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ORIGINAL ARTICLE

Effectiveness of Static and Dynamic Weight Shift Balance Strategies to Improve Balance Performance in patients With Stroke- A randomized controlled trial

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ABSTRACT

Aim: To enhance the balance in post stroke patients by the implementation of static and dynamic weight shift balance strategies.
Methods: Data from 32 patients who complete selection criteria were included to this study. Study design was Randomized controlled trial (RCT). Written informed consent were taken from every individual participating in this study before performing any physical examination. Patients were allocated into two equal groups. On 1st day balance was assessed by Brunel Balance Assessment (BBA), re-accessed by the end of 3rd week and at 6th week. There were two groups, one is Experimental (Group A) receiving static and dynamic weight shift balance training strategies along with conventional physiotherapy treatment while control group (Group B) receiving only conventional rehabilitation program.
Results: The results of the BBA (Brunel Balance Assessment) scale showed statistically significant variations in the pre-post analysis for the experimental group with the p-value less than 0.05. By comparing the BBA scale score of group A and B has shown that there was significant difference between post treatment scores, post treatment mean BBA score was 7.000±1.4142 in group A while 3.6250±1.85742 in group B, with the value of p 0.00, showing that group A is better in improving balance of stroke patients.
Conclusion: Implementation of static and dynamic balance strategies has a significant effect on improvement of balance in the patients suffering from stroke.
Keywords: BBA (brunel balance assessment), CVA (cerebrovascular accident) and RCT (randomized controlled trial)

INTRODUCTION

By definition stroke is vigorously growing global or localized neurological malfunction that persists more than 24 hours due to which results in mortality from causes other than vascular origin. There are two main types of stroke, ischemic and hemorrhagic[1]. Stroke is influencing fifteen million individuals consistently[2].

It is one of the devastating neurological pathology in which blood flow to brain is hindered and due to which stroke stays a health related crisis and ought to be treated accordingly. According survey conducted in 2005 and the American Heart Association's Heart Disease, the majority of strokes (88%) are ischemic in nature, with only about 12% being hemorrhagic. Strokes due to hemorrhagic origin are more likely to end in mortality within 30 days than ischemic strokes[3].

Acute diagnosis of stroke consists of rapid physical examination, screening of vital parameters, basic laboratory parameters, and different brain radiological interventions such as CT-scan or MRI[4]. The inability to maintain an upright position within the limitations of stability or base of support was defined as balance impairment. Balance impairment has a favorable link with other elements of function, such as mobility, ADL, and falls[5]. Sensorimotor issues in stroke patients lead to a loss of static and dynamic balance, as well as a deterioration in proprioception, somatosensory, and vestibular function[6].

The goal of stroke rehabilitation was to improve truncal flexibility, strength, coordination, and symmetry[7]. There is a need to test new ways for improving sitting parity after a stroke, especially in the subacute stage, when neuroplasticity and healing are at their peak[8]. Stroke patients have greater postural instability, which can lead to loss of balance, because they do not have a smooth distal-to-proximal pattern of muscle activation. Visual, vestibular, and proprioceptive inputs all contribute to postural balance, which is necessary for successful performance of daily activities that require[9].

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As the patients suffering from stroke are at a higher chance of developing lethal health issues and psychological problems, such as depression and low health-related quality of life. Therefore, strategies for improving the physical activity after stroke are important[10]. Numerous variables such as abnormal muscle tone, loss of sensory and anticipatory postural control, additionally post-store factors, for example, muscle shortening, muscle decay, limitations of movement, and biomechanical disturbances all contribute hindrance in dynamic activities. The decreased trunk movements seen in patients of stroke, reflects a reluctance to maintain base of support and stabilizing the lower extremity[11].

After a stroke, the first posture to achieve is sitting, which is required for most daily living activities such as eating, transferring, and bathing etc. Within 6 days of the beginning of a stroke, 93% of patients can attain 1 minute of independent sitting balance[12]. In stroke patients, a loss of balance can lead to increased postural sway, a reduction in weight on the affected side of the lower leg, and an increased risk of falling[13]. Reduced postural stability while standing, as well as delayed and less coordinated responses to both self-induced and external balance perturbations, are all symptoms of stroke[14].

Wobble boards, Wii Fit balance training (WBT), virtual reality simulators, computer and robot-assisted gait rehabilitation therapy, artificial-intelligence-based vibrotactile feedback system, and electromechanical gait orthoses have all a positive impact towards the rehabilitation protocols of stroke patients. These high-tech physical treatments necessitate costly equipment and technical knowledge[15].

Clinical balance assessment should evaluate a number of tasks, includes both static and dynamic aspects of balance. Static balance tests are those tests in which there is no overt movement of body during the maintenance of posture, rather than body sway. Dynamic balance tests are those test developed to more adequately evaluate performance on the type of tasks in which falls occur[16].

The importance of this study is that it includes those balance-training strategies that have been incorporated as a part

of early Rehabilitation of stroke patients. These strategies not required any type of expensive, advance and high tech physio equipment or devices. So for the effective and appropriate balance control in stroke patients, these strategies play a basic role in initiation of standing balance and postural control.

MATERIALS AND METHODS

The Institutional Review Board granted ethics approval. Patients and families signed informed written consent forms. The research was carried out at the Mayo Hospital in Lahore's Department of Physiotherapy. The study lasted 6 months after the summary was approved. (1) Acute to subacute stroke; (2) both males and females; (3) a distance of least 10 meters covered by patient with or without assistance (4) the patient could tolerate interventions and evaluations; and (5) the patient could follow a two-step verbal command were the inclusion criteria. Exclusion criteria included: (1) a past history of CVA or any other neurological diseases (e.g., Parkinson's disease); (2) any cardiac related issues such as hearts failure; and. (3) Mini-Mental State Examination (MMSE)24-identified cognitive impairment; and (4) failure to follow directions

By using random numbers in sealed envelopes, all 32 patients who met the criteria were randomly assigned to one of two groups (control or study). Random number tables were used to create the numbers. For six weeks, a single physiotherapist worked with each patient individually. The patient is given three treatments per week, with each session lasting 15 minutes. Starting exercise repetitions will be 5 with progression to 10,12,14,15 per week. Subjects were examined on 1stday, by the end of 3rd week and 6th week. Participants of Experimental (Group A) receiving static and dynamic weight shift balance training strategies along with conventional physiotherapy treatment while control group (Group B) receiving only conventional rehabilitation program. The Brunel Balance Assessment was used to evaluate the sessions' outcomes (BBA).

The BBA is a 12-item questionnaire that assesses post-stroke balance dysfunction in three categories (sitting balance, standing balance, walking function). The scale examination is divided into three sections with a total of 12 elements: sitting (3 items), standing (3 items), and stepping (3 items) (6 items). The total score runs from 0 to 12 (lowest to greatest) (highest). Each item has a pass/fail option; individuals have three attempts to pass each item. The test is finished when an individual is unable to pass after three attempts.

Table 1 shows the exercise protocol for the experimental group (Group A).Total training is of 6 weeks. In week, 1 patient was receiving static sitting weight shift strategy. In week 2 patient was receiving supportive standing with the edge of bed. In week 3 patient was receiving single step training, with further progression into double step training in week 4 and finally in week 5 and 6 further exercise progressions and weight shift maneuvers was added. Table 2 shows the conventional interventions which both groups were receiving.

RESULTS

Table 1 shows the exercise protocol for the experimental group (Group A). Table 2 shows the exercise protocol for the control group. Table 3 depicts the general characteristics of subjects. There were no statistically significant variations in the BBA score findings in the control group and was significantly different in experimental group (Table 4). The results of the BBA score differed statistically significantly between the two groups (p 0.05) (Table 5)

Table 1: Exercise protocol

WEEK 1	**STATIC SITTING WEIGHT SHIFT STRATEGY** Forward Reach Backward Reach Side to side shift Arm raise in anterior and posterior directions	Session is total 15 min for 3 days in a week with 5 repetitions for each.
WEEK 2	**SUPPORTIVE STANDING WITH THE EDGE OF BED** Forward Reach Backward Reach Side to side shift Arm raise in anterior and posterior directions	Session is total 15 min for 3 days in a week with 10 repetitions for each with 1st week interventions
	SINGLE STEP TRAINING (floor markings) Forward Reach with step Backward Reach with step Side to side shift with step Arm raise in anterior and posterior directions with steps	Session is total 25 min for 3 days in a week with 12 repetitions for each with 1st and 2nd week interventions
WEEK 4	**DOUBLE STEP TRAINING** Single leg stance (chair assistance) Double leg stance Add step up training on 1-2 cm block but of same height	Session is total 25 min for 3 days in a week with 14repetitions with previous week interventions
WEEK 5 and 6	**ADD PROGRESSION** Single leg stance and double leg stance (without assistance) Step up training on blocks of different heights Few steps walk Turning around	Session is total 25 min for 3 days in a week with 15 repetitions with previous week interventions.

Table 2: Control group

IN SUPINE LYING (POSITIONING)
- ✓ Head and neck (neutral and symmetrical),supported on pillows.
- ✓ Trunk (aligned in midline)
- ✓ More affected U.E (scapular protracted, shoulder forward, arm supported on pillow with elbow extended, wrist neutral, fingers extended and thumb abducted
- ✓ More affected L.E (hip forward, small towel roll under the knee to prevent hyperextension, foot in neutral position
- ✓ • ***The bed must be the correct height to promote independence and safety for the patient, family and health care workers*.**

IN SIDE LYING (less affected side)
- ✓ Head and neck (neutral and symmetrical)
- ✓ More affected U.E (scapular protracted, shoulder forward, arm supported on pillow with elbow extended, wrist neutral, fingers extended and thumb abducted
- ✓ More affected L.E (hip forward and flexed, knee flexed and supported on pillow)

•ROM (range of motion) of hip, knee and ankle joint.
•Lower limb stretching exercises (For calf muscles, hamstrings and quadriceps stretching

Table 3: General characteristics of Subjects

EG (n=16)	CG (n=16)	
Gender	7/9	9/7
Age	49.37± 5.76	47.31± 6.34
Height	161.5± 4.9	162.1 ± 3.6
Weight	60.9± 4.1	62.2 ±6.4

Values are means ± SD; EG: experimental group; CG: control group

Table 4: Comparison of Pre and Post-Intervention test results in the Control Group & Experimental (mean S.D)

Pre test value	Mid test value	Post test value	P value
BBA score			
3.12± 1.85	3.5 ± 1.85	3.62 ±1.85	0.08*
3.75± 1.43	5.06± 1.28	7.0± 1.41	0.000*

*p>0.05; BBA = Brunel balance assessment

Table 5: Comparison of Pre and Post BBA score test results between the groups (mean S.D)

Experimental group (n=16)	
Pretest value	Post test values
3.75± 1.43	7.0 ± 1.41
Control group)n=16)	
3.12 ±1.85	3.62± 1.85

*p<0.05; BBA = Brunel balance assessment

DISCUSSION

The main objective of this study is that the balance training strategies (static and dynamic) improves balance performance in stroke patients. Total 32 patients were included in this study. There were two groups of patients each having 16 patients. One group was treated with balance training strategies along with conventional therapy and Second group was treated with conventional rehabilitation programme. The patients were treated for six weeks and progression was assessed at the end of treatment. The balance of patients was assessed by Brunel Balance Assessment scale (BBA).

The patients were assessed for balance improvement at the end of 4th week and at 6th week also with the use of Brunel Balance Assessment scale (BBA). I have seen maximum balance improvement in stroke patients after applying the above mentioned strategies. This study includes both static and dynamic components of balance for training. Significant balance is improved in patients having intact sitting posture, they progressed to dynamic activities and postural control.

By the definition balance is a state of a body in which its equilibrium is maintained so that the outcome of all the internal and external forces acting on it is zero. If taken into consideration balance and postural control, it is basically multi-joint interaction of various physiological sensory systems of body. It is the cornerstone of our ability to move and operate freely[17].

The main target of final patients recovery phase for both therapist and patients is to enhance gait ability, since it is a crucial aspect in achieving functional independence[18].

Jen-Wen Hung, Md Chiung-Xia Chou and his coworkers concluded in their study that balance in post stroke patients improved by the combination of exergaming with the weight-shifting training exercises. All the patients included in their study received outdoor rehabilitation maneuvers along with mainstream protocol[19].

In another year (2017) a study conducted by Juliet A. M. Haarman, Mark Vlutters and his colleagues (2017) depicts the effectiveness of comparative paretic and non-paretic stepping feedback following pelvic disturbances must improve the balance in chronic stage stroke patients[20].

Pao-Tsai Cheng, Chin-Man Wang, C and colleagues (2004) stated in their study the productiveness of visual feedback training with rhythmic weight-shift strategies for hemiplegic stroke patients .All the participants of this training group depicts excellent results in terms of improvement in balance. But due to increased time span of 6 months mostly patients don't follow[21].

We found some discrepancies across the trials discussed above, depending on the severity of the stroke, the span of disease occurrence and the goal oriented rehabilitation protocols used. The importance of this study is that it includes those balance-training strategies that have been incorporated as a part of early Rehabilitation of stroke patients. These strategies not required any type of expensive, advance and high tech physio equipment's or devices**.**

CONCLUSION

Static and dynamic balance training strategies are more effective in the improvement of balance training in stroke patients. The result of this experimental study has identified the effectiveness of conventional physiotherapy along with both static and dynamic weight shift maneuvers. The strategies starting from static weight shift exercises to supportive standing to dynamic weight shift training. The difficulty of exercises generally progressed from body stability exercises to gait exercises in a variable environment. .

Ethics approval and consent to participate: The study's goals were explained to the participants, and written informed consent was obtained. The Research Center King Edward Medical University Lahore's Committee of Institutional Review Board (IRB) approved the work.

Competing interests: There was no competing interest among authors. All results of this study are presented honestly, clearly without any false or in appropriate data manipulation.

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