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Effects of Swiss Ball and Mirror Feedback Therapy Along with Conventional Exercise Therapy in Trunk Control and Balance in Post Stroke Patients

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ABSTRACT

Background: post-stroke rehabilitation has concentrated on limb functionality, frequently neglecting trunk control, which is essential for postural stability, and functional autonomy. Swiss Ball Therapy and Mirror Feedback Therapy are two new trunk-focused treatments that have shown promise on their own. However, there has not been a direct study to see which one works better for trunk control outcomes.

Objectives: This study experiment the effects of Swiss Ball exercises and Mirror Feedback Therapy, each integrated with conventional physiotherapy, on trunk control and balance in post-stroke patients, as assessed by the Trunk Impairment Scale (TIS) and the Berg Balance Scale (BBS).

Results: 30 participants in Both groups exhibited highly significant within-group enhancements in BBS and TIS scores ($p=0.000$ for all pairs). Group A (Swiss Ball) had a mean TIS gain of 10.87 points (pre: 7.73 ± 1.39; post: 18.60 ± 1.76), and Group B (Mirror Feedback) had a mean BBS gain of 16.60 points (pre: 9.47 ± 1.46; post: 26.07 ± 5.04). The analysis between groups showed a very significant difference in post-intervention TIS scores, with Group A having the better scores ($t=4.655$, $p=0.000$). This means that Swiss Ball Therapy worked better for improving trunk control. There was no statistically significant difference between the groups in post-intervention BBS scores ($t=-1.200$, $p=0.240$), which means that both interventions improved balance in the same way.

Conclusion: When used with regular physiotherapy, both Swiss Ball Therapy and Mirror Feedback Therapy are good ways for stroke survivors to get better at trunk-focused rehabilitation. Swiss Ball Therapy showed better results in trunk control (TIS), while Mirror Feedback Therapy showed similar improvements in overall balance (BBS). These results support choosing an individualized intervention based on the main goal of rehabilitation. For example, Swiss Ball Therapy is best when trunk stabilization is the main goal, and Mirror Feedback Therapy is best when overall postural balance is the main goal. It is highly advised to routinely integrate these strategies into post-stroke rehabilitation programs.

Keywords: Swiss Ball Exercises, Mirror Feedback Therapy, Trunk Control, Post-Stroke Rehabilitation, Berg Balance Scale, Trunk Impairment Scale, Hemiparesis, Balance.

INTRODUCTION

Stroke, also referred to as a Cerebrovascular Accident (CVA), is a major global health concern characterized by the sudden loss of brain function due to an interruption in blood flow. This neurological

emergency results in a wide range of impairments that can significantly affect an individual's ability to perform daily activities. Among the many challenges stroke survivors face, deficits in motor control, balance, and postural stability are particularly disabling [1, 22]. Effective rehabilitation is essential to restore function, enhance independence, and improve quality of life.

Beyond the standard FAST signs, several other sudden symptoms can signal a stroke. A "thunderclap" headache, which is an intense and severe pain with no known cause, often occurs suddenly. This may be accompanied by acute confusion, where a person becomes disoriented or finds it difficult to understand others. Physical sensations like weakness or numbness, particularly when localized to one side of the body—including the legs—are also major red flags. Additionally, sudden nausea or vomiting can occur, often paired with dizziness or that same severe headache[42].

Stroke continues to be a global health challenge, ranking as the second leading cause of death in people over 60 years and the fifth leading cause of death in individuals aged 15–59 years, according to the World Health Organization (WHO) [22]. Beyond mortality, stroke remains a primary contributor to long-term adult disability, with significant consequences on the patient's physical, psychological, and social well-being.

Among the many impairments post-stroke individuals experience such as weakness, spasticity, sensory deficits, speech disorders, and cognitive dysfunction—trunk impairment has often been underemphasized in conventional rehabilitation approaches. However, evidence now strongly suggests that postural control and trunk stability are foundational for functional recovery in stroke survivors [1, 4, 12]. Hemiparesis, a hallmark of stroke, often involves not just the limbs but also the core musculature of the trunk, resulting in asymmetric postural control, compromised sitting and standing balance, and an altered gait pattern, including reduced stride length, decreased cadence, and instability during movement transitions [25, 26].

The trunk serves as the biomechanical and neurological center of the body, providing the base for controlled limb movement, balance, and proper gait mechanics [24, 27]. Without adequate trunk control, even the best limb-focused rehabilitation can fall short, leading to poor functional outcomes, increased fall risk, and reduced independence in daily living activities [28, 29].

Contemporary rehabilitation strategies are incorporating task-specific, evidence-based interventions that address trunk dysfunction directly. Among these, two notable techniques—Swiss Ball (Physioball) exercises and Mirror Feedback Therapy—have demonstrated promising results [5, 6, 7, 8]. Swiss Ball Therapy introduces instability which stimulates trunk muscles to engage in a coordinated manner to maintain posture, improving core strength, muscle co-contraction, proprioception, and dynamic balance [9, 10, 11]. Mirror Feedback Therapy offers visual sensory input, promoting symmetrical movement, correcting compensatory strategies, and improving body awareness through the mirror neuron system [8].

Despite the individual effectiveness of these techniques, limited studies have compared their relative efficacy or explored their combined potential when integrated with conventional physiotherapy [3, 18, 20]. This research aims to bridge that gap by comparing the impact of these two trunk-specific interventions on post-stroke balance, gait, and functional recovery.

NEED OF THE STUDY

Stroke, also referred to as a Cerebrovascular Accident (CVA), remains one of the leading causes of mortality and long-term disability worldwide [22]. Its sudden onset, resulting from an interruption of cerebral blood flow due to ischemia or hemorrhage, leaves survivors with profound neurological impairments. Rehabilitation, therefore, becomes the cornerstone of recovery, aiming not only to restore

motor functions but also to reintegrate patients into daily life with optimal independence and quality of living.

Traditionally, post-stroke rehabilitation has emphasized limb function, particularly the restoration of mobility in the upper and lower extremities [23, 31]. While this approach has yielded important functional gains, it has often overlooked an essential biomechanical and neurological component of movement: the trunk. The trunk acts as the body's central stabilizer, supporting controlled limb motion, maintaining postural alignment, and ensuring balance during static and dynamic activities [24, 34].

#	Author(s) & Year	Study Design	Key Findings
1	Subrat N. Samal & Snehal S. Samal (2021) [19]	RCT; 70 hemiplegic stroke subjects; 6 weeks	Both groups improved trunk balance; Group A (Swiss ball) significantly more ($p<0.0001$); TIS, BBS, MBI all improved.
2	Ravichandran H et al. [21]	Systematic review & meta-analysis; 8 papers; 273 subjects	Physioball trunk exercise effective in acute/subacute stroke; not significant in chronic stage; BBA outcomes improved.
3	Noreen A, Lu J et al. (2024) [18, 20]	Multi-center RCT protocol; 76 participants aged 30–80	Compares VR+Swiss ball vs individual modalities on balance, mobility, and cortical activation.
4	Alisha & Lu, Jiani [20]	Prospective parallel-armed RCT; 76 participants; 4 weeks	Investigates cortical connectivity and balance outcomes across 4 intervention combinations.
5	Swiss Ball + Conventional PT [16]	Quasi-experimental; 40 subjects aged 45–65; BBS & TUG	Swiss ball + conventional PT improved BBS & TUG significantly ($p<0.0001$).
6	Suwaryo et al. (2023) [17]	Quasi-experimental; 36 post-stroke; 6×/week; 3 weeks	BBS ($p=0.005$) and TUG ($p=0.002$) improved significantly in intervention group.
7	Zhang X et al. (2022) [15]	Systematic review & meta-analysis; 15 RCTs; 512 subjects	Dual-task training improved step length ($p=0.006$) and cadence ($p<0.001$); BBS ($p=0.040$).
8	Yang et al. (2021) [8]	RCT; 28 chronic stroke; 30 min×3×/week; 4 weeks	Trunk support + visual feedback improved PASS,

			FRT, FMA-UL more than trunk restraint group.

When trunk control is impaired—as is commonly observed in hemiparetic stroke patients—the consequences are profound. Postural asymmetry, impaired sitting and standing balance, abnormal gait patterns, and an increased risk of falls emerge as significant challenges [12, 29, 35]. There exists a critical need for clinical evidence comparing specific trunk-focused rehabilitation strategies. Both Swiss Ball Therapy and Mirror Feedback Therapy present promising modalities, yet no study from the Indian population has directly compared their effectiveness on trunk control outcomes.

AIM AND OBJECTIVES

Aim

The study aims to evaluate the effectiveness of Swiss Ball exercises and Mirror Feedback Therapy, combined with conventional physiotherapy, in improving trunk control and balance in post-stroke patients. It focuses on enhancing trunk control and motor coordination with the goal of promoting better functional recovery and independence in daily living.

Objectives

1. To assess the effect of Swiss Ball exercises, combined with conventional physiotherapy, on trunk stability, postural alignment, and dynamic balance in individuals with stroke [1, 5, 11].
2. To evaluate the role of Mirror Feedback Therapy, in conjunction with standard physiotherapy, in promoting symmetrical trunk movement, core stability, and improved balance [8].
3. To compare the relative effectiveness of Swiss Ball exercises versus Mirror Feedback Therapy in improving trunk control and functional balance outcomes [3, 19, 21].
4. To examine whether the integration of these approaches with conventional therapy produces measurable improvements on standardized scales, such as the Trunk Impairment Scale (TIS) and the Berg Balance Scale (BBS) [1, 4].
5. To provide evidence-based guidance for incorporating trunk-focused strategies into routine post-stroke rehabilitation practice [22, 23].

Hypotheses

Null Hypothesis (H_0): There is no statistically significant difference between Swiss Ball exercises and Mirror Feedback Therapy in improving trunk control, balance, and functional mobility in post-stroke patients.

Alternative Hypothesis (H_1): There is a statistically significant difference between Swiss Ball exercises and Mirror Feedback Therapy in improving trunk control, balance, and functional mobility in post-stroke patients.

METHODOLOGY

Study Design

This study is an experimental study with a pre-post test design, aimed at comparing the effect of two interventions in patients diagnosed with post-stroke hemiparesis [1, 5].

Study Details

- Population: Male and female post-stroke patients aged 30–60 years

- Source of Data: Department of Physiotherapy, Government Homoeopathic Medical College and Hospital, Bhopal
- Type of Study: Experimental study
- Study Design: Pre-post test design
- Sample Size: 30 patients (15 per group)
- Age Group: 30 to 60 years
- Duration of Study: 12 months
- Randomization: Simple random sampling

Group Allocation

- Group A (n=15): Swiss Ball Exercises + Conventional Physiotherapy
- Group B (n=15): Mirror Feedback Therapy + Conventional Physiotherapy

Inclusion Criteria

- Age between 30–60 years
- Patients in the subacute stage of stroke recovery (1–3 months post-stroke)
- Clinically assessed impaired trunk balance
- Both male and female patients
- Ability to follow instructions and provide informed consent

Exclusion Criteria

- Visual or sensory disturbances affecting feedback perception
- History of other neurological disorders (e.g., Parkinson's disease, multiple sclerosis, traumatic brain injury)
- Systemic illnesses or musculoskeletal conditions interfering with physiotherapy (e.g., severe arthritis, cardiac conditions)
- Cognitive impairments or inability to follow verbal commands

Outcome Measures

Berg Balance Scale (BBS) [1]: for evaluating static and dynamic balance (ICC r = 0.98). Maximum score = 56. Score 41–56 = low fall risk; 21–40 = medium fall risk; 0–20 = high fall risk.

Trunk Impairment Scale (TIS) [4]: for assessing trunk control in sitting balance and coordination (ICC r = 0.96). Total score 0–23; higher score = better trunk control.

Instruments Used

- Swiss Ball (TheraBand / Physio Ball) — for trunk control and dynamic balance training exercises
- Full-Length Mirror — for visual feedback during trunk rehabilitation
- Plinth / Therapy Couch — for positioning and initial assessment
- Measuring Tools — tape measure, stopwatch, and chair for standardized testing

PROCEDURE

Participants fulfilling the inclusion criteria and providing informed consent were recruited for the study. Eligible patients were randomly allocated into two intervention groups: Swiss Ball Therapy group and Mirror Feedback Therapy group.

Baseline Assessment

All participants underwent initial evaluation including demographic data collection, medical history, and clinical assessment of trunk control and balance. Standardized outcome measures (BBS and TIS) were recorded before commencement of therapy [1, 4].

Exercise	Description / Purpose
Trunk Rotation	Improves spinal mobility and functional reach; activates obliques and spinal rotators; essential for turning while sitting, walking, or reaching sideways.
Neck Extension	Activates deep cervical extensors; maintains postural alignment; reduces forward head posture common in neurological conditions.
Quadruped Position	Encourages core engagement; activates spinal stabilizing muscles; improves weight-bearing symmetry and fosters control of both upper and lower limbs.
Kneeling with Support	Re-educates postural muscles; improves vertical control; provides transitional posture between sitting and standing.
Bilateral Hip Flexion	Improves trunk-pelvic coordination; key component in gait training and transitional movements such as sit-to-stand.
Rolling	Enhances motor planning and sequencing for bed mobility; promotes segmental trunk control and body awareness.
Bridging	Strengthens gluteal muscles and core; promotes lumbopelvic stability; foundational for transitional movements like standing up.
Strengthening Exercises	Core strengthening targeting abdominal, oblique, back, and pelvic muscles for improved trunk control, posture, and stability.
Weight Shifting	Lateral and anterior-posterior weight shifting for balance training; prepares for transitions such as walking or turning; reduces fall risk.
Sitting Balance	Activates trunk stabilizers; foundational for performing daily sitting tasks safely; especially important in individuals with neuromuscular weakness.
Coordination Movements	Targets the neuromotor system to improve synchronized and smooth body motions for complex functional activities like dressing and transferring.
Widening Movement	Discourages wide base reliance; trains balance within a narrower base; encourages improved proprioception and stability.
Knee Flexion	Enhances hamstring strength and joint range; contributes to better mobility and gait mechanics, especially post-stroke.
Reach and Grasp	Develops arm-trunk coordination critical for independence in ADLs such as eating, dressing, and grooming.
Static Sitting Balance	Targets deep core and postural muscles; essential for trunk control; foundation for progressing to dynamic balance tasks.

Group A: Swiss Ball Training Protocol

Patients performed trunk control and balance training exercises using a Swiss ball under therapist supervision [5, 6, 11, 13]. Each session lasted 40–50 minutes, five days per week, for four weeks. Exercises included:

Group B: Mirror Feedback Therapy Protocol

Patients were seated in front of a full-length mirror and performed trunk movements and balance training tasks while observing their posture and alignment [8]. Mirror feedback was provided continuously to enhance self-correction and motor learning. Sessions lasted 40–50 minutes, five days per week, for four weeks.

- Reaching in all directions using the unaffected arm
- Trunk control and posture alignment exercises
- Preventing maladaptive compensatory movement patterns
- Gradual variation in task complexity and reaching distance
- Core stability-enhancing exercises

DATA ANALYSIS

Data Acquisition and Recording

Data was collected from two groups of post-stroke patients—Group A and Group B—over the course of

the intervention program. Each group consisted of 15 participants. A structured dataset was prepared using Microsoft Excel, documenting demographic details (age, gender) and clinical assessment scores (pre-test and post-test) for each participant.

Statistical Methods Used

- Statistical software: SPSS version 20.0
- Descriptive statistics: frequencies, percentages, means, standard deviations
- Within-group comparison: Paired t-test (pre vs. post)
- Between-group comparison: Independent samples t-test
- Levene's test: for equality of variances
- Significance level: $p < 0.05$

Table 1: Gender-wise Distribution of Participants in Group A and Group B

Gender	Group	Freq	Percent	Valid%	Cum%
Male	Group A	14	93.3	93.3	93.3
Female	Group A	1	6.7	6.7	100.0
Male	Group B	13	86.7	86.7	86.7
Female	Group B	2	13.3	13.3	100.0

Table 1 presents the gender-wise distribution of participants in both groups. In Group A, the majority were male (93.3%), while only one participant (6.7%) was female. In Group B, males also formed the larger proportion (86.7%), with females accounting for 13.3%. The equal sample size of 15 in each group ensures balanced comparison between the two groups.

Table 2: Age Distribution among Group A and Group B (Descriptive Statistics)

Statistic	Group A	Group B	Std. Error
Mean	44.53	51.80	2.55 / 2.17
Median	42.00	54.00	—
Std. Deviation	9.91	8.41	—
Minimum	31	30	—
Maximum	58	60	—
Range	27	30	—
Interquartile Range	20.00	11.00	—

Table 2 shows the descriptive statistics of age in both groups. In Group A, the mean age was 44.5 years (range 31–58, median 42, IQR 20). In Group B, the mean age was slightly higher at 51.8 years (range 30–60, median 54, IQR 11), reflecting less spread compared to Group A.

Table 3 & 4: Pre and Post Comparison of BBS and TIS within Groups A and B (Paired t-test)

Group/Measure	Mean Pre	Mean Post	SD Pre	SD Post	t-value	p-value
A – BBS	9.73	23.93	1.44	4.70	-12.468	0.000 ***
A – TIS	7.73	18.60	1.39	1.76	-24.376	0.000 ***
B – BBS	9.47	26.07	1.46	5.04	-13.250	0.000 ***
B – TIS	6.47	15.00	1.36	2.42	-12.773	0.000 ***

In Group A, a significant improvement was observed in both BBS ($t = -12.468$, $p = 0.000$) and TIS ($t = -24.376$, $p = 0.000$) following Swiss Ball intervention. In Group B, similar significant improvements were noted in BBS ($t = -13.250$, $p = 0.000$) and TIS ($t = -12.773$, $p = 0.000$) following Mirror Feedback Therapy. Both groups showed highly significant improvements ($p < 0.05$) after therapy. Group A demonstrated a larger mean gain in TIS (10.87 points) compared to Group B (8.53 points), while Group B showed slightly higher improvement in BBS (16.60 points) compared to Group A (14.20 points). These findings are consistent with earlier meta-analyses by Ravichandran et al. [21] and systematic reviews by Lee & Choi [6].

Table 5: Independent Samples T-Test — Between-Group Comparison (BBS and TIS)

Measure	Lev. F	Lev. Sig.	t	df	Sig.(2-tail)	Mean Diff.
Pre-BBS	.021	.885	.505	28	.618	.267
Post-BBS	.281	.601	-1.200	28	.240	-2.133
Pre-TIS	.009	.925	2.529	28	.017 *	1.267
Post-TIS	1.182	.286	4.655	28	.000 ***	3.600

Pre-BBS scores showed no significant difference between groups ($t = 0.505$, $p = 0.618$), confirming comparable baseline balance. Post-BBS scores also showed no statistically significant between-group difference ($t = -1.200$, $p = 0.240$), suggesting both groups improved balance comparably. However, Post-TIS scores revealed a highly significant between-group difference ($t = 4.655$, $p = 0.000$), with Group A (Swiss Ball) showing significantly greater improvement in trunk control than Group B (Mirror Feedback Therapy). Pre-TIS also showed a significant difference ($t = 2.529$, $p = 0.017$), indicating slightly higher baseline trunk control in Group A.

DISCUSSION

The demographic profile of study participants reveals that the mean age was 51.80 ± 8.41 years, consistent with the known higher incidence of stroke in middle-aged individuals. Gender distribution showed a male predominance in both groups, aligning with earlier evidence that men are often more prone to stroke events [22]. The balanced age and gender distribution at baseline ensured group comparability, reducing the risk of confounding variables influencing the results.

Both Swiss Ball Therapy and Mirror Feedback Therapy, when combined with conventional physiotherapy,

produced statistically significant improvements in trunk control and balance in post-stroke patients. These findings reinforce the importance of trunk-focused rehabilitation as a central component of post-stroke recovery programs [1, 4, 24].

Swiss Ball Therapy emphasizes dynamic postural adjustments through an unstable surface, requiring continuous neuromuscular engagement of the core and trunk. The superior TIS improvement in Group A supports findings by Samal & Samal (2021) [19] and Ravichandran et al. [21], who reported significant trunk performance gains with physioball training. The unstable surface demands active recruitment of trunk stabilizers, promoting core strength, proprioception, and motor coordination [9, 10, 14]. This is further supported by Behm et al. [2], who demonstrated that unstable surface training improves strength and balance across the lifespan.

Mirror Feedback Therapy showed slightly greater BBS improvement, suggesting its particular efficacy in enhancing overall postural stability and balance. The visual feedback mechanism facilitates error detection and self-correction, promoting neuroplasticity through the mirror neuron system. This aligns with Yang et al. (2021) [8], who demonstrated that visual feedback integration significantly enhanced postural alignment and functional reach, particularly in chronic stroke patients. The study found greater gains in PASS, FRT, and FMA-UL scores in the trunk support group compared to trunk restraint.

Noreen & Lu et al. (2024) [18, 20] compared VR training with Swiss ball training and their combination, finding that combined approaches may offer additive benefits in cortical activation and balance recovery. Similarly, Suwaryo et al. (2023) [17] confirmed significant improvements in BBS ($p=0.005$) and TUG ($p=0.002$) with Swiss ball exercise in post-stroke patients. Zhang et al. (2022) [15] further demonstrated that task-specific training approaches improved gait parameters including step length ($p=0.006$) and cadence ($p<0.001$), contributing to overall functional mobility.

The trunk's role as a biomechanical foundation is further supported by Tsuji & Liu [25], who found measurable trunk muscle changes in hemiparetic stroke patients through CT evaluation, and Dickstein & Shefi [28], who demonstrated impaired anticipatory postural adjustments in post-stroke individuals. The findings by Bae et al. [1] additionally confirmed that trunk stabilization exercises on different surfaces effectively improve trunk muscle cross-sectional area and balance ability. These neurophysiological changes underscore the rationale for targeting trunk control directly in rehabilitation.

The observed variations in trunk control and balance highlight the functional challenges faced by stroke survivors, reinforcing the need for targeted rehabilitation strategies. By maintaining demographic balance at baseline, the outcomes of these therapies can be attributed more confidently to the interventions themselves rather than differences in participant characteristics. These results underscore the importance of trunk-specific, evidence-based rehabilitation strategies in comprehensive stroke care [23, 34, 35].

LIMITATIONS AND FUTURE SCOPE

Limitations

1. The study was conducted on a relatively small sample size (n=30), which may limit the generalizability of findings to the wider post-stroke population.
2. The duration of intervention was restricted to four weeks, and no long-term follow-up was undertaken to evaluate the sustainability of the treatment effects.
3. The study did not incorporate advanced biomechanical or neurophysiological assessments (e.g., trunk muscle activation patterns, gait analysis, neuroimaging), relying primarily on clinical outcome measures (TIS and BBS).

4. Participants were recruited from a single institution, limiting the diversity of the study population in terms of demographics and clinical variability.
5. Patient-related factors such as motivation, compliance with therapy, and psychosocial influences were not objectively measured, though they may have influenced the rehabilitation outcomes.

Future Scope

1. Future studies should include a larger and more diverse sample size to improve external validity and applicability across different post-stroke populations.
2. Long-term follow-up studies are required to evaluate the sustained benefits, relapse rates, and carryover effects of Swiss Ball and Mirror Feedback Therapy.
3. Future research could incorporate advanced biomechanical and neurophysiological assessments to provide deeper insights into mechanisms underlying functional recovery.
4. Studies could explore the effectiveness of combining Swiss Ball training with other neuro-rehabilitation techniques to examine possible synergistic effects.
5. Cost-effectiveness, patient compliance, and quality of life outcomes should be assessed in future trials to support clinical decision-making and improve real-world rehabilitation strategies.

CONCLUSION

The present study highlights significant improvements in trunk control and balance outcomes following two distinct rehabilitation protocols in post-stroke patients. Both Swiss Ball Therapy and Mirror Feedback Therapy, when combined with conventional physiotherapy, produced statistically significant improvements ($p < 0.05$) in both BBS and TIS scores within each group [1, 4, 19, 21].

Swiss Ball Therapy demonstrated superior improvement in trunk control as measured by the Trunk Impairment Scale (TIS) [1, 19, 21], while Mirror Feedback Therapy showed comparably effective improvements in overall balance as measured by the Berg Balance Scale (BBS) [8]. Most participants were middle-aged males, aligning with the known higher incidence of stroke in this demographic [22]. The balanced age and gender distribution across both groups ensures fair comparison of interventions.

The null hypothesis (H_0) is partially rejected: while both groups showed significant within-group improvements, a statistically significant between-group difference was found for TIS ($p = 0.000$), favouring Swiss Ball Therapy for trunk control improvement. For BBS, no significant between-group difference was found ($p = 0.240$), indicating comparable balance improvement from both interventions. These results highlight the importance of trunk control and balance-focused rehabilitation, such as Swiss Ball and Mirror Feedback therapies, in improving recovery and functional independence among stroke patients [23, 34, 35].

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B. Outcome Scales

1. Trunk Impairment Scale (TIS)

The Trunk Impairment Scale (TIS) is a standardized assessment tool designed to evaluate trunk performance in patients with neurological impairments, especially post-stroke individuals. It quantifies motor impairment of the trunk and identifies deficits in trunk control, balance, and coordination [4]. The total score ranges from 0 to 23; higher score = better trunk control.

Components of TIS:

1. Static Sitting Balance (0–7): Assesses the patient's ability to maintain a stable sitting posture without support.
2. Dynamic Sitting Balance (0–10): Measures the patient's ability to move the trunk while seated without losing balance.
3. Coordination (0–6): Evaluates trunk rotation and the ability to move the upper and lower trunk segments separately.

2. Berg Balance Scale (BBS)

The Berg Balance Scale (BBS) is a 14-item standardized clinical assessment tool developed by Katherine Berg in 1989 to measure balance ability and assess fall risk in elderly individuals and patients with neurological disorders recovering from stroke. Each of the 14 tasks is scored on a 5-point ordinal scale (0–4), maximum score = 56. Scores of 41–56 = low fall risk; 21–40 = medium fall risk; 0–20 = high fall risk. A score below 45 is considered the threshold for increased fall risk.

14 Tasks of BBS:

1. Sitting to Standing
2. Standing Unsupported
3. Sitting Unsupported
4. Standing to Sitting
5. Transfers
6. Standing with Eyes Closed
7. Standing with Feet Together
8. Reaching Forward with Outstretched Arm
9. Retrieving an Object from the Floor
10. Turning to Look Behind (Over Shoulder)
11. Turning 360 Degrees
12. Placing Alternate Foot on Stool
13. Standing with One Foot in Front (Tandem Stance)
14. Standing on One Foot

C. Abbreviations

Abbreviation	Full Form
CVA	Cerebrovascular Accident
TIS	Trunk Impairment Scale
BBS	Berg Balance Scale
TCT	Trunk Control Test
ROM	Range of Motion
PNS	Peripheral Nervous System
CNS	Central Nervous System
ICF	International Classification of Functioning, Disability and Health
ADL	Activities of Daily Living
MS	Muscle Strength
VR	Virtual Reality
RCT	Randomized Controlled Trial
MBI	Modified Barthel Index
TUG	Timed Up and Go Test
WHO	World Health Organization
PASS	Postural Assessment Scale for Stroke
FRT	Functional Reach Test
FMA-UL	Fugl-Meyer Assessment for Upper Limb
MMT	Manual Muscle Testing
CVA	Cerebrovascular Accident

D. Master Chart — Group A (Swiss Ball Therapy)

S.No	Age	Gender	Pre BBS	Post BBS	Pre TIS	Post TIS
1	51	M	12	35	9	18
2	38	M	10	22	7	18
3	47	M	9	18	5	14
4	41	M	10	21	8	17
5	35	M	11	26	7	19
6	55	M	9	24	8	17
7	55	M	8	22	8	19
8	31	M	11	30	7	20

9	37	F	10	18	6	20
10	32	M	7	30	7	21
11	34	M	8	21	7	18
12	55	M	9	21	8	18
13	57	M	10	24	9	20
14	42	M	10	22	10	20
15	58	M	12	25	10	20

E. Master Chart — Group B (Mirror Feedback Therapy)

S.No	Age	Gender	Pre BBS	Post BBS	Pre TIS	Post TIS
1	57	F	10	25	7	15
2	58	M	10	27	7	15
3	47	M	12	32	8	14
4	60	M	11	26	8	16
5	53	M	9	26	6	15
6	54	M	11	22	8	18
7	58	F	8	18	5	17
8	54	M	9	20	7	15
9	30	M	7	34	4	18
10	59	M	7	23	4	12
11	53	M	9	21	5	11
12	43	M	10	32	7	17
13	53	M	9	29	7	13
14	58	M	9	23	7	11
15	40	M	11	33	7	18