Automated Deep Brain Stimulation Programming in Parkinson's Disease using Neurophysiology and Artificial Intelligence.

Venkat Srikar Lavu[1], Jackson Cagle[1], Tiberio C de Araujo[1], Kara A. Johnson[1,2], Coralie de Hemptinne[*1], Joshua K. Wong[*1]

[1] Norman Fixel Institute for Neurological Diseases, Department of Neurology, University of Florida, Gainesville, FL, USA;[2] Department of Neurosurgery, University of Florida, Gainesville, FL, USA
[*]Co-senior authors

Abstract Deep brain stimulation (DBS) is an effective therapy for medication-resistant Parkinson's disease (PD), but individual patient outcomes can vary significantly. Currently, optimization of stimulation parameters is a manual and time-consuming process based on subjective assessments that can take weeks to months. Recent advancements in DBS technology permit recording of neural physiology in the form of local field potentials (LFPs). However, whether LFP can be used to predict optimal stimulation parameters is still unknown. Here we sought to develop a machine learning (ML) algorithm capable of predicting the optimal DBS contact based on neurophysiology. We conducted a retrospective study with data collected from PD patients implanted with DBS leads in either the subthalamic nucleus (STN) or the globus pallidus internus (GPi) with the LFP recordings from 3 bipolar contacts between 1 week to 3 months after the device implant. Stimulation parameters determined after at least 6 months of standard of care DBS programming were used as the optimal settings. The power spectral density (PSD) was computed and used to construct various ML models predicting the optimized contact. Recordings from 84 brain hemispheres (86 GPi, 12 STN) from 72 patients were included in the analysis. Our ML model achieved a balanced accuracy of 90%. The findings indicate that LFP can be used to guide the selection of therapeutic DBS contacts. This lays the groundwork for developing an automated algorithm that can substantially reduce the clinical workload and duration of DBS programming.

Presenter name and contact information:
Joshua Wong, MD
Assistant Professor of Neurology
Norman Fixel Institute for Neurological Diseases
University of Florida
Email: Joshua.wong@neurology.ufl.edu