

Effect of Virtual Reality Versus Transfer of Training Approach on Improving Cognitive Function in Post Stroke Patients.

Pragyan Singh¹, Amitabh Dwivedi²

¹Lecturer, Svnirtar, Odisha

²Professor and Dean, JSS University, Mysore

Abstract:

The study compared Virtual reality and Transfer of Training approach as means of providing adequate cognitive training. MMSE was used as a screening tool and D-LOTCA was used as the outcome measure for total of 30 participants which were further divided into two groups. The study concluded that both treatment methods are effective but there lies a significant difference between the two, virtual reality being more effective.

Keywords: Virtual Reality, Cognition, Stroke, TOT Approach.

Introduction

According to the World Health Organisation, a Stroke is defined as an accident to the brain with "rapidly developing clinical signs of focal or global disturbance to cerebral function, with symptoms lasting 24 hours or longer, or leading to death, with no apparent cause other than of vascular origin and includes cerebral infarction, intracerebral haemorrhage, and subarachnoid haemorrhage". Stroke is a global health problem. It's the second leading cause of death and fourth leading cause of disability worldwide. In developed countries stroke is the first leading cause of disability, second leading cause of dementia and 3rd leading cause of death. ^{1,2,3,4}

Low- and middle-income countries account for 86% of total stroke deaths & 89% of disabilities adjusted life years (DALY). Number of it is approximately 20 times that of high-income countries. ^{1,2}

Stroke may generate a wide range of specific problem- cognitive, communication, physical, & emotional. Cognitive deficits are common after stroke. Post stroke cognitive impairment of any type has been repeatedly related to stroke severity.

Neistadt (1990) suggested Occupational Therapy intervention approaches in cognitive & perceptual rehabilitation which fall into two categories: remedial approach & adaptive approach. Remedial approach includes: Transfer of training, sensory integrative, neurodevelopmental and Affolter. ⁵

Presently stroke rehabilitation strategies used to improve function is focused on high intensity, repetitive and task specific practice. Virtual Reality is an artificial environment which allows a user to interact with a computer simulated environment near real time feedback on performance. It has a great impact on the recovery of cognitive function as well as motor function in the dementia patients. Cognito-motor function in stroke survivors using VR is still at its infancy. ^{6,7,8,10}

Transfer of training approach is an established approach in Occupational Therapy for managing cognitive perceptual problems in post stroke survivors.^{11,12} In the present study a trial was made to find out the effectiveness of VR in training cognitive perceptual function in stroke survivors. Further it evaluated if it was having comparable effect as transfer of training approach in improving cognitive perceptual function in stroke survivors.

Aim: to compare the effect of transfer of training and Virtual Reality training in improving cognitive perceptual function in post stroke survivors.

Objective: to find out if Virtual reality training was effective in improving cognitive perceptual function in stroke survivors.

Hypothesis:

Alternate Hypothesis 1: Virtual Reality (VR) training is more effective in improving cognitive perceptual function in stroke survivors.

Alternate Hypothesis 2: Transfer of training (TOT) approach is more effective in improving cognitive perceptual function in stroke survivors.

Null Hypothesis: There is no difference between transfer of training approach & Virtual Training in improving cognitive perceptual function in stroke survivors.

Methodology:

Study design: A pretest posttest study design was used.

The independent variable was type of treatment (TOT & VR). Dependent variable was D-LOTCA, screening tool used was MMSE. The subjects were selected from the Department of Occupational Therapy. Subjects were allocated to Group 1 -TOT group or Group 2- VR group using convenient sampling. Each group had 15 subjects each. Post stroke survivors who were medically stable, with no impairment of vision, MMSE score more than 22, age between 18-70 years, both gender and both right and left hemiplegics and had sufficient use of one hand to complete evaluation and to carry out cognitive perceptual activities were included in the study. Patients with aphasia, hemiplegia due to other causes other than CVA eg: TBI were excluded from the study.

After screening, the patients who met the inclusion criteria were consecutively assigned to both groups (TOT & VR). Informed consent was obtained from the patients. After that MMSE & D-LOTCA were administered to all the patients. After the pretest, the therapy was begun for patients. Participants in the transfer of training group received activities for 20 minutes along with conventional Occupational Therapy for five sessions for a week for 12 weeks. The participants in Virtual Reality group received activities for 20 minutes along with conventional Occupational Therapy for five sessions for a week for 12 weeks. The conventional Occupational therapy intervention did not focus on any cognitive perceptual training. Post test was done

For the transfer of training group, intervention consisted of following activities:

1. Block Design
2. Puzzles
3. Pegboard construction
4. Manikin Assembly

For the Virtual Reality group, intervention consisted of following activities:

1. Bursting the balloons with the upper limb movement -5mins
2. Clumping the black sheep together -5mins
3. Playing football – 5mins
4. Putting the required ingredients in the pot to prepare food- 5mins

Results:

The individual characteristics of transfer of training and Virtual Reality group are given in

Table 1 Descriptive Characteristics

Sl. No.	Baseline Characteristics	Group 1 (TOT)	Group 2 (VR)
1.	No. of subjects	15	15
2.	Age range (years)	29-68	32-70
3.	Mean age \pm SD	49.4 \pm 8.18	50 \pm 7.15
4.	Gender (M/F)	9/6	10/5
5.	Right/Left Hemiplegia	10/5	8/7

Table 2 Mean test scores (pre-post) of TOT group & VR group

Outcome measure	Mean test score Group 1 (Transfer of Training)		Mean test score Group 2 (Virtual Reality)	
	Pretest	Posttest	Pretest	Posttest
D-LOTCA	44.26	57.73	45.13	62.8

Table 3 Showing results of Willcoxon Sign Rank Test for DLOTCA scale within the groups.

Groups	Mean diff.	z	p
Transfer of training	13.46	-3.425	0.001
Virtual Reality	17.66	-3.415	0.001

The results of D-LOTCA scale in this table shows there is significant improvement in TOT group and VR group with p values of 0.001 and 0.001 respectively.

Graph- 1 showing results of Wilcoxon Sign Rank Test for D-LOTCA scale within the groups.

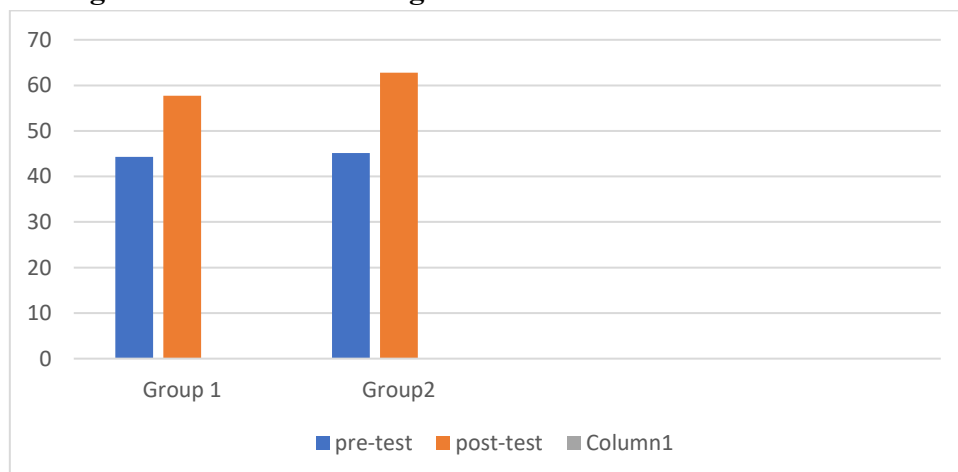


Table-5 Showing results of Mann-Whitney U test results between the groups.

Outcome Measures	Mean Diff.	Z	P
D-LOTCA	26.86	-3.680	.000

The Virtual Reality group showed higher score than the Transfer of Training group and it is statistically significant as shown by results of Mann Whitney U test at the p value 0.000.

Discussion:

The findings of the study suggest that both Virtual Reality training & Transfer of Training approach had a beneficial effect on cognitive deficit in post stroke survivors, and there is statistically significant difference between the groups as shown by scores suggesting Virtual Reality training is more effective in improving cognitive function in post stroke survivors. This finding is supported by the following studies where the VR training has been reported to be effective in improving cognitive function in post stroke survivors.

Martina Maier, Belén Rubio Ballester, Nuria Leiva Bañuelos, Esther Duarte Oller and Paul F. M. J. Verschure (2020) noted that adaptive conjunctive cognitive training in Virtual reality has appositve effect on improving attention, special orientation and depression in chronic stroke survivors.

Jeffrey M. Rogers et. al. (2019) in their study commented that a course of Elements of virtual rehabilitation using goal-directed and exploratory upper-limb movement tasks facilitates both motor and cognitive recovery after stroke. The magnitude of training effects, maintenance of gains at follow-up, and generalization to daily activities provide compelling preliminary evidence of the power of virtual rehabilitation when applied in a targeted and principled manner.

Cho et.al (2019) observed in their study that virtual reality immersive training might be an affordable approach for cognitive function and activity of daily living performance recovery for patients with acute stroke.

Kim et.al (2011) suggested that virtual reality training combined with computer-based cognitive rehabilitation may be of additional benefit for treating cognitive impairment in stroke patients.

Conclusion:

From the present study it can be concluded that VR training is an effective treatment adjunct to conventional Occupational Therapy program to improve cognitive function in post stroke survivors. As the sample size was small and the carry over effect has not been observed in the present study the results can not be generalized. Further the study was conducted in one institution representing a specific geographical area a wider study is mandated to generalize the finding of the present study.

Reference

1. Group GBDNDC.; GBD 2015 Neurological Disorders Collaborator Group. Global, regional, and national burden of neurological disorders during 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Neurol* 2017; 16 (11) 877-897.
2. 1 National Institute for Stroke and Applied Neurosciences, Auckland University of Technology, Auckland, New Zealand.
3. Clinical Neurology, Danube University Krems, Krems an der Donau, Austria.
4. Feigin, V. L., Norrving, B., and Mensah, G. A. (2017). Global Burden of Stroke. *Circ. Res.* 120 (3), 439–448. doi:10.1161/CIRCRESAHA.116.308413

5. Neistadt ME: A critical analysis of Occupational Therapy approaches for perceptual deficits in adults with brain injury: *American Journal of Occupational Therapy* 44:299, 1990.
6. Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: a systematic review. **Lancet Neurol.** 2009; 8:741–754.
7. Henderson A, Korner-Bitensky N, Levin M. Virtual reality in stroke rehabilitation: a systematic review of its effectiveness for upper limb motor recovery. **Top Stroke Rehabil.** 2007; 14:52–61.
8. Weiss, P. L., Rand, D., Katz, N., and Kizony, R. (2004). Video Capture Virtual Reality as a Flexible and Effective Rehabilitation Tool. *J. Neuroengineering Rehabil.* 1 (1), 12. doi:10.1186/1743-0003-1-12
9. Rose F, Attree E, Johnson D: **Virtual reality: an assistive technology in neurological rehabilitation.** *Curr Opin Neurol* 1996,9(6):461. 10.1097/00019052-199612000-00012.
10. Perez-Marcos, D., Chevalley, O., Schmidlin, T., Garipelli, G., Serino, A., Vuadens, P., et al. (2017). Increasing Upper Limb Training Intensity in Chronic Stroke Using Embodied Virtual Reality: a Pilot Study. *J. Neuroengineering Rehabil.* 14 (1), 119. doi:10.1186/s12984-017-0328-9.
11. Geusgens, C. A. V. (2007). Transfer of cognitive strategy training after stroke: no place like home? [Doctoral Thesis, Maastricht University]. NeuroPsych Publishers. <https://doi.org/10.26481/dis.20071003cg>.
12. Edmans JA, Webster J, N. B Lincol et.al, A comparison of two approaches in the treatment of Perceptual problems after stroke, *Clinical Rehabilitation*,(413): 230-243, 2000.
13. Martina Maier, Belén Rubio Balleste, Nuria LeivaBañuelos, Esther Duarte Oller and Paul F. M. J. Verschure. Adaptive conjunctive cognitive training (ACCT) in virtual reality for chronic stroke patients: a randomized controlled pilot trial. *Journal of NeuroEngineering and Rehabilitation.* 2020; 17:42.
14. Jeffrey M. Rogers, Jonathan Duckworth, Sandy Middleton, Bert Steenbergen and Peter H. Wilson. Elements virtual rehabilitation improves motor, cognitive, and functional outcomes in adult stroke: evidence from a randomized controlled pilot study. *Journal of Neuro Engineering and Rehabilitation.* 2019; 16:56.
15. Dong-Rae Cho, OT, MScA , Sang-Heon Lee, OT, PhD,* Effects of virtual reality immersive training with computerized cognitive training on cognitive function and activities of daily living performance in patients with acute stage stroke A preliminary randomized controlled trial, *Medicine* (2019) 98:11(e14752),
16. Yong Mi Kim, M.D., Min Ho Chun, M.D., Gi Jeong Yun, M.D., Young Jin Song, O.T., Han Eun Young, M.D.1, The Effect of Virtual Reality Training on Unilateral Spatial Neglect in Stroke Patients, *Ann Rehabil Med* 2011; 35: 309-315.