ASSESSING LIMB PROPULSION AND GAIT KINETICS USING RESISTANCE IN EARLY-STAGE PARKINSONS DISEASE

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Introduction: People with Parkinson's Disease (PD) often experience deviations in gait including freezing of gait, decreased step lengths, and a shuffling step pattern that may lead to falls. Despite the known deficits in spatiotemporal aspects of gait, relatively little is known about limb and joint kinetics in people with PD during ambulation.

Purpose: We sought to understand limb and joint kinetics associated with gait in people with PD and examined whether deficits (and a concurrent reserve) in the push-off and swing phases of gait might contribute to the development of shortened step lengths. We hypothesized that participants with PD will have reduced hip flexor torque during swing phase and reduced ankle plantar flexor torque during push-off phase compared to unimpaired individuals yet be able to take longer steps through an increase in both hip flexor and ankle plantar flexor torque.

Methods: We recruited 11 older adults without a history of neurologic involvement and 9 participants with idiopathic PD with a Hoehn & Yahr stage of 1 - 3. Testing was completed in a single session. All participants walked on an instrumented treadmill for 1 minute each at their self-selected comfortable and fast gait speeds. Then, participants walked with posterior resistance applied to the pelvis by a long elastic tubing. The resistance force was systematically increased from 0 to 10% bodyweight resistance in 2.5% increments to challenge push-off magnitude (e.g., limb propulsion). Lastly, participants walked with ankle resistance at 2.5% body weight to challenge leg swing and limb advancement. Spatiotemporal, kinematic, and force data were collected and compared between groups and conditions.

Results: We did not observe differences between the Control and PD groups for most spatiotemporal and kinetic outcomes (step length, propulsive impulse, trailing limb angle (TLA), plantarflexion (PF) impulse, and hip flexor (HF) impulse). However, the PD group exhibited significantly decreased hip extension (HE) impulse ($p=0.005$) compared to controls. When challenging limb propulsion at the pelvis, participants in the PD group increased their propulsive impulse ($p<0.001$), PF impulse ($p<0.001$), and HE impulse ($p<0.001$), while they decreased the HF impulse ($p<0.001$). With 2.5%BW resistance at the ankles, participants with PD were able to increase step length ($p<0.001$), ankle PF ($p<0.001$), and HE impulse ($p<0.001$), but did not alter HF impulse.

Conclusions: These data suggest that in early-stage PD, gait kinetics are not as disrupted as originally thought. However, the presence of reduced HE torque might be an early indicator of gait degeneration in this neurodegenerative disease. Our participants with PD were able to increase HE torque in response to demands, but they exhibited difficulty increasing HF torque when challenged. Given the deficits in HE, it is encouraging that HE seemed to be the source of increased force against resistance, providing a possible target for interventions. Likewise, we found that challenging leg swing appeared easily surmountable by our participants with PD, possibly indicating that our resistance force was not large enough. Nevertheless, participants with PD were able to increase leg swing against resistance, suggesting a reserve in leg swing mechanics.