Journal of Positive School Psychology http://journalppw.com
2022, Vol. 6, No. 4, 10391–10397

Early Exercise Intervention Influences Motor Function And Quality Of Life In Parkinson's Disease

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Abstract

Objective–In this research, we tried to find the effect of physiotherapy in freezing to answer the question of the type and duration of intervention that best suits treating FOG in PD. Methods - A total of 64 participants with idiopathic Parkinson's disease were enrolled in the study from Meenakshi medical college and three more private clinics in Chennai. Disease severity was assessed through section III (motor) of the Italian version of the MDS-unified Parkinson's disease rating scale (UPDRS). They were randomized into group A (32) Group B (32). These subjects were made to watch six videos (each lasting 6 minutes), where strategies for countering freezing of gait were presented, and afterward to execute the observed actions as per the instructions given by the physiotherapist. Group A received continuous intervention and Group Bb received intermittent intervention for a day. Results – The group B subjects performed significantly superior to group A in terms of the three selected outcome measures – FOGQ, BBS, and TUG. Conclusion - providing frequent Physiotherapy in the small session can bring about a better improvement than providing one continuous intervention session in a day.

Key Words: Idiopathic Parkinson's disease, freezing of gait, FOGQ, BBS, TUG.

1. Introduction

There has been good support for the adding rehabilitation therapies as an add-on to the pharmacological and invasive treatment of PD and there is support for the move towards a multidisciplinary approach in the management of this gradually progressing disease.(Gage, et al 2004 and Nijkrake et al, 2007) The physiotherapist being a vital part of a multidisciplinary team always works to maximize the functional ability of the patient and also minimize secondary complications by educating the patient and caregivers. Physiotherapy for PD mainly focuses on transfers, posture re-education, upper limb functional training, balance training and fall prevention, gait analysis and correction, and physical capacity enhancement and training ADLs. This is done through cueing strategies, cognitive-motor strategies, and predominantly exercise to maintain or sometimes increase independence in ADLs, and safety, and promote quality of life. (Schrag et al, 2000, Keus et al, 2009)

Research in physiotherapy for people with PD has been low till the end of the previous century, owing to a lack of sufficient patient referrals, and hence poor there was poor evidence for physiotherapy in PD. (Yarrow et al, 1999) In recent times, supportive evidence in favor of physiotherapy in the management of PD has flourished, due to increased referrals and therefore increased the number of clinical trials, particularly in the

last two decades. (National Collaborating Centre for Chronic Parkinson's Disease, 2006; Keus et al, 2007 Keus et al, 2009). In a survey of PD in England in 2008, it was reported that 54% of the total 13 000 members analyzed for the study had seen a physiotherapist. (Parkinson's Disease Society, 2008).

With so much contradicting evidence for physiotherapy in the management of PD over some time, it's imperative to know what best physiotherapy can do to PD as per current knowledge. A recent meta-analysis revealed that resistance training and treadmill training significantly improved gait. Dance therapy, Nordic walking, balance training with strategies, and gait training, improved the much-needed motor symptoms, balance, and gait quality. Exergaming was found useful in improving the quality of life. Hydrotherapy enhanced the balance performance. Finally, the much-hypeddual-task training did not significantly improve motor performance, git, and balance. (Radder et al, 2020) We observed that various modalities of physiotherapy have improved almost every aspect of Parkinson's patients. However freezing episodes were the only aspect that was debated and discussed with huge controversy. (Nonnekes et al, 2015) Thus in this research, we tried to find the effect of physiotherapy in freezing to answer the questionof the type and duration of intervention that best suits treating FOG in PD.

2. Methodology

Participants

A total of 64 participants with PD were enrolled in the study. The samples were selected from Meenakshi medical college and three more private clinics in Chennai. Patients were added to the study if they fulfilled the pre-selected selection criteria:

(i) The subjects should be idiopathic PD, by "*United Kingdom Parkinson's Disease Society Brain Bank criteria"* [Hughes et al, 1992];

(ii) Hoehn and Yahr stage II to III; (Opara J, et al, 2017) (iii) the subject was able to walk without any assistance despite FoG. (iv) All the subjects had to freeze gait at least once a week. (minimum score of one on item two of the new FoG Questionnaire (FoG-Q)) (Nieuwboer, et al, 2009). The episode of freezing was defined as anything longer than two seconds (minimum score of two on item four in FoG-Q).

Exclusion criteria were Participants who were (i) diagnosed with a neurological disorder (other than PD), (ii) subjects treated by a deep brain stimulator, (iii) subjects who scored < 25 in Mini-Mental State Examination (iv) visual issues, and/or acoustic limitations, and (v) severe musculoskeletal problems in the lower extremity.Disease severity was assessed through section III (motor) of the Italian version of the MDS-unified Parkinson's disease rating scale (UPDRS). All patients were under treatment with dopaminergic treatment and were assessed during the ON state (around 1 hour in the wake of taking their anti-Parkinsonian medications). Preceding any method, informed consent was acquired from every member and every one of the subjects gave written informed consent after getting a comprehensive clarification. The demographic and clinical characteristics of participants are accounted for in Table 1.

A total of 64 participants were randomized intothe continuous intervention group (Group A) or the intermittent intervention group (Group B) by using a computerized random-number generator by a blinded researcher. After the randomization process, participants were assembled in groups consisting of 5/6 patients each. Patients enrolled in group A was n = 32; which includes 14 males and 18 females; with a mean age of = 70.4 (4.5). These subjects were made to watch six videos (each lasting 6 minutes), where strategies for countering FoG were presented, and afterward, execute the observed actions as per the instructions given by the physiotherapist.

During each group-based training session, two unique video clips were presented twice and the intricacy of the actions increased progressively over the sessions. The six exercise videos recorded in the video clips were the accompanying: (1) shifting the body weight from one foot to the next; (2) shifting the body weight from one foot to the next making a step forward, in reverse, and to the side; (3) walking straight with long steps; (4) pivoting around the chair (5) stepping over an obstacle after shifting the body weight from one foot to the next; (6) walking through gateway All actions shown in the video clips were performed by a physiotherapist and afterward projected in third-person perspective. The exercises are presented in detail in figure 1. This intervention was

followed by treadmill walking at a speed of 5 km/Hour, without inclination, for 8 minutes. Apart from these interventions the patients underwent general balance training, exercises to improve reaction time and movement time, cognitive behavioural therapy, and functional training for the selected ADLs which weretailor-made depending on the needs of the patient. The intervention was provided continuously for 60 minutes, once a day 3 times a week.

In group B, following physiotherapy instructions, adhering to the physiotherapist's instructions, they played out the same actions, in the specific request and for a similar number of times, as for the group A. Extra consideration was taken to ensure that the mediation was equivalent across groups; thus, actions were performed following a prefixed request in both groups. The preparation can be considered indistinguishable for the two groups and was finished by the same physiotherapist. Instructional meetings were scheduled 2 times each week for quite some time and every session lasted 45 minutes. In both groups, every session started with the observation of video clips (actions or landscape images) displayed on a 32-inch television set. To ascertain that participants focus on appropriate consideration during the video presentation, they were specifically questioned at the end of the session on what was displayed on the screen. This intervention was followed by treadmill walking at a speed of 5 km/Hour, without inclination, for 8 minutes. Apart from these interventions the patients underwent general balance training, exercises to improve reaction time and movement time, cognitive behavioural therapy, and functional training for the selected ADLs which weretailor-made depending on the needs of the patient. The intervention was provided for 20 minutes session three times a day for a total period of 60 minutes with 2 to 3 hours space between each session, 3 times a week. The first two sessions consisted of video clippings presented as one selected video per session followed by treadmill walking and the third session consisted of other interventions.

Outcome Measures

The primary outcome measure used for the study was FoG severity evaluated with the new FoG questionnaire. The quality of gait and balance performances is measured by standardized scales namely Timed Up and Go (TUG), and the Berg balance scale (BBS). Patients were always evaluated in their best medical condition (ON state). Assessments were performed immediately before the physical therapy program (PRE), immediately after the end of the training (POST) and four weeks after the intervention (FU-4w).

Statistical Analysis

The confidence level fixed for the study was 95% and the significance level was 0.05. The data were summarised as parametric (tug) and non-parametric (FOGQ and BBS). ANOVA was used for the within-group analysis of both group A and group B for parametric values whereas Freedman's test was used for the non-parametric component. Bonferroni's test was used for the post-doc analysis of the parametric data whereas the Dunn's test was used for non-parametric data. Mann Witney U test was for the between-group analysis of the non-parametric data and the independent t-test was used for the comparison of the parametric data. All statistical analyses were performed using SPSS22.

3.Results

Totally 64 subjects accounted for the study results. The demographic characteristics of the subjects are presented in table 1. In the within-group analysis of the FOGQ, group A showed that there was a significant difference across the three values with a p-value of less than 0.001. The within-group analysis of group B FOGQ also showed that there was a significant difference between the three scores at three different times. In the between-group analysis of FOGQ values, it was evident that there was no significant difference between the pre-test values with the P-value of 0.589. There was no significant difference between the groups as far as post values are concerned with the P-value of 0.957. There was no statistical difference between the follow-up scores as well with aP-value of 0.242. In the within-group analysis of the BBS, group A showed that there was a significant difference across the three values with a p-value less than 0.001. In the within-group analysis of the BBS, group B showed that there was a significant difference across the three values with a p-value of less than 0.001. In the between-group analysis of BBS values, it was evident that there was no significant difference

between the pre-test values with the P-value of 0.666. There wasa significant difference between the groups as far as post values are concerned with the PP-value of 0.007. There was a high statistical difference between the follow up scores as well with the P value less than 0.001.

In the within-group analysis of the TUG, group A showed that there was a significant difference across the three values with an F value of 4.485 and a p-value less than 0.014.In the within-group analysis of the TUG, group B showed that there was a significant difference across the three values with an F value of 3.862 and a p-value less than 0.024. In the between-group analysis of TUG values, it was evident that there was no significant difference between the pre-test values with the P-value of 0.410. There was no significant difference between the groups as far as post values are concerned with the P-value of 0.221. There was no statistical difference between the follow-up scores as well with the P value less than 0.625. All the post hoc pair analysis is displayed in table 2.

Figure 1. Intervention exercises were shown to the participants through 6 videos clips

1. Shifting the body weight from one foot to the other: standing as still as possible, the actor moved the body weight from side to side quite slowly in the frontal plane always keeping the feet on the floor. No external (rhythmical) cue was used.
2. Shifting the body weight from one foot to the other and taking a step forward, backward, and to the side: starting with feet slightly opened and with the arms by the side, the actor performed steps in different directions always coming back to the starting position. To initiate each step in a specific direction, the actor shifted the weight from side to side first and then performed a step with the opposite foot.
3. Walking straight with long steps: the actor walked back and forth in an aisle trying to maintain a steady pace and to take long steps. No external cues were used.
4. Turning around a chair: the actor walked with long and high steps around a chair, trying to maintain a steady pace, both in the clockwise and counterclockwise directions.
5. Stepping over an obstacle after shifting the body weight from one foot to the other: the actor went over different obstacles (obstacles with different heights and depths) always moving the body weight from side to side in the frontal plane (ie, alternatively, the actor went over an obstacle with one leg after having shifted the weight to the opposite leg).
6. Walking through a doorway: this video was divided into 2 parts. First, the actor went across a doorway without stopping, walking back and forth. Then, the actor walked toward a closed door, opened the door, and walked through it.

Table 1. Demographic and clinical characteristics of participants

Criteria	Group A	Group B	*p*
Age (years)	**64.4 ± 3.5**	**66.8 ± 3.2**	**0.41**
Sex (M/F)	**19/13**	**21/11**	**0.68**

Criteria	Group A	Group B	*p*
Education (years)	**9.6 ± 2.5**	**9.1 ± 3.1**	**0.67**
Disease duration (years)	**10.7 ± 2.7**	**10.1 ± 4.2**	**0.75**
Hoehn and Yarh (stage)	**2.9 ± 0.5**	**3.4 ± 0.3**	**0.73**
MMSE score	**26.9 ± 2.4**	**27.4 ± 2.7**	**0.11**

M: male; F: female; MMSE: Mini-Mental State Examination.

Table 2. Within-group analysis - Pairwise Comparisons

Outcome Measure	Pairs	Sig. level (p-value)	
		Group A	Group B
FOGG	PRE- POST	0.000	0.000
	PRE- 4WFU	0.000	0.000
	POST-4WFU	0.606	0.000
BBS	PRE- POST	0.000	0.000
	PRE- 4WFU	0.000	0.000
	POST-4WFU	0.008	0.003
TUG	PRE- POST	0.053	0.024
	PRE- 4WFU	0.022	0.029
	POST-4WFU	1.00	1.00

4. Discussion

In this phase of the study 11 subjects from phase 1 of the screening were selected after medical examination by a physician and being declared suffering from PD. The main objective of the study was to identify undiagnosed Parkinson's patients fromthe community and treat them with selected physiotherapy interventions. But there were fewer samples from the community accepting to participate in the study. Further, there were fewer subjects who had to freeze with the majority of the screened having a good gait function. Hence we were forced to include subjects who were diagnosed with PD. The results of the study are in agreement with past studies with the use of similar interventions: Pelosi et al. in 2010 and Agosta et al.in 2017. In both the research, freezing improvements (assessed using FOGQ) were analyzed only up to 4 weeks after stopping the treatment. PPelosi'sresults showed that there was a significant improvement at the end of 4 weeks follows up, but there was no improvement at the end of the treatment, but the study performed by Agosta showed that there was a significant improvement following the intervention but there was no sustained improvement in the 4 weeks follows up. Later studies added Sonification along with similar intervention and showed consistent and significant improvement in many secondary outcome measures like the motor impairment measured by UPDRS III, and quality of life measured by the PtheDQ39 mobility scale. The duration used here was the 3 months following the intervention for follow-up evaluation. But the patients kept practicing the intervention on their own and that might be a reason for the better results. (Mezzarobba et al, 2018)

In our study, it is very clear that both group patients improved their gait quality, by acquiring new motor strategies that helped them to overcome FoG, and some of the effects are prolonged overtime for 4 weeks and they were generalized to FoG in daily life.This study did not consider cueing techniques because the evidence on these trainingwasweak and still disputed in alleviating FoG symptoms. Age is a potential factor that could be a reason for few lack of

improvements shown in outcome measures that were not immediate. Although the two groups were similar at the baseline for age and stage of the disease, the average age was high in both the groups limited participants' understanding of the concepts too they were not much used to audio-visual aids. So, future studies can concentrate on trying the same intervention on younger patients with PD. Probably, older patients with a progressive disease like PD may need a more specific intervention to engage in a motor re-education process which includes the feedback-based intervention. The age of samples used in previous research which used such interventions was 66 years—Agosta et al. (2017) and Lu et al. (2017); which was much similar to the current study. The baseline homogeneity of both the groups was made sure by accessing the demographic differences between both the groups and also analysing the pre-test values of the three outcome measure selected for the study. This analysis clearly shows that both groups were similar at the time of baseline before the commencement of the intervention. This clearly states that any difference in the prognosis of freezing of gait, balance, and Gait quality should be completely attributed to the intervention selected for the samples.The results of this study clearly show that freezing has significantly improved with interventions in both the groups of both frequencies. But intermittent exercise has resulted in a reduction of freezing of gait inthe long run as well. Subjects trained with intermittent exercises or increased frequency of exercises in a day showed significant improvement immediately after the intervention and even after the intervention was stopped. However, there was no significant difference in the improvement in group A and group B, in the group analysis. So it is evident that there was a difference in improvement between the two groups which was not so prominent yet cannot be ignored.

The balance component improved in both the groups significantly and was sustained even after the intervention was stopped. This proves that irrespective of the frequency of intervention in the day balance componentstend to increase. When the improvement gained between the two groups was compared, patients who are treated with more frequency of intervention in a day showed significantly better improvement than people who were treated for a long duration. Gait quality also improved with both the interventions, but subjects treated with long-duration intervention did not show steady progress after cessation of the intervention. However, there was no significant difference in improvement when the groups were compared.One can understand from this study that providing small sessions of physiotherapy frequently in a day can improve freezing episodes among Parkinson's disease, by improving the quality of Gait and balance. This can be assumed because of the ability of the human body to produce dopamine, duration of dopamine production, the attention span of the patient and so on which are heavily in the favour of small sessions of physiotherapy provided in a day.Future studies can concentrate on increasing the follow-up period of the study, including Parkinson's disease with other cognitive dysfunction, and also performing the same intervention on a younger group of Parkinson's disease to broaden the idea about the treatment efficacy. Various protocols can also be studied to bring about a better understanding of exercise prescription for Parkinson's disease.The limitations of the study are the small sample size and the lack of blinding of patients. The study did not involve any biomarkers which would have been a sensitive outcome measure when dealing with changes that are very marginal and very sensitive.

5. Conclusion

The objective of this study was to find the effect of various frequencies of physiotherapy sessions on the prognosis of freezing of gait among Parkinson's disease patients. After analysing and interpreting the study results we conclude that providing physiotherapy continuously as well as small episodes of increased frequency can bring about a better improvement in freezing of gait and balance. However, providing frequent Physiotherapy in small sessions can bring about a better improvement than providing one continuous intervention session in a day.

6. References

Agosta F, Gatti R, Sarasso E, Volonté MA, Canu E, Meani A, et al. Brain plasticity in Parkinson's disease with freezing of gait induced by action

observation training. J Neurol., 2017;264(1):88–101.

Gage H, Storey L. Rehabilitation for Parkinson's disease: a systematic review of available evidence. Clin Rehabil. 2004;18(5):463-82.

Hughes AJ, Daniel SE, Kilford L, Lees AJ. Accuracy of clinical diagnosis of idiopathic Parkinson's disease: a clinicopathological study of 100 cases. J NeurolNeurosurg Psychiatry. 1992;55(3):181-4.

Keus SH, Bloem BR, Hendriks EJ, Bredero-Cohen AB, Munneke M; Practice Recommendations Development Group. Evidence-based analysis of physical therapy in Parkinson's disease with recommendations for practice and research. Mov Disord. 2007;22(4):451-60; 600.

Keus SH, Munneke M, Nijkrake MJ, Kwakkel G, Bloem BR. Physical therapy in Parkinson's disease: evolution and future challenges. Mov Disord. 2009;24(1):1-14.

Lu C, Amundsen Huffmaster SL, Tuite PJ, Vachon JM, MacKinnon CD. Effect of cue timing and modality on gait initiation in Parkinson disease with freezing of gait. Arch Phys Med Rehabil., 2017; 98(7):1291–9

Mezzarobba S, Grassi M, Pellegrini L, Catalan M, Kruger B, Furlanis G, Manganotti P, Bernardis P. Action Observation Plus Sonification. A Novel Therapeutic Protocol for Parkinson's Patient with Freezing of Gait. Front Neurol. 2018;8:723.

National Collaborating Centre for Chronic Parkinson’s Disease. National clinical guideline for diagnosis and management in primary and secondary care. Royal College of Physicians, 2006.

Nieuwboer A, Rochester L, Herman T, Vandenberghe W, Emil GE, Thomaes T, Giladi N. Reliability of the new freezing of gait questionnaire: agreement between patients with Parkinson's disease and their carers. *Gait Posture*. 2009;30(4):459-63

Nijkrake MJ, Keus SH, Kalf JG, Sturkenboom IH, Munneke M, Kappelle AC, Bloem BR. Allied health care interventions and complementary therapies in Parkinson's disease. Parkinsonism RelatDisord. 2007;13 Suppl3:S488-94.

Nonnekes J, Snijders AH, Nutt JG, Deuschl G, Giladi N, Bloem BR. Freezing of gait: a practical approach to management. Lancet Neurol., 2015;14:768–778.

Opara J, Małecki A, Małecka E, Socha T. Motor assessment in Parkinson`s disease. Ann Agric Environ Med. 2017;24(3):411-415.

Parkinson’s Disease Society. Life with Parkinson’s today—room for improvement. Parkinson’s Disease Society, 2008.

Pelosin E, Avanzino L, Bove M, Stramesi P, Nieuwboer A, Abbruzzese G. Action observation improves freezing of gait in patients with Parkinson’s disease. Neurorehabil Neural Repair, 2010; 24(8):746–52.

Radder DLM, Lígia Silva de Lima A, Domingos J, Keus SHJ, van Nimwegen M, Bloem BR, de Vries NM. Physiotherapy in Parkinson's Disease: A Meta-Analysis of Present Treatment Modalities. Neurorehabil Neural Repair. 2020;34(10):871-880.

Schrag A, Jahanshahi M, Quinn N. How does Parkinson's disease affect the quality of life? A comparison with the quality of life in the general population. *Mov Disord.* 2000;15(6):1112-8.

Yarrow S. Members’ 1998 survey of the Parkinson’s Disease Society of the United Kingdom. In: Percival R, Hobson, eds. Parkinson’s disease: Studies in psychological and social care. BPS Book, 1999: 79-92.