PROMTING HAND

FUNCTION IN CHILDREN WITH CEREBRAL PALSY

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Enabling Inclusion through
Early Intervention (EI) Programme

AMAR SEVA SANGAM

Amar Seva Sangam (ASSA) is a premier organisation in the field of disability management focusing on rural areas, located in Ayikudy Village in Tenkasi District of Tamil Nadu. Our approach is to establish a centralised resource center to act as a catalyst for change in the development of children and adults who are differently abled and intellectually challenged. We do this by involving the village community in the process. This mission of ASSA is to establish a Valley for the Disabled, whereby persons with physical / intellectual challenges live in a pro-active society where equality prevails irrespective of physical, intellectual or other challenges with the rest of the society. It is a futuristic vision whereby Amar Seva Sangam plays the role of an enabling agent to provide persons with physical / intellectual challenges "equality of status, equality in opportunities and equality in access".

Amar Seva Sangam (ASSA) was established by Mr. Ramakrishnan, in the International year of the Disabled to cater to disability management focusing on rural areas.

S. Ramakrishnan, Founder President

S. Ramakrishnan, while in his 4th year engineering, injured his spine while attending the last round of Naval officers' selection test and became a quadriplegic. He established ASSA in 1981, the year for the Disabled and named it after his Doctor and mentor Air Marshal Dr. Amarjit Singh Chahal of Defence hospital. **Padma Shree awardee** S.Ramakrishnan is the President of ASSA.

S. Sankara Raman, Secretary

S. Sankara Raman, a Chartered Accountant and a wheel chair user, affected by muscular dystrophy joined ASSA in 1992. He is the Secretary of ASSA. Along with Mr. Ramakrishnan, they have built a **Valley for the Differently Abled** in a 30 acre land at Ayikudy, as a Rehabilitation and Development Centre and developing models for self-help initiatives by integrating individuals with disabilities within society for improved living conditions.

In 2020, he established Amar Seva Global, a social enterprise focused on spreading Amar Seva's Enabling Inclusion program globally.

What is Development Delay ?

Skills such as taking a first step, smiling for the first time, and waving "bye-bye" are called developmental milestones. Children reach milestones in how they play, learn, speak, behave, and move (for example, crawling and walking). Children develop at their own pace. However, when developmental milestones are not met by a certain expected age, it is called "developmental delay". Early stimulation and intervention can help children reach these milestones.

What is Development Disability?

Developmental disabilities are a group of conditions due to an impairment in physical, learning, language, social or behavioral areas. These conditions begin during a child's developmental period, may impact day-to-day functioning, and can last throughout a person's lifetime. According to the WHO, "If children with developmental delays are not provided with appropriate early intervention, their difficulties can lead to lifetime consequences, increased poverty and profound exclusion".

What is Early Intervention?

Interventions promoting child development should address physical, social, emotional, language, and cognitive areas of development. Services targeting these domains of development are termed, "Early Intervention therapy" and can encompass physical therapy, occupational therapy, speech-language therapy and special education. Early Intervention has a significant impact for children who have delayed development in physical, cognitive, emotional, sensory, behavioural, social and communication domains of development. With quality early intervention services, children can reach their potential, live a meaningful life and integrate into their communities.

Enabling Inclusion Programme

Amar Seva Sangam's Enabling Inclusion programme uses community rehabilitation workers to provide early intervention services to children in their own homes or in community centres by connecting these community workers with rehabilitation specialists (physiotherapists, occupational therapists, speech therapists/trainers and special educators) through the use of the award winning Enabling Inclusion (EI) app. The program has proven to improve outcomes for children with disabilities and their family members and has allowed many children to reach their potential.

CHAPTER 1:
INTR0DUCTI0N & BACKGR0UND

1.1 Purpose of Resource

The purpose of this manual is to provide guidance for Occupational Therapists (OTs) and Physiotherapists (PTs) in the assessment and management of hand function impairments in children with cerebral palsy (CP). This manual provides evidence-based and context-dependent recommendations for the Amar Seva Sangam (ASSA) organization. The stages in this manual are informed by the Canadian Practice Process Framework, a commonly used occupational therapy process in Canada. The hope of this resource is to ensure the therapeutic approach supports children with CP and their families to achieve their goals, improve their participation in meaningful activities of daily living, and in turn promote their quality of life.

1.2 Introduction to Cerebral Palsy (CP)

Cerebral palsy (CP), is a permanent, non-progressive neurological condition resulting from brain injury that occurs before cerebral development is complete[1]. CP can be caused by brain injury during the prenatal, perinatal, or postnatal periods up to the first few years of life[1]. CP looks different depending on what area of the brain is damaged and the severity of that damage.

CP is caused by damage that occurs to one or more specific areas of the brain[2]:

1) Cerebral cortex
2) Cerebellum
3) Basal ganglia

CP is categorized by:

1) **Severity level:** mild, moderate, severe
2) **Areas of the body impacted:**
3) **Movement disorder:** spasticity, dyskinesia, ataxic, and mixed The child may also have pathological tone:

- **Hypertonia:** increase tightness of muscle tone, reduced stretch capacity of muscles (looks rigid and tight)
- **Hypotonia:** decreased muscle tone, stretch happens too

Classification	Description
Quadriplegia	Impacts both upper extremities, both lower extremities[3].
Diplegia/ bilateral	Impacts both lower extremities. Arms may be impacted to a lesser extent; however, often have issues with fine motor movements of the hands[3].
Hemiplegia/ unilateral	Impacts one side of the body (one arm and one leg)[3]
Monoplegia	One limb involved (less common)[3]
Triplegia	Three limbs involved (less common)[3]

easily (looks floppy and loose)

1.3 Impact of CP on Hand Function

Performance of hand function tasks in children with CP requires coordination of movement sequences, along with well-developed visual-perceptual skills, to be able to reach, grasp, release and manipulate objects[4]. Almost 50% of children with CP have arm-hand dysfunction, and children with hemiplegia CP rarely use their affected hand in daily activities[5]. Among children with CP there is a large degree of individual variation in the pattern of hand and upper- extremity development as the severity of these children's sensory-motor and cognitive impairments varies widely[4].

CP Characteristic	Impact on Hand Function
Hypertonia (high tone) or hypotonia (low tone)	• Difficult to maintain an appropriate grip/grasp on a utensil or object (e.g. pencil, cup, hairbrush) • Poor trunk control, which impacts a child's ability to maintain a posture that is optimal for hand function • Low tone or high tone leads to impairments in fine and gross motor movements (e.g. writing)
Spasticity	• Difficult for the child to perform hand movements that go against the spasticity. For example, if the child's wrist is stuck in a flexed position, it will be difficult to extend the wrist. • Spasticity may present with muscle weakness, making it difficult to lift/carry objects • The increased tone may result in reduced range of motion/function (shortening of the muscle), leading to contractures[6]. Common contracture sites in the upper extremities are the elbow and wrist in a flexed position.

Dyskinesia	• Involuntary movements, such as twisting and clenching/unclenching, can interfere with the ability to manipulate objects (e.g. holding a pencil) • Fluctuating between stiff and floppy can make it difficult to maintain posture, which impacts hand function. • These involuntary movements are often worsened when the individual is trying to move, are excited, agitated or tired.
Ataxia	• Hand movements are shaky/jerky, uncoordinated, clumsy, and unstable. • Ataxia is especially present when the child attempts to perform a voluntary movement such as picking up an object. • Can impact written output legibility, ability to use precise hand movements (e.g. buttoning a shirt, writing, throwing a ball, reaching/picking up objects)
Reduced Sensation	• Integrity of sensory information is necessary for precise grip tasks[7]. • Deficits in sensory function have been suggested to underlie the basis of impairments in predictive motor control of individuals with hemiplegia CP[7]. • Sensory deficits in areas of stereognosis, two-point discrimination, and location of touch are found to contribute to difficulties in hand function[7].

(Table informed by Cerebral Palsy Alliance, 2018[2])

1.4 Importance of Hand Function

Reduced hand function impacts a child's ability to engage in self-care (e.g. dressing, bathing, eating, grooming), leisure (e.g. playing with toys, cards, board games, engaging in arts and crafts, playing sports) and productive activities (e.g. writing, reading, typing, cleaning, house chores). Reduced opportunities to contribute to one's family, friends and community can negatively impact a child's quality of life[8]. Therefore, promoting hand function can increase a child's engagement in their activities of daily living, and in turn promote their overall quality of life.

1.5 Neuroplasticity

With neurological conditions, such as CP, it is important to understand the concept of neuroplasticity. Neuroplasticity is when: 1) the brain stores experiences and learns new behaviors; and 2) the damaged brain relearns lost behaviour in response to rehabilitation[9]. Neuroplasticity can result in either functional and/or structural brain changes and can have either beneficial (e.g. learning how to use an affected hand in daily activities) or

harmful (e.g. neglecting to use the affected hand in daily activities) consequences[9].

Here are a few principles of neuroplasticity that can be used to guide therapy to promote neuroplastic changes:

Principle	Definition
Use it or lose it	A lack of use can degrade brain function. Continue to use the affected hand as much as possible[9].
Repetition matters	Repeating newly learned or relearned behaviours/skills may be required to have lasting neuroplastic changes[9].
Intensity matters	Neuroplastic changes require sufficient training intensity[9].
Time matters	Rehabilitation should start shortly after injury. Time delays may allow for self-taught compensatory behaviours, which may interfere with rehabilitation[9].

1.1 Frames of Reference

There are different theories that can be used to guide a therapist's understanding of what to assess and how to treat a child with CP. Please see **Appendix A** for a list of some of the relevant frames of reference and their definitions.

1.2 International Classification of Functioning, Disability, and Health (ICF)

This manual was developed using the ICF as a way to categorize assessments and interventions. The ICF was developed by the World Health Organization to help guide therapists to select measurement tools, inform goal setting, and aid in the decision-making process to determine outcomes that are meaningful to children with CP and their family/caregivers[10].Assessments and interventions in this manual will be categorized into the main headings:

1. **Body functions** (physiological functions of body systems) and **body structure**
   (anatomical parts of the body such as limbs and their components)[10].

2. **Activity** (execution of a task or action by an individual) and **participation** (involvement in a life situation)[10].
    a. **Mobility** (lifting and carrying objects, fine hand use, moving around using equipment)[10].
    b. **Learning and applying knowledge** (handwriting)[10].
    c. **Major life areas** (education, work, engagement in play)[10].
    d. **General tasks and demands** (daily routines)[10].

CHAPTER 2:
FIRST STEPS WITH A CLIENT

When beginning to work with new clients, it is important to determine how the client and OT will work together and make sure they are in agreement throughout treatment.

2.1 Building Trust with Your Clients

- Client-centred practice: make sure the client is involved in all aspects of therapy to increase their motivation to participate in therapy
- Establish a partnership with the client through:
  - Clear and open communication
  - Provide clear information about therapy
  - Include client in making decisions
  - Don't make assumptions and always ask client questions
- Client provides consent to all services and is allowed to decline treatment at any time[11]

2.2 Learn About the Client

- Have discussions with the client about their issues and personal goals
  - This is to get an idea of what the client wants to work on during therapy and can guide what you choose to assess. The specific goals are decided and agreed upon after the assessment stage as you will have a better understanding of the client's current performance, and what is achievable.
- Learn about the client's priorities
  - This will increase their motivation, participation, engagement and outcomes
- Learn about the client's strengths - do not only focus on their challenges
  - Their strengths can be incorporated into therapy[11]

2.3 Assess and Evaluate

- Conduct an in-depth assessment or evaluation of personal, environmental and occupational factors influencing the client's occupational performance issues (OPIs)

- Collect both standardized and non-standardized information to gain a general understanding of the client (see recommended assessments in next section, 3.0)
- Consider the societal and practice context to determine what assessments are most relevant and practical for the client

- After completing the assessment, analyze and interpret findings to identify possible explanations for client's OPIs
  - Share and discuss assessment findings with the client[11]

2.4 Upper Limb Classification

A classification tool can be used to describe the functional level of a child with cerebral palsy and can be used as a guide for intervention and therapy.

Manual Ability Classification System (MACS)

- MACS provides a systematic method of classifying how children with CP (ages 4-16 years) use their hands when handling objects during daily activities[12]
  - Mini-MACS was created for children ages 1-4 years with CP[12]
- MACS level is determined based on observation and knowledge about the child's actual performance in daily life and their use of both hands in activities. It is done by asking someone who knows the child and how that child performs typically[13]
- The MACS classification can be used to guide CIMT and splinting/orthotic interventions

Manual Ability Classification System (MACS) Levels[13]

I.	Handles objects easily
II.	Handles most objects but with reduced speed and/or quality
III.	Has some difficulty and needs help to modify or prepare activities
IV.	Handles a limited selection of easily managed objects in adapted settings
V.	Does not handle objects

Eliasson et al., 2006

See **Appendix B** for MACS level identification chart to help guide your decision process. Link: https://www.macs.nu/index.php

CHAPTER 3:
ASSESSMENTS

Below, each assessment is categorized according to which ICF domain they address/measure. The assessments under each subheading are ranked in order of suitability for the ASSA context. It is not necessary to complete all of these assessments for every client. This section is meant to help guide your decision in determining which assessment to use with your clients.
Depending on what you want to measure, you may only select to do one or two assessments with a client.

Note about Standardization: Many of the following assessments are standardized. However, if the assessment is not purchased, and therapists are using materials found at ASSA, this affects the quality of the standardization of these assessments. **Using your own materials for an assessment is not appropriate for research purposes.** However, It is still appropriate to use these assessments with your own materials (i.e. without purchasing the assessment kits) within a therapy context or for program evaluation purposes. If this is done, it is important that the exact same materials are used with a client every time the assessment is administered in order to gain the best and most accurate results/outcome measures. This will keep the assessment standardized within individual clients and will provide useful insights for therapy.

3.1 ICF: Activity and Participation

3.1.1 ICF Subcategory: Mobility

Assessment #1: *Quality of Upper Extremity Skill Test (QUEST)*

Purpose: The QUEST is a 36-item activity-based outcome measure designed to evaluate the quality of movement patterns and hand function in children with cerebral palsy. It is administered in a play-based context[14].

Domains: Items assess four main domains: dissociated movements, grasp, protective extension, and weight bearing[14].

Scoring: Percentage score is calculated[14].

Links: https://canchild.ca/en/resources/49-quality-of-upper-extremity-skills-test-quest
https://slpemad.files.wordpress.com/2015/06/1992_quest_manual.pdf

Age Range	Administration Time	Materials	Cost and Training Required
18 months - 8 years[14]	30-45 minutes[14]	Chair or seating system, table just above waist level, four 1 inch cubes, cup, crayon or pencil, bank paper, Cheerios or crackers cut into quarters, mat, toys including a puppet and bubbles[14]	Starts at $99 CAD/person. Institutional subscription is $300 CAD[14]. A license is required to use the QUEST (includes manual and assessment form)[14]

Special Considerations: If you do not wish to purchase this assessment, materials can be adapted and found at ASSA. The manual is available online (see link above) or in the OneDrive folder "Promoting Hand Function Resources".

Assessment #2: *Box and Blocks Test (BBT)*

Purpose: The BBT is an activity-based assessment designed to evaluate unilateral gross manual dexterity[15] (Figueiredo, 2011).

Domains: Areas assessed include coordination, dexterity, and upper extremity function. Both dominant and nondominant hands are assessed separately[15, 16].

Scoring: Clients are scored based on the number of blocks transferred from one compartment to the other compartment in 60 seconds. Each hand is scored separately[15-17]

Links: https://www.physio-pedia.com/Box_and_Block_Test
https://www.performancehealth.com/box-and-blocks-test

Age Range	Administration Time	Materials	Cost and Training Required
6-18 years[16]	<10 minutes[15, 16]	Stopwatch, box, partition middle of box, 150 block cubes[15-17]	$220 USD[18] No formal training required

Special Considerations: BBT is responsive to changes in a brief period of intensive therapy in children with CP. The reliability and responsiveness of the BBT is weak over long assessment

periods[19]. If you do not wish to purchase this assessment, materials can be adapted and found at ASSA and the instructions are available online (see link above). Materials can be created by the carpenter and found at ASSA. Please see **Appendix C** for dimensions of the box and blocks. Please see the document "Assessment and Treatment of the Upper Extremity in Children with CP: Therapy considerations" in OneDrive for more information.

Assessment #3: *Peabody Developmental Motor Scales Second Edition (PDMS-2)* Purpose: The PDMS-2 is an activity-based assessment that measures interrelated motor abilities of children. There are 249 items in the entire PDMS-2[20].

Domains: The items are split into six sub-tests: reflexes (8), stationary (30), locomotion (89), object manipulation (24), grasping (26), and visual-motor integration (72).

Scoring: Scored items are summed. Results of sub-tests may be used to generate three composites (Gross Motor Quotient, Fine Motor Quotient, Total Motor Quotient)[20].

Links:

https://www.pearsonassessments.com/store/usassessments/en/Store/Professional- Assessments/Motor-Sensory/Peabody-Developmental-Motor-Scales-%7C-Second-Edition/p/100000249.html

https://www.therapro.com/Complete-TEST.html

Age Range	Administration Time	Materials	Cost and Training Required
Birth - 5 years[20]	45-60 minutes for the entire PDMS-2[20] 20-30 minutes for either gross motor or fine motor composites	Included in Kit[20]: Black shoelace, 6 square beads, 12 cubes, 1 bottle with screw-on cap, 1 large button strip, 1	Complete kit: starts at $457 USD Manual: $102 USD Pack of 25 record booklets: $90 USD Online scoring and
	separately[20]	pegboard, 1 foam board and 3 forms, 1 lacing card, 1 measuring tape, 1 roll 2-inch wide tape, blackline masters, 3 shape cards Materials from examiner[20]: Rattle, soft plush toy, empty can or cup, 8" ball or tennis ball, spoon, washcloth, 10-15 pieces of paper, pencils, crayons, blunt scissors, large pull toy, book w/ thick pages, food pellets, 4-5' heavy rope, stairs w/ 7" rise, sturdy object (16-21" high), at, stopwatch	report system (includes 5 licenses): $209 USD[21] No formal training required

Special Considerations: Examiner may choose to only perform sub-tests related to hand function. Materials can be adapted and found at ASSA; however, the manual must be purchased as it is not available online.

3.1.1 ICF Subcategory: Learning and Applying Knowledge

Assessment #1: *Test of Handwriting Skills, Revised (THS-R)*

Purpose: The THS-R is an untimed, activity-based measure that assesses a child's neurosensory integration skills involved in both manuscript and cursive writing[22].

Domains: Writing speed, letter reversal, case substitutions, writing from memory, listening (i.e. writing from dictation)[22].

Scoring: Overall standard score, scaled subtest scores, and percentiles[22].

Link: https://www.wpspublish.com/ths-r-test-of-handwriting-skills-revised

Age Range	Administration Time	Materials	Cost and Training Required
6 to 18 years[22]	25 minutes[22]	15 test booklets (manuscripts), 15 test booklets (cursive), 30 record forms, training CD-ROM, manual, pencil or pen[22]	$170 USD[22] No formal training required

Special Considerations: A child's cognition should be taken into consideration. Since CP is a brain injury, a client's cognitive ability may be affected and have an impact on certain tasks, such as writing from memory.

3.1.3 ICF Subcategory: General Tasks and Demands

Assessment #1: *Pediatric Motor Activity Log Revised (PMAL)*

Purpose: The PMAL is an interview-based assessment that examines how often and how well a child uses their impaired upper extremity in their natural environment[23].

Domains: 22 items are listed on two different 6-point scales. The first scale rates how often the child carries out each of the activities with their affected arm. The second scale rates how well the child uses the affected arm for that activity[23].

Scoring: Mean PMAL scores are calculated for both scales (total amount from the rating scores on each scale divided by the number of items asked)[23].

Link:
https://www.uab.edu/citherapy/images/pdf_files/CIT_PMAL_Manual.pdf

Age Range	Administration Time	Materials	Cost and Training Required
7 months - 8 years[24]	5-15 minutes to administer[24] 3 minutes to score[24]	Questionnaire, pen or pencil[23]	Free[23] No formal training required

Special Considerations: If you find that it is impossible for the child to carry out the activity (ie. the activity never carried out in that family), the question is not included, and the mean score is calculated with the remaining items only (ie. divide by 21 instead of 22)[23]. The manual, questionnaire and score sheet can be found in the OneDrive folder "Promoting Hand Function Resources".

Assessment #2: *Jebsen Hand Function Test (JHFT)*

Purpose: The JHFT is an activity-based assessment that measures functional hand motor skills and efficiency of hand function[25, 26].

Domains: There are seven subtests: writing, card turning, picking up small objects, stacking, feeding, moving light and heavy objects. Tasks measure fine motor skills, weighted and non-weighted functional tasks. Both arms are assessed[26].

Scoring: Each task is timed and recorded in seconds. Subtest

score = time to complete task.
Total score = sum of times for each subtest[26, 27].
Links: https://www.strokengine.ca/en/indepth/jhft_indepth/ https://www.sralab.org/rehabilitation-measures/jebsen-hand-function-test

Age Range	Administration Time	Materials	Cost and Training Required
>5 years old[26]	15-45 minutes[25]	Stopwatch, chair, table, pen, 4 pieces of unruled paper on clipboard, sentences written on 5x8 index card, 5 3x5 index cards, 2 paper clips, 2 bottle caps, 2 pennies, 5 kidney beans, 1 teaspoon, wooden board with C clamp and plywood glued to board, 4 red checkers, 5 #303 cans[25, 26]	~$300.00 USD[26] No formal training required

Special Considerations: Materials can be modified and found or built at ASSA. Standardized equipment is not required. Scoring sheets are available online for free: https://scireproject.com/outcome-measures/outcome-measure-tool/jebsen-hand-function-test- jhft/#1467983894177-6b9fb7a3-f550 (Click and download the "worksheet document"). Should not be used with patients with speech and language comprehension difficulties.

3.1.1 ICF Subcategory: Major Life Areas

Assessment #1: *Canadian Occupational Performance Measure (COPM)*

Purpose: The COPM is a 5-step interview-based measure that identifies activities within each domain that the client wants, needs and/or is expected to perform. It also assesses the client's perceived occupational performance in each activity[28].
Domains: 9 items are split into three subgroups: self-care, productivity, and leisure
Scoring: Client uses an 11-point (0-10) rating scale to self-evaluate their level of performance and satisfaction for each of their identified problems. The average score for performance and satisfaction are calculated[28].

Link: http://www.thecopm.ca
https://www.sralab.org/rehabilitation-measures/canadian-occupational-performance-measure

Age Range	Administration Time	Materials	Cost and Training Required
>6 years old[29]	10-45 minutes[29]	COPM interview sheets, pencil or pen, manual[28, 29]	Pack of 500 = $110.00 CAD[30] Digital version: pack of 100 = $17.00; pack of 500 = $79.00 CAD[30] Learning modules on COPM website[30]

Special Considerations: If the child is less than six years of age, you can complete the COPM with the child's parents/caregivers. A study conducted by ASSA looked at the use of the COPM in an Indian context. The study found that there are challenges with using the COPM, including: translation requirement, utility with caregivers with lower formal literacy, western cultural norms, required training (high staff turnover at ASSA), human resource allocation (e.g. time), mismatch between therapists and caregivers' assessments. The study found the following benefits of using the COPM: when properly implemented, demonstrates progress on goals over time, increased family-centred practice, professional development opportunity for therapists, support for ASSA's advocacy for program expansion and funding access. The COPM is in the process of being modified to an Indian context but is currently unavailable[31].

3.2 ICF: Body Structure and Function

Please note: The following assessments are not ranked as they measure different features of a client's body impairments.

Assessment #1: *Hypertonia Assessment Tool (HAT)*

Purpose: The HAT is an activity-based, discriminative measure that assists clinicians in identifying specific types of hypertonia

that are present and how to best manage it[32].

Domains: Consists of seven items in three subgroups: spasticity (2 items), rigidity (2 items), and dystonia (3 items). All seven items are completed on the affected upper extremity. Items are listed in the suggested order of administration[32].

Scoring: Each item is scored in a yes/no format. The presence of at least one item of the subgroup confirms the presence of that subtype of hypertonia (Dystonia, spasticity, or rigidity). The presence of items in more than one subgroup identifies the presence of mixed tone[32].

Link: https://calgarypaeds.org/wp-content/uploads/2014/11/HAT-User-Manual.pdf

Age Range	Administration Time	Materials	Cost and Training Required
4-19 years[32]	Approximately five minutes to conduct per limb assessed[32]	Manual, scoring sheet (see link above), pen or pencil[32]	Free[32] No formal training required

Special Considerations: The manual and scoring sheets are available online (see link above) or in the OneDrive folder "Promoting Hand Function Resources".

Assessment #2: *Hand-Held Dynamometer*

Purpose: A hand-held dynamometer is an activity-based, objective measure of isometric strength of the hand and forearm[33].

Domains: Muscle strength

Scoring: Client squeezes a hand-held dynamometer as hard as they can for three seconds. Three trials are conducted with 60 second rest periods in between trials. Maximum grip is calculated by taking the mean of three trials (mean = total of three scores divided by 3)[33]

Link: https://www.sralab.org/rehabilitation-measures/hand-held-dynamometergrip-strength

Age Range	Administration Time	Materials	Cost and Training Required
+6 years old[34]	5 minutes[33]	Hand-held dynamometer	~$300 USD[35] No formal training required

Special Considerations: Whilst the hand-held dynamometer is generally recommended for measuring grip strength, its use is limited in children with very small hands, or in measuring very small changes. There are 5 preset grip sizes that the dynamometer can be adjusted to in order to ensure it is at an appropriate size for the child's hand to fully grip[35]. A certain level of cognition is required in order to use a hand-held dynamometer, as the client must be able tolisten and follow instructions (ie. proper positioning) and demonstrate maximal effort. It is also important to keep positioning of the upper extremity as well as sitting/standing positioning consistent. For example, if the first measurement is taken with the client seated and arm flexed at 90 degrees, all subsequent measurements must also be taken in the same position. Please see the document "Assessment and Treatment of the Upper Extremity in Children with CP: Therapy considerations" in OneDrive for more information.

Assessment #3: *Burke-Fahn-Marsden Movement Scale (BFM)*

Purpose: The BFM is an observation- and interview-based assessment that rates the severity of primary dystonia. There are two components: 1) a movement scale (BFMMS) based on examination of the patient and 2) a disability scale (BFMDS) based on the client's self-ratings[36] **Domains:** The BFMMS evaluates nine regions: eyes, mouth, speech and swallowing, neck, trunk, right arm and leg, left arm and leg. Two factors are examined in each region: 1) a provoking factor and 2) a severity factor. The BFMDS is based on the individual's assessment of how the dystonia affects his or her activities of daily living. The client rates how his or her speech, handwriting, feeding, eating/swallowing, hygiene, dressing, and walking are affected by the dystonia[36].

Scoring for BFMMS: The provoking factor is rated 0 (no dystonia at rest or with action) to 4 (dystonia at rest). The severity factor is rated 0 (no dystonia) to 4 (severe dystonia). The score for each region is the product of the provoking factor, severity factor, and a weighting factor[36].

Scoring for BFMDS: All of the areas assessed are rated 0 to 4 except for walking, which is rated 0 to 6. The maximum score on the disability scale is 30[36].

Link:
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.852.8887&rep=rep1&type=pdf

Age Range	Administration Time	Materials	Cost and Training Required
Not specified	Not specified	Test scale, paper and pencil[36]	Free No formal training required[36]

Special Considerations: Clients must have adequate understanding of their own performance in order to provide a self-rating.

Assessment #4: *Barry Albright Dystonia Scale (BADS)*

Purpose: The BADS is an observation-based assessment that rates the severity of secondary dystonia in eight body regions (eyes, neck, mouth, trunk, upper limbs, and lower limbs)[36].

Domains: Eight regions of the body are observed and scored[36].

Scoring: Five-point rating scale is applied. Dystonia is scored in each region as no dystonia (0) slight (1), mild (2), moderate (3), or severe (4). Sum of all regions measured is calculated. Maximum scale is 32[36].

Links: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1469-8749.1999.tb00626.x
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.852.8887&rep=rep1&type=pdf

Age Range	Administration Time	Materials	Cost and Training Required
Not specified	Not specified	Test scale, paper and pencil[36]	Free[36] No formal training required

Special Considerations: N/A

CHAPTER 4:
ESTABLISHING GOALS & PRIORITIES

Before establishing goals and priorities, it is important to know about the child and the family such as their daily routine, interests, and needs. Involve the child's family and the child actively in the decision making[37].

There has been a shift in therapy to move away from "normalization" and move towards "optimization"[37]. What this means in terms of goal setting, is that goals are activity-focused rather than aiming to make the child look "normal". Goal setting combined with activity-focused interventions show encouraging results and should be recommended for use in clinical practice[37].

4.1 F-Words of Childhood Disability

There are guidelines available to facilitate developing goals with children and their families. Rosenbaum et al., 2012 has created the F-words of childhood disability: function, family, fitness, fun, friends, and future[38]. These 6 categories can be used to organize goals that address different important aspects of a child's life. These categories are based on the ICF but have been tailored to be appropriate to facilitate goal setting with children and their families.

F-Word	Description	ICF Component
Function	What people do - for children, "play or school" is their "work"	Activity and participation
Family	Essential environment of children	Environmental factors
Fitness	Emphasis on health-promotion, and engaging in play-based physical activities	Body structure and function
Fun	Find out what they want to do and enjoy doing.	Personal factors and participation
Friends	Enhance children's opportunities to develop and nurture meaningful peer relationships	Personal factors and participation
Future	The child's hopes and goals for their future.	N/A

See examples below of different types of goals established in each of the 6 F-word categories. Note, there is also a version available in Tamil. See **Appendix H**, **resource #1** for more information.

CanChild

My F-words Goal Sheet

Name: **Today's Date:**

Instructions: Please use this form to write down one goal for each of the F-words – Function, Family, Fitness, Fun, Friends & Future and explain why this goal is important to you. These can be goals you would like to work on at home, in therapy, in school, and/or in the community. Together let's work on the goals that are meaningful to you!

FUNCTION:

Goal:	To practice kicking the soccer ball while using my walker.
Why?!	So I can participate in my school para-soccer team.

FAMILY:

Goal:	To find ways to make traveling easier for my family.
Why?!	We love to travel as a family, but it can be a lot of work.

FITNESS:

Goal:	To improve my balance.
Why?!	So that I can get better at horse back riding.

FUN:

Goal:	To have more opportunities to play with technology (e.g., new games on my ipad).
Why?!	Video games are fun for everyone!

FRIENDS:

Goal:	To hang out with friends in more recreational activities.
Why?!	To develop lasting friendships.

FUTURE:

Goal:	To improve communication through use of Dynabox.
Why?!	So I can better communicate and tell you what's on my mind.

(Adapted from Fuller & Susini Goal Sheet, 2015)

4.2 Setting Short Term vs. Long Term Goals

	Short Term Goal (STG)	Long Term Goal (LTG)
Description	Stepping stones helping you progress to the long-term goal.	Represents the clients' end-goal.
Time frame	Typically take a few days, weeks to months to achieve. This could also include the mid-point of the client's length of stay at ASSA.	Typically takes a year or longer to achieve. This could also include the end of the clients' length of stay at ASSA.
Example	1) Button a shirt with a button hook in 1 month 2) Learn how to hold a pencil using a writing aid in 2 weeks 3) Pick up a cup and bring it to my mouth 3 weeks	1) Graduating from the integrated school in 2 years 2) Ride a bicycle in 1.5 year 3) Complete self-care routines independently in 1 year

Determining a time frame for a goal also requires considering different factors such as:

- **The type of goal**
  - Some goals are quick to accomplish, such as learning how to use an adaptive aid, while others take more time, such as improving fine motor skills.
- **Client factors**
  - Severity of impairment, level of motivation, resources the client has access to
- **Therapist factors**
  - Level of expertise, ability to develop therapeutic rapport, time and resources they have access to

Remember: Goals are flexible. If you notice the child is progressing better or worse than initially expected, or if the client's priorities change, then you can modify the goals.

4.3 Setting SMART Goals

Goals should be **Specific, Measurable, Attainable, Realistic, and Time-bound (SMART)** to increase the likelihood that the goal will be achieved, and to guide therapy.

- **Specific**
  - What does the client want to accomplish?
  - What level of assistance will the client need?
  - Which resources are involved (e.g. adaptive aids)?
- **Measurable**
  - How will I know when the client achieved their goal? Must be observable.
- **Achievable**
  - Is this goal realistic, considering financial, time, resource constraints?
- **Relevant**
  - Is this goal meaningful/address the client's needs, priorities and preferences at this time?
- **Time-bound**
  - When will the client achieve this goal?

4.1 Goal Attainment Scaling (GAS)

Example of a goal that is SMART	Example of a goal that is not SMART
In 8 weeks, I will be able to throw and catch a tennis ball with my friend who is at least 4 meters away.	I will play ball more with my friends.

There are tools available to help set goals such as Goal Attainment Scaling (GAS). GAS is useful for measuring and evaluating individual goals[39]. Using GAS involves defining a specific goal for a client and then specifying a range of possible outcomes. GAS uses a 5-point rating scale ranging from -2 to +2[39] (see table below):

GAS 5-Point Rating Scale	
Score	**Predicted Attainment**
-2	Much less than expected outcome (this is the child's baseline/current performance).
-1	Less than expected outcome
0	Expected outcome after intervention
+1	Greater than expected outcome
+2	Much greater than expected outcome

The scale should meet the following criteria[39]:

1. Clinically equal intervals between scale levels.
   - The jump from +1 to +2 should not require a much larger change in attainment than the jump from -2 to -1
2. Amount of change between levels needs to be clinically relevant
3. Improvement should be measured using only **one variable of change**, **keeping other variables the same.**
   - For example:
     - -2: the child picks up a cup and holds it to their mouth for **5 seconds** with **minimal assistance**.
     - -1: the child picks up a cup and holds it to their mouth for **10 seconds** with **minimal assistance**
   - The above goal includes 2 variables: **time** and **level of assistance**
   - Only one variable changed between levels, in this case **time**, while **level of assistance** stayed the same.
   - Here are examples of variables:
     - Length of time the person does the behaviour
     - Number of times the person does the behaviour
     - Time to complete
     - Level of assistance needed
     - Percentage of time done correctly
     - Progression sequence
4. Specify a time period for achievement of a goal

Example of GAS

Goal area: self-feeding with a cup with handles	
- 2	In 4 weeks, the child grasps handle of the cup for 5 seconds, and lifts cup to mouth with total assistance
- 1	In 4 weeks, the child grasps handle of the cup for 10 seconds, and lifts cup to mouth with total assistance
0	In 4 weeks, the child grasps handle of the cup for 15 seconds, and lifts cup to mouth with total assistance
+ 1	In 4 weeks, the child grasps handle of the cup for 20 seconds, and lifts cup to mouth with total assistance
+ 2	In 4 weeks, the child grasps handle of the cup for 25+ seconds, and lifts cup to mouth with total assistance

The therapist will re-evaluate the client's ability at a specified time (e.g. in 4 weeks) to determine what level of outcome the client was able to achieve their goal. While evaluating the client's performance, if it is safe, the therapist should not try to help the client. See **Appendix H**, **resource #2** for the GAS training manual.

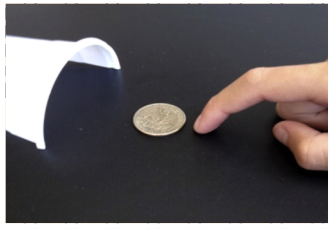
CHAPTER 5:
INTERVENTIONS

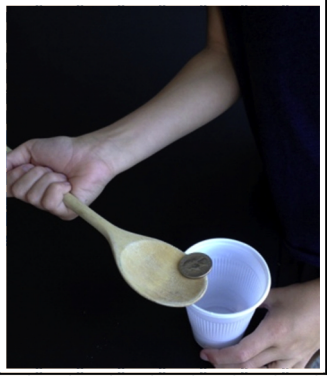
Based on the findings from the assessments that were done, the OT can now make potential recommendations and treatment plans with client consent.

5.1 Play-Based Therapy

Playful activities with everyday items involve purposeful hand skills of pinching, grasping and manipulation. The use of play in therapy can improve the child's motor performance and adherence to hand therapy. Therapy activities should be novel and fun, and include a sense of purpose, play or competition[40]. The use of everyday items can be used, such as coins, buttons, paper clips, rubber bands, rice, hand towel, or spoon. See **Incorporating Play in Therapy: A Resource Manual for Rehabilitation Staff** by Meaghan Meades & Amanda Messina for more ideas on how to incorporate play into your therapy sessions with children with CP.

Here are some examples of play-based activities that incorporate hand therapy exercises. Note these can be modified based on the child's abilities and interests.

Type of Exercise	Play Based Examples	Picture
Finger extension	Push coins/buttons across a table into a paper cup cut in half to serve as a goal. The therapist or another child can have their own cup as well to add competition, where the child and therapist try to score in each other's cup.	
Finger flexion	Hold a toilet paper roll with the fingers loosely held in flexion. Use the toilet paper roll to slide several buttons or cotton balls off the table into a cup held with the other hand at the end of the table.	

Forearm rotation	Grasp the end of a wooden spoon and use it to carry a cotton ball, coin, or button across a room to drop it into a cup. Place the forearm into full pronation or supination with the elbow held at the side of the child's body as you place the item in the cup. You can race/relay with another child. **Note: the child must have full ROM to be able to do this activity. If the child has contractures/spasticity into pronation, preventing them from obtaining full supination, this activity is NOT appropriate.**	

(Table modified from Peck-Murray, 2015[40])

5.2 Modified Constraint-Induced Movement Therapy (mCIMT)

Description: Constraint-induced movement therapy (CIMT) is a behavioral approach to neurorehabilitation based on "learned non-use", where an individual learns to disregard or ignore their affected limb in daily activities due to increased efficiency and effectiveness of the unaffected limb[41].

CIMT involves four main components:

1. Repetitive, structured practice intensive therapy in the affected arm
2. Restraint of the unaffected arm
3. Application of techniques that transfer gains from clinical setting to the real world; and
4. Shaping the task[41].

The modified CIMT (mCIMT) protocol was developed as an alternative to the intensive nature of CIMT, and involves less time utilizing constraint over a longer intervention period. Research shows mCIMT is an effective treatment for children with hemiplegia and 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[42-46]. mCIMT has been more recently paired with bimanual training to further improve the quality and quantity of movement in the affected hand in bimanual upper

extremity use.

Goals: mCIMT aims to improve the use of the affected hand in two-handed activities by improving motor control and use of the affected hand in a play-based, motivating and positive environment.

Activities: For a complete list of activities, please see the **"**CIMT Activities and Materials" and "Holland Bloorview CIMT manual" documents in the OneDrive. Activities focus on the following areas: sensory awareness, gross motor use, reach and range, supination, wrist extension, palmar grasp, power grasp, precision grasp, release, isolated finger movement, and in-hand manipulation. Description of the task, materials required, and ways to grade the activities are included in the documents. Please see **Appendix D** for a list of mCIMT activities and Appendix E for Baby CIMT activities.**How to progress:** mCIMT offers intensive repetitive practice with progressive and systematically graded activities to ensure a client succeeds but is also challenged enough to practice motor movements[47]. Grading an activity up may include changing the size of an object, implementing a time component, or modifying the environment. It is important to keep the activity within a range of difficulty that limits frustration within the child and increases motivation.

Frequency & duration	Materials	Restorative or Adaptive	Population	Group or individual
There is no definite guideline for the optimal number of hours; studies have seen success with as little as 1 hour of therapy per day[48] while others have administered 3 hours a day[49] Total intervention time = 60 hours minimum[50] Variations in treatment design include: - Hours of restraint worn (2-6 hours/day)[51] - Length of the intervention (2-10 weeks)[52] - Intervention frequency (2-7 days, most around 5 days)[52] - Type of restraints - Method of delivery (individual vs. camp) Please see **Appendix F** for an example of an individual therapy protocol and a group (more than 2 clients participating) mCIMT protocol.	No specific materials required. Resources available in the client's environment may be used. Constraint: When choosing a constraint, consider the following: safety, comfort, climate, fabrics, and hygiene. Type of constraint should also depend on the child's characteristics, hand function and the goal(s) of therapy. For example, a sock may be preferable for babies and young children while older children can use a mitt created by the sewing department[47].	Restorative	Age: 1+ year old[47] Condition[47]: unilateral upper extremity impairment(s) associated with neurological conditions (ie. cerebral palsy); one-sided weakness, developmental disregard, impaired strength/sensation /motor control Client must be able to follow instructions and maintain attention for at least 15 minutes **MACS level:** I, II & III[47] A caregiver must be able and willing to commit to the time required for daily procedure and follow-up care[53]	Both

Special considerations: This intervention is not recommended for use with clients with the following: (1) inability to participate in purposeful play or functional activity; (2) contractures that significantly limit functional arm use; and/or (3) dystonia preventing the patient from having any controlled movement with the affected upper extremity[53]. The variation in frequency and duration of mCIMT may be reflective of available resources and/or caregivers' willingness to commit time towards home programming. Factors like client's toleration, time, money, resources, etc are important to consider when creating an mCIMT protocol.

5.3 Bimanual Practice

Description: Bimanual practice aims to improve the use of both arms/hands working together for activities of daily living. The child practices specific tasks or parts of the task, rather than focusing on the underlying functional/structural impairment of the hand. Maintaining an intense level of therapy is important for best outcomes. These activities can be assigned as homework during therapy and as a home-based program after therapy. This is done in order to transfer the skills learned in therapy to real-world activities in their home environment[54]. Bimanual practice can be used in combination with conventional OT approaches. Research has shown bimanual practice to be equally as effective as CIMT for improving hand function in children with CP[55-57]. CIMT can be used for a few weeks, then followed by bimanual practice or both intervention methods can be used together[58-60].

Goals: (1) use affected hand/arm more spontaneously in 2-handed activities; (2) use both hands together (not one hand independently) for activities requiring bimanual function[58]

Activities: For a complete list of activities, please see the HABIT Caregiver Manual in the OneDrive. Activities included: functional, play-based, activities for younger kids. All activities provide a description of the task, materials required and ways to progress the skill[58]. See Appendix G for a list of Bimanual Practice Activities and links to websites with more activities.

How to progress: Goals are achieved in small, successive steps. This is done by gradually making the task more difficult (ex. Changing the set-up, size of materials, environment) as improvements are made. It is important to keep the activity within a range of difficulty that allows the child to succeed at the task most of the time (not too difficult). Only verbal instructions/cues and/or demonstrations are given to the child rather than physically guiding the child's hand[58].

Frequency & duration	Materials	Restorative or Adaptive	Population	Group or individual
90 hours total[58, 59] **Individual session:** 1-2 hour, 2x/week for up to 8 weeks (plus homework - suggested 30 minutes per day)[54] **Group sessions:** 6 hours per day for 2 weeks(followed by home/individual program) **Home-based program:** Suggested 3.5 hours per week for 12 weeks[54]	No specific materials or equipment required. Objects and toys in the child's familiar environment are best to use[58-59]	Restorative	1+ year old, hemiplegia, unilateral CP, spontaneous use of affected hand, selective motor control, basic hand skills, cognitive skills **MACS level:** I, II, III[59]	Both

Special Considerations: Bimanual practice should not be used with children with cognitive deficits as the child must be able to follow verbal cues and/or copy demonstrations from the therapist. Family or caregiver involvement and commitment is important to ensure that the home program is being followed in order to see the best results[59].

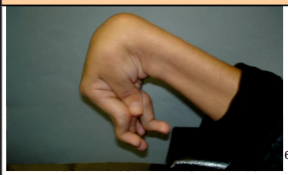
5.4 Orthoses and Splinting

Common physical presentations in hands that would indicate the need for splinting:

- Misaligned joints
- Joints that are in a flexed or extended position due to spasticity
- Joints that are flaccid

Common motor patterns/impairments:

- Wrist/hand[61]:
  - Mild to severe spasticity in wrist, finger, thumb flexors and intrinsics
  - Limited full composite extension
  - Fingers extend only with wrist flexed (tenodesis)
- Thumb[61]:
  - Classic thumb in palm: adducted and flexed

Deformity	Photo
Thumb in palm deformity. Potentially due to intrinsic or extrinsic muscle contracture[62]	 63
Swan-neck deformity of the fingers. May occur as the child attempts to move their fingers to counteract wrist flexion by recruiting long finger extensors. May also be due to hand intrinsic spasticity[62]	 64
Flexion-pronation contracture in the wrist[62]	 65
Wrist and finger flexion	 65

	Cast	Splints/Orthoses
What is it?	Can be inhibitive or serial. The inhibiti cast is a single static cast used to reduce tone (does not lengthen musc and improve function. Serial casting usesa series of progressive casts to increase muscle length using low load prolonged stress to contracted tissue[66]	Device applied to the body to stabilize or immobilize, prevent or correct deformity, protect against injury, promote healing or assist function[67]
Purpose	Used to gain/restore muscle length ar provide soft tissue elongation[66]	3 types and their respective purposes[67] 1) **Protective:** immobilize the joint, promote optimal joint alignment, prevent deformity 2) **Corrective:** correct joint contractures 3) **Functional:** assist movement of joints or to place the hand in a more functional position during functional activities when muscles are weak, reduce muscle tone of spastic muscles to promote joint mobility. E.g. wrist extension orthosis helps keep the wrist in a neutral position for more functiona use of the fingers.
When it is indicated	Casting is indicated when sof contracture is interfering with causing potential biomechani misalignment, particularly effect following Botulinum Toxin injections (NSW guidelines).	Depends on the purpose, see
When it is N indicated	When there are bony change at a joint. Casting is unlikely t effective intervention-term long contractures where bony cha be limiting ROM[66].	Depends on the type of ortho
Commonly u materials	Made of Plaster of Paris or fib	Splints/orthoses are generally manufactured from low tempe thermoplastics or materials su lycra and neoprene or from hi temperature thermoplastics[68]
Duration (sh or long term	Applied between 6 weeks. For se casting, may be removed and to increase stretch. Casts should be left on for more than 5 days as there is evidence to the loss o sarcomeres (contractile unus fibre) if a joint is left immobiliz cast for too long[69]	Long term[64]. Depending on the p of the orthoses, the child may it during certain functional act (functional orthosis), at night (corrective orthosis).
Solid or removable?	Can be both.	Removable

Goals of splinting/orthoses[61]:

- To provide proper position to enhance function
- To stretch tight soft tissue to improve or prevent joint deformity
- To stabilize for post-operative protection

MACS Level and Respective Recommendations for Splinting/Orthoses

Recommended splints based on Manual Ability Classification System (MACS), table modified from The Royal Children's Hospital Melbourne, 2014[64]:

MACS Level	Functional difficulties	Clinical Aims	Goal for manual skills	Splinting
I & II	- Increased tone on activity - Muscle imbalance on activity - Possible joint	- Reduce hypertonicity after activity - Improve muscle balance on activity	Improved speed and quality of performance in activities	Functional splints (thermoplastic) or prefabricated splints)
	instability - Decreased coordination and quality of prehension - Reduced sensory perception	- Joint stabilization - Improve patterns of prehension - Increase strength and endurance		
III & IV	- Tone increased at rest and on activity - Possible soft tissue contracture - Possible joint changes - Limited voluntary movement - Possible sensory neglect	- Reduce hypertonicity - Prevent contracture increase - Improve position for function - Reduce pain - Improve skin integrity	Independence in selected activities using strategies and adaptations	Functional splints (thermoplastic or prefabricated) and resting splint at night for contracture risk
V	- Tone increased at rest - Soft tissue contracture - Joint changes -absence/ limitation of voluntary movement - Pain - Sensory disturbance - Skin maceration risk	- Reduce hypertonicity after activity - Improve muscle balance on activity - Joint stabilization - Improve patterns of prehension - Increase strength and endurance	Meaningful actions where possible	Functional splints (thermoplastic or prefabricated) and resting splint at night for contracture risk

Common splints (Table modified from The Royal Children's Hospital. (2014)[64])

Type of Splint	Indications	Contra-indications	Aims	Materials	Template
Hand/wrist options					
Palmar Resting Splints 	- Moderate to severe hypertonicity at rest and/or activity - Risk of contracture development/ progression - Joint pain	Severe contracture	- Reduce hypertonicity - Maintain soft tissue length - Maintain joint alignment	Sansplint Ezeform Thermoplastic Prefabricated options (see below chart)	
Volar or Dorsal Wrist extension splint / wrist-cock-up splint 	Wrist is in a flexed position.	Severe contracture.	Promote active use of the upper limb, helps keep wrist in extension to help with grasping/hand manipulation	Ezeform Sansplint Prefabricated options (see below chart)	
Thumb Splint options					
Short thumb spica 	Thumb in hand deformity. Thumb is hyperextended at MCP and adducted when trying to grasp objects.	Severe contracture.	- Promote active use of the upper limb, keeps thumb in abduction to help with grasping objects. - Maintain joint alignment, including arches for mechanical advantage	Orfit Aquaplast Polyflex Prefabricated options (see below)	
Finger Splint Options					
Swan neck correction orthosis 	Swan-neck deformity of the fingers	Severe contracture. Not for small children (under 4 years) due to choking hazard if child puts splint in mouth.	Designed to correct or reduce swan neck deformity and improve hand function by permitting full proximal interphalangeal (PIP) joint flexion and preventing hyperextension[68].	Thermoplastic Prefabricated options (see below chart)	N/A

Prefabricated options:

- Lynx and Theraplus
- Joe cool: http://www.joecoolco.com/products.htm
- McKie: https://www.remingtonmedical.com/product/mckie-pediatric-thumb-splint/
- Benik: https://www.benik.com/peds/wrist
- Oval 8 ring (for swan neck deformity): https://www.amazon.ca/Products-Oval-8-Finger- Splint-Graduated/dp/B00GK8WX6A

For more information on splinting best practices, please refer to the resources in the One Drive: Hand-care clinical placement documents > resources and student projects >hand therapy and splinting > splinting

Special considerations: Based on a literature review conducted by Teplicky et al., 2003, it was identified that there is little research to support the use of upper extremity casts, splints, and orthoses for children with CP. Hand splints can improve grasp, and casts increase range of motion and decrease muscle tone[66]. For children ages 2-7 with a MACS level of 2-3, the thumb opponens splints/short thumb spica have been found to improve hand function, and effects remained when splints were not worn[69]. If splinting/orthotics will be used to promote hand function, ensure to combine with other forms of therapy (e.g. functional activities, botox treatment, strengthening exercises, ROM stretching).

5.5 Range of Motion (ROM) Stretches/Exercises

Brief description: When a contracture is only in the muscles and tendons, it can usually be straightened by exercises and casts, although this may take months. If the contracture also involves the joint capsule, it is often more difficult or impossible to correct, and may need surgery[70]. Contractures can be prevented by positioning and ROM exercises.

3 main ways of doing ROM exercises:

1. **Passive:** Muscles are moved passively by an external force (ie. another body part) with no muscle contraction involved. For

example, the therapist moves the child's affected hand/arm during ROM exercises[71].

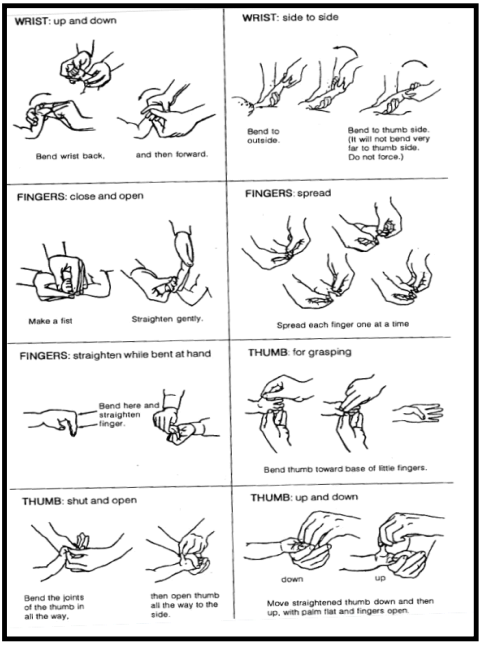
2. **Active-Assisted:** the child moves their limb as much as they can, and the therapist helps move the limb the rest of the way (stop if the child is in pain) during the ROM exercises[70].
3. **Active:** Joints are moved by muscle contraction, whereby the child completes the entire ROM exercise on their own[71].

Recommendations[70]:

- Consider the position of the whole child, not just the joint you are moving
- If the joints are stiff or painful, or tendons and muscles are tight, often it helps to apply heat to the joint and muscles before beginning to move or stretch them. If the child has sensation difficulties, there is a risk of burns as they will not be able to tell you if it is too hot. Be cautious to ensure that the heat does not burn the child.
- Move the joint slowly, do not use force, and stop stretching when it starts to hurt
- Have the child him or herself do as much of the exercise as she/he can
- Protect the joint. Hold the limb both above and below the joint that you are exercising to prevent damaging weak joints.
- Do not do exercises that will increase ROM of joints that are floppy/flaccid or that already bend or straighten more than they should
- Fast movements increase spasticity → do exercises VERY SLOWLY
- Do one joint at a time

ROM exercises:

Examples of ROM exercises for the hand[70]



Please see the document “Assessment and Treatment of the Upper Extremity in Children with CP: Therapy considerations” in OneDrive for more information.

5.6 Considerations for Augmentative and Alternative Communication (AAC)

A key aspect of client-centred care involves being able to collaborate with the client, however in some cases the child with CP may have difficulties communicating their needs, wants and desires. One in 4 children with CP have difficulties with speech and require augmentative and alternative communication (AAC)[59].

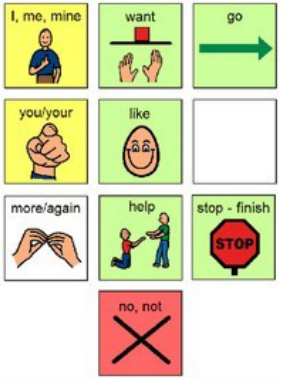
There are two types of AAC:

1. **Unaided systems**: using gestures, body language, facial expressions, and sign language

2. **Aided systems**: tool or device; can be basic (ie. pen and paper, pointing to a picture) or high tech (speech generating devices)[72].ASSA is currently using communication boards for children with speech difficulties, such as using a finger or stick to point to a series of pictures/letters (basic aided system). Although communication boards are useful for children, they can present challenges if a child has fine motor difficulties required to point to the pictures.

Here are some suggestions to make AAC more accessible for children with fine motor difficulties:

Make photos/pictures bigger and more spread out

EASY	DIFFICULT
 73	 74

Add a grid on top of the pictures so that it is easier for the client to keep their finger on the picture. For example, you could outline the pictures with foam, thermoplastic, pipe cleaners, cotton balls, cardboard roll from paper towel/toilet paper, wooden sticks (adhering it to the communication board with glue or tape).

Ensure the stick/pointer they are using is easy to hold.

- If the stick is too small/narrow, you can build it up with foam/pool noodle, or a small towel and adhere it with tape or a rubber band/ hair elastic.
- If the stick is too large/wide try using a thinner pointer (smaller diameter)
- If the stick/pointer is too heavy you can choose a more lightweight material
- If the child has ataxia, with shaky/jerky movements, this can make it difficult to manipulate the stick. You can add weight to the stick/pointer to help reduce shaky movements. For instance you could tape a roll of coins or washers to the stick.

For more ideas see this website:
https://therapyfunzone.net/blog/making-a-comfortable-weighted-pencil/?fbclid=IwAR2MHqgcmP93I7DsSV3tJTmP3x_O5GHDFU1YxcZtTy0RM6eP3Exr8D8fbH Y

CHAPTER 6:
MONITOR EFFECTIVENESS

Throughout the treatment process, it is important to continue evaluating the client and determine whether the current therapy plan is being followed and meeting the therapeutic goals[11]. No formal re-assessment or evaluation needs to be completed at this time. This stage aims to identify what is going well with therapy and what areas of the therapy plan need to be changed.

6.1 Ways to Monitor Effectiveness

6.1.1 Ongoing Observations

- The therapist can informally observe clients during regular therapy sessions
- Observations can help a therapist determine whether to grade an activity up/down to help a client further develop his/her skills[11].
  - If a client masters a skill, grading the activity up will make the skill more challenging
  - If a client is demonstrating difficulties, grading the activity down will make the skill easier to accomplish
  - Allowing a client to master a skill before grading up will help build motivation and self-confidence
- Example: During a bimanual practice session, the therapist watches the client and can determine whether the client's use of the affected hand in bimanual activities has increased, stayed the same, or decreased. If it has increased, consider making the activities more challenging. If it has stayed the same or decreased, consider reducing the difficulty by adapting the task or altering your therapy approach.

6.1.2 GAS Goals

- GAS goals can be reviewed to measure the progress of individual goals (see section 4.0 for more information)[11].
- Example: At baseline, a client is ranked at -2 on the GAS scale (able to hold a cup for 5 seconds with total assistance). Through observation, the therapist can determine if the client has improved and is now at -1 (able to hold a cup for 10 seconds with

total assistance)

6.1.3 Informal Discussions with Client

- Having regular conversations with clients about their progress, expectations and goals achievements will help increase their motivation to continue to succeed and encourage collaboration[11]
- Example: he therapist can ask clients about their views on their progress, motivation and if there are activities they want to increase difficulty/change

6.2 When to Modify or Redesign Treatment

It is important to modify or redesign your treatment plan when new issues arise or when expectations are not being met[11]. Making the right changes to your treatment plan will help improve your client's motivation and progress towards his/her goals. Before modifying the treatment plan, it is important to re-evaluate the outcome measures to help guide these changes (see Section 7.0 for further detail). This will help to know specifically what part of the intervention needs to be changed.

CHAPTER 7:
EVALUATE OUTCOMES

In this stage, the overall outcome of the plan is evaluated using the appropriate methods[11]. Based on the observations made when monitoring the effectiveness of the treatment, the therapist can determine how best to formally re-evaluate the outcomes This information is used to help guide therapists and clients in determining their next steps

7.1 How to Evaluate Outcomes

A therapist can re-administer the assessment(s) that were conducted at the beginning of therapy, the therapist will compare the pre- and post-intervention assessment results to check progress and see if the client's goals were met. The therapist and client can also use this information to identify if there are new issues that need to be addressed. It is important that the therapist re-administers the assessment in the **exact same way** as was done at baseline[11]. For example, ensure the client is in the same position (sitting or standing) and using the same materials. This will provide the most accurate and reliable results.

Typically, reassessment is conducted after an intervention is completed. The number of total sessions a therapist has with a client can help determine when to reassess a client's progress. For example, if there are a total of 10 sessions the therapist may choose to reassess during one of the later sessions (ie. sessions 7-10).

7.2 How to Determine Significant Change?

By comparing the difference between baseline and reassessment scores, the therapist can determine if there were any significant changes in the client's performance.

- **Minimal clinically important differences (MCID)** are scores that are derived from clients that demonstrate meaningful changes within an intervention for the patients and/or the therapist[75].

- **Minimal detectable changes (MDC)** are changes in a patient's score upon reassessment that are valid and not due to chance[76].

Each assessment has different MCID and MDC scores that can be found in the assessment manual or online. The client's scores can be compared to the MCID and MDC values to determine if they present with significant changes in the client's performance. This information is especially useful for research and program evaluation purposes[75-76].

7.3 How to Use This Information

Based on the results of the reassessment, there are three main routes therapy can now take:

1. Goals are met and there are no other issues:
   a. If the client is satisfied with their progress and no other issues are present, the therapist and client can agree to end therapy
2. Goals are met but more issues are identified:
   a. Therapist and client can make new goals and develop a new treatment plan in order to address these new issues.
3. Goals have not been met:
   a. Therapist and client revisit goals, and develop a new approach to address goals
   b. Therapy may end if the client chooses to discontinue treatment

CHAPTER 8:
APPENDICES

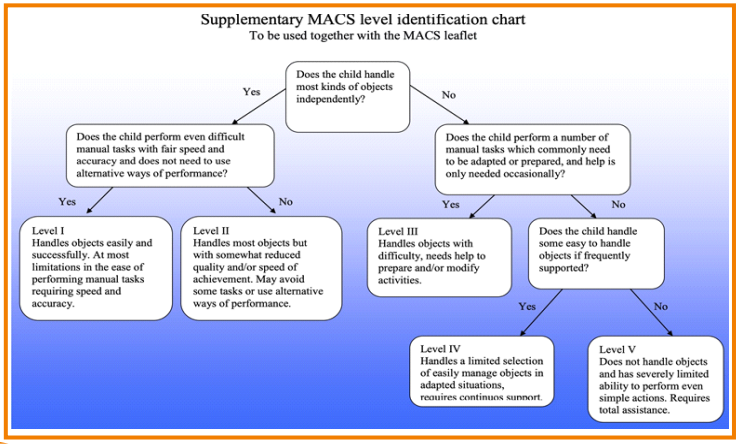
Appendix A: Frames of Reference for Cerebral Palsy

There are different theories that can be used to guide a therapist's understanding of what to assess and how to treat a child with CP. These include, but are not limited to:

Frame of Reference	Description
Learning Theories	Help the patient learn problem-solving strategies which can be used to achieve their goals[77].
Biomechanical	Therapeutic exercise is used to improve range of motion, strength and endurance, which is then thought to lead to improvements in functional abilities[77].
Compensatory	Patients who will not regain functional skills can compensate using adaptive equipment or techniques to complete tasks in a different way[77].

Appendix B: MACS Level Identification Chart

Use this MACS level identification chart to guide your decision process. Start at top and let the "yes" or "no" options lead you to the most suitable level. The chart should be used with the MACS manual, which can be found on the OneDrive[12].

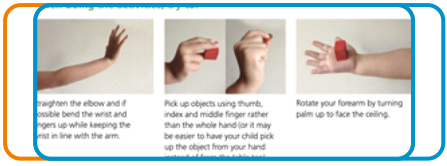


Appendix C: Box and Block Test Equipment Dimensions

Box and Block Test (BBT)[15]

- Wooden box: 53.7 cm x 25.4 cm x 8.5 cm
- Partition: should be placed at the middle of the box, dividing it in two containers of 25.4 cm each
- 150 wooden cubes (2.5 cm in size).

Appendix D: mCIMT Activities



Here are some examples of activities that can be completed during therapy or included in the client's home therapy program. These activities encourage the use of the client's affected hand in reaching and grasping and can be completed while the client is wearing a constraint.

Play-based/games activities[47]

- **Sensory bins**: Fill a container with dried beans, rice, pasta, etc. Hide some of the child's small toys in the box or bag. Let them move their hand around in the box or bag to find their toys.
  - Progression: Client can close their eyes or use an eye covering.
- **Shaving cream on a mirror**: Have the client sit or stand a distance away from the mirror so they have to straighten their elbow. Let them draw in the shaving cream.
  - Progression: Practice drawing shapes or printing their name; use a smaller mirror; place the mirror on a slant to encourage wrist extension.
- **Toss a small ball into a bucket:** Have the bucket at least at the client's shoulder height. Ensure the client's elbow is straight.
  - Progression: Start by dropping the ball into the bucket. Once

the client masters this skill, increase the distance between the client and bucket and start tossing/throwing the ball into the bucket

Functional/ADL activities[47]

- **Everyday activities:** At home, the client is encouraged to practice using their affected hand while participating in their daily tasks.
  - Examples: self-feeding, brushing teeth, combing hair, putting clothes in basket
  - Progression: therapist/caregiver provides less assistance; use build-up handles and slowly progresses to thinner handles
- **Squeeze sponges filled with water**: Start with a sponge in a bucket of water. Place the sponge over an empty bucket and squeeze out the water with the affected hand. Continue to do this until the first bucket is empty.
  - Progression: Squeeze a thicker item (ie. a washcloth, dish towel). The client can wipe the table/floor with their affected hand using the washcloth/dish towel.
- **Colouring/painting/printing** on a vertical surface, chalkboard or tabletop.
  - Progression: Start on a horizontal surface. Once the client masters this skill, increase the angle of the surface (maximum angle = vertical surface).

Activities and ideas to incorporate sensory awareness into your mCIMT sessions

- Playing with items that can easily be made to make noise e.g. silver foil, bubble packaging, tissue paper, newspaper
- Finger painting with pudding, Jell-O, whipped cream
- Dressing and bathing can be excellent times to expose your child to a variety of sensory experiences. Prolong the towel drying giving your child a deep massage. Try dripping, spraying different temperatures of water on the affected side.
- "Treasure hunts" in sand, rice, beans and dried pasta: Use the affected hand to search for items.
  - Progression: Start with hiding big items (ie. comb, ball).

Grade up by hiding smaller items (ie. pen, stick, button, beads)

- Highlight the involved hand by using bracelets, bells, bright stickers.
- Use a mirror so your child can see their arms and legs move and learn a lot about their body.
- Stroking and "dusting" the affected arm using feathers, scarves, brushes
- Once your child is past eating or mouthing things, introduce sticky texture activities like Playdoh, slime, clay
  - Activity idea: Roll out snakes and stick beads on to create eyes, nose, mouth, spikes, etc. As an extra activity (depending on the client's abilities), you can ask the child to use their pincer grasp to pick out the beads.

For more examples of mCIMT activities (including description, materials required, and ways to grade the activities), please view the following documents in the One Drive

- Holland Bloorview CIMT manual
- Holland Bloorview constraint and bimanual therapy "hand" book
- CIMT Activities and Materials

Appendix E: Baby CIMT

Baby CIMT is a further modified version of mCIMT geared towards infants below one year old and who are at risk of developing unilateral cerebral palsy[78]. It is important to plan treatment sessions based on the client's ability and level of development, and not make training too difficult in order to ensure that the client is successful at the activity[78]. Listed below are some activities you may use depending on the client's ability and level of development. It is important for the client to master the assigned task before moving onto the next task. For more information about Baby CIMT, please view the Baby CIMT manual in the One Drive.

First ability level: Pre-grasping and reaching

This ability level focuses on promoting goal-directed reaching and developing pre-grasping skills. Almost all babies have intentional movements, but they may be reduced in the affected hand. To initiate touching/moving/grasping, the client needs to be attracted by toys located near the hand. Below are activities the child and therapist will do at this ability level, including the materials required[78].

What the child does	What the therapist does	Selected toys, ability and age appropriate
1a. Initiates reaching towards objects by touching, moving and sweeping them from a close position	Shows attractive objects and holds them near the baby's hand within the visual field	Items that make noise (ie. keys, rattles, maracas), colourful strings, light up toys, toys that play music
1b. Holds objects placed in the hand without dropping them	Puts objects in the child's hand; if necessary, help the child keep focus and awareness of easy-to-hold objects	Puts objects in the child's hand; if necessary, help the child keep focus and awareness of easy-to- hold objects
1c. Holds objects in the hand while moving the arms in various directions, by waving and flapping the objects around	Gives the child time to explore the objects and their own abilities; attracts the child's attention within his/her visual field and uses objects producing noise	Big plastic rings, small rattles, plastic spoons, and maracas
1d. Scratching, pre-grasping, and squeezing	Holds the objects in front of the child or places them on the child's tummy	Hair bands, soft flexible material (ie. cloth), and rustling papers
1e. Initiates easy grasping actions	Positions the objects close to hand, increasing the distance as the child progresses; for more advanced children, expect some reaching before grasping	Strings, sticks, spoons in various colours, positioned and adjusted close to hand to be easy to grasp
1f. Reaching at a distance	Position objects at a distance where the child is required to reach for the object.	Balloons and/or tower of blocks to knock over

Second ability level: Grasping ability

This ability level focuses on improving grasp ability and more frequent use of the affected hand for object exploration. Infants typically start to grasp and explore toys and other objects by banging, mouthing and squeezing objects. Various grasping actions need to be practiced repeatedly with the client's affected hand to develop smoothness and precision of movement. It is important to use a variety of toys as the client increases with age to keep the client interested in the play session. Below are activities the child and therapist will do at this ability level, including the materials required[78].

What the child does	What the therapist does	Selected toys, ability and age appropriate
2a. Grasps easy-to-grasp objects in easy positions (ie. in front of the child's hands); drops objects	Provides the child with various easy-to-grasp objects, placed in locations where he or she can succeed; expects dropping when new objects are presented	Plastic spoons, items with thin handles, bag-clips, and maracas
2b. Grasps objects in various positions and at various distances (reaching)	Varies the positions of objects to increase reaching distance, just on the edge of success	Any object of interest of appropriate size and shape
2c. Increases the frequency/pace of grasping and releasing actions	Frequently provides toys of the correct grasping difficulty	Use many different objects to obtain many grasping repetitions
2d. Explores objects using various actions, such as waving, banging, pressing, and mouthing behaviours	Provides objects with different shapes, sizes, sounds, and textures	Packages, rubber objects, and cones
2e. Explores objects using various finger movements, such as squeezing, fingering, and re- grasping	Provides objects with different surfaces/textures and object that can change shape	Use things from nature, twigs, packages, and wrapping papers
2f. Increase precision in grasping, by orienting the arm/hand and adjustment of grip size	Provides objects that need to be grasped in a special way and place them in various positions	Bigger toys, sticks Objects placed to provoke hand opening and supination

Third ability level: Refinement of grasping and object manipulation

This ability level focuses on grasping with increased precision and adjusting the hand accordingly to understand how various objects are used. Precision in grasping and releasing objects of various sizes and properties, located in various places needs to be practiced. The ability to orient the hand and arm toward objects of various forms and in various locations before grasping will improve the quality of object handling. Below are activities the child and therapist will do at this ability level, including the materials required[78].

What the child does	What the therapist does	Selected toys, ability and age appropriate
3a. Grasps, releases, and drops objects of various sizes and in various positions	Arranges the play situation so the child has to place and release objects at different distances and in different locations on the table and in boxes of different sizes	Small toys, objects with small bases, and fragile things such as biscuits, cakes, and cereal. Basket, cans and boxes of different size for above objects, take-and-give games
3b. Orients the hand and form the hand before grasping, independent of the toy's location	Places or holds objects so as to promote supination and other hand adjustments	Sticker or small toys to be hidden in the hand
3c. Grasps with increased precision using more distal finger movements and refined pincer grips,	Presents small objects placed in various locations, at different stability and difficulty	Small toys, pearls, and buttons (can be strung on a string for safety precautions) placed in bowls of adequate
3d. Points at pictures and presses buttons	Supports increased recognition of the index finger	Books with a lot of details/pictures, finger puppets Create pretend buttons out of sponges
3e. Catches moving objects	Varies the speed	Balls of different size
3f. Conducts simple sequences of actions	Increases the complexity of sequences based on cognitive ability	Places a spoon in a cup; removes an object from a bowl. Lifts a cup to grab a cube; presses buttons on

Appendix F: Examples of Individual and Camp mCIMT Protocols

Here are examples of an individual mCIMT protocol and camp mCIMT (more than 2 clients participating in a session) protocol. Please note that these examples include bimanual practice in the protocol.

Example of an **individual mCIMT** protocol[53]

	Protocol 1	Protocol 2	Protocol 3
Model of Therapy	Intensive	Intensive	Frequent
Duration of Intervention	3 weeks	6 weeks	8 weeks
Duration of mCIMT/BIT	2 weeks mCIMT 1 week BIT	4 weeks mCIMT 2 weeks BIT	5 weeks mCIMT 3 weeks BIT
Dosage of treatment with therapist	1-2 hours per day for at least 3 days per week	1-2 hours per day; 3 days per week	1-2 hours per day for one day per week
Structured Practice with Caregiver	3 hours **per day** when not with therapist*	2-4.5 hours **per week**	4-6 hours **per week**
Method of Constraint (in alphabetical order)	Ace Wrap Pedi-wrap Splint/Glove Removable Cast	Ace Wrap Pedi-wrap Splint/Glove Removable Cast	Ace Wrap Pedi-wrap Splint/Glove Removable Cast

Example of a **camp mCIMT** (more than 2 participants) protocol[47]

Week 1 focuses on development of unilateral skills

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

Week 2 focuses on 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 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)	Gross Motor (U)	10:00am
10:15am	Gross Motor (U)	Gross Motor (B)	Circuits Motor & Sensory (U)		10:30-12pm Social Work& Networking (Parents)	10:15am
10:30am						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		Lunch (B)	Lunch (B)	Lunch (B)	Lunch (B)	11:30am
11:45am						11:45am
12:00noon		Unilateral Games/Interactive Computer Play (U)	ADL (B)	Unilateral Games/Interactive Computer Play (U)	Closing Ceremonies Awards, Magic Show(B)	12:00noon
12:15pm						12:15pm
12:30pm						12:30pm
12:45pm						12:45pm
1:00pm						1:00pm

Appendix G: Bimanual Practice Activities

Listed here are some examples of different types of bimanual practice activities that therapists can do with their clients that target different age groups, goals and impairments. For a list of more examples, including how to progress the skill, please see the document "HABIT Caregiver Manual" in the OneDrive. More activities and information can be found at the following link: https://www.theottoolbox.com/bilateral-coordination-activities/

Games/Play-Based Activities:

- **Throw and catch a ball** → toss or roll a ball back and forth between child and therapist
  - Progression: increase size/weight of ball; increase distance to throw ball; underhand to overhand toss
- **Theraputty/clay** → manipulating pieces of clay into different shapes using bimanual use of hands including rolling with both hands, using a rolling pin, cookie cutter etc.
  - Progression: increase thickness or resistance level of theraputty; making more complicated shapes/structures with the theraputty
- **Puzzles** → child can put together puzzles, starting with large pieces. The therapist must encourage the child to use both hands when placing the pieces together.
  - Progression: puzzle with smaller pieces; therapist provides less assistance (ex. Therapist doesn't hold down the puzzle for the child); place pieces further away on table so child has to reach for them
- **Beading** → start with large beads and place them through a thick string
  - Progression: use smaller beads, use thinner string
- **Painting** → start finger painting with both hands with paper taped to table
  - Progression: use paint brushes; don't tape paper to table

Functional/Productive Activities:

- **Reading a book** → child can start by holding the book down on the table with both hands and flip pages with unimpaired hand
  - Progression: flip pages with impaired hand; hold the book upright; use a book with thinner pages; change size of the book (ex. Heavier book to hold)
- **Twisting bottle caps** → bottle caps of different sizes can be used
  - Play-based: this can be made into a game by placing a marble inside the bottle and the child has to get the marble out
  - Progression: Use smaller caps; use bigger bottle with larger circumference
- **Getting dressed** → child gets dressed and can begin by putting on looser-fitting clothes and with assistance from therapist
  - Progression: less assistance from therapist; buttons/zippers
- **Washing dishes:** child can start with large bowls/plates, use large sponge
  - Progression: use smaller dishes; dry dishes with a towel

Please Note: There is no standardized protocol regarding how to progress, so any of these suggestions can be used depending on the child's ability to do the task

Appendix H: Additional Resources

1. F-Words Tools:

   https://www.canchild.ca/en/research-in-practice/f-words-in-childhood-disability/f-words- tools

- "The Six F-Words for CP" is based on a paper written by Dr. Peter Rosenbaum and Dr. Jan Willem Gorter which focuses on the key areas of child development
  - https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2214.2011.01338.x
- The six F-words are Function, Family, Fitness, Friends, Fun and Future
- Poster in Tamil: https://worldcpday.org/wp-content/uploads/tools/worldcpday.org.au/posters/fwords/WCPD_Favourite_Words_Poster_Oct_6_Tamil.pdf

2. Goal Attainment Scaling (GAS) Training Manual:

   https://mississaugahalton.rehabcareontario.ca/Uploads/ContentDocuments/gasmanual_. pdf

3. Manual Ability Classification System for Children with Cerebral Palsy (MACS):

   https://macs.nu/files/MACS_English_2010.pdf

4. Mini-Manual Ability Classification System for Children with Cerebral Palsy (Mini-MACS):

   https://macs.nu/files/Mini-MACS_English_2016.pdf

5. NSW Government, 2018. Management of Cerebral Palsy in Children: A guide for Allied Health Professionals:

   https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2018_006.pdf

6. Shirley Ryan Ability Lab: https://www.sralab.org/rehabilitation-measures

- This website allows you to search for detailed information about specific assessment measures

7. CanChild. Cerebral Palsy Resources: https://www.canchild.ca/en/diagnoses/cerebral-palsy/related_resources

- Provides a variety of resources

8. ASSA India Presentation: Promoting Hand Function in Children with CP & Adults Post-Stroke (May 28, 2020):

   https://www.youtube.com/watch?v=XbvHyB9Z7uk&t=1525s

- MScOT students from the University of Toronto, Canada present two educational resources created for ASSA

CHAPTER 9:
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