Effect of Constraint-Induced Movement Therapy Versus Bobath Approach to Improve Upper Limb Motor Function Among Stroke Survivors

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ABSTRACT

Background: Stroke is a leading cause of disability globally, with upper limb motor deficits significantly affecting the quality of life of survivors. Constraint-Induced Movement Therapy (CIMT) and the Bobath approach are two commonly used rehabilitation techniques aimed at improving upper limb function post-stroke.

Objective: To determine the effectiveness of CIMT versus the Bobath approach in improving upper limb motor function among stroke survivors.

Methods: This randomized clinical trial included 26 stroke patients aged 50-70 years, recruited from National Hospital Lahore, Jinnah Hospital Lahore, and home-based sessions. Patients were randomly assigned to either the CIMT group (n=13) or the Bobath group (n=13), and interventions were administered for four sessions per week over eight weeks. Upper limb motor function was assessed using the Fugl-Meyer Assessment (FMA-UE) and the Chedoke Arm and Hand Activity Inventory (CAHAI). Data analysis was performed using SPSS version 25.

Results: Post-intervention, the CIMT group showed significantly greater improvements in FMA-UE scores (56.90 ± 3.39) compared to the Bobath group (53.68 ± 2.10, $p<0.001$). CAHAI scores also favored CIMT (70.77 ± 2.88) over the Bobath approach (69.31 ± 3.14, $p=0.021$).

Conclusion: Both interventions improved upper limb function, but CIMT was more effective.

INTRODUCTION

Stroke is a significant global health challenge and ranks as the third leading cause of death worldwide. It is not only a major cause of mortality but also the most frequently reported source of long-term disability in both developing and developed nations. In Pakistan, stroke follows ischemic heart disease and cancer as one of the leading causes of death and morbidity, with an incidence of approximately 250 cases per 100,000 individuals each year, contributing to a steadily rising number of new cases annually (1). The burden of stroke is particularly prominent in Asia, with reported rates of incidence ranging from 182 to 342 per 100,000 people (2). One of the most disabling effects of stroke is upper limb motor weakness, which severely limits patients' ability to live independently. Approximately 85% of stroke survivors experience upper limb impairment, and this persists in 55% to 75% of patients even after three to six months (3). However, only 5% to 20% of stroke patients achieve complete upper limb functional recovery. Impairments in the upper limb hinder patients from performing basic tasks, such as reaching, grasping, and manipulating objects, making daily activities challenging.

Various rehabilitation techniques have been introduced to restore upper limb function in stroke survivors, but identifying the most effective modality remains elusive. Techniques such as neurodevelopmental methods, biofeedback, and electromagnetic stimulation have all been explored, but none have proven definitively superior (4). Among these approaches, the Bobath method and Constraint-Induced Movement Therapy (CIMT) are two commonly used interventions to enhance motor recovery in hemiplegic upper limbs (5). CIMT, specifically designed to address upper limb deficits post-stroke, is the most widely studied intervention. This therapy involves restricting the unaffected arm and engaging in task-based training to promote use of the affected limb. The therapy has evolved over time, with modified versions reducing the level of constraint on the unaffected arm, but maintaining the task-based training focus (6). Both original and modified CIMT have demonstrated efficacy in improving motor performance, arm-hand tasks, and self-perceived functional use in daily activities, immediately following intervention and over time. Importantly, these improvements are largely independent of the type, duration, or frequency of CIMT (7). The primary mechanism of CIMT involves combining movement practice with behavioral strategies and constraints on the unaffected limb to increase the use of the affected limb in daily activities, prevent learned non-use, and restore motor function (8).

The Bobath approach, another well-established rehabilitation technique, has been shown to improve upper

limb function in patients with chronic stroke. This approach focuses on posture control, task accomplishment, selective movement, and sensory input to foster proper movement patterns (9). The Bobath concept emphasizes the interrelationship between different parts of the body and promotes comprehensive functional recovery. It highlights the importance of proximal stability for upper extremity function, as instability in the core can reduce the capacity of the upper limbs to perform tasks away from the body (10). The Bobath method aims to incorporate motor learning by encouraging movement and active patient participation in practice (11). Tasks such as gross motor functions like carrying or fine motor skills like threading a needle are all part of the Bobath concept's comprehensive approach to restoring upper limb function (12).

In summary, both CIMT and the Bobath approach have shown effectiveness in upper limb rehabilitation following stroke. However, the comparative efficacy of these two techniques remains an area of active research, with the aim of identifying which intervention yields superior results in motor recovery. This study seeks to compare the effects of CIMT and the Bobath method in improving upper limb motor function among stroke survivors, providing insight into the relative benefits of these widely used therapeutic interventions.

MATERIAL AND METHODS

A randomized clinical trial was conducted involving 26 stroke survivors, who were randomly allocated into two intervention groups through simple random sampling techniques. The study was carried out between March 2023 and June 2024, with participants recruited from National Hospital Lahore, Jinnah Hospital Lahore, and home-based sessions. The sample size was calculated using OpenEpi tool software, ensuring sufficient statistical power to detect differences between the two groups. All participants were aged between 50 and 70 years and had experienced either ischemic or hemorrhagic strokes within the past six months. The inclusion criteria required participants to have a Mini-Mental Status Examination (MMSE) score greater than 24, a Glasgow Coma Scale (GCS) score between 11 and 15, and a Fugl-Meyer Assessment for Upper Extremity (FMA-UE) score of less than 21. Participants with significant visual or auditory impairments, neurological disorders such as epilepsy and vertigo, uncontrolled hypertension, or heart disease were excluded from the study.

Group A received Constraint-Induced Movement Therapy (CIMT), while Group B underwent the Bobath approach. Each intervention was administered for four sessions per week over an eight-week period. The FMA-UE scale and the Chedoke Arm and Hand Activity Inventory (CAHAI) were used to assess upper limb motor function both before and after the interventions. The FMA-UE, a widely validated tool, was used to evaluate the motor function of the affected upper limb, while the CAHAI assessed functional hand and arm activities.

Data collection followed standardized protocols, ensuring consistency and accuracy across all sessions. Participants were assessed at baseline and after completing the intervention, with all assessments conducted by experienced clinicians blinded to the group allocation. Ethical approval for this study was obtained from the institutional review boards of all participating institutions, and the study adhered to the ethical principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants before the commencement of any study procedures.

The data were analyzed using SPSS version 25. Descriptive statistics, including means and standard deviations, were calculated for each variable. A mixed model ANOVA was applied to assess differences between the groups for pre- and post-intervention scores on the FMA-UE and CAHAI scales. A p-value of less than 0.05 was considered statistically significant for all comparisons. The results were interpreted in the context of existing literature to determine the relative efficacy of the CIMT and Bobath approaches in improving upper limb motor function among stroke survivors.

RESULTS

A total of 26 stroke survivors, equally divided between two groups (13 in the CIMT group and 13 in the Bobath group), completed the study. The demographic distribution of gender was nearly identical across the two groups, with 7 males (53.8%) and 6 females (46.2%) in each group

Table 1: Frequency Distribution of Gender in Treatment Groups

Gender of Patients	CIMT Group (n=13)	Bobath Group (n=13)	Total (n=26)
Male	7 (53.8%)	7 (53.8%)	13 (50.0%)
Female	6 (46.2%)	6 (46.2%)	13 (50.0%)

Both groups were assessed using the Fugl-Meyer Assessment for Upper Extremity (FMA-UE) and the Chedoke Arm and Hand Activity Inventory (CAHAI) at pre- and post-intervention stages. A comparison of pre- and post-intervention scores was conducted using a mixed model ANOVA to determine the efficacy of both interventions.

Table 2: Between Groups Comparison of FMA Upper Arm Scores

FMA Upper Arm	CIMT Group (n=13)	Bobath Group (n=13)	p-value
Pre-Intervention	25.361 ± 1.899	24.150 ± 1.819	0.355
Post-Intervention	28.461 ± 1.451	27.760 ± 1.691	0.012

The mean pre-intervention FMA upper arm score for the CIMT group was 25.361 ± 1.899, while the Bobath group had a mean score of 24.150 ± 1.819, with no statistically significant difference between the two groups (p=0.355). However, post-intervention scores showed significant improvement, with the CIMT group scoring 28.461 ± 1.451 compared to the Bobath group's 27.760 ± 1.691 (p=0.012).

Table 3: Between Groups Comparison of FMA Wrist and Hand Scores

FMA Wrist & Hand	CIMT Group (n=13)	Bobath Group (n=13)	p-value
Pre-Intervention	16.690 ± 2.878	17.700 ± 2.340	0.940
Post-Intervention	27.464 ± 2.857	23.923 ± 2.254	0.016

Pre-intervention FMA wrist and hand scores were comparable between the CIMT and Bobath groups (p=0.940). After intervention, the CIMT group showed a significantly higher mean score of 27.464 ± 2.857 compared to the Bobath group's 23.923 ± 2.254 (p=0.016).

Table 4: Between Groups Comparison of FMA Total Upper Extremity Scores

FMA Upper Extremity	CIMT Group (n=13)	Bobath Group (n=13)	p-value
Pre-Intervention	42.140 ± 3.860	43.920 ± 2.670	0.563
Post-Intervention	56.900 ± 3.387	53.682 ± 2.099	<0.001

Total upper extremity function improved significantly in both groups. The pre-intervention scores were not significantly different between groups (p=0.563), but post-intervention, the CIMT group demonstrated a significantly greater improvement with a mean score of 56.900 ± 3.387 compared to the Bobath group's 53.682 ± 2.099 (p<0.001).

Table 5: Between Groups Comparison of Chedoke Arm and Hand Activity Inventory (CAHAI) Scores

CAHAI	CIMT Group (n=13)	Bobath Group (n=13)	p-value
Pre-Intervention	59.866 ± 2.023	62.925 ± 4.874	0.515
Post-Intervention	70.769 ± 2.877	69.309 ± 3.136	0.021

The CAHAI scores for both groups were not significantly different pre-intervention (p=0.515). However, post-intervention, the CIMT group showed further improvements with a mean score of 70.769 ± 2.877, which was significantly higher than the Bobath group's mean score of 69.309 ± 3.136 (p=0.021).

While both CIMT and Bobath approaches resulted in significant improvements in upper limb motor function among stroke survivors, the CIMT group demonstrated superior outcomes across all measured variables, particularly in total upper extremity function and hand-wrist coordination, as indicated by the FMA and CAHAI scores.

DISCUSSION

The present study demonstrated that both Constraint-Induced Movement Therapy (CIMT) and the Bobath approach significantly improved upper limb motor function among stroke survivors. However, the findings indicated that CIMT yielded superior results compared to the Bobath method, particularly in terms of total upper extremity function and wrist-hand coordination. These results are consistent with previous studies, such as Huseyinsinoglu et al., who found that CIMT was more effective in enhancing arm functional recovery in stroke patients compared to the Bobath concept (13). Similarly, the findings align with research conducted by Kwakkel et al., which demonstrated that CIMT improved motor performance and the use of the affected limb in daily activities more effectively than other traditional rehabilitation techniques (7).

One of the strengths of this study was its randomized controlled design, which minimized bias and provided robust evidence regarding the comparative effectiveness of the two interventions. The use of validated assessment tools, such as the Fugl-Meyer Assessment for Upper Extremity (FMA-UE) and the Chedoke Arm and Hand Activity Inventory (CAHAI), further ensured the reliability and accuracy of the results. Additionally, the study's inclusion of both ischemic and hemorrhagic stroke patients enhanced the generalizability of the findings to a broader stroke population.

Despite these strengths, the study had several limitations. The relatively small sample size of 26 participants may have limited the statistical power of the analysis, particularly when detecting differences between the two groups. Moreover, the study was conducted over a relatively short intervention period of eight weeks, which may not have been sufficient to capture long-term outcomes and the sustainability of motor function improvements. Future studies with larger sample sizes and longer follow-up periods are recommended to validate these findings and assess the long-term efficacy of both CIMT and the Bobath approach. Another limitation was the reliance on two specific rehabilitation centers and home-based sessions for data collection. This could introduce variability in the delivery of the interventions, as patients receiving treatment in different environments may experience differing levels of supervision and adherence to the therapy protocols.

Standardizing intervention settings or closely monitoring home-based sessions could mitigate this issue in future studies. In terms of clinical implications, this study reinforces the growing body of evidence supporting CIMT as a more effective intervention for upper limb rehabilitation

post-stroke. The significant improvements observed in both FMA-UE and CAHAI scores for the CIMT group suggest that incorporating CIMT into standard rehabilitation protocols may lead to better functional outcomes. However, the Bobath approach also showed considerable improvements, particularly in wrist and hand function, and may remain a viable option for patients who are unable to undergo the intensive constraint required by CIMT. Clinicians should consider patient preferences, tolerance, and specific rehabilitation goals when choosing between these two approaches.

CONCLUSION

In conclusion, while both CIMT and the Bobath approach demonstrated efficacy in improving upper limb motor function among stroke survivors, CIMT provided more substantial benefits. Future research should focus on overcoming the limitations of this study by including larger, more diverse populations, extending follow-up periods, and exploring potential synergies between these interventions to optimize stroke rehabilitation strategies.

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