

An Evidence Based Occupational Therapy Toolkit for Assessment and Treatment of the Upper Extremity Post Stroke

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2.0 Introduction:

Stroke is a common neurological medical condition. Every year 62,000 Canadians experience a stroke or transient ischemic attack (Hebert et al., 2016) and 405,000 Canadians live with the effects of stroke, with that number projected to increase to between 654,000 and 726,000 by 2038 (Krueger et al., 2015). Stroke impacts an individual's ability to participate in former activities and life roles. Occupational therapists provide assessment and treatment to increase independence in self-care, productivity, and leisure activities, and frequently work with clients recovering from stroke. The literature on stroke rehabilitation is continually evolving; therefore, occupational therapists must be knowledgeable about evidence-based practice and apply it within their practice settings.

The Canadian Stroke Best Practice Recommendations (rehabilitation modules) were updated in 2015, 2017 and again in 2019 and published in the International Journal of Stroke in 2020 (Teasell et al., 2020). The upper extremity sections of the Recommendations are of significant value to occupational therapists who frequently work with clients to maximize upper extremity function post stroke. Occupational therapists have noted variations in upper extremity rehabilitation practice between sites and programs in Winnipeg, Manitoba, and have identified the need for increased knowledge to improve the consistency of practice across the stroke rehabilitation continuum of care.

A working group was created in an attempt to consistently implement the upper extremity sections of the Canadian Stroke Best Practice Recommendations into daily clinical practice. A group of occupational therapists from the Winnipeg Health Region collaborated to create a practical Toolkit for occupational therapists working in acute, rehabilitation, outpatient, and community settings. Although this Toolkit was developed specifically for occupational therapists, it is hoped that it will also be of benefit to physiotherapists, rehabilitation assistants, and other healthcare professionals working on upper extremity recovery post stroke. Several occupational therapists and physiotherapists provided feedback throughout various stages of the Toolkit development.

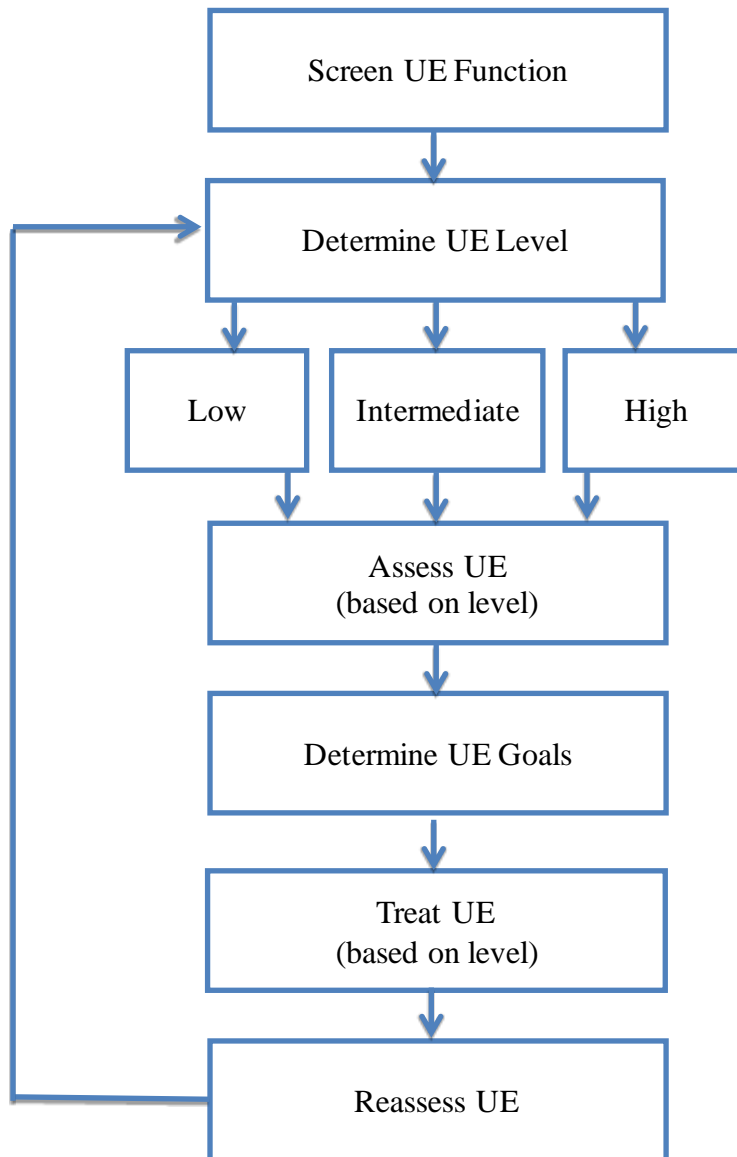
The Toolkit includes: a model for upper extremity management, a list of upper extremity assessment considerations and tools, and a list of specific upper extremity treatments, including practical resources. The Toolkit was initially informed by the 2013 Canadian Stroke Best Practice Recommendations, as well as expertise from Winnipeg occupational therapists across practice settings. The Toolkit was updated after the release of the 2015 Canadian Stroke Best Practice Recommendations (Stroke Rehabilitation Module) and updated a second time after the release of the 2019 Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery, and Community Participation following Stroke.

The purpose of this Toolkit is to improve the consistency of implementing best practice management of the upper extremity following stroke. It provides information to assist occupational therapists with clinical decision making as they assess, treat and educate clients recovering from stroke, with the ultimate goal of promoting client self-management. The affected upper extremity has been categorized into low, intermediate or high levels to guide occupational therapists with selecting appropriate assessment tools and treatments. Occupational therapists still need to consider their client's physical status, cognition, perception, affect, and motivation, as well as their physical and social environments when implementing the resources in this Toolkit.

The evidence for upper extremity rehabilitation post stroke continues to emerge. It is critical that occupational therapists are knowledgeable about the most recent evidence as well as the recommendations and resources available to promote optimal upper extremity function throughout the stroke rehabilitation continuum of care.

3.0 A Model for Upper Extremity Assessment and Treatment Post Stroke

A model was developed to illustrate a recommended process for management of the upper extremity (UE) post stroke. This process includes an approach to screening, assessment, and treatment with each step of the model further described in this Toolkit.



4.0 Screening Guidelines:

The Canadian Stroke Best Practice Recommendations 1.ii states: “Initial screening and assessment should ideally be commenced within 48 h of admission by rehabilitation professionals in direct contact with the patient (Evidence Level C)” (Teasell et al., 2020, p. 767).

An initial screen of upper extremity function is crucial at all points of the rehabilitation continuum of care. The screen will determine further assessments required, assist with goal setting, and assist with the choice of specific upper extremity treatments to best promote recovery and prevent complications (e.g., pain, subluxation, edema, contracture). The following page is an example of some initial screening questions. Questions should be modified based on the individual client’s presentation.

4.1 Screening Questions:

Determine dominant upper extremity. Compare affected side to less affected side.

Shoulder subluxation and position of scapula at rest:

Feel for shoulder subluxation.

Feel position of scapula on ribcage (both with and without active arm movement).

Motor Function: *(Note which movement components are 'missing' vs. weak as well as selectivity of movement)*

“Shrug your shoulders toward the ceiling and down.” *(scapula elevation/depression)*

“Squeeze your shoulder blades together.” *(scapula retraction)*

“Pretend you are giving someone a hug.” *(scapula protraction)*

“Raise your arm in front of you to the ceiling.” (thumb up if possible) *(shoulder flexion in neutral alignment)*

“Raise your arm to the side.” (palm up if possible) *(shoulder abduction)*

“Put your hand behind your back.” *(shoulder internal rotation)*

“Put your hand behind your head.” *(shoulder external rotation; should also be screened 'in sitting' with elbow flexed 90 degrees and forearm parallel to the ground; screen for AROM/PROM and strength)*

“Touch your chin with your hand. Straighten your elbow all the way.” *(elbow flexion/extension)*

“Turn your palm up and down.” (elbow at 90°) *(forearm supination/pronation)*

“Move your wrist up and down.” *(wrist extension/flexion)*

“With your palm down, move your wrist from side to side.” *(wrist ulnar/radial deviation)*

“Open your hand all the way. Make a fist.” *(finger extension/flexion)*

“Squeeze both my hands as hard as you can.” *(is grip strength equal bilaterally?)*

“Touch your thumb to each fingertip slowly.” *(finger isolation and thenar/hypothenar activation)*

“Spread your fingers apart and then bring them together.” *(finger abduction/adduction; hand intrinsic muscles)*

“Keep your fingers straight while bending them at the knuckles (MCP joints).” *(MCP flexion combined with IP extension; hand intrinsic muscles) (Note: MCP = metacarpophalangeal, IP = interphalangeal)*

If client is unable to perform the active movement as requested above, look at gravity reduced / eliminated positions (e.g. side lying, supine, therapist supporting limb) or ‘place and hold’ of the requested movement (i.e. isometric contraction). *When active range of motion (AROM) is lacking assess passive range of motion (PROM). When active movement is present, also assess strength. Observe for changes in tone with movement and tone at rest. Consider the impact of spasticity on movement.*

Pain:

“Do you have any pain at rest? Do you have any pain with movement?” *(Note pain with AROM/PROM)*

Sensation:

“Do you have any numbness or tingling in your arm/hand?”

Consider screen of light touch and localization.

Consider screen of proprioception, such as Thumb Localization Test *(see page 14 for more information)*

Edema:

Note edema in fingers, thumb, hand and wrist.

Functional Use:

“What activities do you do with your arm/hand?”

“What activities are you finding difficult to do with your arm/hand?”

WRHA Occupational Therapy Upper Extremity Working Group 2015 and 2021

5.0 Determining Upper Extremity Level Guidelines:

Upper extremity movement and function varies considerably post stroke. These variations between clients will require the use of different assessment tools and treatments.

The Chedoke-McMaster Stroke Assessment (CMSA) (Gowland et al., 1995) arm and hand sections have been used to help categorize the affected upper extremity into low, intermediate or high levels. These levels can act as a starting point for assessment and treatment planning and can assist occupational therapists with clinical decision making, with the overall goal to progress the client to the next level. The table below can be used to help determine which level a client may best represent. Clients may not “fit cleanly” into a single level (e.g. CMSA hand level 6 with arm level 2). Once the most appropriate level has been determined, occupational therapists should use the corresponding Assessment and Treatment Matrices to guide their therapeutic intervention with the client.

Determinants	Low Level Arm	Intermediate Level Arm	High Level Arm
Chedoke-McMaster Stroke Assessment	<ul style="list-style-type: none"> ▪ Arm stage 1 – 2 ▪ Hand stage 1 – 2 	<ul style="list-style-type: none"> ▪ Arm stage 3 – 5 ▪ Hand stage 3 – 5 	<ul style="list-style-type: none"> ▪ Arm stage 6 – 7 ▪ Hand stage 6 – 7
Arm Movement and Function	<ul style="list-style-type: none"> ▪ Incompletely selective movements* (small amplitude, non-functional) ▪ Primarily used for stabilization tasks 	<ul style="list-style-type: none"> ▪ Biomechanical and muscle imbalances with incompletely selective movements* ▪ Transitioning from stabilization to manipulation tasks 	<ul style="list-style-type: none"> ▪ Selective movements but lacks strength, dexterity, or coordination necessary for “normal” function ▪ Primarily used for manipulation tasks with emphasis on speed, accuracy, and quality of movements

(Adapted from: Stevenson & Thalman, 2007)

**Incompletely selective movement* refers to movements that are not completely isolated or selective (e.g., client cannot bend elbow without also abducting shoulder or cannot move thumb without also moving fingers)

6.0 Assessment Guidelines:

The Canadian Stroke Best Practice Recommendations 2.2.iii states: “Clinicians should consider use of standardized, valid assessment tools to evaluate the patient’s stroke-related impairments, functional activity limitations, and role participation restrictions. Tools should be adapted for use in patients with communication limitations due to aphasia (Evidence Level C).” (Teasell et al., 2020, p. 769).

There are many upper extremity assessment tools available for use with clients post stroke. After the screening is completed and the upper extremity level has been determined, the following Assessment Matrix can then be used to help occupational therapists determine appropriate assessment tools for their clients.

The intent is not to use all the assessment tools with each client but to choose assessments that will be the most valuable in measuring change in that individual. Assessment tools may vary depending on the availability and relevance to the practice setting.

The assessments listed in the Assessment Matrix are categorized according to their use with low, intermediate and high-level upper extremities post stroke. The list is not all-inclusive.

Assessments that evaluate range of motion and strength should consider which movement components are ‘missing’ or weak and the effects of spasticity on those movements, as this will provide a starting point for strengthening and spasticity management interventions.

“One of the first assessment tasks is to identify the positive and negative features influencing the person’s upper limb....The presence of positive and negative features of the upper motor neuron syndrome is often identifiable at rest and can be observed by the clinician whilst conducting the initial interview....For some clients, positive and negative features are not apparent at rest and can only be identified by observing movement patterns” (Copley & Kuipers, 2014, p. 87-88).

Positive features present as ‘too much’ of a particular movement or position (e.g., spasticity, clonus) while negative features present as ‘not enough’ of a particular movement or position (e.g., missing movements, loss of dexterity). When positive features dominate in one muscle group (agonist), negative features often prevail in the opposite (antagonist) muscle group, resulting in an imbalance across the joint and stereotypical movement patterns. Blocking and supporting joints during the assessment of movement can provide helpful information to use when planning interventions that involve joint positioning and stabilization (Copley & Kuipers, 2014).

Since up to 85% of patients with stroke have some impairment of sensation (Kim et al., 1996) and sensory deficits post stroke affect coordinated movement and fine motor control of the upper extremity, as well as participation in daily activities (Carey et al., 2018), early assessment of sensation, including proprioception, is strongly recommended. If impaired, sensory retraining strategies may need to be implemented along with motor recovery strategies for optimal upper extremity recovery.

Observation of the amount of use of the arm and hand in daily activities is also essential. Assessment of the client’s ability to spontaneously incorporate their upper extremity into their self-care, productivity and leisure activities is important.

6.1 Assessment Matrix:

Assessment	Low Level Arm	Intermediate Level Arm	High Level Arm
6.1.1 Motor Function	<ul style="list-style-type: none"> ▪ Fugl-Meyer Assessment – Upper Extremity ▪ Motor Evaluation Scale for Upper Extremity in Stroke Patients 	<ul style="list-style-type: none"> ▪ Fugl-Meyer Assessment – Upper Extremity ▪ Motor Evaluation Scale for Upper Extremity in Stroke Patients ▪ Action Research Arm Test ▪ Chedoke Arm and Hand Activity Inventory ▪ Jebsen Hand Function Test ▪ Wolf Motor Function Test 	<ul style="list-style-type: none"> ▪ Fugl-Meyer Assessment – Upper Extremity ▪ Motor Evaluation Scale for Upper Extremity in Stroke Patients ▪ Action Research Arm Test ▪ Chedoke Arm and Hand Activity Inventory ▪ Jebsen Hand Function Test ▪ Wolf Motor Function Test
6.1.2 Coordination		<ul style="list-style-type: none"> ▪ Box and Block Test ▪ Nine Hole Peg Test ▪ Finger-Nose Test ▪ Rapid Alternating Movement Test 	<ul style="list-style-type: none"> ▪ Box and Block Test ▪ Nine Hole Peg Test ▪ Finger-Nose Test ▪ Rapid Alternating Movement Test
6.1.3 Strength	<ul style="list-style-type: none"> ▪ Manual muscle testing 	<ul style="list-style-type: none"> ▪ Manual muscle testing ▪ Grip ▪ Pinch (lateral, tripod if able) 	<ul style="list-style-type: none"> ▪ Manual muscle testing ▪ Grip ▪ Pinch (lateral, tripod)
6.1.4 Range of Motion (ROM)	<ul style="list-style-type: none"> ▪ Sitting, side lying, and/or supine: <ul style="list-style-type: none"> ➢ Active ROM ➢ Active assisted ROM ➢ Passive ROM 	<ul style="list-style-type: none"> ▪ Sitting, side lying, and/or supine: <ul style="list-style-type: none"> ➢ Active ROM ➢ Active assisted ROM ➢ Passive ROM 	<ul style="list-style-type: none"> ▪ Sitting and/or standing: <ul style="list-style-type: none"> ➢ Active ROM
6.1.5 Tone	<ul style="list-style-type: none"> ▪ Modified Ashworth Scale ▪ Arm Activity Measure 	<ul style="list-style-type: none"> ▪ Modified Ashworth Scale ▪ Arm Activity Measure 	<ul style="list-style-type: none"> ▪ Modified Ashworth Scale ▪ Arm Activity Measure
6.1.6 Pain	<ul style="list-style-type: none"> ▪ Visual Analogue Scale ▪ Chedoke-McMaster Stroke Assessment – Shoulder Pain 	<ul style="list-style-type: none"> ▪ Visual Analogue Scale ▪ Chedoke-McMaster Stroke Assessment – Shoulder Pain 	<ul style="list-style-type: none"> ▪ Visual Analogue Scale ▪ Chedoke-McMaster Stroke Assessment – Shoulder Pain
6.1.7 Sensation	<ul style="list-style-type: none"> ▪ Light touch / Monofilaments ▪ Hot and cold ▪ Proprioception 	<ul style="list-style-type: none"> ▪ Light touch / Monofilaments ▪ Hot and cold ▪ Proprioception ▪ Object recognition 	<ul style="list-style-type: none"> ▪ Light touch / Monofilaments ▪ Hot and cold ▪ Proprioception ▪ Object recognition
6.1.8 Edema	<ul style="list-style-type: none"> ▪ Circumference ▪ Volume 	<ul style="list-style-type: none"> ▪ Circumference ▪ Volume 	<ul style="list-style-type: none"> ▪ Circumference ▪ Volume

6.1.1 Motor Function

Fugl-Meyer Assessment – Upper Extremity (FMA-UE):

[Fugl-Meyer Assessment of Sensorimotor Recovery After Stroke \(FMA\) – StrokenGINE](#)

Motor Evaluation Scale for Upper Extremity in Stroke Patients (MESUPES):

[Motor Evaluation Scale for Upper Extremity in Stroke Patients \(MESUPES\) – StrokenGINE](#)

Action Research Arm Test (ARAT):

[Action Research Arm Test \(ARAT\) – StrokenGINE](#)

Chedoke Arm and Hand Activity Inventory (CAHAI):

[Chedoke Arm and Hand Activity Inventory \(CAHAI\) – StrokenGINE](#)

There are four different versions of this assessment tool. Select the version that would be best suited for the client's upper extremity level.

Jebsen Hand Function Test:

[Jebsen Hand Function Test \(JHFT\) – StrokenGINE](#)

Wolf Motor Function Test:

[Wolf Motor Function Test \(WMFT\) – StrokenGINE](#)

6.1.2 Coordination

Box and Block Test (BBT):

[Box and Block Test \(BBT\) – StrokenGINE](#)

Nine Hole Peg Test (NHPT):

[Nine Hole Peg Test \(NHPT\) – StrokenGINE](#)

Finger-Nose Test (test for dysmetria):

In sitting, have client move his index finger from his nose to the occupational therapist's index finger (which is placed an arm's length away from client). Record number of repetitions in 10 seconds.

Observe quality of movement and compare to less affected side.

Rapid Alternating Movement Test (test for dysdiadochokinesis):

In sitting, have client alternate between supination and pronation arm movements, while his hand is supported on his thigh or on his other hand. Record number of repetitions in 10 seconds. Observe quality of movement and compare to less affected side.

6.1.3 Strength

Manual Muscle Testing:

For *manual muscle testing* protocols, please see:

Clarkson, H. (2012). *Musculoskeletal assessment: Joint range of motion and manual muscle testing* (3rd ed.). Philadelphia: Lippincott Williams & Wilkins.

For further information regarding *grip strength* assessment, please see:

Fess, E. (2011). Functional tests. In T. M. Skirven, A. L. Osterman, J. Fedorczyk, & P. C. Amadio (Eds.), *Rehabilitation of the hand and upper extremity* (6th ed., Vol 1, pp. 152–162). Philadelphia: Elsevier Mosby.

For further information regarding *pinch strength* assessment, please see:

Fess, E. (2011). Functional tests. In T. M. Skirven, A. L. Osterman, J. Fedorczyk, & P. C. Amadio (Eds.), *Rehabilitation of the hand and upper extremity* (6th ed., Vol 1, pp. 152–162). Philadelphia: Elsevier Mosby.

6.1.4 Range of Motion

For *passive and active range of motion* measurement protocols, please see:

Clarkson, H. (2012). *Musculoskeletal assessment: Joint range of motion and manual muscle testing* (3rd ed.). Philadelphia: Lippincott Williams & Wilkins.

Goniometry is the preferred method to measure range of motion and should be used to evaluate goals that are targeted towards an increase in range of motion. Range of motion via goniometry should also be used to determine appropriateness for splinting and to measure outcomes of splinting.

6.1.5 Tone

Modified Ashworth Scale:

[Modified Ashworth Scale – Strokingine](#)

A client’s positioning (sitting versus supine) should be consistent over time when measuring tone. It is important to determine and document tonal differences with changes in position and activity. Clinical observations of changes in tone are important.

Consider using a validated questionnaire to help determine the effect of spasticity on the client’s activities of daily living and to assist with goal setting:

Arm Activity Measure (ArMA):

<https://www.kcl.ac.uk/cicelysaunders/research/outcome/rehabilitation/arma>

6.1.6 Pain

“Causes of shoulder pain may be due to the hemiplegia itself, injury or acquired orthopedic conditions due to compromised joint and soft tissue integrity and spasticity” (Teasell et al., 2020. p. 775).

“The assessment of the painful hemiplegic shoulder could include evaluation of tone, active movement, changes in length of soft tissues, alignment of joints of the shoulder girdle, trunk posture, levels of pain, orthopedic changes in the shoulder, and impact of pain on physical and emotional health (Evidence Level C)” (Teasell et al. 2020, p. 775).

It is important to consider the following when assessing pain: a) present at rest and/or with activity, b) specific location, c) quality (e.g. sharp, burning, radiating, etc.), and d) position of the upper extremity. Be sure to differentiate pain from “stretch” and “stiffness”. The presence of spasticity around the shoulder and scapula should be evaluated as it may contribute to malalignment at the shoulder. This information will help determine the cause of pain and help guide treatment.

Pain Scales:

There are a variety of visual analogue and other rating scales for the assessment of pain. Ensure you use a consistent scale over time. The following website describes and has examples of several measures that can be used to assess pain:

[Outcome Measures January 2019.pdf \(britishpainsociety.org\)](#)

Chedoke McMaster Stroke Assessment – Shoulder Pain:

[Chedoke-McMaster Stroke Assessment – Strokengine](#)

6.1.7 Sensation:

For sensation testing protocols please see:

Cooper, C., & Canyock, J. D. (2013). Evaluation of sensation and intervention for sensory dysfunction. In H. M. Pendleton, & W. Schultz-Krohn (Eds.), *Pedretti's occupational therapy: Practice skills for physical dysfunction* (7th ed., pp. 575-589). St. Louis, MS: Mosby, Inc.

Occupational therapists should also consider more in-depth sensory assessments, such as:

- SENSE Assessment (assessment of tactile discrimination, object recognition and proprioception post stroke) <https://youtu.be/G9V3I30pn6S>
- Nottingham Sensory Assessment Revised <http://www.nottingham.ac.uk/medicine/about/rehabilitationageing/publishedassessments.aspx>
- Fugl-Meyer Assessment – Upper Extremity (FMA-UE)
[Fugl-Meyer Assessment of Sensorimotor Recovery After Stroke \(FMA\) – Strokengine](#)

Sensory assessment should include the domains of tactile discrimination, object recognition and proprioception whenever possible (Carey et al., 2011).

For instructions on the use of monofilaments:

[Semmes-Weinstein Monofilaments Instructions.PDF \(healthproductsforyou.com\)](#)

For a demonstration of the Thumb Localization Test, a test of proprioception:

<https://vimeo.com/138227545>.

The reliability and validity of monofilament testing and the Thumb Localization Test has been confirmed for those with chronic stroke (Suda et al., 2020).

6.1.8 Edema

For descriptions of edema assessment methods, please see:

Kasch, M. C., & Walsh, J. M. (2013). Hand and upper extremity injuries. In H. M. Pendleton, & W. Schultz-Krohn (Eds.), *Pedretti's occupational therapy: Practice skills for physical dysfunction* (7th ed., pp. 1037-1073). St. Louis, MS: Mosby, Inc.

7.0 Goal Setting Guidelines:

It is important to identify goals to assist with planning upper extremity treatment and to determine a client's progress. Goals should be made in collaboration with the client to ensure tasks chosen are meaningful and that the client and the occupational therapist are working toward the same outcomes. "Patients and families should be involved in their management, goal setting and transition planning (Evidence Level A)" (Teasell et al., 2020, p. 771).

The Canadian Occupational Performance Measure (COPM) can be used to help a client identify occupational performance issues, which can then be translated into functional goals. The COPM is a client centered outcome measure that determines change over time in a client's self-perception of their occupational performance issues (Law et al., 2014).

SMART goal setting is a method of setting goals which are: Specific, Measurable, Attainable, Realistic and Time-Based. It clearly identifies a client's goals and clarifies when goal attainment has been achieved. SMART goal setting can be combined with the COPM. A copy of the SMART goals can be provided to the client. Some examples of SMART goals include:

- Client will zip up winter jacket independently with right hand in 2 weeks.
- Client will eat all meals independently with left hand using built up utensils in 4 weeks.
- Client will increase Box and Block Test score to 21 (25%) in 4 weeks.

The Arm Activity Measure (ArMA) can also be used to assist with goal setting, especially pre/post spasticity management interventions:

<https://www.kcl.ac.uk/cicelysaunders/research/outcome/rehabilitation/arma>

The following resources may also assist with goal setting:

- Canadian Occupational Performance Measure
<http://www.thecopm.ca>
- SMART Goals
[The first step to healthy change | Heart and Stroke Foundation](#)
- "Goal Setting 101" (short- and long-term goal setting)
[untitled \(strokebestpractices.ca\)](#)

8.0 Treatment Guidelines:

The Canadian Stroke Best Practice Recommendations 5.1.A states: “Patients should engage in training that is meaningful, engaging, repetitive, progressively adapted, task-specific and goal-oriented in an effort to enhance motor control and restore sensorimotor function (Evidence Level: Early-Level A; Late-Level A). Training should encourage the use of patients’ affected limb during functional tasks and be designed to simulate partial or whole skills required in ADL . . . (Evidence Level: Early-Level A; Late-Level A)” (Teasell et al., 2020, p. 772). “All patients with stroke should receive rehabilitation therapy as early as possible once they are medically stable and able to participate in active rehabilitation (Evidence Level A)” (Teasell et al., 2020, p. 770).

High dose, high intensity upper extremity rehabilitation, involving multiple modalities and with a focus on reducing impairment and promoting re-education of motor control within activities of daily living, has shown promising results, even with patients many months after their stroke (Ward et al., 2019).

There are many options available for upper extremity treatment post stroke and typically several modalities are used in any given treatment program. Based on the upper extremity screening and assessment results as well as the client’s goals, specific treatments should be chosen that best suit the client’s upper extremity level. Treatment activities should be task specific, meaningful to the client, and easily graded so optimal challenge can be maintained. Specific treatments may vary depending on availability and relevance to the practice setting. In all practice settings, the client’s body position, scapular alignment and trunk stability as well as the environmental set-up need to be considered to maximize upper extremity function. In addition, “Retraining trunk control should accompany functional training of the affected upper extremity (Evidence Level C)” (Teasell et al., 2020, p. 774). It is also important to educate the client regarding the purpose of the specific treatments being used. Education may enhance client engagement in the treatment process which may then contribute to improved outcomes and ongoing self-management.

Although the optimal goal of upper extremity rehabilitation is to promote motor recovery and function of the affected upper extremity, at times assistive devices and compensatory strategies may need to be incorporated to enable participation. It is important to note that compensatory behavioral changes “can also be maladaptive and interfere with improvements in function that could be obtained using rehabilitative training” (Kleim & Jones, 2008, p. S226); therefore, early instruction in compensatory strategies may be detrimental to learning new skills with the affected arm and interfere with improvements in function that could be obtained through upper extremity rehabilitation. The Canadian Stroke Best Practice Recommendations 5.1.C.i states: “Adaptive devices designed to improve safety and function may be considered if other methods of performing specific functional tasks are not available or tasks cannot be learned (Evidence Level C)” (Teasell et al., 2020, p. 774). Compensatory strategies and the use of equipment should be frequently re-evaluated and weaned as appropriate.

The specific treatments listed in the Treatment Matrix are categorized according to their use with low, intermediate and high-level upper extremities post stroke. Consider combining treatment interventions to promote increased intensity and number of repetitions (e.g., FES of finger extensors combined with use of the Saeboglove, while completing functional grasp/release tasks; FES of wrist extensors combined with use of a mobile arm support), with the goal of restoring the *balance* between agonist and antagonist muscles groups and promoting normal movement patterns. The list is not all-inclusive. Practical tools are included for several treatments identified in the Treatment Matrix.

8.1 Treatment Matrix:

8.1.1 Task specific training, “the repeated, challenging practice of functional, goal-oriented activities” (Lang & Birkenmeier, 2014, p. xi), should be utilized with all treatment modalities. Occupational therapists should strive for increased intensity and number of repetitions of upper extremity use. The optimal number of repetitions is unknown; however, studies suggest that “hundreds of repetitions of task-specific practice may be required to optimize function post stroke” (Birkenmeier, Prager, & Lang, 2010, p. 620). Early therapy can potentially prevent secondary complications such as contractures and learned non-use (Stuck et al., 2014). The use of sensory-based priming prior to or concurrent with task-specific training may also be beneficial for improving upper extremity recovery post stroke (Stoykov et al., 2021). ViaTherapy, an evidence-based application, may also be useful for therapists when developing upper extremity treatment programs post stroke.

Specific Treatments	Low Level Arm	Intermediate Level Arm	High Level Arm
8.1.2 Constraint Induced Movement Therapy (CIMT)	<ul style="list-style-type: none"> ▪ Work toward minimal active movement requirements for CIMT program 	<ul style="list-style-type: none"> ▪ Work toward minimal active movement requirements for CIMT program 	<ul style="list-style-type: none"> ▪ Refer to traditional or modified CIMT program as available ▪ Provide individual program based on CIMT principles
8.1.3 Functional Dynamic Orthoses (e.g. SaeboFlex, SaeboReach, SaeboGlove)	<ul style="list-style-type: none"> ▪ Work toward minimal active and passive movement requirements for functional dynamic orthosis 	<ul style="list-style-type: none"> ▪ Use functional dynamic orthosis (SaeboFlex or SaeboReach) for daily sessions, followed by functional activities without orthosis ▪ Use functional dynamic orthosis (SaeboGlove) for daily sessions and during functional activities 	<ul style="list-style-type: none"> ▪ Wean from functional dynamic orthosis
8.1.4 Functional Electrical Stimulation (FES)	<ul style="list-style-type: none"> ▪ Target wrist extensor and forearm muscles while engaged in task specific activities ▪ Consider using to reduce or prevent shoulder subluxation 	<ul style="list-style-type: none"> ▪ Target wrist extensor and forearm muscles while engaged in task specific activities ▪ Can also target weak muscle groups such as triceps, biceps, finger extensors and thenar muscles while engaged in task specific activities 	
8.1.5 Mental Imagery	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework 	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework 	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework

8.1 Treatment Matrix (continued)

Specific Treatments	Low Level Arm	Intermediate Level Arm	High Level Arm
8.1.6 Joint Protection and Supports	<ul style="list-style-type: none"> ▪ Educate regarding handling and joint protection when sitting, lying, and mobilizing ▪ Use slings with caution and only with frequent re-evaluation to ensure active movement is not restricted and tone is not increasing ▪ Assess need for custom or pre-fabricated splint to assist with positioning 	<ul style="list-style-type: none"> ▪ Wear slings and/or positioning splints ▪ Consider splint to facilitate functional activities ▪ Consider shoulder girdle taping 	<ul style="list-style-type: none"> ▪ Consider shoulder girdle taping
8.1.7 Spasticity Management	<ul style="list-style-type: none"> ▪ Refer to physiatrist / spasticity clinic for medical management if required ▪ Strengthen antagonist muscles post-injection ▪ Assess need for custom or pre-fabricated splint to maintain prolonged stretch ▪ Progress active movement 	<ul style="list-style-type: none"> ▪ Refer to physiatrist / spasticity clinic for medical management if required ▪ Strengthen antagonist muscles post-injection ▪ Progress active movement 	<ul style="list-style-type: none"> ▪ Refer to physiatrist / spasticity clinic for medical management if required ▪ Strengthen antagonist muscles post-injection ▪ Progress active movement
8.1.8 Supplementary Training Programs	<ul style="list-style-type: none"> ▪ Use portions of Level 1 of Graded Repetitive Arm Supplementary Program (GRASP) ▪ Provide individualized home program with daily homework book 	<ul style="list-style-type: none"> ▪ Use Levels 1-3 of GRASP ▪ Provide individualized home program with daily homework book 	<ul style="list-style-type: none"> ▪ Provide individualized home program with daily homework book
8.1.9 Mirror Therapy	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework 	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework 	
8.1.10 Sensory Stimulation and Re-training	<ul style="list-style-type: none"> ▪ Implement protective sensation teaching ▪ Encourage weight bearing positions ▪ Encourage use of vision during functional activities ▪ Engage in sensory retraining program 	<ul style="list-style-type: none"> ▪ Encourage use in functional activities ▪ Engage in sensory retraining program including tactile discrimination, object recognition and proprioception 	<ul style="list-style-type: none"> ▪ Encourage use in functional activities ▪ Engage in sensory retraining program including tactile discrimination, object recognition and proprioception

8.1 Treatment Matrix (continued)

Specific Treatments	Low Level Arm	Intermediate Level Arm	High Level Arm
8.1.11 Range of Motion (ROM) and Strength Training	<ul style="list-style-type: none"> ▪ Maintain / increase ROM through: <ul style="list-style-type: none"> ➢ Facilitation of active movement by therapist (consider using a mirror for visual feedback) ➢ Progression from bilateral to unilateral activities ➢ Active assisted ROM in sitting, supine, or gravity reduced positions ➢ Passive ROM ➢ Self-ROM ▪ Use strength training through available ROM including use of mobile arm support as indicated ▪ Do not use pulleys 	<ul style="list-style-type: none"> ▪ Maintain / increase ROM through: <ul style="list-style-type: none"> ➢ Active ROM while providing verbal and/or tactile cueing (consider using a mirror for visual feedback) ➢ Progression from bilateral to unilateral activities ➢ Active assisted ROM in sitting, supine, or gravity reduced positions ➢ Passive ROM ➢ Self-ROM ▪ Use strength training through available ROM ▪ Do not use pulleys 	<ul style="list-style-type: none"> ▪ Maintain / increase ROM through: <ul style="list-style-type: none"> ➢ Active ROM while providing verbal and/or tactile cueing ▪ Use strength training through available ROM ▪ Monitor carefully if using pulleys
8.1.12 Edema Management	<ul style="list-style-type: none"> ▪ Encourage active, active-assisted and passive movement ▪ Consider retrograde massage ▪ Educate regarding positioning and elevation ▪ Use compression techniques ▪ Assess need for custom or pre-fabricated splint 	<ul style="list-style-type: none"> ▪ Encourage active movement - especially activation of lumbricals, as able ▪ Consider retrograde massage ▪ Educate regarding positioning and elevation ▪ Use compression techniques 	<ul style="list-style-type: none"> ▪ Encourage active movement - especially activation of lumbricals ▪ Consider retrograde massage ▪ Educate regarding positioning and elevation ▪ Use compression techniques
8.1.13 Virtual Reality	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework 	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework 	<ul style="list-style-type: none"> ▪ Use as an adjunct to other treatments ▪ Use as homework

8.1.1 Task Specific Training Guidelines:

- Choose engaging tasks based on client's goals that will translate into self-care, productivity, and leisure activities.
- Repetition is important and massed practice should be encouraged.
- Can refer to it as "rehearsing a task", do it over and over again, making little corrections each time until the movement gets smoother.
- The "task" should be simple but still hard enough to challenge the client and encourage active problem solving.
- Consider use of an arm activity list (see pages 21 and 22 – Arm Activity List A could be appropriate for a low-intermediate level arm; Arm Activity List B could be appropriate for an intermediate-high level arm).
- Homework sheets should be provided and reviewed with clients (see examples on pages 23, 24 and 25 – Homework A for low level arm; Homework B for intermediate level arm; Homework C for high level arm).
- Consider use of a journal with tasks to be done each day.
- Consider use of a treatment contract (see page 26) to encourage accountability.

(Adapted from: Harley, 2013)

Examples of tasks for each upper extremity level:

Low Level:

- Encourage weight bearing during activities of daily living.
- Work on bilateral grasp, e.g. drink from bottle, eat finger food, wash face, etc.
- Use the *affected upper extremity as a stabilizer*:
 - Against the body (or a table), e.g., carry clothes to hamper, hold purse while taking wallet out, carry newspaper against chest.
- Use the *affected hand as a stabilizer*:
 - To "hold" objects in hand (gross grasp or pinch), e.g., hold a water bottle to open it, hold a toothbrush while applying toothpaste with the other hand, hold a container of food while eating with the other hand.

Intermediate Level:

- Use the affected upper extremity as much as possible, e.g., eat finger food, use utensils (build up handles as needed), pour water, stack/wash dishes, brush hair, wring out washcloths, do up zippers, fold towels, turn pages, etc.
- Teach lateral pinch as a starting point (thumb over index PIP joint) e.g. hold bottom of zipper, hold envelope while opening. Concentrate on release of pinch before taking object from hand.
- Focus on ulnar component of grasp and maintaining wrist extension during grasp/release of daily objects.

High Level:

- Focus on individual goals.
- Make the intermediate tasks harder, focus on isolating and then strengthening movements, e.g., practice keyboarding, practice handwriting, use phone, etc.
- Work on tasks that require finger isolation and strengthen thenar and hypothenar muscles.
- Work on in-hand manipulation tasks, e.g. separate coins, wring out/reposition washcloths, etc.
- Increase intensity and number of repetitions.
- Encourage use of affected upper extremity as much as possible in all daily tasks.
- Practice thumb work, e.g. pick up coins, use remote control, practice texting, use flashlight, etc.

ARMACTIVITY LIST A

Name: _____

Add a new activity every day / week.

“2 hands” refers to interlocking grip as needed.

“Under arm” refers to holding item between upper arm and side of body.

Position hand on table in view _____	Hold food with fork when cutting _____
Hold toothpaste _____	Carry a newspaper (under arm) _____
Hold deodorant _____	Carry a towel (under arm) _____
Pull up blankets (2 hands) _____	Carry a purse / wallet (under arm) _____
Use call bell _____	_____
Pick up water bottle (2 hands) _____	_____
Eat finger food (2 hands) _____	_____
Hold washcloth _____	_____
Wash face (2 hands) _____	_____
Brush teeth (2 hands) _____	_____
Hold towel with hand _____	_____
Dry self (2 hands) _____	_____
Wipe table _____	_____
Hold paper down when writing _____	_____
Hold bowl/plate when eating _____	_____
Apply wheelchair brakes _____	_____
Use a fork / spoon to eat _____	_____

Occupational Therapist: _____ Phone: _____

(Adapted from: Thalman, 2002)

WRHA Occupational Therapy Upper Extremity Working Group 2015 and 2021

ARMACTIVITY LIST B

Name: _____

Add a new activity every day / week. Encourage maximal use of affected arm in all tasks.

Fill out menu _____	Put on shoes _____
Use call bell _____	Put on socks _____
Pull up covers _____	Pour liquids _____
Turn on light switches _____	Use fork _____
Drink from a cup _____	Use spoon _____
Eat finger food _____	Use knife _____
Turn pages in a book / magazine _____	Hold phone while talking _____
Brush teeth _____	Use phone; practice texting _____
Brush hair _____	Open fridge _____
Turn on / off faucets _____	Use computer mouse / keyboard _____
Wash self with washcloth _____	Practice handwriting _____
Flush toilet _____	Open doors _____
Wipe self _____	Unload dishwasher _____
Pull pants up and down _____	Put away groceries _____
Do up zippers / buttons _____	_____
Wipe table _____	_____
Take clothes out of closet / drawer _____	_____
Hang up clothes _____	_____

Occupational Therapist: _____ Phone: _____

(Adapted from: Thalman, 2002)

Name: _____

HOMEWORK A

Try to include your arm in as many tasks as possible to give the muscles an opportunity to “turn on”. Please do these exercises **2-3 times a day**. If something hurts, **STOP** what you are doing and discuss with your therapist. (Note: access to some of the objects required for the tasks below may not be possible in hospital settings. Ask your therapist for alternate options as required.)

Lying in bed (on back):

1. “Push” both your shoulder blades and elbows down into the bed. Relax. Repeat 10 times.
2. With your elbow as straight as possible, “push” your hand down into the bed. Relax. Repeat 10 times.
3. Interlock the fingers of both your hands. Raise your hands to the side of your head and make a slow “chopping” motion across your body. Repeat 10 times each direction.

Sitting up:

1. Place your hand flat (palm down) on a pillow (or arm board). “Push” down through your forearm and hand into the pillow or arm board. Relax. Repeat 10 times.
2. “Wash” the tabletop using a washcloth, back and forth and side to side. Use your other hand to help if needed. Repeat for 2 minutes.
3. Interlock the fingers of both your hands
 - a) Reach for and grasp a plastic bottle or other container. Bring it to your chin, then return to the table and let go **each** time. Repeat 8-10 times.
 - b) Eat finger foods with your fingers interlocked.
 - c) Take a washcloth in both hands. Rub over your entire face (you can do it with a wet or dry cloth). Place on your lap and LET IT GO. Pick it up again and repeat 5 times.
4. Place a towel in your armpit. Try to press your arm to your body to keep it there, while your other hand tries to pull it out. Repeat 10 times.
5. Use your weaker hand to hold a plastic bottle. Open the bottle with your stronger hand, then attempt to **let go** of the bottle with your weaker hand. Relax. Repeat 8 times.
6. Bring both your shoulders to your ears. Relax. Pull your shoulder blades towards each other and towards your spine. Relax. Pull your shoulder blades down (toward your seat). Relax. Repeat each exercise 10 times.

Occupational Therapist: _____ Phone: _____

Name: _____

HOMEWORK B

Use your hand as much as possible with everyday activities such as eating finger food, brushing your hair, washing your face, etc. Try the activities first with your weaker hand, only using the stronger hand **AFTER** you have tried a few times. Please do these exercises **at least 2-3 times a day**. If something hurts, **STOP** what you are doing and discuss with your therapist. (Note: access to some of the objects required for the tasks below may not be possible in hospital settings. Ask your therapist for alternate options as required.)

Lying in bed (on back):

1. “Punch” your hand slowly up toward the ceiling. Control it all the way up and down. Repeat 10 times.
2. Bring your hand up to your chin then slowly lower beside you. Repeat 10 times.
3. Grasp the blankets with your hand and pull them up to your chin, then over your head if you can. Push them back down to your waist and let go. Repeat 10 times.

Sitting up:

1. Grasp a washcloth, bring it to your chin, and then return it to your lap/table and let go. Repeat 10 times. Do the same with a water bottle and repeat 10 times.
2. Place a variety of items on a table (cup, brush, washcloth, pen, phone, utensils, etc). Grasp each item and then let go of it onto your lap or bed. Try to get your thumb *fully around* every object you pick up. Make sure you let go of each item as smoothly as possible. Repeat each item twice.
3. Turn pages in a book or newspaper. If you are not able to turn one page at a time, turn several pages at a time. Repeat from start to finish.
4. Try holding a pen (build up the handle if need be) and color in shapes across a page. They can be circles, squares, triangles, etc.
5. Hold your arms out to your side, and then clap your hands in front of you, keeping your arms straight. Make sure you hear a “clap” sound. Repeat 10 times.
6. Pretend to “punch” with your arm. Make sure to punch to the left, in front of you and to the right. Try to keep your thumb pointing up toward the ceiling if possible, during this movement. Repeat 3 times each direction.

Occupational Therapist: _____ Phone: _____

Name: _____

HOMEWORK C

Use your hand for EVERYTHING! Repeat these exercises **at least 4-5 times a day**. If something hurts, STOP what you are doing and discuss with your therapist. (Note: access to some of the objects required for the tasks below may not be possible in hospital settings. Ask your therapist for alternate options as required.)

1. Hold a pen at the bottom. Work your fingertips up the pen to the top, and then back down slowly. Repeat 10 times.
2. While holding a remote or phone in your hand, take your thumb and touch each outside button once, slowly. Make sure you are moving your weaker hand without help from your stronger hand. Repeat 5 times.
3. Place 5 different coins on a table. Pick them up one at a time and place them into your palm. Slowly take them out in order of amount, one at a time, using your thumb and index finger. Repeat 5 times.
4. Hand writing (as appropriate) - do one paragraph a day in the same notebook to compare your progress.
5. Place 3 washcloths in a basin or sink filled with water. Take one washcloth out at a time, squeezing as much water out as possible, using only your weaker hand to turn the cloth in your hand to change the grip. Repeat 5 times.
6. Practice flipping cards with your weaker hand ensuring you get all fingers as flat as possible on each card prior to flipping it. Play solitaire or another card game.
7. Practice squeezing clothespins with your weaker hand, attempting to use the *pads* of your index and middle fingers, as well as your thumb. Place the clothespins around the edge of a bowl or container and then remove them.
8. Practice getting your thumb 'around' every object you pick up with your weaker hand. Compare the movement with how your stronger hand does this movement.

Occupational Therapist: _____ Phone: _____

Treatment Contract

I agree to perform all homework, as developed with my occupational therapist(s) to the best of my ability. I agree to keep a record in my homework book and bring it to all therapy appointments.

The goals we have agreed to work on until _____ are as follows:
(dd/mm/yy)

1. _____
2. _____
3. _____

Client

Occupational Therapist

Date

8.1.2 Constraint Induced Movement Therapy

The Canadian Stroke Best Practice Recommendations 5.1.B.iv states: “**Traditional or modified constraint-induced movement therapy (CIMT)** should be considered for a select group of patients who demonstrate at least 20 degrees of active wrist extension and 10 degrees of active finger extension, with minimal sensory deficits and normal cognition (Evidence Level: Early-Level A; Late-Level A)” (Teasell et al., 2020, p. 773).

“CIMT can be described as either: a) *Traditional CIMT*: 2-week training program, with 6 hours of intensive upper-extremity training with restraint of the unaffected arm for at least 90% of waking hours. b) *Modified CIMT*: often refers to less intense than traditional CIMT, with variable intensity, time of constraint and duration of program” (Teasell, Hussein, Mirkowski et al., 2020, p. 16 & 17).

CIMT is designed to overcome learned non-use by promoting cortical reorganization (Taub et al., 1999).

Principles of CIMT:

- Use the more affected upper extremity in frequent, intense, massed practice tasks.
- Adapt the tasks for optimal challenge.
- Use consistent “coaching” of client by occupational therapist, rehabilitation assistant or trained family member (as able).
- Constrain the less affected upper extremity with a mitt or splint for up to 90% of waking hours (as negotiated between client and occupational therapist).
- Focus on transfer of skills to daily tasks (use of treatment contract and homework).

For information regarding the CIMT program in Winnipeg, please contact the Health Sciences Centre Occupational Therapy Department at 204-787-2786. Prior to acceptance into a CIMT program or in the absence of a formal CIMT program, occupational therapists should incorporate CIMT principles into a client’s daily therapy sessions and home programs as early as possible.

8.1.3 Functional Dynamic Orthoses

The Canadian Stroke Best Practice Recommendations 5.1.c.ii states: “Functional dynamic orthoses may be offered to patients to facilitate repetitive task-specific training (Evidence Level B)” (Teasell et al., 2020, p. 774).

One example of a functional dynamic orthosis is the SaeboFlex. Significant improvements in impairment-based outcomes as well as activity-based outcomes have been observed after SaeboFlex use (Frank et al., 2013; Stuck et al., 2014) while those who use the SaeboFlex earlier in their rehabilitation programs have demonstrated greater improvement and require the SaeboFlex for less time than those who started later (Rickards et al., 2015). Improvements in postural control have also been noted (McCombe Waller & Prettyman, 2012).

Active wrist and finger extension are not required for SaeboFlex use, as they are for CIMT programs.

Using a dynamic wrist hand orthosis that positions the wrist and hand functionally and assists with finger / thumb extension (e.g. SaeboFlex or SaeboReach), can enable independent participation in an intensive, repetitive upper extremity training program not otherwise possible (Hoffman & Blakey, 2011). The adjustable nature of the SaeboFlex and SaeboReach allows the therapist to increase the degree of challenge as the user progresses; the level of spring resistance used to help open the hand depends on the degree of weakness, the amount of spasticity, the amount of voluntary control as well as the therapy goals (Hoffman & Blakey, 2011). After the orthosis is removed in the daily training sessions, continued practice using the upper extremity in grasp / release and functional activities is recommended.

Some functional dynamic orthoses, for those with minimal spasticity, can be worn for longer periods of time and used during daily activities (e.g. SaeboGlove).

For eligibility criteria and information on Saebo functional dynamic orthoses, please see <http://www.saebo.com/>.

Occupational therapists must be trained in order to prescribe and use Saebo orthoses with their clients. Guidelines have been developed to assist therapists in determining which Saebo functional dynamic orthosis may be appropriate for their client. Trained occupational therapists can contact the Toolkit authors for a copy of these Guidelines.

Other types of functional dynamic orthoses may also be available.

8.1.4 Functional Electrical Stimulation

The Canadian Stroke Best Practice Recommendations 5.1.B.iii states: “**Functional Electrical Stimulation (FES)** targeted at the wrist and forearm muscles should be considered to reduce motor impairment and improve function (Evidence Level: Early-Level A; Late-Level A)” (Teasell et al., 2020, p. 773).

The Canadian Stroke Best Practice Recommendations 5.3.A.ii states: “For patients with a flaccid arm (i.e., Chedoke-McMaster Stroke Assessment Impairment Inventory < 3) electrical stimulation should be considered (Evidence Levels: Early-Level B; Late-Level B)” (Teasell et al., 2020, p. 775).

The Evidence-Based Review of Stroke Rehabilitation states: “There is strong evidence that FES treatment improves upper extremity function in acute stroke (<6 months post onset) and chronic stroke (>6 months post onset) when offered in combination with conventional therapy or delivered alone” (Teasell, Hussein, Mirkowski et al., 2020, p. 32). “Functional electrical stimulation may be effective in reducing subluxation and improving motor function in the hemiplegic shoulder” (Teasell, Hussein, Mirkowski et al., 2020, p. 51).

FES should be combined with task specific treatment activities whenever possible.

Some examples of treatment activities to combine with FES of the wrist / finger extensors are:

- Use the back of the hand to move a cup from one place to another on a table.
- Wrap the hand around a cup when the muscle stimulation is off; let go of the cup when the muscle stimulation is on.
- Work on ‘sit to stand’ using both arms on armrests of a chair. When the muscle stimulation comes on, work on straightening wrist and pushing into standing position.
- Use with the SaeboFlex orthosis or the SaeboGlove to facilitate finger extension during the release of therapy balls, water bottle, cup, etc.

Some examples of treatment activities to combine with FES of the shoulder girdle are:

- Perform shoulder shrugs when the muscle stimulation is on.
- Place hand on ball or pillow beside body and push down when the muscle stimulation is on.

FES can also be used to help strengthen other weak upper extremity muscles (including antagonist muscles post Botox injection) as well as improve the uptake of Botox when stimulated via the motor nerve around the time of injection (Royal College of Physicians, 2018). Weak muscle groups such as the finger extensors and thenar muscles can be targeted for strengthening, combined with repetitive practice of tasks that require activation of those muscle groups.

Prior to providing this intervention, occupational therapists need to be trained regarding the use, protocols and contraindications for functional electrical stimulation.

8.1.5 Mental Imagery

The Canadian Stroke Best Practice Recommendations 5.1.B.ii states: “Following assessment to determine if they are suitable candidates, patients should be encouraged to engage in **mental imagery** to enhance upper-limb, sensorimotor recovery (Evidence Level: Early-Level A; Late-Level B)” (Teasell et al., 2020, p. 773).

A recent Cochrane review update states: “Moderate-certainty evidence shows that MP (mental practice) in addition to other treatment versus the other treatment appears to be beneficial in improving upper extremity activity. Moderate-certainty evidence also shows that MP in addition to other treatment versus the other treatment appears to be beneficial in improving upper extremity impairment after stroke” (Barclay, et al., 2020).

Page (2001) states: “. . . mental practice is a technique by which CVA patients can simulate repeated practice using the affected arm. In so doing, activations occur as if the arm were actually being utilized, which may restore some level of function in patients’ affected limbs” (p. 60).

Patients may have greater or lesser ability to perform mental imagery training, post stroke, depending on the area of the brain affected. Patients with parietal lobe damage may have difficulty performing mental imagery, as may patients with frontal lobe and basal ganglia involvement (McInnes, 2016).

Mental imagery is best done in a quiet environment, so distractions are minimized. The client can be instructed in progressive muscle relaxation techniques, which can be done prior to the mental imagery to improve focus. Imagery is often done either immediately before or after practicing actual movements of the affected upper extremity. The client can be instructed to imagine all the steps of a successful functional activity. The affected upper extremity should be placed in the correct position for the start of the movement that is to be imagined. The occupational therapist provides specific written instructions or a voice recording describing the activity to be imagined, including the specific upper extremity movements required to complete the task, the number of repetitions or the duration of the activity. Mental imagery can be done several times a day. The imagery script should be graded as the client improves.

Mental imagery scripts can be composed for many different activities depending on the client’s goals. Examples include:

- Picking up a pen and positioning it in the hand for writing
- Reaching for a towel and drying the other arm with it
- Grabbing a tissue and bringing it up to the nose
- Squeezing water out of a washcloth
- Wiping a counter with a towel
- Using a knife to spread peanut butter onto bread
- Throwing a ball

For an example of a mental imagery script, see page 31.

Additional mental imagery scripts and a manual for use can be found at:

<http://saebomind.saebo.com/>

Mental Imagery Sample Script:

Activity: Reaching for a Cup

Today we are going to imagine that you are reaching for a cup that is sitting on a table in front of you. The cup is half full of water.

- Picture yourself sitting up tall in an armchair with your arm on the armrest.
- Bring your arm forward slowly toward the table in front of you.
- Straighten your elbow as you reach for the cup.
- Open your fingers and thumb as your hand approaches the cup on the table.
- Think about opening your fingers and thumb just wide enough to go around the cup.
- Grasp the cup gently between your fingers and thumb.
- Squeeze your fingers and thumb hard enough to lift the cup slightly off the table without spilling it.

Repeat this imagery task 10 times before moving onto the next imagery task.

8.1.6 Joint Protection and Supports

The Canadian Stroke Best Practice Recommendations 5.3.A.i states: “Joint protection strategies should be applied during the early or flaccid stage of recovery to prevent or minimize shoulder pain and injury. These include:

- a) Positioning and supporting the arm during rest (Evidence Level B)
- b) Protecting and supporting the arm during functional mobility; avoid pulling on the affected arm (Evidence Level C)
- c) Protecting and supporting the arm during wheelchair use; examples include using a hemi-tray, arm trough, or pillow (Evidence Level C)...” (Teasell et al., 2020, p. 775).

8.1.6a Positioning and Supporting the Arm in Lying and in Sitting

The Canadian Stroke Best Practice Recommendations 5.3.A.v states: “Healthcare staff, patients and family should be educated to correctly protect, position, and handle the involved arm (Evidence Level A). For example, careful positioning and supporting the arm during assisted moves such as transfers; avoid pulling on the affected arm (Evidence level C)” (Teasell et al., 2020, p. 775).

“Shoulder pain has been associated with impaired arm movement, reduced participation in rehabilitation activities, longer lengths of hospital stay, and reduced quality of life (QoL). Since shoulder pain is difficult to treat once it is established, prevention, initiated early post stroke, is emphasized. Improper handling, positioning, and transferring can exert stress on the shoulder with negative consequences and should be avoided” (Teasell et al., 2020, p. 775).

The Evidence-Based Review of Stroke Rehabilitation states: “The muscles around the hemiplegic shoulder are often paralyzed, initially with flaccid tone and later with spasticity...Careful positioning of the shoulder serves to minimize subluxation early on and contractures later on, as well as to promote recovery. On the other hand, poor positioning may adversely affect symmetry, balance and body image.” (Saikaley et al., 2018, p.24).

Optimal positioning in lying and sitting should maximize pain free degrees of shoulder abduction and external rotation while maintaining shoulder joint alignment.

For an example of bed and chair positioning handouts, see pages 33 and 34.

The Heart and Stroke Foundation has also developed positioning posters for their Taking Action for Optimal Community and Long-Term Stroke Care (TACLS) resource. These posters can be found at the end of the TACLS manual:

[tacsls-manual-final-eng.ashx \(heartandstroke.ca\)](https://www.heartandstroke.ca/tacsls-manual-final-eng.ashx)

CLIENT'S NAME: _____

Affected side (shaded): **RIGHT**

BED & CHAIR POSITIONING FOLLOWING A STROKE

Lying on affected side**



- Position affected shoulder so that shoulder blade lies flat and arm appears slightly forward from trunk
- Place unaffected leg forward on one or two pillows
- Place a pillow behind back and ensure that they are not lying directly on hip bone

Lying on unaffected side



- Position affected shoulder forward with arm supported on pillow
- Place pillow(s) between legs
- Place a pillow behind back and ensure that they are not lying directly on hip bone

Lying on back (if desired)



- Place pillow behind affected shoulder blade
- Place affected hand on pillow above heart level
- Place pillow beneath affected hip and/or beneath both knees (optional)

Sitting up



- Ensure client sits well back in the centre of chair or wheelchair
- Place arms well forward onto two pillows on table or arm board if available
- Ensure feet are flat on floor or footrests

ENSURE THAT YOU ASK CLIENT "ARE YOU COMFORTABLE?"

If you have any questions, please contact your Occupational Therapist or Physiotherapist

Name: _____

Phone: _____

BED & CHAIR POSITIONING FOLLOWING A STROKE

Lying on affected side**



- Position affected shoulder so that shoulder blade lies flat and arm appears slightly forward from trunk
- Place unaffected leg forward on one or two pillows
- Place a pillow behind back and ensure that they are not lying directly on hip bone

Lying on unaffected side



- Position affected shoulder forward with arm supported on pillow
- Place pillow(s) between legs
- Place a pillow behind back and ensure that they are not lying directly on hip bone

Lying on back (if desired)



- Place pillow behind affected shoulder blade
- Place affected hand on pillow above heart level
- Place pillow beneath affected hip and/or beneath both knees (optional)

Sitting up



- Ensure client sits well back in the centre of chair or wheelchair
- Place arms well forward onto two pillows on table or arm board if available
- Ensure feet are flat on floor or footrests

ENSURE THAT YOU ASK CLIENT "ARE YOU COMFORTABLE?"

If you have any questions, please contact your Occupational Therapist or Physiotherapist

Name: _____ **Phone:** _____

8.1.6b Positioning and Supporting the Arm during Transfers and Mobility

The Canadian Stroke Best Practice Recommendations 5.3.A.d states: “The use of slings should be discouraged with the exception of the flaccid stage given it may discourage arm use, inhibit arm swing, contribute to contracture formation, and decrease body image (Evidence Level C)” (Teasell et al., 2020, p. 775).

The Evidence-Based Review of Stroke Rehabilitation states: “Arm slings are commonly used but are controversial due to potential disadvantages such as encouraging flexor synergies, inhibiting arm swing, contributing to contracture formation, and decreasing body image which may discourage the patient from further use of the affected arm. As tone returns to the shoulder muscles, the risk of shoulder subluxation decreases, and slings can then be withdrawn. Slings tend to hold the limb in a poor position, which may accentuate the adduction and internal rotation posture and may contribute to shortening of tonically active muscles” (Saikaley et al., 2018, p.28).

It is important that all upper extremity positioning and supportive devices are evaluated each visit and that a client is not discharged from an occupational therapist’s caseload without a plan in place for re-evaluation.

If a sling is required for short term use during ambulation and transfers only, occupational therapists should provide education regarding the purpose of the sling, donning methods, potential benefits and risks of use, and the plan for monitoring use of and discontinuation of the sling. To determine if a client may benefit from a sling for short term use, see page 36.

For information on various upper extremity positioning devices, see page 37.

Sling Me?

If other options for supporting the flaccid upper extremity have been ruled out, a sling could be considered. Slings should **NEVER** be left on while in bed or sitting up. Slings are **NOT** for long-term use and need to be continually **REASSESSED**. The following checklist may help determine if a sling is truly the best option for supporting the upper extremity.

	YES	NO
Decreased Tone		
Acute Edema		
Acute Pain		
Decreased sensation / perception / cognition (risk of trauma)		
Less than 10 degrees of active shoulder movement in any plane		
Caregivers need reminder to not pull on arm		

(Adapted from: Thalman, 2008)

If you have multiple “yes” responses, you could consider providing a sling short-term, then re-evaluate at **each visit**. Sling use can lead to pain as well as decreased passive and active range of motion due to immobilization. There is insufficient evidence for the use of slings solely for the prevention or reduction of subluxation. A client **SHOULD NOT** be discharged from caseload with a sling without a plan for immediate follow-up by an occupational therapist.

If a sling is being used only to remind caregivers not to pull on a client’s affected upper extremity, consider use of a brightly colored arm or wrist band instead and provide education to caregivers.

Positioning Devices

Positioning Devices	Pros	Cons
Arm Boards (full or half lap tray or arm trough)	<ul style="list-style-type: none"> ▪ Protects and supports a low tone upper extremity during wheelchair use ▪ Places upper extremity in view of client ▪ Hand is “free” for functional activity 	<ul style="list-style-type: none"> ▪ Upper extremity may be at risk of trauma secondary to falling off of the arm board; strapping is not advised due to possibility of impingement ▪ Requires height adjustable armrests on a wheelchair to obtain ideal position
GivMohr Sling	<ul style="list-style-type: none"> ▪ Distal support promotes weight bearing 	<ul style="list-style-type: none"> ▪ Hand is not “free” for functional activity ▪ Hand piece can be uncomfortable ▪ Hand piece may cause skin breakdown ▪ Difficult to don/doff independently
Omo Neurexa Sling (Otto Bock)	<ul style="list-style-type: none"> ▪ Hand is “free” for functional activity 	<ul style="list-style-type: none"> ▪ May reinforce dependent edema of upper extremity ▪ Difficult to position sling for optimal shoulder joint position (e.g. humeral head elevation) ▪ Difficult to don/doff independently
Hemi Sling		<ul style="list-style-type: none"> ▪ Hand is not “free” for functional activity ▪ Encourages flexor synergy patterns ▪ Contributes to the development of contractures ▪ Restricts active and passive movement ▪ Inhibits arm swing ▪ May impact functional balance and ambulation ▪ Difficult to don/doff independently
Other (e.g.: pocket, belt, shoulder bag, waist pouch)	<ul style="list-style-type: none"> ▪ Low cost ▪ Readily available ▪ Easy transition from support to functional use of arm 	<ul style="list-style-type: none"> ▪ Trial and error for optimal support and position

8.1.6c Positioning and Supporting the Hand

The Canadian Stroke Best Practice Recommendations 5.2.i states: “Spasticity and contractures may be managed by antispastic pattern positioning, range-of-motion exercises, and/or stretching (Evidence Levels: Early-Level C; Late-Level C), a. Routine use of splints is not recommended (Evidence Levels: Early-Level A; Late-Level B), b. In some select patients, the use of splints may be useful and should be considered on an individual basis (Evidence Level C). A plan for monitoring the splint for effectiveness should be implemented and followed (Evidence Level C)” (Teasell et al., 2020, p. 774).

A recent systematic review evaluating stretching and splinting interventions for post stroke spasticity determined: “for improving functional tasks, moderate strength of evidence was found to support the use of static splinting, dynamic splinting and manual stretching...” (Kerr et al., 2020) while “prolonged stretch may be provided through splinting, casting or strapping...” (Royal College of Physicians, 2018, p. 89).

Occupational therapists should assess each client individually to determine if splinting would be beneficial to promote function, manage spasticity, prevent contracture, and/or assist with positioning for pain and/or edema management. Splinting should always be seen as an adjunct to active task practice and movement retraining. As with any treatment intervention, clear goals should be documented and outcome measurement should occur (College of Occupational Therapists & Association of Chartered Physiotherapists in Neurology, 2015).

If the goal of splinting is to *prevent* joint deformity (maintain range of motion) or *treat* joint deformity (increase range of motion); further considerations may include the length of time post stroke and the amount of spasticity present, along with what/if any other interventions are being trialed to reduce the spasticity (Copley & Kuipers, 2014).

Bondoc and Harmeyer (2013) note that “if muscles are biomechanically imbalanced, and soft tissues shortened, functional motor recovery will be very challenging for the client” (p. 12).

Muscle imbalance between the extrinsic and intrinsic hand muscles is common post stroke. Therapy should focus on improving this balance (strengthening weak intrinsic muscles) as well as minimizing complications (e.g., joint contractures) through proper positioning and support of the wrist and hand.

Additional *splinting considerations* include:

- “For acute stroke survivors, 35° of wrist extension with MCP’s, PIP’s and DIP’s in neutral” is recommended (Saebo Inc., 2013, p. 37).
- “For chronic stroke survivors, start with the wrist in flexion and finger joints in neutral. Passively extend the wrist until resistance is felt (fingers begin to curl). This is the initial wrist position for splinting (“catch one” or resistance, R1)” (Saebo Inc., 2013, p. 37). “The wrist may be extended to a greater angle as long as the digits are maintained in composite extension to achieve optimal stretch of the wrist and finger flexors” (Bondoc & Harmeyer, 2013, p. 11).
- The thumb should be positioned “in abduction and extension” (Bondoc & Harmeyer, 2013, p.11).
- Occupational therapists should monitor for tingling in the fingers (thumb, index, middle and ring fingers) if splinting the wrist in flexion, as the median nerve may be compressed. If median

nerve compression neuropathy occurs, wrist may need to be moved out of flexed position, sacrificing finger extension.

- Occupational therapists should “constantly monitor the progression of the client’s hand by evaluating the range of motion, soft tissue and joint play, and the type of volitional control the client has regained” (Bondoc & Harmeyer, 2013, p. 11). Occupational therapists should also monitor skin integrity and ensure passive range of motion of wrist, finger and thumb joints is maintained, when splint is removed. This may include the addition of self-range of motion exercises (see pages 56-61).
- Occupational therapists should consider splinting with a flexible material that allows fingers to move through flexion with increases in tone (e.g., Aquaplast 3/32), in order to provide a stretch to the long finger and wrist flexors while maintaining joint integrity.
- Serial splinting could be used to progressively increase range of motion (e.g. elbow, forearm, wrist and/or fingers).
- Splinting that provides joint support to facilitate function may also be considered (e.g. opponens splint or dorsal wrist cock-up splint) (Bondoc & Harmeyer, 2013).
- The SaeboStretch is one option available for clients who are able to achieve at least neutral wrist extension with all finger joints in composite extension. Occupational therapists must be trained in order to prescribe and use Saebo orthoses with their clients. For eligibility criteria and information on SaeboStretch orthoses, please see www.saebo.com.
- Ensure education is provided regarding wearing schedules and precautions when a client is provided with a splint. Occupational therapists should monitor the effectiveness of the splint in regards to the specific goals and adjust or discharge the splint as required. Additional information should be provided at the time of discharge, if the client still requires the use of a splint. For an example of a splint instructions handout, please see page 40.

Splint Instructions

PURPOSE OF YOUR SPLINT:

- The splint prescribed was made for you to:
 - Stretch your hand, wrist and/or fingers
 - Support your hand, wrist and/or fingers
 - Prevent contractures (i.e. permanent joint stiffness)
 - Reduce swelling
 - Reduce pain
 - Promote function
 - Stabilize your _____ joint
 - Other: _____

WEARING SCHEDULE:

- Your splint should be worn _____

CARE OF YOUR SPLINT:

- Do not expose your splint to heat sources including a radiator, a stove, the sun, an open flame, hot water or a closed car on a hot day.
- Wash your splint daily with lukewarm water and mild soap. If the straps are removable, they can be hand-washed and laid flat to dry. Splint liners can also be hand-washed and laid flat to dry.

POSSIBLE SPLINT CONCERNS:

- If you notice any of the following issues below, please contact your occupational therapist and discontinue wearing your splint until you are reassessed.
 - Redness or irritation of your skin
 - Pain or numbness in your wrist, hand, or fingers
 - Your fingers or hand are turning blue (circulation is decreased)
 - The splint no longer fits correctly
 - The splint is broken
 - Changes in your finger joints are starting to occur, such as:



Note: If you are no longer followed by an occupational therapist, you will need to obtain a new Occupational Therapy referral from your primary healthcare provider.

Occupational Therapist: _____ Phone: _____

8.1.6d Shoulder Girdle Taping

The Canadian Stroke Best Practice Recommendations 5.3.C.ii states: “Taping of the affected shoulder has been shown to reduce pain (Evidence Level A)” (Teasell et al., 2020, p. 776).

The Evidence-Based Review of Stroke Rehabilitation states: “Taping the hemiplegic shoulder is used as a method to prevent or reduce the severity of shoulder subluxation and may provide some sensory stimulation” (Saikaley et al., 2018, p.31).

There are various taping techniques that are used on the shoulder girdle that seek to optimize alignment and reduce pain (e.g. McConnell approach, Tri-pull).

8.1.7 Spasticity Management

The Canadian Stroke Best Practice Recommendations 5.2.ii states: “Chemo-denervation using botulinum toxin can be used to increase ROM and decrease pain for patients with focal symptomatically distressing spasticity (Evidence Levels: Early-Level B; Late-Level A)” (Teasell et al., 2020, p. 774).

The Evidence-Based Review of Stroke Rehabilitation states: “Botulinum toxin exerts a therapeutic effect by reducing overactivity in spastic muscles through blocking the release of acetylcholine at the neuromuscular junction. The benefits of botulinum toxin injections are generally dose-dependent and last approximately 2 to 4 months (Brashear et al. 2002; Francisco et al. 2002; Simpson et al. 1996; Smith et al. 2000)” (Saikaley et al., 2018, p.56).

The United Kingdom’s National Guidelines for *Spasticity in Adults: management using botulinum toxin* (2018) states, “If used appropriately in the early phases of rehabilitation, it (botulinum toxin) may prevent soft tissue shortening arising from the combined effect of spasticity and limb immobility. This may potentially help to avoid learned disuse and facilitate neurological recovery” (p. 20).

In addition, “post-injection management should include, as appropriate:

- assessment of the need for orthotics / splinting or review of existing orthoses, once the clinical effect of muscle weakening is observed (usually 7–14 days post-injection), and to establish a plan for further review/revision of orthoses as required
- assessment of patient and carer engagement and education on stretching regimes and guidance on task practice activities
- provision of therapy to increase muscle strength of the opposing muscle groups, when indicated
- consideration of other treatments that may enhance the effects of BoNT-A (botulinum toxin) such as constraint therapy or electrical stimulation (of injected and/or antagonist muscle) as appropriate.” (Royal College of Physicians, British Society of Rehabilitation Medicine, The Chartered Society of Physiotherapy, Association of Chartered Physiotherapists in Neurology and the Royal College of Occupational Therapists. 2018, p. 27).

A review of arm function, including range of motion and tone, prior to injection will assist with treatment planning and monitoring of outcomes. Goal setting should occur and may include improving passive function or avoiding progression of impairment, as well as active functional goals, as appropriate (Royal College of Physicians, 2018, p. 22).

It is best to combine botulinum toxin with therapy:

- Occupational therapists should communicate with the physiatrist regarding functional goals, outcome of previous injections and treatment plan.
- Post injection, therapy and home programs can focus on strengthening the antagonist muscles as new movement may now be possible. Active movement training can often be progressed.
- Stretching is widely used “to combat muscle shortening and prevent the development of contractures”; as it is difficult to maintain stretching over a prolonged period or time, “splinting and/or casting are often used to provide a more prolonged stretch” (Royal College of Physicians, 2018, p. 10).
- Splints to help improve range of motion of the elbow, forearm, wrist, and hand as well as functional splints can be considered. Refer to pages 38 and 39 for splinting considerations.
- Splints should be reassessed frequently, including wrist and finger angles, resistance of springs on dynamic splints, wearing schedule, skin integrity, and tolerance as well as changes in functional ability.

8.1.8 Supplementary Training Programs

The Canadian Stroke Best Practice Recommendations 5.1.B.viii states: “Therapists should consider **supplementary training programs** aimed at increasing the active movement and functional use of the affected arm between therapy sessions, e.g. Graded Repetitive Arm Supplementary Program suitable for use during hospitalization and at home (Evidence Level: Early-Level B, Late-Level C)” (Teasell et al., 2020, p. 773).

The GRASP program requires palpable or grade 1 wrist extension and active scapular elevation. A client who is unable to partially open the hand is not appropriate for the GRASP program (Eng et al., 2012). Hospital and home GRASP programs have been developed. Please see the following resource for more details: <http://neurorehab.med.ubc.ca/grasp/>.

Supplementary training programs should be provided so that strengthening, range of motion, fine motor and functional activities completed in therapy can be practiced between therapy sessions with the goal of increasing the intensity and the number of repetitions being done. Since higher repetitions of upper extremity use have been associated with better upper extremity outcomes post stroke (Birkenmeier, Prager, & Lang, 2010), frequent use of the upper extremity between therapy sessions is critical. The use of other therapy interventions such as FES, functional dynamic orthoses, mirror therapy, mental imagery, etc. should also be encouraged, if appropriate, to facilitate intense and repetitive use of the affected upper extremity on a daily basis.

Consider the use of a daily homework log or journal as a way of recording activities done at home, and to increase compliance and accountability.

8.1.9 Mirror Therapy

The Canadian Stroke Best Practice Recommendations 5.1.B.v states: “**Mirror therapy** should be considered as an adjunct to motor therapy for patients with very severe paresis. It may help to improve upper extremity motor function and ADL’s (Evidence Level: Early-Level A; Late-Level A)” (Teasell et al., 2020, p. 773).

The Evidence-Based Review of Stroke Rehabilitation states: “In mirror therapy, a mirror is placed beside the unaffected limb, blocking view of the affected limb and creating an illusion of two limbs as if they are both functioning normally. Mirror therapy functions through a process known as mirror visual feedback wherein the movement of one limb is perceived as movement from the other limb (Deconinck et al., 2015). In the brain, mirror therapy is thought to induce neuroplastic changes that promote recovery by increasing excitability of the ipsilateral motor cortex which projects to the paretic limb (Deconinck et al., 2015). Ramachandran et al. (1995) first used this method to understand the effect of vision on phantom sensation and pain in arm amputees. This method has since been adapted from its original use as a means to enhance upper-limb function following stroke (Sathian et al. 2000)” (Saikaley et al., 2018, p. 87).

“In mirror therapy, a mirror is placed in the client’s sagittal plane so the client cannot see the affected upper limb. The client watches in the mirror the movements made with the healthy limb and simultaneously tries to move the affected limb on the other side of the mirror.” While a mirror ‘box’ is typically used, a larger mirror may be more effective when working on shoulder and elbow movements (McDermott et al., Stroke Engine, 2018).

Mirror therapy can also be used as priming (repetition of specific movements required) for task-specific training to produce improvements in motor function (Bondoc et al., 2018).

A “mirror box” can be purchased (e.g., <http://www.mirrorboxtherapy.com> or [Order the Saebo Mirror Box | Mirror Therapy for Hand Function](#)). Alternatively, mirror boxes can be made by bending cardboard into an inverted V (large enough for the affected hand to fit under) or by using a box with a mirror attached on one side. Homemade versions have been effectively used with many clients.

Mirror therapy can be provided as homework and should include both movement training and tasks (or components of tasks) that are important to the client. Occupational therapists should provide specific written instructions for the client, including the number of repetitions or duration of the activity. For an example of a mirror therapy script, see page 45.

Additional examples of actions and tasks that can be practiced in front of the mirror can be found at: [Mirror Therapy – Upper Extremity – Strokengine](#).

Mirror Therapy Sample Script:

Watch the mirror as you complete the activities. Make sure you are trying to do these activities with your affected (right / left) hand at the same time. Do these exercises a minimum of 30 minutes per day, 5 days per week. Go slowly!

1. Make a fist and then open your hand fully. Repeat 15 times.
2. Pretend to play the piano, pushing each finger on the table one at a time. Continue for 2 minutes.
3. Touch your thumb to the tip of each finger. Repeat 15 times for each finger.
4. Place a washcloth on the table. Wipe the table in a circular motion, back and forth, and up and down, for 2 minutes.
5. Place a water bottle on the table. Grasp it with your hand, lift it up 2 inches, place it back on the table and then let go. Repeat 15 times.
6. Place 5 coins on the table. Pick them up one at a time until they are all in your palm. Place them back on the table, one at a time, using your thumb with your index and middle fingertips. Repeat entire process 3 times.

8.1.10 Sensory Stimulation and Re-training

The Canadian Stroke Best Practice Recommendations 5.1.B.vi states: “Despite mixed evidence, **sensory stimulation** (e.g. transcutaneous electrical nerve stimulation, acupuncture, biofeedback) can be considered as an adjunct to improve upper extremity function (Evidence Level B)” (Teasell et al., 2020, p. 773).

Somatosensory impairment affects one in two people after stroke (Carey, 2012) and includes difficulty “sensing touch, pressure, and temperature; perceiving own limb position; discriminating textures; and recognizing objects through the sense of touch” (Carey, 1995). “Somatosensory impairment is associated with reduced activity participation; however, paresis of upper and lower limbs can mask the contribution of sensory loss” (Carey et al, 2018).

In a recent study looking at stroke survivors’ experiences of sensory changes after stroke, participants identified multiple sensory differences and encountered “various difficulties in completing daily life activities due to sensory changes after stroke” (Alwawi et al., 2020).

As reported in a ‘Study of the effectiveness of neurorehabilitation on sensation (SENSe): a randomized controlled trial’, combining tactile discrimination, proprioception and object recognition training significantly improved sensory capacity, with improvements maintained at 6 months (Carey et al., 2011), while changes in functional arm use were found to be associated with somatosensory skill after SENSe training (Turvill et al., 2017).

SENSe training is based on the *principles* of perceptual learning and learning-dependent neuroplasticity and includes the following principles across the areas of tactile discrimination, object recognition and proprioception training (Carey, 2012):

1. *Select* a sensory task that is important to the client and easily graded for ‘just-right challenge’
2. *Active attention and exploration* of the object with vision occluded, focusing on the differences between textures, objects and movements, to promote training induced neuroplasticity
3. *Feedback* on the ‘exploratory procedure’ used and on the critical features of the sensation
4. *Calibration* – match sensation internally with the unaffected hand and with vision “imagine what the sensation feels like”
5. *Anticipation trials* – limit choices so they know what to expect to feel; start with large differences and progress to smaller differences between textures, objects and movements
6. *Repetition* – intensive training
7. *Progression* - once 75% accurate in determining large differences, make task more challenging
8. *Transfer* of skills to new situations and to functional tasks

Guiding the client to use the preferred ‘exploratory procedure’ for each attribute of object recognition (shape, size, weight, temperature, texture, hardness) should also be included as part of the sensory retraining program. Keeping all attributes as constant as possible, with the exception of the attribute being worked on may be helpful. Aim to eliminate auditory cues during sensory training; use a placement underneath objects or use noise cancelling headphones.

Educating the client / caregiver regarding the purpose of sensation, safety concerns, and upper extremity protection is important as is modifying the environment for safety as required (e.g., adjusting water temperature). For practical retraining examples and safety tips see pages 47 and 48.

Sensory Re-training Practical Examples (aim to practice 30 minutes per day)

1. With your eyes closed and when it is safe to do so, explore the *difference between different textures* starting with textures that are very different from each other; think about how they feel different (e.g., fingers may feel like they ‘slow down’ when moving over rough textures and ‘glide’ across smoother textures). Check with your less affected hand to see how it would accomplish this task. Once you can quite accurately determine the difference between two very different textures, try comparing textures that are more similar to each other. *Imagine* how the texture is supposed to feel.
 - a. Textures may include rubber, glass, leather, fabrics, Velcro, etc.
2. With your eyes closed and when it is safe to do so, explore the *difference between different objects*. Start with objects that are very different from each other in at least one main way and progress toward objects that are more similar to each other. Check with your less affected hand to see how it would accomplish this task and try to copy that technique with your affected hand. *Imagine* how the object is supposed to feel. Some examples include:
 - a. Objects of the same shape, size and texture but have a different *weight* (e.g., a full water bottle compared with a half full water bottle) (*hint*: ‘telling the difference’ will involve unsupported holding of the item)
 - b. Objects of the same weight, shape and size but have a different *temperature* (e.g., a bottle of salad dressing from the cupboard compared with a bottle of salad dressing from the fridge) (*hint*: ‘telling the difference’ will involve prolonged contact of the fingers with the object)
 - c. Objects of the same size, weight and texture but have a different *shape* (e.g., a smooth wooden block compared with a smooth round ball) (*hint*: ‘telling the difference’ will involve feeling for corners and edges) or a fork compared with a spoon
 - d. Objects of the same weight, size and texture but have a different *hardness* (e.g., an empty cup made of a very flexible material compared with an empty cup made from a rigid material) (*hint*: ‘telling the difference’ will involve gentle squeezing/putting pressure on the cup; think about: do your fingers feel like they are getting closer to each other?)
3. Ask your caregiver to gently move your affected elbow (bent versus straight); wrist (bent versus straight); hand (open versus closed) and try to copy that movement with your less affected arm/hand, with your eyes closed and when it is safe to do so (sitting down). Start with movements that are *very different* from each other (e.g., elbow bent all the way compared with elbow straightened all the way) and then as that gets easier, try movements that are not as different from each other (e.g., elbow bent all the way compared with elbow bent half way). *Imagine* how the movement is supposed to feel; it may also help to imagine which way your index finger is pointing.
 - a. Also, can try clapping your hands together at various heights, with/without eyes open
4. Work toward one or two of your ‘hand function’ goals at a time, incorporating the suggestions above into the task you have chosen. Some examples are:
 - a. Using a fork: practice distinguishing the shape, size, texture of the fork from other cutlery you may have (using the techniques mentioned above) prior to using it to try to eat food
 - b. Doing up a bra: run your hand along the material to find the hooks (feel their roughness compared with the smooth material). Practice with larger hooks first and with the material flat on a table, to start.

Safety Tips for Decreased Sensation

After a stroke you may have decreased sensation (feeling) in certain areas of your body, especially your hands and feet. Decreased sensation means that you may have more difficulty feeling pain, pressure, and temperature, making you more at risk of injuring yourself. The following are tips on how to prevent common injuries and increase safety:

- Use your less affected hand to check water temperature (e.g., before having a shower or washing the dishes).
- Label water faucet handles for hot and cold (e.g., red for hot and blue for cold).
- Use your less affected hand to handle sharp, hot or cold objects.
- Look at the position of your affected arm:
 - When your affected arm is actively performing a task (e.g., look before reaching into a cutlery drawer to ensure you do not cut your hand on a knife).
 - When your affected arm is at rest (e.g., look to ensure your hand is not near the stove element or caught between your bed and the bedrail).
- Protect your affected arm during hot and cold seasons:
 - Wear mittens in cold weather to prevent frost bite.
 - Apply sunscreen in warmer weather to prevent sun burn.
- Ensure you are not holding items too tightly which can damage your skin.
- Check your skin daily to ensure there are no pressure (red / darker) areas. Report any changes to your healthcare provider.

8.1.11 Range of Motion and Strength Training

The Canadian Stroke Best Practice Recommendations 5.1.B.i states: “**ROM exercises** (passive and active assisted) that includes placement of the upper limb in a variety of appropriate and safe positions within the patient’s visual field should be provided (Evidence Level C)” (Teasell et al., 2020, p. 773).

The Canadian Stroke Best Practice Recommendations 5.3.A.iii and iv state that to help prevent hemiplegic shoulder pain and subluxation, “Overhead pulleys should not be used (Evidence Level A)” and “The arm should not be moved passively beyond 90 degrees of shoulder flexion or abduction, unless the scapula is upwardly rotated and the humerus is laterally rotated (Evidence Level B)” (Teasell et al., 2020, p. 775).

The Canadian Stroke Best Practice Recommendations 5.3.C.i. states: “Treatments for hemiplegic shoulder pain related to limitations in ROM may include **gentle** stretching and mobilization techniques, and typically involves increasing external rotation and abduction (Evidence Level B). Active ROM should be increased gradually in conjunction with restoring alignment and strengthening weak muscles in the shoulder girdle (Evidence Level B)” (Teasell et al., 2020, p. 775).

The Canadian Stroke Best Practice Recommendations 5.1.B.ix states: “**Strength training** should be considered for persons with mild to moderate upper extremity impairment for improvement in grip strength (Evidence Level: Early-Level A; Late-Level A). Strength training does not aggravate tone or pain (Evidence Level A)” (Teasell et al., 2020, p. 773). The Canadian Stroke Best Practice Recommendations 5.3.E.i states: “Active, active assisted, or passive ROM exercises can be used to prevent Chronic Regional Pain Syndrome (CRPS) (Evidence Level C)” (Teasell et al., 2020, p. 776).

Active range of motion should be encouraged as early as possible, to facilitate neuroplasticity, maintain muscle length and prevent soft tissue contracture (Sheean et al., 2010). Therapists should consider the use of gravity reduced positions to facilitate active movement (e.g., supine, side-lying). Once movement becomes more selective, task practice and active movement retraining, as well as progressive strength training should focus on areas of weakness, generally including shoulder external rotation (to promote improved alignment at the shoulder), supination/pronation, elbow, wrist and finger/thumb extension as well as strengthening of hand intrinsic and thenar muscles. Training should focus on restoring the muscle balance (the interplay of positive and negative features in specific muscles groups of the arm and hand) (Copley & Kuipers, 2014) and on progressing isolated movement. Knowledge of functional anatomy and the action of muscles is essential. Place and hold exercises can be considered as a starting point for weak muscle groups.

Active assisted range of motion describes the client initiating maximal active movement with their affected upper extremity; the movement is then completed by either the client using their less affected upper extremity to assist their affected upper extremity or by the therapist providing assistance.

Passive range of motion should be provided by occupational therapists or trained caregivers to help maintain full joint range of motion and to prevent contractures.

Self-range of motion is often provided to clients as homework to maintain or improve joint range of motion. Self-range may not be appropriate if the client does not have the cognitive abilities to carry out recommendations independently and safely. For an example of a *self-range of motion* program, see pages 50-61.

Self-Range of Motion Exercises for the Arm

What is self-range?

Self-range of motion exercises can be used after a stroke when one arm or hand is unable to perform exercises on its own. During self-range, the less affected arm is used to help the affected arm or hand through the desired movement.

Why is it important?

It is important to move the affected arm to keep the muscles mobile and the joints flexible. Other benefits may include:

- Prevention of stiffness
- Improved movement within the joint
- Improved sensory and body awareness
- Reduced swelling

Most importantly, self-range of motion exercises can help make daily activities (e.g., dressing, grooming) easier.

General Guidelines

- Participate in these exercises at least _____ time(s) a day.
- Keep movements slow and controlled; avoid rapid and jerky movements.
- Hold each position for at least 5 seconds, or as indicated by your therapist; passive range of motion for stretching due to spasticity management will frequently be held longer.
- Do not “overdo it”; do not force the movement.
- Exercises will cause a stretch but should not cause sharp pain.
- If exercises cause sharp pain, stop until you are able to speak to your therapist.

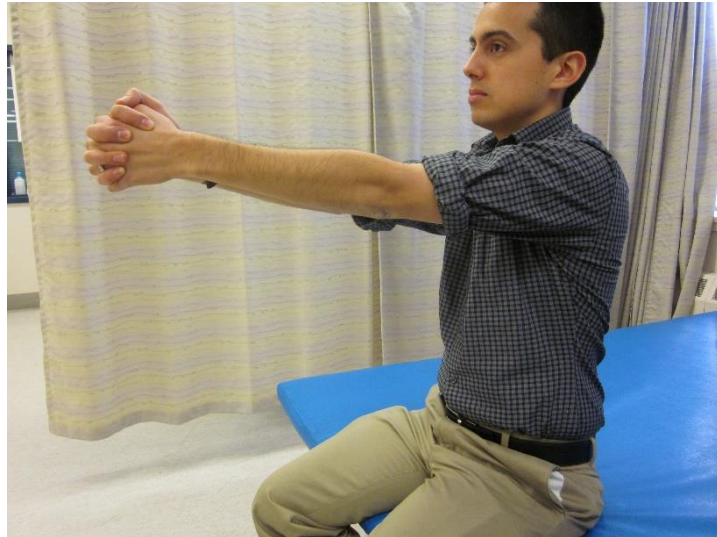
If you have any questions, contact your therapist _____ at _____.

Shoulder Flexion

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by:
 - Interlocking your fingers with your affected (right/left) thumb on top.
 - Holding your wrist to support your affected (right/left) arm.
2. Raise your arms forward and up to shoulder height, leading with your thumb(s) if possible
3. Try to keep both elbows straight.
4. Hold for several seconds.
5. Slowly lower your arms.



Shoulder Abduction

Starting position: Lying on back Sitting

Repeat _____ times.

1. Support the elbow, forearm and wrist of your affected arm (right/left) with your less affected arm (right/left), as if holding a baby.
2. Move your affected (right/left) arm *slowly* away from your body and hold that position for several seconds. The goal is to get your elbow to almost shoulder height.
3. Attempt to move your arms only, without moving the rest of your upper body.

NOTE: photos below show start and end position of abduction of the *left* shoulder



Shoulder External Rotation

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by:

- Interlocking your fingers with your affected (right/left) thumb on top.
 - Holding your wrist to support the affected (right/left) arm.
2. Keep your elbows bent and close to the sides of your body.
 3. Use your less affected (right/left) arm to move your affected (right/left) arm away from your body. Keep the elbow of your affected (right/left) arm bent and ‘tucked into’ your body.
 4. Hold for several seconds.

NOTE: photos below show start and end position of external rotation of the *left* shoulder



Elbow Flexion / Extension

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by:

- Interlocking your fingers with your affected (right/left) thumb on top.
 - Holding your wrist to support your affected (right/left) arm.
2. Bend your elbows to bring your hands toward your chest. Try to touch your chin.
 3. Straighten your elbows. Attempt to straighten both elbows fully.
 4. Hold for several seconds.



Forearm Supination/ Pronation

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by:
 - Interlocking your fingers with your affected (right/left) thumb on top.
 - Holding your wrist to support the affected (right/left) arm.
2. Keep your affected (right/left) elbow bent and close to the side of your body, with your hands pointing forward.
3. Use your less affected (right/left) arm to rotate your affected (right/left) arm so the palm faces upward. Hold for several seconds.
4. Use your less affected (right/left) arm to rotate your affected (right/left) arm so the palm faces downward. Hold for several seconds.

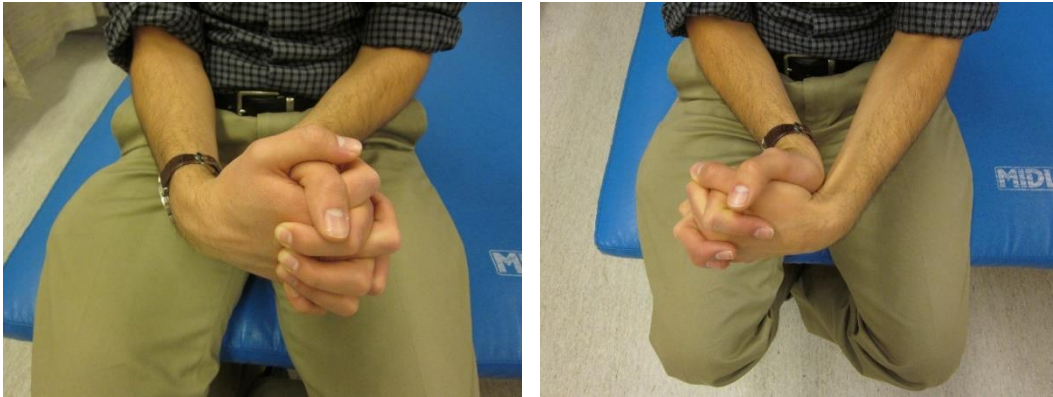


Wrist Flexion / Extension

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by:
 - Interlocking your fingers with your affected (right/left) thumb on top.
 - Holding your wrist to support the affected (right/left) arm.
2. Keep your elbows bent and close to the side of your body, with your hands pointing forward.
3. Use your less affected (right/left) hand to bend your affected (right/left) wrist to the left.
4. Use your less affected (right/left) hand to bend your affected (right/left) wrist to the right.
5. Hold each position for several seconds.



Composite Wrist/Finger Extension

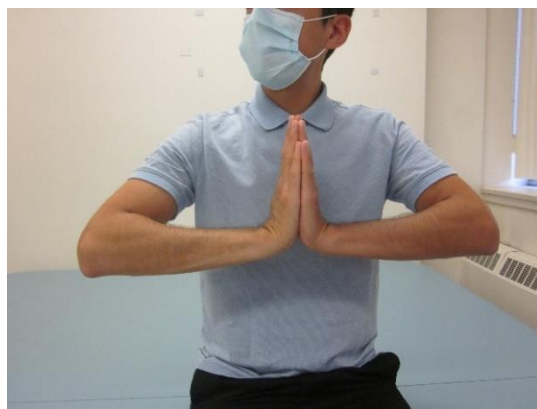
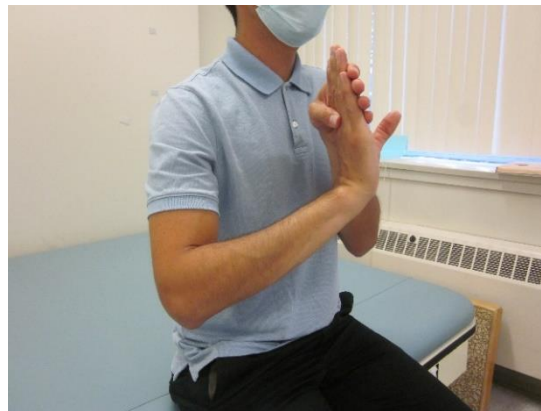
Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Place the fingers of your less affected (right/left) hand against the palm/lower part of your fingers of your affected (right/left) hand.
2. Keep your elbows bent and close to the side of your body, with your hands pointing forward.
3. Use your less affected (right/left) hand to straighten the *fingers* of your affected (right/left) hand.
4. Once the *fingers* of your affected (right/left) hand are straight or nearly straight, continue to slowly move your unaffected (right/left) hand until your affected (right/left) *wrist* straightens as well.
5. Hold for several seconds.

NOTE: Ensure you are straightening the wrist as well as the fingers; excessive extension force into just the finger joints may cause excessive hyperextension at the finger joints.

NOTE: *Alternate position* in bottom photo; ensure entire length of fingers and palms of both hands are ‘touching’ as much as possible.



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Wrist Radial/ Ulnar Deviation

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by:
 - Interlocking your fingers with your affected (right/left) thumb on top.
 - Holding your wrist to support the affected (right/left) arm.
2. Keep your elbows bent and close to the side of your body, with your hands pointing forward.
3. Use your less affected (right/left) hand to bend the affected (right/left) wrist so your hand moves toward your chest.
4. Use your less affected (right/left) hand to bend your affected (right/left) wrist so your hand moves away from your chest.
5. Hold each position for several seconds.



Finger Flexion / Extension

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by placing your affected (right/left) arm on your lap or a table.
2. Use your less affected (right/left) hand to bend all the fingers of your affected (right/left) hand until your fingertips touch your palm. Hold this position for several seconds.
3. Use your less affected (right/left) hand to open all the fingers of your affected (right/left) hand so they are straight. Hold this position for several seconds.

NOTE: Can bend and straighten fingers individually or all together, whatever is necessary to apply the greatest 'stretch' to each finger.

NOTE: Fingers should not be straightened any more than 'neutral' as excessive hyperextension can damage finger joints.



Thumb Flexion / Extension (2 exercises)

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

Top two photos:

1. Begin by placing your affected (right/left) arm on your lap or a table.
2. Use your less affected (right/left) hand to move your affected (right/left) thumb to touch the base of your little finger.
3. Use your less affected (right/left) hand to move your affected (right/left) thumb away from your hand (try to support and keep the small joint of your thumb straight during this exercise).

Bottom two photos:

4. While supporting your affected (right/left) hand on your lap or a table, use the fingers of your unaffected (right/left) hand to gently bend (and then fully straighten) the small joint of your thumb. Hold each position for several seconds.

NOTE: the top two photos show one exercise (described in 1-3) while the bottom two photos show the second exercise (described in 4).

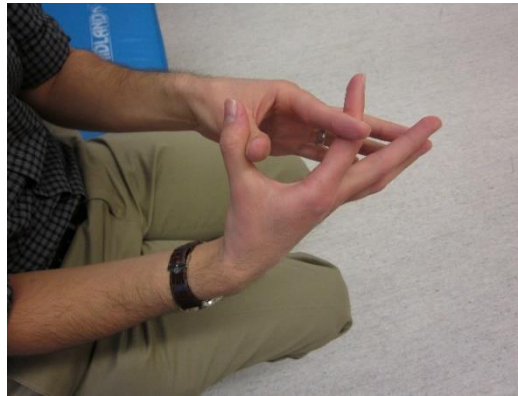


Thumb Abduction

Starting position: Lying on back Lying on less affected (right / left) side Sitting

Repeat _____ times.

1. Begin by placing your affected (right/left) arm on your lap or a table.
2. Use your less affected (right/left) hand to move your affected (right/left) thumb away from your palm (stretch thumb and index finger apart).
3. Hold for several seconds.



8.1.12 Edema Management

The Canadian Stroke Best Practice Recommendations 5.3.D states:

- i. “For patients with hand edema, the following interventions may be considered:
 - a) Active, active-assisted, or passive ROM exercises (Evidence Level C)
 - b) When at rest, the arm should be elevated if possible (Evidence Level C)
 - c) Retrograde massage (Evidence Level C)
 - d) Gentle grade 1-2 mobilizations for accessory movements of the hand and fingers (Evidence Level C)
- ii. There is insufficient evidence for or against compression garments, e.g. compression gloves (Evidence Level C)” (Teasell et al., 2020, p. 776).

“Active and active-assisted extremity movement patterns produce muscular contractions that assist venous and lymphatic return of the fluid” (Ryerson & Levit, 1997, p. 771).

Since “the lumbrical muscles act as the edema pumps for the hand” (Pitts and O’Brien, 2008, p. 462), every effort should be taken to encourage hand positions and tasks that activate the lumbricals as much as possible. This may include tasks such as flipping cards (encourage full ‘straight finger’ contact with the card), holding cards while playing a card game or tasks that encourage a ‘clam style’ pinch, including using clothespins, picking up small game pieces, putting together/pulling apart building blocks, etc. Strengthening of weak lumbrical muscles should include a ‘place and hold’ exercise, in a position of MCP flexion and IP extension and progress toward a ‘blocking’ type of exercise (blocking MCP extension while encouraging active IP extension).

In general, elevating the upper extremity with the hand above the heart can be beneficial in edema management. When sitting or lying down, pillows can be used to assist with positioning the hand (Kasch & Walsh, 2013).

“Compression bandaging may have benefits in the management of edema after stroke” (Gustafsson et al., 2014, p. 203). Compression gloves, sleeves, and wrapping for finger edema (e.g., Coban) can be used and monitored frequently. Adjust wearing schedules as needed to ensure use of glove/sleeve/wrapping is not interfering with the client’s attempts to actively use the hand in daily functional activities.

Splints may be considered and trialed to manage hand edema in the low-level arm post stroke, however they need to be frequently evaluated. They should not be long term interventions or used during the day if they interfere with active movement. Refer to splinting considerations on pages 38 and 39 as needed. Provide client handout regarding splint instructions on page 40 as needed.

Edema can restrict both active and passive range of motion therefore interventions aimed at minimizing edema should be provided as early as possible.

A combination of interventions is typically used for edema management.

8.1.13 Virtual Reality

The Canadian Stroke Best Practice Recommendations 5.1.B.vii states: “**Virtual reality**, including both immersive technologies such as head mounted or robotic interfaces and non-immersive technologies such as gaming devices can be used as adjunct tools to other rehabilitation therapies as a means to provide additional opportunities for engagement, feedback, repetition, intensity and task-oriented training (Evidence Level: Early-Level A; Late-Level A)” (Teasell et al., 2020, p. 773).

Examples of non-immersive systems are the Nintendo Wii, SaeboVR and the SaeboReJoyce.

Further research continues to emerge in this developing area of upper extremity rehabilitation.

9.0 Reassessment Guidelines:

It is important to frequently reassess a client's upper extremity function to monitor progress and modify treatment plans. Reassessment helps to determine if a client's goals have been met or need to be revised. Reassessment can include re-administering initial assessment tools and reviewing SMART goals with the client, as well as evaluating use of the upper extremity in activities of daily living. Treatment plans may be modified based on reassessment results.

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