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Effect of Structured Home Exercises on Residual Spasticity in Chronic Stroke Survivors

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Abstract: ***Objectives: The objective is to evaluate the effect of Departmental Conventional exercises, Structured Home exercises and the combined effect of Conventional exercises and Structured home exercises on Residual Spasticity in Chronic Stroke survivors. Methods: Ethical clearance was obtained from the Institutional Ethical Committee, KIMSDU, A comparative study was conducted at Physiotherapy Department of KIMSDU. A total of 30 subjects were equally divided into two groups by lottery method (Group A and Group B). Baseline treatment was given to both the groups i.e., Conventional training. Group A was given Conventional training, Group B was given Conventional training and Structured Home Exercises. Results: Statistical analysis was performed within the groups by paired t test and between the groups by unpaired t test. p values for Modified Ashworth Scale and Functional Independence Measure were calculated. While on comparing the post-interventional values, the results between the two groups using unpaired t test revealed that there was significant improvement seen in tone and functional dependence of the chronic stroke survivors. Conclusion: This study concludes that, additional Structured home exercise protocol along with conventional training will be significantly effective in normalising the tone in the chronic stroke survivors.***

Keywords: Residual Spasticity, Structured Home Exercises, Functional Dependence, Modified Ashworth Scale, Functional Independence Measure

1. Introduction

Majority of the Chronic stroke survivors have residual impairments caused by stroke, such as hemiparesis, residual spasticity, reduced mobility which affects the Quality of life.Chronic Stroke survivors with spasticity often experience problems with mobility, flexibility, secondary limb deformities, physical disability & pain that limits their ability to perform basic activities of daily living [4]. As a result, spasticity has a significant negative impact on the health-related quality of life of stroke survivors[4].

The goals of Physiotherapy rehabilitation are to help stroke survivors become as independent as possible and to attain the best possible quality of life. Even though rehabilitation does not "cure" the effects of stroke & that it does not reverse brain damage, rehabilitation can help people achieve the best possible long-term outcome.

Conventional exercises are exercises that are traditionally practiced since ancient times & can also be performed with the help of various modifications and with some adjunct measures which may help to achieve a faster recovery at least to improve the patient's functional performance. Stroke being a medical emergency, is mostly treated in the early stages. But, there are prevalent residual impairments which affect the patient's functional activities and this is neglected by the rehabilitative services. Moreover, there is scarcity in the maintenance program as the patient finds difficulty in practicing the exercises.

Spasticity further complicates the functional capability of the Stroke survivors. Uptil now, there is plenty of literature available for post-stroke rehabilitation but there is less specificity in available literature for the treatment protocol for spasticity only.

Therefore setting a Structured protocol specifically for Spasticity along with the Conventional training thereby becomes necessary for rehabilitating the patient upto maximum functional capability.

2. Methods

This was a comparative study conducted in Physiotherapy Department of KIMSDU. 30 subjects were equally divided into two groups using simple random sampling using lottery method. Conventional treatment was given to both the groups as baseline treatment. Group A was given Departmental Conventional treatment regularly for 5 days for 4 weeks and Group B was given Conventional treatment along with Structured Home exercises regularly for 5 days for 4 weeks. Subjects were taken according to Inclusion criteria as follows: (1) Clinically diagnosed stroke patients (2) 6 months Post-stroke subjects (3) Subjects with both genders. Exclusion criteria was as follows: (1) Subjects with Transient Ischemic Attack. (2) Subjects diagnosed with Stroke secondary to traumatic brain injuries. (3) Other medical complications. Informed consent was taken from the patient and patient's caretaker & procedure of the study was explained.

- Conventional Treatment: Passive sustained stretching of spastic muscles, active assisted RIMP for upper and lower limbs, Mat exercises, Electrical stimulation, Task training, Gait training, Community based rehabilitation.
- Structured Home Exercises :

1) Relaxation Technique

It should be performed before and after the exercise program. Breathing Exercises – Sit on a chair or a couch. Relax your shoulders. Take a deep breath slowly without raising your shoulders and breathe out slowly for 3 times.

2) Exercise Program

- Moist Heat
- Apply Moist Heat to the spastic part for 15-20 mins
- Active Stretching

(a) Biceps Stretching- Sit on a couch or a stool. Take your shoulder at the back and extend your wrist such that you feel stretch.

Closed Kinematic Chain exercises:
(a) Upper limb – i. Wall push ups – Place your hands on the wall and perform Push Ups
ii. Quadripod with perturbations
iii. Ball rolling on wall (Shoulder Abduction and Adduction, Shoulder Flexion and making circles clockwise & anticlockwise)
iv. Towel rolling on a table
(b) Lower limb – i. Step-up- Go one step up and come down
ii. Forward Lunges- Stand with your one leg forward and other leg backward. Try going forward by shifting your weight on the leg which is forward by bending the knee. Come back to starting position and repeat.
iii. Lateral Step-ups – Step up the stairs laterally and come down
iv. Side lunges- Stand with distance in between your feet with or without support, bend any one of your knee and shift your weight to that side come back.

• Weight bearing exercises:
(a) Upper Limb –
- Sit on a bed and place the affected hand by your side on the couch and ask someone to give reach outs such that the affected side bears weight.
- In Quadripod position, reach a target by unaffected hand .

(b) Lower Limb –
- Simple Walking- Walk with or without support.
- Plantigrade standing- Stand in front of a table and place your palms on the table and lean forward such that you bear weight on your hands and feet.

• Bed Mobility exercises:
(a) Prone on elbow : Lie down on your stomach
Raise your head and shoulders and rest it on the forearm
(b) Prone on hands : Lie down on your stomach
Raise your head and shoulders and rest it on the hand
(c) Quadripod : Rest your body on your both hands and knees
(d) Kneel Sitting: Bend your knees and sit on your heels with hands resting on the Knees
(e) Kneeling: Stand on your knees with hands at the side of your trunk
(f) Half kneeling: Come to the position of kneeling and take the affected leg in the front till the half kneeling position is achieved.

a) Wand exercises :

- Hold a stick in both the hands and perform shoulder movements with support of the stick.

b) Co-ordination exercises :

- Draw a semi- circle on wall and floor for hands and legs respectively and insert numbers in that circle.
- Ask someone to command to touch the numbers.

c) ADL activities:

- Drinking water
- Combing hair
- Coin picking up and dropping
- Punching a bottle – keep your forearm and elbow supported on a table. Place a bottle filled with water in front of your hand. Glide your forearm forward and try to do a punching movement to the bottle
- Brushing teeth
- Having food with affected hand

3. Results

Modified Ashworth Scale (MAS) – Intragroup comparison (within group) using paired t-test.
Post training following results were seen :
• Shoulder Flexors
CT: p value = 0.0148 significant
CT+SHE: p value = <0.0001 Extremely Significant
• Shoulder Adductors
CT: p value = 0.0035 Very Significant
CT+SHE: p value = <0.0001 Extremely Significant

• Elbow Flexors
CT: p value = 0.0281 significant
CT+SHE: p value = <0.0001 Extremely Significant
• Forearm Supinators
CT: p value = 0.406 Significant
CT+SHE: p value = 0.0002 Extremely Significant
• Wrist Flexors
CT: p value = 0.0281 Significant
CT+SHE: p value = <0.0001 Extremely Significant
• Finger Flexors
CT: p value = 0.0035 Very Significant
CT+SHE: p value = <0.0001 Extremely Significant
• Hip Extensors
CT: p value = 0.0035 Very Significant
CT+SHE: p value = <0.0001 Extremely Significant
• Hip Adductors
CT: p value = 0.0004 Extremely Significant
CT+SHE: p value = <0.0001 Extremely Significant
• Knee Extensors
CT: p value = 0.0035 Very Significant
CT+SHE: p value = <0.0001 Extremely Significant

• Ankle Plantarflexors
CT: p value = 0.0406 Significant
CT+SHE: p value = <0.0001 Extremely Significant

• Ankle Invertors
CT: p value = 0.0192 Significant
CT+SHE: p value = <0.0001 Extremely Significant

Functional Independence Measure(FIMS) – Intragroup comparison (within group) using paired t-test.
CT: p value = 0.0010 Extremely Significant
CT+SHE: p value = <0.0001 Extremely Significant

Modified Ashworth Scale – Intergroup comparison (between group) using unpaired t-test.
Pre-training p values were not significant for all muscle groups on Intergroup comparison.
Therefore, Post training results were seen as follows:
• Shoulder Flexors : p value = 0.0463 Significant
• Shoulder Adductors : p value = 0.0159 Significant
• Elbow Flexors: p value = 0.0320 Significant
• Forearm Supinators : p value = 0.0149 Significant
• Wrist Flexors : p value = Extremely Significant
• Finger Flexors: p value = 0.0994 Not quite significant
• Hip Extensors: p value = 0.0276 Significant
• Hip Adductors: p value = 0.0320 Significant
• Knee Extensors: p value = 0.0187 Significant
• Ankle Plantar-flexors: p value = 0.0860 Not quite Significant
• Ankle Invertors: p value = 0.0277 Significant

Functional Independence Measure – Intergroup comparison (between group) using unpaired t-test
Pre-training p value was not significant on Intergroup comparison.
Therefore, Post training result for FIMS was as follows:
p value = 0.0041 Very Significant

4. Discussion

Chronic stroke survivors have residual impairments like Residual spasticity; which affects the independence with functional activities and this consequently affects their Quality of life. This becomes a major limiting factor for subject's dependency. It increases the energy expenditure, reduces Biomechanical efficiency and effects self esteem.

The study was conducted on 30 subjects. They were divided into Conventional group and Conventional with Structured Home exercise protocol. The interventions were carried out for 5 days a week for 4 weeks regularly. The outcome measures for this study were Modified Ashworth Scale and Functional Independence Measure. The subjects were analysed for Functional Independence.

This study shows that Conventional training with Structured Home exercises group showed significant improvement in the outcome variables concluding that it improves Functional Mobility.This was confirmed using statistical analysis as below.
Within the Group Comparison :

I) Modified Ashworth Scale –
Post training following results were seen :
• Shoulder Flexors
CT: p value = 0.0148 significant
SHE: p value = <0.0001 Extremely Significant
• Shoulder Adductors
CT: p value = 0.0035 Very Significant
SHE: p value = <0.0001 Extremely Significant
• Elbow Flexors
CT: p value = 0.0281 significant
SHE: p value = <0.0001 Extremely Significant
• Forearm Supinators
CT: p value = 0.406 Significant
SHE: p value = 0.0002 Extremely Significant
• Wrist Flexors
CT: p value = 0.0281 Significant
SHE: p value = <0.0001 Extremely Significant
• Finger Flexors
CT: p value = 0.0035 Very Significant
SHE: p value = <0.0001 Extremely Significant
• Hip Extensors
CT: p value = 0.0035 Very Significant
SHE: p value = <0.0001 Extremely Significant
• Hip Adductors
CT: p value = 0.0004 Extremely Significant
SHE: p value = <0.0001 Extremely Significant
• Knee Extensors
CT: p value = 0.0035 Very Significant
SHE: p value = <0.0001 Extremely Significant
• Ankle Plantarflexors
CT: p value = 0.0406 Significant
SHE: p value = <0.0001 Extremely Significant
• Ankle Invertors
CT: p value = 0.0192 Significant
SHE: p value = <0.0001 Extremely Significant

II) Functional Independence Measure –
• CT: p value = 0.0010 Extremely Significant
• SHE: p value = <0.0001 Extremely Significant

Conventional Exercises with patient's following stroke and training with real life activities following stroke may be a stimulus for making new more effective functional connections within remaining brain tissue. Repetitive exercises appear to be major factors in promoting synaptogenesis and are important in rehabilitation of motor weakness following stroke.

Conventional training alone showed improvement in tone, but there was recurrence due to lack of maintenance program and lack of practice of exercises by the patients.

Between The Group Comparison:
I) Modified Ashworth Scale – Post training following results were seen:
• Shoulder Flexors : p value = 0.0463 Significant
• Shoulder Adductors : p value = 0.0159 Significant
• Elbow Flexors: p value = 0.0320 Significant
• Forearm Supinators : p value = 0.0149 Significant
• Wrist Flexors : p value = Extremely Significant
• Finger Flexors: p value = 0.0994 Not quite significant
• Hip Extensors: p value = 0.0276 Significant
• Hip Adductors: p value = 0.0320 Significant
• Knee Extensors: p value = 0.0187 Significant
• Ankle Plantarflexors: p value = 0.0860 Not quite Significant
• Ankle Invertors: p value = 0.0277 Significant

II) Functional Independence Measure – p value = 0.0041 Very Significant
This suggests that Conventional exercises along with Structured home exercises are significantly effective in improving tone and functional independence in chronic stroke survivors as the exercises increase the contact pressure, forces and area which reduces spasticity. This also can be due to practicing of the exercises at home along with the departmental conventional exercises that helped in

reducing the spasticity and helping the patient to become functionally independent.

Post training improvement of functional performance in patients with residual spasticity comes in agreement with study by Guyton and Hall, who stated that exercises gives proprioceptive input which can have an impact on multiple levels of central nervous function. These levels may potentially modulate muscle tone through many mechanisms as pre-synaptic and post-synaptic activity. Thereby reducing the spasticity and helping patient to at least be functionally independent.

The Structured home exercise program involved practice of exercises at home with the patient's active participation whereas the conventional training involved passive exercises program. Although routine functional independence was initially delayed, added structured home exercises program along with conventional exercises helped in gaining faster functional recovery and prevented further risk of recurrence.

While Conventional exercises helped in reducing the spasticity, practicing of structured home exercise protocol with patient's active participation helped patient in achieving his/her routine functional independence.

This accounts to better and faster improvement in chronic stroke survivors with practice of structured home exercise protocol along with the departmental conventional exercises.

5. Conclusion

Through this study, it can be concluded that additional Structured home exercise protocol along with conventional training will be significantly effective in normalising the tone in the chronic stroke survivors.

6. Ethical Clearance

Ethical clearance was taken from the Institutional Ethical Committee of KIMSDU.

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