Diffusion Tensor Imaging Tractography for Deep brain stimulation

DTI scanning is safe and delineation of white matter pathway is feasible for PD patients implanted with the DBS device. Postoperative DTI is a useful technique to strengthen our current understanding of the therapeutic effect of DBS for PD and has the potential to refine target selection strategies for brain stimulation [1].

Tractography has been used to assist with neurosurgical targeting in functional neurosurgery. Rodrigues et al. review provides an overview of DTI principles and discusses current applications of tractography for improving and helping develop novel deep brain stimulation (DBS) targets [2].

Davidson et al. reviewed translational considerations and how DTI and tractography have been used to improve targeting during DBS surgery for depression, obsessive compulsive disorder (OCD) and post-traumatic stress disorder (PTSD) [3].

Diffusion Tensor Imaging Tractography lacks standardization and rigorous anatomic validation, raising significant concern for the use of such data in stereotactic brain surgery. This review covers the technical details, proposed methods, and initial clinical data for the use of DT in DBS surgery. Rather than focusing on specific disease applications, this review focuses on methods that can be applied to virtually any DBS target.

In 2014 a review of the literature on the use of tractography in DBS surgery and provide an overview of the main results.

Tractography has been used in the field of DBS to help clarify relevant aspects in the selection of targets and in evaluating its therapeutic effects in movement disorders, psychiatric diseases and pain.

Studies are scarce so far, but they have provided data that, if confirmed, may optimize DBS surgery. Tractography might become a routine tool for DBS surgery in the near future [4].

1)
Li Y, He N, Zhang C, Liu Y, Li J, Sun B, Lai Y, Li H, Wang C, Haacke EM, Yan F, Li D. Mapping Motor Pathways in Parkinson's Disease Patients with Subthalamic Deep Brain Stimulator: A Diffusion MRI Tractography Study. Neurol Ther. 2022 Feb 14. doi: 10.1007/s40120-022-00331-1. Epub ahead of print. PMID: 35165822.
2)
Rodrigues NB, Mithani K, Meng Y, Lipsman N, Hamani C. The Emerging Role of Tractography in Deep Brain Stimulation: Basic Principles and Current Applications. Brain Sci. 2018 Jan 29;8(2):23. doi: 10.3390/brainsci8020023. PMID: 29382119; PMCID: PMC5836042.
3)

Davidson B, Lipsman N, Meng Y, Rabin JS, Giacobbe P, Hamani C. The Use of Tractography-Based Targeting in Deep Brain Stimulation for Psychiatric Indications. Front Hum Neurosci. 2020 Nov 16;14:588423. doi: 10.3389/fnhum.2020.588423. PMID: 33304258; PMCID: PMC7701283.
4)

Torres CV, Manzanares R, Sola RG. Integrating Diffusion Tensor Imaging-Based Tractography into Deep Brain Stimulation Surgery: A Review of the Literature. Stereotact Funct Neurosurg. 2014 Sep 18;92(5):282-290. [Epub ahead of print] PubMed PMID: 25248076.