Neural and Kinematic Features of Freezing of Gait for Adaptive Neurostimulation

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USA

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Neural and Kinematic Features of Freezing of Gait for Adaptive Neurostimulation

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Research Abstract

PROJECT SUMMARY Freezing of gait (FOG) in Parkinson’s disease (PD) results in unpredictable episodes of gait cessation, which may lead to falls, injury, a loss of independent living, and even death19. The treatment of FOG is inconsistent with either dopaminergic medication or with current open loop, continuous high frequency deep brain stimulation (cDBS)15, 25. Emerging technology using non-continuous, closed loop or adaptive DBS (aDBS), has the potential to improve treatment for FOG. Adaptive DBS can sense patient specific neural and/or kinematic signals and respond by adjusting DBS parameters to provide more efficacious therapy while reducing adverse side effects known to occur with cDBS. The

critical barriers of using aDBS for FOG are the lack of knowledge of: the neural features of FOG that could be ‘sensed’ by aDBS to trigger stimulation, the optimal, patient specific DBS parameters for the treatment of FOG, and whether aDBS for FOG is safe and tolerable in human PD patients. In the Bronte-Stewart Lab, we have the technology, the regulatory approvals and the research experience collecting synchronized neural and quantitative kinematic signals, applying different DBS parameters for FOG, performing the first aDBS experiments in freely moving PD subjects. The Bronte-Stewart Lab was the first group and Stanford was the first site in the United States to implant a sensing neurostimulator for PD, the Activa® PC+S (Medtronic Inc., FDA IDE/Stanford IRB approval, October 2013). This comprised the FDA approved neurostimulator (Activa PC®, Medtronic Inc.) with additional software that enabled recording of brain signals via telemetry from the neurostimulator itself. We have implanted twenty PD patients (largest cohort in the world), from whom we have been collecting synchronized neural and computerized kinematic signals for over thirty months without adverse events. We will use this new technology in conjunction with our expertise in quantitative kinematics and validated measure of FOG to begin understanding the neural features associated with FOG. In addition, we will use quantitative measures of FOG to accurately determine the efficacy of patient specific stimulation parameters for effective and consistent treatment of FOG. No center has had the technological capability to test the safety and feasibility of aDBS for FOG in freely moving PD patients. Whether patients can tolerate aDBS, which continually adjusts output to control a time-varying patient-specific neural signal as they are walking and moving freely is completely unknown and will be assessed in a pilot study in this proposal. This project is expected to signal the beginning of a new era of precise medicine: the possibility to treat FOG in PD in a customized, adaptive manner, while minimizing adverse effects and complementing the treatment of other disabling motor features of PD such as tremor.

Further information available at:

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