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TRR 295 ReTune

Gait Initiation Impairment in Patients with Parkinson's Disease and Freezing of Gait.

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Gait initiation (GI) is a highly challenging task for the balance control system and is of particular interest in the study of neural control of upright posture maintenance during whole-body movement. This task allows the precise assessment of anticipatory postural adjustments (APA), a motor program of timed muscular synergies controlled by supraspinal feedforward mechanisms. The GI task is also interesting because it is one of the conditions in which episodes of gait freezing are often observed. In our study, we studied motor control at GI in patients with Parkinson's disease (PD) and freezing of gait (FoG), with a focus on the first two phases of APA production, i.e., the imbalance phase and the unloading phase.

The first weight shift of APA execution (i.e., the imbalance phase) was altered in all PD patients, with and without FoG. This would suggest a direct involvement of the SMA-proper and the striatum, which chiefly contribute to the execution of these preprogramed movements. Reduced striatal dopaminergic activity could reframe the coding of expected movement-related energetic costs and impair feedforward motor control.

In patients with freezing of gait, we also showed altered anterior-posterior displacement of the centre of pressure during the second phase of weight shift (i.e., the unloading phase). We interpret this result as an alteration in the processing and integration of somatosensory information and voluntary components of weight transfer during GI, which are coordinated by the premotor-parietal-cerebellar circuit. An impaired ability to inhibit stance postural control and initiate stepping, and poor set-shifting, is one of the pathophysiological hypotheses of gait freezing in PD.

Despite impaired APA execution, the sequencing of the movement did not show major alterations in both PD groups. We speculate that additional inputs from the cerebellum could overcome impaired information processing by favouring internal movement timing. The efficacy of an online compensatory role of the cerebellum is suggested in our study by the relatively preserved temporal movement sequencing, which could have also prevented the appearance of gait freezing episodes during our acquisitions. Relative timing of segmental movements was also described as unaltered in patients with PD by previous research, further suggesting a compensatory rather than detrimental role of the cerebellum in PD patients with FoG and balance disturbances.

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Chiara Palmisano is a postdoctoral researcher at the Neurology department of the University Hospital of Würzburg. Her research focus on the study of the supraspinal locomotor network derangements in Parkinson's disease patients with multimodal approaches combining movement analysis, brain imaging and electrophysiological recordings.

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