In Vivo Magnetic Resonance Elastography of Human Brain at 7 T and 1.5 T

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Purpose: To investigate the feasibility of quantitative in vivo ultrahigh field magnetic resonance elastography (MRE) of the human brain in a broad range of low-frequency mechanical vibrations.

Materials and Methods: Mechanical vibrations were coupled into the brain of a healthy volunteer using a coil-driven actuator that either oscillated harmonically at single frequencies between 25 and 62.5 Hz or performed a superimposed motion consisting of multiple harmonics. Using a motion sensitive single-shot spin-echo echo planar imaging sequence shear wave displacements in the brain were measured at 1.5 and 7 T in whole-body MR scanners. Spatially averaged complex shear moduli were calculated applying Helmholtz inversion.

Results: Viscoelastic properties of brain tissue could be reliably determined in vivo at 1.5 and 7 T using both single-frequency and multifrequency wave excitation. The deduced dispersion of the complex modulus was consistent within different experimental settings of this study for the measured frequency range and agreed well with literature data.

Conclusion: MRE of the human brain is feasible at 7 T. Superposition of multiple harmonics yields consistent results as compared to standard single-frequency based MRE. As such, MRE is a system-independent modality for measuring the complex shear modulus of in vivo human brain in a wide dynamic range.

Key Words: magnetic resonance imaging; brain; elastography; ultra high field; motion encoding; viscoelasticity


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