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ORIGINAL ARTICLE

Diffusion Tensor Imaging in Amyotrophic Lateral Sclerosis—Increased Sensitivity with Optimized Region-of-Interest Delineation

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Abstract
Purpose Diagnosis of amyotrophic lateral sclerosis (ALS) can be difficult from clinical symptoms alone. Diffusion tensor imaging (DTI) has been suggested as an adjunct diagnostic method. DTI parameter changes have been repeatedly demonstrated, especially in the corticospinal tract (CST) as the predominantly affected structure. However, a recent meta-analysis reported only a modest discriminatory capability, questioning the value of this method as a confirmatory test in single subjects with suspected ALS. We investigated how methodological differences in CST delineation influence the discriminatory capability.

Methods DTI data were acquired in 13 ALS patients and an age-matched healthy control group. We calculated and compared receiver operation characteristic (ROC) curves of four different analysis methods using either a manual or an atlas-based region of interest (ROI) of the CST in combination with and without tract-based spatial statistics (TBSS).
Results The analysis method combining atlas-based ROIs with TBSS yielded an area under the curve (AUC) of 0.936 and a sensitivity and specificity of 100% and 91.67%. These are the best results among the four analysis methods evaluated: manual ROIs (AUC=0.846, sensitivity: 69.23, specificity: 91.67), atlas-based ROIs alone (AUC=0.917, sensitivity: 76.92, specificity: 91.67), manual ROIs in combination with TBSS (AUC=0.885, sensitivity: 76.92, specificity: 91.67).
Conclusions Sensitivity and specificity strongly depend on the CST delineation approach. The combination of an atlas-based ROI with TBSS is a promising fully automatic method with improved discriminatory capability compared to other approaches. It could ultimately serve as a confirmatory test in single ALS patients.

Keywords Amyotrophic lateral sclerosis · Magnetic resonance imaging · Diffusion-tensor imaging · Tract-based spatial statistics

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Introduction

Amyotrophic lateral sclerosis (ALS) is a rapidly progressive neurodegenerative disease affecting the upper and lower motor neuron simultaneously and has an average life expectancy of only about 2–3 years after symptom onset [1–4]. Diagnosis is mainly based on clinical signs of upper and

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