Effectiveness of constraint-induced movement therapy on activity and participation after stroke: a systematic review and meta-analysis of randomized controlled trials

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CRD summary
This review found that constraint-induced movement therapy with or without modification improved hand mobility and to some extent self-care, in stroke patients. The review was reasonably well conducted and the authors cautious conclusions are likely to be reliable.

Authors' objectives
To examine the effectiveness of constraint-induced movement therapy and modified constraint-induced movement therapy on activity and participation for patients after a stroke.

Searching
MEDLINE, CINAHL, EMBASE, PEDro, OTseeker, and Cochrane Central Register of Controlled Trials (CENTRAL) were searched to May 2011 for relevant studies in Finnish, Swedish, English or German; search terms were reported. The bibliographies of review articles, narrative reviews and abstracts from conference proceedings were checked for additional studies. The reviewers tracked citations of review article references to identify other studies.

Study selection
Randomised controlled trials (RCT) of constraint-induced movement therapy in patients over 18 years old, who had experienced a stroke, were eligible for inclusion. Trials of forced-use therapy were excluded.

The included trials were published between 2001 and 2011. Constraint-induced therapy comprised shaping, standard task training, training without restraint on unaffected upper limbs, and modified constraint-induced therapy with decreased training amount. The outcomes evaluated were motor activity, and measures of function, including the Wolf Motor Function Test, the Functional Independence Measure, the Action Research Arm Test, and the Stroke Impact Scale.

Two independent reviewers performed the trial selection; differences were resolved by discussion.

Assessment of study quality
Methodological quality was assessed by two independent reviewers, using van Tulder criteria assessing the potential for selection, performance, attrition and detection biases. The trials were graded as high, acceptable or poor quality. Any disagreements between the reviewers were resolved by consensus or in consultation with a third reviewer if required.

Data extraction
Data were extracted by two independent reviewers to calculate mean differences for the outcomes and 95% confidence intervals for these estimates. Standardised mean differences were used where outcomes were reported using different scales. The reviewers contacted trial authors if data were missing. Any disagreements between reviewers were resolved by consensus or by a third reviewer.

Methods of synthesis
Pooled weighted mean differences and 95% confidence intervals for the summary estimates were calculated, using inverse variance fixed-effect or random-effects models. The meta-analyses were performed for subgroups according to the amount of constraint-induced movement therapy practice: 60 to 72 hours over two weeks, 20 to 56 hours over two weeks, 30 hours over three weeks, or 15 to 30 hours over 10 weeks. Only trials graded as high or acceptable quality were included in the meta-analysis.

Results of the review
Thirty RCTs were included in the review. The quality of the trials was moderate, with a mean quality score of 5.5 (range three to eight). Two trials were rated as high quality; 17 trials were acceptable quality; and 11 trials were
For 60 to 72 hours for two weeks: Significant benefits with constraint-induced therapy were observed for faster hand and arm use in two high-quality trials (WMD -0.46, 95% CI -0.59 to -0.33; I²=0), and it increased the amount of motor activity (WMD 0.85, 95% CI 0.68 to 1.01; I²=0) and quality of motor activity (WMD 0.69, 95% CI 0.45 to 0.93; I²=13%). There were no differences observed in self-care between the treatment group and a control group in one trial.

For 20 to 56 hours over two weeks: There were significant improvements with treatment, compared with control, in the amount of motor activity (WMD 1.11, 95% CI 0.89 to 1.34; I²=14%; two high-quality trials) and quality of motor activity (WMD 0.78, 95% CI 0.20 to 1.36; one high-quality trial). There were no differences between groups in functional independence measures.

For 30 hours over three weeks: Statistically significant benefits were found with the intervention in the amount of motor activity (WMD 0.63, 0.17 to 1.10; I²=55%; four trials, with five comparisons), quality of motor activity (WMD 0.79, 95% CI 0.26 to 1.32; I²=63%; four trials; five comparisons). Significant benefits were found in three trials for self-care with the intervention, but there were differences between the text and figures for this result.

For 15 to 30 hours over 10 weeks: Hand mobility was significantly enhanced with treatment, compared with control (WMD 11.37, 95% CI 4.17 to 18.57; one trial) and compared with no treatment (WMD 15.34, 95% CI 4.05 to 26.63; one trial).

**Authors' conclusions**
Constraint-induced movement therapy with or without modification significantly improved hand mobility and had some benefit for self-care, but further studies were needed.

**CRD commentary**
The review addressed a clear question and the criteria for the inclusion of trials were appropriate and reproducible. The restriction to particular languages means that there was some risk of language bias. Steps were taken to minimise errors and bias at each stage of the review. There was some variety in the duration and frequency of therapy, which meant that the decision to split the meta-analyses by duration and frequency of intervention was appropriate. Some of the trials were excluded for quality reasons. The authors acknowledged the limitations of their review, such as the wide range of measurement tools used in the trials and trial quality.

The review was reasonably well conducted and the authors cautious conclusions are likely to be reliable.

**Implications of the review for practice and research**
**Practice:** The authors stated that constraint-induced movement therapy for six hours every working day for two weeks was beneficial; there was less evidence of benefit with less therapy.

**Research:** The authors stated that further high-quality research was required to determine the optimal intensity of constraint-induced movement therapy and appropriate therapy protocols.

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