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EFFECT OF WEARABLE LASER GUIDED VISUAL FEEDBACK TRAINING VERSUS MIRROR GUIDED FEEDBACK TRAINING ON LATEROPULSION AND BALANCE AMONG PATIENTS WITH SUB-ACUTE STROKE

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ABSTRACT:
Lateropulsion, a postural control disorder characterized by an active pushing toward the paretic side, poses a significant challenge to balance rehabilitation following stroke. The present study aimed to compare the effectiveness of Wearable Laser-Guided Visual Feedback Training (Group A) and Mirror-Guided Feedback Training (Group B) on Lateropulsion and Balance among individuals with sub-acute stroke. A Pre and Post-test experimental study was conducted involving 30 participants diagnosed with post-stroke lateropulsion, who were randomly allocated to either group A or B. Both groups received conventional physiotherapy. Treatment were given for 30 minutes per session, five sessions per week, for eight weeks. The Burke Lateropulsion Scale (BLS) and Berg Balance Scale (BBS) were administered pre- and post-intervention. Both groups exhibited significant improvements; however, the group A demonstrated greater reduction in lateropulsion and enhancement of balance ($p < 0.05$) which could be a more effective adjunct to conventional therapy for improving postural control in sub-acute stroke rehabilitation.
KEY WORDS: Laser, Visual Feedback, Mirror Feedback, Subacute stroke, Lateropulsion

INTRODUCTION:

A stroke is a neurological disorder that occurs when blood flow to the brain is either blocked or interrupted by a ruptured vessel, leading to bleeding. This disruption limits the supply of oxygen and nutrients to brain tissue, causing functional impairments that vary based on the site and extent of the damage. One of the most common outcomes is hemiplegia on the side opposite to the brain lesion (1). As a result, patients often display an asymmetrical upright posture due to compromised balance and weight-bearing ability on the affected side, making it challenging to maintain stability in both sitting and standing positions.
Approximately 80% of individuals who experience a first-time stroke develop balance impairments during the sub-acute phase (2). Reduced trunk postural stability after a stroke hinders the restoration of overall functional abilities, highlighting the importance of maintaining posture while sitting without support (3). Balance deficits primarily arise from muscle weakness, sensory disturbances, and the adoption of compensatory strategies aimed at preventing balance loss, which ultimately contribute to further functional limitations.
The tendency to actively push the body toward the more affected side or resist weight shifting toward the less affected side is commonly observed in stroke patients undergoing rehabilitation (4,5). Although previously referred to as “pusher behaviour,” “pusher syndrome,” or “contraversive pushing,” the term lateropulsion is now the preferred terminology (6,7). The incidence of lateropulsion among stroke survivors ranges between 10% and 60%, and it can significantly interfere with sitting and standing balance, and in more severe cases, impair rolling, transferring, and walking abilities.
The coexistence of lateropulsion and balance deficits following a stroke is linked to a higher risk of falls (7), reduced mobility, prolonged rehabilitation duration, and poorer functional recovery (8,9). Additionally, it decreases the likelihood of being discharged home, leading to greater disability and dependence in performing daily activities (10).
Lateropulsion and balance impairments are frequent complications after stroke that limit rehabilitation progress and diminish quality of life. To overcome these challenges and improve recovery outcomes, innovative rehabilitation strategies are crucial. However, evidence regarding the effectiveness of various rehabilitation approaches in managing lateropulsion remains limited. A study (11) emphasized the need for more controlled studies to determine whether impairment-based interventions can enhance conventional therapies that emphasize posture and balance through visual feedback.

Another study (12) reviewed the available evidence on treatment approaches for lateropulsion in stroke patients and found that only a few studies demonstrated promising outcomes using somatosensory cues and visual–somatosensory integration. Among the various interventions for post-stroke rehabilitation, feedback-based technology has emerged as a particularly promising and innovative strategy.

MATERIALS AND METHODS:

A Pre and Post-test Experimental Study design was used to compare the effects of Wearable Laser Guided Visual Feedback Training versus Mirror Guided Feedback Training on Lateropulsion and Balance among patients with Sub-acute Stroke. This study was conducted from February to July, 2025 at an Institution in South India. The study was endorsed by the ethics committee of our institution. The study involved participants who provided written informed consent.
Patients (n=86) with stroke were screened for this study from January 2025 to July 2025. A total of 30 patients were recruited based on the following selection criteria (Figure 1). Age between 45 to 60years, Both genders will be included, Patients with MCA infarct of subacute stage (<6 months), Presence of lateropulsion at the first examination (Scale of Contraversive Pushing), Patients with Brunnstrom stage 3 and above, Modified Ashworth Scale ≤ 2, Mini Mental Status Examination score > 24, Ability to stand independently for atleast 5 minutes without the use of an assistive device or physical assistance were included and Visual, vestibular, and proprioceptive disorders that distort the verticality perception, Orthopedic and other neurological pathology that lead to passive or active changes in the body axis, Psychiatric and narcological pathology, Use of drugs that disturb postural balance (anticonvulsants, sedatives, tranquilizers, neuroleptics, tricyclic antidepressants) were excluded.

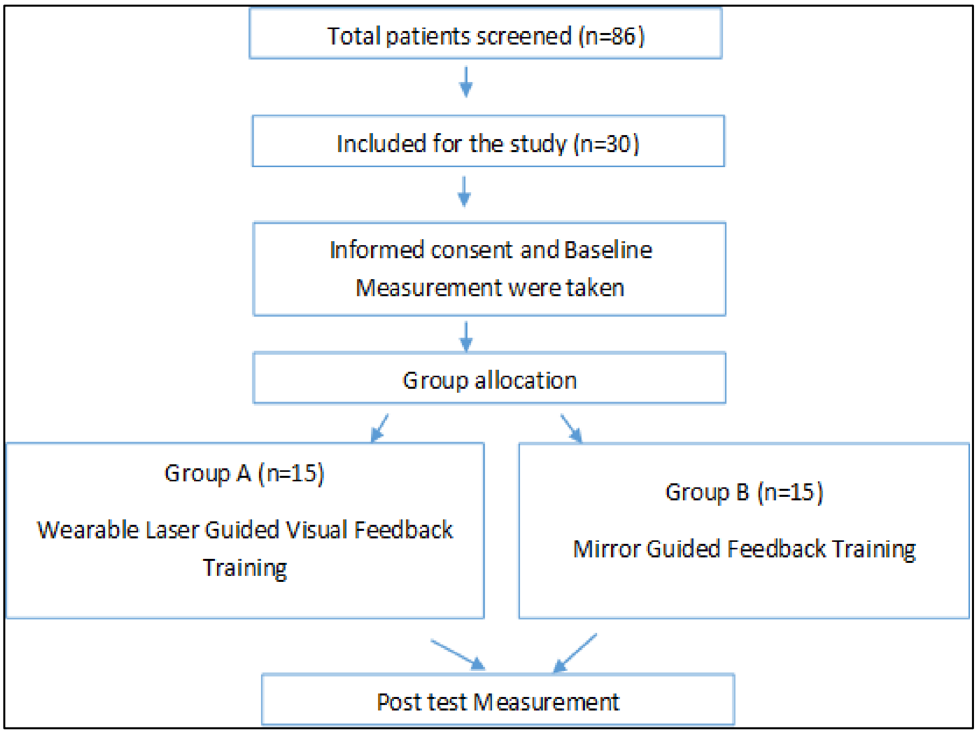


Figure 1 Study flowchart

They were randomly assigned to the Wearable Laser guided Visual Feedback Training group (Group A, n=15) and the Mirror guided Feedback Training group (Group B, n=15).

GROUP – A (Wearable Laser Guided Visual Feedback Training): (30 minutes) Figure 2

- Adjustable strap with Laser pointing device will be given to the patient in 3 reference point.
  - Centre of the Forehead, Chest - 2-inch below the sternal notch and Umblicus
- A specialized visual feedback target (in the shape of a human) will be set at a distance of 6 m from the patient. This target will have gridlines with numbers.
- The patient will be instructed to follow the comments of the therapist (eg: move the laser point to a specific number in the grid which was placed in front of the patient), both in sitting and standing.
- Progression of the protocol: Stable surface (first 2 weeks), Foam (second 2 weeks), Swiss ball/ Bosu ball (third 2 weeks) and Mini trampoline (last 2 weeks).

Figure 2 Wearable Laser guided Visual Feedback Training

GROUP – B (Mirror Guided Feedback Training): (30 minutes) Figure 3

- A mirror will be mounted on a stand in front of the patient so as to view the position of the body.
- The patient will be instructed to follow the comments of the therapist, both in sitting and standing.
- Progression of the protocol: Stable surface (first 2 weeks), Foam (second 2 weeks), Swiss ball/ Bosu ball (third 2 weeks) and Mini trampoline (last 2 weeks)

Both groups will receive Conventional Physiotherapy as a baseline therapy for 30 minutes/ session, 1 session/ day; 5 sessions/ week for 8 weeks. [Mat activities and Movement Re-education for Upper and Lower extremities]

Figure 3 Mirror guided Feedback training

Before group allocation, patients were assessed for Lateropulsion and Balance using Burke Lateropulsion Scale (BLS) and Berg Balance Scale (BBS) respectively. Once they had completed the 8-week intervention, patients were again assessed with BLS and BBS. An independent 't' test was used at $p<0.05$, to examine Lateropulsion and Balance between groups. The SPSS software version 23.0 and Microsoft Excel software was employed to analyse research data.

RESULTS:

A total of 30 Subacute Stroke patients were recruited for the study. Table 1 demonstrates the demographic characteristics of the study sample. Comparison of Pre-test and Post-test scores of BLS and BBS of both the groups were shown in Tables 2 and 3 respectively and in Figure 4 and Figure 5.

Table 1: Demographic Characteristics

SN	CHARACTERISTICS	Group A	Group B
1	Age (years)	54.7 ± 5.3	56.4 ± 1.6
2	Weight (kg)	85.5 ± 5.9	83.7 ± 5.1
3	Height (cm)	163.7 ± 4.5	161.6 ± 4.4

4	BMI (kg/m^2)		31.9 ± 2.0	32.1 ± 2.8
5	Gender N (%)	Male	9 (60%)	10 (66.7%)
		Female	6 (40%)	5 (33.3%)
6	Affected side (Left/ Right)		9/6	8/7
7	MMSE		24.9 ± 0.7	25.1 ± 0.8

Data was expressed as mean ± standard deviation; BMI- Body Mass Index; MMSE- Mini Mental Status Examination

Table 2: Comparison of Pre-test and Post-test scores of BLS and BBS of both groups

SN	Outcome measures	Group	Pre test	Post test
1	Burke Lateropulsion Scale (BLS)	A	11.4	8.3
		B	11.3	9.4
2	Berg Balance Scale (BBS)	A	39.5	46.5
		B	39.3	43.8

Table 3: Comparison of Post-test scores of BLS and BBS of both groups

SN	Outcome measures	Group	Post test	't' value	'p' value (<0.05)
1	Burke Lateropulsion Scale (BLS)	A	8.3	-3.37846	0.002159
		B	9.4		
2	Berg Balance Scale (BBS)	A	46.5	3.70763	0.000915
		B	43.8		

Figure 4:

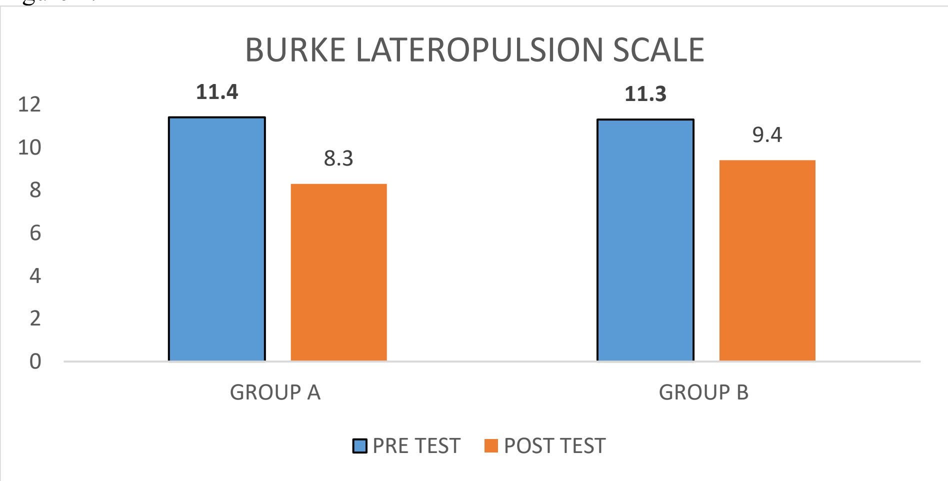
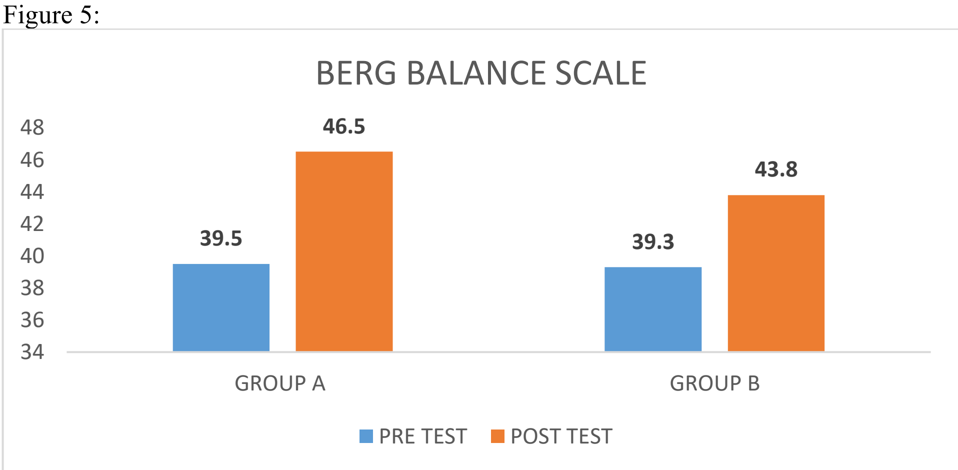


Figure 5:



DISCUSSION:

In this study, Lateropulsion and Balance were assessed on both groups, ie., Wearable Laser guided Visual Feedback training and Mirror guided Feedback training, using the Outcome measures Burke Lateropulsion Scale (BLS) and Berg Balance Scale (BBS). The scores of BLS and BBS were improved in Wearable Laser guided Visual Feedback training group (from pre test scores of BLS and BBS of Group A, 11.4 and 39.5 to post-test scores of BLS and BBS of Group A, 8.3 and 46.5), which is statistically significant than the Mirror guided Feedback training group (from pre test scores of BLS and BBS of Group B, 11.3 and 39.3 to post-test scores of BLS and BBS of Group B, 9.4 and 43.8), by using independent 't' test with the t- values -3.37846 and 3.70763 with ($p<0.05$) respectively.

In line with our results, a study (13) assessed laser pointer visual feedback in trunk stabilization exercises for chronic stroke patients, were 30 participants received either traditional rehabilitation with visual feedback or without it. Both groups improved in balance and walking after 6 weeks, but the experimental group showed significantly greater gains in balance, dynamic plantar pressure, walking speed, and fall efficacy. Visual feedback proved more effective for enhancing these outcomes in stroke rehabilitation. In another study (14), evaluated 39 chronic stroke patients, finding that visual feedback combined with unstable surface balance training significantly improved balance and gait, including stride length and hip/knee flexion angle, compared to conventional therapy. Visual feedback training showed greater benefits in gait speed, trunk stability, and mobility.

The effects of mirror therapy on balance in 34 subacute stroke patients were assigned to either a mirror therapy group or a sham therapy group (15). The mirror therapy group showed significant improvements in overall and medial-lateral stability indices compared to the control group. The study concludes that mirror therapy can enhance balance ability in subacute stroke patients.

The enhanced performance observed in the Wearable Laser guided Visual Feedback training may be attributed to the provision of real-time, task-specific visual feedback, enabling patients to actively correct their postural deviations and improve midline orientation. This aligns with prior research emphasizing the role of augmented feedback in facilitating neuroplasticity and sensorimotor relearning during stroke rehabilitation. In contrast, Mirror guided Feedback training relies primarily on self-observation through mirror reflection, which may be less precise in providing spatial awareness of body alignment (14).

The findings also support the notion that integration of visual-motor feedback enhances the patient's engagement and cognitive participation during balance training. These results are consistent with previous studies, which demonstrated that external visual cues significantly improve postural control in hemiparetic individuals. The wearable laser device, being portable and interactive, offers a practical and motivating rehabilitation tool that can be adapted across clinical and home-based environments.

CONCLUSION:

The study concludes that both Wearable Laser guided Visual Feedback training and Mirror-Guided Feedback Training are effective in reducing lateropulsion and improving balance among patients with sub-acute stroke. Nevertheless, Wearable Laser-Guided Visual Feedback Training produced more pronounced improvements, suggesting its superiority as a rehabilitation approach. The use of wearable laser devices facilitates precise self-correction and enhances body symmetry awareness, thereby promoting better postural alignment and balance recovery.

Incorporating Wearable Laser guided Visual Feedback training as an adjunct to conventional physiotherapy may serve as a valuable strategy in post-stroke rehabilitation, offering an innovative, patient-centered, and task-specific method for enhancing functional independence. Further studies with larger sample sizes and long-term follow-up are recommended to substantiate these findings and explore the sustained effects of wearable visual feedback systems in neurorehabilitation.

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DISCLOSURE OF POTENTIAL CONFLICTS:
The authors declare that they have no potential conflicts of interests.