PDWALK

Spinal-cord stimulation technologies and methods to alleviate gait deficits of Parkinson's disease.

Parkinson's disease (PD) is one of the most prevalent neurodegenerative disorders, affecting more than ten million people worldwide. More than 90% of individuals with PD suffer from locomotor disturbances that affect their quality of life and increase comorbid conditions.

Contrary to upper-limb motor symptoms, these deficits respond poorly to commonly available therapies such as dopamine replacement strategies and deep brain stimulation (DBS). The divergence in the nature and dynamics of the circuits that control manual dexterity versus locomotion may explain why gait deficits are resistant to treatments optimized for upper-limb motor symptoms. Consequently, we propose to target the circuits in the spinal cord that are directly responsible for the production of locomotion. Previous studies reported gait improvements during continuous stimulation of the dorsal columns at the thoracic level of the spinal cord, but the results have been inconsistent and variable.

Here, we will pursue a radically different strategy focused on the modulation of the locomotor circuits within the lumbar spinal cord. We will leverage our newly designed spinal-cord stimulation technology that has been conceived to recruit the individual posterior roots of the lumbar spinal cord. This technology combines a targeted multi-electrode array and an implantable pulse generator with real-time control capabilities. The sequential recruitment of the lumbar posterior roots with a precise timing that coincides with the ongoing movement reinstates the natural dynamics of lumbar motor circuits. We showed that this treatment restored walking in nine individuals with paralysis due to spinal cord injury, and alleviated gait deficits in the gold-standard model of PD in nonhuman primates. Here, we will evaluate the ability of these stimulation technologies and methods to alleviate gait/balance deficits and freezing-of-gait in patients with PD whose locomotor deficits resist to pharmacological and DBS treatments.

We will study both the immediate and long-term impact of spinal-cord stimulation and gait rehabilitation on locomotor performance using high-resolution biomarkers: continuous monitoring of gait kinematics and subthalamus nucleus activity in real-life settings. Our goal is to develop a treatment that alleviates gait and balance deficits and durably improve the neurological condition of people with PD.

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