

Original Article

VIRTUAL REALITY TRAINING IMPROVES BALANCE OUTCOME IN STROKE PATIENTS

Anshad Nawaz Malik¹, Tahir Masood²**Abstract:**

Introduction: Stroke is the leading cause of disability which leads to decline in the functional status and quality of life of patients. The virtual reality training is one of more recent and interesting approaches to facilitate the speedy recovery after stroke.

Objective of study: The objective of this study was to compare the balance outcome in virtual reality training and task oriented training in stroke patients.

Methods: It was a randomized control trial and conducted in Physiotherapy and Rehabilitation Department of Pakistan Railway Hospital, Rawalpindi (March-August 2016). Twenty four patients were enrolled through non probability sampling and were randomly allocated to two equal groups. The baseline assessment was taken through berg Balance Test and 06 weeks of training. The training includes the additional virtual reality through exer-gaming to one group and task oriented training alone to other group. The re-assessment was taken after 02, 04 & 06weeks and statistical analysis was applied to evaluate between- and within-group differences.

Results: The mean age of the participants was 50.0±9.07 of VRT group and 50.16±86 of TOT group. 70% (17) were male and 30% (7) were female in sample. The results showed statistically significant difference between groups after 4 (p = 0.038) and 6 (0.001) weeks of trainings. There was significant improvement seen in both study groups as a result of trainings (p <0.001).

Conclusion: It is concluded that 6 weeks of virtual reality training through exer-gaming has better outcome regarding the balance as compared to the task oriented training.

Key Words: Balance, Exer-Gaming, Stroke, Xbox, Virtual Reality

Introduction

Stroke also called brain attack is a sudden neurological deficit due to compromised vascular supply to brain. The demographic analysis revealed that males are more prone to develop stroke in their 5th & 6th decades of life.⁽¹⁾ Fifteen million people are affected with stroke in the entire world⁽²⁾ and almost 4.8% Pakistani population develops stroke every year.⁽³⁾ Majority stroke survivors need the enriched services for their disablement and enabling them to become an active member of society.⁽⁴⁾ Stroke is directly linked with movement and balance impairments which limit the postural control & activities. The unequal weight distribution and sensory loss are the contributing factor in decreasing the mobility and walking capacity of stroke patients.⁽⁴⁾ The stroke is a disabling condition and the residual impairment leads to poor functional outcome, decline in the community role of patients, and increased economic and social burden on the society.^(3,4)

Various treatment approaches have been used for the appropriate rehabilitating of stroke patients in last few decades.⁽⁵⁾ The most optimal approach for stroke rehab is the task oriented training for achieving and relearning the specific task. The repetition along with context specific task not only improves the functional status but also enhance the neural plasticity.⁽⁶⁾ Hemi paresis after stroke undermines ability to perform

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activities of daily living (ADL's) and some ongoing therapies include Bobath and motor relearning need to motivate patient.⁽⁷⁾

Evidence suggests that including virtual reality to conventional therapy improves upper limb function and ADL's. But it is unknown whether these effects are preserved for a long time and also the most important characteristics of Virtual Reality (VR) are still uncertain.⁽⁸⁾ A Cochrane review of 08 studies concluded that the use of virtual reality significantly improves ADL's as compared to conventional therapy. Evidence encourages the use of VR as part of upper limb training but more research is needed to find out the benefits of VR in improving lower limb function.⁽⁹⁾ A systematic review has reported that virtual reality training enhances the motivation level and also the self-determination with the tasks.⁽¹⁰⁾ The virtual reality training is a new & novel approach which helps in achieving the optimal physical function in stroke patients.⁽¹¹⁾ Evidence suggests that VR training activates cerebral cortex which facilitates in controlling balance and increases motor function.⁽¹²⁾ The VRT causes re organization and neural plasticity in brain, neural networks, It is good

and promising assessment tool for the measurement of balance and fall risk and reliable with high intra and inter rater reliability.⁽¹³⁾ The main objective of this study was to compare the effects of additional virtual reality training through exer-gaming (commercial games) with task oriented training alone on dynamic balance during performance of functional task in stroke patients.

Materials and Methods

It was a randomized control trial and conducted in Physiotherapy and rehab department of Pakistan Railway hospital Rawalpindi from March-August 2016. 24 patients were enrolled through non probability sampling and random allocation into two groups; the control group (n=12) and the interventional group (n=12). The randomization was done through sealed envelope and this was single blinded study. The 02 patients dropped from control group (lack of follow up) and 02 from interventional group (one had re-attack and one missed the sessions) The stroke patients having more than 01 month onset, either type, age bracket 40-70 year and Rankin Modified 1-4 were included in the sample while patients having cognitive & visual impairment were excluded. The written consent form was taken before the recruitment and the ethical approval was taken from Research ethical committee of Riphah International University.

The baseline assessment was measured through Berg Balance Scale (BBS) and 06 weeks of training session was planned. The BBS is used to measure the dynamic balance in performing functional tasks and total score is 56 and the subjects having scored less than 19 are at high risk of fall. The re-assessment was taken after 02, 04 & 06 weeks. The control group (Task oriented training TOT) received the standard task oriented training include the side stepping, high stepping, standing on different surfaces, walking on different surfaces, sit to stand, picking of object, reaching forward etc. The interventional group (Virtual reality Training VRT) along with standard treatment received the additional 15-20 minutes Virtual Reality training through Xbox Kinect gaming software. The training was provided by trained therapists for 3 days per week for 6 weeks. The first day was orientation day and the complete process of

Exer-gaming was introduced to the subjects and explained the advantages and risks of Exer-gaming to subjects. (Figure.1) The games included 20,000 Water leaks River rush & Reflex ridge and these were mentioned in literature because they are easy to understand and play for adult population. Repeated measures ANOVA (RM-ANOVA) was used to analyze the difference in group & Post Hoc Bonferroni for week-wise comparison. Independent samples T-test was applied to seek the between-group differences at baseline and after training.

Results

The mean age of the participants was 50.0 ± 9.07 of VRT group and 50.16 ± 8.6 of TOT group. The overall gender distribution was and 70% (17) male while 30% (7) were female. There was significant difference between groups in scores of Berg balance test. There was a significant effect of intervention with time on berg balance scale in both groups; VRT & TOT group. The results showed that the effects of both treatment approaches are improving with time period. The repeated measures ANOVA showed that there was significant difference over time period in both groups. ($p < 0.001$ (Table 1))

The week wise comparison Through Post Hoc Test (Bonferroni) showed the significant difference within both groups. (Table 1) The week wise difference is represented in the Figure 2.

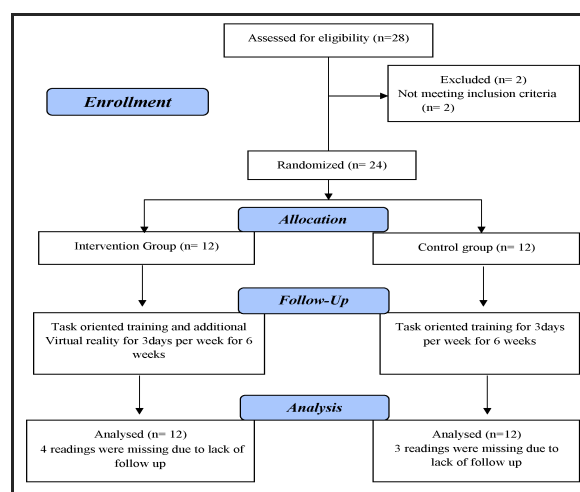


Figure 1: CONSORT flow diagram

Table 1: Week Wise Difference In Baseline To 6weeks Between Groups Through Post HOC Test

0-02 WEEKS				
Group	Mean ±SD	Mean ±SD	Mean difference	P-value
VRT group	25.90±3.31	34.20±4.36	8.30	0.000***
TOT group	25.11±2.52	32.44±3.39	7.33	0.000***
0-04 WEEK				
VRT	25.90±3.31	41.20±4.31	15.30	0.000***
TOT	25.11±2.52	37.11±2.52	12.00	0.000***
0-06 WEEK				
VRT	25.90±3.31	48.10±4.55	22.20	0.000***
TOT	25.11±2.52	41.22±2.48	16.11	0.000***
02-04 WEEK				
VRT	34.20±4.36	41.20±4.31	7.00	0.000***
TOT	32.44±3.39	37.11±2.52	4.66	0.000***
02-06 WEEK				
VRT	34.20±4.36	48.10±4.55	13.90	0.000***
TOT	32.44±3.39	41.22±2.48	8.77	0.000***
04-06 WEEK				
VRT	41.20±4.31	48.10±4.55	6.90	0.000***
TOT	37.11±2.52	41.22±2.48	4.11	0.000***

*** = p value less than 0.001

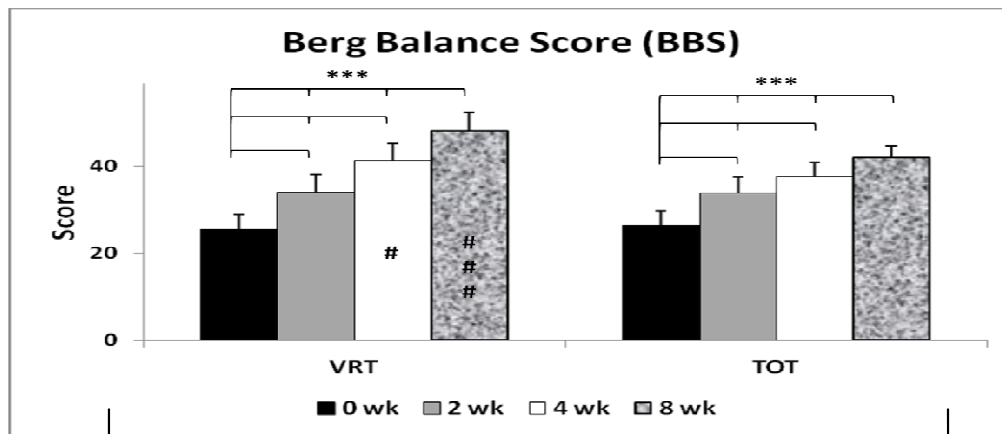


Figure 2: Changes In The Berg Balance Score During And After Training In Both Study Groups

(VRT = virtual reality training; TOT = task oriented training)
 *** indicates significant change (p ≤ 0.001)
 # indicates significant between-group difference (P ≤ 0.05)
 ### indicates significant between-group difference (P ≤ 0.001)

The results also compared the VRT & TOT group at baseline and after 02, 04, 06 weeks of training. The values showed that there was significant difference between groups in improving the balance outcome after 4 and 6 weeks of training. The VRT has better outcome as compare to TOT group. (Table #3)

Table 3: Berg Balance Test (BBS) Pre and Post Comparison of VRT & TOT Group

Berg Balance Test	VRTG (Mean ±SD)	TOTG (Mean ±SD)	P-value
At Baseline	25.58 ± 3.34	26.33 ± 3.28	0.585
After 02 weeks	34 ± 4.0	33.355 ± 3.79	0.878
After 04 weeks	41.18 ± 4.0	37.70 ± 3.02	0.038*
After 06wk	48.09 ± 4.32	41.90 ± 2.70	0.001***

* = p ≤ 0.05, *** = p ≤ 0.001

Discussion

This study is innovative in perspective of Pakistan and utilization of latest technology in stroke rehabilitation. Although it is not easy to incorporate such different tool in traditional treatment approaches but this type of training have substantial outcome in context of physical improvement along with motivation.

The results concluded that the the addition of virtual reality training to the conventional task oriented training significantly improves the balance outcome compared to task oriented training alone. The virtual reality training group has better outcome and effective approach in enhancing the balance as compared to conventional task oriented training. The superiority of VRT in improving balance in stroke patients could be due to its effects on brain re-organization and balance as reported by Mao et al. ⁽¹²⁾

The VR training has notable effect on dynamic balance during performing functional tasks after stroke. A study conducted (n=14) on VR training with treadmill and found that there was no difference in quiet stance but significant improvement in the lateral stability along with sit to stand skills. They also added that the this approach produces good results in walking and balance outcome as compared to the traditional training approach in stroke patients. ^(13,14) The virtual reality training has significant contributes in providing greater mobility at community level and enabling the patients to perform physical functional tasks. A single blind trial was conducted to explore the effects of VR on mobility level of stroke. The virtual reality training added the enhanced level of confidence during performing different task and walking in community. ⁽¹⁵⁾

In the current study there is overall increase in the score of berg balance included the static balance, dynamic balance and all item of Berg Balance Test score. Cho (2012) reported that VR training had no effect on static balance but significantly improved the dynamic balance in stroke and reduced the fall risk. This difference in result perhaps due to the mean age difference, in this study mean age was 65 year while the current study 50 year. ⁽¹⁶⁾ The literature recommended that the virtual reality training should be added to the conventional treatment in stroke

patients. The VR training has good and positive impact on achieving the functional goals in patients and enabling the person to accomplish daily activities independently. ^(17,18) The clinical trial conducted by Llorens (2014) supported the desired outcome in balance and mobility through Virtual reality training and also stated that this training is cost effective, feasible and motivational. The VR training promotes the functional skills linked with the dynamic balance and enables the stroke person to become an active member of community. ⁽¹⁹⁾

Previously Malik & Zafar reported a case of stroke with 06 weeks of virtual reality training for balance and mobility. They suggest that virtual reality training has significant improvement after stroke and is a useful innovative technology for future stroke rehabilitation in Pakistani perspective. ⁽²⁰⁾

Conclusion

It is concluded that addition of virtual reality based training improves the dynamic balance during functional task as compared to task oriented training alone in stroke patients. It also states that 06 weeks of task-oriented training, with and without virtual-reality training, has significant improvement in balance outcome in stroke patients.

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Author's Contribution:

Arshad Nawaz Malik: Conception and design of the work, acquisition, analysis, or interpretation of data for the work and revising content for final approval. Accountable for all aspects of the work

Tahir Masood: Conception and design of the work, revising content for final approval and Accountable for all aspects of the work.