Frontal cortex grey matter integrity determines motor improvement after STN-DBS in patients with Parkinson's disease

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Objective: We hypothesize that the integrity of the cortical structures is an independent predictor for the DBS response.

Background: Deep brain stimulation of subthalamic nucleus (STN-DBS) evolved to an evidence based standard-line treatment procedure for Parkinson's disease (PD). However the targeted cerebral networks are poorly described and only few predictors for the clinical response exist.

Methods: Thirty four patients with idiopathic PD without dementia (26 males, age 63.7 ± 9.3, Hoehn and Yahr 3.5 ± 0.8) were selected for DBS treatment. The patients underwent whole-brain preoperative T1 MR-Imaging at 3 T. We analyze grey matter properties as derived from cortical thickness measurements and address the dependency of the post-operative clinical outcome from the cortical structural integrity.

Results: STN-DBS markedly improves the clinical motor symptoms (UPDRSIII MED OFF pre 38.64 ± 11.2 vs. post 39.46 ± 8.35 and in MED ON state pre 11.54 ± 5.77 vs. post 17.4 ± 9.03). The clinical improvement after DBS-STN at 6 months follow-up correlated with cortical thickness values from the middle frontal, precentral and superior frontal areas. Notably higher stimulation intensities at the STN site were also necessary to compensate for atrophy in the above-mentioned regions to achieve an optimal clinical motor response.

Conclusions: Our data suggest that the effects of STN-DBS in PD directly depend on the microstructural integrity of grey matter in the frontal lobe. A cortical thinning of these cortical areas is associated with a poor postoperative clinical effect. Cortical atrophy might evolve to an important predictor of the clinical outcome to deep brain stimulation in PD patients and be analysed to model and predict the achieved clinical effects or excluded possible non-responders.