

# Use of MRE Elastography in a Community Practice: Correlation of MRE Measurements of Liver Stiffness and Results of Liver Biopsy

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**Purpose:** To compare MR Elastography (MRE) measurements of liver stiffness with the results of liver biopsy.

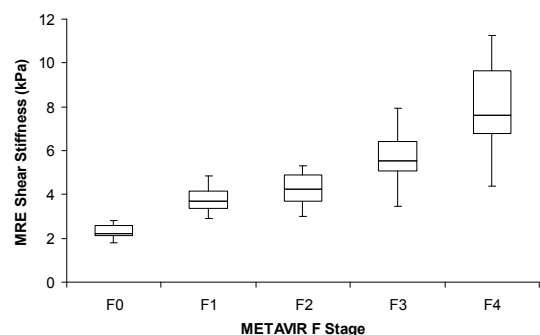
**Background:** MRE is a phase contrast MRI technique that evaluates the stiffness of tissues by directly visualizing and measuring propagated mechanical shear waves in tissues. MRE generates quantitative measurements and colorized spatial maps of shear wave displacement. MRE has been used to evaluate liver fibrosis which shows higher stiffness than normal liver parenchyma. In our community practice quantitative liver evaluation including MRE has been incorporated into our routine liver MRI protocol.

**Materials and Methods:** Seventy patients with known or suspected liver disease underwent MRE on a 1.5T GE MR 450 scanner. MRE was performed on a 1.5T GE HDx or MR 450 scanner using a 19-cm diameter cylindrical passive driver placed against the abdominal wall. Continuous acoustic vibration at 60 Hz was transmitted from an active driver to the passive driver through a flexible vinyl tube. The propagating shear waves were imaged with a modified phase contrast, gradient-echo sequence. Four axial MRE slices were obtained during two 21 seconds breath holds. MR Elastogram was generated by processing the acquired wave image to produce a quantitative map of tissue shear stiffness measured in kilopascals. Mean shear stiffness of liver parenchyma was calculated by drawing a region of interest over the liver on each slice. MRE measurements of liver stiffness were compared to Metavir fibrosis score obtained from liver biopsy (F0-4).

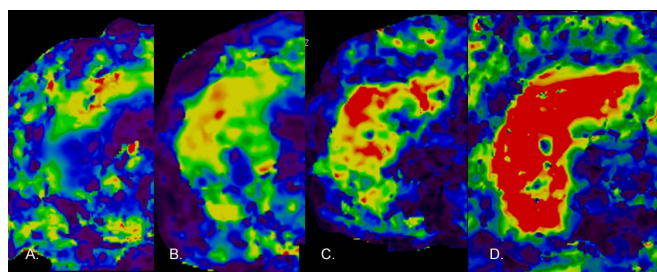
**Results:** For all 70 patients the median MRE measurement of liver stiffness was 4.9 kPa (range 1.85 – 11.25). Liver biopsy results showed 13 patients with Metavir score F0, 11 patients with Metavir score F1, 9 patients with Metavir score F2, 15 patients with Metavir score F3, and 22 patients with Metavir score F4. The median MRE measurement for patients with F0 liver biopsy was 2.23 kPa, compared to 3.68 kPa for F1 Metavir score, 4.23 kPa for F2, 5.55 kPa for F3, and 7.62 kPa for those with F4 Metavir score at liver biopsy. Using a cut off value of 2.93 kPa separated patients with no fibrosis (F0) from those with mild to severe fibrosis (F1-4) with 100% sensitivity and specificity. Using a cut off value of 4.1 kPa separated patients with normal liver and mild fibrosis (F0-F1) from those with moderate to severe fibrosis (F2- F4) with 91% sensitivity, 88% specificity, 90% accuracy, 93% PPV, and 84% NPV. Statistical analysis showed significant difference in MRE measurements of liver stiffness for F0 vs. F1, F1 vs. F3, F2 vs. F3, and F3 vs. F4 ( $p < .05$ ), but not for F1 vs. F2 ( $p = 0.1$ ).

**Conclusions:** MR Elastography is a robust technique that can be implemented in community MR imaging practice. The results of MRE for measuring liver stiffness are highly correlated with the Metavir fibrosis score obtained from liver biopsy and are useful to non invasively assess the degree of fibrosis in patients with known or suspected liver disease.

MRE Liver Stiffness vs. METAVIR F Stage at Liver Biopsy



**Figure 1:** Box and whisker plot comparing results of MRE measurements of liver stiffness and Metavir score of liver fibrosis at liver biopsy in 70 patients.



**Figure 2:** Spectrum of MRE findings compared to liver biopsy Metavir score.

- A. MRE 3.68 kPa – Metavir F1
- B. MRE 5.2 – Metavir F2
- C. MRE 6.5 – Metavir F3
- D. MRE 11.2 – Metavir F4

**References:** [1] Rouvière O, et al. MR Elastography of the Liver: Preliminary Results. Radiology 2006;240:440-448. [2] Venkatesh SK et al. MR Elastography of liver tumors: Preliminary results. AJR 2008; 190:1534-1540.