Technology in the Clinic: Exciting Opportunities

Brain Injury Association of PA
Annual Conference
Harrisburg, PA June 22, 2009

Andy Packel, PT, NCS

Objectives

At the conclusion of this session, the participant should be able to:

- Demonstrate understanding of emerging concepts in neuroplasticity and neurorehabilitation.
- Describe new technologies used in treatment of individuals with TBI.
- Verbalize appropriate rationale for use of new technology-driven treatments

Two converging sources

1. Advances in understanding of neuroplasticity

2. New technology-driven treatments

Neuroplasticity

- Definition: Changes that occur to the organization of the brain as a result of experience

- Important area of study and discovery over past 10-20 years

Understanding Neuroplasticity

- Much active research using advanced imaging technologies
  - PET, SPECT, fMRI, DTI, MRS, MEG
- Application of animal studies to humans
- Improved understanding leads to new treatment concepts and ideas

"Old school"

- CNS neurons do not regrow.
  - "Once it's gone, it's gone"
- Brain is static structure influencing movement
- Rehabilitation focuses on compensation vs. recovering lost function

Current Concepts

- In some areas of the brain, new neurons can actually re-grow
- Brain is very dynamic and the influence of brain and experience is 2-way street
- This is the main target of new rehabilitation strategies

Treatment considerations

- Practice is the biggest factor in recovery of function. Period.
  - Amount of practice is #1. More IS better.
  - Motivation/engagement
  - Skilled, appropriately graded activity
  - Feedback received

Practice, practice, practice

- Reaching with monkeys and rats
  - Skilled movements led to neuroplasticity
- Infants/toddlers and motor learning
  - Toddlers walked an average of 39 football fields per day!
  - Fell an average of 15 times per hour

MORE Practice, practice, practice!

- Cigar-making
- Knitting
- Rug-making
- Pearl handling
- Violin playing
- Basketball
- Baseball

Lessons learned

- What is the primary target of treatment?
  "TRAIN THE BRAIN"
- How do we best accomplish?
  - MASSIVE PRACTICE
  - MAKE IT MOTIVATING
  - SKILLED, CHALLENGING ACTIVITIES
  - PERFORMANCE FEEDBACK

"Old" technology tools

- Electrical Stimulation
  - Augments force that patient can produce
  - Provide additional input and feedback
  - ➢ Allows for additional practice

- Biofeedback
  - Electrical muscle biofeedback and others
  - ➢ Provides feedback and knowledge of performance

"A new spin…"

- E-stim bicycle (Ergys)
  - Tool for providing benefits of exercise to individuals with SCI
- E-stim "bracing" for foot drop
  - Bioness L300, Walkaide

“Gaming” technologies

- Increased motivation
- Increased feedback
- ➢ Increased practice

- Ability to grade activity difficulty

Wii

Wii
\+ Rehabilitation

_____

“Wiihabilitation”

Upper extremity re-training

- Constraint induced therapy (CIT)
  - Aka “forced use” therapy
  - Can be enhanced with e-stim, orthoses
- Bioness H200
- Reo robotic trainer

Locomotion training

- How do we achieve required practice for walking ?

Locomotion training

- BWSTT
  - Allows for increased PRACTICE
  - Improved walking motion MAY improve recovery
  - Significant limitations
    - Therapist tolerance!
    - Patient tolerance to harness, unweighting

Locomotion training
Robotic treadmill training

- Addresses limitations of BWSTT
  - Allows for further improved gait motion
  - Therapist tolerance not an issue
  - Can grade activity more objectively

Robotic treadmill training

What's coming next

- Increased use of robotics

- Increased sophistication of computers
  - More elaborate feedback
  - Virtual reality training

- Neuroprosthetics

What's Next

- Re-walk

Questions

References

- Marshall S, Teasell R, Bayona N, Lippert C, Chundamala J, Villamere J, Mackie D, Cullen N, Bayley M. Motor impairment rehabilitation post acquired brain injury. Brain Inj. 2007 Feb;21(2):133-60.
- Brown TH, Mount J, Rouland BL, Kautz KA, Barnes RM, Kim J. Body weight-supported treadmill training versus conventional gait training for people with chronic traumatic brain injury. J Head Trauma Rehabil. 2005 Sep-Oct;20(5):402-15.
- Hornby TG, Campbell DD, Kahn JH, Demott T, Moore JL, Roth HR. Enhanced gait-related improvements after therapist- versus robotic-assisted locomotor training in subjects with chronic stroke: a randomized controlled study. Stroke. 2008 Jun;39(6):1786-92.
- Hesse S. Treadmill training with partial body weight support after stroke: a review. NeuroRehabilitation. 2008;23(1):55-65.
- Callahan J, Parlman K, Beninato M, Townsend E. Perspective: Impact of the IIISTEP Conference on Clinical Practice. Journal of Neurologic Physical Therapy. 2006; 30(3): 157-166.
- Forrester LW, Wheaton LA, Luft AR. Exercise-mediated locomotor recovery and lower-limb neuroplasticity after stroke. J Rehabil Res Dev. 2008;45(2):205-20.
- Kothari S, Flanagan S, Kwasnica C, Brown A, Elovic E. Congenital and acquired brain injury. 5. Emerging concepts in prognistication, evaluation, and treatment. Arch Phys Med Rehabil. 2008; 89 (Suppl 1): S27-S31.
- Nudo, RJ. Postinfarct cortical plasticity and behavioral recovery. Stroke. 2007; 38 (Part 2): 840-845.