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Effect of novel Tool -action observation rehabilitation training on upper limb muscle spasticity in stroke patients

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Abstract
Introduction: Stroke is one of the main causes of permanent disability and more than two thirds of survivors develop spasticity. Due to the complexity of the interventions for upper limb spasticity, at the moment there is a lack of evidence regarding innovative and effective rehabilitative interventions. Action Observation Rehabilitation Training constitutes a promising rehabilitative method to improve upper limb muscle spasticity on stroke patients
Objective: To find out the Effect of Action Observation Rehabilitation Training on upper limb muscle spasticity in stroke patients admitted in tertiary care hospital, Trivandrum.
Methods: Quasi Experimental research design was used for the study.30 stroke patients who met inclusion criteria were selected using convenient sampling technique and allotted to both experimental(n=30) and control group(n=30). Modified Ash Worth Scale was used to measure the spasticity. Action Observation Rehabilitation Training therapy was given to the experimental group daily for 30 minutes for 6 days for 6 weeks in addition to conventional rehabilitative treatment whereas control group received only conventional rehabilitative treatment. Post intervention measurement was done after 6 weeks of treatment.
Result: The study showed there is a significant difference in the muscle tone of forearm pronator muscle and elbow flexor muscle after the intervention in experimental and control groups. Hence the study revealed Action Observation Rehabilitation Training is effective in improving upper limb muscle spasticity in stroke patients

Keywords: Spasticity, action observation rehabilitation training, disability

Introduction

Stroke is the third leading cause of death in the world, with about 795,000 people experiencing a new or recurrent stroke each year in 2019

A stroke is defined as a sudden focal neurological deficit caused by an abnormality, which depends on the affected area of the brain. It has an incidence ranging from 144 to 187 per 100,000 inhabitants per year, and is one of the top four global causes of death. Strokes have long-lasting and profound effects on the patient, with the greatest impact attributable to impaired neurological function. Stroke are one of the main causes of permanent disability, since more than two thirds of survivors develop spasticity (Global Burden of Disease., 2019)

spasticity as an increased velocity-dependent muscle tone with exaggerated tendon jerks caused by hyperexcitability of the stretch reflex. Poststroke spasticity (PSS) severely impairs upper-limb flexibility and the ability of moving. Long-term PSS may cause a severe deterioration of quality life due to complications including joint contractures, decubitus and pain, leading to a fourfold increase in care burden.

Recent scientific research has shown that spasticity occurs in 20 to 30% of post-stroke patients. One-third of patients with ischemic stroke before 70 years of age showed increased muscle tone at a 7-year follow-up (Abhilash Somasundaran &Narayanan Poti., 2020). Post-stroke spasticity is simply one example of many in which a condition can be the source of pain, impairment, disability, or even handicap

Treatment for spasticity involves a combination of stretching exercises, oral medications, positioning and exercise activities that help to maintain muscle tone and prevent spasticity. For the effective adherence to this conventional treatment need therapist help and hospitalization. High cost and long hospital stay for the treatment again decrease the compliance to the treatment which leads to burden for health care, family and patient.so now it become necessary to find out the treatment which can implemented in a home setting in more affordable way along with less complexity.

Action Observation Rehabilitation Training is a promising approach grounded in basic neuroscience with the recent discovery of the mirror neuron system.It commonly includes action observation and action execution and allows patients to safely practice movements which decrease the incidence of spasticity. There was various studies conducted regarding Action Observation Rehabilitation Training in motor functions but literature on the use relate to muscle spasticity in stroke patient is insufficient (Jianming Fu *et al* 2018) [1]. Therefore, this study aims to assess the effect of Action observation Rehabilitation Training on upper limb muscle spasticity in stroke patients

Objective

1. To assess upper limb muscle spasticity of stroke patients on third day after stroke
2. To find the Effect of Action Observation Rehabilitation Training on upper limb muscle spasticity on stroke patients
3. To find out the association of change in grading of muscle spasticity as a result of Action Observation Rehabilitation Training among stroke patients

Materials and Methods

Quasi Experimental research design is used for the study. The study was conducted in tertiary care hospital at Trivandrum after getting permission in ethics committee of the hospital. A total of 60 stroke patients who were hospitalized after stroke were selected for the study. Criteria for inclusion were 1) Patient with Ischemic stroke 2) Patient with Marked Hemiplegia 3) Patient no cognitive impairment 4) Patient who are willing to participate in the study 5) Patient with Moderate Disability. Exclusion criteria were1) Patient with hemorrhagic stroke 2) Patient with disease in the joints 3)Patients with severe medical problems Patients who met eligible criteria was allotted to experimental(N=30) and control group(N=30) based on the convenient sampling technique. The modified Ashworth scale was used to assess the muscle spasticity during passive range of motion in both groups before and after intervention to assess the effectiveness of the intervention.

The AOT videos was observed by the patient in a laptop with a 15.5-inch screen with the distance of 2 meters. The patients were positioned comfortably in semi fowlers position so that the monitor was visible clearly. Patients was requested to watch motion video which consist of 20 actions and informed to imitate the action in the video. Comprehension of observed activities was tested by asking them to identify the limb moving in the videos and explain the movement observed. After observing each video, patients were motivated to imitate the movements viewed for the next 20 seconds A rest period of one minute was given between observations of consecutive videos to prevent fatigue. Action Observation Rehabilitation Training Treatment was given to the experimental group daily for 30 minutes for 6 days for 6 weeks in addition to conventional rehabilitative treatment whereas control group received only conventional rehabilitative treatment. Post intervention measurement was done after 6 weeks of treatment.

There was a 20 actions video for upper extremity. The action was numbered according to their complexity. Action No 1 is the easiest and No 20 is most difficult. Action no 1 to Action no 5 was named as group one. The rest was done in same manner. Thus there was 4 groups with 5 videos each. Patients was initially shown videos from group 1 and instructed to try their best to simulate the action with their affected limb. Three of the actions in one group was performed by the patient before move to next group of videos.

Results

1. To assess upper limb muscle spasticity on stroke patients on third day of stroke

Table 1: Upper limb muscle spasticity on stroke patients on third day of stroke

Muscle	Muscle tone score	Count	Percent
Elbow Flexional Muscle	2	39	65.0
	3	19	31.7
	4	2	3.3
Forearm Pronator Muscle	1	6	10.0
	2	22	36.7
	3	29	48.3
	4	3	5.0

Table 1 reveals in elbow flexional muscle 65% of patient has more marked increased in muscle tone and 31.7% patient has considerable increase in muscle tone with difficult in passive movement and 3.3% of patient has the limb rigid in flexion or extension

In Forearm pronator muscle 48.3% of the patient has considerable increase in muscle tone whereas 36.7 more marked increase in muscle tone. Only 10 percentage of patient have slight increase in muscle tone. very less 5% patient parts rigid in flexion

Table 2: Distribution of patients based on sample characteristics

		Experimental		Control		Total		p
		Count	Percent	Count	Percent	Count	Percent	
Age	<=60 years	6	20.0	5	16.7	11	18.3	0.739
	>60 years	24	80.0	25	83.3	49	81.7	
Gender	Male	20	66.7	19	63.3	39	65.0	0.787
	Female	10	33.3	11	36.7	21	35.0	
Occupation	Business/Private	20	66.7	12	40.0	32	53.3	0.038
	Professional/Govt. Employee	10	33.3	18	60.0	28	46.7	
Marital status	Married	19	63.3	17	56.7	36	60.0	0.598
	Others	11	36.7	13	43.3	24	40.0	
Physical exercise	Never/Rarely	21	70.0	25	83.3	46	76.7	0.222
	Daily/Weekly once	9	30.0	5	16.7	14	23.3	
History of smoking	Yes	19	63.3	19	63.3	38	63.3	1.000
	No	11	36.7	11	36.7	22	36.7	
History of Alcoholism	Yes	9	30.0	9	30.0	18	30.0	1.000
	No	21	70.0	21	70.0	42	70.0	
Family history of stroke	Yes	15	50.0	19	63.3	34	56.7	0.297
	No	15	50.0	11	36.7	26	43.3	
Dietary pattern	Vegetarian	8	26.7	9	30.0	17	28.3	0.774
	Non Vegetarian	22	73.3	21	70.0	43	71.7	
Hemiparetic location	Right side	9	30.0	7	23.3	16	26.7	0.559
	Left side	21	70.0	23	76.7	44	73.3	
Diabetes Mellitus	No	16	53.3	19	63.3	35	58.3	0.432
	Yes	14	46.7	11	36.7	25	41.7	
Heart Disease	No	21	70.0	15	50.0	36	60.0	0.114
	Yes	9	30.0	15	50.0	24	40.0	
Hypertension	No	6	20.0	2	6.7	8	13.3	0.129
	Yes	24	80.0	28	93.3	52	86.7	

Table 2 reveals that the sample characteristics of age>60 in both experimental (80.0) and control group (83.3) are equal statistically(P>0.05) and there is no difference between two group hence the patient allotted in the experimental and control group are homogenous with respect to age category. similarly, there is no significant difference (P>0.05) between other characteristics such as gender, occupation. marital status, physical exercise, history of smoking, history of alcoholism, family history of stroke, Dietary pattern, hemiparetic location, diabetes mellitus, Heart disease, Hypertension in both experimental and control group groups are homogenous and hence comparable.

2. To assess the Effect of Action Observation Rehabilitation Training on upper limb muscle spasticity on stroke patients

Table 3: Effect of Action Observation Rehabilitation Training on Elbow Flexor Muscle tone on stroke patients

Elbow Flexor Muscle		Experimental		Control		χ^2	p
		Count	Percent	Count	Percent		
Pre	2	22	73.3	17	56.7	1.29	0.198
	3	7	23.3	12	40.0		
	4	1	3.3	1	3.3		
Post	0	25	83.3	7	23.3	4.74	p<0.05
	1	5	16.7	16	53.3		
	2	0	0.0	7	23.3		

Table 3 shows that in pre intervention, the background variables of the patients selected in both groups are homogenous (p>0.05). In preintervention there is no significant difference between elbow flexor muscle tone in experimental and control group,after the intervention 83.3 %has no increase in muscle tone and 16.75 has slight increase in muscle tone in. experimental group whereas only 23.3% has no increase in muscle tone and 53.3% has slight increase in muscle tone in control group. There is a significant difference (P<0.05) in the muscle tone of elbow flexor muscle scores after the intervention in experimental and control groups. Hence the intervention is effective in reducing the muscle tone and there by improvement in the muscle spasticity

Table 4: Effect of Action Observation Rehabilitation Training on Forearm Pronator Muscle on stroke patients

Forearm pronator muscle		Experimental		Control		Z#	p
		Count	Percent	Count	Percent		
Pre	1	4	13.3	2	6.7	0.32	0.753
	2	9	30.0	13	43.3		
	3	15	50.0	14	46.7		
	4	2	6.7	1	3.3		
Post	0	20	66.7	7	23.3	3.68	p<0.01
	1	10	33.3	17	56.7		
	2	0	0.0	4	13.3		
	3	0	0.0	2	6.7		

Mann-Whitney U Test

The data in table 4 shows that in pre intervention, the background variables of the patients selected in both groups are homogenous(p>0.05).In preintervention there is no significant difference between forearm pronator muscle tone in experimental and control group. After the intervention 66.7 %has no increase in muscle tone and 33.3 has slight increase in muscle tone in. experimental group whereas only 23.3% has no increase in muscle tone and 56.7% has slight increase in muscle tone in control group. There is a significant difference (P<0.01) in the muscle tone of forearm pronator muscle scores after the intervention in experimental and control groups. Hence the intervention is effective in reducing the muscle tone score and thereby improvement in muscle spasticity.

3. To find out the association of change in grading of muscle tone as a result of Action Observation Rehabilitation Training on stroke patients

Table 5: Comparison of increase in elbow flexor muscle tone grade as a result of action observation Rehabilitation training based on selected variables

		Grade change			χ^2\$	p
		1	2	3		
Age	<=60 years	0 (0)	5 (83.3)	1 (16.7)	1.17	0.558
	>60 years	3 (12.5)	15 (62.5)	6 (25)		
Gender	Male	2 (10)	13 (65)	5 (25)	0.09	0.954
	Female	1 (10)	7 (70)	2 (20)		
Hemiparetic location	Right side	2 (22.2)	4 (44.4)	3 (33.3)	3.31	0.191
	Left side	1 (4.8)	16 (76.2)	4 (19)		
Diabetes Mellitus	No	2 (12.5)	10 (62.5)	4 (25)	0.33	0.847
	Yes	1 (7.1)	10 (71.4)	3 (21.4)		
Heart Disease	No	1 (4.8)	15 (71.4)	5 (23.8)	2.09	0.351
	Yes	2 (22.2)	5 (55.6)	2 (22.2)		
Hypertension	No	0 (0)	4 (66.7)	2 (33.3)	1.04	0.596
	Yes	3 (12.5)	16 (66.7)	5 (20.8)		

$ Kruskal Wallis Test

The Kruskal Wallis test revealed there is a no significant difference(P>0.05) between grade change in elbow flexor muscle tone score as a result of Action Observation Rehabilitation Training in both the age groups, Thus age is independent of the effect of intervention. Similarly Gender, Location, Diabetes Mellitus, Heart Disease, Hypertension were also independent of the change in grade score of the muscle tone as a result of the intervention.

Result

There were no statistically significant differences between the experimental and control groups with respect to sex, age, gender, location, H/o Diabetes mellitus, H/O Heart disease and H/O Hypertention.

The present study revealed that 83.3 %has no increase in muscle tone and 16.75 has slight increase in muscle tone in. experimental group whereas only 23.3% has no increase in muscle tone and 53.3% has slight increase in muscle tone in control group. There is a significant difference (P<0.05) in the muscle tone of elbow flexor muscle scores after the intervention in experimental and control groups. Hence the intervention is effective in reducing the muscle tone score. 66.7 %has no increase in muscle tone and 33.3 has slight increase in muscle tone in experimental group whereas only 23.3% has no increase in muscle tone and 56.7% has slight increase in muscle tone in control group. There is a significant difference (P<0.01) in the muscle tone of forearm pronator muscle scores after the intervention in experimental and control groups. Hence the intervention is effective in reducing the muscle tone score and thereby improve the muscle spasticity in stroke patients.

The finding of the present study is similar to the study conducted by Mei-Hong Zhu *et al*., 2015. to find the effect of action observation therapy on daily and motor activities.

The study result revealed that there were no significant difference in the evaluation index between the groups before the intervention. However MAS score was significantly better after intervention in the experimental group when compared to the control groups ($p<0.05$). In experimental group before intervention Mean and SD of Elbow flexor muscle tone is 2.71 ± 0.86 and Forearm pronator muscle 3.26 ± 0.68.After treatment it is $1.65 \pm 0.75$and 2.16 ± 1.10, In control group before intervention Mean and SD of Elbow flexor muscle is 2.53 ± 0.90 and pronator muscle 3.07 ± 0.91.After the intervention it is 2.07 ± 0.87 and 2.50 ± 0.90 respectively. These results suggest that action observation rehabilitation training is beneficial for improving the muscle spasticity.This is consistent with the result of present study

Conclusion

The result of the current study demonstrates the supplementation of conventional rehabilitation along with action observation therapy improves the muscle spasticity. Besides reducing the cost it also offer the wider population to avail this exercises in all settings which is very important in developing countries where we lack rehabilitative settings.

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