International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Volume 15; Issue: 2; February 2025
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Comparative Effect of Manual Perturbation Exercises Versus Circuit Class Training Exercises on Improving Balance in Subjects with Subacute Stroke

Dr Nandini B Kadabi[1], Dr Vinod Babu K[2], Dr Virendra Singh Rajpurohit[3], Dr Sai Kumar Nanamala[4], Dr Hemangi Jayantilal Vachhani[5]

Dr Ravi Patil Institute of Physiotherapy, Belagavi, Karnataka

Corresponding Author: Dr Nandini B Kadabi MPT, (Ph. D)

DOI: https://doi.org/10.52403/ijhsr.20250226

ABSTRACT

Background and Objective: Perturbation-based balance training (PBT/Manual Perturbation Exercises) is a novel balance training intervention that incorporates exposure to repeated postural perturbations to evoke rapid balance reactions, enabling individual to improve control of these reactions with practice and Circuit class trainings (CCT) consist of different work stations and these workstations provide the opportunity for maximum repetition of task. Hence, purpose of study is to find effectiveness of PBT versus CCT, along with Conventional therapy (CT) on improving balance in subjects with subacute stroke.
Method: An experimental study was conducted on Thirty participants with two groups: "Group A" (PBT) & "Group B" (CCT), subjects with subacute stroke were randomly allocated i. e,15 in each group. Impairment in balance function was assessed using Berg Balance scale (BBS). Fall risk was measured by Timed Up and Go Test (TUG). Balance and Mobility status was evaluated B for all subjects of before starting the intervention & after 4 weeks of intervention.
Results: Analysis found that there was significant effect of CCT Exercises with CT on improvement of balance in subjects with subacute stroke. When post intervention means of BBS and TUG balance and mobility were compared between Group A & B, results demonstrated that there is statistically significant difference in means between the groups
Conclusion: The present study concluded that four weeks of CCT exercises with CT showed significant effects on improvement of balance and mobility in subjects with subacute stroke. However, the greater percentage of improvement was found in CCT when compared with PBT.

Keywords: Manual perturbation exercises, circuit class training exercises, balance, subacute stroke, berg balance scale, timed up and go test

INTRODUCTION

According to the World Health Organization (WHO), a stroke is defined as "a rapidly developing clinical sign of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin. Worldwide- about 20 million people suffer from stroke each year; 5 million may die as a consequence and 15 million will survive; of those who survive, 5 million may be

disabled by their stroke. Following a stroke, balance issues are prevalent and have been linked to poor recovery from ADLs, decreased mobility, and an elevated risk of falls. Postural control is crucial for maintaining balance during activities of daily living (ADL), and it is influenced by motor, sensory, and higher brain cognitive processes. Stroke patients experience varying degrees of loss of motor, sensory, and higher brain cognitive functions, which results in diminished balance, increased postural sway, asymmetrical weight distribution, impaired weight bearing on the affected side, impaired ability to shift weight, and decreased stability.

Therefore, fall and injury prevention methods are recommended as a crucial component of each individual's stroke rehabilitation plan. Problems with balance can result from injury to the parts of the brain that regulate balance, such as the cerebellum, or from muscle weakness and paralysis.[1]

The ability to recover balance without falling after a postural perturbation is an important skill for fall prevention. Balance recovery from a postural perturbation has been viewed as a fundamental motor skill that is adaptive and centrally organized based on prior experience. Despite control challenges associated executing reactive steps, individuals with impaired balance control are increasingly dependent on these stepping responses because they are the last option to prevent falling. The development of strategies to retrain compensatory stepping following a stroke is crucial since stroke survivors are at a heightened risk of falling. Under such circumstances, perturbation training is a new and promising fall prevention therapy approach.[2]

Task specific training as well as high intensity practice with sufficient repetitions, are the main principles determining effective stroke rehabilitation care. Several meta-analyses have demonstrated the effectiveness of task-oriented workouts that concentrate on gait, transfers, balance control, and gait-related activities like climbing stairs, especially when used during the first six months following a stroke. Other two independent meta-analyses demonstrated that, in comparison to other widely used kinds of physiotherapy, group training using a succession of work stations (known as circuit training) offers advantages in terms of gait speed, walking distance, stair climbing, and transfers. One of the main features of task oriented circuit class training is that the treatment is given in a group setting with more than two participants per therapist, which lowers the staff to patient ratio. This is in addition to group dynamics and an emphasis on progressive repetitive practice of functional tasks.[3]

The circuit or group trainings are made up of various workstations that allow for the greatest amount of task repetition. Treatment given to more than two patients using a customized intervention program that primarily focuses on practicing or repeating functional tasks given to them by the therapist in a group setting is known as circuit class training. These circuits often have a staff-to-patient ratio of 1:3, depending on the patients' functional ability. The interventions can be designed to gait training, range of movement activities and upper limb etc. The definition of circuit trainings is distinct from the group trainings that usually involve patients with similar degree of functional abilities. It thus established the overall effectiveness on individual task specific training.[4]

A manual/postural perturbation is characterized by an abrupt shift in circumstances that causes the body's posture to deviate from equilibrium. The perturbation-based balance training (PBT) is widely used in older adults at a high risk for falls only.[1]

A new balance training technique called perturbation-based balance training (PBT) involves repeatedly exposing a person to postural perturbations that cause quick balance reactions. With experience, this allows the person to become more adept at

controlling these reactions. According to studies, PBT can decrease the frequency of "falls" after controlled postural perturbations in the lab and increase the speed and control of voluntary movements as well as quick balancing reactions.[5] Furthermore, it has been demonstrated that both manual perturbation exercises and conventional physiotherapy by itself can help stroke patients with their mobility, function, and balance.[1] Circuit class therapy (CCT), which can be used in both the acute and chronic phases for individuals with mild stroke severity, has been shown to be beneficial in increasing gait capacity and other elements of mobility in adults following a stroke. [6]

According literature reviews Manual perturbation exercise and Circuit Class training exercise individually has shown significant effect in improving balance, function and mobility in stroke patients. There are other evidences of conventional therapy which have shown improvement in balance and mobility in stroke subjects. There was dearth in literature on comparing effects of Manual perturbation exercise versus Circuit class training exercise, along with Conventional therapy on improving balance in subjects with subacute stroke.

Therefore, there was a need to examine the effects of Manual perturbation exercise versus Circuit class training exercise, along with Conventional therapy on improving balance in subjects with subacute stroke. Study conducted helped in finding the better technique that helps to regain postural balance and mobility of the patient.

Hence, the purpose of the study was to find the effects of Manual perturbation exercise versus Circuit class training exercise, along with Conventional therapy on improving balance in subjects with subacute stroke.

The aim of the study was to determine the comparative effect of Manual Perturbation exercise versus Circuit Class Training exercise, along with Conventional Therapy on improving balance in subjects with subacute stroke.

To evaluate the comparative effect of Manual Perturbation exercise versus Circuit Class Training exercise, along with Conventional Therapy on improving balance using Berg Balance Scale and Timed Up and Go test in subjects with subacute stroke

MATERIALS & METHODS

Study design and ethical consideration- The study was an experimental comparative study conducted on both men and women .The study was approved by Institutional Research and Ethics Committee .The procedures followed during the study were in accordance with the Helsinki declaration of 1975,as received in 1983.The purpose and procedure of the study was explained to the participants before commencement of the study .All the individual participants in this study gave written informed consent before the commencement of the study

PARTICIPANTS

All men and women with post stroke were screened for inclusion and exclusion criteria. Participants were informed about the aims and procedure of the study. Post stroke subjects within the age group of 40 – 60 years were included in the study. Participants were excluded if they had unstable cardiac disease, deformities in lower limb and cognitive and perceptual, proprioceptory and sensory disorders.

INTERVENTION

Conventional Therapy (Common exercise program): Conventional therapy was common intervention given to the manual perturbation group as well as circuit class training group.

Conventional Physiotherapy included:

1. Passive range of motion exercises

- **Hip and Knee Flexion**: Cradle the leg by placing one hand under the bent knee. With the other hand, grasp the heel for stabilization. Lift the knee and bend it toward the chest, with the kneecap pointed toward the ceiling. Do

not allow the hip to twist during this movement. The foot should stay in a straight line with the hip and not swing in or out. The leg was then lowered to the starting position.

- **Hip Rotation**: Place one hand on the thigh and other hand just below the knee. Bend the knee halfway to the chest so that there was a 90 degree angle at the hip and knee. Pull the foot toward you and then push it away. Remember, do not go beyond the point of resistance or pain. Lower leg to starting position.
- **Hip Abduction**: Cradle the leg by placing your hand under the knee and holding it.
- Place the other hand under the heel to stabilize the hip joint. Keeping the knee straight, move the leg along the surface of the bed, toward you and away from the other leg, to approximately 45 degrees. Then bring the leg back to the other leg.
- **Ankle Rotation**: With the knee straight and one hand holding the ankle steady, place the other hand around the foot and turn foot inward, then outward.
- **Toe Flexion and Extension**: With one hand, stabilize the foot just below the toes. With the other hand, gently move each or all of the toes forward and backward.
- **Heel-Cord Stretching**: Cups or cradle the heel with your hand and place your forearm against the ball of the foot. Push the ball of the foot forward, bending the foot toward the knee and stretching the muscles in the back of the leg.

2. Active exercises

The subjects were asked to do the following exercises:

- **Hip and knee bends**: Point your toes. Slowly bend your knee up as close to your chest as possible. Straighten your leg and return it to a flat position on the bed.
- **Leg lifts**: Raise your leg so that your foot is 6 to 12 inches (15 to 31 centimeters) off the bed. Hold it in the air for a few seconds. Return your leg to the bed.
- **Leg movement, side to side**: Flex your foot so your toes point up toward the ceiling. Move your leg out to the side as far as possible. Bring your leg back to the middle.
- **Leg rotation, in and out**: Put your leg flat on the bed. Roll your leg toward the middle so your big toe touches the bed. Then roll your leg out and try to make your smallest toe touch the bed.
- **Knee rotation, in and out**: Lie on your back on the bed. Bend your knee so the bottom of your foot is flat on the bed. Slide your heel towards your buttocks. Return your foot to the starting position.
- **Ankle bends**: Keep your toes on the floor and raise your heel as high as you can. Lower your heel. Then keep your heel on the floor and raise your toes as high as you can.
- **Ankle rotation**: Raise your foot slightly off the floor. Roll your ankle in circles. Then roll your ankle in circles in the other direction.
- **Toe bends**: Curl your toes down toward the sole (bottom) of your foot. Straighten them. Curl them up toward the ceiling. Then straighten them again.
- **Toe spreads**: Spread your toes apart. Bring them together again.

3. Resistive Exercise

- Standing with support, weight at unaffected ankle, step forward and back with unaffected lower extremity. Hip hiking was permitted. Targeted muscles were affected hip abductors with co-contraction of adductors for stabilization of the pelvis. Targeted function was gait.
- Standing with support, affected foot 1ft behind unaffected foot, weight was at affected ankle, step forward to a 1-ft length in front of unaffected foot. Targeted muscles were affected hip flexors, hamstrings (initial swing), and quadriceps (terminal swing). Target function was gait.

- Standing with support, affected foot 1ft in front of unaffected foot, resistance was at affected ankle, pull affected low extremity straight back to a 1-ft length behind unaffected foot. Targeted muscles were hip extensors and co-contraction of hamstrings and quadriceps (stance phase). Target function was gait.
- Standing with support, return to stance unaffected foot was raised from floor (i.e., standing on affected foot only), and bend affected knee to 45° position. Weight was at waist. (Unilateral knee bend.) Targeted muscles were the quadriceps, plantar flexors, and hamstrings (hip extension). Targeted functions were stair climbing, sit to stand, and push-off phase of walking.

4. Weight bearing and weight shifting exercises

- **Weight Shift Side to Side**: Shift weight over the right hip then the left hip. Ribcage should move side to side and hip should lift off of surface. Do not bend at the waist to lean. Repeat 10-15 times. Books were placed under the hands while sitting to allow weight bearing through arms and to keep the hands from coming up off the sitting surface.
- **Weight Shift Forward and Back**: Shift your weight forward and back by arching and rounding your low back. Repeat 10-15 times.
- **Exercise to develop a good walking technique**: This was to improve weight shift and control for correct walking technique. Exercise was performed 2 to 3 times.

➢ Begin with the knees bent, the feet flat on the floor and the knees close together.
➢ Lift the hips from the floor.
➢ Slowly twist the hips side to side. Return to the center and lower the hips to the floor.
➢ Rest for at least 30 seconds and repeat the motion.

- Improve balance with this exercise: This was improve balance, control and weight shift to prepare for walking activities. Exercise was performed 2 to 3 times

➢ Start by positioning yourself on your hands and knees. Distribute weight evenly in both arms and legs.
➢ Rock yourself in a diagonal direction, back toward the right heel. Then, as far forward toward the left hand.
➢ Repeat motion 10 times. Slowly rock as far as possible in each direction.
➢ Return to the center.
➢ Rock yourself in a diagonal direction toward the right hand. Slowly move back as far as possible in each direction

At the end of 4th week of intervention the effects were observed by Berg Balance scale and Timed up and Go Test.

Procedure of intervention for Manual Perturbation Group (Group A):

Group-A subjects were treated with Manual perturbation and Conventional therapy exercises.

Manual perturbation exercises, followed by Conventional PT treatment, were given to the 15 patients. Before giving manual perturbations to the patients, all possible precautionary measures were taken, to avoid risk of injuries. Manual Perturbations were given in the sitting, kneeling, standing positions on the mattress, with 10 sec hold, 10 perturbations in each position,2 sets/6 days/week. For giving manual perturbations patients were placed into sitting positions over the couch, 5 Minutes manual perturbations were given; along with 10 sec break in between two successive sets of manual perturbations.

As patient was able to regain balance following manual perturbations, progression to next position i.e. kneeling & standing was done. Manual Perturbations were given in both Right and Left sideways, forward and backward directions in Sitting, Kneeling and Standing. Manual Perturbations were given at the shoulder, trunk, and waist region.

Total duration of the session was 1 hour; Manual perturbation exercise (20 mins) and Conventional PT (40 mins) treatment for six days in a week for 4 weeks.

Procedure of intervention for Circuit Class Training group (Group B):

The Circuit group received physiotherapy in circuit based workstations. The participants were allocated to workstations according to their functional balance level and the time required for completion of one circuit was about 15-20 minutes.

The overall aim of the treatment program was to improve patient‟s balance. There were 10 work stations incorporated into this study.

(1) Sitting on a table and reaching out in different directions,
(2) Sit/stand from different chair heights
(3) Lower limb strengthening exercises in weight bearing position
(4) Stepping in forward, side and side directions
(5) Postural training in standing
(6) Heel lifts
(7) Standing up from a chair and walk for short distances
(8) Walk on treadmill
(9) Gait training over various surfaces and obstacles
(10) Walking over slopes and stairs with variant environment

Total duration of the session was 1 hour; Circuit Class Training exercise (20 mins) and Conventional PT (40 mins) treatment for six days in a week for 4 weeks.

Post Test evaluation after 4 weeks:

Pretest evaluation followed by treatment protocol of both groups were access for subjective balance using Berg Balance scale and Timed Up and Go Test. To compare the parameters between pre and post evaluation test.

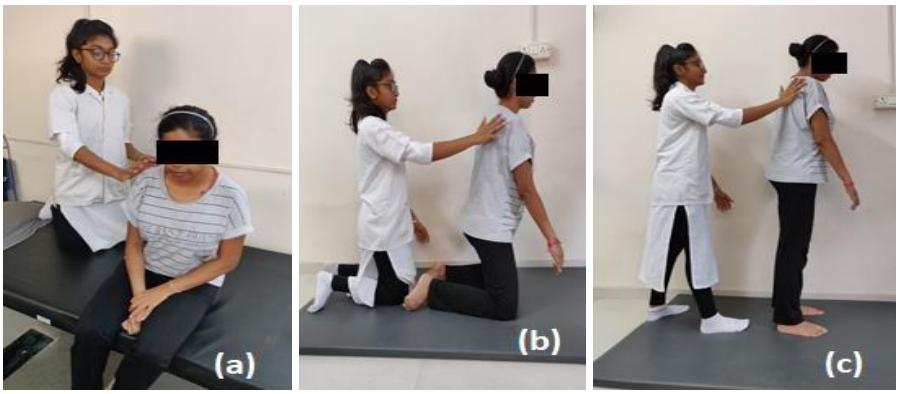


Figure-1: Subjects treating with Manual Perturbation exercises in (a)Sitting, (b)Kneeling, and (c)Standing position

Figure- 2: Subjects treating with Conventional Therapy exercises. (a)Passive Hip and Knee flexion exercise, (b)Active Leg Lifts, (c)Resistive exercise with weight at unaffected ankle and step forward Front view and (d) Lateral view

Figure-3: Subjects performing Circuit Class Training exercises. Stepping forward, (a)Front view and (b)Lateral view, (c)Walk on treadmill.

OUTCOME MEASURES

1.Berg Balance Scale

It is a 14-item scale designed to measure balance of the older adult in a clinical setting. Internal consistency was excellent (Cronbach alpha=.92–.98), interrater reliability (intraclass correlation coefficients [ICCs]=.95–.98), intrarater reliability (ICC=.97), and test-retest reliability (ICC=.98). [10,11]

The Berg Balance Scale (BBS) was developed to measure balance among older people with impairment in balance function by assessing the performance of functional tasks. It is a valid instrument used for evaluation of the effectiveness of interventions and for quantitative descriptions of function in clinical practice and research. [7,8]

2.Timed Up and Go (TUG) Test

It is a measure of function which correlates to balance and fall risk. Equipment required is a stopwatch and armchair. In that patients wear their regular footwear and can use a walking aid if needed. Begin by having the patient sit back in a standard arm chair and identify a line 3 meters or 10 feet away on the floor.

Instructions to the patient: When I say "Go," I want you to:

Stand up from the chair

1. Walk to the line on the floor at your normal pace
2. Turn
3. Walk back to the chair at your normal pace
4. Sit down again

Stop timing after patient has sat back down and record. Results correlate with gait speed, balance, functional level, the ability to go out, and can follow change over time.[9]

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS 16.0 software and Microsoft and Excel was used to generate graphs, tables. Parametric tests were applied to analyse the data. Sample size was calculated to be 30 participants in total

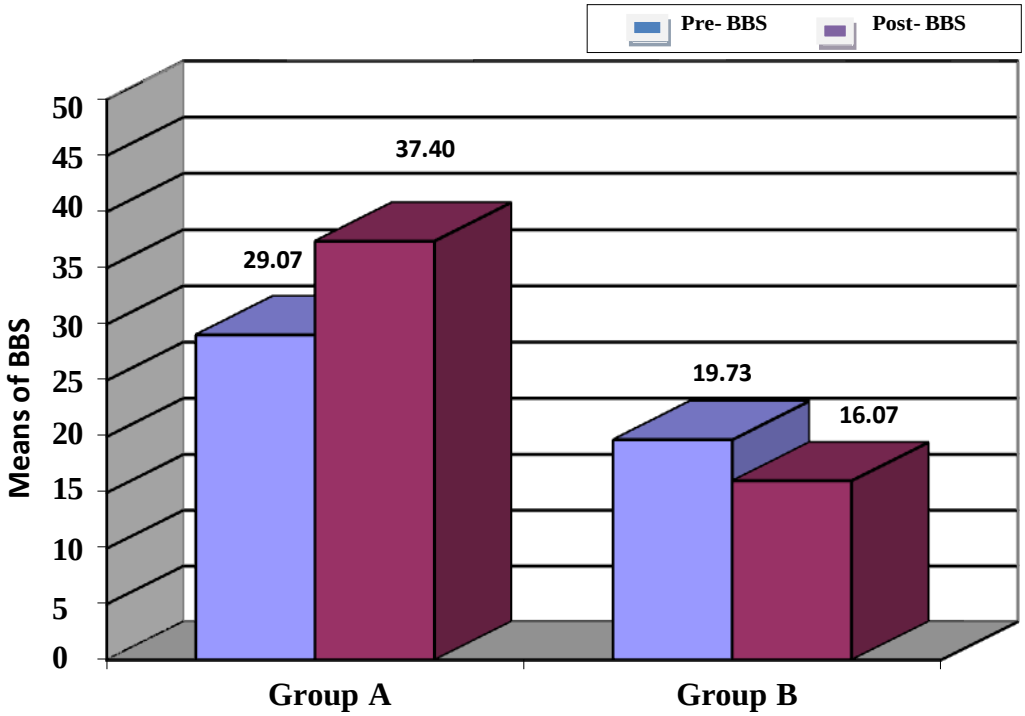
RESULT

Table 1: Basic Characteristics of the subjects

Basic Characteristics of the subjects studied		**Group A (Manual perturbation)**		**Group B (Circuit class training)**		**Between the groups Significance**
Number of subjects studied (n)		15		15		--
Age in years (Mean± SD)		49.00± 5.11 (41-56)		49.93± 5.28 (41-58)		p= 0.604 (NS)
Gender	Males	07	46.67%	07	46.67%	--
	Females	08	53.33%	08	53.33%	
Side	Right	09	60%	8	53.33%	
	Left	06	40%	7	46.67%	

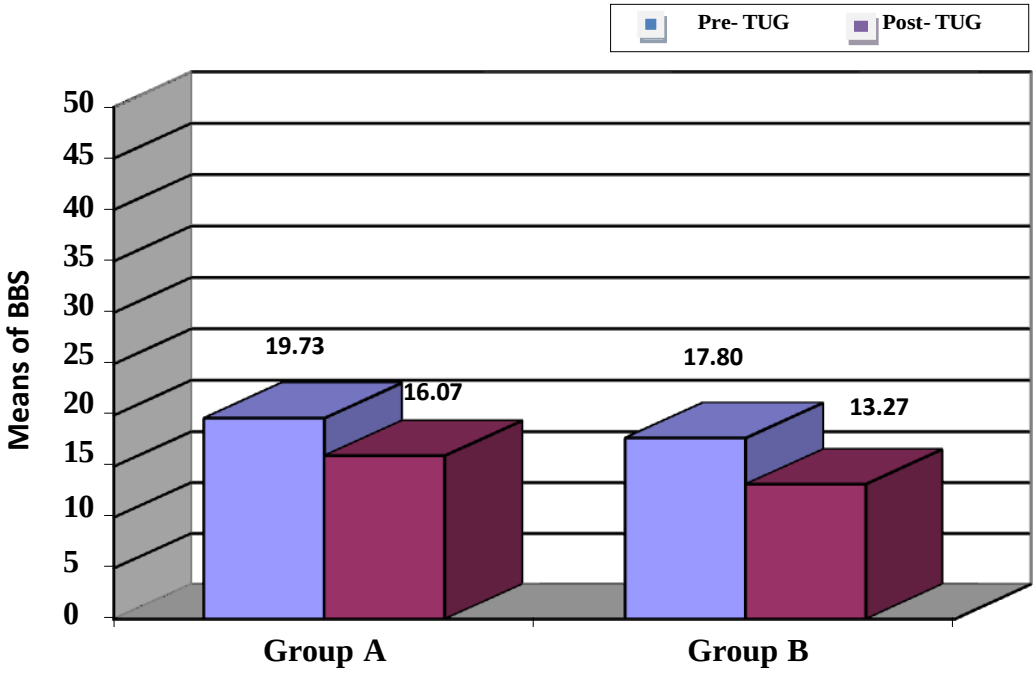
The above table shows that in Group A there were 15 subjects with mean age 49.00 years and there were 07 males and 08 females were included in the study. In Group B there were 15 subjects with mean age 49.93 years and there were 07 males and 08 females were included in the study. There is no significant difference in mean ages between the groups.

Graph- 1: Analysis of Berg Balance scale within Groups (Pre to post test analysis)



The above graph shows that in Group A and in group B there is a statistically significant change in means of Berg Balance scale a when means were analyzed from pre intervention to post intervention within the groups with $p<0.000$.

Graph- 2: Analysis of Timed Up and Go Test within Groups (Pre to post test analysis)



The above graph shows that in Group A and in group B there is a statistically significant change in means of Timed Up and Go Test when means were analyzed from pre intervention to post intervention within the groups with p<0.000.

DISCUSSION

The study was conducted to find the effectiveness of 4 weeks of Manual Perturbation exercises versus Circuit Class Training exercises, along with conventional therapy on improving balance in subjects with subacute stroke. Analysis found that there is significant effect of Circuit Class Training Exercises with conventional therapy on improvement of balance in subjects with subacute stroke. When the post intervention means of BBS and TUG balance and mobility were compared between Group A who received Perturbation exercises with conventional therapy exercises and Group B subjects who received the CCT exercises with conventional therapy exercises shown there is a statistically significant difference in means between the groups.

When pre intervention means was compared between Group A and Group B there is no statistically difference in means of BBS and TUG test between the groups. When post intervention means were compared between groups there is a statistically significant difference in means of BBS and TUG test.

Both the groups received conventional therapy consisting exercises that includes Passive range of motion exercises, active exercises, resistive exercises, weight bearing and weight shifting exercises. There are evidence based studies emphasizing on effect of different therapeutic exercise on improvement of balance and mobility.

Group A (Manual Perturbation group):

In Group A there is a statistically significant change in means of BBS and TUG, when means were analyzed from pre intervention to post intervention within the groups with p<0.000. Group A received Manual perturbation exercises and conventional therapy exercises. A manual/postural perturbation is defined as „Sudden change in conditions that displaces the body posture away from equilibrium“. The perturbation-based balance training (PBBT) is widely used in older adults at a high risk for falls only. Although many factors contribute to increased risk for falls, a specific fall event ultimately occurs when an individual fails to recover from a loss of balance or postural perturbation. Postural perturbations can occur in daily life for a variety of reasons, including failure to control weight shifting during voluntary movement or experiencing a slip or trip while walking. Balance recovery reactions, such as swaying around the ankles or hips, taking a step, or grasping a handhold, are executed rapidly to prevent a fall following a postural perturbation. Individuals with impaired balance control and increased fall risk often show difficulty controlling these balance recovery reactions. Because all ambulatory individuals are at risk for experiencing a loss of balance during daily life, training to improve control of balance recovery reactions may be an effective means of preventing falls.

Stroke survivors are at a high risk of falls, it is essential to develop approaches to re-train compensatory stepping after stroke. Perturbation training involving repeated exposure to applied balance disturbances, is necessary to achieve improvements in control of fast reactive movements.

From the literature Perturbation-based training also shows promise as an effective intervention to improve the ability of older adults to prevent themselves from falling when they lose their balance. Avril Mansfield concluded that Perturbation-based balance training appears to reduce fall risk among older adults and individuals with Stroke and other neurological disorders.[5]

Avril Mansfield also conducted another study and discussed that this training has a potential to not only prevent falls but to also improve safe independent mobility and engagement in daily activities for those with stroke.[2] Marigold DS included Agility or Stretching/weight shifting exercises in their

study which can improve postural reflexes, functional balance and mobility and may lead to a reduction of falls in older adults with chronic stroke.[10]

Perturbation-based balance training (PBT) is a novel balance training intervention that incorporates exposure to repeated postural perturbations to evoke rapid balance reactions, enabling the individual to improve control of these reactions with practice. Studies have shown that PBT can improve speed and control of voluntary movements and rapid balance reactions and can reduce occurrence of "falls" following controlled postural perturbations in the laboratory.[5] And there is also evidence for Manual Perturbation exercises combined with Conventional Physiotherapy and Conventional Physiotherapy alone are beneficial in improving Balance, Function and Mobility in stroke patients

Group B (Circuit Class Training group):

In Group B there is a statistically significant change in means of BBS and TUG, when means were analyzed from pre intervention to post intervention within the groups with $p<0.000$

Group B received Circuit Class Training exercises and Conventional Therapy exercises. The circuit or the group trainings consist of different work stations and these workstations provide the opportunity for maximum repetition of task. Circuit class trainings can be defined as treatment provided to more than 2 patients involving the tailored intervention program, with main focus on repetition or practice of functional tasks assigned to them by the therapist within a group setting. The patients with similar or different degree of functional limitations physically move from one to another workstations under the therapists supervision. Usually, the staff to patient‟s ratio in these circuits is 1:3, depending upon the functional capabilities of patients. The interventions can be designed to gait training, range of movement activities and upper limb etc. The definition of circuit trainings is distinct from the group trainings that usually involve patients with similar degree of functional abilities. It thus established the overall effectiveness on individual task specific training.

Coralie English, in their randomized study documented the results of Circuit Class Therapy (CCT) for the treatment of Subacute Stroke. They stated that CCT may have beneficial effect in improving gait capacity and other aspects of mobility for adults after stroke and can be implemented in the post acute and chronic stages for people with moderate stroke severity. Intensity can vary from daily to three times weekly for four weeks or more to achieve benefits[6] Coralie K. English conducted study to compare the effectiveness of circuit class therapy and individual physiotherapy sessions in improving walking ability and functional balance for people recovering from stroke and they concluded Circuit Class Therapy appeared as effective as individual PT sessions for this sample of subjects receiving inpatient rehabilitation poststroke.[11]Ingrid GL van de Port analyzed and concluded that the effect of Task oriented circuit training can safely replace usual physiotherapy for patients with stroke who are discharged from inpatient rehabilitation to the community and need further training in gait and gait related activities as an outpatient.[3]Based on the existing evidence, circuit class therapy (CCT) is effective in improving gait capacity and other aspects of mobility for adults after stroke and can be implemented in the post acute and chronic stages for people with moderate stroke severity. Conventional Therapy exercises was given to subjects same like Group A.

Hence based on the analysis and findings, the study found that with four weeks of Circuit Class Training exercises with conventional therapy exercises shown there is a statistically significant effect on improvement of balance and mobility, therefore considering the significant difference in outcome measure means the study rejects the null hypothesis. The

greater percentage of improvement is found in Group B compared with Group A.

CONCLUSION

The present study concluded that four weeks of Circuit Class Training exercises with Conventional therapy exercises showed significant effects on improvement of balance and mobility in subjects with subacute stroke when compared to Manual perturbation exercises with Conventional Therapy. It is recommended that implementation of Circuit Class Training exercises along with Conventional Therapy is useful technique to reduce risk of falls and improvement of Balance and Mobility for subjects with subacute stroke.

Declaration by Authors

Ethical Approval: Approved
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Kumar C, Pathan N. Effectiveness of manual perturbation exercises in improving balance, function and mobility in stroke patients: a randomized controlled trial. J Nov Physiother. 2016;6(284):2.
2. Mansfield A, Aqui A, Centen A, Danells CJ, DePaul VG, Knorr S, Schinkel-Ivy A, Brooks D, Inness EL, McIlroy WE, Mochizuki G. Perturbation training to promote safe independent mobility post-stroke: study protocol for a randomized controlled trial. BMC neurology. 2015 Dec;15(1):87.
3. van de Port IG, Wevers LE, Lindeman E, Kwakkel G. Effects of circuit training as alternative to usual physiotherapy after stroke: randomised controlled trial. BMJ. 2012 May 10;344:e2672.
4. Basri R, Ali A, Ullah S, Naseem M, Darain H, Haq ZU. Effects of Circuit Class Versus Individual Task Specific Training on Balance in Post-Stroke Patients. Journal of Dow University of Health Sciences. 2017 Dec 19;11(3).
5. Mansfield A, Wong JS, Bryce J, Knorr S, Patterson KK. Does perturbation-based balance training prevent falls? Systematic review and meta-analysis of preliminary randomized controlled trials. Physical therapy. 2015 May 1;95(5):700-9\
6. English C, Hillier SL, Lynch EA. Circuit class therapy for improving mobility after stroke. Cochrane Database of Systematic Reviews. 2017(6).
7. Walker C, Brouwer BJ, Culham EG. Use of visual feedback in retraining balance following acute stroke. Physical therapy. 2000 Sep 1;80(9):886-95.
8. Geiger RA, Allen JB, O'Keefe J, Hicks RR. Balance and mobility following stroke: effects of physical therapy interventions with and without biofeedback/forceplate training. Physical therapy. 2001 Apr 1;81(4):995-1005.
9. Louie DR, Eng JJ. Berg balance scale score at admission can predict walking suitable for community ambulation at discharge from inpatient stroke rehabilitation. Journal of rehabilitation medicine. 2018 Jan 5;50(1):37-44.
10. Marigold DS, Eng JJ, Dawson AS, Inglis JT, Harris JE, Gylfadottir S. Exercise leads to faster postural reflexes, improved balance and mobility, and fewer falls in older persons with chronic stroke. Journal of the American Geriatrics Society. 2005 Mar;53(3):416-23.
11. English CK, Hillier SL, Stiller KR, Warden-Flood A. Circuit class therapy versus individual physiotherapy sessions during inpatient stroke rehabilitation: a controlled trial. Archives of physical medicine and rehabilitation. 2007 Aug 1;88(8):955-63

How to cite this article: Nandini B Kadabi, Vinod Babu K, Hemangi Jayantilal Vachhani, Virendra Singh Rajpurohit. Comparative effect of manual perturbation exercises versus circuit class training exercises on improving balance in subjects with subacute stroke. *Int J Health Sci Res.* 2025; 15(2):194-204. DOI: *https://doi.org/10.52403/ijhsr.20250226*

******