VIRTUAL REALITY IN STROKE REHABILITATION

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INTRODUCTION

Approximately 700,000 people each year are diagnosed with a stroke (American Heart Association, 2007), and up to 90% of the survivors report one or more disabilities (Duncan, 1991). Previous research in motor learning and motor recovery has shown that if the involved extremities are used in a repetitive and purposeful manner following a stroke, neuroplasticity can occur in brain, resulting in new synaptic connections and a re-learning of motor function (Levin, 2006). For this practice to be effective, it must be a meaningful, goal-directed activity rather than a mindless movement (Levin, 2006). Virtual reality has the potential to give purpose to the repetitive activity of treadmill walking. The purpose of this study was to demonstrate the feasibility of using a virtual reality (VR) environment in conjunction with partial body weight support treadmill walking for gait rehabilitation in patients following stroke.

METHODS AND PROCEDURES

Five patients with hemiparesis, who had a stroke within the previous year, were recruited for this study. Each patient was more than 6 months post-stroke, had completed inpatient and outpatient physical therapy, and had reached a plateau of physical progress. The patients were able to ambulate at least 20 feet with or without a cane, understand 3-step commands, see and hear well enough to watch a television program.

The VR system consisted of a large flat-screen TV placed in front of a treadmill with an overhead suspension system for partial body weight support. While the subject walked, he or she viewed a city environment from the perspective of a person walking down the street. Included in the scene were pedestrians, car traffic, and a random configuration of buildings that was newly generated with each session. During walking, an avatar companion stayed in view and gave the patient encouragement and feedback.

The effect of the VR training on walking ability was assessed by examining changes in various gait related measures, including a) functional gait assessment (FGA) scores, b) walking speed, c) walking duration and d) percent of body weight supported during gait.

RESULTS

Overall, all subjects improved across all measures, and 2 subjects discontinued the use of a cane. As highlighted in Figure 1, subjects exhibited notable increases in walking speed (34%) and walking time (97%) as a result of training. Similarly, the percent body weight supported decreased for each subject by 10% on average while their FGA scores increased by approximately 30% (Figure 2).
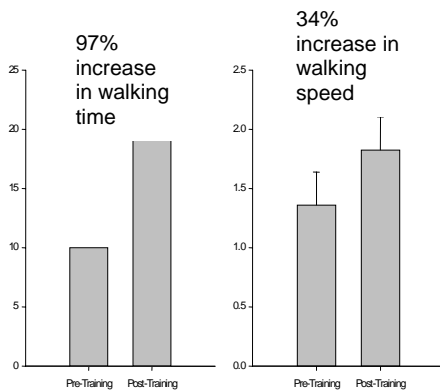

Figure 1. Improvements seen in walking time and walking speed observed across the five stroke patients following 4 weeks of VR training.
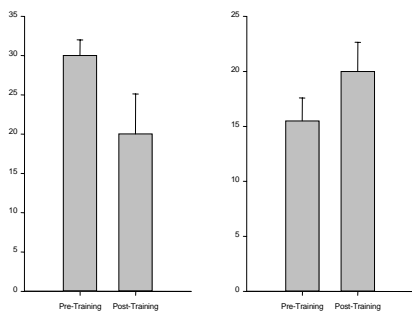

Figure 2. Average changes in Functional Gait Assessment (FGA) scores and percent body weight supported during walking trials for the group of stroke patients following 4 weeks of VR training.

DISCUSSION

This study demonstrated that patients who had reached a plateau in their physical progress could improve their gait with additional gait training using a treadmill with body weight support and virtual reality. Fung et al. also used a treadmill system with VR for gait training and demonstrated that two patients with hemiparesis as a result of stroke increased their speed and learned to walk on a slight slope. This suggests that VR has beneficial effects for rehabilitation and motor relearning. Future studies will include comparing rehabilitation with the treadmill alone and using a treadmill with VR.

SUMMARY

For the five subjects, training using a VR-enhanced treadmill system with partial body weight suspension resulted in improvement in duration of walking and in FGA scores.

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