Differences between patients with Parkinson's disease and healthy controls detected by high spatial resolution 3D-MRSI at 3 T

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Introduction
Parkinson's disease (PD) is characterized by a degeneration of the neurons in the substantia nigra (SN) which leads to a neurological disorder of the extrapyramidal system. However, the causes for neuronal loss are not yet understood and the clinical assessment is very difficult. Proton MRSI is a specific tool for non-invasive evaluation of neurodegenerative diseases and provides biochemical information about the investigated tissue (1). However, the SN is a very small sized region inside the midbrain with high iron content. Therefore, low quality spectra are expected in the SN relative to other brain regions. The few published studies about MR spectroscopy in the region of the SN in PD used single-voxel spectroscopy at 1.5 or 4 T with volumes between 2.2 and 6 ml (2-4). The goal of this study was to develop an optimized 3D-MRSI protocol with a higher spatial resolution at 3 T for the measurement of the SN in patients with PD and healthy controls and to evaluate the diagnostic value of the method.

Results
3D-MRSI in the rostral and caudal regions of the SN was feasible with a voxel size of 0.252 ml at 3 T. For the first time we divided the SN in a rostral and a caudal part. Our results show clear differences between healthy controls and PD patients.

Discussion
We have demonstrated the feasibility to obtain short echo 1H-MRSI spectra of a good quality in the region of the SN with a very high spatial resolution of 0.252 ml at 3 T. For the first time we divided the SN in a rostral and a caudal part. Our results show clear differences between the intra-individual NAA/Cr ratios in the rostral and caudal region of the SN in PD patients compared to healthy controls. A further advantage of this method is that no "absolute" or group-specific metabolite levels are needed for inter-individual results. Only the intra-individual changes are relevant for the differentiation between healthy controls and patients with PD. Our results suggest that aspects of the pathophysiological process at the SN in patients with PD can be assessed by 3D-MRSI with high spatial resolution at 3 T.

References