

Clearing the Muddy Waters: Managing Injuries in the Workplace



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Understanding Acute Versus Persistent Pain

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Objectives

1. Explain the mechanism of persistent pain and how it impacts the sympathetic nervous system.
2. Verbalize educational strategies for patients with persistent pain to optimize outcomes.

What is your prediction for tonight's fight?
Pain...



Mr. T, Rocky Balboa's opponent in Rocky III

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International Association for the Study of Pain (IASP) Definition

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage.

Güven Kose S, Kose HC, Celikel F, et al. 2022. Chronic pain: an update of clinical practices and advances in chronic pain management. Eurasian J Med. 54(Suppl1):57-61.

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2 types of pain:

Acute

↓

Acute pain is most often defined by painful stimuli that are traditionally time limited to less than one month and most often associated with surgical interventions, trauma, illness, or painful medical procedures

Raja SN, Carr DB, Cohen M, et al. 2020. The revised international association for the study of pain definition of pain: concepts, challenges, and compromises. Pain (Amsterdam). 161(9):1976-1982.

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2 types of pain:

Chronic (Persistent)

↓

Chronic pain typically lasts for greater than 3 months according to the IASP

- Primary: occurring in the absence of primary disease
- Secondary: due to presence of underlying medical conditions, such as cancer, inflammatory and autoimmune diseases, neuropathic pain, and others

Treede R, Rief W, Barke A, et al. 2019. Chronic pain as a symptom or a disease: the IASP classification of chronic pain for the international classification of diseases (ICD-11). Pain. 160(1):19-27.

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Chronic (Persistent) Pain

Chronic/Persistent pain commonly results from untreated acute pain which can ultimately lead to decreased autonomy of daily activities, mental health decline, poor quality of life and overall well-being

Osborne NR, Davis KD. 2022. Chapter eight – sex and gender differences in pain. Int Rev Neurobiol. 164:277-307.

Morgan J, Magwood K, Smith, J, et al. 2024. Sex and gender differences in pain perception and management in clinical settings. All Life, 17(1).


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Chronic (Persistent) Pain

“When patients have chronic pain or other symptoms that seem out of proportion to anything we can tell is physically wrong with them, we should not assume they are faking it. The central nervous system can undergo changes—structural, functional, and chemical—that make it more sensitive to stimuli, a process called **central sensitization.**”

Volcheck MM, Graham SM, Fleming KC, et al. 2023. Central sensitization, chronic pain, and other symptoms: Better understanding, better management. Cleve Clin J Med. Apr 3,90(4):245-254.



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Central Sensitization

“Central sensitization” was coined by Woolf and King in 1989 after studies in rats showed that neurons in the spinal cord become hyperexcitable over time after injury.

Subsequent studies showed that central sensitization can be maintained with or without continued peripheral input, and that chemical, structural, and functional changes in the central nervous system may ultimately lead to a persistent, heightened state of neural reactivity.

Woolf CJ, King AE. 1989. Subthreshold components of the cutaneous mechanoreceptive fields of dorsal horn neurons in the rat lumbar spinal cord. J Neurophysiol. 62(4):907-916.

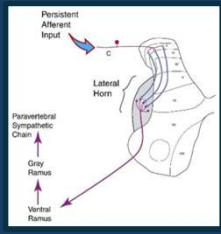
Nijs J, Van Houdenhove B. 2009. From acute musculoskeletal pain to chronic widespread pain and fibromyalgia: application of pain neurophysiology in manual therapy practice. Man Ther. 14(1): 3-12.




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Central Sensitization...

- increased synaptic activity in the somatosensory neurons in the dorsal horn of the spinal cord following intense peripheral noxious stimuli, tissue injury, or nerve damage



Ru-Rong J, Kohno T, Moore KA, et al. 2003. Central sensitization and LTP: do pain and memory share similar mechanisms. TRENDS in Neurosciences. 26(12): 696-705.

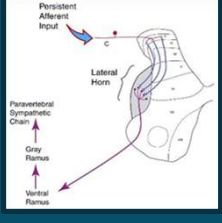


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Central Sensitization...

This heightened synaptic transmission causes:

- reduction in pain threshold
- amplification of pain responses
- spread of pain sensitivity to non-injured areas

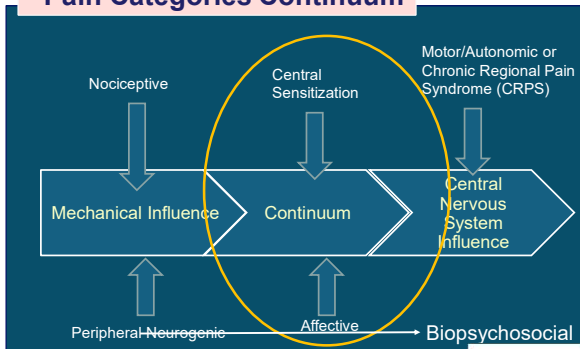


Ru-Rong J, Kohno T, Moore KA, et al. 2003. Central sensitization and LTP: do pain and memory share similar mechanisms. TRENDS in Neurosciences. 26(12): 696-705.




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Pain Categories Continuum



Adaptation by Ellen Braatz from: Kotski MC, O'Connor A. A World of hurt: a guide to classifying pain. 2015. Thomas Land Publishers Inc.




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Central Sensitization...

Central pain terms:

- **Allodynia:** Pain due to a stimulus that does not normally provoke pain.
- **Dysesthesia:** An unpleasant abnormal sensation, whether spontaneous or evoked.
- **Hyperalgesia:** Increased pain from a stimulus that normally provokes pain.
- **Hyperesthesia:** Increased sensitivity to stimulation, excluding the special senses.
- **Sensitization:** Increased responsiveness of nociceptive neurons to their normal input, and/or recruitment of a response to normally subthreshold inputs.

Kotski MC, O'Connor A. A World of hurt: a guide to classifying pain. 2015. Thomas Land Publishers Inc.



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Central Sensitization...

- investigated whether bilateral widespread pressure hypersensitivity exists in patients with unilateral carpal tunnel syndrome (CTS)
- assessed pain thresholds over the median, radial, and ulnar nerves bilaterally, C5-6 facet joint, carpal tunnel, & tibialis anterior muscle
- Results: there was a bilateral and wide-spread decrease in pressure pain thresholds in unilateral CTS compared to healthy controls

These results support a role of peripheral sensitization mechanisms in the initiation and maintenance of central sensitization.

Fernandez-de-las-Penas, de la Llave-Rincon AJ, Fernandez-Camero J. 2009. Bilateral widespread mechanical pain sensitivity in carpal tunnel syndrome: evidence of central processing in unilateral neuropathy. *Brain*.132:1472-1479.



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Central Sensitization...

central sensitization and tendinopathies

- systematic review evaluating 16 studies
- lowered pressure pain threshold was observed across different tendinopathies (rotator cuff and lateral elbow) at the site of tendinopathy as well as other sites, suggestive of central sensitization



Conclusion: it appears likely there is an association between persistent tendon pain and sensitization of the nervous system

Pingsanga M, Brink MS, Vicenzino B, et al. 2015. Evidence of nervous system sensitization in commonly presenting and persistent painful tendinopathies: A Systematic Review. *IOSPT*. Nov;45(11):864-875.



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Central Sensitization...

IDENTIFICATION:

Symptoms

- Disproportionate, non-mechanical, unpredictable pattern of pain provocation in response to multiple/non-specific aggravating/easing factors
- Pain disproportionate to the nature and extent of injury or pathology
- Strong association with maladaptive psychosocial factors (i.e. negative emotions, poor self-efficacy, maladaptive beliefs and pain behaviors)

Signs

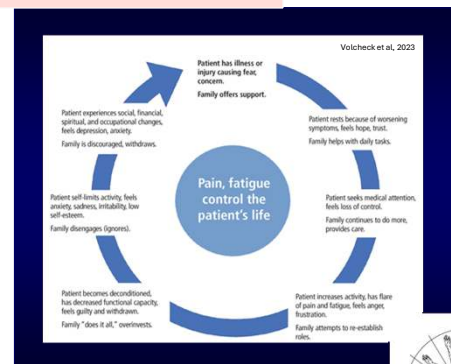
- Diffuse/non-anatomic areas of pain/tenderness on palpation

Smart KM, Blake C, Staines A, et al. 2012. Mechanisms-based classifications of musculoskeletal pain: part 1 of 3: symptoms and signs of central sensitisation in patients with low back (+/-leg) pain. *Man Ther*. 17(4):336-344.



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Central Sensitization...



Volcheck MM, Graham SM, Fleming KC, et al. 2023. Central sensitization, chronic pain, and other symptoms: Better understanding, better management. *Cleve Clin J Med*. Apr 3;90(4):242-254.



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Persistent Pain Considerations

What if everything hurts?



Images from Pixabay.com

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Persistent Pain Considerations

2 response systems in the body

Sympathetic System "fight or flight"

- Designed to be on/off
- Releases adrenaline into the body
- Adrenaline in the body long-term can cause pain magnification

Parasympathetic System "rest and digest"

- Concerned with conserving energy
- Aids in digestion, storing energy and cellular replenishment
- "Calming state": more active during sleep



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Persistent Pain Considerations

Sympathetic system

Increased Sympathetic Activity can cause...

Vasoconstriction: leading to a *sympathetic-mediated ischemia* causing
Slowed healing

pH changes ("*acid tissues*") causing increased mechanical sensitivity



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Persistent Pain Considerations

When pain becomes chronic

Persistent pain can contribute to sleeplessness
Not enough sleep = not enough ongoing repair of tissues
Due to the heightened state of the sympathetic system, the parasympathetic system needs to be activated!



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Persistent Pain Considerations

What can we do for patients?

- Education: explain what's going on--this is NOT all in their head!
- Give the patient some control—useful tools to help increase the parasympathetic system.
- Inhibit the sympathetic nervous system.
“hurt does not equal harm”



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Persistent Pain Considerations

Educational Tools

- Explanation about non-damaging nature of pain: “hurt does not equal harm”
- Explanation of mechanism of central sensitization
- Pain mechanism continuum
- Activity pyramid
- Flare up management
- Identification of activity baseline and explanation of no-worse concept; return control to the patient
- Training in coping strategies: relaxation, diaphragmatic breathing

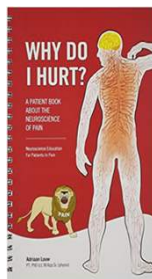
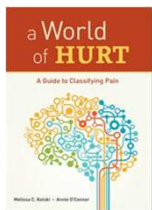
Kolski MC, O'Connor A. A World of hurt: a guide to classifying pain. 2015. Thomas Land Publishers Inc.



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Persistent Pain Considerations

Educational Tools



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Persistent Pain Considerations

Activity

- Low to moderate aerobic activities (HR 55-75% of max) and increase progressively
- Sensory retraining
 - Graded Motor Imagery
- Other motor retraining: isometrics, small ROM with feedback (tape, mirror, vision)

Kolski MC, O'Connor A. A World of hurt: a guide to classifying pain. 2015. Thomas Land Publishers Inc.




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Graded Motor Imagery

- ❖ 2 weeks of laterality recognition
 - ❖ 10 minutes each waking hour
- ❖ 2 weeks of imagined movements
 - ❖ 28 pictures, 3 times each waking hour
- ❖ 2 weeks of mirror therapy
 - ❖ 20 pictures, each waking hour, pain-free

Moseley, G. Graded Motor Imagery for pathologic pain. 2006. A randomized controlled trial. *Neurology*, 67:2129-34.

Prignac, V & Stralka, S. 2011. Graded Motor Imagery. *Journal of Hand Ther.* 24:164-169.



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Graded Motor Imagery

Laterality recognition

Looking at pictures of body parts and identifying them as left or right involves higher level motor centers—the pre-motor cortex.

right

Parsons LM. 2001. Integrating cognitive psychology, neurology and neuroimaging. *Acta Psychol.* 107:155-81.



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Graded Motor Imagery

Imagined Movements

Using the cards or pictures in a magazine, imagine the involved hand in the various positions without physically moving it

Moseley, G. Graded Motor Imagery for pathologic pain. 2006. A randomized controlled trial. *Neurology*, 67:2129-34.

Prignac, V & Stralka, S. 2011. Graded Motor Imagery. *Journal of Hand Ther.* 24:164-169.




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Graded Motor Imagery

History of the Mirror Therapy

What is it?

- ❖ Use of visual feedback, usually of the uninvolved extremity performing motor tasks.
- ❖ Involved limb is kept *hidden* from view.
- ❖ Result: Visual feedback of 2 limbs moving appropriately.




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Graded Motor Imagery

History of the Mirror Therapy

- ❖ Mirror Visual Feedback (MVF) was first used to address perceived involuntary movement & spasms in amputees
- ❖ Rationale: based on the theory that involuntary movements & paralysis in a phantom limb arise from a combination of pre-amputation memories and a mismatch between motor output and sensory feedback
- ❖ MVF would provide artificial sensory feedback, suppressing involuntary movements

Ramachandran & Rogers-Ramachandran. 1996. Synaesthesia in phantom limbs induced with mirrors. *Proc Biol Sci.* 263: 377-386.




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Graded Motor Imagery

History of the Mirror Therapy

- ❖ the experiment set out to improve motor control of a phantom limb....however, it provided pain relief instead!
- ❖ One patient described a permanent disappearance of phantom limb pain after using the mirror box for 10 minutes per day for 10 weeks

Ramachandran & Rogers-Ramachandran. 1996. Synaesthesia in phantom limbs induced with mirrors. *Proc Biol Sci.* 263: 377-386.



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Graded Motor Imagery

History of the Mirror Therapy

How does this work?

- The researchers hypothesized that by “giving back” the amputated limb, via a mirror illusion, it would provide the missing proprioceptive feedback
- Breaks the cycle of abnormal sensory feedback and motor output



Ramachandran & Rogers-Ramachandran. 2000. Phantom limbs and neural plasticity. Arch of Neurology. 57: 317-320.



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Graded Motor Imagery

How does it work?

- interrupts the abnormal loop of motor command and unexpected, inappropriate proprioceptive sensory feedback
- may be like a graded exposure: laterality training “warms up” the primary motor cortex, followed by the imagined movements and mirror therapy which gradually provides progressive exposure to the noxious stimulus---i.e. movement
- may impact other parts of the CNS such as the thalamus which may also have altered sensory representations.

Moseley, G. Is successful rehabilitation of complex regional pain syndrome due to sustained attention to the affected limb? A randomised clinical trial. Pain. 2005; 114: 54-61.

Altschuler E, Wisdom S, Stone L, et al. Rehabilitation of hemiparesis after stroke with a mirror. Lancet. 1999; 363: 235.



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Pain NeuroScience Education

What is it?

- An educational strategy used by clinicians that focuses on teaching people in pain more about the neurobiological and neurophysiological processes involved in their pain experience, especially chronic pain
- It aims to alter a patient’s beliefs and cognitions regarding their pain experience

Louw A, Nijs J, Puenedura E. 2017. A clinical prescriptive on a pain neuroscience education approach to manual therapy. J Man Manip Ther. May 22;25(3):160-168.



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Pain NeuroScience Education

Benefits

- positively influences pain ratings, disability, fear-avoidance behaviors, pain catastrophization, and limitations in movement, pain knowledge, and health care utilization

Louw A, Nijs J, Puenedura E. A clinical prescriptive on a pain neuroscience education approach to manual therapy. J Man Manip Ther. 2017; May 22;25(3):160-168.



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Pain NeuroScience Education

- Systematic Review of 15 RCTs
- Found Pain NeuroScience Education is effective in improving pain, disability, and psychosocial factors in patients with fibromyalgia and chronic low back pain especially if associated with other therapeutic approaches
- Conclusion: Overall, Pain NeuroScience Education seems to be more effective when proposed in one-to-one oral sessions and associated with reinforced elements

Lepri B, Romani D, Storari L, Barbari V. Effectiveness of pain neuroscience education in patients with chronic musculoskeletal pain and central sensitization: a systematic review. Int J Environ Res Public Health. 2023; Feb 24;20(5):4098.



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Dry Needling

- trigger point dry needling reduces the excitability of the CNS by decreasing peripheral nociception associated to the trigger point, reducing dorsal horn neuron activity, and by modulating pain-related brainstem areas
- the application of trigger point dry needling should be integrated into current pain neuroscience paradigm by combining its application with pain neuroscience education, graded exercise and manual therapy



Fernández-de-Las-Peñas C, Nijs J. 2019. Trigger point dry needling for the treatment of myofascial pain syndrome: current perspectives within a pain neuroscience paradigm. J Pain Res. Jun 18;12:1899-1911.



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TENS (transcutaneous electrical nerve stimulation)

- **Background:** This study was primarily aimed to determine whether transcutaneous electrical nerve stimulation (TENS) and interferential current (IFC) treatments have any effect on central sensitization (CS) in patients with knee osteoarthritis (OA) and to investigate which treatment is more effective.
- **Methods:** In this randomized controlled trial, 80 patients were randomized into four treatment groups: TENS, Placebo-TENS, IFC, and Placebo-IFC. All interventions were applied 5 times a week for 2 weeks.
- **Conclusion:** This study showed that TENS and IFC reduced pain sensitivity as compared to placebo groups in patients with knee OA. This effect was more pronounced in the TENS group.

Artuc SE, Uckun AC, Sivas FA, et al. 2023. Comparison of the effects of transcutaneous electrical nerve stimulation and interferential current therapies in central sensitization in patients with knee osteoarthritis. Korean J Pain. Jul 1;36(3):392-403.



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SUMMARY

- There are 2 types of pain: acute and chronic/persistent
- Persistent pain can lead to central sensitization
- Methods to address central sensitization:
 - Pain NeuroScience Education: "Hurt Does Not Equal Harm." Encourage return to regular activities.
 - Encourage low to moderate aerobic activity
 - Graded Motor Imagery: laterality recognition, imagined movements, mirror therapy
 - Trigger Point Dry Needling
 - TENS unit



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