

Diffusion tensor imaging in parkinsonism – Analysis of corticospinal tracts and association bundles in patients with essential tremor vs Parkinson’s disease by quantitative spatially normalized DTI at 3.0T.

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Purpose:

Description of microstructural changes in different fibre pathways in essential tremor vs Parkinson’s disease by quantitative spatially normalized DTI at 3.0T.

Patients and methods:

We retrospectively chose 11 patients (mean age 65) who were proven to suffer from Parkinson’s disease clinically and by Dopamine receptor SPECT ¹ and 11 patients (mean age 65) who were verified to be afflicted with essential tremor from a collective of consecutive patients with clinically probable Parkinson’s disease at admission. All patients were right handed.

Diffusion weighted images were acquired on a three Tesla whole body MR system (Signa, GE, Milwaukee, USA) with 40 mT/m maximum gradient strength. Structural T1 images were acquired at a spatial resolution of 0.8 x 0.8 x 4 mm using three-dimensional MPRAGE. DT images of 25 different directions were acquired with a single-shot echo planar imaging sequence (EPI) (TR 10000 ms, TE 88.9 ms) using a diffusion weighting of $b = 1000$ (field of view 220 x 220 mm, matrix size 256 x 256, slice thickness 4 mm, no gap). In addition, one set of images without diffusion weighting ($b = 0$) was obtained.

Image analysis

The diffusion images of each subject were realigned and the T1-weighted data set was spatially normalized to the template using a home-made software based on the software package SPM2. The normalization allows for a voxel wise group comparison. After normalization the diffusion tensor was determined for each voxel ². Subsequently, eigenvalues $\lambda_1, \lambda_2, \lambda_3$ of the diffusion tensors were determined and fractional anisotropy (FA) were calculated. The resulting images were used to compare groups of patients in a two-sample t-test.

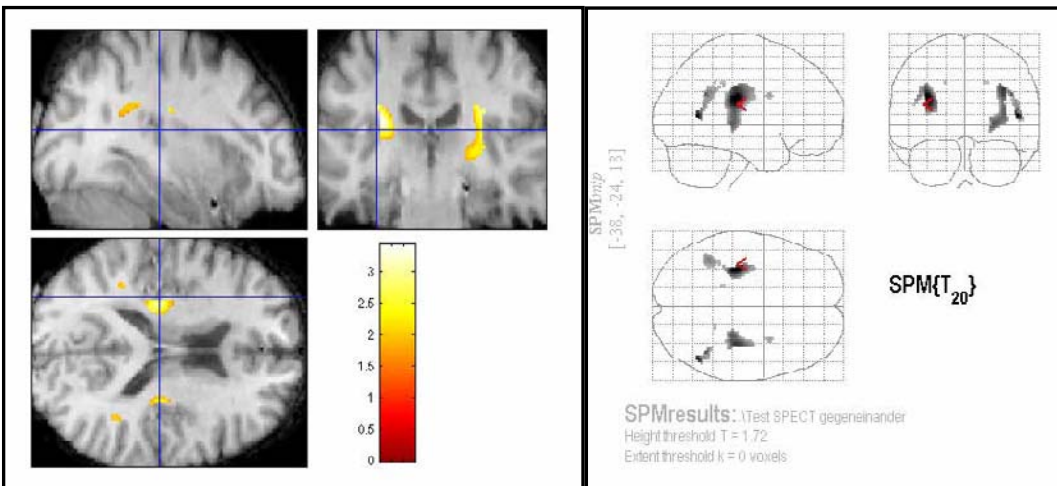
Results:

We could demonstrate a significantly lower fractional anisotropy ($p < 0.05$) in corticospinal tracts and frontooccipital association bundles in patients with essential tremor vs patients with Parkinson’s disease in both hemispheres. A remarkably wider area of lowered FA could be observed in the left hemisphere.

Conclusions:

In the observed collective of patients spatially normalized quantitative DTI could demonstrate a decreased FA in corticospinal tracts and frontooccipital association bundles in patients with essential tremor compared to patients with Parkinson’s disease. Quantitative DTI could therefore be helpful in differentiating patients suffering from Parkinson syndrome.

The registered abnormalities in those bundles could be related to affection of structures involved in the visual/spatial planning of movements in essential tremor. This consideration could be additionally supported by the observed abnormalities in frontooccipital association bundles. The accentuation of the left hemisphere could be due to the right-handedness of patients.



References:

1. Plotkin M, Amthauer H, Klaffke S, et al. J Neural Transm 2005;112(5):677-92.
2. Basser PJ, Mattiello J, LeBihan D. J 1994;66(1):259-67.

Fig.: Example of significantly decreased FA-values in patients with essential tremor.