ABSTRACT SUBMISSION FORM

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PRESENTATION TITLE
feasibility of BLADE-DWI for head and neck radiation treatment planning: phantom and volunteer studies

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ABSTRACT

Purpose: Diffusion weighted magnetic resonance imaging (DW-MRI) is a promising imaging modality for better target delineation in radiotherapy planning application. However, its use for head and neck cancer patient is very challenging due to severe geometric distortion in echo planar based imaging (EPI) DW-MRI. Spin echo based BLADE-DWI is an emerging technique with less geometric distortion. The purpose of this study is to investigate whether BLADE-based DW-MRI can be used to replace EPI-based DW-MRI in head and neck MRI scans, by evaluating geometric distortion parameters.

Materials & Methods: MR imaging was performed on a MAGNETOM Aera 1.5T MR scanner with two 4-channel large flex phased-array coils and spine coil. Phantom measurements were performed using the quantitative imaging biomarkers alliance (QIBA) DWI phantom at 0 °C. DW images were acquired using single shot EPI (SSEPI) DWI, readout segmentation of long variable echo-trains (RESOLVE) DWI, and BLADE DWI. As a measure of image geometric distortion, including compression/dilation, shear distortions, and image shift factors were calculated and compared with gold standard CT images. Three volunteer measurements were also performed and all images were exported to Velocity software. Geometric distortion parameters and ADC values were analysed looking at the following head and neck regions of interest (ROI): salivary glands, and tonsils. Metric evaluation included volume overlap and surface distance (Dice similarity coefficient, Hausdorff distance (HD), and mean distance). T2-weighted images were used as reference for geometric distortion evaluation. All analyses were executed with JMP Pro version 11 software (SAS Institute, Cary, NC, USA).

Results: DW images acquired using BLADE technique showed no or minimal geometric distortions. In phantom experiment (Figure 1), the vials from inner layer to outer layer on the diffusion weighted image became prominently distorted on the SSEPI-DWI and RESOLVE-DWI images, while BLADE-DWI image consistently showed less distortion evaluated by the overall effects of the compression/dilation factor, sheerness factor, and image shift factor. No significant difference in ADC values was observed between BLADE-DWI and gold standard CT images.
values was observed between the three DWI techniques, however BLADE-DWI lead to a reduced SNR in all vials. In volunteer studies (Figure 2), ROI-based overlap metrics analysis of the salivary glands and gross tumour volumes were less distorted for BLADE-DWI than that of EPI-based DWI. **Conclusions:** The BLADE-DWI demonstrated excellent geometric accuracy compared with the EPI-based DW-MRI. Therefore, BLADE-DWI is expected to improve target volume delineation for head and neck radiotherapy.

Figure 1: (a) A schematic diagram for the definition of geometric distortion factors: shear factor, compression factor/dilation factor, and shift factor. (b) Layer definition shown on CT image; (c) The overall geometric distortion factor (the sum of all factors) comparison between SSEPI-DWI, RESOLVE-DWI, and BLADE-DWI.

Figure 2: Example of DWI in a normal volunteer. (a) T2 weighted image with fused organ contours including submandibular glands, parotid glands, and tonsils. These delineated organs are indicated with blue line on (b) T2 weighted image, red line on (c) BLADE b0 image, yellow line on (d) RESOLVE b0 image, and green line on (e) SSEPI b0 image.