Improving the Vim Targeting with DTI-based Tractography in DBS for Essential Tremor

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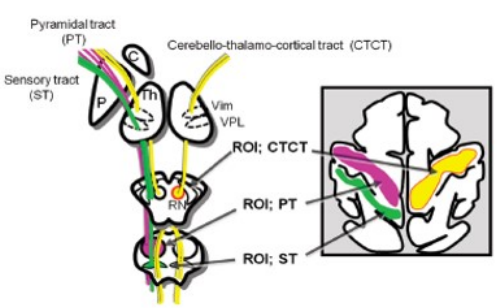
Introduction

The ventralis intermedius nuclei (Vim) of the thalamus is the target of choice for Deep Brain Stimulation (DBS) for essential tremor (ET). Localization of the Vim for electrode placement relies mainly on atlas-based stereotactic coordinates as direct MR imaging visualization is difficult. Tractography obtained through DTI data has been successful in thalamus segmentation based on its connectivity to regions of the cerebral cortex. The Vim is the thalamic relay of the cerebellothalamocortical (CTC) tract, sending projections to the motor cortex. The Vim is bounded laterally by the pyramidal tract (PT), medially by the internal medullary lamina, and posteriorly by the ventroposterolateral (VPL) nuclei. The VPL tract relays nociceptive stimuli from the spinothalamic tract to the primary sensory cortex.

Segmentation of the Thalamic nuclei

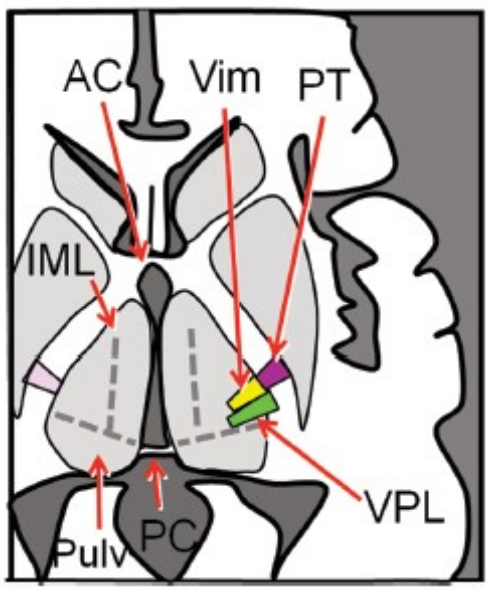


from Yamada K et al MR imaging of Ventral Thalamic Nuclei, AJNR 2010

Methods

Two patients (1F/1M) aged respectively 40 and 29 y, were treated by DBS for severe ET. Preoperative MR imaging was implemented with DTI as reported by Yamada et al. in 2010, allowing the identification of the PT, spinothalamic and CTC tracts. Intraoperative microelectrode recording (MER) and stimulation was obtained before the stereotactic implantation of electrodes.

Localisation of the Vim based on identification of the Pyramidal (purple) and Spinothalamic tracts (green)



from Yamada K et al. MR imaging of Ventral Thalamic Nuclei, AJNR 2010

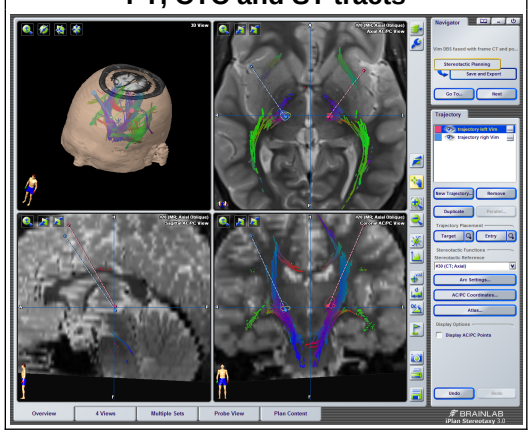
Results

Tractography data correlated significantly with the MER findings. Both patients presented an intraoperative resolution of tremor. They received bilateral Medtronic 3387 lead implantation with an Activa PC IPG. Once the microlesion effect resolved, stimulation parameters were adjusted allowing a dramatic control on tremor at low intensities.

DTI-based identification of the Pyramidal Tract

Pyramidal tract (purple) bounding lateraly the Vim on T2 MRI

DTI-based tractography identifying the PT, CTC and ST tracts



Conclusions

DTI usefully implemented the targeting of Vim in DBS for ET, allowing a precise electrode positioning with excellent clinical response.

Learning Objectives

exploring thalamus nuclei imaging, applying tractography in DBS targeting

References

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Postoperative lead position coregisrtation