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ROLE OF RESISTANCE TRAINING IN PARKINSON DISEASE TO IMPROVE BALANCE, MOBILITY AND QUALITY OF LIFE

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Abstract

The primary objective of the present study is to evaluate the effectiveness of resistance exercises training to improve balance, mobility or quality of life in Parkinson disease patients. Pre and post evaluation was performed on 30 participants using the Timed up and go test (TUG) and SF- 36 Scale. The Study was statistically significant improvements in mobility, balance and quality of life ($p < 0.05$). improving functional ability. At the end of 12 week intervention, the resistance training showed improvement in the symptoms. Based on the results the study there was a significant improvement lower TUG scores, indicating better functional mobility, and higher SF-36 scores, indicating improving in overall quality of life associated with Parkinson disease.

INTRODUCTION

Parkinson's disease has a large effect on society. In terms of the number of people affected, this disease is a common condition, with approximately 6·1 million people who had been affected worldwide in 2016[(1)]. The earliest stages of Parkinson's disease can be difficult to recognise, as reflected by the long delay (average 10 years) that typically separates the person's first noticeable symptom from the timing of diagnosis. Parkinson disease (PD) is the most common neurodegenerative disorder(2). Neuronal loss in the substantia nigra, causing striatal dopamine deficiency, and intracellular inclusions containing aggregates of alpha-synuclein are the neuropathological hallmarks. Multiple other cell groups throughout the central and peripheral autonomic nervous system are also involved, probably already in early disease. Although clinical diagnosis rests on the presence of cardinal sign include bradykinesia, resting tremor and rigidity and other. PD is associated with non-motor symptoms (such as sleep disorder and cognitive dysfunction) adding to overall disability(2,3).

Parkinson's disease (PD) is a progressive and multifactorial neurodegenerative disorder that develops through the interaction of genetic susceptibility and environmental influences. Several pathological mechanisms have been implicated in its development, including mitochondrial dysfunction, oxidative stress, abnormal protein accumulation, impaired autophagy, and chronic neuroinflammation. Reducing the impact of PD requires both preventive strategies aimed at minimizing modifiable risk factors and therapeutic approaches targeting the biological pathways involved in disease progression(4,5). The motor manifestations of Parkinson's disease primarily arise from a disruption of dopaminergic neurotransmission within the basal ganglia. Degeneration of the substantia nigra damages the nigrostriatal pathway, leading to a substantial reduction in dopamine levels within the striatum. This dopaminergic deficiency alters the balance between excitatory and inhibitory neural pathways involved in movement control, resulting in characteristic symptoms such as bradykinesia, rigidity, tremor, and postural instability. The loss of striatal dopamine is therefore considered one of the central neurochemical mechanisms underlying the motor impairments associated with Parkinson's disease(5,6,7,8).

In Parkinson's disease, the cardinal motor symptoms can substantially interfere with an individual's ability to perform ADL activities. These impairments often lead to reduced spontaneous movement, postural rigidity, slower walking, and difficulty initiating or terminating movements. In addition to affecting mobility, the disease may also alter facial expressions and reduce the ability to modulate voice, thereby impacting communication and social interaction. PD is characterized by a wide range of motor and non-motor manifestations. Alongside movement-related impairments, patients may experience sleep disturbances, depression, anxiety, and cognitive dysfunction, which can further reduce overall quality of life[1,2,3,9,10]. Because the presentation and progression of symptoms vary considerably.among individuals, treatment and rehabilitation strategies must be tailored to the specific needs of each patient[11]. The severity of Parkinson's disease differs from person to person. While some individuals experience only mild functional limitations, others may develop significant motor and neurological impairments that affect independence and daily functioning. This variability highlights the importance of individualized management approaches to achieve optimal therapeutic outcomes[12]. Gait and balance are among the most important indicators of functional ability and independence in individuals with neurological disorders[13]. Patients with Parkinson's disease frequently demonstrate abnormalities in gait, including difficulty initiating and stopping walking, shuffling steps, reduced stride length, and decreased mobility of the hip and knee joints due to increased muscle rigidity. A characteristic stooped posture is also commonly observed, which further compromises movement efficiency and stability[14]. Balance impairments in Parkinson's disease are often associated with deficits in proprioceptive awareness, altered sensory processing, and difficulties integrating sensory and muscular feedback. These factors contribute to an increased risk of falls and reduced confidence during mobility-related activities. The management of Parkinson's disease primarily focuses on symptom control and functional improvement. Pharmacological interventions, such as levodopa and dopamine agonists, are widely used to alleviate motor symptoms, while surgical procedures such as deep brain stimulation may be considered in selected cases. Although these treatments can effectively manage symptoms, they do not prevent or stop disease progression. A comprehensive treatment program often includes non-pharmacological interventions alongside medical management. Physical therapy plays a vital role in rehabilitation and may involve techniques such as functional electrical stimulation, electrical muscle stimulation, proprioceptive neuromuscular facilitation (PNF), and neurodevelopmental approaches like Bobath therapy[15]. Additionally, aerobic exercise, resistance training, treadmill training, balance exercises, gait training, and hydrotherapy are commonly incorporated into rehabilitation programs. Through these interventions, physical therapists aim to improve mobility, enhance functional performance, and support the maintenance of independence in activities of daily living.[16]

In this study, the main aim is to find out whether the problems in daily living activities faced by Parkinson's patients can be improved through resistance training. Therefore, in our study, we will provide patients resistance training. Any intervention that can safely increase activity, improve strength, or enhance balance could have a meaningful clinical impact. This motivates the current interest in training paradigms.

Resistance training[17] is a modality of exercise that has been shown to improve most health- and skill-related components of physical fitness. Health-related components include muscle strength, endurance, hypertrophy, flexibility, body composition, and aerobic capacity. Skill-related components include speed, agility, power, balance, and coordination. In order to maximize the benefits of resistance training, adherence to three basic principles is mandatory. These principles are 1) progressive overload, 2) specificity, and 3) variation[18]. Individuals with Parkinson's disease commonly demonstrate lower levels of muscle strength and power compared to healthy individuals of a similar age group. This decline in muscular performance can negatively affect several aspects of physical function, including walking ability, postural stability, balance confidence, and overall functional independence. As a result, patients may experience greater difficulty performing daily activities and may be at an increased risk of falls[19]. Resistance training is a form of exercise designed to improve muscular strength, power, and physical function through the repeated application of external resistance. Regular exposure to progressive loading stimulates muscular adaptations, including increased muscle fiber size, improved motor unit activation, and enhanced musculoskeletal performance. In addition, resistance training contributes to the maintenance of bone health and tendon integrity, which are important for overall physical function[20]. In the context of Parkinson's disease, resistance training has emerged as an important rehabilitation strategy. By addressing muscle weakness associated with bradykinesia, reduced physical activity, and prolonged disuse, it can help improve muscle strength, joint mobility, and functional endurance. These improvements may translate into better performance during activities of daily living and enhanced mobility[22]. Furthermore, strengthening exercises have been shown to support gait performance, improve balance, and reduce the likelihood of falls[21]. Studies also suggests that resistance training may positively influence certain non-motor manifestations of Parkinson's disease, including cardiovascular autonomic dysfunction[23], which can significantly affect quality of life. Studies indicate that moderate-intensity resistance training performed two to three times per week for approximately eight to ten weeks[19] may produce meaningful functional benefits in individuals with early to moderate stages of Parkinson's disease[24].

After conducting the interventions or exercises, the tool we will use to measure the effects is the TUG test and the SF-36 scale. The TUG has a high correlation with other proven tests that measure pure gait speed for longer lengths such as a 10-m walk. TUG could have utility in the assessment of patients at risk for health decline and as a baseline against which to measure treatment progress toward improved function and quality of life[25,26] and the SF-36 the 36-Item Short-Form Health Survey (SF-36) is the most widely used includes eight health concepts judged as the most affected by disease and treatment, selected from 40 concepts assessed in the Medical Outcome Study[27,28]. Together, these outcome measures allowed for a comprehensive assessment of both subjective and objective improvements.

The proposed study is expected to provide valuable insights that can enhance clinical practice and improve patient outcomes, making it a meaningful contribution to the field.

AIM & OBJECTIVES OF THE STUDY

To observe or assess the efficacy of resisitance training in Parkinson disease.

MATERIALS AND METHODOLOGY

The quasi experimental pre- post intervention used in study. The study was designed as a randomized control trail in which data is collected at a single moment in time to evaluate the relationship between variables. The study used randomized sampling as its sample design. The participants were individuals those who had symptoms of Parkinson disease related mobility, balance or functional limitation issues. These people were involved in the study to see how resistance exercises training affected their condition. Paper and pencil for data recording, chair for participants to sit on during assessment and treatment, a treatment couch, resistace band, dumbbells, assessment form, consent form, towel for comfort or support were all used in the study.

SELECTION CRITERIA:

Inclusion Criteria: The study would likely include patients who meet specific criteria such as:

- Patient with Parkinson disease
- Age group of 45 – 75 years
- Patients with normal vitals
- Patients with no other complications

Exclusion Criteria: Certain factors exclude patients from the study, such as:

- Patient having chronic disease
- Patient having multiple attack of neurological disease like stroke
- Age group- below 45 and above 75 age group not included
- Patient with secondary complications
- Unconcious and unoriented patient

SAMPLE SIZE AND STUDY DURATION

For this study the sample size was 30 people the individual were chosen at random from the research population to ensure representativeness and adequate data for analysis. The Study was carried out (5 times a week) for 12 weeks, individuals in a clinical environment had therapy as part of the study in pacific college of physiotherapy, pacific medical university (Udaipur), after obtaining ethical committee approval dated 6-10-2025, **PMU/IEC/MPT/2025/46**. All participants completed information and consent form at recruitment. This time frame allowed for evaluation of subjects response to the therapy as well as any changes in their pain, range of motion and functional ability. Each session was scheduled for 40-45 minutes. This period was set aside to ensure the patient had enough time to execute the procedure correctly.

PROCEDURE

Permission for conduct Study is taken from the institutional ethical committee of PMCH **(PMU/IEC/MPT/2025/46)**, Pacific medical university bhilo ka bedla Udaipur(RAJ).

Individuals Diagnosed with Parkinson disease related mobility, balance or functional limitation issues by the Physiotherapy department, Neurosciences department OPD; initially assessed for the inclusion or exclusion criteria. Prior to the treatment procedure, all participants were informed about the purpose, procedures, potential benefits, and possible risks of the study. Written informed consent was obtained from each participant prior to enrollment.

30 subjects were selected on the basis on inclusion criteria treated with Resistance training

Weeks 1-4: Adaptation Phase

1. Sit-to-Stand (chair squats) **-** Quadriceps, glutes
2. Seated Leg Extension (with resistance band/ankle weights) **-** Quadriceps
3. Heel Raises (standing, standing, support if needed) **-** Calves
4. Seated Row (resistance band/machine) **-** Upper back, posture
5. Wall Push-Ups **-** Chest, arms
6. Bicep Curls (band/dumbbell) **-** Arms
7. Bridging **-** Glutes, core

Weeks 5-8: Strength Development Phase

1. Step-Ups (low step, progress gradually)
2. Squats with Resistance Band/Dumbbell (light load)
3. Seated Row / Resistance Band Pulls
4. Modified Push-Ups (wall or table height, progress to knee push-ups if able)
5. Shoulder Press (band/dumbbells, seated for safety)
6. Deadlifts with Light Dumbbell/Weighted Object (functional lifting)

Weeks 9-12: Progression & Functional Strength Phase

1. Weighted Sit-to-Stand (holding dumbbell/light weight at chest)
2. Lunges (static, holding support if needed)
3. Step-Ups with Light Weights (progress height carefully)

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4. Resistance Band Rows (higher resistance)
5. Chest Press (band or machine)
6. Overhead Dumbbell Press (seated or standing with support)
7. Core Stability: Plank on Knees / Bird Dog (low intensity)

RESULTS

The shift in score between pre-rehab and post-rehab of Parkinson disease and continuous demographic variables was evaluated by comparing using paired t- test.

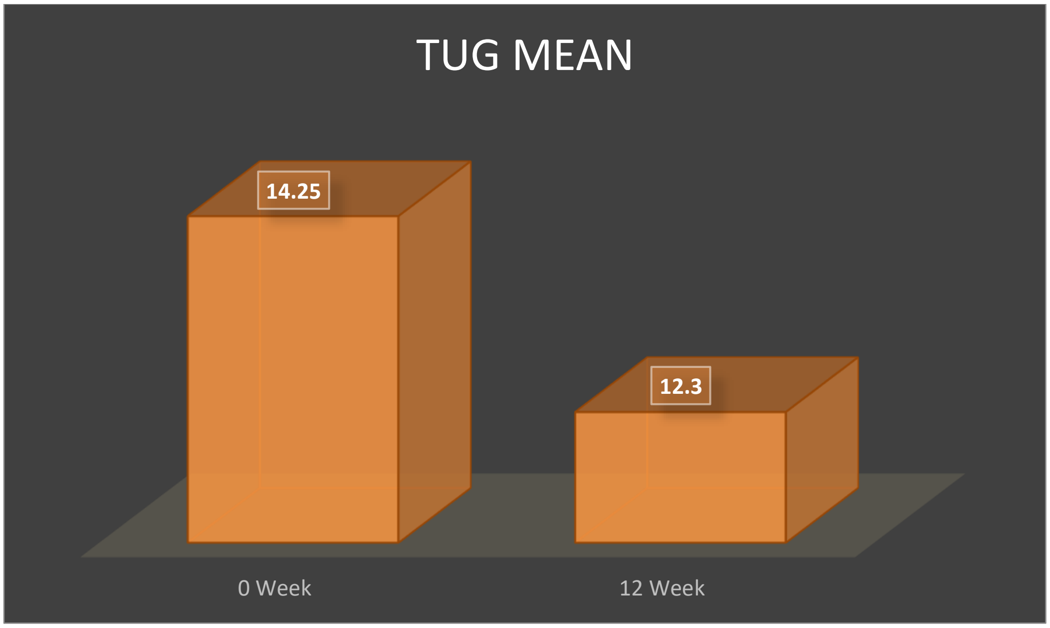
Descriptive statistics, such as mean, standard deviation, frequency, and percentage, were used to summarise the demographic characteristics of the participants, including age and gender distributions.To analyse within-group (intra-group) changes, a paired-samples t-test was used. This test compared the pre-intervention and post-intervention values within group to determine whether the improvement over time was statistically significant.

A total of 30 participants were included in the study, 15 females and 15 males. In the 45-50 years age group 7 participants, 51–55 years age group,6 participants, 56-60years age group, 6 participants,61-65 years age group, 4 participants, 66-70 years age, 4 participants,71-75 years age; 3 participants were participated.

TABLE 1: TIMED UP AND TEST (TUG) (0 WEEK VS 12 WEEKS)

Timepoint	N	Minimum	Maximum	Mean	Std. Deviation	t-value	p-value	Result
0 Week	30	12.5	16.0	14.25	1.05	2.68	0.05	Significant
12 Week	30	10.7	14.0	12.30	1.10			
Overall	60	10.7	16.0	13.27	1.45			

GRAPH 1:TUG (0 WEEK VS 12 WEEKS)



This table and graph show the improvement in functional mobility. At baseline, the mean TUG value was 14.25 seconds, which reduced to 12.30 seconds after 12 weeks,indicating better improvement. The minimum and maximum values also decreased, showing consistent improvement across participants. The t-value of 2.68 and p-value of 0.05 indicate that the improvement is statistically significant. The graph shows a more pronounced downward trend, suggesting greater improvement in mobility.

TABLE 2: SF-36 (0 WEEK VS 12 WEEKS)

Timepoint	N	Minimum	Maximum	Mean	Std. Deviation	t-value	p-value	Result
0 Week	30	45	58	52.40	3.30	2.95	0.05	Significant
12 Week	30	58	68	64.80	3.10			
Overall	60	45	68	58.60	6.20			

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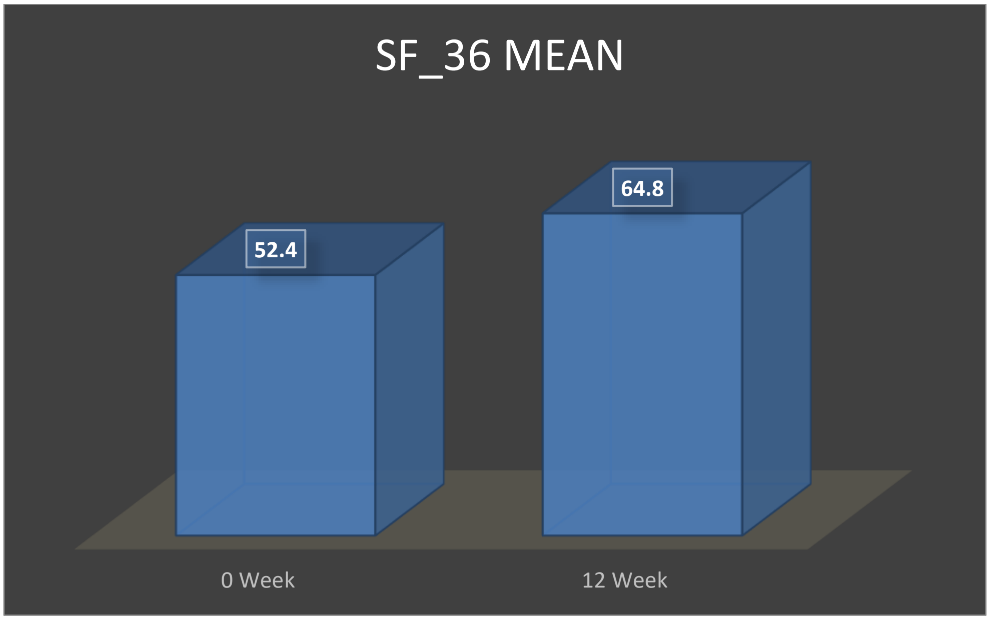
GRAPH 8: SF-36 (0 WEEK VS 12 WEEKS)



This table and graph show the changes in quality of life. The mean SF-36 score increased from 52.40 at baseline to 64.80 after 12 weeks,indicating that participants experienced greater improvement in quality of life. The minimum and maximum scores also improved significantly.

The statistical analysis ($t = 2.95$, $p = 0.05$) confirms that this improvement is significant. The graph shows a strong upward trend, clearly indicating better improvement in participants.

DISCUSSION

The present study was design to examine the effects of Resistance exercises training, in individuals affected with Parkinson disease related mobility, balance or functional limitation issues. A total of 30 patients were included and assessed using pre- and post-intervention outcome measures. The outcome measures used were using the timed up and go test and SF-36 scale. The findings suggest a significant reduction in lower TUG scores, indicating better functional mobility, and higher SF-36 scores, indicating improving in overall quality of life. These data suggest that the application of resistance exercises training is an effective intervention.

Findings of the present study are supported by previous literature that has emphasized

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the benefits of exercise therapy for patients affected with Parkinson disease. The finding of the presented study also supported by Strand KL et.al,(2021), which discussed the effects of periodized resistance training with or without functional training improves functional capacity, balance and strength in Parkinson's disease and summarizes that both exercise (Periodized resistance training with functional training or Periodized resistance training without functional training) strategy can be equally effective in improving functional capacity, balance and strength. As a result, resistance exercises can play an important role in improving functional ability and reducing functional limitations in individuals affected with Parkinson disease. The intervention period was limited to 12 weeks and both rehabilitation protocols produced satisfactory clinical improvements. Future studies with larger sample sizes and longer follow-up durations, preferably extending up to six months to one year, are recommended to better understand the long-term effectiveness of these interventions.

The improvement in mobility and balance may be due to better muscle performance, improve muscular strength, power, and physical function through the repeated application of external resistance, and increased tolerance to physical activity developed during the training period. Regular exposure to exercise may also help patients while walking and improve their ability to perform daily activities. Similarly, the reduction in TUG scores indicates improvement in disability, and activity limitations, which may be related to improved muscle strength, joint mobility, and functional endurance. Overall, the findings of this study suggest that regular and supervised exercise plays an important role in improving functional outcomes in Parkinson disease patient. the present study highlight the role of exercise as a key component of rehabilitation in individuals with Parkinson disease. Parkinson disease arises from a disruption of dopaminergic neurotransmission within the basal ganglia. Degeneration of the substantia nigra damages the nigrostriatal pathway, leading to a substantial reduction in dopamine levels within the striatum. This dopaminergic deficiency alters the balance between excitatory and inhibitory neural pathways involved in movement control, resulting in characteristic symptoms such as bradykinesia, rigidity, tremor, and postural instability. Because these impairments develop slowly over time, improvements in functional ability occur gradually as well.

The improvements observed after 12 weeks of structured exercise training in the present study suggest that regular and supervised exercise can produce meaningful changes in mobility, balance and functional activities or quality of life even within a relatively short intervention period. Exercise programs can help improve muscle strength, joint mobility and neuromuscular coordination, which together contribute to better mobility and increased functional endurance in individuals affected with Parkinson disease.

CONCLUSION

The present study aimed to examine the effects of Resistance exercises training, in individuals affected with Parkinson disease related mobility, balance or functional limitation issues. Parkinson disease often causes reduced walking ability, postural rigidity, muscle weakness, and functional limitations (i.e. difficulty in initiating or terminating movements), which can affect daily activities and quality of life. Therefore, this study evaluated changes in mobility, balance and quality of life using the timed up and go test and SF-36 scale after a 12-week supervised exercise program. The findings of the interventions indicate that exercise program resistance exercises training lead to improvements in mobility, balance, functional ability and quality of life.

Based on these findings, it can be concluded that resistance training in PD Patients are clinically safe and beneficial, resistance exercises more effective in improving functional outcomes and activity of daily living in patients affected with Parkinson disease. Therefore, resistance exercises should be prioritized in evidence-based rehabilitation programs to facilitate optimal recovery, improve functional ability, and support a safe and efficient quality of life while reducing the risk of injury and functional disability.

The findings and results of the present study are clinically important for physiotherapists involved neuro-musculoskeletal, neurological rehabilitation, as well as for rehabilitation professionals and rehabilitation specialists. The use of resistance exercises may contribute to improving treatment strategies in the field of neuro-rehabilitation. The results of this study can be applied clinically to assist healthcare professionals in the better management. However, further studies with a larger sample size and more rigorous inclusion and exclusion criteria are required to validate and generalize these findings.

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