DTI Analysis of White Matter Deficits in Frontotemporal Lobular Dementia

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OBJECTIVE

To identify defects in specific white matter (WM) tracts that correlate with cognitive deficits in frontotemporal lobar degeneration (FTLD).

BACKGROUND

Diffusion tensor imaging (DTI) enables the investigation of white matter integrity through fractional anisotropy (FA), but DTI studies in FTLD are rare. Here we compare FA in FTLD subtypes relative to elderly controls. The results are validated by correlating FA with cognitive measures that depend on semantic and executive processing.

DESIGN/METHODS

We studied 11 elderly controls, and patients with semantic dementia (SD, n=12), social/executive disorder (SOC, n=6) and progressive nonfluent aphasia (PNFA, n=8). Cognitive tests included confrontation naming (relatively sensitive to semantics), FAS (relatively sensitive to executive search), and ANIMAL category naming (sensitive to both semantic and executive processes). DTI was acquired at 3T using 12 directions. A high-dimensional spatial normalization method, optimized for DTI, was used to create a population-specific tensor template[1]. All subject images were registered to the template. FA was computed for the registered images and the white matter region was determined by thresholding FA at 0.2. Statistical analysis was done using statistical non-parametric mapping[2]. Regions of significant group-wise FA differences were computed with two-sample t-tests. Linear regression was used to determine regions where FA correlated to cognitive measures

RESULTS

FA was reduced in the left temporal lobe for SD and SOC patients, and additionally in the right temporal lobe for SOC patients, and in the left frontal lobe for PNFA patients. FA change in the inferior longitudinal fasciculus of the left temporal lobe correlated with all cognitive deficits for all measures in SD. FA in the forceps minor of the left frontal lobe correlated with FAS and ANIMAL category naming for PNFA. The left fornix correlated with all measured cognitive deficits for both SD and PNFA.

CONCLUSIONS

SD deficits are related to the integrity of WM tracts in the left temporal lobe. Additionally, executive resources are related to WM integrity of the left frontal lobe in PNFA.

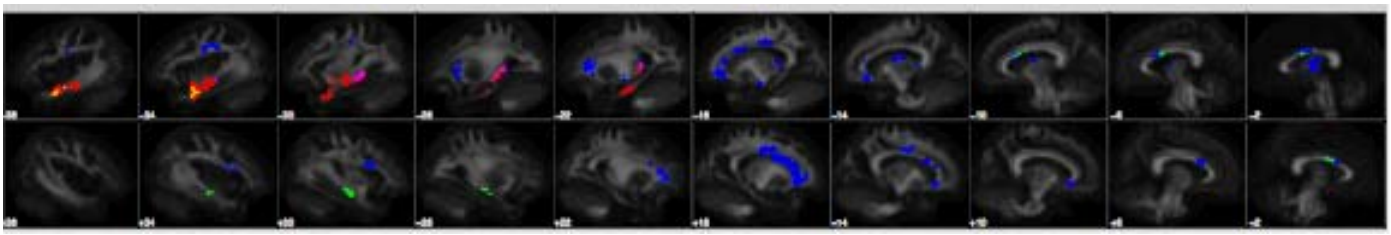

Figure 1 Clusters of reduced FA for SD (*red*), SOC (*green*), PNFA (*blue*), SD and SOC (*yellow*), SOC and PNFA (*cyan*), SD and PNFA (*magenta*)

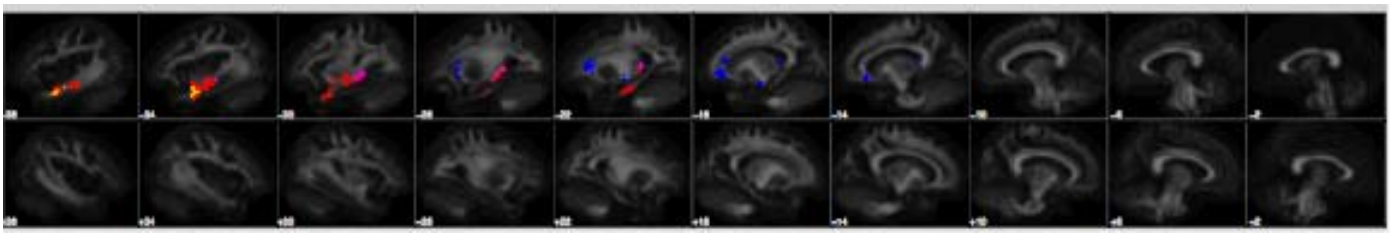

Figure 2 Clusters of reduced FA for patients that are correlated with cognitive measures. (*color scheme same as above*)

References

[1] H. Zhang, et al, *Deformable registration of diffusion tensor MR images with explicit orientation optimization*. Med Image Anal, 10(5):764–785.

[2] T. E. Nichols, et al. *Nonparametric permutation tests for functional neuroimaging: a primer with examples*. Hum Brain Mapp, 15(1):1–25, 2002.