

Effects of virtual reality therapy on improving gait and balance in physical therapy patients

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Introduction

Gait and balance impairments are common consequences of neurological, orthopedic, and age-related conditions and are a major cause of falls. As the elderly population is expected to increase to 88 million by 2050, the number of falls is projected to increase as well (Lee, 2021). Although conventional physical therapy methods remain essential, new technologies are expanding ways to enhance treatment.

Virtual reality (VR) therapy is an emerging field in physical therapy that has shown significant results in previous studies (Park et al., 2015). By immersing users in a three-dimensional interactive environment, physical therapists can simulate real-world challenges within a controlled setting while incorporating real-time feedback. The use of VR has been shown to stimulate neuroplasticity, improving quality of life. It is also more cost-efficient, making rehabilitation more effective and accessible for restoring normal gait and balance functions. Consequently, VR therapy has the potential to improve overall mobility and wellness beyond what conventional therapy alone may achieve. However, more commercially available forms of VR, such as the Meta Quest VR headset, have yet to be studied. This study assessed the effects of using low-cost VR on improving gait and balance in physical therapy patients with impaired mobility.

Methods and Materials

Following physical therapist approval, 14 patients were recruited and provided informed consent to participate. Eight patients were assigned to the control group, and six were assigned to the experimental group. Individuals with mobility-limiting conditions, including stroke, bone fractures, or generalized weakness, were eligible for inclusion. The control group received one hour of standard conventional gait and

balance rehabilitation per session. The VR group received the same conventional therapy in addition to VR training using the Meta Quest 3S headset and controllers (Figure 1). VR exposure was introduced gradually to facilitate patient acclimation and ensure safety. Session duration progressively increased until patients completed 15–20 minutes of VR per session, with the remaining time dedicated to conventional therapy

Figure 1 (right): A student using the Meta Quest 3S headset and controllers. The student is playing the Run game. To gain points, the user must collect tokens on the path by walking toward them.



Methods and Materials (continued)

comparable to that received by the control group.

VR games included Walkabout Mini Golf (Figure 2), Run (Figure 3), and Eleven Table Tennis. These games were selected because they exercise dynamic weight shifting, multidirectional stepping, and postural adjustments, all of which are key components in gait rehabilitation. To measure changes in mobility, three standardized tests were used: the Timed Up and Go (TUG) test, which assesses walking speed, with times under 13 seconds indicating low fall risk; the Berg Balance Scale (BBS), which assesses static and dynamic balance across 14 tasks, with scores above 45 points indicating low fall risk; and the Activities-specific Balance Confidence Scale (ABC Scale), which



Figure 2 (left): The Mini Golf game in Meta Quest 3S exercises directional balance and weight shifting. Players must hit the ball into the hole in as few hits as possible to gain points.

Figure 3 (right): The Run game in Meta Quest 3S exercises multidirectional gait and dynamic weight shifting. Players must walk along the path to collect as many tokens as possible within the time limit.



measures self-reported balance confidence across 16 tasks, with scores above 80% indicating high confidence in balance abilities. These tests were performed by each patient at the initial session and again at four weeks, eight weeks, and the final point at 12 weeks to evaluate changes in gait, balance, and balance confidence.

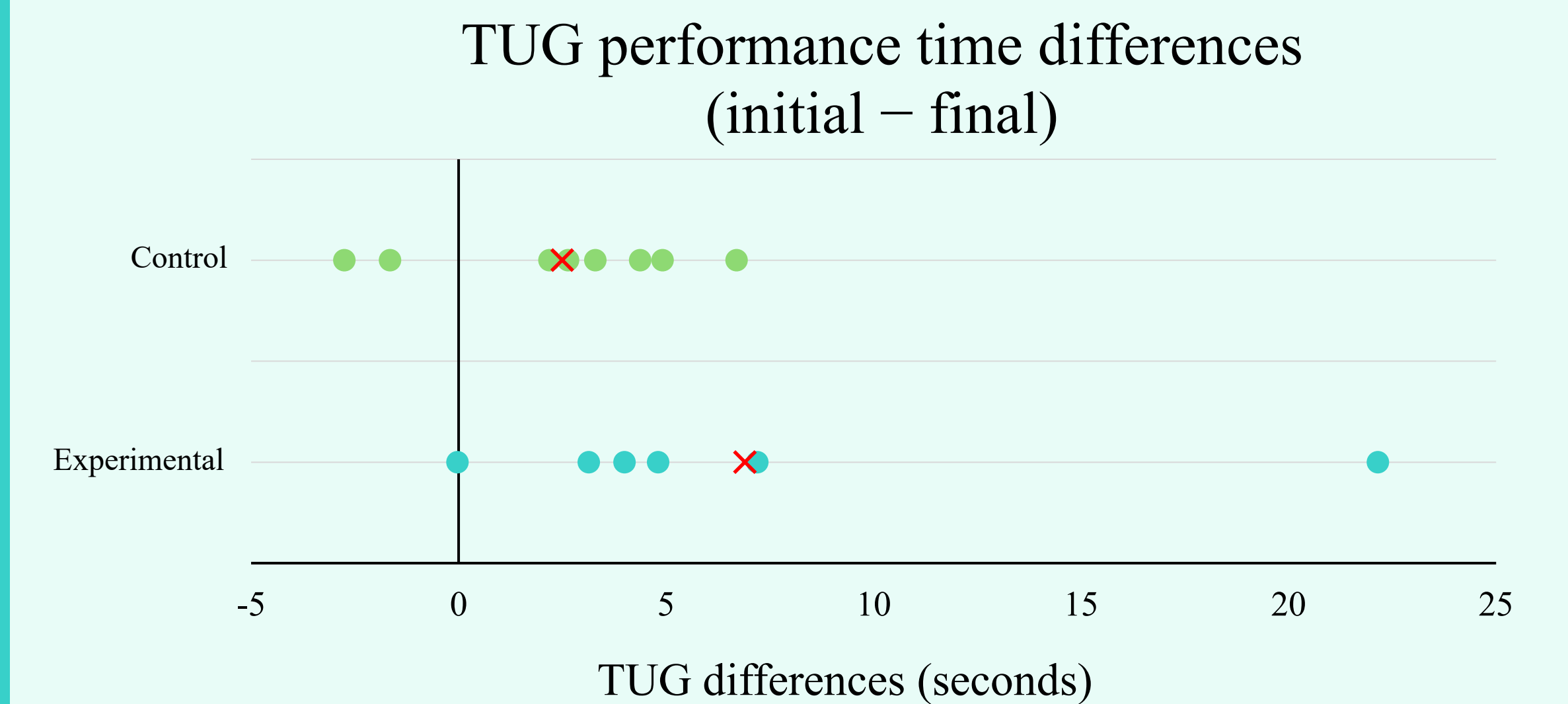
Results

Differences between initial and final TUG times, BBS scores, and ABC Scale scores were compared for the control and experimental groups (Table 1). The mean improvement in TUG times (Graph 1), in seconds, was greater for the experimental group than the control group, suggesting VR therapy improved walking speed and reduced fall risk more than conventional therapy alone.

	TUG time (seconds)	BBS score (points)	ABC Scale score (percentage)
Control Group ($n = 8$)	$M = 2.5, SD = 3.2$	$M = 8.1, SD = 6.4$	$M = 8.4, SD = 10.6$
Experimental Group ($n = 6$)	$M = 6.9, SD = 7.8$	$M = 12.0, SD = 10.9$	$M = 12.5, SD = 11.0$

Table 1 (above): The change in TUG times (initial – final), BBS scores (final – initial), and ABC Scale scores (final – initial). The mean TUG time for the experimental group was 6.9 seconds faster post-treatment ($M = 10.1, SD = 4.8$) than pre-treatment ($M = 17.0, SD = 7.0$).

Results (continued)



Graph 1 (above): Comparisons for TUG differences for the control group and experimental group. The means of each group are denoted by a red ×. The mean of the differences in time for the experimental group ($M = 6.9$) was greater than that of the control group ($M = 2.5$). As patients got faster from treatment, TUG times decreased.

Conclusion

The purpose of this project was to use virtual reality to improve gait and balance within physical therapy patients. Mean TUG times, BBS scores, and ABC Scale scores in the experimental group showed greater improvement compared to the control group, suggesting VR therapy effectively improved gait, balance, and balance confidence more than conventional therapy alone. These improvements may be attributed to the increased sensory feedback and motor learning that occurs in virtual environments. This study supports the use of VR therapy in combination with conventional therapy to maximize the benefits of rehabilitation.

Limitations of this study included small sample size and short VR duration. Future research should focus on the use of VR therapy to rehabilitate other areas of the body, such as upper extremities, and long-term effectiveness of VR therapy. Furthermore, the neurological benefits of VR therapy should also be explored.

References

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