

## Reduction in Dielectric Shading in Liver on Clinical 3T Parallel Transmission MR System

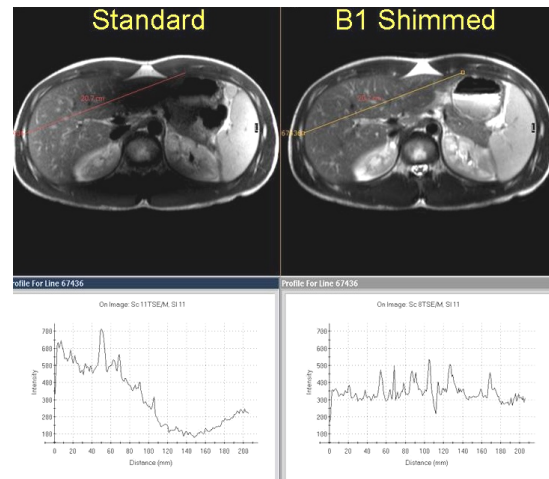
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**Introduction:** Dielectric shading hampers clinical acceptance of 3T body imaging. (1) Parallel radiofrequency (RF) excitation, an application of parallel imaging to transmission, at 3T, reduces dielectric shading by adjustment of RF transmission signals enabling RF “shimming” (2). Other advantages include more homogeneous specific absorption ratio (SAR) (2), and shortened acquisition times. Clinical, qualitative evaluation of parallel transmission to liver imaging has been reported. Our purpose was to quantitatively validate a novel acquisition method for reducing dielectric shading using parallel transmission techniques in clinical 3T abdominal MRI.

**Materials and Methods:** Images acquired on Philips 3T Achieva MR scanner on alpha-version TX upgraded for dual RF transmission, using an integrated pair of RF amplifiers with console software capable of independently calibrating phase, amplitude and shape of RF waveforms transmitters to maximize RF tissue homogeneity for each subject. Sequences studied: T2W-TSE, T2W-TSE with fat sat, in-phase (IP) and opposed-phase (OP) fast-field echo (FFE) and when applicable T1W-TSE post-contrast at 20 and 30 minutes delay. Internal controls were generated by reacquiring pulse sequences using single-transmitter mode imaging. B1 shimming performed on the console by acquiring B1 calibration map at the level of the liver and immediately calculating RF amplifier settings which maximizes RF homogeneity. 7 subjects expected to exhibit B1 inhomogeneity were evaluated. Quantitative linear profiles and regions of interest (ROIs) were placed over liver where the greatest dielectric shading was noted. Statistical analysis was made using Student t-test.

**Results:** For 4 subjects, shading artifact was nearly eliminated. In these, significant central abdominal signal loss was observed with all single transmitter sequences: >72% T2W, >60% T2W fat sat, >45% IP-FFE, and >49% OP-FFE. With multi-Transmit B1 shimming, estimated signal loss was less than 5% in all sequences. In 2 subjects, the artifact was reduced but not eliminated. In this subject the signal loss was estimated (48% T2W; 57% T2W fat sat; 28% IP-FFE; 20% OP-FFE). With B1 shimming signal loss was significantly lower (16% T2W, 20% T2W fat sat, 7% IP-FFE, and 5% OP-FFE). One subject had cirrhotic scarring which hampered ROI selection. In the last subject, no statistically significant dielectric shading was seen with either single or parallel transmission.



**Conclusions:** Parallel RF transmission is a promising emerging technique for body imaging at 3T on clinical 3T MR systems due to reduction of dielectric artifacts. This allows MR at 3T to fulfill the promise of higher SNR and CNR already enjoyed in brain imaging at 3T when compared to imaging at 1.5T. Our experience with RF shimming and reduction of B1 inhomogeneity at the source shows significantly better quality for liver imaging at 3T with improvements in SAR uniformity and decreased scan time.

### References:

<sup>1</sup>Hoult DI, Phil D. Sensitivity and power deposition in a high-field imaging experiment. *J Magn Reson Imaging* 2000;12(1):46-67.

<sup>2</sup>Katscher U, Bornert P. Parallel RF transmission in MRI. *NMR Biomed* 2006;19(3):393-400.