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Rehabilitation in Parkinson's disease: current status and future directions

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Abstract:

Parkinson's disease is a common progressive neurodegenerative disease. Apart from pharmacological treatment, nonpharmacological management in the form of rehabilitation, counselling, and supportive care is an equally important therapeutic pillar. A MEDLINE search strategy using the following terms (1998–2019) was adopted for this review. Limits of "Human" and "English" were applied. Search terms included "Parkinson's Disease" AND "rehabilitation," "physical therapy," "exercise therapy," "physiotherapy," and "dance." Review articles, practice parameters, guidelines, systematic reviews, meta-analyses, randomized controlled trials, and cohort studies were included. Rehabilitation strategies in the management of Parkinson's disease form a vital component of therapy. There is mounting evidence to support physical therapy in these patients. Rehabilitation should be offered to these patients right from the start to encourage an active lifestyle and to improve quality of life.

Key words:

Music therapy, occupational therapy, Parkinson's disease, physical therapy, rehabilitation, speech therapy, supportive therapy, yoga

Key Messages:

1. Rehabilitation forms a vital component of management of patients with Parkinson's disease (PD).
2. Patients with early as well as advanced PD should be offered PD-specific physiotherapy, occupational therapy, and speech and language therapy including assessment, education, and advice.
3. Rehabilitation is also crucial for the management of axial features such as freezing of gait, hypophonia, dysphagia, and postural imbalance in advanced PD that respond poorly to pharmacotherapy.

Introduction

Parkinson's disease (PD) is a chronic progressive neurological illness characterized by diverse clinical features including tremor, rigidity, bradykinesia, postural instability, cognitive and autonomic dysfunction, and sleep disturbances. All of these contribute to impairment in the patient's quality of life (QoL).^[1,2] In early PD, dopaminergic drug therapy improves motor symptoms. In advanced PD, however, dopaminergic therapy is not as effective due to a dominance of nondopaminergic symptoms such as balance and cognitive

impairment.^[3] In addition, in the advanced stages, medications may be associated with troublesome dyskinesias, limiting dose augmentation. Even patients with pharmacologically optimally managed PD will face impairment in activities of daily living.^[4,5] The therapeutic approach in PD is broad, and various nonpharmacological strategies are of benefit including physical and occupation therapy, speech therapy, music therapy, yoga, and meditation.

In fact, there is accumulating evidence to suggest both short- and long-term benefits of exercise and physical therapy in patients with PD.^[6] Rehabilitation therapies may impart neuroprotective effect and

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enable brain repair via neuroplasticity.^[7] The current understanding is that the upregulation of neurotrophins and nerve growth factors are mediators for these beneficial effects of various rehabilitation strategies in patients with PD.^[8] Evidence exists to support early institution of exercise at the time of diagnosis, in addition to the clear benefit now shown in those with well-established disease. Physical therapies instituted in early PD improve their abilities to their functional abilities as well as their QoL.^[9] In fact, a recent prospective follow-up study in North India has revealed that a systematic program of a daily physical activity has an association with improvement in activities of daily living in moderately disabled PD.^[10]

In this review, we highlight the evidence and the impact of these nonpharmacological strategies on the management of patients with PD.

Methods

A MEDLINE (PubMed) search was conducted with the following search terms: "Parkinson's disease AND rehabilitation." The search returned 5470 items with the limits of "Humans" and "English" being applied. We reviewed the abstracts of all clinical trials, clinical trial protocols, observational studies, guidelines, consensus development conference, systematic reviews, and meta-analysis. These were 1962 items. Thirty-six studies were identified with the keywords "Parkinson's disease" AND "yoga," 3010 studies with "Parkinson's disease" AND "physical therapy," 963 with "Parkinson's disease" AND "exercise therapy," 2153 with "Parkinson's disease" AND "physiotherapy," and 84 studies with "Parkinson's disease" AND "dance." Studies specific to physiotherapy, exercise therapy, yoga therapy, dance, music, and tai chi were included. We extracted relevant studies and summarized them in the review.

Role of Physical Therapy in Patients with Parkinson's Disease

Motor problems in patients with Parkinson's disease

Most patients with PD face issues with mobility including impairment of posture, balance, walking, fear of falls, loss of independence, difficulty with transfers, as well as physical inactivity. Gait issues begin early in the course of the disease. PD patients with more than one fall in the previous year are likely to fall again in the next 3 months.^[11] Most falls occur during transfers and freezing of gait. Falls not only lead to physical injury but also increase the psychological fear of falling.^[12] Physical capacity is also diminished in patients with PD. It is also known that patients with PD tend to lead a sedentary

lifestyle, further compounding all these problems. Rehabilitation is also effective for many features of advanced PD such as freezing of gait and swallowing problems that relatively are resistant to dopaminergic therapies.^[13]

Impairment in activities of daily living starts at an early stage in patients with PD and progresses as the disease continues to evolve. Motor activities such as walking and performing manual chores get affected. The activities that involve transfer, such as arising from or sitting on a chair, getting out of bed or turning in bed are also impaired, are complex and usually automated movements which patients with PD find difficult to perform. Normal sequential movements are hampered also by the presence of tremor. Complex motor activities that require mental effort such as planning and set shifting such as gardening and bathing tend to be affected to a larger extent. Nonmotor disabilities such as visual and executive dysfunction also contribute to motor impairment. Both physiotherapists (PTs) and occupational therapists (OTs) educate and train the patients with PD to manage motor impairment. Patients with PD have to be educated and counselled at earlier stages for optimum benefits in motor and nonmotor symptoms.^[14] Optimal delivery of rehabilitation requires a tailor-made, personalized approach in patients with PD.

Physiotherapy interventions

The cornerstone strategies that form the basis of physiotherapy in PD include exercise and compensatory strategy training (such as cueing). Visual rehabilitation is another important strategy as patients with PD are highly dependent on optimal vision.^[15]

The foremost step is patient education and devising an OT/PT program personalized to an individual patient's needs. The ParkFit program is an individualized training program administered by a PT to increase the level of physical activity. A randomized trial comparing this program to general physiotherapy intervention was shown to increase overall physical activity. There was also improvement in secondary outcomes monitored via the activity diary, activity monitor, and the 6-min walk test.^[16,17] Physiotherapy interventions include relaxation exercises, flexibility exercises, strengthening exercises, functional training, and balance training.

Physiotherapy and occupational therapy versus no therapy in mild-to-moderate PD was assessed by the Randomised controlled trial to assess the clinical- and cost-effectiveness of physiotherapy and occupational therapy in Parkinson's disease (PD REHAB) trial, a randomized controlled trial. In total, 762 patients were recruited from 38 sites in the United Kingdom.^[18] Patients who had mild-to-moderate PD with limitations in

activities of daily living were recruited and randomized to receive physical and occupational therapy versus no therapy. The trial did not show much clinical benefit in favor of therapy. A Cochrane systematic review compared physiotherapy versus placebo or no intervention in PD.^[19] This included 39 trials with 1827 participants. There was improvement in all walking outcomes. The Timed Up and Go (TUG) test also showed improvement in mobility and balance. Benefit was also seen in functional reach and Berg Balance scale (BBS). Unified Parkinson's Disease Rating Scale (UPDRS) also showed benefit. No differences were observed between various physiotherapy interventions. These benefits were present over the short term and most differences were small. These are the problems with most trials assessing physiotherapy in patients with PD. Most outcomes are measured over the short or medium term, and whether the small benefits imparted by the intervention sustain to long term remains unclear.

Patients with PD have desynchrony of leg muscles during initiation of movements with reduced peak torque production in knee extension, flexion, and ankle dorsiflexion. Gait patterns in PD are abnormal due to various reasons. These patients experience difficulty in shifting weight or initiating movements. They also have hypokinesia associated with diminished walking speed and step length. They undergo episodes of "freezing" during which there is a lack of or reduction in forward progression of feet despite an intention to walk. Up to 80% of patients with PD may experience "freezing" and festination.^[20,21] They also have impaired balance and postural reactions and decreased upright stance. Although freezing of gait responds to varying extent to medication as well as deep brain stimulation, self-management strategies remain vital in management.^[22] Conceptually, these strategies are used to shift the patient's motor control from habitual control (posterior putamen) to goal-directed control (anterior putamen).^[23] Cueing strategies are used during gait training. Cues are defined targets designed for movement that facilitate execution of gait initiation and propagation. These may include auditory cues (rhythmic music, metronome counting), visual cues (stepping over stripes on floor, focus on an object or color), tactile cues (tapping on the leg), as well as cognitive clues (such as mental image of appropriate step length). The Rehabilitation in Parkinson's Disease: Strategies for Cueing (RESCUE) trial was a single-blind, randomized, crossover trial that included 153 PD patients with Hoehn and Yahr stages 2–4.^[24] These patients were allocated to early training for 3 weeks using a cueing device at home followed by 3 weeks of training-free period. Patients in the late intervention arm underwent this in reverse order. Both groups had a subsequent 6-week follow-up without

training. There were small but significant improvement in the posture and gait score (PG score) after training. However, the effects diminished after intervention suggesting a need for continued training. Recently, laser shoes have also been devised as a means of external visual cueing.^[15]

Exercise therapy

Moderate-to-vigorous exercise has been shown to reduce the risk of development of PD.^[25] Exercise therapy improves function in patients with PD, resulting in improvement in falls, as well as UPDRS. A recent systematic review showed that exercise also improves nonmotor symptoms in PD including depression, fatigue, and apathy.^[26] However, no specific exercise program has been shown to be superior to the others. More rigorous randomized controlled trials are necessary to guide optimal exercise therapy in patients with PD.^[27] Several animal models have suggested the benefit of aerobic exercise.^[28] In the recently published Park-in-Shape trial, home-based high-intensity aerobic exercises were compared to nonaerobic intervention in 130 patients with mild PD for 6 months.^[29] The aerobic exercise group underwent stationary cycling and exergaming (exercise supplemented with gamified constituents), whereas the control group underwent stretching, flexibility, and remote exercises. The off-state Movement Disorder Society-sponsored revision of the UPDRS (MDS-UPDRS) revealed a difference of 4.2 points between groups in favor of aerobic exercise. Moreover, the addition of cognitive elements to exercise has also shown to improve both motor and cognitive effects in patients with PD.

The use of motivational apps for exercise trials with remote coaching by a physical therapist has also been shown to improve outcomes in sedentary people with PD.^[30]

Several other forms of exercise have also been studied in PD:

Treadmill training: The safety of treadmill training in patients with PD was studied in a phase II randomized clinical trial called Study in Parkinson Disease of Exercise (SPARX) trial.^[31] This trial enrolled patients with PD in stages 1–2 of Hoehn and Yahr classification. They were randomized into three groups: high-intensity treadmill training, moderate-intensity treadmill training, and wait-list controls. In the randomized A Treadmill Training Program Augmented by Virtual Reality to Decrease Fall Risk in Older Adults (V-TIME) trial, addition of nonimmersive virtual reality to treadmill training led to reduction in the risk of falls compared to treadmill training alone.^[32]

High-intensity resistance training: Fifteen patients with PD were prescribed 16 weeks of high-intensity exercise

training and compared to matched non-PD controls. This was found to improve physical capacity, muscle mass, as well as mitochondrial function.^[33]

Boxing training: This was assessed in a case series of six patients who attended 24–36 boxing training sessions for 12 weeks and showed improvement in five of 12 outcome measures over 24 and 36 weeks.^[34]

Hydrotherapy: This has also been studied in a small randomized trial that compared hydrotherapy versus land-based therapy in patients with mild-to-moderate PD and has possible additive benefit.^[35]

Exergaming: There are recent trials of role exergame-based therapy in PD, which have shown that exergaming is be feasible, safe, and at least as effective as traditional PD rehabilitation.^[36] Exergame therapy can also be provided at home which can be adapted to our scenario with limited resources which is a major barrier of traditional rehabilitation methods.

Lee Silverman Voice Treatment-BIG (LSVT-BIG): Persons with PD perform small amplitude and slow movements. To bypass this, an alternative therapy based on patients with PD performing large-amplitude limb and body movements was developed called LSVT-BIG. BIG signifies big movements. A systematic review and meta-analysis incorporated three randomized trials and concluded that such amplitude-based exercise could improve motor function in individuals with PD.^[37]

Occupational Therapy

Occupational therapy relies on a mix of strategies including compensatory strategies in daily activities (i.e., movement and cognitive strategies and planning), adaptation of daily routines, as well as adaptation of the environment. OT mainly focuses on enhancing participation in activities of daily life through repeated activities. A recent systematic review examined the effect of occupational therapy on patients with PD. Ten studies were included representing data from 1343 patients. Occupational therapy was shown to improve perceived occupational performance.^[38]

Speech and Language Therapy

Patients with PD often experience hypophonia as well as dysarthria. American Academy of Neurology practice guidelines concluded that there is low quality to evidence to support improvement of volume via speech therapy in patients with PD.^[39] The evidence for the same is in the form of two small trials that compared speech therapy versus no therapy in patients with PD. In one trial, speech therapy focused on pitch and volume (prosody

of speech) along with visual feedback.^[40] In the second trial, the LSVT was used to improve loudness.^[41] No specific speech therapy has been shown to be superior to the other.

A Cochrane review in 2012 on the role of speech therapy included six trials involving 159 patients. Data were excluded from one trial because of changes in patient numbers and from another because the data were not in an appropriate format. A difference of 12.5 points between mean changes in favor of the LSVT-LOUD group was reported for a speech sample overlaid with Babble noise but not for two additional noise conditions under which speech samples were analyzed.^[42] The Cochrane review concluded that in view of small patient numbers in these trials, evidence was not sufficient to support or refute the efficacy of any form of speech and language therapy in patients with PD.^[43]

Nutrition should always be given high priority in these patients in particular with advanced PD in view of poor intake because of swallowing dysfunction and poor absorption of levodopa with high intake of amino acids. High-fiber diet also helps in managing constipation in these patients.^[44]

Tai chi and Qigong

There is moderately strong evidence for tai chi and qigong training as an alternative and supportive treatment in patients with PD. In a recent study from National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, it has been shown that combination of tai chi and qigong might be useful in improving psychological function, QoL, anxiety, as well as motor symptoms in PD.^[45,46]

Several studies support the benefit of tai chi in PD. A randomized trial of 195 participants who has mild-to-moderate PD determined that twice-weekly tai chi training for 6 months was better than resistance training in terms of postural stability, functional reach, as well as stride length.^[47] In another meta-analysis, 21 studies were assessed and 15 trials were included in the meta-analysis with a total of 725 participants.^[48] Tai chi/qigong were found to impart modest benefits in terms of UPDRS III, TUG test, 6-min walk test, falls, as well as balance. Studies that have compared the effectiveness of different forms of exercise therapy do not suggest the superiority of one form over the other.

Dance Therapy

Patients with PD have been shown to be motivated to attend dance classes regularly, with good compliance and low dropout rates, and to continue with it even after

the study period.^[49] Each dance form focuses on various movements that may be PD-specific. For example, tango focuses on movement initiation and cessation, directional change, and turning, whereas ballet focuses more on flexibility and balance. Dance also provides auditory cueing. In a study of dance therapy compared with traditional rehabilitation, 16 patients with PD with recent history of falls were randomized to receive either dance therapy or traditional rehabilitation for 10 weeks. These patients were followed up for both motor and cognitive outcomes up to 8 weeks. Significant changes were found in the dance therapy group in 6-min walk test, TUG test, Trail Making Test-A, and Trail Making Test-B.^[50] In a 2014 systematic review and meta-analysis of randomized controlled trials, effectiveness of dance compared to other exercise therapy or no intervention was assessed.^[51] Five trials were included in the meta-analysis. Dance significantly improved UPDRS motor scores, BBS, and gait speed when compared with no intervention. When compared with other exercise interventions, significant improvements in BBS and QoL (PDQ-39) were found. Dance showed short-term improvement.

In another 2019 meta-analysis that included seven randomized trials, dance therapy showed improvement in executive function but not in global cognitive function, apathy, and depression.^[52]

Music Therapy

Music leads to elicitation of movement in response to it, stimulating interaction between the perceptual and the action systems. Music therapy aims at improving motor function in patients with PD. Music-based therapy includes listening to music, along with singing and playing rhythm, as well as percussion instruments. A systematic review and meta-analysis of clinical trials that assessed the impact of music therapy on motor and cognitive outcomes in patients with PD included eight studies including 241 subjects concluded that music therapy had a positive outcome on motor dysfunction, leading to improvement in BBS, PDQ39, TUG, and UPDRS.^[53]

Role of Yoga in Parkinson's Disease

Yoga has been practiced in India since 2000 BC but is becoming popular lately in the Western world. It has been proved in recent studies that yoga improves functional mobility, balance, and reduces the fear of falling. It has been proved by various studies that yoga is safe and beneficial to PD populations.^[54,55] Iyengar yoga has also been used in PD. However, there are no definite yoga protocols although some studies have used protocols designed and validated for their specific population of patients.^[56]

A recently published randomized trial compared the effects of a mindfulness yoga program compared to stretching and resistance training in patients with mild-to-moderate PD. A total of 187 patients were recruited and the training was given over 8 weeks.^[56] Yoga patients had better outcomes in terms of anxiety, depression, as well as disease-related QoL parameters. Another recent trial of effect of yoga therapy for 8 weeks has also shown significant improvement in nonmotor symptoms as well as in QoL for patients with PD.^[57]

Future Directions

There is an emerging role of newer strategies in the field of PD rehabilitation. Visual rehabilitation and cueing can be delivered effectively in an on-demand manner when they are needed most, and exergaming are some of these newer and emerging rehabilitation techniques for patients with PD. Home-based rehabilitation delivery and care protocols will be the most crucial in Indian settings to make a real impact on improving the QoL of patients with PD. Thus, in our opinion, future clinical trials should focus on adapting and delivery of these existing therapies as home-based rehabilitation and in PD patients with cognitive impairment. Prospective studies directed at long-term implications of these rehabilitative strategies are required in patients with PD.

Limitations of Rehabilitative Strategies So Far

Despite rehabilitative strategies offering multipronged and nonpharmacological benefits to patients with PD, they have certain limitations. Most of these therapies have been studied in early stages of severity so benefit in advanced stages is not known. In addition, the benefit size shown by these strategies are mostly small. Moreover, the effect has been beneficial in the short-term but long-term benefits remain unclear. In addition, how these strategies affect PD individuals who have cognitive impairment is not answered by the evidence so far. Despite these limitations, there is enough evidence that has emerged from literature to recommend rehabilitation as an early strategy in patients with PD.

Conclusions and Authors' Perspectives

Rehabilitation strategies form one of the pillars of management in patients with PD. Rehabilitation is also crucial for the management of axial features such as freezing of gait, hypophonia, dysphagia, and postural imbalance in advanced PD that respond poorly to pharmacotherapy. There is mounting evidence to

support physical therapy and occupational therapy in these patients. With the recently published Park-in-Shape trial, there is now evidence to recommend high-intensity aerobic training in patients with mild disease, aimed at modification of motor symptoms. Various other rehabilitation strategies including music, dance, yoga, speech, and language are also available in the therapeutic armamentarium and should be offered to patients with PD. In spite of robust evidence for rehabilitation in patients with PD, this therapeutic modality is still underutilized. The aim of this review was to emphasize the role of rehabilitation in these patients and in particular in resource-poor countries. We strongly advocate that the rehabilitation should be offered to these patients right from the start to encourage an active lifestyle and to improve QoL.

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Conflicts of interest

There are no conflicts of interest.

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