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A Study on Effectiveness of Postural Trunk Control with Symmetrical Weight Bearing During Sit to Stand Performance in Improving Balance and ADLs for Individuals with Post Stroke Hemiparesis

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ABSTRACT: Background: The endeavor of this study was to assess the effectiveness of sit to stand exercises in individuals with hemiparesis with simultaneous loading of equal weight on both lower limbs. The objective was to control posture for improving balance and reducing inability to do the ADLs (Activities of Daily Livings) in post hemiparetic individuals. **Methodology:** Convenient sampling and random allocation to groups were used to select and assign the sample that comprised of 60 subjects. Standardized tools such as Berg Balance Scale for evaluating the balance, Barthel Index score for evaluating daily activity. Experimental approach was chosen for conducting the study with pre-intervention and post-intervention evaluation of the outcomes. The total four treatment sessions were done by doing sit to stand activities with backward step, forward step followed by affected leg then unaffected leg respectively. Then total body weight bearing was done with assistance. These were done under first and second treatment session. Some balance activities in standing, sitting and training of daily activity was done under third and fourth treatment session. **Result:** The results of the study suggested that there was highly significant difference between the mean values of balance by using pre and post interventions of Berg balance scale. The findings also suggested that there was significant difference for ADLs by using pre and post interventions of Barthel index score. **Conclusion:** this study concluded that with common interventions of equal load distribution and postural trunk control in sit to stand activities, significant improvement can be achieved in balance and daily activity performance.

KEYWORDS: ADLs (Activities of Daily Livings), hemiparesis, Berg balance scale, Barthel index score

I. INTRODUCTION

A stroke, sometimes referred by the older term cerebrovascular accident (CVA), is the rapid loss of brain function due to disturbance in the blood supply to the brain. Stroke is a condition in which the brain cells suddenly die because of a lack of oxygen. [1-3] This can be caused by an obstruction in the blood flow, or the rupture of an artery that feeds the brain. This can be due to ischemia (lack of blood flow) caused by blockage (thrombosis, arterial embolism), or a haemorrhage. As a result, the affected area of the brain cannot function, which might result in an inability to move one or more limbs on one side of the body, inability tounderstand or formulate speech, or an inability to see one side of the visual field. This is a medical emergency and can cause permanent neurological damage and death. [4-7]

The aims of physiotherapy for stroke patients are to maintain mobility of limbs and prevent complications. Weakness would develop in the affected limbs. In more severe cases, even increased spasticity, contracture, joint stiffness and deformity could result. Physiotherapy could improve patients' limb function and self-care ability through appropriate rehabilitation exercises and education about proper usage of assistive devices. [8]

Hemiparetic stroke patients frequently present balanceabnormalities. Balance impairments increase fall risk, resulting in high economic costs and social problems. The ability to stand-up from a seated position is an important functional task

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performed several times throughout the day. [9]

This study planned to see the effects of repetitive sit to stand activitiesby the assistance of therapist or any equipment to get balance and ADLs of post stroke hemiparetic patients during first 6 months of period. [10]

II. MATERIALS & METHODOLOGY

The study adopted experimental design, which was carried out on 60 subjects with hemiparesis to findout the effectiveness of postural trunk control with symmetrical weight bearing in improving balance and ADLs. The subjects had no evident language, cognition, or sensory deficits. Convenient sampling method was adopted for the study and then the subjects were randomly allocated into one study groups for four sessions.

Dependent variables: Trunk control test, Sitting balance test
Independent variables: Berg balance scale**,** Barthel index scale

Inclusion Criteria

1. Age limited between 50-80yrs,
2. Gender eligibility of both sex (male & female),
3. Include both haemorrhagic & ischemic stroke,
4. Post Stroke hemiparesis up to 6 month,
5. Either right or left hemisphere involve stroke,
6. Ability to understand and follow simpleverbal instruction,
7. At least 1 year post stroke onset,
8. Meantime poststroke-10wk,
9. Patient should be able to hear commands,
10. Patientshould be able to sit independently ,with no assistance during initial testing,
11. Patient should be able to do the task from sit to stands with support,
12. Patient having good understanding of simple instructions,
13. Patient having the capability of grasping and hold a cane in their hands,
14. Sitting balance test— 4~4, 15) Trunk control test- 44<100,
15. Berg balance scale- 25<100,
16. Barthel index score—50<100,
17. No serious cognitive problems,
18. No serious uncontrolled medical problems,
19. Ability to understand the content of training period and motivation of participants,
20. Patients of both IPD and OPD,
21. Not participating in any experimental drug field study or in any formal physicalrehabilitation Program.

Method

The Berge balance scale:- The Berg Balance Scale (BBS) was identified as the most commonly used assessment tool across the continuum of stroke rehabilitation. . The Berg Balance Scale (BBS) was originally designed to quantitatively assess balance in older adults The BBS is a psychometrically sound measure of balance impairment for use in post stroke assessment. The Berge Balance Scale is a 14-item scale that quantitatively assesses balance and risk for falls in older community- dwelling adults through direct observation of their performance. The scale requires 10 to 20 minutes to complete and measures the patient's ability to maintain balance—either statically or while performing various functional movements—for a specified duration of time. The items are scored from 0 to 4, with a score of 0 representing an inability to complete the task and a score of 4 representing independent item completion. A global score is calculated out of 56 possible points. Scores of 0 to 20 represent balance impairment, 21 to 40 represent acceptable balance, and 41 to 56 represent good balance. The BBS measures both static and dynamic aspects of balance. The ease with which the BBS can be administered makes it an attractive measure for clinicians; it involves minimal equipment (chair, stopwatch, ruler, and step) and space and requires no specialized training. Berg Balance Scale scores predicted length of stay, discharge destination, motor ability at 180 days post stroke, and disability level at 90 days, but these scores were not predictive of falls. Eight studies focused on responsiveness; all reported moderate to excellent sensitivity. Accurate evaluation of balance is important for prescribing appropriate mobility aids, determining the most effective treatment interventions, and identifying safe and unsafe activities after stroke. Because balance changes over time after stroke, it also is important to have a quantifiable measure that clinicians can use to monitor these changes and adjust treatment accordingly. [11-13]

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Barthel Index Score:- The Barthel index is used to measure performance in activities of daily living (ADL). Each performance item is rated on this scale with a given number of points assigned to each level or ranking. It uses ten variables describing ADL and mobility. The scale was introduced in 1965 and yielded a score of 0–20. The purpose of the Barthel Index in to assess the level of functional independence of physical disability. [12,13]

III. MEASUREMENT PROCEDURE

All the measures were administered before and after the intervention. The physiotherapist obtained informed consent from each patient or a family member, tested the patient's sitting balance, and assessed the trunk control test . First assessed the patient's trunk control . The Trunk Control Test can be used to assess the motor impairment in a patient who has had a stroke. It correlates with eventual walking ability. Testing done by patient lying on bed:

(1) roll to weak side (2) roll to strong side (3) balance in sitting position on the edge of the bed with the feet off the ground for at least 30 seconds (4) sit up from lying down. [15-18]

Then assess the sitting balance. This was tested using the standard technique for evaluating static and dynamic sitting balance. The patient sat on the side of a hospital bed, feet on the floor, back unsupported, and hands on the lap. If the patient could hold this position without assistance for 15 seconds, he was nudged by the physiotherapist anteriorly, posteriorly, and laterally using approximately 5-10 foot-pounds of force. The physiatrist guarded the patient from falling with his free hand. The patient's sitting balance was scored as 4, normal: able to perform the above testing without any physical assistance; 3, good: able to maintain a static position without difficulty but requiring assistance in righting from the hemiplegic side; 2, fair: able to maintain a static position without difficulty but requiring assistance in all righting tasks; or 1, poor: unable to maintain a static position. Sitting balance was evaluated on admission to the rehabilitation unit and every week while the patient was in the hospital. [17-21]

IV. INTERVENTION PROTOCOL

Patients were randomly allocated into one group, four session a day. Each training session consisted of 15 minutes of sit to stand activities. Rest breaks were permitted as needed according to the participant's tolerance, but were not included in the overall STS (sit to stand) activities.

Participants' heart rates and blood pressure were monitored before each session began, at all rest breaks, and after completion of each session to ensure that they could safely continue training. All patients received conventional rehabilitation program for hemiplegic (stretching, strengthening, balance activities, other functional activities) according to the requirement of each patient.

All the 60 patients were seat on an armless chair, brakeless chair or on a bed, which was adjusted to allow for approximately 90 degree of hip and knee joints and back in straight position. The distance between both the feet was measured by measurement tape. Then STS task was performed with shoe off.

First treatment session was lasted for twenty minutes (1st to 2nd month) .The therapist was assist the patient to stand from a sitting position with backward step taken by non-affected limb. Then tell the patient to use his/her paretic limb when taking forward step during standing(7-10 times within 5minute).then again sit to stand with forward step of non-paretic limb with support. Bear the total body weight as symmetrically on both the leg (practice for 7times for 5min.)After these, therapist told the patient to sit down by shifting of weight on affected limb with support.

Second treatment session also lasted for 20 min (3rd to 4th month). Activities done by moderate to mild assistance of therapist.

Third treatment session (4^{th} to 5^{th} month for 20 min) focused on balance achievement, during standing and moving, therapist should give another task like standing the patient by holding a stick, followed by moving in various directions(10min). Then, catching a Swiss ball during standing in different direction (10min). After that therapist assessed the patient by pushing him/her to different direction to assess the balance of patient.

Fourth treatment session (5^{th} to 6^{th} month) focused for ADL of patient. Therapist trained the patient about activities of daily living like how to go to toilet, how to walk on a ramp, stepper etc.

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Measurement 1 The berg balance scale was used to measure the midline position of COG and weight bearing distribution. During each measurement session the patient positioned, patient with recommended foot placement and the patient asked to stand as asymmetrically as possible with keeping his or her feet still and arm relaxed at both side. Weight bearing parameters selected through berg balance scale. Three readings taken for each measurement of weight distribution and the average value used for data analysis. The COG position selected from berg balance standard assessment with patient's eyes open. [21]

Measurement 2

60 patient with acute hemiparesis asked to stand up and sit down at their natural speed in the following foot position :-

- ✓ Spontaneous
- ✓ Symmetrical
- ✓ Asymmetrical with affected foot placed backward
- ✓ Asymmetrical with unaffected foot placed backward And vertical forces are applied to feet and thighs.Some reaching task should be given to patient 's affected side while attempt to stand from a sitting position in 4 different events:- Time of onset
- ✓ Transition (forces under feet and thighs)
- ✓ During seat off During Seat-On
- ✓ At the end of the task [22]

V. STEPWISE PROCEDURES

a. Subjects referred to Physiotherapy Department
b. Subjects were screened for fulfillment of eligibility to be included in the study and evaluated in detail
c. Convenient sampling done. Written consent obtained from subjects [n=60]. Allocation done in a one group, treatment sessions: 04 each session lasted for 20 min/ day for 6months.
d. The first treatment group [n = 60] received sit to stand activities with support of therapist for 20min.
e. The second treatment group [n=60] received same sit to stand activities with mild support of therapists and some reaching ta given for 20 min.
f. The third treatment session group [n=60] did some balance activities for 20min.
g. The fourth treatment group [n=60] train for stepper activities, walk on the parallel bar for 20min.
h. The subjects' treatment outcomes were assessed based on the balance and functional activities at end of 6 months with the help of Berge balance scale and Barthel Index score. All the data pertaining to the outcomes were recorded in a master chart.
i. Interpretation of all the collected data.

VI. DATA ANALYSIS

Statistical Analysis was done by using the statistical software namely, SPSS 10.0 Version. Microsoft word and Excel have been used to generate graphs, tables etc.

Descriptive statistics (mean, median, SD, t value and p value) were calculated to quantify the clinical evaluation, trunk balance, ADL. There was highly significant difference in the effectiveness of postural trunk control associated with weight bearing treated by sit to stand task to improve the balance activity and ADL will be analysed statistically using independent t test.

VII. RESULT

Sixty (60) individual with acute hemparesis participated in this study. They had a moderate level of motor impairment .The sitting balance is scored 4 .during initial sitting, all subjects supported ~60% of body weight on the buttock and ~40%of body weight on the feet. We focused the analyses on a preparatory phase and a rising phase based on the analyses of ground reaction forces. The postural trunk control with weight bearing program for normalization of weight bearing program of post hemiparetic patient.

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Table: 1 Comparison mean, median, mode of age of Hemiparetic subjects

Age	Mean	Med	SD
	55.97	55.0	15.53

Table: 2 Comparison of Mean, Median, Mode, SD of Pre and Post intervention of Berg Balance Scale (BBS)

BBS	Mean	Med	Mode	SD
Pre Scale	31.76	31	28	24.72
Post Scale	33.43	32	30	4.53

Table: 3 Comparison of Mean, Median, Mode, SD of Pre and Post intervention of Barthel Index Score (BIS)

BIS	Mean	Med	Mode	SD
Pre Scale	56.93	57	57	3.73
Post Scale	58.15	58	59	3.92

Table: 4 Comparison of 't' value and 'p' value of both BBS and BIS

Scale	t Value	p Value
BBS	1.67	3.98
BIS	1.67	2.6

VIII. DISCUSSION

Postural stability can be understood as the ability to keep the center of gravity (CG) within the limits of the BS, or stability limits; these limits are not fixed, but rather can be modified according to tasks, movements, individual biomechanics, and environmental aspects. Thus, impairments in range of movement, tone, strength, and muscle control can influence postural control. The CNS has an internal representation of stability limits and uses it to determine how to move and maintain balance. The most important biomechanical constraint to balance is the quality and the size of the BS. In hemiparetic patients, weakness and impaired muscle control of the affected lower limb, decreased range of motion, and pain can lead to changes in the BS. The center of pressure (CP) can be displaced anteriorly in the paretic leg because of anteroposterior muscle imbalance in the ankle joint (equinus foot). A positive correlation exists between balance impairments and decreased lower-limb strength. In addition, poor trunk control negatively influences overall balance. Other strategies keep the centre of mass (CM) inside the base of support (BS). [23-25]

Balance control can be reactive (in response to external forces that displace the CM) or anticipatory (voluntary or in automatic anticipation of internally generated forces during gait or performance of movements, such as raising an arm). It depends on the capability of the CNS to predict and detect instabilities and program appropriate patterns of muscle activation. Delays in postural responses may be caused by a slow increase in muscle activity or changes in spatiotemporal coordination of synergies. Patients with stroke use compensatory strategies, including holding objects or walls, and use the step strategy more frequently than do age-matched controls. To maintain the same BS, patients with stroke predominantly use the hip strategy and use the ankle strategy to a lesser extent. However, these strategies are often not efficient for stability, as indicated by the high incidence of falls in patients with stroke. [25,26]

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Although hemiparetic patients can display some anticipatory control in the orthostatic position, their performance is often inferior to age-matched controls. Generation of propulsive forces to initiate displacements of the CM or interruption of these forces so that the CM does not advance beyond the limits of the BS can be inadequate. Patients with mild motor impairments and high functional levels show better anticipatory postural reactions, in spite of abnormal movement activation patterns. [27]

Trunk position sense retraining and symmetrical weight bearing with an emphasis on sagittal and transverse movements may prove to be an important intervention strategy to improve trunk stability for balance and for coordinated functional extremity movements.

The present study suggest that the weight transfer from sit to stand is induced by ground forces exerted by buttocks and feet before seat-off, that is during the preparatory phase. The buttock generate the isometric “rising forces”. The propulsive impulse for the forward acceleration of the body while the feet exerted adequate damping control prior to seat-off. This indicate that the rising movement is a result of these coordinated forces, targeted to match the subject's weight and support base distance between buttock and feet .The force rate derived profiles of backward directed force beneath the buttocks ,forward directed force beneath the feet, and COM A/P velocity were all bell shaped and peaked before seat-off. This suggest that both the beginning and end of the weight transfer process are programmed before seat-off. The peak deceleration of antero-posterior COM took place shortly after COM peak velocity, resulting in a well-controlled COM deceleration before seat-off. [25, 27-29]

IX. CONCLUSION

The study showed that with common interventions of trunk control activities and equal weight bearing on both the lower limb of sixty patients, significant improvements were seen in balance & activities of daily living with sit to stand exercises by using Berge balance scale and Barthel index score when being compared between pre- & post- interventions of scales.

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