A Study Protocol for Checking Efficacy of Leap Motion Device on Gross Hand Dexterity in Sub-Acute Stroke Patients

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Abstract

Introduction: Stroke survivors have limited everyday living tasks, often because of dexterous issues. Videogame-based training (VBT) with the appearance of virtual reality helps to improve the role of the upper limbs. The leap Motion controller can track both hands and fingers' fine movements. The studies thus demonstrates the efficacy of the leap motion system on gross hand dexterity in patients with sub-acute stroke.

Method: The research has been designed as an experimental study. The total of 40 participants will be taken from AVBRH, sawangi Meghe for study as per inclusion and exclusion criteria. With intervention the span of the study will be 6 months. Leap Motion-based, augmented reality training will be provided to patients for half hour, every single day, Five days of the week a month. Pre and post, box and block test and System usability scale will be taken. Those two will be the patient's major outcome.

Discussion:-This study protocol aims to assess the efficacy of the leap motion controller on the rehabilitation of gross hand dexterity in patients with stroke. The study's expected outcome will concentrate on the evaluation of the usability of VBT using the Leap Motion Controller (LMC) to train gross hand dexterity in stroke patients' early recovery process.

Keywords: *stroke, upper limb, dexterity, virtual reality, videogame-based training (VBT), leap Motion controller (LMC), box and block test, system usability scale.*

Introduction

[1]The World Health Organization (WHO) estimates that stroke is the second-largest cause of death in theworld.[2]Up to 85 percent of patients who survive stroke hemiparesis due to reduced arm and hand function.[3]The upper limb is an important part of the human body, which is very mobile and plays a role in grasping, carrying, moving and touching different objects.[4]Loss of upper limb independence contributes significantly to physical disability, impacting quality of life and independence in the 'basic' and 'instrumental' everyday activities.[1]To further boost the outcome of the upper limbs, work is continuing to explore new approaches. Videogame-based training (VBT) together with virtual reality (VR) is an emerging therapeutic process . Recent meta-analysis suggests there is strong evidence that VR programming can be helpful for upper limb recovery following stroke.

[5]Virtual reality training is becoming a promising technology which can facilitate motor rehabilitation by providing high-intensity, repetitive and task-oriented training with computer programs that simulate three-dimensional scenarios in which patients play by moving their body parts.[6]Virtual Reality (VR) may provide patients with a supportive immersive experience, with the goal of maintaining high quality and intensive

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physiotherapy. [5]Within the literature, the following benefits of using VR within rehabilitation have been identified in improving performance, improving the affected limb and cognitive functions, encouraging neuroplasticity and greater flexibility in everyday life activities, as well as increasing patient engagement and cooperation during rehabilitation programmes. Indeed, some authors have 'found evidence that using virtual reality and immersive video games can be helpful in improving upper limb function and function of ADL (Daily Living Activities) when used as an alternative to regular therapy (to maximize total therapy time) or when compared to the same typical therapy dose.' [7]This makes VR a valuable resource in therapy's future, 'not only because it has been shown to be effective for ill and healthy subjects, but also because it has had very little side effect and was much safer than other aggressive or violent therapies.'

[2]Leap Motion's leap motion controller (https:/ www.leapmotion.com) provides a means to capture and track delicate hand and finger movements, while manipulating a virtual environment that involves hand-arm coordination as part of virtual tasks. [5]The Leap Motion Controller (LMC) is a modern optoelectronic device designed to capture both hands ' movement and manipulate a virtual environment. Unlike previous devices, it optoelectronically monitors fine finger movements, using neither glows nor markers. [8]This system is specifically designed for hand gesture recognition and explicitly measures the location of the fingertips and the orientation of the hand. [5]This is made with 2 cameras and 3 LEDs in infrared. Across three-dimensional space it senses hands, wrist and elbow positions and gestures. LEAP motion setup is quick, since it only requires downloading the SDK from the official LEAP motion website.

Aims and Objective

This research aims to assess the efficacy of the leap motion controller on the rehabilitation of gross hand dexterity in patients with stroke.

Objectives

1. To demonstrate the effect of Virtual Reality based serious gaming using leap motion the dexterity of hand in patients with strokes.

2. To check the usability of VBT to train gross motor function in the upper limb hand function using Leap Motion Controller (LMC).

Methodology

This study will be conducted in the Department of Community Health Physiotherapy at Ravi Nair Physiotherapy College, Sawangi (Meghe), Wardha, India, with the approval of Datta Meghe Institute of Medical Sciences, Institutional Ethics Committee, Deemed to be University.

Study Setting: - Ravi Nair Physiotherapy College

Study Type:- Experimental study

Study DuratioN:- 6 months

Sample Size:- 40

Inclusion Criteria:-

1. Patient willingness to participate

2. Age 30-70 years old

3. 3. Those who rated stage 4 or above in the stages of arm and hand recovery in the Brunnstrom motor.

4. 4. Those who mastered the doctor's guidance in Mini-Mental State Evaluation, with or above 24 marks.

5. About 4–24 weeks had passed since the onset of the stroke.

6. Capable of raising the affected arm and wrist independently of their residual voluntary movement or at least capable of carrying out an ante-flexion of their upper arm and length of one or more fingers against gravity

Exclusion Criteria:-

The exclusion criteria are as follows:

1. Non-willing to participate

2. Recent fractures

3. Visual, hearing deficits

4. On Brunnstrom grading patient score 1,5 or

5. The background of the ischemic transient

attack (TIA);

6. Vital body parts including brain, lung, liver and kidney failure;

7. Past neurosurgery or epilepsy experiences inside the brain;

8. Significant cognitive disability or aphasia (incapable of following the directions of the therapists);

9. Not appropriate for MRI scanning (including but not limited to: metal pieces in the eyes or face; insertion of any electronic devices such as (but not limited to) cardiac pacemakers, cardiac defibrillators, cochlear implants or nerve stimulators; operation on brain blood vessels or heart valves; or defects in the brain or skull);

10. participation in another clinical trial concerning the treatment of physical or investigational medicines.

OUTCOME MEASURES:-

1. The dexterity will be measured using the box and block test.

2. 5-point Likert scale for System Usability Scale.

PROCEDURE:-

The game is played with both hands beginning with non-affected first hand. Participants should sit on a chair with a rectangular pillow on their lap (if not in a wheelchair), so that the elbows can rest on the pillow. The LMC is positioned on a table in front of the person, between the body and the LED screen. During each session, the principal investigator will sit beside the participants, providing online feedback (if necessary) through verbal, visual and/or physical guidance. The LMC is comprised of three infrared emitters and two charged device cameras to monitor all movement of hands, wrists, and forearms. The infrared emitter light reflects back from the hands ' surfaces so no markers are required.

Petal-picking-game:-Designed by picking lotus petals in a simulated environment to develop the finger pinching motor skills. This also strengthened digital dexterity and coordination.

Experimental procedure:- Leap Motion-based, augmented reality training will be provided to patients for half hour, Every single day, Five days of the week a month.

Material Required

· Printed copy of brunnstrom scale, mini mental scale, system usability scale

· Pillow

· Chair with arm rest

· Table

· Stopwatch.

· Wooden box dimensioned in 53.7 cm x 25.4 cm x 8.5 cm.

· 150 wooden cubes (2.5 cm in size)

INSTRUMENTATION:-

Leap motion controller

LED screen

Data Analysis

Analysis of data will be carried out using concise and inferensive statistics using unpaired t test students in chesquare. The software used in the study will be the SPSS 24.0 version, the praphade prism 7.0 version and the degree of significance < 0.005 (p>0.005 m) is considered.

Ethics And Dissemination

The approval of the Committee on Institutional Ethics must be obtained prior to the start of the study. Patients must be treated with respect first. Upon meeting the requirements of inclusion and exclusion criteria, the patients are taken for review.

Observation And Expected Results:-

The study's expected outcome will concentrate on evaluation of VBT usability using the Leap Motion Controller (LMC) to develop gross hand dexterity in stroke patients' early recovery process.

Discussion

This study protocol aims to assess the efficacy of

the leap motion controller on the rehabilitation of gross hand dexterity in patients with stroke. The purpose of this study will help to explain the process of creation of a series of VR mini-games designed to improve the encouragement of patients with stroke when performing repetitive upper limb movements. The study's expected outcome will concentrate on the evaluation of the usability of VBT using the Leap Motion Controller (LMC) to train gross hand dexterity in stroke patients' early recovery process.

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Conflict of Interest: Nil

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