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Review

At-home and in-group delivery of constraint-induced movement therapy in children with hemiparesis: A systematic review

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ABSTRACT

Background: Constraint-induced movement therapy (CIMT) is increasingly recognized as an effective therapy for children with hemiparesis. However, the effectiveness of CIMT outside the standard rehabilitation protocol in clinical settings is less known. The aim of this systematic review was to investigate the effectiveness of CIMT conducted at home or in a group.
Methods: We searched CINAHL, PubMed and ScienceDirect in August 2017 to select articles of studies investigating the impact of CIMT performed at home and in a group on affected upper-limb ability, occupational performance, and quality of life of children. Quality was evaluated with the PEDro scale.
Results: Among 374 reports of studies, 30 met the criteria; 15 examined CIMT at home and 15 in a group. CIMT with the 2 delivery models, at home or in a group, had a positive effect on the affected upper-limb ability and occupational performance. The quality of evidence was high for both these outcomes. However, the evidence was weaker and the results too limited to conclude on the impact on quality of life. The data also suggested that the glove may not be the best type of constraint.
Conclusions: CIMT performed at home or in a group may be a promising intervention for rehabilitation for children with hemiparesis, but more studies on the impact on quality of life are warranted.

1. Introduction

Constraint-induced movement therapy (CIMT) is an intense functional task-oriented practice that aims to increase the use of an upper limb affected by hemiparesis by restricting the unaffected one [1–4]. This therapy promotes cortical reorganization and helps override the learned non-used phenomenon [5,6], which leads to long-term improvement in the function of the affected upper limb [4–9].

First used in adults [1,10,11], CIMT has been the subject of numerous reviews over the years [12–18]. Given the specificity of the developing brain (e.g., the presence of critical periods), a specific focus on children is warranted, and the literature has shown an interest in CIMT specifically in children [12–16,19,20]. Although these reviews reported traditional protocols of CIMT, consisting typically of 6 hr of intensive training in clinical settings [12,13,19], as being efficient to improve upper-limb function in children with hemiparesis [12–16], recent guidelines also advocate the use of CIMT in alternative delivery models, at home or in a group setting [21–24]. However, no systematic review

Abbreviations: AHA, Assisting hand assessment; BOTMP, Bruininks-oseretsky test of motor proficiency; CAPE, Children's assessment of participation and enjoyment; CFUS, Caregiver functional use survey; COPM, Canadian occupational performance measure; CPQOL-Child, Cerebral palsy quality of life questionnaire for children; GAS, Goal attainment scale; INMAPI, Inventory of new motor activities and programs instrument; JTTHF, Jebsen-Taylor test of hand function; LIFE-H, Assessment of life habits; MACS, Manuel ability classification system; MUUL, Melbourne assessment of unilateral upper limb function; PAFT, Pediatric arm function test; PAFTFAS, Pediatric arm function test functional ability scale; PDMS-2, Peabody developmental motor scales (second edition); PEDI, Pediatric evaluation of disability inventory; PEDro, Physiotherapy evidence-based database; PMAL, Pediatric motor activity log; QUEST, Quality of upper extremity skills test; R-PMAL, Revised pediatric motor activity log; SFA, School function assessment; UEFT, Upper extremity functional test; WeeFIM, Functional independence measure for children.

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has investigated the effectiveness of CIMT specifically performed at home or in a group with hemiparetic children.

Performing CIMT at home may help children generalize their learning and skills to their daily environment [25–27]. Indeed, learning in a natural environment favours a greater efficiency of interventions in the development of children with disabilities [28,29]. Moreover, even if children have to meet a therapist occasionally, CIMT performed mostly at home reduces the burden, cost and time for transport [21], particularly for people living far away from a health facility.

However, performing CIMT in a group may reduce the time required for the therapy because several children receive the treatment at the same time [11]. Furthermore, being in a group with other young people with similar difficulties is motivating for a child and can increase the participation in therapy [30]. It also allows for peer-modeling and group problem-solving, which favour both learning and motivation.

We performed a systematic review to examine the effectiveness of CIMT performed at home or in a group for improving the daily functioning of hemiparetic children, assessed with 3 outcomes: functional ability of the affected upper limb, occupational performance and quality of life.

2. Methods

The Preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines for systematic reviews were followed for the review.

We searched CINAHL, PubMed and Science Direct on August 2017 for English or French articles, with no restriction on publication date, by using the keywords "child*" OR "pediatric" OR "youth" AND "cerebral palsy" OR "CP" OR "stroke" OR "traumatic brain injur*" OR "isch*" OR "concussion" OR "cva" OR "brain injur*" OR "tbi" OR "hemip*" AND "constraint induced movement therapy" OR "constraint induced therapy" OR "CIMT" OR "force used therapy".

Inclusion criteria were all experimental designs (randomized controlled trial [RCT], quasi- and pre-experimental designs); intervention CIMT; hemiparetic children < 17 years old; intervention conducted at home or in a group; and results of the study corresponding to the determined outcomes (affected upper-limb ability, occupational performance and quality of life). Exclusion criteria were combining CIMT with another treatment. In addition, we manually searched the references of identified studies. Titles and abstract were checked by 2 independent investigators.

2.1. Data extraction

Data were independently extracted by 4 of the authors who participated in pairs and who resolved any discrepancies by discussion. Data were collected on study design, sample size and characteristics (age and diagnosis), intervention protocol, type of constraint, outcomes, results and individual quality. Combining the data using statistical tools would be misleading because the present review describes heterogeneous experiments, such as RCTs and pre- and quasi-experimental designs. Finally, the effect sizes were collected when available or when it was both possible and appropriate to compute the Cohen's d (the difference between 2 means divided by the standard deviation).

The daily functioning of children with hemiparesis was examined by 3 outcomes: affected upper-limb ability, occupational performance, and quality of life. The affected upper-limb ability included manipulations with the hand, use of the limb, quality of movements and bimanual coordination. These abilities were measured in most studies by the following tools (See section Abbreviations): JTTHF, QUEST, some subtests of the BOTMP, PDMS-2, PMAL, MUUL and AHA. Occupational performance was defined as the participation and the ability to perform in daily activities such as leisure, productivity and self-care activities. Occupational performance was measured by using the COPM in most studies. Finally, quality of life included social and emotional well-being measured by the GAS, CPQOL-Child and KIDSCREEN-52. For all 3 outcomes, parents' perception of their hemiparetic children was sometimes assessed by questionnaires. The synthesis of data was achieved by discussion.

2.2. Evaluation of quality

Two reviewers independently assessed the methodological quality of every study by using the PEDro scale [31]. Scores were cross-checked with the PEDro database. The individual quality of each study was presented as a score out of 10, obtained by compiling the 10 last criteria of the PEDro scale [31], and included in the last column of Tables 1 and 2. In the few cases (10%) of lack of consensus among the 2 raters, a third reviewer decided the score. The quality of the body of evidence was then estimated overall for each outcome of interest by using the GRADE approach, which aims to determine the quality of the evidence of a systematic review [32], and the consistency of the results among the studies was verified to address the risk of meta-biases.

2.3. Secondary analysis

To address the question of any differences in the effectiveness of types of restraint used in CIMT on upper-limb function, we identified how many papers reported significant improvements in affected upper-limb ability, occupational performance and quality of life, for 4 common types of constraints (glove, sling, bandage and splint).

3. Results

We selected 374 reports of studies; 263 were selected for further evaluation after removing duplicates, and 126 were further assessed. A total of 30 reports of studies fulfilled the inclusion and exclusion criteria (Fig. 1). A manual search of the references of the 30 articles found no further studies. To investigate the daily functioning of hemiparetic children, 15 studies addressed the effect of CIMT at home and 15 CIMT in a group. Information on all these studies are in Tables 1 and 2.

3.1. CIMT at home

The designs of the 15 studies addressing CIMT at home were RCT ($n = 12$) and quasi- ($n = 1$) or pre-experimental ($n = 1$). Also, we found a secondary analysis of a quasi-experimental design ($n = 1$). Overall methodological quality was homogenous and the quality was moderate to high (mean PEDro score: 5.6).

3.1.1. Intervention protocol

Studies compared CIMT at home with CIMT conducted in clinical settings ($n = 2$), another treatment at home ($n = 5$) or another treatment in clinical settings ($n = 7$). Other treatments referred to bimanual therapy, neuro-developmental treatment or a traditional rehabilitation treatment. Finally, one study included only one group performing CIMT at home ($n = 1$). Intervention protocols for CIMT at home were of varying frequency and duration. The number of sessions ranged from 2 to 7 per week, for a duration of 2 to 8 weeks. Half of the studies ($n = 7$) had a duration of 8 weeks. Most studies ($n = 9$) had at least 5 sessions per week. The studies included from 10 to 50 children.

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