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In vivo time-harmonic multifrequency elastography of the human liver

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Abstract

Elastography is capable of noninvasively detecting hepatic fibrosis by imposing mechanical stress and measuring the viscoelastic response in the liver. Magnetic resonance elastography (MRE) relies on time-harmonic vibrations, while most dynamic ultrasound elastography methods employ transient stimulation methods. This study attempts to benefit from the advantages of time-harmonic tissue stimulation, i.e. relative insensitivity to obesity and ascites and mechanical approachability of the entire liver, and the advantages of ultrasound, i.e. time efficiency, low costs, and wide availability, by introducing *in vivo* time-harmonic elastography (THE) of the human liver using ultrasound and a broad range of harmonic stimulation frequencies. THE employs continuous harmonic shear vibrations at 7 frequencies from 30 to 60 Hz in a single examination and determines the elasticity and the viscosity of the liver from the dispersion of the shear wave speed within the applied frequency range. The feasibility of the method is demonstrated in the livers of eight healthy volunteers and a patient with cirrhosis. Multifrequency MRE at the same drive frequencies was used as elastographic reference method. Similar values of shear modulus and shear viscosity according the Kelvin–Voigt model were obtained by MRE and THE, indicating that the new method is suitable for *in vivo* quantification of the shear viscoelastic properties of the liver, however, in real-time and at a fraction of the costs of MRE. In conclusion, THE may provide a useful tool for fast assessment

