At least 1 in 5 people in the US (likely 1 in 4) suffer from persistent, chronic pain and the numbers are increasing. This means – 75 million!

(Magni et al, 1993; McMahon and Koltzenburg, 2005)
Clinicians struggle with pain

Therapists traditionally struggle with treating pain, especially chronic pain

(Wolff, Michel et al. 1991; Moseley 2003; Latimer, Maher et al. 2004; Louw, Louw et al. 2009)

Example 1

• What is this?
• How long will it take?
• What do you want the patient to do?
• What should the patient NOT do?
• What will you as the clinician be doing for this?
Example 2

- What is this?
- How long will it take?
- What do you want the patient to do?
- What should the patient NOT do?
- What will you as the clinician be doing for this?

Epidemiological data suggest that chronic, widespread, nonspecific musculoskeletal pain is on the rise, especially in the area of chronic low back pain (CLBP), adding to the ever increasing costs of health care (Magni et al, 1993; McMahon and Koltzenburg, 2005).

The prevalence of chronic pain was 35.5% (Raftery, Sarma et al. 2011) (UK Data)
A brain that feels extremely threatened, confused, hopeless…


A brain that understands, is less threatened and has hope…

Immediate Effect of Preoperative Neuroscience Education for Lumbar Radiculopathy: Case Series

Louw, et al – under review

Graph showing changes in LBP, Leg Pain, PCS, FABQ W, FABQ PA, Pain Knowledge, and CDI over time.
Immediate Effect of Preoperative Neuroscience Education for Lumbar Radiculopathy: Case Series

- Physical Measurements (after education-only):
  - Passive SLR increased 9 degrees
  - Active trunk flexion increased 5cm

Preoperative Neuroscience Education: Single fMRI case

Louw, Butler, Diener, Puentedura and Peoples; 2013 – submitted for publication
Using visual illusion to reduce at-level neuropathic pain in paraplegia

G.L. Moseley

G.L. Moseley / Pain 130 (2007) 294–298
Psychologically induced cooling of a specific body part caused by the illusory ownership of an artificial counterpart

G. Lorimer Moseley®, Nick Olofsson®, Annemelie Venema®, Sanneke Don, Marijke Wijers, Alberto Gallace® and Charles Spence®

PNAS | September 2, 2008 | vol. 105 | no. 35 | 13173

A Participant’s hands placed behind screens. Opposite hand visible for Experiment 1.

B Synchronous manual brushing of real hand and rubber hand.

Sites at which skin temperature was measured.
• CRPS = change in representation
• CRPS patient believes the hand feels 107% bigger
  – Hurts more when it looks bigger
  – Does not move different
  – More swelling when it looks bigger

“Which of these is a true picture?”

Visual distortion of a limb modulates the pain and swelling evoked by movement

G. Lorimer Moseley¹,², Timothy J. Parsons¹ and Charles Spence³
**Left/Right Discrimination**

- Patients perform poorly on tasks in which they are required to judge the laterality of a pictured limb.

- **Most people**: Correct 90%; Ave time = 2.4 sec.
- **CRPS**: Twice as long to recognize (4.7 sec. average)

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**Body Space**

Recent work has suggested that cold-type CRPS is associated with a cold side of space—i.e., crossing the arms so that the healthy hand is on the affected side of the midline reduces the temperature of the healthy hand

The Efficacy of Sham Surgery in Orthopedics: A Systematic Review of the Literature*
Louw A, Diener I, Butler DS, Puentedura L and Fernandez de-Las Penas C.
Submitted for Publication 2013

Moving without moving after Lumbar Surgery

- 60 y.o. lady
- L4/5, L5/S1 decompressive laminectomy and discectomy
- 24 hours post-op

| Easier: examples with few similarities in shape, # strokes or direction changes |
|----------------------------------|---|---|---|---|
| O      | I      | X    | W    | Z    | E    |
| +      | -      | 0    | 1    | 2    | 4    | 7    |
| Moderate: examples with some similarities in shape, # strokes or direction changes; e.g., E vs. F, M vs. L, L vs. U, X vs. K |
| E      | F      | M    | N    | 0    | || |
| >      | ✓      | 8    | 5    | 3    | 2    |
| More challenging: examples with similar shape, # strokes or direction changes; e.g., L vs. U, V vs. X, R vs. B, E vs. P |
| J      | L      | U    | V    | X    | K    |
| P      | D      | Q    | R    | B    | E    |
| 6      | 9      | 7    |       |       | ♦    |

* note: upper row: sensory discrimination training is required to have some ability to
note if position is completely drawn, indicated (no recommended)
Moving without moving after Lumbar Surgery
Louw A, Schmidt S and Puentedura E – in preparation

- Immediately after sensory discrimination, visualization and L/R discrimination:
- Passive SLR increased 7 degrees
- Active trunk flexion increased 2cm

Wild X-Rays

A nail rests in a South Korean man’s skull in December 2004. He’d sought help for a bad headache and upon discovery said it likely happened four years earlier.
The Fundamental Flaw

Gifford, L.S., Pain, the tissues and the nervous system, Physiotherapy, 1998. 84, p. 27-33.
OUTPUTS:
- Pain
- Action programs
- Stress regulation

INPUTS:
- Tissue sampling
- Environment

PROCESSING via
BODY-SELF
NEUROMATRIX:
- Sensory
- Cognitive
  (experience, attention, etc.)

No Brain; No Pain

The Brain’s Processing...

GRANDMA

The Brain’s processing of pain

• Common areas are frequently “ignited”
• Via connections, backfiring neurons, and neurotransmitters, pain is perceived – the pain neural signature


1. PREMOTOR/MOTOR CORTEX
organize and prepare movements

2. CINGULATE CORTEX
concentration, focusing

3. PREFRONTAL CORTEX
problem solving, memory

4. AMYGDALA
fear, fear conditioning, addiction

5. SENSORY CORTEX
sensory discrimination

6. HYPOTHALAMUS/THALAMUS
stress responses, autonomic regulation, motivation

7. CEREBELLUM
movement and cognition

8. HIPPOCAMPUS
memory, spatial recognition, fear conditioning

9. SPINAL CORD
pain from the periphery

Louw A, Butler DS, Diener I, Puentedura E and Peoples, R; 2013 Preoperative Neuroscience Education for Lumbar Radiculopathy: A Single Case fMRI Study

Beliefs  | Knowledge, logic  | Social context  | Anticipated consequences  | Other sensory cues

Denotes synaptic modulation

Beliefs
Knowledge, logic
Social context
Anticipated consequences
Other sensory cues
Physical therapy

Denotes synaptic modulation


Patterns of cortical reorganization in complex regional pain syndrome

Christian Maiböchner, MD; Hermann O. Handwerker, MD, PhD; Bernhard Neundörfer, MD; and Frank Birklein, MD

A Second Fundamental Problem

Neurology 2003;61:1707–1715
PAIN cannot be input...otherwise we’re all in trouble

Simple senses

- **Vision**
  - “The eye contains LIGHT receptors” (not vision receptors)

- **Sound**
  - “The ear contains SOUND receptors” (not hearing receptors)

- **Pain**
  - “Tissues contain DANGER receptors” (not pain receptors)

  • Pain does not correlate to injury, but the perception of threat to the body
**Therapy: So what?**

- Pain is a protective mechanism developed by the brain based on how it interprets information.
- “Feeding the brain better information” seems key to alter pain.

**Consider ALL therapy this way…**

"BOTH"

- Sample
- Environment
- Tissues
- Environment
- Tissues

Gifford, L. S., Pan, the tissues and the nervous system. Physiotherapy, 1961. 44 p. 27-33.
A Few Therapeutic Possibilities...

NUEROSCIENCE EDUCATION  →  TACTILE/SKIN

VISION/PERCEPTION  →  BODY PARTS

BODY SPACE  →  REDUCE THREAT
Neuroscience Education

• If patients want to know more about PAIN, why not teach them about...PAIN (not anatomy or biomechanics)

Therapeutic Neuroscience Education

Emerging research shows that explaining to patients their pain experience from a biological and physiological perspective of how the nervous system/brain’s processes pain allow patients to move better, exercise better, think different about pain, push further into pain, etc.

Efficacy Neuroscience Education

Conclusions: For chronic MSK pain disorders, there is compelling evidence that an educational strategy addressing neurophysiology and neurobiology of pain can have a positive effect on pain, disability, catastrophization, and physical performance.


Patient Example

- “I have bulging discs”
- “I have arthritis”

Cognitive Processing

• Afraid; poorly understood; movement = pain due to tissues being damaged

High Threat

PAIN to defend

versus

• Redefine pain and thus change cognitions regarding pain
• Pain and Tissue injury are two different things
• Reduce threat

Evidence for a direct relationship between cognitive and physical change during an education intervention in people with chronic low back pain

Altering Beliefs

- Decreased cortical activation

A Few Therapeutic Possibilities...

NUROSCIENCE EDUCATION
VISION/P RECEPTION
TACTILE/SKIN
BODY PARTS
BODY SPACE
REDUCE THREAT
Treatment

Sensory Discrimination

Tactile discrimination, but not tactile stimulation alone, reduces chronic limb pain

G. Lorimer Moseley a,b,c, Nadia M. Zalucki c,d, Katja Wiech b
**Sensory Discrimination**

- **Patient Example** - Spine Surgery

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**Graphesthesia training**

| Easier: examples with few similarities in shape, # strokes or direction changes |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|
| O   | I   | X   | W   | Z   | E   |
| +   | -   |     | /   | O   | *   |
| 0   | 1   | 2   | 4   | 7   |

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Recognition of body parts

- All body parts represented in the brain
- Normal: Sharp, know where it is
- Pain: Fuzzy; Not sure
Left/Right Discrimination

- All body parts represented in the brain
- Normal: Sharp, know where it is
- Pain: Fuzzy; Not sure
- Pain: Left and Right
Laterality Retraining

Cards • Internet Images
Recent e-mail from a PT

- Hello Again!
  First, I'd like to say thank you for the guidance you've given me already; second I'd like to say that I've had success in treating my patient with CRPS, but now I am not sure how to proceed.

- Here's the quick story, we started with looking at pictures of feet--playing games with the pictures (matching, sorting, etc.)... and on day 5 the patient woke up with almost total resolution of his pain. He was down to a 2/10. The pain remained low, and by the next day he had 0/10 pain. Yippee!

Another one...

--- Original Message---

To: Adrian Lauer <adrian@ad.com>
Sent: Sun, Apr 15, 2012 9:23 am
Subject: Re: CRPS

Hello once again,

I just wanted to say a very belated thank you. After working with my initial client with CRPS I have had one other. Both were younger children, 10-12. And both have had a full recovery. My latest patient actually sent me pictures of herself running and jumping, skipping and playing (as a silly kind of thank you after I made her look at pictures of her for weeks).

I just wanted to reiterate my thanks. Without your guidance and help, my patients would not have had as successful treatment and recovery.

Best,

i, PT
Changing Interpretation

• Restoring body parts in the brain

Mirror Therapy

• Using mirrors to trick the brain
• Have to restore L and R first
  – If not – confusion = more pain
• Slowly expose the patient to image
A Few Therapeutic Possibilities...

NUEROSCIENCE EDUCATION

VISION/PERCEPTION

BODY PARTS
BODY SPACE

TACTILE/SKIN

REDUCE THREAT

Threat

- Surgery is less scary
- Realistic expectations
- Pain after surgery ≠ something is wrong
Endogenous Mechanisms

So What?

• Physical therapy is ideal to treat pain
• PT needs a major shift in our understanding of pain
We DO NOT manage pain!


Summary

• There are MANY avenues to “attack pain”
• The BRAIN seems to be key
• Think:
  – How can I de-threaten this for my patient?
  – How can I “tell the brain” it’s going to be OK?
• A lot of this research done by physical therapists
Thank you & acknowledgements...

Adriaan@ispinstitute.com

- Colleen, Hailey and Samuel Louw
- Dr. Ina Diener
- Dr. David Butler
- Dr. Louie Puentedura
- Dr. Lorimer Moseley
- Dr. Paul Mintken
- Dr. Cesar Fernandez
- ISPI staff and faculty

Education is Therapy
ispinstitute.com