Volumetric 3D T2-weighted sequence of the prostate (SPACE): comparison with conventional 2D T2 for image quality and tumor detection

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Introduction: The primary sequence used for detection of prostate cancer is 2D TSE T2WI, typically acquired in 3 planes. However, standard T2WI sequences are long, and have limited accuracy for tumor detection (with sensitivity of 53-81% and specificity of 46-61%[1,2]). A recently developed 3D TSE T2WI sequence termed SPACE (Sampling Perfection with Application Optimized Contrasts using different Flip Angle Evolutions, Siemens Medical Solutions)[3,4,5] that uses variable flip angles may provide increased spatial resolution compared with standard 2D T2WI sequence, enabling multiplanar reformats. In this study, we assessed 3D SPACE vs. 2D TSE T2WI sequences in terms of image quality and accuracy of tumor detection in prostate cancer patients before prostatectomy.

Methods: 10 preliminary patients (from an ongoing study) with prostate cancer underwent prostate MRI on a 1.5T Siemens Magnetom Avanto system before prostatectomy. The protocol was performed with phased-array coils and included 2D TSE T2WI in 3 planes [axial, coronal and sagittal using TR/TE 4000/101, voxel size 0.7 x 1.2 x 3 mm, no parallel imaging, 2-3 averages, total acquisition time (TA) 11:44 min (4:32 axial, 2:48 coronal, 4:24 sagittal)] and axial 3D T2WI SPACE (TR/TE 1200/141, FA variable, nearly isotropic voxel size 1.0 x 1.5 x 1.5 mm, parallel imaging factor 2, 2 averages, TA 3:52 min). Two readers reviewed in consensus the 2D TSE and SPACE images to asses: 1) Image quality (score 1-3 for delineation of prostate capsule, zonal anatomy, seminal vesicle and rectoprostatic angle in 3 planes for all 3 multiplanar 2D sequences and for the corresponding multiplanar images generated from the single SPACE acquisition (rectoprostatic angle was not assessed on the coronal images, the max score per patient was 33). 2) Tumor detection per sextant in the PZ (peripheral zone), which was correlated to prostatectomy. 3) The readers then performed an unblinded review of both sets of images in correlation with pathology and placed ROIs over tumor foci and normal PZ, to calculate prostate-to-tumor ratio [= (signal intensity (SI)normalPZ – SItumor)/SInormalPZ].

Results: There was no significant difference between 2D TSE and SPACE in terms of image quality (p = 0.34-1). There were a total of 25 tumor foci at prostatectomy (mean size 10.6 mm, mean Gleeson score 6.7). For tumor detection, SPACE demonstrated higher specificity, accuracy, and PPV, nearly equivalent NPV, but lower sensitivity compared with 2D TSE **(Table)**. In addition, T2 SPACE had significantly higher prostate-to-tumor ratio (p=0.0002).

	2D TSE	SPACE
Image quality		
Image quality (max. 33)	31.5 ± 2.3	31.1 ± 3.1
Prostate-to-tumor ratio	0.48 ± 0.10	0.57 ± 0.14
Tumor detection (per sextant)		
Sensitivity	0.72	0.64
Specificity	0.66	0.80
Accuracy	0.68	0.73
PPV	0.60	0.70
NPV	0.77	0.76

Discussion: Our preliminary findings show the feasibility of obtaining a single volumetric acquisition of the prostate in substantially less time (approximately 1/3 of the time required for multiplanar 2D) with overall similar diagnostic accuracy for prostate cancer detection, and better contrast compared to conventional TSE T2WI. Further analysis with more patients may confirm the potential role of SPACE as a replacement to multiplanar 2D T2WI, which could free up magnet time for functional sequences such as for diffusion imaging.

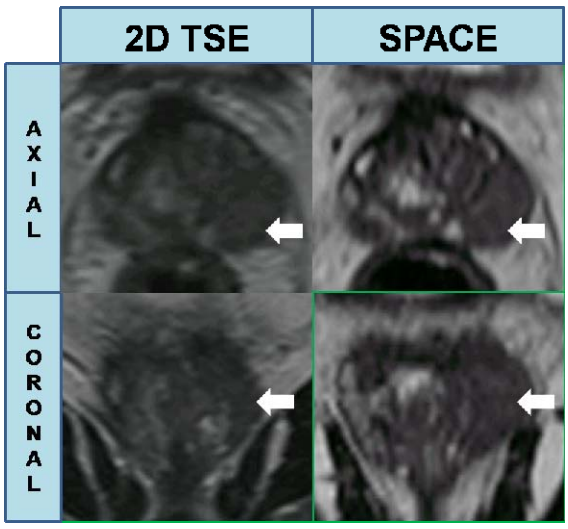

Fig. 1: Axial and coronal 2D T2WI TSE and axial and coronal reformatted SPACE images of the prostate in a patient with left PZ cancer. The tumor (arrow) is easily detected on the SPACE images with better contrast than on 2D T2.

References:
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