Evaluating Beta-Sensing for the Optimization of Deep Brain Stimulation in Parkinson's Disease

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Introduction: Deep brain stimulation (DBS) is a well-established treatment for advanced stage Parkinson's disease (PD). Different approaches have been proposed to optimize stimulation parameters, including clinical monopolar review, 3D-radiological reconstructions and beta-sensing. Notably, the reduction of beta activity through DBS has been associated with improvements in motor symptoms such as bradykinesia and rigidity.

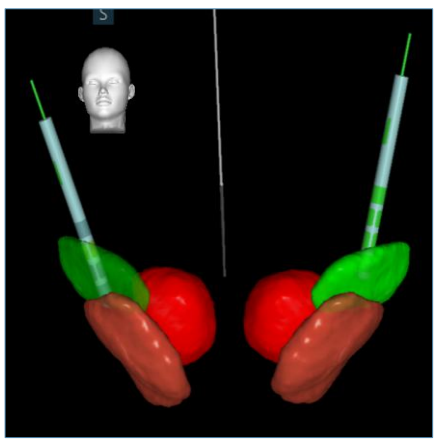
Objective: We aim to compare beta-sensing with clinical and 3D-radiological approaches to optimize DBS stimulation parameters in PD patients.

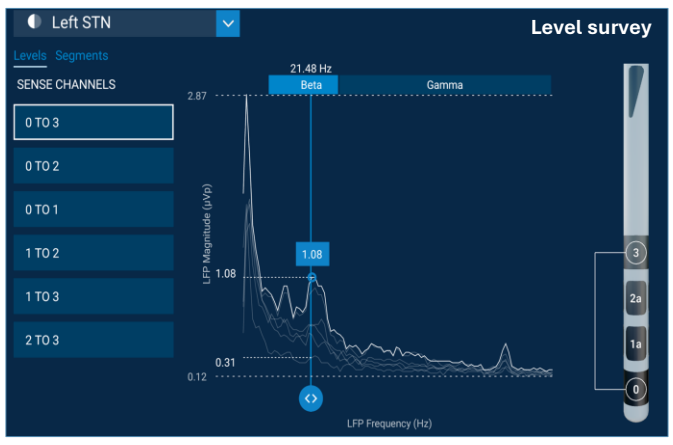
Methods: We included DBS-PD patients with beta-band sensing devices. Baseline motor performances were evaluated using MDS-UPDRS part III in OFF-stimulation/OFF-medication state, the latest defined as a withdrawal of dopaminergic medications of at least 12 hours. Non-motor symptoms, motor fluctuations and quality of life were also assessed, using MDS-UPDRS part I, II and IV, and Parkinson's disease Questionnaire (PDQ-39). First, DBS was activated using parameters pre-established through clinical monopolar review and 3D-radiological reconstructions. Three hours later, patients were clinically examined using MDS-UPDRS-III in an OFF-med state, and new parameters were set based on beta-sensing. At follow-up visits, we reassessed the patients and examined beta-band sensing recording. Levodopa equivalent daily dose (LEDD) and Total Electrical Energy Delivered (TEED) were calculated at every timepoint. Statistical analysis was performed using methods of descriptive statistics.

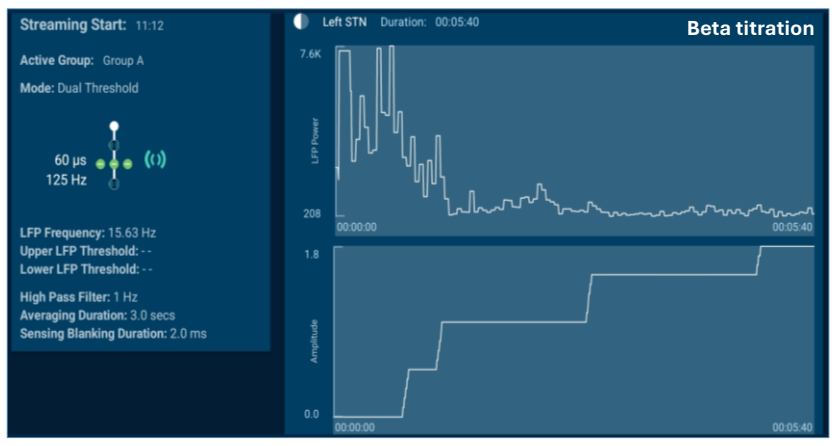
Baseline Cohort

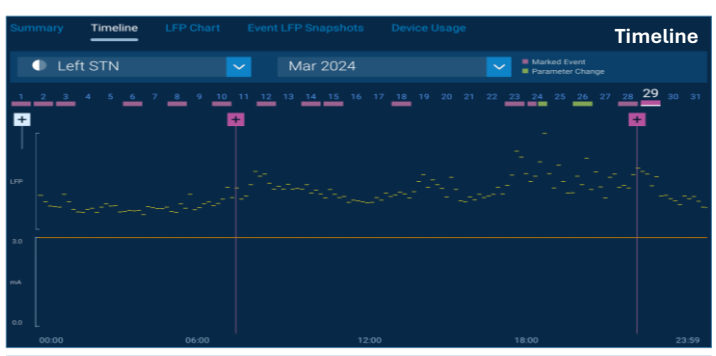
mean (SD)

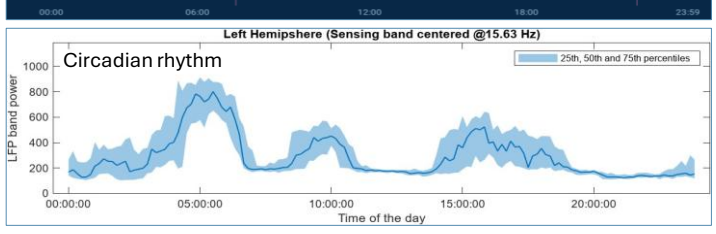
N. Pts	M/F	STN/GPi	Age at onset	Age at DBS	Age at baseline	LEDD (mg/die)
9	6/3	8/1	53.8 (5.2)	63.7 (4.0)	64.7 (3.4)	806.3 (266.5)
UPDRS I	**UPDRS II**	**UPDRS III OFF/OFF**	**UPDRS III ON/OFF**	**UPDRS IV**	**PDQ-39**	**Parameters change (yes/no)**
8.0 (4.8)	8.4 (5.0)	36.0 (6.9)	23.6 (5.1)	4.4 (3.5)	31.4 (26.7)	7/2

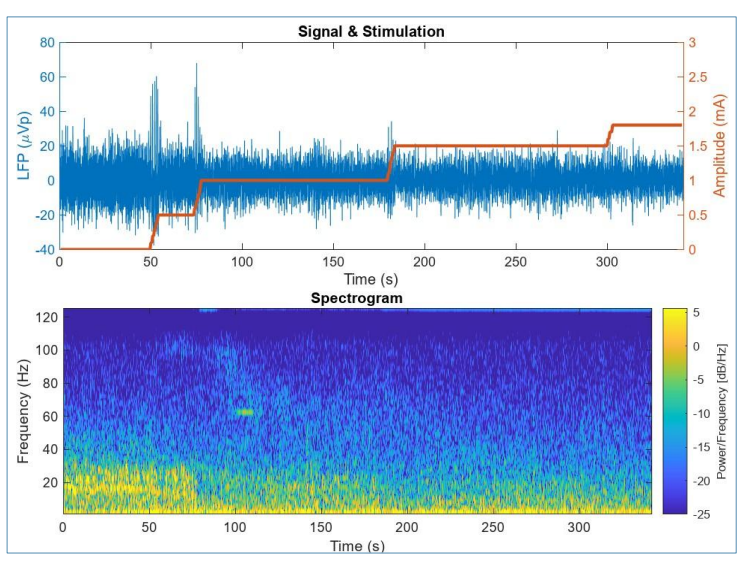


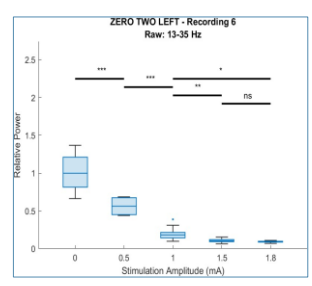


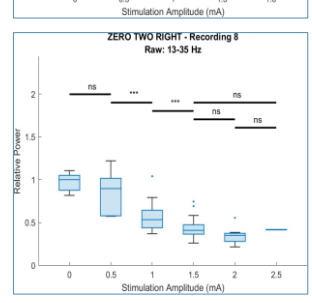




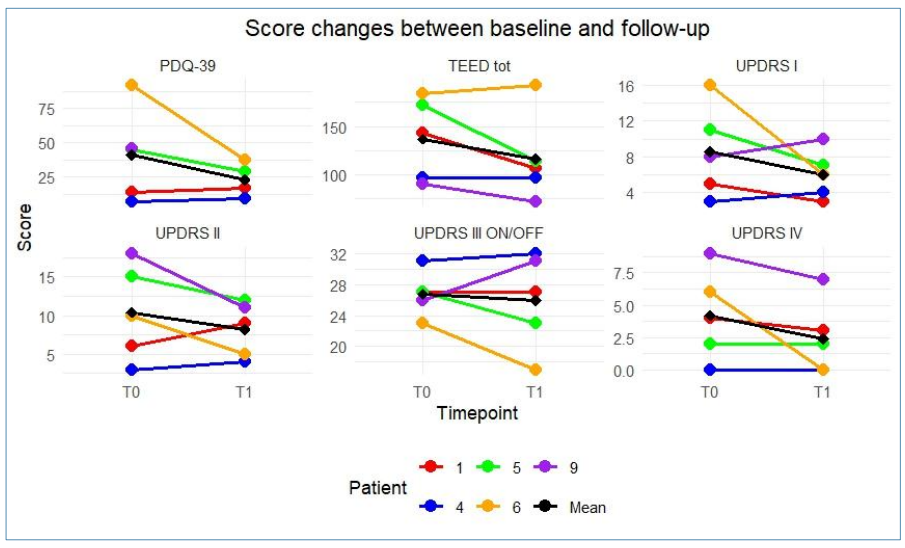








Results



Scores of Patients 1, 4, 5, 6 and 9

	Mean		Difference T0-T1	Difference %
	Baseline (T0)	Follow-up (T1)		
UPDRS I	8.6	6.0	-2.6	-30.2%
UPDRS II	10.4	8.2	-2.2	-21.2%
UPDRS III ON/OFF	26.8	26.0	-0.8	-3,0%
UPDRS IV	4.2	2.4	-1.8	-43.0%
PDQ-39	33.6	23.0	-10.6	-31.5%
TEED tot (µW)	137.0	116.1	**-20.9**	**-15.3%**

Conclusions

Our findings indicate that beta-sensing–based programming offers clinical benefits that are at least comparable to, if not greater than, those of clinical monopolar review and 3D radiological reconstructions for short-term DBS optimization. This comparable effectiveness is achieved while requiring less energy than classical approaches. Consequently, the risk of stimulation-related side effects may be reduced. Further data are needed to establish the long-term efficacy of the beta-sensing approach. To this end, long-term follow-up data from a larger cohort of patients are currently being collected.

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