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ORIGINAL ARTICLE

EFFECTIVENESS OF CROSSED RECIPROCAL INHIBITION TO REDUCE BICEPS BRACHII SPASTICITY IN STROKE SUBJECTS- A RANDOM CONTROLLED TRIAL

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Abstract

Background and Objectives: *Reduction of spasticity is helpful for improving the functional activities and this can be achieved by various techniques. Biceps spasticity is the most common disability in upper limb of a hemiplegic patient, which hinders the ROM at elbow and thus affecting the function of the upper limb as a whole. Biceps spasticity can be reduced effectively by crossed reciprocal inhibition technique. The purpose of this study is to find out the efficacy of crossed reciprocal inhibition in reducing the spasticity in biceps brachi.* ***Methods:*** *Thirty hemiplegic patients were randomly assigned into experimental group that received crossed reciprocal inhibition (n=15) and the control group that received conventional therapy (n=15). Both groups received 30 minutes of either one of the training for 15 days. Treatment outcomes were assessed and compared by measuring the spasticity reduction with the help of Modified Ashworth scale and Goniometry for ROM at Elbow.* ***Results:*** *After 15 days of treatment period, the experimental group patients scored significantly higher improvements than the conventional group for spasticity reduction as per the statistical analysis (P=0.05), and ROM at elbow has also showed considerable improvement.* ***Conclusion:*** *Crossed reciprocal inhibition technique is comparatively more efficient in reducing biceps spasticity in hemiplegics over conventional techniques.*

Keywords: *Crossed reciprocal inhibition, Hemiplegia, Modified Ashworth Scale, Spasticity.*

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INTRODUCTION

Hemiplegia, a paralysis of one half of the body, is the classic sign of neurovascular disease of the brain. It is one of the many manifestations of neurovascular disease, and it occurs with strokes involving the cerebral hemisphere or brainstem[1, 2]. WHO defined stroke as rapidly developing clinical signs of focal or global disturbance of cerebral dysfunction with symptoms lasting 24 hrs or longer or leading to death with no apparent cause other than of vascular origin [3, 4, 5, 6]. Strokes occur due to thrombus, emboli or hemorrhage with an incidence of 203 cases/ 1 lakh population in the age group more than 20 years with male to female ratio being 1:7 and 12% of stroke seen in age group below 40 years [7, 8, 9, 10].

Spasticity is defined as an increase in muscle tone due to hyper excitability of the stretch reflex and is characterized by a velocity-dependent increase in tonic stretch reflexes[11]. The interval between injury and the appearance of spasticity varies from days to months according to the level of the lesion, which is clinically approximated as 1-14 days. In addition to weakness and increased muscle tone, the signs in spasticity include clonus, the clasp-knife phenomenon, hyperreflexia, the Babinski sign, flexor reflexes, and flexor spasms[12, 13]. Once spasticity is established, the chronically shortened muscle may develop physical changes such as shortening and contracture that further contribute to muscle stiffness [14, 15, 16].

Aim and objective of the study was to ascertain the efficacy of crossed reciprocal inhibition technique by reducing spasticity in biceps brachii over conventional technique in hemiplegics due to cerebrovascular accident.

METHODOLOGY

Research design: Pretest and Posttest experimental study design. Population of the study were male and female patients of hemiplegics with cerebral vascular accident. Data collected from Florence Rehabilitation Center, Kalyan Nagar, Bangalore. Materials used in this study were examination table, dumbbells, Modified Ashworth Scale, Stool.

Inclusion Criteria: Subjects who are diagnosed as CVA hemiplegics with biceps spasticity with age between 45-55 years of both genders and spasticity measured by modified Ashworth Scale <3.

Exclusion criteria: Acute Stroke subjects with Shoulder dislocation, Muscle contractures, Fractures, Stroke subjects with spasticity > 3 in Modified Asworth Scale[17, 18].

Sampling method: A total sample size of 30 were selected based on the criteria and equally divided into two groups with 15 participants in each by simple random sampling method from the population. Lottery method was used to assign the samples in each group.

Procedure: Prior to intervention written informed consent was taken from the subjects and were then screened for inclusion/exclusion criteria. Subjects were

made to understand about the study and the purpose of the study in their own language.

Experimental and Control groups: The 30 patients were randomized into one of two groups the control group, group I (n=15) and the experimental group, group II (n=15) by Randomized assignment. The pre-test scores of spasticity and active range of motion of elbow joint was measured in both the groups. The control group received conventional physiotherapy such as proprioceptive neuromuscular facilitation techniques and Bobath techniques for 30 minutes per session daily for a period of 15 days (Fig 1).

The post test scores of spasticity was measured by Modified Asworth Scale and elbow range of motion was assessed by using Goniometer. The experimental group received was given resisted exercises using 3kg weight dumbbells to biceps of unaffected side (Fig 2). The subjects are instructed to do the exercise up to maximal capacity to induce fatigue pain.

Figure 1: Patient receiving Crossed Reciprocal Inhibition technique

Figure 2: Patient receiving Conventional treatment

Modified Ashworth Scale

Modified Ashworth scale is the most commonly used a ratio scale for the assessment of Spasticity. This scale initially has been devised to asses spasticity in elbow flexors, later was used to grade any spastic muscle. Spasticity is graded on a scale of 1 to 4 on Ashworth scale, later added 1^{+} in Modified Ashworth scale. Interrater reliability of a Modified Ashworth scale of muscle spasticity is good as the Kendall's co efficiency of correlation the grades was .847 ($p<.001$)[17].

RESULTS

A total of 30 patients (n=30) were randomly assigned to Control group (n=15) and Experimental group (n=15). The following (Table 1 and 2) show the demographic presentation of the patients:

	Group I	Group II
Mean Age	49.4	49.1
Males	11	10
Females	4	5

Table 1: Demographic presentation of age and gender

	N	Min.	Max.	Mean	Std. Deviation
Age in control Group	15	45.00	53.00	49.467	2.2949
Age in experimental group	15	45.00	53.00	49.133	2.5875

Table 2: Age wise distribution in control and experimental group

Modified Ashworth Scale

Mean age in control group is 49.4 with a standard deviation 2.29 and in experimental group mean age was 49.1 with a standard deviation of 2.58.The range of age was between 45-55 years in both the groups. There were a total of 21 males and 9 females who were put to scrutiny under the study.

The data collected was analyzed for the following outcome measures as variables, 01. Modified Ashworth scale, 02. Elbow Range of Motion- Flexion and Extension. All these variables were tested for normalty and for consistency of data.

Test for Homogeneity of Pre-test variables for MAS scale

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.171	2	8.571	.300	.746
Within Groups	3.429	12	.286		
Total	3.600	14			

Table- 3: Pretest Homogeneity for MAS scale

The homogeneity of the data in the two groups was analyzed by using one-way ANOVA, which showed that the significance was greater than p=0.05 and hence both the groups were homogenous.

Pretest Homogeneity for Elbow Flexion

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	401.667	5	80.333	2.248	.137
Within Groups	321.667	9	35.741		
Total	723.333	14			

Table- 4: Pre-test One Way ANOVA for Elbow flexion

Note: The ANOVA table give the F-values for significance of variance and as all the Values have significance greater than 0.05 hence the groups are considered homogenous.

Pretest Homogeneity for Elbow Extension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	176.667	5	35.333	1.908	.188
Within Groups	166.667	9	18.519		
Total	343.333	14			

Table-5: Pre-test One Way ANOVA for Elbow extension

Note: The ANOVA table give the F-values for significance of variance and as all the Values have significance greater than 0.05 hence the groups are considered homogenous.

Out comes	Control Group (n= 15)			Experimental Group (n=15)		
	Mean ± S.d values			Mean ± SD values		
	Pre test	Post test	Difference	Pre test	Post test	Difference
MAS	2.4 ± 0.50	1.46±0.63	0.93±0.25	2.33±0.72	1.13±0.51	1.2±0.67
Elbow Flexion	71.3 ± 7.1	81.6±12.4	11.6 ± 7.7	73±7.2	90±11.8	17±9.9
Elbow Extension	64.3±4.95	58.0±4.92	6.3 ±4.41	65±7.0	51±5.73	13.6±3.99

Table- 6: Data Analysis for significance of improvements between the groups

Group I data analysis: The data showed that the mean improvements in control group is 0.93 ± 0.25 for MAS scale, 11.6 ± 7.7 for Elbow Flexion and an improvement of 58.0 ± 4.92 for Elbow extension. This clearly indicates that all the patients in this have showed improvements in all the three categories of outcome measures.

Group II data analysis: The data in this group of patients showed mean improvements in all categories, with MAS scale improvements in mean being 1.2 ± 0.67, Elbow flexion mean improvements being 17 ± 9.9, elbow Extension mean improvement of 13.6 ± 3.99. This also indicates that all the patients in this group have showed improvements in all the three categories of outcome measures.

Analysis of Significance of improvement between Control group and Experimental group: The mean improvements between the two groups of Stroke patients were tested for significance using paired t-test. The calculated t-values for the MAS score was significant at p less than 0.05, the Elbow Flexion range also showed a significant variation at p=0.05 and for Elbow extension improvements was significant at p=0.01.

This analysis shows that both the groups have shown improvements with the treatments given, but the mean improvement in the group that is trained with crossed reciprocal inhibition and conventional training showed a significantly higher gains when compared to the group which received only conventional treatment. This clearly indicates that the crossed reciprocal inhibition when combined with conventional training in stroke patients is more effective than conventional training alone in improving Spasticity and Elbow Range of motion.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	**MAS CONTROL DIFF**	.9333	15	.2582	6.667E-02
	MAS EXP DIFF	1.2000	15	.6761	.1746

Table-7: t- values show improvement in MAS scale

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	**MAS CONTROL DIFF - MAS EXP DIFF**	-.2667	.7037	.1817	-.6564	.1230	-1.468	14	.164

Table-8 : t- value show improvement in Elbow Flexion

The calculated p value showed a significancedifference in improvement at p less than 0.05, which indicates that Experimental group patients have higher gains in improvement of Spasticity than the patients in control group.

Paired Samples Test

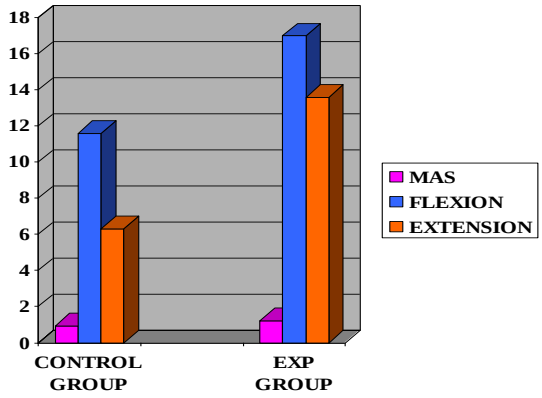
					Lower	Upper			
Pair 1	**FLE CONTROL DIFF - FLE EXP DIFF**	-5.3333	9.5369	2.4624	-10.6147	-5.1976E-02	-2.166	14	.048

Table-9 : t- values for improvement in Elbow Extension

The calculated t value showed a significance of difference in improvement by p=0.05, Which indicates that Experimental group patients had higher gains in improvement of Elbow Flexion range than the Control group.

Outcome measures	Control group	Experimental group
MAS	0.93	1.20
FLEXION	11.6	17.0
EXTENSION	6.3	13.6

Table- 10: Mean improvements between the Groups in MAS, Elbow Flexion and Extension ranges



Graph-1: Mean improvements

DISCUSSION

There was totally 30 individuals taken into this study based on inclusion criteria, of which 21 were males and 9 were females. The participants involved in this study were individuals showing symptoms of stroke having Spasticity in the elbow flexors as a common complaint, who were to derive the benefits from the tone reduction intervention. This amply proved that the

entire group did not comprise representatives of the stroke population and hence there is chance to categorize the symptom as subsidiary to conventionally categorized stroke.

Effect of crossed reciprocal inhibition: The purpose of this study is to evaluate the effects of crossed reciprocal inhibition over conventional methods in reducing biceps spasticity in hemiplegic stroke patients undergoing out patient physical therapy. The subjects in Experimental group demonstrated significant improvements in Spasticity ($p< 0.05$), Elbow Flexion range ($p=0.05$) and Elbow Extension range ($p=0.01$) as measured by Modified Ashworth scale, Range of motion by Goniometry respectively than the Conventional-training group. The reduction of impairments caused by spontaneous natural recovery of neurological function due to neural plasticity of brain is the primary factor contributing to the reduction in disabilities that occurs during rehabilitation. These improvements may be largely due to the learning and practice, which directly reminds the job of the brain to recover and tone up as to enable the functional requirements of the body by resuming its nature of plasticity, which

enforces positive therapeutic effects of rehabilitation. The present observations supported previous evidences that stroke patients improved in their reduction of spasticity and functional ability following rehabilitation [19, 20, 21].

Tanaka et al, 1978 studied Reciprocal reflex connections hemiplegia using Lloyd's technique. Effects of conditioning stimulation of the tibial or peroneal nerve on the H-reflex in the antagonists were examined. Early and strong inhibition, comparable to Ia inhibition was observed from weak stimulation of the tibial nerve on the flexor H reflex, but not from the peroneal nerve on extensor muscle. These results suggest that a flexor spasticity, which is common in hemiplegia, may be due to an imbalance of reflex activities via Ia muscle afferents, and that a part of flexor weakness can be restored by "disinhibition' by reduction of Ia inflow from extensor muscles. [22]

Delwaide PJ et al, 1991 investigated Contralateral influences on short latency reciprocal inhibition between wrist extensor and flexor muscles in three hemiplegic patients where reciprocal inhibition was reduced unilaterally. Contralateral median or radial nerves were stimulated at short intervals before the onset of reciprocal inhibition. The latter was increased by 8.6% after median nerve stimulation and decreased by 16.5% after radial nerve stimulation. The effects produced by mixed nerve stimulation are thus likely to have been mediated by Ia fibres. This result indicates that contralateral effects are not mediated through the Ia inhibitory interneurone ipsilateral to the conditioning stimulus[23].

The probable explanation for the reduction of spasticity is that crossed reciprocal inhibition involves crossed extensor reflex that is elicited after 200-500 m sec after painful stimulus. Many interneurons are involved in the circuit between incoming sensory neuron and motor neurons of the opposite side cord, which is responsible for the crossed extension. This type of inhibition stays even after the removal of pain stimulus, suggesting the involvement of reverberatory circuits among interneuronal cells.

Changes in Range of Motion: Significant improvements in Elbow Flexion ROM occurred in all the patients following training, however Crossed reciprocal inhibition group showed greater improvements than conventional training group. This implies that even severely impaired and old patients with stroke have a good potential for improvement in ROM. This finding is in conformity with other reports in the last decade of significant improvements in ROM in stroke patients over the course of rehabilitation.

Significant improvements also occurred in Elbow Extension ROM in all the patients, except 1 patient in control group and in all the patients in Experimental group. These improvements in elbow Extension are higher in Experimental group compared to the control group.

CONCLUSION

The evidence from the literature seems to be well defined in certain areas, the outcome of this study with significant statistical changes lead us to the conclusion of accepting the research hypothesis, which could be stated as: The efficacy of crossed reciprocal inhibition technique by reducing spasticity in cerebrovascular accident hemiplegics with biceps brachii Spasticity is better over conventional technique.

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