Integrated Brain and Biplanar Spinal Cord MRI using Parallel Imaging and Multi-Array Coil Technology

K. Weier MD[1], Y. Naegelin MD[1], A. Thoeni[2], J. G. Hirsch[2], L. Kappos MD[1], D. Leppert MD[1,3], E-W. Radue MD[2], A. Gass MD[1,2]

[1]Neurology, University Hospital Basel, Basel, BS, Switzerland, [2]Neuroradiology, University Hospital Basel, Basel, BS, Switzerland, [3]Translational Medicine & Genetics, GlaxoSmithKline R&D, Harlow, United Kingdom

Introduction: Although the functional importance of the spinal cord for locomotion is well known MRI examinations of the spinal cord are not routinely performed in MS patients. The spinal cord is a long and relatively thin structure, that has some mobility and may move due to CSF pulsations along the heart cycle. It is usually assessed in the sagittal plane, that allows a fairly quick reference, but is an unusual plane when detailed visualisation of an anatomical structure is the aim. A second plane is the state of the art for the detailed visualisation of the cord cross-section but this strategy has not been feasible for the entire cord due to long acquisition times. Multi-array coils and parallel imaging provide new opportunities. We investigated this aspect in a large MS cohort when brain and spinal cord MRI were combined in a single examination. We were interested in the sensitivity and potential gain of fast spinal cord imaging schemes when combining high resolution, high sensitivity sagittal and transverse MRI of the entire spinal cord.

Material and Methods: A cohort of 256 MS patients (178 women, 78 men, 24-74 years old, EDSS 0-7.0) with different MS subtypes, including clinically isolated syndrome (CIS), relapsing-remitting (RRMS), secondary progressive (SPMS) and primary progressive MS (PPMS) were investigated. Examinations were performed on a new MRI system, the SIEMENS 1.5T Avanto unit, that offers multi-array-coils (Siemens acronym: TIM technology) and parallel imaging techniques, both essential for the fast and complete assessment of the whole neuro-axis. The standardized brain MRI protocol included transverse, coronal and sagittal localizers; transverse 3mm proton density, T2- and before and after gadolinium T1-weighted spin-echo and turbo-spin-echo sequences. For spinal cord MRI, sagittal and transverse Proton Density and T2-weighted turbo-spin-echo sequences with a were included. A standardised qualitative reporting scheme for the presence and location of lesions and diffuse spinal cord signal change was employed by a consensus reading of 2 experienced raters.

Results: Abnormal signal change on spinal cord MRI of MS patients can be subtle. Abnormalities were found in 75% of patients. In more than half of them only focal lesions were identified. Focal lesions were situated primarily in the cervical spinal cord (59%) and about 2/3 show more than 2 lesions. Diffuse cord abnormalities were found in 21% and in almost one third diffuse abnormalities in all levels. Transverse MRI varied in quality (due to artifact). The analysis of transverse slices confirmed equivocal abnormality and added 14% of lesions in total. Equivocal abnormality was confirmed or rejected with the help of transverse slices, in particular lesions in the periphery of the cord were confirmed.

Discussion and Conclusion: This study demonstrates that high resolution screening MRI of the entire cord in 2 planes can be performed in MS patients together with brain MRI. Our data is in line with previous spinal cord studies in regard to the overall frequency and location of spinal cord abnormality in MS. The demonstration of the entire neuro-axis substantiates the clinical assessment of MS patients. It demonstrates that there are various clinical situations, that particularly capitalise on the detection of spinal cord pathology (CIS, primary progressive) and that even a negative spinal cord MRI can be very revealing (e.g. in the presence of multiple brain lesions). Additional transverse MRI adds further information as some focal lesions can be detected, that are difficult to visualise on sagittal slices and that diffuse signal change can be ascertained or detected.

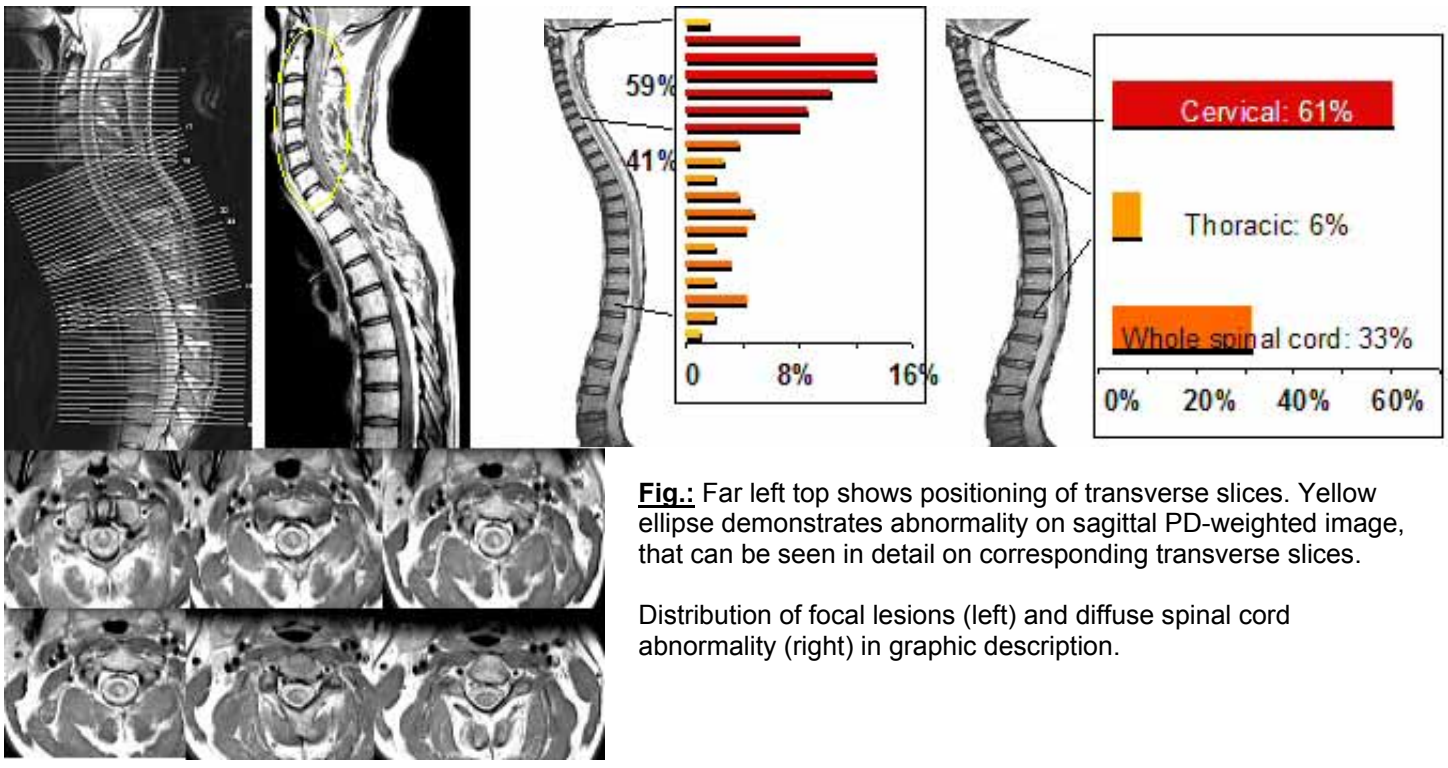

Fig.: Far left top shows positioning of transverse slices. Yellow ellipse demonstrates abnormality on sagittal PD-weighted image, that can be seen in detail on corresponding transverse slices.

Distribution of focal lesions (left) and diffuse spinal cord abnormality (right) in graphic description.