

Striding Out With Parkinson Disease: Evidence-Based Physical Therapy for Gait Disorders

Meg E. Morris, Clarissa L. Martin, Margaret L. Schenkman

M.E. Morris, PT, PhD, is Professor and Head, Melbourne School of Health Sciences, The University of Melbourne, Victoria, Melbourne 3010, Australia. Address all correspondence to Dr Morris at: m.morris@unimelb.edu.au.

C.L. Martin, PT, PhD, is Senior Research Fellow, Centre for Health, Exercise and Sports Medicine, The University of Melbourne.

M.L. Schenkman, PT, PhD, FAPTA, is Professor and Director, Physical Therapy Program, Department of Physical Medicine and Rehabilitation, and Associate Dean of Physical Therapy Education, School of Medicine, University of Colorado Denver, Aurora, Colorado.

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Although Parkinson disease (PD) is common throughout the world, the evidence for physical therapy interventions that enable long-term improvement in walking is still emerging. This article critiques the major physical therapy approaches related to gait rehabilitation in people with PD: compensatory strategies, motor skill learning, management of secondary sequelae, and education to optimize physical activity and reduce falls. The emphasis of this review is on gait specifically, although balance and falls are of direct importance to gait and are addressed in that context. Although the researchers who have provided the evidence for these approaches grounded their studies on different theoretical paradigms, each approach is argued to have a valid place in the comprehensive management of PD generally and of gait in particular. The optimal mix of interventions for each individual varies according to the stage of disease progression and the patient's preferred form of exercise, capacity for learning, and age.



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Parkinson disease (PD) is a common disorder, especially among older adults. Based on an incidence rate of 16 to 19 per 100,000 per year, it is estimated that more than 2 million Americans, and 6 million people worldwide, are currently living with this progressive neurological condition.¹ Movement disorders, and in particular gait disorders, are a hallmark of PD.^{2,3} The slow, short-stepped, shuffling, forward-stooped gait with asymmetrical arm swing is quickly recognizable to clinicians and varies according to the timing of assessment in the PD medication cycle.²⁻⁴ In addition to experiencing difficulties with the performance of well-learned movement sequences such as walking, turning, writing, and transfers, some people with PD report falls, cognitive impairment, and autonomic disturbances.⁵ Together, these problems can affect quality of life and participation in societal roles.⁶

Physical therapist management of gait disorders in people with PD has 3 key elements. The first element is teaching the person how to move more easily and to maintain postural stability by using cognitive strategies. This is known as “strategy training” and targets the primary motor control deficit in the basal ganglia, brain stem, and motor cortex. There are 2 forms of strategy training: (1) compensatory strategies to bypass the defective basal ganglia and (2) learning strategies to improve performance through practice. The second element of physical therapy is the management of secondary sequelae affecting the musculoskeletal and cardiorespiratory systems that occur as a result of deconditioning, reduced physical activity, advanced age, and comorbid conditions. The third element is the promotion of physical activities that assist the person in making lifelong changes in exercise and physical activity habits as well as preventing falls. The re-

searchers who have provided the evidence for these approaches have grounded their studies on different theoretical paradigms and studied targeted questions based on those paradigms. Nevertheless, each element has a valid place in the management of PD. In the clinical setting, physical therapists draw from each approach to provide comprehensive, client-centered care.

Measurement of gait-related outcomes includes a variety of perspectives. Included are the assessment of kinematics of gait (eg, stepping rate, stride length), assessment of functional factors (eg, 2- or 6-minute walk distance, ability to climb stairs), and assessment of factors associated with postural control that are closely related to gait (eg, incidence of falls, measures of balance control such as functional reach). These different outcomes have been used by researchers to better understand the effects of a variety of physical intervention approaches related to gait of people in early and middle stages of PD.

Strategy Training

Morris and colleagues^{2-4,7} provided some of the first evidence that movement strategies can assist people with PD to move, walk, and balance more easily. Their laboratory trials showed that external cues, such as white lines on the floor or a rhythmic beat provided by a metronome or music, enabled elderly people with moderate to severe PD to walk with longer steps and at a more normal stepping rate.^{4,8,9} These strategies assisted people to walk faster by compensating for the most common movement disorder: hypokinesia. *Hypokinesia* refers to reduced movement amplitude and speed and is seen as reduced step length and, in some individuals, alterations in the rate and timing of footsteps (cadence). Morris and colleagues^{3,7} demonstrated that many people with

PD who are cognitively intact and do not have marked postural instability can immediately walk with long, fast steps simply by focusing their attention on walking with long steps, even when floor markers are absent.

Through bypassing the defective basal ganglia and instead using the frontal cortex to regulate movement size or timing by consciously thinking about the desired movement, people with PD arguably compensate for the neurotransmitter imbalance in the basal ganglia. Other strategies include visualizing walking with long steps, mentally rehearsing the desired movement pattern before the action is performed, breaking down long or complex motor sequences into parts and focusing on the performance of each individual segment (segmentation), avoiding dual task performance, reading instructions on a cue card, and verbally reciting phrases such as “think big” or “long steps.”^{2,3,9-13} This model is based on the theory that the ability to move normally is not lost in PD.^{2,3} Instead, there is an activation problem that can be overcome through targeted physical therapy together with optimal pharmacotherapy.¹⁴

Strategy training can be used either to compensate for movement disorder



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ders as just described or to assist people to learn methods to move more easily through carefully structured practice. So far, we have discussed how intact regions of the central nervous system have the potential to compensate for the defective basal ganglia via attention strategies or external cues. The randomized controlled trial by Morris et al⁷ showed that compensatory techniques can be beneficial, yet are sometimes associated with relatively short-term effects. They reported that a 2-week inpatient hospital program of twice-daily therapy of up to 45 minutes per session was effective in reducing disability and improving walking speed and balance, although gains were not fully maintained at a 3-month follow-up. One possible reason for the reversion toward baseline was the relatively small amount of practice. In addition, cognitively driven strategy training can require a lot of mental effort and can be fatiguing for some people. For this reason, therapists usually train people to use the cognitive strategies selectively, when they are needed for key functional tasks, rather than using them continuously throughout the day.²

There is growing evidence that, in the early stages of PD, there remains the capacity to learn new motor skills.^{15,16} For example, Behrman et al¹⁶ reported that the capacity to learn new upper-limb movement sequences was retained in people in the early to middle stages of PD. Subjects with PD and aged-matched comparison subjects repeatedly practiced a series of rapid arm-reaching tasks with different levels of movement complexity over several days.¹⁶ Fast performance of sequential targeting tasks improved with practice in both groups and was retained over 48 hours. Similarly, Canning et al¹⁵ showed that a multiple-task gait training program, combining walking and cognitive and manual activity practice, re-

sulted in increased multiple-task walking speed in people with mild PD. This improvement in walking performance, achieved within only three 30-minute training sessions, was maintained over a 3-week retention period, suggesting that people with mild PD may have the capacity to learn how to walk under multiple-task conditions.

The message from these lines of evidence is that physical therapists should consider taking different approaches to strategy training according to disease severity. For newly diagnosed individuals and those with mild to moderate disease, it is recommended that therapists provide high-intensity, variable, distributed practice regimens with regular booster sessions over the longer term, with the aim of maximizing motor skill learning. How intensive and sustained the practice needs to be will vary according to the type and severity of movement disorders, the capacity of the person for learning, and whether there are coexisting conditions that limit the ability to practice.

As a guide, physical therapy for people with mild to moderate disease could incorporate practice daily up to 3 times per week, for periods of 6 to 8 weeks, until the motor skill is acquired. Bursts of therapy then could be provided 2 to 3 times per year to promote retention of training. For people who are more severely affected or those with cognitive impairment, very advanced age, or comorbidities that compromise skill acquisition, compensatory strategies are recommended. These strategies typically include repetition and drill practice of a given movement or action sequence, avoidance of multitasking, use of external cues and reminders, and segmentation of actions into simple components.^{2-4,7,17} The incidence of cognitive impairment is high in people whose disease severity is moderate

to severe,¹⁸ adding weight to the notion that compensatory methods are likely to be more effective than motor skill learning approaches in this group.

Management of Musculoskeletal Sequelae

Schenkman and Butler¹⁹ were among the first investigators to propose that physical therapy interventions targeting sequelae such as weakness, loss of range, and reduced aerobic capacity could assist some people with PD to improved balance, gait, and function. This concept recognizes that people with PD can develop sequelae to the disorder that might contribute substantially to their difficulty with activities and participation in societal roles. By using physical therapy interventions to reduce the sequelae, it should be possible to improve function despite the primary central nervous system disorder affecting the basal ganglia. Schenkman and colleagues²⁰⁻²² have conducted a number of laboratory experiments designed to test whether improved flexibility, muscle strength (force-generating capacity), and cardiovascular condition can improve task performance, including gait, postural control, and overall function. Not all of these studies focused on gait specifically. We contend that the findings are of importance because these factors are intimately related to gait. Studies are under way to measure outcomes of gait more specifically.²³

It is well recognized that people with PD may have altered posture, including forward trunk flexion and lack of spinal extension range of motion.^{22,24} Schenkman and Butler¹⁹ proposed that loss of range of motion of axial structures (axial mobility) might contribute to loss of postural control, gait impairment, and decline in overall function. Laboratory experiments confirmed that trunk flexibility was associated with

balance (measured by functional reach) and task performance.²⁰⁻²² Exercises designed to improve axial range of motion were shown to improve functional reach distance.²⁵ Furthermore, a secondary analysis of the data demonstrated nearly significant improvements in 6-minute walk distance for participants in the exercise program.²⁵ Although axial flexibility alone might improve balance and gait to some degree, exercises that target balance, gait, and overall function could maximize the functional benefits from improved axial mobility.

Another line of work has focused on the benefits of strengthening exercises for people with PD. The degree to which people with PD are weak is under debate. Furthermore, it is unclear to what extent weakness is a consequence of deconditioning associated with living with a chronic progressive disease, coupled with aging, and how much of the weakness is related to altered central drive to muscles.²⁶ What is well known is that loss of lower-extremity strength contributes to problems with balance, falls, and functional decline in older people.^{26,27} Several investigators have begun to explore the benefits of strength training. Hirsch et al²⁸ carried out one of the first laboratory experiments, demonstrating improvements in lower-extremity strength and response to external perturbations. Dibble et al²⁹ showed that a high-intensity eccentric quadriceps muscle strengthening program resulted in increased quadriceps muscle volume, improved 6-minute walk distance, and improved stair descent time. Dibble and colleagues³⁰ also demonstrated the safety of the program. Although it is not clear whether the loss of strength is a sequel to PD, or associated with disuse or aging, it is apparent that lower-extremity strengthening exercise can benefit some people with PD, both in terms of better

lower-extremity strength among exercisers compared with controls and in terms of balance and function.²⁶

A third line of inquiry has focused on the cardiovascular system. As with loss of strength, cardiovascular decline can contribute to functional loss in older adults.³¹ Protas and colleagues³² measured cardiovascular function in people with PD, noting that 8 people in the early to middle stages were able to achieve maximum oxygen consumption comparable to that of 7 older adults without PD. The adults with PD used as much as 20% more oxygen to perform bicycling tasks than did the people without PD, indicating a reduced economy (or efficiency) of movement. These findings have been replicated in nearly 150 people with a walking task, showing that people with PD consume more oxygen than people without PD at every walking speed from 1 to 4 mph.³³ Importantly, Schenkman and colleagues³⁴ and other researchers^{35,36} have demonstrated that aerobic conditioning programs can lead to improvements in maximum oxygen consumption, economy of movement, 6-minute walk distance, and kinematics of gait, as well as overall function.

The message from all of these studies is that some people with mild to moderately severe PD can benefit from interventions that target flexibility, lower-extremity strength, and cardiovascular conditioning. These interventions may improve aspects of balance, gait, and overall functional ability, although further studies are needed to fully define the scope of benefits from each approach. Such exercise is important for people in early stages of PD to prevent sequelae that can interfere with function, to reverse sequelae early in the disease, and to prevent or reverse declines associated with disuse and aging itself. Nevertheless,

it is neither realistic nor appropriate to think we can always reverse sequelae in later stages (eg, Hoehn and Yahr stage 3 and onward).

As a guide, individuals should exercise daily to 3 times per week, for periods of 6 to 12 weeks, to improve spinal flexibility, depending on the extent of loss of flexibility.²⁵ They should exercise at least 3 times per week for 4 months to improve cardiovascular fitness.³³ In order to achieve muscle strength gains, it is recommended that individuals train 2 or 3 days per week, completing 1 to 3 sets of each exercise using resistance loads equivalent to 8- to 12-repetition maximum, for a minimum of 6 weeks.³⁷

Whichever approach to exercise is used, to sustain benefits, individuals should continue exercising at least a few times per week as part of their daily routine. They should be reassessed by a physical therapist at least annually in the early stages of the disease and more often in later stages of the disease to progress their exercise program.

Promoting Physical Activity and Preventing Falls

Because PD is a chronic progressive disorder, it is probable that sustained exercise is necessary to maintain benefits. Indeed, follow-up data from a number of human exercise interventions have demonstrated a gradual return to baseline abilities after the supervised intervention is finished.^{7,25,38}

Results from several sources (including both animal models and information from humans) support the importance of vigorous exercise for people with PD and raise the question of whether such exercise might play a neuroprotective role. For example, Tillerson et al³⁹ showed that motorized treadmill running twice daily for 10 days enhanced motor

performance and brain neurochemistry in 2 different rat models of PD. Likewise, Dobrossy and Dunnett⁴⁰ reported that rats that received motor training after striatal lesions or striatal grafts showed some recovery in spontaneous movements and skilled motor performance. Data from Fisher and colleagues⁴¹ indicate central effects can occur with exercise for people in the early stages of PD. Finally, Thacker and colleagues⁴² examined the impact of recreational physical activity on future risk of developing PD. Data were examined from 143,325 people who were followed for 8 years. The authors identified a reduced relative risk of developing the disease for those individuals who had reported moderate to vigorous activity at baseline. Although it is not yet clear whether exercise has a neuroprotective effect for people with PD, at a minimum, exercise does assist people to maintain functional ability. Taking all of the results together, we advocate the importance of enabling people with PD to make long-term adaptations to integrate physical activity into their daily lives. Furthermore, we advocate that vigorous exercise begin immediately on diagnosis, if possible, and continue throughout the course of the disease for as long as the individual is able to exercise.

Because weekly intervention with a physical therapist, throughout the entire course of PD, is neither realistic nor desirable, patients need to take responsibility for their physical activity and exercises. Methods have been developed, based on theories of behavior, for improving exercise habits. Strategies include exploration of the patient's beliefs about exercise and barriers to regular exercise and discussing the possibility of looking at things differently to change beliefs and overcome barriers.⁴³⁻⁴⁵ Together, the clinician and patient then establish reasonable goals that the patient thinks are attainable; they

build on those goals as exercise habits improve. Regular follow-up appointments also are important (eg, monthly, quarterly, annually) to monitor progression and provide support to the patient.

Additionally, to assist patients to achieve a regular exercise regimen, we recommend determining how they prefer to exercise (eg, alone, in a group), where they prefer to exercise (eg, at home, in a community setting), and what type of exercise they prefer (eg, dancing; regular brisk walking, biking). Especially in the earlier stages of PD, any form of activity may be useful in maintaining gains made with specific, targeted, supervised exercise. For example, regular dancing is an attractive strategy for some people. Hackney and colleagues^{46,47} have shown improvements in balance with both Argentine tango and American ballroom dancing.

Adherence to a regular exercise regimen may be the most difficult challenge for the physical therapist and the patient. The physical therapist needs to shift roles from being the "doer" and "coach" (both of which may be necessary during the supervised interventions) to a role of "consultant" as the patient takes on the responsibility of maintaining activity. When patients embrace the importance of regular exercise, develop the necessary habits, and accept personal responsibility, optimal outcomes are more likely to occur. There is considerable information regarding exercise psychology for older adults.^{48,49} However, the area of exercise psychology in PD has not been studied extensively, and it cannot be assumed that all of the research in older adults is directly transferable to the PD population. Particularly troubling in this regard is the impact of non-motor signs of PD, such as depression, apathy, and lack of initiative, in many patients.⁵⁰ In-

vestigations are needed to establish the consequences of these impairments with regard to the patient's ability to adopt and adhere to a regular exercise regimen. We recommend that clinicians be alert to the possibility of such non-motor symptoms with their patients and take appropriate steps when possible to facilitate exercise habits even in the face of apathy. Clearly, this is an important area needing research.

As the disease progresses, falls frequently accompany gait disorders in PD. Thus, minimization of falls is a key goal of physical therapy for patients with locomotor dysfunction.^{2,3} Between 50% and 70% people with PD experience one or more falls over a 12-month period, which is much higher than the 30% fall rate reported for community-dwelling older people.^{51,52} Self-reporting is known to markedly underestimate the true fall rate in a range of conditions; thus, there is a need for therapists to look for other indicators of falls such as gait deviations, injuries, increased use of professional services, hospitalization, and reduced participation in societal roles.

Many of the falls in PD occur when people attempt to perform multiple tasks or long or complex movement sequences.^{2,3,8,9,53} Turning during walking is particularly problematic, as is carrying trays and other objects or walking at the same time as talking. Moreover, evidence is emerging that patients who experience freezing (an episodic inability to initiate or continue stepping) are particularly at risk of falls.¹⁴ This group is susceptible to multiple falls, with some individuals falling many times each week despite the best attempts to optimize medication.¹⁴ Health promotion activities that educate patients and their families about fall risk factors and how to prevent slips, trips, and falls, therefore, are integral to comprehensive physical therapy

Table. Overview of Recent Randomized Controlled Trials Investigating Physical Therapy Interventions for Gait Disorders in People With Parkinson Disease (PD)^a

Study	No. of Participants	Hoehn and Yahr Stage	Age (y), $\bar{X} \pm SD$	Intervention	Outcomes
Pohl et al ⁶⁷ (2003) ^b	17	I-III	62.1 \pm 9.1	GT under 3 conditions + 1 control condition: GT1: speed-dependent treadmill training GT2: limited progressive treadmill training GT3: "conventional" GT (based on principles of PNF) C: rest, no therapy	GT1 and GT2 conditions both resulted in significant improvements in temporal-spatial gait parameters measured at self-selected walking speed. No significant changes were detected for the GT3 and control conditions. There was no significant difference in outcome between the GT1 and GT2 conditions.
Cakit et al ⁶⁵ (2007)	54 E: 21 C: 10 W: 23	II-III	71.8 \pm 6.4	E: "exercise," including speed-dependent treadmill training + stretches C: not described	Experimental group demonstrated significant improvements in balance performance (measured on the BBS) and gait performance (measured on the DGI, maximum treadmill walking speed and distance). No significant changes were noted in the control group.
Ebersbach et al ⁶⁶ (2008)	27 E: 13 C: 14	Not described	E: 72.5 \pm 6.0 C: 75.0 \pm 6.8	E: WBV in addition to usual care (inpatient rehabilitation setting) C: "conventional" balance exercises in addition to usual care, as above	Both groups demonstrated significant improvements in balance performance (measured on the Tinetti Balance Score and pull test) and gait performance (measured on the 10-m walk test and Timed "Up & Go" Test). There was no evidence to suggest that WBV therapy was more effective than a conventional inpatient rehabilitation program for people with PD.
Hackney and Earhart ⁶⁶ (2008)	33 E: 13 C: 13 W: 7	I.5-III	E: 64.9 \pm 8.3 C: 62.6 \pm 10.2	E: structured Tai Chi lessons from an experienced instructor C: no intervention	Tai Chi group demonstrated a significant improvement in balance (measured on the BBS and timed tandem stance); modest (nonsignificant) improvements in gait performance on the Six-Minute Walk Test and for backward walking velocity also were reported in the Tai Chi group. No significant changes were detected in the control group.
Fisher et al ⁶¹ (2008)	30 (10 per group)	I-II	Group 1: 63.1 \pm 11.5 Group 2: 61.5 \pm 9.8 Group 3: 64.0 \pm 14.5	Group 1: "zero-intensity" exercise (education and information sessions) Group 2: "low-intensity" exercise based on "traditional" physical therapy for people with PD (including balance, gait, strategy training, and musculoskeletal exercises) Group 3: "high-intensity" exercises (BWSTT with progression of speed and intensity of training)	All groups demonstrated some reduction in disability (measured on the UPDRS) and some improvements in gait performance including self-selected speed and stride length (note: statistical analyses were not reported). Group 3 (BWSTT) demonstrated improvements in gait performance of a greater magnitude than the other 2 groups.
Morris et al ⁷ (2009)	28 E: 14 C: 14	II-III	E: 68.0 C: 66.0	E: movement strategy training in addition to usual care (inpatient rehabilitation setting) C: musculoskeletal exercises in addition to usual care, as above	Movement strategy training produced a significant reduction in disability (measured on the UPDRS) and significant improvements in 10-m walk time, 2-minute walk distance, and quality of life (measured on the PDQ39); the control group demonstrated a significant improvement in quality of life, with no significant change in disability or gait performance.

^a GT=gait training, PNF=proprioceptive neuromuscular facilitation, E=experimental group, C=control group, W=withdrawals, BBS=Berg Balance Scale, DGI=Dynamic Gait Index, WBV=whole-body vibration, UPDRS=Unified Parkinson's Disease Rating Scale, BWSIT=body-weight-supported treadmill training, PDQ39=39-item Parkinson's Disease Questionnaire.

^b Randomized, cross-over trial.

management of people with PD. Again, long-term adaptations by the patient are needed to integrate fall prevention strategies into their daily lives. It is important for the clinician to know when, where, and during what tasks the falls occur, as well as the direction.

Although population-based data provide a good guide, the physical therapist still needs to know the specific experience for each individual. Dibble et al⁵⁴ conducted a systematic review of exercise-based interventions to improve balance in PD and determined that although there is moderate evidence to support the efficacy of exercise in improving postural instability and balance task performance, it remains unclear which specific types and dosages of exercise are optimal for the management of balance disorders in people with PD. However, with exercise interventions as diverse as treadmill training,³⁸ spinal flexibility training,²⁵ Qigong,³⁶ muscle strengthening,⁵⁵ Tai Chi,⁵⁶ and tango dancing,⁴⁶ each proving to be of some benefit to people with PD, it appears that an exercise program tailored to the individual's balance impairment, fall history, lifestyle, and personal interests may be preferable to a "one size fits all" approach.

Evidence Supporting the Efficacy of Physical Therapy for Gait Disorders

A previous systematic review of therapies for PD⁵⁷ has been published, and Kwakkel et al⁵⁸ published a subsequent critical review of the literature on physical therapy for PD. The systematic review produced equivocal results, having been performed at a time when few controlled trials of physical therapy for PD had been published. The review by Kwakkel et al⁵⁸ identified 23 randomized controlled trials investigating the effects of physical therapy on function in

people with PD. Only 3 of these studies targeted gait disorders.^{10,59,60} An additional 6 studies measured gait- and mobility-related outcomes from programs directed toward improving posture and balance.^{25,55,61-64} These studies were of moderate methodological quality and demonstrated some benefits of physical therapy for gait and mobility. The interventions tested and outcome measures used varied markedly, making between-study comparisons difficult. Interventions included cueing, mental rehearsal, exercises, and cycling. As suggested by Kwakkel et al,⁵⁸ the quality of physical therapy research in PD has improved in the last decade, yet gaps in the evidence base for specific interventions remain.

More recently, a number of alternative treatment modalities, such as Tai Chi, treadmill training, and whole-body vibration have been proposed for the management of gait disorders in people with PD.^{41,56,65-67} These treatment modalities were identified when we conducted a systematic search of the physical therapy literature, which identified an additional 6 randomized controlled trials (Table) published since Kwakkel and colleagues' review. Three of these studies investigated the effects of treadmill training, including high-intensity body-weight-supported training,⁴¹ and speed-dependent treadmill training, demonstrating positive results in the small samples tested.^{65,67} Similarly, whole-body vibration therapy⁶⁶ and Tai Chi training⁵⁶ have been reported to produce modest improvements in the gait and balance performance of people with PD. Although all of these studies included a comparison group, none provided control interventions founded on evidence-based "best practice" such as strategy training, cueing, or the management of musculoskeletal sequelae.

Finally, assistive devices sometimes are prescribed for people with PD to improve gait or reduce falling. A small number of trials have shown up-turned walking sticks to be a useful visual cue for some people (see Morris and colleagues^{2,3,17} for summaries). In addition, wheeled walking frames sometimes can be of benefit for people with balance impairment and a high risk for falls, provided that the secondary task of maneuvering the frame does not compromise movement. Specific investigations are needed to measure the degree to which assistive devices optimize movement in people with PD, particularly in the more advanced stages of disease progression.

Conclusion

Comprehensive, client-centered physical therapy for people with PD is based on compensatory strategies to bypass the defective basal ganglia, strategies to improve motor learning and performance through practice, management of secondary sequelae affecting the musculoskeletal and cardiorespiratory systems, and fall education, as well as on assisting people to make lifelong changes in physical activity habits. The extent to which strategies, exercises, and health education are used varies according to individual needs and changes over time as the person ages and the disease progresses. Overall, the aim is to enable the person with PD to live well by providing effective physical therapy interventions at optimal times to promote health and well-being and by educating the individual regarding long-term self-management strategies.

Other articles in this issue relate to the promotion of movement in people with PD. For example, Kuo and Donelan⁶⁸ discuss the principles of dynamic walking; Reisman et al⁶⁹ distinguish between motor adaptation and motor learning, which is relevant to the interventions reviewed

here; and Yogev-Seligmann et al⁷⁰ and Kizony et al⁷¹ explore dual-task methods that are relevant for people with PD who have compromised cognitive performance and are trying to walk.

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