Connectomic DBS informed multifocal transcranial direct current stimulation (tDCS) in Parkinson’s Disease: a crossover double-blinded study

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INTRODUCTION

• Deep brain stimulation (DBS) is an effective treatment option in Parkinson's Disease (PD)
• Recent imaging studies have identified specific brain networks associated with clinical improvement during DBS in PD using connectomic analysis approaches

STUDY DESIGN & METHODS

• A double-blind prospective, cross over trial was designed and preregistered in the German Clinical Trial Register (DRKS00026640). Power analysis revealed that at least N=21 patients have to be included with an underlying power of 70%.

RESULTS

• N=23 patients were included in this study
• Mean age 59.9 years, mean H&Y in off-medication 2.4
• No adverse events were observed during this study

Figure 3. Results.

A: ANOVA results. Baseline UPDRS-III were comparable: stimulation days: 37.38 ± 12.5 points; sham days: 36.95 ± 13.9 points. Following stimulation, scores reduced to 33.76 ± 11.19 points (improvement of 3.62 ± 5.29 points; 9.68 %), while after sham to 36.43 ± 14.15 points (improvement of 0.52 ± 6.11 points; 1.4 %).
ANOVA confirmed significance for main effect contrasting before and after stimulation (F(1,20) = 4.35, p < 0.05) and for the interaction between stimulation and sham condition (F(1,20) = 4.21, p < 0.05).
Tukey post-hoc analysis revealed that UPDRS-III scores improved after stimulation (t=2.9, p < 0.03) but not after sham (t=0.42, p > 0.05).
ANOVA confirmed significance for main effect contrasting before and after stimulation (F(1,20) = 4.35, p < 0.05) and for the interaction between stimulation and sham condition (F(1,20) = 4.21, p < 0.05).

B: Pairwise comparison of UPDRS-III baseline and post-intervention.

C: UPDRS-III improvements on sham-days and stimulation-days. After stimulation, improvements were higher (t=1.76, p = 0.043).

CONCLUSIONS

• Multifocal tDCS under the maximum applicable sum of 4 mA, distributed across the cortex, appears to be a safe method with no reports of adverse events in the current study
• Non-invasive stimulation of a pre-identified PD response network led to a significant improvement in motor symptoms in PD as measured by the UPDRS-III

• This study serves as a proof of principle, demonstrating the possibility of targeting a brain network non-invasively that has been identified through invasive brain stimulation
• The degree of response between multifocal DBS and targeting the same network may be correlated, potentially motivating for the use of multifocal tDCS as a screening tool before undergoing DBS surgery