Subthalamic stimulation lead coordinates correlate with non-motor effects in Parkinson’s disease

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Background
• Subthalamic nucleus (STN) deep brain stimulation (DBS): well-established for patients with Parkinson’s disease (PD)¹
• Beneficial effect of STN-DBS on motor and non-motor symptoms (NMS) in PD²
• However, high inter-subject variance of motor and non-motor effects, possibly due to individual lead locations³
• In Cologne, DBS surgery planning with visual targeting of STN
• Analytic approach in this study: correlation of lead locations with motor and non-motor outcomes

Methods
• Post-hoc analysis of a cohort of the non-motor symptom study group of the IPMDS
• Assessment of motor functions and NMS: UPDRS-II,-III,-IV and NMS Scale (NMSS) at baseline (MedON) and 6 months follow-up (6MFU, MedON/StimON)
• NMSS: Consisting of nine domains corresponding to specific aspects of NMS
• Wilcoxon signed-rank or t-test, if parametric criteria fulfilled; Bonferroni α-correction
• Measurement of Cartesian coordinates of lead tips using OPTIVISE © (see figure 1)
• Spearman correlation: Cartesian coordinates with change score (baseline-6MFU)

Funding
This study was supported from a grant of the German Research Foundation (DFG) Clinical Research Group 219 (Klinische Forschergruppe 219).

Results
• So far, 20 patients included with bilateral subthalamic stimulation (40 hemispheres)
• Mean lead tip positions in relation to AC: x: 10.9 mm (±1.3), y: -18.3 mm (±2.2), z: -6.0 (±2.9)
• Significant improvement of all outcomes (see table 1)
• Post-hoc, significant correlations of lead locations with UPDRS-II, -III, NMSS sleep and cardiovascular domains (see table 2)

Conclusion
• Results of our cohort in accordance with broad agreement that DBS outcomes highly dependent on lead locations
• Further studies needed for more sophisticated DBS models also integrating stimulation parameters and patients’ individual anatomy
• Perspective: tailoring lead placement and stimulation parameter settings to patients’ individual motor and non-motor profiles

Table 1
<table>
<thead>
<tr>
<th>Score</th>
<th>Baseline</th>
<th>6 MFU</th>
<th>Relative change [%]</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>UPDRS-II</td>
<td>14.7</td>
<td>4.8</td>
<td>10.6</td>
<td>5.1</td>
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<tr>
<td>UPDRS-III†</td>
<td>28.1</td>
<td>9.5</td>
<td>19.4</td>
<td>7.5</td>
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<tr>
<td>UPDRS-IV</td>
<td>6.7</td>
<td>4.0</td>
<td>4.0</td>
<td>3.5</td>
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<tr>
<td>NMSS</td>
<td>58.7</td>
<td>34.2</td>
<td>38.7</td>
<td>15.7</td>
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</tbody>
</table>

* p<0.05, ** p<0.01, † n=19, for all other scales n=20

Figure 1: OPTIVISE ©, reconstructed images: both planes aligned to left DBS lead, red squares: contacts 0 to 3

Table 2
<table>
<thead>
<tr>
<th>Lead location</th>
<th>correlated to improvement of</th>
<th>correlation coefficient</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UPDRS-II</td>
<td>0.403</td>
<td>0.010*</td>
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<tr>
<td></td>
<td>UPDRS-III</td>
<td>0.360</td>
<td>0.027*</td>
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<tr>
<td></td>
<td>NMSS sleep</td>
<td>0.427</td>
<td>0.006**</td>
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<tr>
<td>Dorsal</td>
<td>UPDRS-II</td>
<td>0.407</td>
<td>0.009**</td>
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<tr>
<td></td>
<td>NMSS sleep</td>
<td>0.364</td>
<td>0.021*</td>
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<td>Posterior</td>
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<tr>
<td></td>
<td>NMSS cardiovascular</td>
<td>0.358</td>
<td>0.023*</td>
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<tr>
<td>Lateral</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<0.05, ** p<0.01

References
3. K.A. Nestor et al., Plos ONE 2014;10:1371

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