Effects of Virtual Reality Based Video Game and Rehabilitation Exercise on the Balance and Activities of Daily Living of Chronic Stroke Patients

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Abstract

Objectives: The purpose of this study was to identify whether applying a video game program based on virtual reality technology, which was used by Nintendo, to chronic stroke patients could influence their balance and activities of daily living.

Methods: Subjects were randomly divided into two groups, the experimental group (n=7) and the control group (n=10). All subjects underwent Bobath therapy for 30 minutes and FES therapy for 15 minutes. The experimental group performed a virtual reality based video game program for 30 minutes, 5 times per week for 3 weeks. The control group performed cycling and gait training for 30 minutes. Pre- and post-assessments were performed using the open leg standing test (OLST), Timed Up and Go Test (TUG), and Functional Independence Measure (FIM). Wilcoxon Signed Ranks Test was performed to compare the changes of scores pre- and post-assessment. Mann-Whitney U Test was performed to compare the difference between the experimental and control groups.

Results: The experimental group showed significant improvements in FIM (p<0.05), OLST, TUG (p<0.05), and 10m walking test (p<0.05). However, the control group showed significant improvements in FIM and OLST (p<0.05). The difference between the experimental and control groups was not significant.

Conclusion: We concluded that virtual reality based video game programs were effective in improving the dynamic balance and activities of daily living of chronic stroke patients.

Keywords: balance, virtual reality, activities of daily living
I. Introduction

The majority of stroke patients are accompanied by hemiparalysis, and the symptoms include weakening, hardening and pain of muscle, and decrease in exercise ability by damage of sensory organ and sense of balance. Such decrease in exercise ability causes restriction of basic activities like walking, climbing the staircase, standing up from the seat and turning around etc. which are required for independent everyday life(Sharp & Brouwe, 1997). Also with stroke patients, 61 to 81% of body weight is concentrated on non-paralyzed parts due to paralysis of one limb, and the ability to move body weight to paralyzed side is reduced(Sackley & Lincoln, 1997). The imbalance of weight between paralyzed side and non-paralyzed side keeps center of pressure concentrated on non-paralyzed side during physical activities, increasing tumult of posture, and subsequently brings problem to functional activity(Laufer et al., 2000).

Sense of balance is the ability to maintain center of body within basal plane through a complicated process where movement of body put through sensory organ enters central nervous system, is integrated and reacts properly through muscular skeletal system(Nashner, 1994). Stable balancing ability is an element essential in executing functional operation in everyday life, and also is highly related to such functional movements as walking and everyday life movements(Judge et al., 1995). The majority of stroke patients are bound to face significant difficulty in controlling balance, and during static balancing and dynamic balancing, lose the ability to move body weight to paralyzed side. For this reason, hemiparetic stroke patients feel significant inconvenience and hardship in conducting functional activities and everyday life.

Correction of improper posture and improvement of weight distributing ability of stroke patient are very important in raising living quality, and have been treatment goal in functional training process. For improvement of problems of stroke in balancing and walking, various treatments of nerve system promotion concept such as neurodevelopmental therapy of Bobath concept, proprioceptive neuromuscular facilitation that uses spiral and diagnoal movement pattern, Brunnstrum approach that uses proprioceptive neuromuscular facilitation, and system theory based motor relearning program are used(Pollock et al., 2007). In comparison of treatments, no treatment is showing any definite advantage over others, and various methods for effective treatment are being studied (Langhammer & Stanghelle, 2000).

Recently, virtual reality which has been applied in various fields along with dramatic development of science is being introduced as mediation tool for evaluation of patients with various disabilities and improvement of function, and its functions and effectiveness are being studied extensively. Virtual reality has such advantages that it can provide the same environment as actual reality, offering regular visual, auditory and tactile feedback(Fung et al., 2006), and make voluntary participation and suggestion of goal task easy. Also virtual reality can be applied safely while promoting various physical activities of real situation(Waburton et al., 2007). In particular, as it becomes known that regeneration and mediation of virtual reality in appropriate forms of environment and motions is very effective for stroke patient, virtual reality is a major subject in the research in brain related diseases(Burdea, 2003).

The majority of virtual reality mediation methods used in preliminary studies, despite many advantages by using high-priced equipments or specialized programs, is limited in the use for stroke patients. Recently virtual reality based game devices like Nintendo Wii, Xbox and PlayStation are being supplied, and study on stroke and dementia patients with such devices shows positive effects(Kim et al., 2010; Lee et al., 2011). Therefore, in this study, the effects of application of Nintendo Wii a virtual reality based game device in various programs on stroke patients were observed, and its applicability for rehabilitation was examined.