Rehabilitation tools and practices for common movement disorder diseases

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Agenda

Please Cue these videos for the presentation

Video #1

http://youtu.be/fS01kn6YJ94

please cue to 0:29 and will play until 0:48

Video #2

http://youtu.be/Z3a5u6djGnE

please cue to 5:24 and play to 8:57
Agenda

- Introduction
- Rehabilitation Tools
  - Essential Tremor
  - Parkinson’s Disease
- Future Tools
  - Action Observation
  - Motor Imagery
How to Approach Movement Disorders Diseases

Diagnosis of Movement Disorder (ie Essential Tremor, Dystonia, Parkinson's)

Medications
Surgical
Rehabilitation/Therapy Tools

Introduction
Current Rehab Tools
Essential Tremor
PD
Future Tools
How to Approach Movement Disorders Diseases

Introduction

Current Rehab Tools
Essential Tremor
PD

Future Tools

Diagnosis of Movement Disorder (ie Essential Tremor, Dystonia, Parkinsons)

- Medications
- Surgical
- Rehabilitation/Therapy Tools
How to Approach Movement Disorders Diseases

Diagnosis of Movement Disorder (ie Essential Tremor, Dystonia, Parkinsons)

Introduction

Current Rehab Tools
Essential Tremor
PD

Future Tools
How to Approach Movement Disorders Diseases

Introduction

Current Rehab Tools
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Future Tools

Diagnosis of Movement Disorder (ie Essential Tremor, Dystonia, Parkinsons)

Medications
Surgical

Tools

Bedside
PT/OT therapy

Rehabilitation/Therapy Tools
Rehabilitation Tools

What are some tools I can use at bedside?

- Essential Tremor
- Parkinson’s Disease
**Rehab Tools: Essential Tremor**

*Definition:*
- Postural and/or kinetic tremor
  - Characterized by rhythmic shaking that occurs during voluntary movement or while holding a position against gravity
- Not dangerous – but can be very debilitating
- Usually hands, but can also involve legs, voice, and head
Always ASK:

- What activity inhibits you the most?
  - Writing
  - Eating
  - Buttoning
  - Typing
Rehab Tools: Essential Tremor

- **Writing**
  - How to improve writing
  - Holding a pen differently!!
  - Fooling the brain!!
Rehab Tools: Essential Tremor

- Writing
  - Test tremor
    - Archimedes Spiral

- How to improve writing
- Holding a pen differently!!
- Fooling the brain!!
Rehab Tools: Essential Tremor

- **Writing**
  - What are writing tools you can bring and/or talk about at bedside?
Rehab Tools: Essential Tremor Tools at Bedside

Pen Again®
Rehab Tools: Essential Tremor

Before and After

Before
Rehab Tools: Essential Tremor
Before and After

Before

After
Rehab Tools: Essential Tremor Tools at Bedside

- Fat Pen
- Heavy Pen
Rehab Tools:
Essential Tremor

Tools at Bedside

- Fat Pen
- Heavy Pen
- Heavy Utensils
- Wrist weights
Rehab Tools: Essential Tremor

- **Writing**
  - Pen Again
  - Fat pen, Heavy Pen
  - Silly Putty
  - Wrist Weights

- **Eating**

- **Buttoning**

- **Typing**
Rehab Tools: Essential Tremor

- Eating
  - Liftware
Rehab Tools: Essential Tremor

- Eating
  - Liftware

Video #1

- 0:29 to 0:48
Rehab Tools: Essential Tremor

- Writing
  - Pen Again
  - Fat pen, Heavy Pen
  - Silly Putty
  - Wrist Weights

- Eating
  - Liftware

- Buttoning

- Typing
Rehab Tools: Essential Tremor

- Writing
  - Pen Again
  - Fat pen, Heavy Pen
  - Silly Putty
  - Wrist Weights

- Eating
  - Liftware

- Buttoning

- Typing
Rehab Tools: Essential Tremor

- Buttoning
  - Magna Ready®

Introduction

Current Rehab Tools
Essential Tremor
PD

Future Tools
Rehab Tools: Essential Tremor

- Buttoning
  - Other adaptive clothing
Rehab Tools: Essential Tremor

- Writing
  - Pen Again
  - Fat pen, Heavy Pen
  - Silly Putty
  - Wrist Weights

- Eating
  - Liftware

- Buttoning
  - magnet button shirts
  - Velcro pants and shoes

- Typing
Rehab Tools: Essential Tremor

- Typing
  - Big Keys

Introduction

Current
Rehab Tools
Essential Tremor
PD

Future Tools
Rehab Tools: Essential Tremor

- **Writing**
  - Pen Again
  - Fat pen, Heavy Pen
  - Silly Putty
  - Wrist Weights

- **Eating**
  - Liftware

- **Buttoning**
  - magnet button shirts
  - Velcro pants and shoes

- **Typing**
  - Big Keys Keyboard
Rehab Tools: Parkinson’s Disease

- Parkinson’s disease
  - Rigidity, bradykinesia and rest tremor
  - Gait abnormalities
    - Freezing gait
      - Temporary involuntary inability to move legs
      - Feeling “stuck” to the ground
Rehab Tools: Parkinson’s Disease

- Parkinson’s disease
  - Things to do for Freezing Gait
    - Marching - high knee step
    - Counting Out Loud, stepping into a rhythm
Rehab Tools: Parkinson’s Disease

- Parkinson’s disease
  - Things to do for Freezing Gait
    - Marching - high knee step
    - Counting Out Loud, stepping into a rhythm
    - U step Walker
    - U step Cane
Rehab Tools: Parkinson’s Disease

- Parkinson’s disease
  - U step Walker
  - U step Cane
Agenda

- Definitions
  - Essential Tremor, Dystonia, and Parkinson’s disease

- Rehabilitation Tools
  - Essential Tremor
  - Dystonia
  - Parkinson’s Disease

- Future Tools
  - Action Observation
  - Motor Imagery
  - Neuroimaging Feedback
Future Tools

- **Action Observation and Motor Imagery**
  - Action Observation – watching others perform
  - Motor imagery – imaging motor tasks
Action Observation

- **Action observation**
  - Influences motor performance
  - **Athletes**
    - Basketball Free throws Corbin (1972)
  - **Musicians**
    - Increase in performance Leone et al 1995
  - **Other neurological disease**
    - Strokes - Erteit, et al
    - Children with cerebral palsy (Kim, et al)
Action Observation

- Helps with **Functional Reorganization**
- Action Observation activities play an important role in **human development**
  - Toddlers and infants

**Introduction**

**Current**
- Rehab Tools
- Essential Tremor
- PD

**Future Tools**
- Action Observation
- Motor Imagery
- Neuroimaging
Action Observation

- **Action observation**
  - PD patients (Pelosin et al)
  - Bradykinesia improved with VIDEO or ACOUSTIC
    - **VIDEO** – clip showing repetitive finger movements at 3Hz
    - **ACOUSTIC** – listened paced 3Hz
Action Observation

- **Action observation**
  - PD patients (Pelosin et al)
  - Bradykinesia improved with VIDEO or ACOUSTIC
    - VIDEO – clip showing repetitive finger movements at 3Hz
    - ACOUSTIC – listened paced 3Hz
  - Both interventions improved bradykinesia
    - training with VIDEO was more effective than acoustic training in modifying the performance of repetitive finger movements at longer intervals
Action Observation

- **Action Observation in PD**
  - Freezing Gait
    - Increased falls, Negative Impact on QoL

- **Methods**
  - 20 patients
  - Videos – walking by PT
    - Vs control – pictures of landscape
Action Observation

- **Action Observation in PD**
  - **Freezing Gait**
    - Increased falls, Negative Impact on QoL

- **Methods**
  - 20 patients
  - Videos – walking by PT
    - Vs control – pictures of landscape

- **Significant **DECREASE** of Freezing Gait**
  - Walking and balance tests
  - QoL improved as well
Motor Imagery

- **Motor Imagery** is a cognitive process
  - Subject images that he/she performs a movement without actually performing the movement
  - Requires the *conscious activation* of brain regions involved in movement preparation and execution
Fast growing number studies indicate that the brain areas engaged in the ACTUAL PERFORMANCE, also were active during MOTOR IMAGERY (Hallett 1994, Lotze 1999, Kimberley 2006)
Motor Imagery

- Meister et al 2004
  - Musicians who **played piano “in their mind”**
  - Activated
    - LEFT primary sensorimotor area
    - Left cerebellum
    - Premotor/supplementary motor areas
    - **Everything that is activated** in actual action except for primary sensorimotor area and right cerebellum
Stippich et al. (2002) showed imagination of different moving body parts:
- Foot, hand and tongue
- Activated precentral gyrus in a somatotopic manner
Motor Imagery

- Stippich et al (2002) showed imagination of different moving body parts
  - Foot, hand and tongue
  - Activated precentral gyrus in a somatotopic manner

  - Finger movement activated finger area

- Vitals (HR and respiratory rate)
  - Imagined and actual movements
Motor Imagery

- Page (2000)
  - 4 week training, 8 hemiparetic right arm from strokes
  - The results indicated that the stroke patients who received the combined program improved significantly more than those who received only occupational therapy.
Motor Imagery

- Tamir 2007
  - Reported improved motor scores (UPDRS) and ADLs score
  - With motor imagery + PT than PT alone
Liu 2004

The patients in the motor imagery group did improve on neuropsychological tasks measuring attention.

their capacity in attentive processing had been improved as a result of the mental imagery training.
Motor Imagery

- Linden et al 1989
  - Reported **better equilibrium** characteristic in elderly women as measured by walking balance and foot placement
  - As a result of motor imagery and PT
Neuroimaging

- **Action observation and Motor imagery**
  - Engage in the same neural structures involved in movement execution.
  - But can this be supported with **Imaging**?
Neuroimaging

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Motor Imagery
Neuroimaging

% signal change

Left sensorimotor cortex

Right sensorimotor cortex

Stimulus perspective

1st 3rd

observe
imagine
imitate

observe
imagine
imitate
Neuroimaging

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Neuroimaging

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Neuroimaging

![Neuroimaging Diagram](image-url)
Neuroimaging

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Motor Imagery
Neuroimaging
• Hierarchy increased activity during observation are a SUBSET of those engaged in motor imagery
• In turn – a subset of those engaged in imitation
• Imagery thus provides a MORE EFFECTIVE means of driving neural activity in these areas
This raises the questions ---

Can we use **neuroimaging** as a rehab tool?
Real time fMRI Feedback

- Neurofeedback training
- **REAL TIME** brain activation
- Parkinson’s patients
  - 5 experiment, 5 controls
- fMRI neurofeedback session
Real time fMRI Feedback

- Localizer Run

- Visual Feedback Sessions
Real time fMRI Feedback

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Motor Imagery
Neuroimaging
Real time fMRI Feedback

- Session 1 → Session 3 (2-6 months later)
- In between scans – they were asked to daily think about the activity that achieved the highest fMRI reading
Clinical outcomes
- Motor UPDRS: 14.2 → 9
- Finger tapping test
  - Finger tapping device – would count number of taps
  - Timed for one minute: 210 → 266
Discussion

- PD patients can increase activity in the SMA by motor imagery with the help of real time neurofeedback training
- Followup 2 months – still had good results (re: UPDRS and finger tapping)
- Increase motivation
Motor Imagery in Rehab

- Raise the possibility
  - Could we use motor imagery could be used for control of external devices by suing the output signal created by imagination as input signal for a machine
Motor Imagery in Rehab

Dr Geoffrey Ling

Video #2

https://www.youtube.com/watch?v=Z3a5u6djGnE

Queue at 6:12, Stop 9:02
Conclusion

- Rehabilitation starts at the **bedside** clinical assessment
  - Tools
  - Education
  - Working with physical therapy

- **Future rehab tools**
  - Action Observation
  - Motor Imagery
  - Neuroimaging
Questions?


Macuga, K. Frey, S., (2012) Neural Representation involved in observed, imaged, and imitated actions are dissociable and hierarchically organized. Neuroimage. 59: 2798-2807
