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# The Effects of Virtual Reality Interventions on Gait and Balance In Patients With Chronic Stroke: A Systematic Review

Meghan Darrough  
*Misericordia University*

Stephanie Layland  
*Misericordia University*

Breana Kravchick  
*Misericordia University*

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# The Effects of Virtual Reality Interventions on Gait and Balance In Patients With Chronic Stroke: A Systematic Review

MISERICORDIA UNIVERSITY

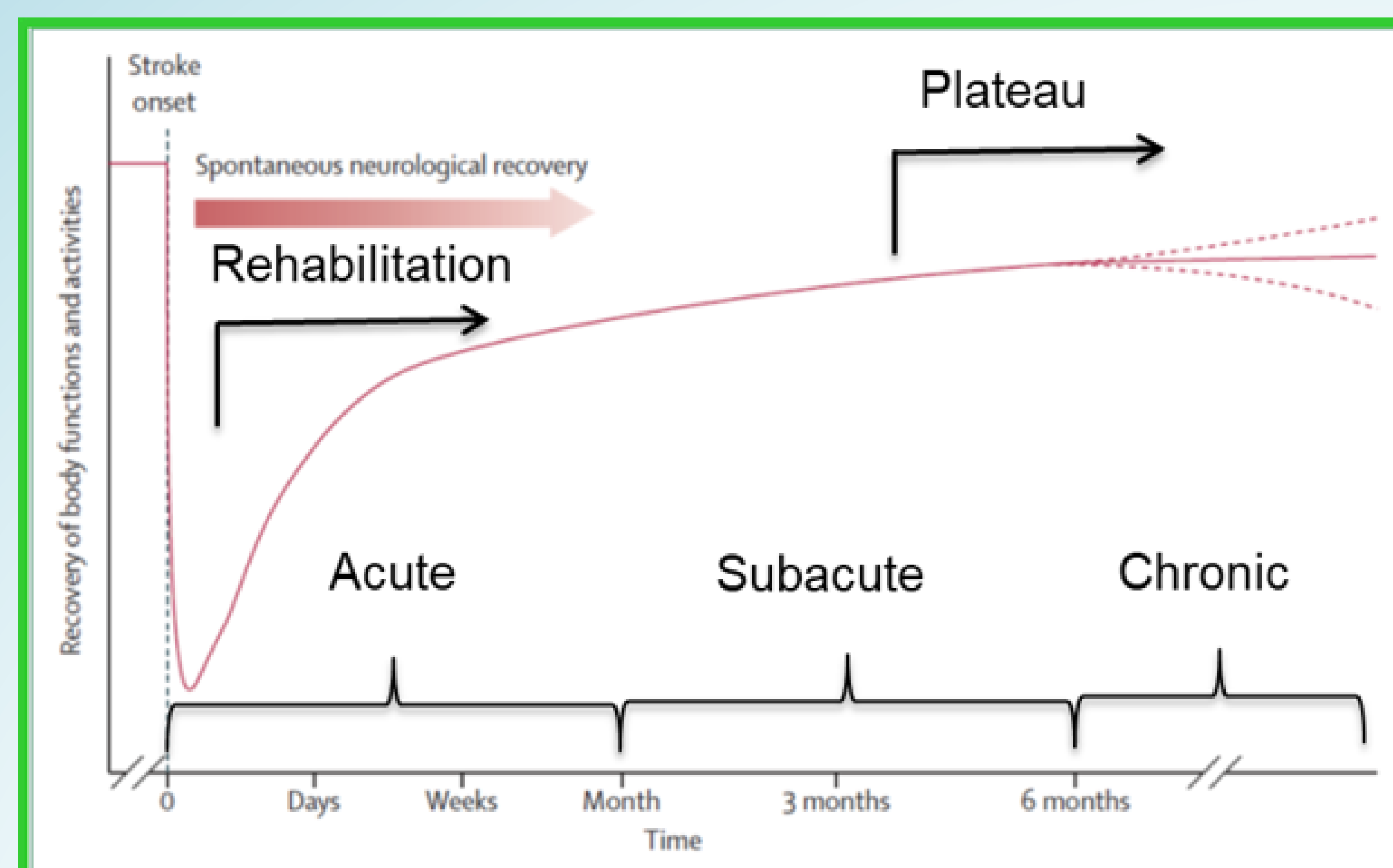
Meghan Darrough, Breena Kravchick, and Stephanie Layland, Heather Biehl, PT, DPT, NCS

## INTRODUCTION

- Approximately 795,000 people in the United States experience a cerebrovascular accident (CVA) annually which can result in cognitive, physical, and emotional impairments.<sup>1</sup>
- Rehabilitation requires an interdisciplinary approach, with physical therapy focusing on improving strength, balance, coordination, and functional mobility. While recovery is emphasized in the acute and subacute stages, meaningful improvements can still occur in the chronic phase (>6 months).<sup>5</sup>
- Virtual Reality (VR) is an emerging rehabilitation tool that provides an interactive and multisensory environment to practice functional tasks and increase neuroplasticity.<sup>6</sup>
- **Purpose:** To evaluate the effectiveness of VR-based interventions on gait and balance in individuals with chronic stroke

## BACKGROUND

- Stroke, including ischemic, hemorrhagic, and transient ischemic attack, can result in long-term gait and balance impairments that limit mobility and functional independence.
- Rehabilitation for individuals with chronic stroke focuses on maintaining and maximizing functional mobility despite persistent deficits.
- Virtual reality (VR) interventions, including immersive, non-immersive, and augmented formats, provide varying levels of sensory feedback and may enhance engagement during task-specific rehabilitation.



## METHODS

- Literature search conducted in September 2025 and January 2026
- Databases: CINAHL Complete, MEDLINE, and PubMed
- 177 articles screened, 14 articles used in study
- Inclusion Criteria:
  - Patient who have been diagnosed with chronic stroke
  - Effects on gait and balance
  - Use of VR technology
  - Peer-reviewed articles published in the last 10 years
- Exclusion Criteria:
  - Patients who have been diagnosed with acute and/or sub-acute stroke
  - Effects on upper extremities
  - Non-translatable articles into English
  - Systematic review articles
  - Other experimental-based interventions that did not involve the use of virtual reality

## RESULTS

- **Balance**
  - VR interventions led to statistically significant improvements in balance compared to conventional therapy alone.

Outcome Measure	Result
Berg Balance Scale	Improvements shown in balance outcomes with VR interventions ( $p < 0.05$ , $P < 0.006$ )
Timed Up and Go	Improvements shown throughout both groups, but often greater gains among the VR group ( $p < 0.05$ , $p < 0.0071$ ).
Tinetti POMA	Strongest improvements shown when VR was combined with robotic training ( $p < 0.05$ ).

- **Gait**
  - VR showed statistically significant improved walking speed, endurance, and step length.

Outcome Measure	Result
10 Meter Walk Test	Improvements shown among VR groups ( $p < 0.05$ ).
Dynamic Gait Index	Improved dynamic balance and mobility among the VR group ( $p < 0.05$ ).
6 Minute Walk Test	Increased walking distance with VR treadmill training ( $p < 0.05$ ).
Gait Parameters	Improved step length and symmetry ( $p < 0.05$ , $p < 0.001$ ).

- **Secondary Outcomes**
  - Evidence suggests VR interventions result in enhanced:
    - Neuroplasticity
    - Dual-task performance
    - Cognitive-motor integration

## DISCUSSION

- **Strengths:**
  - Majority of studies were randomized controlled trials.
  - Moderate to high PEDro scores
- **Limitations:**
  - Variability in types of VR (immersive, non-immersive, augmented)
  - Small sample sizes
  - Inconsistencies in intervention duration, frequency, and outcome measures

## Implications to PT Practice

- VR is an effective adjunct to conventional physical therapy for chronic stroke rehabilitation by improving dynamic balance, gait performance, and functional mobility.
- Enhances patient engagement, motivation, and practice intensity.
- Supports motor learning and neuroplasticity through repetition and real-time feedback.
- Several articles highlighted the importance in dual-task performance and cognitive motor integration, which are important for safe ambulation and daily function.
- Clinicians should consider patient-specific factors such as contraindications when implementing VR and monitor for any adverse effects.

## CONCLUSION

- Virtual reality (VR) is effective in improving gait and balance in individuals with chronic stroke, especially when combined with conventional physical therapy.
- Significant improvements were observed across outcome measures including BBS, TUG, Tinetti, as well as gait speed and endurance.
- **Future Directions:**
  - Standardize VR protocols and parameters
  - Investigate long-term outcomes
  - Expand research to acute and subacute stroke populations

## REFERENCES

