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The Role of Virtual Reality in Enhancing Rehabilitation for Children with Cerebral Palsy

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ABSTRACT

Background: Cerebral palsy (CP) affects motor control and functional abilities, leading to limitations in daily activities. VR-based rehabilitation utilises motion tracking, immersive environments, and real-time feedback to engage children in therapeutic exercises. Through gamification, VR encourages repetitive movements and active participation, enhancing neuroplasticity and motor learning. Traditional rehabilitation methods, while effective, often fail to maintain high engagement levels among children. VR interventions have emerged as a promising alternative, offering interactive and immersive experiences to improve motor function, balance, and mobility in children with CP.

Purpose: This study consolidates research on the effectiveness of VR interventions in CP rehabilitation. It categorises findings related to motor function improvements, balance, postural control, and functional mobility while identifying research gaps and limitations.

Methodology: A comprehensive search was conducted in PubMed, PEDro, Web of Science, and Cochrane Library databases for studies published between 2007 and 2024. Studies were selected based on relevance to VR rehabilitation for CP. Inclusion criteria required Randomised Controlled Trials (RCTs) evaluating VR interventions. Data extraction focused on intervention type, sample size, outcome measures, and key findings.

Results: VR interventions improved balance and postural control. Moderate evidence supports enhancements in gross motor function and gait efficiency. Studies utilising Xbox Kinect and Nintendo Wii demonstrated significant functional gains in children with CP. VR-based training enhances gait by allowing children to practice walking in a controlled, interactive environment, improving lower limb strength, endurance, and coordination.

Conclusion: VR-based rehabilitation is a promising adjunct to conventional therapy for children with CP. The interactive nature of VR enhances engagement, improving balance, motor function, and functional mobility. However, standardisation of VR protocols is needed for definitive clinical guidelines.

Implications: VR has the potential to revolutionise CP rehabilitation by making therapy more engaging and effective. Future research should focus on optimising VR designs, ensuring accessibility, and investigating long-term effects.

Keywords: Cerebral palsy, Virtual reality, Motor rehabilitation, Gait training, Postural control, Balance, Neuroplasticity

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