

# Effects of Reduced Deep Brain Stimulation Frequencies in Parkinson's Disease

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## Abstract

- Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is used in treating motor symptoms of Parkinson's disease (PD).
- High-frequency DBS (>120 Hz) is initially effective in improving patients' motor symptoms (mainly bradykinesia and tremors), but many still develop gait disturbances, such as freezing of gait (FOG).
- Studies report that stimulation of STN with low frequencies produce positive effects on gait disorders and reduces FOG events.
- The aim of this study was to investigate the effects that reduced DBS frequencies have on the severity of PD patients' symptoms.
- The effects were studied in 12 PD patients after reducing their DBS frequency.
- The varied DBS frequencies included: their clinically determined stimulation setting (CDS), a low stimulation setting (30 Hz), and an intermediate stimulation frequency (80 Hz).
- Overall, the results demonstrated that as DBS frequencies are decreased from the patients' clinically determined setting, the clinical symptoms worsened.
- This is an important observation which will allow the appropriate clinical decisions be made as we continue to investigate the effects of reduced frequency DBS on gait and balance control.

## Introduction

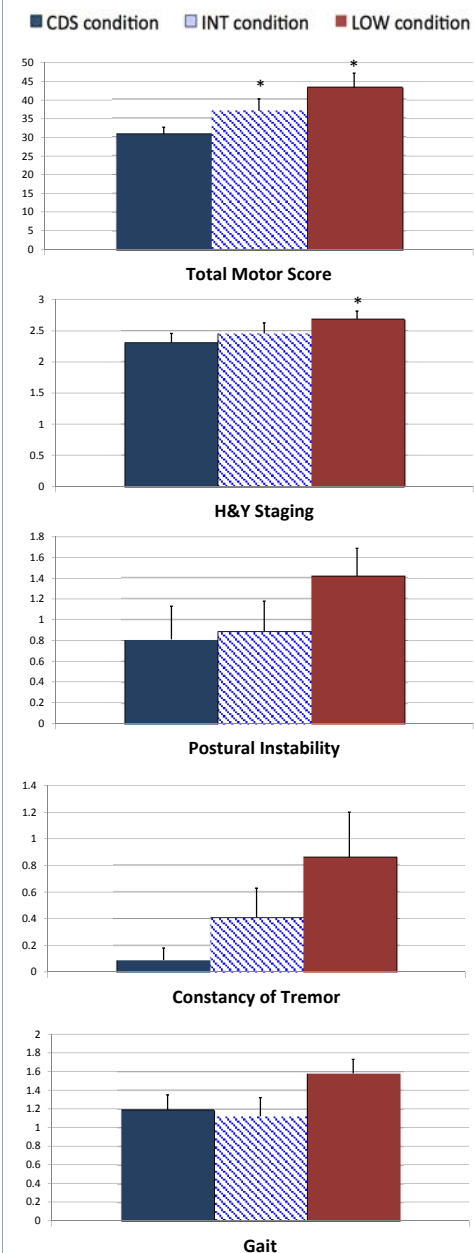
- Parkinson's Disease (PD) is a progressive disorder resulting from idiopathic loss of dopamine production in the substantia nigra.
- PD symptoms vary, however, the cardinal symptoms include: resting tremor, rigidity, bradykinesia, and postural instability.
- DBS of the STN improves motor symptoms (tremor, rigidity, bradykinesia), but many patients still develop gait disturbances & FOG.
- Low frequency DBS produces positive effects on gait disorders and reduces FOG events.
- As research investigates how reduced DBS frequencies will affect gait and balance control, it is important to understand what effects reduced DBS stimulation will have on the clinical severity of PD patients.

## Methods

- PD symptoms were evaluated in the following randomized and double blinded conditions:
  1. **CDS condition**—Med-off and DBS-on
  2. **INT condition**—Med-off and DBS-on intermediate frequency (80 Hz)
  3. **LOW condition**—Med-off and DBS-on reduced frequency (30 Hz)
- Evaluation at CDS condition was performed first, followed by randomization of LOW and INT conditions.
- 30 minute wait times were taken following each change to stimulation frequencies to allow the altered frequency to take effect.
- PD symptoms were evaluated in 12 patients using the UPDRS-III and the HY stage score.
- Subject population (n= 12) consisted of PD patients receiving STN DBS treatment at Muhammad Ali Parkinson Center/Barrow Neurologic Institute. This study was conducted under IRB approval.
- Statistical analysis included 35 ANOVAs testing 33 Parkinson's disease symptoms, a total motor exam score, and a HY staging score for each of the three frequency conditions.
- Table 1 presents a summary of the statistically significant ANOVA findings.

## Results

*Table 1: Effects of DBS Conditions on PD Symptoms. All results depicted in the tables below demonstrated statistically significant ANOVA findings. Boxes marked with an asterisk showed statistical significance when compared to the CDS mean.*



## Discussion and Conclusions

- This study examined the effects of reduced DBS stimulation on the severity of PD symptoms.
- Significant changes were seen in the clinical scores across varied DBS conditions.
- The majority of symptoms increased in severity as the DBS frequency was reduced (p-value <0.05).
- Total Clinical Score (i.e., the cumulative score of the severity of symptoms) increased as the DBS frequency was reduced (p-value of 0.001).
- HY Staging values also increased with decreasing frequencies (p-value of 0.03).
- These results are supportive of what we expected; that as you decrease the frequency of DBS from the patients' therapeutic setting, the clinical symptoms worsen (become more severe).
- This is an important observation to make so that appropriate clinical decisions can be made as we continue to investigate the effects of reduced frequency DBS on gait and posture control.
- It is likely that the potential improvements in gait and posture control at reduced DBS frequencies will have to weighed against the increase in PD clinical severity.
- A limitation of this study includes sample size. Twelve subjects were studied, however, patient recruitment and data collection is ongoing.

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