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Virtual Reality Training in Hemiparetic Hand Rehabilitation: A Narrative Review

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ABSTRACT

Background: Virtual Reality (VR) takes the importance in rehabilitation of the motor impairments of the hand after a stroke. In rehabilitation, virtual reality games offer a productive, safe, and demanding learning environment for the development of motor control and neural plasticity.

Objective: The goal of this review is to describe both known and innovative computerized equipment VR being used in interventions for hand rehabilitation and evaluations and to analyze the existing research evidence of its effectiveness in rehabilitation of the motor impairments of the hand after a stroke.

Methods: A comprehensive search of Science Direct, PubMed, and Google Scholar was conducted using keywords such as Virtual Reality Training, Modified Ashworth Scale, Purdue Pegboard Test, Stroke, Hemiparesis, Hand Held dynamometer. Articles published from January 2016 to the date of launch were included. Search for literature was limited to English language. Oral presentations, conference papers, unpublished articles, and abstracts from smaller scientific investigations were excluded.

Conclusion: Virtual Reality (VR) takes the importance in rehabilitation of motor impairments of hand after stroke.

Keywords: *Virtual Reality Training, Modified Ashworth Scale, Purdue Pegboard Test, Stroke, Hemiparesis, Hand Held dynamometer.*

1. INTRODUCTION

Limitation with manual functions is an important problem for patients suffering from hemiparesis post-stroke. Many hemiparetic patients suffer from hand impairments after resolving stage four (decreasing spasticity) according to Brunnstrom classification. Even after resolving all the seven stages, there will be some remnants of motor hand impairments**.** Millions of people worldwide are impacted by the significant rehabilitation issue of hand function loss after a stroke each year. To recover hand function in these patients, more efficient rehabilitation techniques are required (1). Millions of people worldwide are impacted by the significant rehabilitation issue of hand function loss after a stroke each year. Extended impairment of upper limb function might lead to restrictions in carrying out everyday tasks and engaging in social activities. (2). Movement disability affects most survivors, frequently with long-lasting deficiencies affecting hand use. Chronic upper limb paresis affects about two-thirds of stroke survivors, with 50% of them suffering from severe paresis. Survivors with significant impairments may have few treatment choices (1).

Rehabilitation using various facilitation strategies focuses more on training compensatory maneuvers that emphasize goal completion than on reducing motor impairment (3).

The use of virtual reality (VR) to assist in the delivery of upper extremity motor rehabilitation exercises following a stroke has been attempted (4). Virtual reality (VR) video games provide an enjoyable approach for patients to participate in their therapeutic workout regimen. Virtual reality (VR) plays a significant role in hand rehabilitation after a stroke (5).

2. VIRTUAL REALITY TRAINING IN REHABILITATION OF HAND IMPAIRMENT POST STROKE

A multidisciplinary team of engineers, neuroscientists, and clinicians collaborates to develop and implement Iterative virtual reality (VR) systems for rehabilitation. Motor control principles serve as the foundation for hardware development, according

to scientists. The program was developed using the concepts of motor learning and the results of the enrichment, motor plasticity, and training literature. Virtual environments are designed to give stroke survivors the chance to perform activities that are necessary for their rehabilitation.

. These tasks, related to hand and gait, are trained both at the impairment and al level. The training engages users to allow for the repetitive intensive practice required for behavioral motor plasticity **(6).** 14 -

3. VIRTUAL REALITY SYSTEMS

Recent advancements in virtual reality technology have allowed for the presentation of features that therapists can use to their advantage. The vast amount of research that has been done contributes to a better understanding of the traits that might be relevant in virtual reality-based rehabilitation. Numerous studies have shown that VR systems can deliver intense training that involves a lot of movement repetitions in a single session. It was possible to train using a virtual reality-based motor rehabilitation system, which may offer high rehabilitation doses, an active training period for more effective training sessions, and a large number of repetitions per session (7).

Through the use of the virtual reality system and adherence to an exercise regimen prescribed by their therapist, allowing patients to train more frequently and intensely without having to additional personnel, leading to improved upper limb recovery (8). With regard to tele-rehabilitation, a new solution that enables patients to receive home-based therapy after being discharged from stroke and rehabilitation facilities, as well as to extend the length of their treatment with therapists' remote supervision, these apparent advantages of virtual reality technologies, in particular, open up new perspectives and opportunities (9).

4. VIRTUAL REHABILITATION OF THE HEMIPARETIC UPPER EXTREMITY

One of the issues that virtual reality rehabilitation research has worked to address for a significant amount of the field's existence is the rehabilitation of the hemiparetic hand caused by stroke (10). According to early research, people with chronic stroke can train safely and effectively with this method. They also compared this method to traditional therapies and repetitive task practice. Numerous meta-analyses and systematic reviews provide evidence for The claim that virtual interventions produce gains in the upper extremities as determined by clinical test batteries that are on par with or superior to conventionally presented interventions in individuals with chronic stroke, indicating relative equivalency to in-person, physically presented rehabilitation, is a significant turning point for the field of virtual rehabilitation and warrants increased attention in subsequent research (10).

5. LIMITATIONS AND SIDE EFFECTS:

Despite its promising applications, VR-based rehabilitation has several limitations. Accessibility and cost remain significant barriers, also as side effects of virtual reality are c**yber sickness** that can characterized by symptoms such as nausea, dizziness, and disorientation. This is particularly prevalent in applications that create a high sense of presence in the virtual environment. **Fatigue is also a side effect as** VR sessions can lead to physical and mental fatigue, especially in patients who are not accustomed to prolonged exercise routines **(11).**

6. CONCLUSION

In the rehabilitation of hand function for hemipartic patients, virtual reality forming games offer a productive, safe, and demanding learning environment for motor control and neural plasticity development. Most stroke survivors suffer from movement impairment, frequently with long-lasting deficits affecting hand function.

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