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Virtual Reality Therapy for Motor, Balance, and Cognitive Outcomes in Neurological Disorders: A Systematic Review

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ABSTRACT

Introduction: Virtual reality therapy (VRT) has emerged as an innovative approach in neurorehabilitation, offering immersive and engaging environments that enhance engagement, motivation and functional recovery. Neurological disorders such as stroke, Parkinson's disease, Multiple Sclerosis (MS), Cerebral Palsy (CP), and Traumatic Brain Injury (TBI) result in severe motor, cognitive, and functional impairments. Conventional physiotherapy is effective but often limited by patient adherence and lack of task-specific training, VRT easily overcomes these challenges through the gamification of the rehabilitation protocols.

Aim: This systematic review of randomised controlled trials evaluating the effects of VRT across major neurological conditions, focussing on functional, motor, balance, cognitive, and quality-of-life outcomes.

Materials and Methods: A systematic review of randomised controlled trials published between 2021 and 2024 was performed. Twenty eligible trials with PEDro scores ranging from 5 to 7 were included. The studies enrolled diverse populations, from children with cerebral palsy to adults with stroke, Parkinson's disease, MS and TBI. VRT platforms included Adapt Rehab VR, PRISMA, Oculus, Unity, and EPIC, with interventions ranging from 4 to 12 weeks. Outcomes assessed included upper and lower limb motor recovery, balance, gait speed, cognitive function, swallowing, and activities of daily living.

Results: In stroke populations, VRT improved upper limb motor scores, gait speed, balance, independence, and recovery from neglect and dysphagia. Parkinson's trials demonstrated enhanced gait, reduced freezing of gait, and improved Unified Parkinson's Disease Rating Scale (UPDRS) and balance confidence. MS patients benefited from VR exergaming with reduced fatigue, better balance, and cognitive gains. Paediatric CP trials showed significant improvements in gross motor function and upper limb active range of motion. In TBI, VR cognitive rehabilitation improved attention and memory performance. Across conditions, VRT was consistently safe and well-tolerated, with outcomes superior or comparable to conventional therapy.

Conclusion: Evidence from randomised controlled trials supports VRT as an effective, engaging, and feasible adjunct to conventional rehabilitation in neurological disorders. Benefits span motor, balance, cognitive, and functional domains, although long-term efficacy and standardised protocols require further study.

Keywords: Cerebral palsy, Multiple sclerosis, Parkinsons's disease, Stroke rehabilitation

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