## **VIM targeting**

The ventral intermediate nucleus of the thalamus is not readily visible on structural magnetic

resonance imaging. Therefore, a method for its visualization for stereotactic targeting is desirable.

The objective of a study of Sammartino et al., from the Toronto Western Hospital was to define a tractography-based methodology for the stereotactic targeting of the ventral intermediate nucleus.

The lateral and posterior borders of the ventral intermediate nucleus were defined by tracking the pyramidal tract and medial lemniscus, respectively. A thalamic seed was then created 3 mm medial and anterior to these borders, and its structural connections were analyzed. The application of this method was assessed in an imaging cohort of 14 tremor patients and 15 healthy controls, in which they compared the tractography-based targeting to conventional targeting. In a separate surgical cohort (3 tremor and 3 tremor-dominant Parkinson's disease patients), they analyzed the accuracy of this method by correlating it with intraoperative neurophysiology.

Tractography of the thalamic seed revealed the tracts corresponding to cerebellar input and motor cortical output fibers. The tractography-based target was more lateral (12.5 [1.2] mm vs 11.5 mm for conventional targeting) and anterior (8.5 [1.1] mm vs 6.7 [0.3] mm, anterior to the posterior commissure). In the surgical cohort, the Euclidean distance between the ventral intermediate nucleus identified by tractography and the surgical target was 1.6 [1.1] mm. The locations of the sensory thalamus, lemniscus, and pyramidal tracts were concordant within <1 mm between tractography and neurophysiology.

The tractography-based methodology for identification of the ventral intermediate nucleus is accurate and useful. This method may be used to improve stereotactic targeting in functional neurosurgery procedures <sup>1)</sup>.

Krishna et al., from the Center for Neuromodulation, The Ohio State University Wexner Medical Center, prospectively assessed the outcomes of Focused ultrasound thalamotomy (FUS-T) in 10 essential tremor (ET) patients using tractography-based targeting of the ventral intermediate nucleus



## (VIM).

VIM was identified at the intercommissural plane based on its neighboring tracts: the pyramidal tract and medial lemniscus. FUS-T was performed at the center of tractography-defined VIM. Tremor outcomes, at baseline and 3 months, were assessed independently by the Tremor Research Group. They analyzed targeting coordinates, clinical outcomes, and adverse events. The FUS-T lesion location was analyzed in relation to unbiased thalamic parcellation using probabilistic tractography. Quantitative diffusion weighted imaging changes were also studied in fiber tracts of interest.

The tractography coordinates were more anterior than the standard. Intraoperatively, therapeutic sonications at the tractography target improved tremor (>50% improvement) without motor or sensory side effects. Sustained improvement in tremor was observed at 3 mo (tremor score:  $18.3 \pm 6.9 \text{ vs } 8.1 \pm 4.4$ , P = .001). No motor weakness and sensory deficits after FUS-T were observed during 6-mo follow-up. Ataxia was observed in 3 patients. FUS-T lesions overlapped with the VIM parcellated with probablisitic tractography. Significant microstructural changes were observed in the white matter connecting VIM with cerebellum and motor cortex.

This is the first report of prospective VIM targeting with tractography for FUS-T. These results suggest that tractography-guided targeting is safe and has satisfactory short-term clinical outcomes <sup>2)</sup>.

## **Clinical trials**

Optimization of VIM Targeting in Essential Tremor Surgery (Opti-VIM) https://clinicaltrials.gov/ct2/show/NCT03760406

## References

1)

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