Zoomed EPI using parallel transmission for tractography of the prostate gland without an endorectal coil: a feasibility study.

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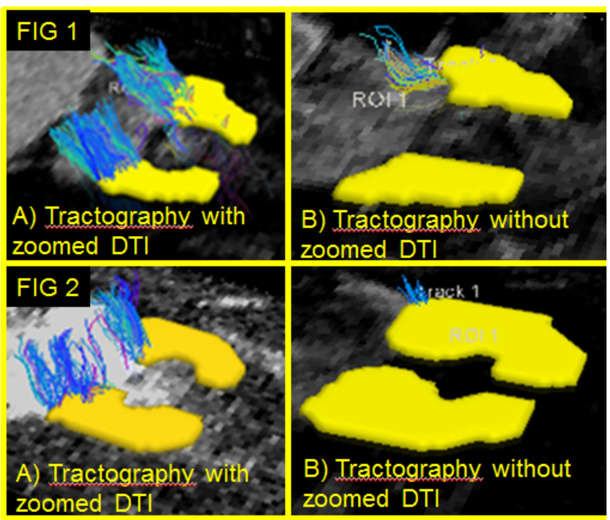
Purpose: Prior studies reporting tractography of the prostatic neurovascular bundle (NVB) using diffusion-tensor imaging (DTI) [1] [2] have used an endorectal coil for acquisition and suffered from significant distortion due to long readout durations. The recent advent of two-channel parallel transmission (pTx) with zoomed inner-volume excitation [3] allows high-resolution DTI of the prostate with reduced phase FOV requiring shorter echo times. This results in reduced distortion and increased SNR without the need for an endorectal coil, although the utility of this new technology for prostate tractography has not been previously investigated. Thus, the purpose of this study is to assess the feasibility and image quality of DTI performed with standard excitation (full FOV) and 2D-selective excitation enabled by pTx (reduced FOV) to enable tractography of the prostatic NVB using a pelvic phased array coil at 3T.

Methods: 4 healthy volunteers (25.5 ± 3.7 years) underwent prostate MRI at 3T (MAGNETOM Skyra, Siemens AG) using a 2-channel pTx system with zoomed-excitation capability and an 18-channel pelvic-phased array receive coil. Examinations included a single-shot EPI DTI sequence (b-values of 0 and 1000 s/mm^2, 6-12 directions, TR 3700 ms) performed with a standard sinc pulse (TE 109 ms) and a 2D-selective RF pulse using pTx allowing for zoomed EPI (TX PF 6/8, TE 74-87 ms). Tractography analysis, including generation of a 3D visual representation of the neurovascular bundle, was performed using TrackVis Diffusion Toolkit [4]. After DTI data was processed by TrackVis, single-slice regions-of-interest encompassing the expected location of the bilateral NVBs were drawn. For both standard and zoomed-EPI DTI, fractional anisotropy (FA) maps and NVB tractography overlayed onto the b0 images were scored in terms of various measures of image quality (1-5 scale) by a radiologist who was blinded to the sequence. Measures were compared using paired t-tests.



Figs 1, 2: Neurovascular bundle tractography representation with (A) and without (B) zoomed EPI acquisition of DTI data. The zoomed acquisition demonstrates higher visual quality, symmetry, fiber coherence, and more similarity to the anatomic NVB.

Table 1: Comparison of standard and zoomed diffusion tensor imaging (DTI)

Feature	Standard EPI	Zoomed EPI	p
FA map			
Absence of overall artifact	2.0±0.0	3.5±0.6	**0.014**
Absence of distortion of prostate	2.0±0.3	4.3±0.5	**0.018**
Tractography			
Overall visual quality	1.8±1.0	4.3±1.0	**0.003**
NVB symmetry	1.3±0.5	3.5±1.0	**0.018**
NVB coherence	1.5±1.0	3.8±0.5	**0.018**
Similarity of NVB to anatomic T2WI	1.5±1.0	3.8±0.5	**0.018**

Results: (Fig. 1,2; Table 1) Compared with standard EPI, FA data acquired with the zoomed EPI acquisition showed significantly reduced artifact (p=0.014) and less anatomic distortion of the prostate (p=0.018). Using zoomed EPI, derived tractography maps demonstrated better visual quality (p=0.003), greater symmetry (p=0.018), higher visual coherence of the NVB (p=0.018), and more similarity to the anatomic appearance of the NVB on T2WI (p=0.018).

Discussion: Parallel transmission with zoomed-EPI enables increased quality in acquisition of prostate DTI compared with standard transmission, enabling tractography of the prostatic neurovascular bundle using a pelvic phased-array coil. Continued optimization of the pTx DTI sequence and evaluation in clinical patients remain warranted.

Conclusion: Tractography of the prostatic NVB is feasible without the use of an endorectal coil by employing pTx with zoomed-EPI.

References: **[1]** Finley et al Urology 2012, 80(1): 219-223 **[2]** Kim et al BJR 2012, 85(1015):e279-83 **[3]** Schneider R et al, Proc ISMRM 2012 #3459. **[4]** Wang et al, Proc ISMRM 2007 #3720.