Increased cortical grey matter lesion detection in multiple sclerosis with 7T MRI

Multiple sclerosis (MS) has been seen as a classic white matter disease for a long time. Over the past decades, the relevance of grey matter pathology in MS has been increasingly recognized and a lot of effort has been put into visualizing corticogrey matter lesions with MRI, but unfortu-
nately sensitivity to cortical lesion detection remains low. Being able to depict cortical lesions is important, since it has high clinical relevance. Cortical lesions are common, present in the earliest stages of the disease, and relate better to physical and cognitive disability than white matter lesions. It has even been suggested that sensitivity of MRI diagnostic criteria would improve when taking cortical lesions into account.

In vivo studies have shown improved detection of cortical lesions by using higher magnetic field strengths up to 7T. So far, a systematic histopathological verification of ultra-high field MRI pulse sequences has been lacking, so we still do not know how many of the cortical lesions we actually see and – more importantly – how many we still miss.

In the post-mortem study that will be presented today we determined the sensitivity of 7T versus 3T MRI pulse sequences for the detection of cortical MS lesions, by directly comparing them to histopathology. Coronal hemispheric brain slices of 19 MS patients and four controls were scanned on a 7T and 3T system using a multi-contrast protocol T1-weighted, T2-weighted, fluid attenuated inversion recovery (FLAIR), double inversion recovery (DIR) and T2*-Lesion detection was verified by comparing MR images to histopathology as a reference, and after that, sensitivity of pulse sequences was calculated. Additionally a second un-blinded (retrospective) scoring of MR images was performed.

The most important result of our study was that, regardless of pulse sequence, 7T MRI detected more cortical lesions than 3T. The largest improvement was seen with 7T FLAIR, which detected 22% more cortical lesions than 3T FLAIR (Z=2.22, p < 0.05) and 7T T2* detected lesions in 42% (Z=2.22, p < 0.05) of 19 MS patients and four controls.

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