Physical Therapist Interventions for Parkinson Disease

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<LEAP> highlights the findings and application of Cochrane reviews and other evidence pertinent to the practice of physical therapist. The Cochrane Library is a respected source of reliable evidence related to health care. Cochrane systematic reviews explore the evidence for and against the effectiveness of appropriate interventions—medications, surgery, education, nutrition, exercise—and the evidence for and against the use of diagnostic tests for specific conditions. Cochrane reviews are designed to facilitate the decisions of clinicians, patients, and others in health care by providing a careful review and interpretation of research studies published in the scientific literature.[1] Each article in this PTJ series summarizes a Cochrane review or other scientific evidence on a single topic and presents clinical scenarios based on real patients or programs to illustrate how the results of the review can be used to directly inform clinical decisions. This article focuses on an adult patient with relatively early Parkinson disease. Can physical therapist intervention strategies improve his physical functioning and help him reach his goal of engaging in an exercise program to prevent decline related to progressive Parkinson disease?

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Parkinson disease (PD) is a multifaceted neurodegenerative disorder affecting both motor and nonmotor functions.[2–4] Parkinson disease is considered to be a disorder of the basal ganglia because of its effect on the transmission of signals from the basal ganglia to the thalamus for roles in voluntary movement (including initiation, execution, and termination), cognition, and emotion. One of the major consequences of PD, degeneration of the substantia nigra of the midbrain, is the trigger for abnormal signaling from the basal ganglia. The cardinal signs are tremor, rigidity, bradykinesia, and postural instability. Other motor symptoms include difficulty with motor planning and dual-task performance.[4] In addition, this disorder leads to a wide range of nonmotor symptoms that could affect a person's quality of life and participation in exercise.

Approximately 1% of Americans older than 60 years and an estimated 4% of the oldest Americans are now diagnosed with PD. This prevalence is anticipated to double by 2030.[5] The mean age of initial diagnosis is about 60,[6] although a type of young-onset PD can occur, and diagnosis also can occur later in life. In most cases, there is no known cause of the disorder (ie, it is idiopathic). People with PD often are categorized by Hoehn and Yahr (H&Y) stages (from 1 to 5), with stage 1 indicating only minor symptoms and stage 5 indicating that the person is completely disabled and typically is confined to a bed.[7] Presentation of symptoms varies among people. Although there is a spectrum of presentation, 2 specific subtypes with distinct clinical features and with different implications for prognosis have been identified. Specifically, PD is differentiated into 2 forms: tremor predominant and postural instability and gait difficulty.[8,9]

The mainstay of intervention for people with PD of all stages is medical management, including pharmacological options in early stages and surgical options (eg, deep brain stimulation) in later stages.[2] Common pharmaceutical approaches include the use of dopamine replacement, dopamine agonists, inhibitors of dopamine metabolism, and anticholinergic agents. In the past 15 years, several investigations demonstrated positive outcomes from physical rehabilitation for people in the early and middle stages of PD.[10–12] Some of the intervention approaches were framed around improvements in the direct consequences of PD (eg, difficulty with dual-task performance), others focused on sequelae (eg, strength, flexibility, and aerobic conditioning), and some were more global, addressing a variety of underlying impairments.[7,13,14]

In the past decade, numerous reviews and systematic reviews consistently suggested that physical intervention is beneficial for people with PD.[10–13] However, most of the reviewed studies were relatively small and were not of strong methodological quality.

Given the burgeoning number and increasing quality of more recent studies, Tomlinson et al[15] conducted a systematic review of the literature up to December 2010; this review was published in the *Cochrane Database of Systematic Reviews* in 2012. The review was conducted as a follow-up to a Cochrane review published in 2001 and included only

trials in which physical therapist interventions were compared with either placebo or no intervention. A total of 33 trials with 37 comparisons were selected for review. In 29 of the 33 trials, physical therapist interventions were compared with no intervention; in the other 4 trials, physical therapist interventions were compared with placebo intervention. A total of 1,518 participants were included. Their characteristics included any duration of PD, any age, any drug therapy, and any duration of physical therapist treatment. The trials were categorized as follows: 5 general physical therapist, 12 exercise, 7 treadmill, 7 cuing, 2 dance, and 4 martial arts. The number of treatment hours varied widely across the studies (4.5–72), as did the number of weeks (2–52). Information about whether home programs were included in the protocols was not provided. Not all interventions were delivered by a physical therapist.

Tomlinson et al[15] concluded that the risk of bias in the included trials had decreased since the 2001 Cochrane review; however, improvement still is needed in both implementation and reporting. For example, the studies were larger (~50 participants versus 25 in 2001). However, the United Kingdom Brain Bank Criteria, the standard for diagnosing PD, were used in only 7 of the 33 trials. Assessors were masked in only 64% of the studies, and adherence was reported in only one-third of the studies. Follow-up was short term (usually ~3 months). Numerous outcome measures, including self-report and performance-based measures, were used across the studies. Many of the measures were related to balance, gait, and falls, although measures of overall symptoms, quality of life, and disability also were included. Sufficient data for a meta-analysis of 18 outcome measures were available.

Take-Home Message

On the basis of their review, the authors concluded that significant short-term benefits for the following outcome measures were obtained with physical therapist intervention: 2- and 6-minute walk tests, walking speed, step length, Timed "Up & Go" Test (TUG), Functional Reach Test (FRT), Berg Balance Scale, and Unified Parkinson Disease Rating Scale (total, activities of daily living, and motor scores) (Tab. 1). Only the improvements seen for walking speed and Berg Balance Scale and Unified Parkinson Disease Rating Scale scores were judged to be at levels of clinical importance. Post-intervention between-group differences were small but were judged by the review authors to be clinically meaningful. The authors compared improvements obtained by different intervention approaches and concluded that they were small, supporting the notion that any of the interventions could lead to relatively comparable outcomes on these key measures. However, they cautioned that the comparisons were indirect; direct comparisons of intervention approaches are needed.

Improvements also were demonstrated for other walking outcomes, such as cadence and stride length. However, the differences were not judged to be clinically meaningful. In addition, there were no significant differences between the data from people receiving physical therapist interventions and the data from people in the control groups for falls or patient-rated quality of life.

Case #26: Applying Evidence to a Patient With Early Stage PD

Can physical therapist intervention help this patient?

"Mr Jennings," a 54-year-old financial planner currently in H&Y stage 2, had been diagnosed with PD 4 years earlier. His symptoms had begun 7 years earlier with weakness and tremor on his left side. He had not received physical therapist for PD. Medications and supplements included pramipexole, selegiline, amantadine, coenzyme Q_{10}, a multivitamin, and fish oil containing omega-3 fatty acids. He had no significant comorbid conditions. His goal was to engage in a therapeutic exercise program to prevent decline related to aging and PD. Mr Jennings did not report any falls but reported feeling stiff, moving slowly, and being concerned about balance and walking, particularly in crowded environments.

The physical therapist evaluation included measures of function and an assessment of underlying impairments that could limit current or future abilities with balance and gait. Several of these measures, including the TUG, the FRT, and the 6-minute walk test, were reported in the Cochrane review.[15] Additional measures of balance and gait included the Five-Times Sit-to-Stand Test (FTSST) and the Functional Gait Assessment (FGA).[16] His score of 25 of 30 on the FGA indicated a mild fall risk (Tab. 2). He was able to ascend and descend a full flight of stairs without the use of a railing, indicating good lower extremity strength. This finding was further confirmed by his ability to perform the FTSST in 10 seconds and without the use of hands.

The clinical examination revealed cardinal signs of PD, including resting tremor observable in his left hand, bradykinesia (limb and whole-body movements), and mild rigidity (limbs and trunk) that increased when he performed a cognitive task during a passive range-of-motion examination (dual task). Mr Jennings' sitting posture was characterized by a posterior pelvic tilt, and he stood with mild thoracic kyphosis.

Table 1.
Key Results From the 2012 Cochrane Review

The review included 33 randomized controlled trials with a total of 1,518 participants in Hoehn and Yahr (H&Y) stage 2.4; the number of participants in each trial ranged from 6 to 153. The search included trials published up to the end of December 2010.
Of the reported criteria[a] for risk of bias in the studies, 44% had low risk, 46% had unclear risk, and 10% had high risk. The most frequent areas of high risk were randomization and withdrawals.
➢ General physical therapist (5 trials; 5 compared with no intervention and 0 compared with placebo [control]) ▪ *Participants*: N=197; mean age of 65 years; 70% men; H&Y stage 2.3; 4 years since diagnosis ▪ *Intervention*: approach—movement strategies, exercise, hands-on treatment, education, and advice on gait, balance transfers, posture, and fitness; duration—5 weeks to 12 months; session length not provided
➢ Exercise (12 trials; 10 compared with no intervention and 2 compared with placebo [control]) ▪ *Participants*: N=635; mean age of 67 years; 63% men; H&Y stage 2.4; 6 years since diagnosis ▪ *Intervention*: approach—strength, balance, walking, falls prevention, neuromuscular facilitation, resistance and aerobic training, education, and relaxation; duration—3 to 24 weeks; session length—30 minutes to 2 hours
➢ Treadmill (7 trials; 5 compared with no intervention and 2 compared with placebo [control]) ▪ *Participants*: N=179; mean age of 67 years; 68% men; H&Y stage 2.4; 5 years since diagnosis ▪ *Intervention*: approach—walking on treadmill with adjustment of speed and incline; duration—4 to 8 weeks; session length—30 to 60 minutes
➢ Cuing (7 trials; 7 compared with no intervention and 0 compared with placebo [control]) ▪ *Participants*: N=303; mean age of 68 years; 60% men; H&Y stage 2.5; 7 years since diagnosis ▪ *Intervention*: approach—audio, visual, and sensory feedback (6 trials applied cues to gait, and 1 trial applied cues to sit-to-stand transfer); duration—2 to 8 weeks; session length—20 minutes to 2 hours
➢ Dance (2 trials; 2 compared with no intervention and 0 compared with placebo [control]) ▪ *Participants*: N=635; mean age of 69 years; 64% men; H&Y stage 2.3; 7 years since diagnosis ▪ *Intervention*: approach—trained instructor for tango, waltz, or fox-trot; duration—12 to 13 weeks; session length—1 hour
➢ Martial arts (4 trials; 4 compared with no intervention and 0 compared with placebo [control]) ▪ *Participants*: N=143; mean age of 66 years; 72% men; H&Y stage 2.1; 7 years since diagnosis ▪ *Intervention*: approach—Tai Chi (3 trials) and Qigong (1 trial); duration—12 to 24 weeks; session length—1 hour
Numerous outcomes were reported in the various studies. Of those that were included, the following showed significant improvements with physical therapist intervention relative to placebo (control) or no intervention:
Gait outcomes
➢ Two- or 6-minute walk test: mean difference of 16.4 m; 95% confidence interval (CI) of 1.90 to 30.90 Approach: exercise, dance, and martial arts; trials: 4; participants: N=172
➢ Ten- or 20-m walk test: mean difference of 0.40 second; 95% CI of 0.00 to 0.80 Approach: exercise and treadmill; trials: 4; participants: N=169
➢ Speed: mean difference of 0.05 m/s; 95% CI of 0.02 to 0.07 Approach: general physical therapist, exercise, treadmill, cuing, dance, and martial arts; trials: 11; participants: N=529
➢ Step length: mean difference of 3 cm; 95% CI of 0.00 to 0.06 Approach: general physical therapist, exercise, treadmill, and cuing; trials: 3; participants: N=239
Clinician-rated Unified Parkinson Disease Rating Scale score for disability
➢ Total score: mean difference of −4.46 points; 95% CI of −7.16 to −1.75 Approach: general physical therapist and treadmill; trials: 2; participants: N=105
➢ Activities of daily living score: mean difference of −1.36 points; 95% CI of −2.41 to −0.30 Approach: general physical therapist, treadmill, and dance; trials: 4; participants: N=157
➢ Motor score: mean difference of −4.09 points; 95% CI of −5.59 to −2.59 Approach: general physical therapist, exercise, treadmill, cuing, dance, and martial arts; trials: 9; participants: N=431
The following outcomes did not show any difference with physical therapist intervention relative to placebo (control) or no intervention:
Gait outcomes
➢ Cadence (steps per minute): mean difference of −1.72 steps per minute; 95% CI of −4.01 to 0.58 Approach: general physical therapist, exercise, treadmill, and cuing; trials: 6; participants: N=327
➢ Stride length (meters): mean difference of 0.03 m; 95% CI of −2.78 to 7.57 Approach: general physical therapist, exercise, treadmill, cuing, dance, and martial arts; trials: 5; participants: N=202
➢ Freezing of Gait Questionnaire: mean difference of −1.19; 95% CI of −0.02 to 0.09 Approach: exercise, cuing, and dance; trials: 3; participants: N=246

(Continued)

Table 1.
Continued

Functional mobility and balance outcomes
➢ Activities-specific Balance Scale: mean difference of 2.4 points; 95% CI of −2.78 to 7.57 Approach: general physical therapist and cuing; trials: 3; participants: N=66
➢ Falls Efficacy Scale: mean difference of 2.4 points; 95% CI of 4.76 to 0.94 Approach: exercise and cuing; trials: 4; participants: N=353
Patient-rated quality of life
➢ Parkinson Disease Questionnaire: mean difference of −0.35 point; 95% CI of −2.66 to 1.96 Approach: general physical therapist, exercise, dance, cuing, and martial arts; trials: 6; participants: N=387
No trial reported data on adverse events.

[a] Not every study reported every criterion.

Both postures were somewhat flexible, suggesting a potential for remediation. Functional axial rotation (FAR) was measured. This test quantifies the combined movements of multiple spinal regions when a seated person turns as far as possible without unweighting the pelvis. Functional axial rotation was asymmetric and was limited to 103 degrees on the right and 97 degrees on the left. These findings are in contrast to data from 18 men who were 40 to 59 years old and for whom mean FAR was 117.9 degrees (SD=14.2°) (M. Schenkman, unpublished data). Mr Jennings had a Parkinson Disease Questionnaire summary index score of 5.1, indicating a mild impact of PD on his quality of life.[17]

How did the physical therapist apply the results of the Cochrane review to Mr Jennings?

Mr Jennings' physical therapist posed the following question: Will a physical therapist program (compared with no treatment) improve the physical functioning of a 54-year-old man in H&Y stage 2 of PD? Findings from the Cochrane systematic review completed by Tomlinson et al[15] were applied by use of the patient-intervention-comparison-outcome approach, as follows.

Patient. The review included people in H&Y stages 1 to 4 (mean stage of 2.4) of PD, with a mean age of 67 years, and 6 years after diagnosis. Mr Jennings was in H&Y stage 2, was younger than the mean age (54 years), and had been diagnosed 4 years earlier. Thus, Mr Jennings fit the overall criteria but was younger and had had the diagnosis for a time shorter than the mean time for the people in the studies reported in the review.

Intervention. The studies reported in the review included interventions categorized as general physical therapist, exercise, treadmill, cuing, dance, and martial arts. The strategies chosen for Mr Jennings, on the basis of his individual impairments and his goal of preventing decline associated with aging and PD, were most similar to those categorized as general physical therapist and exercise. Specifically, the intervention included progressive resistive exercises, aerobic conditioning, balance reeducation, and flexibility training with the axial mobility exercise program.[18] In contrast to what was done

Table 2.
Outcomes of the Intervention for Mr Jennings

Outcome Measure	Value at:		Change in Value
	Baseline	Discharge (8 wk)	
Functional Reach Test	35.56 cm	38.10 cm	2.54 cm
Timed "Up & Go" Test	10 s	8 s	−2.0 s
Six-Minute Walk Test	500 m	650 m	150 m
Five-Times Sit-to-Stand Test	10 s	10 s	0
Functional Axial Rotation	100°	120°	20°
Functional Gait Assessment (total score: 30)	25	27	2

in most of the studies reported in the review, much of his plan of care was implemented with a home exercise program. With regard to dose, Mr Jennings was seen for 6 physical therapist sessions (45–60 minutes each) over 8 weeks, consistent with the lowest doses reported. To encourage adherence to home exercise, the therapist stayed in contact with Mr Jennings through e-mail. Mr Jennings submitted exercise logs, asked questions, and received feedback and encouragement.

Comparison and alternate approaches. In the studies reported in the review, physical therapist interventions were compared with either placebo (control) or no intervention. Mr Jennings had not been exercising. On the basis of the review, it appeared that various physical therapist approaches could benefit Mr Jennings. Decisions regarding which specific elements of the various intervention possibilities to include were determined by Mr Jennings' specific underlying impairments and his preferences. For Mr Jennings, it was deemed important to improve axial mobility. He had limitations in FAR and reported stiffness as a concern. Furthermore, one of his goals was to prevent declines in flexibility and function while aging with PD. Therefore, axial mobility was a significant component of his exercise program. Mr Jennings was offered dance as an option for treatment, but he was not interested in that option. He had home exercise equipment (treadmill and weight machine) and expressed a desire to learn how to exercise with the equipment. It was difficult to make direct comparisons with the reviewed studies, as they varied widely in terms of both the dose and the timing of the interventions.

Outcome. The review indicated that all interventions, including general physical therapist and exercise, resulted in small, short-term beneficial changes in gait, balance, or functional mobility measures for people with PD. Some of the outcome measures used for Mr Jennings were consistent with those reported in the review.

How well do the outcomes of the intervention provided to Mr Jennings match those suggested by the systematic review?

The interventions provided for Mr Jennings were most similar to those in the general physical therapist and exercise trials. Tomlinson et al[15] reported significant improvements in the FRT with data from the exercise and cuing groups and in the TUG with data from the exercise, cuing, dance, and martial arts groups. Mr Jennings' improvements in balance, as evidenced by the FRT and TUG results (Tab. 2), were at the high end of the changes reported by Tomlinson et al.[15]

Only limited data for the minimal clinically important difference of measures in people with PD are available; they are predominantly from one study to date. The data reported may have been from people with much greater impairments, as indicated by the changes noted (eg, 9 cm in the forward FRT and 11 seconds in the TUG); they would have been improbable for Mr Jennings, given his baseline status. Mr Jennings' 6-minute walk test change score (Tab. 2) met the criterion of 50 m as the minimal clinically important difference reported for a variety of people with a variety of cardiopulmonary diagnoses.[19]

Three outcomes that were not included in the review—FAR, FTSST, and FGA—were chosen. Functional axial rotation was considered important because of Mr Jennings' limited axial mobility compared with that of people of a comparable age and because of the known relationship between FAR and balance.[20] The FTSST was chosen because of its ability to predict fall risk and as a proxy for lower extremity strength. The FGA was used rather than the Berg Balance Scale because the latter would have been too easy for Mr Jennings and because the FGA includes tasks, such as walking backward, turning the head while walking, and ambulating on stairs, that were particularly relevant for Mr Jennings.

Changes in FAR were not reported in the systematic review, but it is noteworthy that the change in FAR for Mr Jennings (20°) (Tab. 2) was at the high end of the improvements reported by Schenkman et al.[21] No comparison data were found for the other 2 outcomes.

Can you apply the results of the systematic review to your own patients?

On the basis of the patient-intervention-comparison-outcome analysis, the results of the Cochrane review can be applied to patients such as Mr Jennings. Clinicians should, however, consider several limitations of the data. First, the outcomes were related to gait and balance but not to overall functional ability. This fact is important because improvements in gait do not necessarily lead to improvements in basic activities of daily living, such as dressing and hygiene, or overall household activities, such as cooking, cleaning, and managing laundry. Second, only short-term outcomes were examined. Parkinson disease is a progressive condition, and although short-term benefits are important, true benefits may be realized only if the patient develops the skills and strategies for long-term adherence to appropriate exercise and activity.[22] Data regarding the best strategies for assisting patients in developing appropriate activity

and long-term exercise habits are needed.

Additional limitations include the following. No evidence regarding the specificity of intervention approaches was provided. Evidence was insufficient to determine the most appropriate dose (intensity and frequency). Physical therapist interventions were compared with either placebo (control) or no intervention. Constraints of third-party payers may preclude a sufficient number of supervised sessions; hence, consideration should be given to a combination of supervised and home programs to achieve the desired goals, although data regarding safety and the optimal balance between supervised components and home components of a combined intervention are lacking.

Furthermore, evidence is not yet available to determine the best intervention strategies on the basis of subgroups of PD (tremor predominant form versus postural instability and gait difficulty form) or H&Y stages of PD. Finally, many patients have substantial comorbid conditions that should be taken into account in the design of a plan of care, both because of safety implications and because they can contribute to deficits in movement and function.

It is worth noting that across studies within the review, many outcomes were used, and they varied among the studies. These facts are indicative of the lack of consistency that investigators are using to identify the impact of PD on health, function, and quality of life.

What can be advised based on the results of this systematic review?

Findings from the systematic review demonstrated that people with PD achieve greater short-term improvements in gait and balance with physical therapist intervention than with placebo (control) or no physical therapist intervention. Because PD is a progressive condition, short-term benefits are important, but true benefits may be realized only if the patient develops the skills and strategies for long-term adherence to appropriate exercise and activity.[23] Furthermore, the results were obtained with a range of intervention approaches, including general physical intervention, exercise, cuing, treadmill, dance, and martial arts. Hence, clinicians can consider any of a range of intervention approaches when working with people with PD, especially in the early and middle stages of PD, and can take into account people's preferences. This finding is important given that people with PD likely need to develop long-term exercise habits to sustain benefits. People are most likely to adhere to an exercise regimen if they are doing something they enjoy. Furthermore, some people may be more likely to develop sustained exercise habits if they can vary their approach. At the same time, clinicians are cautioned to consider the impairments that are most limiting to their patients when deciding which intervention approaches to use.

Several large-scale randomized controlled trials comparing interventions with one another were published since the Cochrane review.[22,24–26] These studies illustrated the specificity of training. For example, aerobic training improves cardiovascular function, and resistance training improves muscle strength. This finding is important because patients' problems are multifaceted and there is no single presentation of PD across patients. Additionally, the fact that considerable recent attention has been focused on the possibility that exercise of sufficient intensity may be neuroprotective[23] suggests that intensity may be critical. Finally, attention also has been focused on the importance of overall physical activity in addition to prescribed exercise for managing the health of people with PD.[27]

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