070-HS

Enhancing Physical Therapy Outcomes With Extended Reality: Exploring the Impact of Extended Reality Integration on Neurological Patient Rehabilitation and Functional Improvement

Abstract

Background: Neurorehabilitation is a multidisciplinary approach aimed at restoring function and independence in individuals with neurological conditions. Traditional physical therapy has been instrumental in motor recovery, but emerging technologies like Extended Reality (XR) offer new opportunities to enhance patient outcomes. XR, encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), provides immersive environments that can improve neuroplasticity, patient engagement, and functional recovery.

Objective: This scope review evaluates the current literature on XR integration in neurorehabilitation, specifically for individuals with stroke, Parkinson's disease, multiple sclerosis, and fall-related neurological impairments. The review assesses the impact of XR interventions on motor function, neuroplasticity, patient adherence, and quality of life, comparing them to traditional physical therapy methods.

Methods: A systematic search was conducted across PubMed, Google Scholar, and Tennessee State University (TSU) library databases. Studies published in the last 10 years were selected based on predefined inclusion criteria, including research on XR interventions targeting motor function, cognitive improvements, and rehabilitation adherence in neurological populations.

Results: All XR interventions, particularly VR, were the most commonly studied, used in 69% of the included research. A total of 20 studies met the inclusion criteria: 13 focused on stroke rehabilitation, 2 on Parkinson's disease, 1 on multiple sclerosis, 2 on brain activity, 1 on pain management, and 1 on fall prevention.

Discussion: Findings indicated significant improvements in motor function, balance, and neuroplasticity. Stroke patients demonstrated enhanced upper limb function and postural stability, while individuals with Parkinson's disease exhibited increased motor-related cortical activity. XR-based rehabilitation also promoted cognitive improvements in multiple sclerosis patients. Additionally, XR interventions fostered greater patient engagement and adherence, surpassing traditional physical therapy methods in motivation and compliance. However, challenges such as accessibility, cost, and technological constraints were identified as barriers to widespread clinical adoption.

Conclusion: XR technologies show promise as additions to traditional neurorehabilitation by enhancing motor recovery, neuroplasticity, and patient adherence. Despite positive outcomes, further research is needed to standardize protocols, address cost-effectiveness, and evaluate long-term benefits. Future studies should explore optimization strategies to integrate XR into clinical rehabilitation settings effectively.