Liver MRE is particularly appealing as it can eliminate the need for invasive biopsies, and could serve as a monitoring tool for fibrotic treatment response. As MRE sensitivity:

$$\frac{\text{mm}}{\text{Hz/pixel}}$$

MEG displacement:

$$420 \text{ mm} \times 400 \text{ mm}$$

Acquired voxel size:

$$1.6 \text{ mm} \times 4.6 \text{ mm} \times 10 \text{ mm}$$

Mechanical excitation lasting 13.5 s per slice.

The driver amplitude was adjusted to the largest area of the liver as seen from the scout images.

From the scout images, the relative position of the transducer center (from the location of the vitamin E capsule on the transducer) and the center of the liver were determined, and the transducer was moved in the FH direction so that the center of the transducer was consistently over the largest area of the liver.

A TTL signal from the scanner triggered the driver system for synchronizing mechanical excitation with MEG. The driver amplitude was adjusted (30% or 60% of the peak capacity of the driver) to ensure sufficient penetration of shear waves within the liver.

The displacement images were converted to LS maps using MRE software developed by the Mayo Clinic (used under a research agreement). The software also provided confidence maps (CM) for LS estimates. Regions of interest (ROI) were drawn on magnitude images masked by the CM (custom written software) to estimate regional LS.

Statistics: Test-retest reproducibility was calculated between the B1 Vs B2, as well as A1 Vs A2. Statistical significance of LS values before and after meal ingestion were also assessed using pair-wise, two-tailed Student’s t-test. A p-value < 0.05 was assumed to be statistically significant.

Results: A total of 288 slices were analyzed (8 subjects x 3 slices/subject x 3 directions/subject x 4 measurements/subject). A representative MRE image is shown in panels A-C. Specific findings from the study are as follows: (1) LS measurements in the FH direction were consistently lower than AP/RL directions (Figure panels D-F). (2) MRE images acquired in the mid-liver location were most reproducible in the FH direction (< 15% for both pre and post meal ingestion or 0.3 kPa). (3) In normal healthy volunteers, the consumption of a 1050 calorie meal did not affect LS measurements. There was a trend toward slight elevation in LS after ingesting the meal when MEG was along the FH direction (p<0.05 for B2 Vs A1). This finding needs to be confirmed in a larger group of subjects. We expect to confirm these initial findings in this ongoing study.

Conclusions: MRE estimates of LS are most reproducible (less than 0.3 kPa) when MEG is applied along the FH direction. In this study, the imaging slice positioned directly over the largest area of liver yielded the best reproducibility (slice 2). In this group of normal subjects, there was little difference in LS before or after 1050 calorie meal ingestion.

Acknowledgements: This study was partly funded by the Ronald MacDonald fund at St. Luke’s Medical Center, Houston, and Philips Healthcare. The authors thank Dr. Richard Ehman for the post-processing software.

References: