

**Laver KE, George S, et al. Virtual reality for stroke rehabilitation. Cochrane Database of Systematic Reviews 2011, Issue 9, Article # CD008349.pub2.**

Design: Meta-analysis of randomized clinical trials

PICOS:

- Patient population: Patients 18 years and older with stroke as defined by World Health Organization criteria: Rapid onset loss of cerebral function lasting more than 24 hours diagnosed by imaging or neurological examination
- Intervention: Virtual reality interventions defined as “an advanced form of human-computer interface that allows the user to ‘interact’ with and become ‘immersed’ in a computer-generated environment in a naturalistic fashion”
- Control: no intervention, or any activity designed to be therapeutic which does not involve virtual reality
- Outcomes: Primary outcomes were based on 3 kinds of activity
  - o Upper limb function and activity
  - o Gait and balance function and activity
  - o Global motor function
  - o Secondary outcomes included cognitive function, activity limitation, participation restriction and quality of life, adverse effects, and imaging studies
- Study types: randomized or quasi-randomized (e.g., allocation by birth date) controlled trials comparing virtual reality with no intervention or with an alternative intervention; no quasi-randomized trials were found or included in the review

Study selection:

- Databases included the Cochrane Stroke Group specialized register and several electronic databases through Feb 2008
  - o Further searches were done on a digital database of academic dissertations and theses, reference lists, and book chapters, and hand searches of conference proceedings; 12 manufacturers of virtual reality equipment were contacted to ask for details of trials; trials published in languages other than English were translated
- Two authors extracted data and assessed quality based upon consideration of randomization method, allocation concealment, blinding and the success of blinding, intention-to-treat analysis, and participant withdrawal from the trial

Pertinent results:

- 19 studies with 565 participants were found which met the inclusion criteria
- All trials took place between 2004 and 2010 and were conducted in 11 countries; all were published in English
- 12 studies involved sample sizes of less than 25 patients; 5 studies had between 26 and 50, and the two other studies had sample sized of 58 and 83

- 5 intervention approaches were used: activity retraining, upper limb training, lower limb and gait training, global motor function, and cognitive/perceptual training
- Most of the interventions were customized programs; 2 were commercially available gaming consoles, and 3 were commercially available but more difficult to obtain than off-the-shelf gaming consoles
- Amount of therapy varied from less than 5 hours to more than 21 hours
- All outcomes were measured post-intervention; since different scales were used to measure treatment effects, the pooling of data was done as standardized mean differences between virtual reality and control
- For upper extremity function and activity, 7 studies presented outcomes for 205 patients
  - o For arm function, several measurements, such as the Action Research Arm Test, the Wolf Motor Function Test, and others, were pooled to estimate a treatment effect of 0.53 standard deviations (SD) in favor of virtual reality; this is a moderate effect size
  - o For hand function, 2 trials with 44 participants did not demonstrate a significant difference between virtual reality and control
- For gait function and activity, results were presented for gait speed
  - o 3 studies with 58 patients showed no significant effect on gait speed
- For global motor function, the 2 available studies made comparisons which the authors decided not to analyze further due to the disparity in methods of the studies
- For cognitive function, there was insufficient reporting to perform an analysis
- For ADL function, 3 studies with 90 patients showed a significant treatment effect on ADL; virtual reality had a benefit of 0.81 SD, which is considered a large treatment effect

Authors' conclusions:

- Results suggest, but do not prove, that virtual reality is more effective than conventional therapy in improving arm function; there is insufficient information to estimate its effect on grip strength
- There is insufficient evidence to draw conclusions about the effect of virtual reality on lower limb function and global motor function
- Virtual reality appeared to have an advantage over conventional treatment in improving ADL
- Because of the heterogeneity between studies (some being targeted to very specific activities like riding the bus), the ability to pool results was limited
- Many studies were small and the risk of bias was often unclear due to poor reporting of randomization and allocation concealment
- The majority of virtual reality programs were specialized programs designed by researchers, and are unavailable for use by clinicians at present

Comments:

- The data on virtual reality is limited as the authors report; the only trial of the easily available Nintendo Wii (Saposnik 2010) randomized only 22 patients and was reported as a pilot study
- As the authors report, the majority of the studies were quite small and are also best regarded as pilot studies of clinically unavailable products
- ADL data were taken from three studies which used different scales; one used the Barthel index, one used the Functional Independence Measure, and one used the Abilhand scale as a quality of life measure: the latter is focused on upper limb function for patients with stroke and rheumatoid arthritis, and emphasized 23 mostly fine motor activities rather than toileting, transfers, etc
- The authors reluctance to draw conclusions and the unavailability tend to support the conclusion that currently, virtual reality is mostly a research tool for stroke rehabilitation

Assessment: High quality review which does not support any evidence statement regarding the effectiveness of virtual reality outside a research setting