

## CONSTRAINT INDUCED MOVEMENT THERAPY FOR MOTOR RECOVERY IN CHRONIC STROKE PATIENT IN RURAL INDIA

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### Abstract

A possible explanation for the substantial remaining motor deficits in stroke patients might be the occurrence of learned nonuse, a phenomenon first described by Taub. Stroke patients who initially attempt to use the affected extremity find themselves unable to do so because the process of spontaneous recovery of function has not yet proceeded sufficiently far. This results in the experience of failure or punishment for attempts to move the extremity and in positive reinforcement for compensatory movements by the unaffected extremity—a learning process that might be supported by the teaching of compensatory activity during rehabilitation.

**Keywords:** CIMT, Motor recovery, Stroke patients

### Introduction

16.9 million people worldwide have a first stroke every year, resulting in about 33 million stroke survivors and 5.9 million stroke-related deaths,<sup>1</sup> making stroke the second most common cause of death and one of the main causes of acquired adult disability.<sup>1,2</sup> Around 80% of these survivors have motor impairments of the upper limb<sup>3</sup> that gravely affect their ability to perform activities of daily living and their social participation. The severity of upper limb paresis is an independent determinant of the outcome of basic activities of daily living after stroke.<sup>4</sup>

### Origin of CIMT:

Original CIMT, although seen as the gold standard, has been investigated in only one RCT<sup>28-30</sup> that included patients who had had a stroke more than 3 months previous to enrolment in the trial (Supplementary Web Appendix). After CIMT, significant positive medium to large effect sizes were reported for arm-hand activities, self-reported amount of arm-hand use in daily life, and self-reported quality of arm-hand movement in daily life.

Stroke is the leading cause of disability in the adult population and is frequently accompanied by substantial loss of motor function. Although acute and post-acute rehabilitation programs are available to stroke patients, substantial impairment and disability may persist for years. In a long-term follow-up study of stroke: it was found that 56% of the patients tested 5 years after stroke still had pronounced hemiparesis, which was the most common complaint at that time. The literature on the efficacy of rehabilitation programs targeting motor dysfunction (for a comprehensive review, see Duncan<sup>4</sup>) suggests that few

effective methods are available and that their effects on chronic motor disability after stroke may be especially weak and not permanent.<sup>5</sup>

### *Current Perspectives of Signature CIMT and the Evolution of mCIMT*

Constraint-induced movement therapy (CIMT) is a widely explored treatment protocol to increase functional use of the more impaired upper extremity (UE) for persons with hemiparetic stroke. The theoretical basis for CIMT was developed through early research in nonhuman primates from which the concept of learned nonuse following limb somatosensory deafferentation emerged.<sup>6,7</sup>

Signature CIMT, developed by Taub and later used in the excite trial, included restraint of the less impaired upper extremity by donning a protective safety mitt for 90% of waking hours over a two-week intervention period. Subjects were also required to participate in six hours/day (five days/week) of ATP and RTP.<sup>8,9</sup>

Despite significant variability in protocols, each form of treatment delivery claims the name “modified” CIMT.<sup>10,11</sup> The issue therein is the lack of standardization by which to establish a consistent reference point for monitoring treatment dosage, creating confusion among the researcher, therapist and reimbursement communities. Therefore, an analysis of existing modified CIMT protocols, to devise a reasonable synthesis of approaches called “alternative” CIMT, should be performed and becomes a necessary precursor before a best model alternative intervention that incorporates key elements, such as intensity, duration, and subject chronicity.<sup>12</sup>

## Methods

### Subjects:

Four patients (3 women, 1 man) participated in the study. Their ages ranged from 45 to 65 years, with a median age of 52 years. Time after stroke varied from 3 to 15 years, with a median time after stroke of 6 years). Immediately poststroke, each patient participated in 6 to 8 weeks of rehabilitation; subsequently, they received conventional physical therapy once or twice a week for varying amounts of time.

The following exclusion criteria were used:

1. Stroke experienced less than 1 year earlier.
2. Serious sensory, cognitive, or aphasic deficits (Mini-Mental Test scores ranged from 26 to 30; Token Test14 scores, from -2 to 2) or severely depressed mood (CES-D Scale scores ranged from 6 to 22).
3. Lesion in the primary sensory or motor areas of the cortex.
4. Inability to extend at least 10" at the metacarpophalangeal and interphalangeal joints and 20" at the wrist.
5. Ability to make extensive use of the involved upper extremity (Motor Activity Log score above 2.5) so that significant further improvement could not be expected.
6. left-arm dominance, and
7. Age more than 80 years

### Assessment

The Actual Amount of Use Test (AAUT) was developed by Taub as an implicit measure of actual use of an upper extremity. The test contains 21 items (eg, filling out a form). All patients signed informed consent for videotaping before the assessment phase but were not aware that they were being videotaped while performing AAUT activities.

The Arm Motor Ability Test (AMAT)<sup>13</sup> assesses the motor ability of the hand and arm during ADL tasks. The test consists of 13 complex tasks that include one to three components each, with a total of 28 component tasks. Sample items are eating with a spoon, drinking from a cup, putting on a sweater, and buttoning it.

### Procedure:

The initial evaluation included the psychological and neurologic examination. Before and after the 2-week intervention period, as well as 3 months after treatment, the structured interview (MAL) and the laboratory motor tests (WMFT and AMAT) were administered. The AAUT was given only before and immediately after treatment.

### Data Analysis:

For all the variables in the study Friedman one-way analysis of variance (ANOVA) was used to determine the overall change from pretreatment to posttreatment and to follow-up.

## Results

### Efficacy of the Intervention:

Almost doubled (increase of 98%) and quality of movement increased by 124% in the pretreatment to posttreatment comparison (both Wilcoxon tests:  $Z = -2.02$ ,  $p = .020$ ; table 2). The MAL showed a 166% increase in quality of movement of the affected extremity at posttreatment and 165% at follow-up (Friedman test:  $\chi^2 = 6$ ,  $p = .049$ ; individual subject pretreatment to posttreatment and pretreatment to follow-up comparisons, all  $p$  values  $< .05$ ). A similarly strong improvement occurred on the amount of use scale of the MAL: it showed an improvement of 136% at posttreatment and 122% at the follow-up assessment. Amount of use MAL data were available for only three subjects.

**Table 1:** Pretreatment, Post-treatment, and Follow-Up Means, Standard Deviations, and Effect Sizes for All Patients

	Pretreatment		Posttreatment		Follow-Up		Effect Sizes Mean	
	Mean	SD	Mean	SD	Mean	SD	Pre-Post	Pre-Fol
AAUT AOU	0.62	0.36	1.23	0.38			1.63	
QOM	0.92	0.57	2.06	1.57			1.05	
MAL AOU	1.95	0.50	3.97	0.28	3.99	0.31	9.55	7.58
QOM	1.30	0.37	3.47	0.66	3.52	1.09	3.21	1.98
AMAT Time	11.39	4.40	9.21	3.40	9.35	3.34	0.62	0.60
FA	2.95	0.73	3.52	0.70	3.71	1.04	0.54	0.58
QOM	2.75	0.71	3.41	0.71	3.48	1.04	0.91	0.60
WMFT Time	13.12	6.69	7.60	4.42	12.10	7.08	1.23	0.25
FA	3.36	0.60	3.90	0.61	3.73	0.82	0.90	0.64
QOM	3.16	0.54	3.67	0.60	3.47	0.81	0.84	0.27

AAUT, Actual Amount of Use Test; AOU, amount of use; QOM, quality of movement; MAL, Motor Activity Log; AMAT, Arm Motor Ability Test; FA, functional ability; WMFT, Wolf Motor Function Test

### Comparison of Effect Sizes

The ESs in all the CI therapy reports combined, including this one. Show that it is an effective method for the treatment of upper extremity dysfunction in chronic stroke patients. The lowest but still positive ESs were obtained in the Wolf study, IO with ES ranging from 0.21 to 0.43

There is often a very large difference between what a stroke patient can do and what she or he does<sup>2i</sup>; CI therapy reduces this difference. As noted above,<sup>6,8</sup> the disparity between the motor capacity of many stroke patients and their actual use of the limb may be due to learned nonuse that develops in the early poststroke period but which can be overcome by the application of an appropriate technique, such as CI therapy

### Conclusion:

All the patients in this study were several years poststroke, and their condition had not improved for many months to years. Although some (nonsignificant) regression took place, the improvements were retained at the 3-month follow-up, suggesting that the therapy had produced a long-term treatment effect, as noted in previous research.\* Taken together, the results from the previous studies and this experiment suggest that CI therapy is a powerful technique for the modification of motor deficit late after stroke for the substantial number of patients for whom it is applicable.

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