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A Systematic Review on AI-Enhanced Play Therapy: Personalizing Pediatric Rehabilitation through Smart Games in Children with Cerebral Palsy

Abstract:

Background: Cerebral palsy (CP) is a non-progressive neurological disorder that impairs motor function, posture, and coordination in children, often leading to long-term physical and psychosocial limitations. Traditional rehabilitation programs, though effective, are frequently repetitive, resource-intensive, and fail to sustain children's motivation. The integration of Artificial Intelligence (AI)-enhanced play therapy through smart and adaptive gaming platforms has emerged as a promising approach to address these limitations by personalizing interventions and increasing therapeutic engagement.

Objective: This systematic review aimed to synthesize evidence from the past decade (2015–2025) regarding the effectiveness of AI-driven and game-based rehabilitation interventions in improving motor function, engagement, and functional independence among children with cerebral palsy.

Methods: Electronic databases (PubMed, Scopus, PEDro, IEEE Xplore, and Google Scholar) were searched for peer-reviewed studies published between 2015 and 2025 using keywords Cerebral Palsy, AI, PlayTherapy, Serious Games, Virtual Reality, and Rehabilitation. Randomized controlled trials, quasi-experimental, and systematic reviews evaluating AI-enhanced or game-based rehabilitation were included. Data were extracted on intervention type, duration, outcome measures, and clinical efficacy.

Results: Thirty eligible studies were included. The majority reported significant improvements in motor coordination, upper-limb function, balance, and therapy adherence. Adaptive difficulty algorithms and real-time biofeedback, powered by AI, enhanced task personalization and engagement. Across studies, participants demonstrated statistically significant improvements in gross and fine motor functions, balance control, and hand eye coordination compared to conventional therapy ($p < 0.05$). However, evidence on long-term outcomes and standardized protocols remains limited.

Conclusion: AI-enhanced play therapy represents an innovative, child-centered adjunct to conventional physiotherapy in CP rehabilitation. While short-term functional and motivational benefits are evident, future multi-center RCTs integrating machine-learning-based personalization and longitudinal follow-up are recommended to establish standardized clinical guidelines.

Biography

Sri Valli Chekuri was a licensed Physical Therapist in the U.S. (Texas) and a Registered Physiotherapist in Canada, with a Doctor of Physical Therapy from Northeastern University and a Master's in Exercise Physiology from Wichita State University. Her experience spans home health, skilled nursing, and outpatient settings, specializing in rehabilitation for geriatric patients and individuals with complex medical conditions such as stroke, Parkinson's disease, dementia, and joint replacements. She also has sports clinic experience in Canada, treating athletes and active individuals. Passionate about patient-centered care, she combines clinical expertise with empathy and currently serves as a Study Buddy Mentor, helping future Physical Therapists prepare for the NPTE.