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A Study to Compare the Efficacy of Visual Cues and Wobble Board Training in Recovery Stage of Stroke Patients in Improving Balance

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Abstract

Objective: To compare the efficacy of visual cues and wobble board training in recovery stage of stroke patients in improving balance. *Methods*: Prior to the recruitment, criteria was established to identify patients who would be considered appropriate for the treatment, i.e. recovery stage of stroke, unilateral hemiparesis as a result of stroke, maintain independent stance for 1 minute, ability to follow simple instructions, patients with no orthopedic or no neurological deficits, Brunnstorm recovery stage of lower limb (stage 5). They were confirmed by examination and evaluation. The subjects were randomly selected and assigned to two groups, Group I (Control group) consisted of 15 patients which receive only visual cues therapy for 4 weeks. Group II (experimental group) consisting of 15 patients which receive wobble board therapy for 4 weeks. Balance was assessed with the help of Berg Balance Scale on day1, 15 and day 30. *Results*: Out of the 30 subjects, who were divided in two groups I and II. According to the received treatment both the group shows significant improvement statistically with a "t" value of 7.690 on 30th day. But Group II showed higher scores on Berg Balance Scale than Group I on 30th day. *Conclusion*: Both the treatment methods are effective in the treatment of training balance in the recovery stage of stroke. Group II showed higher scores on Berg Balance Scale than Group I.

Keywords: Stroke; Visual Feedback; Berg Balance Scale.

Introduction

Stroke is also known as cerebrovascular accident (CVA), is the rapid loss of brain function(s) due to disturbance in the blood supply to the brain. This can be due to ischemia (lack of blood flow) caused by blockage (thrombosis, arterial embolism), or a haemorrhage (leakage of blood) [1]. As a result, the affected area of the brain cannot function, which might result in, inability to move one or more limbs on one side of the body, inability to understand or formulate speech, or an inability to see one side of the visual field [2].

The traditional definition of stroke, devised by the World Health Organization in the 1970s, is a "neurological deficit of cerebrovascular cause that persists beyond 24 hours or is interrupted by death within 24 hours" [3].

Each year, >1 million patients experience a stroke in the European community, and ~30% of the survivors experience a severe upper limb paresis without volitional distal activity [4]. Their prognosis for regaining functional hand activity 6 months later is very poor [5].

Stroke is the third leading cause of death in the United States and the leading cause of adult disability [6]. Annually, approximately 750 000 Americans suffer a stroke [7]. Although incidence rates have remained constant over the last 3 decades; mortality has declined, leaving an increasing number of patients requiring rehabilitation [8]. Approximately two thirds of stroke survivors have residual neurological deficits that persistently impair function.

Cerebral infarction (thrombosis or embolism) is the most common form of stroke, accounting for 70% of all strokes. Hemorrhages accounts for another 20%, and 10% remains unspecified.

The three most commonly recognized risk factors for cerebrovascular diseases are hypertension, diabetes mellitus, and heart disease. The most important of these factors is hypertension [9].

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Strokes can be classified into two major categories: ischemic and hemorrhagic [10]. Ischemic strokes are those that are caused by interruption of the blood supply, while hemorrhagic strokes are the ones which result from rupture of a blood vessel or an abnormal vascular structure. About 87% of strokes are caused by ischemia and the remainder by hemorrhage. Some hemorrhages develop inside areas of ischemia ("hemorrhagic transformation"). It is unknown how many hemorrhages actually start as ischemic stroke [2].

The focal neurological deficit resulting from a stroke, whether embolic, thrombotic, or hemorrhagic, is a reflection of the size and location of the lesion and the amount of collateral blood flow.

Unilateral neurological deficits results from interruption of the carotid vascular system which includes, middle cerebral artery, anterior cerebral artery, posterior cerebral artery and internal carotid artery.

Among this the most common is middle cerebral artery [9]. Whereas the bilateral neurological deficit result from interruption of the basilar vascular system [11].

The clinical symptom varies according to the involvement of the specific arteries and anatomical structures.

The Major Impairments following Stroke are

1. Somato sensory,
2. Speech and language,
3. Perceptual dysfunction ,
4. Cognitive dysfunction,
5. Affective disorder ,
6. Behavioral hemispheric difference,
7. Bladder and bowel dysfunction,
8. Motor deficits.

Balance is frequently disturbed following stroke with impairments, steadiness, symmetry, and dynamic stability. Problems may exist when reacting to a destabilizing external force or during self initiated movements as the major requirement for good balance are an accurate sense of being balanced, the ability of muscles, particularly of the lower limbs, to produce force rapidly and at the appropriate time, and muscles which are extensible, i.e. not stiff or short and the system involves need to be adaptive, since balance control requires the ability to adopt the movements for changes occurring both internally and in our external environment.

Thus a stroke patient may be unable to maintain a sitting or standing posture to move into a weight-bearing posture without loss of balance. Disruptions of central sensorimotor processing may lead to inability to adapt postural movements to change in task and environmental demands and impaired motor learning.

Patients with stroke typically demonstrate asymmetry with most of the weight in sitting or standing shifted to the non paretic side. They also demonstrate increased postural sway in standing.

Balance dysfunction, particularly in standing, is a devastating sequel of stroke since the ability to balance the body mass over the base of support under different task and environmental condition is one of the most critical motor control factors in daily life. Balance involves the regulation of movements of link body segments over supporting joints and base of support.

Training balanced movement may be the most significant part of rehabilitation. When training a patient its not sitting up or standing up straight that is important, but the taking up of a position which optimizes performance and maximize success, because when we are about to carry out an action we make certain preparations to ensure effective performance. This postural alignment is one which favors the necessary activity and feels comfortable [12].

Muscle weakness or abnormal tone leads to atypical alignment patterns in the trunk, shoulder and pelvic girdle. This loss of alignment creates an atypical starting position for functional movement, interferes with muscle activation pattern, and limits weight transfers between extremities. In standing, because the need for leg stability and movement control is much greater than in sitting, trunk alignment patterns change to accommodate the demands on the leg.

The atypical alignment pattern in one patient may be different in sitting and standing as a result of the pattern of loss of control in the leg [9].

When standing quietly an individual can use visual information from fixed visual environment to reduce atypical alignment. It is thought that by giving additional visual information to the patients, they will become more aware of the body's displacement and orientation in space [13].

Vision also plays a key role in motor learning and is probably the most widely used source of information feed back in performing motor task. Vision provides powerful intrinsic feedback, information about environmental conditions and

exproprioceptive information for determining the individual's relative position within the environment [12].

Use of a mirror can be an effective adjunct for some patients to improve visual feedback especially during postural and positioning activities [10]. Visual feedback related to weight distribution has also shown to be an efficacious method to gain symmetrical stance following stroke [14].

In the adults, vision also reinforces movement, manual contact may also be used to place a demand on the patient and gives the patient security, manual contact with slight pressure is more helpful as it acts as a sensory cue and helps the patient to understand the direction of the anticipated movement.

This interaction between therapist and patient is a form of social tracking. The therapist response provides guidance by which the patient can direct his own movement [15].

Physiotherapists often assess and prescribe intervention to address balance impairments that results from cerebrovascular accident [16,17]. The most common scale used by the clinicians to assess balance impairments is Berg balance scale.

Need of the Study

The literature reveals that balance master increases balance aspect in individual with stroke (Ruth Ann Geiger et al). Balance master is an expensive modality and is rarely available in the Indian set up , at present.

By keeping this fact in view the present study has been considered as the alternate method of improving balance in the recovery stage of stroke by using visual mirror.

Operational Definitions

Balance

"Balance refer to an individual to maintain their LOG with in their BOS. It can also be described as the ability to maintain equilibrium ,where equilibrium can be defined as any condition in which all acting force are cancelled by each other resulting in a stable balance system"[18].

Berg Balance Scale[18]

It is widely used clinical test of a person static and dynamic balance abilities.

Berg balance test consist of 14 different function tasks which the patient needs to perform the Therapist grades the performance of each task with the scores ranging from 0 to 4. "0" is for unable to perform and "4" is for ability to perform without difficulty. The tasks consist of:

Sitting to Standing

Standing unsupported for 2 minutes without holding on to an external support

Sitting unsupported with feet on floor for 2 minutes

Standing to sitting

Transfers

Standing unsupported with eyes closed for 10 seconds.

Standing unsupported with feet together

Reaching forward with outstretched arm

Pick up object from the floor

Turn 360 degrees

Count number of times the step stool is touched with the foot

Standing unsupported one foot in front

Standing on one leg.

Visual Feedback

Vision can assist in guiding movement, maintaining balance as well as improving accuracy of discrimination task; visual feedback can be an effective mechanism to compensate partially for Dorsal column medial leminisceal pathology [19].

Methodology

Participants

After considering, about the inclusion and exclusion criteria, the subjects were randomly divided into two groups- Group A and Group B. The study will consist of 30 subjects in the age group of 30-60 years. Both males and females are included.

Sampling

Total of 30 subjects assigned 15 each Randomly to either Group 1 or Group 2.

Study Design

Experimental study.

Source of Data

KMC Hospital, Baghpat road, Meerut & Saran hospital and institute of paramedical science Bareilly.

Subjects

1. 30 subjects (includes male and female subjects)
   Males - 25, Females - 5.
2. Age group (30years - 60 years)
3. Randomly assigned to either Group I or Group II.

Inclusion Criteria

1. Recovery stage of stroke.
2. Unilateral hemiparasis as a result of stroke.
3. Maintain independent stance for 1 minute.
4. Ability to follow simple instructions.
5. Patients with no orthopedic or no other neurological deficits.
6. Brunnstrom recovery stage of lower limb (stage 5). (Annexure 2)

Exclusion Criteria

1. Bilateral stroke.
2. Visual impairment.
3. Absence of active movements in paretic limb.
4. Medically unstable (uncontrolled hypertension).
5. Uncooperative patients in hospital.
6. Perceptual, Cognitive and Comprehensive impairment.

Data Collection

After completing the inclusion criteria, subjects were randomly assigned to either control group or experimental group.

- A written consent has been taken from the patient.
- The measurements were taken through Berg balance scale. On 1st day, 15th day and on 30th day as the study is for 30 days or 4 weeks.

Group 1: 15 patients have received visual feedback therapy for 2 hours/day, 5 days/week for 4 weeks.

Group 2: 15 patients have received balanced board therapy for 2 hours/day, 5 days/week for 4 weeks.

Material Used

1. Mirror
2. Chair with armrest
3. Rocker board
4. Measuring tape/Scale
5. Stop watch
6. T. Shirt with vertical strips
7. Stepper

Procedure

Assessment Before starting the protocol, consent form has been filled up by the patient. Balance berg scale examination was then conducted to check the balance of the patient. Brunnstorm recovery stages of the patient has also assessed to see whether the patient is fulfilling the inclusion criteria. Furthermost, the evaluation performa has been filled up. They will be evaluated at the day 1 pre treatment and on 31 day post treatment.

Visual Training

In front of the mirror by placing vertical line (red) on the mirror. The effect of a mirror is enhanced by making the patient wear a white T-Shirt with a vertical stripe (red) down the center and asking him or her to try to match the stripe on the T-shirt to a vertical stripe on the mirror.

The patient can use the mirror and T-shirt approach when performing a variety of tasks, such as reaching for an objects and picking of the objects from the floor, which require that the body may be moved away from the vertical line and then re-establish a vertical position.

Visual training of 2 times/week for 15 min for 4 weeks .

Balance Board Training

The basic exercise is standing on the wobble board with both feet and tilting in any direction without letting the board tilt so far that its edge touches the ground. Some of the many other common exercises are squats; standing on the board with one foot while keeping the other foot off the ground; push-ups (pressing down on the board with the hands while lying face-down with only the knees or toes contacting the ground); and sit-ups (with the board under one's rear end).

With your feet planted squarely on the Wobble Board, begin a slow controlled movement from side-to-side without the front or back touching the floor. Position your feet shoulder width apart, centrally on the Rocker Board. Begin by slowly moving the Board side-to-side, or front-to-back with a controlled movement. Try adding in other exercises while

attempting to maintain control. Some suggestions are squats, lunges, push-ups and ball tossing/bouncing. Incorporate other equipment such as a Body Blade. Advanced users may Attempts these exercises on one foot for greater challenge. Begin with a gentle Range of Motion (R.O.M.) on the Wobble Board until you become familiar with the movement. Exercises such as side-to-side, front-to-back, and circular rotation are all excellent basic exercises to start with. By rotating your stance on the Rocker Board, you can gently increase your ankle's R.O.M. Helps to restore stability.

Keep the heel of your back leg on the floor and lean forward until you feel a stretch. Effectively stretches the calf (gastrocnemius & soleus). Rotate the Wobble Board using a controlled circular motion. Remain balanced on the sphere without the sides touching the floor. Slowly move the Wobble Board front-to-back, feeling the movements you are going through. It is important to always maintain stable upright body position and proper heads-up posture with eyes looking straight ahead when using your Balance Board. Balance Aids can be used by individuals with limited balance and during early rehabilitation for additional safety and support.

Wobble Board Exercises

Basic

Begin with a gentle Range of Motion (R.O.M.) on the Wobble Board until you become familiar with the movement. Exercises such as side-to-side, front-to-back, and circular rotation are all excellent basic exercises to start with.

Beginner Wobble Board Exercises

Side to Side

With your feet planted squarely on the Wobble Board, begin a slow controlled movement from side-to-side without the front or back touching the floor.

Front to Back

Slowly move the Wobble Board front-to-back, feeling the movements you are going through.

Rotation

- Rotate the Wobble Board using a controlled circular motion.
- Remain balanced on the sphere without the sides touching the floor.

Calf Stretch

- Keep the heel of your back leg on the floor and lean forward until you feel a stretch.
- Effectively stretches the calf muscles.

Intermediate Wobble Board Exercises

Balanced Push-ups

- Start on your knees and work up to full push-ups as you become more comfortable with the challenge.
- Use caution and be aware that the wrists are in a fully flexed position for this activity.
- Ensure that your hands stay on top of the Wobble Board or your fingers may get pinched!
- Improves core stability.

Abdominal Training

- Sit upright on the Wobble Board keeping your back straight and the Board level to improve stability and coordination.
- For improved mobility, use your hips to tap the Wobble Board side to side and front to back.
- Closing your eyes will increase the difficulty and enhance body awareness.
- Improves core strength, R.O.M. and mobility in the lower back and trunk.

Kneeling Exercises

- Kneel on the Wobble Board with your hands on your hips, or by your side.
- Use your trunk muscles to begin a slow rotational movement.
- After several rotations, stop and rotate the Wobble Board in the opposite direction.
- Increases R.O.M. and stability of the trunk and pelvic areas

Advanced Wobble Board Exercises

Motor Skill Training

- Perform any of the previous exercises while bouncing or throwing a ball or some other dynamic activity.
- Enhances eye-hand coordination and subconscious reaction.
- Your conscious mind focuses on one activity while your subconscious mind is working on ankle R.O.M. and overall stability.

One Leg Exercises

- Perform the basic moves while balancing on one leg.
- Position the arch of your foot directly over the center of the Wobble Board, so that you can comfortably move the Board in any direction.
- These exercises require more strength and stability. You may feel that one leg is much stronger than the other.

Eyes Closed

- This is the most diffi cult way to use Wobble and Rocker Boards.
- Always start the exercise with your eyes open. When you and your spotter are ready, close your eyes only until you feel off balance.
- Enhances proprioceptive response and reaction time.
- Only attempt when you have achieved an advanced level of stability and balance.

Results

The data were analyzed for the inter group conversion of Group I (Control group) and Group II (experimental group) for assessment of balance in patients with Berg balance scale by student "t"-Test (unpaired)

The table 1 shows the initial mean value 43.33 with the SD of 1.633 in Group-1and initial mean value of 44.27 with SD of 1.099 in Group-II with the "t" value of 1.836 and (p=0.077) which was statistically found to be non significant.

Table 2 shows that On Day- 15 the mean value of 47.26 with SD of 2.250 in Group-I and the mean value of 50.67 with SD of 1.718 with the "t" value of 2.707 and (p=0.01) which was statistically found significant.

Table 3 shows that on Day-30 the mean value of 49.73 with SD of 1.624 in Group-I and the mean value of 53.87 with SD of 1.302 with the "t" value of 7.690 and (p=0.0001) which was statistically found very highly significant.

Graph 1 shows the initial mean value 43.33 with the SD of 1.633 in Group-I and initial mean value of 44.27 with SD of 1.099 in Group-II with the "t" value of 1.836 and (p=0.077) which was statistically found to be non significant.

On Day-15 the mean value of 47.26 with SD of 2.250 in Group-I and the mean value of 50.67 with SD of 1.718 with the "t" value 2.707 and (p=0.01) which was statistically found to be significant.

On Day-30 the mean value of 49.73 with SD of 1.624 in Group-I and the mean value of 53.87 with SD of 1.302 with the "t" value 7.690 and (p=0.0001) which was statistically found to be very highly significant.

Intra group comparision of berg balance scale for group i and group ii on day 1, day 15, day 30

Table 1: Inter group comparision of berg balance scale for group i and group ii on day 1

Group	N	Mean	Std Deviation	T	P Value
Group I	15	43.33	1.633	1.836	p= 0.077 ns
Group II	15	44.27	1.099		

N= Number of subject
Std = Standard deviation
t = t value
p = Probability

Table 2: Inter group comparision of berg balance scale for group i and group ii on day 15

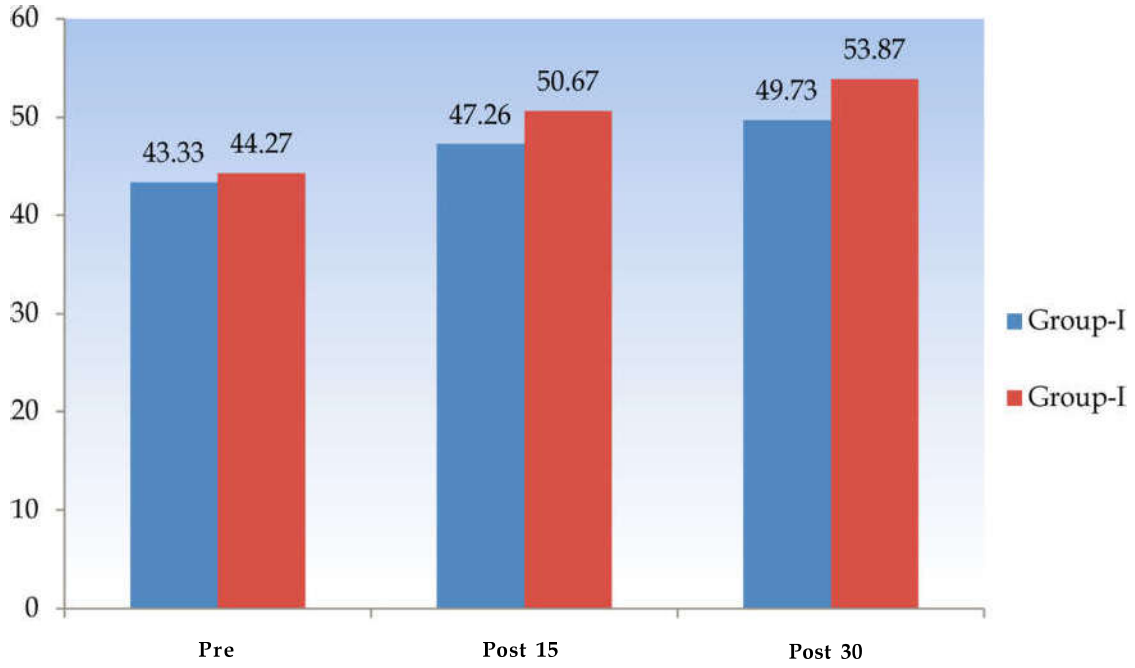
Group	N	Mean	Std. Deviation	T	P Value
Group-I	15	47.26	2.250	2.707	0.01**
Group-Ii	15	50.67	1.718		

N= Number of subject
Std = Standard deviation
t = t value
p = Probability

Table 3: Inter group comparision of berg balance scale for group I and group II on day 30

Group	N	Mean	Std. Deviation	T	P Value
Group-I	15	49.73	1.624	7.690	<0.0001***
Group-Ii	15	53.87	1.302		

N= Number of subject
Std = Standard deviation
t = t value
p = Probability



Graph 1: Shows the inter group comparison of berg balance scale for group-I and group-II on day-1, day-15 and day-30

Table 4: Intra group comparision of berg balance scale for group I on day 1 and day 15

Group	Paired Differences		T	P
	Mean	Std. Deviation		
Group-I	-3.933	2.781	5.478	<0.0001***

SD = Standard deviation
P = Probability
VHS = Very highly significant

Table 5: Intra group comparision of berg balance scale for group I on day 1 and day 30

Group	Paired Differences		T	P
	Mean	Std. Deviation		
Group-I	-6.400	3.626	11.82	<0.0001***

SD = Standard deviation
P = Probability
Vhs = Very highly significant

The data were analyzed for intra group comparison of Group I (control group) and Group II (experimental group) for the assessment of balance in stroke patients with Berg Balance scale by using student "t" test (paired).

Table 4 shows that on the Day-1 and Day-15 Group-I shows the mean value of -3.933 with SD of 2.781 with a "t" value of 5.478 and (p=0.0001) which was found highly significant.

Table 6: Intra group comparision of berg balance scale for group I on day 15 and day 30

Group	Paired Differences		T	P
	Mean	Std. Deviat Ion		
Group-I	-2.467	2.300	9.646	<0.0001***

SD = Standard deviation
P = Probability
Vhs = Very highly significant

Table 7: Intra group comparision of berg balance scale for group II on day 1 and day 15

Group	Paired Differences		T	P
	Mean	Std. Deviation		
Group-Ii	-5.133	3.119	8.228	<0.0001***

SD = Standard deviation
P = Probability
Vhs = Very highly significant

Table 8: Intra group comparision of berg balance scale for group II on day 1 and day 30

Group	Paired differences		T	P
	Mean	Std. Deviation		
Group-ii	-9.600	5.023	31.42	<0.0001***

SD = Standard deviation

P = Probability

Vhs = Very highly significant

Table 9: Intra group comparision of berg balance scale for group II on day 15 and day 30

Group	Paired differences		T	P
	Mean	Std. Deviation		
Group-ii	-4.467	2.882	8.375	<0.0001***

SD = Standard deviation
P = Probability
Vhs = Very highly significant

Table 10: Comparision of berg balance scale for group-i and group II on day 15

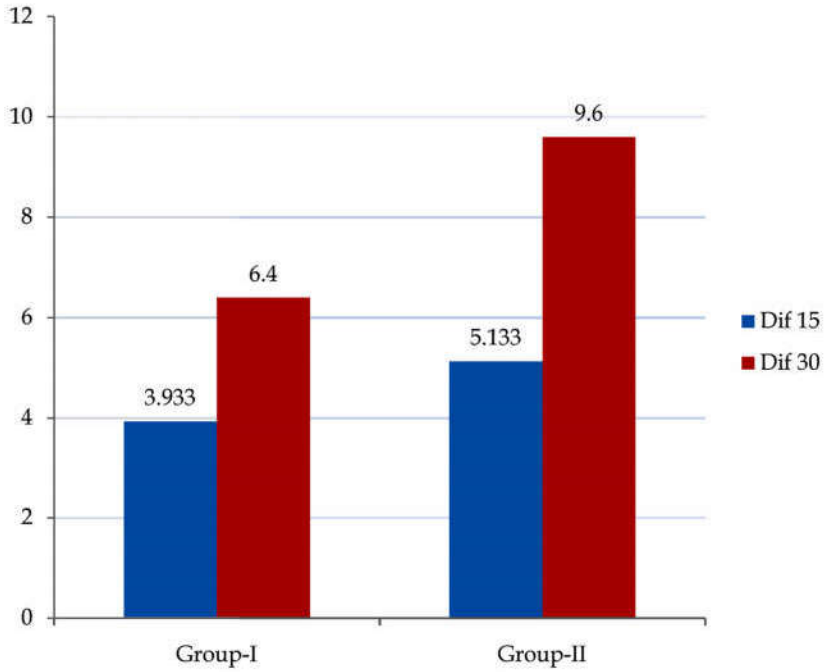
Group	N	Mean	Std. Deviation	T
Group-I	15	-3.933	2.781	2.458
Group-Ii	15	-5.133	3.119	P=<0.0209*

N= Number of subject
Std = Standard deviation
Sig= significant
Dif= difference

Table 11: Comparision of berg balance scale for group I and group II on day 30

Group	N	Mean	Std. Deviation	T
Group-I	15	-6.400	3.626	7.690
Group-Ii	15	-9.600	5.023	P=<0.0001***

N= Number of subject
Std = Standard deviation
Sig= significant
Dif= difference



Graph 2: Shows the comparison of berg balance scale for group I and group II from pre to post from day 1 to day 15 and day1 to day 30

Table 5 from Day-1 to Day-30 shows the mean value of -6.400 and SD of 3.626 with the "t" value of 11.82 and (p=0.0001) which was statistically found to be highly significant.

Table 6 from Day-15 to Day-30 shows the mean value of -2.467 SD of 2.300 with "t" value of 9.646 and (p=0.0001) which was statistically found to be highly significant.

Table 7 shows that the intra group conversion of Group-II from Day-1 to Day-15 shows the mean value of -5.133 with SD of 3.119 with the "t" value of 8.228 and (p=0.0001) which was statistically found to be highly significant.

Table 8 From Day-1 to Day-30 shows the mean value of -9.600 with SD of 5.023 with "t" value of 31.42 and (p=0.0001) which was statistically found very highly significant.

Table 9 from Day-15 to Day-30 shows the mean value of -4.467 with SD of 2.882 with "t" value of 8.375 and (p=0.0001) which was statistically found very highly significant.

Table 10 shows the difference of 15 Day of Group-I with the mean value of -3.933 with SD of 2.781 and Group-II with the mean value of -5.133 with SD of 3.119 with "t" value of 2.458 and (p=<0.0209) which was statistically found to be significant.

Table 11 shows the difference of 30th Day of Group I with the mean value of -6.400 with SD of 3.626 and Group-II with the mean value of -9.600 with the SD of 5.023 with "t" value of 7.690 and (p=<0.0001) which was statistically found to be highly significant.

Graph 2 shows the difference of 15 day of Group I with the mean value of 3.933 with SD of 2.781 and Group-II with the mean value of 5.133 with SD 3.119 with "t" value 2.458 and (p=0.0209) which was statistically found to be significant.

The difference of 30th day of Group I with the mean value of 6.400 with SD 3.626 and Group II with mean value of 9.600 with SD 5.023 with "t" value of 7.690 and (p=0.0001) which was statistically found to be highly significant.

Discussion

This study is designed to investigate and compare the effectiveness of visual cues and Balance Board Training in recovery stage of stroke patients in improving balance.

The purpose of this study was to compare the effectiveness of visual cues and balance board training in recovery stage of stroke patients. The study consists of 30 patients, who were randomly assigned into two groups. Both the groups were assessed for balance on Berg balance scale which

had a maximum score of 54. The results of the study showed improvements in both the groups ie group I receiving visual cues therapy and group II receiving balance board therapy. But group II receiving balance board therapy showed a better effect than visual cues therapy in balance training on berg balance scale score.

Group I which had a initial mean value of 43.33 had improved to 47.26 on 15th day which further progressed to 49.73 on 30th day shows that group I had progressive improvements which because of visual cues therapy.

Group II which had a initial mean value score of 44.27 had improved to 50.67 on 15th day which further progressed to 53.87 on 30th day which shows that group II also had progressive improvements, but it had a higher score of Berg balance scale on 30th day than that of group I.

This shows that group II receiving Balance board therapy fared better on Berg balance score values than visual therapy.

The study revealed benefits of visual training on balance. Thus supporting the study of Geiger et al 2001, Walker et al (2000), Winstein et al (1989), New 7. The study done by Sackley CM and Lincolin NB (1997) concluded that visual feed back training have improved balance following stroke (A).

The study conducted by Lee and Aronson (1974) states that vision plays a key role in motor learning and is most widely used source of information feed back in performing motor tasks. Vision provides powerful intrinsic feed back, information about environment conditions and exproprioceptive information for determining the individuals relative position with in the environment [13].

Nilson and Nordholm (1992): States physiotherapists often prescribe intervention to address balance impairments that results from cerebrovascular accidents.

Geiger, Allen et al (2001): Have examined the use of visual feed back in rehabilitation subsequent to stroke as a training tool.

Redfern, et al (2001). When standing quietly, individuals can use visual information from a fixed visual environment to reduce postural and way. When visual information is altered such as with moving visual scences, postural was is increased.

Future scope of the study

- Further studies can also be done on level of activities using EMG biofeedback.
- Further studies can be done involving other factors of rehabilitation like functional activities.

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