**Original article**

# Effects of Action Observation Treatment Upper Limb Motor Function in Chronic Stroke Patients

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## ARTICLE INFO

## ABSTRACT

The rate of cerebrovascular accident is keep on increasing in Pakistan which cause major disability in affected person. In developed countries it has been reported that an action observation treatment for rehabilitation, promotes motor function of upper limb in stroke population. **Objective:** To find out effects of action observation treatment on upper limb motor functions of chronic stroke patients. **Methods:** A randomized control trial with registered number NCT05084820. Fourteen chronic stroke patients were taken from Umer hospital and Riphah rehab center Lahore. Total duration of study was 6 months. A randomized control trial was done containing total 14 chronic stroke patients. Patients in experimental group were given action observationtreatment three days per week for one month along with conventional physiotherapy treatment. Patients in conventional group, received strengthening exercises, reach and grasp of hand, stretch of hand muscles. Modified Barthel Index was used to measure function of upper limb and Fugl-Meyer Assessment for upper extremity (FMA-UE) for assessment of motor function. Statistical analysis was done by using SPSS 21. **Results:** There were significant difference in MBI and FMA-UE score, P value was <0.05, but sensation and joint pain from FMA-UE tool P value was >0.05 which was non-significant. **Conclusion:** Action observation treatment together with conventional treatment was an effective treatment approach on improving motor function of upper limb in chronic stroke patients.

## INTRODUCTION

The rate of cerebrovascular accident is keep on increasing in Pakistan which cause major disability in affected person [1]. Almost 85% of people experienced change in arm function after CVA, with almost 40% of individuals being affected by upper extremity functions long term and this loss adversely affects quality of life [2]. Primary goal of all physical therapists is functional recovery in affected upper extremities in hemiplegic patients.At chronic stage of stroke the patient may be paralyzed or having contractures in upper or lower limb due to which they depend on others for their ADLs [3], because they forgot how to perform those specific motor tasks or they don't have enough strength to do so [4]. Rehabilitation of motor functions is an elementary part of every therapeutic approach to such patients. There is a new approach in neuro rehabilitation regarding "action observation treatment" (AOT). This approach depends upon a concept of observational learning [5], as a motor task is shown to patients by performing the task practically or shown through the videos so they can observe, the areas within the mirror neuron system becomes active by observing the model until the execution of task [6]. Mirror neurons are a type of neurons that harmonize their functioning either by performing a specific motor act or by observing the same from others [7]. Yawning is the simplest example regarding the working mechanism of mirror neurons, yawning triggered involuntarily by observing another person yawn [8].By observing other individuals performing day-to-day

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activities, structures involved in actual implementation of these activities are assemble in the brain of observer as they are actually doing that activity [9]. In this way it is a beneficial way to learn the performance of that particular motor skill [10]. Through different studies it is proved that AOT has a positive effect on recovery of motor functions for post-stroke patients as well, through reactivation of motor areas in action observation system [11]. Virtual reality, mirror neuron, mirror therapy all of these approaches used worldwide for rehabilitation purpose for stroke patient [10]. As system of mirror neuron is bilaterally symmetrical so we should apply this method regardless to the site of lesion [8]. Therefore, this study is conducted to discover the effects of action observation [12] treatment clinically and the utilization of this trial for rehabilitation of patients with hemiplegia [13].

## METHODS

**Selection and description of participants:** A randomized controlled trial was done with registry number NCT05084820. Fourteen chronic stroke patients were taken from Umer hospital and Riphah rehab center Lahore.Total duration of study was 6 months. Sample size was calculated through Epitool [14]. Inclusion criteria was 50 to 70 years of age, both males and females, Hemiplegics either right or left side weakness, chronicity time from six months to two years, Patients can talk and understand easily, Patients with normal cognition level, more than 24 score on mini mental scale. Exclusion criteria was Patients with other neurological conditions like ALS, multiple sclerosis, Parkinson's, Hemiplegic patients with visual issues, Hemiplegic patients with auditory issues, Hemi neglect patients with perceptual issues, Patients with other musculoskeletal issue like arthritis, fracture.

**Assessment Tools**

Fugl-Meyer Assessment Upper-Extremity (FMA UE)
Modified Barthel Index (MBI).

**Intervention groups**

**Group A:** Patients in Group A were given conventional treatment which included resisted exercise protocol for upper limb to weaker muscle group with for ten minutes. To the tighten muscle groups like flexors of upper limb, the static stretching exercise were given. Activities of hand like active reaching, picking, holding and releasing exercise were also given. Total treatment time was forty minutes.

**Group B:** The experimental group patients watched five videos of common tasks like drink a glass of water. Out of five motor tasks, each clip is of 30 sec duration, patient watched that clip for four times. After watching the clip patient performed this motor task with weaker side.Videos were then recorded from different angles. Along with strengthening exercises, reach and grasp of hand, stretch

of hand muscles was performed. Patients in this group received session of forty minutes.

**Data collection procedure:** Study was performed in OPD department of Umar Hospital and Riphah Rehab Centre Lahore. After initial neurological assessment consent form was given to patients. The patients who fulfilled inclusion criteria were randomized by lottery method and the patients and assessor were blind for treatment purpose. The protocol was conducted in 40 minutes treatment session (according to group allocated) with 10 minutes of rest duration, three days in a week for one month. The subjects were assessed with the MBI and FMA-UE before and after the treatment and results were compared before and after 4 weeks treatment. The Modified Barthel Index score was used for practical evaluation in activities of daily living. Patients of group A given conventional PT treatment while patients of group B watched videos of motor tasks for 30 seconds of an activity for 4 times (i.e. 2 minutes) along with conventional PT treatment (that includes: stretching, strengthening and active and passive range of motion). The session was held in a comfortable environment and the participant was sitting close to the laptop. All the objects used in the clips were provided to participants. Each task was sub-divided into three or four acts. For instance, in case of having a glass of water, the subdivisions were: reaching for the glass, grasping it, bringing the glass to the mouth to drink and place the glass back on the table. Then patients imitate the activity after observation for 2 minutes with impaired limb.

**Statistics:** Data analysis was done using SPSS-21

## RESULTS

Results of this randomized controlled trial showed in the form of tables. Table 1 showed there were 10 (71.4%) males and 4(28.6) females who participated in this study with mean age of 58.71± 6.269 years respectively. Right side involvement of patient's limb in the study was 64.3 percent, and the left side involvement of patient's limb in the study was 35.7 percent. Table 2 showed summary of results for Modified Barthel Index pre and post treatment values and the results were significant as P value is less than 0.05 in all areas. Table 3 showed summary of results for Fugl-Meyer assessment for upper extremity test ,as the P value is less than 0.05 the results were significant for all motor functions domain of FMA-UE but for sensation and joint pain results were non-significant as the P value is greater than 0.05.Furthermore among the two groups there was significant difference in motor function after the treatment protocol. Action observation treatment showed greater improvement in motor function of upper limb in chronic stroke patients.

|  |  | Frequency(N) | Percent% | Mean | SD |
|---|---|---|---|---|---|
| **Gender** | Male | 10 | 71.4 |  |  |
|  | Female | 4 | 28.6 |  |  |
| **Age (years)** | 50–55 | 5 | 35.5 | 58.7 | 6. |
|  | 55–60 | 5 | 35.5 |  | 2 |
|  | 60–65 | 3 | 21.3 |  |  |
|  | 65–70 | 1 | 7.1 |  |  |
| **Side involve** | Right | 9 | 64.3 |  |  |
|  | Left | 5 | 35.7 |  |  |

**Table 1:** Summery of demographics of participants

|  | Pre-treatment | | Post-treatment | | P-value |
|---|---|---|---|---|---|
|  | Mean | SD | Mean | SD | |
| **Control group** | 16.0 | 2.82 | 16.57 | 2.82 | 0.02 |
| **Experimental group** | 15.00 | 3.51 | 17.42 | 3.64 | 0.01 |

**Table 2:** Summary of results for Modified Barthel Index pre and post treatment valuesand the results were significant as P value is less than 0.05 in all areas

| Experimental group | Site | Pre-treatment | | Pre-treatment | | P-value |
|---|---|---|---|---|---|---|
|  |  | Mean | SD | Mean | SD | |
|  | Upper extremity function | 23.85 | 10.12 | 30.57 | 8.36 | 0.02 |
|  | Wrist function | 5.85 | 3.53 | 8.14 | 2.96 | 0.01 |
|  | Hand function | 7.28 | 4.8 | 11.28 | 4.4 | 0.03 |
|  | Coordination | 2.71 | 1.97 | 4.14 | 2.11 | 0.04 |
|  | Sensation | 10.57 | 1.90 | 11.42 | 0.97 | 0.07 |
|  | Passive joint motion | 18.71 | 3.63 | 21.71 | 2.42 | 0.03 |
|  | Join pain | 18.71 | 4.71 | 21.42 | 4.39 | 0.08 |
| **Control group** | Upper extremity function | 25.0 | 11.23 | 27.14 | 11.23 | 0.03 |
|  | Wrist function | 6.71 | 2.81 | 7.14 | 2.19 | 0.06 |
|  | Hand function | 10.0 | 4.24 | 10.71 | 4.11 | 0.03 |
|  | Coordination | 3.28 | 2.42 | 4.14 | 1.95 | 0.02 |
|  | Sensation | 10.85 | 1.57 | 10.85 | 1.57 | 0.03 |
|  | Passive joint motion | 19.14 | 5.14 | 22.28 | 2.42 | 0.06 |
|  | Join pain | 15.14 | 4.29 | 19.28 | 3.94 | 0.03 |

**Table 3:** Summary of results for Fugl-Meyer assessment for upper extremity test for experimental and control group

## DISCUSSION

The rate of stroke has increased recently, with dysfunctions like cognition and loss of motor actions often noticed. Many studies have conducted to check the effects of action observation treatment on brain's characteristic of neuroplasticity in chronic stroke patients for motor functions recovery. In relevance to this study, different treatment protocols are used to enhance motor function in chronic CVA patients [15]. According to the study done by H Mao and co-partners, the mirror neuron system based training is a new advancement in neuro rehabilitation [16].

It provides a treatment approach regarding observation and execution of motor activity for rehabilitation after CVA. J Plata-Bello explained the dual property of mirror neurons and states that mirror neurons play important role in imitation of movements in very few time [17]. All participants showed improvements with this treatment. During Action Observation Treatment, in the practicing stage the participants were compelled to utilize their weaker limb to practice the perceived activity [18]. The rehabilitative treatment suggested in this research is easily reproducible, with no hazard and it is very much acknowledged by participants. Disclosure of the mirror neuron is the main advancement in the fields of neuropsychology [19]. Mirror neuron work simultaneously when observing and executing the same movements. Mirror neurons are consequently viewed as a significant neural substrate for comprehension of activity, execution, learning of language and tolerance [20]. Through this study we can educate post stroke patients, the use of weaker upper limb through action observation treatment.

## CONCLUSION

It is concluded from the analyzed results that the action observation treatment proved better and faster recovery in chronic stroke patients when it is applied along with conventional physical therapy

## REFERENCES

[1] Wolf PA, D'Agostino RB, Belanger AJ, Kannel WB. Probability of stroke: a risk profile from the Framingham Study. Stroke. 1991;22(3):312-8. doi: 10.1161/01.STR.22.3.312.

[2] Rudd AG, Bowen A, Young G, James MA. National clinical guideline for stroke: 2016. Clinical Medicine. 2017. doi: 10.14336%2FAD.2020.0119.

[3] Buccino G, Arisi D, Gough P, Aprile D, Ferri C, Serotti L, et al. Improving upper limb motor functions through action observation treatment: a pilot study in children with cerebral palsy. Developmental Medicine & Child Neurology. 2012;54(9):822-8. doi: 10.1111/j.1469-8749.2012.04334.x.

[4] Kilner JM, Lemon RN. What we know currently about mirror neurons. Current biology. 2013;23(23):R1057-R62. doi: 10.1016/j.cub.2013.10.051.

[5] Brown BJ, Kim S, Saunders H, Bachmann C, Thompson J, Ropar D, et al. A neural basis for contagious yawning. Current Biology. 2017;27(17):2713-7. e2. doi: 10.1016/j.cub.2017.07.062.

[6] Buccino G. Action observation treatment: a novel tool in neurorehabilitation. Philosophical Transactions of the Royal Society B: Biological Sciences.

2014;369(1644):20130185. doi:10.1098/rstb.2013.0185.

[7] Franceschini M, Agosti M, Cantagallo A, Sale P, Mancuso M, Buccino G. Mirror neurons: action observation treatment as a tool in stroke rehabilitation. Eur J Phys Rehabil Med. 2010;46(4):517-23.

[8] Keci A, Tani K, Xhema J. Role of Rehabilitation in Neural Plasticity. Open access Macedonian journal of medical sciences. 2019;7(9):1540. doi.: 10.3889%2Foamjms.2019.295.

[9] Wairagkar M, McCrindle R, Robson H, Meteyard L, Sperrin M, Smith A, et al. MaLT-combined motor and language therapy tool for brain injury patients using Kinect. Methods of information in medicine. 2017;56(2):127-37. doi: 10.3414/ME16-02-0015.

[10] Mao H, Li Y, Tang L, Chen Y, Ni J, Liu L, et al. Effects of mirror neuron system-based training on rehabilitation of stroke patients. Brain and Behavior. 2020;10(8):e01729. doi: 10.1002/brb3.1729.

[11] Plata-Bello J. The Study of Action Observation Therapy in Neurological Diseases: A Few Technical Considerations.  Neurological Physical Therapy: Intech Open; 2017. 1-13.

[12] Keller J, Štětkářová I, Macri V, Kühn S, Pětioký J, Gualeni S, et al. Virtual reality-based treatment for regaining upper extremity function induces cortex grey matter changes in persons with acquired brain injury. Journal of NeuroEngineering and Rehabilitation. 2020;17(1):1-11. doi: 10.1186/s12984-020-00754-7.

[13] McGurgan IJ, Ziai WC, Werring DJ, Salman RA-S, Parry-Jones AR. Acute intracerebral haemorrhage: diagnosis and management. Practical Neurology. 2021;21(2):128-36.  dx.doi.org/10.1136/practneurol-2020-002763

[14] Mao H, Li Y, Tang L, Chen Y, Ni J, Liu L, et al. Effects of mirror neuron system-based training on rehabilitation of stroke patients. Brain and Behavior. 2020;10(8):e01729. doi.org/10.1002/brb3.1729

[15] Donkor ES. Stroke in the century: a snapshot of the burden, epidemiology, and quality of life. Stroke research and treatment. 2018;2018. doi: 10.1155/2018/3238165.

[16] Habibi-Koolaee M, Shahmoradi L, Niakan Kalhori SR, Ghannadan H, Younesi E. Prevalence of Stroke Risk Factors and Their Distribution Based on Stroke Subtypes in Gorgan: A Retrospective Hospital-Based Study—2015-2016. Neurology research international. 2018;2018. doi: 10.1155/2018/2709654.

[17] King D, Wittenberg R, Patel A, Quayyum Z, Berdunov V, Knapp M. The future incidence, prevalence and costs of stroke in the UK. Age and ageing. 2020;49(2):277-82. doi: 10.1093/ageing/afz163.

[18] Rudd AG, Bowen A, Young G, James MA. National clinical guideline for stroke: 2016. Clinical Medicine. 2017.

[19] Pan A, Sun Q, Okereke OI, Rexrode KM, Hu FB. Depression and risk of stroke morbidity and mortality: a meta-analysis and systematic review. JAMA. 2011;306(11):1241-9. doi:10.1001/jama.2011.1282.

[20] Sharif F, Ghulam S, Malik AN, Saeed Q. Effectiveness of functional electrical stimulation (FES) versus conventional electrical stimulation in gait rehabilitation of patients with stroke. J Coll Physicians Surg Pak. 2017;27(11):703-6.