Accurate interindividual comparability of deep brain stimulation (DBS) lead locations in relation to the surrounding anatomical structures is of eminent importance to define and understand effective stimulation areas.

The objective of a work of Nowacki et al. from the Department of Neurosurgery, Department of Neurology, Department of diagnostic and interventional Neuroradiology, Inselspital, University Hospital Bern, Switzerland, Medical Research Council Brain Network Dynamics Unit and Nuffield Department of Clinical Neurosciences, University of Oxford, United Kingdom, was to compare the accuracy of the DBS lead localisation relative to the STN in native space with four recently developed three-dimensional subcortical brain atlases in the MNI template space. Accuracy is reviewed by anatomical and volumetric analysis as well as intraoperative electrophysiological data.

Postoperative lead localisations of 10 patients (19 hemispheres) were analysed in each individual patient based on Brainlab software (native space) and after normalization into the MNI space and application of 4 different human brain atlases using Lead-DBS toolbox within Matlab (template space). Each patient's STN was manually segmented and the relation between the reconstructed lead and the STN was compared to the 4 atlas-based STN models by applying the Dice coefficient. The length of intraoperative electrophysiological STN activity along different microelectrode recording tracks was measured and compared to reconstructions in native and template space. Descriptive non-parametric statistical tests were used to calculate differences between the 4 different atlases.

The mean STN volume of the study cohort was 153.3 ± 40.3 mm3 (n = 19). This is similar to the STN volume of the DISTAL atlas (166 mm3; p = .22), but significantly larger compared to the other atlases tested in this study. The anatomical overlap of the lead-STN-reconstruction was highest for the DISTAL atlas (0.56 ± 0.18) and lowest for the PD25 atlas (0.34 ± 0.17). A total number of 47 MER trajectories through the STN were analysed. There was a statistically significant discrepancy of the electrophysiogical STN activity compared to the reconstructed STN of all four atlases ($p < .0001$).

Lead reconstruction after normalization into the MNI template space and application of four different atlases led to different results in terms of the DBS lead position relative to the STN. Based on electrophysiological and imaging data, the DISTAL atlas led to the most accurate display of the reconstructed DBS lead relative to the DISTAL-based STN [1)].

1)

Nowacki A, Nguyen TA, Tinkhauser G, Petermann K, Debove I, Wiest R, Pollo C. Accuracy of different three-dimensional subcortical human brain atlases for DBS -lead localisation. Neuroimage Clin. 2018 Sep 27;20:868-874. doi: 10.1016/j.nicl.2018.09.030. [Epub ahead of print] PubMed PMID: 30282063.