

# Integrating Virtual Reality with Constraint-Induced Movement Therapy for Motor Recovery in Spastic Hemiplegic Cerebral Palsy Patient: A Review

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## ABSTRACT

Cerebral Palsy (CP) refers to a group of disorders that affect movement, posture, and coordination due to early brain damage affecting 2-3 children per 1,000 years. This condition, which is not progressive, typically results from injury before, during, or shortly after birth, while the brain is still developing. Spastic hemiplegic CP is a common form that impacts one side of the body, reducing a child's ability to perform everyday tasks independently. Although the initial brain injury does not worsen, changes in movement can occur over time due to growth, nervous system development, muscle imbalances, and treatment responses. Over the past two decades, rehabilitation strategies such as Constraint-Induced Movement Therapy (CIMT) and Virtual Reality (VR)-based interventions have gained attention for improving motor performance and functional independence in children with hemiplegic CP.

This review aimed to summarise and compare the evidence on the effectiveness of CIMT and VR in enhancing upper limb function, motor control, and participation in children with CP.

An extensive search of databases, including PubMed, Scopus, Web of Science, and Google Scholar were searched for articles published

between 2005 and 2025 only in English language. Studies focusing on children aged 3-16 years with CP undergoing CIMT and VR-based rehabilitation were included. Randomised controlled trials and pilot studies were analysed.

CIMT has been shown to improve hand function, strength, and the performance of specific upper-limb tasks through structured, repetitive practice. VR-based therapy offers similar benefits, particularly in enhancing movement speed, coordination, and user motivation, due to its interactive and engaging design. While CIMT is effective for refining targeted motor skills, VR tends to boost participation and consistency. Integrating both methods may provide more comprehensive and effective rehabilitation outcomes.

Both CIMT and VR-based therapies are evidence-supported for improving upper-limb function in children with CP. VR offers a motivating and accessible option, whereas CIMT remains a gold standard for structured motor retraining. Future studies should explore combined protocols, long-term outcomes, and accessibility of VR in clinical and home-based settings.

**Keywords:** Muscle imbalance, Paediatric neurorehabilitation, Upper-limb rehabilitation

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