TITLE: Constraint Induced Movement Therapy for Children: Update of Clinical Effectiveness and Guidelines

DATE: 16 June 2016

RESEARCH QUESTIONS

1. What is the clinical effectiveness of constraint induced movement therapy for children with unilateral upper extremity impairment?

2. What are the evidence-based guidelines regarding the use of constraint induced movement therapy for children with unilateral upper extremity impairment?

3. What are the evidence-based guidelines regarding the optimal non-technology or non-drug based therapy for treatment of children with unilateral upper extremity impairment?

KEY FINDINGS

Five systematic reviews, 25 randomized controlled trials, and three evidence-based guidelines were identified regarding the use of constraint induced movement therapy for children with unilateral upper extremity impairment.

METHODS

A limited literature search was conducted on key resources including Ovid Medline, PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, ECRI Institute, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit retrieval by publication type for research questions 1 and 2. For question 3, methodological filters were used to limit retrieval to systematic reviews, health technology assessments, meta-analyses and guidelines. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2010 and May 30, 2016. Internet links were provided, where available.
The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

**SELECTION CRITERIA**

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Selection Criteria</th>
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<tr>
<td><strong>Population</strong></td>
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</table>
| **Intervention** | Q1 and 2: Constraint Induced Movement Therapy (CIMT)  
Q3: CIMT, bimanual training, occupational or physical therapy, observational training, mirror therapy, casting  
*Excluding robotic or technology based therapies and drug or procedural therapies such as Botulinum toxin or blockades* |
| **Comparator** | Q1: Bimanual training, occupational or physical therapy, observational training, mirror therapy, casting;  
Usual care;  
Q1 to 3: No comparator required |
| **Outcomes** | Q1: Clinical effectiveness (e.g., upper extremity functional outcomes [e.g., hand function, functional skills, movement quality and efficiency, unimanual capacity, bimanual performance], self-determined goal achievement, patient satisfaction, quality of life);  
Q2: Evidence-based guidelines regarding the use of CIMT including appropriate indications as well as how it should be administered and by whom;  
Q3: Evidence-based guidelines regarding the use of non-technology, non-drug-based therapy including which therapy is the most appropriate, who should be treated, how therapy should be administered and by whom |
| **Study Designs** | Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, evidence-based guidelines |

**RESULTS**

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials (RCTs), non-randomized studies, and evidence-based guidelines.

Five systematic reviews, 25 RCTs, and three evidence-based guidelines were identified regarding the use of constraint induced movement therapy (CIMT) for children with unilateral upper extremity impairment. No relevant health technology assessments were identified.

Due to the large number of relevant studies identified, non-randomized studies have been included in the appendix with other references of potential interest.
OVERALL SUMMARY OF FINDINGS

Five systematic reviews and 25 RCTs were identified regarding the clinical effectiveness of CIMT for children with unilateral upper extremity impairment. The results of these studies generally indicate that CIMT was as, or more, effective than bimanual or conventional therapies. The findings of these studies are summarized in Table 2.

Three evidence-based guidelines were identified. One guideline addresses the use of pediatric modified CIMT plus bimanual training (BMT) for children with unilateral upper extremity impairment; and two guidelines address optimal non-technology or non-drug based therapy, including CIMT, for treatment of children with unilateral upper extremity impairment.

The modified CIMT guideline from the Cincinnati Children’s Hospital provides three suggested treatment protocols. Treatment should be undertaken by a physiotherapist or occupational therapist trained in CIMT and BMT and the treatment protocol should be decided upon in consultation with the primary caregivers of the child.

For children with, or at risk for, cerebral palsy (CP) the guideline from the American Occupational Therapy Association recommends:

- “Use of constraint-induced movement therapy to improve motor performance in young children with CP.”
- “Use of neurodevelopmental treatment for young children with CP to improve motor performance.”
- “Child-focused and context-focused intervention were equally likely to improve motor performance.”

The guideline from National Institute for Health and Clinical Excellence addressing management of spasticity and co-existing motor disorders and their early musculoskeletal complications recommends a number of specific strategies including postural management strategies and active-use therapy, such as CIMT.

Table 2: Summary of Included Studies

<table>
<thead>
<tr>
<th>First Author, Year</th>
<th>Patient Population</th>
<th>Intervention and Comparator</th>
<th>Results and Author’s Conclusions</th>
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</thead>
<tbody>
<tr>
<td>Chen, 2014¹</td>
<td>Children with CP</td>
<td>CIMT vs conventional therapy</td>
<td>CIMT showed an overall beneficial effect when compared to conventional therapy. The authors concluded CIMT was an effective intervention to improve arm function in children with CP.</td>
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<tr>
<td>27 RCTs</td>
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<tr>
<td>Sakzewski, 2014²</td>
<td>Children with unilateral CP</td>
<td>Non-surgical upper limb therapies</td>
<td>CIMT resulted in modest to strong treatment effects when compared with usual care or equal doses of bimanual OT.</td>
</tr>
<tr>
<td>42 RCTs evaluating 113 interventions</td>
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<tr>
<td>Tinderholt, 2014³</td>
<td>Young children with CP</td>
<td>Intensive motor function and functional skills</td>
<td>Hand function and functional skills outcomes from CIMT were examined in 6 SRs. The authors indicated that the</td>
</tr>
<tr>
<td>First Author, Year</td>
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<tr>
<td>38 controlled studies</td>
<td>training</td>
<td>results “supported the existing evidence of CIMT.”</td>
<td></td>
</tr>
<tr>
<td>Dong, 2013</td>
<td>Children with unilateral CP</td>
<td>CIMT vs BMT</td>
<td>CIMT and BMT both resulted in similar improvements in overall performance and in bimanual and unimanual function of the affected arm.</td>
</tr>
<tr>
<td>Novak, 2013</td>
<td>Children with CP</td>
<td>All interventions for CP</td>
<td>The authors graded the interventions from “do it” to “do not do it”. CIMT was rated as a “do it” therapy.</td>
</tr>
<tr>
<td>Kirton, 2016</td>
<td>Children with perinatal stroke hemiparesis (n = 45)</td>
<td>Two weeks of daily rTMS, CIMT, both, or neither added to intensive therapy</td>
<td>The addition of rTMS, CIMT, or both resulted in a doubled chance of clinically significant improvement. QoL scores were improved.</td>
</tr>
<tr>
<td>Zafer, 2016</td>
<td>Children with hemiplegic CP (n = 20)</td>
<td>CIMT vs BMT</td>
<td>Participants in the CIMT group had significantly greater improvement in functional status.</td>
</tr>
<tr>
<td>Gelkop, 2015</td>
<td>Children with hemiplegic CP in an educational setting (n = 12)</td>
<td>mCIMT vs HABIT</td>
<td>Children in both treatment groups showed similar significant functional improvement. This improvement was maintained in both groups at six month follow-up.</td>
</tr>
<tr>
<td>Xu, 2015</td>
<td>Children with hemiplegic CP (n = 68)</td>
<td>CIMT vs CIMT + electrical stimulation vs traditional OT</td>
<td>Functional outcomes (muscle recruitment and coordination) of the wrist were more improved in the CIMT + electrical stimulation group.</td>
</tr>
<tr>
<td>Abdel-Kafy, 2014</td>
<td>Children with congenital hemiparesis (n = 30)</td>
<td>Child-friendly CIMT vs conventional non-structured therapy group (control)</td>
<td>Upper extremity performance was more greatly improved in the CIMT group as compared to the control group. This improvement was maintained at three months follow-up.</td>
</tr>
<tr>
<td>Chen, 2014</td>
<td>Children with unilateral CP (n = 47)</td>
<td>CIMT vs TR</td>
<td>The authors reported larger effects in favour of CIMT on motor performance, daily function, and some aspects of reaching control than in the TR group.</td>
</tr>
<tr>
<td>Chen, 2014</td>
<td>Children with unilateral CP (n = 45)</td>
<td>Home-based CIMT vs TR (including unimanual and bimanual training)</td>
<td>The CIMT group had significantly shorter reaction time and normalized movement time. The treatment group also showed significantly greater improvement than the traditional group on measurement scales.</td>
</tr>
<tr>
<td>Choudhary, 2013</td>
<td>Children with hemiplegic CP (n = 31)</td>
<td>mCIMT + conventional therapy vs conventional therapy alone</td>
<td>The mcCIMT group showed significant improvement in the affected upper limb vs the control group. The functional improvement was maintained at eight weeks following treatment.</td>
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<tr>
<td>First Author, Year</td>
<td>Patient Population</td>
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<tr>
<td>Deppe, 2013&lt;sup&gt;16&lt;/sup&gt;</td>
<td>Children with unilateral CP (n = 47)</td>
<td>mCIMT vs intensive BMT</td>
<td>There was a significantly greater improvement in isolated motor functions in the affected arm in the mCIMT group. The authors determined that children with more severe disability improved more than those with less severe disability.</td>
</tr>
<tr>
<td>Kingels, 2013&lt;sup&gt;15&lt;/sup&gt;</td>
<td>Children with unilateral CP (n = 51)</td>
<td>mCIMT vs mCIMT + IT</td>
<td>There were significant between group differences observed in the Assisting Hand Assessment in favour of the mCIMT + IT group. The authors suggested that younger children benefited from both approaches and older children benefited most from the combined intervention.</td>
</tr>
<tr>
<td>de Brito, 2012&lt;sup&gt;16&lt;/sup&gt;</td>
<td>Children with hemiplegic CP (n = 16)</td>
<td>CIMT vs HABIT</td>
<td>Functional measures were significantly improved in both treatment groups.</td>
</tr>
<tr>
<td>Rostami, 2012&lt;sup&gt;17&lt;/sup&gt;</td>
<td>Children with spastic hemiparetic CP (n = 32)</td>
<td>VR vs mCIMT vs mCIMT + VR</td>
<td>Significantly greater improvements in amount of limb use, quality of movement, and speed and dexterity were observed in the mCIMT + VR group. These improvements were maintained at 3 months follow-up.</td>
</tr>
<tr>
<td>Sakzewski, 2012&lt;sup&gt;18&lt;/sup&gt;</td>
<td>Children with congenital hemiplegia (n = 44)</td>
<td>CIMT vs BMT</td>
<td>Significant within group improvements were observed in both intervention groups; however, the two groups did not differ significantly from each other in physical activity or skills scales.</td>
</tr>
<tr>
<td>Sakzewski, 2012&lt;sup&gt;19&lt;/sup&gt;</td>
<td>Children with unilateral CP (n = 63)</td>
<td>CIMT vs BMT</td>
<td>No changes in social or emotional well-being were reported in either group. “Children and parents from both groups reported a significant improvement in their or their child’s feelings about functioning…”</td>
</tr>
<tr>
<td>Xu, 2012&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Children with hemiplegic CP (n = 68)</td>
<td>CIMT vs CIMT + electrical stimulation vs OT</td>
<td>All three groups showed significant improvements in range of motion, grip strength, and upper extremity functional test scores. The CIMT + electrical stimulation group showed significantly greater improvements when compared to the other interventions.</td>
</tr>
<tr>
<td>Al-Oraibi, 2011&lt;sup&gt;21&lt;/sup&gt;</td>
<td>Children with unilateral CP (n = 20)</td>
<td>CIMT vs NDT</td>
<td>There was a significant improvement in hand function in the CIMT group when compared with the NDT group.</td>
</tr>
<tr>
<td>Eliasson, 2011&lt;sup&gt;22&lt;/sup&gt;</td>
<td>Young children with unilateral CP (n = 25)</td>
<td>Eco-CIMT vs usual care</td>
<td>The authors determined there was a significant treatment effect when Eco-CIMT was compared with the control.</td>
</tr>
<tr>
<td>Faccin, 2011&lt;sup&gt;23&lt;/sup&gt;</td>
<td>Children with hemiplegic CP</td>
<td>mCIMT vs BMT vs standard treatment</td>
<td>Paretic hand function was significantly improved in both the mCIMT and BMT groups.</td>
</tr>
<tr>
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<tr>
<td>Gordon, 2011&lt;sup&gt;26&lt;/sup&gt;</td>
<td>Children with hemiplegic CP (n = 42)</td>
<td>CIMT vs HABIT</td>
<td>Both treatment groups showed similar improvement in scale scores. Goal Attainment Scale scores were more improved in the HABIT group.</td>
</tr>
<tr>
<td>Lin, 2011&lt;sup&gt;25&lt;/sup&gt;</td>
<td>Children with CP (n = 21)</td>
<td>CIMT vs home-based control intervention</td>
<td>Significantly better results were observed in grasping control, motor efficacy, and unilateral functional performance in the CIMT group. The results were maintained at six month follow-up.</td>
</tr>
<tr>
<td>Sakzewski, 2011&lt;sup&gt;26&lt;/sup&gt;</td>
<td>Children with congenital hemiplegia (n = 64)</td>
<td>CIMT vs BMT</td>
<td>Significant changes in the Canadian Occupational Performance Measure were observed in both groups at 3 weeks and were maintained at 26 weeks. Minimal difference was reported between the two interventions.</td>
</tr>
<tr>
<td>Sakzewski, 2011&lt;sup&gt;27&lt;/sup&gt;</td>
<td>Children with congenital hemiplegia (n = 63)</td>
<td>CIMT vs BMT</td>
<td>Unimanual capacity was significantly greater in the CIMT group. There were no other significant differences reported after the interventions.</td>
</tr>
<tr>
<td>Taub, 2011&lt;sup&gt;28&lt;/sup&gt;</td>
<td>Children with congenital hemiparesis (n = 20)</td>
<td>CIMT vs usual care</td>
<td>Children in the CIMT group “first exhibited emergence of more new classes of motor patterns and skills” and had significantly improved use of the more effected arm.</td>
</tr>
<tr>
<td>Wallen, 2011&lt;sup&gt;29&lt;/sup&gt;</td>
<td>Children with hemiplegic CP (n = 50)</td>
<td>mCIMT vs intensive OT</td>
<td>No clinically or statistically significant differences in outcomes between groups were identified. The authors concluded that mCIMT was not more effective than intensive OT.</td>
</tr>
<tr>
<td>de Brito, 2010&lt;sup&gt;30&lt;/sup&gt;</td>
<td>Children with CP (n = 16)</td>
<td>CIMT vs usual care</td>
<td>Functional skills and independence following the intervention were significantly greater in the CIMT group.</td>
</tr>
</tbody>
</table>

BMT = bimanual therapy; CIMT = constraint-induced movement therapy; CP = cerebral palsy; HABIT = hand-arm bimanual intensive therapy; IT = intensive therapy; mCIMT = modified constraint-induced movement therapy; NDT = neurodevelopmental treatment; OT = occupational therapy; QoL = quality of life; rTMS = repetitive transcranial magnetic stimulation; SR = systematic review; TR = traditional rehabilitation; VR = virtual reality
REFERENCES SUMMARIZED

Health Technology Assessments
No literature identified.

Systematic Reviews and Meta-analyses


Randomized Controlled Trials


Guidelines and Recommendations


APPENDIX – FURTHER INFORMATION:

Previous CADTH Reports


Clinical Practice Guidelines – Methodology Not Specified


Randomized Controlled Trials – CIMT versus CIMT

Dosing


Treatment Setting


Non-Randomized Studies


PubMed: PM26565094


