Effect of CSF suppression using the FLAIR technique on diffusion tensor MR tractography

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Purpose:

Diffusion tensor MR imaging has been widely used to perform the MR tractography. However, the effect of CSF contamination is a potential problem in quantitative derivation of the fractional anisotropy in the region near the cerebral ventricle [1], which will possibly cause errors in DT MR tractography and lead to apparent reduction of white matter fibers adjacent to the cerebral ventricle. Therefore, the purpose of this study is to investigate the effects of CSF suppression using FLAIR on white matter tractography.

Materials and Methods:

Diffusion tensor images were acquired using the spin-echo echo-planar imaging sequence that applied diffusion-sensitizing gradient in six independent directions. In FLAIR, diffusion-tensor-weighted images were obtained using the same spin-echo echo-planar imaging sequence, with the exception that a slice selective 180^0 inversion RF pulse was added at TI = 2200 msec before the 90^0 excitation pulse. For tractography, we use the EZ-tracing [2], which is a data-driven algorithm, to obtain the tractograms derived from FLAIR and standard DTI data. For quantitative analysis, we calculated the total length of all fibers of tractograms from both techniques.

Results:

Figure 1a and 1b shows the tractograms derived from standard and FLAIR DTI data, respectively. It can be seen that there are more fibers found in the FLAIR DTI data, especially in the genu region of the corpus callosum (rectangle). Correspondingly, the FA value in the genu of corpus callosum is greater in FLAIR images (d) in comparison with standard technique (c). The vector map derived from FLAIR DTI data (f) is more reliable than that obtained using standard DTI imaging (e), which is reasonable because the 1st eigenvector of a high-FA tensor is less sensitive to system noise. The total length of tracts in tractograms were calculated and shown in Figure 2. The result demonstrates that CSF suppression on DT tractography helps tracing more fibers than the standard technique.

Conclusion:

Diffusion tensor MR tractography using fluid-attenuated inversion recovery (FLAIR) to suppress the cerebrospinal fluid (CSF) can reduce the partial volume averaging of CSF that help tracing more fibers, especially in the peri-ventricular region.

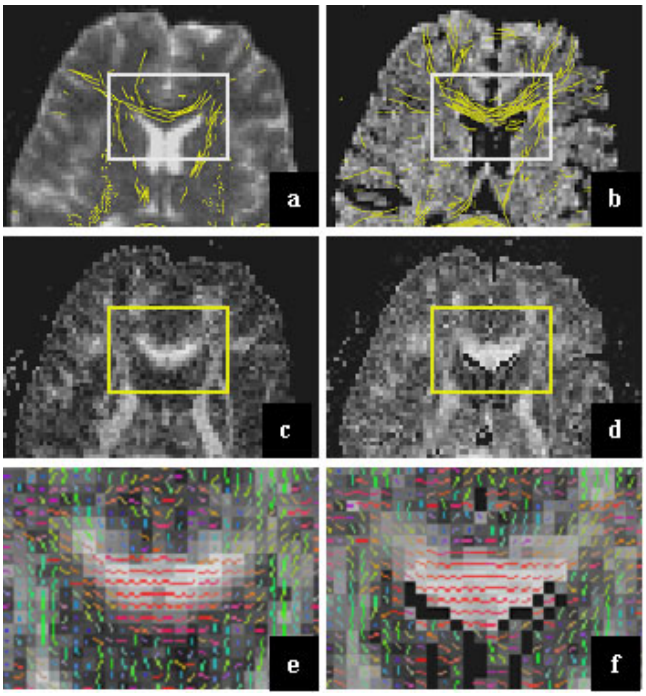

Figure 1. (a) Tractograms obtained from standard DTI and (b) from FLAIR-DTI. (c) FA map derived from standard DTI and (d) from FLAIR-DTI. (e) 1st eigenvector map of standard DTI and (f) of FLAIR- DTI.

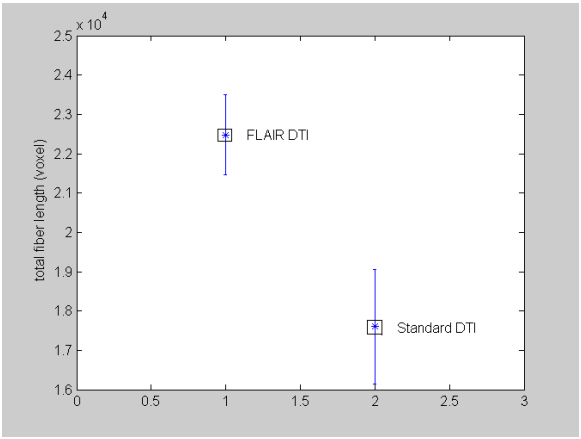

Figure 2 shows the mean total fiber length and the standard deviation of two techniques in six consecutive examinations of single subject (slice thickness 4mm)

References:

[1] Hirsch, *et al. Magnetic Resonance in Medicine*, 48:394-398 (2002)

[2] Terajima, *et al. Journal of Neuroscience Methods*, 116:147-155 (2002)