Quantifying Abnormal Muscle Tone Due to Neurological Impairment

Thursday March 20th, 2014
Starts at 12:00 PM EST
Presented by
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Kinesia HomeView™  Kinesia ProView™
MyoSense
• Impact of Neurological Impairment
  – Abnormal Muscle Tone

• MyoSense
  – Development
  – Bench Testing
  – Clinical Evaluation
• High incidence of neurological disorders
  – Abnormal muscle tone
  – Reduced independence

Center for Disease Control; Jan 2006 Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations, and Deaths, 2002-2006
Resistance force to passive movement
Abnormal muscle tone presents in many different forms.

– Rigidity
– Dystonia
– Spasticity
– Hypertonia
• Parkinson’s Disease
  – Stiffness or heaviness
    • Lead pipe
    • Cog wheel

UCD Medicine
https://www.youtube.com/watch?v=sJqKvaUClk
Dystonia

• Cerebral Palsy
  – Rigid/Posturing
  – Unintentional movement
Spasticity

- Stroke and Traumatic Brain Injury
  - Speed based
  - Catch
Hypertonia

- Stroke and Traumatic Brain Injury
  - Range of motion
Treatments

• Various types of treatment
  – Botox
  – Baclofen
  – Phenol injections
  – Surgical intervention
  – Deep brain stimulation
• Abnormal tone types respond differently

• Difficult to distinguish different types of tone
  – Cerebral palsy
    DBS ➔ Dystonia    Baclofen ➔ Spasticity
    ? ➔ Spasticity    ? ➔ Dystonia

• Research limited by current clinical outcome measures
Clinical Scales

• Specific aspects of abnormal tone
  • Modified Ashworth, Tardieu (spasticity)
  • Fahn Marsden Burke (dystonia)

<table>
<thead>
<tr>
<th>FMB Arm Evaluation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>No dystonia present</td>
</tr>
<tr>
<td>1</td>
<td>Slight dystonia. Clinically insignificant</td>
</tr>
<tr>
<td>2</td>
<td>Mild. Obvious dystonia but not disabling</td>
</tr>
<tr>
<td>3</td>
<td>Moderate. Able to grasp, with some manual function</td>
</tr>
<tr>
<td>4</td>
<td>Severe. No useful grasp</td>
</tr>
</tbody>
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• Low resolution
• Subjective interpretation
MyoSense Development

- Quantitative assessment of abnormal tone
- Integrate with conventional practice
  - Clinician worn
    - Reduce patient burden
  - Typical Assessment
    - Speed
    - Position
    - Force
• Prototype Hardware
  – Flexiforce FSR sensors and XBee
  – GLNT Movement Sensor (bluetooth)
• Information about orientation and speed

• Correlate with force data
MyoSense Bench Testing
Simulated Abnormal Elbow Tone

Threshold set at 45 deg/s
Distinguishing Profiles

• Hypertonia Evaluation
  – Move the simulated elbow at 5 deg/s

• Position bins and average force

• Correlation to theoretical = 0.93
• Mod-Ashworth Evaluation
  – Move the simulated elbow at 90 deg/s

• Speed bins and average force

• Correlation to theoretical = 0.80

• High speed effects of device mechanics
  – Belts and filtering
Comparing Different Abnormal Tone Profiles

• Issue
  – High speed mechanical effects
  – Acceleration
  – Change in direction

• Solution
  – Track specific speeds
  – Examine the change across speed
• Tracking specific speeds
  – 5, 25, 45, 65, 85 deg/s

• At each 20s trial
  – Average speed and average force
Comparing Different Abnormal Tone Profiles

- Correlation of 0.99
- Distinguish Profiles and Changes in magnitude
• Successful pilot evaluation of MyoSense

• Clinical evaluation with individuals with spasticity, dystonia, and cerebral palsy
MyoSense Clinical Evaluation
Clinical Evaluation Protocol

• Subjects
  – 10 Pure dystonia
  – 10 Pure spasticity
  – 10 Mixed dystonia and spasticity (Cerebral Palsy)
  – 30 Age matched controls

• Clinician manipulates limb
  – 5, 45, 90, 135, 180
  – wrist, elbow, knee, ankle
  – Mod Ashworth and Fahn Marsden Burke
Preliminary Results

**Unimpaired Control**
- Control 1 Right Wrist
  - 1st Evaluation

**Individual with Dystonia**
- FMB = 1
- FMB = 0

**Subject 2 Right Wrist**
- 1st Evaluation
- 2nd Evaluation

**Force in lbf vs Speed Deg/S**
- Extension
- Flexion
Clinical Evaluation Goals

• Goal from Clinical Evaluation
  – Differentiate types of abnormal muscle tone
  – Examine correlation to clinical measures

• Commercialization
  – Effects of spasticity and dystonia
  – Effects of treatments
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GLNT Movement Sensor

http://glneurotech.com/motion-sensor
Questions?

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