The Use of Cryotherapy to Alter Lower Extremity Motoneuron Pool Excitability in a Patient with an Acute Lateral Ankle Sprain - A Case Report

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Lateral Ankle Sprain

• Common orthopedic injury
  – 1-2 million/year US

• High recurrence rate
  (van Rijn et al, 2008)

• Mechanism
  – Inversion and Plantarflexion
Common Impairments

• Acute Ankle Sprain
  – Pain
  – Decreased range of motion
  – Decreased balance
  – *Altered motor neuron pool excitability
    • Result of pain and decreased ROM

  – Goal of interventions are to address cause of dysfunction
H – Reflex Research

- H-reflex is analogous to muscle stretch reflex
- Used to study altered motor neuron pool excitability

- Injected ankle joint effusion (Palmieri et al, 2004; Petrik et al, 1996)
  - Increased soleus, peroneal, tibialis anterior
  - Increased muscle co-contraction aimed at immobilizing

- Acute lateral ankle sprain (Klykken et al, 2011)
  - Increased soleus, decreased tibialis anterior
  - Positions ankle in the most comfortable position
Common Interventions s/p Ankle Sprain

• Cryotherapy and compression
  – Decrease pain
  – Improve function

• Cryotherapy
  – Alters motoneuron pool excitability in individuals with chronic ankle instability (McVey et al, 2005)
  – Has not been investigated following an acute injury
Purpose

• To describe changes in soleus and fibularis longus motoneuron pool excitability following an acute lateral ankle sprain
Subject

• 26 year old recreational basketball player
  – height = 194 cm, mass = 105 kg
  – Inversion ankle sprain (left)
• PMHx:
  – Left leg: no previous ankle injuries
  – Right leg: ankle sprains and fibular fracture resulting in ORIF in 2006

• Foot and Ankle Ability Measure
  – ADL: 96%; Sport: 78%
• Examination
  – Point tenderness along ATF ligament
  – Positive anterior drawer
  – Moderate swelling per visual observation
  – Negative Ottawa Ankle Rules – no ankle fracture
Motor Neuron pool excitability of Soleus and Fibularis Longus

- Surface EMG
- Maximum values for H-reflex and M-response
  - Pre and post intervention
  - H-Max-stimuli delivered in 0.2V increments
    - 3 measurements recorded
  - M-Max delivered in 1.0mV increments beyond H-Max
Intervention

• Cryotherapy & compression (Game Ready)
  – 20 minutes
  – Ice water at 34 °F
  – Intermittent Compression 5-50 mmHg (3 min)
## Results

<table>
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<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Percent Change</th>
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</thead>
<tbody>
<tr>
<td>Soleus H/M Ratio</td>
<td>.39</td>
<td>.67</td>
<td>+70%</td>
</tr>
<tr>
<td>Fibularis Longus H/M Ratio</td>
<td>.75</td>
<td>.36</td>
<td>-52%</td>
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</table>
Conclusion/Clinical Relevance

• Cryotherapy and compression may alter motoneuron pool excitability
  – Increase soleus
  – Decrease fibularis longus

• Clinical relevance
  – May help restore postural control
  – May decrease splinting and increase function
Limitations

• Single subject case study
  – Can not establish cause & effect

• Ankle circumference not measured
  – Visual interpretation of swelling only

• Clinical relevance of change in motor neuron pool excitability has not been established
Future Research

• Investigate the use of cryotherapy and compression as interventions to alter lower extremity motoneuron pool excitability and better determine the effects on functional outcomes
Questions?
References


Hoffman Reflex

- Electrically induced muscle stretch reflex
- Estimates $\alpha$MN excitability (Palmieri et al, 2004)
  - Musculoskeletal injuries
  - Effects of therapeutic modalities
  - Pain response
  - Arthrogenic muscle response with joint effusion
Hoffmann reflex (H-reflex) and muscle response (M-wave) pathways.

(Palmieri et al, 2004)
Sensory Stimuli and Inhibition

Fig 2. Pickar, 2002
Hoffmann Reflex

- Measure of motoneuron (MN) recruitment
- Electrical stimulation of mixed nerve
- Two distinct EMG responses
  - M-response- efferent motor axon
  - H-reflex- afferent (Ia sensory) fibers
H-Reflex

- H-reflex
  - Measure of maximal reflex activation (MN pool)

- M-response
  - Represents activation of entire MN pool

- $H_{max}/M_{max}$
  - Proportion of entire MN pool that can be recruited
H-Reflex Limitations

• Unable to determine amount of muscle activation in single session
  – Individual variability

• Electrically induced reflex does not occur naturally
  – Muscle spindle is neglected