

# **Technology in the Clinic: Exciting Opportunities**

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## **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

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“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

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