

The Effects Of Deep Brain Stimulation On Stuttering In Parkinson's Disease

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Background

Parkinson's Disease (PD)¹

- A neurodegenerative disease (ND) with dopaminergic neurodegeneration and disruptions to the basal ganglia
- PD is characterized by tremor, bradykinesia, and rigidity
- 90% of patients have hypokinetic dysarthria

Acquired Neurogenic Stuttering (ANS)²

- Often occurs in adulthood
- Mostly occurs due to stroke, TBI, & ND's
- Characterized by repetitions, prolongations, and blocks
- The basal ganglia systems and their interaction with the frontal cortex play a crucial role in the onset of ANS
- ANS may occur as a new symptom or may be a worsening or reoccurrence of pre-existing developmental stuttering

ANS and PD^{2,3}

- PD is the most common ND associated with ANS
- Preliminary data show that the prevalence ranges from 4-57%
- The occurrence and severity of stuttering in PD may be affected by the dosage of L-Dopa
- Studies suggest that choral reading reduces stuttering, while monologue speech & solo reading increases stuttering in PD
- Some studies suggest there may be differences in the characteristics of stuttering between ANS in PD and developmental stuttering (i.e., less frequent in ANS)



Deep Brain Stimulation (DBS)

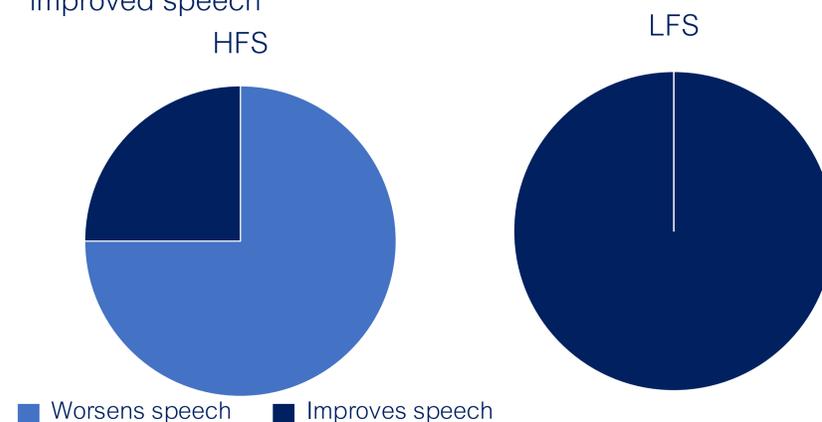
- A common procedure in PD in which electrodes are inserted into the subthalamic nucleus (STN) or globus pallidus internus (GPi) and are stimulated via a pulse generator under the skin

Purpose

- DBS is often used to reduce gross motor symptoms
- It may lead to speech worsening or improving
- The effect of DBS on ANS are still unclear, but are important to consider for quality of life in PD patients

Stimulation Frequency

- Low frequency stimulation (LFS) tends to reduce general speech difficulties
- High frequency stimulation (HFS) tends to worsen general speech difficulties
- The effects on stuttering parallel those for other speech problems
- Out of 16 studies, 12 concluded that HFS worsened speech, while 4 studies claimed speech was not impacted or improved
- All 3 studies comparing LFS and HFS concluded that LFS improved speech



- Sometimes the improvement of one symptom is accompanied with the decline in another. For example, stuttering may improve from DBS, while dystonia worsens⁴

Programming⁵

- Individualized and novel programming of DBS can be optimized using short-pulse width, directional stimulation, or both
- Best direction stimulation at 30 and 60 μ s led to improvements in dysarthria, dyskinesia, and pyramidal side effects that were maintained at 6-months
- The effect of various programming and techniques of stimulation on stuttering is not yet known

Anatomy

Unilateral vs Bilateral Stimulation

- DBS electrodes can be implanted unilateral or bilaterally
- Most studies examining the impact of DBS on speech and stuttering in PD have electrodes implanted bilaterally
- There are no large-scale studies directly comparing the two
- Randomized cohort data suggest that either approach is effective for motor dysfunction but differ in terms of mood and cognitive side effects⁶
- Whether unilateral or bilateral stimulation has an impact on speech, and specifically stuttering, in PD is currently unknown

Location

- For LFS, a study by Rusz et al. (2018) suggests that laterally located contacts in the GPi *reduces* hypokinetic dysarthria and disfluencies
- For HFS, several specific locations were associated with *increased* speech difficulties
 - Dorsally located contacts in the STN⁸
 - Bilateral contacts in the GPi⁹
 - Medially located contacts in the STN¹⁰

Limitations and Conclusions

- Most studies don't have a clear definition or measurement of stuttering
- The term stuttering was often used interchangeably with the terms disfluencies and intelligibility
- Studies do not always precisely specify how they define HFS or LFS
- Many studies don't tease apart the effect of DBS with or without L-dopa
- While there is a trend for LFS to reduce disfluencies, this requires further investigation
- Further research is needed with a focus on long-term effects
- Insights into the effects of DBS is important for patient education and clinical decision making, as well as for quality of life

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