AbstractID: 9147 Title: Evaluating and Understanding Relative Phase Angle between Fat and Water and its Effect on Fat Quantification in the Dixon Methods

Purpose:

The purpose of this study is to measure phase angle α between water and fat as a function of TE and demonstrate that uncertainties in setting the exact TE or knowing the exact α can lead to variations in the fat quantification by the Dixon methods.

Methods and Materials:

Two phantoms were constructed. One consisted of half pure water solution and half soybean oil with a clear interface, which was used to measure the relative phase angle between water and fat as a function of TE. The other consisted of 7 vials of homogeneously mixed vegetable oil and distilled water with different oil/water volume ratios (0/100, 10/90, 20/80, 30/70, 40/60, 50/50 and 100/0). We used a 2D FSPGR sequence to acquire the images with the following parameters: TR=180ms, flip-angle $=80^{o}$. TE was varied between 2.0 and 5.5ms in 0.1ms steps. A recently-developed 2-point Dixon algorithm was used to generate separated water and fat images.

Results:

We obtained the relationship between α and TE in phantom and in vivo by experiments. The least-squares linear fits of the experimental results for phantom and in-vivo yield $\alpha = 72.1t_{TE} + 6.6$ and $\alpha = 69.9t_{TE} - 5.6$, respectively. From these relationships, the real α can be easily derived. Also, we demonstrated that the variations of TE allowed in the clinical range may lead to variations up to 40% in the apparent fat quantification due to the deviation of α.

Discussion and Conclusion:

It is desirable to know the true relationship of α and TE in in- and out-of-phase imaging. Such a relationship can guide us to select certain parameters to obtain desired relative phase angles. The variations in TE may lead to variations in fat quantification. The systemic experimental studies on TE dependence of α are expected to help improve the use of Dixon methods and reduce the fat quantification errors.