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Temporal coordination of head, trunk, and feet during 360-degree turning in Parkinson's Disease

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Keywords

Parkinson's Disease, 360-degree turning, falls, balance, Movement Disorders

Abstract

Background: The activity where people with PD have the most falls is during turning, and Turning is involved in about 40% of the daily steps. However, turning is less studied than straight-ahead gait or balance. The purpose of this study is to describe different strategies of temporal coordination of the head, trunk, and feet in people with PD.

Methods: 47 individuals with idiopathic PD (age=67±7 years, disease duration=8±5 years, MDS-UPDRS-III=32±10 score, MoCA=26±2 score) were assessed in the ON-medication state. The task was to turn 360 degrees for 1 minute, alternating right and left turnings with steps. The turning strategies were measured with 5 inertial sensors (head, sternum, lumbar, right foot, and left foot). Using gyroscope signals, particularly the yaw axis, we first estimated the period of motion of each segment using a threshold of the angular velocity of 0.6 rad/seg. Second, we selected when the head, sternum, and lumbar segments rested (combined resting). Third we computed the onsets of all segments after the combined resting periods.

Results: 8 out of 47 participants with PD used an “en bloc” strategy during the 360-degree turning in place. The head led turning in 17 participants, the lumbar segment led in 13 participants, the sternum in 2 participants, and another 7 participants did not have a clear preference. The onset of left versus right foot stepping was without side preference in 19 participants; 12 preferred starting with the Right foot and 16 with the Left. Disease progression is correlated with an increase in head onset leading to the turn and a decrease in the lumbar leading to the turn ($r=0.6$, $p=0.01$)

Conclusions: The “en-bloc” turning strategy and the preference to start turning with one foot is not supported by our results. Disease progression is associated with an increase in head onset leading to the turn.