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A randomized comparison of effectiveness of modified constraint induced movement therapy versus conventional physiotherapy on upper-extremity dysfunction in the treatment of adult hemiplegia

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ABSTRACT

This study is designed to compare the effectiveness of Modified Constraint-Induced Movement Therapy Versus Conventional Physiotherapy for improving involved upper extremity movement efficiency in Adult Hemiplegic patients. To know the effectiveness of Modified Constraint-Induced Movement Therapy on Upper Extremity dysfunction for management of Adult Hemiplegia. The study is carried out at the Vihar Hospital, Anand. 40 patients of adult hemiplegia were recruited into two groups after inform consent was taken from all patients. Group 1: Experimental group received Modified Constraint-Induced Movement Therapy (mCIMT) which includes active/passive Mobility exercises, Muscle Stretching, Muscle Strengthening, Weight Bearing Exercises, Task-specific and Fine motor practice of affected upper limb. Group 2: control group received conventional physiotherapy which includes active/passive mobility exercises, muscle stretching, muscle strengthening, weight bearing exercises, throwing a ball, moving, transferring, reaching and manipulating an object with detailed evaluation including ARAT score were taken as a baseline as well as postoperatively after the 4th week of treatment. Both the groups showed clinically and statistically significant improvement in total ARAT score at 4-weeks. The total ARAT scores had improved by 38.10 % in the experimental group and by 20.61 % in the control group. Results of the study concluded that there was a significant improvement in both the groups; however the Modified Constraint-Induced Movement Therapy group was more effective for improving involved upper extremity movement efficiency in patients of adult hemiplegia.

Keywords— *Modified constraint-induced Movement therapy, Conventional physiotherapy, Adult hemiplegia*

1. INTRODUCTION

Stroke is defined by WHO as a rapid development of clinical signs, symptoms and focal neurological disturbance lasting more than 24 hrs or leading to death with no apparent cause other than the vascular origin. [1] According to the India Stroke fact sheet updated in 2012, the estimated age-adjusted prevalence rate for stroke ranges between 84 – 262 per 1 lakh in rural and 334 – 424 per 1 lakh in Urban areas.[2] The incidence of stroke is about 1.25 times greater for males than females. It increases dramatically with age, doubling in the decade after 65 years of age.[3]

Upper limb hemiparesis is one of the most debilitating effects of stroke and is the primary impairment underlying functional disability following stroke. Stroke survivors are often afflicted with temporary hemiparesis resulting in impairment of upper extremity and 55-75% survivors continue to experience upper extremity functional limitations, which also lead to decrease in quality of life even after 3-6 months.[4] Many patients compensate for this by using their unaffected side reinforcing the non-use of their hemiplegic limb. Such patients often fail to develop full potential use of their affected upper extremity perhaps due to a 'learned non-use phenomenon'.[5]

Rehabilitation given to the patients with hemiplegia have conventionally included passive stretching of spastic muscles, strengthening of antagonistic muscles, passive and active free movements to improve range of motion, trunk balance exercises, weight bearing through the affected upper limb, reaching activities in a seated position, pegboard activities and other task-oriented activities.[6]

Constraint-Induced Movement Therapy (CI or CIMT) helps stroke and Central Nervous System damage victims to regain the use of affected limbs. The focus of CI lies with forcing the patient to use the affected limb by restraining the unaffected one for 90%

of the waking hours. The affected limb is then used intensively for either three or six hours a day for at least two weeks. The goal is to maximize or restore motor function.[6] The more common disadvantage of the CIMT programme is the non-compliance of patients due to the inconvenience of restraining the unaffected extremity for 90% of waking hours, affecting the independence of the subject who was probably functional using compensation.

Studies have been done where the constraint is worn for as less as 3-6 hours is termed as Modified Constraint-Induced Movement Therapy (mCIMT). The available literature shows that mCIMT is also effective in improving upper limb motor function, through to a lesser extent than traditional CIMT. There are very few studies done which have studied the effects of mCIMT for 3 hours and compared it to conventionally used exercises for stroke on upper limb function.[7] So, there was a need to study it.

2. AIMS OF THIS STUDY

- To compare the effectiveness of Modified Constraint-Induced Movement Therapy versus Conventional Physiotherapy for improving involved upper extremity movement efficiency in Adult Hemiplegic patients.
- To know the effectiveness of mCIMT on Upper-Extremity dysfunction for management of Adult Hemiplegia.

3. MATERIALS AND METHODOLOGY

An experimental study with Simple Random Sampling technique was done. The sample size was 40 in which 20 subjects were in each group.

3.1 Inclusion criteria

(1) Subjects with age group of adult hemiplegic between 40-90 years were included.
(2) Both the genders were included.
(3) Diagnosed as having first-time stroke, right or left hemiplegia by neurophysician.
(4) Subjects with duration of stroke more than 10 days and less than 1 month.
(5) AROM of at least 90° of shoulder flexion and abduction, 45° external rotation of the shoulder, 30° of elbow extension, 45° of forearm supination and pronation (from the neutral position), Able to perform actively 10-degree extension at MCP and IP joints, and 20° at the wrist.

3.2 Exclusion criteria

(1) Subjects with other Neurological or musculoskeletal Dysfunctions.
(2) Excessive spasticity, defined as having a score of 3 on the Modified Ashworth Spasticity Scale.
(3) Subjects with bilateral lesions in the brain, visual-perceptual problems and communication barriers.
(4) Subjects with serious cognitive deficits (MMSE score >24).

3.3 Primary outcome measure

Action Research Arm Test (ARAT) (includes 19 questions to measures the patient's Grasp, Grip, Pinch, Gross Movement).

3.4 Instruments used in study

Wooden Block (2.5 cm , 5 cm, 7.5 cm, 10 cm cube), Ball (Cricket) :- 7.5 cm diameter, Stone: -10 x 2.5 x 1 cm, Glass, Tube (1 x 16 cm, 2.25 cm), Washer (3.5 cm diameter) over bolt, Weighing machine, Ball bearing : - 6 mm, Marble :- 1.5 cm, Upper extremity restraint consisting of shoulder sling and hand mitt, Goniometer, Pegboard with pegs, Jar, Bottle, Table, Rubik's cube, Ball (small, medium large), Sandbags (½, 1, 2kgs), Dumbbells (½, 1, 2 kgs).

3.5 Methodology

Baseline data includes demographics, history of present & past problem, posture, ROM, Muscle power, Reflexes, Sensations, Action Research Arm Test (ARAT) were taken.

Action Research Arm Test (ARAT) includes 19 questions to measure patient's Grasp, Grip, Pinch and Gross movement. There are 4 subtests of ARAT:
(a) Grasp consists of 6 questions
(b) Grip consists of 4 questions
(c) Pinch consists of 6 questions
(d) Gross movement consists of 3 questions.

Each question was answered and grading as given below:
0- Can't perform any part of the test.
1- Performs test partially.
2- Completes test but takes abnormal long or has great difficulty.
3- Performs test normally.

4. PROCEDURE

Following baseline measurements, the subjects were randomly divided into 2 equal groups: Group 1: EXPERIMENTAL GROUP received Modified Constraint-Induced Movement Therapy which includes Active/ Passive mobility exercises, Muscle Stretching, Muscle Strengthening, Weight Bearing exercises, Task-specific and Fine motor practice of upper limb. Group 2: CONTROL GROUP received Conventional Physiotherapy which includes Active/ Passive Mobility Exercises, Muscle Stretching, Muscle Strengthening, Weight Bearing Exercises, Throwing a ball, moving, Transferring, Reaching and Manipulating an object. On day one, pre-test measurements were taken for both the groups which include ARAT. After pre-test measurement, exercise regime was

started for both the groups. At the end of the 4th week, post-test measurements were taken for both the groups as similar to the pre-test measurements.

4.1 Group 1: Experimental group-Modified constraint induced movement therapy

The subjects wear shoulder sling and hand mitt for 3 hours a day on the unaffected upper limb, including 2 hours of intensive exercises in the department and 1 hour of home exercises. A set of exercises for affected upper limb are as follows:

(1) Active/passive mobility exercises of all joints of the upper limb.
(2) Stretching exercises for tight muscles of upper limb, muscle strengthening of weak upper limb muscles and weight-bearing exercises of the affected upper limb.
(3) Task-Specific Practice including moving an object from one shelf to another, pouring water in a glass from the jar, arranging an object in a line, lifting an object and making hand gestures.
(4) Fine motor practice including putting a peg on pegboard, separating the similar looking objects based on their color/shape/size etc. Some Activities like reaching for an object, holding an object, grasping it and releasing it.

Fig. 1: Strengthening Exercises for wrist extensor muscles

Fig. 2: Putting a peg in a pegboard

4.2 Group 2: Control GROUP - Conventional physiotherapy

Each session consisted of following types of exercises of affected upper limb:

(1) Active / Passive mobility exercises of all joints of the upper limb.
(2) Stretching exercises for tight muscles of upper limb, Muscle Strengthening of weak upper limb muscles and weight-bearing exercises of the affected upper limb.
(3) Moving an object (Glass, Peg, Bottle) up from the right side of the table and place it on the left side of the table then vice versa.
(4) Transferring one object from one shelf to another.
(5) Manipulating a Rubik's cube.
(6) Taking an object from table bringing to mouth and then placing it back on the table.
(7) Throw a ball and if possible to catch a ball.
(8) Reaching activities in a seated position.

All these activities will be done using both the hands simultaneously. All the tasks will be started with simple exercises, less number of repetitions, progressed to challenging and increased number of repetitions.
All the above clinical exercises were given as a home exercise program in both groups and they were advised to practice the regimen twice a day at home during the total intervention period.

5. DATA ANALYSIS

Basic information is given in our analysis using frequency/ cross table with the percentage value. P-value is used to test two-tailed hypothesis at 5% level of significance that is if P-value is less than 0.05, the difference is significant otherwise not.

Table 1: Frequency distribution of age for both the groups

Age (years)	Experimental Group (No. of Subjects)	Control Group (No. of Subjects)	Total
40-50	4 (20%)	4 (20%)	8 (20%)
50-60	1 (5%)	3 (15%)	4 (10%)
60-70	7 (35%)	6 (30%)	13 (32.5%)
70-80	5 (25%)	6 (30%)	11 (27.5%)
80-90	3 (15%)	1 (5%)	4 (10%)
Total	20 (100%)	20 (100%)	40 (100%)

Mean ± S.D of age for the experimental group was 63.95 ± 14.35 and for the control group was 61.65 ± 12.48. 't' cal value was 0.5877 and P-value was 0.5490.

Table 2: Descriptive statistics for sex distribution

Sex	Experimental Group (No. of Subjects)	Control Group (No. of Subjects)	Total
Male	9 (45%)	14 (70%)	23 (57.5%)
Female	11 (55%)	6 (30%)	17 (42.5%)
Total	20 (100%)	20 (100%)	40 (100%)

So, a number of males (57.5%) was more than females (42.5%) in both the groups.

Table 3: ARAT scores between both the groups

ARAT	Experimental Group (Mean± S.D.)	Control Group (Mean± S.D.)	't' calculated value	P- value
Total score	24.35± 7.922	13.05± 3.268	5.897	0.0003

P<0.01. There is a significant difference between the groups for total ARAT score. That is mean total ARAT score of the experimental group shows significantly higher improvement than the control group

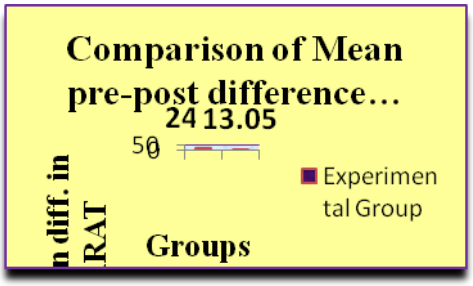

Fig. 3: Comparison of the mean pre-post difference of ARAT total score between the two groups

6. RESULTS

Results obtained from the study after 4-week intervention program showed that there was a significant improvement in total ARAT score within the groups. However, the experimental group showed much significant improvement in total ARAT score compared with the control group after intervention between the groups.

7. DISCUSSION

Results observed in the experimental group showed an average improvement of about 38.10% and in the control group, about 20.16% in total ARAT scores over the 4-week period. The results observed in the experimental group in this study are nearly identical to those previously reported in an earlier study for the same intervention.

Wu CY et al, 2007 shows that Modified CIMT is important for fine motor control in functional tasks for adult hemiplegic.[8] Seibers A et al, 2010 concluded that 6 hours of mCIMT in outpatient clinic also reduces spasticity and increases functional use of the affected arm, with improvement persisting at 6 months of therapy.[9] Yeu X. Shi et al, 2011 concluded that 6 hours of mCIMT could reduce the level of disability, improve the ability to use the paretic upper extremity and enhance spontaneity during movement time. [10] Qiang Wang et al, 2011 showed that mCIMT showed an apparent advantage over both conventional intervention and intensive conventional rehabilitation for the patient after stroke. [11]

These changes in test scores may be attributed to several factors. They could reflect improvement in physical capabilities of the upper extremity, a change in learned nonuse behaviors, a Hawthorne effect or use-dependent cortical changes. [3] Use-dependent cortical reorganization, similar to subjects with greater movement ability, it may have occurred as a result of the mCIMT program. Because they attempted to move and use their dominant upper extremity during this program more as it was their habit, the fact that their test scores increased may be similar to the outcomes of published studies with individuals who demonstrated a greater degree of movement ability.[12-18] They did possess a higher level of ability than they demonstrated prior to intervention and their test scores increased as a result of attempting to move their arm, this would suggest a change in learned nonuse behaviors. [3]

The limitations of the study are sample size was small, Study duration was only four weeks, there may be chances of biased for subjects performing home exercises program, only ARAT score was used as outcome measures also long-term benefits and follow up were not checked. The further implications are, other interventions may be used along with modified CIMT, long-term benefits can be checked, other outcome measures can be taken as assessment tools.

8. CONCLUSION

Results of the study concluded that there was a significant improvement in both the groups; however the Modified Constraint-Induced Movement Therapy Group was more effective for improving involved upper extremity movement efficiency in patients of adult hemiplegia.

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