



Review

Rehabilitative therapy in patients with Parkinson's disease

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ABSTRACT

Long-term complications of Parkinson's disease (PD) include impairments of speech, swallowing, limb function, gait, balance, and activities of daily living. Even with optimal medical management (pharmacological, surgical) these deficits cannot be controlled satisfactorily in the vast majority of patients and have a negative impact on quality of life [1,2]. Rehabilitative therapy including physiotherapy, speech training, and occupational therapy is often administered on empirical grounds to counteract the progressive pharmaco-resistant motor disturbances. Studies meeting high methodological standards have been published on this field in recent years, moving rehabilitative therapy toward a more evidence-based approach. In addition, basic science research in animal models of PD has documented the value of exercise for improving motor performance and potentially slowing progression of motor symptoms and neural degeneration [3]. Collectively, these findings have accentuated the important role of exercise and rehabilitation in the management of PD.

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Rehabilitative therapy in PD

Attempts to ease motor impairment in PD with physical therapy and other rehabilitative measures date back to the 19th century. Clinical practice of rehabilitation in PD still relies only partly on scientific evidence and also includes approaches justified by empirical experience, plausibility and intuition.

Rehabilitative therapy in PD intends to provide physical and psychosocial aid that helps to secure quality of life and to reduce the characteristic complications of long-term disease. Rehabilitation cannot halt or reverse the progressive nature of PD but may slow the increase of disability in the course of the chronic disease. Physiotherapy, occupational therapy and speech therapy are the mainstays of rehabilitation in PD which are complemented by spa,

music and sport therapy. Neuropsychologic interventions have not yet been tried systematically but may have a role in the management of cognitive disturbances in PD. Psychosocial counseling is provided in order to enable patient and caregivers to cope with the evolving disease and may influence mood, social integration and autonomy.

Rehabilitative therapy in PD is often aimed at impairments which are not or not sufficiently accessible to pharmacologic treatment. Dopa-resistant deficits become increasingly prominent in the late stage of PD [1,2] and may cause significant problems even at the onset of disease in atypical Parkinson syndromes such as MSA or PSP. Table 1 gives an overview about symptoms which often turn out to be insufficiently influenced by pharmacologic treatment.

Rehabilitation programs are sometimes restricted to later stages of PD or as reactive referrals for secondary impairments, such as aspiration due to swallowing dysfunction, or hip fracture due to falling. Recent advances in clinical and basic research suggest that such programs are therapeutic options to be

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Table 1
Motor symptoms which may not respond satisfactorily to dopaminergic medication.

Speech and swallowing disorders
Hypophonia
Dysarthria
Dysprosodia
Dysphagia
Disequilibrium
Retropulsion
Imbalance
Falls
Complex gait disorders
Start hesitation
Turn hesitation
Freezing
Festination
Postural disturbances
Camptocormia (“bent spine”)
Antecollis (“dropped head”)

prescribed early in the course of PD that may potentially contribute to slowing of motor symptom progression [3,4].

General considerations

An important issue in the rehabilitation of motor symptoms in PD are fluctuations due to pharmacodynamic or circumstantial factors. Response fluctuations including wearing-OFF and ON/OFF-states may dramatically alter motor abilities but also mood and motivation [5]. Learning can be strongly determined by dopaminergic medication and exercising in medication OFF-state can be associated with an increased propensity for negative self-perception and frustration [6]. In general terms, symptoms restricted to the OFF-states are rather a domain of medical treatment including adjustment of medication or deep brain surgery. Rehabilitative strategies should thus rather concentrate on deficits which persist during ON-states.

Further salient features of PD with relevance to exercise and physiotherapy are motor blocks with or without relation to medication, strong influence of external stimuli and attention on motor performance, dysexecutive disturbances and mental changes such as apathy, loss of motivation and depressive mood. It has been shown that patients with PD walk faster and with larger steps when concentrating on their performance but return to bradykinetic gait when attention is distracted from movement execution [7]. The underlying problem is that skill acquisition may be preserved but the ability to transfer skills to automatic routines is impaired [8]. Improvements observed in the setting of therapy may thus not translate to improved performance in routine motor activities.

Changing from one motor program to another (set-shifting) may be disturbed and sequencing of repetitive movements may occur with prolonged and/or irregular intervals and reduced and/or irregular amplitudes [9]. A core problem of akinesia in PD is the disturbance of execution of automatized motor routines [10]. Intracerebral recordings in monkeys have shown that in predictable and easy movements phasic internal motor cues from the globus pallidus exert inhibitory action on premovement activity in the supplementary motor cortex facilitating sequential execution of movement components [11]. External cues may exert disproportionate influence on motor performance and can trigger both motor blocks and kinesia paradoxa [12].

Complementary to the increased reliance on external sensory information impaired processing of proprioceptive information, presumably due to disturbed central integration has been described in PD [13]. In clinical practice diminished awareness

for underscaling of amplitude and acceleration of cadence is often evident both for gait and speech. Reduced perception of impaired body posture, in some cases resembling “postural neglect”, is a further clinical feature evidencing deficient somatosensory processing.

These alterations of sensorimotor control in PD suggest implementation of specific therapeutic strategies to restore somatosensory perception and to compensate for loss of generation of internal cues. External sensory cues, including acoustic, tactile or visual stimuli, are used for the latter purpose and may be provided in order to trigger initiation of movements or to facilitate repetitive and sequential movements. This approach includes delivery of cues by therapists or devices as well as training of patients to employ sensory stimuli or trick maneuvers [14]. A conceptually different approach is aimed at the restoration of deficient functions.

Behavior modification techniques, cueing and trick maneuvers

Since the publication of Purdoch Martin’s seminal description in 1967 [15] numerous behavior modification techniques, using the effect of external cueing like visual lines or metronomes, have been published. One rationale behind implementing cues in the rehabilitation of patients with PD is to substitute defective signaling between basal ganglia and supplementary motor area (SMA). Patients are thus enabled to modify their motor strategies to involve a “closed-loop” performance [16]. Another theory is that cues de-automatize motor routines and thus avoid reliance on the disturbed pallidum–thalamus–SMA motor circuit. This should be achieved by means of focused attention or using less overlearned motor strategies, for example marching instead of walking [17].

Sensory-motor cueing has been used as an isolated trick maneuver or embedded in complex behavioral therapy protocols. Special emphasis has been given to the improvement of gait with sensory cueing (see [14] for comprehensive review). Sensory tricks are used to overcome start hesitation (which has been synonymously termed gait ignition failure) and to maintain steady pacing. Martin [15] defined various features of visual cues that are critical for their effectiveness. According to Martin visual stimuli need to be on the trajectory and are optimally effective when transverse and contrasting. The best distance between visual cues is about step-length (25–50 cm). Response to one visual cue (e.g. strips attached to the ground) does not predict the response to other visual cues (e.g. inverted walking stick). Cues usually work most dramatic at first presentation and rather lose effectiveness with further use. When use of cueing strategies is compromised in patients with cognitive deficits, care-givers can be instructed to apply cues.

Thaut et al. [18] suggested rhythmic auditory stimulation (RAS) in order to improve gait velocity and speech rhythm. Subjects are instructed to entrain their walking pace to metronome-pulses embedded into rhythmical instrumental music. Compared to controls receiving no training or training based on internal (self-)pacing patients treated with RAS showed larger gait velocity that was not only attributable to higher cadence (step-rate) but also to improved step-length.

Three recent studies investigated cueing for training PD patients with freezing and falls. Nieuwboer et al. [19] performed a single-blind crossover multicenter 12-week study in 153 PD patients with gait disturbance in H&Y stages 2–4 (RESCUE trial). During the first week of intervention, patients were made familiar with cueing devices including an auditory beep signal apparatus, diodes placed on the patients’ glasses to emit light flashing cues, and pulsed vibrations from a wristband for somatosensory cues. At the end of the first week of training, patients chose their preferred method: 67% chose auditory and 33% chose somatosensory cueing.

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