Diffusion-weighted Zoomed EPI of the larynx and oral cavity/oropharynx

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Introduction: Tumors of the larynx and oral cavity/oropharynx are frequent mainly in smokers. Imaging is a challenge especially in the early stage of tumors or to differentiate recurrence from post-therapeutic changes after radio-chemotherapy. Diffusion-weighted MRI (DW-MRI) is a promising technique, however, using single shot echo planar imaging (EPI) readout of the oral cavity/oropharynx and larynx has always been difficult due to many tissue, air and bone interfaces which result in signal drop-outs and distortion artifacts due to local susceptibility variations. A specific artifact of EPI is the signal pileup from voxel shifts in the phase-encode (PE) direction. There are various options to overcome these artifacts, eg. Use of a spiral or propeller trajectory or parallel imaging. which have signal to noise penalties and are often not readily available commercially. Zoomed-EPI [1] using a restricted FOV in PE direction is an method using a 2D rf pulse to excite partial volume in the slice, which in turn reduces measurement time. The aim of the current study is to compare Zoomed-EPI with conventional EPI qualitatively and quantitatively.

Methods: Seven healthy volunteers were examined on a 3T MR unit (Siemens Verio, Erlangen, Germany). Conventional sequences including T1-, T2-weighting axial and coronal TIRM (Turbo Inversion Recovery Magnitude) images were acquired. In addition, conventional EPI (product) and Zoomed-EPI (works in progress) of the larynx and oral cavity/oropharynx were performed using the same geometry. Zoomed-EPI used an echo-planar spokes trajectory for excitation with TE/TR 66/4827 msec, 3 averages, matrix 36x192, FOV 12x40cm, 22 slices, 4mm. Conventional EPI was acquired with TE/TR 68/4400 msec, 3 averages, GRAPPA 2, matrix 102x128, FOV 25x25cm, 22 slices, 4mm. Measurement times were similar and average 4.5 minutes using 7 b-values 0, 10, 20, 50, 100, 500, 1000 sec/mm^2. Equal shim volume placing within the neck region behind the throat was used in order to rule out distortion due to shimming. ADC values were measured in the muscle, spinal cord, spinal fluid, tongue and tonsil on auto generated ADC maps.

Results: Figure 1 shows the typical image quality of the EPI and Zoomed-EPI sequence for the larynx (left, a,c) and oral cavity/oropharynx (right, b,d). The overall spatial resolution with Zoomed-EPI is higher and having less distortion artifact. This is caused by the shorter echo train leading to a reduced phase evolution induced by the local field inhomogeneities. This results in less image distortions. The faster acquisition time allows for larger matrix size, which improves resolution; and possibly yields more average when using parallel imaging (GRAPPA) for better signal to noise. The comparison of the ADC values as shown on Figure 2 demonstrates that there are no quantitative differences between the two techniques.

Conclusion: Zoomed-EPI has various advantages over conventional EPI read out scheme for DW-MRI of various tissues such as the larynx and oral cavity/oropharynx. A qualitative improvement of this challenging region using Zoomed-EPI can be achieved, e.g. less distortion artifacts, higher resolution in equal scan time maintaining equal quantitative results (ADC).

Reference:

1. J. Pauly et al., Journal of Magnetic Resonance 81, 43-56 (1989)

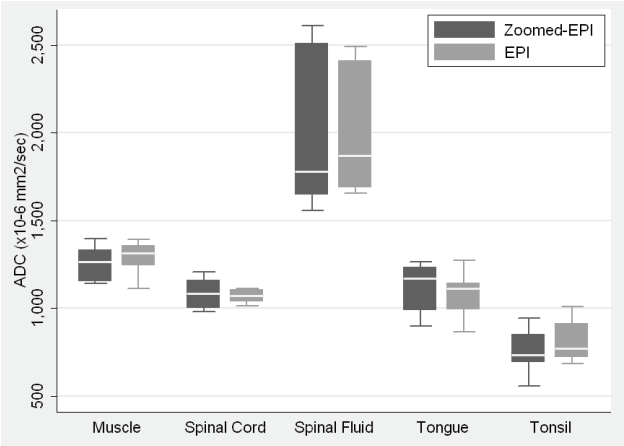

Figure 2 ADC value comparison between ZOOMED-EPI and conventional EPI for various tissues of the oral cavity/oropharynx and reference structures (muscle, spinal cord and spinal fluid).

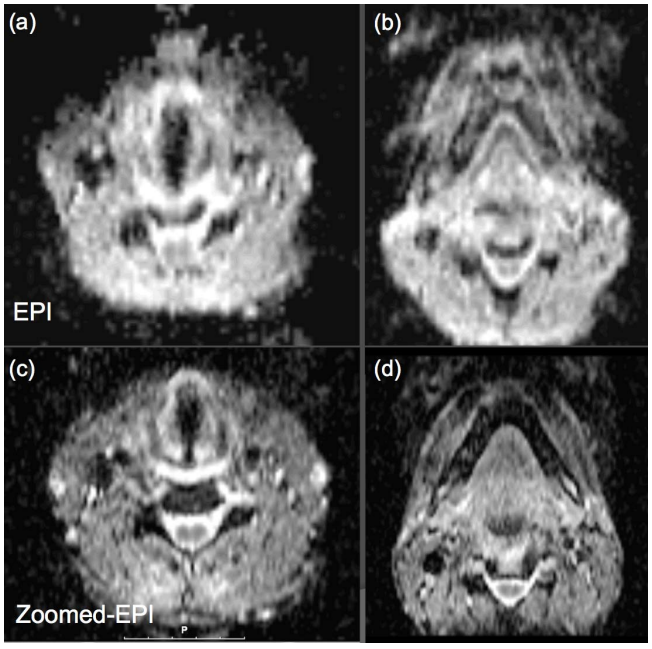

Figure 1 Image quality comparison between conventional EPI (a, b) and Zoomed-EPI (c, d) acquisition scheme for larynx (a, c) and oral cavity/oropharynx (b, d).