Original Article

Comparison of Virtual Reality and Conventional Balance Training to Improve Balance and Walking in Parkinson's Disease Patients

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ABSTRACT

Objective: This study is done to compare home based virtual reality training and conventional balance training in Parkinson's disease patients to improve balance and walking.

Study Design: A quasi experimental study

Place and Duration of Study: This study was conducted at the Kanaan Physiotherapy & Spine clinic from July 2020 till December 2020.

Materials and Methods: A convenient sample 24 patients were recruited with diagnosis of Parkinson's' disease. Patients were divided in to 2 groups of 12 patients in ach group. Virtual Reality Group (n=12) received 45 minutes training session, 3 days a week for 4 weeks and Conventional Physical therapy group (n=12) received balance training. The outcome measure was Berg balance scale (BBS) and timed up and go test. Data was analysed through SPSS 24.

Results: The data was found to be normally distributed. Virtual reality training group shows better effects as compared to conventional balance training group in terms of BBS ($p<0.001$) and TUG-test ($p<0.001$).

Conclusion: It was concluded that virtual reality balance training group showed more significant effect on balance and walking than conventional balance training group. Conventional balance training was also effective but Virtual reality training group showed better effects.

Key Words: Virtual reality, Rehabilitation, Stroke, Physiotherapy

Citation of article: Anwar N, Akram S, Ilyas A, Khalid K, Munir M, Hayat MK. Comparison of Virtual Reality and Conventional Balance Training to Improve Balance and Walking in Parkinson's Disease Patients. Med Forum 2021;32(7):129-133.

INTRODUCTION

Patients who suffer from Parkinson's disease present with balance dysfunction and difficulty in walking.[1,2] These patients are more instable while in standing posture and as there is reduced postural correction response from the body systems.[3] Parkinson's patients walk with small steps and increased stride to stride variation.[4] This increase the chances of patients fall and therefore, deteriorating impact on patient's quality of life.[5]

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Received: March, 2021
Accepted: May, 2021
Printed: July, 2021

Recently, virtual reality has proven to be an important therapeutic tool for patients with neurological dysfunctions. It involves multiple sensory channels in the simulated environment to increase patients interaction.[6,7] There are multiple ways of applying VR training. A number of devices are available in the market e.g., Nintendo Wii with balance board. Esculier et al used Wii Fit with a balance board for balance training of Parkinson patients. VR can be very beneficial in improving static as well as dynamic balance and thus overall walking experience of patients suffering from neurological disorders.[8,9] Another study compared the effect of Nintendo Wii-based motor cognitive training versus balance exercise therapy in patients with PD via a randomized controlled trial. Both the interventional groups showed remarked improvement on balance and the effects were maintained at follow-up too. Well, this is still not clear how beneficial Nintendo Wii based VR balance training in comparison with conventional balance training.[10]

Hsieh et al[11] cleared that Parkinson's patients showed more impairment in internal cues skills rather than external cues skills. So if external visual feedback is given to such patient then it will make compensation of impaired kinaesthetic feedback. This way internal cuing

can be bypassed.[12-14] It was cleared that VR could improve cognitive and visual cues and ultimately motor learning of a patient with more retention of memory.[14] So, the objective of the present study was to compare the Virtual reality balance training and conventional balance training.

MATERIALS AND METHODS

It was a quasi-experimental study design. The 24 patients of Parkinson's disease were included in the study from Kanaan Physiotherapy & spine clinic. The study was completed in six months from July 2020 to December 2020. The inclusion criteria were (1) age 45–65 years; (2) the score on mini mental state examination should be > 24(15) (3) Hoehn–Yahr Stages II–III; (4) bot under any kind of therapy in last 2 to 3 months; (5) some medical conditions like osteo-arthritis that directly affects walking and balance function. The exclusion criteria were anxiety or depression or having any underlying visual or auditory disturbances. An informed consent was signed by all participants before inclusion in to the study. All patients received twelve 45-minute training, 3 times in a week for 4 weeks. The trainings were conducted by 2 trained physical therapists. All patients were assessed before and after the 4 weeks of intervention by an assessor who was blinded about the group allocation. There were total 12 sessions for each patient.

VR balance training system: Nintendo Wii gaming device was used for virtual reality training group patients. Wii has a console, 2 hand held wireless sensors, 1 infrared bar, remote and adapter. Patients stands at 6-meter distance and plays different balance games under the supervision of a physical therapist. Balance board was used for balance games. The games used for these patients were Wii sports and balance board games. The warm up session was conducted with each patient before the start of intervention.[16,17]

Conventional Balance Training Group: In this group, training was done under the supervision of a trained therapist. Participants were asked to maintain static posture for 10 minutes and dynamic posture maintaining for 20 minutes. Patients were provided with verbal instructions by therapist throughout the session. Different balance exercises were performed in addition to static and dynamic balance control.[18,19]

Outcome measures

The main outcome measure in the study was berg balance scale[20]. The other outcome used was 3 meter Timed up & go test.[21]

Data analysis: Data was found to be normally distributed. Between group analysis was done by independent t-test and within group comparison was done by paired t-test. Significance was set with $p < 0.05$. All statistical tests were done by using SPSS.

RESULTS

Twenty-eight patients were physically screened between July 2021 and august 2021. Two patients were excluded for not fulfilling the criteria. Twenty-four patients were enrolled and randomized into the Virtual reality training group ($n = 13$) or Conventional training ($n = 13$) group. One patient from each group left the study due to personal reasons.

Participants in VR group were presented with mean age of 55.0±6.84years and in Conventional Balance Training group with 52.25±6.77 years. Participants in Virtual Reality Group were presented with mean height of 1.68± 0.13centimeters and in Conventional training group with 1.67± 0.16 centimeters. Participants in the Virtual Reality Group were presented with mean weight of 89.41±12.70kg and in Conventional Balance Training category with 90.16± 17.33 kg. Participants in Virtual Reality Group were presented with mean BMI of 31.94± 5.93 kg/m2 and in Routine Physical Therapy group with 32.88±8.04 kg/m2 as shown in Table 1.

The comparison of pre and post treatment BBSS values in two groups was done using independent sample t test. Analysis revealed that there was significant difference ($p<0.001$) in both groups. Virtual Reality Training group showed greater improvement in BBSS as compared to Conventional balance training group as shown in table 2. The pre and post treatment 3 meter Timed up and Go test values between two groups was done using independent sample t test. Analysis revealed that there was statistically significant difference in both groups with p value < 0.001. Virtual Reality Training Group showed greater improvement in TUG test as shown in Table 2.

Table No.I: Demographic data

Study Group		N	Mean± Std. Deviation
Virtual Reality	Age of Participants	12	55.0±6.84
	Height in m	12	1.68± 0.13
	Weight in kg	12	89.41±12.70
	Body Mass Index of Participants	12	31.94± 5.93
	Valid N (list wise)	12	
Routine Physical Therapy	Age of Participants	12	52.25±6.77
	Height in cm	12	1.67± 0.16
	Weight in kg	12	90.16± 17.33
	Body Mass Index of Participants	12	32.88±8.04
	Valid N (list wise)	12	

Table No.2: Independent t-test Between Group Analysis

Scale		Treatment group		P value
		Virtual reality Balance Training	Conventional Balance Training Group	
BBSS	Pre-treatment (Mean±SD)	19.92 ± 4.48	19.91±3.99	0.97
	Post-treatment (Mean±SD)	38.17±8.01	23.0±3.76	<0.001
TUG	Pre-treatment (Mean±SD)	13.92±1.40	13.97±1.68	0.94
	Post-treatment (Mean±SD)	8.81±1.08	11.05±1.36	<0.001

Table No.3: Paired t-test within Group Analysis

Paired Sample t test		Treatment group		p-value
		Virtual reality Balance Training (Mean difference ±SD)	Conventional Balance Training Group (Mean difference ±SD)	
BBSS	Pre-treatment - Post-treatment (Mean±SD)	18.25 ±6.15	3.08±3.42	<0.001
TUG test	Pre-treatment - Post-treatment (Mean±SD)	5.12±1.52	2.92±1.27	<0.001

Paired sample t-test was used to compare the values of BBSS score and TUG test within each treatment group. Results declared significant difference ($p<0.001$) in both the groups but greater improvement was seen in Virtual Reality balance training Group as shown in Table 3.

DISCUSSION

Many of the studies related to VR showed better effects of VR in terms of time, velocity, balance, control of posture and function of upper and lower extremity as compared to other treatment options.[19,22] The focus of this study is to compare VR training and conventional balance training in Parkinson's disease patients to improve balance and walking.

The results of our study showed significant effect on berg balance scale score. The berg balance scale score showed more improvement in VR training group ($p<0.001$) as compared to conventional training group. Results of current study are supported by another study and similar results were found.[23,24]

It was hypothesized that VR training is superior than conventional balance training in improving walking and balance of patients effected by Parkinson's disease. The results were similar to our hypothesis. Both treatments were effective but VR is more effective as proven by results. The possible explanation for this could be the neuroplasticity effect of VR training. Patients were found to be more interested in VR training group games.[25]

This hypothesis was further supported by Baltaci et al[25]

Other explanations of improvements can be following: VR training tasks mimics the daily tasks and activities; difficulty of tasks can be increased as required and VR training does not require any preparation in advance. Patient remains calm and focus on his treatment plan.

VR training relies on visual feedback and patient tries to achieve the required movement as early as possible. Patient learns the skills on priority as that skill is required to play the games perfectly.[26]

In current study, patients in VR training group showed more improvement in 3 meter timed up and go test as compared to conventional training group ($p<0.001$). Similar results were found in other studies with early improvement in walking function and balance.[27] The possible explanation of this walking improvement in VR group can be due to neuroplasticity effect of VR training. VR training focus on motor learning of patients are the movements performed are real time movements as done by patient in routine life.[28] Patient has the knowledge of performance as well as the knowledge of results and tries to improve the results and thus more productive in VR training. Conventional balance training is a bit more hectic for patient and loses confidence.

There is degeneration of basal ganglia circuits in Parkinson's disease patients and that's why patients have difficulty in implicit learning.[29] So auditory pacing, visual feedback and visual targets and knowledge of performance and results are important clinical ways to improve motor learning in patients with Parkinson's disease.[26] Thus VR training would be so helpful.

CONCLUSION

It was concluded that virtual reality balance training group showed more significant effect on balance and walking than conventional balance training group.

Conventional balance training was also effective but Virtual reality training group showed better effects.

Author's Contribution:

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Conflict of Interest: The study has no conflict of interest to declare by any author.

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