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In adult patients with unilateral stroke, is distributed constraint-induced therapy or bilateral arm training more effective in improving upper extremity motor and functional outcomes compared with a routine approach?

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AOTA Critically Appraised Papers Series

Evidence Exchange

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CRITICALLY APPRAISED PAPER (CAP)

FOCUSED QUESTION

In adult patients with unilateral stroke, is distributed constraint-induced therapy or bilateral arm training more effective in improving upper extremity motor and functional outcomes compared with a routine approach?

Wu, C., Chuang, L., Lin, K., Chen, H., & Tsay, P. (2011). Randomized trial of distributed constraint-induced therapy versus bilateral arm training for the rehabilitation of upper-limb motor control and function after stroke. *Neurorehabilitation and Neural Repair, 25*(2), 130–139. http://dx.doi.org/10.1177/1545968310380686

CLINICAL BOTTOM LINE

Stroke survivors may experience deficits and impairments of upper extremity (UE) function that limit their engagement in meaningful everyday occupations. It is important for occupational therapists to identify and test the effectiveness of interventions targeted to decrease UE learned nonuse, improve functional performance, and increase participation in one's daily occupations.

This study compared the efficacy of distributed constraint-induced therapy (dCIT) and bilateral arm training (BAT) in improving movement strategies and functional abilities of the UE in stroke survivors. Each intervention group participated in the intervention 2 hr/day, five times per week for 3 consecutive weeks. Participants in the dCIT group focused on practicing use of the affected UE during occupational therapy, plus additional functional use of the affected UE in daily activities by restricting the unaffected UE for six hours daily. Participants in the BAT group focused on concurrent movements using both UEs in functional tasks during occupational therapy only.

On the basis of the results of the study, both dCIT and BAT may help decrease UE learned nonuse in patients with stroke. Both interventions may facilitate the use of the affected UE, thereby improving the quality of motor control and movement and increasing stroke patients' self-efficacy and safety during functional activities such as cooking, shaving, and eating. Although BAT may result in greater improvement of force generation during movement initiation, dCIT may result in increased functional ability, including longer time using the

affected UE and enhanced quality of movement. Thus, occupational therapists working with patients who have had strokes may use dCIT to increase the quality of functional performance and use BAT to improve force generation in movement.

With the additional 6 hours/day forced use of the affected arm in the dCIT group, this group had more intervention time than the BAT group. To achieve equality in comparison, future research may focus on providing the participants with the same amount of intervention for both the dCIT and the BAT groups to integrate use of affected UE in daily activities. Furthermore, additional research may place an emphasis on whether the effects after dCIT or BAT can be generalized to daily functional tasks and maintained beyond therapy.

RESEARCH OBJECTIVES

Compare the efficacy of dCIT, BAT, and control routine treatment in increasing motor control and functional performance of the affected upper limb in patients with stroke.

DESIGN TYPE AND LEVEL OF EVIDENCE

Level I: Randomized controlled group design with pretest and posttest

SAMPLE SELECTION

How were participants recruited and selected to participate? Please describe.

Participants were recruited through convenience sampling from the stroke rehabilitation units at four hospitals. Participants with unilateral stroke were identified through brain imaging and assessments conducted by occupational therapists and rehabilitation physicians to determine eligibility. A total of 326 individuals with unilateral stroke were assessed for eligibility, and 66 met the inclusion criteria. Participants were randomized to dCIT, BAT, or control treatment (CT) groups through computerized block randomization. In addition, a prestratification strategy ensured that the three treatment groups were implemented at each of the hospitals.

Inclusion Criteria

Participants included individuals who (1) had had a hemorrhagic or ischemic stroke more than 6 months ago; (2) were assessed at Brunnstrom stage III or above for proximal and distal parts of the affected UE; (3) had substantial nonuse of the affected UE, on the basis of a Motor Activity Log amount of use (MAL-AOU) score of less than 2.5; (4) had mild cognitive impairment to normal cognitive function, on the basis of a Mini Mental State Examination score of at least 23; (5) had limited spasticity of the affected UE, on the basis of a Modified Ashworth Scale score of 2 or lower; (6) had not participated in

any drug studies or experimental rehabilitation within 6 months prior to the study; and (7) had no balance issues that might have compromised their safety when they were wearing a restrictive mitt.

Exclusion Criteria

NR

SAMPLE CHARACTERISTICS

N = (Number of participants taking part in the study)	66

#/% Male	49/74%		#/% Female	17/26%

Ethnicity	NR

Disease/disability diagnosis	Participants were individuals who had sustained a unilateral stroke, either hemorrhagic or ischemic, and had considerable nonuse of the affected UE.

INTERVENTION AND CONTROL GROUPS

Group 1: dCIT group

Brief description of the intervention	Participants in this group wore a restrictive mitt on the unaffected hand continuously 6 hr/day. They also participated in intensive training of the affected UE in functional tasks. Examples of tasks used during this intervention included picking up coins, reaching for and moving a cup, and using a utensil to pick up food. The tasks were graded for each participant on the basis of his or her abilities and improvement. The dCIT intervention lasted for 2 hr and was given during regular occupational therapy sessions.
How many participants in the group?	*n* = 22 (15 men, 6 women; 14 left-sided lesion, 8 right-sided lesion; mean age in years = 51.91; mean months poststroke = 14.91)
Where did the intervention take place?	Intervention occurred during occupational therapy sessions at the four hospitals.

Who delivered?	Intervention was delivered by five occupational therapists, who were trained in administration of the dCIT protocol.
How often?	Five sessions per week. Mitt was worn daily.
For how long?	Three consecutive weeks

Group 2: BAT group

Brief description of the intervention	Participants in this group participated in training of both UEs (affected and unaffected) in functional tasks. They engaged in tasks that required concurrent or alternating movements of both UEs. Examples of tasks included lifting two cups, wiping a table with two hands, and picking up two pegs. The BAT intervention sessions lasted 2 hr and were given during regular occupational therapy sessions.
How many participants in the group?	*n* = 22 (18 men, 4 women; 10 left-sided lesion, 12 right-sided lesion; mean age in years = 52.22; mean months poststroke = 15.92)
Where did the intervention take place?	Intervention occurred during occupational therapy sessions at the four hospitals.
Who delivered?	Intervention was delivered by five certified occupational therapists, who were trained in the administration of the BAT protocol.
How often?	Five sessions per week
For how long?	Three consecutive weeks

Group 3: CT group

Brief description of the intervention	Participants in this group participated in treatment with two approaches: neurodevelopmental treatment (NDT) and compensatory approach. Approximately 75% of the treatment followed the NDT approach, and the participants engaged in functional tasks focusing on UE coordination, balance, stretching, weight bearing, and hand function. The remaining 25% of the treatment used the compensatory approach, and the participants engaged in functional tasks using their affected UE

	or both UEs. CT intervention sessions lasted for 2 hr and were given during regular occupational therapy sessions.
How many participants in the group?	*n* = 22 (16 men, 6 women; 12 left-sided lesion, 10 right-sided lesion; mean age in years = 55.19; mean months poststroke = 17.77)
Where did the intervention take place?	Intervention occurred during occupational therapy sessions at the four hospitals.
Who delivered?	Intervention was delivered by five certified occupational therapists, trained in administration of the CT protocol.
How often?	Five sessions per week
For how long?	Three consecutive weeks

Intervention Biases

Check yes, no, or NR, and explain, if needed.

Contamination:

YES ☐ NO ☒ NR ☐	*Comment:*

Co-intervention:

YES ☐ NO ☒ NR ☐	*Comment:* Regularly scheduled physical therapy and speech therapy treatments continued during the intervention period as long as the treatments did not involve UEs.

Timing:

YES ☐ NO ☒ NR ☐	*Comment:* Treatment frequency and duration of this study were based on previous studies that showed beneficial outcomes from dCIT and BAT using similar timing.

Site:

YES ☒ NO ☐ NR ☐	*Comment:* Site bias is possible, because interventions were administered at four different hospitals. It is not clear from the study whether environmental differences existed, such as layout and equipment.

Use of different therapists to provide intervention:

YES ☒ NO ☐ NR ☐	*Comment:* Five occupational therapists each were trained in dCIT, BAT, and CT; however, it is not clear from the study whether treatment sessions were equally distributed among the occupational therapists.

MEASURES AND OUTCOMES

Complete for each measure relevant to occupational therapy.

Measure 1

Name/type of measure used	Kinematic analysis quantifying motor control efficiency
What outcome is measured?	Researchers used kinematic analysis to quantify motor control efficacy using four variables. Normalized movement time measures movement efficiency, defined by total time to complete the task. Normalized movement unit (NMU) measures movement smoothness, defined by number of cycles of acceleration and deceleration to complete the task. Peak velocity measures maximum force during initiation of movement during completion of the task. Percentage of movement time when peak velocity occurred measures the percentage of time of increasing force during completion of the task.
Is the measure reliable?	YES ☐ NO ☐ NR ☒
Is the measure valid?	YES ☐ NO ☐ NR ☒
When is the measure used?	Pretest and posttest

Measure 2

Name/type of measure used	Wolf Motor Function Test (WMFT)
What outcome is measured?	The WMFT includes 17 motor-based activities measuring functional ability (WMFT-FAS), performance time (WMFT-Time), and strength (WMFT-Strength).
Is the measure reliable?	YES ☒ NO ☐ NR ☐
Is the measure valid?	YES ☒ NO ☐ NR ☐
When is the measure used?	Pretest and posttest

Measure 3

Name/type of measure used	Motor Activity Log (MAL)
What outcome is measured?	The MAL measures participants' perception of actual use of the affected UE in 30 functional daily activities, including amount of use (AOU) and quality of movement (QOM).
Is the measure reliable?	YES ☒ NO ☐ NR ☐
Is the measure valid?	YES ☒ NO ☐ NR ☐
When is the measure used?	Pretest and posttest

Measurement Biases

Were the evaluators blind to treatment status? *Check yes, no, or NR, and if **no**, explain.*

YES ☒ NO ☐ NR ☐	*Comment:* All pretest and posttest measurements were administered by occupational therapists blinded to the treatment status of each participant.

Was there recall or memory bias? *Check yes, no, or NR, and if **yes,** explain*.

YES ☐ NO ☒ NR ☐	*Comment:*

Others (list and explain):

N/A

RESULTS

List key findings on the basis of study objectives. Include statistical significance where appropriate ($p < .05$). Include effect size if reported.

In terms of motor control, the results of this study indicated that the dCIT and BAT groups had improved posttreatment scores compared with the CT group in unilateral and bilateral tasks in some of the measured kinematic variables. In both unilateral and bilateral tasks, participants in the dCIT and BAT groups, but not the CT group, had significantly greater movement smoothness (unilateral tasks: for dCIT vs. CT, $p = .21$, for BAT vs. CT, $p = .32$; bilateral tasks: for dCIT vs. CT, $p = .25$, for BAT vs. CT, $p = .19$). Between the dCIT and BAT intervention groups, data showed no difference in NMU. The BAT group generated significantly greater force when compared with the CT group (unilateral, $p < .001$; bilateral, $p = .006$). However, the researchers found no such significance when comparing the dCIT group with the CT group and the dCIT group with the BAT group. In terms of functional performance and functional outcomes, the results of the study indicated that the dCIT group significantly improved in performance time (WMFT-Time, $p = .044$) and functional ability (WMFT-FAS, $p = .020$), compared with the CT group. Furthermore, the dCIT group had significantly greater improvements in participants' perceived amount of use (MAL-AOU; for dCIT vs. CT, $p = .002$; for dCIT vs. BAT, $p = .010$) and quality of movement (MAL-QOM; for dCIT vs. CT, $p = .036$; for dCIT vs. BAT, $p = .005$) than the BAT and CT groups. No significant differences were found between the BAT and CT groups in regard to the WMFT and MAL.

Was this study adequately powered (large enough to show a difference)? *Check yes, no, or NR, and if **no**, explain*.

YES ☒ NO ☐ NR ☐	*Comment:*

Were appropriate analytic methods used? *Check yes, no, or NR, and if **no**, explain.*

YES ☒ NO ☐ NR ☐	*Comment:*

Were statistics appropriately reported (in written or table format)? *Check yes or no, and if **no**, explain.*

YES ☒ NO ☐	*Comment:*

Was the percentage or number of participants who dropped out of the study reported?

YES ☒ NO ☐

Limitations:

What are the overall study limitations?

First, the dCIT study group received longer treatments outside the regular intervention sessions than the BAT and CT group, because dCIT consisted of wearing a restrictive mitt on the unaffected UE daily for 6 hr. Second, given that only two motor tasks were used to measure changes in participants' movement strategies, readers should use caution in generalizing the findings outside of the study. Last, participants still had some motor abilities on inclusion in the study, so they cannot be considered participants with minimal movement abilities.

CONCLUSIONS

State the authors' conclusions related to the research objectives.

The researchers contended that the effects on movement smoothness provided positive effects in both dCIT and BAT. However, force effects on the initiation of movement and functional performance differed between the two interventions. The researchers concluded that the BAT was an appropriate treatment method in improving force generation and that the dCIT would be more effective for improving the use of one's affected arm and functional performances in daily activities compared with conventional compensatory and NDT-based treatment.

This work is based on the evidence-based literature review completed by Courtney Beyer, OTS, Christine Kim, OTS, Janice Li, OTS, Angelica Soltis, OTS, and Kitsum Li, OTD, OTR/L, Faculty Advisor, Dominican University of California.