The Brain, Pain and the Neuroplastic effects of Chiropractic Care

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Enlightening the world about the science of chiropractic

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Outline

• Pain – what is it? And where does it come from?
• Structural pathology model vs Neural plasticity model of pain
• Plasticity and its role in pain
• Plasticity and its role in chiropractic care
• Implications for patients
• Implications for you guys as chiropractors
• How to communicate this information and why
Low back and Neck Pain Burden Worldwide

- In 2015, low back and neck pain were ranked the fourth leading cause of disability-adjusted life years (DALYs) globally, only preceded by:
  - Ischemic heart disease
  - Cerebrovascular disease
  - Lower respiratory infection

- In 2015, over half a billion people worldwide had low back pain and more than a third of a billion had neck pain of more than 3 months duration (= CHRONIC PAIN)

- Low back and neck pain are the leading causes of years lived with disability in most countries and age groups


The Pain Burden – Example Australia 2018

3.24 million Australians were living with chronic pain in 2018.  
53.8% are women  
56% of Australians who are living with chronic pain their pain restricts what activities they are able to undertake.

$73.2 billion - total financial cost of chronic pain in Australia  
$12.2 billion in health system costs  
$48.3 billion in productivity losses  
$12.7 billion in other financial costs

People with chronic pain also experience a substantial reduction in their quality of life, valued at an additional $66.1 billion.

The costs of chronic pain are expected to increase from $139.3 billion in 2018 to $215.6 billion by 2050

Major changes in our understanding of pain in past few decades

“The contemporary understanding of pain involves consideration of different broad categories of pain with different underlying mechanisms, activation of a network of neural systems, neuroimmune interactions (peripherally and centrally), and tissue-level changes, as well as psychological and social domains. All of these have a potential role in the sensorimotor adaptation to pain, as well as in the development and maintenance of pain.”


Chronic (3months+) PAIN FACTS

Pain severity ≠ degree of tissue damage

Pain location ≠ site of problem

Feeling Pain ≠ nociceptive neurons firing

Nociceptors firing is ONE small part of our ‘Danger-Warning’ system

What you tell your patient matters!

Discussion: The results of this study show that a neuroplasticity explanation, compared to a traditional biomechanical explanation, resulted in a measureable difference in SLR in patients with CLBP when receiving manual therapy.

Neuroscience education about pain helps on its own!!

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.


Feel Pain

OLD SCHOOL
Latest understanding shows this is far too simplistic
Critical Review

Relations Between Brain Alterations and Clinical Pain Measures in Chronic Musculoskeletal Pain: A Systematic Review

“among all included chronic MSKP conditions it seems that brain regions involved in the limbic-affective and cognitive component of pain processing are involved in the observed neuroplastic brain remodeling. On the basis of this compelling evidence it can be stated that chronic MSKP is not only involved with somatosensory processing but also critically involves cognitive and affective-limbic processing in regions such as the ACC, insula, prefrontal cortex, and amygdala.”

Acute Pain vs Chronic Pain

INJURY

Nociception

Emotional Amplification and learning!

3 months +

Nociception

Adapted from Vachon-Presseau et al., 2016


Widespread CNS neural plastic changes with chronic pain

- Plasticity at synapses
  - Spinal presynaptic and postsynaptic changes
  - LTP and LTP (fire together, wire together)

- Spinal cord changes
  - reduced descending inhibition
  - Remodelling of spinal circuits

- Structural & function changes in glial cells
  - nociceptive hypersensitivity
  - Microglia, astrocytes, satellite glial cells, & oligodendrocytes,

Widespread CNS neural plastic changes with chronic pain

- Resting-state networks changes
  - decreased connectivity of the **medial Prefrontal cortex** with the posterior constituents of the default mode network (DMN) and increased connectivity with the insular cortex in proportion to the intensity of pain
- Major cortical reorganisation
  - **prefrontal regions**, the anterior insula, **anterior cingulate cortex**, basal ganglia, thalamus, periaqueductal grey, post-and pre-central gyri and inferior parietal lobule
  - more intense and expanded brain activation patterns involving areas, such as somatosensory cortices, the insula or **anterior cingulate cortex**, that tend to correlate with clinical pain duration


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Structural and Functional changes in chronic pain

- **Expansion and shift of cortical representation**
  - ACC, Insular, M1, S1 & S2
- **Altered structural integrity and connectivity**
  - PFC and BG
- **Impaired descending inhibitory control**
  - ACC and PAG
- **Alterations in grey matter volume**
  - ACC, M1, S1, PFC, BG, Thalamus, Insular, Hippocampus
- **Altered resting-state and pain-evoked functional connectivity**
  - ACC, S1, S2, PFC, BG, Amygdala, Thalamus, Insular, Hippocampus
- **Altered glial activity**
  - S1 and Thalamus

Chronic Pain is an example of faulty inner body schema/maps and maladaptive neural plastic changes


Abstract

Background: Musculoskeletal rehabilitative care and research have traditionally been guided by a structural pathology paradigm and directed their resources towards the structural, functional, and biological abnormalities located locally within the musculoskeletal system to understand and treat Musculoskeletal Disorders (MSD). However, the structural pathology model does not adequately explain many of the clinical and experimental findings in subjects with chronic MSD and, more importantly, treatment guided by this paradigm fails to effectively treat many of these conditions.

Discussion: Increasing evidence reveals structural and functional changes within the Central Nervous System (CNS) of people with chronic MSD that appear to play a prominent role in the pathophysiology of these disorders. These neuroplastic changes are reflective of adaptive neurophysiological processes occurring as the result of altered afferent stimuli including nociceptive and neuropathic transmission to spinal, subcortical and cortical areas with MSD that are initially beneficial but may persist in a chronic state, may be part and parcel in the pathophysiology of the condition and the development and maintenance of chronic signs and symptoms. Neuroplastic changes within different areas of the CNS may help to explain the transition from acute to chronic conditions, sensory-motor findings, perceptual disturbances, why some individuals continue to experience pain when no structural cause can be discerned, and why some fail to respond to conservative interventions in subjects with chronic MSD. We argue that a change in paradigm is necessary that integrates CNS changes associated with chronic MSD and that these findings are highly relevant for the design and implementation of rehabilitative interventions for this population.

Summary: Recent findings suggest that a change in model and approach is required in the rehabilitation of chronic MSD that integrate the findings of neuroplastic changes across the CNS and are targeted by rehabilitative interventions. Effects of current interventions may be mediated through peripheral and central changes but may not specifically address all underlying neuroplastic changes in the CNS potentially associated with chronic MSD. Novel approaches to address these neuroplastic changes show promise and require further investigation to improve efficacy of current approaches.

Keywords: Musculoskeletal disorders, Chronic low back pain, Osteoarthritis, Neuroplasticity, Periaqueductal grey, Posterior ventromedial medulla, Rehabilitation, Primary somatosensory cortex, Primary motor cortex, Limbic, Prefrontal, Pain.
Bio-plasticity model of pain

E.g. You have back pain because of any of these issues and/or a combination of some or all of them.

Structural Pathology model of pain

E.g. You have back pain because there is a tissue pathology in your back.

Structural Pathology Models

Bone out of place squashing nerve theory

Clinical biomechanics problem

Neuroplasticity Model

Compromised movement patterns

Compromised awareness & adaptability

Compromised neurophysiology
Discussion: The results of this study show that a neuroplasticity explanation, compared to a traditional biomechanical explanation, resulted in a measurable difference in SLR in patients with CLBP when receiving manual therapy.

So brain does NOT know accurately what is going on

Poor body awareness
Poor body control
Poor function

Changes brains internal representations about what is going on inside and outside body

Info sent to brain

Small muscles closest to spine and skull go to sleep

Self perpetuating cycle

OR

Stress

INJURY

Improves body awareness
Improves body control
Improves function

So brain knows MORE accurately what is going on

Changes brains internal representations about what is going on inside and outside body

Info sent to brain

Effects of Adjustment

Small muscles closest to spine and skull

Stretches small muscles closest to spine and skull

Adjustment

Effects of Adjustment

Info sent to brain

Bombards brain with mechanoreceptor input

Stretches small muscles closest to spine and skull
What does the CLINICAL research say about chiropractic care and helping with PAIN?

Clinical vs Basic Science Research

Clinical research important for ‘external’ marketing in Australia, UK and Canada

Evidence Based Chiropractic Science Gem webinar on Online Resource Library @therealitycheck.com

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Marketing

External
• Your Website
• Emails to clients
• Social Media

(you are NOT present)

• MUST have high level of clinical evidence
  (basically mainly back pain, neck pain, some types of headaches)

Internal
• Your Waiting room
• iPad in your office
• Health talks
• IN YOUR OFFICE

(you ARE present)

• ALL our products can be ‘safely’ used as all are evidence-based and referenced
Patient-Focused
Evidence-Informed
Chiropractic Care

Take home message for Chiropractic & Low Back Pain

“For people with low back pain chiropractic care is as effective, if not more effective than other treatment options.

More research needs to be done to work out just how effective it is.

But for now, the research suggests there are no better treatment options available.”
Take home message for Chiropractic & Neck Pain

“For people with neck pain, chiropractic care is as effective care option.

More research still needs to be done to work out exactly how effective it is, but its as good as other care options that are available.

It’s also cost effective and it’s safe.”


Take-home message for Chiropractic & Headaches

“For people with some types of headaches (migraine & cervicogenic) chiropractic care is as effective, or more effective than drugs and other treatment options.

For some types of headaches more research still needs to be done to work out exactly how effective chiropractic care is.

But chiropractic care is safe and well worth trying if you or someone you know is suffering from headaches.”

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Pain – What is it?

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Pain is in the brain

- Pain sensation is caused 100% of the time in the brain
- IT IS VERY REAL!!!! (caused by brain does NOT mean patient is making it up!!)
- Can be due to tissue damage (especially in acute situations)
- BUT can be due to brain perception of potential threat of tissue damage
- Pain sensation ≠ tissue damage (particularly for chronic pain)
Subluxations likely cause incongruent sensory experiences – hence lead to pain (danger) feelings

Incongruent sensory experiences!!!!

Do we have any evidence for this?
Spinal dysfunction vs Healthy people

Subclinical neck pain references

- Farid B, Yelder P, Holmes M, Haavik H, Murphy B. Subclinical neck pain leads to altered multi-sensory integration at baseline and four week follow-up relative to healthy controls. Paper presented at: ACC-RAC Platform and poster presentation abstracts, 2017; Washington DC, USA.
- Baarbé J. Effects of Altered Sensory Input from the Neck on Cerebellar Function, Body Schema and Sensorimotor Integration. Ontario, Canada: Health Sciences, University of Ontario Institute of Technology; 2015.
A person comes in and you discover they have recurring mild ache pain or tension in their spine...

<table>
<thead>
<tr>
<th>What MIGHT be going on for this person:</th>
<th>How MIGHT this be expressed for this person?</th>
<th>What questions could you ask?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor shoulder/elbow proprioception</td>
<td>Might bump into things, Might knock elbow on door frames</td>
<td></td>
</tr>
<tr>
<td>Poor motor learning</td>
<td>May not learn movements well. Struggling to write, struggling with sport, struggling with work-related movement skills (not learning well)</td>
<td></td>
</tr>
<tr>
<td>Poor multimodal integration of sound and visual information</td>
<td>May have more falls (as slower to identify surroundings and respond to them appropriately), may find it hard to function in noisy sensory-rich surroundings, may struggle to identify objects fast</td>
<td></td>
</tr>
<tr>
<td>Poor arm movements</td>
<td>May be clumsy, miss objects they are trying to grasp, put cup down so falls off table (as missed table edge), etc</td>
<td></td>
</tr>
<tr>
<td>Poor cerebellar-cortex communication</td>
<td>Clumsiness, poor motor learning, struggling to learn instrument, sport, work tasks, shaky, poor fine motor control,</td>
<td></td>
</tr>
<tr>
<td>Neck muscle fatigue</td>
<td>Gets sore neck, feels head is too heavy for their body, needs to rest often</td>
<td></td>
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</table>

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Neuroplasticity:
Changes to the function or structure of neurons due to changes in afferent input.
Bio-plasticity

Your brain and body remembers!

Maladaptive vs Adaptive Plasticity
Symptoms to fit disease category

Spinal Arthropathy
Disc herniation
Spinal cancer
Fractures

Adaptive Plasticity
Maladaptive Plasticity

Healthy
Subclinical Pain Category

Chronic pain

Critical Reviews in Oral Biology & Medicine

The Emotional Brain as a Predictor and Amplifier of Chronic Pain


Abstract

Human neuroimaging studies and complementary animal experiments now identify the gross elements of the brain involved in the chronicization of pain. We briefly review these advances in relation to somatic and orofacial persistent pain conditions. First, we emphasize the importance of reverse translational research for understanding chronic pain—that is, the power of deriving hypotheses directly from human brain imaging of clinical conditions that can be invasively and mechanistically studied in animal models. We then review recent findings demonstrating the importance of the emotional brain (i.e., the corticolimbic system) in the modulation of acute pain and in the prediction and amplification of chronic pain, contrasting this evidence with recent findings regarding the role of central sensitization in pain chronication, especially for orofacial pain. We next elaborate on the corticolimbic circuitry and underlying mechanisms that determine the transition to chronic pain. Given this knowledge, we advance a new mechanistic definition of chronic pain and discuss the clinical implications of this new definition as well as novel therapeutic potentials suggested by these advances.

Effects of Stress on Pain

“Stress has multifaceted effects on pain. On the one hand, it is a powerful inhibitor of nociception and inflammation; on the other hand, it contributes to enhanced pathological states including the establishment and continuation of chronic pain.”

Chronic Stress causes/worsens/chronifies Pain


Biologically plausible mechanisms for how you get subluxated

STRESS (emotional, chemical or structural)

“However, if the long muscles are turned on, the shorter ones, for example the stabilizing muscles between vertebrae, go to sleep – there is no need for them if you are trying to avoid danger.”

(Butler & Moseley, 2003; Explain Pain; page 90)

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3. Pain-Related Changes in Amygdala Neurocircuitry

Importantly, changes in the amygdala neurocircuitry have been detected in different preclinical models of pain and linked mechanistically to pain behaviors, indicating that these maladaptive neuroplastic changes are a brain mechanism of pain.

How the brain processes STRESSFUL sensory information

Stress

Sensory info comes in

Amygdala
- threat detection

Hippocampus
- memory categorization

Prefrontal cortex
- conscious rational categorization

PFC does NOT inhibits amygdala and hippocampus

Brainstem nuclei activation:
- Locus coeruleus (noradrenalin)
- Substania Nigra (dopamine)

ANS sympathetic nervous system
- Fight or flight

Increased HR, BP, BR

Hypothalamus
- Endocrine activation
- Adrenals (via pituitary gland)
- Adrenalin and cortisol floods the body

Brainstem takes over
- Increased release of adrenalin and cortisol
- Emotional Arousal
  - Irritability
  - Can seem irrational
  - Startle easy
  - Freeze easy
  - Get enraged easy
  - Cry easy
- Increased HR, BR and/or BP
- Memory and attention problems
- Big muscles tense
- Small paraspinal muscles ‘go to sleep’
- Sleep disturbance
- Functional gastrointestinal disorders
- Addictions
  - Can lead to:
    - Auto immune disorders
    - Fibromyalgia & CFS
    - Psychiatric disorders
      - Schizophrenia, Anxiety, Depression, PTSD, Bipolar disorder, etc
    - Chronic Disease
      - Coronary artery disease, Diabetes, Cancer, Obesity, Alzheimer’s disease, Endocrine disorders

Emotional Brain takes over

Prefrontal regulation shuts down during major stress

DMPFC
- Reality testing
- Error monitoring

DLPCF
- Top down guidance of attention and thought

IPFC
- Inhibition of inappropriate actions

VMPFC
- Regulation of emotion

Increased HR, BP, BR

Prefrontal cortex
- Reality testing
- Error monitoring

Amygdala
- threat detection

Hippocampus
- memory categorization

Stress management

PFC plays key role in pain processing and Involved in chronification of Pain


And since chiropractic adjustments affect the PFC we are probably turning down or off the pain IN THE BRAIN itself

The Limbic areas of your brain CHANGE due to your experiences!

**Stress Induced Maladaptive Neuro (bio) plasticity**

- **Potentially stressful**
- **Potentially stressful**
- **Stress (eg VS)**
- **Stress (eg VS)**

**HEALTH**

- Increased HR, BP, BR
- Sleep & digestive
  - Drug/alcohol abuse
  - Memory/Attention
- Emotionally Aroused
- Tight/sore big muscles
- Frequent subluxations
- Pain
- Addictions

**Symptoms Appear**

**PATHOLOGY**

- Chronic pain
- Coronary artery disease
- Diabetes
- Cancer
- Obesity
- Alzheimer’s disease
- Endocrine disorders
- ADHD
- Autism
- Heroin addiction
- Autoimmune
- Fibromyalgia
- CFS

- PTSD
- Anxiety
- Suicide
- Bipolar disorder
- Schizophrenia
- Major Depression

The dynamics of the stress neuromatrix

N Sousa

Stressful stimuli in healthy subjects trigger activation of a consistent and reproducible set of brain regions; yet, the notion that there is a single and constant stress neuromatrix is not sustainable. Indeed, after chronic stress exposure there is activation of many brain regions outside that network. This suggests that there is a distinction between the acute and the chronic stress neuromatrix. Herein, a new working model is proposed to understand the shift between these networks. The understanding of the factors that modulate these networks and their interplay will allow for a more comprehensive and holistic perspective of how the brain shifts “back and forth” from a healthy to a stressed pattern and, ultimately, how the latter can be a trigger for several neurological and psychiatric conditions.

Molecular Psychiatry (2016) 21, 302–312; doi:10.1038/mp.2015.196; published online 12 January 2016


PA stress affects Brain

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Chronic Pain and Mental Health Disorders go Hand in Hand

Chronic Pain and Mental Health Disorders: Shared Neural Mechanisms, Epidemiology, and Treatment

W. Michael Hooten, MD

Lack of sleep, Chronic Pain & Inflammation


Haack M, Sanchez E, Mullington JM. Elevated inflammatory markers in response to prolonged sleep restriction are associated with increased pain experience in healthy volunteers. Sleep. 2007;30(9):1145-1152;


Low HRV in Chronic Pain

Timing of stress event matters

There have been significant advances made towards understanding the processes mediating extinction of learned fear. However, despite being of clear theoretical and clinical significance, very few studies have examined fear extinction in adolescence, which is often described as a developmental window of vulnerability to psychological disorders. This paper reviews the relatively small body of research examining fear extinction in adolescence. A prominent finding of this work is that adolescents, both humans and rodents, exhibit a marked impairment in extinction relative to both younger (e.g., juvenile) and older (e.g., adult) groups. We then review some potential mechanisms that could produce the striking extinction deficit observed in adolescence. For example, one neurobiological candidate mechanism for impaired extinction in adolescence involves changes in the functional connectivity within the fear extinction circuit, particularly between prefrontal cortical regions and the amygdala. In addition, we review research on emotion regulation and attention processes that suggests that developmental changes in attention bias to threatening cues may be a cognitive mechanism that mediates age-related differences in extinction learning. We also examine how a differential reaction to chronic stress in adolescence impacts upon extinction retention during adolescence as well as in later life. Finally, we consider the findings of several studies illustrating promising approaches that overcome the typically observed extinction impairments in adolescent rodents and that could be translated to human adolescents.

Adverse Childhood Experiences (ACE) studies

- ACE categories studied (psychological, physical, or sexual abuse) increased health risks for:
  - smoking
  - poor self-rated health
  - more than 50 sexual intercourse partners
  - sexually transmitted disease
  - physical inactivity
  - severe obesity
  - ischemic heart disease
  - cancer
  - chronic lung disease
  - skeletal fractures
  - liver disease

- Chronic pain
- Chronic headaches
- Widespread pain
- Anxiety
- Depression
- Suicide
- Bipolar disorder
- PTSD
- Alcoholism
- drug abuse
- suicide attempt

**Conclusion:** “We found a strong graded relationship between the breadth of exposure to abuse or household dysfunction during childhood and multiple risk factors for several of the leading causes of death in adults.”

• Children who had ACE have higher risk of chronic widespread pain as adult:

• Each of the ACEs (e.g. emotional, physical, sexual) was associated with an increased prevalence and risk of frequent headaches.

• As the ACE score increased the prevalence and risk of frequent headaches increased in a “dose–response” fashion.
Maternal stress levels affects their babies by sensitizing their pituitary-adrenal responses to subsequent stress exposure later in life

And affects their epigenome and its regulatory role in the expression of specific genes (altered gene methylation), including genes that guide neurodevelopment.


Maternal reported exposure to stressful life events and perceived stress can be measured with EEG in babies as young as 2 months old!

Inheritance of parental traumatic exposure!

- A higher prevalence of PTSD, mood and anxiety disorders is observed in Holocaust offspring
- Increased prevalence of PTSD among offspring with parental PTSD
- Cherry blossom study


Local Spinal Changes After an Injury

TIME

<table>
<thead>
<tr>
<th>Injury happens</th>
<th>MINUTES</th>
<th>3-6 months</th>
<th>12 months +</th>
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<tr>
<td></td>
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<tr>
<td></td>
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<td>Multifidus muscle fibrosis</td>
<td>Multifidus atrophy</td>
</tr>
<tr>
<td>Increased corticospinal drive to Multifidus</td>
<td>Localised Multifidus atrophy due to neural inhibition</td>
<td>Fatty infiltration</td>
<td>Fibrosis</td>
</tr>
<tr>
<td>Localised Multifidus atrophy due to neural inhibition</td>
<td>Slow-to-fast twitch fiber type change</td>
<td>Hypomobility DJD around joint</td>
<td>Fatty infiltration</td>
</tr>
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</table>

Paraspinal muscle proprioceptive signaling plays a pivotal role in driving the neural plastic changes in spinal pain

Abstract
Motor control, which relies on constant communication between motor and sensory systems, is crucial for spine posture, stability and movement. Adaptations of motor control occur in low back pain (LBP) while different motor adaption strategies exist across individuals, probably to reduce LBP and risk of injury. However, in some individuals with LBP, adapted motor control strategies might have long-term consequences, such as increased spinal loading that has been linked with degeneration of intervertebral discs and other tissues, potentially maintaining recurrent or chronic LBP. Factors contributing to motor control adaptations in LBP have been extensively studied on the motor output side, but less attention has been paid to changes in sensory input, specifically proprioception. Furthermore, motor cortex reorganization has been linked with chronic and recurrent LBP, but underlying factors are poorly understood. Here, we review current research on behavioral and neural effects of motor control adaptations in LBP. We conclude that back pain-induced disrupted or reduced proprioceptive signaling likely plays a pivotal role in driving long-term changes in the top-down control of the motor system via motor and sensory cortical reorganization. In the outlook of this review, we explore whether motor control adaptations are also important for other (musculoskeletal) pain conditions.

Small Intervertebral Paraspinal muscles are primarily sensors

Sense change in position (accelerometers)

The complexity of spinal movement control

CNS Strategies:
Anticipatory
Reactive
Tonic

Diaphragm
Transversus abdominis
Pelvic floor muscles

Multifidus
Summary So Far

- Pain sensation is caused 100% of the time in the brain
- Can be due to tissue damage
- BUT can be due to brain perception of potential threat of tissue damage
- Pain sensation ≠ tissue damage (particularly for chronic pain)
- Structural pathology model no longer best model
- Neuroplasticity model of pain is a better fit
- Spinal function is complex..... So is spinal dysfunction
- Changes all the time in adaptive or maladaptive manner depending on state of the person (structural, chemical and mental stress levels)

Symptoms don’t just appear out of thin air

<table>
<thead>
<tr>
<th>Traumatic experiences</th>
<th>Genetics</th>
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<tbody>
<tr>
<td>Dorsal horn cells of spinal cord firing</td>
<td>Exercise</td>
</tr>
<tr>
<td>Peripheral neuroimmune Influences</td>
<td>Leaky gut</td>
</tr>
<tr>
<td>Local inflammation</td>
<td>Spinal function</td>
</tr>
<tr>
<td>Beliefs &amp; Expectations</td>
<td>Thoughts</td>
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<table>
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<tr>
<th>Stress HPA activation</th>
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<tr>
<td>Central neuroimmune Influences</td>
</tr>
<tr>
<td>Poverty</td>
</tr>
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<td>Systemic inflammation</td>
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<tr>
<td>Sleep</td>
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<td>Family background</td>
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<tr>
<td>Stress autonomic sympathetic activation</td>
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<tr>
<td>Social problems</td>
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<tr>
<td>Mental health issues</td>
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<td>Nociceptors firing</td>
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<tr>
<th>Attitudes &amp; Personality</th>
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<tr>
<td>Learning bio- (neuro-) plastic effects</td>
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</table>
COMMUNICATION IS KEY

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Motor Control Changes with Low back pain/injury


• LBP patients less likely to be able to feed forward activate core ab muscles (Marshall & Murphy, J Electromyogr Kinesiol. 2010 Oct;20(5):833-9; Hodges & Richardson, Arch Phys Med Rehabil. 1999 Sep;80(9):1005-12)


• Delayed trunk muscle reflex responses significantly increases the odds of sustaining a low back injury (Cholewicki et al Spine (Phila Pa 1976). 2005 Dec 1;30(23):2614-20)


“The results reveal that chronic low back pain can influences the three subsystems (the passive system, the muscular system and the control system) of spinal stability, according to the findings of Van Dieën et al. (2003). Pain alters sensorial perception such as tactile (Puta et al., 2012; Weiss et al., 2011) and visual discrimination (De Lussanet et al., 2012) and probably proprioception (Radebold et al., 2001). It seemingly alters central and peripheral motor programs. The minor changes may require a little input (Boström et al., 2013). However, the minor changes may be adversely influence stability (Fritz and Wagner, 2014) and thus in turn affect muscle recruitment (Van Dieën et al., 2003) even generating new pain in a vicious circle.”

Motor Control Changes with Low back pain/injury


- LBP patients less likely to be able to feed forward activate core ab muscles (Marshall & Murphy, J Electromyogr Kinesiol. 2010 Oct;20(5):833-9; Hodges & Richardson, Arch Phys Med Rehabil. 1999 Sep;80(9):1005-12)


- Delayed trunk muscle reflex responses significantly increases the odds of sustaining a low back injury (Cholewicki et al Spine (Phila Pa 1976). 2005 Dec 1;30(23):2614-20)

LBP subjects exhibit altered anticipatory postural adjustments, impaired detection of the postural perturbation, and enhanced late-phase monitoring of postural challenge. (Jacobs et al 2016; Jacobs et al 2010)


Movement Related Cortical Potentials (MRCPs)

Motor Control Changes with Low back pain/injury


- Delayed trunk muscle reflex responses significantly increases the odds of sustaining a low back injury (Cholewicki et al Spine (Phila Pa 1976). 2005 Dec 1;30(23):2614-20)

LBP subjects exhibit altered anticipatory postural adjustments, impaired detection of the postural perturbation, and enhanced late-phase monitoring of postural challenge. (Jacobs et al 2016; Jacobs et al 2010)

LBP subjects redistribute their postural control strategy to distal body segments (Bruning et al., 2008; Claeyss et al. 2011; Jacobs et al. 2011; Jacobs et al 2016).

Chronic LBP exhibit altered cerebrocortical activity prior to self-initiated, voluntary arm movements (Jacobs et al 2016)

Motor control changes following spinal manipulation/chiro care


- Spinal Manipulation can improve feed forward activate core ab muscles (Marshall & Murphy J Manipulative Physiol Ther 2006; 29(3): 196–202)


Spinal Manipulation can change the early BP, known to be involved in anticipatory postural adjustments at the cortical level (Haavik et al 2017, Brain Sci; in press)

Spinal manipulation improves ankle proprioception and can enable subjects to take a faster compensatory step (Hall et al J Manipulative Physiol Ther 2015; 39(4):367-78).

Spinal Manipulation alters cerebellar-M1 and Cerebellar-S1 communication in relation to arm movement control (Ouladji et al J Manipulative Physiol Ther 2013;36:527-537; Andrew et al. 2018. Exp Brain Research)
Gut, stress, inflammation and pain

- Excessive bacterial dysbiosis, small intestinal bacterial overgrowth, or increased intestinal permeability ('leaky' gut) may produce systemic and/or central nervous system inflammation.

- The routes of communication between the microbiota and brain are slowly being unravelled, and include:
  - the vagus nerve
  - gut hormone signaling
  - the immune system
  - tryptophan metabolism
  - microbial metabolites such as short chain fatty acids

- Altered intestinal permeability is found in patients with primary fibromyalgia and in patients with complex regional pain syndrome.

- Diet is one of the most important modifying factors of the microbiota-gut-brain axis.

Gut Microbiome & the Brain

“CNS and neuroendocrine activity, stress responses in particular, may, in turn, influence the composition of the gut microbiome by differentially altering the growth of bacterial species and the production of bacterial virulence factors.”

“Gut microbes shape the architecture of sleep and stress reactivity of the hypothalamic-pituitary-adrenal axis.”

“They influence memory, mood, and cognition and are clinically and therapeutically relevant to a range of disorders, including alcoholism, chronic fatigue syndrome, fibromyalgia, and restless legs syndrome.”

So what is the evidence now for a neuroplasticity effect of chiropractic care?

And what does this mean?
Summary of the Evidence

**Post spinal manipulation**
- Improved elbow and ankle JPS
- Changes to SMI
  - Decreased N30 SEP peak amplitude (pre-frontal cortex)
  - Altered SICI & SICF and shorter CSP
- Improved mental rotation
- Improved multimodal integration (sound and vision)
- Improved Cerebellum-M1 modulation
- Altered Cerebellum-S1 communication
- Increased strength and cortical drive to upper & lower limb muscles
  - 16% students
  - 6% elite athletes
  - 65% chronic stroke patients
- Relaxed female pelvic floor muscles
- Increased jaw strength
- Larger MRCPs
- Altered SR curves to both upper and lower limb muscles
References for neuroplastic effects of chiropractic care


References for neuroplastic effects of chiropractic care continued


27/06/2019
The role of chiropractic therefore appears to be re-establishing accurate communication between the brain and the body and the environment

- By improving spinal function by adjusting subluxated segments (dysfunctional spinal segments) we appear to improve:
  - brain awareness of body schema (elbow JPS, ankle JPS, spine JPS)
  - brain awareness of environment schema (visual and sound perception, mental rotation of objects in space)
  - sensorimotor integration (TMS, SEPs, Cerebellum)
  - body control (strength efficiency, feedforward activation)

- Clearly a neural plastic mechanism
- Clearly help with spinal (neck & back) and head pain (clinical evidence)
So chiropractic adjustments are probably improving PFC function and through this we are probably turning down or off the pain in the BRAIN itself.


COMMUNICATION IS KEY

www.therealitycheck.com/event
Why it's important the public understand

1) Because we ‘learn’ to be in pain
2) Opioid Epidemic

www.therealitycheck.com/event
Pain in Kids does NOT go away

And they are likely to get worse!
Why chronic stress and pain leads to opioid addiction

Dysfunction of the prefrontal cortex in addiction

“imaging studies in addictive behaviours have identified a key involvement of the prefrontal cortex (PFC) both through its regulation of limbic reward regions and its involvement in higher-order executive function (for example, self-control, salience attribution and awareness)”


Low back pain patients seeing chiropractors are 55% less likely to use prescription opioids!

• Why? (we don’t know)

• Valid Biologically Plausible Possibilities:
  • We are not pill pushers
  • We improve their function and thus reduce their pain (so they don’t need the pain meds)
  • We turn the sensation of pain off at the level of the brain (so they don’t need the pain meds)
  • We affect their prefrontal cortex which helps regulate their limbic system and/or improve their self control against addictive behaviors

Chronic Pain and Chronic Stress go hand in hand
Lack of sleep, pain, stress and inflammation are all linked
Mental health issues is also common with all of the above
Chronic stress, microbiome, leaky gut, chronic pain go hand in hand

Chronic pain and chronic stress leads to consistent neuroplastic changes in the central nervous system (in particular amygdala and prefrontal cortex)
The brain ‘learns’ to be in chronic pain
We know we (chiropractors) impact several parts of the stress/pain neuromatrix!!

What your patients need to know?

Understand what we have covered so far
The bio (neuro)plasticity of pain (a learnt problem)
Neuroscience education about pain helps on its own!!

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.


What your patients need to know?

- Understand what we have covered so far
- The role of neuroplasticity of pain
- The neuroplastic effect of chiropractic care
Discussion: The results of this study show that a neuroplasticity explanation, compared to a traditional biomechanical explanation, resulted in a measureable difference in SLR in patients with CLBP when receiving manual therapy.


What you tell your patient matters!

What your patients need to know?

- Understand what we have covered so far
- The role of neuroplasticity of pain
- The neuroplastic effect of chiropractic care
- Symptoms do NOT arise out of thin air & pain is an ALARM system
Symptoms often only arise when there are a 1000 things that have gone wrong already.
Symptoms don’t just appear out of thin air

- Nociceptors firing
- Local inflammation
- Systemic inflammation
- Dorsal horn cells of spinal cord firing
- Peripheral neuroimmune influences
- Exercise
- Leaky gut
- Diet
- Local inflammation
- Spinal function
- Beliefs & Expectations
- Thoughts
- Learning bio-(neuro-)plastic effects
- Stress HPA activation
- Central neuroimmune influences
- Poverty
- Sleep
- Family background
- Stress autonomic sympathetic activation
- Social problems
- Mental health issues
- Nociceptors firing

Pain is Basically Your Alarm System
What your patients need to know?

- Understand what we have covered so far
- The role of neuroplasticity of pain
- The neuroplastic effect of chiropractic care
- Symptoms do NOT arise out of thin air & pain is an ALARM system
- Chronic pain may be fully (or predominantly) a brain problem

Pain may fully or partially be in the brain

Pain may be coming from here more than from here
The Brain’s Pain Matrix

- Spinal cord
- Amygdala
- Pre-frontal cortex
- Cingulate cortex
- The pre-motor areas
- Sensory cortex
- Thalamus
- Hypothalamus
- Cerebellum
- Hippocampus

What your patients need to know?

- Understand what we have covered so far
- The role of neuroplasticity of pain
- The neuroplastic effect of chiropractic care
- Symptoms do NOT arise out of thin air & pain is an ALARM system
- Chronic pain may be fully (or predominantly) a brain problem
- The important role of the Prefrontal Cortex in pain (and stress)
How to talk about the role of the PFC in emotional regulation to a patient

- Make a fist
- Explain the wrist is the brain stem (controls breathing, heart rate, etc)
- The hidden thumb is the ‘emotional’ limbic brain (no reasoning, no time, no words)
- The four fingers covering the limbic brain are your prefrontal cortex (reasoning, calming)

- When a stressor occurs our prefrontal cortex (the four fingers) gets disengaged
- Lift your four fingers up
- Without the inhibition from the prefrontal cortex we go into our limbic ‘emotional’ brain
- Now we become irrational, emotional, angry, sad
- Here we have no reasoning and time does not exist so no point in trying to ‘talk’ or ‘reason’ with someone who is operating in this place

Physical, chemical and emotional/mental stress causes maladaptive plastic changes

Chiropractic (exercise, mediation, etc) appears to have a positive adaptive effect
The Prefrontal Cortex - the Brain’s Conductor

Chiropractic Care impacts the Prefrontal Cortex

Understanding Stress, Pain and the Immune System
What your patients need to know?

- Understand what we have covered so far
- The role of neuroplasticity of pain
- The neuroplastic effect of chiropractic care
- Symptoms do NOT arise out of thin air & pain is an ALARM system
- Chronic pain may be fully (or predominantly) a brain problem
- The important role of the Prefrontal Cortex in pain (and stress)
- The importance of beliefs, attitudes, expectations, feelings, isolation, loneliness, financial problems, emotional problems, etc that influence the feeling of pain

### The Feeling of Pain

- Traumatic experiences
- Genetics
- Spinal (dys)function
- Dorsal horn cells of spinal cord firing
- Peripheral neuroimmune influences
- Local inflammation
- Beliefs & Expectations
- Thoughts
- Nociceptors firing
- Learning bio- (neuro-) plastic effects
- Diet
- Leaky gut
- Exercise
- Stress autonomic sympathetic activation
- Social problems
- Mental health issues
- Stress HPA activation
- Systemic inflammation
- Sleep
- Family background
- Central neuroimmune influences
- Poverty
- Genetics
- Attitudes & Personality

Nociceptors firing
Local inflammation
Dorsal horn cells of spinal cord firing
Peripheral neuroimmune influences
Spinal (dys)function
Genetics
Beliefs & Expectations
Thoughts
Learning bio- (neuro-) plastic effects
Diet
Leaky gut
Exercise
Stress autonomic sympathetic activation
Social problems
Mental health issues
Stress HPA activation
Systemic inflammation
Sleep
Family background
Central neuroimmune influences
Poverty
Genetics
Attitudes & Personality
Beliefs & Expectations
Thoughts
Learning bio- (neuro-) plastic effects
Your patients Goals need to shift away from us fixing the tissues and towards:

- Re-establishing proper brain-body communication (chiro)
- Improving posture and body movements (physio/chiro)
- Reducing excess inflammation, possibly due to poor gut health and/or nutritional deficiencies (naturopath/chiro/physio/GP/patient)
- Assessing and working on emotional resilience, such as mindfulness meditation (psychologist/patient/chiro)

Implications for the Chiropractor

- Patient Education/Public Awareness about the neural plasticity model (of pain and of chiropractic care) is essential!

- Improving the patient’s (and your own) Understanding about:
  - Pain is complex
  - Spine function and dysfunction is complex
  - Patients themselves are complex and multi-dimensional

- Reassessing how we talk about pain
  - do you always refer to the tissues as the cause?

- Inter-professional Collaboration
So let's get busy communicating this!!!
External Communication
• Websites
• Emails
• Social Media

Internal Communication
• In person talks
• In your office
• In your waiting room

Marketing External vs Internal

External
• Your Website
• Emails to clients
• Social Media
(you are NOT present)

• MUST have high level of clinical evidence
(basically mainly back pain, neck pain, some types of headaches)

Internal
• Your Waiting room
• iPad in your office
• Health talks
• IN YOUR OFFICE
(you ARE present)

• ALL our products can be ‘safely’ used as all are evidence-based and referenced
What can we claim about chiropractic in EXTERNAL marketing?

• We CAN make claims about chiropractic being helpful for things that we have a high level of research evidence for such as;
  • Back pain
  • Neck pain
  • Cervicogenic headaches
  • Migraine
  • Cervicogenic dizziness (UK, not Australia)

• We CAN discuss the mechanisms of chiropractic care, having a neuroplastic effect (in Australia and UK but NOT in Canada) — BUT — you must be careful not to claim any clinical benefit from this mechanism for anything other than the conditions to the left.

• So you can say chiropractic care most likely helps people with back pain by altering the way your brain responds to signals from your body

What can we NOT claim about chiropractic in EXTERNAL marketing?

• Any topic that we do NOT have high level of clinical evidence for, so we cannot make claims about ANYTHING other than;
  • Back pain
  • Neck pain
  • Cervicogenic headache
  • Migraine
  • Cervicogenic dizziness (in UK only, not Australia)

• Although we CAN discuss the mechanisms of chiropractic care, having a neuroplastic effect — you CANNOT claim any clinical benefit from this mechanism for anything other than the conditions to the left.

• So you CANNOT say chiropractic care makes your brain function better

• YET!!!!!
What can we claim about chiropractic in INTERNAL (in your office) marketing?

• We CAN make ALL claims we have made in ALL our Animations and Science Gems because ALL our resources are based on scientific evidence!!!!

• And you are there to discuss limitations!

• (and if you have forgotten the limitations just check out the Science Gems and other webinars!)

Now links on membership site to SAFE materials for external marketing in Australia and the UK

• Sparse materials there so far because this takes TIME!!!

(only worked through 8/40 animations over past 6 months!!!)

• Great help from ACA helping to work through animation to ensure they are AHPRA-proofed

• Great help from UK members who have had dealings with ASA in UK

• Starting this process with members in Canada!
How do you educate your practice members and the effects of stress and how Chiro can help?

1. First you educate **yourself**!! (watch our Science Gems, follow up on references in this webinar)
2. Educate your **team**!! (watch our Science Gems, and/or this webinar; workshop together key questions and how to answer them)
3. Prepare your **website** (as a member you can embed all/any animation on your website)
4. Email links to your entire **database**
5. Have relevant animations downloaded and running on loop in your **waiting room**
6. Have an **iPad** in your office with all the animations on it so you can play them for a practice member
7. Get **Office Posters** up in your waiting room and in your adjusting rooms
8. Get **Brochures** (Pain is in the brain and The effects of an Adjustment) to give out to everyone
9. Give **talks** in your practice! (I can put together a PowerPoint talk and script if you like)
10. Set up **Social Media** campaign using all our snippets and quotes on this topic

    www.therealitycheck.com/event

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**Loads of Science Gem webinars on our membership site under Science Mastery**

• Explain topic by topic what evidence we have and what you can and cannot say!
The Brain, Pain and the Neural Plastic effect of Chiropractic Content in Online Library for members

• Many Science Gems
• Lots of Social Media Content

And Many Public Animations

English
Norwegian
Danish
Swedish
German
Spanish
French
Italian
Dutch
Dr Heidi Haavik’s international best-selling book
The Reality Check
is now available in Spanish, French and German

NOW available in SWEDISH
Being printed now in Danish
Coming soon in Norwegian

www.drheidi.net
New Pain Brochure and Poster
CHIROPRACTIC TURNS OFF THE PAIN IN THE BRAIN

Your brain can learn its way out of pain with chiropractic care

For more information, please take a brochure
Special Offer next 48 Hours!

27/06/2019

Pain is supposed to be helpful and informative

Our brain creates for us the experience of pain to let us know something is not OK. Maybe we are overworking ourselves, or perhaps bending into awkward positions, causing harm to the body. You might have an injury that you need to be careful of, to allow the body to heal and to avoid further damage. The pain can let us know what not to do while the body heals the problem. This pain is helpful and informative. If we listen to our body, these pain experiences can be a good thing.

Chronic Pain is a Brain Problem

But for some people, pain can persist even after the initial injury that caused it has healed. And for some people the pain can spread to other areas that are not injured at all. For these people, the pain has become non-informative and non-helpful. The pain itself has then become a problem. The brain has learnt to be in pain. This pain needs brain evaluation!

Why you need to exercise and see your family chiropractor when you are under stress

When you feel pain your brain is trying to protect you from danger. It will activate your "fight & flight" (sympathetic) nervous system, and prime your big muscles for action. For example, your heart rate and blood pressure will go up, giving you the fuel you need to fight or run away from danger - i.e. like a saber tooth tiger.

Small deep paraspinal muscles get switched off when you are under stress

When these small muscles close to your spine and scull are not working properly, it makes it harder for your brain to know accurately what is going on in and around you. Your chiropractor can help you activate these muscles again.

What can you do?

If you suffer from chronic pain, do your best to stay positive, reduce stress, eat well, sleep well, and see your family chiropractor to help retain your brain out of pain.

Special Offer next 48 Hours!

74.95 49 39 60 29
Major Sale on other online shop products!!

Take advantage of this Event Offer to join our online membership!

www.drHeidi.net
Further readings on pain and plasticity


Haack MK, Sanchez E, Mullington JM. Elevated inflammatory markers in response to prolonged sleep restriction are associated with increased pain experience in healthy volunteers. Sleep. 2007;30(9):1145-1152.

Further readings on pain and plasticity continued


