Comparative Study to Assess the Effect of Gaze Stability Exercises and Perturbation Based Balance Exercises on Balance for Stroke Patients

Rakshith BR[1*] and Prem Kumar BN[2]

[1]Post-Graduate Student, Kempegowda Institute of Physiotherapy, Bengaluru

[2,]Associate Professor, Kempegowda Institute of Physiotherapy, Bengaluru

[*]**Corresponding Author:** Rakshith BR, Post-Graduate Student, Kempegowda Institute of Physiotherapy, Bengaluru.

Abstract

Background

Impairment in perception of sensory input disturbs static and dynamic balance in patients with stroke. Gaze stability exercises and perturbation-based balance exercises (PBBT) have shown results in improving balance and reducing risk of falls. However, the effect of these interventions has not been assessed and compared for balance in stroke patients. This study aims to assess and compare the effect of gaze stability exercises and PBBT for balance in stroke patients.

Methods

Forty stroke patients were recruited in the study. Patients were divided into group A and group B and they received gaze stability exercises and PBBT respectively. Berg Balance Scale (BBS), Timed Up and Go test (TUG) and Stroke Impact Scale (SIS) were the outcome measures. The pre and post intervention scores were recorded and assessed respectively.

Results

The analysis of BBS, TUG and SIS showed improvement in both group A and group B with $p<0.05$ significance. In comparison to Gaze stability exercises group and PBBT group, both performance oriented and clinical measures of balance was better improved in PBBT group than in gaze stability group (8.55 ± 6.85 and 5.10 ± 5.67 respectively) and (2.7 ± 5.43 and 1.15 ± 4.32 respectively) with respect to the scores of BBS and TUG respectively. Health- related quality of life improved better in PBBT group than in gaze stability group (15.45 ± 11.54 and 7.4 ± 9.11 respectively) with respect to the scores of SIS.

Conclusion

Gaze stability exercises and PBBT are effective for balance training and improving health- related quality of life in patients with stroke. However, in this study PBBT showed better results for balance and health-related quality of life in patients with stroke in comparison to Gaze stability exercises.

Keywords: Stroke, balance, Gaze stability exercises, PBBT.

Introduction

Acute ischemic stroke, due to occlusion of blood vessels, has inability to maintain static and dynamic balance results in balance disorders [1-4]. Muscle weakness, paralysis, damage to the areas of the brain that control balance leading to Loss of balance [3,4]. Stroke also leads to increased postural instability [5]. The vestibular system controls postural stability [5].

Chronic motor impairments and limitations in activities of daily living are observed in 41-45% of patients with stroke [6]. Gaze stability exercises have been found to resolve the sensory mismatch among visual, vestibular, and somatosensory inputs being beneficial for postural control in stroke patients [5]. PBBT during stroke rehabilitation has shown improvement in reactive balance responses, performance-based measures of balance [7]. Gaze stability exercises and PBBT have shown results in improving balance in patients with stroke. However, the effect of Gaze stability exercises and PBBT are not compared. Hence, the current study aimed to assess and compare the effect of gaze stability exercises and PBBT for balance in stroke patients.

Materials and methods

The study was conducted in KIMS hospital, Bengaluru. 40 stroke patients who met the inclusion criteria were randomly divided into two groups. performance oriented and clinical measures of balance in Ischemic Stroke patients were assessed by BBS and TUG respectively and health-related quality of life was assessed by SIS [8,9] on the first day of treatment and the end of 4th week.

Ischemic Stroke patients within 45 days of occurrence, with a score of 26 points or higher of the Montreal cognition assessment, positive Romberg test and having the ability to walk at least 3 meters alone with or without an assistive device were included. Subjects with terminal illness or medically unstable, severe cardiopulmonary disease, visual and auditory disorders, perceptual and cognitive deficits, balance impairment and orthopedic or any other neurological disorders which impair balance were excluded in study.

Group A patients received Gaze stability exercises and Group B patients received PBBT. The patients of both groups received conventional exercises such as active assistive exercises, active exercises, resistive exercises, exercises in different functional positions, weight bearing exercises, weight shifting exercises, reaching exercises in sitting, standing. The treatment lasted for 45 minutes per day, 5 days per week, for 4 weeks.

Results

The baseline characteristics of subjects were analysed. The mean age of Group A was 57.3 and Group B 56.9, with standard deviation of 10.15 and 10.2 respectively. The Z value and P value of the age group was 0.54 and 0.82 respectively (Table 1 and Fig.1). Group A included 17 male subjects (85%) and 3 female subjects (15%), and Group B included 16 male subjects (80%) and 4 female subjects (20%) (Table 2 and Fig.2).

		Group A-Gaze stability Exercise	Group B-Manual Perturbation Exercise	Z value (Mann Whitney U test)	P Value
	Mean	57.35	56.9		
Age	SD	10.15	10.2	0.54	0.82

Table 1: Distribution of subjects based on age in both the groups. P<0.005 is statistically (Shapiro Wilkinson Test, p<0.05).
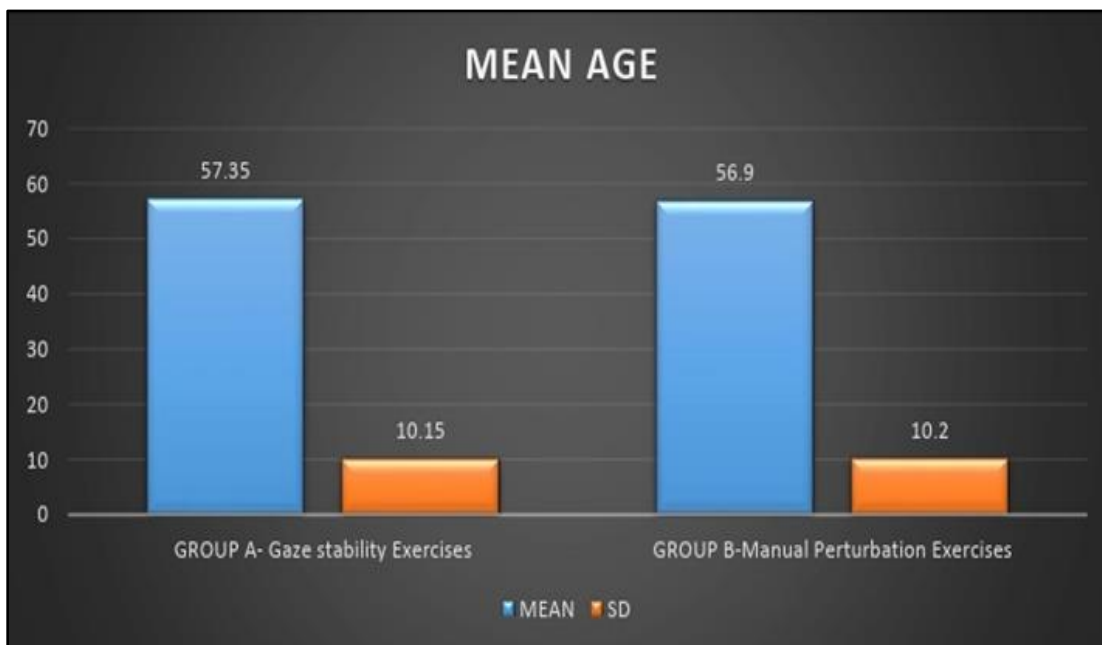
Figure 1: Distribution of subjects based on age in both the groups.

		Group A Gaze Stability Exercise	Group B Manual Perturbation Exercise	X² Value	P Value
	Male	17(85%)	16(80%)		
Gender	Female	3(15%)	4(20%)	0.29	0.83

Table 2: Distribution of subjects based on gender in both the groups. *P<0.005 is statistically significant.

Figure 2: Distribution of subjects based on gender in both the groups.

The analysis of BBS, TUG and SIS showed improvement in both group A and group B with p<0.05 significance. The PBBT group than the gaze stability group showed better improvement in performance-oriented measures of balance in accordance with BBS with the standard deviation of 8.55 ± 6.85 and 5.100 ± 5.67(Table 3 and Fig.3) respectively, clinical measures of balance with the standard deviation of 2.7 ± 5.43 and 1.15 ± 4.32 (Table 4 and Fig.4) respectively and Health-related quality of life with the mean difference and standard deviation of 15.45 ± 11.54 and 7.4 ± 9.11 (Table 5 and Fig.5) respectively between Pre and Post test. Data was analysed using the statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at p<0.05.

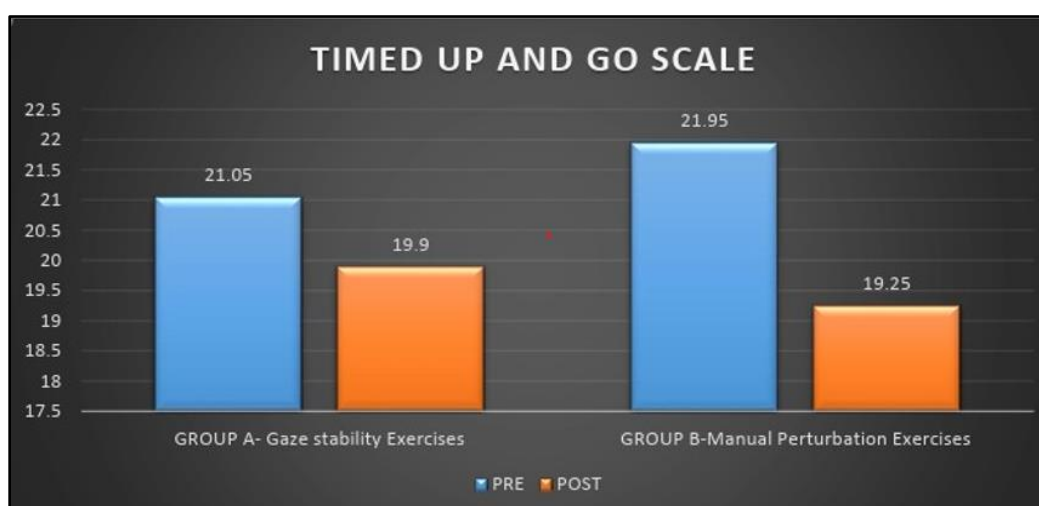|		Group A-Gaze stability Exercise	Group B- Manual Perturbation Exercise	Z value (Mann Whitney U Test)	P Value
Berge balance Scale	PRE	34.15 ± 5.85	33.2 ± 7.15	0.56	0.77
	POST	39.05 ± 6.27	41.75 ± 6.20	1.96	0.16
Z Value		2.55	4.04		
P value (Wilcoxon Pair Test)		0.0001*	0.0003*		
Difference		5.10 ± 5.67	8.55 ± 6.85		

Table 3: Comparison of Berg Balance Scale (For 54 Points). *P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05).

Figure 3: Comparison of berg balance scale.

|		Group A- Gaze Stability Exercise	Group B-Manual Perturbation exercise	Z value (Mann Whitney U Test)	P Value
Timed Up and Go Scale	PRE	21.05 ± 4.38	21.95 ± 5.08	0.49	0.69
	POST	19.9 ± 4.77	19.25 ± 5.40	0.25	0.77
Z value		0.79	1.62		
P value (Wilcoxon Pair test)		0.43	0.11		
Difference		1.15 ± 4.32	2.7 ± 5.43		

Table 4: Comparison of Timed Up and Go scale (seconds). *P<0.05 is statistically significant (Shapiro Wilkinson test, p<0.05).

Figure 4: Comparison of timed up and go scale.

		Group A- Gaze Stability Exercise	Group B- Manual Perturbation Exercise	Z value (Mann Whitney U Test)	P value
Stroke Impact Scale	PRE	54.95 ± 9.08	55.75 ± 12.54	1.86	0.06
	POST	62.35 ± 9.36	71.2 ± 9.24	0.8	0.42
Z Value		2.53	4.41		
P value (Wilcoxon pair Test)		0.01*	0.0001*		
Difference		7.4 ± 9.11	15.45 ± 11.54		

Table 5: Comparison of Stroke impact scale (%). *P<0.05 is statically significant (Shapiro wilkinson test, p<0.05).
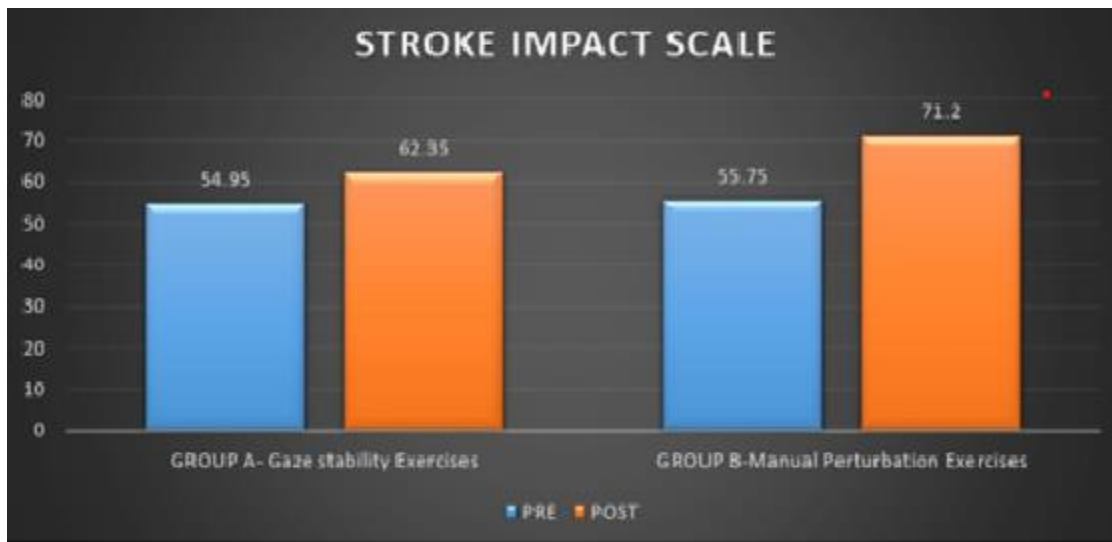
Figure 5: Comparison of stroke impact scale (%).

Discussion

Stroke alters the weight distribution and loading on affected and unaffected lower limbs, followed by loss of balance [10,11]. complex integration and coordination of multiple body systems includes the vestibular, visual, auditory, motor, and higher-level premotor systems achieves balance [12]. Gaze stability exercises, the adaptation exercises to modify the magnitude of the vestibulo-ocular reflex (VOR) of the vestibular system are found to be effective for postural stability and dynamic visual acuity [13,14]. PBBT, a task specific intervention improves reactive balance control after loss of balance in a safe and controlled environment [7,15]. A randomized control study (2018) showed that gaze stability exercises are a short-term intense rehabilitation help resolve the sensory mismatch among visual, vestibular, and somatosensory inputs [5]. A randomized controlled trial (2021) has results which show that gaze stability exercises are

efficient strategies to improve balance and reduce the risk for falls in patients with stroke [16]. A single-subject design study (2011) concluded that PBBT improved time to stabilization, improved balance and reduced the risk for falls [17]. The present study was done to assess and compare the outcomes of Gaze stability exercises and PBBT.

The present study was done on 40 stroke subjects randomly divided into two groups. Patients were assessed with BBS, TUG and SIS to evaluate performance-oriented measure of balance, clinical measure of balance and health-related quality of life respectively.

Gaze stability exercises and PBBT being for balance training, PBBT showed better results for balance and health-related quality of life in patients with stroke in comparison to Gaze stability exercises.

This study could provide better evidence with a greater sample size. The inclusion of Brunnstrom stages of recovery would have given a clear result of the interventions applied. Since the interventions were administered at the acute stage of stroke, further studies can be done on chronic stroke patients.

Conclusion

This study intended to assess and compare the outcomes of Gaze stability exercises and PBBT. Improvement was shown in both the groups. Greater improvement in performance- oriented measure of balance, clinical measure of balance and health-related quality of life was observed in patients who received PBBT than in those who received Gaze stability exercises.

References

1. Donkor ES. Stroke in the 21st Century: A Snapshot of the Burden, Epidemiology, and Quality of Life. Stroke Res Treat. 2018;2018:3238165. PubMed | CrossRef

2. Wang J, Xu J, An R. Effectiveness of Backward Walking Training on Balance Performance: A Systematic Review and Meta-Analysis. Gait Posture. 2019;68:466-475. PubMed | CrossRef

3. Pimenta C, Correia A, Alves M, Virella D. Effects of Oculomotor and Gaze Stability Exercises on Balance After Stroke: Clinical Trial Protocol. Porto Biomed J. 2017;2(3):76-80. PubMed | CrossRef

4. Bayouk JF, Boucher JP, Leroux A. Balance Training Following Stroke: Effects of Task-Oriented Exercises with and Without Altered Sensory Input. Int J Rehabil Res. 2006;29(1):51-9. PubMed | CrossRef

5. Mitsutake T, Sakamoto M, Ueta K, Horikawa E. Transient Effects of Gaze Stability Exercises on Postural Stability in Patients with Posterior Circulation Stroke. J Mot Behav. 2018;50(4):467-472. PubMed | CrossRef

6. Rehani P, Kumari R, Midha D. Effectiveness of Motor Relearning Programme, Mirror Therapy on Hand Functions in Patients with Stroke-A Randomized Clinical Trial. J Therap Rehab Res. 2015;4(3):1-5. PubMed | CrossRef

7. Handelzalts S, Kenner-Furman M, Gray G, Soroker N, Shani G, Melzer I. Effects of Perturbation-Based Balance Training in Subacute Persons with Stroke: A Randomized Controlled Trial. Neurorehabil Neural Repair. 2019;33(3):213-224. PubMed | CrossRef

8. Steffen TM, Hacker TA, Mollinger L. Age- and Gender-Related Test Performance in Community-Dwelling Elderly People: Six-Minute Walk Test, Berg Balance Scale, Timed Up and Go Test, and gait speeds. Phys Ther. 2002;82(2):128-37. PubMed | CrossRef

9. Almalki O, Alshehri MA, El-Fiky AA, Abdelaal AA, Alzaidi JH, Al Attar WSA, et al. Can the Stroke Impact Scale 3.0 Detect Cognitive Impairments in Patients with a Recent Stroke? J Phys Ther Sci. 2019;31(7):563-568. PubMed | CrossRef

10. Kumar C, Pathan N. Effectiveness of Manual Perturbation Exercises in Improving Balance, Function, Mobility

in Stroke Patients: A Randomized Controlled Trial. J Nov Physiother. 2016;6(284):2. CrossRef

11. Chen IC, Cheng PT, Chen CL, Chen SC, Chung CY, Yeh TH. Effects of Balance Training on Hemiplegic Stroke Patients. Chang Gung Med J. 2002;25(9):583-90. PubMed

12. Mancini M, Horak FB. The Relevance of Clinical Balance Assessment Tools to Differentiate Balance Deficits. Eur J Phys Rehabil Med. 2010;46(2):239-48. PubMed

13. Bhardwaj V, Vats M. Effectiveness of Gaze Stability Exercise on Balance in Healthy Elderly Population. Int J Physiother Res. 2014;2(4):642-7. CrossRef

14. Herdman SJ. Exercise Strategies for Vestibular Disorders. Ear Nose Throat J. 1989;68(12):961-4. PubMed

15. Gerards MHG, McCrum C, Mansfield A, Meijer K. Perturbation-Based Balance Training for Falls Reduction Among Older Adults: Current Evidence and Implications for Clinical Practice. Geriatr Gerontol Int. 2017;17(12):2294-2303. PubMed | CrossRef

16. Correia A, Pimenta C, Alves M, Virella D. Better Balance: A Randomised Controlled Trial of Oculomotor and Gaze Stability Exercises to Reduce Risk of Falling After Stroke. Clin Rehabil. 2021;35(2):213-221. PubMed | CrossRef

17. Bieryla KA, Madigan ML. Proof of Concept for Perturbation-Based Balance Training in Older Adults at A High Risk for Falls. Arch Phys Med Rehabil. 2011;92(5):841-3. PubMed | CrossRef