# PAPER OF THE MONTH 07/2023

TRR 295 ReTune

# Machine versus physician-based programming of deep brain stimulation in isolated dystonia: A feasibility study.

Lange F, Soares C, Roothans J, Raimundo R, Eldebakey H, Weigl B, Peach R, Daniels C, Musacchio T, Volkmann J, Rosas MJ, Reich MM.
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Deep brain stimulation of the internal globus pallidus effectively alleviates dystonia motor symptoms. However, delayed symptom control and a lack of therapeutic biomarkers and a single pallidal sweetspot region complicates optimal programming. Postoperative management is complex, typically requiring multiple, lengthy follow-ups with an experienced physician – an important barrier to widespread adoption in medication-refractory dystonia patients.

Previously, we reconstructed an anatomical map of motor improvement probability across the pallidal region using individual stimulation volumes and clinical outcomes in dystonia patients. We used this to develop an algorithm that tests in silico thousands of putative stimulation settings in de novo patients after reconstructing an individual, image-based anatomical model of electrode positions, and suggests stimulation parameters with the highest likelihood of optimal symptom control. Interestingly, the C-SURF algorithm changed the active contact in 13 of 20 leads when compared to best clinical programming. Long-term motor outcomes showed better symptom control with C-SURF programs compared with clinical programming, with a dystonia symptom reduction of 74.9 ± 15.3% vs. 66.3 ± 16.3% measured in BFMDRS or TWSTRS (Wilcoxon signed-rank test: $P < 0.012$), with an effect size of 1.2 (Cohen's d). In the corresponding Bayesian statistical analysis, a Bayes factor (BF) of >22.1 indicated that the data were approximately 22 times more likely to occur under the assumption of better motor control with C-SURF (error percentage <0.0001%). A posterior distribution of δ 1.37 showed the effect size, with a central 95% credible interval (δ range 0.276–2.913).

Despite the small cohort, the dystonia motor score improvement suggests machine-based programming is superior to programming in best long-term clinical care. Improved symptom control was not offset by increased stimulation energy or changes in stimulation-related adverse effects.

Our findings highlight the clinical potential of machine-based programming in dystonia, which could markedly reduce the programming burden in postoperative management.

**Dr. Florian Lange**

Florian Lange is a neurologist at the Julius-Maximilians-University Hospital Wuerzburg and advanced clinician scientist in the visualDBSlab. His primary research focus is the direct implementation of state-of-the-art imaging or electrophysiological methods into the daily patient care of patients with DBS. He has already demonstrated the clinical applicability of sweet spot programming, LPF-based DBS parameter selection, and now fully AI-based programming of DBS in studies with long-term follow-up.

**Dr. Martin Reich**

Martin Reich is a Senior Attending Neurologist and group leader at the Julius-Maximilians-University Hospital Wuerzburg. His laboratory, visualDBS-lab, tackles clinical questions related to deep brain stimulation and the pathophysiology of movement disorders through computer visualisation, modelling and imaging with a multidisciplinary neuroscience team. He was awarded the David Marsden Award in 2021.

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