Effects of a Mirror Neuron-Based Virtual Reality System and Adaptive Software on Upper Extremity Function in an Individual Experiencing Hemiparesis Post-Stroke: A Case Study

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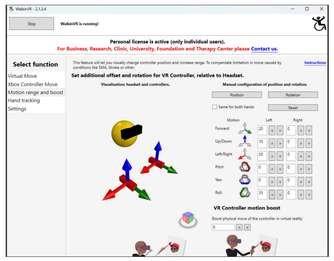
Introduction

Upper extremity function is often impaired following stroke. Many rehabilitation strategies are aimed at helping stroke survivors relearn motor skills through training. Evidence supports that brain motor areas can be activated when a person observes another person perform an action. This is attributed to the mirror neuron system (MNS). The MNS may then be used to prime the motor cortex and has been an effective target in successful stroke rehabilitation programs that improve upper extremity function and quality of life.

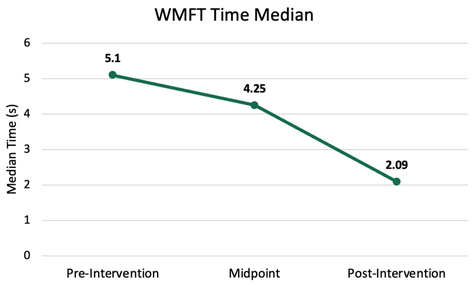
Virtual reality (VR) is increasingly being used as a treatment modality for stroke intervention. WalkinVR is an adaptive gaming software that allows the user to alter control of the VR gameplay to fit their needs. By recalibrating the VR game control to magnify the visual representation of hemiparetic UE movements, we propose to improve hemiparetic UE movements through stimulation of the MNS.

Methods

- A prospective case study involving a 72 y/o male with a 3+ yr. history of upper extremity limitations from a prior stroke
- Participant underwent a 5-wk VR + adaptive gaming software program (240-min/wk.)
- Assessments Include the Wolf Motor Function Test (WMFT), DASH Questionnaire (pre, midpoint, and post), Active Range of Motion (AROM) (pre and post), and participant Interview (post).

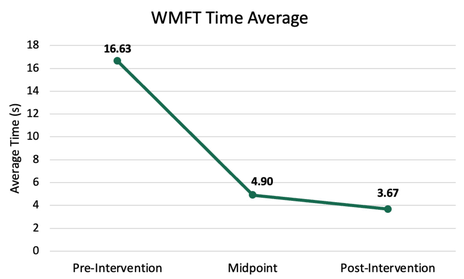


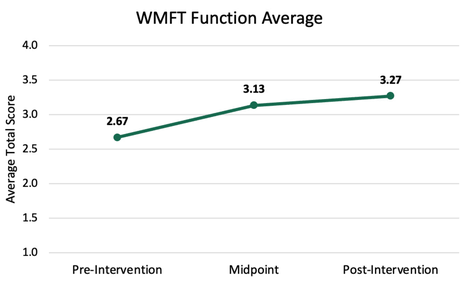
Results



The median time required to complete WMFT tasks improved by 59% during the course of the intervention.

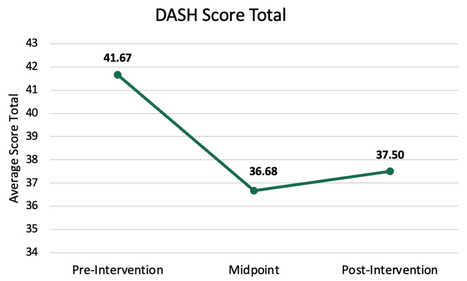
The average time to complete WMFT tasks rapidly improved, meeting both the Minimal Detectable Change (MCD) and Minimally Clinically Important Difference (MCID) by midpoint.



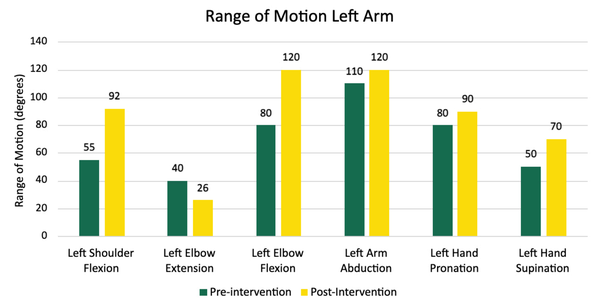


All WMFT Functional Ability Scores met the MDC and MCID except mid- to post- which only met the MDC.

The DASH Questionnaire indicates the participant's subjective improvement throughout the intervention.



MCID calculated using the following formula:
Cohen's $d = M_1 - M_2 / s_{pooled}$ where $s_{pooled} = \sqrt{[(s_1^2 + s_2^2) / 2]}$



All active range of motion (AROM) measures improved from pre- to post. Percent change of 35.6%.

Discussion

- Improvements in participants' WMFT Time Score, AROM, WMFT Functional Ability Score, and DASH scores were seen at 2.5 weeks into the program. This may serve as guidance for future studies in determining the optimal length of mirror neuron-based intervention programs.
- VR exercise therapy may be more effective than mirror therapy, but this will need to be further tested in comparative studies.
- This study demonstrated short-term effects. Additional studies will be required to determine sustainability.

Conclusion

VR gaming with adaptive software shows the potential to be a fun, accessible, and effective way to activate the MNS to aid in the rehabilitation of those with residual upper extremity limitations from a prior stroke.

References

Acknowledgement & Contact information

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