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Effects of unstable surface task oriented training and visual deprived balance training in hemiparetic individuals: A comparative study

Riyas Basheer KB[1*], Anup Nair[2], Sukumar S[3], Jinson K Paul[4], Deepu S Chandran[5], Jazeel NM[6], Sreejisha PK[7], Madhuripu P[8]
[1, 6-8] Assistant Prof., Sree Anjaneya College of Paramedical Sciences, Malabar Medical College Hospital & Research Centre, Calicut, Kerala, India
[2] Associate Professor, College of Paramedical Sciences, EMS Memorial Co-operative Hospital & Research Centre, Perinthalmana, Kerala, India
[3] Assistant Professor, NITTE Institute of Physiotherapy, Mangalore, Karnataka, India
[4] Professor, College of Paramedical Sciences, EMS Memorial Co-operative Hospital & Research Centre, Perinthalmana, Kerala, India
[5] Scientific Assistant (Physiotherapy), General Hospital, Calicut, Kerala, India

Abstract
Balance deficits in stroke patients are common due to the reduction in multisystem functions. Task oriented training on unstable surface and visual deprived balance training are used to treat balance deficits. Aim and objective was to compare the effects of unstable surface task oriented training and visual deprived training on improving balance and mobility. 160 subjects selected using simple random sampling equally divided into two groups. 80 subjects in group one treated with unstable surface balance training using swiss ball and wobble board and another group with 80 subjects were treated with task oriented training by masked vision. Both groups were treated six days in a week for two consecutive months. Balance was assessed using Berg Balance Scale and functional status was assessed using Katz Index on the first day and two month after treatment. In this present study it was found that there was a significant increase in BBS score and functional mobility in subjects who performed task oriented exercises on unstable surface. As similar significant improvement was also found on subjects who performed task oriented exercises by masked vision. Both task oriented training on unstable surface and task oriented training by masked vision can be used for balance and functional mobility training in the management of individuals with post stroke hemiparesis.

Keywords: unstable surface task oriented training, stroke management, balance training, visual deprived balance training

1. Introduction

The traditional Definition of stroke, devised by the world health organization in the 1970's, is a "neurological deficit of cerebrovascular cause that persists beyond 24 hours". This definition was supposed to reflect the reversibility of tissue damage and was devised for the purpose, with the time frame of 24 hours being chosen arbitierly [1]. The 24 hour limit divides stroke from transient ischemic attack, which is a related syndrome of stroke symptoms that resolve completely within the hours. With the availability of treatments that, when given early, can reduce stroke severity, many now prefer alternative concepts, such as brain attack and acute ischemic cerebrovascular syndrome (modeled after heart attack and acute coronary syndrome respectively), that reflect the urgency of stroke symptoms and the need to act swiftly.

Balance is a complex motor control task involving the detection and integration of sensory information to assess the position and motion of the body in space and the execution of appropriate musculoskeletal responses to control body position within the context of environment and task. It is the ability to control the body mass relative to the base of support. Whether we are stationary or moving, we are unaware of the complex neuromuscular and mechanical processes that control our balance. The forces that disturb balance are gravitational and interactions between segments during movements, or from disturbances as a result of an unexpected perturbation such as push a trip or a collision [2].

Balance emergence from a complex interaction between sensory and musculoskeletal systems modified within the CNS in response to changing internal and external conditions. Sensory systems (Vestibular, visual and somatosensory) provide information about where the body is in space and whether it is stationary or in motion. The vestibular system provides information about the position of the head in relation to gravity as well as information about motion through linear and angular acceleration of the head. The Proprioceptive systems, consisting of muscles and joints, cutaneous (tactile & pressure) receptors, provides information about the state of the effector system of muscles and joints, such as length and force output of muscles, our position in space and information about the environment such as surface conditions. It provides information about movement of the body in relation to base of support, and movement and orientation of body segments in relation to each other [3]. The visual system provides information about where we are in relation to our surroundings and is interpreted in light of experience. Our sensitivity to visual information appears particularly important to skill in balancing the body while walking, since it specifies the relationship between ourselves and the properties of the environment. The narrower the support base and the lower the skill level of individual, the more critical vision seems to be for balance, suggesting a critical interaction between BOS, the

availability of visual inputs and skill level [4].
The role of different sensory inputs is controversial, but it is likely that they are integrated and co-ordinated in a task relevant manner that is dependent on the environment. Redundancy of sensory inputs and ability of CNS to modify the relative importance of any one sense for postural control enables able-bodied individuals to maintain balance in a variety of environments and to improve balance as a part of learning a new motor skill [5]. Redundancy within the sensory system can have functional advantages. It may enable not only verification of inputs that may be conflicting, but also allows for compensation when one system is dysfunctional.
Sensory information is regulated dynamically and modified by changes in environmental conditions. Despite the availability of multiple sources of sensory information, in a given situation, the CNS gives priority to one system over another to control balance in the orthostatic position. Nondisabled individual tends to use somatosensory information from their feet in contact with the surface while standing in a controlled environment with a firm BOS. Under this condition, somatosensory afferents account for 70% of the information required for postural control, while 20% of vestibular and 10% of visual inputs. Visual and vestibular inputs are likely to be more relevant sources of information when Proprioceptive information is unreliable or relative during sway. The ability to choose and rely on the appropriate sensory input for each condition is called sensory reweighting [6]. The ability to analyze, compare and select the pertinent sensory information to prevent falls can be impaired in strokes.
In patients with stroke, balance impairments and decreased ankle Proprioception are positively correlated. Abnormal interactions between the three systems involved in balance could be the source of abnormal postural reactions. In situations of sensory conflict, a patient with stroke can inappropriately depend on one particular system over another. Laboratory measurements of sensory organization demonstrate that patients with chronic stroke perform worse in conditions of altered somatosensory information and visual deprivation or inaccurate visual input [7]. Excessive reliance on visual input may be a learned compensatory response that occurs over time. Relying on a single system can lead to in appropriate adaptations and hence balance disturbances. Furthermore, sensory integration and reweighting can be impaired in patients with stroke, emphasizing visual input even when it provides inaccurate information.
The most important biomechanical constraints to balance are the quality and size of the BOS. In stroke, weakness and impaired muscle control of the affected lower limb, decreased ROM and pain can lead to changes in the BOS. The dramatic increase in the incidence and prevalence of neurological disorder like stroke has always demanded the need of new interventions in limiting the disability outcome.
Balance impairment is important to consider after stroke since the number of falls can be as high in the first year post lesion. These falls can be further lead to pathological events and additional declines in function and disability status. The decreased ability to maintain static and dynamic balance after stroke could be related to the inability to select reliable sensory information in order to produce the proper motor action necessary to maintain postural stability. It was found, for instance, that stroke subjects having impaired ankle Proprioception exhibited a significant increase in postural sway as compared to stroke subjects showing intact Proprioception during double legged stance [8]. Furthermore when sensory inputs from the visual, vestibular and somatosensory systems were manipulated, stroke subjects exhibited greater postural instability than healthy subjects.
Exercise interventions in the form of task oriented exercise programs are now recognized as a new strategy to improve the functional status of stroke patients. Hence, following several weeks of functional training, hemiparetic subjects secondary to stroke have shown significant improvements in functional mobility, walking speed and endurance and in clinical measures of balance. Since stroke subjects often present with somatosensory deficits, the adaptation of regular exercise with use of surface and vision manipulation to challenge balance could improve the process of somatosensory integration and have a positive effect on postural stability. These types of intervention have further shown to be effective at improving postural stability in neurologically intact elderly people. Therefore this study was to compare the effects of task oriented exercise program with and without altered sensory input on postural stability and balance strategy over two groups and thereby assessing strength, mobility and functional outcome after rehabilitation.
This study also reveals the relationship of sensory organization to balance function in patients with hemiplegia. Balance training should not be confined to instrumentation and departmental settings but transferred into task oriented training for functioning in daily life at home and in the community.
Each one of has undergone several falls as part of our development. However a fall in adulthood always keeps us speculating on the probable cause. Physiotherapists play a vital role in managing balance problem of a stroke individual. A knowledge of functional anatomy is essential to delineate the cause and structure causing balance impairment for not only a differential diagnosis but also apply appropriate therapeutic techniques.
What is ethical cruelty is, neglecting the balance problem of the stroke patient, leave them without treating the balance and after four or five month the patient subjected to dynamic hip screwing (DHS) procedure due to fall as a sequel to stroke. So vision masking is not an ethical cruelty to the society, but it is our (physiotherapist) duty to ensure them and train with proper care for balance training.

2. Materials and Methods

This pre-post experimental comparative study was a Multicentre hospital based study done at 1) Justice K.S Hegde Charitable Hospital, Mangalore, Karnataka, 2) Department of Physiotherapy, Shree Devi college of Physiotherapy, Mangalore, Karnataka, 3) Department of Physiotherapy, Malabar Medical College Hospital & Research Centre, calicut, Kerala 4) Department of Physiotherapy, EMS Memorial Co-operative Hospital & Research Centre, Perinthalmanna, Kerala. The inclusion criteria were Left MCA territory stroke, both males and females of age group between 40- 60 years, patient should be medically stable and mentally stable, medically diagnosed stroke patient with less than one year after stroke and Brunnstorm stage of recovery Grade IV. The excluded patients were brain tumours, orthopedic disorders including fractures, dislocations, history of diseases like vertigo or vestibular dysfunction, demyelinating diseases, myelopathy, traumatic brain injury, peripheral neuropathy of lower limb, cognitive impairment, Wernicke's aphasia, Global aphasia and Cardio-pulmonary diseases (CAD, Dyspnea).

Treatment Techniques

Conventional stroke rehabilitation exercises were given to both groups which includes Spasticity management **(**slow Sustained stretching, electrical stimulation, strengthening of antagonistic muscle groups)**,** Mobility exercises **(**patients were performed active, active assisted or passive as required pertaining to the individual joint ranges for 10 repititions**, s**pinal mobility exercises - trunk flexion/extension/rotations in lying and standing), strengthening exercises **(**resistance training was done for weaker group of muscles pertaining to their grades from manual muscle testing, with help of optimal resistance weight cuffs throughout the ROM), gait training (inside the parallel bar gait is corrected with help of biofeedback (mirror) and proper commands to improve all the gait parameters to an optimal level) [9, 10].

Group A were given by unstable surface task oriented activities which includes Swiss ball training (with the free vision make the patient to sit on the ball with feet touches on the ground. One therapist holds the hands of patient from behind the ball. One therapist hold both feet on the ground. Two therapist either side of the ball assist in forward backward and sideways hip movements over the ball. Repeat each movements for 20 times), Balance board training (patient is on balance board with free vision. Therapists support the patient from either side. Then ask the patient to shift weight to either side. Repeat for 20 times), object manipulations (on Swiss ball & balance board), walking on the foam surface.

Group B were given by visual deprived balance training which includes includes manual perturbations (patient in sitting with legs hangs down and blocked vision. Ask the patient to hold both hands together. Then therapist stands in front of the patient and instruct to touch his forehead to hands of therapist in forward, backward and either sides. Repeat for 20 times), sit to stand (patient sit on a chair with back rest and feet placed on ground and vision deprived. Ask to hold both hands together. Then give assurance on fall prevention. Instruct to stand from the chair without touching anywhere on chair by hands and then to starting position (Sitting). Repeat for 20 times), walking forwards, backwards, sideward in parallel bar (prepare the patient ready to gait training with marked vision. Give proper instructions to walk forward and backward for 20 times inside the parallel bar. And then to sideward for 20 times), stair climbing (prepare the patient to climb the stairs with vision blocked. Instruct properly. Then ascend the stair for 5 steps and descend. Repeat for 10 times).

Duration

Both the groups were treated six days in a week for two consecutive months after taking informed consent from each subject. The total duration of the study was 4 years and 8 months.

Outcome measures

Berg Balance Scale was used to assess the static and dynamic balance of the subjects. Katz Index of independence in activities of daily living was used to assess the functional status of subject's ability to perform ADLs independently.

Statistical Analysis

The data was analysed by using SPSS 21.0 and described in the form of mean and standard deviation, frequencies and percentiles. Intra group comparison inferential statistics was done using paired t test. Inter group comparison inferential statistics was done using independent t test. Statistical analysis have done for 95% Confidence Interval (CI) & alpha level at 5% (P <0.005).

3. Results

The parametric outcome based upon the Berg balance scale and Katz Index of ADL has been studied in both groups. The mean and SD of the unstable surface training group and visual deprived training group were 51.80 ± 6.20 and 51.13 ± 6.30 respectively (Table 1).

Table 1: Description of variables of participated subjects

Variable	Unstable Surface Training (Group 1) N=80			Visual Deprived Training (Group 2) N=80		
	Mean	S.D	Error mean	Mean	S.D	Error mean
Age	51.80	6.20	1.60	51.13	6.30	1.62
BBS pre	15.00	2.07	0.53	13.60	1.54	0.40
BBS post	52.40	2.41	0.62	50.80	2.70	0.69
KATZ pre	6.53	0.63	0.16	6.53	0.63	0.16
KATZ post	22.53	1.12	0.29	21.93	1.27	0.33

The table 2 shows subjects performed task oriented exercises on unstable surfaces for the period of two months had shown significant improvement in balance function (P=0.001) Similar improvement was noticed those patients treated with visual deprived training in the group 2 (P=0.001).

Table 2: Intra group comparison of BBS scores using paired t test

Group		Mean	Mean Difference (Pre- Post)	S.D (pre – post)	95% C.I		t-value	p-value	Sig.
					Lower	Upper			
UST	Pre	15.00	37.40	2.89	35.79	39.00	49.97	0.001	VHS
	Post	52.40							
VDT	Pre	13.60	37.20	3.00	35.53	38.86	47.94	0.001	VHS
	Post	50.80							

Table 3 shows intra group comparison of mobility function using paired t test results suggesting that both treatment methods are equally effective in improving mobility and functional independence.

Table 3: Intra group comparison of Katz Index of ADLs scores using paired t test

Group		Mean	Difference	S.D	95% C.I		t-value	p-value	Sig.
					Lower	Upper			
UST	Pre	6.53	16.00	1.19	15.33	16.66	51.84	0.001	VHS
	Post	22.53							
VDT	Pre	6.53	15.40	1.59	14.51	16.28	37.40	0.001	VHS
	Post	21.93							

Table 4 and Graph 1 shows the post intervention effects comparison of balance (P=0.854) and mobility (P=0.253) using independent t test evidencing that there is no significant difference between the two treatment methods.

Table 4: Inter group comparison of BBS score and Katz Index of ADLs score using independent t test

	Group	Mean Difference (pre-post)	S.D	Difference	95% C.I		t-value	p-value	Sig.
					Lower	Upper			
BBS	UST	37.40	2.89	.20	-2.00	2.40	0.186	0.854	NS
	VDT	37.20	3.00						
KATZ	UST	16.00	1.19	.60	-0.454	1.654	1.16	0.253	NS
	VDT	15.40	1.59						

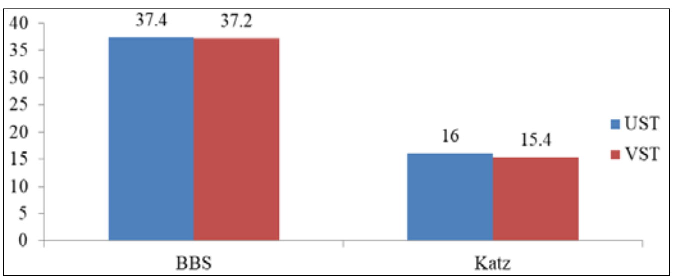

Fig 1: Inter group comparison of BBS and Katz Index of ADLs

The mean pre-post difference of BBS score in unstable surface training and visual deprived training were 37.40 and 37.20 respectively and Katz Index of ADLs score were 16 for the unstable surface training group and 15.4 for the visual deprived training group.

4. Discussion

The aim of this study was to study and compare the effectiveness of balance training on unstable surface over visual deprived training on improving balance and mobility in hemiparetic subjects. The results of this comparative study between the unstable surface training and visual deprived training correlates with previous study results of Sukumar S *et al.* [11] and Akshatha Nayak *et al.* [12] who were suggesting Swiss ball training can be effective method to improve balance and mobility. Visual deprived training effects on balance and mobility also shown the consistent correlation with some of previous studies (Isabella V B *et al*, 2004 & Jibi Paul, 2014) [13] which were proved the use of VDT in improving balance and mobility.

Proprioception and somatosensory pathway has been found to contribute to the vision deprived therapy to a great extent stroke patients are disabled by the weakness persisting after stroke; deprived visual feedback promotes the use of affected side and prevents the compensatory over use adaptability. Multisensory training improves balance by a reduction in latency of muscle in reaction to platform translation perturbations [14]. The deprivation probably induces patients to increase their use of somatosensory and vestibular information to make up for the absence of a visual compensatory strategy.

Possible mechanism for balance improvement is that stroke subjects were able to select reliable sensory information for postural control more efficiently following the multisensory training. Postural imbalance might be due more to a higher level inability to select reliable sensory input than to an elementary sensory impairment [15]. When the subjects were standing on the soft surface, their balance was challenged due to the unstable surface and the lack of accurate somatosensory information. In this condition, the pertinent sensory input for postural stability might come from the vestibular and visual systems. And these compensatory mechanisms can occur and be improved with proper sensory training after a CVA.

Balance behavior is complex and multiple clinical assessments may be needed to fully assess balance control deficits. It is helpful from clinical perspective to couple functional status assessment with tools that identify problems underlying the observed deficits and their interrelationships. The correlation between sensory organization and balance was related to each other with functional status. These results, if demonstrated on larger patient populations, may provide the basis for a clinical assessment strategy that quantifies the cause of balance dysfunction as well as the impact of balance disorders on daily functional activities.

Physical therapy programs focusing on balance in patients with hemiplegia should consider including exercises to be performed under conditions of visual deprivation. Clinical practice should be consistent with the research and the understanding of normal and abnormal postural control and balance keeping in mind the role of environmental constraints faced in human functioning. Human beings are motivated by functional task goals. Balance training should not be confined to instrumental and departmental settings but transferred into task oriented training for functioning in daily life at home and in the community.

5. Conclusion

This study reveals both unstable surface training and visual deprived training can be effectively used to improve balance and mobility in hemiplegics after stroke. We suggest further studies with larger sample size may helpful in producing strong statement regarding the effectiveness of unstable surface training and visual deprived training.

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Conflict of interest: The authors have no conflicts of interest to disclose.

7. References

1. Fiona C, Suresh K. Stroke in India factsheet. South Asia network for chronic disease, 2012, 1-25.
2. Phil Page. Somatosensory training a global approach for balance training. Bodywork and movement therapies. 2006; 10(1):77-84.
3. Robert Peterka J, Patrick Loughlin J. Dynamic regulation of sensorimotor integration in human postural control. J Neurophysiology. 2004; 91:410-423.
4. Ordahan B, Karahan AY, Basaran A, *et al*. Impact of exercises administered to stroke patients with balance trainer on rehabilitation results: a randomized controlled study. Hippokratia. 2015; 19(2):125-130.
5. Bonan IV, Colle FM, Guichard JP, *et al*. Reliance on visual information after stroke Part-I Balance on dynamic posturography; Arch Phys Med Rehab. 2004; 85(1):268-273.
6. Isabelle V, *et al*. Reliance on visual information after stroke Part-II Archive of phys Med Rehabil. 2004; 85(2):274-278.
7. Walker C, Bruwer BJ, Culham EG. Use of visual feedback in retraining balance following acute strok. Phys.ther. 2000; 80(9):886-895.
8. Salsabili H, Bahrpeyma F, Forogh B, Rajabli S. Dynamic stability training improves standing balance control in neuropathic patients with type 2 diabetes. J. Rehabil. Res. Dev. 2011; 48(7):775-86.
9. Sullivan S, Schmitz T. Physical rehabilitation. Clifton Park, NY: Thomson Delmar Learnig, 2007.
10. Umphred D. Neurological rehabilitation. St.Louis, Missouri: Mosby Elsevier, 2007.
11. Sukumar S, Jayasrikanth S. Efficacy of modified task oriented exercises performed on swiss ball over conventional task oriented exercises on improving balance post stroke. Int J Health Sci Res. 2015; 5(2):217-223.
12. Akshatha Nayak, Vijay kumar K, Karthik Babu S. Does Swis ball training improve trunk performance after stroke?- a single blinded quasi experimental study. Ind J Physiotherapy Occup ther. 2012; 6(1):172-5.
13. Jibi Paul. Comparative effect of vision deprived balance training over free vision balance training among stroke subjects. Int J Physiother. 2014; 1(2):46-53.
14. Marigold DS, Eng JJ, Daeson AS, Inglis JT, Harris JE, Gylfadottir S. Exercises leads to faster postural reflexes, improved balance and mobility, and fewer fall in older persons with chronic stroke. J Amer Geriatr Soc. 2005; 53:416-423.
15. Bayouk, Jean Rancois A, Boucher, Jean P, Leroux, Alain BC. Balance training following stroke; effects of task oriented exercises with and without altered sensory input. International Journal of Rehabilitation Research. 2006; 29(1):51-59.
16. Dean CM, Shepherd RB. Task oriented training improves performance of seated reaching task after stroke. A randomised control trial. Stroke. 1997; (4):722-8.
17. Behm DG, Leonard AM, Young WB, Bonsey WA, Mackinnon SN. Trunk muscle electromyograhic activity with unstable and unilateral exercises. J Strength Cond Res. 2005; 19(1):193-201.
18. Karatas M, Cetin N, Bayramoglu M, Dilek A. Trunk muscle strength in relation to balance and functional disability in unihemispheric stroke patients. Am J Phys Med Rehabil. 2004; 83(2):81-7.
19. Verheyden G, Vereeck L, Truijen S, Troch M, Herregodts I, Lafosse C, *et al*. Trunk performance after stroke and the relationship with balance, gait and functional ability. Clin Rehabil. 2006; 20(5):451-8.
20. Monaco MD, Trucco M, Monaco RD, Tappero R, Cavanna A. The relationship between initial trunk control or postural balance and inpatient rehabilitation outcome after stroke: a prospective comparative study. Clin Rehabil. 2010; 24(6):543-54.
21. John Jeka J, Leslie Allison K, Tim Kiemel. The Dynamics of Visual Reweighting in Healthy and Fall-Prone Older Adults. J of motor behavior. 2010; 42(4):197-208.