Hurts So Good: Pain Science and Manual Therapy

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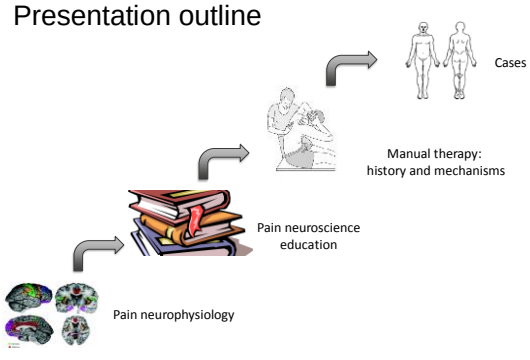
Objectives

- Upon completion of this course, attendees will be able to:
  - Discuss basic pain neurophysiology
  - Describe the neurophysiological effects of manual therapy
  - Identify patients who would benefit from a combination of pain neuroscience education and manual therapy
  - Integrate a pain science and manual therapy approach to their clinical practice

Presentation outline



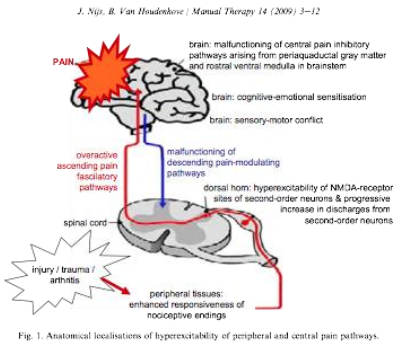


Fig. 1. Anatomical localisations of hyperexcitability of peripheral and central pain pathways.

The Pain Epidemic

- Estimated 100 million Americans are affected by chronic pain (Dzau and Pizzo 2014)

- Persistent pain costs the US between $560 to $635 billion annually (Gaskin and Richard 2011)

What is pain?

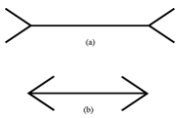
- The International Association for the Study of Pain defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”

Tissue Damage ≠ Nociception ≠ Pain

- 37% of asymptomatic 20 year olds and 96% of asymptomatic 80 year olds have evidence of disc degeneration (Brinjikji et al. 2015)
- 30% to 50% of patients with severe OA-related joint damage are asymptomatic (Arendt-Nielsen 2017)

Pain and perception

- Pain is produced by the brain when it **perceives** that danger to the body tissue exists and that action is required (Moseley 2003)



Visual cues and pain

- Moseley and Arntz (2007) conducted a study pairing noxious stimuli with visual cues that carried meaning – a red or blue light
  - Noxious stimulus was perceived as hotter and more painful when paired with red light

What can affect pain?

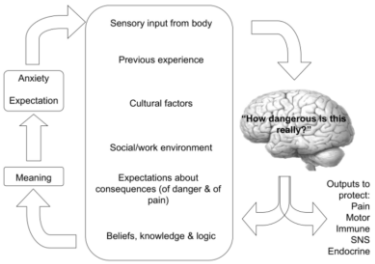
- DIMs (Danger In Me) and SIMs (Safety in Me)
  - Things we see, hear, smell, taste, touch
  - Things we think and believe
  - Things we say
  - Things we do
  - Places we go
  - People we meet
  - Things happening in our body

Butler and Moseley 2017

ABCDEFW- Psychosocial risk factors

- **A**ttitudes and beliefs
  - Catastrophization, maladaptive beliefs, passive attitude towards rehab
- **B**ehaviors
  - Extended rest, decreased activity, activity cycling, fear avoidance
- **C**ompensation
  - Lack of incentives to return to work, history of previous claims
- **D**iagnosis
  - Conflicting diagnoses, diagnostic language leading to fear and catastrophization
- **E**motions
  - Fear, depression, anxiety
- **F**amily
  - Overly solicitous family, punitive responses from family
- **W**ork
  - Belief that work is harmful, job dissatisfaction

Re-conceptualizing Pain

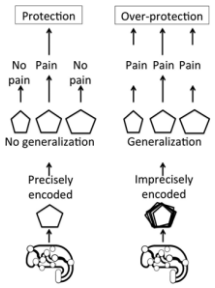


(Moseley 2007)

Distributed brain processing

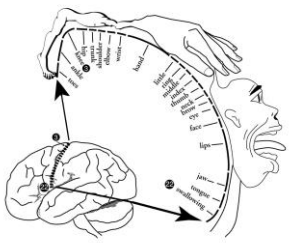
Puentedura and Louw 2011

Imprecision Hypothesis



Moseley and Vlaeyen 2015

Somatosensory cortex



Somatosensory cortex and smudging

https://zaccupples.com/tag/smudging/

Somatosensory system

- Variety of sensory neurons respond to a range of changes in tissue environments
  - Aα: proprioceptive
  - Aβ: safe and dangerous mechanical and thermal events
  - Aδ: hair follicle deflection and dangerous mechanical events
  - C: safe and dangerous mechanical, thermal and chemical events

Afferents

- Labeled for their optimal stimulus
  - What best activates the neuron is dependent on sensors that sit on nerve terminals
    - Pacinian corpuscle: vibration
    - Meissner corpuscle: moving stimulus
    - Merkel cell: indentation
    - Ruffini: stretch
    - Nociceptor

Nociceptors

- Optimal stimulus: noxious
- Free nerve endings
  - Neuron itself is capable of generating an action potential
- Can be Aβ, Aδ, or C fibers
- How do nociceptors get triggered into action?
  - Ion channels

Ion Channels

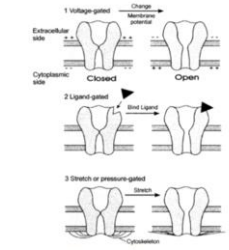


Fig. 1.3 Ion channels in the cell membrane of sensory neurones: 1. Voltage gated. 2. Ligand gated. 3. Stretch or pressure gated channels.

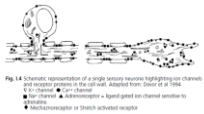
Gifford 1999

Pain Mechanisms

- Nociceptive
- Neuropathic
- Central Sensitization

Nociceptive pain

- Increased sensitivity of peripheral afferent nerves
  - Inflammatory mediators contribute to increased sensitivity to other stimuli
  - Upregulation of existing ion channels
  - Upregulation of new ion channels



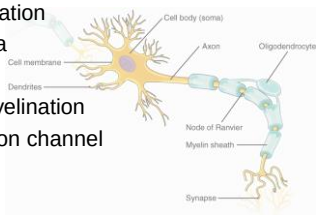
Gifford 1998

Nociceptive pain

- Cluster found to have high levels of classification accuracy (Sn 90.9%, Sp 91.0%) (Smart et al. 2012)
  - Pain localized to the area of injury/dysfunction (with/without somatic referral)
  - Clear, proportionate mechanical/anatomical nature to aggravating and easing factors
  - Usually intermittent and sharp with movement/mechanical provocation; may be a more constant dull ache or throb at rest
  - Absence of pain in association with other dysesthesias, night pain/disturbed sleep, antalgic postures/movement patterns, and pain described as burning, shooting, sharp or electric-shock-like

Neuropathic Pain

- Sensitivity at the nerve can spread due to the following (Nee and Butler 2006):
  - Changes in axoplasmic flow
  - Immune cell activation
  - Intraneural edema
  - Fibrosis
  - Progressive demyelination
  - Up-regulation of ion channel



Neuropathic pain

- Cluster found to have high levels of classification accuracy (Sn 86.3%, Sp 96.0%) (Smart et al. 2012)
  - Pain referred in a dermatomal or cutaneous distribution
  - History of nerve injury, pathology, or mechanical compromise
  - Pain/symptom provocation with mechanical/movement tests (e.g. Active/passive, Neurodynamic) that move/load/compress neural tissue

Central Sensitization

- Defined by :
  - Augmentation of sensory processing in the central nervous system
  - Impaired descending inhibitory pain pathways
  - Over-activation of facilitatory pain pathways
  - Temporal summation of second pain
  - Long term potentiation of brain synapses

Central sensitization

- Cluster found to have high levels of classification accuracy (Sn 91.8%, Sp 97.7%) (Smart et al. 2012)
  - 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
  - Diffuse/non-anatomic areas of pain/tenderness on palpation
  - Strong association with maladaptive psychosocial factors (e.g. negative emotions, poor self-efficacy, maladaptive beliefs and pain behaviors

So now what…

Physical Therapy Interventions and Chronic Pain

- Education
- Manual Therapy
- Goal setting
- Pacing activity
- Graded exposure/graded exercise
- Coping skills
- Aerobic exercise
- General stabilization/Strengthening
- Neural tissue mobilization
- Aquatic PT
- Graded motor imagery
- Sensory discrimination
- Sleep hygiene

Patient Education

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Patient Education

- Biomedical model
  - Focuses on anatomy, biomechanics, and pathoanatomy
  - Emphasizes tissues and tissue pathology

Pain Neuroscience Education

- Focuses on neurophysiology and neurobiology of pain
- Uses metaphors to re-conceptualize pain experience (Gallagher et al. 2013)
- Has been shown to decrease pain, disability, catastrophization, and improve physical performance (Louw et al. 2011)
- Moderate level evidence (Delitto et al. 2012)

Pain Neuroscience Education

- Evidence (Butler and Moseley 2017):
  - 20 RCTs, 4 Systematic Reviews
  - Effect Size: 0.7 (95% CI 0.4 to 1.0)
  - Number Needed to Treat: 4

Who would benefit?

- Individuals with:
  - Central sensitization
  - Persistent pain
  - Psychosocial factors
  - Multiple treatment failures
  - “E flags”

Educating patients about pain

- Ask permission first
  - *Is it ok if I explain pain to you?*
- Have to initially “de-educate”
  - Out of biomedical paradigm
  - Share normative data

De-threatening Diagnoses

- Spondylolisthesis
- Heel spur
- Bulging Disc
- Degenerative Disc Disease
- Fibromyalgia

Common Target Concepts

- Pain is normal, personal, and always real
- There are danger sensors, not pain sensors
- Pain and tissue damage rarely relate
- Pain depends on the balance of danger and safety
- Pain involves distributed brain activity
- Pain relies on context
- Pain is one of many protective outputs
- We are bioplastic
- Learning about pain can help
- Active treatment strategies promote recovery

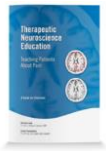
Butler and Moseley 2017

Neuroscience Education +++

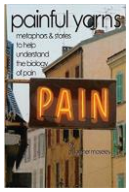
- More effective when combined with exercise or manual therapy
- More research is coming out with Neuroscience education combined with other approaches: aquatics, dry needling
- Patients have to experience physical success for approach to be effective

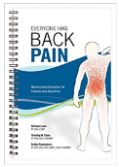
Louw et al. 2016

Resources for clinicians



Resources for patients





Online video resources

- Tame the beast: https://www.youtube.com/watch?v=XwBYkw-iZdQ
- Understanding the complexity of pain: https://www.youtube.com/watch?v=Zv6RPoVZx9M
- Understanding pain in under 5 minutes: https://www.youtube.com/watch?v=C_3phB93rvI
- Lorimer Moseley TED talk: https://www.youtube.com/watch?v=gwd-wLdIHjs

J. Nijs, B. Van Houdenhove / Manual Therapy 14 (2009) 3–12

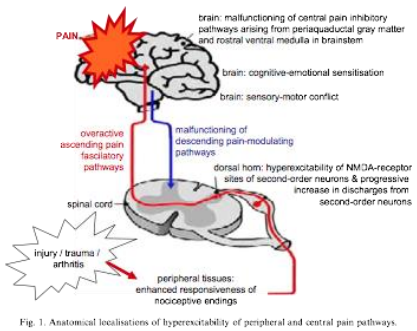


Fig. 1. Anatomical localisations of hyperexcitability of peripheral and central pain pathways.

History of Manual Therapy

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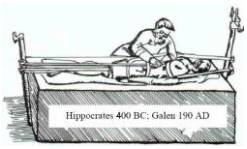
History of Manual Therapy

- Hippocrates (460-355 B.C.)
  - First in recorded history to describe joint manipulation and traction
  - First described in hip joint, TMJ and shoulder
- Edward Harrison (1827)
  - Champion of manipulation



Bone Setters

- Friar Moulton

- Published first book in 1656

"The Complete Bone-Setter"

- "Clicking sounds" thought to be due to moving joints back into place

Osteopathy

- Founded by Andrew Still in 1874
- 1896 founded first school
- "Rule of the Artery" – Manipulate the spine to restore blood flow and restore body's innate healing ability

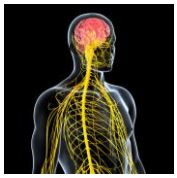
Chiropractic Founded 1895

- D.D Palmer (1845 – 1913)
- Founder of Chiropractic care
- A magnetic healer applied an "adjustment" to Harvey Lillard in September 1895 to the T4 vertebra that resulted in restoration of lost hearing

Chiropractic Philosophy

- Belief in body's innate ability to heal itself
- "The Law of the Nerve"

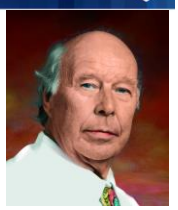
- Adjust spinal "subluxations" to restore nerve flow and facilitate the body's innate healing ability



Manipulation in PT

- 1925-1939 Began to start seeing publications on manipulation and related topics
- Mobilization/articulation terminology used to separate PT from chiropractic

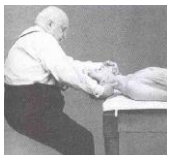
Freddy Kaltenborn

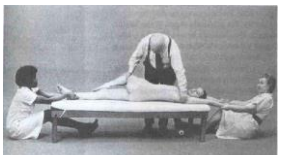


- Nordic approach
- First to relate manipulation to arthrokinematics
- Convex-Concave Rules
- 1950s designed first pneumatic high-low adjustment treatment table for manual therapists

James Cyriax

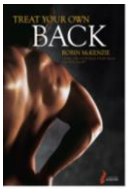
- Selective tissue tension examination
- AROM, PROM, isometric muscle testing
- Concept of end-feels
- capsular or non-capsular patterns



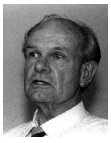


Robin McKenzie

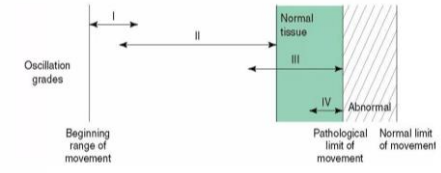
- Mechanical Diagnosis and Therapy
- Examination and treatment based on signs and symptoms
- Building patient self-efficacy



Geoffrey Maitland



- Vertebral Manipulation 1964
- Treats “reproducible signs”
- Oscillatory techniques (Grade I-V)



Brian Mulligan

- Mobilization with movement
- Clinician and patient overpressure

Stanley Paris

- Founding Member of AAOMPT and first president of Orthopaedic Section
- Founder of University of St. Augustine

The Future

Mechanism of Manual Therapy

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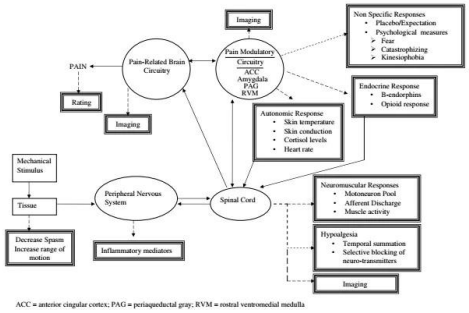


ACC = anterior cingular cortex; PAG = periaqueductal gray; RVM = rostral ventromedial medulla

fig. 1. Comprehensive model of the mechanisms of MT. Figure key: The model suggests a transient, mechanical stimulus to the tissue produces a chain of neurophysiological effects. olid arrows denote a direct mediating effect. Broken arrows denote an associative relationship which may include: ----→ = an association between a construct and its neasure . Bold boxes indicate the measurement of a construct.

Manual Therapy

- Biomechanical mechanisms (Bialosky 2009):
  - Biomechanical effects are transient
  - Biomechanical assessment is unreliable
  - Choice of technique does not seem to matter
  - Force is spread over a large area
  - Improvements are seen away from the treated area

Manual Therapy

- Neurophysiological mechanisms (Bialosky 2009)
  - Peripheral
  - Spinal
  - Supraspinal

Peripheral effects

- Decreased blood levels of cytokines
- Increased levels of endorphins, serotonin, and endogenous cannabinoids
- Altered acute inflammation

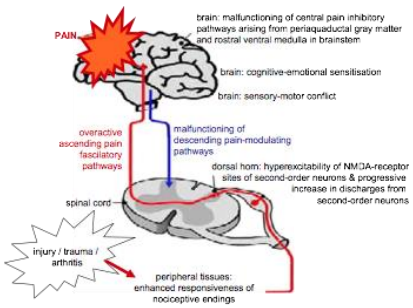
Spinal effects

- Decreased temporal summation
- Selective blocking of neurotransmitters

Supraspinal effects

- Improved descending inhibition
- Placebo/expectation
- Psychological
- Changing neural signatures
- Changes in somatosensory cortex

J. Nijs, B. Van Houdenhove / Manual Therapy 14 (2009) 3–12



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Case Studies

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