic injury or chronic illness and infants with negative histories. A significant relationship was found between SOS and prematurity (p=.011). Simple linear regression analyses indicated that SOS was significantly related to age (p <.001). After birth, SOS decreased with increasing age until ~3 months of age. After ~3 months of age, SOS gradually increased with increasing age until ~9 months of age, at which point it appears to plateau. Removal of the premature infants from the analysis did not appreciably change the relationship between age and SOS. SOS was also significantly related to estimated gestational age (p=.008), birthweight (p=.005), weight (p<.001), weight for age percentile (p=.004), height (p<.001), length for age percentile (p=.018), and leg circumference (p=.002). When age was included as a covariate, there was a significant association between SOS and CI (p<.001) and MD (p<.001). After removal of chronically ill infants from the analyses, the relationships between SOS and TD (p=.017) and CT (p=.043) became significant. After premature infants were removed from analyses, SOS was only significantly related to height (p<.001) and weight (p=.019).

In conclusion, SOS measurements are significantly affected by growth and health-related factors. The significant association between SOS and bone health factors is consistent with previous research and suggests that QUS is an effective tool for evaluating bone strength in infants. Before QUS may be considered a valid tool for evaluating infant bone strength, more research is needed to identify other factors that may significantly affect bone SOS readings in infants.

Quantitative Ultrasound, Infants, Bone Quality

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