Universität Basel

Research Project

Development, validation and application of novel strategies for MRI data acquisition, image registration and segmentation of the spinal cord in patients affected by multiple sclerosis.

Third-party funded project

Project title Development, validation and application of novel strategies for MRI data acquisition, image registration and segmentation of the spinal cord in patients affected by multiple sclerosis.
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Multiple sclerosis (MS) is an inflammatory-demyelinating disease of the central nervous system. Neurodegeneration seems to be the key driver for the accrual of physical and neuropsychological disability and atrophy is one of the hallmarks of neurodegeneration in MS. Spinal cord (SC) atrophy in MS has previously been reported both in cross-sectional and longitudinal studies. Moreover, MS-related physical disability seems to be especially severe when there is spinal cord atrophy. Several MRI-based approaches for measuring SC cross-sectional area and/or volume have been proposed including manual or semi-automatic cross-sectional area measurements and active surface models. However, previous approaches have been hampered by the relatively low-resolution and contrast of the acquired MR images, long measurement times, artifacts as well as the low reproducibility of the segmentation techniques. Moreover, many of the currently applied post-processing techniques require considerable manual interventions leading to high costs and again low interobserver agreement. Such techniques are currently not suitable for application in clinical practice or as outcome measures in therapeutic clinical trials. Moreover, segmentation of the SC into grey and white matter has not been previously achieved using automated methods in MS and hence, so far no clear-cut conclusions on whether volume loss of the spinal cord primarily affects grey or white matter are possible in larger patient populations.We here propose a comprehensive interdisciplinary approach combining MRI sequence development in the setting of cutting-edge 3T MRI infrastructure, development of new techniques for image post-processing and segmentation with the systematic validation and application of such techniques in a large cohort of deeply phenotyped MS patients. This approach will allow studying the relation of SC volume loss to SC lesions and brain lesions, determine the degree and relevance of white versus grey matter loss in the SC, depict key areas of spinal cord involvement and to relate spinal cord changes to other advanced (brain and spinal cord) MRI measures in MS. Finally and most importantly, we will explore the clinical correlations of spinal cord atrophy, specifically spinal cord grey matter atrophy and the suitability to detect changes over time. Once reliable and automated techniques for spinal cord segmentation become available, this will importantly impact the follow-up of MS patients in clinical practice and also provide new potentially more sensitive outcome metrics for clinical trials.

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