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Original Research Article

EFFICACY OF TRUNK EXERCISES ON SWISS BALL VERSUS BED IN IMPROVING TRUNK CONTROL IN HEMIPARETIC PATIENTS

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ABSTRACT

Background: Stroke is a global health problem. It is the second commonest cause of death and fourth leading cause of disability worldwide. Along with hemiplegic limb muscles, trunk muscles are also impaired multidirectional in stroke patients. Trunk control is important for functional outcome and also an early predictor for activities of daily living after stroke. Treatment focusing on this aspect in stroke patients is needed. Since sufficient literatures are not available in comparing the effect of trunk exercises on bed and Swiss ball in trunk control among hemi paretic patients, there is a need for incorporating it in this study.

Objectives: To compare the efficacy of trunk exercises performed on Swiss ball versus bed in trunk control among hemi paretic patients.

Materials and Methods: Study was conducted as a Quasi Experimental Design – Pretest and Posttest Designs with Two Comparison Treatments. at Department of Physiotherapy, PSG Hospitals, Coimbatore, Tamil Nadu, India. A total of 16 stroke patients in the age group of 45 to 60 years participated in the study. The participants who satisfied the selection criteria were selected by convenience sampling and randomly assigned into two groups. Group A received trunk exercises on Swiss ball and Group B received trunk exercises on bed for 12 days [6 sessions per week for 2 weeks (45minutes/session)]. Outcomes were measured with Trunk Impairment Scale score and Motor Assessment Scale score.

Results: All participants in group A and group B showed significant improvement in TIS scores with a mean difference of 6.5 and 4.38 respectively. The calculated 't' value using the paired test for group A and B were 9.96 and 8.21($P<0.001$) respectively. In MAS scores group A and group B showed significant improvement with a mean difference of 2.12 and 1.25 respectively. The calculated 't' value using the paired test for group A and B were 9.34 and 7.83($P<0.001$) respectively. When comparing between the groups using independent 't' test, the TIS scores showed mean difference of 2.12 and 't' value of 2.56 ($P<0.005$) and MAS scores showed mean difference of 0.87 and 't' value of 3.22($P<0.05$).

Conclusion: This study revealed that there was significant improvement in trunk control following trunk exercises on Swiss ball than on bed among hemi paretic patients.

KEY WORDS: Swiss Ball, Hemi Paretic, Trunk Control, Trunk Exercises, Functional Outcome, Trunk Impairment, Bed Exercises.

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INTRODUCTION

Hemiparesis refers to weakness of one side of the body, weakness includes muscles of upper and lower limbs, trunk and face. The sensory-motor impairment of trunk interferes with the functional performance after stroke [1]. Along with hemiplegic limb muscles, the trunk muscles are also impaired multidirectional following a

unilateral stroke [2]. Trunk muscle strength in stroke patients was reduced in bilateral lateral flexors measured by a hand held dynamometer, when compared with that of age matched controls [3]. Studies using an isokinetic dynamometer have shown that muscular weakness of trunk flexors, extensors, and bilateral rotators in post stroke patients [4,5]. A study using trunk impairment scale also found that selective movement of the upper and lower trunk is impaired after a stroke [6].

The trunk being the central key point of the body proximal trunk control is very essential for distal limb movement control, balance and functional activities. A cross sectional study has shown that trunk control is related to measures of balance, gait and functional ability in patients with stroke [7]. A prospective study demonstrated trunk control as an early predictor of comprehensive ADL function in stroke patients [8-11]. similarly; a cross sectional study by Vanita'dsouza et al demonstrated that trunk performance is correlated with functional outcome of stroke patients [12].

Recent work by Karthikbabu et al demonstrated that selective trunk muscle exercise regime has improved trunk control, balance and gait in chronic stroke patients [13]. A randomized controlled trial by verheyden et al demonstrated that additional trunk exercises performed on plinth along with regular rehabilitation had a beneficial effect in improving selective performance of trunk lateral flexion in sub-acute stroke patients [14].

A study by Duncan et al have shown that trunk muscle activity was greater when trunk exercises are performed on a Swiss ball in comparison to similar exercises performed on stable surface in healthy adults [15]. Similarly a recent study by AkshanthaNayak et al has demonstrated that task specific trunk exercises performed on Swiss ball provided significant improvement in dynamic sitting balance and trunk coordination in stroke patients [16]. In a previous study, trunk exercises performed using the Swiss ball have showed an significant improvement in trunk control and functional balance when compared with similar exercises performed on plinth [17].

The potential activation of trunk muscles is greater when trunk exercises are performed on a Swiss ball because it is an unstable surface which provides an postural perturbation to which the trunk muscles has to respond in order to maintain the desired posture [18-21].

Need for the study: Based on the available literatures, there are evidences to show that trunk exercises performed on bed had beneficial effects on trunk control among stroke patients. There are also evidence to support that trunk exercises performed on Swiss ball also improved trunk control in stroke patients, but there are very few studies that compared the effects of trunk exercises performed on bed and Swiss ball. Hence the need of this study is to compare the effect of trunk exercises performed on bed versus Swiss ball and to find out which of these two shows the most beneficial effect in improving trunk control among hemi paretic patients.

Objectives: To compare the efficacy of trunk exercises performed on Swiss ball versus bed in trunk control among hemi paretic patients.

MATERIALS AND METHODS

This study was a pre and post-test study with two comparison treatments. The study was conducted in Physiotherapy department at PSG hospitals. The study obtained ethical clearance from Institutional Human Ethics Committee, PSG institute of Medical Sciences and Research.

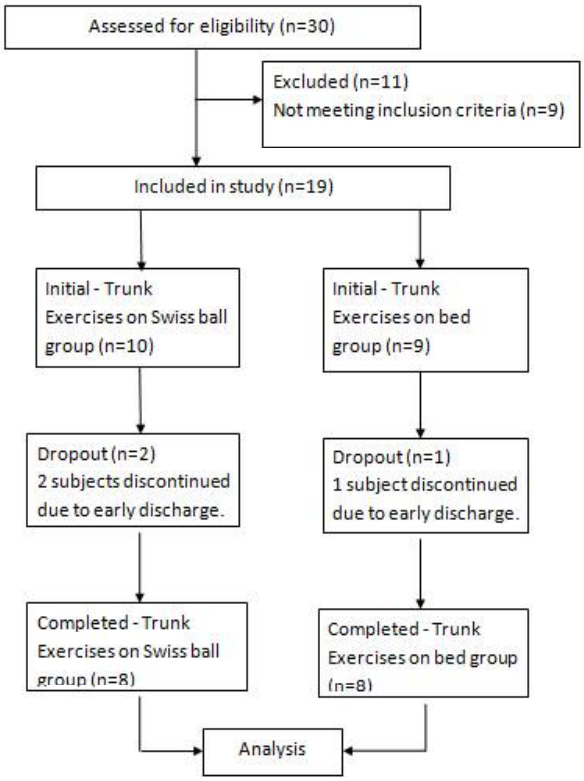
Participants: A total of 30 hemiparetic patients were assessed for eligibility. Out of it 11 patients were excluded for not meeting the inclusion criteria. Remaining 19 patients were randomly assigned to two groups. Group A- 10 patients and group B- 9 patients. There were two drop outs in group A and 1 drop out in group B. Finally the study had 8 patients in each group. (Fig. 1)

Inclusive criteria for the study includes the Acute ischemic MCA stroke patients with age between 45 to 60 years and with post stroke duration of less than 1 month. The Mini Mental Status Scale score was 24 or above. The Patient should be able to sit for 1 minute unsupported on a stable surface and the patient should be able to understand and follow simple verbal instructions.

Exclusive criteria for the study includes Obese patients (BMI>30), Neurological disease affecting balance other than stroke such as cerebellar disease, Parkinson's disease, vestibular lesion and Musculoskeletal diseases such as low back ache, arthritis, degenerative diseases of the lower limbs affecting motor performance.

Procedure: Informed consent was obtained from the patients. Patients were assessed for eligibility based on the inclusion and exclusion criteria. Eligible patients were randomly assigned to two groups. Group A received trunk exercises on Swiss ball and conventional therapy. Group B received trunk exercises on bed and conventional therapy. An outcome assessor who was blinded to the group allocation took the outcome measurements using Trunk Impairment scale and Motor assessment scale. Initial assessment was taken on the first day of physiotherapy reference by using outcome measures. Intervention was given to each group separately for 12 days. Post assessment was taken after the 12 days of physiotherapy treatment using the same outcome measures.

Fig. 1: Schematic representation of flow of participants.



Comparison of pretest and posttest values within the group and between the groups was done finally.

Fig. 2: Illustrates the treatment protocol.

Group A- Trunk exercises on Swiss ball	**In supine lying**	**Pelvic bridging:** in supine lying both the patient's legs are placed on a Swiss ball and asked to lift the pelvis off the support surface. Initially the ball was kept beneath the knees and advanced to the lower leg. **Unilateral bridging:** was performed by lifting the uninvolved leg off the ball while maintaining the pelvic bridge position. **Trunk rotation:** was performed by placing the both the patient's legs on the Swiss ball and asked to move the ball to both the left and the right by rotating the pelvis. Initially the ball was placed beneath the knees, and then advanced towards the ankles.
	In sitting	**Static sitting balance:** the patient was seated on the Swiss ball with hips and knee bent at 90 degrees and the feet kept flat on the support surface. **Trunk flexion- extension:** the patient flexes and extends the trunk without moving the trunk forwards or backwards. **Trunk lateral flexion:** Upper trunk lateral flexion: was executed by initiating movement from the shoulder girdle so as to bring the elbow towards the ball. **Lower trunk lateral flexion:** was achieved by initiating movement from the pelvic girdle so as to lift the pelvis off the ball and bring it towards the ribcage. **Trunk rotation:** Upper trunk rotation: was performed by moving each shoulder forwards and backwards. Lower trunk rotation: was performed by moving each knee forwards and backwards. **Forward reach:** was performed by asking the patient to reach a fixed point at shoulder height by forward flexing the trunk at the hips. **Lateral reach:** was performed by asking the patient to reach out for a fixed point at shoulder height so as to elongate the trunk on the weight-bearing side and shorten the trunk on the non-weight-bearing side.
Group B-Trunk exercises on bed	**In supine lying**	**Pelvic bridging:** in supine lying both the patient's legs are placed on the bed and asked to lift the pelvis off the bed. **Unilateral bridging:** performed by lifting the uninvolved leg off the bed while maintaining the pelvic bridge position. **Trunk rotation:** was performed in crook lying position by rotating the pelvis to both sides.
	In sitting	**Trunk flexion- extension:** the patient flexes and extends the trunk without moving the trunk forwards or backwards **Trunk lateral flexion:** Upper trunk lateral flexion: the patient touches the exercise table with one elbow and returns to the starting position. **Lower trunk lateral flexion:** the patient lifts one side of the pelvis and returns to the starting position. **Trunk rotations:** Upper Trunk: the patient, while sitting in the upright position, moves each shoulder forwards and backwards. **Lower trunk:** the patient, while sitting in the upright position, moves each knee forwards and backwards. **Forward reach:** was performed by asking the patient to reach a fixed point at shoulder height by forward flexing the trunk at the hips. **Lateral reach:** was performed by asking the patient to reach out for a fixed point at shoulder height so as to elongate the trunk on the weight-bearing side and shorten the trunk on the non-weight-bearing side.

Intervention: Both the groups received intervention for twelve days. Each session was for 45mins Group A patients performed a set of trunk exercises using Swiss ball. The exercises were performed in supine lying and sitting position. Group B patient performed the same set of exercises on a bed. For both the groups the exercises were gradually introduced and the number of repetitions was determined on the basis of the patient's performance. The intensity of the exercises was increased by: Reducing the base of support, Increasing the lever arm, Advancing the balance limits, Increasing the hold time. Exercises that were performed by both the groups are given in Figure 2.

Outcome measures: Trunk control before and after intervention was assessed using Trunk Impairment Scale and balanced sitting component of Motor Assessment Scale. A systemic review of clinical of clinical tools designed to evaluate trunk performance after stroke has concluded Trunk Impairment Scale developed by Verheyden et al has found to be with essential Psychometric properties in stroke [22]. Test-retest and interobserver reliability for the TIS total score (ICC) was 0.96 and 0.99, respectively [23]. The MAS was found to be highly reliable with an average interrater correlation of .95 and an average test-retest correlation of .98 [24].

Data analysis: The data were analyzed using SPSS 17.0. Descriptive statistics were established for both the groups. Paired't' test was used to find the difference within the group between pre and post intervention scores in the outcome measures. Independent't' test was used to find the difference between the groups in the outcome measures. The statistical significance for this study was set as p< 0.05.

RESULTS

The aim of this study was to examine whether trunk exercises performed on Swiss ball are more beneficial than similar exercises performed on bed.

As shown in Table 1, all participants in group A and group B showed improvement in Trunk Impairment Scale scores with a mean difference of 6.5 and 4.38, standard deviation of 1.84 and 1.50 respectively. The calculated 't' value using the paired test for group A and B were 9.96 and 8.21 respectively, which was greater than the table value of 5.41; P<0.001. This shows there is a significant improvement in Trunk Impairment scale in both groups.

Table 1: Mean, Mean difference, Standard Deviation and Paired 't' test values of Trunk Impairment Scale of groups A&B.

Groups (TIS)	Mean	Mean Difference	Standard Deviation	't' Value	'p' Value
Group A					
Pre-test	10.5	6.5	1.84	9.96	P<0.001
Post-test	17				
Group B					
Pre-test	10.87	4.38	1.5	8.21	P<0.001
Post-test	15.25				

As shown in Table 2, in Motor Assessment Scale scores group A and group B showed significant improvement with a mean difference of 2.12 and 1.25, standard deviation of 0.64 and 0.45 respectively. The calculated 't' value using the paired test for group A and B were 9.34 and 7.83 respectively, which was greater than the table value of 5.41;P<0.001.This shows there is a significant improvement in Motor Assessment scale in both groups.

Table 2: Mean, Mean difference, Standard Deviation and Paired 't' test values of Motor Assessment Scale of groups A&B.

Groups (MAS)	Mean	Mean Difference	Standard Deviation	't' Value	'p' Value
Group A					
Pre-test	2.75	2.12	0.64	9.34	P<0.001
Post-test	4.87				
Group B					
Pre-test	2.75	1.25	0.45	7.83	P<0.001
Post-test	4				

As shown in Table 3, when comparing between the groups using independent 't' test, the Trunk Impairment Scale scores showed mean difference of 2.12, standard deviation of 1.67 and 't' value of 2.56 which was greater than the table value of 2.145; P<0.05.The Motor Assessment Scale scores showed mean difference of 0.87, standard deviation of 0.54 and 't' value of 3.22 which was greater than the table value of 2.145; P<0.05. This result shows that there is statistically significant improvement in group A which underwent trunk exercises in Swiss ball than group B which underwent trunk exercises in bed.

Table 3: Independent "t" Test valueS for Trunk Impairment scale and Motor Assessment scale.

Outcome Measures	Mean Difference	Standard Deviation	't' value	'p' value
Trunk Impairment Scale (TIS)	2.12	1.67	2.56	P<0.05
Motor Assessment Scale (MAS)	0.87	0.54	3.22	P<0.01

DISCUSSION

The possible reason for better trunk control improvement in the Swiss ball group may be as the movement of the Swiss ball under the patients provided a postural perturbation to which the trunk muscles respond reactively in order to maintain the desired postural stability.

The study results had shown that trunk exercises performed on a Swiss ball resulted in a greater improvement in trunk lateral flexion as measured by the dynamic sitting balance subscale of the Trunk Impairment Scale as compared with the improvement in the group which performed trunk exercises performed on bed. A recent study by KarthikBabu et al has found that significant improvement in trunk lateral flexion in the physio ball training group than in plinth training group [25]. The results found in their study were similar with the results obtained in our study.

Another finding from our study which is shown in Table 4 is that there was greater improvement in trunk rotation in the Swiss ball group as measured by coordination subscale of the trunk impairment scale as compared with the improvement registered in the trunk exercises performed in bed group.

The possible improvement might be due to the improved weight shift ability with the Swiss ball training. Furthermore, the trunk exercises performed on the bed involves the same exercises as Swiss ball training, but the inadequacy of trunk training on bed acting on coordination would only be due to lack of postural perturbation.

A study by Verheyden et al has concluded that 10 hours of additional supervised trunk exercises on ground level results showed change in dynamic sitting balance but not in coordination subscale in Trunk Impairment Scale [14]. Similar results was found in our study in the group which performed trunk exercises on bed which showed change in dynamic sitting balance and not in coordination subscale, but the group which performed trunk exercises on Swiss ball showed significant change in both Dynamic Sitting balance and Coordination subscales in Trunk Impairment Scale. The change in coordination subscale in the Swiss ball training group may be as we trained in the unstable surface which may result in better recruitment of trunk muscles.

For the static sitting balance subscales, there is no notable result in both groups as the participants in the study was able to sit without support for 1 minute and also the mean score on the static sitting balance subscale for both groups pretreatment was 6 out of a maximum of 7 points.

Limitations of the study

1. This study included only a small number of participants.

2. There was a lack of long term follow up of

	Group A (within group comparison)			Group B (within group comparison)		
Outcome Measures	Pre-intervention	Post-intervention	Change scores	Pre-intervention	Post-intervention	Change scores
Trunk Impairment scale (0-23)	10.5	17	6.5	10.87	15.25	4.38
Static Sitting Balance (0-7)	5.87	6.62	0.75	6	6.75	0.75
Dynamic Sitting Balance (0-10)	3.62	7.25	3.62	3.87	6.62	2.75
Coordination (0-6)	1	3.12	2.12	1.12	1.87	0.75

Table 4: Comparison of change in Mean scores in subscales of Outcome Measures.

patients to find out the carry over effects of the intervention.

3. The functional status of the patients was not assessed following intervention.

CONCLUSION

This study was conducted to compare the efficacy of trunk exercises on Swiss ball with trunk exercises performed on bed in improving trunk control among hemi paretic patients. The results of the study shows that trunk exercise performed on either Swiss ball or bed can improve the trunk control. But statistically Swiss ball training gives more significant improvement in trunk control than bed exercises. Moreover the trunk coordination improves more when trained on Swiss ball than on bed.

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Conflicts of interest: **None**

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