

THE INFLUENCE OF TURNING STRATEGY ON DYNAMIC POSTURAL STABILITY IN PERSONS WITH EARLY STAGE PARKINSON'S DISEASE

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INTRODUCTION

Two main strategies for turning have been identified in healthy young adults: the step turn and the spin turn. [1,2] Adaptations during turning are influenced by both the phase of turning and the turning strategy.

Persons with *early stage* Parkinson's disease (EPD) typically demonstrate minimal levels of functional impairment and disability, yet often report difficulty with turning tasks. [3,4] Difficulty turning is thought to be associated with 1) impaired postural control and 2) the inability to adjust the type of turning strategy in response to the demands of the task. To date, most of the studies evaluating turning in persons with PD have focused on those in advanced stages of the disease; little is known in regard to persons with EPD. Therefore, the purpose of this study was to: 1) compare turning preferences between persons with EPD and healthy control (HC) participants, and 2) determine the influence of EPD on dynamic postural stability during turning.

METHODS

Fifteen persons with EPD, diagnosed within 3 yrs, and 10 HC subjects participated. All EPD participants were tested in the "on" medication state (i.e., fully responding to their PD medications). At the time of testing, none of the participants exhibited dyskinesia, dystonia, or other signs of involuntary movement.

Three-dimensional kinematics (8 camera, VICON Motion System, 60 Hz) and segment inertial parameters were used to calculate the whole body center of mass (COM). Center of pressure (COP) was determined from force plate measures during single and double limb stance (AMTI force plate 1.2m x 1.2m, 1560Hz).

Participants walked 4 meters to a designated location and turned to the right at a 90° angle. Ten trials were collected. An equal number of trials were completed starting with the right and left foot to control for the influence of the start foot.

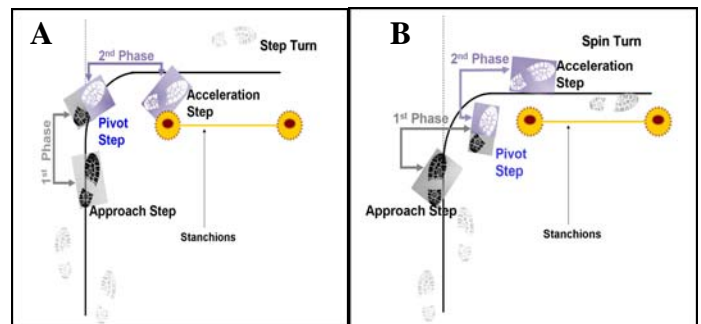


Figure 1. Schematic representation of steps during the step turn (A) and the spin turn (B).

1st phase: from approach step to pivot step; 2nd phase: from pivot step to acceleration step

The turn includes three consecutive steps: the *approach* step, the *turn* step, and the *acceleration* step. Turn strategies were defined as either step, when the change in direction was to the *opposite* side of the pivot foot (Figure 1A) or spin, when the change in direction was to the *same* side of the pivot foot (Figure 1B). [1,2] The number of step and spin turns were recorded for each participant.

Dynamic postural stability was quantified during three successful trials, using the method previously described by Hof [5], as the distance between the COP and extrapolated COM (eCOM). The eCOM was calculated using COM position and velocity. Greater postural stability was indicated by shorter COP-eCOM distances in the direction of initial forward progression (DIFP) and the direction of the turn (DOT). Two phases of turning were

considered; Phase 1 was defined from the heel strike of the approach step to the heel strike of the pivot step. Phase 2 was defined from the heel strike of the pivot step to the heel strike of the acceleration step.

A Mann-Whitney U test was used to determine the difference in the ratio of the number of step versus spin turns between groups. Independent t-tests were used to determine the difference in peak dynamic postural stability in the DIFP and DOT between groups for each phase of turning ($p < 0.05$).

RESULTS

The step/spin ratio was significantly greater in persons with EPD indicating that they used the step turn strategy more frequently than the spin turn when compared to HC subjects. All subsequent analyses were performed on step turns.

In the first phase of turning, approach to pivot step, there was no difference between groups in the DIFP; whereas, persons with EPD demonstrated a significantly shorter COP-eCOM distance in the DOT compared to HC participants (Figure 2A). In the second phase of turning, pivot to acceleration step, significantly shorter distances in both DIFP and DOT were seen in persons with EPD when compared to HC participants (Figure 2B).

DISCUSSION

Persons with EPD preferred the step turn strategy 1.4 times more often than the spin turn strategy during turning.

Analysis of the COP-eCOM distances indicated that persons with EPD demonstrated increased postural stability during step turning. These findings suggest that persons with EPD may preferentially adopt a more cautious postural-control strategy, in an attempt to ensure safety.

CONCLUSIONS

Persons with EPD demonstrated greater postural control during the step turn compared to HC participants. This strategy may be an effort to maintain balance and prevent falls.

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ACKNOWLEDGEMENTS

Supported by the Magistro Family Foundation Research Grant

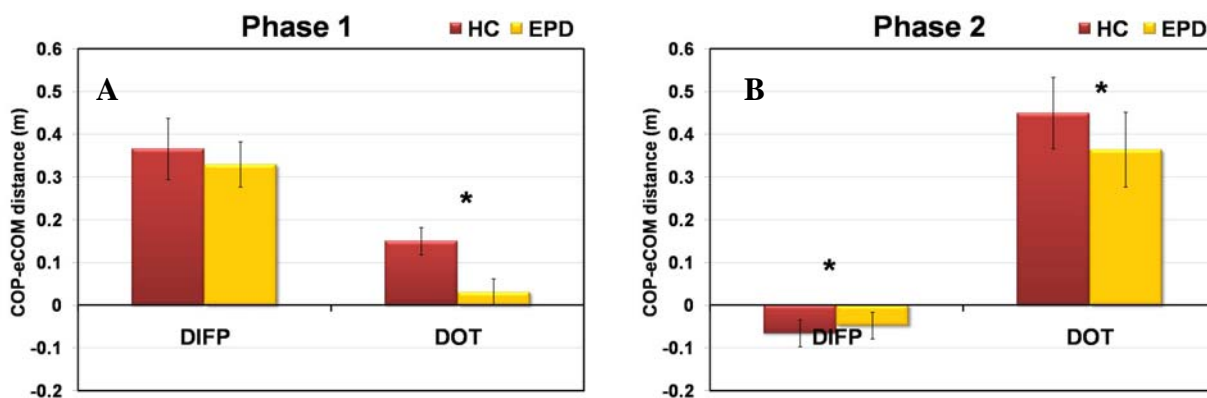


Figure 2. The COP-eCOM distances between groups in the 1st Phase (A) and 2nd Phase (B)
* $p < 0.05$