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A STUDY ON EFFECTIVENESS OF BOBATH APPROACH AND MIRROR THERAPY ON UPPER LIMB MOTOR FUNCTION IN STROKE PATIENTS

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ABSTRACT

Background: Stroke remains a significant cause of long-term disability worldwide, with upper-limb motor impairment significantly reducing independence in daily activities. Practical rehabilitation approaches are essential to enhance functional recovery. Bobath therapy (neurodevelopmental treatment) and mirror therapy have been widely applied in stroke rehabilitation, targeting neuroplasticity and motor relearning. However, evidence regarding their combined application remains limited.

Objective: To evaluate the effectiveness of Bobath therapy and mirror therapy on upper-limb motor function in stroke patients.

Methodology: An experimental study was conducted in the Department of Physiotherapy, Dr. B. R. Ambedkar College, Bangalore. Twenty post-stroke patients (age 40–60 years) with middle cerebral artery infarction (>6 months post-stroke) and Motor Evaluation Scale for Upper Extremity (MESUPES) score ≥ 20/58 were recruited. Patients underwent a 4-week intervention, receiving Bobath therapy (weight-bearing exercises) and mirror therapy in structured sessions, three times per week for each treatment. Pre- and post-intervention upperlimb motor functions were assessed using MESUPES.

Result: Of the 20 stroke participants, 55% were female and 45% male, with equal distribution of right and left hemiparesis. Post intervention analysis showed statistically significant improvement in upper limb motor function ($p < 0.001$), with a strong correlation between pre and postscores ($p < 0.001$). Patients with left hemiparesis demonstrated greater recovery compared to those with right hemiparesis.

Conclusion: Both bobath therapy and mirror therapy were effective in improving upper-limb motor function in stroke patients. The findings highlight the value of integrating neurofacilitation and visual feedback strategies into rehabilitation programs. Moreover, extensive controlled studies are suggested to confirm these results.

Keywords: Stroke rehabilitation, upper-limb function, Bobath therapy, mirror therapy, neuroplasticity, MESUPES.

INTRODUCTION:

Stroke remains a critical global health problem and is one of the major causes of mortality and persistent impairment worldwide. Stroke is defined by the World Health Organization as a sudden interruption of neurological function brought on by either an arterial blockage or a burst in a cerebral blood vessel[1]. A hemorrhagic stroke is caused by intracranial bleeding, while an ischemic stroke is caused by arterial obstruction; in both cases, oxygen supply to the brain tissue is eventually reduced, resulting in neuronal death.

Globally, stroke is a leading cause of disability-adjusted life years, with many survivors experiencing chronic impairments that compromise their quality of life and independence[2].

The ability to live independently is severely affected by the loss of upper limb function. The arm and hand are crucial for delicate activities like holding, lifting, reaching, and moving things. A reduction in the quality of life results in these functions that restrict not just physical performance but also social and professional involvement[3]. Rehabilitation is thus crucial for promoting brain reorganization and neuroplasticity, which in turn help to restore function and facilitate recovery.

Two interventions, mirror therapy and Bobath treatment, have demonstrated encouraging outcomes among numerous strategies created for motor rehabilitation. To treat phantom limb pain in amputees, Ramachandran and Rogers- Ramachandran first developed mirror therapy in the 1990s[4]. By using a mirror to reflect the movement of the healthy limb, the procedure gives the visual impression that the afflicted limb is working as it should. By inducing cortical reorganization and activating mirror neurons, this visual illusion aids in motor recovery[5].

Recent studies have revealed favorable outcomes of mirror therapy in stroke rehabilitation. In patients with acute stroke, structured mirror therapy programs have been shown by Lee and Cho to enhance both functional performance and upper-limb motor recovery[6]. Similarly, Cristina et al. demonstrated that combining mirror therapy with traditional physiotherapy enhanced upper-limb recovery in subacute ischemic stroke[7]. At the same time, Wen et al. reported that more sessions of mirror therapy resulted in notable improvements in both motor functions and daily activities for patients with acute and subacute stroke[8].

Another popular approach in neurorehabilitation is Bobath therapy, sometimes referred to as Neurodevelopmental Treatment (NDT). The method, which was first created for children with cerebral palsy in the 1940s by Dr. Karel Bobath and Berta Bobath, was later extended to adult stroke patients[9]. The Bobath approach prioritises hands-on, guided facilitation techniques that aim to enhance posture, balance, and selective motor control. It aims to normalise muscle tone and support functional task performance by fostering effective movement strategies.In the literature, there has been evidence supporting the use of Bobath therapy.In a home-based Bobath program for people with moderate to severe chronic stroke, Pumasart and Pramodhyakul found notable gains in upper-limb function, tone, and sensation[10].
This supports its use even incommunity settings where organised clinical follow-up might not always be possible.By emphasising postural alignment, weight shifting, and purposeful activity, the therapy promotes functional independence and recovery.

It is essential to have dependable evaluation methods in order to quantify improvements in function after rehabilitation. The Motor Evaluation Scale for Upper Extremity in Stroke Patients (MESUPES) is a 17-item scale used to evaluate the quality of arm and hand movements following a stroke. The total score is 58, made up of an 8-item arm subscale (maximum 40 points) and a 9-item hand subscale (maximum 18 points). According to studies, MESUPES is a trustworthy instrument for assessing upper limb rehabilitation in stroke patients because it has strong construct validity and outstanding inter-rater reliability (ICC ~ 0.98)[1112]. In this work, the upper limb motor recovery before and following treatments with Bobath therapy and mirror therapy is assessed using MESUPES. Recovery from a stroke goes beyond regaining mobility.It includes the restructuring of neuronal pathways, the retraining of motor skills, and the reintegration of patients into their social and daily lives.Both Bobath and mirror therapy are based on the idea of neuroplasticity, which is the brain's ability to change and create new connections in response to specific therapy. These methods aid recovery and lessen the risk of long-term impairment by providing particular motor and sensory experiences. Identifying successful rehabilitation techniques is crucial given the burden of stroke and the prevalence of upper-limb dysfunction. This experimental study aims to examine how mirror therapy and Bobath therapy affect the recovery of upper-limb motor skills in stroke patients. The goal of this study is to determine the efficacy of these strategies in promoting recovery and fostering functional independence through organised interventions and standardised evaluation.

OBJECTIVE:
To evaluate the effectiveness of Bobath therapy and mirror therapy on upper-limb motor function in stroke patients.

HYPOTHESIS:

Null Hypothesis (H_o): The bobath approach and mirror therapy does not produce a significant improvement on upper limb motor function in stroke patients.
Alternative Hypothesis (H_1): The bobath approach and mirror therapy produces a significant improvement on upper limb motor function in stroke patients.

METHODOLOGY

STUDY DESIGN: Experimental study.

STUDY SETTING: DR. B R Ambedkar College of Physiotherapy, Bangalore

560045 And Manipal Hospital Miller's Road Bangalore 560001

SAMPLE SIZE: 20 stroke patients

CRITERIA FOR SAMPLE COLLECTION:

INCLUSION CRITERIA:

- Glasgow Coma Scale (GCS) score ≥ 13
- Modified Ashworth Scale (MAS) ≤ 2 (mild to moderate spasticity)
- Diagnosis with middle cerebral artery (MCA) infarction
- Stroke duration 6 months – 3 years
- Age between 40 and 60 years
- Inclusion of patients diagnosed with ischemic stroke
- Stroke affecting either right or left side of the body
- Motor Evaluation Scale for Upper Extremity (MESU) score ≥20/58

EXCLUSION CRITERIA:

- Severe cognitive impairment (unable to understand/follow instructions)
- Numerical pain rating scale (NPRS)≥ 8 (severe adhesive capsulitis) (pain likely to interfere with therapy)
- Modified Ashworth scale (MAS) ≥2 or fixed deformities/contractures in the affected arm
- Diagnosis other than middle cerebral artery (MCA) infarction
- Stroke duration less than 6 months
- Motor evaluation scale for upper extremity (MESUPES)< 20/58
- Shoulder subluxation on clinical examination
- Exclusion of patient diagnosed with haemorrhagic stroke
- Significant visual problems interfering with mirror therapy
- Any other medical/neurological condition likely to hinder participation
- Heterotrophic ossification in upper limb

Treatment Duration: 4 weeks (Treatment was given for 4 weeks, comprising 3 sessions/week of Bobath therapy and 3 sessions/week of Mirror therapy)

PROCEDURE AND TREATMENT:

All 20 patients were evaluated using the motor evaluation scale for upper extremity before treatment and reassessed with the same outcome measure after the treatment.

Procedure for Mirror Therapy:

The affected arm placed behind a mirror, such that the unaffected arm is visible in the mirror's reflection. The affected arm remains hidden from view. The patient was asked to focus on the reflection of the unaffected am in the mirror, which gives the illusion that both arms are functioning normally.

All the jewellery was removed from arms. Mirror therapy was conducted for 30 minutes. The patient was instructed to perform the 10 actions, with each action lasting for 3 minutes. The actions include Flexing and extending elbow, pronation and supination of forearm on the table, extending and flexing wrist, ulnar and radial deviation of wrist, clenching and opening of fist, tapping on the table, grasping and releasing objects, with hands closed try to lift each fingers ,lifting both the arms in front of the body with elbow extended,

abducting and adducting shoulder.

Procedure for Bobath therapy:

The following exercises were given to stroke patients to improve upper extremity function, scapular mobility, and coordination.

- Quadruped Rocking
  - Static Hold (Quadruped Position)
  - Modified Plantigrade
  - Bimanual weight-bearing exercise
  - Seated Table Weight Bearing
  - OUTCOME MEASURE: Motor evaluation scale for upper extremity in stroke patients (MESUPES).

DATA ANALYSIS

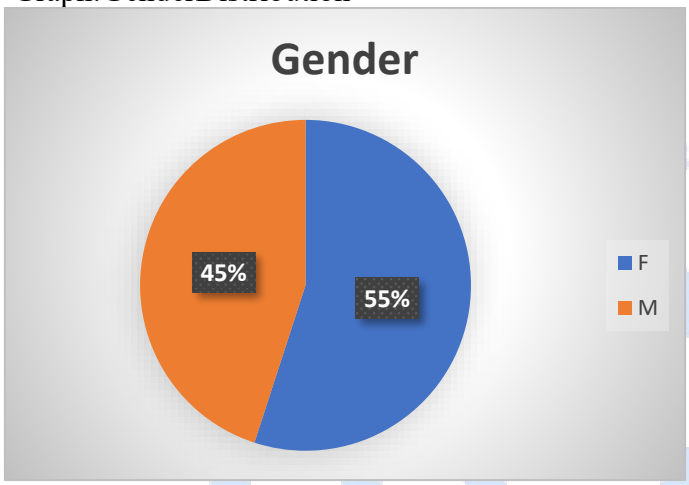
1 Demographic characteristics

Table Gender Distribution of Stroke Patients

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	11	55.0	55.0	55.0
	M	9	45.0	45.0	100.0
	Total	20	100.0	100.0	

Interpretation: The study population consisted of 20 participants, with a higher proportion of females (55%) compared to males (45%). This indicates that female patients were slightly more represented in the sample.

Graph:GenderDistribution



2 Clinical Characteristics:

Table: Side of Hemiplegia

Affected					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Right	10	50.0	50.0	50.0
	Left	10	50.0	50.0	100.0
	Total	20	100.0	100.0	

Interpretation: Out of the 20 stroke patients, 10 (50%) presented with right-sided hemiplegia and 10 (50%) with left-sided hemiplegia. This shows an equal distribution of side involvement in the study population.

Gender * Affected Crosstabulation				
Count				
		Affected		Total
		Right	Left	
Gender	F	4	7	11
	M	6	3	9
Total		10	10	20

Interpretation: The cross-tabulation revealed that left-sided hemiplegia was more common in females (7 out of 11), while right-sided hemiplegia was more common in males (6 out of 9). This suggests a possible variation in side involvement based on gender.

3.Motor Function Outcomes

Table : Correlation Between Pre- and Post-Treatment Scores

Measure	Mean	Std. Deviation	Average improvement	T value	P value
Pre	29.45	5.88	5.15	13.59	<0.0001

Interpretation: The Motor Evaluation Scale demonstrated significant improvement following intervention. The mean pre-treatment score was 29.45 ± 5.88, which increased to 34.60 ± 6.51 post-treatment, with an average improvement of 5.15 points. A paired t-test revealed a t value of 13.59 and a p-value < 0.0001, indicating that the observed improvement was highly statistically significant.

Graph 4.2: Pre Post comparison of MESUPES score

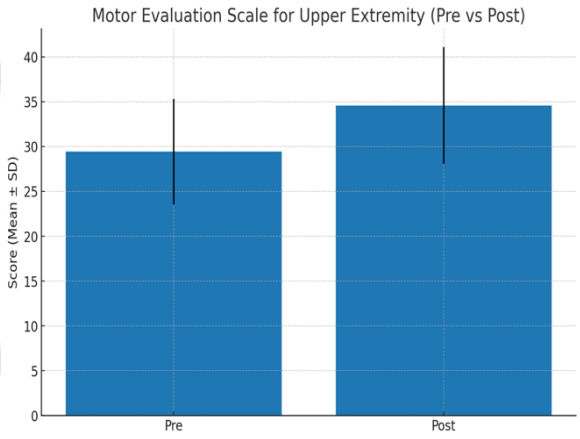


Table :ANOVA Results for Pre- vs. Post-Treatment (Overall Sample)

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	753.563	1	753.563	264.731	.000[b]
	Residual	51.237	18	2.847		
	Total	804.800	19			
a. Dependent Variable: Post						

Table: Regression Coefficients for Pre- vs. Post- Treatment

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.059	.975		2.549	.039
	Pre	1.071	.066	.968	16.271	.000
a. Dependent Variable: Post						

There is an effect of treatment as there is a significant regression coefficient between pre and post

Post = 3.057 + 1.071 (Pre)

Table :Model Summary for Left-Side Affected Patients

Model Summary				
Model	R Affected = Left (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.912[a]	.833	.812	1.37540
a. Predictors: (Constant), Pre				

Table : ANOVA Results for Left-Side Affected Patients

ANOVA[a,b]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	75.266	1	75.266	39.787	.000[c]
	Residual	15.134	8	1.892		
	Total	90.400	9			
a. Dependent Variable: Post						
b. Selecting only cases for which Affected = Left						
c. Predictors: (Constant), Pre						

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Table : Regression Coefficients for Left-Side Affected Patients

Coefficients[a,b]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.220	4.047		3.019	.017
	Pre	.796	.126	.912	6.308	.000
a. Dependent Variable: Post						
b. Selecting only cases for which Affected = Left						

There is an effect of treatment that the regression is significant

Post = 12.220 + .796 (Pre)

Table : Model Summary for Right-Side Affected Patients

Model Summary				
Model	R Affected = Right (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.978[a]	.956	.950	1.72367
a. Predictors: (Constant), Pre				

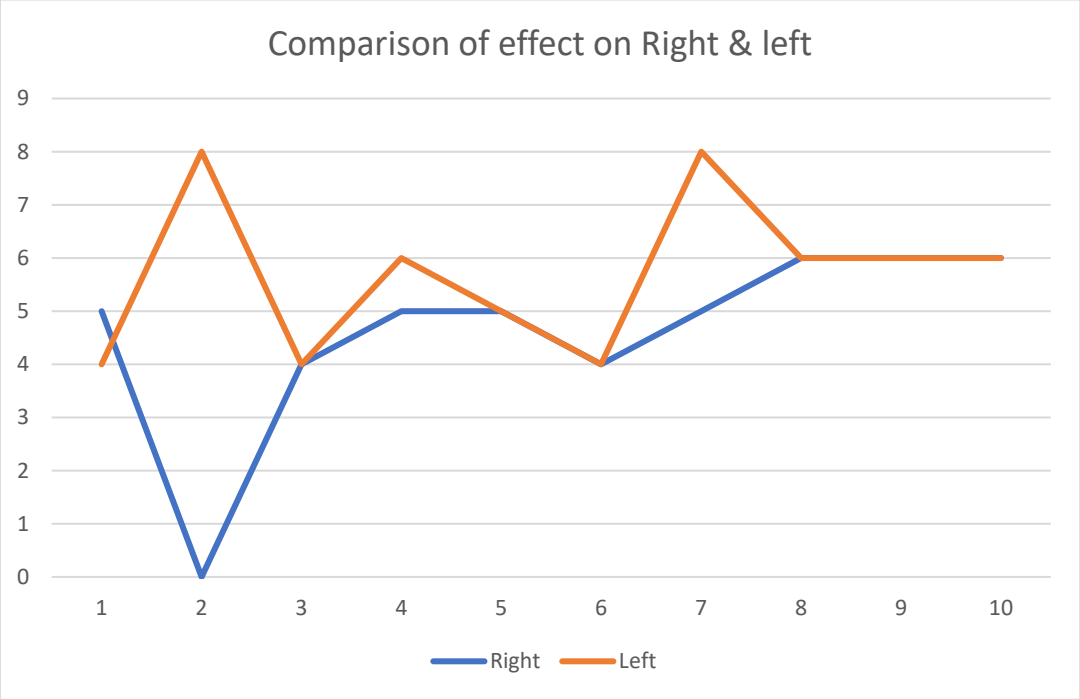
Table : ANOVA Results for Right-Side Affected Patients

ANOVA[a,b]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	510.632	1	510.632	171.869	.000[c]
	Residual	23.768	8	2.971		
	Total	534.400	9			
a. Dependent Variable: Post						
b. Selecting only cases for which Affected = Right						
c. Predictors: (Constant), Pre						

Table : Regression Coefficients for Right-Side Affected Patients

Coefficients[a,b]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.758	2.341		.751	.474
	Pre	1.105	.084	.978	13.110	.000
a. Dependent Variable: Post						
b. Selecting only cases for which Affected = Right Initial Value is not significant But there is a relation Post = 1.105* Pre.						

Graph 4.3: Comparison of effect of change in variables for right and left



Results:
The patients having left affected have a higher relief than right

RESULTS:
A total of 20 stroke patients were included in the study. The demographic analysis showed that 55% were females (n = 11) and 45% were males (n = 9). Regarding clinical characteristics, hemiplegia was equally distributed, with 10 patients (50%) presenting with right-sided hemiplegia and 10 patients (50%) with left-sided hemiplegia. Cross-tabulation revealed that left-sided hemiplegia was more frequent in females (7 out of 11; 63.6%), whereas right-sided hemiplegia was more frequent in males (6 out of 9; 66.7%).
For motor function outcomes, the Motor Evaluation Scale demonstrated significant improvement following intervention with the Bobath approach and mirror therapy. The mean pre-treatment score was 29.45 ± 5.88, which increased to 34.60 ± 6.51 post-treatment, showing an average improvement of 5.15 points. A paired t-test yielded a t-value of 13.59 with a p-value < 0.0001, confirming that the observed improvement in upper limb motor function was highly statistically significant.

On subgroup analysis, both right- and left-affected patients showed significant recovery, but patients with left hemiparesis demonstrated greater functional improvement compared to those with right hemiparesis.

DISCUSSION:

The present study assessed the impact of Bobath therapy (weight-bearing exercises) and Mirror therapy on upper-limb motor function in post-stroke patients. The findings showed a statistically significant improvement in motor outcomes, with a strong correlation between pre- and post-treatment scores ($r = 0.968$, $p < 0.001$). This indicates that both interventions were effective in promoting motor recovery, supporting their use in clinical practice.

Effectiveness of Intervention:

The improvement observed in this study aligns with previous literature. Mirror therapy has been reported to enhance motor recovery by engaging mirror neuron systems and providing visual feedback that stimulates cortical reorganization in stroke patients[13 14]. Clinical trials and systematic reviews have highlighted moderate but consistent benefits in upper-limb function across acute, subacute, and chronic stages of stroke rehabilitation. Similarly, Bobath therapy, although debated in some systematic reviews, continues to be widely used in clinical practice. Its focus on postural control, alignment, and facilitation of normal movement patterns through techniques such as weight-bearing is thought to contribute to improved functional outcomes. In this study, patients who underwent Bobath-based weight-bearing exercises also showed significant recovery, supporting the practical value of this approach.

Clinical Relevance :

The significant positive outcomes observed in this study emphasize the clinical importance of combining neurofacilitation strategies like Bobath therapy with sensory-motor approaches like Mirror therapy in routine rehabilitation. Both methods can be applied in cost-effective ways and are accessible in most rehabilitation setups, making them suitable for community-based as well as institutional programs. The results suggest that even short-term interventions can produce measurable improvements, which is encouraging for clinicians and patients alike.

Its focus on postural control, alignment, and facilitation of normal movement patterns through techniques such as weight-bearing is thought to contribute to improved functional outcomes. In this study, patients who underwent Bobath-based weight-bearing exercises
also showed significant recovery, supporting the practical value of this approach.

Side-specific Difference:

This study found that patients with left hemiplegia (right hemisphere stroke) showed greater improvement in upper limb motor function compared to those with right hemiplegia (left hemisphere stroke). A key reason is the difference in how the two hemispheres control movement. The left hemisphere is specialized for planning precise, skilled movements of the dominant right hand, while the right hemisphere mainly supports spatial awareness and posture. Damage to the left hemisphere therefore leads to greater difficulty in regaining motor control, whereas right hemisphere lesions often allow better response to rehabilitation[15]

Another factor is hand dominance. Since most people are right-handed, left hemisphere strokes affect the dominant right hand, making recovery more challenging and often leading to learned non-use. By contrast, right hemisphere strokes usually affect the non-dominant left hand, allowing patients to adapt more easily and benefit more from therapy. Similar findings have been reported in earlier studies, where patients with right hemisphere lesions responded better to upper limb rehabilitation than those with left hemisphere lesions[16 17].
In summary, the better improvement in left hemiplegia patients may be due to hemispheric specialization, hand dominance, and differences in neuroplastic recovery patterns, consistent with the dynamic dominance hypothesis[18].

Patient-Specific Factors:

Although the majority of participants demonstrated significant improvement in upper limb motor function as reflected in Motor Evaluation Scale for Upper Extremity in Stroke Patients (MESUPES) . One patient did not show a significant change in outcome scores.
Several factors may account for this variation. According to Feng and colleagues (2015), patients with larger infarct sizes and greater corticospinal tract involvement tends to result in less favorable motor recovery, even when rehabilitation is provided[19].

Individual recovery potential after middle cerebral artery (MCA) infarction is influenced by lesion size, location, and the extent of cortical and subcortical involvement, which directly affect motor pathways[20]. Additionally, chronicity of stroke, pre-existing comorbidities, reduced neuroplasticity, and individual differences in responsiveness to motor relearning strategies may limit treatment efficacy in some cases. This finding highlights that while the combination of Bobath and mirror therapy appears effective, patient-specific neurological and biological factors can result in variable outcomes.

Limitations:

• The sample size was small (n = 20), limiting generalizability.
• The intervention duration was short, and long-term outcomes were not measured.
• The study did not include a separate control group, so the individual contribution of each therapy could not be fully isolated.
• Use of broader standardized outcome measures like the Fugl–Meyer test might have provided stronger evidence.
• Possible therapist-related bias and absence of blinding may have influenced results.
• Both therapies were applied to the same patient; administering each therapy to separate patients would better reveal their individual effectiveness.
Despite these limitations, the findings add to the growing body of evidence that structured rehabilitation using Bobath weight-bearing techniques and mirror therapy can significantly improve upper-limb motor function following stroke.

CONCLUSION:
The present study concludes that both Bobath therapy (weight-bearing exercises) and Mirror therapy are effective interventions for improving upper-limb motor function in stroke patients. Statistically significant improvement was observed after therapy, with patients having left-side hemiparesis showing greater functional gains compared to those with right-side involvement. These results emphasise the importance of incorporating both neurofacilitation and visual feedback approaches into stroke rehabilitation programs. Future research with larger sample sizes, longer follow-up, and controlled designs is recommended to strengthen these findings and explore side-specific recovery patterns further.

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