EMG Biofeedback & EMG-Triggered Electrical Muscle Stimulation in pediatric rehabilitation

Creating permanent changes in patient outcomes.

Presented by: Pia Stampe, PT, DPT
Owner of Advanced Muscle Stimulators, LLC

Schedule

10:00-10:20: Overview of Electrical Muscle Stimulation Technologies and the scientific basis for use of EMG Biofeedback and EMG-Triggered Muscle Stimulation

10:20-10:50: EMG Biofeedback: clinical applications and demonstration of the use of EMG Biofeedback units

10:50-11:30: EMG-Triggered Muscle Stimulation: clinical applications and demonstration of the MyoTrac Infiniti NeuroPD

11:30-12:00: Case examples and Q & A

Advanced Muscle Stimulators, LLC

Products:

- MyoTrac Infiniti NeuroPD: EMG Biofeedback and EMG+STIM. Sole distributor.
- MyoTrac: EMG Biofeedback unit
- NT 2000 TES: Threshold Electrical Stimulation (TES). Sole distributor.

Electrical Stimulation Technologies

- Neuromuscular Electrical Stimulation (NMES)
- Functional Electrical Stimulation (FES)
- Threshold Electrical Muscle Stimulation (TES)
- EMG Biofeedback
- EMG-Triggered Muscle Stimulation (EMG+STIM)

NMES

- Commonly used in rehabilitation of weak muscles
- Recruits muscle fibers in a non-selective manner that does not assemble a normal muscle contraction which recruits fibers from small to large
- Risk for overwork damage in very weak muscles (Gregory 2005)
- Risk of reduction in neural sprouting in a partially denervated muscle (BPI) (Tam, 2001)
- Des not require patient participation

Functional Electrical Stimulation

- Neuromuscular Electrical Stimulation applied during a functional activity
- A trigger is used to stimulate a muscle during an activity
- Problem: activating with an external trigger with perfect timing during a motor task is very difficult.

Threshold Electrical Stimulation

- Sensory level Neuromuscular Stimulation
- Treats disuse muscle atrophy with night time low level stimulation
- Growth of muscle tissue due to increased circulation– long term benefit
- Improvement in awareness – short term benefit (Nolan et al, 2008)

EMG Biofeedback

- Displays the muscle action potential signal in mV (weak activity=weak signal – strong activity=strong signal)
- Gives visual or auditory feedback to patient
- Goal for EMG Biofeedback training: Improve volitional muscle control = IMPROVE AWARENESS
- Up-training and down-training

EMG-Triggered Muscle Stimulation A neuroplastic intervention

- Patient generated EMG signal triggers the stimulator. Patient has to actively participate = closed loop training
- Recruits fibers from small to large resembling normal muscle fiber recruitment
- Goals: Improved volitional muscle control as a result of improved neuroplasticity and improvement in muscle strength

Use it or lose it – use it and grow it! Brain plasticity 101

- The brain is mapped from use.
- If an area of the brain is not used, it is lost.
- Brain mapping is competitive in nature – areas not used will be taken over
- The brain maps can change at any age
- Loss of function due to loss of a brain map is reversible with the right kind of training

Recommended easy reading: The Brain That Changes Itself by Norman Doidge. Penguin Group (USA) 2007) http://www.normandoidge.com/

Habits are hard to break

- "Therapy walk" versus habitual walk
- Habitual movements hides neural recovery
- Developmental apraxia because neuroplasticity is activity dependent

Real obstacles to Real progress

Prescription for reaching goals in neuro rehabilitation

Providing the right intervention in the right order, at the right time, in the right dose…….

New extremely promising technology is available to "fill this prescription"

MyoTrac Infiniti NeuroPD

Three-in-one neuromuscular trainer:
- EMG Biofeedback assessment and training
- NMES
- EMG Triggered Muscle Stimulation

Features:
- Pre-programmed assessment protocol
- Pre-programmed protocols that are safe and efficient for pediatric and adult neuromuscular training
- Compact and portable
- Easy to program for home training

EMG Biofeedback

- Detecting the electrical signal from muscle action potentials via surface (skin) electrodes
- Used to diagnose and treat neuromuscular disorders
- Goal for biofeedback: improve volitional muscle control

Information obtained with EMG Biofeedback

- Resting potential: (normal 1-3mV) assesses innervation of a muscle
- Up-training (activation) of a muscle: assesses the ability to generate tension in a muscle
- Down-training (relaxation) of a muscle: assesses the ability to relax tension in a muscle

Patient selection

Diagnosis:
- Any age (video clip)

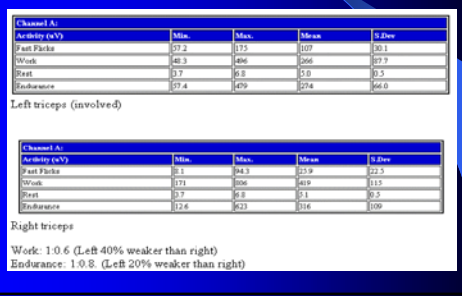
Training:
- Cooperative - >2 years old and up (understands cause/effect)
- Examples of diagnoses:

-Brachial Plexus Injury
-Cerebral Palsy
-Stroke
-Post immobilization
-Hypotonia (up-training)
-Hypertonia (down-training)

Demonstration

- Assessment of innervation (video)
- Assessment protocol
- Open EMG Biofeedback Training: Up-training, down-training, grading of muscle contractions
- Gait training with auditory feedback

Information from assessment protocol



Channel A:

Activity (uV)	Min.	Max.	Mean	S.Dev
Fast Flicks	57.2	175	107	30.1
Work	48.3	496	266	87.7
Rest	0.7	6.8	5.0	0.5
Endurance	57.4	479	274	66.0

Left triceps (involved)

Channel A:

Activity (uV)	Min.	Max.	Mean	S.Dev
Fast Flicks	8.1	94.3	23.9	22.5
Work	171	806	419	115
Rest	0.7	6.8	5.1	0.5
Endurance	12.6	623	316	109

Right triceps

Work: 1:0.6 (Left 40% weaker than right)
Endurance: 1:0.8. (Left 20% weaker than right)

EMG-Triggered Muscle Stimulation (EMG+STIM)

Closed loop training

- Patient triggers the stimulation – even if the patient is only able to generate a low EMG signal
- Patient receives feedback about the movement and learns how to generate movement

Results:

- improved volitional muscle control as a result of improved neuroplasticity
- Improved ability to recruit muscle fibers in a selective manner from small to large resulting in a smooth and graded movement.

Pre-Programmed EMG+STIM Training protocols and features

Pre-programmed protocols:

1. "Atrophy" for muscle strength ≤ 3/5
2. "Strength" for muscle strength ≥ 3+/5

Threshold:

1. Manual setting
2. Automatic setting and adjustment

Patient selection

- Cooperative - >3 years old and up (understands cause/effect)
- Examples of diagnoses:

-Brachial Plexus Injury
-Cerebral Palsy
-Stroke
-Post immobilization
-Hypotonia
-Hypertonia

Demonstration

Definition of "Threshold":

The EMG level (mV) at which the electrical muscle stimulation is activated to complete the movement

EMG+STIM with manual setting of threshold

EMG+STIM with automatic setting and adjustment of threshold

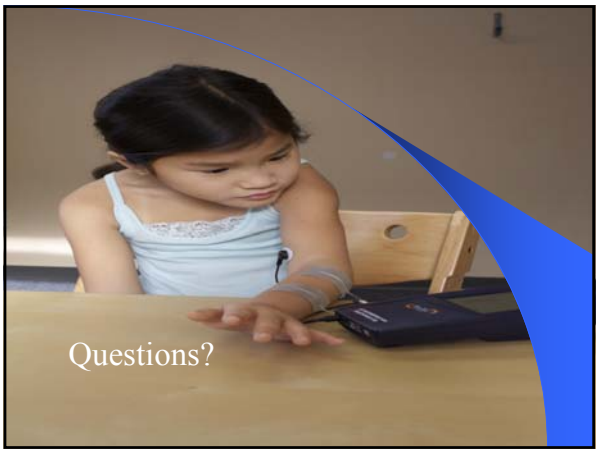
MyoTrac Infiniti NeuroPD – a fusion of clinic and home therapy

Clinic use:

1. Diagnostic information about innervation and muscle function
2. Training
3. Monitoring of training compliance

Home use:

1. Easy to operate
2. Fun and engaging
3. The right dose of repetition of correct movement patterns → neuroplastic changes



Case examples

- Infant with BPI (TES)
- 7 year old with hemiparesis
- 16-year old with BPI (EMG+STIM)
- 8-year old with BPI