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Research Notes

Feasibility and preliminary effects of group modified constraint-induced movement therapy in Chronic Stroke: A pilot study

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HIGHLIGHTS

- Group-based mCIMT was feasible and well accepted by people with chronic stroke
- Most participants achieved minimal detectable change in at least one outcome
- Therapists reported higher motivation, peer interaction, and engagement in groups
- Therapists reported enhanced motivation, peer interaction, and engagement during group sessions
- Participants cited peer support as a facilitator and glove discomfort as a barrier.
- Results support wider adoption of group mCIMT in resource-limited settings

ABBREVIATIONS

A1	Group-based mCIMT
A2	Conventional rehabilitation
ADL	Activities of daily living
B	A1 followed by a washout/follow-up period
COPM	Canadian Occupational Performance Measure
COPM-P	COPM – Performance
COPM-S	COPM – Satisfaction
FMA-UE	Fugl-Meyer Scale Assessment of the Upper Extremity
MAL	Motor Activity Log
MAL-A	MAL – Amount of use
MAL-Q	MAL – Quality of movement
mCIMT	Modified constraint-induced movement therapy
MDC	Minimal detectable change
mRs	Modified Rankin Scale
ROM	Range of Motion
TREND	Transparent Reporting of Evaluations with Nonrandomized Designs
WMFT	Wolf Motor Function Test

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BACKGROUND: Upper limb impairment after stroke significantly limits independence in daily life. Modified constraint-induced movement therapy (mCIMT) is effective for improving paretic upper limb use, and group-based delivery may enhance feasibility, motivation, and scalability in clinical settings.
AIM: To examine the feasibility and preliminary clinical effects of group-based mCIMT compared with conventional rehabilitation in individuals with chronic stroke, and to explore therapist and patient perceptions of the group format.
METHODS: A nonrandomized pilot quasi-experimental repeated-measures design (A1–B–A2) was conducted with five individuals with chronic stroke. Participants underwent group-based mCIMT (A1), followed by a washout/follow-up period (B), and then conventional rehabilitation (A2). Outcomes included the Motor Activity Log (MAL), Wolf Motor Function Test (WMFT), and Canadian Occupational Performance Measure (COPM). Qualitative feedback was collected through open-ended interviews with patients and therapists.
RESULTS: Individual responses varied across outcomes, with minimal detectable change attainment observed in 1 to 4 participants depending on the measure and phase. Three out of five participants achieved minimal detectable change thresholds for at least one MAL, WMFT, or COPM outcome. Therapists described enhanced motivation, peer support, and engagement during group sessions. Three patients reported facilitators such as peer encouragement and structured guidance, as well as barriers including glove discomfort and challenges with some ADLs.
INTERPRETATION: Group-based mCIMT was feasible, acceptable, and associated with promising trends in upper limb use and perceived performance. However, the findings remain exploratory given the very small sample size, the absence of randomization, and the fixed intervention order. Larger randomized controlled studies are needed to evaluate the clinical impact of group-delivered mCIMT.

KEYWORDS: Stroke rehabilitation | Occupational therapy | Physical therapy | Restriction-induced movement therapy | Upper limb | Group therapy

INTRODUCTION

Stroke is a leading global health issue, representing the second main cause of death worldwide [1]. Despite advances in rehabilitation, many individuals continue to experience persistent upper-limb impairment that restricts independence in daily life [2]. This highlights the need for evidence-based interventions targeting functional upper-limb use.

Constraint-Induced Movement Therapy (CIMT) was designed to address learned non-use of the affected limb[3] and is strongly recommended in stroke rehabilitation guidelines [4]. Systematic reviews show that CIMT improves arm use in activities of daily living and enhances participation when compared with conventional therapy [5]. CIMT incorporates three core components: intensive task-oriented training, adherence-enhancing behavioral strategies, and restraint of the less-affected limb [6]. Training typically progresses from shaping—progressively challenging motor tasks—to whole-task functional practice [6,7].

Modified CIMT (mCIMT) protocols have been proposed to improve accessibility and adherence [8], and evidence suggests they remain effective in promoting upper-limb recovery [9]. A group-delivered version of mCIMT has also been explored, with preliminary studies reporting increased paretic arm use and functional gains [10,11], as well as enhanced motivation and engagement [12,13]. However, evidence on the feasibility and preliminary clinical impact of group-based mCIMT remains limited.

The primary aim of this preliminary exploratory study was to examine the feasibility and early effects of group-based mCIMT compared with conventional rehabilitation. Secondary aims included evaluating changes in upper-limb function, exploring therapists' perceptions, and identifying patient-reported barriers and facilitators.

METHODS

Design

This study employed a nonrandomized pilot quasi-experimental repeated-measures design (A1–B–A2), consisting of:

- Phase A1: Group-based modified Constraint-Induced Movement Therapy (mCIMT)
- Phase B: Follow-up/washout period
- Phase A2: Conventional rehabilitation

The study was conducted between January 2019 and July 2020 and followed the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) guidelines [14]. Randomization and the use of parallel control groups were not feasible due to limited patient availability and organizational constraints within the public health service. Additionally, financial support for patients was not available. As such, the present work should be interpreted as a pilot feasibility study, rather than a comparative efficacy trial.

A washout interval of 10 months was implemented to minimize potential carryover effects from Phase A1. All assessments, procedures, and session durations were standardized across phases to optimize internal consistency.

Sample

Participants were recruited from a public university outpatient clinic in northeastern Brazil, integrated Clinic of FACISA. All volunteers provided written informed consent in accordance with the Declaration of Helsinki. The study was approved by the Research Ethics Committee of the Faculty of Health Sciences of Trairi (FACISA/UFRN; CAAE: 78878217.0.0000.5568) and registered in the Brazilian Registry of Clinical Trials (RBR-2q98vj).

A total of 46 registered chronic stroke patients were initially contacted. After unsuccessful telephone contact, screening, and application of eligibility criteria, five participants met all criteria and completed the full protocol (Figure 1).

Inclusion criteria were:

- age ≥ 18 years-old;
- diagnosis of ischemic or hemorrhagic stroke in the chronic phase (≥ 6 months post-event);
- unilateral upper limb impairment;
- at least 20° of wrist extension and visible active finger movement;
- cognitive eligibility according to Mini-Mental State Examination [15]:
  - ≥ 13 points (illiterate),
  - ≥ 18 points (low/medium education),
  - ≥ 26 points (high education).

Exclusion criteria included:

- concurrent participation in other rehabilitation or research programs targeting the upper limb;
- uncorrected auditory or visual impairments that could interfere with participation.

Cognitive function

Cognitive function was evaluated using MMSE, an easy and simple questionnaire comprising orientation, registration, attention, calculation, recall, language, and copying [15]. Total scores range from 0 to 30 points, with higher scores representing better cognitive states.

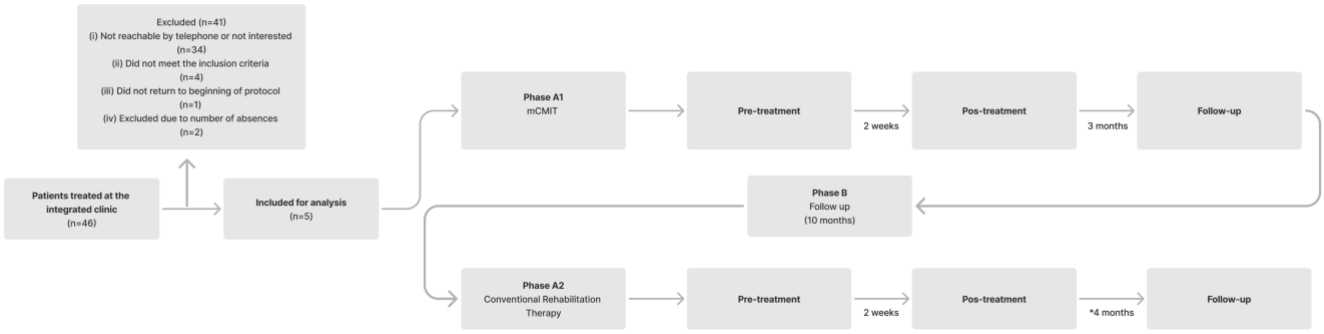

Figure 1. Flowchart of research participants. *Due to COVID-19 pandemic.

Range of motion

A goniometer assessed the wrist and finger joints' range of motion (ROM) [16]. First, the joint was positioned onto the device axis, stabilizing the body segment parallel to the stationary arm of the goniometer. Then, the mobile part of the body segment was aligned parallel to the goniometer moving arm, allowing ROM measurement in degrees.

Functionality

Modified Rankin Scale (mRs) and Fugl-Meyer Scale Assessment of the Upper Extremity (FMA-UE) assessed functionality. mRs assessed disability before and after rehabilitation. The scale has seven levels: 0 = no symptoms; 1 = no significant disability; 2 = slight disability; 3 = moderate disability; 4 = moderately severe disability; 5 = severe disability; and 6 = death [17]. FMA-UE evaluates post-stroke sensorimotor impairment using a 3-point scale (0 = cannot perform; 1 = performs partially; 2 = performs fully). Higher scores indicate better motor function [18].

Primary and secondary outcomes

Primary outcomes were obtained using the Motor Activity Log (MAL), while secondary outcomes included the Wolf Motor Function Test (WMFT) and the Canadian Occupational Performance Measure (COPM)

The Brazilian versions of the MAL and WMFT were used. The MAL assesses amount of use (MAL-A) and quality of movement (MAL-Q) across 30 daily activities, scored on a 6-point scale, with higher values indicating better performance [19]. The total score is the mean for each scale (the sum of the scores divided by the number of questions); the higher the mean, the better the quality and quantity of movement. The WMFT evaluates upper limb motor function through timed and functional tasks, with scores ranging from 0 to 85; in this pilot study, we used the mean score, calculated as the sum of total scores divided by the number of questions. Higher scores denote better performance [6,20].

Occupational performance was assessed using the COPM, in which participants identify problematic daily activities, rate importance (1–10), and select the five most meaningful ones. Performance (COPM-P) and satisfaction (COPM-S) are then rated on a 10-point scale [21].

Follow-up after Phase A1 was performed in person three months post-treatment, whereas Phase A2 follow-up was conducted by telephone four months post-treatment due to COVID-19 public health restrictions.

Primary and secondary outcomes were assessed at three time points: pre-treatment, post-treatment, and follow-up.

Therapist's perception

Qualitative data were collected through two open-ended questions:

1. for therapists: *"What was your perception of patients regarding the group modality?"*
2. for patients: *"What were the barriers and facilitators related to the group mCIMT intervention?"*

Responses were analyzed using thematic content analysis. Two researchers independently reviewed the written transcripts, coded meaningful units, and grouped them into preliminary themes. Discrepancies were resolved through discussion until consensus was reached. An audit trail was maintained to support methodological transparency and credibility.

Because two patients (P1 and P4) did not provide feedback and the number of responses was small, qualitative findings are considered exploratory and should be interpreted with caution.

Intervention

Phase A1- Group-based mCIMT

The group-based mCIMT protocol was delivered for 90 minutes/day, five days/week over two weeks (total: 15 hours). Sessions were conducted in small groups with individualized coaching provided by a multidisciplinary team. The protocol emphasized task-specific training, reduction of compensatory strategies, and peer interaction to enhance engagement.

The intervention combined shaping and task practice. Each session included two shaping activities and one task practice, selected according to functional priorities identified through the COPM. Each shaping activity consisted of approximately ten 45-second repetitions, accompanied by verbal feedback focused on movement quality. Difficulty levels were progressively increased using graduated corrective feedback.

Participants wore a restrictive glove on the less-affected hand for 90% of waking hours throughout the protocol to encourage greater use of the affected limb. On the first day, patients signed a behavioral contract committing to glove use and identifying three meaningful home-based activities to practice during daily life. For safety, tasks presenting risk of fall could be performed without the glove.

Daily monitoring of affected-limb use was conducted using MAL-A before each therapy session. Activities were repeated when participants were unable to complete them, and new tasks were assigned once mastery was achieved. Across the two-week protocol, participants completed a total of 30 shaping tasks and 10 task practice activities, with progression tailored according to individual performance.

Phase B – Follow-up

After completing Phase A1, participants engaged in a general group-based health promotion and mobility program held once per week for one hour, over approximately ten months. This phase served primarily as a washout interval, minimizing potential carryover effects from mCIMT before the start of conventional rehabilitation in Phase A2. The program did not include task-specific upper limb training and was not expected to directly influence the outcomes assessed in this study.

Phase A2 – Conventional Rehabilitation Therapy

Phase A2 was conducted over two consecutive weeks, with 90-minute sessions, five days per week (total: 15 hours), matching the intensity and duration of Phase A1. The same multidisciplinary team delivered all sessions to ensure consistency across phases.

Occupational therapy targeted:

- task-oriented training,
- activities of daily living (ADL) and instrumental ADL,
- fine motor coordination and hand function,
- recreational and meaningful functional tasks, and
- training for community reintegration.

Physical therapy included:

- gait and balance exercises,
- mobility and transfer training,
- active and passive joint mobilization, and
- upper and lower limb strengthening.

The structure of task repetitions, feedback, and progression was designed to approximate the therapeutic intensity of mCIMT, while reflecting standard clinical practice.

At the conclusion of Phase A2, participants were interviewed regarding perceived barriers and facilitators experienced during their earlier participation in group-based mCIMT.

Statistical analysis

Clinical and demographic characteristics were summarized using medians, interquartile ranges, and percentages. Normality was assessed with the Shapiro–Wilk test, and all variables demonstrated non-normal distribution. Given the small sample size and exploratory nature of the study, analyses focused on descriptive statistics rather than inferential comparisons. All statistical procedures were performed using BioEstat 5.3, and significance was set at $p < 0.05$ where applicable.

To interpret individual changes over time, minimal detectable change (MDC) values were used, representing the smallest change detectable beyond measurement error with 90–95% confidence. MDC thresholds applied in this study were:

- WMFT: 4.36 seconds (Time subscale) and 0.37 points (Functional Ability subscale) [22]
- MAL-A: 16.8% and MAL-Q: 14.4% [23]
- COPM-P and COPM-S: 2.0 points [24]

These thresholds guided the interpretation of individual response patterns across phases.

RESULTS

Clinical and demographic characteristics are presented in Table 1. Four participants were older adults (≥ 64 years), three were male, and two were illiterate. Most had experienced an ischemic stroke (n = 4), with the left side affected in three cases. Stroke onset occurred within the previous three years for most participants. All participants demonstrated mild to moderate sensorimotor impairments, with no cognitive impairment or significant disability at baseline.

Table 1. Demographic and clinical variables of participants.

Participant	Age	Sex	Educational level	Stroke type	Affected side	Time since stroke (years)	mRs	FMA-UE	MMSE
P1	62	M	CPS	I	R	13	1	57	19
P2	50	M	II	H	L	3	2	35	20
P3	73	F	IPC	I	R	4	1	52	20
P4	76	M	II	I	L	1	1	53	25
P5	64	M	CMS	I	L	1	1	53	25
Median	64	-	-	-	-	3.00	1.00	53.00	20.00
(1Q/3Q)	(56.00/ 74.50)	-	-	-	-	(0.80/ 8.50)	(1.00/ 1.50)	(43.50/ 55.00)	(19.50/ 25.00)
Values (%)	-	M: 80% F: 20%	II: 40% CPS: 20% IPS: 20% CMS: 20%	H: 20% I: 80%	R: 40% L: 60%	-	-	-	-

mRs: Modified Rankin Scale; FMA-UE: Fugl-Meyer Scale for upper limbs; MMSE: Mini-Mental State Examination. M: male; F: female; II: illiterate; CPS: Complete primary school; IPS: Incomplete primary school; CMS: Complete middle school. I: Ischemic; H: Hemorrhage. R: Right; L: Left.

Supplementary Figure 1 presents the individual trajectories for MAL-A in MDC values (%). In Phase A1, two patients (P3 and P5) reached the MDC between pre- and post-treatment. However, this difference was not mainained at follow-up. One patient (P1) showed worse performance in MDC from pre- to post- and from pre-treatment to follow-up. In Phase A2, one patient (P2) reached the MDC between pre- and follow-up, while two patients (P3 and P5) decreased MDC points.

Supplementary Figure 2 shows the individual trajectories for MAL-Q (%). In Phase A1, three patients (P3, P4, and P5) improved their scores between pre- and post-treatment, while the others (P1 and P2) experienced a decrease in MDC. In Phase A2, one patient (P2) reached the MDC between pre-treatment and follow-up, and one patient (P4) showed a negative effect between post-treatment and follow-up.

Supplementary Figure 3 displays individual mean values for the WMFT-Time component. No participant reached the MDC in Phase A1, while only one participant (P3) reached it in Phase A2.

Supplementary Figure 4 presents the individual mean values for WMFT–Functional Ability. In Phase A1, only one patient (P2) showed improved performance from pre- to post-treatment and from pre-treatment to follow-up. Negative performance was observed in 3/5 patients. In Phase A2, three patients (P2, P3, and P5) reached the MDC between pre- and post-treatment.

Supplementary Figure 5 shows the individual mean values for COPM–Performance. In Phase A1, one patient (P5) reached the MDC between pre-treatment and follow-up. In Phase A2, two patients (P4 and P5) reached it between pre-treatment and follow-up, and one patient (P4) reached it between post-treatment and follow-up.

Supplementary Figure 6 displays the individual mean values for COPM–Satisfaction. In Phase A1, one patient (P2) reached the MDC between pre- and post-treatment; three patients (P2, P4, and P5) reached it between pre-treatment and follow-up; and one patient (P4) reached it between post-treatment and follow-up. In Phase A2, only one participant (P3) reached the MDC between pre- to post- and pre-treatment and follow-up.

Qualitative findings

Therapists reported the following positive aspects of the group-based mCIMT format, including:

- increased patient motivation and engagement;
- a more relaxed and enjoyable therapeutic environment;
- constructive peer competition and collaboration;

• strengthened interpersonal bonds and emotional support;
• improved generalization of therapeutic gains to daily activities.

Collectively, these perceptions suggest that the group modality created a socially reinforcing and dynamic rehabilitation context that may have contributed to greater adherence and sustained participation.

Patients also identified specific barriers and facilitators.

• P2 described initial difficulty adapting to ADL training using the affected hand but noted that therapist guidance and interaction with peers helped overcome this challenge.
• P3 reported hand numbness following the stroke and perceived the glove as a barrier for home activities; however, participation in group sessions helped reduce symptoms.
• P5 found early home practice with the glove challenging but emphasized that peer encouragement and structured session routines increased motivation and confidence in using the paretic upper limb.

These qualitative accounts contextualize the observed improvements in performance and satisfaction outcomes, indicating that social interaction, therapist support, and shared experiences may have played an important role in facilitating functional gains.

DISCUSSION

This pilot study examined the feasibility and preliminary effects of delivering mCIMT in a group-based format for individuals with chronic stroke. Overall, the intervention was feasible, acceptable, and well received by both participants and therapists. Qualitative perceptions highlighted enhanced motivation, peer support, and a positive therapeutic environment, suggesting that social and behavioral elements may have contributed to engagement and adherence.

Trends observed in clinical outcomes indicated potential benefits of group-based mCIMT, especially in self-perceived performance and satisfaction measured by the COPM. Although a subset of participants (2–4/5) demonstrated improvements in MAL and WMFT scores, changes varied considerably across individuals. Given the small sample size, high inter-individual variability, and the fixed order of interventions, these results should be interpreted cautiously. The design limits any causal inference regarding the comparative effects of mCIMT and conventional rehabilitation.

Previous studies have reported that group-delivered mCIMT can enhance upper limb function and occupational performance [25,26]. Similarly, one to four participants showed MDC attainment in selected WMFT components, depending on the WMFT subscale and phase and gains in COPM scores, consistent with the notion that structured, meaningful task practice may support functional improvements. In particular, higher COPM performance and satisfaction scores were observed in 3–4 participants during and after Phase A1 (group-based mCIMT) align with prior findings suggesting that group formats foster motivation, engagement, and generalization of gains [24–26].

Upper limb impairment remains a major barrier to participation after stroke [27]. Improvements in COPM scores in this study corresponded with changes in MAL performance, suggesting that increased use of the more affected limb in meaningful activities may help support functional independence [25]. Importantly, shaping tasks were selected based on each participant's COPM priorities, which may have contributed to enhanced relevance and engagement during therapy.

Therapists also emphasized benefits specific to the group format, including increased motivation, positive peer dynamics, exchange of experiences, emotional support, and improved transfer of training effects to real-life activities. These observations are consistent with the literature indicating that group interventions may foster social support networks, reduce costs, optimize space and therapist time, and potentially increase the use of the affected arm in daily activities [10,11,23,27,28].

This study has several limitations. The very small sample restricts generalizability, and the lack of randomization or counterbalancing introduces potential order and carryover effects. The COVID-19 pandemic affected follow-up procedures, and qualitative findings were limited by a small number of respondents and the absence of thematic saturation.

Despite these constraints, the results provide preliminary evidence supporting the feasibility, acceptability, and potential value of group-delivered mCIMT, particularly in resource-limited environments where group-based care can improve efficiency. These insights may help inform future, larger-scale studies designed to more rigorously evaluate the clinical effectiveness of this approach.

CONCLUSION

This pilot quasi-experimental study demonstrated that delivering modified constraint-induced movement therapy in a group setting is feasible, acceptable, and well tolerated by individuals with chronic stroke. Preliminary trends indicated potential improvements in occupational performance and upper limb use; however, given the small sample size, fixed intervention order, and lack of randomization, these findings should be interpreted as exploratory. No comparative effectiveness conclusions can be made. Larger, randomized controlled trials are required to rigorously assess the clinical impact of group-based mCIMT and optimize its implementation in real-world rehabilitation settings.

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