AbstractID: 13665 Title: High Fidelity, Low Distortion Diffusion-Weighted MRI for Head and Neck Cancer Radiotherapy Planning

Purpose:
Diffusion-weighted (DW) MRI can provide information to improve target delineation in radiation treatment planning. However, acquisition of DW images in head and neck presents several challenges, including tissues with short T2s and off-resonance effects arising from air-tissue/air-bone interfaces. We implemented a multi-shot, variable density spiral (VDS) acquisition method and demonstrate that it is capable of generating low distortion, high fidelity DW images of head and neck cancer patients suitable for radiation treatment planning.

Method and Materials:
A multi-shot, VDS sequence of our own design with Stejkal and Tanner diffusion encoding gradients was implemented on a 3.0T Siemens Verio scanner. Multi-shot, DW images were acquired on three head and neck cancer patients (FOV: 220mm^2, matrix: 128^2, interleaves: 16, TE: 67 msec, TR: 3500 msec, TH: 3 mm, b=0, 600 s/mm^2, scan time: 3.7 minutes). Custom reconstruction software was written to exploit the self-navigating capabilities of the VDS readout gradients, which facilitated correction of each spiral interleaf for eddy current- and motion-induced phase errors encoded by the diffusion gradients.

Results:
In terms of signal-to-noise ratio, short T2s impose an upper limit on echo times and, thus, the maximum achievable degree of diffusion weighting in head and neck regions. The use of the Stejkal and Tanner diffusion encoding scheme permits a reduction in minimum echo time, relative to the widely used twice-refocused spin-echo, which facilitates acquisition of DW images in tissues with short T2s. In addition, the combination of VDS readout gradients and the custom reconstruction algorithm permit effective correction of both eddy current and motion-induced phase errors, thereby facilitating acquisition of high fidelity, low distortion DW images in the head and neck.

Conclusions:
High-fidelity, low distortion diffusion-weighted MR imaging of the head and neck useful for radiation treatment planning is achievable using multi-shot, variable-density spiral acquisitions.

Research supported by Siemens Healthcare