Holland Bloorview
Kids Rehabilitation Hospital

A Practical Guide to Implementing Constraint Therapy and Bimanual Training

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Table of Contents

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Disclaimer

This manual contains recommendations based on recent evidence and the authors' clinical experience with constraint and bimanual therapy for children with hemiplegic cerebral palsy.

This manual was developed for healthcare providers to use as a guide to provide practical suggestions to implement constraint and bimanual therapy and does not constitute professional clinical advice. Healthcare providers are required to exercise their own clinical judgment in using the manual and application of any information contained in this manual should be based on individual/client/patient needs, the relevant circumstances, and local context. Neither Holland Bloorview nor any of the authors and/or contributors of the manual are providing treatment services through the information contained in this manual. Moreover while every effort has been made to ensure the accuracy of the content of the Manual at the time of publication, neither Holland Bloorview, nor any of its agents, appointees, directors, officers, employees, contractors, members, volunteers or related parties: (i) give any guarantee to the completeness or accuracy of the information contained herein; and (ii) TO THE EXTENT PERMITTED BY APPLICABLE LAW, ACCEPT ANY LIABILITY OR RESPONSIBILITY FOR THE USE

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Introduction

Children with hemiplegic cerebral palsy (HCP) have trouble using their affected arm and hand on one side of their body. Evidence from randomized controlled trials, clinical controlled trials, and systematic reviews has shown constraint therapy improves hand and arm movement in children with HCP. [1,5,6,8] The development of constraint therapy as an emerging best practice at Holland Bloorview started in 2005 when constraint therapy was initially offered on an individual client basis. Subsequently in 2008, Holland Bloorview developed the summer constraint and bimanual therapy camp.

Though constraint therapy has high levels of evidence to support its effectiveness we have noticed a challenge in accessing this treatment throughout Ontario. We receive numerous questions from children treatment centres and community therapists on how to implement constraint therapy in their setting. Examples of questions include; how can we provide intensive constraint therapy? what types of constraint should we use? and can we make constraint therapy enjoyable? To address this gap we created this manual for occupational therapists that provides a "how to" approach for implementing constraint therapy.

Purpose of the manual

The purpose of this manual is to provide occupational therapists with practical suggestions on how to implement evidence-based modified constraint induced movement therapy (mCIMT) and bimanual training (BIM) into clinical practice for children with hemiplegic cerebral palsy. The manual illustrates Holland Bloorview's current practices on mCIMT and BIM. Although mCIMT has been used with children with acquired brain injury (ABI) and adults with stroke this manual focuses on children with hemiplegic cerebral palsy.

What is the evidence?

What is constraint therapy?

Children with hemiplegic cerebral palsy (HCP) often have weakness, poor selective motor control, and sensory impairments affecting one side of their body.[1,2] They learn early it is more efficient and effective to use their unaffected limb often disregarding or ignoring their affected limb in daily activities; a phenomenon described by DeLuca as developmental disregard.[3] Children with HCP often will have challenges with activities such as self-care, productivity, and leisure. The goal of occupational therapy is to promote improved independence in self-care, productivity, and leisure activities while integrating the affected hand in day-to-day bimanual activities to achieve increased functional independence, increased participation, and increased quality of life.[4]

Many different interventions are used for children with HCP. In the past 10 years, evidence for modified constraint induced movement therapy *(mCIMT)* has increased exponentially, and has been shown to be an effective treatment for children with HCP.[5] A Cochrane review found positive results from mCIMT, and a systematic review found mCIMT improved the frequency of use of the affected limb.[6,7] Several RCTs found mCIMT improved participants' use of the affected limb in bimanual activities, increased the amount of use of the affected limb, and improved quality of use of the affected limb for functional activities.[8-11] Furthermore, a case study found clinical improvement, and cortical reorganization following three weeks of constraint therapy.[12]

An expert consensus[13] described mCIMT as an intensive intervention with the following features:

1. Constraint of the unaffected upper limb (regardless of the type of constraint being used) and,
2. Intensive structured training (regardless of type of training being used)

Research findings on mCIMT

There is no definitive guideline for the optimal amount of hours for constraint therapy (i.e. dosing); however, most studies adopt a total dose of 60 hours or more.[8,9,14,37] The dosing, the type of constraint, where the training takes place, the format of the training, and the frequency at which mCIMT is repeated are all important components that need to be considered.[13,14]

Important components of mCIMT
✓ The dosing
✓ The Type of constraint
✓ Where the training takes place (i.e. clinic, rehab facility, home)
✓ The format of the training (i.e. individual vs. group)
✓ The Frequency at which mCIMT is repeated

More recently, *bimanual training* (BIM) has been paired with mCIMT. BIM has also been established as an effective treatment for children with HCP.[5] BIM addresses the limitations of mCIMT, which is primarily a unilateral treatment, by maintaining the same intensity and the same structured practice associated with mCIMT.[15] A study found BIM to improve both the quality and quantity of movement of the affected limb in bimanual upper extremity use.[16]

A study comparing mCIMT and BIM with the same intensities found both mCIMT and BIM demonstrated similar improvements in hand function.[14] A systematic review and other studies comparing mCIMT and BIM found significant improvements in both types of intervention for improving impaired arm function and overall functional performance.[17,18,19] In addition, the mCIMT group made significant improvements in unimanual performance, while the BIM group made significant improvements in bimanual performance.[17,18,19] This suggests mCIMT should be paired with BIM to achieve optimal results for children with HCP who present with difficulties in both unimanual and bimanual hand functions.[19,20] A study combining mCIMT and BIM demonstrated more frequent and more effective use of the affected limb, and better performance in self-care and leisure tasks. [21]

In addition to motor impairments children with HCP often face sensory deficits affecting motor function and motor control.[22] Presently, there is insufficient literature to guide clinicians on the management of sensory deficits in children with HCP. Future research on the treatment of sensory deficits could explore the benefits for children with HCP.

Who would benefit from constraint therapy?

There is very little guidance from the literature on who would most benefit from constraint therapy.[13] We do know mCIMT is a treatment for children with one sided weakness, and all various forms of mCIMT result in positive changes.

In our clinical experience mCIMT has been an effective treatment for those children who have developmental disregard, and who have impaired strength, impaired sensation, and impaired motor control.

How to assess a child for constraint therapy?

Assessment

Prior to assessment, the **Manual Ability Classification System (MACS)**[23] is used to describe how a child uses their hands to handle objects in daily activities. The MACS helps to classify a child's usual upper limb function.

At Holland Bloorview, children are assessed prior to starting mCIMT, one week after the completion of mCIMT, and six months after the start of mCIMT. These assessments provide information on the effectiveness of mCIMT.

While there are many assessments one can use, the following is a list of assessments used by the OTs in the Child Development Program at Holland Bloorview. These assessments were chosen based on the evidence to date and using the World Health Organization's International Classification of Functioning, Disability and Health framework.[24]

We recognize this is a lengthy list of assessments, and for some OTs completing every assessment is not feasible for many reasons (i.e. time constraints, lack of resources, etc.). Given the literature and our clinical experience, assessment **should minimally include a measure of:**

- ✓ Unilateral function
- ✓ Bimanual function
- ✓ Participation

Unimanual function

The Quality of Upper Extremity Skills Test (QUEST)[25] is utilized as a measure of upper extremity function to evaluate a child's quality of movement in four domains: dissociated movements, grasp, weight bearing,

and protective extension. Scoring only the affected limb is recommended to better evaluate changes in the affected limb.[26]

Grip strength is recorded using a sphygmomanometer. Efficiency is assessed using the **Jebsen-Taylor Hand Function Test (JTHFT)**[27] which provides a timed evaluation of hand function using simulated activities of daily living.

Sensory function is assessed using the Semmes Weinstein monofilaments to measure tactile registration by producing standardized tactile stimuli of increasing intensity. **Stereognosis** is tested through tactile identification of familiar objects. **Proprioception** is evaluated by accurately identifying wrist and digit joint position. A proprioception testing protocol comprising a static and a dynamic component with and without vision to assess joint-position sense recovery has been utilized as part of research protocols at Holland Bloorview.[28]

Bimanual function

The Assisting Hand Assessment (AHA)[29] measures how effectively the affected limb is used in bimanual performance.

Participation

The Children's Hand-use Experience Questionnaire (CHEQ)[30] is a web-based questionnaire used with children ages 6 to 18 years to assess the experiences in using the affected hand to perform tasks. For younger children ages 2 to 8 years, **the Acquire c Therapy Motor Activity Log (Acquire C Mal)**[31] can be used to examine how often and how well the affected limb is used for functional activities. **The Canadian Occupational Performance Measure (COPM)**[32] is used to identify client and family goals for occupational performance. **Goal Attainment Scaling (GAS)**[33] is an alternative option to measure participation.

How to implement constraint therapy?

Individual mCIMT

In individual mCIMT, a client is seen initially by an OT to assess if s/he is a candidate for constraint therapy. If the decision is made to proceed, the OT together with the parent and the child establish goals and decides on a type of constraint.

Constraint Schedule/Dosing: The child participates in a 12-week block of occupational therapy at a frequency of once per week with each session being one hour. If the client utilizes a removable intermittent constraint s/he wears the constraint for a total of two to four hours per day over six weeks. If the client uses a non-removable constraint, s/he wears the constraint for three weeks. See types of constraints under "how to constrain the unaffected upper limb" on page 17.

Staffing: The OT develops a mCIMT program that offers intensive repetitive practice with progressive and systematically graded activities. This program can be carried out by an occupational therapy assistant (OTA) under the supervision of the OT.

Activities: The mCIMT program provides intensive, repetitive, systematic, and progressive practice of motor and sensory skills, while including a strength, and speed component (see section on how to provide systematically and progressively graded activities for constraint therapy on page 29). The mCIMT program is followed by intensive bimanual training, which includes integration of learned unilateral skills into bilateral activity practice. The OT actively monitors the program and modifies the program as needed.

Group based mCIMT and BIM

At the time of print there were no studies comparing the efficacy of individual mCIMT to group based mCIMT, however, group based mCIMT has several advantages (see table below).[35] At Holland Bloorview, the mCIMT and BIM camp is offered annually for two weeks in the summer. A 1:2 ratio of staff to children is used as this is ideal to maximize the advantages of a group based mCIMT and BIM approach while maintaining close monitoring and attention to providing intense, repetitive and progressive practice.[36]

Advantages of group based mCIMT and BIM
✓ Simulating a more natural collaborative environment similar to schools
✓ Peers providing each other with support and motivation[34,35]
✓ A group can be more cost effective to implement

Constraint Schedule/Dosing: One week prior to the start of camp the participants wear a non-removable cast. This cast is bi-valved on the first day of camp and made into a removable constraint. Participants attend the camp daily for four hours per day. During the first week of camp the participants wear the constraint for three hours and for the second week of camp they wear the constraint for up to 1.5 hours during the day**.**

Staffing: Staffing includes OTs, OTAs, volunteers, social workers, music therapists, magicians and aquatic lifeguards. Social workers provide client and parent support, and disability awareness intervention. Using a multi professional approach provides enriching activities that are fun and enjoyable while participating in mCIMT.

Activities: Camp activities are developed using the model of motor learning and motor control and are embedded within an activity-based framework during the camp. The activities are progressively and systematically graded to ensure success but are also challenging enough for the child to practice motor movements. A home program is provided for additional practice. See figure 1 (page 15) and figure 2 (page 16) for the typical camp schedule.

Week of camp	Duration of wearing constraint	Objective
Week One	Goal: 3 hours wear time	Development of unilateral skills
Week Two	Goal: 1 to 1.5 hours wear time	Integrating learned unilateral skills into bimanual activities

Legend:

U=unilateral activities, clients use only the affected limb during activity

B=bilateral activities, clients integrate learned unilateral skills into bimanual practice

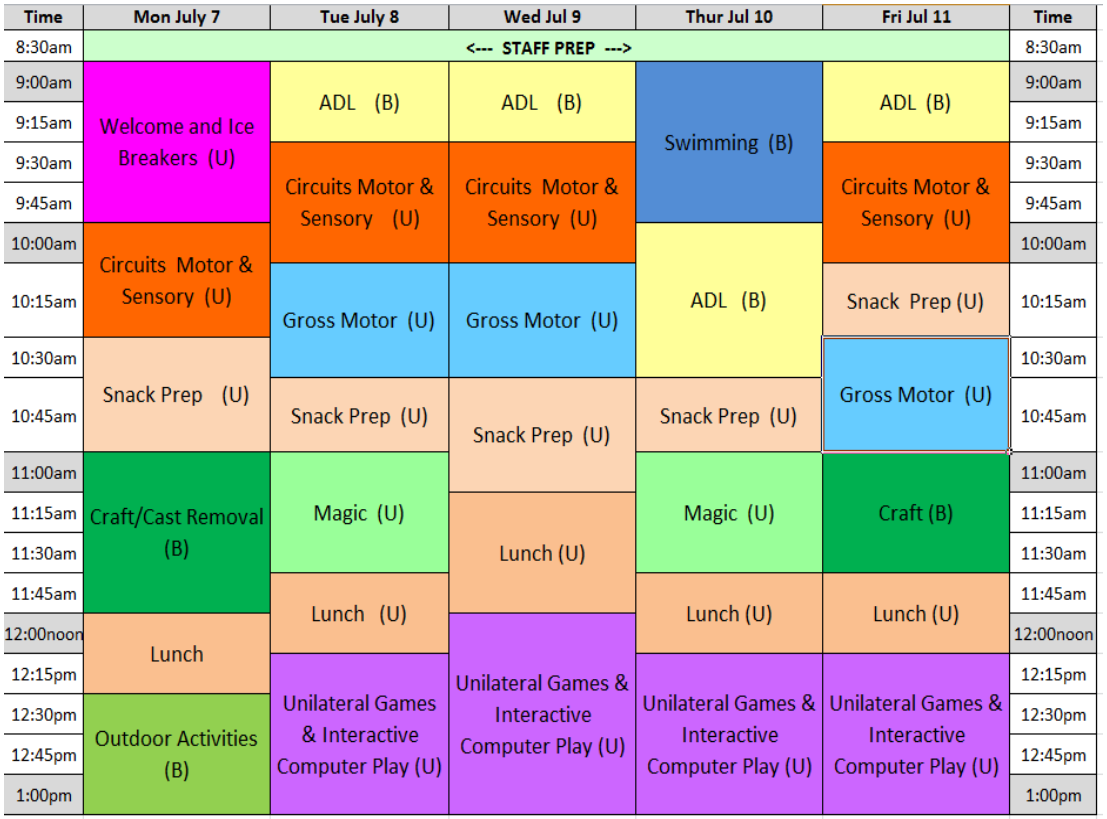
Circuits=timed fine motor stations for practice of specific selective motor control and speed

Sensory= sensory activities for practice of stereognosis, spatial awareness, two point discrimination

ADL =practice of identified goals, which are primarily bimanual

Interactive Computer Play= activities using iPads, and virtual reality system to practice unilateral skills

Figure 1. Typical camp schedule week 1



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ADL =practice of identified goals, which are primarily bimanual

Interactive Computer Play= activities using iPads, and virtual reality system to practice unilateral skills

Figure 2. Typical camp schedule week 2

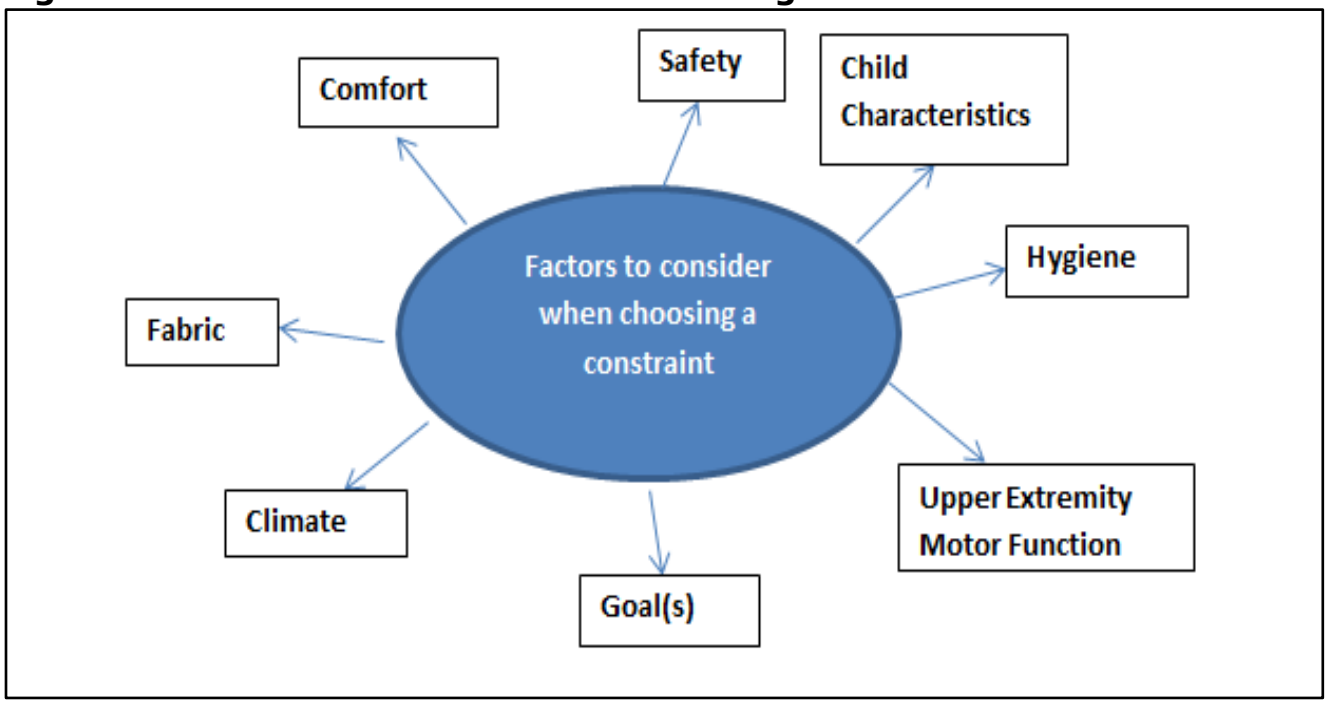
Time	Mon July 14	Tue July 15	Wed Jul 16	Thur Jul 17	Fri Jul 18	Time
8:30am	<--- STAFF PREP --->					8:30am
9:00am	ADL (B)	ADL (B)	Meal Prep/ Baking (B)	Swimming (B)	ADL (B)	9:00am
9:15am						9:15am
9:30am	Circuits Motor & Sensory (U)	Circuits Motor & Sensory (U)			Circuits Motor & Sensory (U)	9:30am
9:45am						9:45am
10:00am				ADL (B)		10:00am
10:15am	Gross Motor (U)	Gross Motor (B)	Circuits Motor & Sensory (U)		Gross Motor (U)	10:15am
10:30am					10:30-12pm Social Work& Networking (Parents)	10:30am
10:45am		Snack Prep (B)		Snack Prep (U)		10:45am
11:00am	Meal Prep /Pizza Lunch (B)	Magic (B)	Social Work (Campers)	Magic (B)	Meal Prep for closing ceremonies (B)	11:00am
11:15am						11:15am
11:30am						11:30am
11:45am		Lunch (B)	Lunch (B)	Lunch (B)	Lunch (B)	11:45am
12:00noon						12:00noon
12:15pm		Unilateral Games/Interactive Computer Play (U)	ADL (B)	Unilateral Games/Interactive Computer Play (U)	Closing Ceremonies, Awards, Magic Show(B)	12:15pm
12:30pm						12:30pm
12:45pm						12:45pm
1:00pm						1:00pm

How to constrain the unaffected limb

Does the type of constraint matter?

At the time of print, there were no studies directly comparing types of constraint with similar amounts of practice.[13] All studies using various constraints demonstrate improvements. When choosing a constraint factors therapists should consider the following: safety, comfort, climate, fabrics and hygiene (see figure 3 below).[13] Additionally, our clinical experience suggests the type of constraint selected should also depend on child characteristics, upper extremity motor function, and the goal(s) of constraint therapy.

Figure 3. Factors to consider when choosing a constraint.



Types of constraints

Review of the literature suggests there are many different types of constraints being used, and they can best be categorized as either removable or non-removable.[13,38] Removable constraints are predominantly utilized for short periods of practice during the day, while non-removable constraints are worn at all times for a defined period of time.

Examples of *removable constraints* include volar thermoplastic splints inhibiting use of fingers and thumb, gloves with a thermoplastic insert, long mitts, or bivalved casts (see figure 4 on page 19 and 20). An example of a *non-removable constraint* is a water resistant lightweight fiberglass below elbow cast that encloses the fingers and thumb in a neutral position and is worn for a defined amount of time (see figure 5 on page 20).

How to constrain the unaffected upper extremity

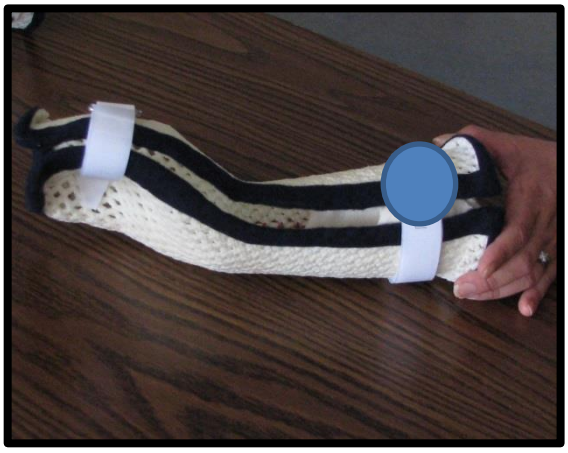
We recommend the following for both removable and non-removable constraints:

- Position the wrist in slight extension (i.e. 10 degrees to minimize migration of the constraint distally)
- Enclose the fingers with metacarpal phalangeal and proximal phalangeal joints in slight flexion, and distal phalangeal joints in neutral
- Position the thumb in neutral alignment with forearm with open web space
- Extends the constraint approximately ½" to 1" distal to the fingertips to prevent the child from using the fingers for grasping.

There are many creative ways to constrain the unaffected hand. For example, enclosing the elbow may be suitable for a child or youth who is working on both reach and grasp. In this example the constraint extends above the elbow and positions the elbow in 90 degrees of elbow flexion and encloses the wrist, fingers, and thumb to prevent the child from using elbow extension to reach and grasp with the unaffected extremity. In another example, for a child or youth who has very little to no distal motor control

(i.e. hand movement) and whose goal is to improve proximal control at the shoulder and/or elbow a constraint may consist of an elbow extension gaitor and a "wrap" to adduct the shoulder and prevent the child from using the shoulder on the stronger side.

Figure 4. Examples of removable constraints



Bivalved cast

Mitt with thermoplastic insert

Applying a sock over a splint

Elbow extension gaitor and "wrap" to work on proximal control

Figure 5. Example of a non-removable constraint

Fiberglass light weight cast

How to select the appropriate constraint?

When choosing a constraint it is important to consider child characteristics, the child's occupation and the child's environment(s) as this will help to maximize effectiveness of mCIMT, ensure client safety, and achievement of goals.

Factors to consider	***Some questions to ask***
Child factors	1. How old is the child? • Is s/he preschool aged? School aged? A teenager? 2. Is the child usually compliant with therapy? • What is the client's frustration for challenging activities? 3. Does the child frustrate easily or accept new routines easily? 4. How will you grade activities to provide "a just right challenge" to minimize frustration?
Physical factors	1. What is the child's balance and mobility? 2. Is the child tripping and/or falling and/or at risk for falling and/or tripping? 3. What is the child's gross motor function? • Is the child developing gross motor skills such as crawling, walking, pulling to stand, other? 4. Will constraint therapy impact on developing gross motor abilities? 5. Does the child have asymmetrical upper extremity use? • What is the child's unilateral arm/hand function? • Does the child only have proximal motor control? Distal motor control? Or both? 6. Does the child disregard the affected arm/hand?

Factors to consider	*Some questions to ask*
Child's occupational factors	1. What is the child using his/her affected arm and hand for during the day at home, school, preschool, and/or in the community? 2. What activities is the child presently doing in his/her environments, need to do and/or want to do? 3. Will constraint therapy affect independence in daily activities and if so, how will you support with these activities while s/he is participating in constraint therapy?
Child's environmental factors	1. Where does the child spend most of his/her day? 2. Who looks after the child during the day? 3. Can you teach the parent/guardian/caregiver, teacher, assistant, daycare worker to implement the constraint programming?

In our experience the effectiveness of mCIMT depends on:

- ✓ Family/caregiver/client commitment to the program
- ✓ Realistic achievable goals
- ✓ The acceptance of wearing the constraint
- ✓ Working with an occupational therapist for programming

Case example: Sam

Sam is a 4 year old boy with right hemiplegic cerebral palsy referred for constraint therapy. He is functioning at MACS level I. Sam just started school and is independent with toileting, dressing, and feeding. He is starting to help with bathing. He ambulates independently but reportedly falls when running. He is having difficulty holding objects with his right hand, and frequently does not always remember to use his right hand when needed. Having read about constraint therapy his parents are very keen to see if this will work for Sam. On assessment, you find he has a strong preference for using his left unaffected arm/hand, and he requires reminders and encouragement to integrate his right hand into activities. When asked to use his right hand he is easily frustrated. He presents with a weak ability to grasp objects using a gross grasp, and is inconsistently able to release objects. He has difficulty identifying objects placed in his hand when his eyes are occluded. You also notice Sam does not tolerate gentle constraint during the assessment visit. Parents' goals include improving Sam's hand strength, incorporating his right hand into daily activities, and improving his grasp and release.

How to treat Sam using constraint therapy:

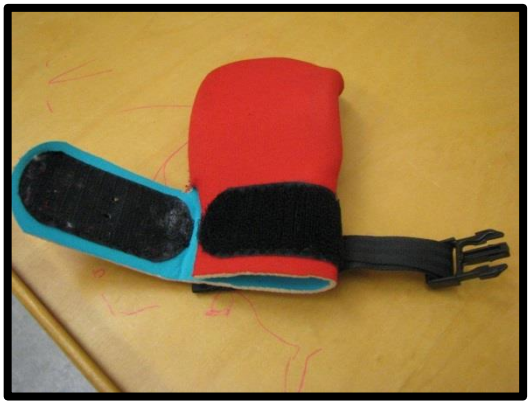
Type of constraint: Given Sam's poor tolerance for gentle constraint and challenging activities, a removable constraint for intermittent practice was suggested to the parents. The removable constraint will also permit Sam to use his stronger arm to protect himself in the event he accidentally trips or falls. The removable constraint will enable Sam to preserve his independence in his routine activities (i.e. toileting, bathing, mealtimes), which may help to minimize frustration. As well, using a removable constraint will not interfere with school activities such as printing.

Constraint schedule/dosing: You recommend using the removable constraint for a total of two to four hours during the day for six weeks. You inquire if the teacher at school could implement the removable constraint during times when Sam is seated and doing fine motor activities. You also inquire if the parents are able to commit to carrying out the constraint therapy program daily at home. You provide the parents with a home program for implementing mCIMT at home outside of therapy sessions. You also recommend Sam receive weekly OT with the OTA. You develop a mCIMT program that is intensive, repetitive,

and offers developmentally appropriate and progressively graded activities. Following the six week of mCIMT you provide BIM.

Advantages and disadvantages of removable and non-removable constraints

Removable constraints



Advantages.

- ✓ A removable constraint enables practice for short periods of time
- ✓ Minimizes frustration for children who have a low tolerance for challenging activities and/or for children with poor distal motor control
- ✓ Maintenance of independence in daily activities (i.e. mealtime and toileting) by allowing use of the unaffected hand to complete daily activities
- ✓ Minimizes risk of falls for clients with poor ambulation; the use of a removable constraint during periods of seated fine motor work at a table will greatly minimize risks of falls

Disadvantages.

- × For some children using a removable constraint may make it more challenging for the parent/ caregiver to reapply the constraint if the child knows the constraint is removable
  - If this is the case, the child may not receive the optimal amount of dosing

Non-removable constraints

Advantages.

- ✓ May help to ensure dosing and compliance for some children
  - For some children, the use of a non-removable constraint may be frustrating initially, however, most children quickly accept the constraint recognizing the constraint is not removable

Disadvantages.

- × May lead to significant frustration resulting in non-compliance especially if the child has very poor distal motor control
- × May lead to a loss of independence and safety risks depending on the child's motoric abilities in the affected limb (i.e. limited protective extension during a fall)
- × Need to diligently check child's skin condition and circulation daily when using a non-removable constraint
- × Increase likelihood this type of constraint can get wet and dirty which may increase the risk of skin irritation; can use a waterproof material to minimize this

How to provide developmentally appropriate programming

Preschool ages up to 2 years:

Implementation of constraint therapy for the young child

- Use of removable constraint while seated
- Play based, individualized programming
- Consider safety as young children are developing gross motor skills and may be at risk of falling and/or tripping
- Be creative

A removable, intermittent constraint may be considered most appropriate for children under 2 years of age due to the necessity of using the unaffected upper limb in the development of gross motor skills (i.e. weight bearing during crawling, pulling to stand) as well as the early development of bilateral integration skills. Given the above factors, a removable intermittent constraint may be most appropriate for this very young age group.

The OT may need to be creative on how to best restrain the unaffected limb. Creative examples of constraints include use of a long glove/mitt with a thermoplastic insert to prevent grasp or pinning of the unaffected limb within the sleeve. Young children are often developing their gross motor skills thus for safety, it is recommended that the child be seated when using the constraint. In our clinical experience, constraint therapy for the young child can be carried out for example in his/her high chair. The duration and frequency of constraint therapy is more customized to suit the young child's developing attention and interests but incorporates the core components (see page 29) and is delivered in a play-based format. Programming potentially could be integrated into the preschool or daycare environment under the direction of the child's therapist.

Preschool ages 2-4 years

Implementation of constraint therapy for the preschool aged child

- Use of removable constraint, possible consideration for a non-removable constraint
- Play based, individualized programming
- Consider safety as gross motor skills may still be developing
- Be creative

As children approach preschool age some may be able to participate in a structured group based program, however individualized programming continues to be most often utilized due to developing attention, motivation, and the child's ability to participate independent of caregivers. The duration and frequency of constraint therapy is more customized to suit the young child's developing gross and fine motor skills, attention, and interests. A removable constraint may be most appropriate for this age group given the above factors. Although the constraint therapy is customized, it should still include the core components (see page 29) and delivered in a play-based format. Integrating programming into the child's preschool environment would help to increase the dosing of mCIMT.

While a removable constraint may be the most appropriate for this age group, a non-removable constraint may be an option for those children whose parents are having difficulty reapplying a removable constraint. For these children a non-removable constraint will provide optimal dosing. Given this age group is primarily assisted with their daily activities there will be less concern about loss of independence. Consideration for a removable constraint is indicated in a child with balance and mobility issues due to safety and/or the child's inability to tolerate a non-removable constraint.

School aged 5+ years

Implementation of constraint therapy for the school aged child 5+ years

- Consider a group format for constraint therapy
- Encourage the child to help decide on the type of constraint, and to help develop goals
- Consider the impact of the constraint on the child's:
  - Independence in daily activities
  - Participation at school
  - Social acceptance

Children and youth in this age group will be able to participate in a group format. A group provides the added benefits of socialization, peer support, and modeling of similar peers. These children can often follow a more formalized program incorporating all the core components (see page 29).

Children of this age can help to make decisions towards which type of constraint to use (i.e. removable or non-removable). Children and youth in this age group are much more able to participate in goal setting as well as develop a plan, and strategies to achieve their goals. For this age group, consider the impact of the constraint on independence (such as toileting, bathing, personal hygiene, eating), school, and possibly social acceptance. A removable constraint may help to meet all of these needs. For example, using a removable constraint outside of school hours (i.e. during a March break, winter holiday, and summer) will not interfere with school productivity such as printing, will help to maintain independence in personal care, and address issues of social acceptance.

How to provide systematically and progressively graded activities for constraint therapy

Some common goals of constraint therapy include:

- Improve strength in the affected limb
- Improve selective motor control specifically for elbow extension, forearm supination, wrist and finger extension, and thumb out of palm movements
- Improve sensory awareness of the affected limb
- Improve spontaneous use of the affected limb
- Improve coordination for bimanual activities

Constraint therapy involves the following core components:

- Intensity
- Repetition
- Grading
- Shaping

Grading has been described as "task demands that are progressed with specific rules on how the affected hand is used during an activity for success while avoiding use of compensatory strategies", and shaping as "practice of a targeted movement within context of completing a task".[9] The shaping process can be assisted through modelling the desired movement, providing hand over hand facilitation, and fading the assistance as desired results are achieved.[38]

The following are examples of activities commonly used at Holland Bloorview during both individual and group constraint therapy and bimanual training. A practice log (see Appendix A on page 39) may be used to track progression of grading during therapy.

Activity: Painting

Objective: Reaching

Child paints on a mural mounted on a wall.

Grade down

- Child is allowed to sit to reduce postural demands
- Child moves closer to the mural
- Therapist provides active assisted facilitation to maximize elbow extension
- Therapist implements use of adjuncts (i.e. splints)
- Mural is positioned on horizontal surface (i.e. on a table or on the floor and incline is gradually increased)
- Therapist decreases grasp demands (i.e. vary drawing tool diameters, secure drawing tool for child with velcro wrap, use of sponges, finger paints)

Grade up

- Child stands for the activity
- Child stands further away from the activity
- Mural is positioned on an inclined vertical surface (i.e. on the wall)
- Therapist places drawing tools or mural at distance and height to promote maximum elbow extension during reach
- Child is encouraged to cross midline using the affected limb to fill in the mural, and/or when grasping colouring tools
- Increase the height of mural, length of time for the activity and size of area to be filled in on mural
- Child is asked to use a variety of drawing tools that challenge grasp
- Therapist encourages frequent gripping and release of drawing tools to switch colours for repeated repetitions of elbow flexion and extension

Activity: Pin the tail on the donkey

Objective: Sensory reach, proprioception

Child stands comfortably in front of "pin the tail on donkey" game mounted on wall and the target is pointed out to the child. Child is blind folded, and takes turns with a partner to accurately target tail placement.

Grade down

- Therapist provides kinesthetic feedback of location of target through passive assist followed by asking the child to mimic the movement
- Therapist provides auditory clues/feedback to assist with targeting (i.e. "getting warmer", ring bell/rattle as getting closer to target)
- Child wears weighted cuff or sound bracelet in order to increase feedback of where arm is in space
- Target size is increased
- Therapist decreases grasp demands (i.e. vary shape/thickness of tail, secure tail for child in hand with velcro wrap)
- Child is allowed increased response time

Grade up

- Target location is varied during the game (i.e. encourage crossing midline, approaching end range)
- Target size is decreased
- Response time is decreased and/or child is challenged to target within allocated time
- Child is asked to grasp different tails of varying properties to challenge grasp

Activity: Interactive computer play

Objective: Proprioception

Child plays Kinect or Wii games to encourage use of the affected arm for targeting. Rehabilitation based virtual reality are available, allowing therapists to customize parameters to grade the activity. Examples used include SeeMe and Jintronix.

http://www.virtual-reality-rehabilitation.com/products/seeme/what-is-seeme
http://www.jintronix.com/

Grade down

- Therapist provides active assisted reaching to facilitate targeting
- Therapist applies adjuncts to facilitate targeting (i.e. elbow extension immobilizers)
- Therapist chooses an easier game (i.e. with an increased response time, less targets, larger targets, less busy background, not needing to cross midline, limit active range of movement)
- Therapist allows the child to use both hands to target (i.e. baseball, golf, and hockey stick)

Grade up

- Therapists chooses progressively more difficult games (i.e. with a decrease response time, timed component, more targets, smaller targets, busier backgrounds, crossing midline, targeting using a larger range of movement and/or more ranges of movements)
- Child only uses the affected hand for playing
- Child plays with a partner

Activity: Card game

Objective: Forearm supination

Child sits and plays a card game involving turning cards.

Grade down

- Therapist provides support and stability in upper body/ arm and/or allows child to stabilize his/her forearm on the tabletop to isolate forearm supination
- Therapist provides active assisted facilitation for supination to turn cards over
- Therapist uses adjuncts (i.e. supination strap)
- Child uses larger size playing cards, thicker and stiffer playing cards
- Timed component is removed

Grade up

- Child uses a regular deck of cards to turn cards over
- Child independently isolates forearm supination
- Timed component is added
- Child plays a game with a partner i.e. "war"

Activity: Bubbles

Objective: Wrist extension

Child sits comfortably in a chair and supports his/her affected arm on a table. The therapist holds a bubble wand with a bubble above the child's wrist. The child is asked to extend his wrist to pop the bubble while keeping his/her forearm on the table.

Grade down:

- Therapist stabilizes the child's forearm on the table to help isolate wrist extension

- Therapist uses adjuncts
- Therapist provides active assisted facilitation for wrist extension to pop the bubbles
- Therapist holds the bubble wand closer to the child's hand to decrease the wrist range of movement needed to pop the bubble
- Child is asked to pop the bubble with a closed hand (i.e. no finger extension)
- Therapist uses a bubble wand that produces a bigger bubble
  Remove timed component

Grade up:

- Therapist holds the bubble wand further from the child's hand to facilitate a greater excursion through active range of wrist extension
- Therapist uses a bubble wand that produces smaller bubbles
- Child is asked to pop as many bubbles as s/he can in a specified amount of time
- Child is asked to place wrist over the edge of table and to lift his/her wrist from flexion to neutral to above neutral to pop the bubble
- Child is asked to pop the bubbles with more finger extension, (i.e. wrist and finger extension together)
- Child is asked to hold wrist and finger extension following popping the bubbles for a specified amount of time
- Add a timed component

Activity: Squeezing sponges

Objective: Sustained grip

Child stands at a table and uses his/her affected hand to squeeze sponges filled with water into a container/ bucket. The amount of water squeezed out in a specified amount of time can be measured.

Grade down

- Child is allowed to stabilize wrist on the edge of the container/ bucket to support wrist for gripping/ squeezing

- Therapist positions wrist in neutral to slight extension to provide active assisted facilitation for a power grasp
- Child starts initially with forearm in pronation
- Child uses non cellulose sponges that are easier to squeeze
- Therapist places sponge in child's hand
- Use of adjuncts (i.e. elbow extension splint/gaitor to decrease flexor pattern)
- Remove time component

Grade up

- Therapist assists the child to squeeze sponges with forearm in neutral rather than in pronation
- Child uses cellulose sponges and smaller sponges
- The amount of sponges to squeeze is increased
- A time component is put in place (i.e. how much can you squeeze in 1 minute)

Activity: Building a tower with blocks

Objective: Grasp and release

Child sits to build a tower.

Grade down

- Child stands to build a tower for gravity assisted placement of blocks
- Therapist provides an adjunct (i.e. wrist splint)
- Therapist allows the child to stabilize his/her wrist on tabletop or an external surface to work on isolated release
- Child is asked to pick up and release blocks into a container if unable to stack
- Child uses larger blocks, magnetic blocks, or velcro blocks to help stack a tower
- Remove timed component

Grade up

- Child sits to work on grasp and release against gravity to stack a tower
- Release is voluntary and above surface with no external stabilization
- Child uses smaller blocks.
- A timed component is put in place

Activity: Curtained box game

Objective: Sensory grasp: Stereognosis

Child sits and his/her vision is occluded (i.e. can use a blindfold, ask to close his/her eyes, or use a curtained box). Therapist presents a number of common items and asks the child to name the items through touch.

Grade down

- Therapist places the object in the child's hand to facilitate grasp
- Therapist moves the object within the child's hand if the child is unable to grasp
- Therapist limits the number of objects presented
- Therapist provides a visual aid for reference (i.e. picture of the same set of objects to be identified)
- Therapist gives descriptors of the objects to cue the child
- Therapist provides objects with very different characteristics (i.e. size, shape, texture)
- Remove timed component

Grade up

- Child reaches behind the curtain and grasps the objects on his/her own
- Child moves the object within his/her own hand
- No visual aid for reference is provided
- Therapist increases the number of objects presented
- Therapist provides objects with very subtle differences
- Therapist places the objects within a medium (i.e. place the objects in a bin of sand, uncooked beans)
- A timed component is put in place

Activity: Tongs pick-up game

Objective: Pinch

Child sits and uses tongs to pick up small objects to fill a container.

Grade down

- Child stands for this activity to use gravity to assist motor movements
- Therapist provides adjuncts (i.e. thumb splint)
- The objects and the container are positioned closer to the child to decrease the number of required motor movements (i.e. straightening elbow and pinch)
- The therapist holds the object for the child and positions the object strategically/optimally for pinch rather than ask the child to pick up from the tabletop
- Child picks up objects using his/her affected hand
- Therapist chooses objects that are easier to feel and thus pick up (i.e. larger in size, firm vs. soft, rough vs. smooth, shape)
- The therapist chooses a container with a larger opening
- If using tongs, therapist gives larger tongs to enable child to use a less refined grasp
- Timed component is removed
- Repetitions are decreased

Grade up

- Therapist positions objects and container at a further distance to combine number of motor movements (i.e. elbow extension to reach and pinch)
- The size of the container opening is smaller
- Therapist chooses objects that are more challenging to pick up (i.e. smaller objects, less firm, smooth vs rough, irregularly defined shapes defined objects)
- Child uses smaller tongs to work on a more refined grasp and pinch pattern
- A timed component is incorporated
- Therapist increases required repetitions to incorporate endurance

Activity: Pickup coins game

Objective: In-hand manipulation

Child sits and picks up coins to put into a piggybank

Grade down

- Child stands to do this activity using gravity to assist with motor movements
- Provide adjuncts as needed (i.e. thumb splint)
- Objects and piggybank are positioned closer to the child to decrease the need to work on combined motor movements (i.e. reach and hand skills)
- The size of the objects and slit of the piggybank can be made larger
- Child practices finger to palm translation initially (i.e. picks up coin using a pincer grasp and moves the coin into his/her palm using thumb and fingers)
- Timed component is removed
- Repetitions are decreased

Grade up

- Objects and piggybank are positioned further away from child to increase the need to use more combined motor movements (i.e. reach and hand skills)
- Child uses smaller coins and the slit of the piggybank is smaller
- Child picks up a number of coins, translates into the palm and then to fingertips to release into piggybank
- Therapist incorporates other in-hand manipulation skills with stabilization (i.e. child practices translation with stabilization i.e. while holding the first coin, pick up another coin; translation and rotation).
- Timed component is used
- Increase repetitions

Appendix A
Excerpt from Constraint Therapy Hand Book

One-handed activities

☐ Position objects, toys, game pieces to encourage elbow straight when reaching. Encourage reaching in different directions: above shoulder, out to side, in front with elbow straight. 	☐ Place rings on a post. Move the location and height of the post so your child has to reach in different directions. 
☐ Pop bubbles. Aim for wrist extension (fingers pointed up). Your child should try to pop bubbles using the pointer finger only and pinch the bubbles with pointer finger and thumb. 	☐ Push down on a switch toy or a toy with a large push button. Place the toy away from your child so s/he has to reach for it. 
☐ Sensory Bin. Fill a container with dried beans, rice, pasta, etc. Hide some of your child's small toys in the box or bag. Let them move their hand around in the box to find their toys. To make this harder, your child can close their eyes or use an eye covering. 	☐ Shaving cream on mirror or bathtub wall. Have your child sit or stand a distance away from the wall so they have to straighten their elbow. Let them draw in the shaving cream (this is also a great opportunity to practice drawing shapes or printing their name). 

Two-handed (bimanual) activities Continued

☐ Household chores. E.g. sweep, wash and dry dishes, set the table, fold laundry, garden or shovel snow. 	☐ Cook. Chop, slice, spread, pour, roll, grate, mix or use a rolling pin. 
☐ Grooming activities. E.g. put up a ponytail, put on nail polish, cut finger nails, put toothpaste on a toothbrush, floss teeth, wash hair, put on jewelry. 	☐ Grocery shopping. E.g. push cart, take money out of wallet, pack groceries and carry groceries in both hands. 

Practice log

Name: _____ Date (week of): _____

	Activities	Time spent	Constraint on: Y/N?	Comments
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Saturday				
Sunday				

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