Immediate Effects of Speed-Dependent Treadmill Training on Gait Parameters in Early Parkinson's Disease

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ABSTRACT. Pohl M, Rockstroh G, Rückriem S, Mrass G, Mehrholz J. Immediate effects of speed-dependent treadmill training on gait parameters in early Parkinson's disease. Arch Phys Med Rehabil 2003;84:1760-6.

Objective: To compare the immediate effects of different training interventions on gait parameters in patients with early Parkinson's disease (PD).

Design: Randomized, multiple intervention crossover pilot study.

Setting: A rehabilitation center for adult persons with neurologic disorders.

Participants: Seventeen patients with early PD (Hoehn and Yahr stages I through III) and gait disturbances.

Intervention: Patients were randomly assigned to varying sequences of the following interventions over 4 consecutive days: structured speed-dependent treadmill training (STT), limited progressive treadmill training (LTT), conventional gait training (CGT), and a control intervention.

Main Outcome Measures: Basic gait parameters (overground walking speed and stride length at self-adapted speeds) and parameters of gait analysis based on vertical ground reaction forces.

Results: STT and LTT improved all basic gait parameters and the double stance duration compared with preintervention values ($P<.05$). No changes were found after CGT and the control intervention ($P<.05$). Significantly higher gains were observed in all basic gait parameters after STT and LTT when compared with CGT and the control intervention ($P<.05$). Additionally, a greater reduction of double stance duration was found after STT than after the control intervention ($P<.001$). No significant differences in gains were observed between STT and LTT, or between CGT and the control intervention, in all gait parameters.

Conclusion: The main disturbances of gait in PD, namely, speed and stride length, can be improved through a single intervention of STT or LTT, but not through CGT and the control intervention.

Key Words: Gait; Parkinson's disease; Physical therapy techniques; Rehabilitation; Treadmill test.

GAIT HYPOKINESIA IS among the primary movement disorders associated with Parkinson's disease (PD).[1,2] Although occasionally kinematic measures have been found to have been altered in individual patients, abnormal slowness of gait is the only symptom that has been consistently reported in group comparisons between control subjects and patients with idiopathic PD.[3] Cadence control remains unaffected throughout its entire range in PD, and gait hypokinesia is directly attributable to an inability to internally generate sufficiently large steps.[1,4] Therefore, improvements in walking speed and stride length are the primary goals of gait therapy in patients with PD.[5]

The use of treadmill training has long been a promising investigational therapy in the rehabilitation of patients with hemiparesis and impaired gait.[6-8] Used as a supplement to conventional therapies, treadmill training can significantly improve the results of other gait training therapies.[6,9,10] With seriously afflicted hemiparetic patients who cannot walk under their own power, treadmill training with body-weight support (BWS) is recommended.[6,7] As recently described,[11,12] treadmill training with BWS is also used in patients with PD, and results in better improvement of gait parameters than does conventional gait therapy. However, the most effective combination of training parameters (eg, amount and timing of BWS during the gait cycle, belt speed, and acceleration) is still unknown.[11]

Recent training techniques in neurologic rehabilitation have begun to include sport-physiologic approaches such as aerobic exercise and circuit training.[13,14] Drawing from these studies, and from our own experience, we developed a gait training program that is suitable for patients with PD and stroke,[10] which involves the use of structured speed-dependent treadmill training (STT). Sprint training at maximum speed is used, with care being taken not to overexert the patients, who often have multiple morbidities.

Patients with PD have been shown to benefit from practice in some motor tasks,[15,16] although often these improvements come more slowly than in healthy subjects.[15] To date, however, the influence of speed training on gait patterns in PD has not been studied. The purpose of this study was to compare the immediate effects of STT with the effects of limited progressive treadmill training (LTT), conventional gait training (CGT), and a control intervention.

To this end, patients in the early stages of PD were treated with all 4 interventions on 4 consecutive days, with the order of the treatments being randomly selected for each patient. Immediate effects after each intervention were assessed through measurements of overground walking speed and stride length during self-adapted and fastest comfortable walking, and by gait analysis based on vertical ground reaction forces.

METHODS

Participants

Inclusion criteria for the study were early PD, defined as Hoehn and Yahr stages I through III,[17] subjective disturbances in gait, United Parkinson Disease Rating Scale (UPDRS) gait subscore of 1 or more,[18] and no change in medication during the study period. All patients were in a stable drug program and had adapted to their current medications for at least 2 weeks. Also, they were in stable cardiovascular condition, with a risk

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