THE TOPOGRAPHY OF BRAIN MICROSTRUCTURAL DAMAGE IN AMYOTROPIC LATERAL SCLEROSIS ASSESSED USING DIFFUSION TENSOR MRI

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Introduction: Amyotrophic lateral sclerosis (ALS) leads to macrostructural (i.e., cortical atrophy and hyperintensities along the corticospinal tract [CST]) and microstructural (i.e., white [WM] and gray matter [GM] intrinsic damage) central nervous system (CNS) abnormalities.

Aims: We used a multimodal voxel-wise imaging approach to assess microstructural changes independent of macrostructural volume loss in ALS patients compared to healthy controls.

Materials and methods: Twenty-three ALS patients and 14 healthy controls were studied. Conventional and diffusion tensor (DT) MRI were acquired. Images were processed using SPM5 to assess measures of GM and WM atrophy as well as microstructural damage (i.e., mean diffusivity [MD], and fractional anisotropy [FA]). DT MRI alterations independent of volume loss were investigated.

Results: Accounting for both GM and WM atrophy, ALS patients showed increased MD values in several GM and WM regions mainly located in the orbitofrontal and frontotemporal regions bilaterally, in the right genu of the corpus callosum, and in the right posterior limb of the internal capsule. Accounting for WM volume loss, ALS patients showed a decreased FA along the CST bilaterally, and in the left inferior frontal lobe relative to HC. The MD of the orbitofrontal regions was associated significantly with disease duration.

Conclusions: In ALS patients, DT MRI detects microstructural changes independent of brain tissue loss. DT MRI alterations in ALS, in terms of increased MD and decreased FA, might indicate where atrophy will occur later in the course of the disease.