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A comparison of methods for T2-mapping of the myocardium

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Introduction

T2-weighted imaging in acute myocardial infarction has been suggested for detecting regions of edema. The need to carefully account for variations in coil sensitivity patterns has been noted with these techniques. An alternate approach is to generate quantitative T2 maps. In this work we compare 3 different myocardial T2 mapping methods; multi-echo double-IR FSE (MEFSE), segmented T2-prepared SSFP (T2pSSFP) similar to [1] and T2-prepared spiral (SpiralT2) [2].

Methods

Details for each sequence are as follows:

MEFSE 256 × 256 matrix, 34 × 27 cm FOV, ASSET × 2, etl = 32, 62.5 kHz RBW, total scan time of 16 heart-beats for one slice.

T2pSSFP 256 × 128, 34 × 34 cm FOV, ASSET × 2, 2NEX with RF chopping via an inversion pulse on even excitations to preserve image contrast, VPS = 32, total scan time of 16 heart-beats for 3 slices.

SpiralT2 12 spiral interleaves of 3072 points each, 125 kHz RBW (approx in-plane resolution of 1.5 mm), free breathing, respiratory compensation using the Diminishing Variance Algorithm with 4 overscans, total scan time of 5-7 minutes for 3 slices.

Each sequence was used to generate T2 maps on 3 consecutive 8 mm short-axis slices on 4 volunteers. A qualitative comparison of scan characteristics is given in Table 1. For quantitative comparisons, regions of interest encompassing the myocardium on each slice were drawn manually and T2 values computed using a 2-parameter or a 3-parameter (including a baseline offset) exponential fit.

Results

Example T2 maps from a representative volunteer are given in Figure 1. Quantitative T2 measurement results are illustrated in Figure 2. Mean T2's from each of 3 slices are grouped for all 4 subjects and all 3 techniques in Figure 2.

Discussion/conclusion

Two parameter fits generally had less inter- and intra-subject variability but with higher values than 3-parameter fits. This may be attributed to noise and fitting bias, suboptimal TE's, and B1-errors. MEFSE had the highest source image signal-to-noise and least in-slice T2 variability, but with the highest inter-subject T2 variability. T2pSSFP and SpiralT2 had higher in-slice T2 variability with T2pSSFP variations dominated by noise contributions and SpiralT2 by regions affected by residual blur. These 3 mapping techniques have unique strengths and weaknesses. This suggests that the specific requirements of the application may dictate which technique to use. Further investigation of these in the context of clinical applications, such as identification of myocardial edema, is being explored.

Table 1: Qualitative comparison of 3 different T2-mapping techniques

	Free Breathing Spiral T2	T2 Prepared SSFP	Multi-Echo DIR FSE
Max # slices	++	+	-
Acquisition Window	++	+	-
Scan Time (4 Echoes)	-	+	+
Spatial Resolution	+	+	++
Image Quality	-	-	+
Signal to Noise	+	-	++

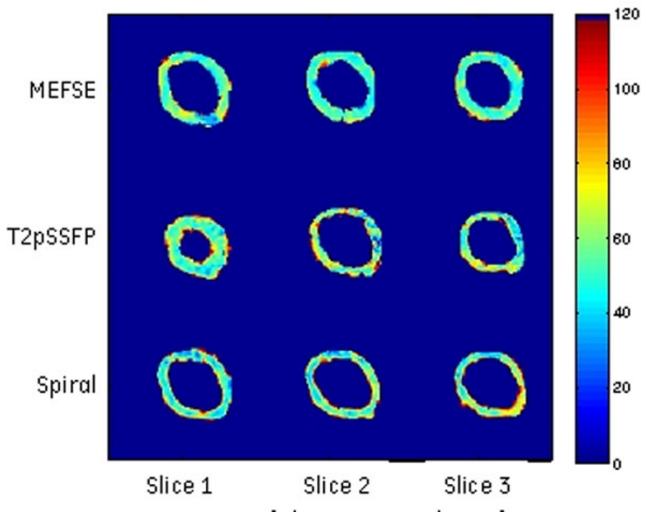

Figure 1
T2 maps of the myocardium for 3 consecutive SAX slices using the 3 mapping methods (multi-echo FSE, T2prep SSFP, Spiral T2 and a 2-parameter fit from one volunteer.

References

1. Huang , *et al.*: *MRM* 2007, **57:**.
2. Foltz , *et al.*: *MRM* 2003, **49:**.

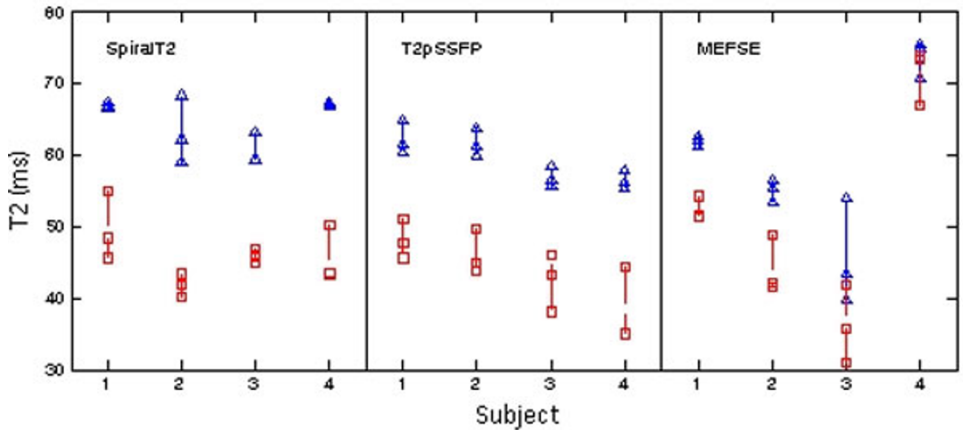

Figure 2
T2 values from 2-parameter fits (triangles) and 3-parameter fits (squares) across all 4 subjects and all 3 techniques. Mean T2 values for each of 3 slices are grouped together.