Stepping to recover from a fall is not helped by Deep Brain Stimulation in people with Parkinson's disease

Poor balance is common in people with Parkinson's Disease and can limit the activities people are able to engage in. If a fall occurs the injuries can be debilitating and impair quality of life. The ability to generate a step quickly and accurately after a loss of balance is critical to avoid falling. The most effective drug treatment for Parkinson's Disease (levodopa) has done wonders for improving common Parkinson's Disease symptoms such as tremor, stiff joints and slow movements, however this drug offers no benefit to balance.

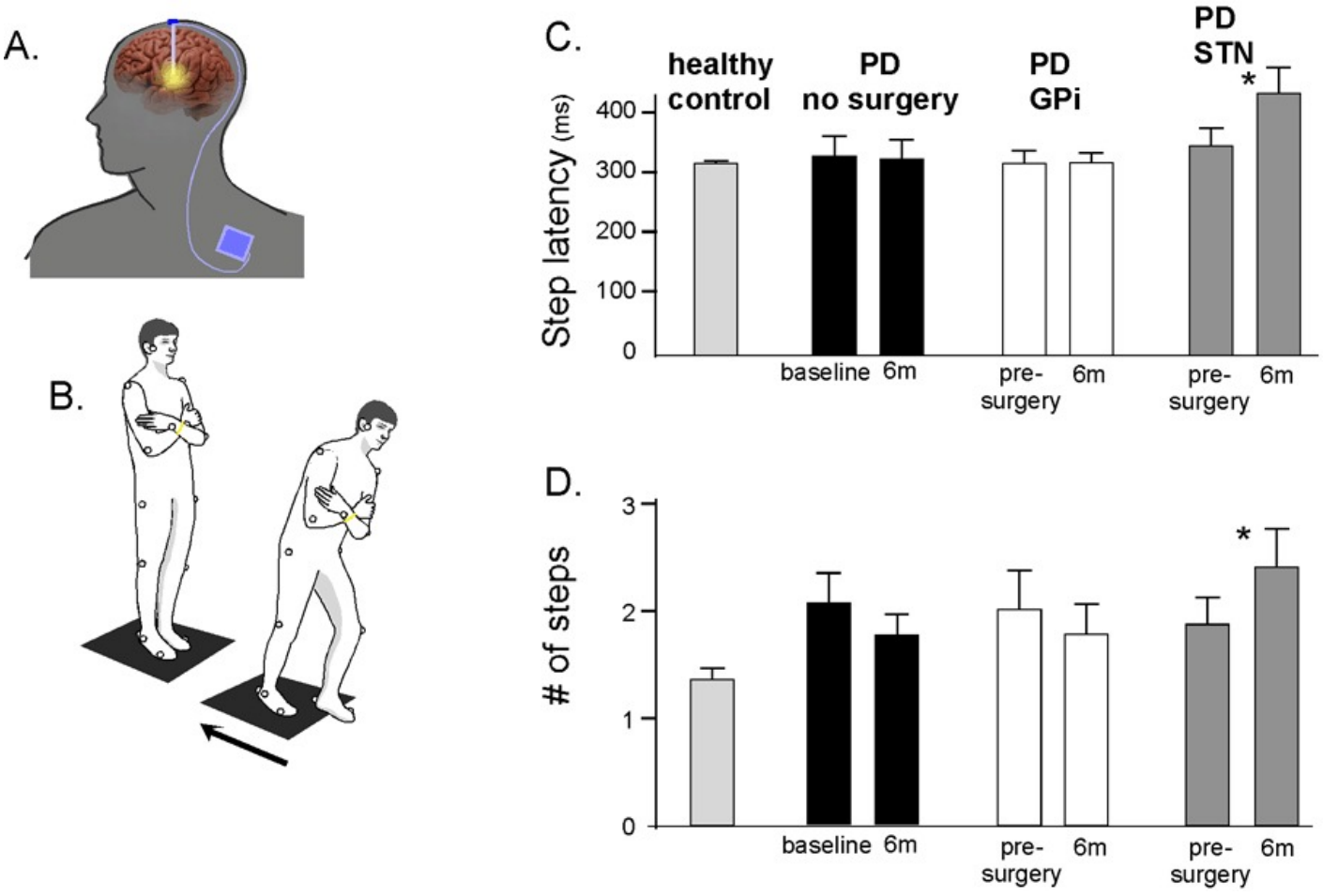

Fig. 1. A. Implantation of the Deep Brain Stimulation device. B. The experiment: stepping to recover balance after the floor moves. C. The time to lift the foot off the ground after the floor moved. D. The total number of steps needed to recover balance. For C and D, the bars show performance in the normal treated state pre-surgery and 6 months later. People with Parkinson's Disease (PD) had worse balance recovery than healthy control subjects. The Parkinson's Disease group that had undergone Deep Brain Stimulation of the Subthalamic Nuclei (STN) had worse balance recovery 6 months after surgery, whereas the Parkinson's Disease group who did not

have surgery or who had surgery in the Globus Pallidus nuclei (GPi) had no change in their balance response.

Deep Brain Stimulation is an increasingly popular surgical therapy that is considered as a second line of defense for controlling Parkinson's Disease symptoms if levodopa loses its effectiveness over time. Deep Brain Stimulation surgery involves implanting electrodes deep into the region of the brain that is most affected by Parkinson's Disease (the basal ganglia). An electrical current is continually applied to the electrodes through a battery-operated programming unit implanted near the collarbone (Fig. 1A). In this way, Deep Brain Stimulation acts like a pacemaker for the area of the brain that is disrupted in Parkinson's Disease. Deep Brain Stimulation has been shown to have significant effects in reducing Parkinson-related tremor, slowness of movement and rigid joints. Apart from human observation studies, there have been very few studies that empirically test whether balance is improved by Deep Brain Stimulation. In our state of the art balance and gait laboratory we studied stepping reactions that were needed to avoid falling when the standing surface was unexpectedly moved (Fig. 1B). High speed, 3D body movement and muscle activity of the step responses were measure before and after DBS surgery. The subjects with Parkinson's Disease had Deep Brain Stimulation electrodes implanted at one of two different locations within the basal ganglia (the subthalamic nuclei - STN, or the globus pallidus interna - GPi), to test which of these two common implantation sites had the greatest effect on Parkinson's Disease.

We found that Deep Brain Stimulation did not improve the compensatory step response in the GPi group and Deep Brain Stimulation caused delays in the preparation phase of the step in the STN group (Fig. 1C,D). The results suggest that people with Parkinson's Disease should not undertake Deep Brain Stimulation surgery with the expectation their balance will be improved. Furthermore, if balance is of primary concern, the GPi location should be considered over the STN location.

RJ St George, P Carlson-Kuhta, LA King, KJ Burchiel, FB Horak

Publication

Compensatory stepping in Parkinson's disease is still a problem after deep brain stimulation randomized to STN or GPi.
St George RJ, Carlson-Kuhta P, King LA, Burchiel KJ, Horak FB
J Neurophysiol. 2015 Sep