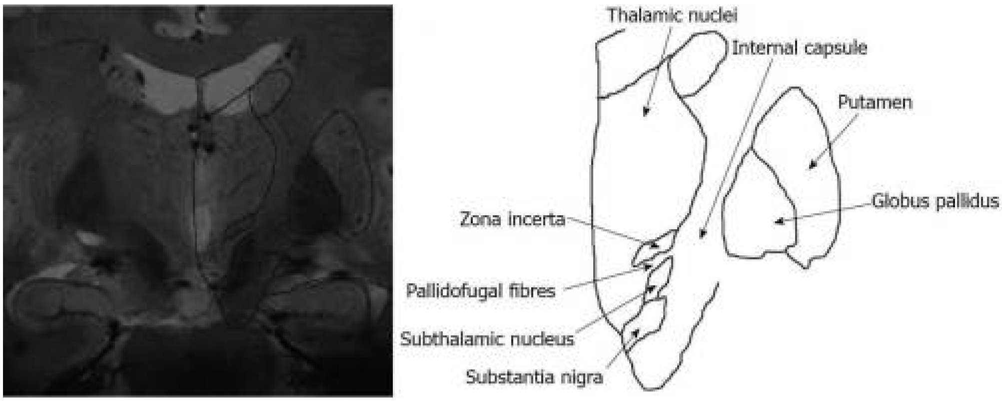
Zona incerta stimulation



Surgical targets for Tourette's syndrome have included the frontal lobes, the cingulate gyrus, the anterior limb of the internal capsule (ALIC), the limbic system, and the subthalamic zona incerta. [1] Current targets of interest for DBS include: GPi, STN, ALIC, and thalamus. Early results have been promising. [2].

Posterior subthalamic deep brain stimulation (DBS) targeting the zona incerta (ZI) is an emerging treatment for tremor syndromes, including Parkinson's disease (PD) and essential tremor (ET).

Evidence from animal studies has indicated that the ZI may play a role in saccadic eye movements via pathways between the ZI and superior colliculus (incerto collicular pathways).

Optics can be used for guidance in deep brain stimulation (DBS) surgery. The aim of Zsigmond and Wårdell was to use laser Doppler flowmetry (LDF) to investigate the intraoperative optical trajectory along the ventral intermediate nucleus (VIM) and zona incerta (Zi) regions in patients with essential tremor during asleep DBS surgery, and whether the Zi region could be identified.

A forward-looking LDF guide was used for the creation of the trajectory for the DBS lead, and the microcirculation and tissue greyness, i.e., total light intensity (TLI) was measured along 13 trajectories. TLI trajectories and the number of high-perfusion spots were investigated at 0.5-mm resolution in the last 25 mm from the targets.

All implantations were done without complications and with significant improvement of tremor ($p < 0.01$). Out of 798 measurements, 12 tissue spots showed high blood flow. The blood flow was significantly higher in VIM than in Zi ($p < 0.001$). The normalized mean TLI curve showed a significant ($p < 0.001$) lower TLI in the VIM region than in the Zi region.

Zi DBS performed asleep appears to be safe and effective. LDF monitoring provides direct in vivo measurement of the microvascular blood flow in front of the probe, which can help reduce the risk of hemorrhage. LDF can differentiate between the grey matter in the thalamus and the transmission border entering the posterior subthalamic area where the tissue consists of more white matter tracts [3].

Sixteen patients (12 with PD and 4 with ET) underwent DBS using the MRI-directed implantable guide tube technique. Active electrode positions were confirmed at the caudal ZI. Eye movements were tested using direct current electrooculography (EOG) in the medicated state pre- and postoperatively on a horizontal predictive task subtending 30°. Postoperative assessments consisted of stimulation-off, constituting a microlesion (ML) condition, and high-frequency stimulation (HFS; frequency = 130 Hz) up to 3 V.

With PSA HFS, the first saccade amplitude was significantly reduced by 10.4% (95% CI 8.68%-12.2%) and 12.6% (95% CI 10.0%-15.9%) in the PD and ET groups, respectively. With HFS, peak velocity was reduced by 14.7% (95% CI 11.7%-17.6%) in the PD group and 27.7% (95% CI 23.7%-31.7%) in the ET group. HFS led to PD patients performing 21% (95% CI 16%-26%) and ET patients 31% (95% CI 19%-38%) more saccadic steps to reach the target.

PSA DBS in patients with PD and ET leads to hypometric, slowed saccades with an increase in the number of steps taken to reach the target. These effects contrast with the saccadometric findings observed with subthalamic nucleus DBS. Given the location of the active contacts, incerto-collicular pathways are likely responsible. Whether the acute finding of saccadic impairment persists with chronic PSA stimulation is unknown [4].

References

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