

Introduction to MRE

MR Elastography is an MR based elastography technique that uses mechanical shear waves to evaluate viscoelastic properties of tissues. Mechanical shear waves produced by an external driver are propagated into the liver using a passive abdominal driver placed over the liver and in contact with the abdominal wall. Tissue displacements in the range of microns produced by propagating shear waves because phase shifts that can be detected with motion encoding gradients in the MRE sequence. The frequency of shear waves used for clinical liver MRE is 60Hz. An inversion algorithm automatically produces stiffness maps using the phase shift information. Liver stiffness values can be obtained by drawing regions of interest over liver in the stiffness maps and expressed in kilopascals (kPa), MRE is FDA approved and available on all major vendors of clinical MRI scanners.

When and how to use MRE

MRE can be performed on both 1.5T and 3T clinical MR scanners. MRE should be performed with at 4 to 6 hours fasting. Stiffness measured with MRE is not affected by presence of gadolinium (MR contrast) and therefore can be performed before or after intravenous contrast administration. It is also operator independent. MRE can be performed in children and post liver transplant recipients.

MRE is useful for the following clinical indications

- Detection and staging of liver fibrosis
- Differentiate simple steatosis from non-alcoholic steatohepatitis (NASH)
- Assessing response to treatment of chronic liver disease
- Clinical longitudinal follow up and prediction of decompensation

Accuracy of MRE

Several studies have shown that MRE is a robust, reliable, repeatable and reproducible technique for detection and staging of liver fibrosis. The accuracy of MRE ranges from 0.85 to 0.99 for differentiating different stages of liver fibrosis. The performance of MRE for differentiating mild fibrosis (stage I) from normal liver or inflammation is lower and the performance is highest for diagnosis of cirrhosis (stage 4).

- MRE has high positive predictive value for ruling in significant fibrosis (\geq stage 2) and high negative predictive value for ruling out advanced fibrosis/cirrhosis
- Liver stiffness \geq 5.8kPa is associated with liver decompensation.

Limitations of MRE

- The 2D MRE sequence is sensitive to liver iron content and may fail in moderate to severe liver iron overload due to low liver parenchyma signal.
- Liver stiffness is affected by inflammation, increased biliary pressure and portal hypertension similar to other elastography techniques.

References:

- Venkatesh SK, Yin M, Ehman RL. Magnetic resonance elastography of liver: technique, analysis, and clinical applications. J Magn Reson Imaging. 2013; 37(3):544-55
- Singh S, Venkatesh SK, Wang Z et al. Diagnostic performance of magnetic resonance elastography in staging liver fibrosis: a systematic review and meta-analysis of individual participant data. Clin Gastroenterol Hepatol. 2015; 13 (3):440-451.e6.
- Venkatesh SK, Talwalkar JA. When and how to use magnetic resonance elastography for patients with liver disease in clinical practice. Am J Gastroenterol. 2018; 113(7):923-926.

MRE of liver Technique- 3 steps

