



Diffusion Tensor Imaging in Spinal Cord Injury

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Background: Anatomical MR contrasts (such as T_1 and T_2) fail to identify ultrastructural changes known to occur after Spinal Cord Injury (SCI). Diffusion tensor imaging (DTI) can potentially discern axonal loss in white-matter tissue and serve as a marker for loss of tissue integrity (demyelination, axonal degeneration). It is emerging as an important tool for displaying anatomic changes in the brain after injury or disease but has rarely been applied to investigate disorders of the spinal cord. Poor image quality and the limited resolution in spinal cord has so far impeded focal evaluation of spinal cord tissue i.e. the differentiation between grey and white matter. Furthermore, adequate image quality was achievable only at the cervical level of the spinal cord. Recent improvements in MR pulse sequence design have overcome these problems, thereby providing a new instrument for the assessment of Spinal cord injury.

Working Hypothesis: It is assumed that diffusivity of the spinal cord measured as ADC (Apparent Diffusion Coefficient) and FA (Fractional Anisotropy) is altered at the level of lesion as well as through the entire length of the spinal cord. Diffusivity changes are expected to correlate with clinical (ASIA-Score) and electrophysiological (motor and sensory evoked potentials) measures.

Specific Aims: To characterize structural changes in the spinal cord which occur as a result of long-term recovery from spinal trauma.

Experimental Design: Imaging is performed on a 3 T Philips Achieva (Philips Healthcare, Best, the Netherlands) using a dedicated spine coil. DTI data of volunteers and patients with chronic SCI are acquired at cervical (~C2 and C5) and thoracic (~T5) level as well as at the lumbar enlargement of the spinal cord. In each region 10 transverse slices are acquired using an outer volume suppressed reduced field of view single-shot EPI sequence. After subsequent image co-registration fractional anisotropy (FA) and apparent diffusion coefficient (ADC) maps are calculated. Diffusivity values are evaluated in 10 regions of interest (ROIs) comprising the cross sectional area (CSA) as well as certain parts of gray and white matter where motor and sensory tracts are located. For correlation with the diffusivity values, an ASIA score as well as sensory and motor evoked potentials were obtained in all patients.

Expected Value of the Proposed Project: will be to clarify if DTI is a useful tool to quantify the extent of a spinal lesion in chronic SCI.