Magnetic Resonance Imaging of the Prostate using a 32 channel vs. an 8 channel coil at 3T

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Introduction

Multi-channel coil systems have been reported to allow acquisition of more homogeneous MR images of the abdomen and pelvis [1]. The purpose of this study was to objectively assess imaging performance of a newly available, commercial 32 channel coil system vs. the standard 8 channel coil system for prostate MR imaging at 3T. Our group is especially interested in high quality imaging of the prostate without using an endorectal coil due to special clinical considerations. Magnetic Resonance Imaging (MRI) of the prostate is gaining increasing importance in diagnosis, characterization and therapy planning. Signal inhomogeneities in pelvic images are a known challenge especially at higher field-strengths and have limited the diagnostic potential of prostate MRI [2].

Material and Methods

After purchasing a newly available 32 channel torso/cardiac coil, we started an intraindividual blinded cross-over comparison with the previously used 8 channel torso coil to specifically assess image quality characteristics. Imaging was performed on a 3T MR system (Philips, Achieva, R2.6, 32 channels) using the 8 and 32 channel torso coils (both Philips Healthcare). The 32 channel phased-array coil design has two halves, each with 16 active coils; the 8 channel coil has two halves with each 4 elements. For this initial evaluation, data from four adult male healthy volunteers (34±3 years) are analyzed. The study design was powered to include 20 subjects in the final analysis. All imaging was performed identical except using the different coils. No coil optimization was performed and two sequences from the current clinical imaging protocol were used in this evaluation: [A] T_2-weighted 2D TSE sequence with and without SPAIR fat suppression (TR/TE=4167/100ms; FOV=220mm; voxel=0.72x0.91x3.0mm^3; gap=0.3mm) and [B] 3D VISTA sequence (TR/TE=1980/200ms; FOV=200 mm; voxel=0.75x0.96x3.0mm^3). Three experienced readers, who were completely blinded, individually analyzed the images and measured the contrast to noise ratio (CNR) in defined regions of the prostate and in the surrounding muscles. All ROI placements were recorded as well as the reader assessment of subjective image characteristic preferences.

Results

Compared to the 8 channel, the 32 channel coil produced on average a 23% (range 12-32%) higher signal to noise ratio (SNR). The CNR for the peripheral zone vs. the central gland was 56% higher ($p<0.05$) with the TSE and 53% higher ($p=0.05$) with the VISTA sequence in the 32 channel coil images. The CNR for the peripheral zone vs. the surrounding muscle was 32% higher ($p<0.05$) with the TSE and 40% higher ($p<0.05$) with the VISTA sequence. The neurovascular bundle could be better delineated with the use of the 32 channel coil compared to the 8 channel coil. Only the 32 channel coil allowed visualizing prostatic ducts on T_2-weighted coronal TSE images (Figure 1). Using the same sequences in the prostate of the subjects showed an improved differentiation of the peripheral vs. the inner part of the prostate gland in all cases (Figures 1 and 2). Table 1 displays the average contrast to noise ratio of different parts of the prostate and the surrounding muscle tissue. The subjective assessment identified the 32 channel images as preferred in all readings in this initial population assessment. More detailed assessments will be evaluated upon completion of the study anticipated in January 2009.

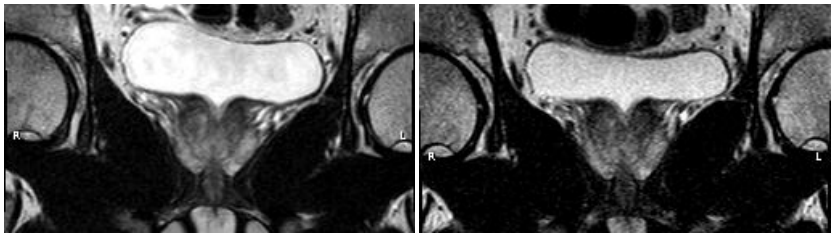

Figure 1 Coronal T_2-weighted TSE MRI of the prostate of a volunteer acquired with a 32 channel coil (left) and an 8 channel coil (right) at 3T. The TSE image acquired with the 32 channel coil allows a better differentiation of peripheral zone and the central zone of the prostate and shows prostatic ducts within the prostate.

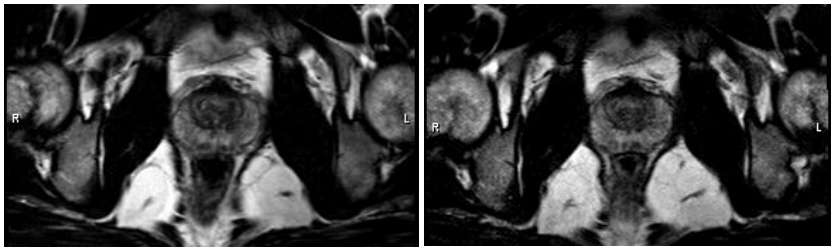

Figure 2 Axial 3T VISTA MRI of the prostate of a volunteer acquired with a 32 channel coil (left) and an 8 channel coil (right). The image acquired with the 32 channel coil displays the neurovascular bundle more clearly compared to the image acquired with the 8 channel coil.

Table 1 Average contrast to noise ratios (CNR) of peripheral zone and the central zone of the prostate and the surrounding muscle tissue acquired with a 32 channel and an 8 channel coil in volunteers at 3T.

CNR	T_2-weighted TSE		VISTA	
	32 channel	8 channel	32 channel	8 channel
peripheral/central	5.3±2.3	3.4±1.5	5.0±2.6	3.3±2.4
peripheral/muscle	9.0±1.6	6.8±0.8	12.0±1.4	8.6±1.9

Conclusion

Pelvic/prostate MR imaging at 3T using a 32 channel coil revealed substantially improved image quality, both quantitatively and qualitatively, compared to the previous 8 channel coil used under identical conditions and in an intra-individual comparison. Using coils with a higher number of elements appear to help overcome some of the challenges of high field MR body applications. In addition, comparing optimized acquisition approaches with previous standard of care imaging will likely reveal even more exciting advances.

References

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[2] Hambrock T et al. Invest Radiol. 43(10):686-94 (2008).