Pain with Movement: Transforming Theoretical Models to Physical Therapist Practice

Katie Butera, PT, DPT
Cory Simon, PT, DPT, PhD
Annalisa Nar, PT, DPT, PhD, Board-Certified Orthopaedic Clinical Specialist
Mari Lundberg, PT, PhD
Combined Sections Meeting 2019
Washington, D.C., January 23 – 26, 2019

Objectives

- To describe current conceptual models for pain with movement and subsequent movement adaptation
- To interpret sensory, psychological and motor influences of pain with movement
- To distinguish pain with movement and subsequent movement adaptations through clinical measurement tools
- To assess pain with movement in common orthopaedic conditions

Pain with Movement and Movement Adaptation Models

Katie Butera, PT, DPT
PhD Candidate in Rehabilitation Science
Department of Physical Therapy
University of Florida
Disclosure

- No relevant financial relationship exists

People in PAIN, MOVE differently

Research and Clinical Questions

- What factors contribute to individual differences in motor/movement behavior?
- Why do changes in motor/movement behavior persist?
- How is recovery defined?
Research and Clinical Questions

- Limited evidence to answer these questions
- Decreased effectiveness of current pain management approaches
- Need more research to effectively:
  - Treat pain AND optimize movement
  - Prevent long-term disability

Pain With Movement

- Conceptual models integrating pain with movement are critical to support research and clinical practice

Nervous System Pain Processing

[Diagram showing inputs to body self neuroconnects, body self neuroconnects, and outputs from body self neuroconnects with labels such as sensory, affective, and motor connections]
Nervous System Pain Processing

- Lots of detail on pain processing (inputs)
- Motor behavior (action programs) is vague
- Does not address impact of system relationships over time

Movement Changes in Response to Pain

- Has more detail on motor and movement changes
- Multiple levels; shows variability
- Nervous system changes are vague
Need for an Integrated Model

- Should characterize pain processing and movement
- Should not treat pain and movement as separate entities
- Should acknowledge potential for multiple recovery endpoints

A Model for Integrating Pain With Movement

Bulera, George, & Fox, PTJ. 2016

Bulera, George, & Fox, PTJ. 2016
Integration #1: Nervous System Processing
-inclusion of a motor component

Integration #2: Movement Changes
-consideration of function

Critical Addition
-feedback loop
Critical Addition
-recovery component

Significance of an integrated model
• Characterizes pain processing alongside movement responses
• Movement is dynamic and leads to potential changes in function
• Changes in movement and function impact recovery over time

Next Steps in Research
• Utilize integrated models to test hypotheses longitudinally in clinical populations
• Identify individualized neural risk factors and/or potential treatment targets
• Develop and test personalized pain management approaches to enhance pain-relief and optimize functional outcomes
Next Steps in Clinic

- Increase physical therapists’ understanding of the relationship between pain and movement
- Implement comprehensive, personalized treatment strategies into clinical practice
  - Measure/monitor pain factors
  - Measure/monitor movement and function
  - Evaluate pain during movement (movement-evoked pain)
- Focus should be on treating pain while also optimizing movement and function

Acknowledgements

Mentors: Dr. Steven George (Duke) & Dr. Emily Fox (UF)
Committee: Dr. Mark Bishop & Dr. Stephen Coombes (UF)
Lab: Dr. Trevor Lentz, Kelly Hawkins, & Tommy Storer

Funding
- T32 NMPT Pre-Doctoral Fellowship (NICHD) T32 HD 043730
- Brooks-PHHP Research Collaboration
- Foundation for Physical Therapy (PODS I & II Awards)

References

- Metzner, R. From the gate to the neuropeptide, Pain, 1999; 82:1211-1216.
- Bulaara KA, Fox EJ, George SJ. Point of View. Towards a transformed understanding from pain and movement to pain with movement. Physical Therapy, 2015; 95(10):1523–1527.
Sensory & Psychological and Influences of Pain with Movement

Corey Simon, DPT, PhD
Duke University
‘Silent’ Nociceptors

A. Control 72 min after Kaolin 240 min after Kaolin
Flexion  Reson

B. Control 82 min after Kaolin 108 min after Kaolin
OFF  ON

C. Control 82 min after Kaolin

(Graphis 1998)

The Immune System

(Rec 2010)

The Immune System

C. Repeated arm movements

(Pain intensity, 0-10)

(Day 0 Day 1 Day 2 Day 3 Day 4)

(Cheng 2010)
Pain Modulation

Mechanical Pain Modulation:
\[ R^2 = .09, \ p < .01 \]

Coronado, 2013:
Shoulder Pain with Movement
\[ R^2 = .05, \ p < .001 \]

Rakel, 2015:
Knee Pain with Movement
\[ R^2 = .16, \ p < .01 \]

Simon, In Review:
Low Back Pain with Movement
\[ R^2 = .13, \ p < .01 \]
Pain Catastrophizing

Summary

- Multiple biopsychosocial influences on pain with movement:
  - Nociceptor activation
  - The Immune System
  - Pain Modulation
  - Psychological Distress

Thank You!

@DukeMSK
Duke Clinical Research Institute
Musculoskeletal Research Team
Moving with Pain

Annalisa Na, PT, DPT, PhD,
Board Certified Orthopaedic Clinical Specialist
Post-doctoral Fellow
Division of Rehabilitation Sciences
Department of Orthopaedic Surgery and Rehabilitation
University of Texas Medical Branch

Disclosure

• No relevant financial relationship exists

Objectives

• To explore the relationships between pain and movement through biomechanical, clinical, and pain models.
  - Mechanistic
  - Movement Analysis
  - Integration of models
Movement
Series of external and internal forces acting on joints

[Diagrams and images related to movement and forces on joints]

Hodges et al 2015
Effects of Gait Speed on Gait Parameters

<table>
<thead>
<tr>
<th>Muscle activation and concentration at 1.0, 1.5, and 4.0 m/s.</th>
<th>1.0</th>
<th>1.5</th>
<th>4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM (Hamstrings + Gastrocnemius)</td>
<td>M2</td>
<td>M1</td>
<td>M1</td>
</tr>
<tr>
<td>Concentration</td>
<td>M2</td>
<td>M1</td>
<td>M1</td>
</tr>
<tr>
<td>Walking difficulty (GM + SH)</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Muscle activation</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Co-contraction</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Gait Observations

- Self-reported Walking Difficulty
- Pain
- Instability
- Stiffness

Symptom-avoidance gait strategies

- Antalgic Gait Strategy
- Knee Stiffening Gait Strategy

- Sagittal Plane Knee Excursion
- Knee Adduction Moment
- Limb Dynamics
- Co-contraction
Sensor Data

![Sensor Data Chart]

Integrating pain and movement theories

- Those with self-perceived walking difficulty use different modification strategies than those with no walking difficulty.
- These modifications may be the novel aspect with the thesis.
- Theories:
  - Decreased postural stability leading to increased at more distal ends.
  - Open loop vs. closed loop
    - Walking difficulty = open overshoot of the neuromuscular system, all or none
    - No Walking difficulty = closed — effective and efficient with neuromuscular system, able to gaps and adjust

- Self-expressed walking difficulty made even though they are able to walk at fast and functional gait speeds, just parameter differences appear to eliminate when walking at fast gait speeds.
- Gait adaptations in those without walking difficulty although may have knee OA-related symptoms, appear to be more useful than those with walking difficulty.

References

- **Na**, Buchanan TB. Self-reported walking difficulty moderates the relationship between knee kinematics and muscle co-contraction in people with knee osteoarthritis, Human Movement Sciences 2018, in press.
Intervention Strategies and Clinical Applications

Mari Lundberg, Associate Professor
University of Gothenburg, Karolinska Institutet, Sweden
Mari.Lundberg@gu.se

Disclosure

- No relevant financial relationship exists

Learning Objectives

After this lecture the participant will be able to...
- Identify different intervention strategies and clinical applications to be applied to reduce fear of movement
Why addressing fear?

<table>
<thead>
<tr>
<th>Acute pain</th>
<th>Chronic pain</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E.g. tendon rupture</em></td>
<td><em>E.g. chronic low back pain</em></td>
</tr>
<tr>
<td>Olsson and his co-workers found a negative correlation between kinesiophobia and functioning 12 weeks after an Achilles tendon rupture (Olsson et al. 2012)</td>
<td>70% of the patients with low back pain in an orthopaedic setting report a high degree of fear of movement (Lundberg, 2008)</td>
</tr>
</tbody>
</table>

Who is afraid of moving?

Cardio rehabilitation

Relevance of Kinesiophobia in Relation to Changes Over Time Among Patients After an Acute Coronary Artery Disease Event


High degree of kinesiophobia after lumbar disc herniation surgery


Rationale for fear reduction
Theoretical framework

How can we decrease fear?

What do WE need to learn?

First, therapists require an in-depth understanding of pain mechanisms (Butler and Moseley, 2003)

and the dysfunctional central nociceptive processing in those with chronic musculoskeletal pain (Woof and Salter, 2000; Woof, 2011)
What do WE need to learn?
Psychological informed…
Pain neuroscience education…
Cognitive exposure…

Application: Prehabilitation
Physical Therapy
Therapists are fearful

Physical therapists’ kinesthetic beliefs negatively influence lifting capacity of healthy adults (Ladee et al., 2016).

More than two-thirds reported that they would advise a patient to avoid painful movements (Lazarou et al., 2012).

References