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Original Research Article

Efficacy of Restraint Wear and Massed Task Specific Practice on Upper Limb Function in Elderly Subjects Following Stroke

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ABSTRACT

Introduction: Stroke is defined as a sudden, non-convulsive loss of neurologic function due to an ischemic or hemorrhagic intracranial vascular event. Roughly one third of all people who experience a stroke have some residual impairment of upper extremity which affects basic ADL skills such as bathing, dressing, toileting etc. Upper limb impairments are therefore a considerable problem following stroke and maximizing upper limb function is a key factor in motor rehabilitation following stroke. The purpose of the study was to find the effect of restraint wear and massed task-specific practice on improvement of upper limb function such as functional upper limb recovery and specific task function of hand in elderly stroke population.
Materials and Methods: Total 30 subjects were included based on inclusion and exclusion criteria and randomly allocated into Study and Control group, 15 in each. The functional recovery of upper limb was measured using Chedoke Arm and Hand Activity Inventory (CAHAI) and specific task function of the hand was measured using Action Research Arm Test (ARAT) before the intervention. Subjects in the study group received restraint wear and massed task specific practice for 2 hours/day for 5 days in a week for 4 weeks along with conventional treatment. Subjects in the control group received conventional treatment. After the treatments, the outcome measures were reassessed again.
Results: After analyzing the data, the experimental group has shown significantly greater improvement than the control group.
Conclusion: The result of study concluded that 4 weeks of restraint wear and massed task specific practice improved the upper limb function such as functional upper limb recovery and specific task function of hand in elderly stroke population.

Keywords: Stroke, Functional Training, Constraint Induced Movement Therapy, Upper Limb, Geriatric Rehabilitation, Arm Training

INTRODUCTION

Stroke is defined as a sudden, non-convulsive loss of neurologic function due to an ischemic or hemorrhagic intracranial vascular event.[1] The overall incidence rate of stroke is around 2–25 per thousand populations and in older adults, the effects of stroke are exacerbated.[2] Roughly one third of all people who experience a stroke will have some residual impairment of upper extremity[3,5] due to which basic ADL skills such as bathing, dressing, toileting etc. are compromised.[8] Upper limb impairments are therefore a considerable problem following stroke and a significant contributor to stroke-related disability.[4,6] Therefore, maximizing upper limb function is a key factor in motor rehabilitation following stroke.[7] A number of interventions have been published evaluating the effect of various rehabilitation methods in improving upper extremity motor control and functioning, such as exercise training of the paretic arm, mirror therapy, functional electric stimulation, robotic-assisted rehabilitation, and bilateral arm training. However, most of the treatment protocol for the paretic upper extremity are labor intensive and require one to one manual interaction with therapist for several weeks.[9] A series of studies has also demonstrated that Constraint-induced movement therapy (CIMT) coupled with exercise training has proven to be effective in reducing spasticity and increasing function of the hemiplegic upper extremity in chronic stroke patients.[10,11,12] The focus of CIMT is to combine restraint of the unaffected arm in patients with stroke for 90% of waking hours and intensive use of the affected limb in a range of everyday activities.[13,14] More specifically, these involves the person performing supervised structured tasks with the affected limb 6 hours a day for 10 days over a 14 days period, in addition to wearing the restrictive sling for 90% of waking hours.[15,16] As stroke is more common in the elderly, there is a need to know the effect of restraint wear massed task-specific practice, a modified CIMT in elderly stroke patient. Hence the purpose of the study was to find the effect of restraint wear and massed task-specific practice on improvement of upper limb function such as functional upper limb recovery and specific task function of hand in elderly stroke population

MATERIALS & METHODS

This was an experimental design where simple random sampling method was adopted. Study was conducted in various clinics and hospitals in and around Bangalore, India with institutional ethical clearance. Total 30 subjects were included based on inclusion and exclusion criteria.

Inclusion criteria:

- Subjects with stroke diagnosed by a neurophysician that confirmed by MRI or CT and referred to physiotherapy for treatment
- Both genders with age between 65-75 years
- Subjects having minimum 20 degree of active wrist extension and 10 degree of finger extension along with independent sit to stand[18]

Exclusion criteria:

- Subjects with psychological disorders
- Perceptual disorders
- Significant visual & auditory impairment
- Any musculoskeletal condition that affects the ability to perform the motor tasks.

All subjects were informed about the study and a written consent was taken. Subjects were randomly allocated into Study and Control group, 15 in each. The functional recovery of upper limb was measured using Chedoke Arm and Hand Activity Inventory (CAHAI) and specific task function of the hand was measured using Action Research Arm Test (ARAT) before the intervention. Subjects in the study group received restraint wear and massed task specific practice for 2 hours/day for 5 days in a week for 4 weeks along with conventional treatment.

Conventional exercises include strengthening exercise of upper limb, control of the hemiplegic arm in weight bearing and functional non-weight bearing patterns, activities of daily living and vocational and recreational activities using the involved arm and avoiding patterns that will increase spasticity, Weight bearing through hand to help stabilize objects. Fanning out the hand on the table, manual dexterity exercises. To equalize treatment intensity, same number of therapy session was provided for 2 hours/day for 5 days in a week for 4 weeks. No restraint was used and subjects were free to use both hand for all the activities. Bed mobility tasks such as rolling, moving from supine to sitting by coming over the involved side and using the involved arm for support, and bridging exercise were performed.

For restraint wear and massed task specific practice, participants were asked to seat in a chair without arm rest in erect posture keeping the feet flat on the floor maintaining the elbow on the edge of the table. During the treatment, the participants wore the padded sling on their unaffected side and focused on activities that required use of their affected side. Participants were also instructed to wear the sling outside of the treatment session for an additional 4 hours per day resulting in a total of 6 hours per day of sling wear.

Tasks performed:

Open Jar of coffee	**Dry back with towel**	**Place container on table**
Draw a line with a ruler	Put tooth paste on tooth brush	Grasping a ball
Pour a glass of water	Cut medium resistance putty	Pour water from glass to glass
Wring out wash cloth	Zip up the zipper	Holding a marble
Do up 5 buttons	Clean a pair of eyeglasses	Place hand on top of head

After the completion of treatment sessions, the Chedoke arm and Hand Activity Inventory (CAHAI) and Action research arm test (ARAT) was re-evaluated again as post intervention scores.

RESULT

Table 1: Basic Characteristics of the subjects studied

Basic Characteristics of the subjects studied		**Study Group**	**Control Group**	**Between the groups Significance**
Number of subjects studied (n)		15	15	--
Age in years (Mean± SD)		68.00± 2.67 (65-75)	69.40± 3.13 (65-75)	p=0.200 (NS)
Gender	Males	9	12	--
	Females	6	3	

In the study group, there were 15 subjects from which 9 males and 6 females with mean age 68.00 years. In control group, there were 15 subjects from which 12 males and 3 females with mean age 69.40 years. There is no statistically significant difference in mean ages between the groups.

Table 2: Analysis of CAHAI and ARAT score within Study group and Control group

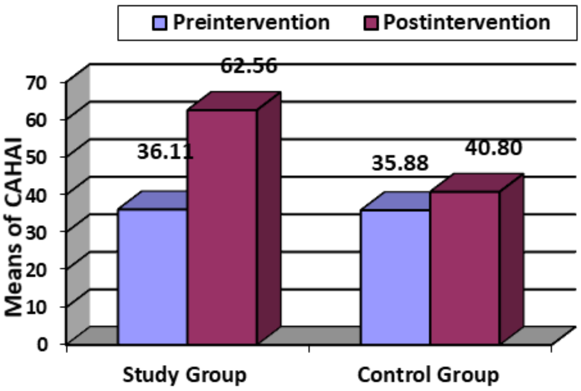
	Pre intervention (Mean ± SD in %) min-max	**Post intervention (Mean ± SD in %) min-max**	**Percentage of change**	**t value ^a^ (Parametric)**	**Z value^b^ (Non parametric)**	**95%Confidence interval of the difference Lower**	**Upper**	**Effect Size R**	**Significance (2-tailed) P value**
STUDY GROUP									
CAHAI	36.11± 7.68 (21.97-49.45)	62.56± 13.24 (6-16)	73.24%	-7.041	-3.408 P =0.001**	-34.50	-18.39	+0.77 (Large)	P <0.000**
ARAT grasp	5.67± 4.33 (1-16)	10.87± 3.22 (4-10)	91.71%	-7.108	-3.190 P =0.001**	-6.76	-3.63	+0.56 (Large)	P <0.000**

ARAT grip	2.47± 2.23 (0- 8)	7.73± 1.71 (50.00-76.62)	21.29%	-11.141	-3.427 P =0.001**	-6.28	-4.25	+ 0.79 (Large)	P <0.000**
ARAT pinch	3.40± 2.41 (0- 10)	8.80± 3.09 (2-16)	15.8%	-8.559	-3.420 P =0.001**	-6.75	-4.04	+ 0.69 (Large)	P <0.000**
ARAT gross movement	2.27± 1.58 (0- 5)	6.33± 2.82 (1-10)	17.88%	-7.550	-3.436 P =0.001**	-5.22	-2.91	+ 0.66 (Large)	P <0.000**
CONTROL GROUP									
CAHAI	35.88± 8.03 (24.17-52.74)	40.80± 7.24 (32.96-56.04)	13.74%	-5.846	-3.412 P =0.001**	-6.72	-3.11	+0.30 (Medium)	P <0.000**
ARAT grasp	4.40± 3.37 (0-11)	7.20± 3.27 (2-12)	63.64%	-5.403	-3.330 P =0.001**	-3.91	-1.68	+0.38 (Medium)	P <0.000**
ARAT grip	2.87± 2.56 (0-9)	5.60± 2.92 (1-11)	95.12%	-8.657	-3.441 P =0.001**	-3.41	-2.05	+0.44 (Large)	P <0.000**
ARAT pinch	3.27± 3.01 (0- 10)	6.00± 3.92 (0-12)	83.48%	-5.782	-3.191 P =0.001**	-3.74	-1.71	+ 0.36 (Medium)	P <0.000**
ARAT gross movement	2.73± 2.73 (0- 11)	4.27± 2.93 (0-11)	56.41%	-5.602	-3.235 P =0.001**	-2.12	-.94	+ 0.26 (Medium)	P <0.000**

**** Statistically Significant difference p<0.05 a. Paired t test. b. Wilcoxon Signed Ranks Test ; NS- Not significant**

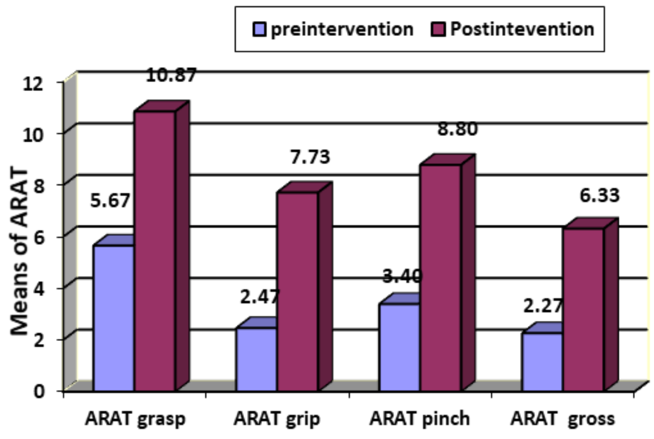
The above table shows that when means of CAHAI and ARAT Scores analyzed from pre to post intervention within study and control group, there is a statistically significant improvement in means with p<0.000. There is negative percentage of change showing that there is decrease in the post means and with positive percentage of change showing there is increase in post means. There is a clinical significance effect with medium and large effect size.

Chart 2a: Analysis of means of CAHAI within the study and control Group (Pre-post analysis)



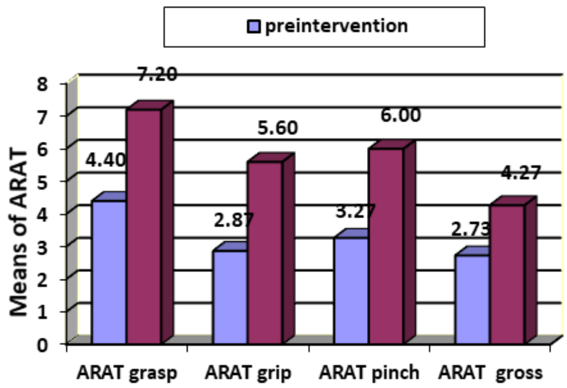
The above graph shows that there is a statistically significant improvement in means of CAHAI within study and control Group when analyzed within groups from pre intervention to post intervention.

Chart 2b: Analysis of ARAT within the study Group (Pre-post analysis)



The above graph shows that there is a statistically significant increase in means of ARAT when analyzed within study Group from pre intervention to post intervention.

Chart 2C: Analysis of ARAT within the control Group (Pre-post analysis)



The above graph shows that there is a statistically significant increase in means of ARAT when analyzed within control Group from pre intervention to post intervention.

Table 3: Comparison of CAHAI and ARAT means between study and control Group

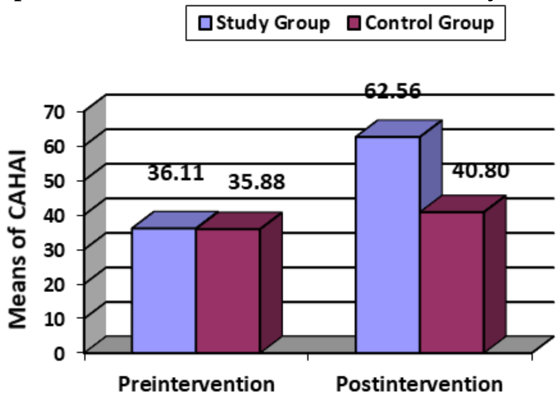
	Study Group (Mean ± SD) in percentage min-max	**Control Group (Mean ± SD) in percentage min-max**	**Percentage of difference**	**t value [a] (Parametric)**	**Z value[b] (Non parametric)**	**95%Confidence interval of the difference**		**Effect Size**	**Significance (2-tailed) P value [a]**
						Lower	**Upper**		
PRE-INTERVENTION COMPARISON									
CAHAI	36.11± 7.68 (21.97-49.45)	35.88± 8.03 (24.17-52.74)	-0.63%	0.078	-0.249 P=0.803 (NS)	-5.65	6.10	+0.01 (Small)	P =0.939 (NS)
ARAT grasp	5.67± 4.33 (1-16)	4.40± 3.37 (0-11)	-25.22%	0.893	-0.710 P=0.478 (NS)	-1.64	4.17	+0.16 (Medium)	P=0.380 (NS)
ARAT grip	2.47± 2.23 (0- 8)	2.87± 2.56 (0-9)	14.98%	-0.456	-0.422 P=0.673 (NS)	-2.19	1.39	+0.08 (Small)	P =0.652 (NS)
ARAT pinch	3.40± 2.41 (0- 10)	3.27± 3.01 (0- 10)	-3.89%	0.134	-0.482 P=0.630 (NS)	-1.90	2.17	+0.02 (Small)	P =0.895 (NS)
ARAT gross movement	2.27± 1.58 (0- 5)	2.73± 2.73 (0- 11)	18.4%	-0.572	-0.021 P=0.983 (NS)	-2.13	1.20	+0.10 (Small)	P =0.572 (NS)
POST INTERVENTION COMPARSION									
CAHAI	62.56± 13.24 (6-16)	40.80± 7.24 (32.96-56.04)	-42.10%	5.58	-3.949 P=0.000*	13.76	29.73	+0.71 (Large)	P<0.000**

ARAT grasp	10.87± 3.22 (4-10)	7.20± 3.27 (2-12)	-40.61%	3.08	-2.592 P=.010 (NS)	1.23	6.09	+0.49 (Medium)	P= 0.005 **
ARAT grip	7.73± 1.71 (50.00-76.62)	5.60± 2.92 (1-11)	-31.95%	2.44	-2.157 P=0.031 (NS)	0.34	3.92	+0.40 (Medium)	P =0.021 **
ARAT pinch	8.80± 3.09 (2-16)	6.00± 3.92 (0-12)	-37.83%	2.16	-1.868 P=0.062 (NS)	0.15	5.44	+0.36 (Medium)	P =0.039 **
ARAT gross movement	6.33± 2.82 (1-10)	4.27± 2.93 (0-11)	-36.78%	1.96	-1.898 P=0.058 (NS)	-0.08	4.22	+0.33 (Medium)	P =0.059 *

**** Statistically Significant difference p<0.05; NS- Not significant; a. Independent t test. b. Mann Whitney U test**

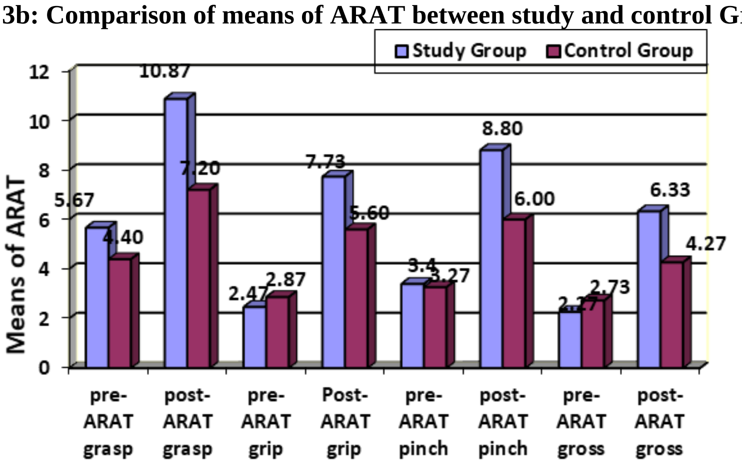
The above table shows that when pre-intervention means were compared between the groups found that there is statistically significant difference in means of CAHAI and ARAT. When post intervention means of CAHAI compared there is a statistically significant difference whereas post intervention means of ARAT compared there is no statistically significant difference between the groups.

Chart 3a: Comparison of means of CAHAI between study and control Group



The above graph shows that when pre-intervention means were compared between the groups found that there is no statistically significant difference in means of CAHAI. When post intervention means of CAHAI compared there is a statistically significant difference between the groups.

Chart 3b: Comparison of means of ARAT between study and control Group



The above graph shows that when pre-intervention means and post-intervention means were compared between the groups found that there is no statistically significant difference between the groups.

DISCUSSION

The objective of this study was to find the effect of restraint wear and massed task-specific practice on upper limb function such as functional upper limb recovery and specific task function of hand in elderly stroke population.

The baseline comparison between both the groups showed statistically significant difference. However, the experimental group has shown significantly greater improvement than the control group. This improvement may relate to short term learning changes at the central level. Intensive use of the affected upper extremity and restraint of the unaffected upper extremity provided opportunity for patients to explore optimal ways to perform various functional tasks.[19] According to Taub and colleagues,[11] repetitive exercises with the affected limb produces new neural pathways in the brain which is referred to as cortical reorganisation or neuroplasticity. Restraint wear and massed task specific practice improves motor planning and promote adaptation of brain function, leading to more planned movement.[20,21] Therefore, in this study, the tasks performed by the subjects might have shown improvement in functional upper limb recovery and specific task function of hand.

In control group, the improvements could be due to use of bimanual hand activities. Bimanual movement trigger inter-hemispheric disinhibition that may allow the activation of alternative recruitment pathway to improve movement efficiency of the affected arm.[23,24] Because, inter extremity coupling may persist after damage to one hemisphere. Another possibility is that a bimanual movement involving the unaffected upper extremity might drive the activity of the affected limb more effectively than a unilateral movement with the affected upper extremity, because bimanual movement involves undamaged parts of brain in planning and execution.[21,22] Both the group received conventional exercises as common treatment protocol that might have also influenced in improving hand functions. The effect of conventional exercises causes cortical reorganization, the mechanism probably reflects either an increase in the excitability of neurons already involved in the innervations of more affected hand movements or an increase in excitable neuronal tissue in the infarcted hemisphere.[24] The post intervention comparison of means found significant difference between the groups in improvement of functional recovery of upper limb, the subject in study group found greater percentage of improvement when measured by CAHAI as percentage of change 73.24% than the subject in control group with 13.74%. The CAHAI is one of the primary measurement tool used to evaluate the capacity of paretic upper limb of stroke subject in the accomplishment of ADL. The CAHAI examines clinically important change in the affected upper extremity’s progression from stabilising to manipulating objects as part of upper limb working in a coordinated fashion in a real-life task of daily living.[25] Specific task function of hand as measured by ARAT were less evident in grip in the study group as 21.29% than the subject in control group as 95.12%; pinch as 15.8% than the subject in control group as 83.48%; gross movement as 17.88% than the subject in control group as 56.41% whereas the exception results on the Grasp subtest found greater percentage of improvement as 91.71% in study group than the subject in control group with 63.64% .On all the subtests, the results were variable, making it difficult to draw conclusions. The ARAT is also one of the primary measurement tool used across restraint wear and massed task specific practice studies for impairment. Dromerick and colleagues analysed the ARAT by subtest and found that all mean post treatment ARAT subtest scores were higher for patients in the CIMT group than in the control group; however, only the Pinch subtest scores achieved statistical difference and perhaps this difference is due to the large focus of treatment only on pinch activities. However other researchers, using total ARAT score, have demonstrated improvements.[26,27] Furthermore, analysis showed that more of the subjects scored relatively higher-improvement for hand function. Several possibilities may account for this. First is an inclusion criterion along with the methodologies described in previous restraint wear and massed task specific practice studies, where subject has minimum 20^0 of active wrist extension and 10° finger extension were enrolled which suggests that finger extension ability predicts the effects of CIMT. The motor learning literature suggests that massed practice has only a neutral or negative effect on the learning of continuous tasks and a variable effect on the learning of discrete tasks. However, CIMT employs massed practice to increase the tendency of patients to use their more-impaired limb, and thereby induces a use-dependent functional reorganization of brain structures.[25] This study has various limitations. The choice of outcome measures can be one factor. The time needed to complete the component of CAHAI and ARAT may not totally represent the effect of restraint wear and massed tasks specific practice because the quality of the movement is not measured. Subjects might use compensatory strategy, such as synergy pattern, to complete the task. However, the goal of the training is to restore the ability of motor function and not only to complete the tasks. This represents the difficulty in selecting an appropriate outcome measure.

The limitations of this study were small sample size, complex outcome measures, incomplete details of information about the anatomical location, type of stroke, hemisphere involvement, premorbid function status of each stroke patient included in the study. Future studies can be carried out on a large sample size, with lesions in different hemispheres, type & locations, to evaluate motor, sensory and perceptual component, to find the long-term effect of restraint wear and massed task specific practice on follow-up basis.

CONCLUSION

The result of study concluded that 4 weeks of restraint wear and massed task specific practice improved the upper limb function such as functional upper limb recovery and specific task function of hand in elderly stroke population.

Declaration by Authors

Ethical Approval: Approved

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