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Intervention Techniques for the Hemiplegic Upper Limb

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Learning Outcomes

As a result of this course, participants will be able to:

- Identify current evidence for treatment techniques such as NMES, slings, splints, traditional neurorehabilitation techniques, and functional use.
- State how to increase occupational performance of patients with hemiplegia through addressing underlying performance skills and motor skills.
- List 4 educational topics to address with the patient and their caregivers
Neurofacilitation Techniques

- Brunnstrom’s Movement Theory
  - Limited Evidence
    - Wagennar et al. (1990)
      - Brunnstrom phases vs NDT phases, n = 7
      - One participant performed better with Brunnstrom than NDT
    - Sawner & LaVigne, 1992
      - Studies cited to support the approach were published between 1898-1960

(Sabari, 2010, Gillen, 2011)

- Proprioceptive Neuromuscular Facilitation
  - Smedes, 2006 Systematic review of 4 RCT
    - In a home and structured program Inclusive PNF is effective, treadmill training is more effective than PNF on gait, and NMES is more effective than PNF on hand function
  - Rood
    - No Evidence

(Sabari, 2010, Gillen, 2011)
Neurofacilitation Techniques

- **NDT/Bobath**
  - Langhammer et al, 2000
    - Motor learning better than Bobath
  - Tang et al, 2005
    - Task oriented approach better than NDT
  - Hafsteonsdottir et al, 2005 n=324
    - Bobath vs. standard therapy
    - No difference, Bobath group had more treatment sessions
  - Systematic Review
    - Kollen et al. (2009)- Bobath Concept is not superior to other approaches
    - Rao (2011)- Lack of effectiveness of the Bobath approach when compared with a task-oriented approach

- (Sabari, 2010, Gillen, 2011)

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Neurofacilitation Techniques

- **Proprioceptive Neuromuscular Facilitation, Rood, and Brunnstrom Approach**
  - Evidence “sparse and inconclusive” (Sabari, 2010)
  - Based on outdated views of motor recovery and motor control (Ma & Trombly, 2002; Pollock, Baer, Pomeroy, & Langhorne, 2007; Steultjens et al., 2003)

- **Neurodevelopment Treatment**
  - No evidence of significantly better outcomes for NDT when compared with other treatments to improve upper limb motor function (Luke, Dodd, & Brock, 2004; Packi, 2003)

(Sabari, 2010, Gillen, 2011)
Shift in Rehabilitation Approach

- Self Examination
- Intervention supported by Evidence and Research
- Paradigm shift from traditional theories to Neuroplasticity and Task Oriented Approach

Task Oriented Approach

- Based on systems model of motor control and theories of motor learning
- Therapist is a teacher of motor skills
  - Select contextually appropriate functional tasks
  - Vary tasks to increase transfer of learning
  - Provide feedback

Positive Effects of Task Oriented Approach on Impairment level and Function

- Barker et al., 2008
- Blennerhasset et al., 2004
- Caraugh et al., 2006
- Michaelson et al., 2006
- Nelles et al., 2001
- Stinear et al., 2008
- Theilman et al., 2004
- Weinstein et al., 2004

Task Oriented Approach

- Hubbard et al, 2009, Systematic Review
  - “We recommend that task-specific training be routinely applied by occupational therapists as a component of their neuromotor interventions, particularly in management related to post-stroke upper limb recovery”
Functional activities vs. Non-functional activities

- Improved function of hemiplegic upper limb when using functional objects and activities vs. performing similar movement sequences in the absence of task performance
  - (Wu, Trombly, Lin, and Tickle-Degnen, 1998; Trombly and Wu, 1999; Wu, Trombly, Lin, and Tickle-Degnen, 2000; Fasoli, Trombly, Tickle-Degnen, and Verfaellie, 2002; Smedley et al., 1986; Winstein et al., 2004)

- Client’s are not making connection between non-functional activities and functional outcomes

Functional Treatment Activities

- Lower Level – Gross Grasp
  - Placing eating utensils in organizer
  - Placing magazines in organizer
  - Table setting for 8
  - Removing dishes from drying rack
  - Placing tools in tool box
  - Placing CD’s in rack
  - Placing cooking utensils in tall container
  - Placing folded socks in bin/ drawer
  - Placing cans/jars on shelving
Functional Treatment Activities - Bilateral coordination and fine motor coordination

- Folding clothes in laundry basket
- Hanging clothes on retractable clothes line
- Packing a suitcase with clothes
- Putting batteries in remote control
- Putting toilet paper on holder and pull off a sheet
- Installing toilet paper holder on base
- Sanding plywood
- Installing a door knob
- Installing a smoke alarm

- Sorting and assembling assorted sized nuts and bolts
- Separating and placing play money in wallet
- Coins in coin bank or change purse
- Medication into pill organizer
- Wrapping a gift/package
- Stuffing envelopes
- Sorting paper clips
- Cutting and stapling paper
- Sorting coupons
- Scrap booking

Mental Practice - Imagery

- Rehearsing task or series of tasks mentally
  - Cognitive Rehearsal
- No physical activity
- Athletes – Sports psychology
- Supplement conventional therapy
- Used at any stage in recovery
  - (Braun et al., 2006, & Jackson et al., 2001)
Mental Practice

- Activates the musculature in the same pattern that correlates with imagined movements – measurable on EMG
- Activates the cortical representation in the same pattern that correlates with imagined movements – measurable on fMRI
- Improves learning & performance
- Reorganizes motor cortex – Neuroplasticity

(Levine, 2009)

Mental Practice

- Most plausible mechanism to explain “Stored motor plans for executing movements can be accessed and reinforced during mental practice”

(Page, 2001)
Mental Practice – How is it done?
Audio recording
1. Period of deep relaxation (3-5 min.)
2. Mental Practice Portion
   Involve every aspect of the experience including size of room, and full description of the movement including the feel of the movement.
   “Imagine you are sitting in your favorite chair. The room is quiet. There is a table in front of the chair. Imagine there is a cup on that table with fresh apple juice in it. Feel yourself reaching for the cup. Feel the weight of your arm as you reach out. Feel your elbow straightening and your wrist extending. Your hand opens, and your fingertips touch the cool china cup….etc.”
3. Practice in the real world. Three listening sessions to one practice session.
   (Levine, 2009)


Method
- Tape recorded guided imagery + traditional therapy vs. audio placebo + traditional therapy
- Mentally perform series of tasks
  - Ex: reach for cup
- 20 min. – 1 hr/ day, 2-5 sessions/ week, 4-6 weeks

Results
- Significant improvement in Fugl-Meyer and Action Research Arm Test Scores
Liu et al, 2005

- Mental imagery of specific task + traditional therapy vs. Functional training of specific task + traditional therapy

- Method
  - Over 3 weeks, trained to perform 3 sets of daily tasks for 1 hr./day

- Results
  - Mental imagery group had higher ADL function than functional training, no difference in Fugl-Meyer scores

Mental Practice Evidence

- Nilsen, et al., 2010
  - “Consistent and positive outcomes have been documented, including decreased upper extremity impairment, increased upper extremity function, and increase in everyday use of the limb outside of structured therapy”

- Jackson, 2001
  - “Data from psychophysical, neurophysiological, and brain imaging studies support the existence of a similarity between executed and imagined actions.”
Systematic Reviews

- Cotoi, 2018 (ebrsr.com)
  - “There is level 1a evidence that mental practice therapy is effective for improving upper extremity motor function; however, the evidence for its effect on activities of daily living is limited and conflicting.”

- Nilsen, et al., 2010
  - “When added to physical practice, mental practice is an effective intervention. Further research is warranted to determine who will benefit, dosing, and most effective protocols.”

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Neuro Muscular Electrical Stimulation (NMES) after Stroke

- Cyclic Neuro Muscular Electrical Stimulation (NMES)
  - Contracts muscles on a preset schedule, does not require active participation

- Electro Myograph Generated (EMG)
  - Triggered
    - Must actively move to reach established threshold to “trigger” NMES to activate

  (Hill-Herman, 2010)
**EMG – Triggered NMES**

- **How does it work?**
  - Set stimulation intensity and EMG threshold
  - Electrodes sense trace contraction/muscular attempt
  - Device rewards patient with stimulation
  - Begin sequence again…

(Hill-Herman, 2010)

Photos from personal collection of Christine Griffin. Used with permission.
EMG – Triggered NMES Video
Exercise & Functional Use

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Functional Electrical Stimulation (FES)

Cyclic NMES during functional movements and functional activity

- **Adaptive**
  Similar to an adaptive device to be used in order to engage in functional activity

- **Therapeutic**
  Used during therapy in order to retrain brain and muscles how to work and how to work together

- **Supplemental**
  Can be used above and beyond what is done in treatment and can be combined with other interventions

(Hill-Herman, 2010, Popovic et al, 2002)
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Video for FES
Functional Use & Gravity Eliminated AAROM

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NMES Evidence – Systematic Review
Cotoi, 2018 (ebrsr.com)

- “FES, and (cyclic) NMES may help improve impaired upper extremity motor function during all phases of stroke”
- “FES may be more beneficial at improving impaired motor function when delivered early (<6 months) than late (>6 months).”
- “There is level 1a and level 2 evidence that both EMG-triggered and cyclic approaches to NMES/electrical stimulation may improve upper limb motor function”

Slings

- Debated in literature for at least 30 years
  - Variety of available slings
  - Controversy regarding effectiveness
  - When and how slings should be used
  - Possibly add to complications resulting from an extremity affected by stroke
    - (Sabari, 2010, Gillen, 2011)
- Common goals by surveyed therapists
  - Decrease and prevent subluxation and pain
    - (Boyd & Gaylord, 1986)
Slings

- Hurd, 1974, Full arm sling:
  - No difference found in shoulder ROM, pain, or subluxation for pt’s with or without slings
- Zorowitz, 1995, Single-strap hemisling, Bobath roll, Cavalier support, Roylan humeral cuff sling:
  - “No absolute evidence that supports prevent or reduce long term shoulder subluxation” “or that a support will prevent complications of the shoulder subluxation”
- Dieruf, 2005, GivMohr Sling:
  - Reduces a subluxation when worn. No comment on long term effects, functional outcomes, ROM, or pain

(Sabari, 2010, Gillen, 2011)

Slings

- Ada et al., Cochrane Database Systematic Review, 2005
  - “There is insufficient evidence that to conclude whether slings and wheelchair attachments prevent subluxation, decrease pain, increase function or adversely increase contracture in the shoulder after stroke”
- Ebrsr.com, 2012
  - “There is limited evidence that shoulder slings influence clinical outcomes”
Slings and Subluxation – Cailliet, 1980

- If goal of sling is to provide glenohumeral joint stability, then the device must support the scapula on the rib cage in approximation to compensate for lack of support of the rotator cuff.
- Currently no slings on the market assist with realigning the scapula on the rib cage
- Therefore, slings cannot be prescribed to “reduce a subluxation”

(Sabari, 2010, Gillen, 2011)

Slings

- Minimize use!!
- Immediate removal
- Pt. becomes dependent
- Avoid slings that position G-H joint in Internal Rotation
- Investigate alternate means of support
  - Lap trays, positioning in bed

(Gillen, 2011)
Resting hand splints

- Hand splints are widely used to prevent contracture and reduce spasticity.
- Positions the wrist in either a neutral or an extended position
- Worn overnight for, on average, between 9 and 12 hours

(Sabari, 2010, Gillen, 2011)

Evidence for resting hand splint

- Lannin et al., 2003
  - Resting hand splint worn (functional position) at night vs. no splint with PROM included in standard of care
  - The effects of splinting on wrist/digit extension and motor function were statistically nonsignificant and clinically unimportant
  - “An overnight splint-wearing regimen with the affected hand in the functional position does not produce clinically beneficial effects in adults with acquired brain impairment.”
Evidence for resting hand splint

- Lannin et al., 2007
  - Resting hand splint with wrist in neutral position worn at night vs Resting hand splint with wrist in extended position vs no splint with PROM included in standard of care
  - “Splinting the wrist in either the neutral or extended wrist position for 4 weeks did not reduce wrist contracture after stroke. These findings suggest that the practice of routine wrist splinting soon after stroke should be discontinued”

Prevention of Secondary Impairment of Immobility: Splints

- Resting hand splint
  - “Despite numerous studies, two Level I systematic reviews reported that there is insufficient evidence to support the use of resting hand splints as a routine intervention in stroke rehabilitation” (Sabari, 2010)
Questions?

- References available upon request
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