

Comparison of Virtual Reality Therapy versus Non-Gamified Robotic Therapy for Upper Limb Motor Recovery after Stroke: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Abstract:

Research Problem: Upper extremity (UE) impairment is a common and disabling consequence of stroke, limiting motor function. Conventional therapy often fails to deliver the high-intensity, task-specific practice required to promote neuroplasticity.

Aim: To compare the effectiveness of virtual reality therapy (VRT) and non-gamified robotic therapy (RT) on UE motor recovery post-stroke.

Objectives: To systematically identify and analyse randomized control trials (RCTs) comparing VRT and non-gamified RT for UE motor recovery in adults post-stroke populations; to quantitatively compare the magnitude of the effect measured by the sub-scale of Fugl-Meyer Assessment – upper extremity (FMA-UE) scores using meta-regression with intervention type as a moderator.

Hypotheses: Does non-gamified RT yield significant larger improvements in UE motor function as measured by the FMA-UE compared to VRT among post-stroke population.

Research Methods: A PRISMA-compliant systematic review and meta-analysis of RCTs was conducted using Scopus, PubMed, and Medline (2019–2026). Eligible studies included post-stroke adults receiving either VRT or non-gamified RT, reporting FMA-UE outcomes. Effect sizes were calculated using standardized mean differences and analyzed using a mixed-effects meta-regression model with intervention type as a moderator. Risk of bias was assessed using the Cochrane RoB 2 tool.

Main Findings: 16 RCTs (VR = 11, robotic = 5) were included. Both interventions significantly improved FMA-UE scores. RT demonstrated significantly greater effectiveness than VRT ($\beta = 0.482$, $SE = 0.162$, $Z = 2.97$, $p = 0.003$, 95% CI [0.164, 0.799]) (intercept + moderator coefficient: $-0.356 + 0.482$) was approximately $SMD = 0.126$.

Conclusions: RT yielded greater improvements than VRT; however, findings should be interpreted with caution due to study imbalance.

Keywords:

Virtual Reality, Robotic Therapy, Stroke Rehabilitation, Upper Extremity, FMA-UE, Meta-analysis.