EFFECTIVENESS OF VIRTUAL REALITY THERAPY ON MOTOR CONTROL IN HEMIPLEGIA PATIENTS: A PILOT STUDY

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Abstarct:Stroke rehabilitation is underdeveloped in India due to lack of professionals. Organized rehabilitation services for stroke were available only in the cities, mainly in private hospitals. Many people cannot afford to receive the secondary prevention medication during an episode of stroke although generic drug production is done in a major scale in India. Virtual Reality is the recent trending rehabilitation modality practiced in the western countries. There have been various studies to prove that the Virtual reality is an effective way to promote complex tasks such as fast and large movements involving the whole body, rather than performing the movement in a single joint. By carrying out this study, the researcher can prove effectiveness of virtual reality in improving motor control in hemiplegia patients. Hence it is imperative to investigate the ability of patients towards performing the voluntary motor functions

KEYWORDS: Stroke, Virtual reality, hemiplegia, rehabilitation

I.INTRODUCTION

Stroke is a global leading cause of disability and the third most frequent cause of death. Stroke is also referred to as Cerebrovascular Accident which is the rapid loss of brain function for to disturbance in the blood supply to the brain. The effect of stroke following a cerebrovascular accident on the general population has become a global problem. Every country in the world has got its share of this life changing event.

World Health Organization (WHO) defined a stroke as "The rapid development of clinical signs and symptoms of a focal neurological disturbance lasting more than 24 hours or leading to death with no apparent cause other than vascular origin".

Sudan, 2013 stated that stroke rehabilitation is underdeveloped in India due to lack of professionals. Organized rehabilitation services for stroke were available only in the cities, mainly in private hospitals. Many people cannot afford to receive the secondary prevention medication during an episode of stroke although generic drug production is done in a major scale in India. The government has recently started to take countermeasures by taking the initial step by starting the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases & Stroke (NPCDCS). Early detection and early management are the primary focus of the government along with increasing awareness about different non-communicable diseases at different levels of the health care system. Various plans have been made by both private health care institutions as well as government hospitals in order to tackle the increasing incidence of stroke in India[1].

The most commonly used testing method is mentioned by Rogers (2009) to diagnose stroke based on symptoms which are called as 'FAST' or Face, Arm, Speech and Time: Face – the face may drop towards one side; the person may not be able to smile as their mouth or eye may have dropped to one side. Arms – The suspected person may not be able to lift both arms and keep them in the lifted position because of arm weakness or numbness in one arm. Speech – their speech may be slurred, or the person may not be able to talk at all despite appearing to be awake[2].

Time – it is time to dial for a medical assistance immediately if any of these signs or symptoms are present.

The certain population of people affected by stroke may require a long duration of rehabilitation so that they can gain functional independence while other people with stroke may require lifetime rehabilitation and may

completely depend on someone. A majority of the affected individuals will be dependent on some source of support be it an aid or a person (Rogers, 2009).

Virtual reality is defined as - an artificial environment, which is computer generated, that promotes to person who experiences a different environment which will enable him/her to perform tasks or skills that may not be achieved in a regular normal life, that is, a person may not be able to perform walking on a rope in real life but in the virtual environment he will be able to perform this with ease. The person receives different visual and auditory feedbacks while performing the task which promotes him/her to correct the performance or continue in the correct way (Laver, 2015).

Virtual reality has been used in the field of rehabilitation to improve different functional skills in different conditions, for example, it has been used in Parkinson's disease to improve cognition and other physical difficulties; it is used for stroke to improve cognition, balance, gait, Activities of daily living performance, etc. (Laver, 2015)

Virtual Reality is the recent trending rehabilitation modality practised in the western countries. There have been various studies to prove that the Virtual reality is an effective way to promote complex tasks such as fast and large movements involving the whole body, rather than performing the movement in a single joint. Besides this, Virtual reality also provides auditory and visual feedback that can contribute to an improved- physical performance. (Laver, 2015)

Wuang (2011) performed a study on virtual reality-based therapy in one hundred and fifty-five children diagnosed as Down's syndrome aimed to compare the effect of standard occupational therapy (SOT) and virtual reality using Wii gaming technology (VRWii). Participants in the VRWii group had a change on motor proficiency, visual-integrative abilities, and sensory integrative functioning while comparing the pre- test and post- test scores. Hence the study proved that virtual reality using Wii gaming technology demonstrated benefit in improving sensorimotor functions among children with Down's syndrome. (Wuang, 2011)

Voluntary motor control is mostly affected by upper motor neuron lesion. Voluntary contractions of skeletal muscles are performed by centrally generating motor commands that result in delivering inputs to a motor neuron in the lower levels. Perceived motor commands have a role in stimulating the sensations of muscle force and timing (Gandevia, 2003). If there is an impairment of the voluntary control, then there would be adverse effects in the functioning of the individual.

Loss of voluntary control is common in conditions such as stroke. A study performed to assess the efficacy of neuromuscular stimulation in enhancing the upper extremity motor and functional recovery of acute stroke survivors identified that there is a major loss of function which results in functional deficit due to poor or no voluntary motor control (Chae, 1998).

By carrying out this study, the researcher can prove effectiveness of virtual reality in improving motor control in hemiplegia patients. Hence it is imperative to investigate the ability of patients towards performing the voluntary motor functions[3].

II.MATHODOLOGY & MATERIALS

Ten Participants, diagnosed with hemiplegia were recruited from community setup in Chennai. Five participants were selected for this experiment. Patients diagnosed with left hemiplegia of Both gender with Age group- 40 to 60 years fulfilling Brunnstorm stages of Motor Recovery: Arm- stage 3 or above Hand- stage 4 or above is included and patients with Osteoarthritis and Rheumatoid Arthritis were excluded Rand et al., (2009) conducted a study to train multitasking skills within a virtual supermarket after stroke. The objective of this study was to identify the use of a virtual mall-based application and if this application can be used as an intervention for people with stroke. Four post- stroke patients underwent this training procedure for a total of ten sessions which was spread over a 3 week period, each session had a duration of 1 hour. Promoting multitasking while engaging in a virtual shopping was the primary goal of intervention.

The Multiple errands test was used as the tool to assess the multitasking executive functions. The study concluded that the patients showed significant change in the scores of the multiple errands test. The study concluded that the virtual mall application can be used as a possible treatment method in the field of rehabilitation for stroke patients to improve the multitasking ability4.

Ekman, 2018 conducted a study where the objective was to identify new effective rehabilitation interventions for patients with stroke to correct spatial neglect. A design called as RehAtt® was utilised for the study. The design was a virtual scanning activity that integrates visual, auditory and sensorimotor stimulations. The activities of daily living were directly impacted by the training program. Patients affected with chronic neglect were examined using the fMRI to identify the changes in brain activity after the training was complete. Participants for the study

were 12 individuals diagnosed with chronic neglect. The interventions for a total of 15 hours, 3 times/week, for a total of five weeks. Patients improved their task-evoked brain activity after the VR interventions was performed. The fMRI results suggest that a top-down method of control was enhanced by the training program. The results also were able to improve information about the neural plasticity and the effects of RehAtt® as an intervention on chronic neglect

III.RESULTS AND DISCUSSION

This study detailed a functional activity based virtual reality training program emphasizing on its effects on motor control. This study was based on previous literature emphasizing the need for the use of virtual reality in the field of rehabilitation[5].

During intervention, the participants actively engaged and were able to participate at relatively similar levels, as indicated by duration on task, despite differences in upper extremity voluntary control. Activities were easily adapted to meet the functional level of each individual and progressed to challenge emerging skills through neural reorganization of the motor cortex.

The one of the objective of the study was to identify the effectiveness of virtual reality treatment protocol on stroke patients on voluntary motor control. The significance of the study was attributed to activities being function-based and monitored with adequate clinical guidance by the Occupational therapist (primary investigator) at different levels through repeated practice and encouragement. The participants were able to perform the activity with the Leap motion- based Virtual reality training as the activities were interactive games that were task-oriented and the virtual reality equipment was able to provide an immediate visual and auditory feedback which further improved the motivation of the participants, this ensured the participants that they were independent while performing the activities[6]. The participants were able to enjoy while performing different activities rather than stating that the activities were difficult to perform. It was observed that even if the participant was not able to perform an activity, he tried to continue or repeat to perform the task. Participants also experienced a new environment where they felt that the performance of an activity was comparatively easier than the performance of the same task in a real-life situation (eg. Driving, participants either had difficulties to drive or were completely not able to drive in the real world, but the same task was comparatively easier in the virtual environment). In addition, one participant regained functional hand use with minimal assistance to which enabled him to go back to his work (Salesman in a cloth store). This finding is consistent to a previously published study by Wang et al., (2017) where it stated that participants in the experimental group was able to attain greater improvement than that attained by the control group and that leap motion based virtual reality associated with the principle of high-intensity repetitive task- oriented training.

Lipert et al., (2000) suggested that the repetitive practice of the affected limb may increase practice-induced neuroplasticity by generating effective synaptic potentiation.

Laver et al., (2015) suggested that interactive virtual reality games provide task-oriented practice and feedback regarding performance and gain, which further motivate and engage players to increase the rehabilitation intensity. The higher intensity of the practice could promote a more obvious shift in the sensorimotor cortex between brain hemispheres in the experimental group than that in the control group through practice-induced neuroplasticity.

Table 1: Demographic variables

Variables		Total	
		Experimental	
		Count	N %
Age	53-54	5	10
Gender	Males	5	0
	Females	0	0
Side affected	Left	5	10
	Right	0	0

Table 2: Effectiveness of virtual reality therapy on motor control

Pilot study group	Mean	Std. Deviation	'U Test	'p' value
Pre-test	20.00	5.423		
Post test	40.40	4.000	-1.033	0.004*

Level of significance p ≤ 0.05*significant

The results revealed that there was statistical significance difference between the pre- test and post- test scores of the following virtual reality programme

CONCLUSION

The pilot study investigated the effectiveness of virtual reality programme to improve motor control. The findings revealed that patients were more enthusiastic to perform the activities in the virtual environment suggesting that learning and performance in the virtual environment is comparatively faster than in the normal environment and the participants were able to transfer the perform from the virtual environment to the normal environment.

RECOMMENDATION

As this pilot study should be done on large population to know the reliability and validity of virtual reality programme on hemiplegia patients

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