ACOUSTICS2008/3006
Microelastic Imaging of Mineralized Tissues - Principles and Applications in Musculoskeletal Research

Kay Raum
Martin Luther University of Halle-Wittenberg, Dept. of Orthopedics, Q-BAM Group, Magdeburger Str. 22, 06097 Halle, Germany

High frequency ultrasound has become one of the most powerful tools for microelastic characterization of hard biological materials. A major advantage is the possibility to map not only the microstructure, but also the heterogeneous anisotropic elasticity of mineralized tissues. Quantitative concepts for deriving anisotropic elastic parameters with frequencies from 50 MHz to the GHz range will be presented. Due to the scalability ultrasound can be applied for large animal studies, e.g. to predict the mechanical stability in sheep tibiae after callus distraction, as well as for small animal models, e.g. to study the effects of genetic differences in inbred strain mice. Moreover, SAM data are suitable for numerical deformation or sound propagation analyses on "real- life" models. Such models are crucial for the development and validation of new non-invasive diagnostic tools dedicated to the prediction of an individual fracture risk. For example, it has been shown that the velocity of the first arriving signal - measured with the axial transmission technique at the radius - can be predicted by a non-linear combination of fracture determining parameters, i.e. porosity, cortical thickness and tissue elasticity, assessed by 50-MHz SAM. These findings may lead to the establishment of pathology specific treatment and regeneration monitoring strategies.