



EFFECTIVENESS OF VIRTUAL REALITY ON BALANCE AND GAIT REHABILITATION IN PATIENTS WITH PARKINSON'S DISEASE- AN EVIDENCE BASED STUDY

Physiotherapy

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ABSTRACT

Background: Parkinson's Disease is a progressive neurodegenerative disease in which death of dopaminergic neurons occur. With the progression of the disease patients experience increase in difficulty in balance and gait. VR shows significant future scopes in the rehabilitation of balance and gait. The aim and objective of the study is to collect and assess the recent evidences to find out the effectiveness of VR in balance and gait in Parkinson's disease affected patients. **Methodology:** A literature search on search engines Google Scholar, PEDro, PubMed, Research Gate and ScienceDirect was carried out. The articles found were screened through by applying the inclusion/exclusion criteria. The collected studies were assessed using PEDro score and CEBM's Level of Evidence scale. **Result:** A total of 7 studies were included in this study, 4 Randomized controlled trials and 3 Systematic reviews and evaluated according to Prisma guidelines. **Conclusions:** In this Evidence based Study, articles comparing the effectiveness of Conventional Physiotherapy versus Virtual Reality Rehabilitation on balance and gait in Parkinson's Disease were collected and assessed. The evidences suggest moderate to strong evidence about Virtual reality being more effective in comparison to conventional therapy.

KEYWORDS

Virtual Reality, Parkinson's Disease, Balance and Gait Rehabilitation

INTRODUCTION

James Parkinson had written a monograph which was entitled as "An Essay on the Shaking Palsy", in which there were detailed note regarding six patients with "involuntary tremulous motion with lessened muscular power in parts not in action even when supported, with a propensity to bend the trunk forward and to pass from a walking to a running paced," he had hoped that it would be able to persuade nosologists that he had described a disorder which had been unrecognized previously.^[1]

Parkinson's disease (PD) is a neurodegenerative disorder characterized by the death of dopaminergic neurons in the brain.⁽²⁾ It affects approximately 6.1 million people worldwide.⁽³⁾

Parkinson's Disease is a disorder of movement consisting of these most easily perceptible signs which are tremors, rigidity, elements of bradykinesia [slowness of movement], hypokinesia [reduced movement], akinesia [loss of movement] and postural abnormalities.^[4] Since early stages PD patients have greater risk of fall with significant impact over the Quality of life of patients.^[5]

Levodopa treatment helps alleviate some symptoms, but long-term use leads to motor disturbances, like motor fluctuation and dyskinesias.^(6,7) The term Virtual Reality [VR] indicate a complete, 3-D virtual representations of any object, places or the actual world; In any traditional computer, PC etc. user watches object on the screen but is also connected to the real world. But in VR they get fully immersed in the 3-D computer generated world.^[8]

VR provides a safe and immersive environment for balance training. Studies demonstrate VR's effectiveness in improving balance and reducing postural instability, with better results compared to conventional therapies^[9]

Methodology

- **Study Design:**
- This is an Evidence based study, which was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines.

Literature Search:

- A specific literature search was performed from 2019 to 2024 (last 6 years)
 - Literature was searched using following search engines:
1. Google Scholar
 2. PEDro
 3. PubMed
 4. ResearchGate
 5. ScienceDirect

Key Words Used Were:

- Virtual Reality
- Parkinson's Disease
- Balance
- Gait Rehabilitation

Method Of Selection Of Articles Or Eligibility Criteria:

A. Inclusion Criteria

- i. Studies involving balance rehabilitation in Parkinson's Disease from 2019 to 2024 (last 6 years)
- ii. Studies which used virtual reality for balance and gait rehabilitation in Parkinson's Disease.
- iii. Articles on Parkinson's Disease having study design of systemic reviews, Meta-analysis and randomized controlled trials.
- iv. Articles published in English in full text.
- v. Studies done on human participants.

B. Exclusion Criteria

- i. Articles having study design of Case Control and Cohort.
- ii. Studies done on animals
- iii. Studies published in languages other than English

Assesment Of Methodological Quality:

- **Data was assessed using 2 parameters:**

1. **Centre for Evidence-** Based Medicines (CEBM's) Levels of Evidence
2. PEDro Scale

Table 1: Characteristics of Included Studies

AUTH OR	TITLE OF THE STUDY	INTERVENTION	OUTCOME MEASURES	CONCLUSION	LEVEL OF EVIDENCE/ PEDRO SCALE
Mylonas et al. 2020 ⁽¹⁰⁾	The effect of rehabilitation in a virtual reality environment on improving balance in older adults with Parkinson's	A Total of 8 studies were found which met the inclusion and exclusion criteria with a total sample size of 259 older adults	BBS, DGI, and FGA	The studies concluded that VR treatment gives equivalent or more better results than convention	1a -

	disease: A Systematic review.	with PD		nal therapy	
Wang W et al. 2021 ⁽¹¹⁾	The effect of virtual reality rehabilitation on balance in patients with parkinson's disease: a systematic review and meta-analysis.	Following the PRISMA guidelines a systematic review was conducted in which 15 studies were included and analyzed	BBS, TUG	In comparison to traditional exercises application of VR proved to show more significant improvement in the balance of PD patients	1a -
Lei C et al. 2019 ⁽¹²⁾	Effects of virtual reality rehabilitation training on gait and balance in patients with Parkinson's disease: a systematic review	16 articles with 555 PD patients were included after a comprehensive search. In accordance of the PRISMA guidelines a systemic review was conducted	Gait, balance function, mobility, Global motor Function, ADL, Quality of life	VR rehabilitation gives equal to or more better results than conventional therapy, and at failure of conventional therapy VR can be used as an alternate option	1a -
Kashif M et al. 2024 ⁽¹³⁾	Effects of virtual reality versus motor imagery versus routine physical therapy in patients with parkinson's disease: a randomized controlled trail.	A sample size of 60 PD patients were randomized into 3 groups 20 patient each. Group A (VR with routine PT, Group B (MI with routine PT)	UPDRS – part III, BBS, ABCs	Compared to MI+RPT or RPT alone combination of VR and RPT has proved to be most effective treatment method	1b 8/11
Usama M et al. 2023 ⁽¹⁴⁾	Comparative Analysis of the Impact of Virtual Reality Training and Conventional Physiotherapy on Balance and Gait in Older Adults with Parkinson's Disease	A total of 56 PD patients were randomized into 2 groups, in which one received traditional PT while one received VR Rehabilitation	Time up and Go Test (TUGT), BBS, Mini-Balance Evaluation System Test (Mini-BESTest)	VR therapy surpasses the conventional therapy in improving balance and gait in older adults with PD and emerges as a potent modality for augmented rehabilitation	1b 5/11
Kashif M et al. 2022 ⁽¹⁵⁾	Combined effects of virtual reality techniques and motor imagery on balance, motor function and activities of daily living	44 patients with idiopathic PD were randomly allocated into 2 groups, both received PT treatment while the experimental group received	UPDRS – part III, BBS, ABCs, UPDRS – part II	Combining VR and MI techniques with PT treatment shows significant positive effect on motor function,	1b 8/11

	in patients with Parkinson's Disease: a randomized controlled trial.	VR and MI with PT		balance and ADLs which lasted longer in PD patients compared with PT treatment alone	
Feng H et al. 2019 ⁽¹⁶⁾	Virtual reality rehabilitation versus conventional physical therapy for improving balance and gait in Parkinson's disease patients: a randomized controlled trial.	A total of 28 PD patients were included in the study and randomized into 2 groups. The experimental group received VR training and control group received conventional therapy	BBS, Timed Up and Go Test (TUGT), Functional Gait Assessment (FGA)	After 12 weeks compared to conventional physical therapy the VR group Shows greater improvement in balance and gait	1b 7/11

RESULT

Table 2: - PEDro Scale Analysis of Included Studies

PEDro	H. Feng et al, 2019	Usama M; et al, 2023	M. Kashif et al, 2024	M. Kashif et al, 2022
Specific Eligibility Criteria	1	1	1	1
Random Allocation	1	1	1	1
Concealed allocation	0	0	1	1
Baseline Comparability	1	0	1	1
Blind Subjects	0	0	0	0
Blind Therapists	0	0	0	0
Blind Assessors	1	0	1	1
Adequate follow-up	0	0	1	1
Intention-to-treat analysis	1	1	0	0
Between-group Comparisons	1	1	1	1
Point estimates and variability	1	1	1	1
Total	7	5	8	8

A total of 87 articles were found after using the key words out of which 7 articles were included in the study and the rest were excluded on the basis of the inclusion and exclusion criteria. The evidences were reviewed and analyzed on the basis of CEBM's Level of Evidence Scale and PEDro score.

There are 4 Randomized controlled trials and 3 systematic reviews which gives moderate to high evidences toward the effectiveness of virtual reality in balance and gait rehabilitation.

DISCUSSION

This evidence based Study analyzed 7 studies(4 randomized controlled trials and 3 systematic reviews) on the effectiveness of virtual Reality in rehabilitation for Parkinson's Disease(PD) patients .

There are 3 systematic reviews which gives strong evidences that virtual reality is a more effective treatment therapy compared to conventional physiotherapy in the rehabilitation of balance and gait in Parkinson's Disease.

There are 4 studies (randomized controlled trials) which gives moderate to high quality of evidences which suggest that virtual reality is more effective treatment modality for balance and gait affection in Parkinson's Disease. The programs are easy to perform and attractive to patients. the novelty of VR makes patients more receptive and welcoming to it. It also provides a safe enclosed environment which is easy to monitor and maintain preventing any injury and emergency In PD patients compared to normal postural response strategies are

smaller and slower. The CoM displacement within the base of support of the body because of reduced scaling up for larger perturbations the feet-in-place postural responses are slow to develop force.⁽¹⁷⁾

While using VR patients feels enjoyment which in turn increases willingness to participate more in the rehabilitation program. Dynamic balance exercise with VR showed improved balance abilities and reduced risk of fall.⁽¹⁸⁾ VR provides a safe, enjoyable, and engaging environment for rehabilitation.

Due to the distinctiveness of VR technology the blinding of subjects is near paradoxical. Hence, double-blind method is difficult to execute. VR can also lead to simulator disease, if not handled properly causing eyestrain, eye fatigue, nausea, dizziness etc. so it necessary to educate subjects properly before starting the study.⁽¹⁹⁾ There is difference of perceived distance in real and virtual world. Hence subjects may suffer from discontent in making proper judgement of distance in real life

There is a latency between the input devices and the output devices. This delay causes sensory conflict which can lead to sickness or fall. The MTP (Motion-to-photon) latency can cause a loss of performance and can provoke cybersickness.⁽²⁰⁾

A more classified approach to show effectiveness of VR in each stage of H&Y and small range of age criteria is necessary to assess the exact effectiveness of VR. More studies are needed to be conducted with a larger sample size, multicentered, and narrow range of age and Hoehn-Yahr classification.

Overall, the study suggests that VR is promising treatment modality for PD patients, but further research is needed to fully establish its effectiveness.

CONCLUSION

In this Evidence based Study, articles comparing the effectiveness of Conventional Physiotherapy versus Virtual Reality Rehabilitation on balance and gait in Parkinson's Disease were collected and assessed. The evidences suggest moderate to strong evidence about Virtual reality being more effective in comparison to conventional therapy.

Limitations

There is lack of articles which conducted studies on effectiveness of VR on balance in Parkinson's Disease

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