COMPARISON OF RELATIONSHIPS BETWEEN TWO DIFFERENT WHITE MATTER TRACTS AND MEMORY FUNCTION WITH HEALTHY INDIVIDUALS BY USING DIFFUSION TENSOR TRACTOGRAPHY

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Introduction

The integrated white matter tracts measured by DTI are related to individual differences in performance across a wide range of cognitive function. The purpose of this study was to investigate that the degree of DTI parameters in the fornix and the uncinate fasciculus would correlate with changed memory scores.

Subjects and Methods

This study included a total of 33 healthy right-handed controls (age range 20-60 years). The study was approved by the Institutional Review Board of the National Hospital Organization Nara Medical Center, and all subjects gave informed consent prior to enrollment in the study. MR-images were acquired on a 1.5T whole body MR scanner (Toshiba Medical Systems Inc). The subjects had DTI acquisitions. The DTI acquisition comprised axial 2D echo planar imaging (2D EPI) diffusion-weighted sequence with TR/TE = 12000/130 ms, FOV = 24 cm, matrix = 128 × 128, 3 mm contiguous slices without gap, two b values = 0 and 1000 s/mm^2; 6 directions. DTI Studio software[1] based on the fiber assignment by continuous tracking (FACT) algorithm was used for white matter fiber tracking. Diffusion tensor tractography using multiple regions-of-interest (ROI) were also used to trace the fornix (Fig. I left) and uncinate fasciculus (Fig. I right) bilaterally[2]. The tracking method used a fractional anisotropy (FA) threshold of 0.15 and angle threshold of 60 degrees. These thresholds were similar to previous publications[3]. All subjects underwent a comprehensive neuropsychological evaluation. The Wechsler Memory Scale-Revised (WMS-R) was examined as part of the neuropsychological battery. Five memory indices from the WMS-R were used in this study to evaluate memory performance such as Verbal, Visual, General, Attention / Concentration and Delayed Recall Index were used to assess each memory performance. For examining all memory scores, any age related scaling was not done. Spearman correlations between DTI and memory scores were obtained.

Results

DTI parameters and the correlations with DTI measures in the fornix and uncinate fasciculus were summarized in Table I. FA in the left uncinate fasciculus shows higher correlation in almost all memory indexes than in the right uncinate fasciculus except visual. On the other, ADC had higher correlations in the right than in the left UF and both of these tendencies are not similar to the fornix. FA in the left fornix only shows higher correlation in visual and attention/concentration. ADC in the right fornix had higher correlations in visual and delayed recall. Significant correlations were not found between all DTI measurements and memory scores.

Discussion

Correlations between DTI measures and memory performance suggest the relationships in the uncinate fasciculus and functions in memory tasks lateralization are different from those of the fornix. These correlations between lateralized memory performance and DTI abnormalities in the uncinate fasciculus have also been shown in diseases[4]. Correlations between lateralized memory performances should be investigated further regarding to the difference between the function of the fornix and that of the uncinate fasciculus.
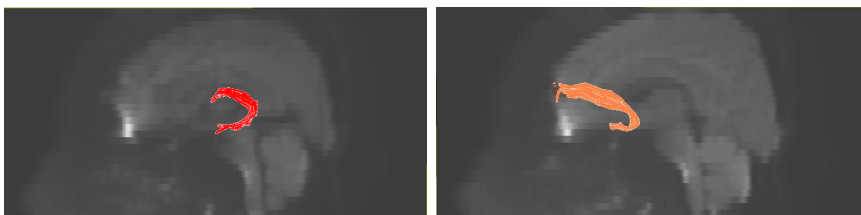
References

[1] Jiang H, et al., Comput Methods Programs Biomed. 2006 Feb; 81(2):106-16.
[2] Wakana S, et al., Neuroimage. 2007 Jul 1; 36(3):630-44.
[3] Hasan KM, et al., J Magn Reson Imaging. 2008 Apr; 27(4):700-9.
[4] Kubicki M, et al., Am J Psychiatry. 2002 May; 159(5):813-20.

Figure I. Illustration of the DTI-based fiber tracking of the fornix (left), uncinate fasciculus (right).

TABLE I. CORRELATIONS BETWEEN DTI MEASUREMENTS AND MEMORY SCORES

Left fornix	Mean±SD	verbal	visual	general	att/con	delayed recall
FA	0.345±0.0363	-0.038	-0.131	-0.078	-0.207	-0.002
ADC	1.173±0.207	0.114	0.026	0.115	0.014	-0.026
Right fornix						
FA	0.361±0.0322	0.070	-0.085	0.031	0.092	0.053
ADC	1.018±0.113	0.015	0.451	0.152	0.034	0.240
Left UF						
FA	0.373±0.0248	-0.384	-0.270	-0.413	-0.302	-0.277
ADC	0.858±0.0480	0.109	0.156	0.160	0.103	0.160
Right UF						
FA	0.359±0.0240	-0.074	-0.056	-0.094	-0.048	0.035
ADC	0.852±0.0800	0.114	0.039	0.116	0.047	0.070