Regional white matter abnormalities and cognitive impairment in MS: a multicenter TBSS study

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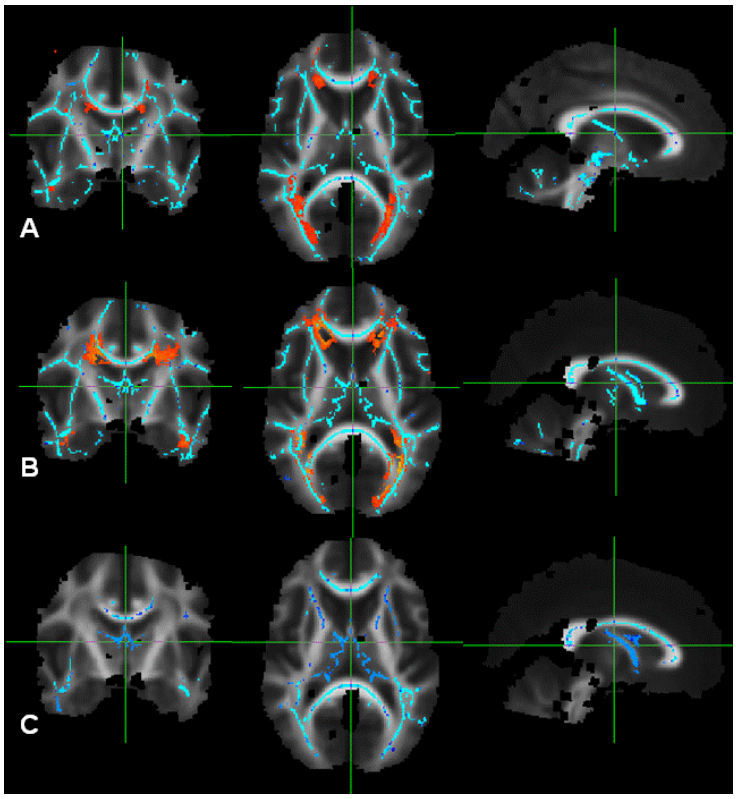
Target audience. Neuroradiologists, radiologists, neurologists.

Background. Single center studies have shown an association between disrupted white matter architectural integrity and clinical manifestations, including cognitive impairment, in multiple sclerosis (MS).

Purpose. To apply Tract Based Spatial Statistics (TBSS)[1] in a multi-center setting to assess the spatial distribution of white matter damage in MS and its relationship with global cognitive impairment as well as deficits in selected cognitive domains.

Methods. This study was conducted at six European sites using 3.0 Tesla scanners. Fifty-one MS patients and 57 sex-matched healthy controls (HC) underwent MRI, including diffusion tensor imaging. MS patients underwent the Rao battery and the Wisconsin Card Sorting test (WSCT). Patients with at least two abnormal tests were considered as cognitively impaired (CI). TBSS was applied for voxel-wise analysis of fractional anisotropy (FA) and mean diffusivity (MD) maps. T2 lesion probability maps were also derived. Between-group differences and correlations with cognitive tests were reported at a threshold of 0.01 (adjusted for age and scanner).



Results. Twenty-two MS patients were CI. Compared to cognitively preserved, CI patients showed FA/MD abnormalities of the corpus callosum, forceps major and minor, superior and inferior longitudinal fasciculi, corona radiata, inferior fronto-occipital fasciculi, uncinate fasciculi, anterior thalamic radiation, fornix, thalamus, left cingulum (Figure 1). Only a minimal overlap was found between regional diffusion tensor MRI abnormalities and T2 lesion probability maps. Significant correlations were found between: 1) global cognitive, attention and spatial memory Z score vs FA/MD of the majority of the damaged areas; 2) verbal fluency Z score vs FA/MD of corona radiata, corpus callosum, inferior fronto-occipital fascicului, left uncinate fasciculus; 3) WCST scores vs MD of the thalamus and fornix.

Figure 1 Voxels with significant decreased FA are shown in blue, overlaid on the FA atlas for the comparisons: CP MS patients vs HC (A), CI MS patients vs HC (B) and CI vs CP MS patients (C). T2 lesion probability maps are shown in red for each group of patients.

Conclusions. The application of TBSS to define the regional distribution of white matter damage in a multi-center setting in MS patients is feasible and contributes to better characterize disease cognitive manifestations.

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References. [1] Smith SM, Jenkinson M, Johansen-Berg H, et al. Tract-based spatial statistics: Voxelwise analysis of multi-subject diffusion data. NeuroImage, 2006;31:1487-1505.