Appendix 2

Managing upper limb function

With spastic diplegia, the lower limbs are much more affected than the upper limbs, which frequently only show fine motor impairment. For those with spastic diplegia who have upper limb involvement, the following addresses occupational therapy for managing upper limb function, including the use of orthoses. Some occupational therapists—certified hand therapists—also specialize in upper limb involvement.

Information is also included on adaptive equipment to support activities of daily living (ADLs) and recreational activities.

Individuals with CP GMFCS levels I to III generally do not need tone reduction or orthopedic surgery for upper limb problems.

Stretching and strengthening

As with physical therapy, occupational therapy contains elements of stretching and strengthening. These may be included to directly help with an occupational therapy activity.

Orthoses

Occupational therapists play a large role in assessing and identifying appropriate orthoses to enhance participation in ADLs. Upper extremity orthoses are used for the fingers, hands, wrists, elbows, and shoulders. They are intended to maintain ROM of the joint, to provide support, and/or to maximize positioning and function. The following upper extremity orthoses may be used in upper limb involvement and are described in Table A2.1:

- Hand finger orthosis (HFO)
- Wrist hand finger orthosis (WHFO)
- Wrist hand orthosis (WHO)
- Elbow orthosis (EO)

Table A2.1 Common upper extremity orthoses for individuals with upper limb involvement

ORTHOSIS TYPE	SUBTYPE	DESCRIPTION
Hand finger orthosis (HFO)	Static 	A static HFO is a device that fits in the palm of the hand and allows the fingers to wrap around it. This counteracts finger flexion contractures and prevents the pain and skin breakdown that can result from maintaining a prolonged fist position.
	Finger 	The finger HFO is worn on the hand and fingers. It is made either of a rigid material to help extend and stretch the fingers or a softer material to assist with grasp, release, and positioning of the hand. These orthoses can help with functions such as pressing a button or improving grasp. (Note: This HFO includes a thumb abduction component to assist with thumb positioning.)
	Thumb abduction orthosis 	A thumb abduction orthosis covers the hand and thumb. It can be made from rigid thermoplastic* or softer, flexible neoprene material. It supports the thumb joint in a functional grasp position, preventing hypermobility, and it can be useful during play activities. It also prevents the thumb from coming into the palm during fisting.
Wrist hand finger orthosis (WHFO)	Static 	A static WHFO holds the wrist, hand, and fingers in one position and does not allow movement. The rigidity of the material can vary, and it may be worn at night or at rest due to its impact on the user's functionality. It is typically used to counteract or prevent painful wrist and/or finger contractures.

Wrist hand orthosis (WHO)		A WHO covers only the wrist and hand (not the fingers). It can be made of a variety of materials including neoprene, nylon, thermoplastic,* or metal. A WHO helps to maintain wrist positioning while allowing finger flexion and thumb opposition (touching the tip of the thumb to the tip the fingers).
Elbow orthosis (EO)		An EO (elbow immobilizer) is worn around the elbow joint. There are a variety of options, from static EOs that maintain one position to counteract flexion contractures and protect the joint, to dynamic EOs that allow movement and can improve ROM. The image is of a static EO.

* Thermoplastic material becomes more pliable when heated and is therefore useful for making or adjusting orthoses. *Adapted from Ward and colleagues. Dynamic WHFO image reproduced with kind permission from Saebo Inc.*

Constraint-induced movement therapy and bimanual therapy

Using both hands reflects everyday typical hand function. Constraint-induced movement therapy (CIMT) and bimanual therapy (performed with both hands) are two therapy types that encourage the use of the affected arm or hand. Naturally, an individual with upper limb involvement tends to favor using their unaffected hand because it functions so well.

These therapies are appropriate in spastic diplegia if there is considerable upper limb involvement, but not if there is only minimal to no upper limb involvement.

CIMT and bimanual therapy can help maintain ROM, prevent learned disuse, and increase awareness of the presence and functionality of the affected arm and hand. Both interventions require a high level of parent and child education and engagement, as practicing skills at home when not in structured therapy will optimize gains of either intervention.

CIMT involves two main components used in combination: restraint of the unaffected hand and intensive structured therapy. The restraint may be a soft restraint such as a mitten (on the unaffected hand). In an older child, a cast on the unaffected arm and hand may be used to enable longer periods of treatment. The child then participates in games and activities that require use of their affected hand.

Bimanual therapy consists of games and activities designed to improve the child's ability to use both arms or hands together (without any restraint placed on the unaffected hand). It involves a high level of repetition. This therapy helps translate to the child using their affected upper limb in everyday tasks such as carrying a lunch tray at school.

CIMT and bimanual therapy tap into the brain's neuroplasticity. There is strong evidence supporting both (green light).[1] It is recommended that CIMT and/or bimanual therapy begin as soon as upper limb involvement is suspected.[2] Each of these therapies has different functions so one should not be chosen over the other; it is good to do both in sequence.

Robot-assisted therapy

Robot-assisted therapy involves using a robotic device to support the arm in movement and task completion (see Figure A2.1). Research supports its use.[3]

Figure A2.1 Robot-assisted therapy.

Table A2.2 shows appropriate ages for different upper limb therapies, although each of these therapies remains relevant throughout life.

Table A2.2 Appropriate ages for upper limb therapies

THERAPY	APPROPRIATE AGES
CIMT	3 months to 18 years
Bimanual therapy	Infancy through adolescence
Robot-assisted therapy	4 years plus; depends on size of child as there is a minimum size needed to engage with most devices

Activities of daily living

Occupational therapy to enhance an individual's ability to perform or assist with activities of daily living (ADLs) is goal based, and for individuals with upper limb involvement, ADLs focus on performing tasks independently such as dressing, grooming, feeding, bathing, and toileting. The therapy is informed by the individual's motor abilities, cognitive abilities, and impairments. For example, occupational therapists often screen for vision impairments and use these screening results to plan ongoing treatment and adapt activities appropriately, taking into consideration how vision impairment may impact actions such as hand use. Specific ADLs focused on during occupational therapy also change depending on age:

- Young children—focus is on activities that feel like play, encouraging the child to engage and participate.
- Middle childhood to adolescence—focus is on increased engagement in family responsibilities, organized activities, and socialization, such as completing weekly chores (e.g., setting the table, taking out trash) and participating in sports and recreational opportunities to begin building skills and capacity for independence in adulthood.
- Adolescence to young adult—focus is on building skills for living independently and managing adult tasks such as scheduling appointments or managing money.

Occupational therapists can also make recommendations for adaptive equipment for completing ADLs. The following may help:

- Adaptive shoes with Velcro, zipper closures as opposed to laces, to allow for easier fastening
- Clothing with magnetic zippers[*]/zipper pulls[†] to allow for easier dressing

There are also many "one-handed techniques" that allow for shoe tying and dressing that don't include equipment.

The following are examples of equipment that may help with food preparation and eating:

- Adaptive cutting board to help secure a food item to allow for cutting with one hand. See Figure A2.2.

[*] Uses magnets instead of traditional interlocking teeth or coils to fasten two sides of a garment together. They typically have strips of magnets embedded along the edges of the fabric, which attract each other to create a secure closure when brought together.

[†] A small, usually metallic or plastic attachment that can be put on the slider of a zipper, making it easier to open and close.

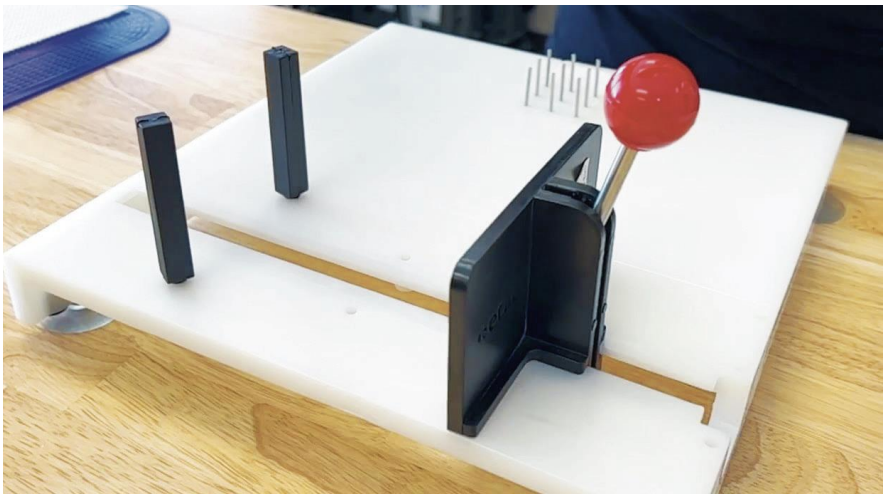

Figure A2.2 Adaptive cutting board. Reproduced with kind permission from Rehab-Store.com.

- Adaptive silverware to allow the weak hand to assist with eating. See Figure A2.3.

Figure A2.3. Adaptive silverware.

Building autonomy

An important part of occupational therapy is building autonomy—maximizing the capacity for the individual to be independent. Goals for independence are set based on functional and cognitive abilities. For individuals with upper limb involvement, these goals may center on the ability to live independently and complete necessary home management tasks such as cooking, cleaning, and grocery shopping. They may also include skills such as money management and medication management.

Adaptive recreational equipment

Examples of adaptive recreational equipment that may help individuals with upper limb involvement include:

a) Technology options
b) Adaptive art and crafts equipment
c) Reading stands
d) Adaptive equipment for games

a) Technology options

An adaptive joystick and adaptive color-coded keyboard with large keys and letters can help with computer use (see Figure A2.4).

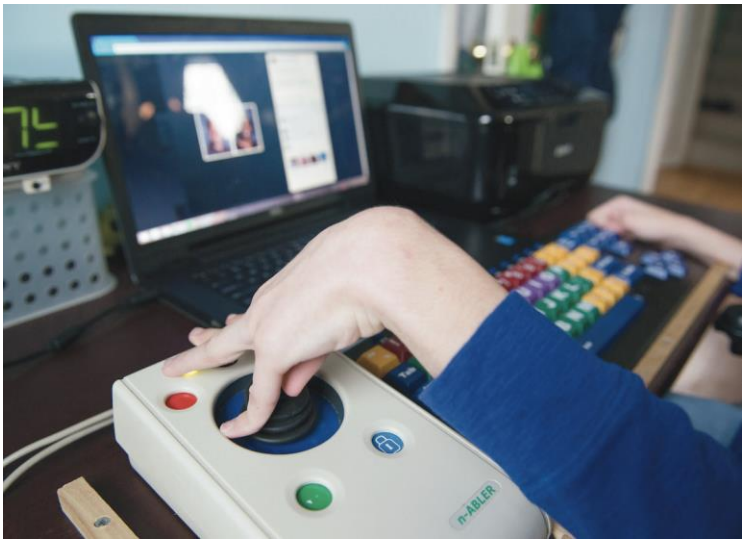

Figure A2.4 Adaptive joystick and keyboard.

b) Adaptive art and crafts equipment

Adaptive art and crafts equipment may include:

- Single-extremity scissors with a stability base
- Single-extremity scissors
- Easy-grip scissors
- Universal cuff (can be used for many purposes; here to hold a writing utensil)
- Foam grip aid to assist weak grip
- Paintbrush holder that may prevent fatigue
- Glue dots, paper clamps, easels, and egg-shaped palm crayons

See Figure A2.5.

Figure A2.5 1) Single-extremity scissors with stability base; 2) Single-extremity scissors; 3) Easy-grip scissors; 4) Universal cuff; 5) Foam grip aid.

c) Reading stands

A table-top book stand allows for page turning (see Figure A2.6).

Figure A2.6 Table-top book stand.

d) Adaptive equipment for games

Adaptive equipment for playing games may include the following:

- Card shuffler
- Card holder
- Adaptive switch for use with a regular soap bubble-maker
- Dice popper

See Figures A2.7 to A2.10.

Figure A2.7 Card shuffler.

Figure A2.8 Card holder.

Figure A2.9 Adaptive switch for use with a regular soap bubble-maker.

Figure A2.10 Dice popper.

References

1. Novak I, Morgan C, Fahey M, et al. (2020) State of the evidence traffic lights 2019: Systematic review of interventions for preventing and treating children with cerebral palsy. *Curr Neurol Neurosci Rep,* 20, 1-21.
2. Morgan C, Fetters L, Adde L, et al. (2021) Early intervention for children aged 0 to 2 years with or at high risk of cerebral palsy: International clinical practice guideline based on systematic reviews. *JAMA Pediatr*, 175, 846-858.
3. Gilliaux M, Renders A, Dispa D, et al. (2015) Upper limb robot-assisted therapy in cerebral palsy: A single-blind randomized controlled trial. *Neurorehabil Neural Repair*, 29, 183-92.