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Medical Rehabilitation • Therapeutic Preschool • Employment Services

Constraint Therapy in Stroke Rehab—
The Cooperation of Neuroplasticity and Behavioral Intervention

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Objectives

- Define Constraint Therapy
- Understand the strengths of constraint intervention based on it's foundational theories
- Know for whom to recommend use of constraint intervention
- Consider ways to make it an accessible intervention to more individuals post stroke

What is it?

- *A short-term,* ***intensive intervention*** *that involves* ***constraint*** *of the non-involved arm and* ***intensive movement practice*** *of the involved arm." (Ostendorf and Wolf, 1981)*

- Constraint: the state of being checked, restricted, or *compelled* to avoid or perform some action.

What is it?

- CIMT combines ideas from a range of theories
  - Neuroplasticity of the brain
  - Behavioral-Analytic Psychology
  - Learning theories including shaping
  - Motor learning theories
  - Sensory Processing
  - Occupation-based theories

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Photo Credit: http://www.freeiconspng.com/img/837

Why is it relevant to practice?

- Highly researched
- Consistently results in improvements in physical and daily functional performance
- Gains are resilient, and tend to endure over time

Why is it relevant to practice?

- CIMT has been thoroughly researched over the passed 30 years and yielded consistent functional gains in this population.
  - "This treatment has been shown to substantially increase the amount of use of an affected upper extremity after stroke and also greatly alter the size of the regional brain activity or activation pattern associated with the more affected arm)" (Gauthier et al., 2008)

NEUROPLASTICITY

Neuroplasticity

- Plasticity
  - "The adaptive capacity of the CNS…the mechanism by which the brain relearns lost behavior in response to rehabilitation" (Kleim & Jones, 2008)

http://lepilates.com.au/wp-content/uploads/2016/05/neuroplasticity.jpg

Principles of Neuroplasticity
(Kleim & Jones, 2008)

- Use it or lose it
- Use it and Improve it
- Specificity
- Repetition Matters
- Intensity Matters
- Time Matters
- Salience Matters
- Age Matters
- Transference
- Interference

Plasticity Over the Lifespan

Experience Expectant Plasticity

- Brian development during sensitive periods
- Dependent on external stimuli to shape neural structure and connections
  - Greenough et al 1987

Experience Dependent Plasticity

- Establishes connective patterns in the brain
- Refines connections over a lifetime
  - Zao et al., 2011

Review of Cellular Change Related to CI Therapy

- Increased cortical representation of important muscle in hand (Leipert et al. 1998, 2000)
- Increased excitability and recruitment of larger number of neurons (Leipert et al. 1998, 200)
- Ipsilateral motor cortex recruitment to facilitate hemi-UE function (Kopp et al. 1999)

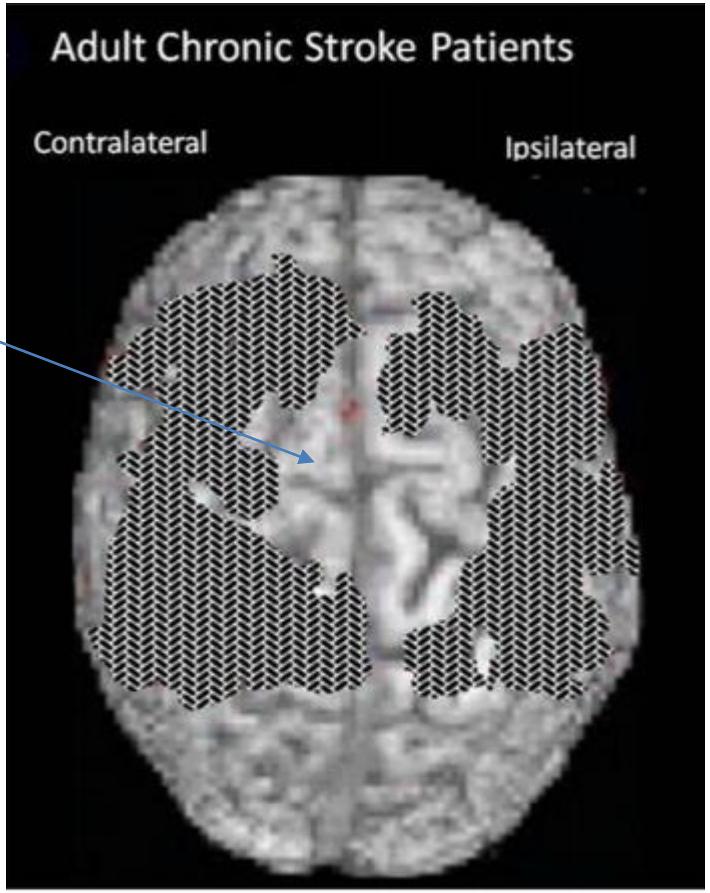
  – Review of results by Taub et al. 2014

Review of Cellular Change Related to CI Therapy

- Increases in grey matter in sensorimotor cortices both contra and ipsilateral to affected arm
  - Increases correlated with increased daily function (Gauthier et al. 2008)
- Increased volume in the posterior hippocampus
  - Associated with memory and learning

  - Review of results by Taub et al. 2014

Grey matter increases



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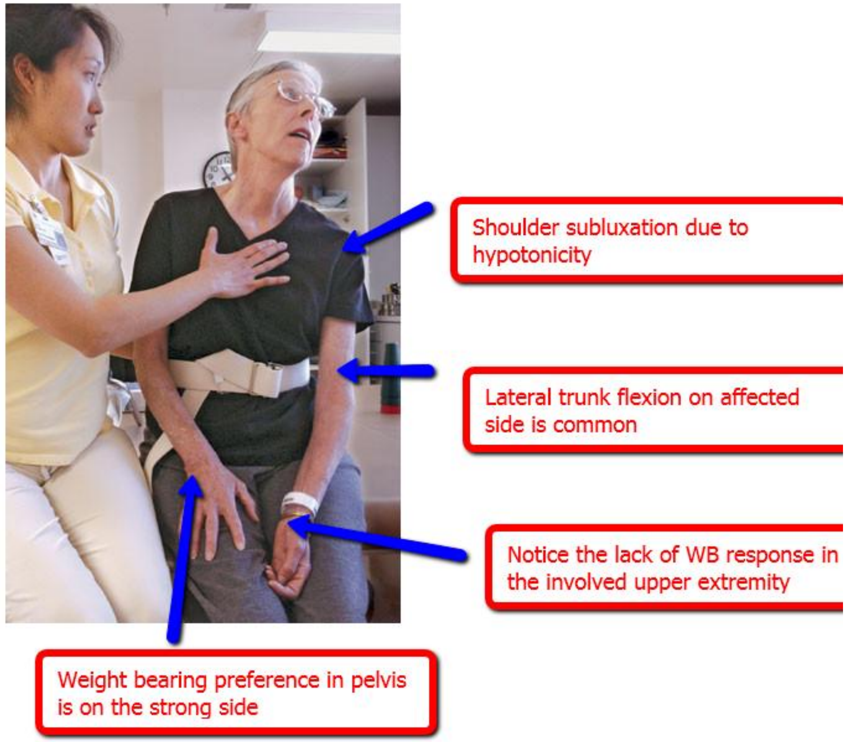
BEHAVIORAL THEORY/INTERVENTION

Review of Behavioral Therapy

- Involves operant conditioning
  - an association is made between a behavior and a consequence for that behavior.
- Demands structure to achieve a preferred outcome
  - Enables massed practice
  - Preferred behavior is encouraged
  - Redirection feedback for non preferred outcome

Behavioral Foundations

- Learned nonuse
  - learning phenomenon of the conditioned suppression of movement. Depression in motor or perceptual function (Taub, et.al. 1999)
  - Most frequently noted in adult and pediatric populations following and acquired injury



https://media.lanecc.edu/users/howardc/PTA204L/204LNeuromuscReEd/204LNeuromuscReEd_print.html

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Behavioral Foundations

- Developmental disregard
  - A behavior of inattention and disuse of an affected limb that results from the child's development of compensatory techniques which engage the stronger UE and avoid use of an impaired UE.

http://noahsdad.com/early-crawling-methods-inchworm/

Principles of Constraint Intervention

- Intense training of the more affected arm
  - High dosage
  - Concentrated repetitive practice
  - Shaping
- Constraint of the less affected arm for 90% of waking hours
    - (Taub, et.al. 1999)
- Home programming and practice

Photo credit: https://sites.google.com/a/macalester.edu/hemispatial-neglect/home/more-recent-approaches

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Impacting Behavior – Clinical Environment

- Constraint
- Daily Structured Interviewing
- Shaping
  - success
- Intense training
- Feedback

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Impacting Behavior—Natural Environment

- Constraint
- Diary
- Home programming/Task Practice

Plasticity and Behavior Interlaced

- Use it or Lose it
- Interference
- Specificity
- Salience Matters
- Behavioral outcomes
  - Immediate
  - Longitudinal

Who is appropriate?
Determinants of Change in Stroke Specific QOL

(Huang, et al., 2013)

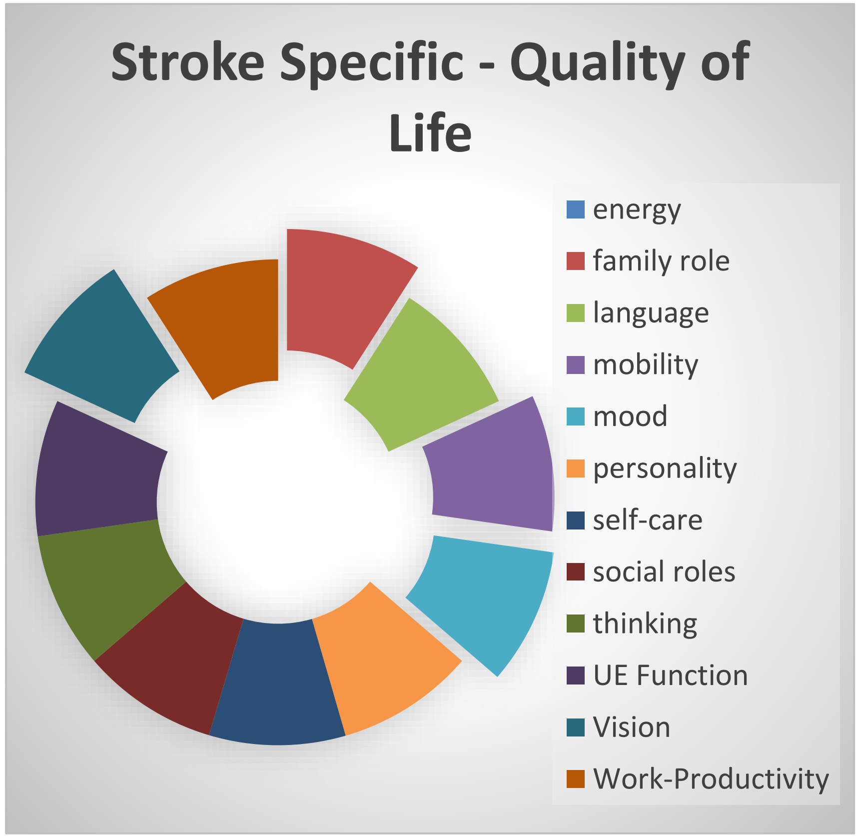
- Measures:
  - Stroke Specific Quality of Life Measure (SS-QOL)
  - Fugl-Meyer Assessment (FMA)
  - Functional Independence Measure (FIM)
  - Nottingham Extended Activities of Daily Living Scale
- Intervention:
  - Assessment 1 week pre and 1 week post intervention
  - dCIT for 2 hr./day, 5 days/wk., x3 wk.; constraint wear 6 hr./day

Determinants of Change in Stroke Specific QOL

(Huang, et al., 2013)

Predictors of SS-QOL

- Side of Lesion
  - Impacted energy
- Time since stroke
  - Impacted energy
  - Impacted Family Roles
- IADL performance
  - Predictor of SS-QOL Mobility domain
- Age
  - Impacted mood



Who is appropriate?

- Individuals with hemiparesis of varying degree
  - Recent or chronic hemiparesis
- Basic attention, reflection, and problem solving skills
- Family/caregiver support
- Motivation for improved arm use

Accessibility to Many Persons

Table 1

CIMT System for Classifying More-affected Arm Impairment in People with Upper-extremity Hemiparesis*

Severity of Impairment	Minimum Active Range of Motion Required				
	Shoulder	Elbow	Wrist	Fingers	Thumb
Grade 2	Flexion ≥45° and Abduction ≥45°	Extension ≥20° from a 90° flexed starting position	Extension ≥20° from a fully flexed starting position	Extension of all MCP and IP (either PIP or DIP) joints ≥10°†	Extension or abduction of thumb ≥10°
Grade 3	Flexion ≥45° and Abduction ≥45°	Extension ≥20° from a 90° flexed starting position	Extension ≥10° from a fully flexed starting position	Extension ≥10° MCP and IP (either PIP or DIP) joints of at least 2 fingers†	Extension or abduction of thumb ≥10°
Grade 4	Flexion ≥45° and Abduction ≥45°	Extension ≥20° from a 90° flexed starting position	Extension ≥10° from a fully flexed starting position	Extension of at least 2 fingers >0° and <10°‡	Extension or abduction of thumb ≥10°
Grade 5A¶	At least *one* of the following:	Initiation of extension**	Must be able to *either* initiate extension of the wrist *or* initiate extension of one digit		

What if it is modified?

- Can be done
  - Longitudinal outcomes unknown
- Try to maintain at least 3 hr. bursts of therapeutic intervention
  - Be creative
- Places even more weight on home programming and self-reflection
- Consistent constraint wear
  - Behavioral contract

QUESTIONS

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