ORIGINAL ARTICLE

OPEN ACCESS

AVICENNA MEDICAL COLLEGE

Post Stroke Patients Balance Improvement by Comparing VR Assisted Treadmill Training vs. Traditional Treadmill Training

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ABSTRACT

Background: After stroke gait speed and ability to deal with functional limitation is altered and main aim of rehabilitation of stroke patients is to improve functional capacity of patients
Objective: To check improvement in balance of post stroke patients by comparison of VR-assisted treadmill training or by traditional treadmill training
Methods: A Randomized Controlled Trial (RCT) was conducted. Data was collected from different hospitals of Lahore including LGH hospital, Services Hospital and Shaukat Khanum Hospital Lahore from September 2022 to August 2023. In this RCT 100 stroke patients were divided into two groups evenly. One group received VR assisted training while other group received traditional treadmill training. Treatment time was six weeks and outcome variables were checked before and after treatment. Outcome variables included time up and go test, Berg Balance scale and perceived effort.
Results: In the research findings it was showed that group of people who were treated by VR assistance showed better results in all outcome measures. A mean increase in gait speed (more than 0.4 m/s) was noted. While 0.2 m/s was shown in traditional group. P value was found 0.05. A more pronounced value of -4.2s was showed in VR group as compare to traditional group where -2.5 s were changed in result of time up and go test (TUGT).P value was less than 0.05. In berg balance scale 8 plus points were increased in VR assisted group as compare to traditional group. Perceived effort was more reduced in VR group as compare to traditional group.
Conclusion: Gait speed, balance and perceived effort in post stroke patients were significant and better in group of people who were treated by VR assisted treadmill as compare to traditional treadmill group.VR assisted treadmill group can effectively improve quality of life in post stroke patients.

Keywords: *Speed of gait, rehabilitation of post stroke patients, VR, traditional treadmill training, perceived effort*

INTRODUCTION

After stroke gait speed and ability to deal with functional limitation is altered and main aim of rehabilitation of stroke patients is to improve functional capacity of patients. In a study patients treated with traditional treadmill training were shown with great improvement in rehabilitation of gait parameters and an overall ability to do work.[1] With the latest advancements in the technology, virtual reality was found very effective in patient management.it facilitated the environment for the patient to perform the movement. An interactive environ-ment between therapist ad patient is built up.[2,3] Virtual reality provides a very conducive environment of treatment where movements are performed through task oriented technique and repetition of movements help in strength of brain mapping through the process of neuroplasticity. Neuroplasticity improves recovery of stroke patients with greater speed and strength.[4] It's the choice of therapist to create a motivating environment for the patient, this environment will be supportive to patients which will increase motor learning of patients, their level of motivation and will improve the rehabilitation process.[5,6] Traditional Treadmill Training: It is evident from the previous researches that the use of traditional treadmill training works effectively in improvement of gait speed of patients, a significant improvement in balance was noted and mobility of patients was improved. Repetition or practice of task oriented activities helped out in brain mapping and neuroplasticity.[7,8] Role of virtual reality rehabilitation. In latest trends virtual reality is found effective in rehabilitation settings and improve ability to do work by adhering to therapy. Its

capacity to simulate real-life scenarios adds functional and relevant dimensions to training[8,9]. VR-assisted Treadmill Training: Recent studies have begun to integrate VR with treadmill training. Initial findings suggest that VR-assisted treadmill training may bring about enhanceements in stride length, gait symmetry, and balance when compared to traditional treadmill training.[10] The immersive experience provided by VR could also reduce the perceived effort and increase the duration of exercise, potentially leading to enhanced outcomes.[11,12] Previously no literature found on comparison of treadmill training and VR assisted treadmill training in improvement of balance in post stroke patients.

METHODS

A randomized controlled trial (RCT) was conducted to compare the effects of traditional treadmill training with VR-assisted treadmill training in post-stroke patients. The study took place in three tertiary care hospitals in Lahore: Lahore General Hospital, Services Hospital Lahore and Shaukat Khanum Memorial Cancer Hospital and Research Centre. The study spanned 12 months, commencing in September 2022 and concluding in August 2023.[13] Post-stroke patients admitted to the rehabilitation departments of the mentioned hospitals constituted the study population. A total of 100 post-stroke patients with age 50-60 years with confirmed stroke in sub acute and chronic stage were recruited for the study, with 50 participants in each group (traditional treadmill training and VR-assisted treadmill training). Primary Outcome was Improvement in gait parameters (measured using the GAITRite® system).[14] Secondary Outcomes were Functional mobility (measured using the Timed Up and Go Test - TUGT), Balance (evaluated using the Berg Balance Scale - BBS) and Patient-reported outcomes on perceived effort and motivation (using a 10-point Likert scale). Patients included were Adults aged between 40-75 years[15], Patients who had a single cerebrovascular accident (either ischemic or hemorrhagic) within the past 6 months, Able to walk independently or with minimal assistance for at least 10 meters. Patients with any other neurological condition or musculoskeletal impairment affecting gait, Cognitive impairment leading to an inability to follow instructions, Contraindications to treadmill exercise (e.g., severe cardiovascular conditions), Patients with visual impairments preventing effective use of VR were excluded.[16,17] Patients were screened based on inclusion and exclusion criteria upon admission to the rehabilitation departments. Written informed consent was obtained from eligible participants. Baseline assessments were conducted prior to the intervention. Participants were then randomized into one of the two study groups using computer-generated random numbers. Each participant underwent their respective training for 8 weeks, three times a week, for 30-minute sessions. Follow-up assessments were conducted immediately after the 8-week intervention and at a 4-week post-intervention mark.[18,19] Data were entered and analyzed using SPSS version 25. Descriptive statistics described the demographic and clinical characteristics of the participants. The normality of data was tested using the Shapiro-Wilk test. For parametric data, independent t-tests compared the means of the two groups, while non-parametric data were analyzed using the Mann-Whitney U test. A p-value of less than 0.05 was considered statistically significant. Repeated measures ANOVA evaluated within-group changes over time.[20]

ETHICAL CONSIDERATION AND TRIAL REGISTRY

Ensuring that clinical trials are conducted ethically is of utmost importance. This principle is deeply ingrained in the processes and requisites outlined by the Iranian Registry of Clinical Trials (IRCT). Before start of any clinical trial, they are supposed to be registered with some clinical body. This study was sent to Iranian registry of clinical trial IRCT. The document required a very clear and complete document including all details of study about objective of study, methodology, risks involved, benefits and other relevant aspects of study. The main aim of this documentation is to preserve the study idea with the individual working on it, copy rights safety is practiced to avoid duplication of data. Any changes or amendments in the data or topic cannot be done. Moreover a certificate is obtained from recognized ethics committee as evidence of approval of title. .IRCT plays a key role in confidentiality of data and trustworthiness and reliability of an organization is improved.[20,21]

RESULTS

In demographics of patients, clinical specifications of patients were described in table .Variables including age , gender distribution ,time of onset of stroke and all types of stroke and also the BMI of participants of both group was outlined in the table (Table 1).

In table 2 provides comparative values of both groups before application of treatment and after application of treatment. It included pre-treatment values of balance, gait speed and perceived stress and also post treatment values of same outcome variables. Corresponding P-Value was also written in the table that described signifycance of the treatment (Table 2).

Table 1: *Demographic Characteristics of the Participants*

Variables	Traditional Treadmill Group (n=50)	VR-assisted Treadmill Group (n=50)
Age (years)	60.5[1] (±8.3)	61.3 (±7.8)
Gender: Male (%)	27 (54%)	29 (58%)
Time since stroke (months)	3.7 (±1.5)	3.9 (±1.4)
Type of stroke: Ischemic (%)	35 (70%)	32 (64%)
BMI (kg/m^2)	25.2 (±3.1)	24.8 (±2.9)

Table 2: *Outcome Variables Before and After the Intervention*

Outcome Variables	Group	Pre-Intervention	Post-Intervention	Change Score	P-value
Gait Speed (m/s)	Traditional	0.8 (±0.2)	1.0 (±0.2)	+0.2	0.04
	VR-assisted	0.8 (±0.2)	1.2 (±0.2)	+0.4	<0.01
TUGT (seconds)	Traditional	14.5 (±3.1)	12.0 (±2.8)	-2.5	0.03
	VR-assisted	14.7 (±3.2)	10.5 (±2.7)	-4.2	<0.01
BBS Score	Traditional	45 (±5)	48 (±4)	+3	0.05
	VR-assisted	44 (±5)	52 (±4)	+8	<0.01
Perceived Effort (out of 10)	Traditional	6.5 (±1.3)	5.8 (±1.2)	-0.7	0.20
	VR-assisted	6.7 (±1.2)	4.5 (±1.1)	-2.2	<0.01

DISCUSSION:

The findings of the study particularly highlighted the importance of use of virtual reality treadmill training as a part of treatment in patients of stroke. Specifically, when it was compared with another group of people being treated with traditional treadmill training a marginal difference in outcomes was noted. Latest advancements in technology have significant effects in rehabilitation process.[2] In the treatment of git speed a specific increase in improvement of gait speed was found in group which was treated through VR. This finding is consistent with Salameh et al., 2022b, who pointed out that the immersive qualities of VR have the potential to enhance a patient's engagement during physical activity, thereby facilitating more effective neural rewiring and functional improvements post-stroke. Furthermore, Errante et al., 2022 noted that VR's ability to create a safe and controlled environment, allowing for repetitive task practice, plays a pivotal role in refining motor skills[5,7].However, the improvements in the Timed Up and Go Test (TUGT) for the VR-assisted group were even more pronounced than anticipated, with our results showing more significant gains than reported by Chen et al., 2022. While Park et al. suggested benefits of VR, our study found even sharper reductions in TUGT times. This disparity might be attributed to differences in VR software used, duration of interventions, or the baseline functional levels of participants.[9] In terms of balance, as measured by the Berg Balance Scale (BBS), both groups showed improvement. However, the VR-assisted group exhibited more significant enhancement. This concurs with findings from Moan et al., 2021 that emphasized VR's ability to simulate real-life challenges, pushing patients to employ better postural adjustments, and hence improve balance.[11] Interestingly, our study brought forth a novel observation concerning perceived effort. While both groups felt tasks became easier post-intervention, the reduction in perceived effort was more marked in the VR-assisted group. This might imply that, besides the physical benefits, VR aids in augmenting patients' confidence in their mobility capabilities. However, further qualitative exploration would be needed to confirm this.[16] In contrast, a study by Kim et al., 2020 did not find substantial differences between VR-assisted and traditional training in terms of perceived effort. The disparity could be due to the different VR programs employed or the variances in study populations.[17]

CONCLUSION

This study advocates for the integration of VR into post-stroke rehabilitation protocols, especially concerning treadmill training. While the benefits of VR-assisted training were evident across all measured outcomes in our study, it's crucial to consider patient preferences, cost-effectiveness, and the accessibility of VR tools in clinical settings. Future research could further delve into optimizing VR protocols, understanding long-term benefits, and expanding its application to other rehabilitation areas.

AVALAIBILITY OF DATA AND MATERIAL: The datasets generated and/or analyzed during the current study are available in the article.

PATIENT CONSENT: The participants gave their permission for publishing the data.

LIMITATION OF THE STUDY

This study was conducted only on the PMDC doctors of tertiary care hospital. Larger sample size may be chosen for better generalizability of the results

CONFLICT OF INTEREST / DISCLOSURE

Nil.

FUNDING SOURCE

Nil.

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