Analysis of Globus Pallidus Internus Local Field Potentials in Dystonia Patients post Deep Brain Station Implantation

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Abstract

Introduction: Deep brain stimulation (DBS) of the globus pallidus internus (GPi) is an established treatment for medically intractable dystonia. Dystonia clinical presentation is heterogenous and response to DBS is variable. DBS devices capable of recording local field potentials (LFPs) have recently become available for clinical use. Closed loop adaptive DBS (aDBS) has been used for Parkinsons's disease by using beta peaks as a biomarker to alter stimulation in real-time to best suit the patient. Reliable biomarkers to use in aDBS algorithms for dystonia are yet to be established. We report findings from the use of a DBS system capable of recording LFPs in a single centre with the aim of identifying potential biomarkers that could be used in the optimal programming of DBS systems and potential use of aDBS in dystonia.
Method: Clinical data and GPi LFPs were recorded from 3 patients with cervical dystonia implanted with Medtronic SenSight leads and Percept RC DBS systems from 10/01/24 to 26/07/24. GPi LFP data were collected using Medtronic BrainSense during the activation and programming visits. These data were exported and analysed in MATLAB to compute long term LFP timelines and power spectra, the latter with varying stimulation settings.
Results: Long-term recordings of LFPs evidenced increased LFP power over time even while stimulation is turned off. Power spectra while stimulation was turned off evidenced significant oscillatory activity in the theta and alpha range but also increased activity across the beta frequency band. There was no clear correlation between the lateralisation of dystonic symptoms and theta-alpha power in the ipsilateral or contralateral hemisphere. When stimulation was turned on or increased, temporary increases in LFP power in the theta-alpha band, followed by a sustained decrease were seen in 2 patients. These increases in LFP power were also mirrored in the contralateral hemisphere. Fluctuations in beta band activity were also seen when the stimulation current was changed in 1 patient.
Discussion: The effect of increased LFP power over time from the date of implantation while stimulation is turned off could be explained by the microlesion effect. Oscillatory activity in the theta-alpha band has been well documented previously and has been associated with dystonia severity. The role of pallidal beta oscillations in dystonia is contested but recent studies have suggested that there is a negative correlation between beta power in the GPi and dystonic severity and that the ratio of beta to alpha power correlates with potential benefit from DBS, and thus the presence of beta activity may present a useful biomarker for DBS and could potentially be used as a guide during implantation of DBS electrodes. The lack of correlation between interhemispheric differences in theta-alpha band power is likely a result of the small size of the sample. The effect of increased LFP power in the contralateral hemisphere to the one where stimulation was being increased provides some evidence for interhemispheric pallidal connections in dystonia which warrants further exploration.
Conclusions: Our findings suggest that beta power and LFP dynamics such as bursting should also be considered as potential biomarkers to be used in future aDBS algorithms in dystonia alongside theta-alpha power.

References

1. Tisch S. Deep brain stimulation in dystonia: factors contributing to variability in outcome in short and long term follow-up. Current Opinion in Neurology. 2022;35(4):510–7.
2. Ledingham D, Baker M, Pavese N. Local field potentials: Therapeutic implications for DBS in dystonia including adaptive DBS for dystonia. Deep Brain Stimulation. 2024;5:4–19.
3. Stanslaski, S., Summers, R.L.S., Tonder, L. et al. Sensing data and methodology from the Adaptive DBS Algorithm for Personalized Therapy in Parkinson's Disease

(ADAPT-PD) clinical trial. npj Parkinsons Dis. 2024.10, 174.
4. Fischer P, Piña-Fuentes D, Kassavetis P, Sadnicka A. Physiology of dystonia: Human studies. International Review of Neurobiology. 2024;18;169:137–62.
5. Zhang R, Nie Y, Dai W, Wang S, Geng X. Balance between pallidal neural oscillations correlated with dystonic activity and severity. Neurobiology of disease. 2023;183:106178–8.
6. Geng X, Quan Z, Zhang R, Zhu G, Nie Y, Wang S, et al. Subthalamic and pallidal oscillations and their couplings reflect dystonia severity and improvements by deep brain stimulation. Neurobiology of Disease. 2024;199:106581.

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