Constraint Induced Movement Therapy for Infants

Jane Case-Smith, EdD, OTR/L FAOTA & Andrew Persch, MS, OTR/L
Jane Case-Smith, EdD, OTR/L, FAOTA
Professor, Chair
Division of Occupational Therapy
School of Health and Rehabilitation Sciences
The Ohio State University
jane.case-smith@osumc.edu

Andrew Persch, MS, OTR/L
PhD Candidate, Research Associate
School of Health and Rehabilitation Sciences
The Ohio State University
andrew.persch@osumc.edu
Session Objectives

• Understanding where to find and how to use Evidence Based Practice Clinical Guidelines

• Discuss home-based interventions for cerebral palsy: Example constraint induced movement therapy.

• Explain the active ingredients of home-based interventions and generalize to other home-based interventions.

• Explain working with parents and best practice methods for educating parents
Using EBP Clinical Guidelines

• Clinical guidelines are becoming readily available.
• These are developed from comprehensive reviews of the research literature of a diagnosis (e.g. cerebral palsy) and an intervention (e.g., constraint induced movement therapy).
• Guidelines are developed by expert clinicians who come to consensus on best practice based on the research literature.
Model for Evidence-based Clinical Decisions\textsuperscript{1}

\textsuperscript{1} Haynes et al., 1996
Why are Clinical Guidelines Important?

• CPG are systematically developed statements that assist practitioner and client decisions”\(^1\)
• “..point the way to higher quality and more-effective care by making readily accessible the clinical knowledge distilled from outcomes research.”\(^2\)
• In the past, physical and occupational therapists emphasized individualized interventions.
• We approached clinical reasoning using a frame of reference and theory-based practice models.
• Individualized intervention resulting in
• Inconsistency & inefficiencies in practice
• Theory-based practice does not always equal evidence-based practice.

\(^1\) Law & MacDermid, 2003
\(^2\) Institute of Medicine, 1990
Process and Product:

Systematic Reviews → Clinical Practice Guidelines

• The development of a clinical practice guideline is highly systematic
  • Requires a group of experts
  • Requires an extended period for finding the research, appraising the research, and interpreting it for clinical practice
  • Includes consensus statements.

Examples of Clinical Practice Guidelines

• Agency for Healthcare Research & Quality (AHRQ) [www.guidelines.gov](http://www.guidelines.gov)
• Cincinnati Children’s Hospital and Medical Center [www.cincinnatichildrens.org](http://www.cincinnatichildrens.org)
• American Occupational Therapy Association [http://www.aota.org/Practice/Children-Youth/Evidence-based.aspx](http://www.aota.org/Practice/Children-Youth/Evidence-based.aspx)
Home-based interventions for children with CP

- CIMT
  - Extensive evidence for effectiveness
  - Systematic Reviews of CIMT for children

- EPB Guidelines: Cincinnati Children’s Hospital (CCHMC)
Cincinnati Children’s Hospital Clinical Guidelines

- Occupational and Physical Therapy Guidelines (more than 40)

- Includes Best statements and Clinical Guidelines

- Physical Therapy Guidelines:
Cerebral Palsy

• Is the most common and severe motor disorder of childhood
• Estimates of CP range from 2 to 4 per 1,000
• Spastic CP is the most common
• Children with CP benefit from OT and PT services in early childhood and intermittently throughout their lifespan.
• Optimal models for intervention are few; CIMT is the most researched to date\(^1,2,3,4,5,6,7\)

• Findings from trials are positive; virtually all trials have shown benefits.

1 Charles et al., 2006
2 DeLuca et al., 2012
3 DeLuca et al., 2006
4 Eliasson et al., 2005
5 Hoare et al., 2007
6 Sakzewski et al., 2011
7 Wu et al., 2013
Home-based CIMT

- Who may benefit:
  - Young children 18 months to 3 years (optimal)
  - Children 3 years to 12 years (clinic or home)
  - With unilateral cerebral palsy
  - Includes children with cognitive delay (although must follow directions)
  - Less effect for children with seizures, visual deficit (significant), and very dense hemiparesis.
  - Excludes children with dystonia
  - Excludes recent Botox to Upper Extremity
<table>
<thead>
<tr>
<th>Measure</th>
<th>Age range</th>
<th>Description</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assisting Hand Assessment</td>
<td>18 mo – 12 yrs</td>
<td>Measures involved arm and hand skills in bimanual activities</td>
<td>Goal standard Requires certification</td>
</tr>
<tr>
<td>Peabody Develop Motor Scales</td>
<td>Birth to 6 yrs</td>
<td>Assesses gross and fine motor skills</td>
<td>Not specific to unilateral CP</td>
</tr>
<tr>
<td>QUEST: Quality of Upper Extremity Skills Test</td>
<td>18-8 yrs</td>
<td>Specific to movement patterns observed in CP. Use only dissociated movement</td>
<td>Not standardized; criterion referenced.</td>
</tr>
<tr>
<td>Pediatric Motor Activity Log</td>
<td>2-8 yrs</td>
<td>Parent rating of frequency and quality of UE movement</td>
<td>No standardized. Used in many/most CIMT trials</td>
</tr>
<tr>
<td>PEDI-CAT (Pediatric Evaluation of Disability Inventory)</td>
<td>6 mo – 21 yrs</td>
<td>Parent report of self care and mobility ability and need for assistance</td>
<td>Well developed; not uses computer adapted testing.</td>
</tr>
</tbody>
</table>
## Pediatric Motor Activity Log

<table>
<thead>
<tr>
<th>Items</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold a bottle/cup</td>
<td>Turn a knob</td>
</tr>
<tr>
<td>Pick up and hold a small item</td>
<td>Pick up a cylindrical object</td>
</tr>
<tr>
<td>Pick up and hold a large item</td>
<td>Throw a ball or similar object</td>
</tr>
<tr>
<td>Eat finger foods</td>
<td>Hold a handle on a riding, pulling or push toy</td>
</tr>
<tr>
<td>Pick up an object out of arm’s reach</td>
<td>Push up front of body with both arms</td>
</tr>
<tr>
<td>Push a button</td>
<td>Hold an item while standing</td>
</tr>
<tr>
<td>Open a door of a cabinet</td>
<td>Carry an item from place to place</td>
</tr>
<tr>
<td>Use arm to move across floor</td>
<td>Push into sitting position</td>
</tr>
<tr>
<td>Take off shoes or socks</td>
<td>Reach to be picked up by parent</td>
</tr>
<tr>
<td>Pull a toy with a string</td>
<td>Push arm through sleeve of clothing</td>
</tr>
</tbody>
</table>

Each item is scored by the parent for frequency (“how often”) and quality of movement (“how well”).
PEDI-CAT

- Measures 4 domains (3 with relevance to young children)
- Now has 4 point scale (did have yes/no)
- Parent is informant; spans ages 1 to 20 years.

- **Daily Activities** is the ability of a child to carry out daily living skills such as eating, dressing, and grooming activities. The Daily Activities domain also includes items related to household maintenance and the operation of electronic devices. Often, these items require coordination and discrete movements of the hands and arms to complete the activities.

- **Mobility** is the ability of a child to move in different environments such as in the home (getting in and out of own bed) or in the community (getting on and off a public bus or school bus). Mobility items range from foundational motor skills of rolling over and sitting unsupported to more advanced skills of jumping, running, or carrying heavy objects. The use of mobility equipment such as a wheelchair or walking devices is also included in this domain.

- **Social/Cognitive** is the ability to interact with others in a community and participate in one’s family and culture. This domain includes skills needed for effective social exchange and to function safely. Social/Cognitive items address communication, interaction, safety, behavior, play, attention, and problem-solving.
CIMT Active Ingredients

- Casting: full inhibition of less affect UE movement
- Intensive intervention: Motor control/motor learning
  - Just right challenge
  - Repetition: how to elicit in a young child
  - Reinforcement and shaping
- Generalizing
  - Working in the natural environment
  - Parent coaching and education
CIMT Casting

- Custom fabricated long arm univalve cast worn continuously
- Justification & benefits of full arm cast:
  - Safety (reduced risk of skin irritation)
  - Effectively inhibits sensory motor input to unaffected UE
  - Provides functional positioning (for supporting objects and weight bearing)
  - Ensures compliance
CIMT Casting

• Materials
  • Strong and lightweight DeltaCast Conformable focused rigidity cast
  • “Perfect” fit with just enough padding to ensure comfort

• Casting position
  • 90° elbow flexion, neutral forearm
  • Slight wrist extension, partial finger extension, radial thumb abduction

• Cast secured/wrapped using Coban with distal end open
• Cast is removed/made into univalve design using a flat safety cutting strip and bandage scissors
• Cast is removed each week to check skin.
CIMT Casting of a Young Child

1. Padding applied
2. Stockinette fixed
3. Cutting strip applied
CIMT Casting of a Young Child

DeltaCast immersed in water

Cutting strip aligned to 90°

Cutting strip @ 90°; Casting proximal to distal
CIMT Casting of a Young Child

Reinforced weight-bearing surface

Cast remains somewhat flexible
CIMT Casting of a Young Child

Begin cutting before cast hardens

Cut is univalved; 90°

Lateral aspect of cast
CIMT Casting of a Young Child

- Edges are covered with fleece
- Cast secured with Coban
Select Goals

- Guided by assessment
- Specific movements that are missing or impaired
- Parent’s priorities
- Objectives include:
  - Sensory (awareness/discrimination)
  - Bilateral UE skills
  - Unilateral UE skills (affected arm)
  - Gross motor skills
  - Self care
  - Play (ride tricycle, play in sand, push baby cart)
CIMT Intervention (active ingredients)

- Motor learning intervention at high Intensity
  - 2 hours of occupational or physical therapy sessions 5 days per week
  - 1 hour of additional activities completed with parent/caregiver targeting specific skills/movements

- Natural environment
  - Home based intervention selected because it is a comfortable environment for the infant and family and the infant can easily generalize newly learned skills in naturally occurring opportunities

- Parent Involvement
  - Parents participate in the session
  - Discussion of how to practice and reinforce in daily routine
  - Daily Home program

1 Lowes et al., in press
2 Valvano et al., 2004
CIMT Intervention

- Foundations for treatment: Motor learning theory and principles
  - Tasks selected to elicit repeated movement and motor patterns targeted for therapy
  - Child’s just right challenge (emerging skills)
  - Repetition and elaboration of motor skills
  - Frequent reinforcement
  - Shaping
    - Reinforcement
    - Repetition
    - Refinement
Selecting Targeted Movements and
The Just - Right Challenge

<table>
<thead>
<tr>
<th>Targeted Movement</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach overhead</td>
<td>Tall toy; stacking; vertical surface</td>
</tr>
<tr>
<td>Supination</td>
<td>Hold plate; hold cup; turn knob</td>
</tr>
<tr>
<td>Reach across midline</td>
<td>Dressing tasks; bathing tasks; fill the bucket</td>
</tr>
<tr>
<td>Wrist extension</td>
<td>Insert marble; hold spoon; vertical surface: magnets ; crawling</td>
</tr>
<tr>
<td>Isolated finger movement</td>
<td>Sand play; game pieces; prehending small objectives</td>
</tr>
</tbody>
</table>
Task Selection

• Select specific tasks:
  • Require the child move through the range of motion that is deficit
  • Focus on highest potential to improve
  • Are motivating to the child.
  • Can be modified to require higher level skill;
Repetition and Reinforcement

• Tasks selected include natural opportunities for repetition; supports are provided to encourage practice
Shaping

• The therapist uses small steps, slowly increasing the difficulty of the task.
• As the child improves, the task are made more challenging
• Constraints are added to the task to elicit particular movements.

Example: Target is moved further away, is moved higher.
Examples of Task Selection
CIMT Intervention Activities

Functional/play activities

- **Sensorimotor play**
  - Manipulating books, busy boxes and pretend play, e.g., cars, trucks, and dolls.

- **Self-care**
  - Finger feeding, spoon feeding, holding a bottle or cup, taking off socks

- **Functional gross motor**
  - Crawling, pulling to stand, cruising

- **Use of the arm/hand for communication:**
  - Waving, blowing kisses, pointing to a desired object
CIMT Interventions

• Sensory-motor activities:
  • Finding items in containers filled with dried media
  • Crawling on carpet
  • Exploring various textured materials,
  • Messy play
  • Water play

• Strengthening activities
  • Weight bearing on hands in crawling or transitions
  • Handling small weighted play items
  • Playing with materials that have resistive qualities
  • Moving hand (e.g., drawing, painting) on a vertical surface
Bilateral Activities : Cast Removed

• Intervention includes 3-4 days after cast is removed when bimanual coordination is emphasized.

• Goal of bimanual days is to help with the transition from treatment to the post-treatment period and to help the child spontaneously use the more affected arm and hand in functional activities.
• Documentation of Sessions and Progress
  • Daily treatment log is used to:
  • Record approximate amount of time spent on activity and the movement or motor pattern addressed
  • Keep track of objectives
  • Monitor child’s tolerance and progress
  • Show development of skill acquisition and helpful for future treatment planning
Partnering with Parents and Caregivers

- Invite parents into sessions
- Identify the emerging skills and the movement/functional skills that are currently the focus of intervention
- Ask parents about their routines and optimal times for them to practice the child’s emerging skills
- Target self care skills and those that can easily be implemented in the daily routine – bath time routines; dressing routines
Research on Engaging Parents

- Anecdotally and through research, we know that parents typically do not implement home programs.
- 34% of families complete PT home programs\(^1\)
- 66% of families completed all or some of their home program\(^2\)
- McQuiddy\(^3\) suggests therapists use motivational interviewing with parents to:
  - Understand the parent’s frame of reference
  - Determine parent’s concerns
  - Assess the parent’s degree of readiness to implement a home program
  - Affirm that the parent determine how, when, where therapy home program is implemented

---

\(^1\) Rone-Adams et al., 2004
\(^2\) Law & King, 1993
\(^3\) McQuidy, 2012
Steps in Partnering with Parents

• Check/ask
  • What are family’s priorities and concerns?
  • What part of the therapy program is most important to the parents?
  • What are good opportunities to implementing the recommended strategies?
  • Can the home program become part of the family’s daily routine?
  • Are the parents confident in implementing the home program?
Teaching the Parent to Implement A HEP

• Ask the parent:
  • Are you comfortable doing the strategy or activity?
  • Would you like to try it with me?
  • How often do you think you can implement the strategy? When do you think it will work in your day?

• Home Program in our Infant CIMT study:
  • At the end of each session, the OT described the skills that she and the infant practiced along with specific goals for that day.
  • The OT gave the parent activities that continued to address those goals
  • The parent was given a form that he/she checked off at the end of the day to document what activities of those prescribed they accomplished with the infant including approximately how much time was spent on each activity (60 min expectation)
  • Adapted so the activities could easily be implemented during the family’s/child’s daily routine
Reinforcing Parents’ Ongoing Participation

- Ask:
  - How did it go?
  - Did you have any problems implementing the strategies, do you have any questions?
  - Can I help you adapt the strategy so that it is easier to accomplish?

- Home Program:
  - Invite the parent to implement it and you coach, provide positive reinforcement.
  - Explain the importance and compare the activity to other similar activities that you know the parent does with the child.
  - Encourage the parent to identify how the same strategy might be done at another time, in another way…that could allow the child practice opportunities.
Ohio State – Nationwide Children’s Hospital

Infant CIMT Study

- Five infants with unilateral CP completed one month of usual and customary care OT, one month of CIMT with continuous casting, and one month of UCC (follow up)
- Protocol: CIMT as described in this session
- Measures:
  - Developmental Skills (Bayley-3)
    - Fine motor affected upper extremity
    - Gross motor
    - Fine motor non-affected upper extremity
  - Functional Performance (IMAL)
    - How Often and How Well
Intervention Fidelity

- Therapists achieved 89% fidelity using motor control principles
  - Provided activities that met specific sensory-motor goals
  - Used repetition and practice
  - Applied positive reinforcement
  - Varied the activity to obtain generalization
  - Provided the just right challenge

- Infants demonstrated 74% on-task behavior
Outcomes for Infant CIMT

• Primary outcomes:
  • Pre- to post-test 4 infants gained 3 to 7 fine motor items on the Bayley Scales of Infant and Toddler Development (BSID)
  • BSID Fine Motor for affected arm improved significantly pre to post CIMT
  • BSID Gross Motor improved significantly pre to post CIMT and post to follow-up test.
### Results for BSID Raw Scores

<table>
<thead>
<tr>
<th>BSID Scale</th>
<th>Pretest Mean (SD)</th>
<th>Posttest Mean (SD)</th>
<th>T test (p value)</th>
<th>Follow up Test Mean (SD)</th>
<th>T test (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Motor (more affected)</td>
<td>19.6 (6.3)</td>
<td>23.8 (6.8)</td>
<td>-5.25 (.006)**</td>
<td>23.0 (7.7)</td>
<td>.825 (.456)</td>
</tr>
<tr>
<td>Gross Motor</td>
<td>31.6 (5.8)</td>
<td>34.8 (7.2)</td>
<td>-3.00 (.04)*</td>
<td>37.8 (8.3)</td>
<td>-3.59 (.023)*</td>
</tr>
<tr>
<td>Fine Motor (less affected)</td>
<td>27.2 (3.9)</td>
<td>28.6 (5.4)</td>
<td>01.61 (.184)</td>
<td>30.2 (6.1)</td>
<td>-2.36 (.078)</td>
</tr>
</tbody>
</table>

*significant; ** highly significant
Infant Motor Activity Log (adapted from PMAL)

Figure 3: Individual Infant Movement Activity Log (IMAL) scores across intervention phases

- Baseline
- OT1
- CIMT
- OT2

Legend:
- 1
- 2
- 4
- 5
- 6
IMAL Results (continued)

IMAL Score How Well

干预阶段

Baseline OT1 CIMT OT 2

□ 表示第2位患者在CIMT阶段后的缺失数据点。平均差异值在治疗阶段后OT阶段的估计被用于图的绘制。
Benefits of Home-Based Intervention

• Therapists gain thorough understanding of the family
• Infants and parents are comfortable (possibly less stressed) in their own home
• Parents observe and participate in therapy sessions
• Therapists can easily observe the parents implementing the strategies.
• Using the infant’s own toys and natural home environment allows for easier generalization of new skills.
Summary

• Use EBP Clinical Guidelines to improve the consistency of therapy programs across therapists

• Evaluate using a range of clinical measures that include assessment of performance components (QUEST), functional skills (AHA or Bayley), and parent perspective (PMAL)

• Home-based services offer opportunities to
  • Partner with parents
  • Provide services where children can easily generalize new skills

• Use motor learning and shaping principles to guide intervention strategies
  • Identify the just right challenge
  • Select activities that target the emerging skills and can easily be repeated
  • Use specific and positive reinforcement
Summary

• Select activities across all performance domains, including self care.
• Provide family with home program that fits easily into the daily routine.
• Coach parents in strategies; encourage parents to try strategies and provide feedback
• Document daily program; ask parents to document home program implementation
• Measure outcomes routinely to monitor intervention effects
• Report outcomes to your stakeholders, including your families and administrators.