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Original Article

Effect of Constraint-Induced Movement Therapy (CIMT) on Upper Extremity Function in Stroke Patients

Kiran Bashir[1]*, Alina Noreen[2], Mehreen Arshad[2], Amna Tariq[2], Anees Arshad[3]

[1]Senior Lecturer, Islamabad College of Physiotherapy, Margalla Institute of Health Sciences, Rawalpindi, Pakistan.

[2]Physical Therapist, University of Sargodha, Women Campus Faisalabad, Pakistan.

[3]Demonstrator, Islamabad College of Physiotherapy, Margalla Institute of Health Sciences, Rawalpindi, Pakistan.

Corresponding Author: Kiran Bashir, Senior Lecturer; Email: Kiranbashir303@gmail.com

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ABSTRACT

Background: Stroke is a leading cause of disability worldwide, with upper extremity impairments presenting significant rehabilitation challenges. Constraint-Induced Movement Therapy (CIMT) has emerged as a potential intervention for enhancing upper limb functionality, but its efficacy compared to traditional therapy methods requires further exploration.

Objective: The study aimed to evaluate the effectiveness of CIMT versus traditional therapy in improving upper extremity function among stroke survivors.

Methods: In this quasi-experimental study, 58 stroke patients from Aziz Fatima and Allied Hospital in Faisalabad were recruited and allocated to either the CIMT group (n=29) or the traditional therapy group (n=29). Eligible participants were those aged 30-50 years with ischemic or infarctive stroke and impaired use of their hemiparetic arm. The CIMT group received standard treatment plus CIMT, while the traditional group received only standard treatment, including manual therapy and TENS, for 8 weeks. Pre- and post-treatment assessments utilized the Upper Extremity Motor Activity Log (UEMAL) scales. Data analysis was conducted using SPSS version 25, employing independent t-tests.

Results: The CIMT group showed a significant improvement in the UEMAL Amount Scale (pre-treatment: 1.64 ± 0.51, post-treatment: 3.04 ± 0.75; p=0.000) and the UEMAL How Well Scale (pre-treatment: 2.28 ± 0.57, post-treatment: 3.81 ± 0.55; p=0.000). The traditional therapy group also demonstrated gains but to a lesser extent (UEMAL Amount Scale pre-treatment: 1.08 ± 0.24, post-treatment: 1.69 ± 0.33; UEMAL How Well Scale pre-treatment: 1.47 ± 0.30, post-treatment: 2.11 ± 0.40; p=0.000 for both).

Conclusion: CIMT provided significant functional improvements in upper extremity motor activity compared to traditional therapy, suggesting that CIMT may be a more effective approach for post-stroke rehabilitation of the upper limb.

Keywords: Stroke Rehabilitation, Constraint-Induced Movement Therapy, Upper Extremity Function, Motor Activity Log, Quasi-Experimental Study, Stroke Therapy.

INTRODUCTION

Stroke is a major cause of mortality and long-term disability globally, with a significant burden observed in low-income and middle-income countries. Approximately 6.5 million deaths annually are attributed to stroke, alongside 113 million disability-adjusted life years, underscoring its impact on health systems and economies, particularly in countries like Pakistan where stroke mortality rates are notably high, yet public awareness and understanding of stroke determinants and outcomes remain limited(1)(2). The increasing prevalence of stroke among younger populations, especially in women aged 18–44, and the stable rates of ischemic stroke and intracerebral hemorrhage among younger adults contrasted with a decline in older adults over 70 years, highlight the evolving demographic and clinical patterns of stroke incidence(4)(5)(6). This shift, alongside global aging trends, projects a significant increase in the demand for rehabilitation services, with estimates suggesting up to 70 million stroke survivors by 2030. This anticipated need for expanded rehabilitation services was recognized by the World Health Organization's "Rehabilitation 2030: a call for action," aiming to enhance healthcare systems' capacity to manage the growing burden(7).

Despite the acknowledged efficacy of rehabilitation in improving outcomes for stroke survivors, rehabilitative health strategies often receive inadequate attention compared to treatment-focused approaches(8). Traditional rehabilitation modalities, including

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neurodevelopmental treatment, proprioceptive neuromuscular facilitation, constraint-induced movement therapy (CIMT), and task-oriented training, remain foundational in stroke recovery, aiming to enhance functional capabilities and quality of life. CIMT, in particular, which involves restricting the unaffected limb to promote use of the affected limb, has shown promise not only in improving upper extremity function but also in balance, suggesting its broader applicability in motor function enhancement(9).

Motor recovery typically plateaus within 3 to 6 months post-stroke, underscoring the importance of optimizing rehabilitation interventions during the subacute phase. CIMT has been effective in improving motor function in stroke patients, including those in chronic stages, by addressing the phenomenon of "learned nonuse," where patients become overly reliant on their unaffected limb for daily activities. The therapy, which involves restraining the unaffected limb for a period (usually 6 hours daily), encourages the use of the affected limb in motor tasks. This approach is not only feasible for home settings but also cost-effective, making it an attractive option for widespread adoption(11).

The persistence of upper limb impairments in about two-thirds of stroke survivors, with a minority achieving full recovery six months post-stroke, highlights the necessity for effective rehabilitation strategies(12). Both CIMT and proprioceptive neuromuscular facilitation have been beneficial in enhancing upper limb function, with CIMT showing greater advantages, suggesting its preferential use for managing chronic impairments(13). Despite CIMT's demonstrated efficacy, there remains a scarcity of literature comparing its outcomes with those of traditional treatment methods for upper extremity rehabilitation in post-stroke patients. Our study aimed to assess motor skills and functional improvement following CIMT treatment, testing the hypothesis of whether there is a significant difference in outcomes between the CIMT group and the traditional treatment group. This study contributes to the literature by investigating the effectiveness of CIMT as a treatment option for upper extremity rehabilitation in post-stroke patients, specifically in improving functional activities.

MATERIAL AND METHODS

The methodology of this quasi-experimental study, conducted at Aziz Fatima and Allied Hospital in Faisalabad, adhered to rigorous ethical and procedural standards to ensure the reliability and validity of its findings. The study's protocol received approval from the Ethical Review Committee of the University of Sargodha Women Campus Faisalabad, aligning with the principles outlined in the Declaration of Helsinki for research involving human subjects. The research spanned a period of 6 months, during which a total of 58 participants were recruited through a convenient non-probability sampling technique, ensuring a broad representation of the targeted demographic(15).

Eligibility for participation was strictly defined. Individuals aged between 30 and 50 years, diagnosed with ischemic or infarctive stroke, experiencing their first stroke episode, and demonstrating impaired use of the hemiparetic arm were considered. The criteria required participants to have had the stroke at least six months prior to their enrollment in the study, exhibit some degree of active movement in the affected extremity, and possess the ability to walk, maintain balance, and comprehend the training content without significant cognitive deficits or uncontrolled medical conditions that could impede engagement in the training program.

Upon meeting these criteria, participants were informed about the study details and, upon consenting, were randomized into two groups. Group A, designated as the CIMT group, received standard baseline treatment in conjunction with Constraint-Induced Movement Therapy. Group B, referred to as the Traditional group, was administered only the baseline treatment, which included manual therapy techniques such as range of motion and strengthening exercises, supplemented by Transcutaneous Electrical Nerve Stimulation (TENS). The sample size was determined using OpenEpi, based on assumed mean and standard deviation for each group(15).

Both groups were assessed for pre-treatment values across all outcome measures. Following this initial assessment, each group received a different intervention: Group A, consisting of 29 subjects, received 8 weeks of Constraint-Induced Movement Therapy (CIMT), whereas Group B, also with 29 subjects, received 8 weeks of baseline treatment sessions. Upon completion of the interventions, post-treatment values were measured for all outcome measures in both groups, allowing for comparative analysis of the effectiveness of CIMT versus traditional therapy methods.

Data collection involved a comprehensive evaluation of each participant at the outset and conclusion of the intervention. This evaluation encompassed a brief medical history, physical examination, and an assessment of motor and sensory function using the Motor Activity Log (MAL) Manual, which includes both the amount and how well scales, to quantify motor activity levels(16). The interventions for both groups were delivered over a period of two consecutive months.

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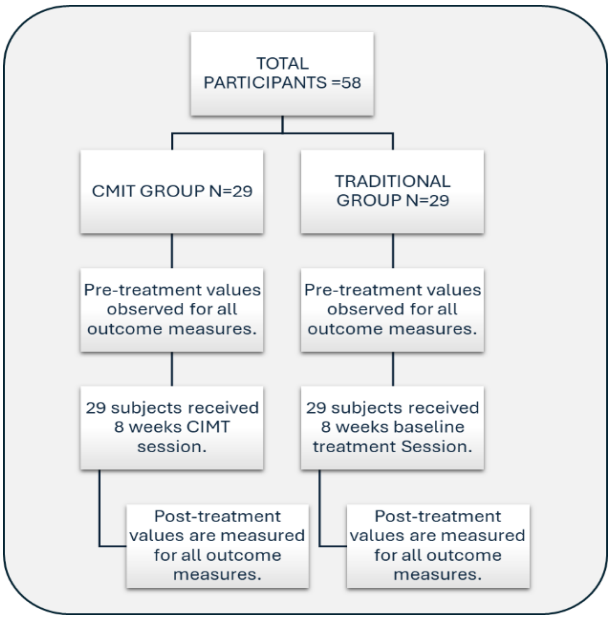

Figure 1 Treatment Flow Chart

The analysis of collected data was conducted using SPSS version 25. Descriptive statistics were utilized to summarize participant demographics and baseline characteristics. The independent t-test was employed to compare the outcomes between the two groups post-intervention, focusing on improvements in motor function and functional activities as measured by the MAL scale.

RESULTS

In the comparative analysis of rehabilitative approaches for stroke patients, the socio-demographic profile of participants was closely matched between the two intervention groups. As detailed in Table 1, a total of 58 individuals were equally distributed across the CIMT and Traditional therapy groups, each comprising 29 participants. Gender distribution within the CIMT group included 19 males and 10 females, whereas the Traditional group comprised 21 males and 8 females. The mean age of participants was 47.00 years with a standard deviation of 8.20 in the CIMT group, slightly younger than the Traditional group, which had a mean age of 48.03 years and a standard deviation of 7.12.

Baseline functionality of the upper extremity, assessed through the Upper Extremity Motor Activity Log (UEMAL) scales, revealed initial disparities between the groups. Table 2 encapsulates the baseline measurements where the CIMT group exhibited a mean UEMAL Amount Scale score of 1.64 (±0.51) compared to the Traditional group's mean of 1.08 (±0.24), with the difference not reaching statistical significance ($P > 0.05$). The UEMAL How Well Scale further distinguished the two cohorts at baseline, with the CIMT group scoring a mean of 2.28 (±0.57), indicating a moderately higher functional status than the Traditional group, which scored a mean of 1.47 (±0.30).

Table 1. Socio-demographic Information of Participants

Variables	CIMT Group	Traditional Group
Numbers	29	29
Gender	19 Males, 10 Females	21 Males, 8 Females
Age		
Mean	47.00	48.03
Standard Deviation	8.20	7.12

Table 2. Baseline Measurements of Upper Extremity Motor Activity Log (UEMAL) Scales

Scales	CIMT Group Mean (SD)	Traditional Group Mean (SD)	P-value
UEMAL Amount Scale	1.64 ± 0.51	1.08 ± 0.24	>0.05
UEMAL How Well Scale	2.28 ± 0.57	1.47 ± 0.30	

Table 3. Between-Group Comparison of UEMAL Amount Scale and How Well Scale

Outcome Measure	Group	Pre-treatment Mean±SD	Post-treatment Mean±SD	P-value
UEMAL Amount Scale	CIMT (n=20)	1.64 ± 0.51	3.04 ± 0.75	0.000
	Traditional (n=20)	1.08 ± 0.24	1.69 ± 0.33	0.000
UEMAL How Well Scale	CIMT (n=20)	2.28 ± 0.57	3.81 ± 0.55	0.000
	Traditional (n=20)	1.47 ± 0.30	2.11 ± 0.40	0.000

Post-treatment evaluations, as shown in Table 3, indicated significant improvements in both groups; however, the extent of these improvements varied considerably. The CIMT group's UEMAL Amount Scale scores improved from a pre-treatment mean of 1.64 (±0.51) to a post-treatment mean of 3.04 (±0.75), a substantial increase that was statistically significant ($P = 0.000$). In parallel, the Traditional group showed improvement, though to a lesser degree, with scores rising from a pre-treatment mean of 1.08 (±0.24) to a post-treatment mean of 1.69 (±0.33), also recording a statistically significant change ($P = 0.000$).

The UEMAL How Well Scale reflected a similar pattern. The post-treatment scores for the CIMT group soared to a mean of 3.81 (±0.55) from a pre-treatment mean of 2.28 (±0.57), whereas the Traditional group's scores increased from a pre-treatment mean of 1.47 (±0.30) to a post-treatment mean of 2.11 (±0.40). These enhancements were both statistically significant (P = 0.000), underscoring the effectiveness of therapy. Notably, the increments observed in the CIMT group surpassed those in the Traditional group, both in terms of the amount and quality of motor activity, as depicted by the scales. These results collectively demonstrate a marked advantage of the CIMT approach in rehabilitating motor function of the upper extremities in stroke patients.

DISCUSSION

The research undertaken in this investigation sought to compare the therapeutic efficacies of Constraint-Induced Movement Therapy (CIMT) and traditional therapy modalities for enhancing upper extremity functionality in patients post-stroke. Drawing from a sample size comparable to Tien Ni Wang et al.'s quasi-experimental study, which comprised 50 participants split into two groups, this study expanded the participant pool to 58, thereby augmenting the statistical power and potentially the robustness of the findings(17). The Upper Extremity Motor Activity Log (UEMAL) served as the primary assessment tool, similar to Alaca et al., who utilized the Motor Activity Log (MAL) to gauge improvements in daily living activities, thereby reinforcing the validity of these measurement techniques in this context(18).

Mirroring the results of Joyce Araújo de Azevedo et al., this study corroborated the superior efficacy of CIMT in improving functional use of the upper limb for Activities of Daily Living (ADL) and functional independence among stroke survivors, thereby contributing to the growing body of evidence favoring CIMT over conventional treatment approaches(19). The participant age demographic in this research closely aligned with that reported by Ingela et al. in 2023, indicating a representation of middle-aged stroke survivors who are likely to benefit from focused rehabilitative interventions(20).

However, the findings of this study stand in contrast to those reported by Olipa et al., where no significant disparities were noted between treatment groups. This divergence underscores the critical influence of specific treatment protocols, including variations in intensity, duration, and techniques, on patient outcomes, suggesting that a standardized approach in CIMT protocols may be warranted for consistent results across studies(21).

Reflecting on the strength of the study, the methodology employed allowed for a direct comparison between two distinct therapeutic approaches in a real-world clinical setting, adding to its external validity. However, the study's limitations must be acknowledged, including the non-randomized design and potential confounding factors such as participant motivation and adherence to treatment protocols outside the clinical environment, which may have influenced the results. Additionally, the exclusion of patients with hemorrhagic stroke or significant cognitive deficits limits the generalizability of the findings to the broader stroke population.

CONCLUSION

In conclusion, the study presented evidence that CIMT is a viable and effective intervention for improving functional activities in patients recovering from stroke. It is recommended that subsequent research explores comparative analyses between CIMT and other emerging treatment modalities, encompassing a broader stroke survivor demographic to validate these findings. Such studies should strive to mitigate the limitations noted herein, perhaps by employing a randomized controlled trial design, to further substantiate the role of CIMT in stroke rehabilitation.

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