CHANGING THE BRAIN IN PAIN

Investigating the Body Scan in MBCPM™

BODY AWARENESS AND PAIN

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Physician and Associate Professor
Dept. Anaesthesia, University of Toronto
Chronic Pain Consultant
St. Michael’s Hospital Pain Clinic, Toronto
Getting Pain Sufferers back in touch with their Body

- Body Scan Meditation
- Loving Kindness Meditation
- Mindful Movements Meditation
- Guided Imagery

*Do the practice of these change the Somatosensory cortex?*

*Could they change Tactile Acuity?*

*Are they actively promoting Neuroplasticity?*
**Dr. Penfield**, a pioneering neurosurgeon and a professor at McGill University, was the first person to map out the cortical homunculus in 1951 which is well known to us today: somatosensory and motor.
Dr. Penfield suggested that the size of cortical representation also reflects kinesthetic proprioception, ...the body as felt in motion
Post injury, physiotherapists typically work hard at preventing loss of ROM and strength in their patients, but we need to equally focus on specifically preventing the loss of cortical representation by ... **Focusing on awareness**
Neuroplasticity

- Consider this, infants can’t make precise individual finger movements that they have not yet learnt...therefore we may safely say, they have no awareness of their hands
- Learned movements develop body awareness
Michael Merzenich is a leading neuroscientist in the field of Neuroplasticity at the University of California, San Francisco and he says...

“Neuroplastic changes occur when the brain pays close attention while learning”

Your brain - every brain - is a work in progress. It is 'plastic.' From the day we're born to the day we die, it continuously revises and remolds, improving or slowly declining, as a function of how we use it.

— Michael Merzenich —
Tactile practice by reading Braille leads to an enlargement of the finger areas in the somatosensory cortex.

Clinical Relevance:

The more often we are aware and sense and move in a specific pattern, (touching, walking, throwing, sit to stand) the patterns get merged in the Homunculus.
Neuroplasticity

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☒ This is negative if you are limping for a prolonged period of time after a knee injury or not moving and guarding self due to persistent low back pain
Lorimer Moseley, PT, PhD has shown that “body image is disrupted, and tactile acuity is decreased, in the area of usual pain, in patients with chronic back pain.”

Moseley GL1. I can't find it! Distorted body image and tactile dysfunction in patients with chronic back pain Pain. 2008 Nov 15;140(1):239-43.
So How do we Evaluate Tactile Acuity?

- 2-point discrimination (2PD) may be used to evaluate the function of the primary somatosensory (S1) representation.
2-point discrimination (2PD)

- 2PD can be measured using an inexpensive mechanical caliper
- The tips of the caliper are applied until the very first blanching of the skin appears around the points.
2-point discrimination (2PD)

- Testing begins by setting the caliper to 0 mm and gradually increasing the distance until the patient perceives two points instead of one.
- The patient is instructed to say ‘one’, when one point was felt, ‘two’, when two points are felt.
2-point discrimination (2PD)

- Once **two** is perceived, the caliper is slowly closed again until **one** is perceived again.
- The average of the two distances (Transition from two to one and from one to two) is considered the value for 2PD for that specific region.
2-point discrimination (2PD)

- 2PD was developed and originally written about by a German physician EK Weber in 1834.
- He is known as the father of sensory physiology and wrote the book “concerning touch” ... The two-point threshold, is the smallest distance between two points where a person determines that it is two points and not one
2-point discrimination (2PD)

- 2PD reflects the size and spacing of cutaneous receptive fields
- 2PD reflects the density of slowly adapting tactile axons
Why is Tactile Acuity Relevant?
Why is Tactile Acuity Relevant?

- The latest systematic review based on 16 studies concludes that tactile acuity is diminished in arthritis, CRPS, and chronic LBP...

...tactile acuity training may benefit those with chronic pain disorders suggests that clinical trials may be warranted.

Why is Tactile Acuity Relevant?

- The extent of tactile acuity impairment and the extent of cortical reorganization have been shown to directly relate to pain intensity in some conditions.

2PD & Painful Knee OA

- 2PD has been shown to be larger in patients with painful knee OA
- Asymptomatic (33mm ± 5mm)
- Symptomatic (40mm ± 5mm)

The reduced tactile acuity at the knee implies disturbed representation of the knee in the primary sensory cortex.

2-point discrimination

(2PD)

- Normal values on asymptomatic population (kids & adults) has been researched for the hands, feet, face and even the tongue.
- The normal values on the spine are quite variable


TPD was assessed at the neck, back, hand and foot. Mean TDP thresholds measured in 28 healthy subjects are reported for each of the four locations assessed.

\[ \bar{x} = 45.9 \text{ mm} \]
\[ \text{SD} = 18.4 \text{ mm} \]
\[ \text{Intra-rater ICC: .79} \]
\[ \text{Inter-rater ICC: .81} \]

\[ \bar{x} = 55.5 \text{ mm} \]
\[ \text{SD} = 12.7 \text{ mm} \]
\[ \text{Intra-rater ICC: .81} \]
\[ \text{Inter-rater ICC: .66} \]

\[ \bar{x} = 10.4 \text{ mm} \]
\[ \text{SD} = 4.2 \text{ mm} \]
\[ \text{Intra-rater ICC: .82} \]
\[ \text{Inter-rater ICC: .62} \]

\[ \bar{x} = 20.9 \text{ mm} \]
\[ \text{SD} = 8.9 \text{ mm} \]
\[ \text{Intra-rater ICC: .86} \]
\[ \text{Inter-rater ICC: .78} \]
Some researchers have discussed the pitfalls and limitations of 2PD and suggest 2POD to be a more accurate measure of tactile acuity.

For 2POD the patient must discriminate the orientation (horizontal vs. vertical) of two points of contact.
2-Point Orientation Discrimination

- 2POD is proposed to provide a more accurate measure spatial acuity

Tong J1, Mao O, Goldreich D. Two-point orientation discrimination versus the traditional two-point test for tactile spatial acuity assessment. Front Hum Neurosci. 2013 Sep 13;7:579.
I don’t know where it is!

- Patients with chronic neck & back pain have been shown to have reduced proprioceptive acuity


Low Back Pain (LBP)

- People with chronic LBP have been shown to have markedly different cortical representation of their back when compared to healthy controls.

Patients with chronic LBP have also been shown to have a disruption of their body schema of their trunks as they have difficulty identifying images involving left versus right trunk rotation.

I can’t find it! Distorted body image and tactile dysfunction in patients with chronic back pain

Lorimer Moseley

Patients with Chronic LBP were instructed to complete a drawing of their back. They were instructed “Concentrate on your back, draw the outline of your back as you track it in your mind. Concentrate in where you feel your back to be.”

The patients given this task had difficulty completing the simple act of drawing an outline of their back, reporting

“I can’t find it”

“It feel as though my back has shrunk”

Is this happening in early body scan meditations?

Moseley GL1. I can't find it! Distorted body image and tactile dysfunction in patients with chronic back pain Pain. 2008 Nov 15;140(1):239-43.
The patients also demonstrated decreased tactile acuity (2PD) at the level and side of their back pain.

2PD in low back is generally 50mm but on the side and level of pain it increased to 75mm.

Why Measure 2PD?

- Cortical reorganization and altered tactile acuity are both associated with chronic pain conditions including osteoarthritis.
- Clinicians can reliably assess 2PD thresholds using calipers.

Catley MJ...Moseley GL. Assessing tactile acuity in rheumatology and musculoskeletal medicine--how reliable are two-point discrimination tests at the neck, hand, back and foot? Rheumatology (Oxford). 2013 Aug;52(8):1454-61
There is certainly evidence that persistent pain is associated with changes in the somatosensory cortex disrupting cortical representation of the painful body area.

There is now growing evidence that patients with CLBP also have distorted cortical representation of the sensorimotor area representing the low back.


Wand BM, et al: **Tactile thresholds are preserved yet complex sensory function is impaired over the lumbar spine of chronic non-specific low back pain patients**: a preliminary investigation. Physiotherapy 2010, 96:317–323.

In patients with CLBP, the representation of the back has been shown to be shifted by about **2 cm** in the somatosensory cortex.

Somatosensory reorganization distorts the cortical body map that the brain relies on to execute movement.

This distortion causes incompatibility between motor commands and sensory feedback ... which may produce pain!

It is hypothesized that the cortical changes contribute to pain maintenance. Therefore interventions to “normalize” cortical representation are being developed and researched.

By reversing the cortical distortion, the motor commands become once again compatible with the sensory feedback, ...voila no pain!

Tactile Acuity Training

- Tactile acuity training has been shown to be effective in patients with phantom limb pain and CRPS resulting in pain reduction and cortical reorganization of the body area as seen on fMRI.


Tactile Acuity & Chronic Low Back Pain

- Four studies have shown that tactile acuity is reduced in people with CLBP with 2PD being larger by up to 2cm
- In those with unilateral LBP, 2PD is larger on the painful side
- There appears to be no association between pain intensity or pain duration and tactile acuity in acute LBP

Tactile Acuity & CLBP

- Although tactile acuity can be evaluated relatively easily using 2PD test, the challenge is how do we know what is normal and what is not?
- The studies on healthy and patients with CLBP show a wide variability in 2PD values.
- Again, what is normal 2PD? What is abnormal 2PD? We need to know what is normal within each individual.

There is minimal difference (2-5mm) between sides in healthy backs.

Therefore, in people with unilateral CLBP the non-painful side may be used as reference value when assessing 2PD on the painful area.

A 2PD difference between sides may be considered significant if it is greater than 13 mm when assessed horizontally.

A 2PD difference between sides may be considered significant if it is greater than 17 mm when assessed vertically.

Tactile Acuity & CLBP

- Greater 2PD has been associated with poorer voluntary lumbo-pelvic control.

Tactile Acuity & CLBP

- It is suggested that tactile discrimination training may improve motor control and proprioception in patients with CLBP

Tactile Acuity & CLBP

It has been shown that discriminating the location and the size of the tactile stimuli on a body part can decrease pain and improve 2PD.

Why?

Mindful exposure to non-painful stimuli may be the reason for the reduction of pain.

Patient with CLBP were randomly assigned to two needling groups but both patient groups received the same number of needles, in the same points, inserted to the same depth and with an identical type and amount of needle manipulation.

The only difference was that the patients in the control group were asked to relax and not focus on the needles.

Acupuncture & Neuroplasticity

On the other hand the patients in the experimental group were instructed to consciously focus on the location of each needle and be aware when a needle was moved ... they were to refer to an image and estimate the position of each needle.

Compared to the patients who received “passive needling”, those in the “mindfulness needling” reported immediately less pain with movement.

Perhaps sometimes acupuncture might help people with back pain by improving self-perception and awareness of the back.

• Perhaps needling a painful area improves symptoms through a sensory discrimination like effect

“...acupuncture may offer specific benefit that is not dependent on precisely where the needles are inserted so much as that the patient attends to where they are...”

A case series study was done to investigate the potential effects of tactile acuity training on three patients with chronic LBP.

The 3 patients had all been through multiple failed past treatments such as PT, Chiro, Pilates, Yoga, nerve block and narcotics.
Tactile Acuity Training & Chronic LBP

- They attended twice a week for 8 weeks for one hour sessions and were to do daily home exercises with the assistance of a family member for 30 minutes, 3 times a day

All 3 patients greatly benefitted from the 10 weeks of daily tactile acuity training; two ended up with zero pain! (Note: They also received pain education and gentle motor control training)

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The latest systematic review based on 16 studies concludes that **tactile acuity** is diminished in arthritis, CRPS, and chronic LBP...

The extent of tactile acuity impairment and the extent of cortical reorganization have been shown to directly relate to pain intensity in some conditions.


Mailis Gagnon A1, Keith N. **The paradox of less sensation and more pain.** Pain. 2012 Sep;153(9):1787-8.
Body scan in a participant with sensory loss:

- The following case study showed the benefits of Body Scan in a patient with sensory loss due to neck surgery, which resulted in profound head pain, so severe she was on opioids and adjuvants to try to control the pain for 2 years before entering the MBCPM™ course.

- She participated in the MBCPM™ course from Barrie, Ontario with the facilitator at Sunnybrook HSC in Toronto
Cheryl’s Story of Head Pain

- Cheryl in her 30s, had intolerable head pain and loss of sense of touch below mid chest after surgery for a rare condition. Initially she was in a wheelchair and was in rehabilitation to relearn to walk.

- High doses of opioids would only temporarily control her pain. Over the next 2 years she was in agony, while opioid rotations, anticonvulsants, anti-depressants, and muscle relaxants were tried.

- She was on oxygen, walked with a walker and had attendant care funded by the Province of Ontario.
Cheryl’s creative work

- She attended MBCPM™ via telemedicine to her home town, during which she drew this picture of her pain.
- She meditated daily, gradually reduced her medications, still staying on a low dose, and 3 years later, returned to her job in the auto factory where she had originally worked.
- Meditating with the **Body Scan** daily was the main way she controlled her pain.
Cheryl’s Pain Management

- Body scan kept her at 4/10 in pain intensity
- Had to be done daily
- Its effectiveness was likely related to her loss of touch acuity with the sensory loss
- Allowed pain reduction so reduced medication---
- Which reduced hyperalgesia from the medication

MBCPM™ allowed clarity to:

- Change her toxic psychosocial circumstances which she recognized contributed to her pain
- While still on some opioid she was able to return to work at her factory after 5 years on disability
- Body scan would also allow increased proprioception for safety.
“Patterning” in Polio

- In the epidemics of polio in the early 1900s children recovering from paralysis would have teams of volunteers and family members come, in shifts, to move their legs for them, called “patterning”, until they could move them by themselves.

- This is an example of the mind/body disconnect.

- Awareness, assisted by movement, reconnects those neural pathways and trains the mind to move the neglected body again.

- Could Body Scan, and Loving Kindness meditations have more applications than at first realized?
Formal Practice

- Body Scan is a visualization which brings back awareness and recognition.
- Loving Kindness toward self enhances and strengthens the practice.
- Mindful Movement Meditation, or Yoga done mindfully, brings back recognition and awareness by using movement and proprioception.

All strengthen the mind body connection and, by synchronizing movement with sensation and proprioception, may enhance safe, well coordinated, movement, reducing pain and injury.