Multi-parametric Quantitative Magnetic Resonance Imaging of the Normal Appearing Brain in Multiple Sclerosis

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Introduction. Quantitative Magnetic Resonance Imaging aims at the absolute measurement of physical parameters such as the R1 and R2 relaxation rates and proton density PD. These parameters are independent of MR scanner settings and hardware imperfections and hence directly reflect the intrinsic tissue characteristics. QMRI was applied to a group of patients diagnosed with Clinically Definite Multiple Sclerosis (CDMS) to measure the differences of the normal appearing brain compared to the normal, healthy brain.

Methods. A group of 16 healthy subjects and 16 patients diagnosed with CDMS were age and gender matched with 4 male and 12 female subjects (median age 48 years, range 27-62 and 48 years, range 29-63 respectively). The patient group consisted of 8 relapsing–remitting and 8 secondary progressive MS patients with a mean disease duration of 16±10 years, a mean Expanded Disability Status Scale (EDSS) of 4.0±2.3 and a mean Multiple Sclerosis Severity Score (MSSS) of 4.6±2.8.

Fig.1. Example of MR quantification on an axial slice of the brain of one of the MS patients. A: R1 relaxation rate on a scale 0-20 s⁻¹, B: R2 relaxation rate on a scale 0-20 s⁻¹ and C: proton density on a scale 50-100% water. In D-F synthetic T2-weighted images are shown were the 18 separate ROIs of the study are displayed.

Results. Observed values for R1, R2 and PD of cerebrospinal fluid (CSF), parasagittal frontal cortex (FCX), head of the caudate nucleus (HCN), putamen (PT), thalamus (TH), centrum semiovale (CS), occipital white matter (OWM), peritrigonal white matter (PWM), splenium of the corpus callosum (SCC) and PD characteristics but

Discussion and conclusion. The normal appearing brain of MS patients shows a larger variation in R1, R2 and PD characteristics but for most tissues the mean difference compared to healthy subjects is not significant. These findings suggest that MS has little effect on the complete brain but is mainly restricted to the lesions and diffuse hyper-intense (dirty-appearing) white matter.