DOMS and EIMD: separate conditions?

By Jonathan Luke
Initial Purpose

• To investigate the acute effects of a high volume, low intensity workout on DOMS in eccentrically injured individuals.

• Due to limitations of time, equipment, and protocol this treatment was not tested.
Case study

- Instead, a case study was produced in which an individual exhibited clear *positive symptoms of DOMS*, *without accompanying signs of EIMD*. 
“Differential diagnosis: the distinguishing of a disease or condition from others presenting with similar signs and symptoms.”

(Merriam-Webster)
Background

• Delayed Onset Muscle Soreness (DOMS)

  • The subjective experience of pain or soreness localized to a muscle group while at rest, on stretch, or during contraction.

  • Cause: Eccentric or unaccustomed exercise

  • Onset at 12 to 24 hours.

  • Peaks 1-3 days prior to onset and lasts 3-7 days

  • (Nosaka, 2002)
Background

• Exercise Induced Muscle Damage (EIMD)

• Causes: Eccentric or unaccustomed exercise

• Symptoms:
  • Strength losses
  • Soreness (DOMS)
  • Stiffness
  • Edema
  • Structural disruption (Fig. 1)

• Peak symptoms: 1-5 days prior to damage

• Some symptoms measurable as long as 30 days

• (Howatson, 2008)
DOMS and EIMD in Literature

In reference to injuries resulting from eccentric exercise:

“[E]ven a cursory perusal of the literature demonstrates that a wide variety of criteria for muscle injury has been employed, and that there has been no general agreement on the best methods for quantifying the pathology.”

(Warren, 1999)
Laboratory Markers

- Papers referring to DOMS
  - Soreness or pain
  - Strength (typically MVC)
  - Joint angles and ROM
  - CK and other blood-borne proteins

- Papers referring to EIMD or damage
  - Soreness or pain
  - Strength (typically MVC)
  - Joint angles and ROM
  - CK and other blood-borne proteins
MRI evaluations

- Limited number of studies using T2 relaxation times

- All report
  - Significant increase in T2 relaxation times
  - Significant increase in delayed onset pain
  - Significant decreases in strength

- Only one employs a submaximal exercise protocol
  - Reported high group variability in pain ratings and T2 times
  - (Evans, 1998)
Methods: Measurement Protocols

• MRI
  • T2 relaxation times
  • Measure of muscle damage (Foley, 1999; Jayaraman, 2004)
• Strength tests
  • Isometric MVC (Interpolated Twitch Technique at 90 degrees)
  • Performed on a Cybex Dynamometer
• Perceived pain
  • 100mm Visual Analog Scale (VAS)

*How severe is your pain? Place a vertical mark on the line below to indicate how bad you feel your pain is:*

No Pain _____________________________ Unbearable Pain

Fig 3. A 100mm VAS. Raters place a mark upon the line best representing their pain along the spectrum.
Methods: Injury Protocols

• Knee Extensions: Quadriceps

• Intensity: 80% Concentric 1RM

• 3 second eccentric lowering with one leg
• Concentric raising with opposite leg

• 5 sets / 2 min rest
Methods: Injury Protocols

- Moderate protocol
  - Sets of 10 repetitions
  - Did not reach failure
  - Did not produce DOMS

- Heavy protocol
  - Sets conducted to concentric failure
  - Produced DOMS
  - Subject P
Methods: Time Course

• Baseline

• Eccentric exercise protocol

• 30 min post

• 24 hr post

• 48 hr post
Results: Pain

Perceived pain ratings, VAS scores (mm).

<table>
<thead>
<tr>
<th>Subject</th>
<th>Subject P</th>
<th>Eccentric leg</th>
<th>Concentric leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Post</td>
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<tr>
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<td>60</td>
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</tbody>
</table>
Results: T2 relaxation times

Increases in T2 relaxation times in Subject P

Relative increase from baseline (%)

- Eccentric leg
- Concentric leg
- Jayaraman et al
Results: T2 relaxation times

Subject P

Knee Extensors

Pre

Post

24 HR

48 HR

Pre-exercise

Knee Flexors

Day 2

Day 3

Day 4

Day 6

Day 8

Day 15

(Jayaraman, et al., 2004)
Results: Isometric strength

Change in MVC torque relative to baseline in Subject P

Percent of baseline torque (%)
Results: Voluntary activation

Estimated voluntary activation in Subject P

% Voluntary activation

Eccentric leg
Concentric leg

Pre  Post  24HR  48HR

70  80  90  100
Results: Potentiation

Change in potentiated twitch torque relative to baseline

Percent of baseline torque (%)

Pre  Post  24HR  48HR

Subject P eccentric leg

Subject P concentric leg
Explanations

• High inter-subject perceived pain and T2 variability
  • May be statistical chance that a single subject showed no clear
decrement in strength or increase in T2 relaxation times

• Alternatively,
  • DOMS reproducible without muscle damage
  • DOMS and EIMD share an MOI but not a direct cause
  • A differential diagnosis for DOMS and EIMD may exist
Precedents

• Evans, et al (1998) did not find a significant correlation between change in T2 and pain with muscle damage

• In a review, Warren, et al (1999) found pain did not correlate well with muscle damage

• Nosaka, et al (2002) found pain did not reflect the magnitude of muscle damage; suggesting, “DOMS may not be directly related to muscle damage and subsequent inflammation.”

• Yu, et al (2004) proposed myofibrillar disruption associated with DOMS in literature represented remodeling, not damage
Implications

• Further research is required

• If the results can be replicated, may indicate a differential diagnosis exists between DOMS and EIMD

• If replicated, DOMS in the absence of EIMD should be confirmed through other markers of structural damage (i.e. blood proteins, myofibrillar damage)

• If confirmed, DOMS in absence of EIMD should be investigated and described to aid in the understanding of causes and potential treatments
References