



# Effectiveness Of Two Structured Balance Rehabilitation Protocols On Dynamic Balance And Functional Mobility In Parkinson's Disease: A Comparative Study

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## Abstract

**Background:** Parkinson's disease (PD) is a progressive neurological condition associated with impaired balance, altered gait and decreased functional mobility. These problems increase the likelihood of falls and can negatively affect quality of life. Exercise-based physiotherapy programs emphasizing balance and strengthening are commonly used in rehabilitation practice; however, comparative evidence between different structured balance rehabilitation protocols remains limited. **Aim:** To compare the effectiveness of two structured balance rehabilitation protocols on dynamic balance and functional mobility in individuals with Parkinson's disease. **Methods:** Sixty individuals diagnosed with Parkinson's disease (Hoehn and Yahr stage I-II) aged 50 to 70 years participated in the study. Participants were randomly allocated into two groups (n=30 each). Group A received an Otago-based balance and strengthening program, while Group B received task-oriented functional balance training with progressive resistance exercises. Both groups underwent intervention for 40 minutes per session, three sessions per week for six weeks. Outcome measures included the Timed Up and Go Test (TUG) and Dynamic Gait Index (DGI). Statistical analysis was performed using paired and unpaired t-tests with significance set at  $p < 0.05$ . **Results:** Both intervention groups showed statistically significant improvements in TUG and DGI scores after six weeks of training. However, the Otago-based balance training group demonstrated greater improvements compared to the functional balance training group. **Conclusion:** Structured balance rehabilitation programs are effective in improving functional mobility and gait in individuals with Parkinson's disease. The Otago-based balance training program demonstrated superior outcomes and may be considered a preferred rehabilitation strategy.

**Keywords:** Parkinson's disease, balance training, functional mobility, gait, rehabilitation, exercise therapy.

## Introduction

Parkinson's disease is among the most common neurodegenerative disorders worldwide and mainly affects the ageing population. It occurs due to degeneration of dopaminergic neurons in the substantia nigra, which leads to reduced dopamine activity in the basal ganglia. This disruption in motor control manifests as tremor, rigidity, bradykinesia, and postural instability<sup>(1)</sup>.

Among these symptoms, postural instability and gait disturbances are major contributors to reduced functional independence and increased risk of falls<sup>(2)</sup>. Individuals with Parkinson's disease often experience difficulty maintaining balance during walking, turning, and performing functional activities. These impairments significantly affect their quality of life.

Physiotherapy plays a vital role in the management of Parkinson's disease. Exercise interventions that include balance training, gait practice and strengthening exercises have been shown to improve mobility and reduce fall risk. Structured programs such as the Otago Exercise Program emphasize progressive strengthening and balance exercises aimed at improving postural stability. Another commonly used rehabilitation approach is task-oriented functional balance training combined with resistance exercises. This approach focuses on performing functional tasks that simulate daily activities, thereby improving strength, coordination, and mobility<sup>(2)</sup>.

Although both approaches have demonstrated positive effects, limited research has directly compared these two rehabilitation approaches in individuals with Parkinson's disease. Therefore, the present study aimed to compare the effectiveness of an Otago-based balance training program and task-oriented functional balance training with resistance exercises on dynamic balance and functional mobility in individuals with Parkinson's disease.

**Aim:** To compare the effectiveness of two structured balance rehabilitation protocols on dynamic balance and functional mobility in individuals with Parkinson's disease.

**Objectives:** 1. To compare the effectiveness of two structured balance rehabilitation protocols on dynamic balance in individuals with Parkinson's disease using timed get up and go test.

2. To compare the effectiveness of two structured balance rehabilitation protocols on functional mobility in individuals with Parkinson's disease using Dynamic Gait Index

## METHODOLOGY

**RESEARCH DESIGN:** Experimental study.

**SOURCE OF DATA:** The subjects with Parkinson's patients were taken from the Parkinson's society, hospitals and old age homes in metropolitan city.

**TYPE OF DATA:** The data was primary which was collected by the principle investigator.

**DURATION OF STUDY:** The study was conducted for 40 minutes per session in a day, 3 days per week for 6 weeks, which was given to both the groups. The total duration of the study was 2 years.

**SUBJECTS:** Both male and female subjects of age group between 50 to 70 years diagnosed with Parkinson's disease were included for this study.

**SAMPLE SIZE:** With Parkinson's disease aged between 50 to 70 years, n=60, were included for the study and alternately assigned into 2 groups with 30 subjects in each group.

**SAMPLING METHOD:** The subjects who satisfied with inclusion criteria were assigned into 2 groups with Purposive Sampling. Random allocation {Even- odd methods (Even numbers in group A and Odd numbers in group B on arrival of the patient)}

## SELECTION CRITERIA: INCLUSION CRITERIA.

The inclusion criteria for this study were as follows:

1. Age: 50 to 70 years<sup>[4]</sup>.
2. Berg Balance score: 21-40 (Medium risk of fall.)<sup>[12]</sup>
3. A score of 21 or higher on mini mental state examination
4. Patient with normal sensation.
5. Patient with Hoehn and Yahr scale with grade III and IV.<sup>[4]</sup>
6. Patient is in the ON period (2 to 3 hours after taking medications.)<sup>[13]</sup>

## □ EXCLUSION CRITERIA

Subjects were excluded if they had:

1. Patient with orthopaedic problems which will affect the intervention.
2. Patient with history of any surgery which are limiting the balance.
3. Non cooperative patients.
4. Patients with diagnosed diabetic neuropathy and Peripheral neuropathy.

## MATERIALS USED

Following materials were used for the recording purpose –

- Consent form
- Stopwatch
- Chair with straight back without arm rest. (Hip and knees should be 90 degrees)
- Chair with straight back with arm rest.(Hip and knees should be 90 degrees)
- Weight cuffs. (Half kgs)
- Plinth.( Height should be as the level of sink of the kitchen).

## PROCEDURE

The study was conducted after obtaining the approval from the Institutional Ethical Committee (IEC). The patients from Parkinson's society, old age homes and hospitals with Parkinson's disease were selected and screened for the inclusion and exclusion criteria. Those subjects who satisfied the inclusion criteria were included for the study. Total 60 subjects (n=60), were included for the study and the written informed consent was obtained from all of the sixty subjects after they were explained about procedure of the study. The selected subjects were alternately allocated into group A and B with 30 subjects in each group. Group A received Otago exercises which contains strengthening and balance exercises. Group B received Task oriented functional balance training with resisted exercises. with strengthening exercises, which contains exercises of balance and strength training. Each subject in both the groups received an exercise activity booklet of the respective exercise program, with illustrations and Procedure about the program. The subjects in each group were assessed for the baseline measurements with berg balance scale and functional outcome (Timed get up and go test and Dynamic Gait Index) before starting on with exercise program. The subjects in both the group were explained about the study and intervention in the language best understood by them. They were encouraged to clarify questions regarding the study if any. The post intervention measurements were recorded 6 weeks after intervention.

After that every alternate participants were allocated to group A and rest of participants were allocated in group B. Group A participants underwent Otago exercises and group B participants underwent Task oriented functional balance training with resisted exercises. with strength training.

Exercises included in otago exercises were= Strength Exercises:

1. Front Knee Strengthening Exercise
2. Back Knee Strengthening Exercise
3. Side Hip Strengthening Exercise
4. Calf Raises – Hold Support and then progress to without support
5. Toe Raises – Hold Support and then progress to without support.

Balance exercises:

1. Knee Bends – Hold Support and progress without support
2. Backwards Walking – Hold Support and then progress to without support.
3. Walking and Turning Around.
4. Sideways Walking
5. Heel Toe Standing – Hold Support and progress to without support
6. Heel Toe Walking – Hold Support and progress to without support
7. One Leg Stand – Hold Support and progress to without support
8. Heel Walking – Hold Support and progress to without support
9. Toe Walking – Hold Support and progress to without support
10. Heel Toe Walking Backwards: With support and without support
11. Stand To Sit – Two Hands, One Hand and then No support
12. Stair Walking: with support then progress to without support.

Exercises included in Task oriented functional balance training with resisted exercises. with strength training were:

Task oriented functional balance training with resisted exercises.:

1. Half Squats
2. Heel lifts
3. Toe lifts
4. Side kicks
5. Back kicks
6. Side lunges
7. Standing feet together
8. Stand with one foot a half step ahead
9. Heel to toe standing
10. High step marching
11. Sit to Stand.

Strengthening exercises:

1. Heel and toe raises: (Progress by increasing the repetitions)
2. Squats: (Progress by increasing the repetitions)
3. Hip Extension
4. Lunges (side lunges): (Progress with increasing repetitions).

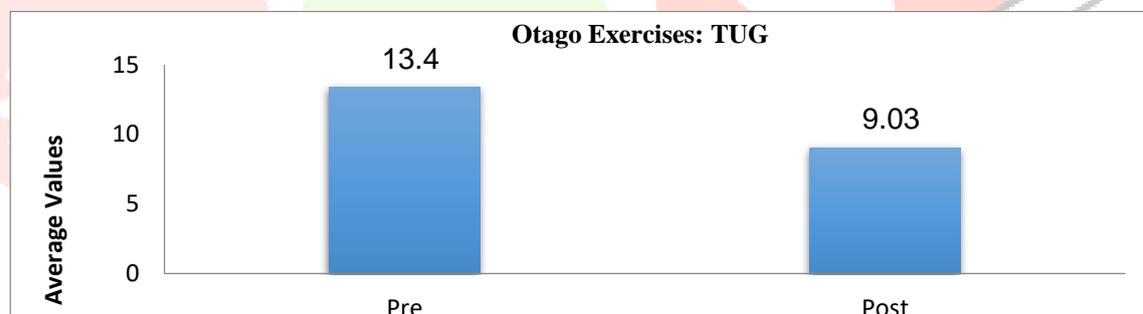
DATA ANALYSIS AND RESULTS

Once Data was collected, it was analyzed using Stastical Package of social service (SPSS) version 20. Paired t-test is used to analyze the difference between pre and post measurements within the group, and unpaired t-test is performed to analyze the effectiveness of the Otago exercises when compared with the Task oriented functional balance training with resisted exercises. with strength training exercise. Various statistical measures such as mean, standard deviation (SD) and test of significance were utilized to analyze the data. The results were concluded to be statistically significant if,  $p < 0.05$ .

Table 1: Showing effectiveness of Otago Exerises on Timed Get Up and Go test in Parkinson’s Patients.

GROUP A	Pre treatment Mean $\pm$ SD	Post treatment Mean $\pm$ SD	p value ( $<0.05$ )	Result
Timed Get Up and Go test	13.4 $\pm$ 2.17 secs	9.03 $\pm$ 0.7 secs	0.00	Extremely significant

Graph 1: Showing effectiveness of otago exercises on Timed get up and go test

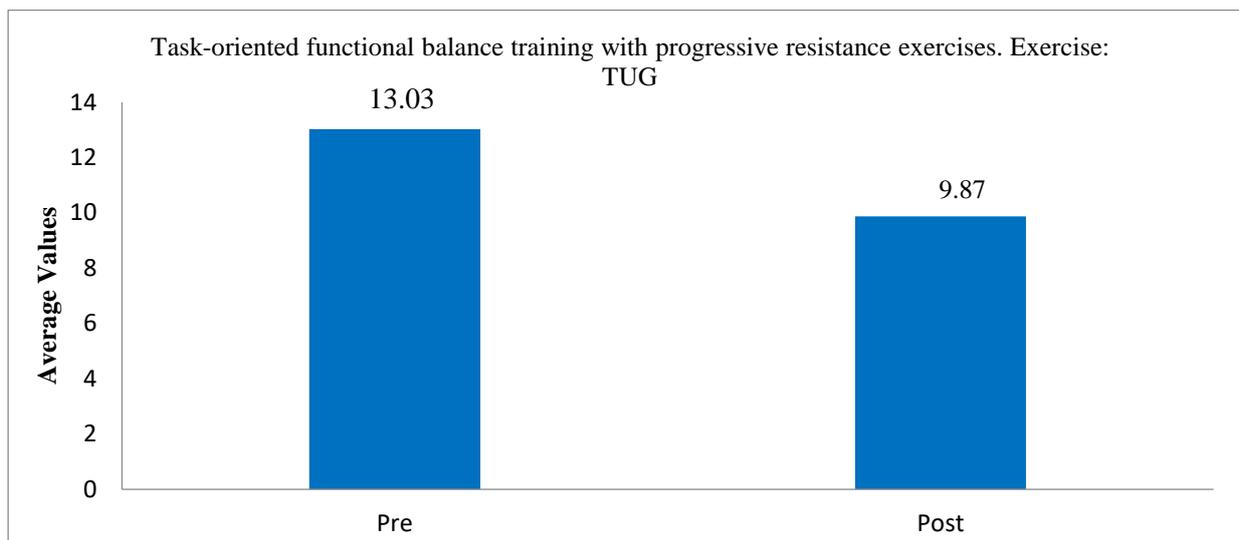


There was a significant difference ( $p < 0.00$ ) between the pre treatment and post treatment mean scores of Timed Get Up and Go test in Group A receiving Otago exercise program.

Table 2: Showing effectiveness of Task oriented functional balance training with resisted exercises. With strength training on Timed Get Up and Go test in Parkinson’s Patients.

GROUP B	Pre treatment Mean $\pm$ SD	Post treatment Mean $\pm$ SD	p value ( $<0.05$ )	Result
Timed Get Up and Go test	13.03 $\pm$ 0.92 secs	9.8 $\pm$ 0.87 secs	0.00	Extremely significant

Graph 2: Showing effectiveness of Task oriented functional balance training with resisted exercises. with strength training on timed get up and Go test

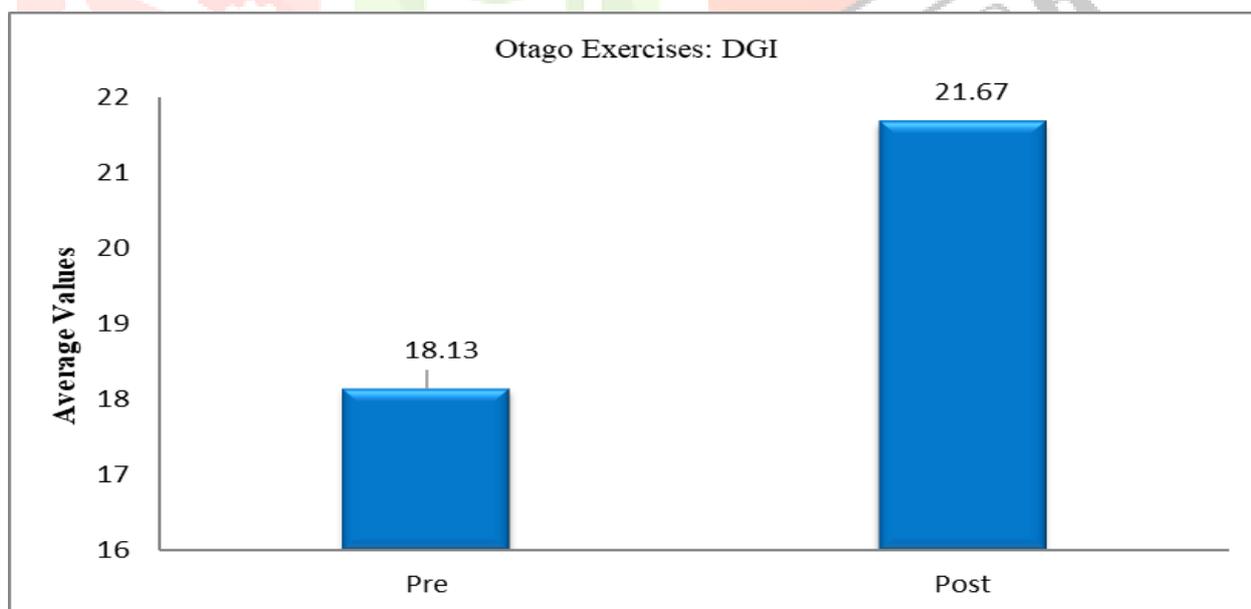


There was a significant difference ( $p < 0.05$ ) between the pre treatment and post treatment mean scores of Timed Get Up and Go test in Group A receiving Task-oriented functional balance training with progressive resistance exercises. exercise with Strength training program.

Table 3: Showing effectiveness Otago Exercises on Dynamic Gait Index in Parkinson’s Patients.

GROUP A	Pre treatment Mean + SD	Post treatment Mean + SD	p value ( $p < 0.05$ )	Result
Dynamic Gait Index	18.13± 0.8	21.66± 2.22	0.00	Extremely significant

Graph 3: Showing effectiveness of Otago exercises on Dynamic Gait Index.

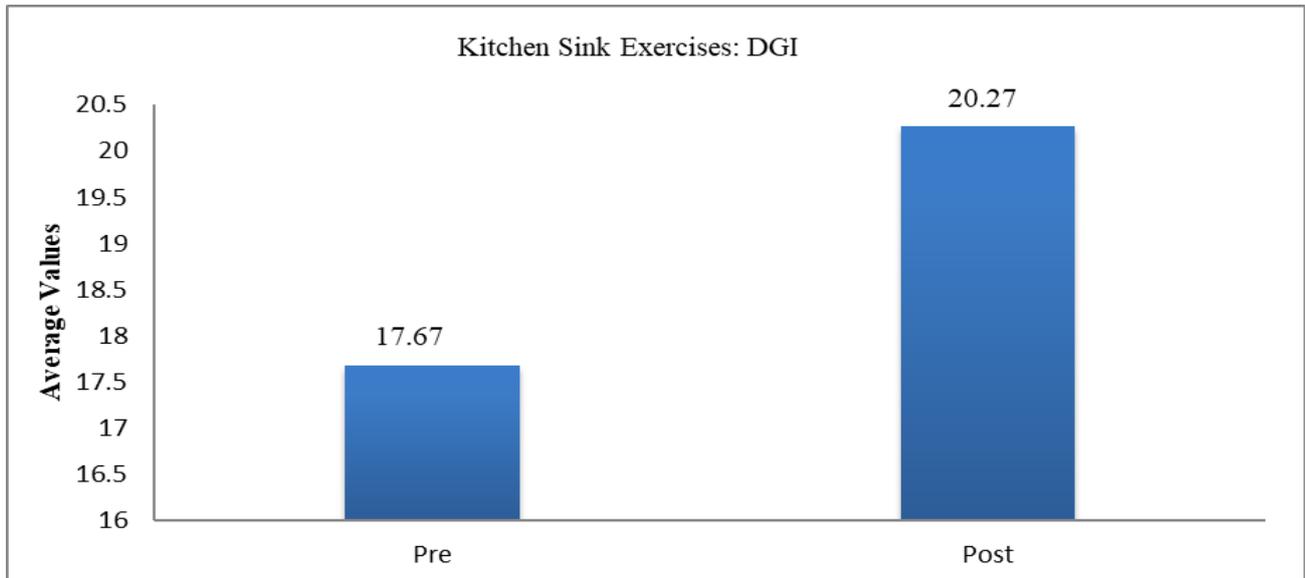


There was a significant difference ( $p < 0.05$ ) between the pre treatment and post treatment mean scores of Timed Get Up and Go test in Group A receiving Otago exercise program.

Table 4: Showing effectiveness Task oriented functional balance training with resisted exercises. with Strength Training on Dynamic Gait Index in Parkinson’s Patients.

GROUP A	Pre treatment Mean + SD	Post treatment Mean + SD	p value (p<0.05)	Result
Dynamic Gait Index	17.66±0.9	20.66±2.17	0.00	Extremely significant

Graph 4 : Showing effectiveness Task oriented functional balance training with resisted exercises. with Strength Training on Dynamic Gait Index in Parkinson’s Patients

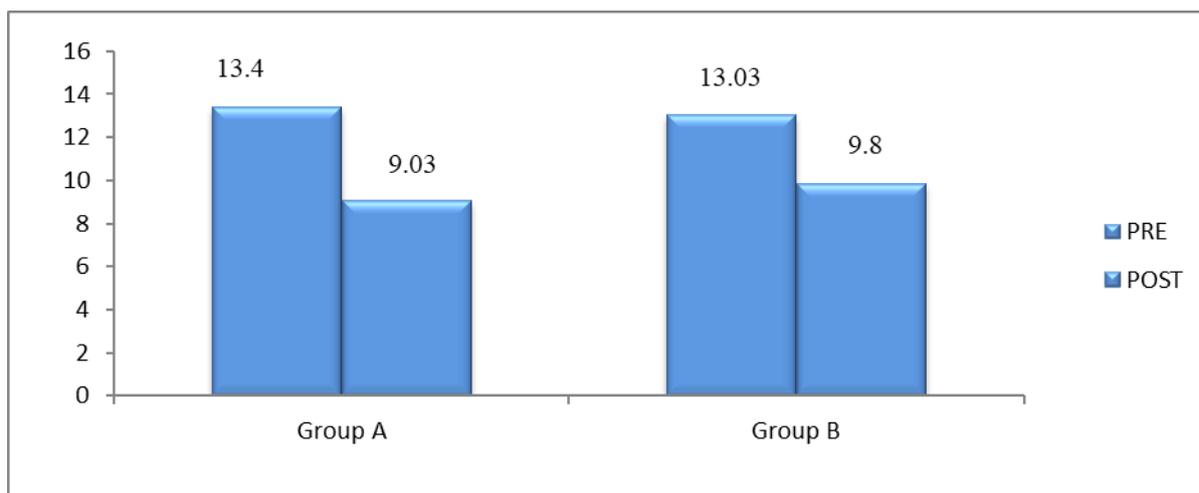


There was a significant difference (p<0.05) between the pre treatment and post treatment mean scores of Dynamic Gait Index in Group A receiving Task-oriented functional balance training with progressive resistance exercises. exercise with Strength training program.

Table 5: Comparison of Otago exercises and Task oriented functional balance training with resisted exercises. with strength training on Timed Get up and go test in Parkinson’s patients

Timed Get Up and Go test	Group A Mean + SD		Group B Mean + SD	
	Pre Test Score	Post test score	Pre Test Score	Post test score
	13.4± 2.17 secs	9.03± 0.7 secs	13.03± 0.92 secs	9.8± 0.87 secs
P value(p<0.05)	0.0008		0.0002	
Results	Extremely significant		Extremely significant	

Graph 5: Comparing effectiveness of Otago exercises with Task oriented functional balance training with resisted exercises. with Strength Training on Timed get up and go test in Parkinson’s Patients.

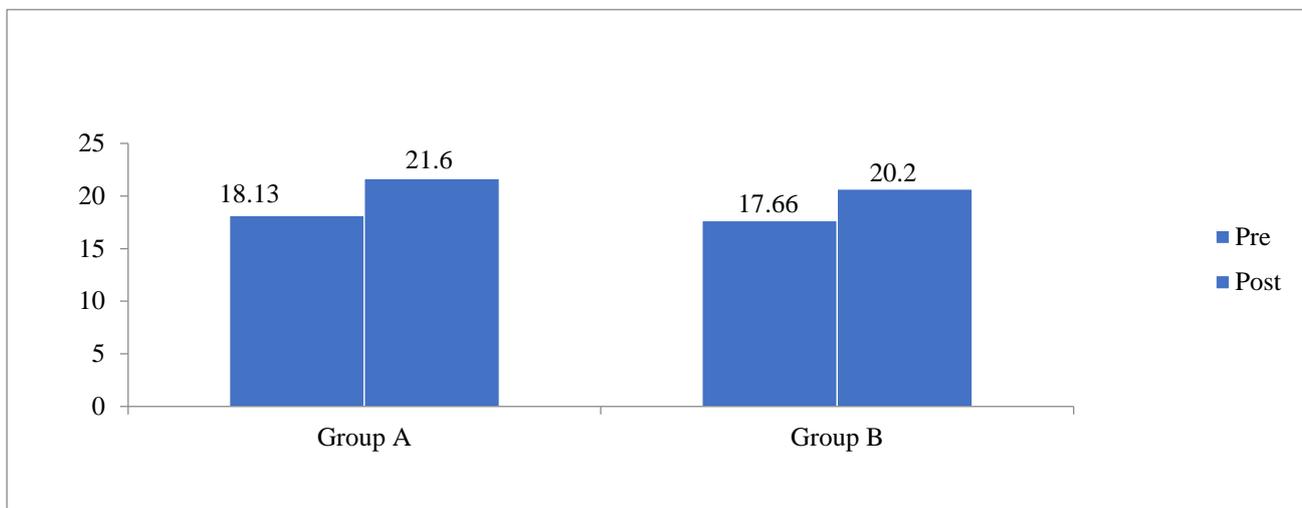


There was a significant difference ( $p < 0.05$ ) when comparing post scores of Otago exercises treatment versus Task oriented functional balance training with resisted exercises. with strength training mean scores on Timed Get up and Go Test.

**Table 9:** Comparison of Otago exercises (Group A) and Task oriented functional balance training with resisted exercises. with strength training (Group B) on Dynamic Gait Index in Parkinson’s Patients.

Dynamic Gait Index	Group A Mean $\pm$ SD		Group B Mean $\pm$ SD	
	Pre test	Post test	Pre test	Post test
	18.13 $\pm$ 0.8	21.66 $\pm$ 2.22	17.66 $\pm$ 0.9	20.66 $\pm$ 2.17
p value ( $p < 0.05$ )	0.00		0.00	
Results	Extremely significant		Extremely significant	

Graph 9 : Comparing effectiveness of Otago exercises with Task oriented functional balance training with resisted exercises. with Strength Training on Dynamic Gait Index in Parkinson’s Patients



There was a significant difference ( $p < 0.05$ ) when comparing post scores of Otago exercises treatment versus Task oriented functional balance training with resisted exercises. with strength training mean scores on Dynamic Gait Index.

## 6. DISCUSSION

In this study both the groups i.e group A (Otago exercises) and group B (Task oriented functional balance training with resisted exercises. with strength training) showed significant effect on Timed Get up and Go test and Dynamic Gait Index while treating Parkinson's patients. But while comparing both the techniques Otago exercises proved to be more effective than Task oriented functional balance training with resisted exercises. with strength training in treating Parkinson's patients with respect to Timed Get up and Go test and Dynamic Gait Index. In this study we found that in otago there was a significant difference ( $p < 0.05$ ) between the pretreatment ( $13.4 + 2.17$  secs) and post treatment ( $9.03 + 0.79$  secs) mean scores of Timed Get up and Go test in Group A receiving Otago exercise program. Also there was significant difference ( $p < 0.05$ ) between pretreatment ( $18.13 + 0.80$ ) and post treatment ( $21.6 + 2.22$ ) of dynamic gait index.

An important focus of balance training for patients with Parkinson's disease is centre of mass and limits of stability control training. Patients should be instructed in how COM influences balance and how to improve posture in sitting, standing and during dynamic movement tasks. Patient should explore their LOS and practice working toward expanding them in both sitting and standing. In standing people with PD typically demonstrate restricted LOS with forward displacement of centre of foot pressure.

Balance training should emphasize practice of dynamic stability tasks. Training should focus on achieving faster initiation and execution movement times supported by the use of appropriate cueing strategies.[2]

In a study of "Evaluation Of An Otago-Based Exercise Group For People With Parkinson's Disease". In this study Patients attended an exercise group weekly for 8 weeks with each session lasting 75 minutes. Six groups were held over an eighteen month period with 4 to 6 participants and 2 therapy assistants in each. Berg Balance and LPAS (includes "timed up and go") were assessed pre and post group and concluded that this small study has shown that an 8 week programme of Otago-based exercises improved balance as assessed by the Berg Balance Scale. The biggest improvement in those at greatest risk of falling is encouraging. Lack of improvement in mobility (LPAS) may be because of a ceiling effect in the assessment scale[10]. So in our study we compared otago exercises with Task oriented functional balance training with resisted exercises., to see which intervention is more effective.

When it was compared between two groups i.e Group A receiving Otago exercises program And the group B receiving Task oriented functional balance training with resisted exercises. with strength training program it was found that Group A proved to be more effective than Group B with respect to Timed Get Up and Go test ( $p = 0.0008$ ) Dynamic Gait Index ( $p < 0.001$ ) in patients with Parkinson's Disease.

In our study both the groups clinically showed improvement on dynamic balance but statistically otago exercises showed more effect. Though the clinical effect between both the groups did not showed much difference but stastical difference was seen due to small sample size.

## CONCLUSION:

In this study both the groups i.e group A (Otago exercises) and group B (Task oriented functional balance training with resisted exercises. with strength training) showed significant effect on Timed Get up and Go test and Dynamic Gait Index while treating Parkinson's patients

But while comparing both the techniques Otago exercises proved to be more effective than Task oriented functional balance training with resisted exercises. with strength training in treating Parkinson's patients with respect to Timed Get up and Go test and Dynamic Gait Index.

## LIMITATION OF THE STUDY:

1. Sample size is limited.
2. Prolonged effects of otago exercises and Task oriented functional balance training with resisted exercises. with strength training could not be studied.
3. Effect of these interventions in "off period" is not studied.

## FUTURE SCOPE OF STUDY:

1. Age group-studies can be carried out using different age group.
2. Study can be carried out for longer period of time.
3. Effects can be studied in "off" period.
4. Study can be conducted in high risk of fall patients.
5. Study can be carried out with larger sample size.
6. Study can be carried out in different conditions affecting Balance.

## References:

1. O'Sullivan, Physical rehabilitation, fifth edition,
2. Koller W. et al. Falls and Parkinson's disease. Clin Neuropharmacol 1989; 12 : 98.
3. GBD 2013 Mortality and Causes of Death, Collaborators (17 December 2014). "Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013.". Lancet 385: 117–71. doi:10.1016/S0140-6736(14)6168
4. Shulman JM, De Jager PL, Feany MB (February 2011) [25 October 2010]. "Parkinson's disease: genetics and pathogenesis.". Annual review of pathology 6: 193–222. doi:10.1146/annurev-pathol-011110-130242. PMID 21034221.
5. Jankovic J (April 2008). "Parkinson's disease: clinical features and diagnosis. Journal of Neurology, Neurosurgery, and Psychiatry 79 (4): 368–376. doi:10.1136/jnnp.2007.131045 PMID 18344392.
6. Samii A, Nutt JG, Ransom BR (29 May 2004). "Parkinson's disease". Lancet 363 (9423): 1783–1193. doi:10.1016/S0140-6736(04)16305-8 PMID 15172778
7. Schrag A (2007). "Epidemiology of movement disorders". In Tolosa E, Jankovic JJ. Parkinson's disease and movement disorders. Hagerstown, Maryland: Lippincott Williams & Wilkins. pp. 50–66. ISBN 0-7817-7881-6.
8. Nevitt MC, Cummings SR, Kidd S, et al. : Risk factors for recurrent nonsyncopal falls. A prospective study. JAMA, 1989, 261: 2663–2668.

9. World Health Organization: WHO Global Report on Falls Prevention in Older Age. Geneva: World Health Organization, 2007
10. Rose DJ.: Preventing falls among older adults: No “one size suits all” intervention strategy. *J Rehabil Res Dev*, 2008, 45: 1153–1166.
11. Persad CC, Cook S, Giordani B.: Assessing falls in the elderly: Should we use simple screening tests or a comprehensive fall risk evaluation *Eur J Phys Rehabil Med*, 2010, 46: 249–259 .
12. Tillerson JL, Caudle WM, Reveron ME, Miller GW. Exercise induces behavioral recovery and attenuates neurochemical deficits in rodent models of Parkinson's disease. *Neuroscience*.2003;119: 899–911.
13. Spirduso WW, Francis K, MacRae P.: *Physical Dimensions of Aging* (2nd ed.). Illinois: Human Kinetics, 2004
14. Bonder BR, Wagner MB.: *Functional Performance in Older Adults* (3rd ed.). Philadelphia: F. A. Davis Company, 2001
15. Bishop MD, Meuleman J, Robinson M, et al. : Influence of pain and depression on fear of falling, mobility, and balance in older male veterans. *J Rehabil Res Dev*, 2007, 44: 675–683
16. Agid Y. 1991. Parkinson's disease. *The Lancet* 337:1321-1323.
17. Allen NE, Hons B, Canning CG, et al. 2009. Bradykinesia, muscle weakness and reduced muscle power in Parkinson's disease. *Movement Disorders* 24(9):1344-1351.
18. Ashburn A, Stack E, Ballinger C, et al. 2008. The circumstances of falls among people with Parkinson's disease and the use of Falls Diaries to facilitate reporting. *Disability and Rehabilitation* 30(16):1205-1212.
19. Barbic F, Perego F, Canesi M, et al. 2007. Early abnormalities of vascular and cardiac autonomic control in Parkinson's disease without orthostatic Hypotension. *Hypertension* 29:120-126.

