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Brain functional connectivity changes induced by neurosurgical thalamotomy for tremor in PD

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Introduction: Neurosurgical thalamotomy has proved highly effective for treating medication-resistant tremor related to Parkinson's disease (PD) targeting the thalamic ventral intermediate nucleus (Vim) involved in the dentate-ponto-cerebello-thalamo-cortical pathway.

Objective: To test whether resting-state functional connectivity (rs-FC) between Vim and the rest of the brain was modulated by thalamotomy, and whether such changes correlated with individual clinical outcomes.

Methods: An observational clinical and resting-state magnetic resonance imaging (rs-fMRI) in a single subject with tremor-dominant PD who underwent Gamma knife (GKRS) Vim thalamotomy was carried out. The patient was assessed by clinical, wearable motion sensors and rs-fMRI evaluation before treatment and at 3, 6 and 12 months after surgery. Ten age- and sex-matched controls were also enrolled. Targeted left Vim was selected as region of interest and a seed-based rs-fMRI connectivity analysis was performed in PD patient and controls at baseline and over time. 1-year trend of progression of brain network changes was evaluated in PD patient and compared to controls. Correlations among functional measures and both clinical and motion sensors data were tested.

Results: A 76-year-old right-handed woman with a 13-year history of PD was deemed to be a candidate for GKRS left Vim thalamotomy for treatment of refractory tremor in the dominant hand. Seed-based analysis showed a significantly increased FC between left Vim and left visual areas relative to controls before treatment. Over 1 year, PD patient showed a progressive decreased FC between left Vim and visual cortex, mainly after 6 months from GKRS. At 12 months after treatment, a normalization of aberrant pre-therapeutic FC between left Vim and visual areas was obtained. These FC changes over the follow-up were positively related to progressive tremor improvement over time.

Conclusions: Our findings converged towards parts of the extrastriate visual system as being involved in tremor generation and further arrest after thalamotomy.