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"TRUNK DISSOCIATION RETRAINER" FOR IMPROVING BALANCE, FUNCTIONAL ACTIVITIES AND GAIT IN HEMIPLEGIA.

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ABSTRACT

Devising equipment for postural rehabilitation where the subjects can rehearse the movements with minimal physiotherapist guidance is must. Determine the effect of "Trunk Dissociation Retrainer" (TDR) in improving balance, functional activities and gait in hemiplegia. In this single blinded randomised controlled trial,56subjects were equally allotted by Simple random sampling into TDRGroup and Control group (CG). Berg balance scale(BBS), Functional Indipendent Measure scale(FIMS)and Gait velocity(GV) were used as outcome measures.Both groups were homogeneous at baseline. TDR group showed statistically significant improvement in the within group analysis for BBS, FIMSand GV with $p<0.001$.CG showed statistically significant improvement in the within group analysis for BBS, FIMS and GV $p< 0.0001$. TDR group showed statistically significant improvement than the CG in GVand FIMS with $p<0.001$ and BBS with $p<0.007$. TDR is a better alternative tool in improving balance, functional activities and gait in hemiplegia as compared to manual techniques.

KEY WORDS: **Trunk Dissociation Retrainer, Trunk Training, Gait, Balance, Hemiplegia, functional activities**

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INTRODUCTION

Most literature concerning rehabilitation after stroke focuses on the motor recovery of upper and lowerextremity[1].The consequences of stroke has a wide spectrum. Out of that, a majority of the survivors from stroke have a combination ofsensory, motor, cognitive and emotional impairmentsleading to restrictions in their capacity to perform basicactivities of daily living[2].Most of the ADL 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 objectslocated both within and beyond arm's length[3].For such functions to occur smoothly, both trunk and limbs have to move in specific pattern,compensating each other. Of all possible sensorimotorconsequences of stroke, impaired postural controlprobably 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, trunk dissociation etc. That's why among many biological and functional characteristics, postural control is the best predictor of achieving independent[6] and shows the highest correlation with person-perceived disability after discharge from rehabilitation[7]. Loss of postural control has been recognised as a major health problem in individuals with stroke resulting in a high incidence of falls both during rehabilitation and thereafter,particularly in those patients with both motor and sensorydeficits[8]. There was a significant correlation between abnormal movement patterns of trunk in stroke patients and the level of upper limb motor impairment. As specificity of exercise plays a vital role in the prognosis of the stroke patients[9], adaptation of body or posture which precedes movement which allows for smooth, economical movement should be trained[10]. These postural sets are position or posture of symmetry or alignment of key-points from which a normal person evolves a 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 by us, 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 balance, functional activities and gait in hemiplegic subjects.

METHODOLOGY

Subjects

56 hemiplegic subjects from two different rehabilitation centres from Chennai were randomised into two groups, namely TDR group and Control Group with 28 subjects in each group, using Simple random sampling (lottery method). All the subjects signed an informed consent form before participation. Study was approved by the institutional ethical committee.The subjects were included in the study if they fulfil the following criterias. Both Male and female subjects with history of stroke before 15 days, in the age group of 40 to 75 with demographic details as shown in table 1. Subjects who scored minimum 6 in static sitting balance rating using Trunk impairment scale were selected, so that it is made sure that all subjects were able to sit without support which is a prerequisite for TDR training. Subjects who had impaired comprehension, perceptual deficits that may interfere with the study and previous history of stroke, double hemiplegia or any other coexisting neurological and orthopaedic disorders were excluded from the study.

Table 1
Demographic detail of the subjects

	TDR Group (mean ± SD)	Control Group (mean ± SD)
Age (years)	56.5±4.53	54.87± 5.2
Time since stroke (months)	3.8± 1.2	3.5± 1.7
Gender (N)		
Male	20	18
Female	8	10
Hemiplegic side (N)		
Right	14	16
Left	14	12

Interventions

A.Trunk Dissociation retrainer Group

The subjects in TDR Group received conventional stoke rehabilitation programme and additional TDR training programme. TDR consists of two units namely the wheel unit and the patient unit

Figure1
Trunk dissociation retrainer.

The wheel unit consists of a metal upright rod fixed to a central pivot axis with equal halves above and below (fig.1). On upper end of the upright rod there is a curved rod simulating a steering, for the upper limb to hold. Straps were used whenever there was difficulty in gripping with the affected hand. The lower end of the upright rod consists of horizontal rests, on either side of the rod for incorporation the feet which is held in place by buckled footwear. The patient unit consists of an adjustable seat in front of the wheel unit for the patient to sit. The seat's height can be adjusted depending on the patient's height and it does not have a back rest. The distance between the patient unit and the wheel unit can be adjusted depending upon the patient's height and comfort. The central pivot axis of the wheel unit were fixed so that it corresponds to the umbilical level of the subject. After making sure that the patient is comfortably seated, the therapist explained the concept of the TDR and then the subjects perform the movement with the physiotherapist's guidance. 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 moving in 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 with 5 minutes of exercises and 5 minutes rest for three sets. The subjects also

received conventional exercises in the form of Voluntary control training for the affected extremities [11] and strengthening exercises[12]for 15 minutes, Static and dynamic balance training[13] for 10 minutes, Hand function training with task oriented approach for 15 minutes, Gait training[14] for 10 minutes, trunk activities like reaching to anterior aspect and lateral direction clasping the hands from a seated posture[15] for 10 minutes. Total duration of exercises for TDR group was 90 minutes a day, 3 days in a week for 4 weeks.

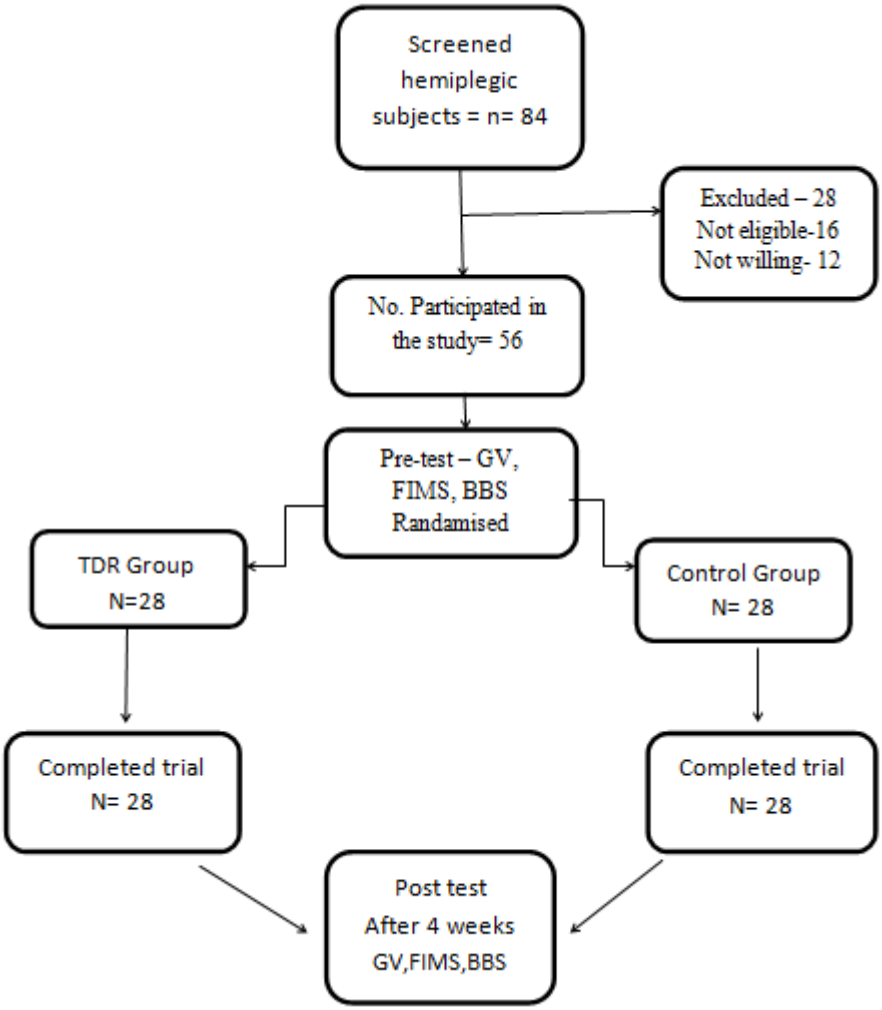
B. Control Group

The subjects in this group received conventional exercises as mentioned in the TRD group for 60 minutes and received manual trunk dissociation training for 30 minutes. Total duration of exercises for Control Group was90 minutes, 3 days in a week for 4 weeks.

Outcome measures

All the subjects underwent baseline analysis before the subjects were assigned to the groups and Post analysis was done at the end of the last treatment session. Berg balance scale was used to assess the outcome of balance[16], FIMS was used to measure the functional performance andgait velocity over a distance of 10 meters out of given 14 meters was measured to gauge the gait performance[17]. A physiotherapist, who was blinded about the study, was used to evaluate the outcome measures before and after the intervention.

Figure2
Study flow chart



RESULTS

There were no dropouts in the study as shown in fig.2. The mean performance of the groups at the baseline in BBS was 22.07±2.36 and 21.35±2.30 for TDR and control group respectively.Between group analysis of the pre-test value was done using Mann-Whitney Test. The groups were homogenous at the base line value with p value = 0.307. Both groups showed statistically significant improvement in the within group analysis done using Wilcoxon Signed Rank Test with p value <0.001 for both the groups. The mean performance of the groups, at the end of four weeks of intervention for BBS was34.78±2.26for TDR group and 30.5±3.715 for control group. Between group analyses of the post-test value revealed that TDR group showed a statistically significant improvement than the control group with p value < 0.007. The mean performance of the groups at the baseline in GV was 0.277±0.037and 0.262±0.035 for TDR and control group respectively. Between group analysis of the pre-test value was done using independent t test. The groups were homogenous at the base line value with p value = 0.307. Both groups showed statistically significant improvement in the within group analysis done using paired t test with p value <0.001 for both the groups. The mean performance of the groups, at the end of four weeks of intervention for GV was 0.410±0.049for TDR group and 0.328±0.0413 for control group. Between group analysis of the post-test value revealed that TDR group showed a statistically significant improvement than the control group with p value < 0.001.The mean performance at the baseline for FIMS was 80.64±5.78for TDR group and 79±4.65 for control group. Between-group analysis of the pre-test value was done using Mann-Whitney Test which showed homogeneity of the groups with p value = 0.627. Both groups showed statistically significant improvement in the within group analysis done using Wilcoxon Signed Rank Test with p value <0.001. The mean performance of the groups, at the end of four weeks of intervention for FIMS was 102±4.07 for TDR group and 88.14±5.11 for control group. Between group analyses of the post-test value revealed that TDR group showed a statistically significant improvement than the control group with p value < 0.001.

DISCUSSION

The trunk dissociation is very important component for most of the functional activities.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 centre of gravity as low as possible. In 1984, Friedli WGstudied postural adjustments associated with rapid voluntary limb movements and concluded thattrunk muscles activity began much prior to activity in the limb muscles and demonstrated a distal to proximal order of activation[17]. He also considered muscles of lower limb as part of postural muscles and are recruited prior to upper extremity movement in an anticipatory fashion.ChariVR,in 1986, studied the lower limb influence on trunk control on sitting while reaching forwards and reported that lower limbs contribute to trunk control when a person reaches forwards[18]. SonK, in 2001, stated that to maintain posture there is a significant activation of trunk, hip, knee, ankle joints in a seated position in normal subjects[19].Crosbie J,in 1995, found that, during rapid arm movement in normal subjects towards the targets located beyond the arm's length, weight bearing was greater on the foot ipsilateral to the direction of the movement[20].Dean C, in 1999, studied the activity of trunk and limb muscles during reaching and found out that electromyography data demonstrated that the lower limbs actively contribute to reaching tasks[21].In this study effort is being taken to prove that training trunk dissociation using a new device named Trunk Dissociation Retrainer has multidimensional benefits. 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 repetition 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. Future studies can also concentrate on comparing the trunk dissociation Retrainer's effectiveness as compared to physiotherapist guided trunk dissociation training which is presently in use. The effect of TDR on other aspects like, functional improvement, reaching tasks and trunk performances are also of research interest in future.

CONCLUSION

This study concludes that Trunk Dissociation Retrainer is a better alternative tool in improving balance, Functional activities and gait in hemiplegic subjects compared to manual trunk dissociation training.

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