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Modified Constraint-Induced Movement Therapy (mCIMT) employing a modern restriction cuff

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Summary

Constraint-Induced Movement Therapy (CIMT) is a modern therapeutic procedure with a high degree of evidence to support it. Modified, less intensive forms are more practical and also intensively promote arm function and reuse of the affected limb in everyday life.

Schlüsselwörter: modified Constraint-Induced Movement Therapy, arm function, everyday life

Modifizierte Constraint-Induced Movement Therapy (mCIMT) – der Einsatz einer modernen Restriktionsschiene

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Zusammenfassung

Die Constraint-Induced Movement Therapy (CIMT) ist ein modernes Therapieverfahren, das über einen hohen Evidenzgrad verfügt. Modifizierte, weniger intensive Formen dieses Verfahrens sind leichter durchzuführen und tragen ebenfalls dazu bei, die Armfunktion und den Wiedergebrauch der betroffenen Extremität im Alltag intensiv zu fördern.

Key words: modifizierte Constraint-Induced Movement Therapy, Armfunktion, Alltagsaktivitäten

Introduction

The brain possesses the ability to adapt its functional and structural organisation; this is described as neuroplasticity of the brain. These plastic adaptations in the cortex are influenced by learning and training processes. But learned non-use of the affected arm and conditioning of these negative learning experiences are caused by a lesion-induced sensomotor restriction. CIMT was developed based on the insights of neuroplasticity and the theory of learned non-use. This consists of three components: movement restriction of the unaffected arm; active, repetitive, task-oriented training of the affected arm; and the principle of shaping. A modified form of CIMT has been successfully practiced for several years at the Bad Neustadt Neurological Clinic. Movement restriction of the healthy upper limb in this context occurs by means of a newly developed restriction cuff.

Methods

40 patients, which show the CT-secured diagnosis of a ischemic brain stroke were enrolled in this study between June 2007 to February 2010. The time between the ischemic stroke and the initiation of the mCIMT was: 2 – 4 weeks (n=14), 1 – 6 months (n=11), 6 – 12 months (n=8), (longer than 12 months (n=7). Modified CIMT was offered in small groups with up to 4 patients. Training was implemented under intensive therapeutic guidance in 5 one-hour sessions each week (Monday – Friday) for a total of 3 weeks. Inclusion criteria were at least 20° extension in the wrist as well as 10° in the metacarpophalangeal joint, minimal grasping function of the thumb, and sufficient balance for activities while standing. Exclusion criteria were severe cognitive disorders and severe receptive language problems as well as spasticity of the affected arm (Ashworth scale 5). The patient's consent occurs in the form of a treatment contract. In addition to complete restriction of the healthy arm, the use of the affected arm was activated through adapted task-oriented training (Fig. 1).

Treatment includes individually adapted, repetitive exercises of individual movement elements of the arm and hand, up to the training of complex activities of daily living under the principles of shaping (Fig. 2). ICF assessments via the Wolf Motor Function Test (modified form) and the Nine-


Fig. 1: Complete restriction of the healthy arm


Fig. 2: Adapted task-oriented training

Fig. 3: Nine-Hole Peg Test

Hole Peg Test (NHPT) were utilised for regular sequential diagnostics (Fig. 3). The test parameters of the modified Wolf Motor Function Test (mWMFT) include shoulder abduction, elbow extension, shoulder joint flexion, elbow flexion, grasping and lifting a bottle to the mouth and folding a towel. The required time, functioning, and quality of movement or sequence of actions were recorded for each test parameter. During the NHPT, finger dexterity was determined by how many pegs out of a total of nine pegs can be inserted and removed from a plastic block during a maximum permissible time period of 60 seconds. The test was performed with 40 patients, and the test results of the WMFT and NHPT achieved the 1st and 3rd week of treatment were compared.

Results

The patient population treated so far over a period of two years could be readily evaluated over time by using the documentation of all conducted tests. The average perfor-

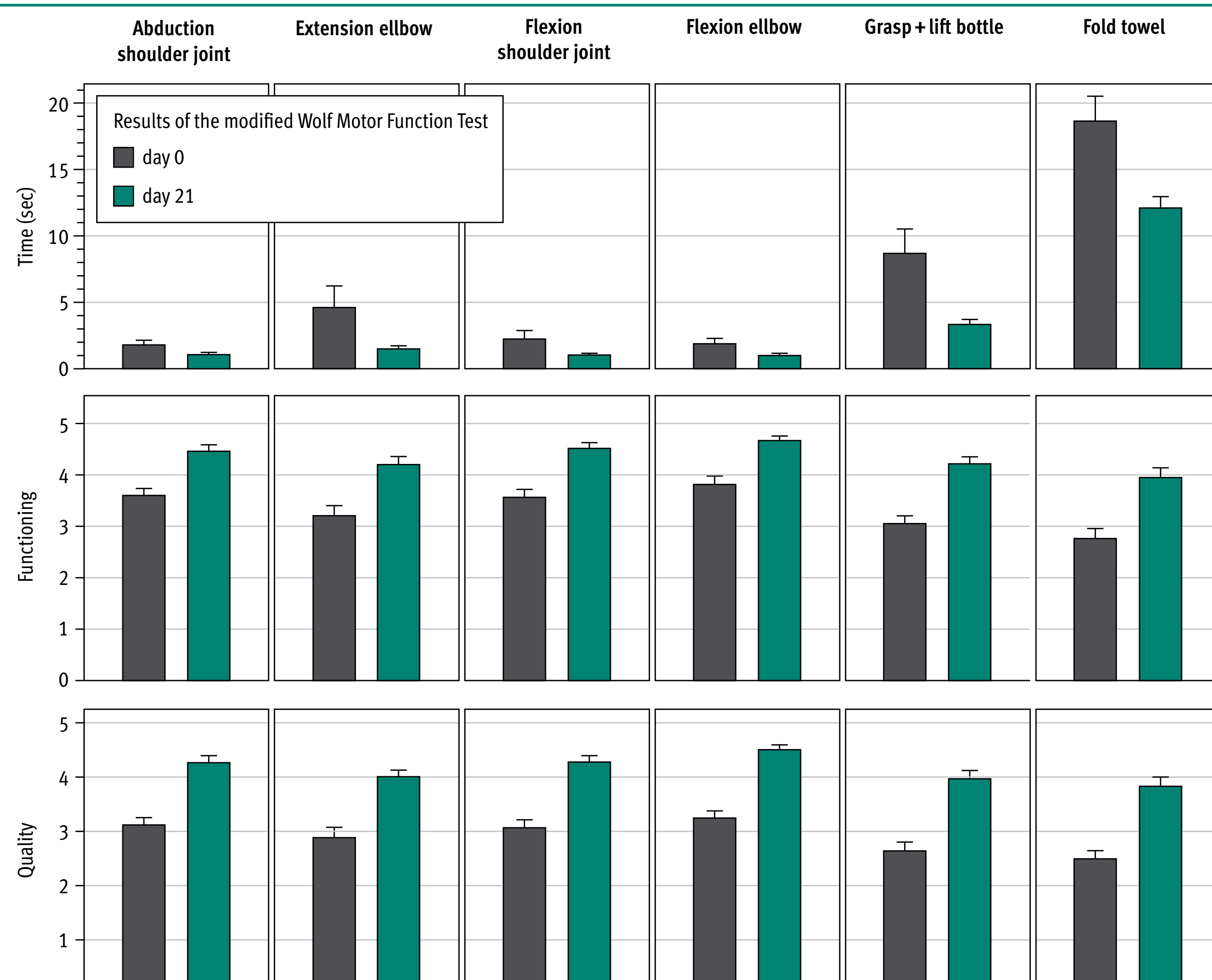

Figure 4: Bars represent the mean and standard errors of mean. All changes were P < 0.001.

Result	Criteria	Exercise					
		Abduction shoulder joint	Extension ellbow	Flexion shoulder joint	Flexion ellbow	Grasp + lift bottle	Fold towel
Excellent	Exercise time improved AND functioning and quality improved or were maintained at maximum	24	24	27	26	26	17
Good	Time or functioning or quality improved AND none deteriorated	10	11	10	6	7	12
Poor	Time or functioning or quality deteriorated OR none improved	6	5	3	8	7	11

Table 1: Results of the modified Wolf Motor Function Test (mWMFT)

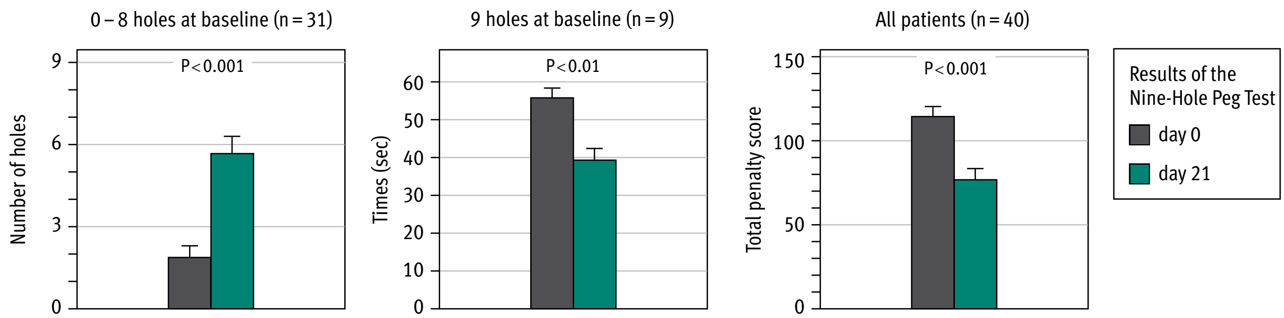

Fig. 5: *Left:* Increased number of holes in patients with submaximal performance at baseline. *Middle:* Acceleration of exercise in patients who completed all holes. *Right:* Improvement in the total penalty score (1 point per second of exercise duration, 10 points for each missed hole). Bars represent the mean and the standard error of the mean.

mance in the Modified Wolf Motor Function Test improved significantly ($P < 0.001$) from day 0 to 21 in all six exercises and with respect to all three criteria (exercise time, functioning score, quality score, see Fig. 4).

On an individual level, excellent, good or poor results were achieved (numbers of patients see table 1).

Out of all 40 patients, 36 (90 %) predominantly improved (18/11/7 achieved an excellent or good result in 6/5/4 of these exercises, respectively). Only 2 patients (5 %) deteriorated (4 or 5 exercises with poor result).

Out of 31 patients performing submaximally in the Nine-Hole Peg Test at baseline, 25 (81 %) exhibited an increased number of holes, and 12 completed all holes in the follow up test on day 21. Out of nine patients who completed all holes in both tests, 8 improved their exercise time. Out of all 40 patients, 33 (82.5 %) improved their performance in this test, three maintained their level, and four patients remained unable to perform this exercise. The average number of holes completed and the exercise times are shown in figure 5.

Conclusions

The achieved results concerning the functionality of the affected arm and the hand confirm the efficacy and high quality of CIMT. Despite modification and necessary adaptation to existing therapeutic sequences, the clinical course demonstrated a high degree of practicability. The high compliance of patients with use of the modern restriction cuff (which promotes the reuse of the affected upper limb even more because of the complete restriction of the non-affected arm) should also be mentioned as a positive consideration. Because of the improvements achieved, the efficient application and the positive feedback provided by all patients treated so far, this modified form of CIMT can be recommended as an essential component of modern neurorehabilitation for patients after ischemic stroke.

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Conflicts of interest:
Therapeutic devices were provided by Sporlastic Orthopaedics GmbH.

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