ORIGINAL RESEARCH PAPER

Physiotherapy

EFFECTS OF TRUNK EXERCISES ON PHYSIOBALL VS PLINTH ON TRUNK CONTROL AND FUNCTIONAL BALANCE IN POST STROKE HEMIPLEGIC PERSONS

KEY WORDS: balance, hemiplegia, Physioball, plinth, trunk rehabilitation, trunk control, stroke

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ABSTRACT

INTRODUCTION: Involvement of trunk in hemiplegia due to stroke has an impact on balance and functional ability, which is assessed clinically using tools like trunk impairment scales and Brunel balance assessment scale. The aim of the study was to find out the effects of trunk exercises performed using the physio ball as against the plinth, on trunk control and functional balance in patients with post stroke hemiplegics.

METHODOLOGY: Thirty patients with mean post-stroke duration 3.6 months who had the first onset of unilateral haemorrhagic or ischemic lesion and an independentability to sit for 30 seconds were randomly distributed into 2 groups. The physioball group performed trunk exercises on physioball while the plinth group performed them on plinth. Trunk Impairment Scale and Brunel Balance Assessment were measured prior to the beginning of treatment and were repeated after the completion of 4 weeks treatment.

RESULTS: Post-intervention, both the groups improved on trunk control and functional balance but the physioball group improved more significantly than the plinth group (The change score of 2.86 between-group comparison for the total Trunk Impairment Scale of 12.46% favours the physioball group, change score of 1.74(14.5%) between-group comparison for the total brunel balance assessment scale favours the physioball group).

CONCLUSIONS: The trunk exercises performed on the physioball are more effective than those performed on the plinth in improving both trunk control and functional balance in stroke patients.

INTRODUCTION

The trunk being the central key point of the body, proximal trunk control is a prerequisite for distal limb movement control, balance and functional mobility. Trunk performance is considered to be less affected after stroke than the performance of the upper and lower extremities because trunk muscles are innervated by both hemispheres.[1] Contrary to the extremities, trunk is involved bilaterally in stroke whose identification plays a crucial role in planning treatment strategies in rehabilitation. Trunk control requires appropriate sensory-motor ability of the trunk in order to provide a stable foundation for balance functions in persons with stroke. Involvement of trunk is assessed clinically using tools like trunk control test, and trunk impairment scales (TIS). Hand held dynamometers, isokinetic dynamometers, posturography and surface electromyography (EMG) are of choice to quantify the involvement of trunk.

Study using Trunk Impairment Scale (TIS) found that selective movements of the upper and the lower trunk are impaired in post stroke patients. The exercises consisted of selective trunk movement of the upper and the lower part of trunk had shown larger effect size index for trunk control and balance in persons with chronic stroke. Recent evidence supports that the ability of balance and walking in stroke subjects depends on the performance of trunk function as measured by trunk control test and TIS. [2] Hemiparetic persons with poor trunk function (trunk control) at admission stayed longer in a rehabilitation ward compared to persons who had better initial trunk function and could walk longer distances with speed at discharge. [3] Recent work by Verheyden et al. demonstrated that 10 hours of additional task-specific trunk exercises performed on the physioplinth along with regular physiotherapy had a beneficial effect on the selective movement control of the lateral flexion in persons with subacute stroke. [4]

Many physiotherapists working with persons after a stroke in order to improve their trunk control and balance use a dynamic treatment instrument (i.e. physioball) the efficacy of the method has limited study. Trunk exercises performed on a physioball lead to better trunk muscle activity in healthy individuals, it is therefore possible that the same may be beneficial for patients who have had a stroke. [5] There studies providing effectiveness of physioball training and plinth trunk exercises in improving trunk control but comparative study which one is better is limited for stroke persons, hence attempts has been made to know the effectiveness of physioball training over physiotherapy in improving trunk control and functional balance in post stroke hemiplegic persons.

METHODOLOGY

- STUDY DESIGN: Pre-test and post-test experimental study design
- SOURCE OF DATA: SVNIRTAR, Cuttack, Odisha
- SAMPLE SIZE: 30 subjects
- POPULATION: Hemiplegic stroke subjects who met the inclusion and exclusion criteria were recruited for the study. A written informed consent was obtained from each subject.
- GROUP ASSIGNMENT: Selected subjects were randomly assigned to the two groups after getting written consent.
- INCLUSION CRITERIA:
- Persons with hemiplegic due to stroke who were medically stable and able to understand and follow simple verbal instructions.
- scoring less than or equal to 21 out of 23 on Trunk Impairment Scale
- Persons diagnosed as stroke without any fixed hip, knee and ankle deformity
- Could able to sit independently with their feet touching the ground for 30 seconds on a stable surface.
- Post stroke duration greater than 1 month and less than 6 months
- Both the genders included in the study.
- EXCLUSION CRITERIA:
- Any neurological disease affecting balance other than stroke such as cerebellar disorders, Parkinson's disease and/or Vestibular lesion
- maximum trunk performance score at the start of the study
- 70 years of age or older
- Musculoskeletal disorders such as low backache, arthritis or degenerative diseases of the lower limbs affecting motor performance.

PROCEDURE:
After meeting the inclusion and exclusion criteria, informed consent was taken from the participants willing to participate in the study and randomly allocated to the two groups:-

Group 1: **PHYSIOBALL**
Group 2: **PLINTH**

All participants underwent an initial baseline assessment of TIS and BBA.

TRUNK IMPAIRMENT SCALE (TIS)
- A new tool to measure motor impairment of the trunk after stroke. The total score ranges from minimum 0 to maximum 23 points, a higher score indicating a better performance.
- It measure static and dynamic sitting balance as well as trunk co-ordination. It also aims to score the quality of trunk movement and to be a guide for treatment.
- The total TIS score above 21 is considered to be the normal trunk performance in sub-acute and chronic stroke persons.

BRUNEL BALANCE ASSESSMENT (BBA)
- BBA consists of a hierarchical series of functional performance tests that range from supported sitting balance to advanced stepping tasks. There are three sections to the assessment: sitting, standing and stepping.

Both the groups received 30 minutes of trunk exercises, 5 times a week, for 4 weeks. Exercises consisted of selective movements of the upper and lower part of the trunk in supine and sitting. The physioball group performed trunk exercises on a (unstable surface) physioball while the plinth group performed same exercises on a (stable surface) plinth. The trunk exercises were initiated with moderate assistance and progressed to a state of no assistance. The number of repetitions and intensity of the exercise were determined by the physiotherapists based on the patient's performance. The exercises were performed with adequate rest periods in between. The intensity of the exercises was increased by introducing one or several of the following change. (1) Reducing the base of support (2) Increasing the lever arm (3) Advancing the balance limits (4) Increasing the hold time (5) Increasing number of repetitions on the basis of patients' performance.Conventional exercises includes tone facilitation, stretching and range of movement exercises for the hemiplegic side.
Exercises include following.

SUPINE EXERCISE
- Pelvic bridging (unilateral and bilateral)
- Flexion rotation of lower trunk
- Upper trunk rotation (diagonal reach)
- Lower trunk rotation (both leg on ball)

SITTING EXERCISE
- Flexion extension of lower trunk (anteflexion and retroflexion of the lower part of the trunk)
- Upper trunk lateral flexion
- Lower trunk lateral flexion
- Upper trunk rotation (by moving each shoulder forward and backward)
- Lower trunk rotation (while sitting in the upright position, moves each knee forwards and backwards)
- Weight shift (shifts weight from one side to other and moves forward and backwards)
- Forward/forward diagonal/lateral reach
- Sitting leaning backwards and forwards

Conventional exercises include tone facilitation, stretching and range of movement exercises for the hemiplegic side.

DATA COLLECTION:
Measurements were taken prior to the beginning of treatment and were repeated finally after the completion of 4 weeks treatment protocol.

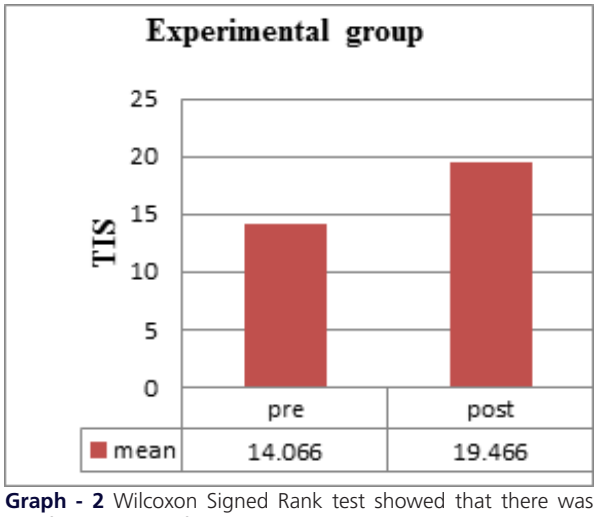
DATA ANALYSIS:
Data was analyzed using non parametric, **Mann - Whitney U Test** to test difference between pre to post change scores of plinth group with that of the physioball group.

Wilcoxon Signed Rank Sum test is used to test the within group difference in pre and post intervention scores. 0.05 level of significance was used for hypothesis testing. Analysis was performed using SPSS versions 16.0 package

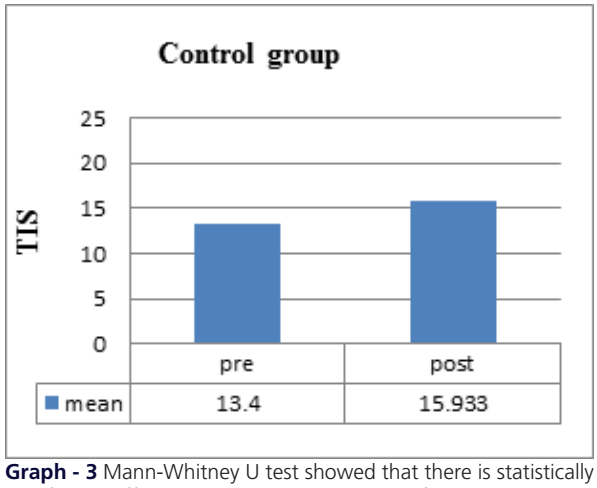
RESULTS:
The study results showed that trunk exercises performed on the physioball are more effective than those on the plinth for improving trunk control as measured by Trunk Impairment Scale and functional balance as measured by BBA. Trunk control and functional balance improvement was significant from pre to post measurements in both experimental and plinth group, however physioball group showed significant more improvement than plinth group, providing selective trunk muscle exercise regimen on physioball along with conventional treatment is more effective than same exercises on plinth along with conventional treatment. Furthermore, the experimental (physioball) group showed greater improvement in functional balance, than the plinth group, suggesting a carry-over effect with trunk rehabilitation.

TRUNK IMPAIRMENT SCALE

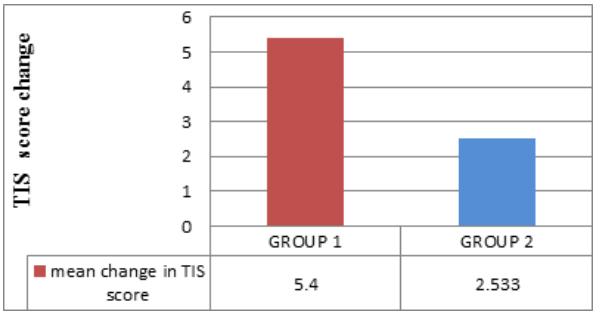
Graph - 1 Wilcoxon Signed Rank test showed that there was significant change from pre to post score within physioball group. P=0.001, Z= -3.421. Graph 1 also depicts the same.



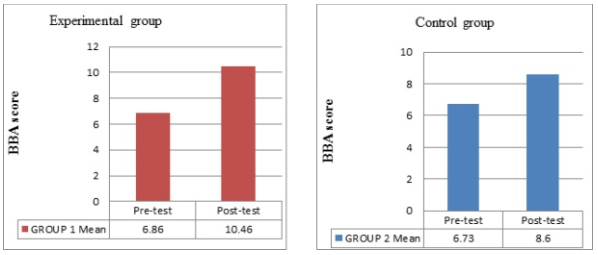
Graph - 2 Wilcoxon Signed Rank test showed that there was significant change from pre to post score within plinth group. P=0.001, Z=-3.448. Graph 2 also depicts the same.

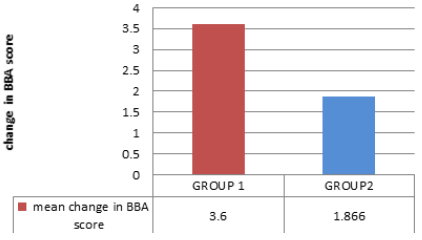


Graph - 3 Mann-Whitney U test showed that there is statistically significant difference in the change score of TIS between the groups. P=0.00, Z=-4.155. So the extent of improvement in physioball group is more which is depicted in graph 3.



BRUNEL BALANCE ASSESSMENT





Graph - 6 Mann-Whitney U test showed that there is statistically significant difference in the change score in BBA between the groups. P=0.001, Z=-3.37. So the extent of improvement in physioball group is more significant which is also depicted from Graph 6.

DISCUSSION

RATIONALE FOR IMPROVEMENT OF TRUNK CONTROL

The plinth group, the change score of 2.53 of TIS suggests 11.01% improvement post intervention, Rrationale for improvement in trunk performance in plinth group was i) elective trunk exercise designed based on the items in TIS, ii) strengthening of trunk muscle, iii) increased awareness of trunk position, iv) anticipatory postural adjustments. Following studies favour the same result Geert Verheyden et al. examined the effect of additional trunk exercises on trunk performance after stroke. [4] The physioball group received 10 hours of individual and supervised trunk exercises; 30 minutes, 4 times a week, for 5 weeks. Trunk performance was evaluated by the Trunk Impairment Scale (TIS) and its subscales of static and dynamic sitting balance and coordination. Post treatment, a significantly better improvement was noted in the physioball group compared to the plinth group who receives only conventional exercises for the dynamic sitting balance subscale. Karthikbabu S et al.studied to determine the role of trunk rehabilitation on trunk control, balance and gait in patients with chronic stroke. [2] The exercises consisted of selective trunk movement of the upper and the lower part of trunk had shown larger effect size index for trunk control and balance than for gait in persons with chronic stroke.

Within physioball group change score of 5.4 of the Trunk Impairment Scale suggests a 23.47% improvement in the post-intervention phase. The significant trunk control improvement in physioball group may be attribute to training on dynamic surface leads to better potential activation of trunk musculature rather than when they are performed on a plinth, since the movement of a ball beneath the participants provides postural perturbation to which the muscles respond in order to maintain the desired posture.In addition anticipatory postural adjustments of trunk muscles play a major role in maintaining antigravity postures like sitting when a reaching task is executed. [6]

The change score of 2.86 between-group comparison for the total Trunk Impairment Scale of 12.46% favours the physioball group. In this study it was observed that difference in effect between the two interventions (trunk exercises on the physioball vs. those on the plinth) was 2.86, Which may be compared with the observed mean difference of 3.06 between the two interventions (trunk exercises on the physioball vs. those on the plinth) in the study done by Karthikbabu S et al. [2, 7]

RATIONALE FOR IMPROVEMENT OF FUNCTIONAL BALANCE

The change scores of within-group comparison were statistically significant for both the plinth group 1.87 (15.5%) and the physioball group 3.6 (30%), suggesting improvement for both the groups in the post intervention period.

Rationale for the gains in balance when all the training was done in supine and sitting is given below. Selective trunk muscle exercises in supine position include the use of lower limb muscles also, which could account for change in BBA results. Experts in the field of neurological rehabilitation have addressed the trunk as the central key point of the body, and the control of movement proceeds from proximal to distal body regions. Motor control literature suggests that if an improved level of proximal trunk control gains were attained, a better distal limb control might be anticipated during balance and functional mobility. A cross sectional studies by Verheyden et al. favours this hypothesis. [8] Furthermore, studies by Dean CM et al. found that, there was an improvement of standing balance following dynamic sitting balance training in persons with stroke. Dean CM et al. did a randomized placebo-controlled study to evaluate the effect of a 2-week task-related training program aimed at increasing distance reached and the contribution of the affected lower leg to support and balance. After training, experimental subjects were able to reach faster and further, increase load through the affected foot, and increase activation of affected leg muscles compared with the plinth group. [9]

In this study, the physioball group after trunk rehabilitation had advanced almost two levels more than the plinth group, and this may affirm a factual clinical importance for Brunel Balance Assessment. According to Tyson people with stroke progressing from one level to another level is of clinical importance for the Brunel Balance Assessment. [10] Persons with stroke treated on physioball were able to walk 5m without an aid in one minute, which means they could change the base of support between double and single stance. Furthermore, they had attained a dynamic single stance level (i.e. placing the sound leg twice on and off a step while standing on the hemiplegic leg for 15 seconds). The reason for the significant stepping balance improvement using the physioball intervention may be an improvement in lower trunk muscle control which is essential for the stabilization of the pelvis. If an improved level of proximal pelvic stability is attained, better distal lower extremity mobility might be anticipated, such as that involved in stepping balance. An intervention study by True blood et al. gives further support to this hypothesis. In their study, proprioceptive neuromuscular facilitation (PNF)-based resisted anterior elevation and posterior depression of pelvic movements for lower trunk muscles resulted in an improvement in walking in early phase stroke person. [11]

CONCLUSIONS: The trunk exercises performed on the physioball are more effective than those performed on the plinth in improving both trunk control and functional balance in stroke patients.

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