2013

For patients with acute cerebral vascular accident, is virtual reality gaming more effective than standard recreational therapy for the improvement of hand function?

Amy Marie Sequeira Boeschen
Dominican University of California

Elizabeth Jeanne Szoboszlay
Dominican University of California

Martha Welderufael
Dominican University of California

Kitsum Li
Department of Occupational Therapy, Dominican University of California

AOTA Critically Appraised Papers Series

Evidence Exchange

**A product of the American Occupational Therapy Association's Evidence-Based Literature Review Project*

CRITICALLY APPRAISED PAPER (CAP)

FOCUSED QUESTION

For patients with acute cerebral vascular accident, is virtual reality gaming more effective than standard recreational therapy for the improvement of hand function?

Saposnik, G., Teasell, R., Mamdani, M., Hall, J., McIlroy, W., Chung, D. … Bayley, M. (2010). Effectiveness of virtual reality using Wii gaming technology in stroke rehabilitation: A pilot randomized clinical trial and proof of principle. *Stroke: Journal of the American Heart Association, 41*(7), 1477–1484. http://dx.doi.org/10.1161/STROKEAHA.110.584979

CLINICAL BOTTOM LINE:

Occupational therapists should consider virtual reality (VR) gaming when planning therapeutic intervention for patients who have had a stroke, or cerebral vascular accident (CVA). A large percentage of patients who have survived a stroke experience hemiparesis, resulting in functional limitations of the upper extremity (UE). Rehabilitation, involving repetitive and task-oriented training, has shown to be effective in helping individuals who have had a stroke to regain motor function. Virtual reality–based interventions provide the required intensity needed for development of skills through neuroplasticity. VR, as a novel approach to rehabilitation, is affordable and easily accessible for use in home or community settings. The purpose of this research study was to determine whether VR is an effective tool for rehabilitation to improve UE function in patients who have experienced a stroke.

In this study, 22 participants who had had a first time ischemic or hemorrhagic stroke were selected. Fourteen men and 8 women were randomly assigned to either the VR therapy group or the recreational therapy (RT) group, but only 17 participants completed the program. The recruited participants had a mean time of 25 days and a range from 10 to 56 days poststroke. The study implemented 8 sessions within a 2-week time period. Participants in the VR Nintendo Wii group spent 30 minutes of the session playing Cooking Mama and 30 minutes playing Wii Sports. They were encouraged to use the affected UE during the session and played the games from a seated position. Arm movements included shoulder extension and flexion, shoulder rotation, elbow extension and flexion, wrist supination and pronation, and thumb flexion. Participants in the recreational therapy group used the 60-minute session to play cards, Jenga, and BINGO. Both groups participated in standard rehabilitation therapy of 20 hours, combining occupational therapy and physiotherapy during the 2-week study period. Measurements were taken at baseline, postintervention, and 4-week postintervention. Results discussed in the article focused on the difference between baseline and 4-week postintervention. Although both interventions demonstrated improvements in UE function, there was not a statistically significant difference between the two groups for the Box and Block test (BBT), Stroke Impact Scale (SIS), or grip strength, even after adjusting for age, baseline stroke severity, and baseline grip strength differences

between the groups. However, after adjusting for age, baseline functional status, and stroke severity, the VR intervention group showed significantly greater improvement in the Wolf Motor Function Test (WMFT) when compared to the standard recreational therapy. In addition, the research team used the Borg perceived exertion scale to ensure safety and that excessive challenges did not occur as a result of the interventions. This study suggests that VR may be a safe, feasible, and effective therapeutic intervention for patients who have experienced a stroke.

VR gaming is an affordable option and can provide real time sensory feedback to clients. This allows therapists to work with clients on improving skills in real time as they are playing the game. VR gaming could potentially be detrimental for patients with seizures or repetitive motion injuries, so special care should be taken when working with these populations. Because this is a pilot study, additional research should be conducted to support the use of VR gaming on the Nintendo Wii or other gaming systems. Larger participant groups will further improve the statistical power of the results to examine the effectiveness of VR gaming as a therapeutic intervention.

RESEARCH OBJECTIVE(S)
List study objectives.

To evaluate the safety, feasibility, and efficacy of VR gaming using the Nintendo Wii vs. standard recreational therapy for the improvement of UE function in patients who have experienced a stroke.

DESIGN TYPE AND LEVEL OF EVIDENCE:

Level I: randomized control trial

Limitations (appropriateness of study design):
Was the study design type appropriate for the knowledge level about this topic? *Circle yes or no, and if no, explain.*

YES/NO	This design type is appropriate to the study as the research team was able to use standardized measures to determine outcomes. Under these circumstances, a rigorous research design type provides strong evidence.

SAMPLE SELECTION
How were subjects selected to participate? Please describe.

The research team screened 110 patients at the Toronto Rehabilitation Institute. Of these 110 individuals, 78 were not eligible and 10 refused to participate. The remaining 22 were randomly assigned to two study groups.

Inclusion Criteria

Inclusion criteria required that participants be between ages 18 and 85 years and suffering from a first time CVA within the past 6 months (either ischemic or hemorrhagic). Acute stroke was diagnosed through neuroimaging and neurological assessment. Participants also had to meet a level of >3 on the Chedoke–McMaster hand or arm scale.

Exclusion Criteria

Exclusion criteria included the inability to follow directions, a prestroke score of ≥ 2 on the Rankin scale, medically instability, hypertension that could not be controlled with medication, life expectancy of less than 3 months, unstable angina or myocardial infarction, history of seizures, participation in another research trial (either an experimental drug trial or physical therapy trial), or the diagnosis of any additional physical condition that would cause the patient to be at risk during the trial.

SAMPLE CHARACTERISTICS

N = 22

% Dropouts	23%

#/ (%) Male	14 (64%)	#/ (%) Female	8 (36%)

Ethnicity	NR

Disease/disability diagnosis	First-time recent ischemic or hemorrhagic stroke (within the past 6 months)

Check appropriate group:

<20/study group	20–50/study group	51–100/study group	101–149/study group	150–200/study group

INTERVENTION(S) AND CONTROL GROUPS

Add groups if necessary

Group 1

Brief Description	The participants in the VR Nintendo Wii group received eight Wii-therapy sessions of 60 minutes each, over a 2-week period. Thirty minutes were allocated for Wii Sports and 30 minutes for Cooking Mama software. The participants were asked to remain seated and were encouraged to use the affected UE during the game. In addition, the participants received a total of 20 hours of standard occupational therapy and physiotherapy, as tolerated, over the 2-week intervention period.
Setting	Toronto Rehabilitation Institute.
Who Delivered?	The trial staff conducted the intervention. The study coordinator supervised sessions and monitored the participants for symptoms.
Frequency?	Eight 1-hour sessions within a 2-week period; sessions were separated with a minimum of 5 hours.
Duration?	2 weeks.

Group 2

Brief Description	The recreational therapy (RT) group served as the control group. The participants in the RT group received 8 sessions of 60 minutes over a 2-week period. Examples of activities included in RT were playing cards and BINGO. In addition, the participants received a total of 20 hours of standard occupational therapy and physiotherapy over the 2-week intervention period.
Setting	Toronto Rehabilitation Institute.
Who Delivered?	Trial staff.
Frequency?	Eight 1-hour sessions within a 2-week period. Sessions were separated with a minimum of 5 hours.
Duration?	2 weeks.

Intervention Biases: *Circle yes or no and explain, if needed.*

Contamination

YES/**NO**	

Co-intervention

YES/**NO**	

Timing

YES/NO	The intervention period of 2 weeks might not be long enough to affect significant improvement in arm function.

Site

YES/**NO**	

Use of different therapists to provide intervention

YES/NO	**NR.** The article was not clear on who administered which interventions and whether multiple staff members were used. However, the authors did state that the trial staff received training prior to the study.

MEASURES AND OUTCOMES

Complete for each relevant measure when answering the evidence-based question:

Name of measure, what outcome was measured, whether the measure is reliable and valid (as reported in article–yes/no/NR [not reported]), and how frequently the measure was used.

The research team used the WMFT to measure efficacy and improvement in motor function. It consists of 15 timed and two weighted strength tasks. The study did not report reliability or validity. This research team performed the test at baseline, postintervention, and at 4 weeks after intervention.

Name of measure, what outcome was measured, whether the measure is reliable and valid (as reported in article–yes/no/NR [not reported]), and how frequently the measure was used.

The research team used the BBT to measure gross manual dexterity. The study did not report reliability or validity. The research team performed the test at baseline, postintervention, and at 4 weeks after intervention.

Name of measure, what outcome was measured, whether the measure is reliable and valid (as reported in article–yes/no/NR [not reported]), and how frequently the measure was used.

The SIS is a validated scale that measures quality of life. This measure is stated as valid, but the study did not include a validity value or report on its reliability. This test measures strength, hand function, activities of daily living, instrumental activities of daily living, mobility, communication, emotion, memory and thinking, and participation. For this study, the measure was broken down into categories of SIS hand function, SIS composite function, and SIS perception of recovery. This research team performed this test at baseline, postintervention, and 4 weeks after intervention.

Name of measure, what outcome was measured, whether the measure is reliable and valid (as reported in article–yes/no/NR [not reported]), and how frequently the measure was used.

The research team used the Borg perceived exertion scale to ensure no intervention-related problems or safety issues occurred during the study. The study did not report reliability or validity of this measure. The scale, ranges from 6 (*no exertion*) to 20 (*maximal exertion*), and measures the client's perceived fatigue and the amount of effort used to perform the task after each treatment session. The researchers asked the participants to rate their perceived exertion of strenuous and heavy exercise using the Borg scale after each intervention session. Scoring of 13 or greater indicated excessive fatigue. This was done 8 times for each study group.

Measurement Biases

Were the evaluators blind to treatment status? *Circle yes or no, and if **no**, explain*.

YES/NO	Yes, the outcome assessor was blinded to patient randomization and was not involved in the intervention administration.

Recall or memory bias. *Circle yes or no, and if **yes,** explain*.

YES/NO	Yes, the research team used the same assessments for baseline, postintervention, and at the 4-week follow up. The subjects may have had some improvement due to repetition and learning effect. In addition, recall bias may exist with the Borg perceived exertion scale, because the participants provided the ratings at the end of the 60-minute session.

Others (list and explain):

NR

RESULTS

List results of outcomes relevant to answering the focused question.

Include statistical significance where appropriate ($p < 0.05$).

Include effect size, if reported.

At 4 weeks postintervention, the study found that participants in the VR gaming group had significant improvement on the WMFT, with an average improvement of 7.4 seconds using a 95% confidence interval. Other results indicated greater improvement scores for the VR gaming group in the grip strength, BBT, and SIS, though these were not statistically significant,. Initially, the research team believed these results to be significant; however, after adjusting for ages, baseline grip strength, and stroke severity among the control and experimental groups, these results did not reach the significant level. At the end of the 2-week intervention, results from the Borg perceived exertion scale demonstrated that there was no difference between the recreational therapy group and the VR Wii group in reported exertion or fatigue level from the participants.

Was this study adequately powered (large enough to show a difference)? *Circle yes or no, and if no, explain*.

YES/**NO**	The study was not adequately powered to demonstrate a difference between the two groups. However, because this is a pilot study, this is appropriate and it indicates the need for further research with larger groups.

Were appropriate analytic methods used? *Circle yes or no, and if no, explain.*

YES/NO	The analytic methods used were appropriate and able to account for differences between the groups' ages, stroke severity, and baseline grip strength.

Were statistics appropriately reported (in written or table format)? *Circle yes or no, and if no, explain*.

YES/NO	Yes, but the results section could have included additional written information to support the tabled results.

CONCLUSIONS

State the authors' conclusions that are applicable to answering the evidence-based question.

This pilot study found that the VR Wii intervention improved UE motor function and was a safe and feasible method of intervention for individuals after stroke. The study successfully demonstrated statistical and clinical significant gains in UE motor function, with an average of 7.4 seconds improvement on the WFMT. One limitation to this study is that it was a single-blinded study. Individuals in the group with VR Wii may have been more motivated by the new technology and unintentionally demonstrated this excitement to the examiner, revealing their group placement to the examiner. The research team accounted for this limitation by asking the blind assessor to guess the group assignment for each participant. The assessor was unable to do this with any accuracy. Lastly, VR Wii may encourage movement strategies for game play that were not necessarily conducive to functionally adaptive movements. It is therefore important to include patient supervision during game play. To further improve the effect of the study, it is recommended that further studies to be of a longer duration and have a larger sample size. Nevertheless, this pilot study demonstrated that VR gaming was a safe, feasible, and an effective form of intervention to improve UE function for patients with an acute stroke.

This work is based on the evidence-based literature review completed by Amy Sequeira, OTS; Elizabeth Szoboszlay, OTS; Martha Welderufael, OTS; and Kitsum Li, OTD, OTR/L, Faculty Advisor, Dominican University of California.