Arm & Hand Rehabilitation after Stroke: From Physiology to Participation

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LEARNING OBJECTIVES

Upon completion of this course, you will be able to:

1. Identify at least two mechanisms of, and strategies to promote plasticity time- and experience dependent plasticity that foster arm and hand motor recovery.
2. Analyze compensatory strategies and their impact on function.
3. Apply principles and evidence-based strategies to improve functional capacity and promote skill acquisition.
4. Assess behavioral theory and psychosocial factors associated with behavioral change that may be necessary to improve participation.

OUTLINE

I.   Introduction to the clinical problem

    A. Stroke can occur at any age: neonates to older adults
(Atkinson et al., 2017b; Basu, 2014; Beslow et al., 2011; Cramer, 2008)

    B. Clinical problems
(Beslow et al., 2011; Kimberley et al., 2017; Lang et al., 2015; Winstein & Kay, 2015)

        1. Infants: Late onset of hemiparesis may delay therapy referral and services

        2. Despite innovative interventions and better activity performance there is limited change in recovery patterns and participation

    C. Limitations to positive recovery
(Friel et al., 2012, 2013; Hardwick et al., 2017; Lang et al., 2015; Winstein & Kay, 2015)

        1. Reduced opportunity for enriched experiences
        2. Psychosocial barriers
        3. Timing and intensity of rehabilitation

    D. Agenda

II. What is compensation in the midst of recovery?

    A. Influences
(Burke & Cramer, 2013; Ezaz et al., 2018; Jones, 2017; Mani et al., 2014; Sainburg & Duff, 2006)

        1. Neural substrate diminished
        2. Delayed or variable recovery
        3. Need for independence vital

    B. Atypical movement patterns

        1. Reduced degrees of freedom *(Bernstein, 1967; Fisher & Winstein, 2000; Vereijken et al., 1992)*
        2. Insufficient muscle activation *(Atkinson & Duff, 2017; Ellis et al., 2018)*
        3. Slow, deliberate, inefficient movement *(Dawson et al., 2010; Fisher & Winstein, 2000)*
        4. Disuse

C. Resultant motor control

    1. Limited or ineffective prehension patterns *(Atkinson & Duff, 2017; Duff & Wolff, in press; Jeannerod, 1984; Goodale & Humphrey, 1998)*

    2. Absent or labored in-hand manipulation *(Duff & Wolff, In-Press, Exner, 1993)*

    3. Interlimb coordination *(Duff et al. 2018; Kantak et al., 2016a; Miller et al., 2018; Krumlinde-Sundholm et al., 2017)*

D. Optimal Theory and fostering motor learning *(Muratori et al., 2015; Shumway-Cook & Woollacott, 2017; Wulf et al., 2017)*

III. What drives neuroplastic mechanisms for motor recovery and learning?

  A. Mechanisms of restitution and learning

    1. Predictors and mechanisms of change in impairments

    2. Interventions to remediate impairments

  B. Time-dependent changes in neural networks following stroke

    1. Potential interventions to harness early post-stroke neural reorganization

  C. Experience dependent changes in neural reorganization

    1. Principles that augment experience-dependent plasticity

    2. Implications on upper extremity interventions

IV. Interventions to augment capacity and skill acquisition

  A. Traditional- Structuring Practice to Facilitate Recovery

    1. Task Related Training

    2. Motor Learning

  B. CIMT

  C. Station-based, UE Task Related Training sessions

  D. Priming

    1. Movement and Sensory Based

    2. Mirror Therapy

    3. transcranial direct current stimulation (tDCS)- with demonstration

  E. Documenting change as shown by Current Research findings

    1. Behavioral changes- outcome measures

    2. Neuroplastic changes with Biomarkers (i.e., fMRI)

  F. Planned studies and Future

V. Behavioral theories, psychosocial factors, and participation

  A. Theories

    1. Motor Relearning

    2. Task Oriented Approach *(Mathiowetz & Bass-Hugen 1994); Gillen & Burkhardt, 2004)*

      a. Systems model of motor behavior

      b. Ecological Approach

  c. Dynamical Systems Theory

    i. Treatment principles - Decisional tree for UE rehab *(Hatem et al., 2016)*
    ii. Outcome measurements of functional recovery i.e., AMPS

 3. Health Belief Model *(Champion & Skinner, 2008)*

  a. Client health beliefs and impact on treatment engagement and motor learning
  b. Treatment principles
  c. Outcome measures of health beliefs
   - Health Beliefs Questionnaire

 4. Transtheoretical Model *(Prochaska et al., 2008)*

  a. Clients stage of readiness to make recovery changes
  b. Treatment principles
  c. Outcome measures of readiness to change - Readiness & Confidence to Change Q

B. Participation
 1. International Classification of Function *(ICF World Health Organization)*

 2. Define participation

  a. Activity selection and engagement
  b. Community participation

 3. Treatment principles. Examples:
   - Review of effective intervention for motor recovery *(Nilsen et al., 2015)*
   - Task-oriented training *(Rowe & Neville, 2018)*
   - Accelerated Skill Acquisition Program *(Winstein et al., 2013)*
   - Interventions for stroke prevention *(Hill & Towfighi, 2017)*

 4. Outcome measurements of participation
  a. SIS
  b. Self-Efficacy
  c. ASPEN/ MAPA

VI. Questions, discussion, conclusion and take-home points

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