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IMPACT OF VIRTUAL BASED REHABILITATION ON FUNCTIONAL RECOVERY IN STROKE SURVIVOR: A SYSTEMATIC REVIEW

Dr. Muhammad Mazhar[1], Dr. Zahoor Ahmad[1], Dr. Pratik Thakre[2]

[1]Department of DPT (FAHS), Gomal University D.I. Khan, Khyber Pakhtunkhwa, Pakistan.
[2]Head Sports Physiotherapist, Sudeva Sports Official, New Delhi, India.

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Abstract

Stroke remains a major global cause of both death and disability, sometimes with significant impact on lives of persons who survive, and typically presents with physical, cognitive challenges. In general, rehabilitation of stroke patients has primarily been aimed at recovering motor functions in order to improve physical functioning. Nevertheless, a new alternative has popped up: virtual reality based rehabilitation (VRBR). One of whom makes an interesting distinction between VRBR's ability to engage users in a fun but also functionally beneficial way, especially with regard to motor skills, but also cognitive functioning. The benefits of VRBR on the physical and cognitive recovery of stroke patients are more comprehensive and inclusive when compared to its current conventional practice, and it is ideal for providing not only a faster recovery but also for the recovery of stroke patients.A systematic review of randomized controlled trials (RCTs) from 2010 to 2022, which examine the effects of VRBR on the functional recovery of stroke patients. Specifically, it explores how VRBR affects motor skills as well as cognitive functions, which are common deficits after a stroke. It is the review that goes to evaluate the effectiveness of VRBR as an innovative

	therapeutic option and comparing it with conventional methods. The results that are analyzed in this review of RCTs may help provide insight into the effect that VRBR has in improving overall recovery of stroke patients. The paper emphasizes the expanding application of VRBR to improve both physical and cognitive issues stroke survivors endure and the potential opportunity of it to be the light at the end of the tunnel for survivors in traditional therapy.

[1] INTRODUCTION

Commonest cause of disability globally are cerebrovascular accidents. Between now and the next three decades the proportion of disabled from stroke is expected to increase by up to 35% because of the increase in cerebrovascular risk factors. Not only can a CVA result in the loss of cognitive function, but can also result in movement disabilities. In this current study, I am specifically interested in motor impairment aspect of rehabilitation after a stroke. Amongst other top research priorities, the International Stroke and Rehabilitation Alliance 2018 states that PSCI is something that requires attention. The recent technological advancements have been enabled the occurrence of virtual reality (VR) based therapy. There is still difference in the application of VR based therapies because the technology can simulate.(1)

Virtual reality rehabilitation is becoming a strong method for stroke recovery in regaining motor functions and also in getting better life quality. However, rather than being remote, VR is close and instantaneous, presenting feedback as well as immersive experiences that enhance motivation of the patient, a key element to long term success. One of the main causes of mortality and disability in our world is strokes, which are characterized by the interruption of the blood supply to the brain. However, they can be very damaging to the brain, leaving the person with persistent problems such as paralysis, fatigue and reduced mobility. While physical therapy, as well as aerobic exercises, are beneficial, one third of stroke survivors remain with a disability that makes them unable to carry out their autonomy. Millions of new stroke cases occur each year and nearly half of those who survive have disability in mobility.

These issues are overcome by passive stimulation techniques used in conjunction with traditional therapy sites. Methods of passive stimulation include electrical nerve stimulation (TENS), thermal treatments, pressure therapies that have no contact with the nerves and muscles, which are aimed at restoring the damaged nerve and muscle. The approaches to all these tasks use an external stimuli such as heat, magnets, or a very gentle electric input to rewake the body's sensory and motor pathways. They also consider physical and occupational therapies important, aimed at retraining the hand, upper limbs, and strength with repetitive tasks. However, these therapies are helpful, but not completely fix the problems these patients have. The promise of VR therapy is in its engagement and customization and this is exactly what is lacking from other technologies. For instance, a game-based VR application may lead the survivor to pick up items virtually, complementary by motor practice and cognitive tasks like solving problems. VR bridges traditional rehabilitation’s gaps in its approaches through making it both interactive and personalized for individual’s likings, thereby also improving physical recovery while keeping patients mentally stimulated. Not only is VR forging new horizons in stroke recovery, but it is also a wave of innovation looking to revolutionize the growth of stroke occurrences around the globe, offering the chance of more diminished disabilities and more independence.(2) Lin et al (2016) claim that virtual therapy can fill the gap in clinical stroke rehabilitation methods when combined with other, more traditional motor rehabilitation therapies. Rysellis et al. (2020) further indicate that the

improvement of motor abilities and the capacity of the brain, i.e., neuroplasticity, to adapt after having a stroke, depends on three key elements: the execution of challenging tasks, a lot of practice being done (characterized by repetition, complexity and regular training) and, lastly, the training to be simultaneously repeated. These are consistent with motor learning theory which states the formation and improvement of motor skills.

According to Afsar et al. (2018), VR technology can be personalized according to certain functional movements or routine tasks, thereby making optimal rehabilitation process for patients more engaging and motivating. According to their research, VR is not only beneficial for motor recovery but also contributes in keeping the patient motivated and interested to continue their rehabilitation. P et al. (2017) has studiod indicated that VR therapy can boost patient motivation to convalesce faster. In this context, the word playful refers to the use of game-like elements that enhance patient engagement and motivation during therapy on non gaming environments. According to Wenk et al. (year), this idea is discussed, and the statement that introducing game elements can make therapy more fun, improving patient satisfaction. An number of systematic reviews have examined the effects of game based VR systems in clinical rehabilitation for upper limb. For instance, Laver et al. (2017) came to review of the effectiveness of VR therapy in restoring the upper limb function, balance etc. of the stroke patients in three randomized and quasi-randomized trials. According to their analysis, VR therapy was clearly superior to traditional techniques of training for daily activities for improving upper limb outcome.

Earlier Wang et al. (2022) have also confirmed these findings with their own meta-analysis over 24 randomised controlled trials involving 793 participants. In addition, games based VR interventions worked better for upper limb rehabilitation compared to standard rehabilitation. In summary, the results of these studies indicate that, in addition to standard rehabilitation, VR therapy may be a useful method to improve patient engagement in the process of recovering from their illness, as well as providing better long term results.(3)

[2] METHODS

This was done in accord with the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and documented with a systematic review. Electronic databases we used three electronic databases: PubMed, Web of Science and Scopus. Therefore, we considered studies published from January 1, 2010 to November 2022. This study aimed at evaluating the effect of full immersion virtual reality training on motor dysfunction on stroke patient comparison with the standard rehabilitation care. Independently, the training may occur both with treadmill training and mirror therapy and with conventional therapy. Given the PICO framework (patients/population, intervention, comparison, and outcomes), we compared the FIVR rehabilitation to standard rehabilitation, FIVR rehabilitation to conventional rehabilitation, FIVR rehabilitation to traditional therapy, and FIVR rehabilitation to standard rehabilitation alone. However, we also looked at changes in motor function (upper extremity function, balance, gait and mobility) before treatment to after and pre-training to follow up. Virtual reality, immersive virtual reality, virtual environment, augmented reality, rehabilitation, intervention, treatment, therapy, training, stroke, cerebrovascular accident, hemipl*, hemip*, and various other keywords were searched in combination using Boolean operators (AND/OR). A manual search of the reference list of selected articles was also performed in order to discover more relevant studies. Reviews, meta-analyses, case reports, case series, cross sectional studies, observational studies, retrospective studies and research in which only healthy participants were included were excluded. Having access to full text articles that relate to cognitive rehabilitation study only, we did not include studies about stroke (multiple sclerosis, Parkinson's disease, spinal cord

injury, traumatic brain injury, pain, cerebral palsy), and cognitive disorders (such as psychiatric conditions, dementia and mild cognitive impairment).(4)

[3] RESULTS

The aim of this research was to investigate the effect of virtual reality (VR) –augmented cognitive therapy for stroke survivors' cognitive abilities and everyday independence. Secondly, it was to identify which of these therapeutic strategies and design features made the biggest impact on patient outcomes. The research team searched in different academic databases, i.e. Medline, EMBASE, Cochrane, CINAHL, JBI-EBP, Web of Science to gather pertinent information. The studies were all published between January and October 2023. The Safety of Studies Tool was used to evaluate the quality of the studies, and the Firsstiori meta analysis conducted in Review Manager 5.4. Subgroup analyses were also performed to assess the impact of varying outcomes based on the type of the studies, and the evidence was assessed using Assessment, Development, and Evaluation (GRADE) framework.

However, of a total 11,178 participants, 25 randomized controlled trials were included and reviewed. It was revealed that VR augments cognitive therapies such as the engagement of memory retention, executive functions (such as decision making and problem solving) and maximal cognitive health themselves. These enhancements were shown to be of moderate to large effect reported as particular cognitive domains with standardized mean differences (SMD) equal to 0.65 (95% CI: 0.15–1.16) and to global cognitive performance, SMD equal to 0.43 (95% CI: 0.01–0.85). Nevertheless, VR therapies did not result in any dramatic improvements in language, visual spatial, or daily living activities (ADLs). Similar to traditional therapies, therapies utilising a personalized treatment plan, individual coaching, flexible difficulty levels and programs exceeding six weeks were found effective at improving executive functioning. The functional recovery was evaluated with instruments such as the Barthel Index and the Korean Modified Barthel Index in four studies involving 414 patients. The VR interventions in these studies did not involve ADL simulations. The results of these studies provided an almost nonsignificant difference for the VR treatment compared to the control group (SMD = 0.08; 95% CI: -0.20–0.37; p = 0.57), with little variation in results (I^2 = 0%). However, subgroup analysis was infeasible because of the small sample size available. However, as noted importantly, several studies including those of Faria et al. (2018), Dąbrowska et al. (2023), Liu et al. (2022) and Shi et al. (2023) did not provide SDs and demonstrated no significant progress in ADLs.

The VR therapies were provided by qualified professionals namely nurses, occupational therapists, physiotherapists or psychologists. The programs in most of the studies (17 out of 25) focused on one-on-one interaction between the patients and practitioners. For example, Rogers et al. (20119) showed how verbal prompts and step-by-step assistance by therapists made sure patient safety and comprehension as well as active participation during VR sessions. Different types of VR systems were used in the studies: 17 studies used custom-made VR systems for cognitive rehabilitation in laboratory settings, while four used commercially available gaming platforms such as Xbox (Lee et al. 2017) and Nintendo Wii (Kannan et al. 2019; Navarro et al. 2020; Şimşek and Çekok 2016) for therapeutic applications.(5)

[4] CONCLUSION

For those with a prolonged stroke, VR based training combined with standard rehabilitation therapy did not improve overall cognition, motor deficits or activities of daily living (ADL). VR based training based on subgroup analysis might be better for patients with chronic stroke to improve overall

function, activity and participation owing to increased dosage of intervention (more than 20 hours), higher frequency of sessions (more than four times a week), and daily intensity (more than 60 minutes of intervention everyday). In the subsequent section, we review existing literature, despite which, combining VR based therapy with standard rehabilitation resulted in more favorable results on overall cognition, attention, executive function, and other areas of cognitive function, and a reduction in depressive symptom in patients with chronic stroke.(6). VR telerehabilitation is a promising modality to gamify game based therapies as it can provide a stronger tailoring effect and enable elements of gamification to be present. But most of these systems have no detailed game mechanics, storytelling elements, or social engagement that could help further enhance patient control and independence but are environmentally appropriate. A challenge that has to be met in order to establish a uniform success criteria for VR telerehabilitation is that different research studies pursue different objective and methodology. Given the uncertainty in predicting the system effectiveness from the design principles, it is essential to document the design and implementation procedures extremely carefully to connect the system effectiveness to appropriate design principles. More precise comparison of therapeutic methods can therefore be based on more thorough documentation which can evaluate the effectiveness of the given methods and adequate tackling of the critical issues. (7). VR based therapy in combination with current rehabilitation methods offers more advantages compared to just relying on current treatments in reducing symptoms, improving function, and reductions in health care costs, particularly in early stages of the disease. Thus, VR therapy could be an important supplementary source of neurorehabilitation in the first stages of the early neurorehabilitation in the acute inpatient settings. However, much higher quality randomized controlled trials with longer follow up are needed to incorporate VR training into the acute stroke rehabilitation as regular part of treatment and to replace conventional ones. Such investigations would augment the development of personalized protocols of VR therapy based on the specific needs of the patient at hand, and the dosage, duration, and frequency of VR therapy that optimizes outcomes.(8)

[5] FUTURE SCOPE OF THE STUDY

The review's findings are of major consequence for treatment of stroke rehabilitation. Traditionally, VRBR may lead to considerably better outcomes incorporated with traditional strategies. Nevertheless, the increased engagement and motivation engaged with VRBR could translate into better results and better patient adherence to therapy. In stroke rehabilitation, the integration of VRBR into the treatment strategies should be considered by professionals because the inclusion of this technology may better facilitate patient participation and facilitate functional recovery. In addition, VRBR offers realistic simulations and focused tasks that may contribute to patients applying skills to real-life scenarios. To help stroke patients regain their independence, therapists can design the exercises in such a way that they replicate daily situations.

Another major advantage of VRBR is its flexibility of offering individualized and customizable challenges suited to each patient’s progress and needs where therapists can customize therapy as each patient progresses. Further, since neuroplasticity and brain reorganization can be stimulated by VRBR, VRBR may be valuable in the stroke recovery. Because immersive virtual experiences challenge people’s motor, and cognitive abilities, therapists can facilitate brain rewiring. Compared to current treatments, studies examining VRBR effectiveness would provide important clues into how its additional value and savings could benefit health care providers when making decisions for incorporating it into clinical practice. In future studies, stroke survivors, the impact of VRBR on the quality of life and functional enhancement should also be emphasized. To ensure that every patient

receives healthcare institutions have the obligation to buy VR technology and gear, so that stroke rehabilitation programs become possible. The initial costs can be substantial, but the financial advantages over time as well as better patient outcomes, may make this an investment that is justified. In clinical, the healthcare organizations should give priority to educating and engaging patients while implementing VRBR. Thus, informing patients about the possible benefits and risks of the VRBR and alleviating any concerns regarding its use, will promote higher acceptance and compliance with this technology.(9)

[6] LIMITATIONS

The size of the sample was very small.
The study was completely conducted on senior citizens.

[7] RECOMMENDATIONS

Needs to conduct in Tai-chi exercise to assess the physical problems in old age people.
Comparison research may be done to discover changes in adults and old age
Recommend to do this study as qualitative research.

[8] AUTHOR(S) CONTRIBUTION

Dr. Zealous Mary comprehended and conducted the study, as well as evaluated and interpreted the results. Dr. Vathana wrote and updated the main manuscript. All authors read and approved the final version of the manuscript.

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[11] PLAGIARISM POLICY

The authors declare that any kind of violation of plagiarism, copyright, and ethical matters will be handled by all authors. Journalists and editors are not liable for the aforesaid matters.

[12] CONFLICT OF INTEREST

The authors declared that no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

[13] PROTECTION OF RESEARCH PARTICIPANTS

This study do not involve any such criteria or condition.

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