



Research articles

Impact of leap motion controller on pinch grip in sub-acute and chronic stroke patients

Prasad Dhage, Waqar M. Naqvi*, Sakshi P. Arora, Chaitanya A. Kulkarni

Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical sciences, Wardha, Maharashtra, India.

ABSTRACT

Stroke patients have limited everyday tasks. For that videogame-based training (VBT) with the effect of virtual reality helps to improve the role of upper limb and motor function of hand rehabilitation (finger pinch grip). The Leap motion controller can track the both extremities (hand and fingers) fine movements. The study will demonstrate the impact of the leap motion controller on pinch grip in patient with sub-acute and chronic stroke. The total of 40 participants will be taken for study as per inclusion and exclusion criteria. The duration of the study will be six months with intervention. Leap motion -based, augmented reality training will be provided to patients for half hour, Every single day, 5days of the week a month. Formant's sign and system usability scale will be taken. Those two will be the patient's measure outcomes. Impact of the leap motion controller device will be evaluated by using the system usability scale and Formant's sign. The result from the study will significantly provide evidence on the use of Leap motion controller on pinch grip in subacute and chronic stroke patient.

Keywords: Stroke, virtual reality, leap Motion controller (LMC).

Received - 20-09-2021, Reviewed - 02/10/2021, Revised/ Accepted- 26/10/2021

Correspondence: Waqar M. Naqvi*, ✉ waqar.naqvi@dmimsu.edu.in

Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical sciences, Wardha, Maharashtra, India.

INTRODUCTION

Most important cause of death and disability is stroke. [1]. After the effect of stroke, the most common is hemiplegia. Stroke patients lose the potential of the paralyzed limbs, experience very weak agency sense and start to avoid using paralyzed side bodies who are suffering from hemiplegia. In fact, less-utilized paralyzed side bodies are at risk for a significant change in their own body experience. [2]. The most common associated conditions are hemiparesis, lack of responsiveness, spasticity of the upper limb, which have no of effects in the performance of those affected activities of daily living. [3].

The upper limb is an essential part of the human body, which is mobile and has a role in gripping, carrying, moving and touching various objects. [4]. While performing activities of daily living the stroke patients with upper extremity functional restriction are particularly susceptible to problems. After stroke several treatment options are available with varying levels of supporting evidence. [4]. Through goal-oriented practice and repetition the therapy is based on enhancing practical task efficiency for the UE. To provide feedback repetitive movements linked to specific skills will promote neural plasticity and motor recovery if intense and able. [5].

Loss of upper limb independence contributes significantly

to physical disability, impacting quality of life and independence in the basic and instrumental everyday activities. [6]. To further boost the outcome of the upper limb, work is continuing to explore new approaches. Videogame-based training (VBT) together with virtual reality (VR) is an emerging therapeutic process. Virtual reality training is developing a unique technology which can facilitate motor rehabilitation by providing high intensity, repetitive and task oriented training with computer programs that stimulate three-dimensional scenarios in which patient play by moving their body parts. [7]. Virtual Reality (VR) may provide patients with supportive immersive experience, with the goal of maintaining high quality and intensive physiotherapy. [8]. Leap Motion's leap motion controller (LMC) 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. [9]. To capture both hands movements and manipulate a virtual environment the modern optoelectronic device is designed that is the Leap Motion Controller. Unlike previous devices, it optoelectronic monitors fine finger movements, using neither glows nor markers. [7]. This system is specifically designed for recognition of hand gesture and explicitly measures the orientation of the hand and the location of the

fingertips.^[10] This is made with 2 cameras and 3 LEDs in infrared. Across three-dimensional space it senses hands, wrist and elbow position and gestures.^[11,12] LEAP motion setup is quick, since it only requires downloading the SDK from the official LEAP motion Website and from LEAP app store download the pluck a petal game for the improvement in pinch grip of hand.^[7]

The aim of this study will be to examine the effect of Leap motion controller on Stroke patient for pinch grip movement and mechanisms of recovery in patients with sub-acute strokes. The objectives will be to demonstrate the effect of virtual Reality based serious gaming using Leap motion the pinch grip movement of hand in patients with strokes, and to check the usability of VBT to train gross motor function in the upper limb hand functions using Leap Motion Controller.

METHODOLOGY

After approval from Institutional Ethics Committee of DMIMS, (DU) this study will be carried out at the Department of Community Health Physiotherapy, RNPC, Sawangi (Meghe), Wardha, India. Total 40 stroke patients will be recruited for 6 months. The inclusion criteria will be including willingness to participate, age group from 40-60 years, about 4-24 weeks had passed since the onset of the stroke, those who mastered the doctor's guidance in Mini-Mental State Evaluation, with or above 24 marks. The exclusion criteria will be the patient is not willing to participate in activity, the individual with recent stroke, recent hand fractures, visual or hearing deficits, the background of the ischemic transient attack, vital body parts including brain, lung, liver and kidney failure and last neurosurgery or epilepsy experiences inside the brain.

The equipment will be Leap motion controller device, Projector Screen/ LCD Screen, Projector, Plucking a petal Application for opposition and pinch grip movement. The outcome measures will be System usability scale and Froment's Sign.

Procedure

The participants will be selected according to inclusion and exclusion criteria. The procedure will be explained and exposure to the modalities will be given. Further informed consent from the participants will be taken. Beginning with non-affected hand first then the game is played with both hands. With a rectangular pillow on their lap participants should sit on a chair (if not in a wheelchair), so that the elbows can rest on pillow. Between the body and the LED screen, in front of the person the LMC is positioned on the table. The principal investigator will sit beside the participants during each session for providing online feedback (if necessary) either verbal, visual or physical guidance. To monitor all movement of hands, wrists and forearms the LMC comprised two charged device cameras and three infrared emitters. No markers are required because of the infrared emitter light reflects back from the hands surface. Petal-

picking -game: Designed by picking lotus petals in a stimulated environment to develop the finger pinching motor skills. A questionnaire will be provided after the session to the participants.

Statistical Analysis

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 ($p > 0.005m$) is considered. Analysis of data will be carried out using concise and inferensive statistics using unpaired t test students in chi-square.

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 the inclusion and exclusion criteria, the patients are taken for review.

RESULT

Impact of the leap motion controller device will be evaluated by using the system usability scale and Froment's sign. The result from the study will significantly provide evidence on the use of Leap motion controller on pinch grip in subacute and chronic stroke patient. The study will be started after the approval of the committee. A total 40 subjects will be finalised and used for the study. These subjects should have no objections and should be cooperative and fit in eligibility criteria. The study is estimated to complete within the six months, and will be presented in the form of research paper.

CONCLUSION

Impact of the leap motion controller device can be significant or insignificant on pinch grip in subacute and chronic stroke patient following an interventional use of device for six months.

FUNDING

This study has not received any external funding.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interests.

REFERENCE

1. Kim J-H, 2018. "Effects of a virtual reality video game exercise program on upper extremity function and daily living activities in stroke patients", *J Phys Ther Sci* 30(12), 1408-11.
2. Aoyagi K, Wen W, An Q, Hamasaki S, Yamakawa H, Tamura Y, et al, 2019. "Improvement of Sense of Agency during Upper-Limb Movement for Motor Rehabilitation Using Virtual Reality", in 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBC 118-21.
3. Achanccaray D, Pacheco K, Carranza E, Hayashibe M, 2018. "Immersive Virtual Reality Feedback in a Brain Computer Interface for Upper Limb Rehabilitation", in 2018 IEEE International Conference on Systems, Man and Cybernetics (SMC), 1006-10.
4. Ikbali Afsar S, Mirzayev I, Umit Yemisci O, Cosar Saracgil SN, 2018. "Virtual Reality in Upper Extremity Rehabilitation of Stroke Patients, A Randomized Controlled Trial", *J Stroke*

- Cerebrovascular Dis 27(12), 3473–8.
5. Ocampo R, Tavakoli M, 2019. “Visual-Haptic Colocation in Robotic Rehabilitation Exercises Using a 2D Augmented-Reality Display”, in 2019 International Symposium on Medical Robotics (ISMR), 1–7.
 6. Hunter SM, Crome P, 2002. “Hand function and stroke”, *Rev Clin Gerontol*, 12(1), 68–81.
 7. Iosa M, Morone G, Fusco A, Castagnoli M, Fusco FR, Pratesi L, et al, 2015. “Leap motion-controlled videogame-based therapy for rehabilitation of elderly patients with subacute stroke, a feasibility pilot study”, *Top Stroke Rehabil* 22(4), 306–16.
 8. Alimanova M, Borambayeva S, Kozhamzharova D, Kurmangaiyeva N, Ospanova D, Tyulepberdinova G, et al, 2017. “Gamification of Hand Rehabilitation Process Using Virtual Reality Tools, Using Leap Motion for Hand Rehabilitation”, in 2017 First IEEE International Conference on Robotic Computing (IRC), 336–9.
 9. Wang Z, Wang P, Xing L, Mei L, Zhao J, Zhang T, 2017. “Leap Motion-based virtual reality training for improving motor functional recovery of upper limbs and neural reorganization in subacute stroke patients”, *Neural Regen Res* 12(11), 1823–31.
 10. Marin G, Dominio F, Zanuttigh P, 2014. “Hand gesture recognition with leap motion and kinect devices”, in 2014 IEEE International Conference on Image Processing (ICIP), 1565–9.
 11. Waqar M Naqvi, 2021. “Gamification as an entrepreneur well-being intervention, A study protocol for a single-blinded randomised controlled trial”, *Protocol Exchange* 1323, v1.
 12. Bhamra MK, Naqvi W, 2021. “A Study Protocol for Checking Efficacy of Microsoft Kinect Azure for Evaluation of Spatial Parameters of Gait in Normal Healthy Population”, *Indian J Forensic Med Toxicol* 15(1), 1728–31.

How to cite this article

Prasad Dhage, Waqar M. Naqvi, Sakshi P. Arora, Chaitanya A. Kulkarni, 2021. Stroke, virtual reality, leap Motion controller (LMC), *Jour. of Med. P'ceutical & Allied. Sci.* V 10 - I 6, 1354, P- 3834 - 3836. doi: 10.22270/jmpas.V10I6.1354