Original Research Article

Effectiveness of Visual Feedback Balance Training on Equiboard Versus Traditional Balance Training in Post Stroke Patients: A Comparative Study

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Abstract

Background: A Stroke is classically characterized as a neurological deficit attributed to an acute focal injury of the central nervous system by a vascular cause and is a major cause of disability and death worldwide.(1) Balance problems are thought to be common after stroke and they have been implicated in the poor recovery of activities of daily living and mobility and increased risk of falls.(2) Postural sway for patients with hemiplegia can be twice that of their age matched peers. Many balance training are used but No general physiotherapy approach has proven to be superior for promoting balance recovery from stroke.(3) Novel biofeedback devices based on Virtual reality (VR)technology are now being used for neuromotor rehabilitation. Traditional balance training is based on the automatic repetition of specific movements. These methods can become repetitive and thus reduce the motivation of the patient and adherence to treatment. So the need of my study is to compare the effectiveness of visual feedback balance training on equiboard and traditional balance training in post stroke patients.

Aims and objectives: To study and compare the effectiveness of visual feedback balance training on equiboard versus traditional balance training in post stroke patients.

Methodology: 30 patients with stroke were equally divided into two groups. patients in group A received the conventional physiotherapy while the patients in group B received visual feedback balance training on equiboard. All the subjects were treated for 1 month, 5 days a week. BBS-Berg Balance Scale and step test was used as the outcome measure at the beginning and end of study.

Results: Results showed significant improvement within both the groups for both the outcome measure(p,0.05), while there was no significant difference between two groups in BBS($p>0.5$), but there was significant difference in the step test of experimental group($p<0.5$)

Conclusion: It can be concluded that visual feedback balance training is more effective than the traditional balance training alone in stroke patients.

Keywords: stroke, balance training, visual feedback.

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Introduction

A Stroke is classically characterized as a neurological deficit attributed to an acute focal injury of the central nervous system by a vascular cause, including cerebral infarction, intracerebral hemorrhage and sub arachnoid hemorrhage and is a major cause of disability and death world wide.[1] After congenital heart disease & cancer of all types, stroke is the 3rd leading cause of death worldwide. However unlike caucasians, Asians have a low rate of Chronic Heart Disease(CHD)& have a higher prevalence rate of stroke. Among the Asians the number of people died from stroke was 3 times that of CHD.[4] It is the most common condition affecting many people. The incidence rate in India is 119- 145/100000 based on the recent population based Studies(2013). The estimated adjusted prevalence rate of stroke range 84-262/100000 in rural and 334-424/100000 in urban india.[5] The most common impairments seen post stroke are sensory impairments, weakness, headache, visual changes, alteration in muscle tone, abnormal synergy pattern, abnormal reflexes, altered coordination, altered motor programming, postural control, balance, ipsilateral pushing, speech, language, swallowing, emotional status, bladder and bowel function, perception and cognition.[6] Balance problems are thought to be common after stroke and they have been implicated in the poor recovery of activities of daily living and mobility and increased risk of falls. [2] Postural sway for patients with hemiplegia can be twice that of their age matched peers.[7] Symmetry of weight bearing is also impaired following stroke with patients bearing as much as 61% to 80% of their body weight through their non paretic lower extremity.[8] Among many biological and functional characteristics, postural control is the best predictor of achieving independent living and shows the highest correlation (rp=0.70) with person-perceived disability after discharge from rehabilitation.[9] Balance problems in hemiparetic patients after stroke can be caused by different impairments in the psychological system involved in postural control, including sensory afferents, movement strategies, biomechanical constraints, cognitive processing and perception of verticality.[10] The commonly used interventions for training balance include pertubation training, force plateforms, it to stand, one leg standing, standing on narrow BOS(tandem standing & tandem walking, training on foam pads, wobble boards & vestibular ball , step up and down etc.[11] Novel biofeedback devices are now being used for neuromotor rehabilitation. In the last few years, there has been increasing research interest in the application of virtual reality (VR) technology to rehabilitation procedures. In contrast with traditional rehabilitation procedures, which may be tedious, resource intensive & costly VR provides patient with stroke opportunities to engage in meaningful, intensive, enjoyable & purposeful tasks related to real life interest and ADL. The published clinical results indicate that the recovery of motor function in stroke patients with motor difficulties appears to be enhanced by using VR technology. Virtual reality is the use of interactive simulations created with computer hardware and software to present users with opportunities to engage in environments that appear to be and feel similar to real world objects and events. User interact with displayed images, move and manipulate virtual objects and perform other actions in a way that attempts to immerse them within the simulated environment.[12]

Biofeedback can be defined as the use of instrumentation to make covert physiological processes more overt. The use of biofeedback provides patients with sensorimotor impairments with opportunities to regain the ability to better assess different physiological responses and possibly to learn self-control of those response.[13]

Visual feedback related to weight distribution and center of pressure positioning has been shown to be effective in increasing stance symmetry following stroke. Upon changing the COG on the support base, the patient can view the movement of the object on the monitor. Visual biofeedback stimulate proprioceptive information that may be negatively affected in stroke victims.[14]

One such device is equiboard sport by technoconcept. Equiboard is a freeman board with biofeedback used in physiotherapy and specially adapted for reprogramming sensorimotor skills and balance training. The equiboard plate is fitted with an 3D accelerometer. This sensor measures the oscillation of the plate in all directions . The red dot (ball), in different games represents the angular position of the

plate. A tilt in the sagittalplane(rotation along x axis) provides the movement path following the y axis. A tilting movement in the frontal plane (along the y rotation axis) gives a path following the x axis. It is a device with Bluetooth wireless connectivity that is battery operated. The equiboard software contains different games that provides motivational task oriented exercises specifically designed for balance affected people by clinical therapists. The user caninteract naturally with the game by the means of weight transference of feet.[15]

Materials and Methodology

The patients coming to physiotherapy department on OPD basis were selected according to the inclusion and exclusion criteria. All the patients were discussuced about the nature and purpose of study. Written informed consent was taken from all the patients in their understandable language. Inclusion criteria for the patients were Willingness to participate in 4 week study,. having ischemic or haemorrhagic stroke, diagnosed clinically with stroke > 6 months, age group 40-70 years, who are able to stand with or without support, spasticity MAS<3, BBS score>21. (i.e moderate risk of falling), MMSE score>26 and Patients without any visual defects. Exclusion criteria were Patients with brain tumor or any other neurological condition, with any other medical condition which might hamper patient's participation in the intervention, with any perceptual problems, with ataxia or any other cerebellar symptoms, with dementia or aphasia and the Patients who are undergoing any other intervention to improve balance. Total 30 patients were selected for the study and were equally divided into two groups. Demographic data of all the patients were taken and pre treatment assessment was done. Patients in group A were given traditional balance training which included Balance training consisted of 20 minutes session which included following exercises: double leg stance, tandem stance, step forward and backward, step sideways on exercise step, sitting on a swiss ball with support and bending trunk forward and side to side, walking forward and backward in tandem walking pattern and perform single leg stance[16]. The patients in group B were given traditional balance training along with visual feedback games exercises on equiboard Protocol for games

Week 1- sagittal bridge, frontal bridge, sagittal path, frontal path and tracking(with single hand supported)

Week 2- self control left-right, self control rear front, basket, tracking and glutton. (with 2 finger supported)

Week 3- Sagittal bridge, frontal bridge, sagittal path, frontal path and tracking (without hand support)

Week 4- self-control left-right, self-control rear front, basket, tracking and glutton (without hand support)

Protocol for week 1 and 3 was similar and for week 2 and 4 was similar. There was no fixed schedule of the game presentation, rather it was presented randomly. This was done to prevent blocked practice of learning. Rests was given in between as and when patient got fatigue. Outcome measure BBS (Berg Balance Scale)and Step test were taken at the beginning and end of 1 month treatment.

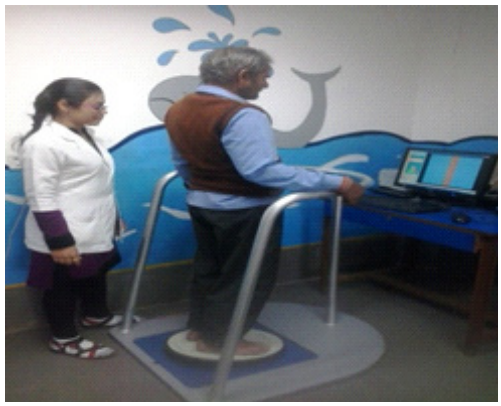

Fig.1 Visual feedback balance training on equiboard – given to experimental group

Results

Data of 30 patients group A(13 male, 2 female) and group B(11 male and 4 female) were analysed by using statistical package for social science version 16(SPSS 16) and Microsoft excel 2010.Wilcoxen signed rank test was applied to analyse pre and post outcome measures within groups,while between group analysis was done by using Mann Whitney U test for all the outcome measures. Baseline measurement showed no significant difference for pre berg balance and step test outcomes between both the groups.

Table 1: Analysis of Berg Balance Scale in both groups

	Pre BBS (Mean±SD)	Post BBS (Mean±SD)	Z value	P value
Group A	**43.6±6.17**	**51.53±3.27**	-3.302	0.001 (<0.05)
Group B	**43.73±6.25**	**51.26±3.28**	-3.415	0.001 (<0.05)

Table 2: Analysis of Step test in both the groups

	Pre ST (Mean±SD)	Post ST (Mean±SD)	Z value	P value
Group A	**1.8±1.33**	**3.36±1.27**	-3.309	0.001
Group B	**1.56±0.94**	**1.27±0.94**	000	1.00

Between Group Analysis.

Analysis of Berg Balance Scale in between group.

"Mann- Whitney U test" was applied for between group comparison of Group A and Group B.

Table 3: Table shows Mean changes in Berg Balance Scale (Mann- Whitney U Test)

Groups	Mean of difference of post treatment Score	SD	U value	p value
Group A	7.533	4.70	111	0.950
Group B	7.533	3.90		

Above results showed significant improvement in BBS and Step test within the group(p,0.05) while there was no statistically significant difference in BBS(p>0.05) in between group but there was a statistically significant difference in step test(p,0.05) t for the group 2. A recent study (2023) also showed that balance training on an unstable surface along with visual feedback had greater impact on gait speed, trunk stability and mobility in chronic stroke patients[17].

Discussion

The goal of the present study was to compare the effectiveness of visual feedback balance training on equiboard versus traditional balance training in post stroke patients. Thirty subjects were conveniently divided into Control Group (n= 15) and Experimental Group (n=15). The patients in experimental group received visual feedback balance training on equiboard as well as other conventional physiotherapy exercises. The patients in control group received traditional balancing exercises as well as other conventional physiotherapy exercises. Both the control and the experimental group were similar at the baseline characteristics of age, gender distribution, side of affection (dominant and non dominant), duration of stroke, Pre scores of Berg Balance Scale and Step Test. The result of within group analysis shows significant improvement in the score of Berg Balance Scale (p=0.001). The analysis for Step test score within the experimental group showed significant improvement (p=0.001) but there was no significant improvement within the control group (p=1.000). The result of between group analysis shows highly significant improvement in the step test (p=0.000) but there was no significant improvement in the Berg Balance Scale Score (p=0.95). The major finding of the study is that the subjects treated with visual feedback balance training on equiboard (experimental group) showed significant improvement in the Step Test score.

The intervention required the subject to stand on the wobble board and maintain balance by using the visual feedback received by playing different types of games with there feet. The different games involve by shifting weight in antero-posterior direction, medial-lateral direction and in rotatory direction.

The improvement in functional balance and stepping frequency might be due to

- Better alignment
- Decreased postural asymmetry
- Improved proprioception of lower limb
- Increased ankle ROM
- Increased strength of lower limb muscles
- Activation of hip and ankle postural control strategies

Conclusion

From the present study it can be concluded that both the traditional balance training and visual feedback balance training are effective in improving balance in post stroke patients but stepping frequency was more in visually guided patients. Further studies should be carried out in future for better conclusions.

Source of funding: Nil

Ethical clearance: Ethical committee clearance was taken prior to study(25-3-14) ref no-IECGSI/ Approval/56/14.

Conflict of interest none

LIMITATIONS OF THE STUDY

1. One of the limitations of this study was the small sample size. The results of the study can't be made applicable to the whole population of Stroke patients.
2. There was no specific follow up of the subjects.
3. Only subjects with mild to moderate risk of fall were taken into the study.

FUTURE RECOMMENDATIONS

1. A large sample size study should be done to make the findings more specific and applicable to whole stroke community.
2. Specific follow up periods should be set, to find the carryover effect of the visual feedback balance training intervention.
3. The mechanisms of effects of visual feedback balance training are probably multi factorial and require further study for definition.
4. An experimental study should be conducted for the patients with high risk of falling i.e. BBS<21. 5) As patients get dependent on visual sense, they must be further treated with eyes closed so that their vestibular and somatosensory system gets activated.

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