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ORIGINAL ARTICLE

Improved Clinical Status, Quality of Life, and Walking Capacity in Parkinson's Disease After Body Weight-Supported High-Intensity Locomotor Training

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Abstract

Objective: To evaluate the effect of body weight-supported progressive high-intensity locomotor training in Parkinson's disease (PD) on (1) clinical status; (2) quality of life; and (3) gait capacity.

Design: Open-label, fixed sequence crossover study.

Setting: University motor control laboratory.

Participants: Patients (N = 13) with idiopathic PD (Hoehn and Yahr stage 2 or 3) and stable medication use.

Interventions: Patients completed an 8-week (3 × 1h/wk) training program on a lower-body positive-pressure treadmill. Body weight support was used to facilitate increased intensity and motor challenges during treadmill training. The training program contained combinations of (1) running and walking intervals, (2) the use of sudden changes (eg, in body weight support and speed), (3) different types of locomotion (eg, chassé, skipping, and jumps), and (4) sprints at 50 percent body weight.

Main Outcome Measures: The Movement Disorders Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS), Parkinson's Disease Questionnaire-39 items (PDQ-39), and the six-minute walk test were conducted 8 weeks before and pre- and posttraining.

Results: At the end of training, statistically significant improvements were found in all outcome measures compared with the control period. Total MDS-UPDRS score changed from (mean ± 1SD) 58±18 to 47±18, MDS-UPDRS motor part score changed from 35±10 to 29±12, PDQ-39 summary index score changed from 22±13 to 13±12, and the six-minute walking distance changed from 576±93 to 637±90m.

Conclusions: Body weight-supported progressive high-intensity locomotor training is feasible and well tolerated by patients with PD. The training improved clinical status, quality of life, and gait capacity significantly.

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Parkinson's disease (PD) is a neurodegenerative disorder characterized by progressive motor and nonmotor symptoms gradually leading to major disability and impaired quality of life.[1,2] The motor symptoms of PD are akinesia, bradykinesia, muscle rigidity, resting tremor, and postural instability. Different neurorehabilitation regimes based on physical training have been suggested as an adjunct to medical and neurosurgical treatment. In general, positive effects of training have been reported, including improved balance, gait, sit-to-stand performance, and muscle strength.[3,4] In addition, some studies have shown positive effects on the Unified Parkinson's Disease Rating Scale (UPDRS)[5-7] and health-related quality of life.[8] However, other studies have shown that physical training has no effect on the UPDRS and health-related quality of life.[9-11] This inconsistency may in part be explained by the very different training programs applied in the studies. A challenge in PD rehabilitation today is to develop a concept of training that optimizes the beneficial effects of training.

Training intensity is an important parameter to consider in the design of a physical training program suitable for patients with PD. In this article, by intensity we refer to both motor difficulty

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and aerobic/anaerobic physical effort. It has been reported that paced exercise is more beneficial for patients with PD[12] and that the natural worsening of symptoms associated with PD over time can be counteracted when an intensive rehabilitation training program is used.[13] Furthermore, in healthy subjects, primary motor cortex neural activation has been shown to increase with increased training intensity,[14] which may indicate that high-intensity training results in an increased training stimulus within the motor system. Furthermore, the type of exercises in a physical training program specialized for patients with PD should be targeted at specific PD-related difficulties,[15] such as locomotion and postural stability. Combined, high-intensity and type-specific locomotor training could include locomotion in a changing environment to facilitate motor adaptation and running or even sprinting, which indeed would challenge motor control and physical effort.

High-intensity locomotor training at this level has not previously been investigated in PD. In order to investigate high-intensity training based on locomotion suitable for patients with PD, one has to face the fact that most patients with PD are not capable of performing extensive locomotor challenges and sprinting in a natural environment. One way to cope with this is to perform the training in a body weight (BW)-supported milieu. We hypothesized that BW-supported high-intensity locomotor training would be feasible for patients with PD and that this type of training could induce a specific effect on gait capacity and a global effect on clinical status measured by improved UPDRS scores. The aim of this study was to evaluate the effect of BW-supported progressive high-intensity locomotor training in PD on (1) clinical status; (2) quality of life; and (3) gait capacity.

Methods

Participants

Thirteen patients with idiopathic PD were recruited by a movement disorders specialist between August 2010 and June 2011 at the movement disorder clinic (Bispebjerg University Hospital in Denmark). All patients were diagnosed using the UK Parkinson's Disease Society Brain Bank Criteria, and had effect of anti-parkinsonian medication, further supporting the diagnosis of PD. The patients had clinically moderate to advanced severity of disease, reflected in significant bradykinesia and rigidity; some patients had severe tremor and some patients had developed motor fluctuations, all of which influence functional status, mobility, and activities of daily living. For further clinical details see table 1. Exclusion criteria were any known disease other than PD that might interfere with motor function, any contraindications to exertion of physical exercise, or patients being treated with deep brain stimulation. All patients followed their normative schedule for medication and all experimental procedures were performed in a self-reported ON state at approximately the same time of the day. Prior to participation, all participants received careful explanation of the procedures and gave written informed consent. The Committee on Ethics in Science in Copenhagen approved the study.

Table 1 Profile of patients with PD

Patient	Age (y)	Disease Duration (y)	HY	MDS-UPDRS (Motor Part)	MDS-UPDRS (Total)	Medication (LED in mg)
1	64	7	2	16	18	510
2	60	3	2	39	50	591
3	56	6	2	43	78	1163
4	71	4	2	40	81	710
5	64	8	2	31	46	340
6	53	8	2	36	56	975
7	64	5	2	29	67	620
8	70	13	3	37	83	950
9	75	5	2	28	42	665
10	68	8	2	19	30	310
11	58	1	2	51	80	160
12	63	9	2	31	63	1298
13	58	6	2	25	64	1563

NOTE. The HY staging scale is a 5-point scale (1–5) describing the natural progression of PD. In short, the stages are characterized as: (1) unilateral involvement, (2) bilateral involvement without balance impairment, (3) bilateral involvement with balance impairment, (4) severely disabling disease, and (5) confinement to bed or wheelchair. Abbreviations: HY, Hoehn and Yahr; LED, levodopa equivalent dose.

List of abbreviations:

BW	body weight
MDS	Movement Disorders Society
PD	Parkinson's disease
PDQ-39	Parkinson's Disease Questionnaire-39 items
UPDRS	Unified Parkinson's Disease Rating Scale

Protocol

A fixed sequence crossover design was used. All patients were first included for an 8-week control period and then crossed-over to complete an 8-week intervention period. Thus, each subject acted as their own control. The Movement Disorders Society (MDS)-UPDRS,[16] the Parkinson Disease Questionnaire-39 items (PDQ-39),[17] and the six-minute walk test[18] were performed 8 weeks before, as well as pre- and posttraining.

MDS-UPDRS is the criterion standard in the evaluation of clinical status of PD. It is used as a measurement of disease severity, disease progression, and effect of treatment. The MDS-UPDRS covers 65 items distributed among 4 different parts: part 1 (nonmotor experiences of daily living), part 2 (motor experiences of daily living), part 3 (motor examination), and part 4 (motor complications). The total MDS-UPDRS score ranges from 0 to 260, and part 3 ranges from 0 to 132. In order to achieve a total score of 260, the patients should get an evaluation in all items that stated symptoms/signs that prevent function, and this score is therefore never seen in practice. The score is dependent on effect of medication; hence, a higher score would be expected if patients were examined off medication. The patients in the present study had a mean total MDS-UPDRS score of 58, which is high compared with other training studies. The MDS-UPDRS ratings were completed by the same experienced movement disorder specialist. The medication was noted, and the levodopa equivalent dosage calculated.[19] The mean levodopa equivalent dosage was unchanged during the study period.

The PDQ-39 covers 8 aspects of quality of life. The PDQ-39 summary index combines all aspects of the PDQ-39 into a single index ranging from 0 to 100. A PDQ-39 score of 100 corresponds to the maximal measurable negative impact of PD on quality of life.

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