CENTRAL SENSITIZATION PAIN IN PHYSICAL THERAPY PRACTICE AROUND THE WORLD

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CENTRAL SENSITIZATION PAIN IN PHYSICAL THERAPY PRACTICE AROUND THE WORLD

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Romy Parker

- Associate Professor University of Cape Town
- Director of Train Pain Academy www.trainpainacademy.co.za
- chronic pain management team Groote Schuur Hospital
- President-elect of PainSA
- Chair of the Pain, Mind and Movement Special Interest Group of IASP

CENTRAL SENSITIZATION PAIN IN PHYSICAL THERAPY PRACTICE AROUND THE WORLD

http://www.wcpt.org/wcpt2017/COURSE-11

Michele Sterling

- Professor Griffith University
- Director NHMRC Centre of Research Excellence in Road Traffic Injury
- Chair Scientific Program Committee Australian Pain Society
- ranked #1 whiplash injury researcher in the world www.expertscape.com
- > $13M competitive research funding
- > 150 scientific papers

CENTRAL SENSITIZATION PAIN IN PHYSICAL THERAPY PRACTICE AROUND THE WORLD

http://www.wcpt.org/wcpt2017/COURSE-11

Kelly Ickmans

- Visiting & research professor
- Postdoctoral researcher
- PT - clinician
- Pain in Motion *kids*
- PhD supervisor
- > 30 papers

PAIN IN MOTION

Medical diagnosis
Low back pain
Pediatric pain
Post-cancer pain
Osteoarthritis
Whiplash associated disorders
Nontraumatic neck pain
Shoulder pain
Fibromyalgia

Medical diagnosis	Estimated % predominant central sensitization pain
Low back pain	25%
Pediatric pain	?
Post-cancer pain	15%
Osteoarthritis	30%
Whiplash associated disorders	90%
Nontraumatic neck pain	10%
Shoulder pain	10%
Fibromyalgia	100%

Medical diagnosis	Medical discipline	Estimated % predominant central sensitization pain
Low back pain	Orthopedics	25%
Pediatric pain	Pediatrics	?
Post-cancer pain	Oncology	15%
Osteoarthritis	Rheumatology	30%
Whiplash associated disorders	Emergency medicine	90%
Nontraumatic neck pain	Physical medicine	10%
Shoulder pain	Physical medicine	10%
Fibromyalgia	Rheumatology	100%

Content overview

- Introduction
- Central sensitization: maladaptive neuroplasticity in patients with chronic pain (Kelly)
- Neuropathic central sensitization pain in physical therapy practice: HIV-related neuropathic pain as an example (Romy)
- Neuropathic central sensitization pain in physical therapy practice: assessment (Romy & Michele)
- Non-neuropathic central sensitization pain in physical therapy practice: Neck pain as an example (Michele & Jo)
- Non-neuropathic central sensitization pain in physical therapy practice: case study (Kelly & Jo)

PAIN IN MOTION

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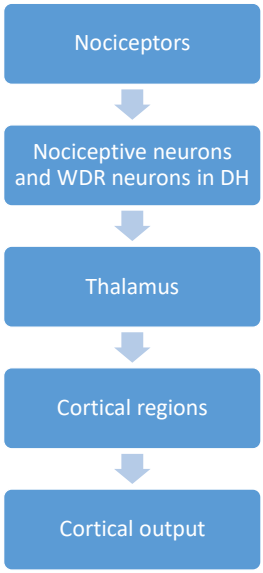
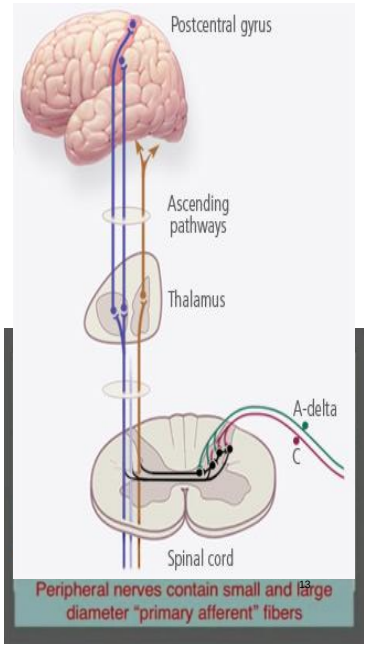
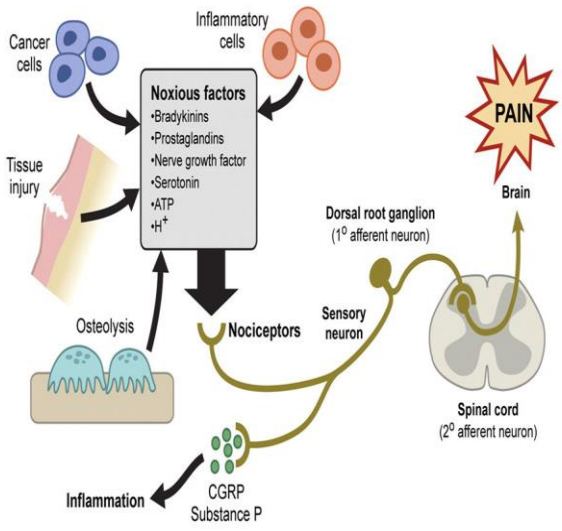
PAIN IN MOTION

Pain





Nociceptive pain



→ Inflammation
→ Tissue injury
→ Growing mass
→ …
  → distension
  → rupture
  → stimulation mech. receptors

→ **activation nociceptors**

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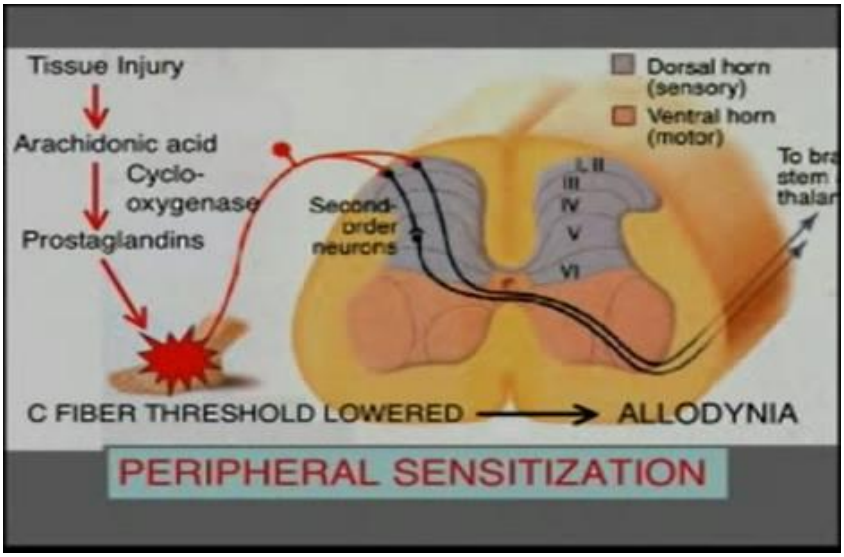

↓ threshold
↑ firing rate

→ Nerve impulses ↑↑ →

Primary HYPERALGESIA
ALLODYNIA

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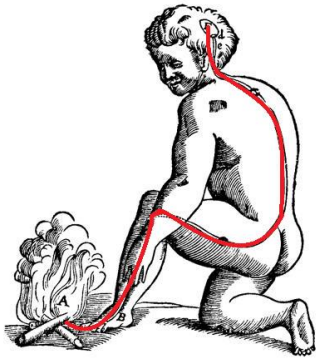
Why?

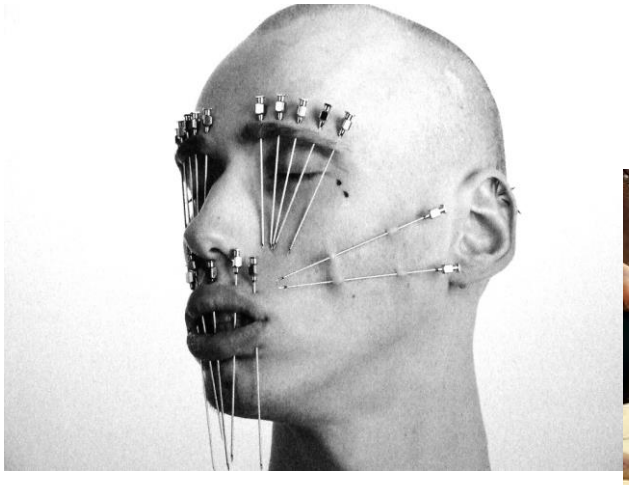
Primary hyperalgesia = adaptive response of the nervous system, preventing further damage and hence facilitating tissue healing.

Nociception vs. pain



- There's a direct link between the amount of tissue damage and the level of pain experienced

Pain vs. Nociception



Nociception ≠ Pain & Pain ≠ Nociception

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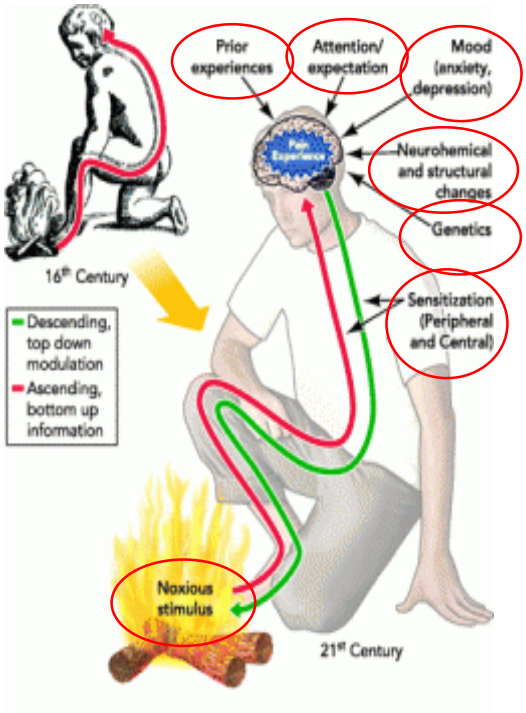

If pain persists

- After injury → tissue sensitization

- Inflammatory mediators or strong noxious stimulation sensitise primary nociceptors (c-fibres)

⇒ ***Peripheral sensitization***

If pain still persists

→ lack of distinct localisation
→ lack of tissue damage

- No longer adaptive function
- ≠ Prolonged acute pain

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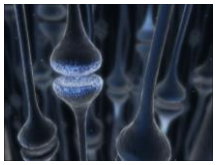
Chronic pain

- Disproportional to peripheral input
- Therapy resistant, bad recovery

Peripheral or central problem?



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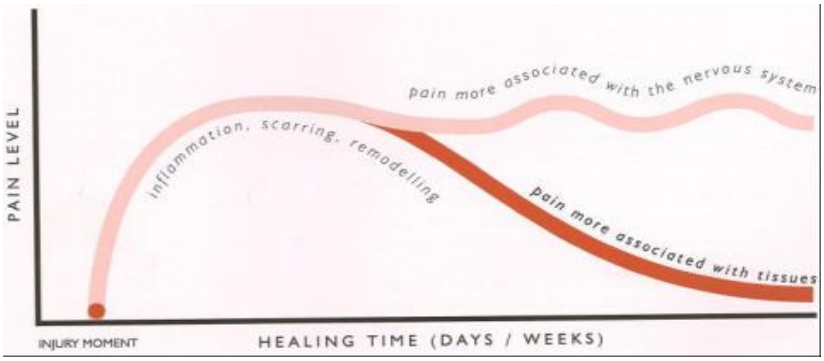

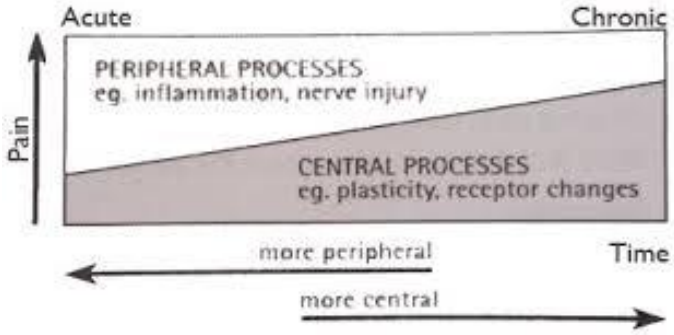

Sensitization

= NEUROPLASTIC PAIN:

- Synaptic and non-synaptic changes
- Peripheral
- Central: spinal cord and brain

Neuroplasticity =
Planning a better response

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Central sensitization

- = Hyperexcitability CNS
- = Hypersensitivity for all mechanical stimuli

Allodynia
Generalized hyperalgesia
Widespread pain
Chronic pain

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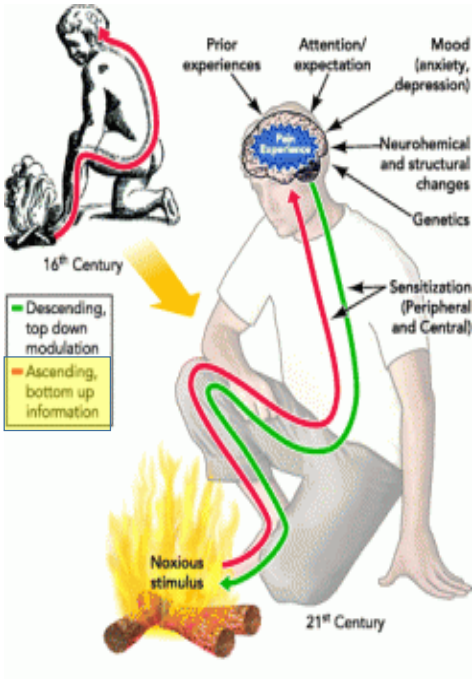


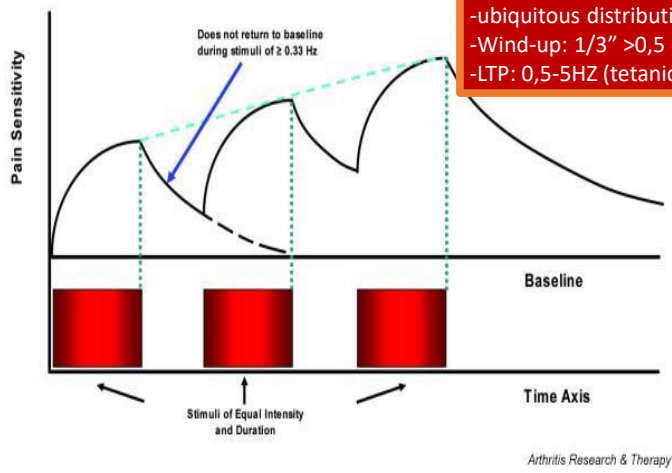
1. Overactivation bottom-up system:
↗ nociceptive transmission

Central Sensitization: mechanisms

Meeus & Nijs, 2007; Nijs & Van Houdenhove 2008; Yarnitsky et al. 2010

Wind-up & LTP

C-fibres:
-prolonged discharge
-ubiquitous distribution
-Wind-up: 1/3" >0,5 HZ
-LTP: 0,5-5HZ (tetanic)



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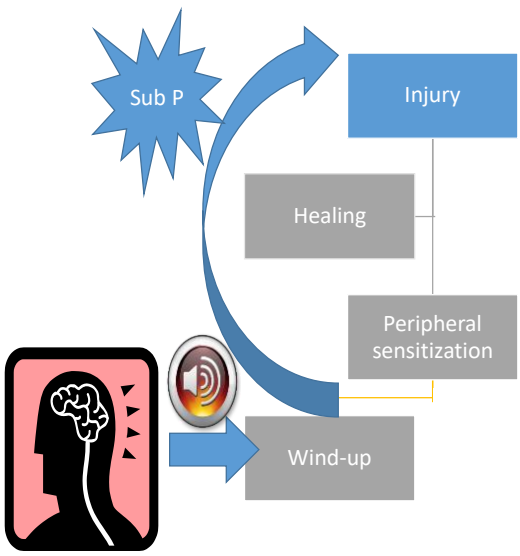

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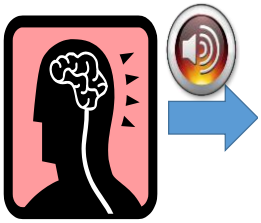
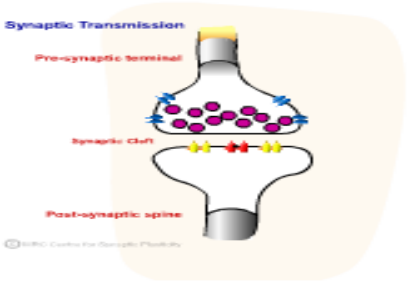


Healing with neuroplastic changes

LTP

CS

31



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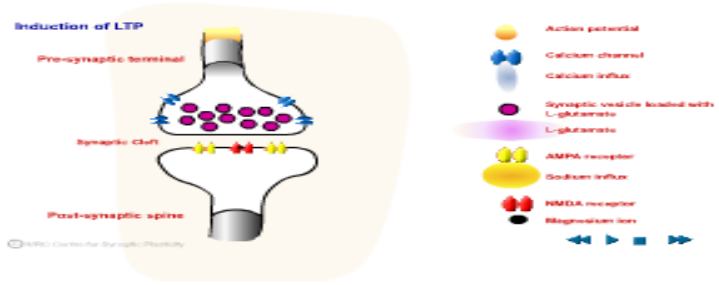
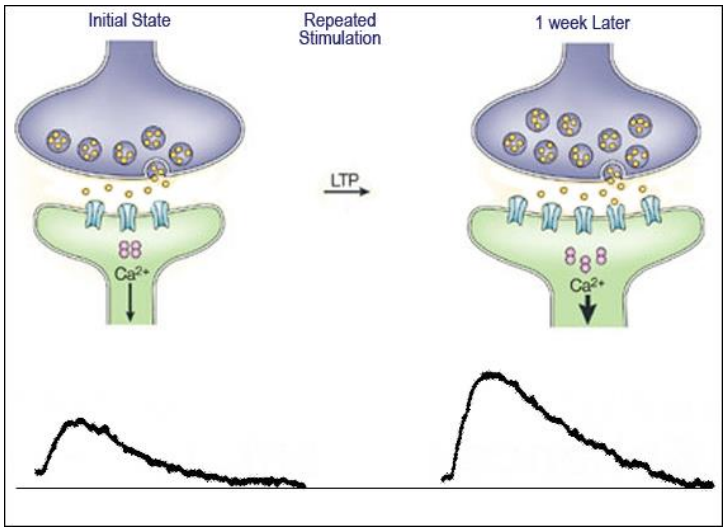
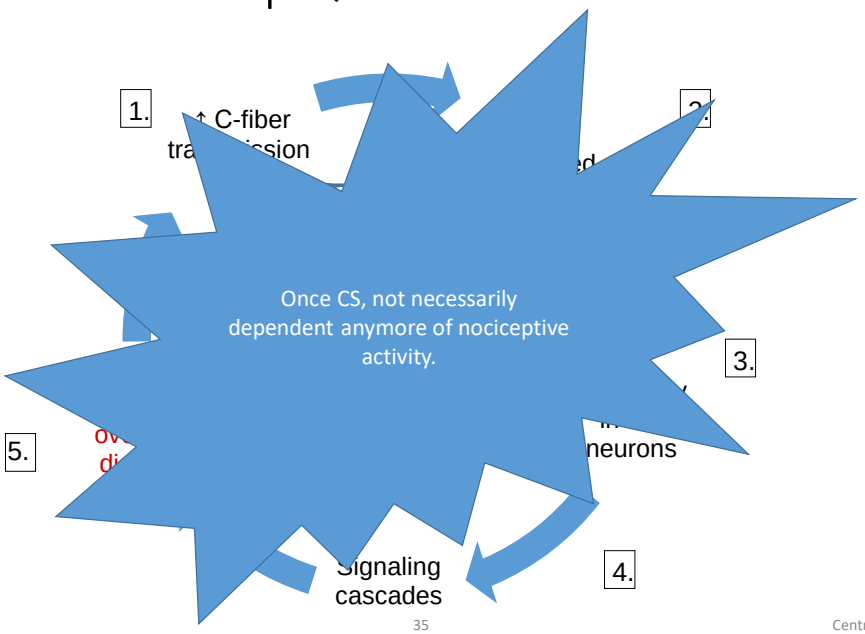




Long-term potentiation

CS: Wind-up → LTP



Wind-up	LTP
Low frequency (0,33 HZ- 0,50HZ)	High frequency (0,5-5HZ)
Up to few minutes	Up to months
Can lead to LTP: NMDAr activation + retrograde Sub P	Early phase: NMDAr activation + post-synaptic changes Late phase with protein synthesis
Rather a paradigm to test excitability	Source for CS
Activity-dependent	After installation no longer activity dependent
Homosynaptic	Heterosynaptic
Dorsal horn	Dorsal horn & brain

Temporal summation (TS)

- Paradigm to evaluate bottom-up excitability
- Enhanced TS in CS:
  - Faster
  - More intense
  - Longer after-sensations

(Lemming et al. 2102; Staud, etc.;)

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TS in cancer pain

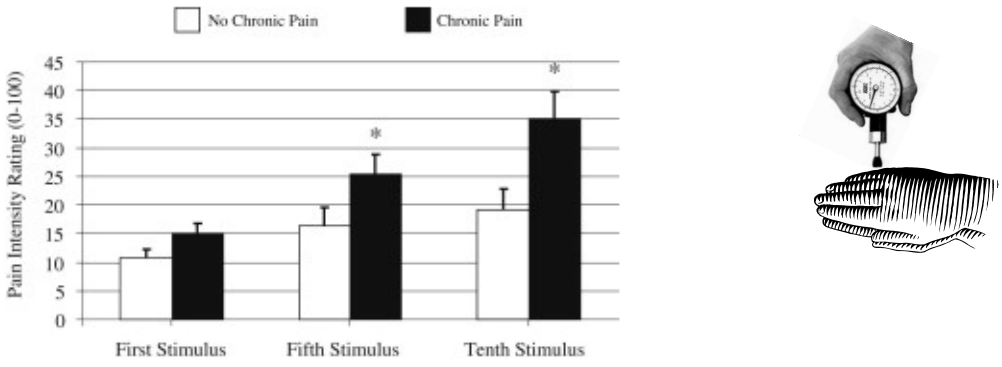

Fig. 1. Pain ratings (0–100) for repetitive punctuate mechanical stimuli (data presented as means ± SEM). *Groups differ significantly at $P < 0.05$.

Edwards et al. *J Pain Symptom Manage* 2013; 46(1): 30-42

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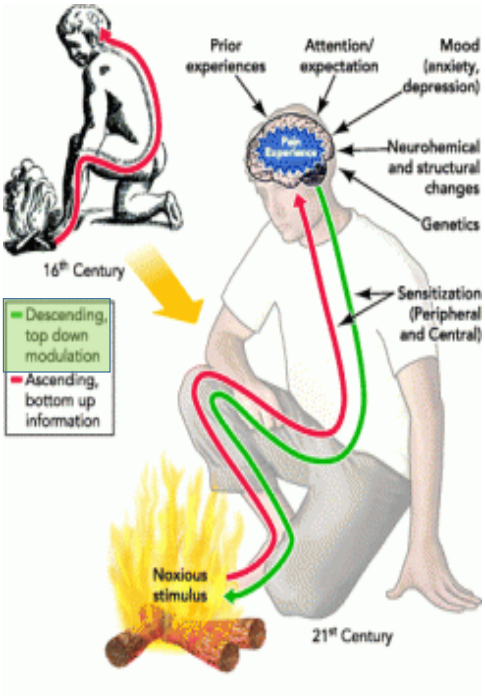

2. Changes in top-down pathways:

Inhibitory

Facilitatory

Central Sensitisation: mechanisms

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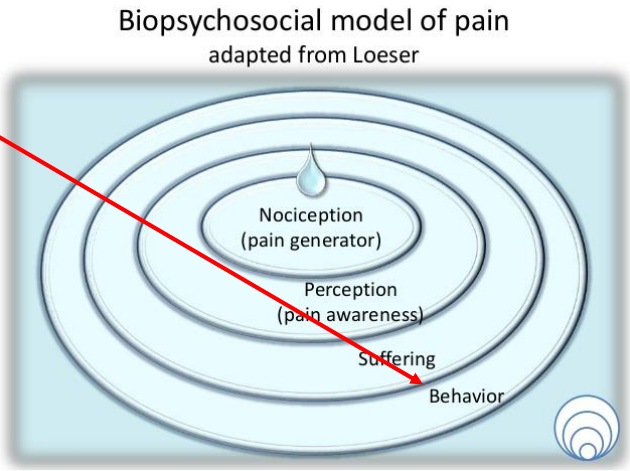
Meeus & Nijs, 2007; Nijs & Van Houdenhove 2008; Yarnitsky et al. 2010

Would this hurt?

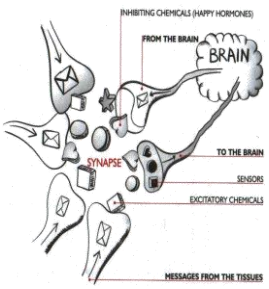


What if?

Impaired pain inhibition

Descending inhibitory pathways in dorsolateral funiculus:

- Inhibitory substances (serotonin, opioids, etc.) in synapses in dorsal horn



Experimental block or lesions of pathways

→ **equivalent of CS**

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CS: Impaired pain inhibition

- **Spinal block ⇒ ~~inhibition~~**
  - ⇒ expansion receptive fields
  - ⇒ hypersensitivity
  - ⇒ faster Wind-up

⇒ Presynaptic activity not essential for CS

⇒ CS by failing endogenous pain inhibition

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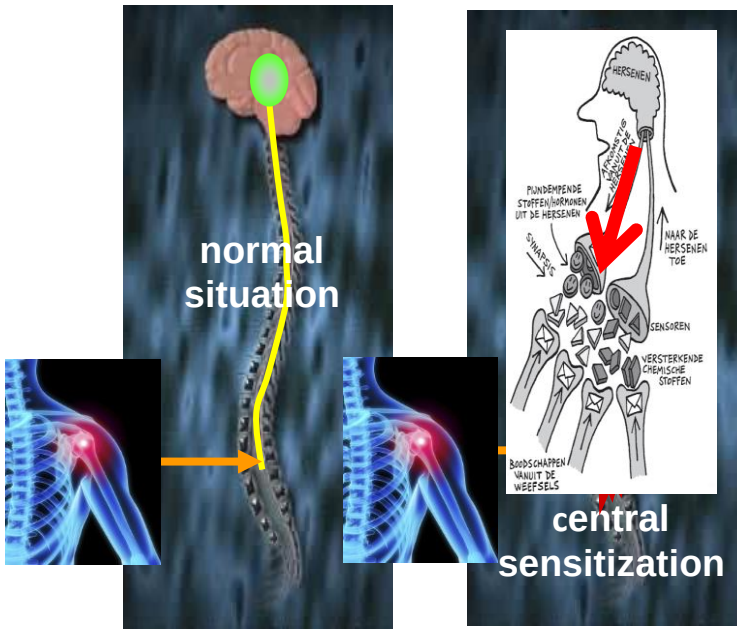

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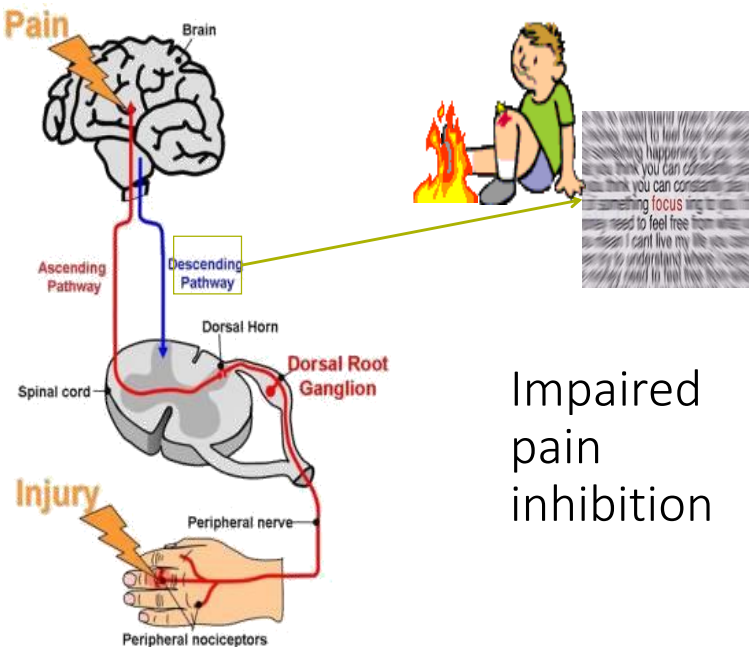

Impaired pain inhibition

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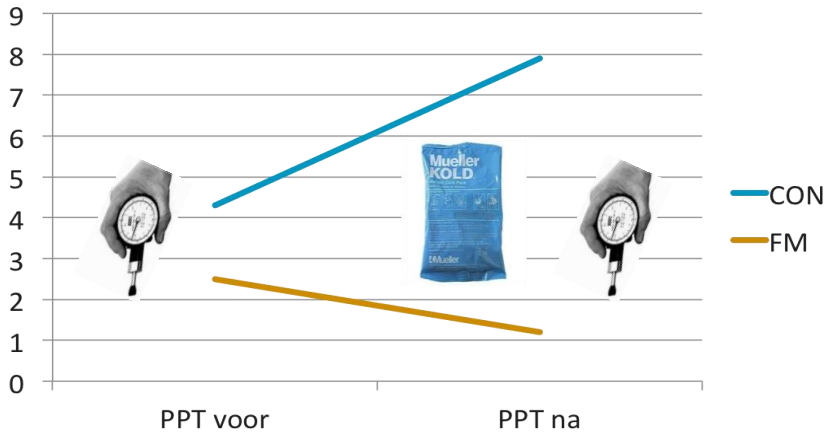
Conditioned pain modulation

- Defficient in different chronic pain populations



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CPM in cancer pain

Left trapezius (PPT measure)

Right hand

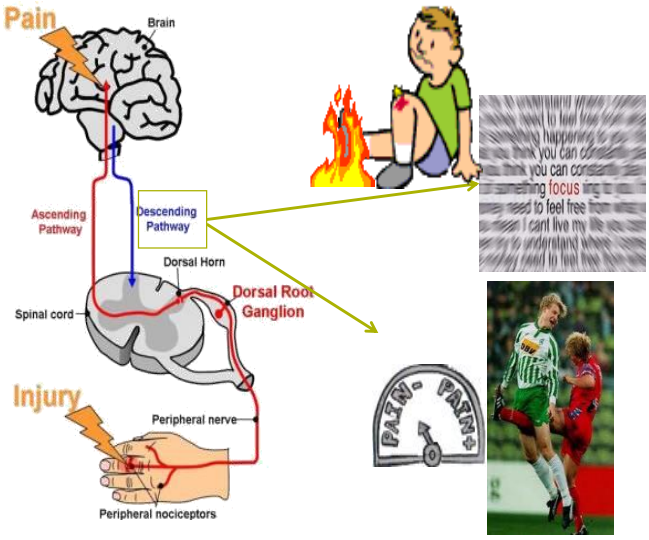
+

Left trapezius (PPT measure)

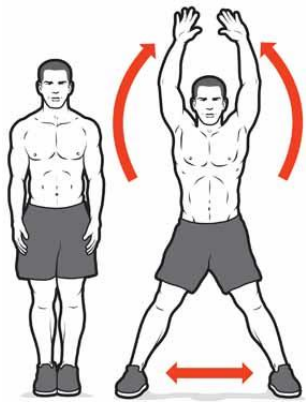
CPM = % change in $PPT_{counterstimulus}$ relative to $PPT_{baseline}$

CPM in pain group < non-pain group!

Edwards et al. *J Pain Symptom Manage* 2013; 46(1): 30-42



Experiment (n=2)



20 x

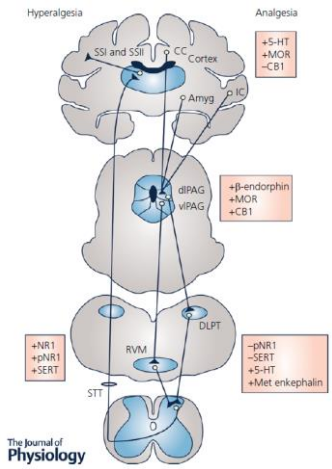
Exercise-induced hypoalgesia

Evidence for exercise-induced hypoalgesia

Naugle et al. *J Pain* 2012; 13(12): 1139-1150

Top-down & bottom-up influences on nociceptive processing

Mechanisms of EI hypoalgesia



Lima et al. *J Physiol* 2017: Epub ahaed of print

Evidence for exercise-induced hypoalgesia

- ↑
- ↓

➔ C… **…arge effect** (iso and dyn ex.)
➔ **V… …pread** hypoalgesia (isometric ex.)
➔ Up to **10 min post-exercise** (contracting muscle)
➔ Dynamic resistance ex.: little evidence available

- ↑ pain thresholds
- ↓ pain intensity ratings

➔ Overall **moderate effect**
➔ Most consistent at **high intensity** (> 75% of VO_{2max}) and **longer duration** (> 10 min)
➔ Up to **15 min post-exercise** (trivial to small effect at 30 min)

Naugle et al. *J Pain* 2012; 13(12): 1139-1150

Evidence for exercise-induced hypoalgesia in chronic pain?

Evidence for exercise-induced hypoalgesia in chronic pain?

Chronic low back pain	?	+
Shoulder myalgia	+ (generalized and localized when contracting painfree muscle)	?
Rheumtoïd arthritis	+ (generalized and localized)	+
Osteoarthritis (hip and knee)	-/+ (depending on CPM)	-/+ (depending on CPM)
Chronic whiplash-associated disorders	+	-/= (depending on CPM?? Ex intensity??)
Fibromyalgia	-/+ (depending upon ex intensity)	-/+ (depending upon ex intensity)
CFS with chronic widespread pain	?	-

Burrows et al. 2014; Fingleton et al. 2017; Fridén et al. 2013; Hoffman et al. 2005; Ickmans et al. 2017; Kadetoff & Kosek 2007; Kosek et al. 2013; Lannersten & Kosek 2010; Meeus et al. 2010; Meeus et al. 2015; Newcomb et al. 2011; Smith et al. 2017; Staud et al. 2005; Van Oosterwijck et al. 2012; Vierck et al. 2001

Why exercise-induced **hyper**algesia?

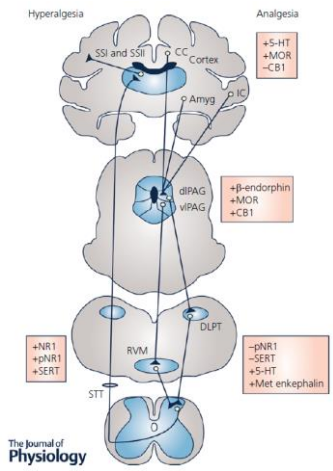
- ↑ NMDA receptor function in the RVM
- ↑ SERT activity

- Abnormal CPM ≈ Central Sensitization?

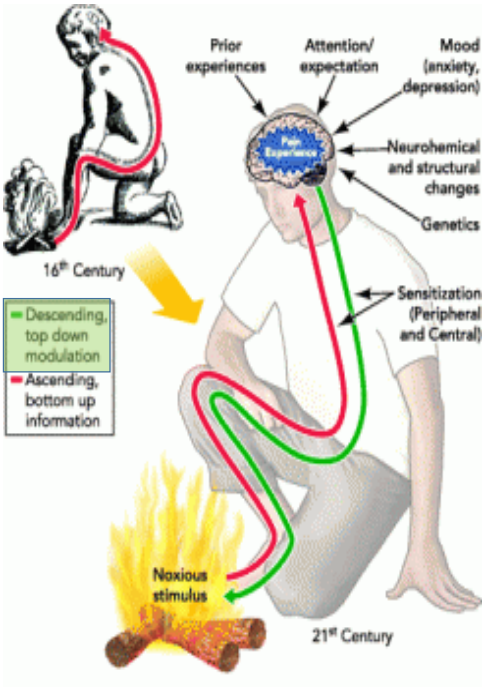
- Psychosocial variables?

- ↑ peripheral nociceptive input?

- …?



Lima et al. *J Physiol* 2017: Epub ahaed of print



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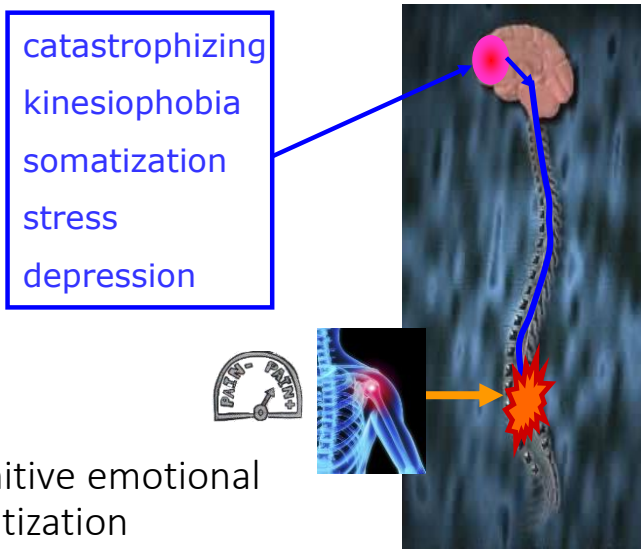


Cognitive emotional sensitization

Zusman, 2002

Catastrophizing

Catastrophic thinking about pain

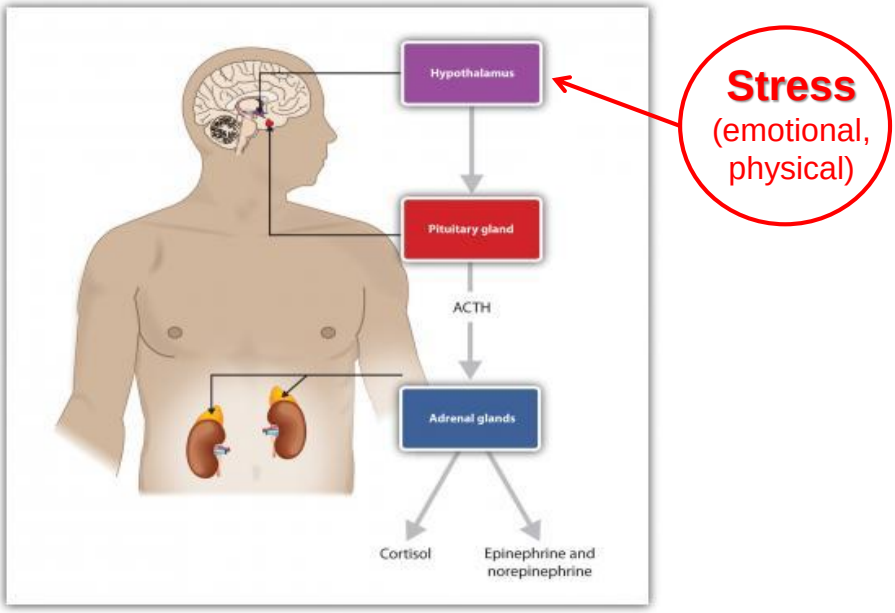
More intense pain

Higher disability

Increased use of health care services and medication

Predictive of persistence of pain and disability

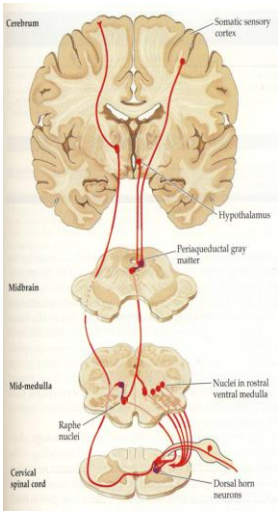
Sullivan at al. (2001), Crombez et al. (2003), Quartana et al. (2009), Lu et al. (2011), Edwards et al. (2009)



Tak et al. *Biol Psychol* 2011

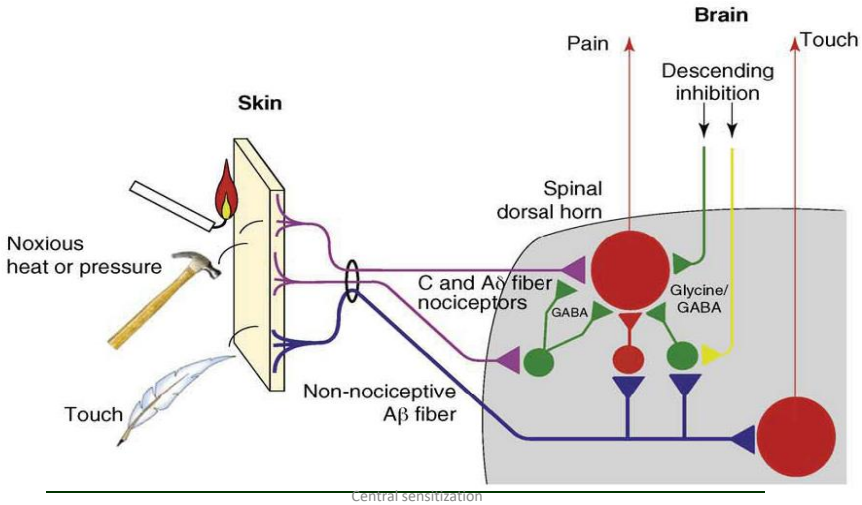
Chronic stress

GABA neurotransmission↓



Suarez-Roca et al. 2008

Gaba, main inhibitory NT



Chronic stress

GABA neurotransmission↓

⬇

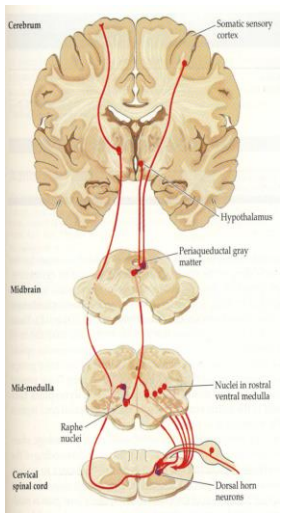
Serotonergic activity↓

⬇

Disinhibition

⬇

Hyperalgesia



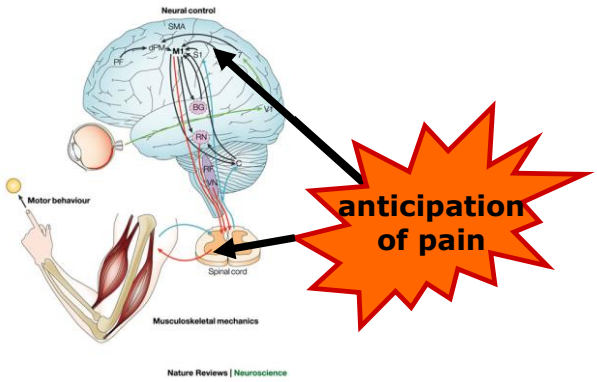
Suarez-Roca et al. 2008

Pain is not over when the needle ends…

- **Children's memories for pain** may contribute to the development and maintenance of later **chronic pain** (→ operant and respondent learning processes and altered processing within the CNS).
- Early pain memories relate to **fear** and **avoidance** of medical care in **adulthood**.

- In addition to experiencing pain during medical procedures, many children also experience **fear before procedures** even begin, which **can heighten a child's pain perception**

Cohen et al. 2002; Flor & Birbaumer 1994; Pate et al.1996; Rhudy & Meagher, 2003; Sun-Ok & Carr 1999



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Tucker et al. *Pain* 153 (2012) 636–643.

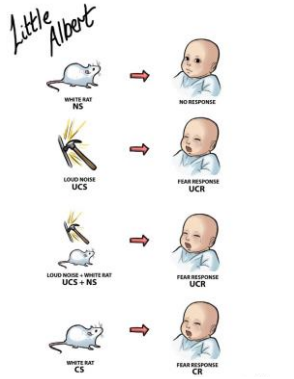
Psychosocial basis

Classical conditioning

- Automatic or reflexive response
- Learning through association of stimuli

Pavlov's dogs

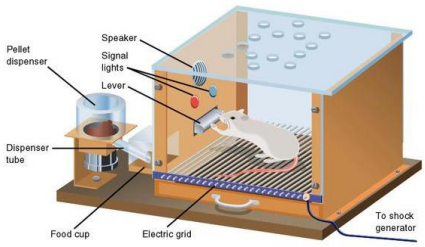
Watson's little Albert



Operant conditioning model

- Active response
- Learning through consequences of behavior (punishment or reward)

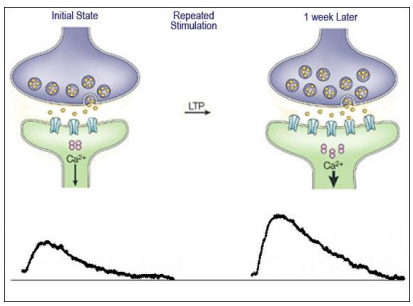
The Skinner Box

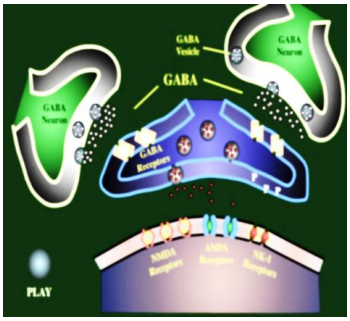


Biological basis

- Central sensitization entails increased synaptic efficiency / excitatory synapses ~ learning / memory (hippocampus)

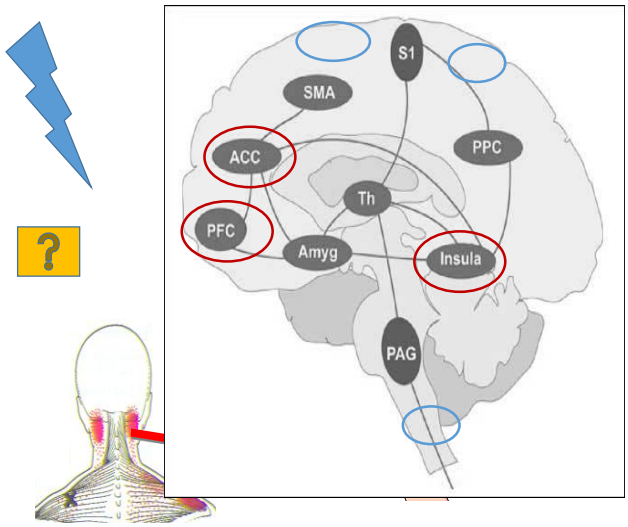
→ LTP in part regulated by cortisol & noradrenaline in the brain (stress!)



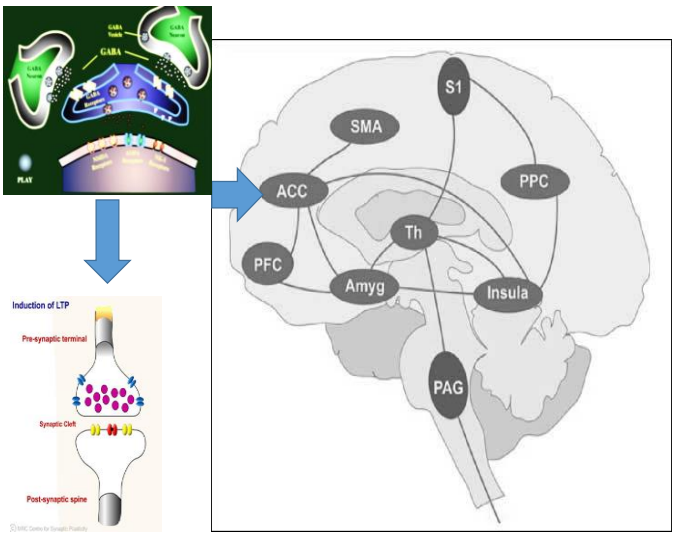


PAIN IN MOTION

Overactive pain neuromatrix



Moseley, 2003



Mechanisms of CS

- ↓ descending inhibition
- ↑ descending facilitation
- Cognitive emotional sensitization
- Altered sensory processing in the brain

- Wind-up dorsal horn neurons
- ↑ neuronal receptive fields
- Persistent sensitization of WDR neurons

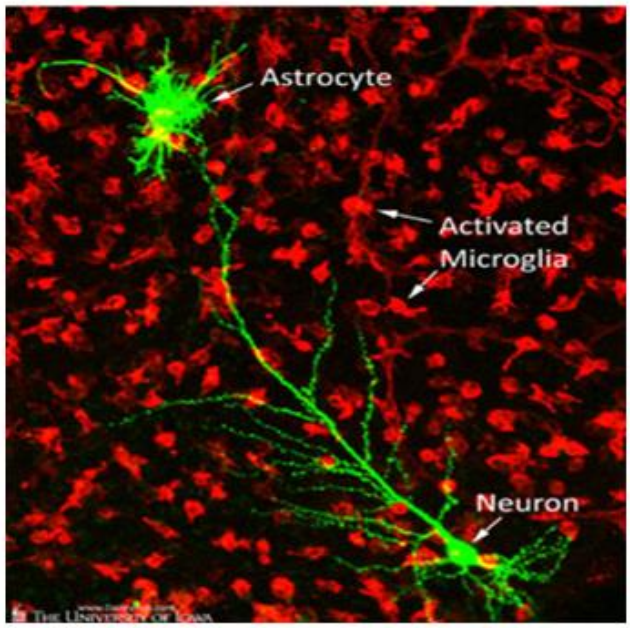


Table 1
Distinct reaction of microglia, astrocytes, and satellite glial cells (SGCs) in different pain conditions, as examined by upregulation of the glial markers IBA1, CD11b, and glial fibrillary acidic protein (GFAP).

Pain conditions	Microglia	Astrocytes	SGCs
Nerve injury	↗	↗	↗
Spinal cord injury	↗	↗	
Paw incision	↗	↗	
Inflammation	↔/↗	↗	↗
Joint arthritis	↗	↗	↗
Bone cancer	↔/↗	↗	↗
Skin cancer	↔	↗	
Chemotherapy	↔/↗	↗	↗
Diabetes	↗	↗	
HIV neuropathy	↔	↗	
Chronic opioid	↗	↗	
Acute opioid	↔	↔	↗

Detailed, with related references, in Section 2.1.
Symbols: Right-upward diagonal arrow (↗) denotes upregulation; right&left horizontal arrow (↔) denotes no regulation; right-downward diagonal arrow (↘) denotes downregulation.

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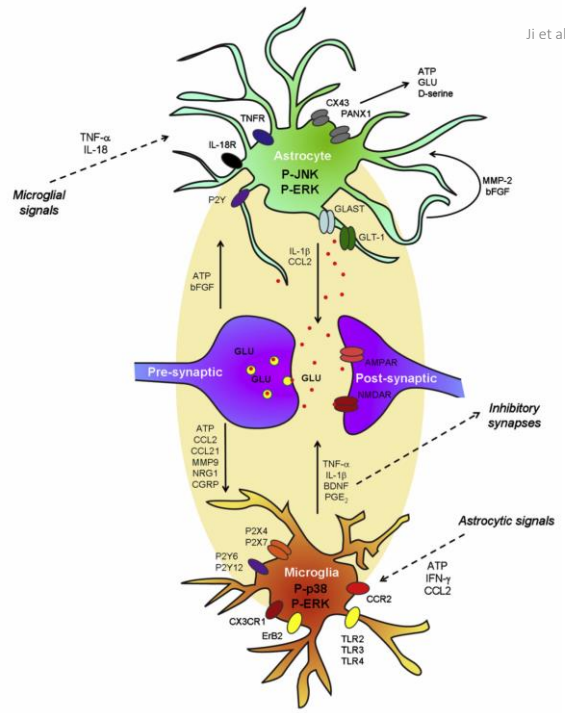


Ji et al. *Pain* 2013;154:S10-28.

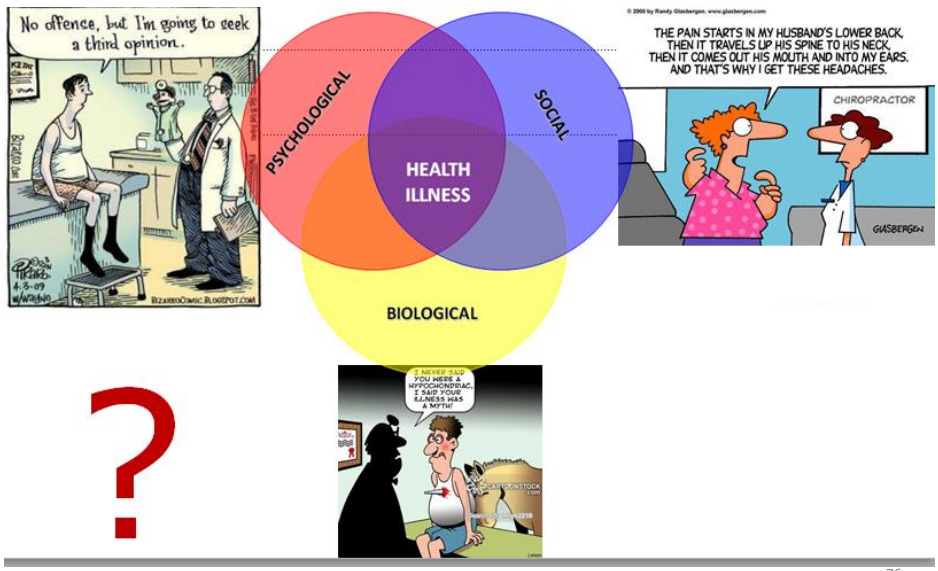
Symptoms related to the presence of central sensitization.

Symptom	Characteristic of CS	Might be related to CS
Hypersensitivity to bright light	✓	
Hypersensitivity to touch	✓	
Hypersensitivity to noise	✓	
Hypersensitivity to pesticides	✓	
Hypersensitivity to mechanical pressure	✓	
Hypersensitivity to medication	✓	
Hypersensitivity to temperature (high and low)	✓	
Fatigue		✓
Sleep disturbances		✓
Unrefreshing sleep		✓
Concentration difficulties		✓
Swollen feeling (e.g. in limbs)		✓
Tingling		✓
Numbness		✓

CS, central sensitization.

Symptoms of central sensitization

Nijs et al. *Manual Therapy* 2010;15:135-141.



Content overview

- Introduction
- Central sensitization: maladaptive neuroplasticity in patients with chronic pain (Kelly)
- **Neuropathic central sensitization pain in physical therapy practice: HIV-related neuropathic pain as an example (Romy)**
- **Neuropathic central sensitization pain in physical therapy practice (Romy & Michele)**
- Non-neuropathic central sensitization pain in physical therapy practice: Neck pain as an example (Michele & Jo)
- Non-neuropathic central sensitization pain in physical therapy practice: case study (Kelly & Jo)

PAIN IN MOTION

Neuropathic central sensitization pain in physical therapy practice

HIV-related neuropathic pain as an example

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A/Prof Romy Parker[PhD]
Director: Pain Management Unit

Neuropathic Pain

- ***What is neuropathic pain?***
  - pain that arises as a 'direct consequence of a lesion or disease affecting the somatosensory system' (Jensen et al, 2011)
- ***What conditions do you treat that involve neuropathic pain?***
  - HIV, diabetes, alcohol abuse, spinal injuries, trigeminal neuralgia

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PAIN IN HIV/AIDS

- Pain is recorded as the second most commonly reported symptom in several populations of People Living With HIV/AIDS (PLWHA)
- Systematic review (Parker et al, 2014a)
  - 60 studies reporting on prevalence of pain
  - Samples predominantly
    - Male
    - Homosexual
    - Developed countries

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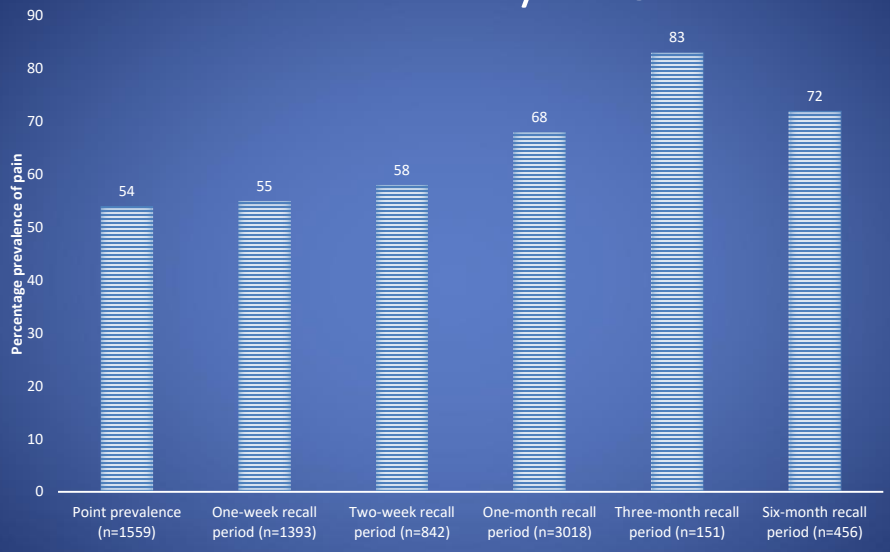
PAIN IN HIV/AIDS



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PAIN IN HIV/AIDS

- But what is the prevalence of pain in developing countries where people living with HIV are predominantly female and have contracted the virus through heterosexual contact?
- Cross-sectional study of amaXhosa women in Cape Town, South Africa (Parker et al, 2017)

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The sample

- 229 amaXhosa women living with HIV/AIDS
- Mean age 30 yrs (± 4.83)
- Able to speak and write a mean of 2 different languages
- 65.5% (150) unemployed.
- Completed 10 ± 1.69 years of school
- 58% single, 36% married or living with a partner

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Disease markers

- CD4+ count
  - 213 ± 185 on diagnosis
  - 330 ± 211 most recent
- Clinical Stage:
  - 58% stage III or IV
- 79% on first line ARV's

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Pain

- Prevalence of pain – 74% (95%CI 68–79%).
  - 170 of the women interviewed had pain in the previous week
- Median of 2 different painful areas (1 – 6)

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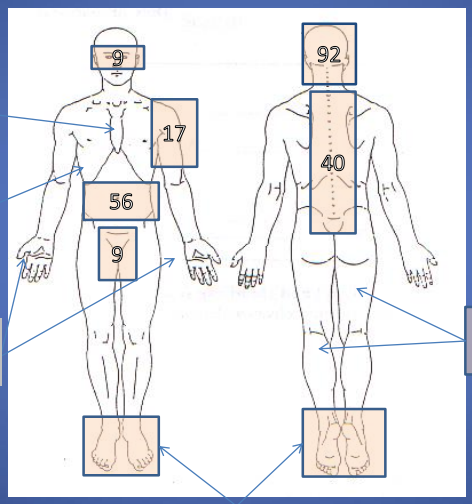
Sites of Pain



Thorax 33

Flank 23

Bilateral Hands 3

Full body pain 7

Bilateral Lower limbs 32

Bilateral Feet 31

Parker et al, 2017

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Pain

- Pain Severity Score 5.06 ± 1.57
- Pain Interference Score 6.39 ± 1.96
  - Greatest interference was with the category “enjoyment of life” (7.07 ± 2.46)

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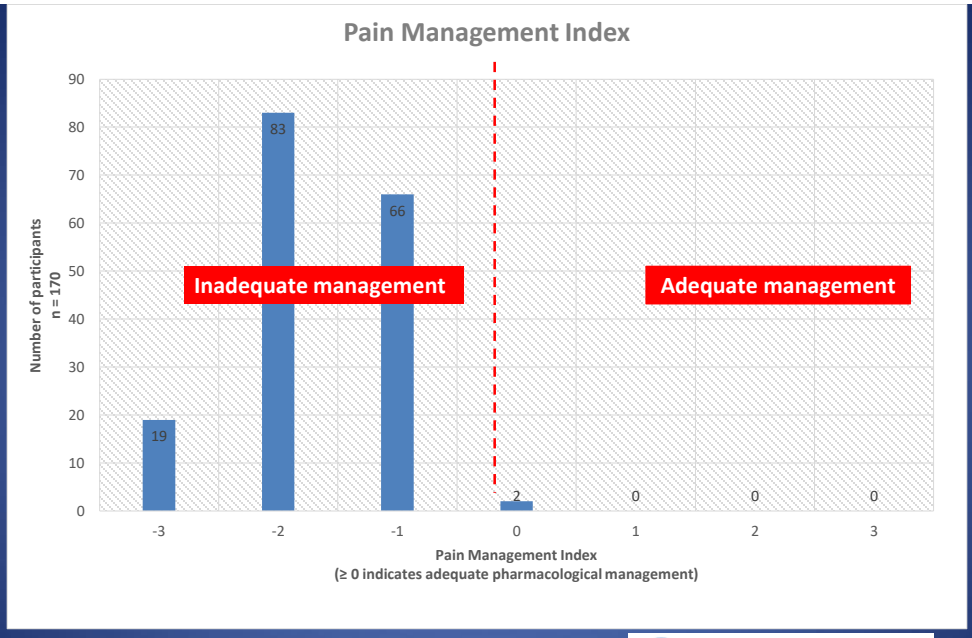

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Predictors of pain?

- Those with pain had significantly worse scores on
  - Self-efficacy ($p < 0.05$)
  - HRQoL ($p < 0.01$)
  - Depression ($p < 0.01$)
  - Likelihood of PTSD ($p < 0.05$)

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Predictors of pain in HIV/AIDS

- People with pain have
  - Higher levels of unemployment ($p < 0.05$)
  - Fewer number of years in school ($p < 0.01$)
- There are no links between any disease markers and pain in PLWHA

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Pain in HIV/AIDS

What does this suggest about pain in PLWHA?

Neuropathic Pain in HIV

- Painful neuropathies in HIV include:
  - Distal Symmetrical Polyneuropathy (DSP) and Antiretroviral Toxic Neuropathy (ATN)
  - Herpes
    - Acute and postherpetic neuralgia
    - Mononeuritis multiplex

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Neuropathic Pain

- Treatment guidelines suggest:
  1. Pregabalin or Gabapentin
  2. Tricyclic antidepressants
  3. SNRI's

– But none of these are effective in HIV neuropathies

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Neuropathic Pain

- *Does Central Sensitization contribute to Neuropathic pain in PLWHA?*
  - Multiple pain sites
  - No links between pain and disease processes
  - Large placebo responses to treatment

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Placebo or Meaning Responses

- PLWHA with neuropathic pain appear to have significant placebo responses to treatment:
  - Six-week peer-led exercise and education
  - Pregabalin

Non-pharma Treatment of Pain in PLWHA

- What effect a six-week peer-led exercise and education intervention on pain in PLWHA?

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Testing the intervention

- A single blind randomised controlled trial exploring the effects of a 6-week peer-led exercise and education intervention in amaXhosa women living with HIV.
- Participants identified from a previous study determining the prevalence of pain.

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The intervention

- A six-week peer-led exercise and education intervention
  - Six-weeks
  - Group work
  - Peer-leaders
  - Education
  - Exercise

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The intervention

- "Positive Living" workbook
  - Self-management
  - Exercise
  - Managing common symptoms
  - Pain
  - Nutrition
- All linked with problem solving tasks and goal setting activities

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Testing the intervention

- Experimental group: attended intervention programme once a week for 6-weeks (2hours)
  - Exercise
  - Education and discussion
  - Weekly goal setting
  - Relaxation
- Control group: provided with information workbook used to guide intervention programme.

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Testing the intervention

- Participants were interviewed at weeks 0, 4, 8, 12 and 16
  - Demographic and disease history
  - Pain (BPI-Xhosa)
  - Self efficacy (SE-6-Xhosa)
  - Health related quality of life (EQ5D-Xhosa)
  - Risk for depression (BDI-Xhosa)

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Results

- Week 0 measures vs. prevalence of pain measures (15 months previously - a period of normal care with no interventions)
  - No changes in pain, self-efficacy, or depression.
  - Improvement in HRQoL

  - i.e. routine care had no effect on their pain

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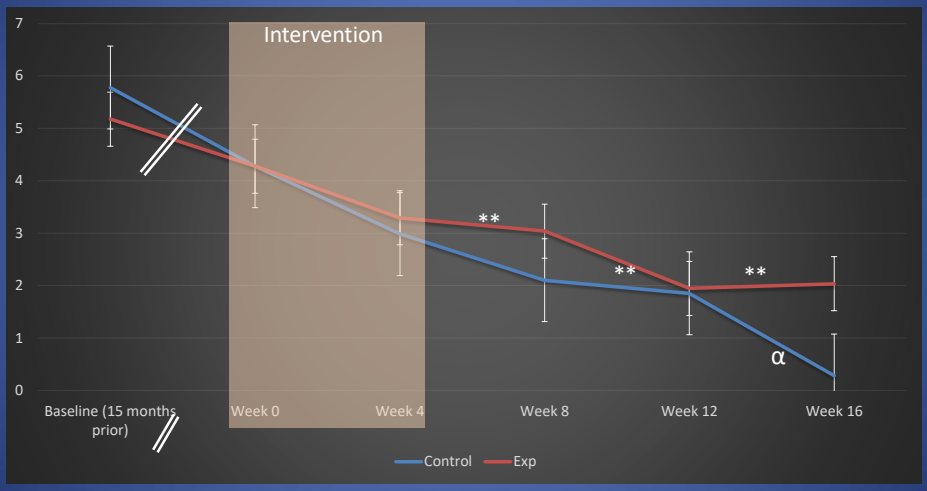
Change in Pain Severity Score



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What was the effect?

- Both the experimental and control groups had clinically meaningful improvements in pain
- Why
  - The "care effect" or meaning response
  - The South African health care setting has been described as "hostile"
    - ***What effect might this have on someone with a chronic illness?***

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Meaning Responses elsewhere?

Neurology. 2010 Feb 2; 74(5): 413–420. PMCID: PMC2816006
doi: 10.1212/WNL.0b013e3181ccc6ef

Pregabalin for painful HIV neuropathy

A randomized, double-blind, placebo-controlled trial

D. M. Simpson, MD, G. Schifitto, MD, D. B. Clifford, MD, T. K. Murphy, PhD, E. Durso-De Cruz, PhD, P. Glue, MD, PhD, E. Whalen, PhD, B. Emir, PhD, G. N. Scott, PharmD, R. Freeman, MD, and On behalf of the 1066 HIV Neuropathy Study Group*

Conclusions: Pregabalin was well-tolerated, but not superior to placebo in the treatment of painful HIV neuropathy. Factors predicting analgesic response in HIV neuropathy warrant additional research.

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Pharmacological Management of Neuropathic Pain in HIV

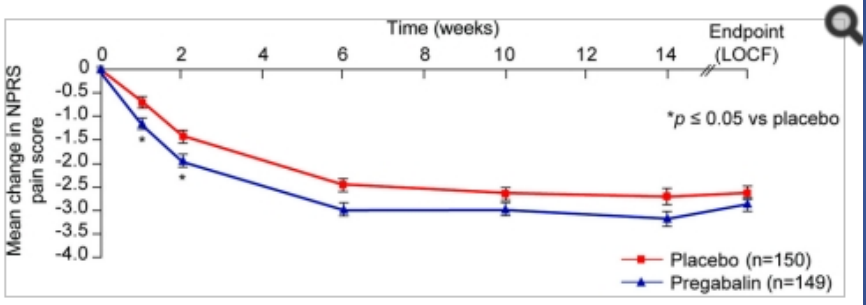

Figure 3 Mean change from baseline in Numeric Pain Rating Scale score

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Meaning Responses

- Why do PLWHA and pain respond so well in studies?
  - Pain is a response to threat – even neuropathic pain
  - People with HIV (and other chronic illnesses?) suffer from:
    - Persistent traumatic stress (Frenkel et al, 2017)
    - Stigma (Wadley et al, 2016)
    - Hostile treatment settings (Parker et al, 2017)

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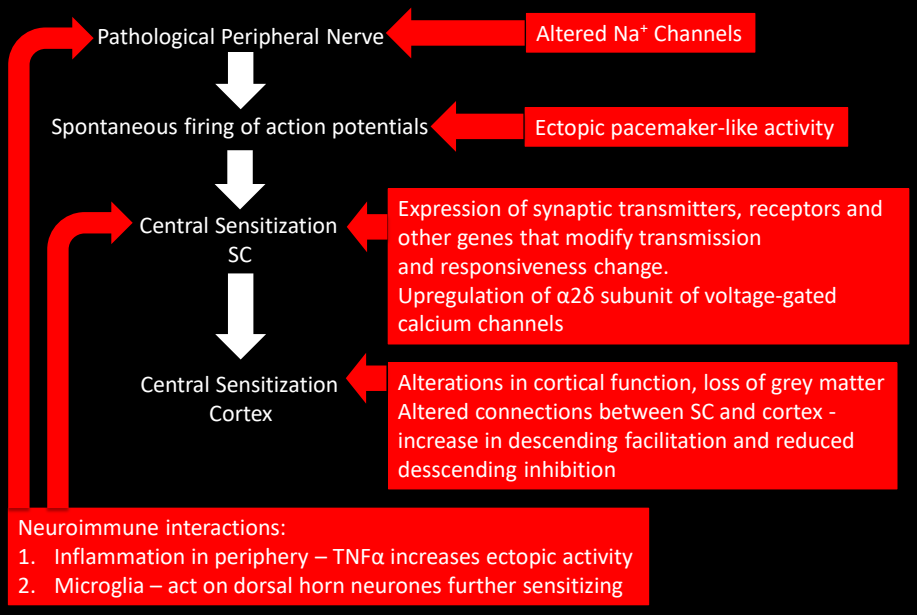

Neuropathic Pain and Central Sensitization

- Treatments that target the peripheral nerve limited
- Treatments that target the spinal cord are limited
- Treatments need to target *all* the mechanisms
  - We need to include the cortex in our assessment, reasoning and treatment of neuropathic pain

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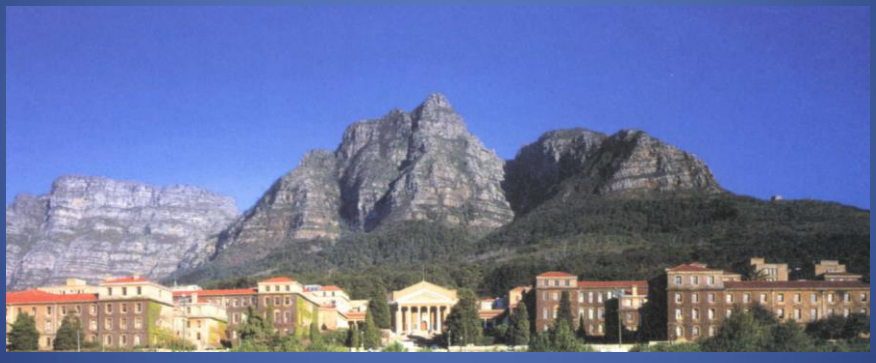
Tea Break



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Romy.parker@uct.ac.za

Neuropathic central sensitization pain in physical therapy practice

Skills training

A/Prof Romy Parker[PhD]
Director: Pain Management Unit

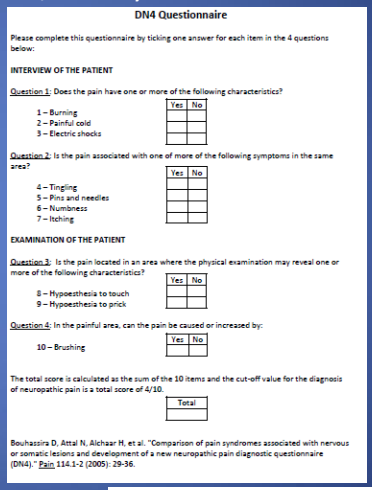
Assessing for Neuropathic Pain

- Diagnosing neuropathic pain is based on:
  - History
  - Clinical examination
- Some useful tools
  - DN4
  - LANSS
  - PainDETECT

DN4

(Bouhassira et al, 2005)

- 10 item clinician-administered
- Seven items related to pain quality (i.e. sensory and pain descriptors) are based history,
- 3 items based on the clinical examination.
- A score of ≥4 positive for neuropathic pain.



DN4 Questionnaire

Please complete this questionnaire by ticking one answer for each item in the 4 questions below:

INTERVIEW OF THE PATIENT

Question 1: Does the pain have one or more of the following characteristics?

	Yes	No
1 – Burning		
2 – Painful cold		
3 – Electric shocks		

Question 2: Is the pain associated with one of more of the following symptoms in the same area?

	Yes	No
4 – Tingling		
5 – Pins and needles		
6 – Numbness		
7 – Itching		

EXAMINATION OF THE PATIENT

Question 3: Is the pain located in an area where the physical examination may reveal one or more of the following characteristics?

	Yes	No
8 – Hypoesthesia to touch		
9 – Hypoesthesia to prick		

Question 4: In the painful area, can the pain be caused or increased by:

	Yes	No
10 – Brushing		

The total score is calculated as the sum of the 10 items and the cut-off value for the diagnosis of neuropathic pain is a total score of 4/10.

Total

Bouhassira D, Attal N, Alchaar H, et al. "Comparison of pain syndromes associated with nervous or somatic lesions and development of a new neuropathic pain diagnostic questionnaire (DN4)." Pain 114.1-2 (2005): 29-36.

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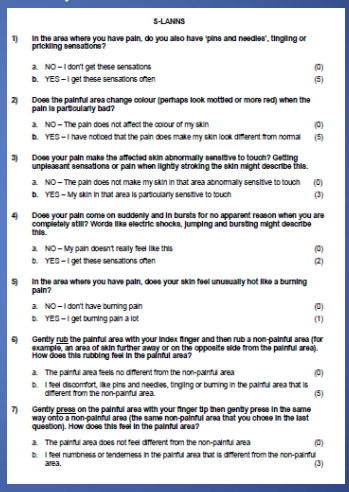
LANSS

(Bennett, 2001)

- Leeds Assessment of Neuropathic Symptoms and Signs
  - Self-report
- Score of ≥ 12 indicates pain of neuropathic origin



S-LANNS

1) **In the area where you have pain, do you also have 'pins and needles', tingling or prickling sensations?**
   a. NO – I don't get these sensations (0)
   b. YES – I get these sensations often (5)

2) **Does the painful area change colour (perhaps look mottled or more red) when the pain is particularly bad?**
   a. NO – The pain does not affect the colour of my skin (0)
   b. YES – I have noticed that the pain does make my skin look different from normal (5)

3) **Does your pain make the affected skin abnormally sensitive to touch? Getting unpleasant sensations or pain when lightly stroking the skin might describe this.**
   a. NO – The pain does not make my skin in that area abnormally sensitive to touch (0)
   b. YES – My skin in that area is particularly sensitive to touch (3)

4) **Does your pain come on suddenly and in bursts for no apparent reason when you are completely still? Words like electric shocks, jumping and bursting might describe this.**
   a. NO – My pain doesn't really feel like this (0)
   b. YES – I get these sensations often (2)

5) **In the area where you have pain, does your skin feel unusually hot like a burning pain?**
   a. NO – I don't have burning pain (0)
   b. YES – I get burning pain a lot (1)

6) **Gently rub the painful area with your index finger and then rub a non-painful area (for example, an area of skin further away or on the opposite side from the painful area). How does this rubbing feel in the painful area?**
   a. The painful area feels no different from the non-painful area (0)
   b. I feel discomfort, like pins and needles, tingling or burning in the painful area that is different from the non-painful area. (5)

7) **Gently press on the painful area with your finger tip then gently press in the same way onto a non-painful area (the same non-painful area that you chose in the last question). How does this feel in the painful area?**
   a. The painful area does not feel different from the non-painful area (0)
   b. I feel numbness or tenderness in the painful area that is different from the non-painful area. (3)

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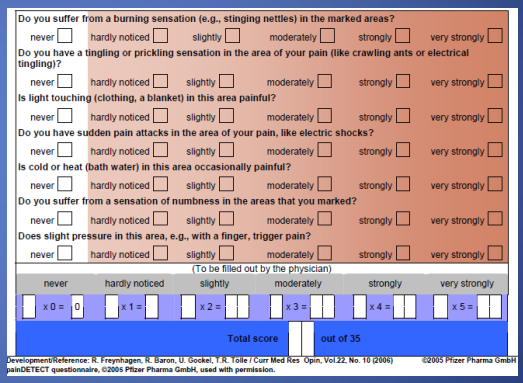
Pain DETECT

(Freynhagen et al 2006)

- Designed to assess for neuropathic pain in LBP
- Self-report
- Interpretation
  - ≤12 neuropathic pain unlikely
  - ≥19 neuropathic pain likely
  - In between – further examination recommended



painDETECT questionnaire

Do you suffer from a burning sensation (e.g., stinging nettles) in the marked areas?
never ☐ hardly noticed ☐ slightly ☐ moderately ☐ strongly ☐ very strongly ☐

Do you have a tingling or prickling sensation in the area of your pain (like crawling ants or electrical tingling)?
never ☐ hardly noticed ☐ slightly ☐ moderately ☐ strongly ☐ very strongly ☐

Is light touching (clothing, a blanket) in this area painful?
never ☐ hardly noticed ☐ slightly ☐ moderately ☐ strongly ☐ very strongly ☐

Do you have sudden pain attacks in the area of your pain, like electric shocks?
never ☐ hardly noticed ☐ slightly ☐ moderately ☐ strongly ☐ very strongly ☐

Is cold or heat (bath water) in this area occasionally painful?
never ☐ hardly noticed ☐ slightly ☐ moderately ☐ strongly ☐ very strongly ☐

Do you suffer from a sensation of numbness in the areas that you marked?
never ☐ hardly noticed ☐ slightly ☐ moderately ☐ strongly ☐ very strongly ☐

Does slight pressure in this area, e.g., with a finger, trigger pain?
never ☐ hardly noticed ☐ slightly ☐ moderately ☐ strongly ☐ very strongly ☐

(To be filled out by the physician)

never	hardly noticed	slightly	moderately	strongly	very strongly
x 0 = 0	x 1 =	x 2 =	x 3 =	x 4 =	x 5 =

Total score ☐☐ out of 35

Development/Reference: R. Freynhagen, R. Baron, U. Gockel, T.R. Tölle / Curr Med Res Opin, Vol.22, No. 10 (2006)
painDETECT questionnaire, ©2005 Pfizer Pharma GmbH, used with permission.
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Workshop

- In groups of three
  - Each person complete one of the instruments as the patient
  - As a group check you can score them
  - Discuss the clinical utility of each instrument for your setting

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Treating Neuropathic Pain

- ***Workshop***
  - In groups of 6 discuss
    - What treatments do we have a physiotherapists which target Neuropathic mechanisms?
    - What are the barriers to these treatments in your setting?
    - What facilitators are there to using these treatments?

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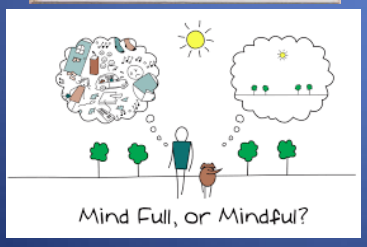
Treating Neuropathic Pain



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Treating Neuropathic Pain

- ***How can we enhance the meaning effect?***

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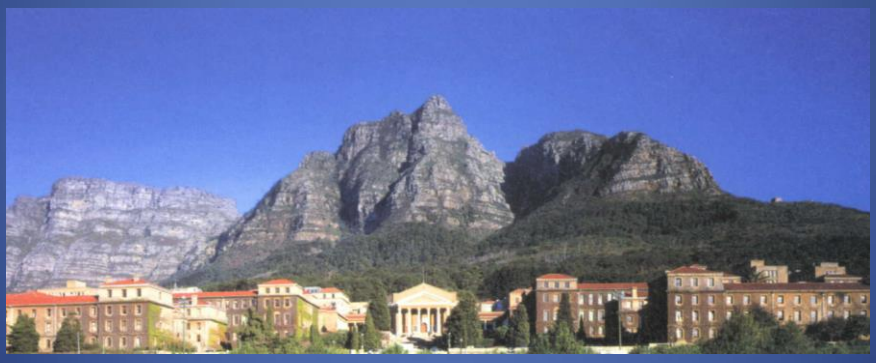
Lunch Time



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Clinical assessment of central sensitisation - physiotherapy

Michele Sterling

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Central Sensitisation

There is no Gold Standard of measurement

How do we recognize it in the clinic:

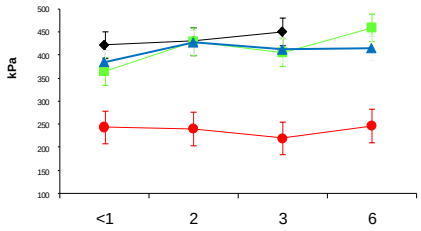
- Patient history/interview
- ?Questionnaires
- Physical examination

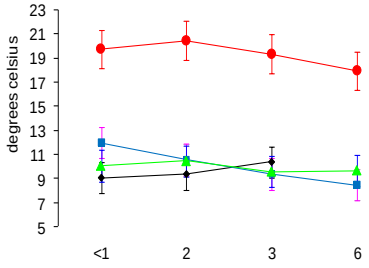
THINK PAIN MECHANISMS !!

Sterling M. JMPT (2008), 31(7)

Patient Interview (subjective examination) is Important

- May also have higher levels of pain & disability – use validated measure





C5/6, C2/3, Upper limb nerve trunks
Tibialis Anterior

Control
Recovered NDI <8%
Milder pain NDI 9-29%
Moderate to severe pain NDI 30>%

Sterling et al (2003) Pain 104:509-517

Patient Interview (subjective examination) is Important

- Detailing of patient's symptoms
  - pain area
  - nature of the pain
  - irritability
  - sleep disturbance
- Cold hyperalgesia
  - pain with cold
- Mechanical hyperalgesia/allodynia
- Autonomic disturbances

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Findings from patient interview that may be suggestive of central sensitisation

Symptom	Example of patient report
Mechanical allodynia/hperalgesia	Pain with touch Pain from clothes or bedclothes
Thermal allodynia/hperalgesia	Pain with cold (eg ice, cold weather)
Irritable condition	Pain is easily aggravated but difficult to settle infers the presence of sensitisation
Sleep disturbances	Difficulty sleeping due to pain

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Questionnaires

- S-LANSS Bennett M et al: The S-LANSS score for identifying pain of predominantly neuropathic origin: validation for use in clinical and postal research. The Journal of Pain 2005, 6:149-158
- PainDetect Freynhagen R et al painDETECT: a new screening questionnaire to identify neuropathic components in patients with low back pain. Current Medical Research and Opinions 2006, 22:1911-1920
- Central Sensitisation Inventory (CSS)

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Physical Examination

Clinical tests	Interpretation
Manual examination of the affected area	Presence of allodynia (pain with light touch) infers central sensitisation
Manual examination of structures away from the affected area eg UL and LL in patient with neck pain	Presence of allodynia/hyperalgesia infers central sensitisation
Pressure pain thresholds	Decreased pain thresholds at sites away from the neck may indicate central sensitisation
Cold sensitivity	Pain with ice application - cold hyperalgesia
Neural tissue provocation test eg ULTT, SLR	Bilaterally reduced elbow extension infers central hyperexcitability of motor responses

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Types of Quantitative Sensory Testing (QST)

- Mechanical
  - Pressure Detection Threshold
  - Two-point Discrimination
  - Pressure Pain Detection Threshold
  - Pressure Pain Tolerance
- Thermal
  - Cold/Warm Detection Threshold
  - Cold/Warm Pain Detection Threshold
  - Cold/Warm Pain Tolerance
  - Cold/Warm Endurance
- Electrical
- Vibratory
- Chemical

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Pressure Pain Thresholds (PPTs)

Local – over site of injury/pain

- could be peripheral sensitisation

Remote – away from site of injury/pain

- likely indicates CNS changes

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How to apply

- Instructions:
  - *'I'm going to slowly apply pressure to the skin over top of your muscle. Please [tell me] the moment the sensation changes from pressure to pain.'*
- Application tips:
  - Screen facing away from you
  - Increase force ~5N/s
  - Wait <u>at least</u> 30 seconds b/w applications

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What is sensitive?

PPT (neck):
< 185 kPa; 1.8 kgF (females)
< 210kPa; 2.1 kgF (males)

PPT (med N):
< 210 kPa, 2.1 kgF (females)
< 250 kPa; 2.5 kgF (males)

Tib Ant:
< 230 kPa, 2.3 kgF (females)
< 360 kPa; 3.6 kgF (males)

Need the most sensitive unit

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Cold Sensitivity

- 'Gold standard'
  - Medoc TSA-II Neurosensory Analyzer
  - ~$20,000
- Other options
  - Ice
  - Cold nail
  - Different materials

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The 'cheap' method – apply something cold

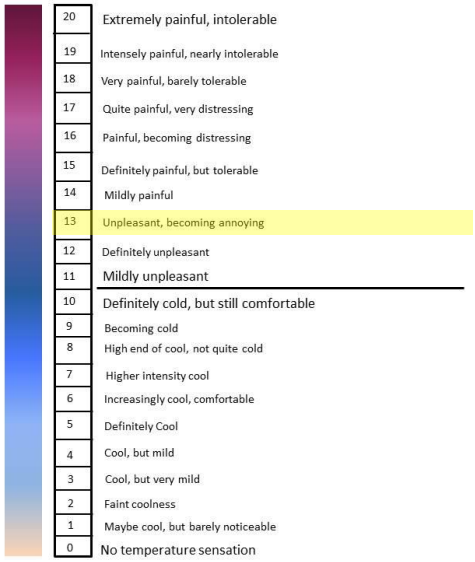
An investigation of the use of a numeric pain rating scale with ice application to the neck to determine cold hyperalgesia

Samuel Maxwell [b], Michele Sterling [a,*] Manual Therapy 18 (2013) 172–174

10 seconds of ice application

NRS score	Positive likelihood ratio (95% CI)	Negative likelihood ratio (95% CI)
=0	1.00	
>0	1.81 (1.4–2.4)	0.13 (0.05–0.3)
>1	2.23 (1.8–2.8)	0.18 (0.08–0.4)
>2.3	2.55 (2.1–3.2)	0.33 (0.2–0.6)
>3	3.84 (3.1–4.8)	0.43 (0.2–0.8)
>4	4.69 (3.7–6.0)	0.51 (0.2–1.1)
>5	8.44 (6.3–11.3)	0.61 (0.2–1.9)
>6.33	5.00 (3.3–7.7)	0.79 (0.3–2.4)
>7		0.77

5 seconds of cold iron nail application



Measurement of cold pain threshold

- No clinical device available to quantify cold pain threshold
- N=63 chronic WAD
- testing with lab equipment
  - Cold hyperalgesic ≥ 13 degrees C
  - Not Cold hyperalgesic < 13 degrees C
- Application of ice to neck, 10 seconds, NRS pain
- ROC analysis

(Maxwell & Sterling 2012, Manual Therapy,)

Measurement of cold pain threshold

- No clinical device available to quantify cold pain threshold
- Application of ice to neck, 10 seconds (Maxwell & Sterling 2012, Manual Therapy,)

NRS score	Sensitivity (95% CI)	Specificity (95%CI)	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)
=0	100.0(94.4-100.0)	0.0(0.0-6.0)	1.00	
>0	93.75(84.8-98.3)	48.33(35.2-61.6)	1.81(1.4-2.4)	0.13(0.05-0.3)
>1	89.06(78.8-95.5)	60.00(46.5-72.4)	2.23(1.8-2.8)	0.18(0.08-0.4)
>2.3	76.56(64.3-86.2)	71.67(58.6-82.5)	2.55(2.1-3.2)	0.33(0.2-0.6)
>3	64.06(51.1-75.7)	83.33(71.5-91.7)	3.84(3.1-4.8)	0.43(0.2-0.8)
>4	54.69(41.7-67.2)	88.33(77.4-95.2)	4.69(3.7-6.0)	0.51(0.2-1.1)
>5	42.19(29.9-55.2)	95.00(86.1-99.0)	8.44(6.3-11.3)	0.61(0.2-1.9)
>6.33	25.00(15.0-37.4)	95.00(86.1-99.0)	5.00(3.3-7.7)	0.79(0.3-2.4)
>7	23.44(13.8-35.7)	100.0(94.0-100.0)		0.77

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Dynamic Tests: Does the system work?

- Conditioned Pain Modulation (CPM)
  - Test pain threshold
  - Apply a 'conditioning stimulus'
  - Re-test pain threshold after 30 seconds
  - Positive test: <10% increase in pain threshold on the re-test
  - Indicates dysfunctional descending nociceptive inhibitory control (DNIC)

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CPM: Conditioning Stimuli

- Ice water immersion x 1-2 mins
- Inflation of a BP cuff x 30 – 60 sec
- High-intensity exercise or isometric holds (e.g. wall squat, plank, neck flexion in supine)

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Temporal Summation

- To add

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Summary

- QST is a psychophysical test that tells you something different about a patient's pain condition than other clinical tests or PROs
- Can help to develop a prognostic or theranostic phenotype
- PPDT is accessible now and reasonably well-supported
- CPDT is emerging, mechanism still unclear

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Thank you

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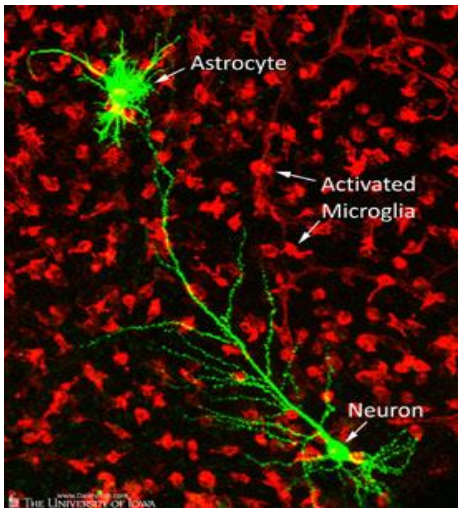
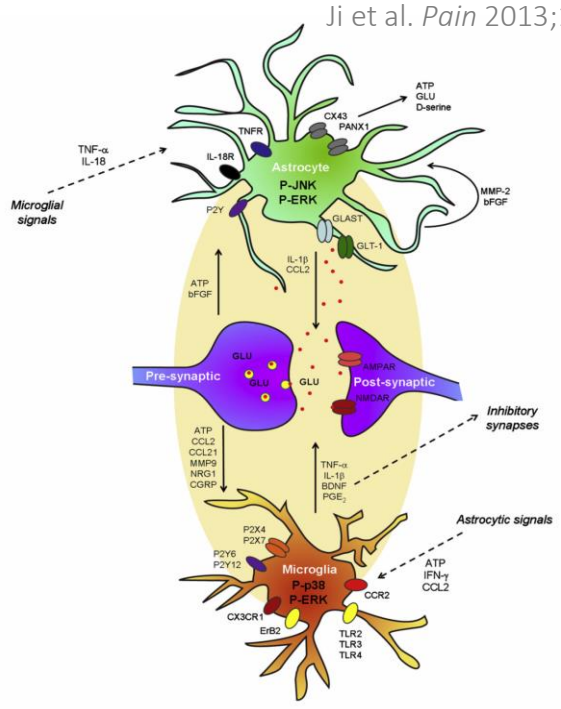
Content overview

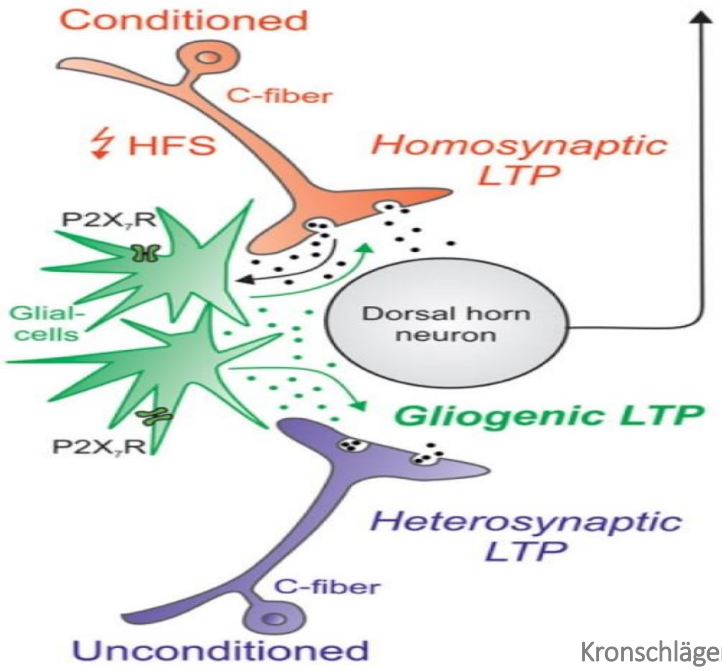
- Introduction
- Central sensitization: maladaptive neuroplasticity in patients with chronic pain (Kelly)
- Neuropathic central sensitization pain in physical therapy practice: HIV-related neuropathic pain as an example (Romy)
- Neuropathic central sensitization pain in physical therapy practice (Romy & Michele)
- **Non-neuropathic central sensitization pain in physical therapy practice: Neck pain as an example** (Michele & Jo)
- Non-neuropathic central sensitization pain in physical therapy practice: case study (Kelly & Jo)

PAIN IN MOTION

Ji et al. *Pain* 2013;154:S10-28.

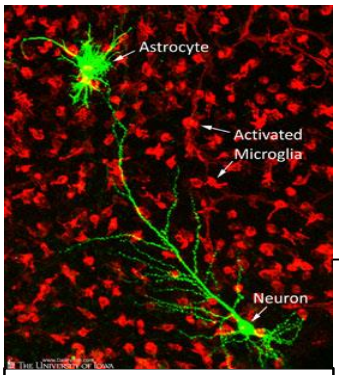






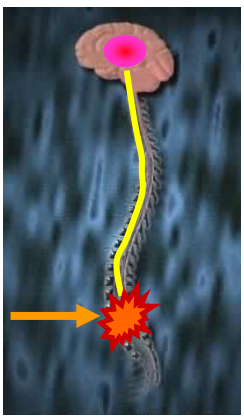
Kronschläger et al. *Science* 2016

Aberrant glia activity & central sensitization



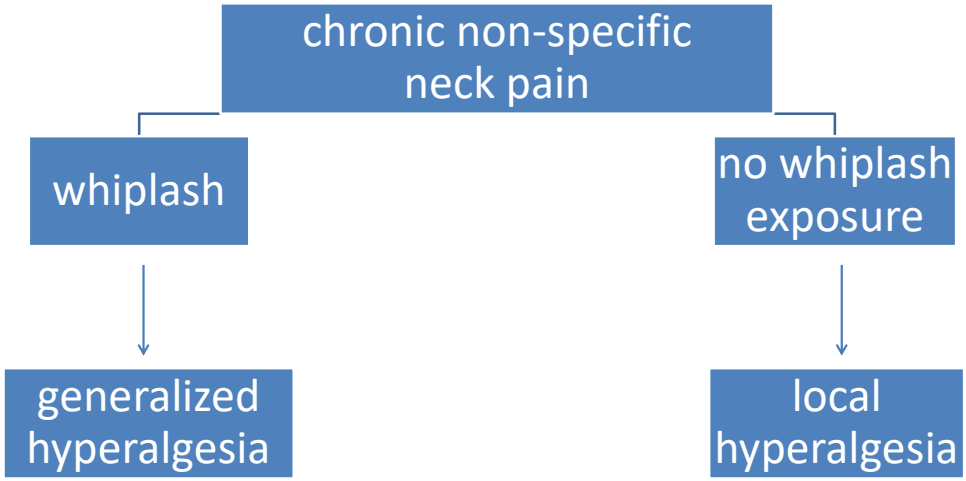
activated glia in PFC + amygdala + hippocampus

IL-1↑ + IL-6↑ = neuroinflammation

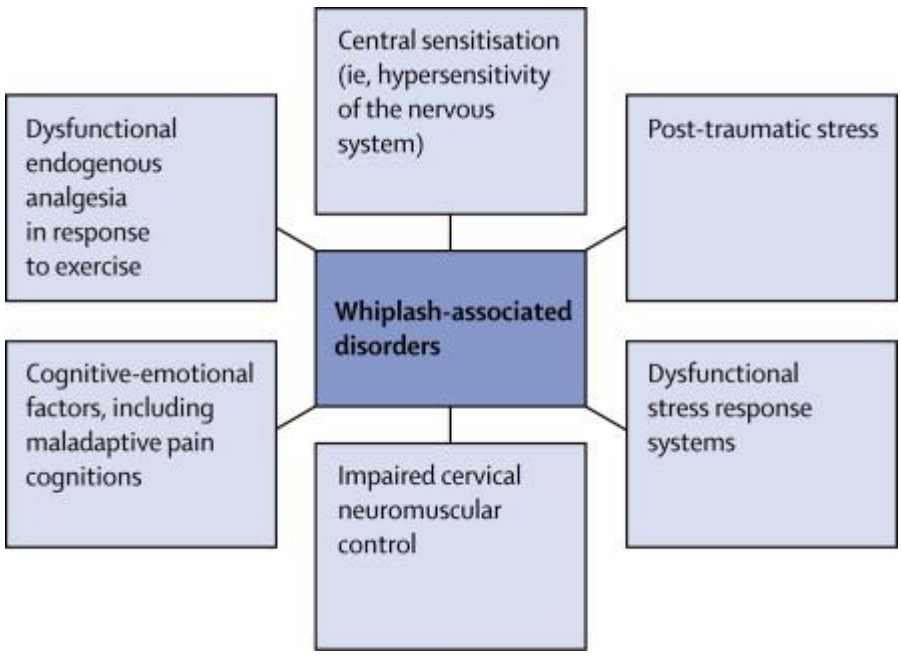


PAIN IN MOTION

The role of physical trauma



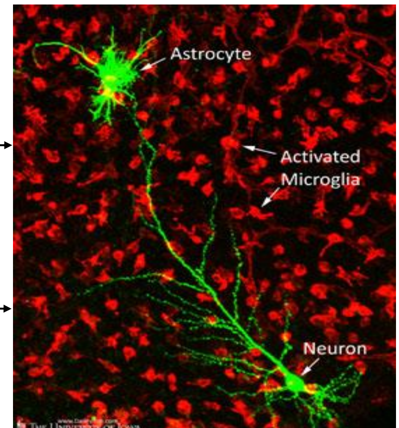
Malfliet et al. *Pain Physician* 2015
Van Oosterwijck et al. *Eur J Pain* 2013
Stone et al. *Man Ther* 2013



Nijs & Ickmans *The Lancet* 2014;384(9938):109-111.

Chronic stress activates the glia

chronic stress → adrenaline → / chronic stress → cortisol →

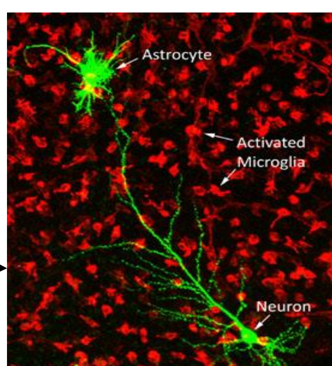


activated glia in PFC + amygdala + hippocampus

PAIN IN MOTION

Stress & central sensitization

chronic stress →

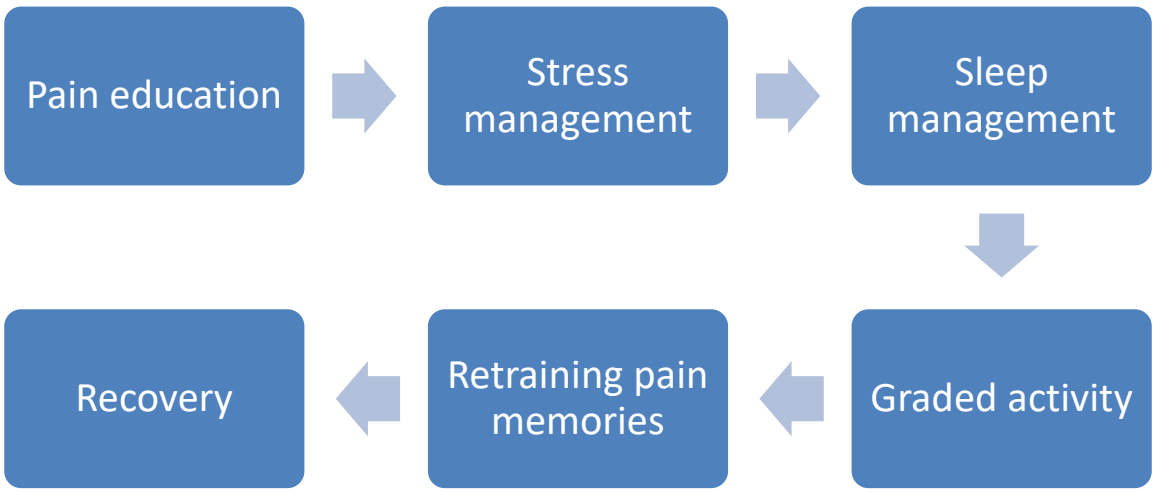


activated glia in PFC + amygdala + hippocampus

→ IL-1↑ + IL-6↑ = neuroinflammation →

PAIN IN MOTION

PAIN IN MOTION



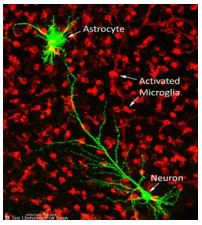
PAIN IN MOTION

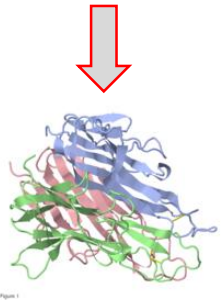
Stress & sleep interconnected

stress ↑ → sleep ↓

PAIN IN MOTION

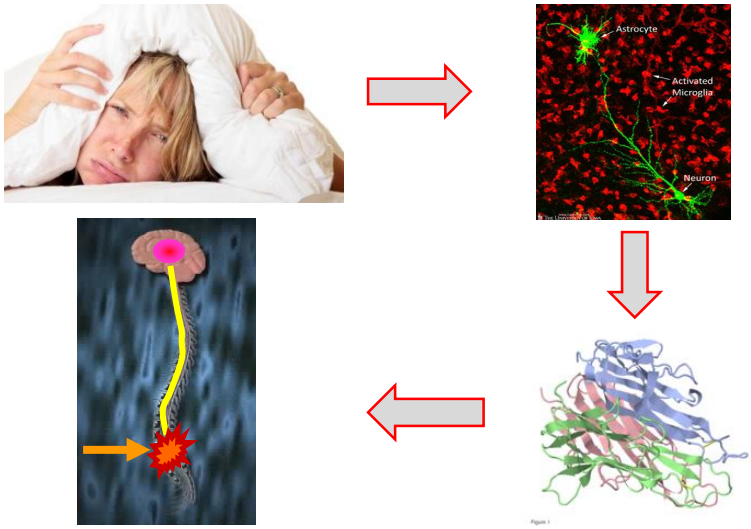
Sleep deprivation triggers brain inflammation





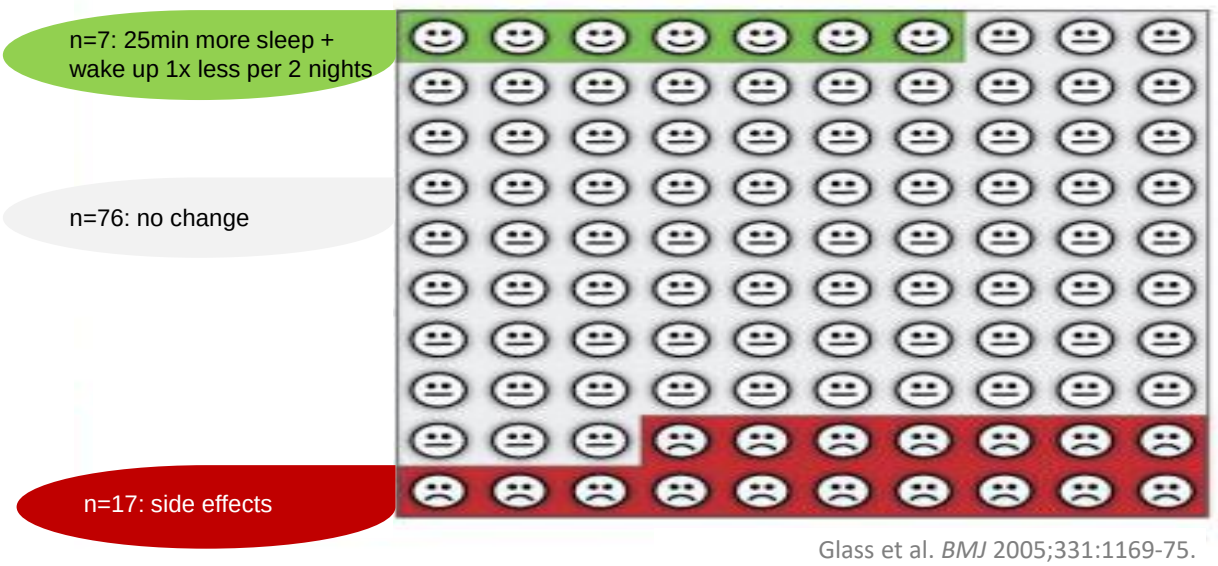
Haack et al. *Sleep* 2007; Kalinchuk et al. *J Neurosci* 2010; Wisor et al. *Sleep* 2011

Sleep deprivation triggers brain inflammation



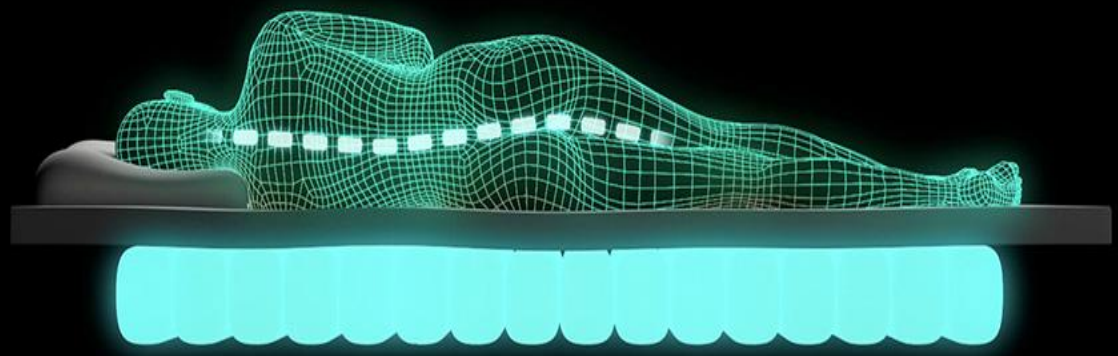
Campbell et al. *Arthritis Care & Research* 2015; de Tomasso et al. *J Headache Pain* 2014; Schuh-Hoher et al. *Pain* 2013; Mundal et al. *Pain* 2014

What if 100 people >60y take sleep drugs for 1 week ?



Glass et al. *BMJ* 2005;331:1169-75.

Do patients need to buy an expensive mattress?



How can we improve sleep in chronic pain patients?

1) **Cognitive behavioural therapy**

2) **Acceptance & commitment therapy**

3) **Exercise therapy**

Johnson et al. 2015, Ritterband et al. 2012, Mishra et al. 2012, Pigeon et al. 2012, Jungquist et al. 2010, Daly-Eichenhardt et al. 2016

History taking about sleep

- Sleeping hours
- Sleeping at daytime
- Sleep quality & quantity
- Recovering sleep?
- Premorbid sleep
- Activities & food intake hours before going to bed
- Sleep perceptions
- Sleep medication

PAIN IN MOTION

Sleep management

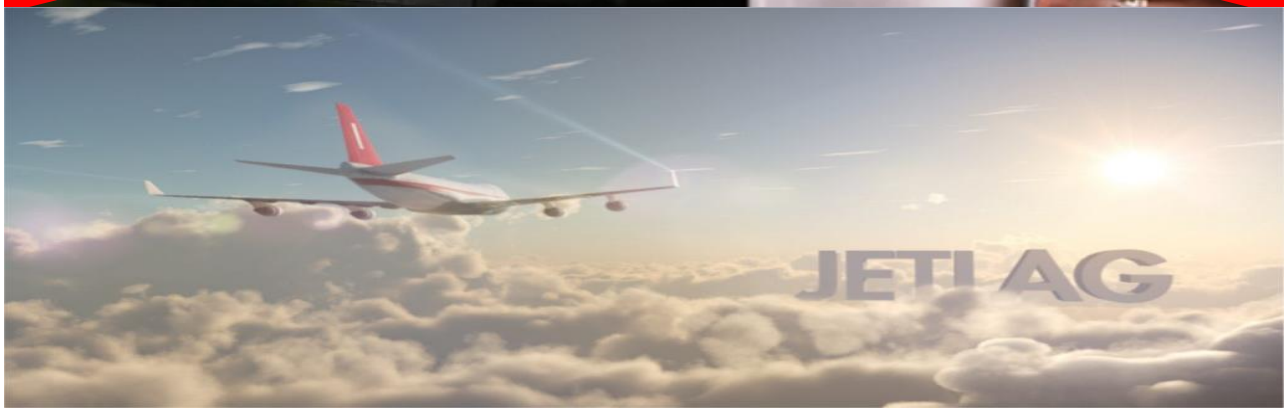
changing negative thoughts about sleep

Because of your poor sleep, your central nervous system becomes inflamed …

Sleep management

- changing negative thoughts about sleep
- sleep hygiene

The brain should (re)connect bedroom + sleep



Sleep education

Daytime sleeping

Hourglass metaphor

Jetlag metaphor

Secretion melatonin epiphyse
~ sleep-waking rhythm

PAIN IN MOTION

Sleep management

- changing negative thoughts about sleep
- sleep hygiene
- sleep restriction therapy

Sleep restriction therapy

4 hours of sleep / night
11:00 pm
7:00 am
= 50% sleep efficiency

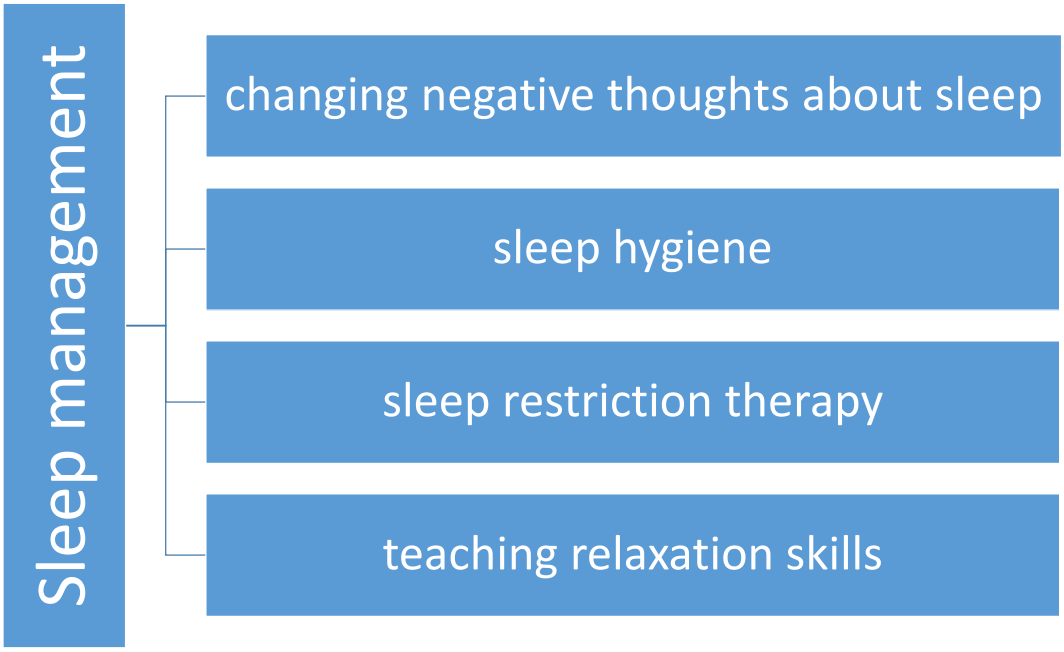
12:00 pm
5:00 am
= 80% sleep efficiency

Sleep restriction therapy

12:00 pm - 5:00 am (4 hours sleep)
= 80% sleep efficiency

12:00 pm – 6:00 am (5 hours sleep)
= 83% sleep efficiency

11:00 pm – 6:00 am (6 hours sleep)
= 86% sleep efficiency



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Non-neuropathic central sensitization pain in physical therapy practice: Neck pain as an example

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Adjunct Professor, Centre for Advanced Imaging, UQ

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Stress Related Responses

- PTSD symptoms predict poor recovery

Original Investigation

Relationship Between Stressfulness of Claiming for Injury Compensation and Long-term Recovery
A Prospective Cohort Study

JAMA Psychiatry. doi:10.1001/jamapsychiatry.2013.4023
Published online February 12, 2014.

Genevieve M. Grant, LLB, PhD; Meaghan L. O'Donnell, PhD; Matthew J. Spittal, PhD; Mark Creamer, PhD; David M. Studdert, LLB, ScD, MPH

- 34% high levels of stress understanding claim
- 30.4% with claim delays
- 27% with number medico-legal assessment
- 26% with amount of compensation
- Predicted disability:
  - WHODAS (+6.94 pts); HADS (+2.61)
  - Lower QOL – WHODAS (-0.73 pts)

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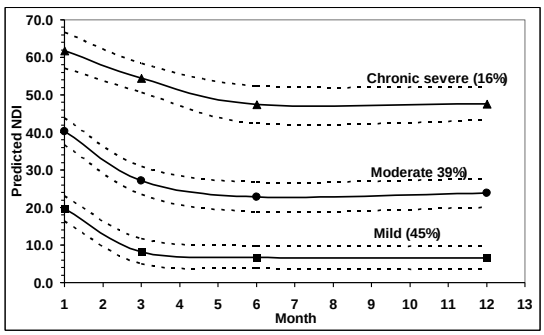
Recovery Pathways

Predicted disability trajectories & predicted probability of membership (%).

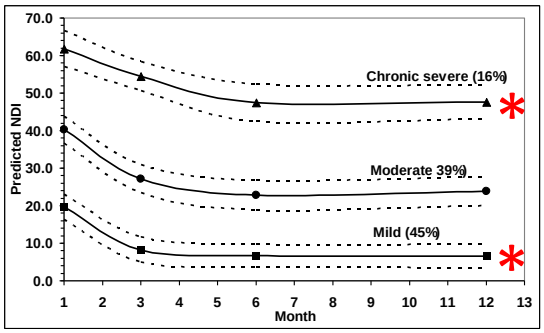


N=155

Group based trajectory modeling

2-3 months important

Sterling, Hendrikz, Kenardy 2010 Pain 150:22-28



Predictors of Disability Trajectories

Variable	Coeff (SE)	OR (95% CI)	p
Cold Pain TH > 13°C	3.27 (0.85)	26.3 (4.98, 139)	0.0001
Pain (VAS) > 5/10	1.46 (0.27)	4.31 (2.55, 7.28)	0.0001
Age (> 37)	0.103 (0.03)	1.11 (1.04,1.18)	0.001

Sterling, Hendrikz, Kenardy 2010 Pain 150:22-28

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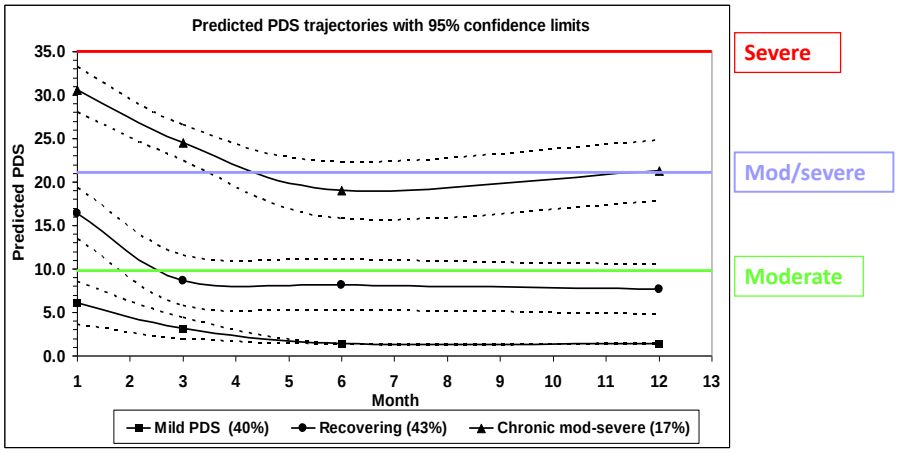
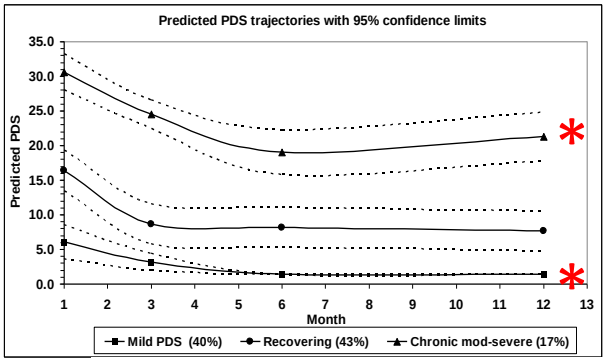
Posttraumatic stress symptoms



Sterling, Hendrikz, Kenardy 2010 Pain 150:22-28

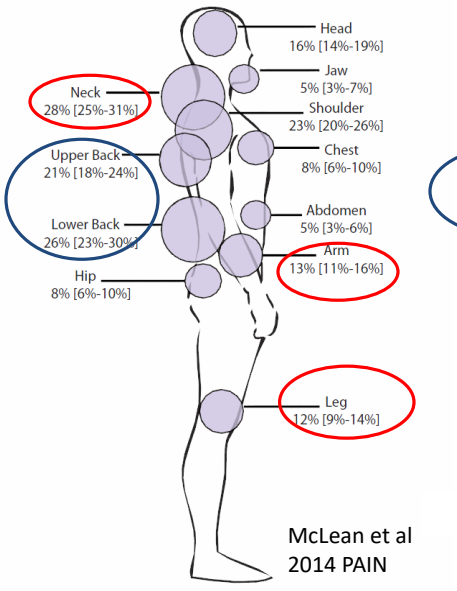


Predictors of posttraumatic stress Trajectories

Variable	Coeff (SE)	OR (95% CI)	p
Cold Pain TH > 13°C	2.27 (0.75)	9.7 (2.2, 42.4)	0.0027
Pain (VAS) > 5/10	0.76 (0.20)	2.13 (1.43, 3.17)	0.0002
Age	-0.006 (0.03)	0.99 (0.98,0.99)	0.02
PPT neck >200KPa	-0.01 (0.005)	0.99 (0.98,1.0)	0.05

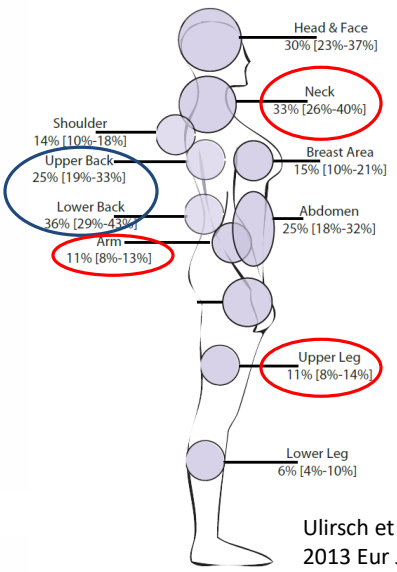
Sterling, Hendrikz, Kenardy 2010 Pain 150:22-28

New Clinically Significant Pain 6 Weeks after trauma



McLean et al 2014 PAIN

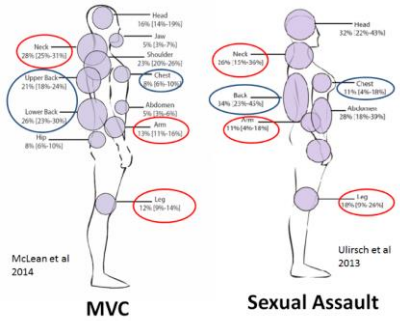
MVC

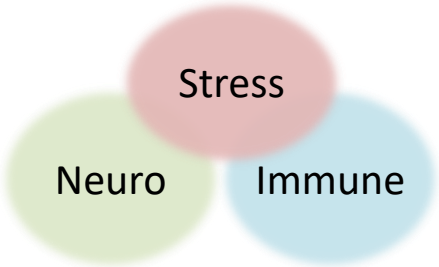


Ulirsch et al 2013 Eur J Pain

Sexual Assault

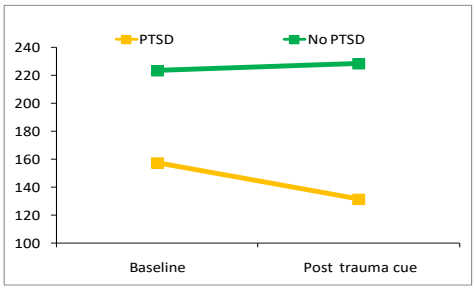
Striking similarity in proportion of trauma survivors with new neck or back pain at six weeks, despite radically different types of tissue trauma (< 1/3 of sexual assault survivors report any physical assault), suggests that no specific tissue injury is necessary or sufficient to cause posttraumatic neck or back pain

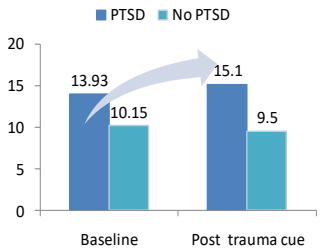




Recall of traumatic event

Pressure Pain thresholds





Thermal Pain thresholds

Dunne-Proctor, Kenardy, Sterling Clin J Pain 2015

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RECOVER
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Implications for Management

- Stress comes from a variety of sources
  - The event/accident/injury
  - Interactions with health care providers
  - Interactions with compensation process
- Stress factors influence 'biological' processes
  - Sensory thresholds/pain processing
  - Possibly healing processes
- Treatment may need to address stress related factors
  - Acute vs chronic
  - Target those most at risk; many recover well
  - Improve compensation procedures

Targeting stress responses &central sensitisation

Journal of Physiotherapy 61 (2015) 157

Journal of PHYSIOTHERAPY

journal homepage: www.elsevier.com/locate/jphys

Appraisal Trial Protocol

StressModEx – Physiotherapist-led Stress Inoculation Training integrated with exercise for acute whiplash injury: study protocol for a randomised controlled trial

Carrie Ritchie [a], Justin Kenardy [b], Rob Smeets [c], Michele Sterling [a]

- Whiplash Grade II
- No psychopathology – PHQ-9, ASDS, past history
- Medium/high risk based on CPR
- 6 week intervention & 6wk, 6 and 12 month follow-up

Australian Government
National Health and Medical Research Council

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Targeting psychological factors in acute whiplash

- Potential to prevent later sequalae
  - Central neuroplastic changes may be irreversible
- Target vulnerable and 'at risk' patients
- Treatment based on peripheral pathology models are not very effective
  - Exercise/MT interventions only small effects
    (Southerst et al 2014, The Spine Journal)
  - Too much might even be iatrogenic
    (Skillgate et al, Arch Phys Med & Rehab, 2016)

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The case for using physiotherapists

- Patients not keen on seeing a psychologist

"GP and/or insurance company sent me to a psychologist – that was worthless- I have whiplash."

- Not feasible to see a psychologist

Psychological debriefing non recommended post trauma (Aust PTSD Guidelines)

- Physiotherapists are commonly involved

"GP not listening and not believing that I am in pain"; "feel let down by lawyers and GPs"

"Start Physiotherapy as soon as possible"

"Physiotherapy is very good as soon as possible. Doing the exercises the Physio gives you. I also used warmth on my neck to ease pain twice a day"

- Using current primary care resources
  - Funding/compensation implications

Maujean, Sterling, Sterling 2016, under review

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Interventions

- SIT + physiotherapy exercise
- Physiotherapy exercise alone

Week	Sessions/week	SIT and Physiotherapy Exercise	Physiotherapy Exercise
1	2	Session 1: Intro to SIT, Physiotherapy Exercise Session 1b: Physiotherapy Exercise	Session 1: Physiotherapy Exercise Session 1b: Physiotherapy Exercise
2	2	Session 2: SIT/Physiotherapy Exercise Session 2b: Physiotherapy Exercise.	Session 2: Physiotherapy Exercise. Session 2b: Physiotherapy Exercise.
3	2	Session 3: SIT/Physiotherapy Exercise. Session 3b: Physiotherapy Exercise	Session 3: Physiotherapy Exercise Session 3b: Physiotherapy Exercise
4	2	Session 4: SIT/Physiotherapy Exercise. Session 4b: Physiotherapy Exercise	Session 4: Physiotherapy Exercise Session 4b: Physiotherapy Exercise
5	1	Session 5: SIT/Physiotherapy Exercise	Session 5: Physiotherapy Exercise
6	1	Session 6: SIT/Physiotherapy Exercise	Session 6: Physiotherapy Exercise

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Exercise Program

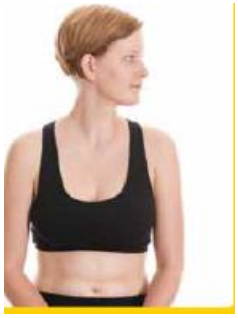
Specific Exercise – Low load movement/control & sensorimotor training

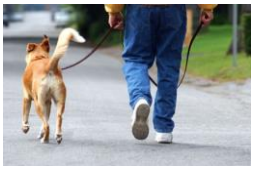
Progression to higher loads

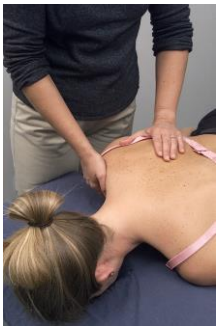
Progression to functional activities

Return to usual enjoyable activities

Aerobic exercise







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SIT + Physiotherapy Exercise

Stress Inoculation Training:

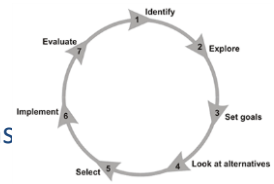
3 phases

Identifying and understanding stress

- Education about the influence of stress on nociception/pain
- What thoughts, feeling, actions have you noticed increase or decrease your whiplash pain?

Developing skills

- Relaxation
- Problem solving
- Helpful coping self statements



Applying skills in various stressful situations

- Identify specific stressor
- Prepare for stress
- Plan into action and review
- Cannot move all anxiety, just keep it manageable

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Outline of SIT Sessions

Session	Overview
1	Introduction to Stress Inoculation Training, why it is important, theories of pain and abdominal breathing exercise
2	Body Scans
3	Problem Solving
4	Coping Statements
5	Applying SIT to the real world
6	Coping Skills Maintenance: Early warning signs, coping plans, relapse prevention and maintenance

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Preliminary Results

- Intervention is acceptable to patients and physiotherapists
  - Credibility/expectancy questionnaire
  - Physios (n=11) ranked credibility as 20±2
  - Patients (n=57) ranked credibility as 19.6±2.5/10
- Physiotherapists can successfully deliver the intervention
  - Audit of recorded sessions by clinical psych
  - 2 day training + accreditation
  - Random follow-up audits

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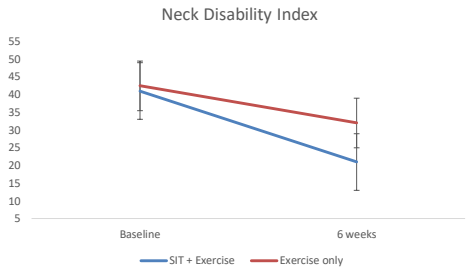
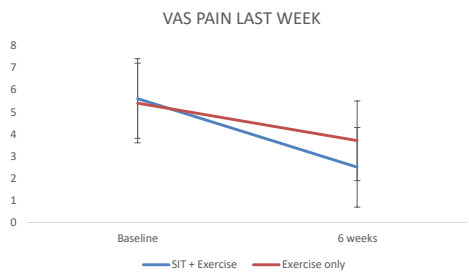
Preliminary Data



DISABILITY

PAIN



N=80

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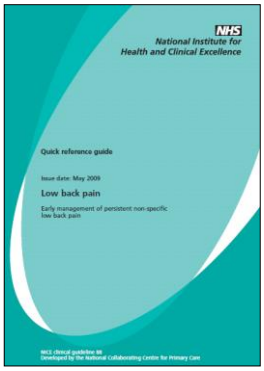
Musculoskeletal Pain

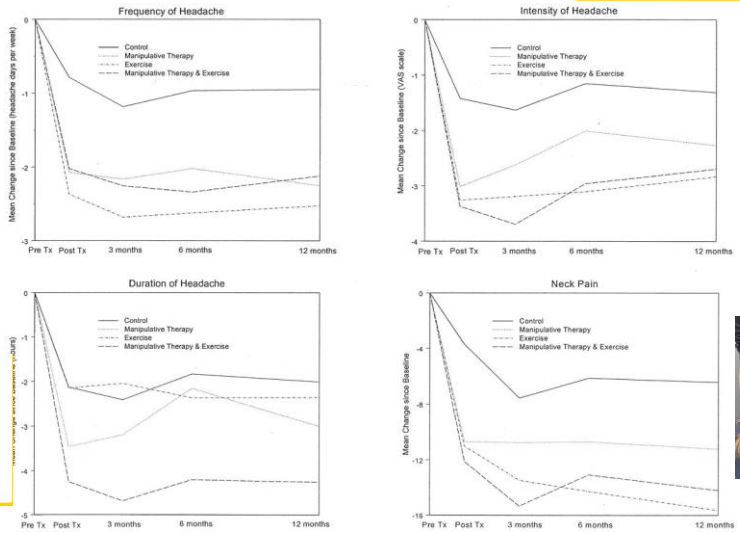
- Exercise based interventions are common
- Exercise recommended in clinical guidelines



SPINE Volume 27, Number 17, pp 1835–1843
©2002, Lippincott Williams & Wilkins, Inc.

A Randomized Controlled Trial of Exercise and Manipulative Therapy for Cervicogenic Headache

Gwendolen Jull, PT, PhD,* Patricia Trott, PT, MSc,† Helen Potter, PT, MSc,‡ Guy Zito, PT, Grad Dip Manip Ther,§ Ken Niere, PT, Mph,‖ Debra Shirley, PT, BSc,¶ Jonathan Emberson, MSc,# Ian Marschner, PhD,# and Carolyn Richardson, PT, PhD*

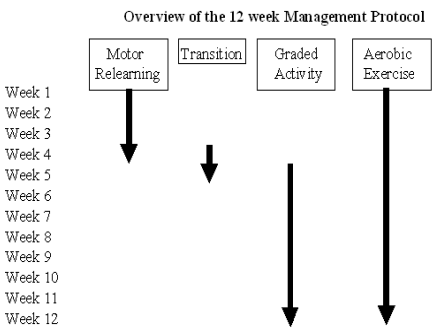


Chronic WAD

Comprehensive physiotherapy exercise program or advice for chronic whiplash (PROMISE): a pragmatic randomised controlled trial (ACTRN12609000825257)

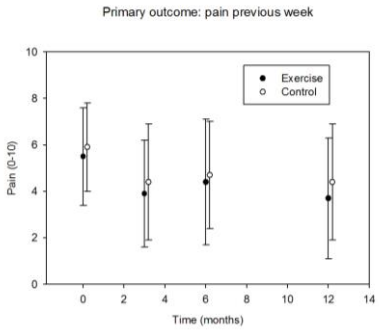
Michaleff, Maher, Lin, Rebbeck, Jull, Connelly, Sterling

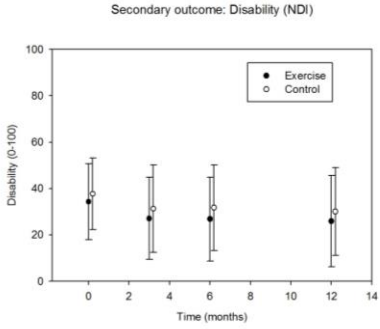
The Lancet (2014)



Vs

Act as usual
- 1 PT session/information booklet





Exercise

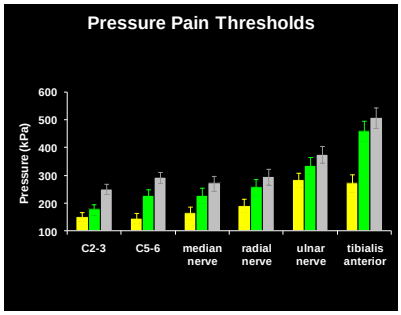
? DOSE

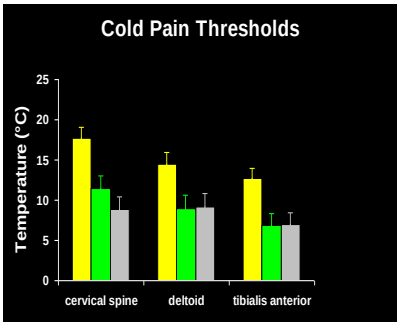
? TYPE

? Duration

? INTENSITY

Different mechanisms seem to underlie different MSKconditions





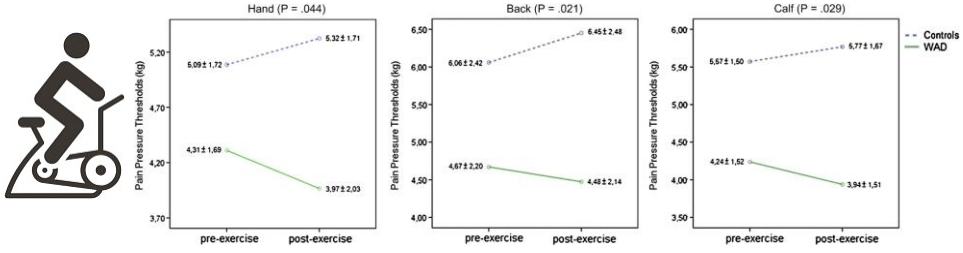
- Chronic WAD; NDI 44(12)%
- Chronic Idiopathic; NDI 29(16)%
- Controls

Scott, Jull, Sterling 2005 Clin J Pain (21):175-181

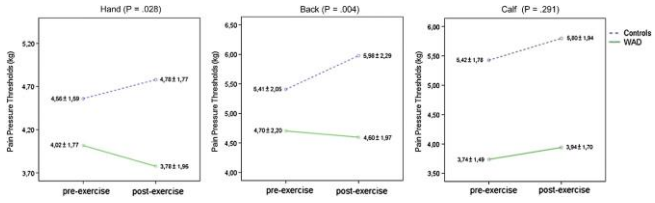
Elliott et al Clinical Radiology 2008

Chien, Eliav, Sterling 2009 Manual Therapy

Hypoalgesia & Exercise



Sub-Maximal Exercise 75% MHR, 15 mins

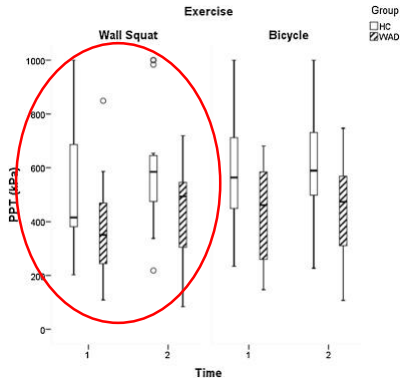


Self-paced, physiologically limited , aerobic threshold >80% MHR

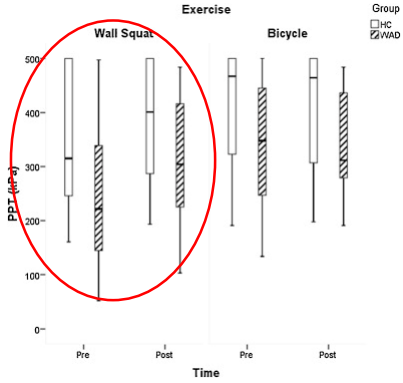
Van oosterwickj et al Clin J Pain, 2012, 13(3): 242

Scandinavian Journal of Pain 15 (2017) 14–21

Exercise induced hypoalgesia is elicited by isometric, but not aerobic exercise in chronic WAD
Ashley Smith, Carrie Ritchie, Ashley pedler, Kaitlin McCamley, Kathryn Roberts, Michele Sterling

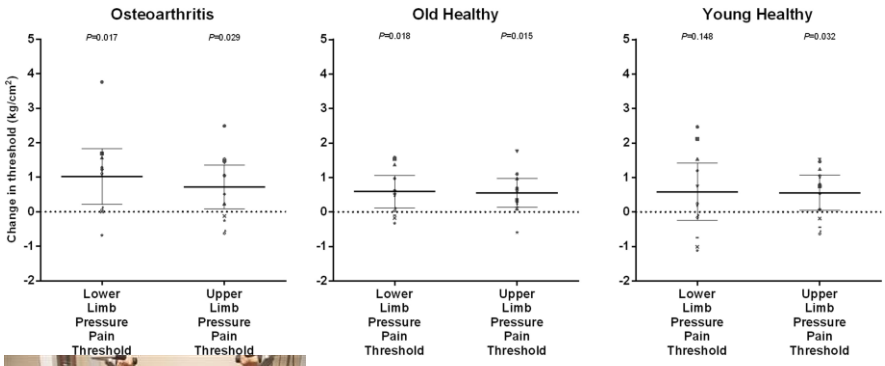


Tibialis Anterior



Cervical Spine

Knee OA



Only upper body exercise significantly raised pain thresholds in the knee OA group, with variable non-significant effects following lower body exercise.
Burrows et al (2014) Osteoarth & Cartilage 22(3)

ORIGINAL ARTICLE

Hypoalgesia After Exercise and the Cold Pressor Test is Reduced in Chronic Musculoskeletal Pain Patients With High Pain Sensitivity

Henrik B. Vaegter, MSc,† Gitte Handberg, MD,* and Thomas Graven-Nielsen, DMSc, PhD†*

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M.H. Pitcher, F. Tarum, I.Z. Rauf, L.A. Low, M.C. Bushnell

Modest amounts of voluntary exercise reduce pain- and stress-related outcomes in a rat model of persistent hind limb inflammation The Journal of Pain, 2017, Available online 7 February 2017

- Inflamed Knee/ankle
- Voluntary exercise
- 2 hours/day, 4 days/week for 3 weeks in running wheel cages

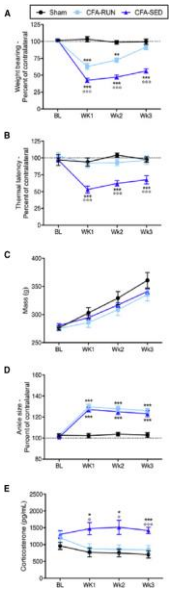


Figure 2A. Voluntary exercise is anti-nociceptive. (A) While static weight bearing on the CFA-injected paw remained significantly impaired in the CFA-SED group over the course of the study, the CFA-RUN group improved from week 1 to be indistinguishable from shams by week 3

NeuroImage: Clinical 9 (2015) 134–139

Contents lists available at ScienceDirect

NeuroImage: Clinical

journal homepage: www.elsevier.com/locate/ynicl

Normalization of aberrant resting state functional connectivity in fibromyalgia patients following a three month physical exercise therapy

P. Flodin [a,*], S. Martinsen [a], K. Mannerkorpi [b], M. Löfgren [c], I. Bileviciute-Ljungar [c], E. Kosek [a], P. Fransson [a]

[a]Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden
[b]Department of Rheumatology and Inflammation Research, Institute of Medicine, Sahlgrenska Academy, Gothenburg University, Gothenburg, Sweden
[c]Department of Clinical Sciences, Danderyd Hospital, Karolinska Institutet, Stockholm, Sweden

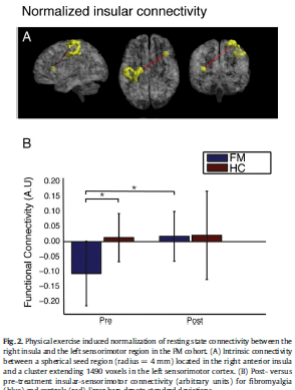


Fig. 2. Physical exercise induced normalization of resting state connectivity between the right insula and the left sensorimotor region in the FM cohort. (A) Intrinsic connectivity between a spherical seed region (radius = 4 mm) located in the right anterior insula and a cluster extending 1490 voxels in the left sensorimotor cortex. (B) Post- versus pre-treatment insular-sensorimotor connectivity (arbitrary units) for fibromyalgia (blue) and controls (red). Error bars denote standard deviations.

Who Responds to exercise ?

Low Back Pain

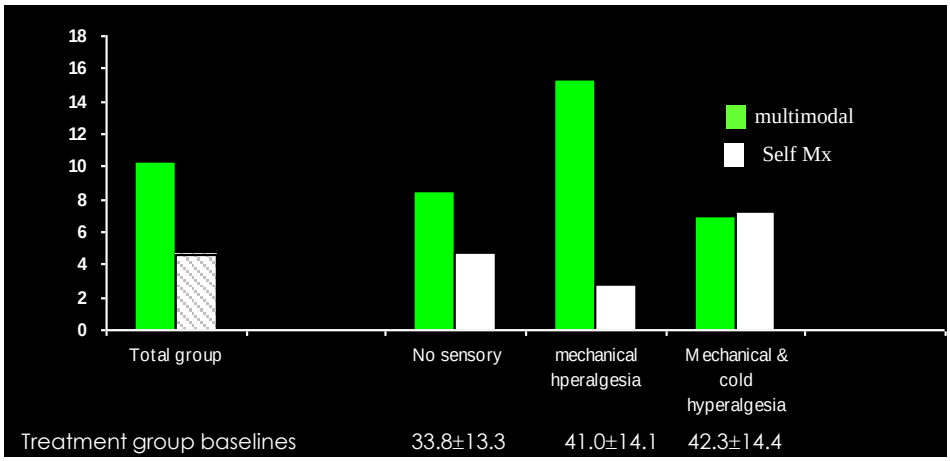
- Self-reported clinical instability predicted response to motor control exercises *(Macedo et al Phys Ther. 2014 Nov;94(11):1543-54)*

- Baseline pain, pain with movement, leg pain, constant pain, pain with flexion, expectations of good effect did not predict response to McKenzie exercises *(Sheets et al Eur Spine J. 2012 Jul;21(7):1250-6)*

Who Responds to exercise ?

- Psychological factors did not predict response to exercise and advice in LBP (Smeets et al, Arthritis Rheum. 2009 Sep 15;61(9):1202-9)
- SES, education, and number of pain medications as treatment effect modifiers of prognostic stratified care delivered in the STarT Back Trial (Bennecuik J, J Pain. 2017 Jan;18(1):54-65)
- No effect modifiers were found in rehabilitation trial for chronic WAD (Michaleff, Maher, Lin, Rebbeck, Jull, Connelly, Sterling, The Lancet (2014) 384(9938):133-41)

RCT Chronic Whiplash Jull et al 2007, *Pain* 129:28-34



- Sensory hypersensitivity moderates the effects of multimodal physiotherapy

Comprehensive physiotherapy exercise programme or advice for chronic whiplash (PROMISE): a pragmatic randomised controlled trial

Zoe A Michaleff, Chris G Maher, Chung-Wei Christine Lin, Trudy Rebbeck, Gwendolen Jull, Jane Latimer, Luke Connelly, Michele Sterling

	Treatment*time *effect modifier p value	Estimate (95%CI)	Effect for 1 SD increase
EFFECT MODIFIER			
SLANSS total score sum of 7 items (SD~6)	0.293	0.02 (-0.07 to 0.11)	0.12 (-0.42 to 0.66)
PDS total score sum of questions 22-38 (SD~12)	0.288	0.06 (0.02 to 0.1)	0.72 (0.24 to 1.20)
Mean of six PPT tests of tib ant (SD~148)	0.672	-0.002 (-0.005 to 0.001)	-0.30 (-0.74 to 0.15)
Mean of three PPT tests of cervical spine (SD~92)	0.452	-0.002 (-0.007 to 0.003)	-0.18 (-0.64 to 0.28)
Mean of six cold tests (SD~8)	0.380	-0.009 (-0.08 to 0.06)	-0.07 (-0.64 to 0.48)
PCS total score sum of 13 items (SD~13)	0.444	0.01 (-0.03 to 0.05)	0.13 (-0.39 to 0.65
***Duration of symptoms (SD ~17)**	0.780	0.00 (-0.03 to 0.03)	0.0 (-0.51 to 0.51)

	1 Responder (n=38)	0 Non-responder (n=36)	P
PPT Tibialis Anterior	381.0	346.9	.368
PPT Neck	199.8	190.6	.702
Cx Cold Hyperalgesia	13.6	12.6	.578
ROMtotal - Neck	188.8	184.3	.747
SF36MH0	67.5	57.8	.042*
PTSD : Re-experiencing	2.2	3.7	.045*
PTSD: Avoidance	2.7	5.3	.020*
PTSD: Arousal	3.6	5.9	.015*
PTSD: Total	8.5	14.9	.015*
PCS rumination	5.6	7.0	.210
PCS magnification	2.7	3.6	.147
PCS helplessness	7.3	8.6	.376
PCStotal - catastrophising	15.6	19.1	.217
SLANSStotal	9.9	10.7	.576
Compensation claim settled	Yes: (37%)	Yes: (37%)	

RECOVER
INJURY RESEARCH CENTRE
RESEARCH DRIVING REHABILITATION

Thank you

m.sterling@uq.edu.au

@micheleSterlin7

Website

www.recover.edu.au

Content overview

- Introduction
- Central sensitization: maladaptive neuroplasticity in patients with chronic pain (Kelly)
- Neuropathic central sensitization pain in physical therapy practice: HIV-related neuropathic pain as an example (Romy)
- Neuropathic central sensitization pain in physical therapy practice (Romy & Michele)
- Non-neuropathic central sensitization pain in physical therapy practice: Neck pain as an example (Michele & Jo)
- **Non-neuropathic central sensitization pain in physical therapy practice: case study** (Kelly & Jo)

PAIN IN MOTION

Case study knee osteoarthritis

Discuss in small groups (n=3):

1) Does Mrs. Ni presents a predominant nociceptive, neuropathic or central sensitization type of knee pain?

2) What options do we have for treating Mrs. Ni's knee pain? "Bottom-up" or "top-down" oriented interventions or a combination? Rationale behind the selection of interventions?

3) Pick an order for the selected interventions.

4) Can we treat her in a monodisciplinary PT setting?

PAIN IN MOTION

Central sensitization predicts pain following surgery

Shoulder impingement syndrome
Total knee replacement
Thoracotomy
Spinal fusion

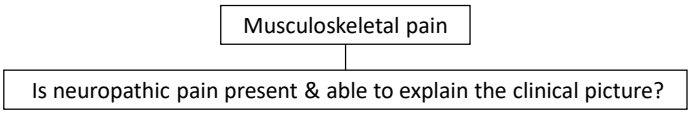
Baert et al. *Osteoarthritis Cartilige* 2016
Gwilym et al. *J Bone Joint Surg Br* 2011
Bennet et al. *World Surgery* 2017
Valencia et al. *Clin J Pain* 2014
Yarnistky et al. *Pain* 2008

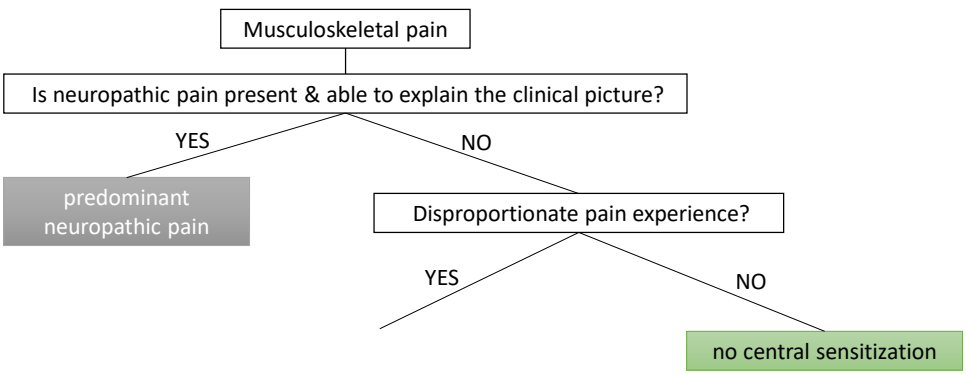
PAIN IN MOTION

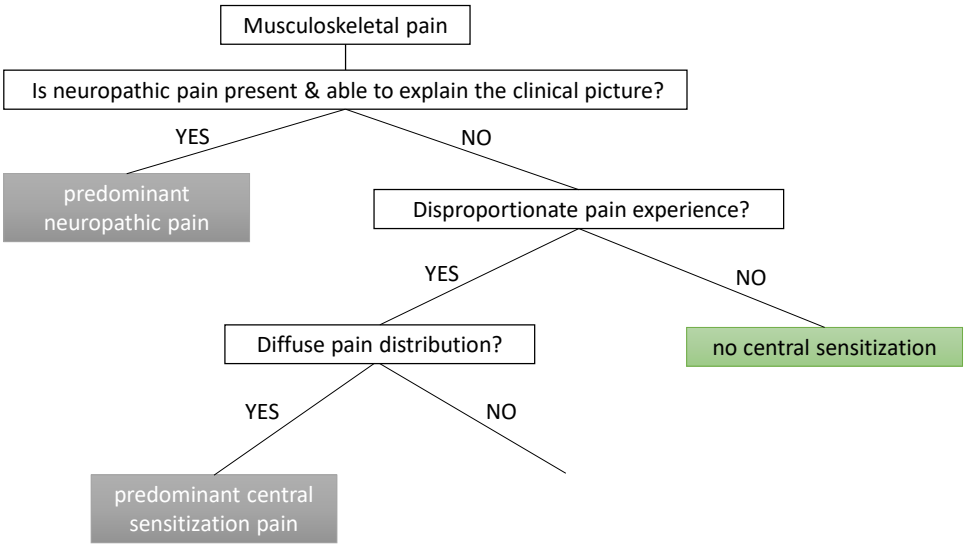
Case study knee osteoarthritis

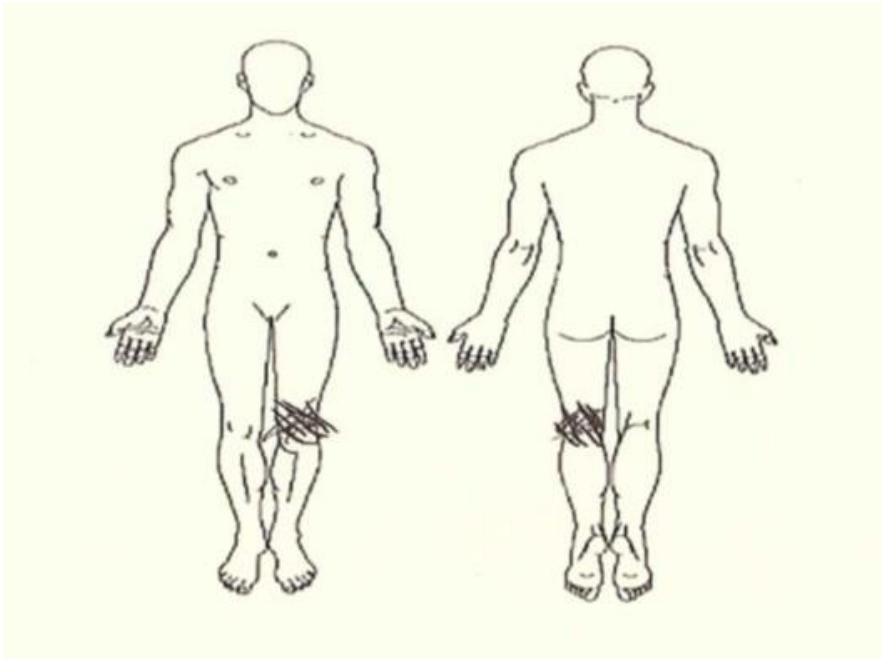
1) Does Mrs. Ni presents a predominant nociceptive, neuropathic or central sensitization type of knee pain?

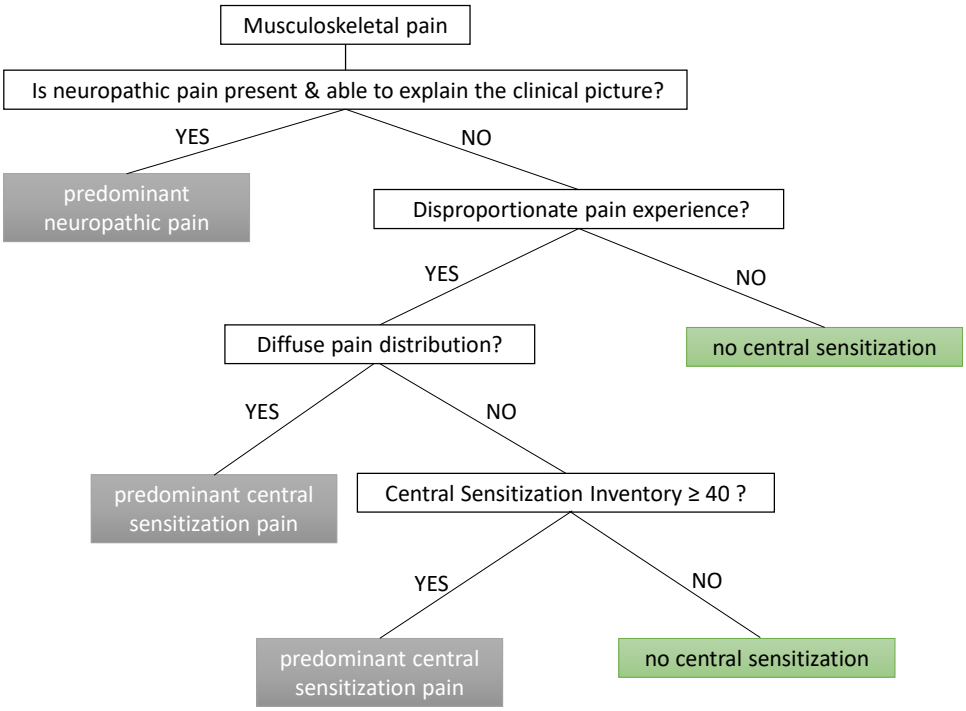
PAIN IN MOTION


Musculoskeletal pain
Is neuropathic pain present & able to explain the clinical picture?


Musculoskeletal pain
Is neuropathic pain present & able to explain the clinical picture?
YES
NO
predominant neuropathic pain
Disproportionate pain experience?
YES
NO
no central sensitization


Musculoskeletal pain
Is neuropathic pain present & able to explain the clinical picture?
YES
NO
predominant neuropathic pain
Disproportionate pain experience?
YES
NO
Diffuse pain distribution?
no central sensitization
YES
NO
predominant central sensitization pain





Case study knee osteoarthritis

Discuss in small groups (n=3):

1) Does Mrs. Ni presents a predominant nociceptive, neuropathic or central sensitization type of knee pain?

2) What options do we have for treating Mrs. Ni's knee pain? "Bottom-up" or "top-down" oriented interventions or a combination? Rationale behind the selection of interventions?

PAIN IN MOTION

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PAIN IN MOTION

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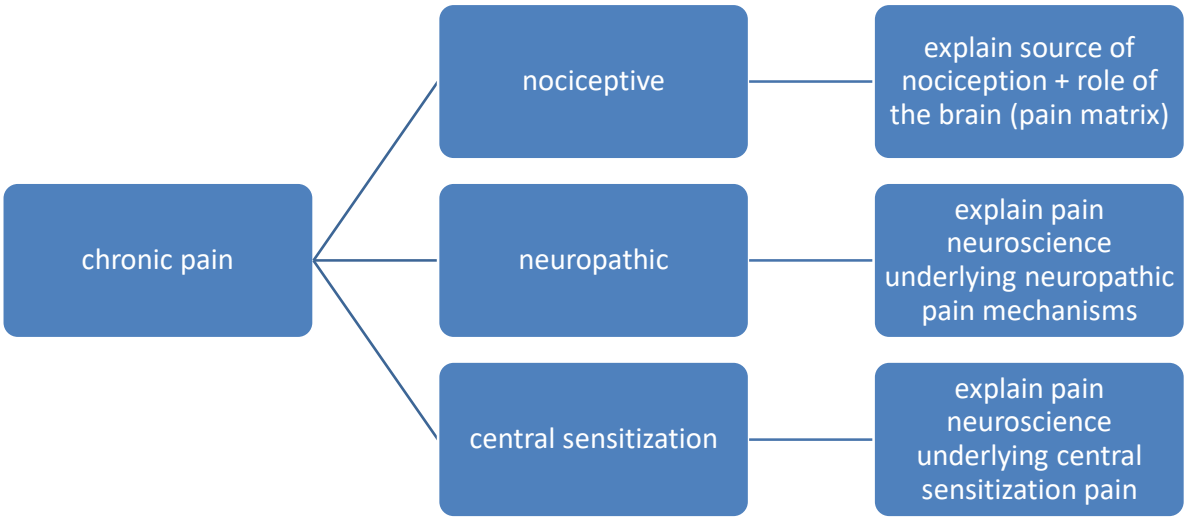
3) Pick an order for the selected interventions.

4) Can we treat her in a monodisciplinary PT setting?

PAIN IN MOTION

Tailored pain neuroscience education



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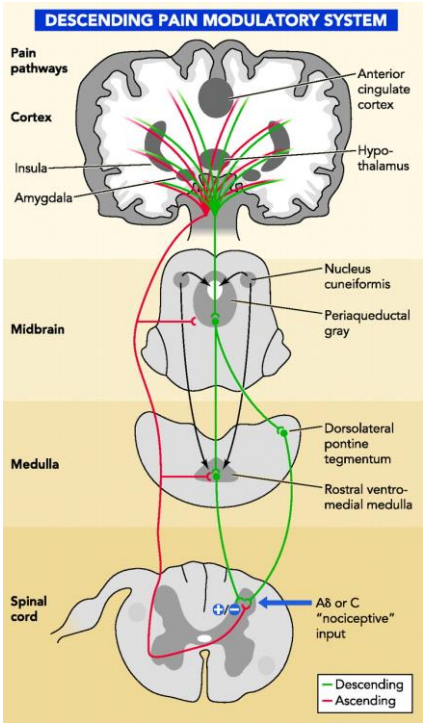
Spam filter methaphor

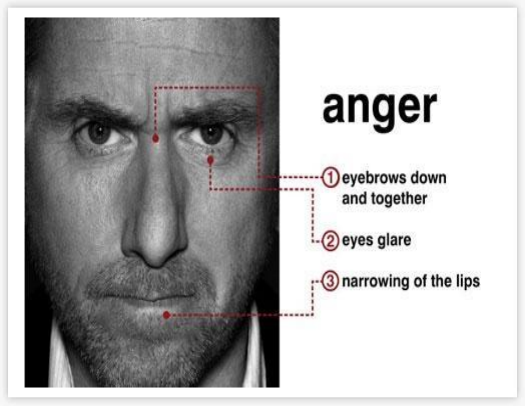
PAIN IN MOTION



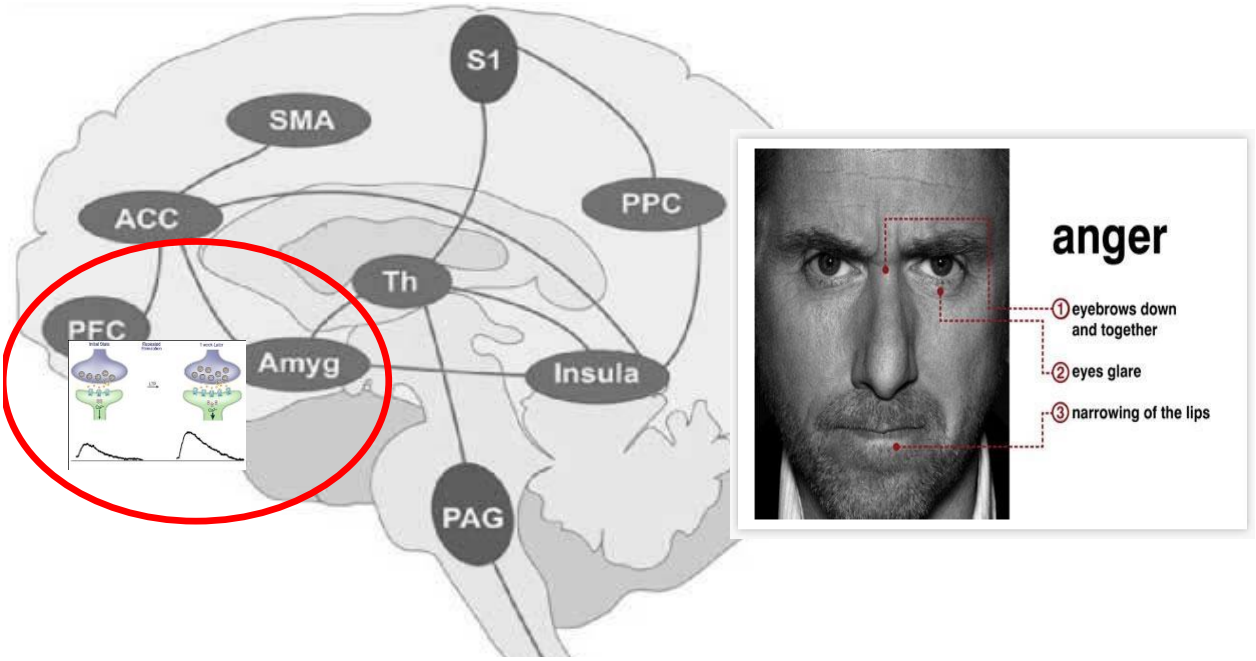
‘Most people don’t understand how severe my condition is’

‘No one should have to live this way’

‘I worry that my condition is not being taken seriously’

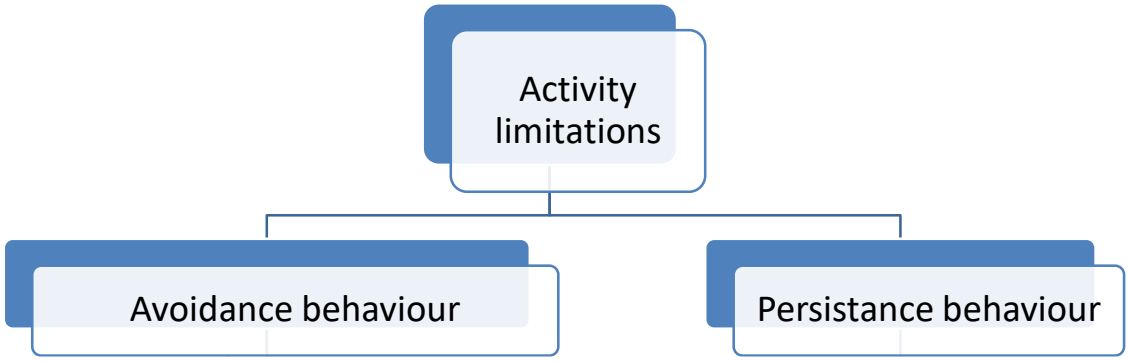


Perceived injustice, anger & chronic pain. Sullivan et al. *Clin J Pain* 2012

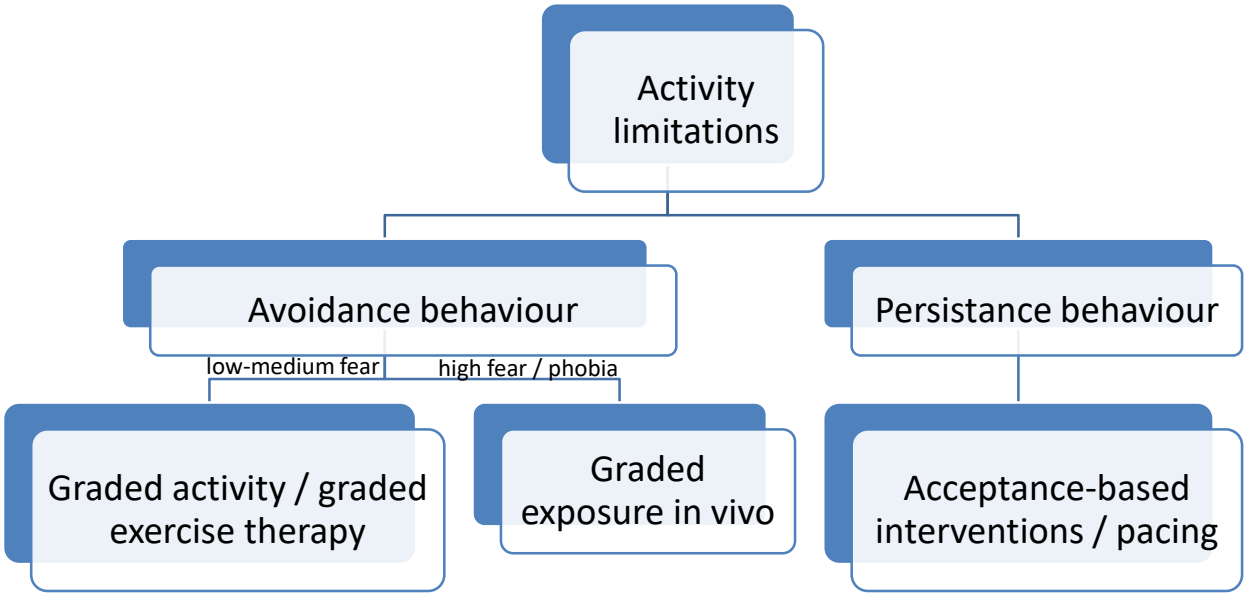


Perceived injustice, anger & chronic pain. Sullivan et al. *Clin J Pain* 2012

To grade or not to grade daily activities?



To grade or not to grade daily activities?



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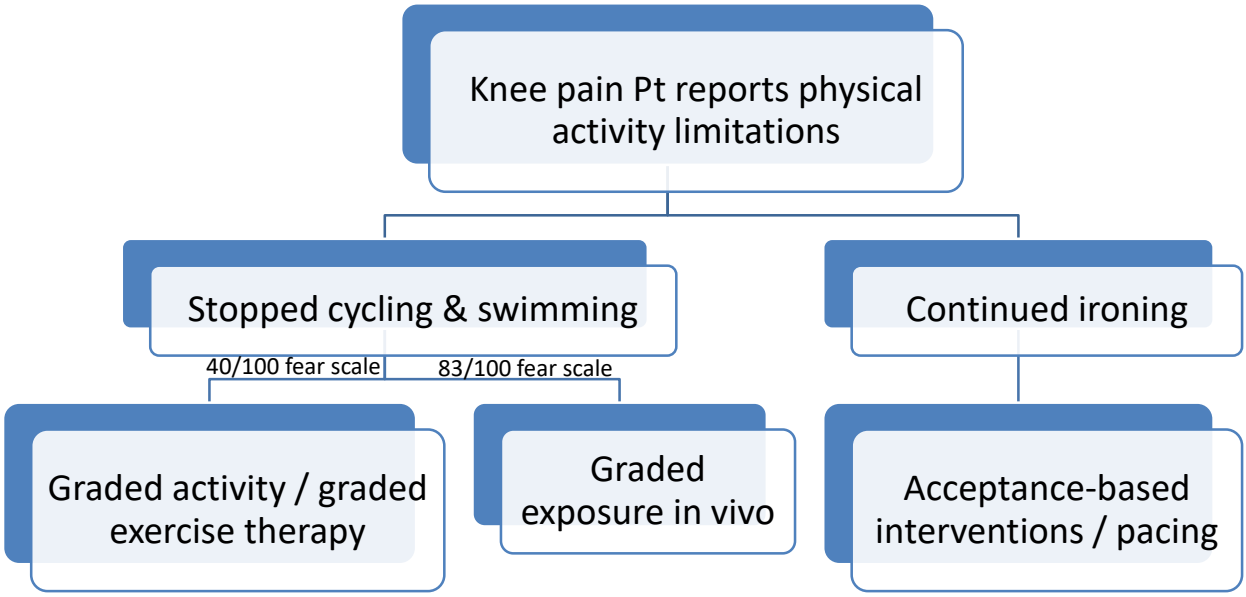
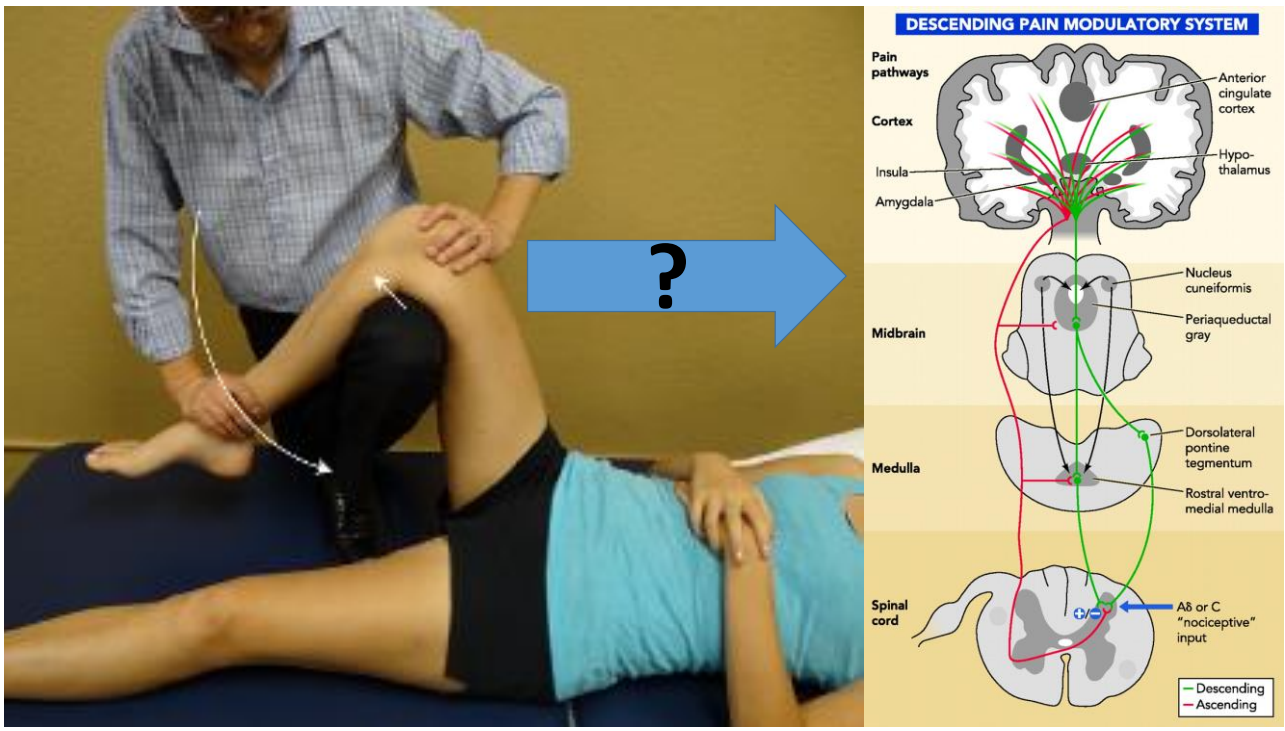
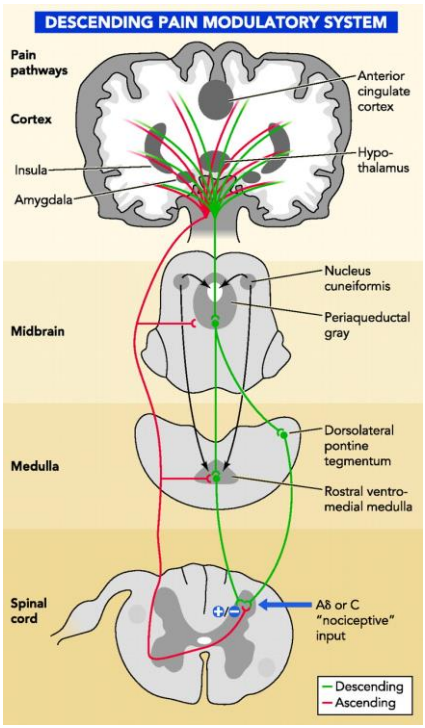




Boy your back muscles and spinal joints feel very stiff – luckily you didn't wait longer to come and see me!

I'm now activating the spam filter in your brain, to prevent danger messages to enter your brain



Balancing hands-on with hands-off interventions

Hands-on treatment:

- Following pain neuroscience education
- Explain brain effects
- Do not ↑pain anticipation
- Do not rely on pain self-report

Lluch et al. *Manual Therapy* 2015

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Combining pain education with Mulligan joint mobilisation in knee osteoarthritis

RCT – total knee replacement surgery for OA

pain education + Mulligan vs. biomedical education + Mulligan

Pain education + Mulligan:

- Pain catastrophizing↓
- Pain hypervigilance ↓
- Fear of movement ↓
- Global rating of change >>

Lluch-Girbès et al. *Clin J Pain* 2017

Stay connected

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