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Review Article

Neuromotor rehabilitation and virtual reality: A review

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ABSTRACT

This research examined how effective and easy-to-use virtual reality (VR) is for neurorehabilitation. They reviewed studies from 2000 to 2021 and found 40 that fit their criteria. Most studies focused on stroke patients and physiotherapists. Simple VR systems were the most common, and the average rehabilitation program lasted 4.5 weeks with 11 sessions. The results showed VR to be promising for rehabilitation because it motivates patients and allows for personalized therapy. However, challenges exist. VR systems can be difficult to learn and require mental effort to operate. Future research should focus on overcoming these limitations to make VR even more useful and effective in helping people with neuromotor disorders.

1. Introduction

A key component of the treatment and recovery of many neurological and musculoskeletal disorders is neuromotor rehabilitation. It includes a variety of therapeutic approaches intended to improve motor abilities, increase mobility, and improve the general quality of life for people suffering from neurological diseases, traumatic brain injury, multiple sclerosis, Parkinson's disease, musculoskeletal disorders, and other conditions. Conventional rehabilitation techniques have frequently involved a lot of work, repetition, and perhaps little patient involvement, which has decreased desire and possibly produced less-than-ideal results.[1–6]

2. Materials and Methods

To find pertinent research that assessed the usefulness and effectiveness of VR in neuromotor rehabilitation, a thorough systematic review was carried out. From the time of their creation until December 2021, the following electronic databases were thoroughly searched: PubMed, Medline, Scopus, Web of Science, CINAHL, and PsychINFO. The search approach included keywords and concepts from the medical topic headings (MeSH) with the terms "neuromotor rehabilitation," "virtual reality," "usability," and "efficacy." To guarantee the identification of all pertinent studies, a rigorous and inclusive search approach was developed. The AI tool/LLM was used for grammar correction and statistical calculation.

3. Results

3.1. Participant features

The systematic review identified 40 studies in total that satisfied the inclusion criteria. Stroke patients made up 69.2% of the participants, with musculoskeletal problems (18.5%) and multiple sclerosis (9.2%) following closely behind. The majority of participants (32.3%) underwent outpatient rehabilitation, while 29.2% underwent inpatient rehabilitation. A sizable portion (38.5%) did not obtain any clear definition. The majority of healthcare professionals who participated in the studies (88.9%) were physiotherapists.

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3.2. Features of VR interventions

While some research used completely immersive (15.0%) and semi-immersive (15.0%) VR systems, the bulk of studies (70.0%) used non-immersive VR systems. With an average of 11.4 sessions per participant, the VR therapies had an average duration of 4.5 weeks. The sessions lasted 33.2 minutes on average.

3.3. Assessments of usability and efficacy

VR equipment were widely thought to have strong usability, to encourage patient motivation and participation during therapy, and to give the possibility of individualized rehabilitation sessions. Participants did, however, draw attention to issues with VR systems' learnability and the mental work needed to operate them.

4. Discussion

Based on a thorough examination of the body of research, the results of this systematic review offer insightful information about the usefulness and effectiveness of VR in neuromotor rehabilitation.

4.1. Virtual reality's usability in neuromotor rehabilitation

The review's findings show that VR devices are often regarded as having good usability and are useful in encouraging patient motivation and involvement during treatment. This is in line with earlier research that has shown the potential advantages of VR in generating an immersive and dynamic environment that can mimic real-world activities and scenarios, giving patients a more interesting and inspiring rehabilitation experience.[7–10]

Another important benefit of VR systems is the ability to personalize therapy sessions. VR enhances the personalization and efficacy of the rehabilitation process by enabling the customization of rehabilitation activities to meet the needs of individual patients. This is especially significant for neuromotor rehabilitation, where customized treatment regimens based on the unique requirements and capacities of every patient are essential to attaining the best possible results.[11–15]

4.2. Obstacles and restrictions

The learnability of VR systems has been cited as one of the primary issues. Studies that were included in the analysis mentioned that users had trouble getting the hang of VR systems, which could be a hindrance to the general acceptance and efficacy of VR-based rehabilitation initiatives.[5,16–20]

Another restriction found with VR systems was the tremendous mental effort required to operate them. Patients with cognitive disabilities or communication disorders may find it very difficult to interact with and use VR systems

4.3. Consequences for medical practice

In order to improve healthcare workers' knowledge and abilities in utilizing VR systems and to solve the difficulties related to learnability and usability, it is imperative that they receive proper training and assistance.[4,14,15,21,22]

The usability and efficacy of VR-based rehabilitation programs may also be improved by customizing the VR experience to each patient's unique requirements and capabilities and by offering individualized guidance and assistance during the rehabilitation process.[8–10,23–25]

4.4. Future prospects

Future studies should concentrate on resolving the issues and problems this analysis raised, as well as creating plans to maximize VR's usefulness and effectiveness in neuromotor rehabilitation. In addition, the development and validation of standardized outcome measures and assessment tools specifically designed to evaluate the usability and effectiveness of VR in neuromotor rehabilitation are required in order to assess the long-term effects of VR-based rehabilitation programs on motor functions, functional independence, and quality of life in patients with various neuromotor disorders. Longitudinal studies with larger sample sizes and rigorous research designs are required.

5. Conclusion

VR shows promise for neuromotor rehabilitation, boosting motivation, and personalizing therapy. However, challenges exist, such as system complexity and mental effort required. Tailoring VR experiences and training healthcare professionals are crucial for maximizing VR's effectiveness and improving patient outcomes. Future research should focus on overcoming these limitations to fully harness VR's potential.

6. Source of Funding

None.

7. Conflict of Interest

None.

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