



## Original Article

## Effectiveness of Treadmill Training Alone Versus Treadmill Training with External Clues on Improving Gait and Functional Ability in Parkinson's Patient

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## ABSTRACT

Parkinson's disease is a progressive neurological disease caused by degeneration of nerve cells in Substantia Nigra. It is characterized by postural instability, slowing of movement and tremor. Treadmill Training with Visual clues extensively used as an intervention to improve gait and Functional mobility. **Objective:** To compare the Treadmill training alone versus treadmill training with visual clues on improve gait and functional ability in Parkinson's disease. **Methods:** It is assessor blind randomized controlled trial conducted in CMA Research and Teaching hospital, Lahore from 6<sup>th</sup> June 2022 to 6<sup>th</sup> January 2023. The sample size of 74 were divided into two groups. Group A received treadmill training session for 30 minutes while. The Group B received treadmill training with external clues like visual, auditory, etc. Each Participant received total 56 sessions for 28 weeks. The outcome measures was functional Activity measures with Wisconsin gait scale for Gait and Motor Aspects of Experiences of Daily Living (M-EDL) questionnaire. The Data were assessing at baseline by using these two scales. **Results:** The between groups comparison of post value showed that Group B showed a significant (<0.05) improvement in the (M-EDL) scale for the activities of daily living and significant (<0.05) improvement in the step length, stance width, hip hiking, pelvic rotation, external rotation, and toe clearance. **Conclusions:** It was concluded that the treadmill training with external clues is better as compared to the treadmill training alone for improving the gait and functional ability in the Parkinson patient.

## INTRODUCTION

Parkinson's disease is a neurological disease that is progressive and the mostly affects the movement and start with tremor in just one hand, the stiffness in the body day by day and reduces the speed of movement [1]. At the start patient is expressionless or may be patient show little expression [2]. It is ranked 2<sup>nd</sup> among the diseases that affect the elderly population. The prevalence of the disease is more common and higher in the men compared to the females. It's estimated that 1.5% to 2.0% population of

elderly people get affected by this disease. The risk is getting higher up to 4% in ages above 80 years old [3]. The patho-physiology of the Parkinson's disease explains that this disease occurs due to the damage or necrosis in the substantia nigra brain part and the mostly degenerated the dopaminergic neuron which is the brain region responsible for the synthesis of the neurotransmitter dopamine (DA), decreasing the synaptic cleft [4]. Patients with Parkinson's disease usually walk or move with very slow speed. Patients

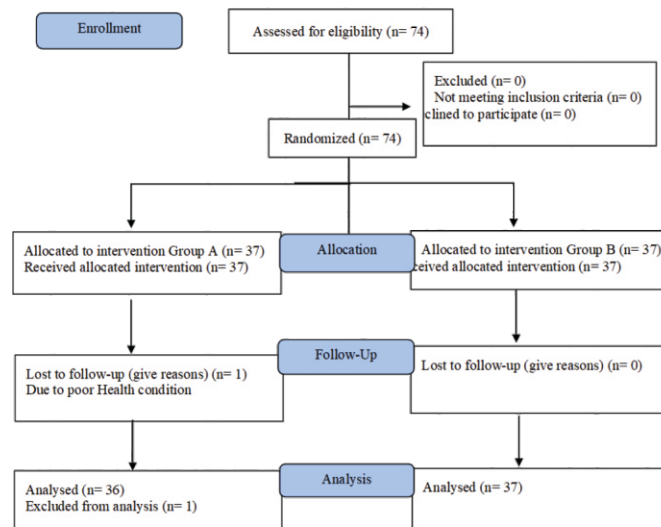
usually walk with the bend posture, with restricted or no arm swing and patient walk with short steps that shuffle alternatively. These are signs make the patients of Parkinson at a higher risk of fall [5]. People with PD can still be able to learn in a feed-forward manner. They are unable to change requiring the use of automatic or reactive mechanisms [6]. The Cueing techniques in different forms like Visual, Tactile and auditory helped the individual to improve their ability to walk properly without a history of fall [7]. The visual cues are the most effective in improving the PD gait. It is unclear, however, whether improvements might be the result of improved use of optic flow, greater attention directed toward walking, or cortically driven planning of discrete steps that bypass the basal ganglia. The optic flow theory provided the best explanation and benefits by using the transverse lines. The use of the inverted sticks while walking, by providing the projected laser beam and using the different parallel lines are authentic and mostly used visual-guided cues that helped improve the walking speed and in the improvement in step length [8]. The effectiveness of the visual cues combined with the treadmill training in improving the gait speed and increasing the gait performance in Parkinson's disease (PD). External cuing facilitates hypokinetic gait patterns in PD. Study results have suggested that the efficacy and improvement increased by using the treadmill training along with external cues [9]. Visual cues provided strong evidence improving the daily life activity in individual with Parkinson's. This technique provided a significant impact because it helped to develop the positive sequencing in brain that improved the functional activity in Parkinson's patient. It has seen that only visual cues have not provided significant improvement in gait parameters [10]. The visual clues with treadmill training impact the motor learning process and develop a normal pattern of the movement that helps walk properly and to increase the speed of the walk. It hypothesized that the use of the visual clues help develop the normal synergy movement and help the patient develop the better improve the gait, balance and functional activity.

## METHODS

This study was Single blinded randomized controlled trial registered in the Iranian registry of clinical trial no IRCT20220414054537N1. The study was started after approval from the Research Ethical Committee The Superior University with Reference No REC/FAHS/DPT/B(AP)/June 2022/991. The patients with Parkinson disease were recruited from Chaudhary Muhammad Akram research and Teaching Hospital, Lahore from June 5<sup>th</sup>, 2022. The trial took 28 weeks to complete and follow-up measurements were taken in January 6<sup>th</sup>, 2023. We have applied a continuous treatment session

around 7 months and we have given total 56 sessions. The Patient from Both Gender was included with Age range from 50 to 65 years. Patients with Idiopathic Parkinson's disease. Patients with Disease severity of II to V on the Hoehn and Yahr Scale and with minimum assistance and support are required. Parkinson patient was able to stand without any support and to walk on a treadmill (with body weight support, if required). Patients having the efficient ability to see the cues. A Patients with Parkinson disease wheel-chair bond and bed-ridden were excluded from this study. Patients with any other neurologic orthopedic disorder-affecting gait and postural stability also were excluded from this study. It was calculated by using the data from past studies; it was used to measured outcome tool with epitool software. The Estimated Sample size was calculated after adding the dropout ration overall sample size was 74 [11]. The Patients who participated in this study fulfilled the inclusion criteria. We have used convenient sampling method to select the patients and all selected individual were randomly allocated to group A and Group B by using the Lottery method. This distribution process is hidden at assessor level. It's a single blinded study where only the assessor was blind about the study procedure. Control group: This group received the training session of treadmill for 30 minutes. Patients with Parkinson's in the Control group received treadmill training protocol for '2' days per week and this treatment protocol was continued for 28 weeks. At first week the Speed of the treadmill training was adjusted up to 80% of each patient capacity to walk. In next 2 week this walking speed at treadmill were encouraged to reach the 90% and 100% capacity of each participants. From 4<sup>th</sup> week to onward till 28<sup>th</sup> week the treadmill speed was increased by 0.2km/h at next session [12]. Experimental Group: This Group Received the treadmill training session over 30 minutes along with external clues like visual. The Visual Clues was given by adding some visual signals during training at treadmill and on the floor. It consisted of few techniques like putting different sign of footprint on floor, giving instructions by hands on slowing the movement or fasting it and provided visual signals to increase its step length through video. The Protocol of treadmill training was same as describe above. Participants in This group received 2 sessions per week and total interventional training time was 28 weeks. The data were collected through the Wisconsin gait scale for gait with Inter-rated reliability (0.81 - 0.91) and intra-rated reliability (0.75 - 0.90) [13] and the Motor Aspects of Experiences of Daily Living (M-EDL) questionnaire for functional activity with inter-rater reliability was 0.93 and for intra-rater reliability was 0.99 - 1.00 [14]. Outcome measurements: Statistical analysis was performed and the Data were analyzed using SPSS version 22.0. The result

of normality test was shown that data were normally distributed. After fulfilling the assumption of the parametric tests, so the paired sample t-test was used for pre-post analysis. While to compare the both groups independent t-test was applied. The level of significance in the study was set at  $p < 0.05$ . Figure 1 shows CONSORT diagram of the study.



**Figure 1:** Consort Diagram

## RESULTS

The total participant of the group was  $n=74$  in which  $n=56$  (75%) were in both Groups and  $n=18$  (25%) were female. We had 55 (76.38%) normal individuals with reference to BMI range (18.5-24.9) and 17 (23.61%) participants were underweight with BMI range ( $<18.5$ ). In the results, we have found that 41(55.5%) participants had the symptoms for less than 1 year, 30(40.5%) participants had the symptoms of Parkinsonism between 1 year to 5 years and 3(4.1%) participants were having symptoms for more than 5 years. It was observed that Wisconsin gait scale, Step length, Stance width, External rotation, Pelvic rotation, Hip hiking, Toe Clearance and Motor Experience of Daily Living scale Values was significantly improved ( $p < 0.001$ ) in both the experimental and control group after 28th weeks intervention (Table 1).

**Table 1:** Pre-Post analysis of control and Experimental group separately

Variable		Control group (n=36)		Experimental group (n=37)	
		Mean +SD	p-value	Mean +SD	p-value
Wisconsin	Pre	29.16±3.86	0.00*	29.93±3.39	0.00*
	Post	23.58±3.95		19.63±3.11	
Step length	Pre	2.86±0.34	0.00*	2.97±0.16	0.00*
	Post	1.80±0.40		1.00±0.00	
Stance width	Pre	2.83±0.37	0.00*	3.00±0.00	0.00*
	Post	2.25±0.50		1.00±0.00	
External rotation	Pre	2.32±0.47	0.00*	2.32±0.47	0.00*
	Post	2.00±0.00		1.00±0.00	
Pelvic rotation	Pre	2.24±0.43	0.00*	2.54±0.50	0.00*
	Post	1.97±0.16		1.00±0.00	
Hip Hiking	Pre	2.94±0.22	0.00*	2.02±0.16	0.00*
	Post	2.00±0.00		1.00±0.00	
Toe Clearance	Pre	2.00±0.00	0.00*	2.05±0.22	0.00*
	Post	1.42±0.50		1.00±0.00	
Motor Experience for daily Living	Pre	34.70±3.49	0.00*	34.97±3.49	0.00*
	Post	29.86±3.11		17.94±3.45	

Wisconsin gait scale, Step length, Stance width, External rotation, Pelvic rotation, Hip hiking, Toe Clearance and Motor Experience of Daily Living scale Values. Which was significantly improved in experimental group as compared to control group ( $p=0.000$ ) (Table 2).

**Table 2:** Comparison Between Experimental and Control Group

Variables		Study Groups		p-value
		PPIUCD	Interval IUCD	
Wisconsin	Pre	29.16±3.86	29.93±3.39	0.370
	Post	23.58±3.95	19.63±3.11	0.00*
Step length	Pre	2.86±0.34	2.97±0.16	0.91
	Post	1.80±0.40	1.00±0.00	0.000*
Stance width	Pre	2.83±0.37	3.00±0.00	0.10
	Post	2.25±0.50	1.00±0.00	0.00*
External rotation	Pre	2.32±0.47	2.32±0.47	1.000
	Post	2.00±0.00	1.00±0.00	0.00*
Pelvic rotation	Pre	2.24±0.43	2.54±0.50	0.08
	Post	1.97±0.16	1.00±0.00	0.00*
Hip Hiking	Pre	2.94±0.22	2.02±0.16	0.00*
	Post	2.00±0.00	1.00±0.00	0.00*
Toe Clearance	Pre	2.00±0.00	2.05±0.22	0.156
	Post	1.42±0.50	1.00±0.00	0.00*
Motor Experience for daily Living	Pre	34.70±3.49	34.97±3.49	0.736
	Post	29.86±3.11	17.94±3.45	0.00*

## DISCUSSION

Both Treadmill training alone versus Treadmill training with external clues has shown the Positive effect on improving the functional ability and gait including its parameters like step length, stance width, hip hiking, toe clearance, external rotation at hip and pelvic rotation. When we applied the between group analysis was done it showed that significant improvement has seen in Experimental Group B. Our recent study results has shown that Treadmill training along with external clues were more effective in improving the walking speed as compare to the treadmill training alone. Parkinson's patients in experimental group showed a significant difference as compare to the control group after 28 weeks of continuous treatment plan. It has observed that patients of experimental group now has shown the better performance in doing their daily life work and the quality of life of these individual has been improved. Patients in experimental group showed better performance in daily living task and activities compare with control group. Our result shows similarity with the research conducted by Zhao *et al.*, and Frazzitta *et al.* They concluded that external rhythmical clues showed a significant result by improving the walking speed without any fall. The Gait pattern of such individual has emerged and significant difference has seen [15, 16]. Luessi *et al.*, conducted a study in 2012 and the main objectives of the study was to evaluate the effectiveness of treadmill treading along with visual clues on walking speed and gait parameters. They concluded that a significant difference has observed in the walking speed and velocity of the gait while giving the visual clues. Their result also suggested that with visual clues overall performance of patients at treadmill significantly improved. Our Research finding also

provided the same result because the step length of the individual was significantly improved in experimental group. The overall comparative results between Control and experimental group showed that ration of swing to stance ration significantly improved and it helped the patients to walk with more confidence and attention [9]. In patients with Parkinson's disease it has observed that waking disturbance and balance both things correlate with each other any difficulty in walking directly affected the static and dynamic balance of the individuals. Our study has showed that experimental group patients after receiving treadmill training with external clues showed a significant improvement in static and dynamic balance. We observed in our study the single and double leg support during walking has significantly improved and patients tend to walk and complete gait cycle and long distance walk with less double support and the risk of fall also reduced significantly. These results are coherent with the study by Magdi *et al.* The conducted a meta-analysis of different published research on all available search engine and the result of the study has showed that cueing techniques provide the significant improvement in balance activity, walking and functional activities as compare to non-cueing techniques in Parkinson patients [10]. Calabro *et al.*, conducted a study and result showed that Cueing techniques provided the better significant improvement in the gait training and it helped to reshape of sensorimotor rhythms and fronto-centroparietal/temporal connectivity. The cuing technique along with treadmill training provides the patients with better motor control of their body and improves the gait mechanisms. External clues help provide the restore the function and proper signaling in the cerebrum area, cerebellum and basal ganglia. A study by Chawla *et al.*, also concluded the same results. Our recent study showed the same result in which our experimental group provided a significant improvement in mental re-learning process and helped to develop a new connection to understand a normal way of walking with optimal speed and improvement in gait parameters [17, 18]. The results of our study showed the beneficial effects and helped improve the functional activities like daily living tasks with proper normal speed and attention. The Patient of Parkinson has showed the significant improvement in the walking speed and the static and dynamic balance. Cuing during the treadmill walk helped the patients in group B to control their body movement especially of lower limb. The results have showed that patients with Parkinson's disease present with the poor balance, slow speed and a history of falls but with proper cues helped the patients to manage to control their body in well manner and provided the patients with a strong base to walk with confidence without any fall history this study is coherent with the study by Sherron *et*

al., and Rodriguez. They conducted a meta-analysis and result of the study showed that cueing with the treadmill training has given the significant effects as well [19, 20].

## CONCLUSIONS

It was concluded that the treadmill training with external clues has significantly improved as compared to the treadmill training alone for improving the gait and functional ability in the Parkinson patient. It has shown the Positive effect on improving the functional ability and gait including its parameters like step length, stance width, hip hiking, toe clearance, external rotation at hip and pelvic rotation.

## Authors Contribution

Conceptualization: FG, KF

Methodology: FG, ZA

Formal analysis: MF, AM, ZA

Writing-review and editing: FG, KF, MF, AM, MJB, ZA

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

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## REFERENCES

- [1] Bearss KA and DeSouza JF. Parkinson's disease motor symptom progression slowed with multisensory dance learning over 3-years: A preliminary longitudinal investigation. *Brain Sciences*. 2021 Jul; 11(7): 895. doi: 10.3390/brainsci11070895.
- [2] Gomez LF, Morales A, Fierrez J, Orozco-Arroyave JR. Exploring facial expressions and action unit domains for Parkinson detection. *Plos one*. 2023 Feb; 18(2): e0281248. doi: 10.1371/journal.pone.0281248.
- [3] Marino BL, de Souza LR, Sousa K, Ferreira JV, Padilha EC, da Silva CH, et al. Parkinson's disease: a review from pathophysiology to treatment. *Mini Reviews in Medicinal Chemistry*. 2020 Jun; 20(9): 754-67. doi: 10.2174/1389557519666191104110908.
- [4] Simon DK, Tanner CM, Brundin P. Parkinson disease epidemiology, pathology, genetics, and pathophysiology. *Clinics in Geriatric Medicine*. 2020 Feb; 36(1): 1-2. doi: 10.1016/j.cger.2019.08.002.
- [5] Soh SE, McGinley JL, Watts JJ, Iansek R, Morris ME. Health-related quality of life of australians with Parkinson disease: a comparison with international studies. *Physiotherapy Canada*. 2012 Oct; 64(4): 338-46. doi: 10.3138/ptc.2011-26.
- [6] Yitayeh A and Teshome A. The effectiveness of physiotherapy treatment on balance dysfunction and postural instability in persons with Parkinson's disease: a systematic review and meta-analysis. *BMC Sports Science, Medicine and Rehabilitation*. 2016 Dec; 8: 1-10. doi: 10.1186/s13102-016-0042-0.
- [7] Palacios-Navarro G, Albiol-Pérez S, Garcia IG. Effects of sensory cueing in virtual motor rehabilitation. A review. *Journal of Biomedical Informatics*. 2016 Apr; 60: 49-57. doi: 10.1016/j.jbi.2016.01.006.
- [8] Lebold CA and Almeida QJ. An evaluation of mechanisms underlying the influence of step cues on gait in Parkinson's disease. *Journal of Clinical Neuroscience*. 2011 Jun; 18(6): 798-802. doi: 10.1016/j.jocn.2010.07.151.
- [9] Luessi F, Mueller LK, Breimhorst M, Vogt T. Influence of visual cues on gait in Parkinson's disease during treadmill walking at multiple velocities. *Journal of the Neurological Sciences*. 2012 Mar; 314(1-2): 78-82. doi: 10.1016/j.jns.2011.10.027.
- [10] Magdi A, Sayed Ahmed AM, Elsayed E, Ahmad R, Ramakrishnan S, Gabor MG. Effects of cueing techniques on gait, gait-related mobility, and functional activities in patients with parkinson's disease: a systematic review and meta-analysis. *Physical Therapy Reviews*. 2021 Mar; 26(3): 188-201. doi: 10.1080/10833196.2021.1908728.
- [11] Arfa-Fatollahkhani P, Safar Cherati A, Habibi SA, Shahidi GA, Sohrabi A, Zamani B. Effects of treadmill training on the balance, functional capacity and quality of life in Parkinson's disease: A randomized clinical trial. *Journal of Complementary and Integrative Medicine*. 2019 Aug; 17(1): 20180245. doi: 10.1515/jcim-2018-0245.
- [12] Nadeau A, Pourcher E, Corbeil P. Effects of 24 weeks of treadmill training on gait performance in Parkinson disease. *Medicine and Science in Sports and Exercise*. 2014 Apr; 46(4): 645-55. doi: 10.1249/MSS.000000000000144.
- [13] Yaliman A, Kesiktas N, Ozkaya M, Eskiyurt N, Erkan O, Yilmaz E. Evaluation of intrarater and interrater reliability of the Wisconsin Gait Scale with using the videotaped stroke patients in a Turkish sample. *NeuroRehabilitation*. 2014 Jan; 34(2): 253-8. doi: 10.3233/NRE-131033.
- [14] Sritipsukho P. Inter-rater and intra-rater reliability of the gross motor function measure (GMFM-66) by Thai pediatric physical therapists. *Journal of Medical Association of Thailand*. 2011; 94: 139-44.
- [15] Zhao Y, Nonnekes J, Storcken EJ, Janssen S, van Wegen EE, Bloem BR, et al. Feasibility of external rhythmic cueing with the Google Glass for improving

- gait in people with Parkinson's disease. *Journal of Neurology*. 2016 Jun; 263: 1156-65. doi: 10.1007/s00415-016-8115-2.
- [16] Frazzitta G, Maestri R, Uccellini D, Bertotti G, Abelli P. Rehabilitation treatment of gait in patients with Parkinson's disease with freezing: a comparison between two physical therapy protocols using visual and auditory cues with or without treadmill training. *Movement Disorders*. 2009 Jun; 24(8): 1139-43. doi: 10.1002/mds.22491.
- [17] Calabrò RS, Naro A, Filoni S, Pullia M, Billeri L, Tomasello P, et al. Walking to your right music: a randomized controlled trial on the novel use of treadmill plus music in Parkinson's disease. *Journal of Neuroengineering and Rehabilitation*. 2019 Dec; 16(1): 1-4. doi: 10.1186/s12984-019-0533-9.
- [18] Chawla G, Hoppe M, Browner N, Lewek MD. Individuals with Parkinson's disease retain spatiotemporal gait control with music and metronome cues. *Motor Control*. 2020 Oct; 25(1): 33-43. doi: 10.1123/mc.2020-0038.
- [19] Sherron MA, Stevenson SA, Browner NM, Lewek MD. Targeted rhythmic auditory cueing during treadmill and overground gait for individuals with Parkinson disease: A case series. *Journal of Neurologic Physical Therapy*. 2020 Oct; 44(4): 268-74. doi: 10.1097/NPT.0000000000000315.
- [20] Rodriguez J. Is Auditory Cueing during Treadmill Training a More Effective Method to Improve Gait Parameters in Individuals with Parkinson's disease Compared to Either Intervention Alone? California State University, Fresno; 2021.