International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 2, January-February 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Effects of Sensory Re-Education on Hand Dexterity in Post Stroke Clients – A Comparative Study

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ABSTRACT

INTRODUCTION: CVA is a lesion in the brain commonly referred to as stroke, an insult or shock because of its sudden onset. It results in paralysis of one side of the body (hemiplegia) or both sides of the body (bilateral hemiplegia). The lesion is characterized by an interruption of the blood supply to the brain tissues in a particular location, caused by thrombus, embolus, anoxia, hemorrhage or aneurysm.

OBJECTIVE: To see the effect of sensory re-education on hand dexterity in post stroke clients.

HYPOTHESIS:

- Active sensory training is less effective as compared to passive sensory training in improving hand dexterity in post stroke clients.
- No difference is observed between active sensory training and passive sensory training in post stroke clients.

DESIGN: An experimental pretext – posttest study design was used.

PARTICIPANTS: 30 adults, both male and female with history of first stroke, who were attending the Department of Occupational Therapy S.V.N.I.R.T.A.R, who fulfilled the inclusion criteria, were recruited for the study.

MAIN OUTCOME MEASURES: -

- MINNESOTA MANUAL DEXTERITY TEST (MMDT)
- MOBERG PICK-UP TEST

RESULTS: The result of the study shows that both after stroke of active sensory training and passive sensory training as an adjunct to conventional occupational therapy showed significant improvement in the MMDT and MPUT scores for hand dexterity within the group but in between the groups in MMDT only turning shows significant improvement where as the MMDT placing subtests and MPUT score does not show any significant improvement.

CONCLUSIONS: From the obtained results of the study is seen that the stroke patients improve in their MMDT turning subtest score where as there is no improvement in MPUT score for the dexterity so it suggests that there is improvement in motor component in both the groups but there is no significant improvement in sensory component on both the groups.

KEYWORDS: *Stroke, proprioception, Sensory reeducation, Dexterity, sensory feedback, Impairments*

How to cite this paper: Miss. Ankita Rout | Mrs. Pragyan Singh "Effects of Sensory Re-Education on Hand Dexterity in Post Stroke Clients – A Comparative Study" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-2, February 2021, pp.5-10, URL: www.ijtsrd.com/papers/ijtsrd38338.pdf

IJTSRD38338

INTRODUCTION

Cerebrovascular accident is a complex dysfunction caused by a lesion in the brain. WHO defines stroke as acute neurological dysfunction of vascular origin with symptoms and signs corresponding to the involvement of focal areas of the brain.[1]

Stroke is a significant cause of disability which reduces independence and decrease quality of life worldwide.[2] Up to 85% persons affected by stroke has sensory impairments of the upper limb. Deficits in somatic sensation (touch, temperature, pain and proprioception) are common after stroke.[3] Impairments in touch sensation (64%-94%), proprioception (17%-52%), vibration (44%) and loss of pin prick sensation (35%-71%) have been reported.[4]

A central factor in the ability to perform daily activities is dexterity of hand. Dexterity is defined as the ability to grip and release object, perform precision grips, coordinate finger movements and manipulate objects. It has been shown that dexterity can predict post stroke upper limb recovery and is an important factor in the long term use of the affected hand in daily life .Previous studies have been shown

that single factors such as sensory impairment muscle strength and spasticity are associated with dexterity after stroke .[6]

A high degree of manual dexterity is a central feature of human upper limb. A rich interplay of sensory and motor components in the hand and fingers allow for activities of daily living and impacting quality of life.[7]

Profound sensory impairments will negatively affect motor performance, motor learning and rehabilitation outcomes and contribute to unilateral neglect and learned non- use of limbs.[4]Disturbance of other sensory modalities including two point discrimination, stereognosis (recognition or identification of object by use of touch), kinesthesia (detection of bodily position, weight, or movement of the muscles, tendons and joints), graphasthesia (recognition of writing on the skin by the sensation of touch and pain are found).[8,9]

Touch sensation impairments impact individual's occupational performance and decrease their ability to perform everyday tasks and valued occupations.[2] The quality of sensory deficits experienced after stroke include delayed perception, uncertainty of responses, changes in sensory thresholds, fatigue, altered time for sensory adaptation, sensory persistence and altered nature of the sensation.[8]

Sensory deficits have been shown to predict poor functional outcome after stroke including increased length of hospitalization, lower levels of discharge home, lower numbers of home discharges and increased mortality rates. [10,11,12]

Sensory reeducation following CVA is based on the concept of neural plasticity .In their review of the scientific evidence for the ability of the brain to reorganize following brain lesions, state that reorganization seems to be related to frequency of use. They suggest the enlargement of sensory receptive areas within the cortex is a result of increased participation of the body part in activities requiring tactile sensations. Therefore, the goal of sensory reeducation following CVA is to gain a larger cortical representation for the areas of skin from which sensory feedback is crucial to performance of daily tasks. Sensory reeducation has the potential to facilitate increased functional use of the hand and prevent loss of function due to learned nonuse.[5]

RATIONALE

Sensory impairment significantly limited the ability to use the upper extremity after stroke. [15]Sensory re-education has the potential to facilitate increased functional use of the hand and prevent loss of function due to learned non-use .[8]

Up to 80% of people who have a stroke experience sensory loss in their affected arm. The sensory loss puts the arm at risk for injury and impacts functional use of the arm and the survivours level of independence during daily activities. We found 13 studies involving 467 participants that tested different treatments for sensory loss. There is limited evidence that these treatments may be effective. No more than one study examined each particular intervention; frequently the studies were of poor quality and lacked sufficient information. Further research is needed before clear recommendation can be made.[15]

AIMS AND OBJECTIVE-

1. To see the effect of sensory re-education on hand dexterity in post stroke clients.

ALTERNATIVE HYPOTHESIS-(H1)

Active sensory training is less effective as compared to passive sensory training in improving hand dexterity in post stroke clients.

NULL HYPOTHESIS- (H2)

No difference is observed between active sensory training and passive sensory training in post stroke clients.

METHODOLOGY

The study was conducted at Swami Vivekananda National Institute of rehabilitation and Training and Research, Cuttack, Odisha.

SAMPLE SIZE-

30 adults, both male and female with history of first stroke, who were attending the Department of Occupational Therapy S.V.N.I.R.T.A.R, who fulfilled the inclusion criteria, were recruited for the study.

SAMPLING METHOD-

Each subject was alternatively allocated to the research groups.

STUDY DESIGN-

An experimental pretext – posttest study design was used.

INCLUSION CRITERIA-

1. History of 1st stroke (1-6)month
2. MMSE score 25 or above
3. Stroke with Brunstrom stage of hand 3-4
4. Age group 18-60yrs
5. Sensory impairment of the affected upper limb in stroke survivor
6. Ability to understand the verbal information and communication verbally
7. As expressively aphasic patient, who can nod, gesture, point written or pictured cues.

EXCLUSION CRITERIA-

1. Unhealthy skin condition/ allergy
2. Cardiac complication / pacemaker
3. Any metal implants inside the body
4. History of epilepsy or pregnancy
5. Associated psychiatric condition

OUTCOME MEASURES-

1. MINNESOTA MANUAL DEXTERITY TEST (MMDT) - It is a frequently
2. MOBERG PICK-UP TEST

PROCEDURE

24 subjects who fulfilled the inclusion criteria after obtaining the informed consent from them were included in the study.

1. Treatment protocol was explained to the patient
   - A Pretest score was taken using Minnesota Manual Dexterity Test (MMDT) and Moberg Pick-Up Test for the baseline data.
   - All patients received the intervention

- 12 patients received Functional Electrical Stimulation for specific time period (6 weeks for 3 sessions per week, 45 min per day).
- 12 patients received Yuketiel and Guttman's Sensory Reeducation protocol for specific time period (6 weeks for 3 sessions per week, 45min per day).

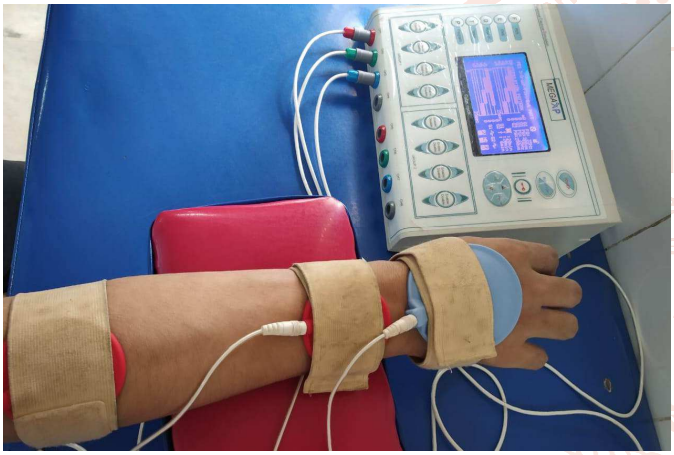
2. After that again post test score was determined through the Minnesota Manual Dexterity Test and Moberg Pick-Up Test.

INSTRUMENTS USED:

1. Mega xp Functional electrical stimulator machine.

Treatment Procedure in Functional Electrical Stimulation:

- Patient is seated comfortably in chair in front of the machine
- Apply the gel to the electrodes, then attach them to the target stimulation (3 pairs of electrodes are attached to ulnar, radial and median nerve motor points)
- Remove dirt and sweat to ensure the target location is clean
- Attach the stimulation patches tightly so that there are no gaps or air pockets between the patches and the skin.
- Turn the Power on, Select Mode, Activate the channels and enable them after setting the Parameters desired for every patient and press Run.



Treatment procedure in Yuketiel and Guttman's Sensory Reeducation Protocol-

- Patient is seated comfortably in a chair in front of a table.
- Environment should be distraction free.
- Patient is informed about the Therapy protocol.
- 1st step of protocol: identification of the number of touches.
- Patients hand is placed comfortably on the table.
- Patient's vision is occluded.
- Patient is touched with cotton on the hand and arm and asked to count the touches.
- 2nd step of protocol: Graphesthesia test
- Patient is blind folded.
- On the back of the pen, one letter or number is drawn on the skin and the patient is asked to identify from the card.
- 3rd step of protocol: Find your Thumb.
- Patient's vision is occluded and patient is asked to find the (Plegic) thumb.
- 4th step of protocol: Identification of shape, weight and texture
- Patient is blind folded.
- 4 different texture, 4 different shapes and 4 different weight of object materials are placed in the hand and patient is asked to identify.
- 5th step of protocol: Passive drawing and writing
- Patient vision is blind folded.
- Patient holds a pencil and passively his hand is moved and patient is asked to identify letter, number or drawing made by the therapist by showing the cards.

DATA ANALYSIS

After completion of all (pretreatment and post treatment) evaluation results were collected and data were put ad analyzed by using SPSS version 23.0. The raw score of pretreatment and post treatment data of outcome measures MMDT and Moberg pickup test ware analyzed. This data is an ordinal level of measurement. So parametric test were used for comparison of the changes in MMDT and MPUT within both groups and between the groups. The design of this study was pretest and posttest experimental group design. So in parametric test simple pair t-test was used to analyses the change in MMDT and MPUT scores. Between the experimental groups and independent T test was used to analyses the changes within the group.

RESULTS

The analysis of data gives the following tables showing the demographic characteristics and test results. The individual characteristics of both groups are in table 1.

Table 1 shows men age of all the participants in the study the mean age of group a subject was 47.83% and group B was 49.41% respectively

Sl. No	Baseline characteristics	GR-A Experimental group	GR-B Experimental group
1	Number of subject (Male/Female)	12 (M=12, F=0)	12(M-11, F=1)
2	Age range (Years)	18-60	18-60
3	Mean age	4le 17.83	49.41

Table 2 showing results of paired t test in between the groups for MMDT and MUPT

	Standard deviation	Mean	t	P
1 AprmdP-ApomdP	37.21	106.16	9.88	0.00
2 AprmdT-ApomdT	41.60	105.41	8.77	0.00
3 AprmpO-ApompO	4.99	13.91	9.64	0.00
4 AprmpC-ApompC	15.69	23.33	5.14	0.00
5 BprmdP-BpomdP	33.90	67.16	6.86	0.00
6 BprmdT-BpomdT	23.34	53.16	7.88	0.00
7 BpompO-BpompO	10.32	20.14	6.84	0.00
8 BpompC-BpompC	3.91	11.66	10.32	0.00

Table 3 for independent sample test group statistics

Sub-Test	Group	N	Mean	Sd
MDp	A	12	106.166	37.213
	B	12	67.166	33.905
MDt	A	12	105.250	41.883
	B	12	56.083	24.912
MPo	A	12	13.91	4.999
	B	12	20.00	10.224
MPc	A	12	25.16	41.883
	B	12	11.50	24.912

This table describes the mean values of group A and group B. In group A MMDT placing 106.166, B 67.16, turning A 105.250, group B turning 56.083. In MPUT group A eyes open 13.91 and group B eyes open 20.00, in group A eyes close 25.16 and for group B 11.50 respectively.

This table is showing MMDT placing p value .014, turning p value .002 and MPUT eyes open p vale is .o78 and eyes close p value is .044.so It suggest that MMDT turning shows significant improvement.

Table 4 showing independent sample test

Items	t	df	Sig (2-tailed)	95% confidence interval of the difference	
				Lower	Upper
Placing	2.684	22	0.14	8.860	69.13
Turning	3.495	22	0.02	19.991	78.341
Eyes-open	-1.852	22	0.78	-12.897	-730
Eyes-close	2.135	22	0.44	.389	26.24

DISCUSSION

The present study investigates the effect of sensory reeducation on hand dexterity in post stroke client by comparing between active sensory training and passive sensory training. The hypothesis of this study was there is no difference is observed between active sensory training and passive sensory training in post stroke clients.

The result of the study suggest that both after stroke of active sensory training and passive sensory training as an adjunct to conventional occupational therapy showed significant improvement in the MMDT and MPUT scores for hand dexterity within the group but in between the groups in MMDT only turning shows significant improvement where as the MMDT placing subtests and MPUT score does not show any significant improvement . In independent sample test group statistics it shows that group 2 is having mean improvement than group A in MMDT placing and turning. So it suggests that in this study there is improvement in motor component is seen but in sensory component there is no improvement is found.

In support of the above study Kahori and Kohei Otaka (2013) studied on a pilot study of sensory feedback by transcutaneous electrical nerve stimulation to improve manipulation deficit caused by severe sensory loss after stroke. The result demonstrated that the patient's manipulatation capability was improved through training with SENS and her maintainted the maintained the manipulation capability even after SENS was removed, despite there being no recovery of sensation.

In this study male are more in number than female. Only one female patient is there out of 24 total numbers of patients. In each age group, women performed significantly better than men in most of the test components of MPUT [55]. Hence the improvement in the sensory component in sensory component did not show a good improvement.

In this study out total 24 patients 16 numbers of patients are above 50 years. The age related decline in dexterity is significant after 50 years of age. This may be of clinical relevance in assessment and goal setting, especially for patients who are 50 -59 years old.[55]Hence the improvement in dexterity was not appreciably observed in MPUT.

In group A significant improvement within the group found. This might happen due to the inducing brain plasticity by sensory or proprioceptive input in order to facilitate motor function. It has been demonstrated that strong sensory input can induce plastic changes in the motor cortex via direct or indirect pathways. In this case electrical stimulation that provides steady and adequate somatosensory input can be an idle method of simulating the motor cortex.

These two studies goes with the support of the findings.

1. Carolyn W WU, PhD, Hyae-Jung Seo, MD, Leonard G Cohem, MD conducted a study on the influence of electric somatosensory stimulation on paretic hand function in chronic stroke .This study concluded that somatosensory stimulation applied to a paretic limb can benefit performance of a functional test in patients with chronic stroke supporting the proposal that in combination with training protocol electrical somatosensory stimulation may enhance the benefit of customary neuro rehabilitative interventions and possibly motor learning.
2. Adelyn P Tuchan, Nikhilesh Natraj, Jason Godlove & Gargabrams (2017) studied the effects of somatosensory electrical stimulation on motor function and cortical oscillation. They concluded that the positive effects of somatosensory electrical stimulation on finger individuation and cortical oscillation that may be important electrophysiological bio makers of individual responsiveness somatosensory electrical stimulation. These bio makers can be potential targets when customizing somatosensory electrical stimulation parameters to individuals with hand dexterity deficits.

This below mentioned studies contradicts the findings.

In group B that is sensory training using Sensory Re-education protocol. In group B significant improvement found. This might have happened due to the potential for recovery depends on regeneration of structures within the somatosensory system as well as capacity for neural plasticity and reinterpretation of altered stimuli.

These three studies goes with the support of the findings.

1. Elena L. Pavlova and Jorganborga (2017) conducted a study on the impact of tactile sensation on dexterity. A cross sectional study of patients with impaired hand function after stroke. In this study hey discussed that the study shows that the tactile sensation in the paretic hand of patients in the chronic stage after stroke has an impact on the performance of the strength dexterity test and 9 hole peg test. But not on the result of the ABILHAND questionnaire.
2. Elisabeth Ekstrand, Lans Rylander, Jan Lexell and Christian Brogarnelh (2016) conducted a study on the perceived ability to perform daily hand activities after stroke and associated factors. In this study they concluded that dexterity and participation are particularly important to consider in the rehabilitation of upper extremity after stroke. The explained variance implies that other factors may also be important to improve the ability to the use of hand in daily life after stroke.
3. Haken Carlsson, RPT, MSc, Elisabth Ekstrand, RPT, PhD, Christina Brogardh (2018) conducted a study on the sensory function, measured as active discriminative touch, is associated with dexterity after stroke. This study concludes that sensory function in terms of active discriminative touch is a measure contributing factor to different dexterity in persons with mild to moderate stroke, whereas spasticity and grip strength may be of lesser importance.

Therefore based on this study and taking view of previous studies it is possible to suggest that Active sensory training and Passive sensory training both can significantly improve hand dexterity in post stroke client's .However it was not concluded between the two treatments approaches which one is more effective than other.

CONCLUSION

From the obtained results of the study is seen that the stroke patients improve in their MMDT turning subtest score where as there is no improvement in MPUT score for the dexterity so it suggests that there is improvement in motor component in both the groups but there is no significant improvement in sensory component on both the groups.

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