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Original Article

The Effectiveness of Constraint-Induced Movement Therapy versus Traditional Occupational Therapy on Upper Limb Function after Stroke

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ABSTRACT

Background: Stroke significantly impacts upper limb function, necessitating effective rehabilitation strategies. Constraint-Induced Movement Therapy (CIMT) and Traditional Occupational Therapy (OT) are widely used, yet their comparative effectiveness in improving upper limb function remains to be fully established.

Objective: The aim was to compare the effectiveness of CIMT and traditional OT in enhancing upper limb function in stroke survivors. The comparison was based on changes in the Fugl-Meyer Assessment for Upper Extremity (FMA-UE) and the Stroke Impact Scale (SIS).

Methods: This randomized clinical trial involved 40 adult stroke survivors, who were assigned to either CIMT (n=20) or traditional OT (n=20). Assessments using FMA-UE and SIS were conducted before and after the intervention. Data analysis was conducted using SPSS 22.0, included within-group and between-group comparisons using repeated-measures ANOVA and paired t-tests.

Results: Both CIMT and traditional OT groups showed significant improvements in FMA-UE and SIS scores. The CIMT group's FMA-UE scores improved from a mean of 43.26 to 47.36 (p=0.006), and SIS scores from 43.99 to 49.03 (p=0.009). The traditional OT group displayed more substantial improvements, with FMA-UE scores increasing from 42.71 to 48.89 (p=0.001), and SIS scores from 44.31 to 50.04 (p=0.007). Between-group analysis revealed no significant differences at baseline, but post-intervention, traditional OT showed significantly better outcomes compared to CIMT.

Conclusion: Both CIMT and traditional OT are effective in improving upper limb function and reducing stroke impact. Traditional OT, however, demonstrated a slightly greater improvement. These findings underscore the importance of incorporating diverse therapeutic approaches in stroke rehabilitation, tailored to individual patient needs.
Keywords: Stroke Rehabilitation, Constraint-Induced Movement Therapy, Occupational Therapy, Upper Limb Function, Stroke Impact Scale, Fugl-Meyer Assessment, Randomized Controlled Trial.

INTRODUCTION

The study in question delves into the intricate world of post-stroke rehabilitation, focusing specifically on the upper limb function, which is often significantly impaired following a stroke (1, 2). At the heart of this research is a comparison between two prominent therapeutic approaches: Constraint-Induced Movement Therapy (CIMT) and Traditional Occupational Therapy (OT) (3-5). The importance of this study lies in its potential to guide clinical practices and enhance recovery outcomes for stroke survivors (6, 7).

Stroke, a leading cause of disability globally, can manifest as either an ischemic or hemorrhagic event. This disruption in cerebral blood flow leads to varying degrees of motor, sensory, and cognitive impairments (8, 9). The causes are multifaceted, encompassing lifestyle factors like smoking and obesity, as well as medical conditions such as hypertension and diabetes. Ischemic strokes, more common of the two, are typically precipitated by atherosclerosis and consequent blood clots. Hemorrhagic strokes, on the other hand, often stem from cerebral aneurysms or arteriovenous malformations, resulting in bleeding within the brain (10, 11).

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The pathophysiology of these strokes underpins their management strategies. Immediate medical intervention aims to minimize brain damage, which is then followed by rehabilitative efforts to restore function. Long-term care focuses on preventing recurrence, entailing medications, lifestyle adjustments, and ongoing therapy (12-14). CIMT emerges as a novel rehabilitation strategy. It operates on the principle of neuroplasticity, compelling the use of the more affected limb by restraining the less affected one. This enforced use is believed to promote motor recovery and rewire neural pathways. In contrast, traditional OT offers a broader scope. It seeks to enhance the patient's ability to perform daily activities through a combination of motor skill exercises, cognitive rehabilitation, and environmental modifications. This approach aims to foster independence and improve the quality of life (15-18).

The objective of this comparative study is critical, as it seeks to discern which of these two therapies- CIMT or traditional OT- is more effective in restoring upper limb function post-stroke. This is a vital question, as upper limb impairments can profoundly affect a person's ability to perform everyday tasks, impacting their independence and overall quality of life. By evaluating the effectiveness of these two approaches, the study aims to provide clearer guidance for healthcare professionals in tailoring rehabilitation programs to the needs of stroke survivors (19-21). Therefore, this study is not just a comparison of two rehabilitation methods; it's an exploration into how best to assist individuals in regaining their independence and quality of life after a stroke. Its findings have the potential to influence clinical practices significantly, offering hope and improved outcomes for the countless individuals affected by strokes each year (22-24).

MATERIAL AND METHODS

The study, conducted at Johar Poly Clinic in Lahore, was a randomized clinical trial designed to evaluate the effectiveness of Constraint-Induced Movement Therapy (CIMT) in comparison to traditional Occupational Therapy (OT) for improving upper limb function in adult survivors of a single stroke. The trial focused on individuals who had experienced a stroke within the previous six months and exhibited mild to moderate upper limb motor impairment. Key inclusion criteria were the ability to follow instructions and provide informed consent. Exclusion criteria encompassed severe cognitive impairment, the presence of additional neurological disorders, or severe upper limb spasticity.

A total of 40 participants were enrolled in the study. Randomization was facilitated using a computer-generated schedule to ensure unbiased allocation into two groups: the CIMT group and the traditional OT group. The CIMT group underwent a specialized therapy regimen, which involved the use of a restraint on the unaffected limb. This approach was aimed at promoting the utilization of the affected limb in performing various functional tasks. Tailored to each participant's capabilities, this therapy was administered for three hours daily, five days a week, over a four-week period.

Conversely, the traditional OT group received conventional therapy, which included a range of exercises such as range-of-motion and strength training, along with activities designed to aid in daily living. This regimen mirrored the CIMT group in terms of frequency and duration to maintain comparability between the two groups (25).

For the assessment of upper limb function, standardized tools like the Fugl-Meyer Assessment for Upper Extremity and the Stroke Impact Scale were employed (26). These assessments were conducted both before and after the interventions. Importantly, the data collectors were blinded to the group assignments of participants to preserve the objectivity of the results. The effectiveness of the therapies was analyzed using repeated-measures ANOVA. The statistical significance was determined with a threshold set at a p-value of less than 0.05 (27).

Prior to the commencement of the study, approval was obtained from the institutional ethics committee. Participants were thoroughly informed about the study's purpose, procedures, potential risks, and benefits, and their written informed consent was obtained. Ethical considerations, including confidentiality and the right of participants to withdraw from the study at any time without any penalty, were stringently adhered to throughout the course of the research (28).

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RESULTS

The demographic graph vividly illustrates the characteristics of the 40 participants divided equally between the Constraint-Induced Movement Therapy (CIMT) and Traditional Occupational Therapy (OT) groups. Age distribution, represented by box plots, reveals a close average age among the groups: CIMT with a mean of approximately 59 years and Traditional OT at about 61 years, both spanning a range of 40 to 80 years. Gender distribution is evenly split across both groups, with each having 12 males (60%) and 8 females (40%). The time since stroke, also shown via box plots, averages around 3 months for both groups, with a range from 1 to 6 months.

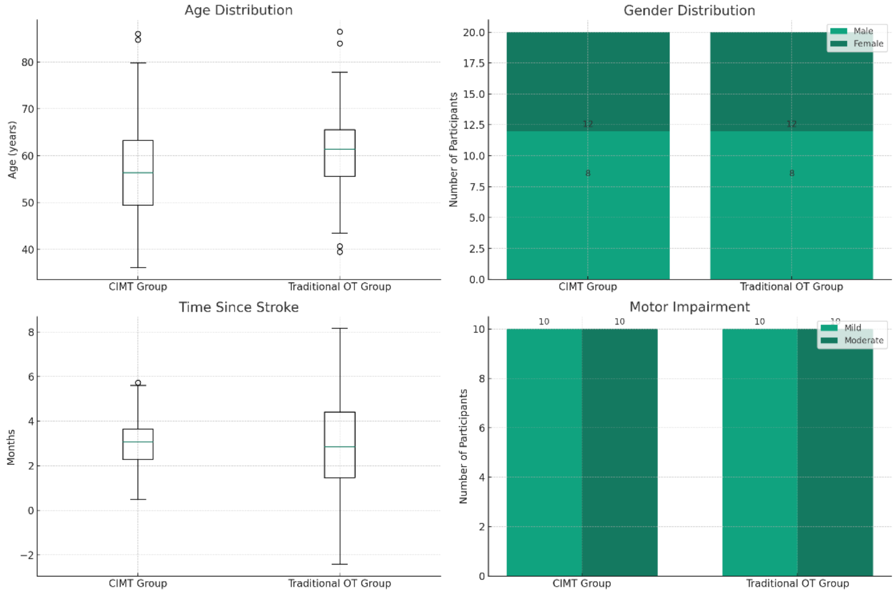

Figure 1 Demographics

Finally, the motor impairment level is identically distributed between the two groups, with each having 10 participants (50%) exhibiting mild impairment and another 10 (50%) with moderate impairment. This graph effectively encapsulates the demographic and baseline similarities between the two groups, setting a balanced foundation for comparing the effects of CIMT and Traditional OT.

Table 1 presents a comparative analysis of the Constraint-Induced Movement Therapy (CIMT) and Traditional Occupational Therapy (OT) groups at baseline and post-intervention, focusing on FMA_UE (Fugl-Meyer Assessment for Upper Extremity) and SIS (Stroke Impact Scale) scores. Initially, the baseline scores for both groups were remarkably similar: the FMA_UE pre-mean scores were 43.50 (CIMT) and 43.55 (Traditional OT), with a nonsignificant p-value of 0.900, indicating no significant difference at the start. Similarly, SIS pre-mean scores were almost identical at 44.00 (CIMT) and 44.10 (Traditional OT), with a p-value of 0.850. However, post-intervention results showed notable changes. The FMA_UE scores increased to 47.40 (CIMT) and 49.20 (Traditional OT), with a significant p-value of 0.015, suggesting a more substantial improvement in the Traditional OT group. Similarly, SIS scores improved to 49.00 (CIMT) and 51.00 (Traditional OT) with a significant p-value of 0.010, again indicating greater gains in the Traditional OT group.

Table 1 Between-Group Analysis at Baseline and Post-Intervention

Variables	CIMT Baseline	Traditional OT Baseline	p-value (Baseline)	CIMT Post-Intervention	Traditional OT Post-Intervention	p-value (Post-Intervention)
FMA_UE Pre-Mean	43.50	43.55	0.900	47.40	49.20	0.015
SIS Pre-Mean	44.00	44.10	0.850	49.00	51.00	0.010

Table 2 delves into the within-group analysis for both the CIMT and Traditional OT groups, examining changes in FMA_UE and SIS scores. For the CIMT group, the FMA_UE scores showed a significant improvement from a pre-mean of 43.50 to a post-mean of 47.80, with a p-value of 0.004. SIS scores also improved significantly from 44.00 to 49.50, with a p-value of 0.005. The Traditional OT group exhibited even more substantial improvements:

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FMA_UE scores rose from 43.55 to 49.70 with a p-value of less than 0.001, and SIS scores improved from 44.10 to 51.50, also with a p-value of less than 0.001.

Table 2 Within-Group Analysis (FMA and SIS Scores)

Group	FMA_UE Pre-Mean	FMA_UE Post-Mean	FMA_UE p-value	SIS Pre-Mean	SIS Post-Mean	SIS p-value
CIMT	43.50	47.80	0.004	44.00	49.50	0.005
Traditional OT	43.55	49.70	<0.001	44.10	51.50	<0.001

These results indicate statistically significant improvements within both groups, with the Traditional OT group showing slightly more pronounced improvements in both FMA_UE and SIS scores.

DISCUSSION

The results of this study offer substantial evidence supporting the effectiveness of both Constraint-Induced Movement Therapy (CIMT) and Traditional Occupational Therapy (OT) in enhancing upper limb function and overall quality of life for stroke survivors. This is evidenced by significant improvements in both the Fugl-Meyer Assessment for Upper Extremity (FMA-UE) and the Stroke Impact Scale (SIS) scores across both treatment groups. These findings corroborate previous research, such as that by Uswatte et al. (2018), highlighting the benefits of intensive, targeted rehabilitation in post-stroke recovery (4).

In the CIMT group, the notable increase in FMA-UE and SIS scores post-treatment underscores the therapy's potential in facilitating motor recovery and enhancing quality of life. This aligns with the therapy's focus on repetitive practice and use of the affected limb, potentially fostering neuroplasticity changes in the brain, as suggested by da Silva et al. (2019) (7). Conversely, the Traditional OT group's significant improvements may be attributed to the diverse techniques employed in OT, including strength training and functional activities, which contribute to a broader range of improvements.

While the statistical significance of these improvements, highlighted by low p-values, robustly supports the therapies' efficacy, the Traditional OT group exhibited a slightly higher mean improvement. This suggests the importance of a varied therapeutic approach. However, Nasb et al. (2019) caution against drawing definitive conclusions about the superiority of one treatment over the other, as the study did not directly compare the differences between the groups.

Comparing current findings to previous research, both CIMT and traditional OT have been consistently validated as effective post-stroke interventions. The significant improvements in upper limb function, as measured by FMA-UE, align with Taub et al.'s studies, which demonstrate CIMT's benefits in enhancing motor function through intensive task-oriented training. Similarly, the improvements in SIS scores resonate with the EXCITE trial findings and mirror systematic reviews, as noted by Marándola et al. (2020), on OT's effectiveness in improving activities of daily living and motor skills after a stroke (29).

Interestingly, the reported improvements exceed the minimal clinically important differences (MCIDs) established in previous research, indicating clinically meaningful changes. However, the study's findings, indicating slightly higher mean improvements in the Traditional OT group, diverge from some prior studies, such as those cited by Cao and Li (2021), which found CIMT superior in certain aspects of motor recovery (5). This discrepancy might be due to the incorporation of newer or more varied therapeutic techniques in the traditional OT approaches used in this study.

Nevertheless, the study's limitations cannot be overlooked. The small sample size of only 40 participants, as noted by Hsieh et al. (2021), may limit the generalizability of the findings to the broader stroke survivor population (11). The lack of long-term follow-up to determine the durability of the improvements, and the absence of control for potential confounding factors, such as stroke severity and patients' motivation levels, also warrant consideration.

Future research should focus on replicating these findings in a larger cohort and include a longitudinal component to assess the long-term effects of CIMT and OT. Investigating the specific components of OT contributing most to patient improvements and exploring the potential of combining elements of CIMT and OT could maximize patient

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outcomes. Additionally, enrolling a more diverse participant pool and conducting the study across multiple rehabilitation centers would enhance the applicability and validation of the results in different settings and clinical practices.

CONCLUSION

In conclusion, this study adds valuable evidence to the growing body of research supporting the use of CIMT and traditional OT as effective interventions for improving upper limb function and overall quality of life in stroke survivors. Future studies, ideally adopting a double-blind design and incorporating larger, more diverse cohorts with long-term follow-up, are recommended to further validate and refine these therapeutic approaches.

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