

Effects of Virtual Reality based Therapy on Balance in patients with neurological disorder - A Pilot Study

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Abstract

The present study explores the use of virtual reality-based game as an enjoyable yet effective intervention to improve balance in patients with neurological disorder. VR Therapy described below consist of exercise which challenge balance and delivered with low-cost equipment like VR google card board. Methods: Efficacy was tested in a pilot group of 5 participants (2 male and 3 female) with varying neurological disorder with affected balance. Balance evaluation was done with Standard Berg-Balance scale and Functional reach test at the beginning of intervention and at 6 weeks. Total duration of intervention was 15-20 min, 4days/week for 6 weeks. Conventional therapy was also given to Participants along with VR therapy for 35-45min. Intervention was given in a supervised environment to establish safety criteria. Results: This study shows that there is significance improvement in BBS score and Functional reach test from baseline to end of 6 weeks. Conclusion: These pilot study suggests that VR game therapy along with conventional therapy is effective in improving balance in patients with neurological disorders with impaired balance.

Key words: VR game, Balance, Google card board, Pilot study, Neurological disorder.

INTRODUCTION

Balance refers to an individuals ability to maintain their line of gravity within their Base of support. There are two types of balance Static and Dynamic balance.¹ Balance dysfunction leads to impaired postural control so, hamper activity of daily living. Balance depends mostly on proprioceptive, vestibular and processed by the CNS, for that it require the integrated functioning of sensory, motor and cognitive systems.^{2,3,4} As the technology advances, virtual reality based training along with task shows greater improvement in function.⁵ Flynn et al.⁶ observed that this vr therapy motivate the patient by giving fun and interest. virtual reality. Reliability of VR based therapy has been proven.^{7,8} Virtual reality makes possible to perform different task as challenge then performed as actual movement. Via virtual reality, user face the created situation and environment which seems to be actual situation.^{9,10} Sensory feedback in the form of auditory, vision, and proprioception can be used in virtual environment exercise training programs, and the program can be according to individual ability to complete level of training.¹¹ Adamovich et al. proposed that the rapid development of virtual reality technology raised the possibility of developing new exercise strategies.¹² Many previous studies have examined the use of virtual reality in treating various conditions, such stroke, cerebral palsy, and traumatic brain injury. This study investigating the effect of virtual reality based therapy on balance in patients with neurological disorders. The hardware side of Google Cardboard uses low-cost viewers, with the reference design made of foldable cardboard (hence the name) 45mm plastic lenses, and a magnet or capacitive-taped lever to operate the screen.¹³ Once we get everything folded into the right configuration (most kits come pre-folded and assembled) you slip the phone into the front of the viewer (usually held in place by Velcro) and germ booster game was used. The viewer only needs to do two things — hold the phone in front of the lenses at the right distance, and provide a way to interact with the screen.

AIM OF THE STUDY

Aim or need of the study to find out the effect of VR game on balance in any neurological patient with balance disorder by using google card board which is not costly and also easy to use anywhere.

METHOD

All 5 participants were recruited from government college of physiotherapy Jamnagar. Selection was based on the following criteria.

Inclusion criteria

- Ability to understand and follow the command.
- Minimum BBS score of 15(the minimum level deemed safe for balance intervention participation).

- Ability to walk 10m independently, with or without an assistive device.
- Intact visual and Auditory system.

Exclusion criteria

- Psychiatric disorder or dementia.
- Apraxia or hemineglect
- Epilepsy, cardiovascular disorder
- Orthopaedic disorder that affect balance indirectly
- Blurred vision.

Materials to be used

- Android version 6 for game play
- Google VR card board
- Stop watch
- Mat, chair for rest, Measure tape, chock stick, Stepper for BBS scale
- Data collection sheet, Paper, Pen

PROCEDURE

All 5 Subjects were taken from the government physiotherapy college, Jamnagar based on the inclusion and exclusion criteria. BBS and Functional reach test was taken as an outcome measure at pre and post treatment at the 6 weeks of intervention. Verbal instruction was given to the patients about the procedure that they have to kill the germ with bubble shoots from the gun by moving their trunk or head and during treatment they were allowed to take rest if feel fatigue and dizziness.

In these study BBS that evaluates static and dynamic balance ,functional reach test that which assess stability and static balance was used. Baseline data(height, weight and age) was collected before the intervention.it is given in table 2. In the intervention phase , first subject receive both conventional therapyfor 35-40 min

after that VR therapy for 15-20 min.

conventional therapy protocol for subjects 1) stretching of tight muscle like pectoral, calf, adductor and hamstring, 2) Active movement of upper limb and lower limb.3) Mat exercise kneeling, half kneeling, kneel sit to stand 4) Bridging 5) upper and lower limb strengthening 6) balance exercise reach outs in sitting, on balance board, step up and down, crossing hurdles, one leg standing, gait training.

After conventional therapy, VR game intervention was given on android version 6.0 support germ-buster game application. before that Verbal instruction was given to the patients about the procedure that they have to kill the germ with gun with use of head and trunk movement. 15-20 min time was used for VR game therapy during these training period ,if patient was feels fatigue and dizziness they allow for rest.

RESULTS

After the completion of therapy participants improved scores on two tests to a different extent. As shown in Below figure BBS score has increase from the mean \pm SD of 40.00 ± 19.4 to 44.33 ± 21.8 , points and forward FRT scores improved from 8.3 ± 4.92 to 10.32 ± 5.2 , B.FRT improve from 6.5 ± 3.9 to 7.8 ± 4.1 , LT.L.FRT improve from 8.62 ± 2.32 to 10.30 ± 0.32 , Rt. L.FRT improve from 8.62 ± 2.14 to 9.7 ± 0.98 . Maximal improvement achieved in F.FRT.

| PRE BBS | NO. SUBJECT | MEAN | SD | Z VALUE | P VALUE |
|-------------|----------------|-------|----------|---------|---------|
| | 5 | 40.00 | 19.64688 | -2.032 | 0.42 |
| POST BBS | 5 | 44.33 | 21.84186 | | |

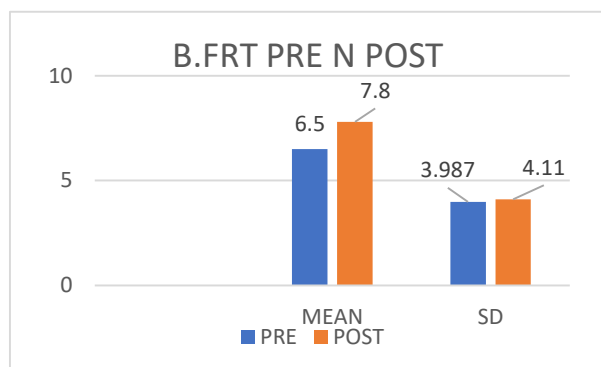


figure-1pre and post value of Backward functional reach test(B.FRT)

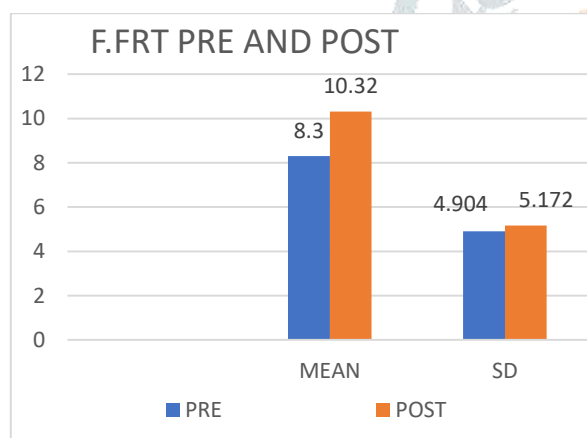


Figure-2 Pre and post value of Forward Functional reach test(F.FRT)

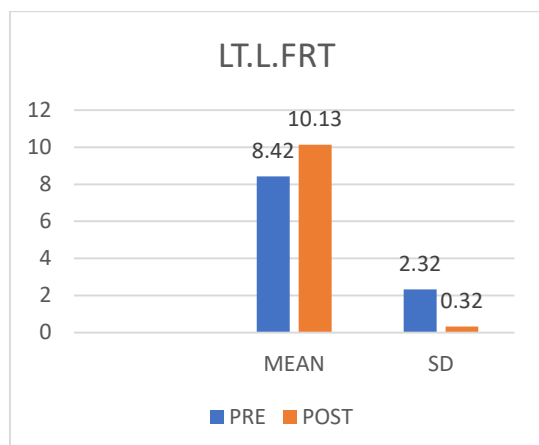


Figure -3 pre and post value of Lt. lateral FRT

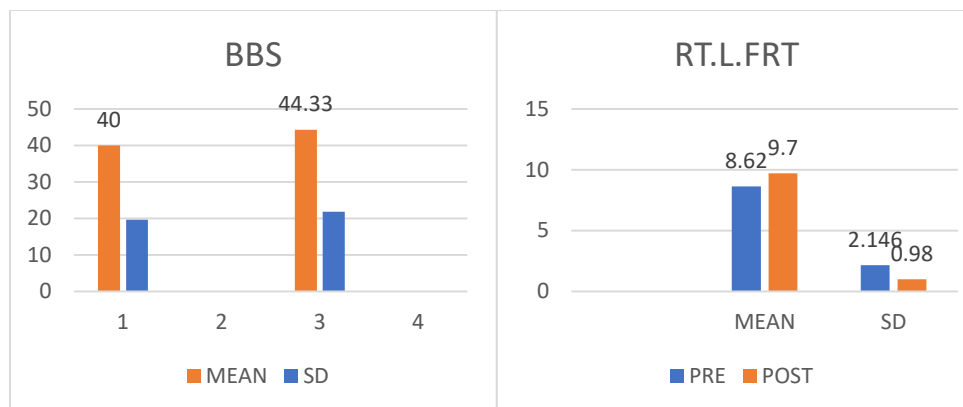


Figure -4 pre and post value of BBS Figure-5 pre and post value of Rt.lateral FRT

Discussion

The results of this study suggest that effect of VR game therapy is effective in increasing balance in patients with neurological disorders. Baseline data of patients given in Appendix:1. All 5 subjects shows improvement in balance as there is increase in BBS score from 1 weeks of training to 6 weeks of therapy. The components of the BBS in which the participants exhibited the most improvement were standing on one leg from unable to stand to stand for 2-3 sec, standing tandem unsupported for 2-3sec and turning 360°. Above figure:1 shows pre and post value of mean and SD of BBS score which shows greater improvement. out of 5 subject one subject also having improvement in sit to stand and also BBS score. There are also improvement in Functional reach test from initial training to end of 6 week. Lee HC, et al 2017 done one study and they concluded that VR balance training by using X-box games along with the traditional method having positive effects on the balance in patients with stroke. D. Corbetta and M.Locatelli suggest that VR after stroke improves balance abilities measured by BBS and it may be strategy to promote motor recovery after stroke and this is probably due to the provision of multisensory feedback (Visual, auditory and sometimes tactile).¹⁴ Task designed in the VR programme permit a gradual increase task difficulty level and can be adapted to subject motor capabilities. Jorge Alves and Adriana Santos 2016 had done one study in Normal elders and in patients with different Neurological condition they suggest that VR therapy is useful to improve balance, walking speed and elderly reduction of falls and fear of falling. So, based on this study which suggest that effect of VR game therapy on balance in patients with neurological disorder by using Google card board is an easy to implement, engaging with or substitute to traditional balance training in neuro patients. It also suggest that VR balance training is also short duration programme which may lead to neural change and neural plasticity.¹⁵

Limitation of study

- As this is pilot study so sample size is small.
- Other variables like gait mobility, postural control was not measured.
- Only one single group was taken for training but control group can be taken to compare the effect of VR alone or along with new balance exercise.
- Can be use in geriatric patient to improve balance.

Implication of use

It is useful to improve not only Balance but also gait stability so, reduce fall risk also, can be use for postural control.it As activity is fun. it would be interesting to examine the motivational effects of participants in this game.

Conclusion

The result of this study Suggest the potential effectiveness of utilizing the google VR card board as a therapeutic device to improve balance in patients with Neurodisorders.

Acknowledgement

We would like to thank the participants for their participation in this research.

Reference

1. Susan B O sullivan, Leslie G Portnry. 2014. Physical Rehabilitation :Sixth Edition. Philadelphia: FA Davis.
2. Peterka RJ 2002 Sensorimotor integration in human postural control. J Neurophysiol 88: 1097–1118,.
3. GUI BIN SONG, EUN CHO PORK, J 2015 Effect of dual tasks on balance ability in stroke patients. physiotherapy science 27,2457-2460.
4. Carr, JH, Shepherd RB, Nordholm L, et al. Investigation of a new assessment scale for stroke patients, Phys Ther.0985,65:175-180.
5. Bryanton C, Bossé J, Brien M, et al. 2006 : Feasibility, motivation, and selective motor control: virtual reality compared to conventional home exercise in children with cerebral palsy. Cyberpsychol Behav, , 9: 123–128
6. Flynn S, Palma P, Bender 2007 A: Feasibility of using the Sony PlayStation 2 gaming platform for an individual poststroke: a case report. J Neurol Phys Ther, , 31: 180–189
7. Clark RA, Bryant AL, Pua Y, et al. 2010 : Validity and reliability of the Nintendo Wii Balance Board for assessment of standing balance. Gait Posture, , 31: 307–310
8. Yamada M, Aoyama T, Nakamura M, et al. 2011: The reliability and preliminary validity of game-based fall risk assessment in community-dwelling older adults. Geriatr Nurs, , 32: 188–194
9. Gyeong He echo,gak Hwangbo, 2014The Effects of Virtual Reality-based Balance Training on Balance of the Elderly J.Phys Therapy sci Apr; 26(4): 615–617
10. Burdea GC: 1997 Virtual rehabilitation—benefits and challenges. Methods Inf Med, 2003, 42: 519–523
11. Wilson PN, Foreman N, Stanton D: Virtual reality, disability and rehabilitation. Disabil Rehabil, ,19: 213–220
12. Adamovich SV, Fluet GG, Tunik E, et al. 2009,: Sensorimotor training in virtual reality: a review. NeuroRehabilitation, 25: 29–4
13. ougherty, Conor (May 28, 2015)Google intensifiers focus on its cardboard Virtual reality device. New York Times. Retrieved June 17.
14. D. Corbetta, M. Locatelli: 2016 Virtual reality for improving balance in stroke patients:systemic review and meta analysis, Italian journal of physiotherapy,3, Jorge Alves and Adrina Santos : Virtual Reality therapy for balance training in Aging and Neurological Disorders, Journal of advanced neuroscience research:3,1-8.

| NO. | MEASURES | PRE – INTERVENTION (0-week) | POST- INTERVENTION (6-week) |
|-----|---------------------------------------|--------------------------------|--------------------------------|
| 1 | BBS | 46/56 | 50/56 |
| | FR BR Lat.(Right) Lat.(left) | 10.7 8 8.7 9.7 | 13.6 8.5 9 10 |
| 2 | BBS | 47/56 | 51/56 |
| | FR BR Lat,(Right) Lat.(left) | 5 3.5 5 5 | 12 7.3 8.4 9.9 |
| 3 | BBS | 46/56 | 54/56 |
| | FR BR Lat.(Right) Lat.(left) | 9.5 7.5 9 - | 10.5 8.5 10 - |
| 4 | BBS | 53/56 | 56/56 |
| | FR BR lat.(Right) lat.(left) | 11.5 9.5 10.5 10 | 12.5 10.6 10.8 10.5 |
| 5 | BBS | 54/56 | 55/56 |
| | FR BR Lat.(Right) Lat.(left) | 13.1 10.5 9.9 9 | 13.5 11.4 10.3 9.5 |

| No. Subject | VARIABLE | FORWARD. FRT | | BACKWARD. FRT | | RIGHT.LAT.FRT | | LEFT.LAT.FRT | |
|----------------|----------|-----------------|-------|------------------|------|---------------|------|--------------|-------|
| 5 | | PRE | POST | PRE | POST | PRE | POST | PRE | POST |
| | MEAN | 8.30 | 10.32 | 6.5 | 7.80 | 8.62 | 9.70 | 8.42 | 10.13 |
| | SD | 4.90 | 5.172 | 3.987 | 4.11 | 2.146 | .980 | 2.32 | 0.320 |
| | Z VALUE | -2.032 | | -2.023 | | -2.032 | | -1.826 | |
| | P VALUE | 0.42 | | 0.43 | | 0.42 | | 0.68 | |