ORIGINAL ARTICLE

Effect of Virtual Reality Training on Dynamic Balance of Chronic Stroke Patients

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ABSTRACT

Objective: This study was conducted to determine the effects of virtual reality training on dynamic balance in chronic stroke patients.

Study Design: Quasi experimental design.

Place and Duration of Study: The study was conducted from 01st July 2015 to 31st December 2015 in the department of physical therapy, Pakistan Railway Hospital Rawalpindi.

Materials and Methods: Eight patients of chronic stroke with balance impairment were included through purposive non-probability sampling. The intervention was provided for 6 weeks including virtual reality training for 10-15 minutes per day, 4 days/ week to all patients. Dynamic Balance was measured using Berg Bbalance Test and mobility was assessed through Timed Up and Go Test. Tinetti performance oriented mobility assessment was used to assess both the mobility and dynamic balance. The pre and post mean was compared through SPSS 21 version.

Results: Mean score of berg balance scale was 35±08 and after 6 weeks of intervention score was 53.33±2.65. Mean score and standard deviation of tinetti performance oriented mobility assessment scores which were initially 12.37±8.21 and after 6 weeks of intervention score was 25±02.09. Mean score and standard deviation of timed up and go scores which was initially; 29.08±15.03 and after 6 weeks of intervention score was 8.96±3.4. Overall improvement was seen in dynamic balance of stroke patient, along with increased confidence in performing activities of daily living.

Conclusion: This study demonstrates improvement in dynamic balance after virtual reality training, indicating that virtual reality can play an important role in rehabilitation of balance impairment in chronic stroke.

Key Words: *Dynamic Balance, Stroke, Virtual Reality Training, Xbox.*

Introduction

The cerebrovascular accident or stroke is neurological condition of sudden onset which leads to focal neurological deficits due to lack of appropriate blood supply to brain[1] The global annual prevalence of stroke is 15 million and one third of them die secondary to stroke. The stroke is the 2nd most common cause of death worldwide and 4th in low income countries.[2] The annual incidence of stroke in Pakistan is 250 per 10,0000.[3] The economic loss and social burden is greater in young stroke population.[4] The stroke disability is directly linked with the loss of balance, gait disturbance, functional loss and increase risk of fall.[5] The negative consequences of impairments include the restricted community participation, lack of activities of daily living and marked restrictive role in the society.[6,7]

The appropriate stroke rehabilitation is progressive, dynamic and goal oriented process which aimed to enable a stroke person to reach optimal functional level.[8] There are multiple approaches designed to enhance the level of independence in stroke patients include Bobath treatment[9] progressive resisted training,[10] Proprioceptive neuromuscular facilitation PNF,[11] constraint induced movement therapy CIMT[12] and task oriented training.[13] These all approaches mainly focus on repetition of activities but there is lack of interesting and encouraging activities for maximum repetitions. But patients find such approaches boring and no incentive in performing such activities.[14]

In recent times a concept of virtual reality training

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through exer-gaming has been introduced for physical rehabilitation of stroke patients.[15] The virtual reality (VR) is a computer generated environment which delivers the sensory gesture and make the person with imaginary objects and incidents are real. In such VR environment patients perform task like walking, moving objects, picking and throwing which feel like real activity.[16] There is positive impact of virtual reality training through exer-gaming with neural plasticity in post stroke patients.[17] The VR training has significant improvement in functional outcome and level of motivation in stroke patient but the just mention in the beginning and then specific equipment is too expensive to use for patients. So there are few commercial video games are available like Xbox are being used for the purpose of stroke rehabilitation.[5] The Xbox with Kinect is effective to enhance the activity level, functional recovery motivation, interest, engagement, repetition and chronic Activity of Daily Life in stroke patients[18] The exer-gaming through X box is effective for physical performance and also have greater positive effect on emotional functions and to promote selective attention.[19] The main issue regarding the motivation of patient towards training is considered in the current study.

The VR training with X box has significant addition in stroke rehabilitation in terms of functional outcome with enhance level of motivation. It can be cost effective regarding financial, time, manpower and in future can be integral part of home based stroke rehabilitation.[20] This study will provide the framework for using VR training and would be an addition to existing literature. The purpose of this study was to determine the effect of additional virtual reality training on dynamic balance in chronic stroke patient.

Materials and Methods

This was quasi interventional pilot study conducted from 01st July to 31st December 2015 in department of physical therapy, Pakistan Railway Hospital Rawalpindi. Eight chronic stroke patients, above 40 year of age, who were able to stand without support for at least 30 seconds were included through purposive sampling technique. The exclusion criteria were cognitive impairment, severe balance loss and vision impairment. The ethical approval was taken from ethical committee of Riphah College of Rehabilitation sciences. The informed consent was taken and the treatment procedure was briefly explained to the patients. The standardized test for balance and mobility including Berg Balance Test (BBT), Timed Up and Go (TUG) and performance oriented mobility test (POMA) were used at baseline, after 02, 04 and 06 weeks. The BBT used for analysis of dynamic balance while TUG is reliable tool for assessment of mobility. The POMA is a valid tool for the assessment of both gait and balance.

Task oriented training included the reaching activities, standing balance, marked gait training, sit to stand practice and in addition to that 10-15minutes virtual reality training through exer-gaming was provided. Virtual reality training was given using Kinect. Virtual training was given for 6 weeks with 4 days per week, 1atand 2nd day of 1st week were orientation session where patient got tutorial about the game, later on with each week difficulty was increased to maintain a challenging environment for patient. The trained therapist assessed the patients and performed the functional tasks. The data was analyzed through SPSS 21 version and the mean and standard deviation was compared. (Table I) The data was compared with pre and post training at baseline and after 02, 04 and 06 week. The mean difference was analyzed for difference at multiple time periods.

Table I: Virtual Reality Training Protocol

Intervention	Game types
1st week	20,000 Water leaks
2nd week	Gold rush
3rd week	River rush
4th week	Funnel cake
5th week	20,000 Water leaks & River rush
6th week	Gold rush & Funnel cake

Results

Eight patients followed intervention for 6 weeks out of which, 7 were males and 1 female. The mean age of the patients was 52.23±6.45 year.

Table II: Descriptive Analyses of Timed UP and GO Test

Timed Up and Go Score	Mean Score (Seconds)	Standard Deviation
Baseline	29.08	15.03
After 2 weeks	21.98	9.93
After 4 weeks	13.36	4.29
After 6 weeks	8.96	3.46

The table II shows mean score and standard deviation of TUG scores (measure level of mobility in seconds) which was initially; 29.0875(±15.036) after 2 weeks improved to be: 21.987(±9.931), then after 4 weeks of intervention TUG score was; 13.362(±4.2), and after 6 weeks of intervention score was 8.966(±3.4).

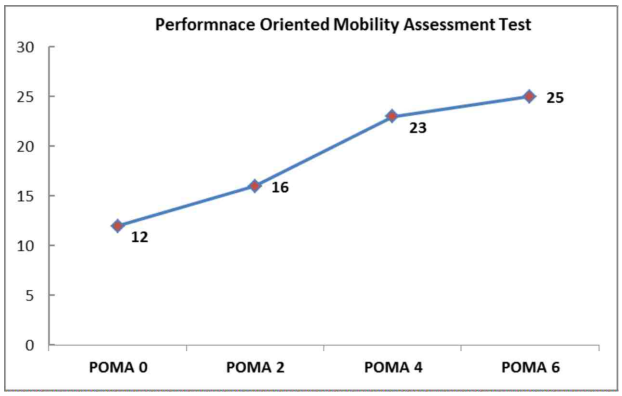

Fig 1: Graphic Representation of POMA Test

The Fig 1 shows an improvement in score of performance oriented mobility assessment scale used to measure dynamic balance and gait. Mean score of POMA initially is 12, which after 2 weeks of intervention improve to 16, further after 4 weeks of intervention Mean score is 23, and reach 25 after 6 weeks of intervention.

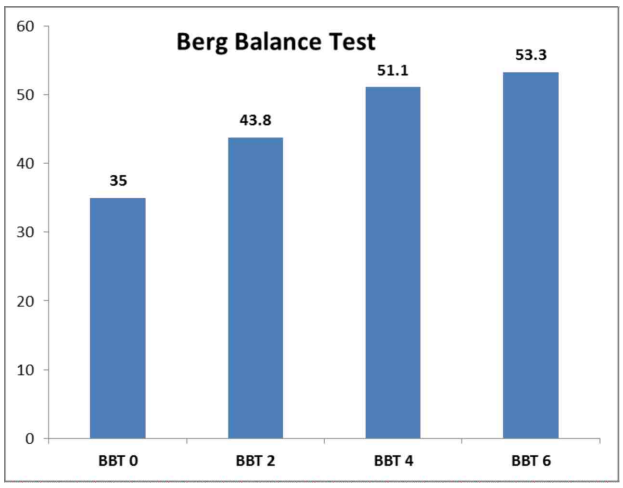

Fig 2: Graphic Representation of Berg Balance Test

The Fig 2 shows an improvement in score of berg balance scale used to measure dynamic balance. Mean score berg balance scale initially is 35, which after 2 weeks of intervention improve to 43.8, further after 4 weeks of intervention Mean score is 51.1, and reach 53.3 after 6 weeks of intervention.

Discussion

The current study reveals that virtual reality training has better outcome regarding balance in stroke patients. The balance training mainly focuses on stability functions like equal weight bearing; attainment of the motor strategies is usually loss during stroke and is needed to perform the fast and safe postural changes. This training can directly improve stability and balance and indirectly improve the safety and gait speed of the chronic stroke population. In this study Improvement in dynamic balance was assessed using berg balance scale and improvement was reported after two weeks of intervention, but significant improvement was observed after 4 weeks of intervention. The study reported low fall risk after 4 weeks and also found berg balance is good tool for assessment of balance.[16] A study conducted by Wagner Henrique Souza Silva et al. also suggested that stroke patients have significant improvement in dynamic balance after virtual reality training. They also recommended that virtual reality have positive effect in addition to conventional therapy to improve functional independence and dynamic balance in chronic stroke patients.[21]

The mobility was assessed through Timed up and Go Test and it was reported that after 06 weeks of training, there was significant improvement in mobility level of stroke patients. Ki Hun Cho elaborated the result of time up and go and found that virtual reality group has significant improvement in mobility level as compare to the traditional training in chronic stroke.[5] Similar studies in literature are suggesting that the additional virtual reality training has better result in stroke improvement. The virtual reality treatment is augmented rehabilitation along with the conventional treatment.[22] The virtual reality training has linked in the formation of neural reorganization and re learning of stroke patients.[23] The clinical improvements reported here confirm the positive relationship between balance function and other aspects of functional mobility and gait previously published. Previous studies also suggest the importance of balance ability besides muscle strength as an important determinant of performance in gait functions in individuals with stroke. A systemic review conducted by Marcela

Cavalcanti Moreira ET all focusing use of VR or the improvement of gait in post-stroke patients demonstrated that the use of VR promotes changes in gait parameters. This also concluded that suggest that VR is a promising method to improve the gait of patients with stroke.[24] Commonly increase in functional strength and balance reduce risk of fall in older adults, virtual reality treatment is therefore beneficial in improving balance and reducing fall risk. Abel Angel Rendon Et all conducted a study to evaluate effect of virtual reality on dynamic balance of older adults by randomized control trial show significant improvement in VRG in the 8-foot Up & Go test and the Activities-specific Balance Confidence Scale. Proving that virtual reality gaming is a useful clinical tool for improving dynamic balance and balance confidence in older adults.[25] Malik reported in case report that virtual reality through exer-gaming has significant effect in enhancing the dynamic balance in chronic stroke.[26]The study design and the sample size was one of major limitation in study. Further research needed to determine and compare the effects of virtual reality training on elderly and stroke patients.

Conclusion

It is concluded that virtual reality training improves dynamic balance, mobility and functional status of chronic patients. It provides a safe environment to the patient to perform real life task without the risk of fall which is an important factor in increasing patient's confidence in mobility.

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