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EFFECT OF TRUNK DISSOCIATION RETRAINER" IN IMPROVING REACHING CAPACITY IN HEMIPLEGICSUBJECTS

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ABSTRACT

This study aims to find the effectiveness of "trunk dissociation retrainer" for improving trunk performance and functional activities in hemiplegia. A total of 156 hemiplegic subjects from both genders, who were aged between 40 to 75 years, who scored 6 or more in trunk impairment scale were randomly assigned to three groups by random number method with 52 in each group. "Trunk dissociation retrainer" group received training using the new tool "Trunk Dissociation Retrainer" and conventional exercises, the MTD group received manual trunk dissociation training and conventional exercises, the control group received only the conventional exercises. Duration of intervention was 60 minutes per day, three days a week, for four weeks. Functional reach test was used to measure the outcome using a blinded evaluator. The results of the study showed that there was a significant improvement in reaching in TDR group compared to the other two. There were no significant difference in improvement between the MTD and the control group. This study concludes that trunk dissociation retrainer can be a better tool for training trunk dissociation. Training in Trunk dissociation retrainer results in a significant improvement of functional reaching capacity in subjects with hemiplegia.

KEY WORDS: Trunk dissociation retrainer, hemiplegia, reaching, functional reach.

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1. INTRODUCTION

Most literature concerning rehabilitation after hemiplegia focuses on the motor recovery of upper and lower extremity[1]. The consequences of stroke have a wide spectrum. Out of that, a majority of the survivors from stroke have a combination of sensory, motor, cognitive and emotional impairments leading to restrictions in their capacity to perform basic activities of daily living[2]. Most of the activities of daily living are performed either in sitting or standing. Sitting and standing involves not only the ability to maintain a static posture, but also the ability to move around and reach for a variety of objects located both within and beyond arm's length[3]. For such functions to occur smoothly, both trunk and limbs have to move in a specific pattern, compensating each other. Of all possible sensorimotor consequences of stroke, impaired postural control and sensory motor deficit probably has the greatest impact on ADL independence and quality of gait [4, 5]. Postural control includes both static posture and dynamic postural responses like trunk-limb coordination, anticipatory trunk muscle recruitment before limb movement, reciprocal inhibition, and trunk dissociation[6 - 8]. There was a significant correlation between abnormal movement patterns of the trunk in hemiplegic patients and the level of upper limb motor impairment. This goes to show that trunk posture and motor control plays a crucial role in rehabilitation of hemiplegic subjects, training of the same become imperative. As specificity of exercise plays a vital role in the prognosis of the stroke patients, adaptation of body or posture which precedes movement which allows for smooth, economical movement should be selected for training[9,10]. These postural sets are position or posture of symmetry or alignment of key-points from which a normal person evolves movement or sequences of selective movements. Berta Bobath proposed the manual training for trunk dissociation in 1990, which concentrates mainly on specific trunk patterns along with limb movements. Manual trunk training is provided by therapist positioned either to control the trunk or to control the distal limb movement. The major flaws of this procedure are that, it is a time consuming process and involves constant manual effort by the physiotherapist. So, there is a strong need for devising new equipments which can reduce the human effort involved in trunk training following hemiplegia. To our knowledge there is no equipment for training trunk dissociation so effectively like manual training. "Trunk Dissociation Retrainer" is equipment designed for training the trunk movements following hemiplegia. In this study an earnest effort has been taken to find out the effectiveness of "Trunk Dissociation Retrainer" in improving reaching in hemiplegic subjects.

2. SUBJECTS AND METHODS

This Randomized Single Blind Controlled Clinical Trial was performed in two study setup namely, Physiotherapy Out Patient Department, Saveetha Medical College and Hospital, Saveetha University, Chennai and Physiotherapy Out Patient Department, Sri Jayendra Saraswathi College and Hospital, Chennai. Human ethical clearance was obtained for study from Saveetha University (013/10/2013/IEC/SU). Simple Random sampling by random number sampling method was used. The duration of intervention for the subjects in each group was 4 weeks. Sample size for the study was calculated based on the prevalence rate of stroke in urban population in India which was 424/100000 population using the following parameters, Population Proportion Po = .62, Sample Proportion Pa = .424, Power (%) = 80, Alpha Error (%) =5. The exact number of subjects required accordingly was 49 per group. The sample is further increased by 5% to account for contingencies such as non-response, non-completion etc, which made it 52 subjects per group and 156 overall sample size. The subjects were included in to the study if they fulfil the following criteria. Subjects with history of hemiplegia resulted due to stroke, both male and female, with age between 40 to 75 years were selected. Further, the subjects were recruited only after they scored minimum 6 in static sitting balance rating using Trunk impairment scale. Both right and left hemiplegia due to ischemic stroke were included in the study. The subjects were excluded if they had impaired comprehension, perceptual deficits that may interfere with the study, previous history of stroke, double hemiplegia, Coexisting neurological and orthopedic disorders. All subjects were provided with informed consent for participation and allotted with an identification code before starting baseline assessments which was kept confidential and randomly allotted in to the groups with 52 subjects in each group. The Demographic detail of the subjects is furnished in table 1. The study was approved by the institutional ethical committee, Saveetha University on 15th December 2013.

Table 1
Demographic detail of the subjects

	TDR Group	MTD group	Control Group	TOTAL
No of subjects	52	52	52	156
Age(years)	56.5±4.53	54.96±6.88	54.87± 5.2	55.44±5.53
Time since stroke	1.8± 1.2	1.4 ± 1.3	1.5± 1.7	1.56±1.4
Gender(N)				
Male	36	33	38	107
Female	16	19	14	49
Hemiplegic side (N)				
Right	31	30	29	90
Left	21	22	23	66

The subjects in TDR Group received conventional stoke rehabilitation programme and additional TDR training programme. Two different movements were trained. The first set was done towards the affected as well as the unaffected side, parallel to the frontal plane. When the upper end of the upright rod moved to affected side the lower limb moves to the opposite side simulating in normal postural adjustment pattern. The second set was done moving to front and back parallel to the sagittal plane. When the upper end of the upright rod moved anteriorly the lower limb moves posteriorly. The subjects trained in TDR for 30 minutes for 5 sets of 10 repetitions to each side, including rest. The subjects also received conventional exercises in the form of range of motion exercises for the affected extremities and strengthening exercises for the muscles which were out of synergy [10], Static and dynamic balance training in sitting and if the subject is able to stand without support, standing balance was also trained, positioning activities, electrical stimulation trunk activities like reaching to anterior aspect and lateral direction clasping the hands from a seated posture. Total duration of exercises for TDR group was 60 minutes including rest, once in a day, 3 days in a week for 4weeks. The subjects in MTD group received conventional exercises as mentioned in the TRD group for 30 minutes and received manual trunk dissociation training for 30 minutes. The intervention was provided by two physiotherapists one guiding the upper trunk and the other directing the lower trunk and limb in contralateral direction to the movement of the former. Total duration of exercises was 60 minutes, once in a day, 3 days in a week for 4 weeks. The subjects in control group received conventional exercises as mentioned in the TRD group for 60 minutes, once a day, 3 days in a week for 4 weeks without any emphasize on specifically training trunk dissociation movements. All the intervention was provided by three Physiotherapists who were postgraduate in physiotherapy having more than 5 years of clinical experience in stroke rehabilitation, which includes the researcher. Intervention was provided by three physiotherapists including the researcher in both the clinical set up. All the three therapists who gave intervention were postgraduate physiotherapist having more than 5 years of clinical experience in neurorehabilitation. Functional reach test was used to measure the outcome of reaching performance. The outcome measures were evaluated by a postgraduate physiotherapist having more than 5 years of clinical experience in neuro rehabilitation or an undergraduate in physiotherapy with minimum of 10 years clinical experience in neuro rehabilitation. The evaluators were blinded to group allotment.

3. RESULTS

The data were analyzed using SPSS software (IBM SPSS Version 20), the principal investigator first described the demographic, baseline, and post intervention evaluation data of each group using means and SDs for all variables. The homogeneity of variances of the data at baseline and significant differences of post intervention data for the three groups were analyzed using analysis of variance (ANOVA). The distribution of gender and hemiplegic side in the three groups were analyzed using Chi-Square test. Post HOC analysis with Tukey HSD multiple comparisons were done if there was a significant difference between groups. Significant changes within group were analyzed with Paired t Test. An overall significance level was maintained at $p < 0.05$.

Table 2
One way ANOVA for the age differences

	Sum Of Squares	df	Mean Squares	F	Sig
Between group	122.498	2	61.249	2.321	0.102
Within group	3852.441	146	26.387		
Total	3974.940	148			

The table 2 shows that between group analyses of subject's age using one way ANOVA. It showed that there was no significant difference among the three groups with a p value equal to 0.102. There were 88 right hemiplegics and 61 left hemiplegic subjects. Chi Square test was used to analyze if there was a significant difference among the groups, which showed that there was no significant difference among the groups with p value equal to 0.979 as shown in the table 3. There were 106 Male and 43 female hemiplegic

subjects overall. Chi Square test was used to analyze the data, which showed that there was no significant difference among the groups with p value equal to 0.756 as shown in the table4.

Table 3
Chi – Square test for between group analyses of side involved

	Value	Df	Asymp.sig (2-sided)
Pearson Chi-square	0.042[a]	2	0.979
Likelihood ration	0.042	2	0.979
Linear-by-linear Association	0.041	1	0.839
N of Valid Cases	149		

Table 4
Chi-Square analysis for gender difference

	Value	Df	Asymp.sig (2-sided)
Pearson Chi-square	0.561a	2	0.756
Likelihood ration	0.557	2	0.757
Linear-by-linear Association	0.048	1	0.826
N of ValidCases	149		

Table 5
One way ANOVA for baseline comparison

OUTCOME MEASURES	GROUP DIFFERENCES	SUM OF SQUARES	Df	MEAN SQUARE	F	Sig P=0.05
FRT	Between Groups	2.842	2	1.421		
	Within Groups	192.420	146	1.318	1.078	0.343
	Total	195.262	148			

The base line analysis of the pre-test values of all the five outcome measure, using the ANOVA showed that there was no significant difference among the groups at baseline (table 5). This shows that the groups were homogenous at baseline. The pre and post mean and standard deviation for FRT are shown in table 6. The analysis shows that there was significant difference among the pre and post data of the three groups.

Table 6
Within group analysis of pre and post-test values

Groups	Pre	Post	T	DfSig.(2-tailed)
TDR	13.46±1.147	26.92±3.343	-36.109	490.001
MTD	13.14±1.258	19.73±1.923	-28.728	480.001
CONTROL	13.20±1.030	18.78±2.063	-20.691	500.001

The between group analysis of the post-test values of all the three groups showed that there was a significant difference between the three groups as shown in table 7. Post hoc analysis with Tukey -HSD multiple comparisons were done to find if there was any significant difference between groups. The analysis of the post-test values of FRT showed significant difference between TDR group and MTDR with p <0.001 and TDR and Control group with p <0.001. There was no significant difference between MTDR and the control group with P =0.149.(table8)

Table 7
Between group Analysis of the post-test values using ANOVA

OUTCOME MEASURES	GROUP DIFFERENCES	SUM OF SQUARES	Df	MEAN SQUARE	F	Sig P=0.05
	Between Groups	1975.652	2	987.826	154.445	
FRT	Within Groups	933.811	146	6.396		0.001
	Total	2909.463	148			

Table 8
Post HOC analysis (Tukey -HSD multiple comparisons) - post-test values.

Dependent variables	(I)Group	(J)Group	Mean Differences	Std. Error	Sig
FRT - POST TEST VALUES	TDR	MTD	7.185	0.508	0.001
		CONTROL	8.14	0.506	0.001
	MTD	TDR	-7.185	0.508	0.001
		CONTROL	0.955	0.508	0.149
	CONTROL	TDR	-8.14	0.506	0.001
		MTD	-0.955	0.508	0.149

7. DISCUSSION

Trunk dissociation is the act of upper and lower half of the bodies compensating equally with each other, there by bringing the line of gravity as close to the body as possible and also keeping the center of gravity as low as possible. In normal subjects the trunk muscles activity began much prior to activity in the limb muscles and demonstrated a distal to proximal order of activation[11,12]. Even in a maintaining a static posture there is a significant activation of trunk, hip, knee, ankle joints[13]. Trunk plays a vital role both in stability as well as mobility of limbs and body as a whole in normal subjects. With so much of importance, there should have been more equipment for training trunk. But, hardly there are any standardized equipments for training trunk in hemiplegia to the researcher's knowledge. The trunk dissociation retrainer was devised on the lines of a mariner's wheel model. After enough considerations and inputs from senior physiotherapists, the idea was presented to the engineers, who gave shape to the idea. The main factor while designing of the equipment was the safety factor and durability of the equipment. Hence standard materials, tested and certified by the engineers were used. In addition enough belts, modified foot rest and hand glows were used to make sure that the patient were secure and safe. The same was educated to the patients and they were reassured of their safety. This was to make sure that the patients trained in the equipment without fear of fall, as fear of fall may cause apprehension to move. Out of 156 subjects selected for the study only 149 completed the post-test analysis. There were 7 drop outs out of which 3 subjects got discharged against medical advice and three subjects were volunteer ed to leave the study on personal grounds. The 7 subjects were considered as drop out and were not considered for statistical analysis. To make sure the quality of treatment and uniformity of treatment, before the study commenced, the researcher discussed with the other two physiotherapists regarding the idea behind the equipment, the ways of handling it, safety precautions, and verbal instructions to be provided during the training, treatment duration and protocol. Apart from that, periodic discussions were held once in a month. From the results of the study it is evident that there is a significant difference in the within group analysis of all the three groups for both the outcome measures, which may be attributed to the 4 weeks of intervention. The results of TDR training had shown better improvement than the other two groups for all the five outcome measures, with statistical significance. When comparing the results of MTD and the control group, there was no significant difference between the control group and MTD group. This shows that there was no added advantage in training a subjects with manual trunk dissociation compared to giving only conventional physiotherapy exercises. This shows that TDR can be an effective replacement for existing manual trunk dissociation training. In the previous studies done by the researcher it is proved that TDR is an effective tool in improving Gait and balance[14,15]. This equipment is first of its kind and can add on to the strengths of physiotherapist. The subjects were able to do the task in a self-passed speed and at the same time were able to increase the speed of performance in subsequent days. While using the TDR the number of repetitions of the given task was more compared to the manual training. In our study all the subjects felt safe and reported that they felt highly motivated on using the equipment. Though a physiotherapist was present supervising the treatment session, the subjects did not required the physical support of the therapist after the second sitting on an average.

4. CONCLUSION

This study concludes that "Trunk dissociation retrainer" (TDR) is an effective tool in improving reaching in hemiplegia. Hence TDR can be used as an effective replacement tool for manual trunk dissociation training for hemiplegic subjects.

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