

Parallel RF transmission at 3.0T High-field MRI: Preliminary results of high spatial resolution pelvic MRI

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Introduction: The potentially higher SNR at 3T allows to increase the spatial resolution for pelvic and prostate (without endorectal coil) imaging while still maintaining an acceptable acquisition time. Any increase of spatial resolution should improve the detection of small imaging details which in turn may have an impact on diagnostic confidence (1-3). A combination with parallel imaging, half Fourier and variable refocusing angle (FAS) technique (4) already enables to significantly reduce scan time, but nevertheless a further shortening of the acquisition time or increase of the spatial resolution is requested in some clinical applications. In this paper, we investigate to further reduce the acquisition time of high-resolution pelvic imaging using parallel RF transmission (5-6).

Material and methods: A clinical 3.0T MRI system (Philips Achieva 3.0T TX) equipped with fully flexible multi-source RF transmission (MultiTransmit, mTX) was used. The RF power was distributed to the ports of the system body coil using multiple independent RF transmit channels under full software control. With this design it was possible to independently control phase, amplitude and shape of the RF waveforms. A 6-channel SENSE cardiac coil was used for pelvic MR Imaging. 6 female volunteers (range: 31 – 58 years) were examined with a conventional, optimized high-resolution T2W sequence (TR/TE 3958ms /70ms; 0.45 x 0.46 x 4mm voxel size; SENSE-factor 3, and FAS130°, scan time 8:27). This sequence was repeated using MultiTransmit. All six volunteers were examined with the T2W sequences. Two (2/6) volunteers underwent a mTX-sequence with identical TR as compared to the conventional T2-w high spatial resolution sequence (2) and four (4/6) with shortest TR (3200ms). Institutional ethics committee approval was available and written informed consent was obtained.

Results: 3.0T MultiTransmit MRI pelvic studies were technically successful and of diagnostic image quality in all volunteers. Image quality of all plane orientations was rated comparable with regard to a standard sequence with identical parameter setup (see Fig 1). Maintaining TR of the standard sequence (3958 ms) in combination with mTX resulted in a scan time reduction from 8:27 to 5:00 minutes and allowed to preserve the SNR. With use of shortest TR scan time could be halved but SNR was slightly lower as compared to the conventional T2-w sequence.

Conclusion: High spatial resolution pelvic and prostate MR studies with high image quality can be obtained using MultiTransmit RF excitation on a 3.0T system. This technique allows to significantly reduce acquisition time. This time gain can be invested to perform additional scans in all plane orientations. Whether or not this also translates into clinically relevant additional diagnostic information remains to be seen and is the subject of an ongoing study.

Fig 1.



Reference List: 1.) Morakkabati-Spitz-N;Gieseke-J;Kuhl-CK;Lutterbey-G;von-Falkenhausen-M;Schild-HH. 3T High field MRI with ultra-high spatial resolution .*Proc. Intl. Soc. Mag. Reson. Med.*: 2004 11 932, 2.) Morakkabati-Spitz-N;Gieseke-J;Kuhl-CK;Lutterbey-G;Von-Falkenhausen-M;Traeber-F; Park-Simon-W;Zivanovic-O;Schild-HH. MRI of the pelvis at 3.0T: very high spatial resolution with sensitivity encoding and flip-angle sweep technique in clinically acceptable scan time .*Eur Radiol*: 2006 16 634-641, 3.) Morakkabati-Spitz-N;Bastian PJ, Gieseke-J Traeber-F, Kuhl-CK; Wattjes MP, Müller SC, Schild HH: MR Imaging of the prostate at 3.0T with external phase array coil - preliminary results, *Eur J of Med Res* (2008) 13, 287-291 4.) Gieseke-J;Kuhl-CK;Von-Falkenhausen-M;Bömer-R;Gür-O;Van-Yperen-G;Schild-HH. Ultra Fast T2-weighted TSE sequences with Flip Angle Sweep and SENSE at 3T .*Proc. ISMRM*: 2004 11 74, 5.) Katscher U, Bornert P. Parallel RF transmission in MRI. *NMR Biomed.* 2006;19:393-400, 6.) Graesslin, I, Niemann, M, Harvey, P et al. SAR and RF power reduction with parallel excitation using non-cartesian trajectories. *MAGMA* 18, S251. 2005.