Nature Reviews Neurology | Published online 23 Jun 2017; doi:10.1038/nrneurol.2017.91

PARKINSON DISEASE

Deep brain stimulation — making the right connections

> Our results clearly show which brain areas a DBS electrode should or should not be connected to

A specific pattern of connectivity between the site of deep brain stimulation (DBS) and other brain areas is linked to a positive outcome in patients with Parkinson disease (PD), new research has shown. The study highlights the importance of precise DBS electrode placement.

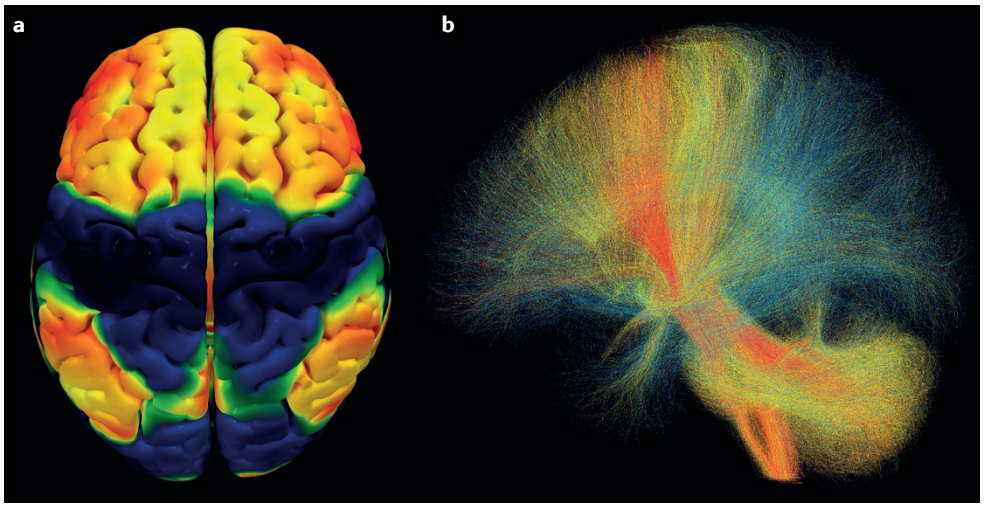
DBS in the subthalamic nucleus is an established treatment for motor dysfunction in patients with PD. Some effects of DBS might result from the activation of brain regions remote from the site of stimulation, and the identity of these regions depends on the precise location of the electrode. Whether certain patterns of connectivity between the DBS site and other brain areas are predictive of a good outcome was previously unknown.

Investigators led by Michael Fox and Andreas Horn precisely located DBS electrodes in 51 patients with PD. The researchers used publicly available data on the functional and structural connections in the human brain to determine which brain regions and networks would be stimulated by the electrodes, and whether certain connectivity patterns were associated with beneficial or detrimental effects on Unified PD Rating Scale (UPDRS) outcomes.

The analysis produced a map of brain areas for which connectivity was associated with clinical improvement; for example, structural connectivity to the supplementary motor area was linked to a positive outcome, whereas functional connectivity to the primary motor cortex correlated inversely with a beneficial result. The team tested this model in a separate cohort of 44 patients with PD, and found that connectivity at the DBS electrode location could predict individual patient UPDRS scores with an average error of 15%.

"Our results clearly show which brain areas a DBS electrode should or should not be connected to," explains Horn. The team now plan to improve the predictive accuracy of their model to enable its future use in the clinic. "The effective connectivity profiles could be used to guide a more patient-specific, custom-tailored DBS therapy," Horn concludes. "Connectivity data could be obtained for each patient before surgery and their 'wiring diagram' could then be used to guide the targeting procedure."

Charlotte Ridler



Functional connectivity between electrode locations and certain areas was correlated positively (hot colours) or negatively (cold colours) with beneficial outcomes (**a**). Fibre tracts were associated with either a beneficial outcome (red), a poor outcome (blue), or were neutral with regard to outcome (yellow) when connected to DBS stimulation sites (**b**). Image courtesy of A. Horn and M. Fox.

ORIGINAL ARTICLE Horn, A. *et al.* Connectivity predicts deep brain stimulation outcome in Parkinson's disease. *Ann. Neurol.* http://dx.doi.org/10.1002/ana.24974 (2017)