Use of constraint-induced movement therapy in Chinese stroke patients during the sub-acute period

MWW Myint 邱慧慧
FC Yuen 阮鳳姿
KK Yu 余劍琴
PL Kng 康佩玲
MY Wong 王美儀
KC Chow 周傑志
CK Li 李志剛
CP Wong 王春波

Key Messages

1. Constraint-induced movement therapy is an effective technique for the rehabilitation of sub-acute stroke patients with moderately impaired arm function.
2. It proved superior to conventional occupational and physical therapy over a 10-day period in a day hospital setting and the effects were maintained at 12 weeks.

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Ruttonjee Tang Shiu Kin Hospital, 266 Queen's Road East, Wan Chai, Hong Kong SAR, China
Department of Integrated Medical Services
MWW Myint, KK Yu, PL Kng, CP Wong
Department of Occupational Therapy
FC Yuen, MY Wong, KC Chow, CK Li

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Principal applicant and corresponding author:
Dr Chun-por Wong
Department of Integrated Medical Services, Ruttonjee Tang Shiu Kin Hospital, 266 Queen's Road East, Wan Chai, Hong Kong SAR, China
Tel: (852) 2291 1333
Fax: (852) 2291 1335
E-mail: cpwong@ha.org.hk

Introduction

Stroke is the most common cause of disability in the adult and elderly population in the world and a major cause of hospitalisation. Long-term motor deficits in stroke patients may be due to 'learned non-use', a process enhanced by the teaching of compensatory activity during rehabilitation. Recovery may be improved by constraint-induced movement therapy (CIMT) or 'forced use'[1,2] which involves restraining the unaffected upper extremity (UE) and training the affected extremity.

Aims and objectives

This study aimed to investigate whether CIMT can improve function in hemiplegic upper limbs during the sub-acute period after strokes in Chinese patients. A secondary aim was to investigate whether adding CIMT to the stroke rehabilitation service in Hong Kong is feasible.

Methods

This study was conducted from November 2004 to November 2005 and is a randomised controlled study comparing the pre-intervention, post-intervention, and 12th-week UE function in patients with strokes. The observer was blinded and the subjects were randomised by drawing sealed envelopes. Subjects were recruited from the acute stroke and rehabilitation services of three regional hospitals.

The inclusion criteria were: being 2 to 16 weeks after an ischaemic or haemorrhagic stroke; hemiparesis, with the affected limb having a functional level of grade 3 to 6; minimal movement of ≥20 degrees of wrist extension and ≥10 degrees of extension of all digits; being ethnically Chinese; and achieving a score of 17 or above in the Cantonese version of the mini-mental state examination (MMSE) .The subjects also needed to be able to ambulate with or without aid. The exclusion criteria were severe aphasia, a high risk of falling, cerebellar stroke, and severe shoulder pain affecting therapy.

The intervention group underwent a 10-day training programme given by a designated occupational therapist, focusing on the hemiplegic UE with the unaffected limb restrained in a shoulder sling. The intervention subjects signed a contract in which they agreed to wear a padded shoulder sling for most of the day, except during high-risk activities, during the 10-day treatment period. The subjects were treated with 4 hours of supervised activities including shaping, which is a behavioural method used to improve motor performance using small increments and encouragement with positive feedback and increasing level of difficulty.

The control group received standard occupational and physical therapy, which included bimanual tasks for the UE, compensatory techniques for activities of daily living, hemiplegic UE strength and range of motion, positioning and mobility training. Both groups received 4 hours of therapy daily, 5 days per week, for 2 consecutive weeks.

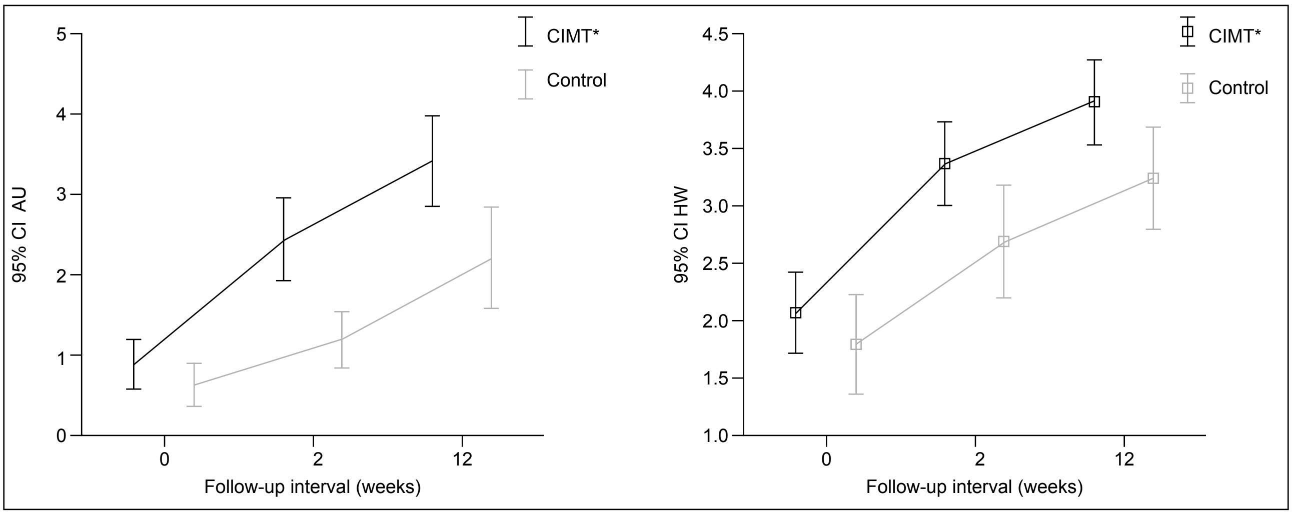

Fig 1. Motor Activity Log: amount of use (AU) scale and how well (HW) scale
* Statistically significant; CI denotes confidence interval, and CIMT constraint-induced movement therapy

The primary end points for this study include the real world measure of Motor Activity Log (MAL) score and the laboratory UE functional measure Action Research Arm Test (ARAT), after 2 and 12 weeks. The secondary outcomes were measured by using the modified Barthel Index and the ability to complete the Nine Hole Peg test.

Results

There were 122 patients available for recruitment and of these, 23 patients were recruited to the intervention group and 20 enrolled in the control group. Five patients refused to begin the intervention after randomisation and consent and three patients dropped out after beginning CIMT. The intervention group was recruited at a mean interval of 38.2 (standard deviation [SD], 20.4) days from the onset of their stroke. All subjects were assessed 2 weeks after therapy began but two patients from the CIMT group could not be assessed at 12 weeks as one died of liver malignancy and one was lost to follow-up. The patients in the control group were recruited at a mean interval of 44.9 days (SD, 28.6) from the onset of their strokes. One patient suffered a recurrent stroke and could not be assessed at 12 weeks.

Baseline characteristics including age, sex, type of stroke, laterality, interval between onset of stroke and therapy, presence of hemianaesthesia, presence of hemi-neglect and the level of functional return at the baseline assessment were comparable. Baseline variables such as the MMSE, functional test for hemiplegic upper limb, MAL which consists of the amount of use scale (AU) and the how well scale (HW), ARAT, Nine Hole Peg test and modified Barthel Index showed non–statistically significant differences between the control group and CIMT group.

The outcome measurements at the pre-intervention [0], post-intervention [2] and 12th-week [12] assessments are presented in Figures 1 and 2. After the intervention, the mean MAL scores comprising the amount of AU and HW improved significantly over the two observation points in the intervention group (F=12.673, P=0.001 for AU and F=5.816 P=0.021 for HW).

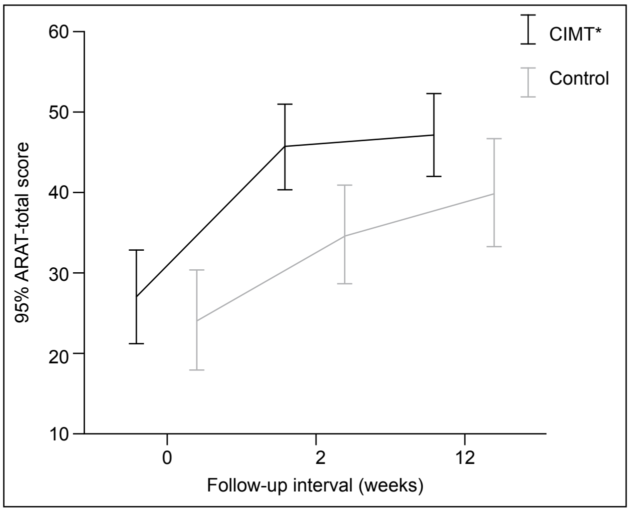

Fig 2. Action Research Arm Test (ARAT) [total score]
* CIMT denotes constraint-induced movement therapy

The sub-components of the ARAT were compared by using the Kruskal Wallis test. The intervention group's grasp (P=0.004), grip (P=0.004), pinch (P=0.032) and gross (P=0.006) components were found to have improved significantly over the control group after the first 2 weeks. Their grip component (P=0.019) and the total ARAT score using analysis of covariance (F=7.601, P=0.009) were superior to the control group at 12 weeks. There was no significant difference, however, in the grasp, pinch and gross components at 12 weeks. This early plateauing of the hemiplegic UE function is illustrated in Figure 2.

The Nine Hole Peg test could only be performed by those with a high level of UE function as it requires considerable dexterity. The number of patients who could perform this test at baseline was not significant—eight (35%) in the intervention group and six (30%) in the control group. After CIMT, 16 (70%) patients were able to perform the test, significantly more than the nine (45%) control group patients who could perform it during the post-intervention assessment (P=0.022). A similar trend was evident at 12 weeks (P=0.029).

There were no significant differences in Modified Barthel Index scores at assessments 2 and 3 (F=1.083 P=0.305). No major complications occurred. One patient complained of exacerbation of shoulder pain 1 month after the end of the intervention period. There were no falls documented in all 23 CIMT patients.

Discussion

Theoretically, early implementation of CIMT during the sub-acute stroke period may minimise learned non-use of hemiplegic upper limbs. Another explanation may be neural re-organisation: there is some biological evidence supporting the role of early training of the affected limb to maximise neuroplasticity.[3]

This study demonstrates that use of CIMT in the sub-acute period after a stroke improved subjective and objective measures of UE function in our patients. Although these functional gains plateaued over 12 weeks, most of the improvements were still significant at the 12-week assessment.

Some safety issues have been raised over the use of CIMT in sub-acute rehabilitation settings. Painful overuse syndromes, the risk of falls, and the frustration engendered by focusing on a weak and clumsy limb have been cited as potential problems. In this study, only one patient reported exacerbation of shoulder pain, 1 month after the end of the intervention period.

There are concerns about starting CIMT in the acute stroke period raised by finding that lesioned rats started on CIMT immediately had their lesions enlarged.[4] Human studies of use of CIMT in the acute period (within 1 to 2 weeks of the stroke) have not shown any clinical adverse effects although neuro-imaging data are lacking. Our patients were recruited relatively late after their strokes, averaging 38 to 44 days, so there were no major concerns about early lesion enlargement.

Conclusion

Constraint-induced movement therapy was able to improve the rate of recovery of upper limb function during the sub-acute phase post-stroke in this subset of Hong Kong Chinese patients and the improvement was maintained at 12 weeks. The feasibility of applying this therapy was demonstrated by its effective use in a Geriatric Day Hospital setting.

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