



The Effects of Combining Constraint-Induced Movement Therapy (CIMT) with Virtual Reality (VR) in an Individual with Upper Extremity (UE) Hemiparesis

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Introduction

- CIMT promotes functional use of a hemiparetic extremity for individuals with stroke or other neurological conditions.
- Signature CIMT follows a protocol of 3.5 hours of therapy per day with a behavioral transfer package whereas Modified CIMT (mCIMT) is typically less than 3 hours per day and may not include a transfer package.
- VR has also shown to promote functional use of extremities in similar populations through engaging in interactive virtual game play.
- Current literature focuses on mCIMT with non-immersive VR in children with cerebral palsy or individuals with hemiparesis.
- There is limited research that involves the use of signature CIMT with immersive VR.
- In the current case study, signature CIMT was used in combination with immersive VR gaming to promote functional use of the more-affected UE in an interactive and enjoyable platform.

Methods

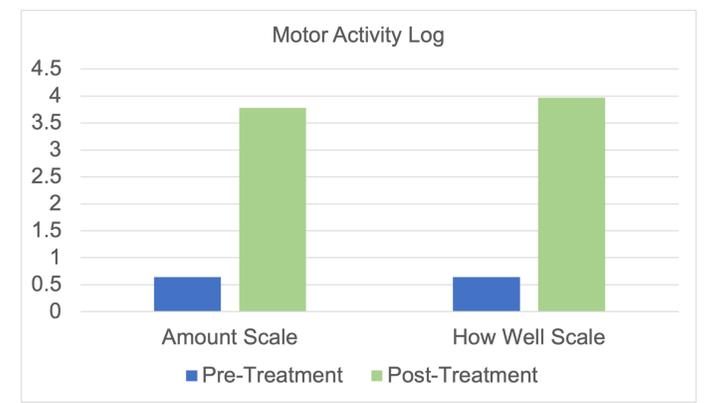
- 72-year-old male status post-stroke in 2014 affecting his dominant UE with no history of seizures who met the minimum motor requirement was recruited through the Neuroplasticity Rehabilitation Program.
- CIMT components consisted of 3.5 hours of treatment for 5 consecutive weekdays for 2 weeks.
- Two forms of movement training: shaping tasks to promote motor progress in small steps and increase confidence and task practice to increase functional UE use.
- A mitt restraint on the less-affected UE was worn during 90% of the waking hours.
- A behavioral transfer package was used to encourage transfer of capacity gains from the laboratory to safe performance in the life situation.
- Brief VR gaming was performed after each shaping task.
- The VR game was a rhythmic-movement-to-music game that allowed the participant to use one hand to perform light-to-moderate intensity exercise while completing enjoyable in-game tasks.
- Outcome measures were administered at pre-, during, and/or post-testing to determine changes in areas of UE movement capacity and use; occupational performance and satisfaction; mood; motivation and enjoyment; and quality of life.

Results

- Data was analyzed using basic descriptive statistics to determine any changes from pre- to post-testing after completing the 10-day treatment protocol.
- Motor Activity Log (MAL) is the main outcome measure used in CIMT to examine amount and quality of movement in the more-affected UE. Amount score at pre-testing was 0.64 and at post-testing 3.78; quality of movement score at pre-testing was 0.64 and at post-testing 3.97; scores met the minimally clinical important difference (MCID).
- Wolf Motor Function Test (WMFT) was used to measure motor capacity. Median time for all 15 items at pre-testing was 3.98 seconds and at post-testing 2.91 seconds. The median functional ability (FA) rating at pre-testing was 3 and remained a 3 at post-testing. The average FA rating at pre-testing was 2.87 and at post-testing increased to 3.4.
- Canadian Occupational Performance Model (COPM) was used to measure occupational performance and satisfaction. Performance score at pre-testing was 4.8 and at post-testing 5.8; satisfaction score at pre-testing was 4.2 and at post-testing 5.4. The scores did not meet MCID.
- Zung Self-Rating Depression Scale was used to measure mood prior to treatment and post-treatment. Participant's raw score was within normal range at pre-testing and remained within normal range at post-testing with slight improvement.
- Stroke Impact Scale was used to measure quality of life after stroke and is broken down into 8 domains and a perceived recovery percentage. Hand function domain at pre-testing was 25 and at post-testing 75 meeting the MCID.
- Enjoyment/Motivation Visual Analog Scale (VAS) was completed after each VR task. Average score for enjoyment was 82.37 out of 100; average score for motivation was 82.95 out of 100.

Outcome Measure	Results	
	Pre	Post
MAL Amount Scale	0.64	3.78*
MAL How Well Scale	0.64	3.97*
WMFT Median Time	3.98	2.91
WMFT Median Functional Ability	3	3
WMFT Average Functional Ability	2.87	3.4
COPM Performance	4.8	5.8
COPM Satisfaction	4.2	5.4
Zung Self-Rating Depression Scale	42	40
Stroke Impact Scale	Strength: 37.5 Memory: 75 Mood: 64 Communication: 78.5 Mobility: 75 ADLs/IADLs: 80 Hand Function: 25 Participation: 68.75 Recovery: 70%	Strength: 43.74 Memory: 82.25 Mood: 66.75 Communication: 78.5 Mobility: 77.75 ADLs/IADLs: 77.5 Hand Function: 75* Participation: 56.25 Recovery: 75%
	<u>During</u>	
VR Enjoyment VAS Average	82.37	
VR Motivation VAS Average	82.95	

* Indicates meaningful change



Discussion

- The case study implemented all components of signature CIMT with the addition of brief moments of immersive VR.
- Positive changes were seen in amount, use, capacity, and function of the more-affected UE
- Participant consistently rated high levels of enjoyment and motivation regarding his experiences with brief moments of VR.
- Introduced novel movement tasks through VR into CIMT without disrupting the protocol and still elicited improvements in overall hand function.
- Limitations: Findings may not be generalizable to all populations due to single case study; limited time spent in VR due to safety concerns related to seizures and motion sickness risk.

Conclusion

- Future research should explore safely adding VR gameplay to CIMT with increasingly longer amounts of time spent in VR with a larger sample size.
- The study provides evidence that it is possible to include VR in CIMT to promote an effective and enjoyable rehabilitation experience without disrupting the protocol while improving overall UE function including use in everyday activities and quality of movement.

References

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