Automatic Segmentation of the STN for DBS

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Products

Elements Object Manipulation, Elements Segmentation Basal Ganglia, Elements Stereotaxy

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Clinical Background

For effective deep brain stimulation (DBS) of the subthalamic nucleus (STN) in Parkinson's disease, it is crucial that the leads are implanted in the ideal target position. Intraoperative microelectrode recording (MER) has long been considered the gold standard to achieve this. However, modern imaging technology enables a patient-specific 3D visualization of the STN via advanced MRI-based automatic segmentation algorithms (Elements Segmentation Basal Ganglia). This can facilitate preoperative planning, provide support during surgery and aid image-guided programming, which is especially beneficial for directional DBS systems.

Study Objective

The aim of the study was to investigate the feasibility of automatic STN segmentation with Brainlab Elements Segmentation Basal Ganglia for patient-specific planning and visualization in DBS. For this purpose, its concordance with intraoperative MERs was evaluated.
N = 30 patients, 175 MER trajectories, retrospective study

Results

- **105 of 175 trajectories penetrated the STN directly or touched it** (≤ 0.7 mm, half of the DBS electrode diameter)
- **Median deviation** between the segmented STN boundary and electrophysiological recordings was 1.1 mm (IQR 0.6-1.9 mm) for the STN entry and 2.0 mm for the STN exit (IQR 1.35-3.0 mm)
- For the **entry point** of the STN, the automatic segmentation and intraoperative MERs showed **high concordance** (no significant difference)
- The **exit point** was **significantly different** in both methods in central and lateral trajectories

Summary

- **Preoperatively**, Elements Segmentation Basal Ganglia provides MRI-based automatic, patient-specific segmentation and 3D visualization of the STN in high concordance with gold standard MER. Alongside traditional targeting methods it can thus improve surgical planning in DBS
- **Intraoperatively**, the visualization of the DBS target structure as well as the trajectory can aid 3D perception and understanding
- **Postoperatively**, it can support the optimization of DBS programming by visualizing the implanted lead in relationship to its anatomical surroundings in 3D and thus facilitating the understanding of stimulation effects and side effects

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