Investigation of lesion volume dynamics in MS patients as detected by Voxel-Guided Morphometry – A multi center study

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Background: Chronic active lesions ('smoldering lesions') in MS patients have recently gained increasing interest as possible markers of MS activity. Yet there is no in vivo marker to detect these lesions and characterize their structural dynamics.

Objectives: To detect chronic active lesions in MS patients and characterize their intraindividual volume dynamics over time.

Methods: 581 MRI datasets in 200 relapsing-remitting MS patients (2 - 5 per individual) from a 3-year multi-centre observational INSPIRATION-MRI study were investigated using Voxel-Guided-Morphometry (VGM), a method for intraindividual detection and quantification of structural changes in volumetric MRI scans (T1 – weighted MPRAGE-sequence) over time. Chronic active lesions were identified and differentiated into chronic shrinking vs. chronic enlarging lesions.

Results: Intervals between consecutive scans varied between 53 and 1199 days, mean = 443 days. Overall, individual MRI scan intervals varied between 53 (2 scans) and 1360 (3 scans) days. In total, 2419 active lesions were identified, characterized and quantified, corresponding to a mean active lesion load of 12 lesions per patient. In chronic shrinking lesions, mean volume change was -33% (from -11% to -59%), in chronic enlarging lesions mean volume change was +53% (from 29% to 425%). We found a mean annual volume decrease for white matter of 0.17% and gray matter of 0.12%. 31 patients exclusively demonstrated chronic enlarging lesions, in 16 patients only chronic shrinking lesions were detected, and 119 patients were found to have a mixture of both types of active lesions. In 34 patients, no active lesions were identified.

Conclusions: Chronic active lesions were detected in 83% of the investigated patients using Voxel-Guided-Morphometry in longitudinal 3D-MRI datasets. As these chronic active lesions are supposed to represent MS activity with corresponding brain tissue damage also in patients who do not demonstrate new contrast-enhancing lesions, they might be regarded as an additional biomarker for MS activity. The relationship between chronic active brain tissue lesions and clinical MS progression needs to be further investigated.