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A study to assess the knowledge of virtual reality on postural and balance control in patients with stroke

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Abstract
Stroke is the leading cause of death and disability worldwide. Stroke survivors often have deficit in motor control which contributed to reduced balance, postural control and mobility. The majority of published studies reported positive results but traditional rehabilitation programmes tend to be tedious and require specialized facilities or equipment. Virtual reality (VR) has a prominent role in promoting functional recovery after stroke. It has the potential to deliver the effective intervention at low cost. VR provides enriched motivational training and goal-orientated tasks which improve patients' adherence to programme. Previous studies indicated that it might be more effective in improving dynamic balance control and preventing falls in subacute and chronic stroke patients compared to conventional therapy. To critically evaluate the studies that were conducted and to assess the impact of virtual reality on static and dynamic balance control in the stroke population.

Methods: We did a systematic review and network meta-analysis. We searched PubMed, Google Scholar and MedRxiv for correct data. In this study we included all the descriptive studies, meta-analysis and statistical analysis studies which deals with virtual reality on postural and balance control among stroke. We extracted data following predefined hierarchy. In this studies, we assessed the knowledge of virtual reality of postural and balance control among stroke patients.

Findings: According to the 15 studies we identified, involving 1000 individuals, Reduced balance and postural control is a major contributor to functional limitations and barriers to perform activities of daily living in patients with stroke. This study reviewed existing evidence on the effect of the virtual reality training on balance and postural control.

With the fair and moderate quality evidences, the study found that the virtual reality training is an effective alternate to the routine rehabilitation to improve dynamic balance and static balance in patients with chronic stroke. But simply the virtual reality training wouldn't be an effective way to deliver balance control in patients within a home setting without therapist's input. However, the virtual reality training combined with conventional rehabilitation program with some therapeutic exercises will be more effective in delivering static and dynamic balance control in stroke patients.

Keywords: Balance control, stroke, death and disability worldwide

Introduction
A stroke is a medical condition in which poor blood flow to the brain causes cell death. There are two main types of stroke: ischemic, due to lack of blood flow, and hemorrhagic, due to bleeding. Both cause parts of the brain to stop functioning properly. Signs and symptoms of a stroke may include an inability to move or feel on one side of the body, problems understanding or speaking, dizziness, or loss of vision to one side. Signs and symptoms often appear soon after the stroke has occurred. If symptoms last less than one or two hours, the stroke is a transient ischemic attack (TIA), also called a mini-stroke. A hemorrhagic stroke may also be associated with a severe headache [1]. The symptoms of a stroke can be permanent. Long-term complications may include pneumonia and loss of bladder control. The main risk factor for stroke is high blood pressure. Other risk factors include tobacco smoking, obesity, high blood cholesterol, diabetes mellitus, a previous TIA, end-stage kidney disease, and atrial fibrillation. An ischemic stroke is typically caused by blockage of a blood vessel, though there are also less common causes. A hemorrhagic stroke is caused by either bleeding directly into the brain or into the space between the brain's membranes [2]. Bleeding may occur due to a ruptured brain aneurysm. Diagnosis is typically based on a physical exam and supported by medical imaging such as a CT scan or MRI scan. A CT scan can rule out bleeding, but may not necessarily rule out ischemia, which early on typically does not show up on a CT scan.

Other tests such as an electrocardiogram (ECG) and blood tests are done to determine risk factors and rule out other possible causes. Low blood sugar may cause similar symptoms [3].

Prevention includes decreasing risk factors, surgery to open up the arteries to the brain in those with problematic carotid narrowing, and warfarin in people with atrial fibrillation. Aspirin or statins may be recommended by physicians for prevention. A stroke or TIA often requires emergency care. An ischemic stroke, if detected within three to four and half hours, may be treatable with a medication that can break down the clot. Some hemorrhagic strokes benefit from surgery. Treatment to attempt recovery of lost function is called stroke rehabilitation, and ideally takes place in a stroke unit; however, these are not available in much of the world [4].

In 2013, approximately 6.9 million people had an ischemic stroke and 3.4 million people had a hemorrhagic stroke. In 2015, there were about 42.4 million people who had previously had a stroke and were still alive. Between 1990 and 2010 the number of strokes which occurred each year decreased by approximately 10% in the developed world and increased by 10% in the developing world. In 2015, stroke was the second most frequent cause of death after coronary artery disease, accounting for 6.3 million deaths (11% of the total).About 3.0 million deaths resulted from ischemic stroke while 3.3 million deaths resulted from hemorrhagic stroke. About half of people who have had a stroke live less than one year. Overall, two thirds of strokes occurred in those over 65 years old [5].

Virtual reality (VR) is a simulated experience that can be similar to or completely different from the real world. Applications of virtual reality include entertainment (e.g. video games) and education (e.g. medical or military training). Other distinct types of VR-style technology include augmented reality and mixed reality, sometimes referred to as extended reality or X [6].

Currently standard virtual reality systems use either virtual reality headsets or multi-projected environments to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual environment. A person using virtual reality equipment is able to look around the artificial world, move around in it, and interact with virtual features or items [7]. The effect is commonly created by VR headsets consisting of a head-mounted display with a small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. Virtual reality typically incorporates auditory and video feedback, but may also allow other types of sensory and force feedback through haptic technology [8].

Methods

We did a systematic review and network meta-analysis. We searched PubMed, Google Scholar and MedRxiv for correct data. In this study we included all the descriptive studies, meta-analysis and statistical analysis studies which deals with virtual reality on postural and balance control among stroke. [9] We extracted data following predefined hierarchy. In this studies, we assessed the knowledge of virtual reality of postural and balance control among stroke patients. Studies must have involved adult patients with stroke during acute, subacute, or chronic phase. All included studies must have assessed the impact of virtual reality programme on either static or dynamic balance ability and compared it with a control group. Utilized specific outcome measures to assess balance [10] Data extracted were age, time since stroke onset, intervention and control protocol, frequency and duration of interventions, outcome measures, main results. To assess the impact of virtual reality on postural balane control in the stroke population. The scores from each assessor were cross-checked. Some other studies used Berg Balance scale (BBS) and the Timed-up and Go test (TUG) [11].

Results

In this meta-analysis, according to 15 studies involving 1000 individuals, this is the systematic review on knowledge of virtual reality on postural and balance control in patients with stroke. All studies showed significant improvement in postural and balance control in the stroke patient's outcome measure. [12] Further studies recommended to investigate the knowledge of virtual reality and participation level with an adequate follow up period. All studies recorded more than one outcome measure at baseline and after intervention. A range of outcome measures was used to measure static balance, dynamic balance, walking balance. Berg Balance Scale (BBS and Timed Up and Go test (TUG) scales were used in the studies [13].

According to Ling Chen, Wai Leung Ambrose Lo (07 Dec 2016) was conducted the effect of virtual reality in postural and balance control in patient with stroke. For past 10 years the studies were conducted and to assess the impact of virtual reality and balance control in the stroke patient. A systemic review of randomized controlled trial published. Databases searched were PubMed, Scopus and web of science studies must have involved adult patient with stroke during acute, sub-acute or chronic phase. Results: Nine studies were included in this systematic review. The PED scores ranged from 4 to 9 points. All studies, except one, showed significant improvement in static or dynamic balance outcomes group. This review provided moderate evidence to support the fact that virtual reality training. Further research is required to investigate the optimum training intensity and frequency to achieve the desired outcome [14].

According to Jerome Iruthayarajah, Amanda Mcintyre (Sep 2015) was conducted the use of virtual reality for balance among individual with chronic stroke a systematic review &meta-analysis. A literature search of Pubmed, Scopus, CINAHL, Embase, Psycinfo, and Web of Science databases was conducted. Study selection: English randomized controlled trials published up to September 2015 assessing balance with VR in chronic stroke participants. Data extraction: Mean and standard deviations from outcome measures were extracted. Pooled standard mean differences ± standard error were calculated for the Berg Balance Scale (BBS) and the Timed Up and Go test (TUG).Results: In total, 20 studies were selected which assessed the Nintendo® Wii Fit balance board (n = 7), treadmill training and VR (n = 7), and postural training using VR (n = 6) [15].

Conclusion

The study concludes that this review provided moderate evidence to support the fact that the virtual reality training is an effective adjunct to standard rehabilitation programme to improve postural and balance control for patients with chronic stroke. The effect of VR training in balance

recovery is less clear in patients with acute or sub-acute stroke. Further research is required to investigate the optimum training intensity and frequency to achieve the desired outcome.

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Authors Contribution
All the authors actively participated in the work of study. All the authors read and approved the final manuscript.

Conflict of Interest
The authors declare no conflict of interest.

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