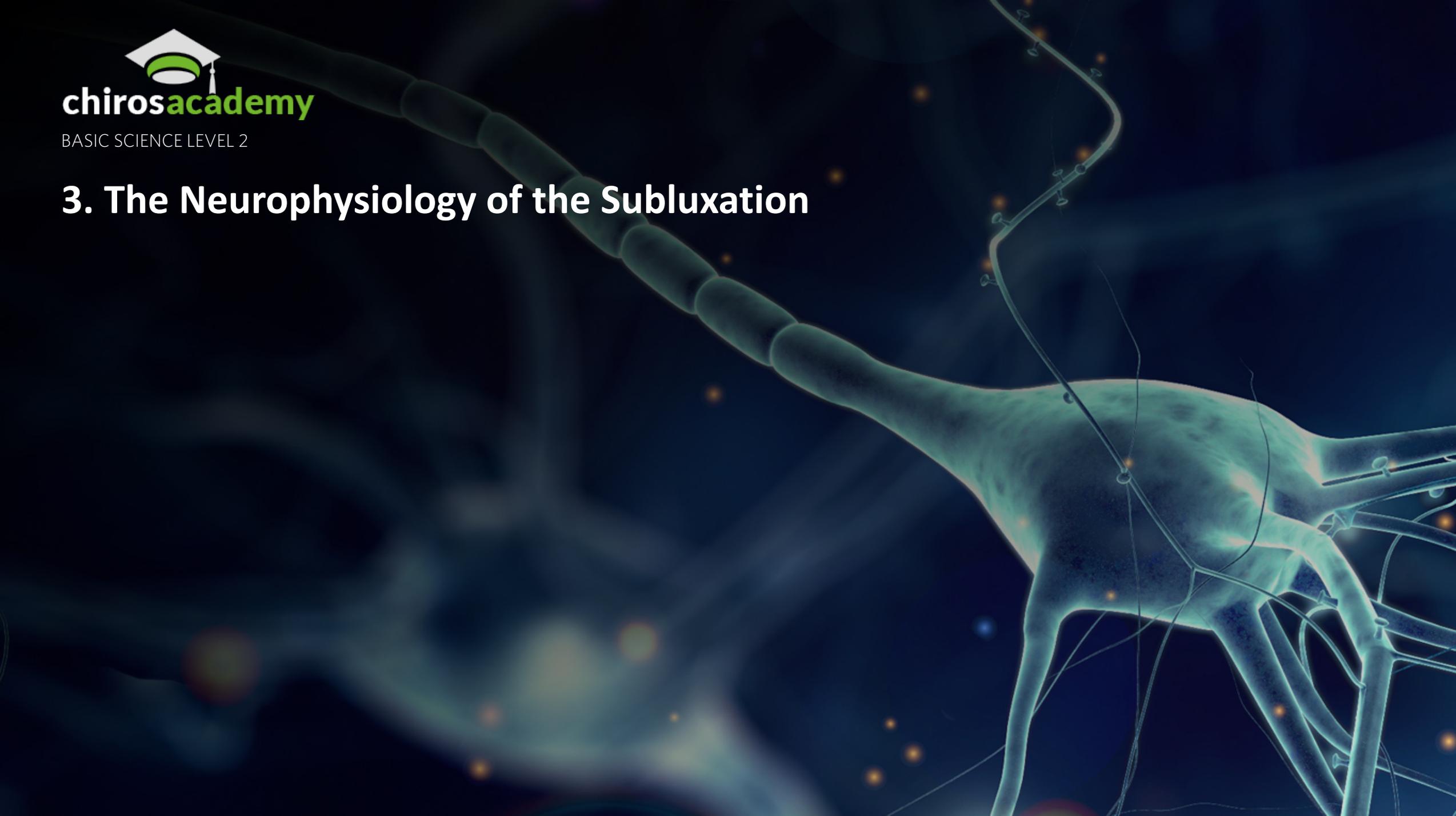


3. The Neurophysiology of the Subluxation



Outline

- The Chiropractic Subluxation: What it IS
- The neurophysiology of the vertebral subluxation
- How to communicate this with patients or the public who have neck pain
- How do we get subluxated?
- What are the neurophysiological consequences to spinal injury?
- What happens in the brain when we have spinal dysfunction?
- How to use the online resource library at www.therealitycheck.com to communicate this science and educate the public?



RUBICON

The Rubicon Group Model of Subluxation

“We currently define” indicates that this definition is subject to revision as new evidence evolves.

We acknowledge that the chiropractic use of the term subluxation differs from the medical/orthopedic use of the term.

Self-perpetuating, (as opposed to self-originating) implies a negative self-reinforcing cycle.

A central segmental control problem connotes that the central nervous system is not controlling the movement of the spinal segment as it should, as opposed to being exclusively a local motor control problem.

Inappropriate movement would be hypo-, hyper-, or movement inconsistent with function and need.

“We currently define a chiropractic subluxation as a self-perpetuating, central segmental motor control problem that involves a joint, such as a vertebral motion segment, that is not moving appropriately thereby yielding ongoing maladaptive neural plastic changes that interfere with the central nervous system’s ability to self-regulate, self-organize, adapt, repair and heal.” (The Rubicon Group, May 2017.)

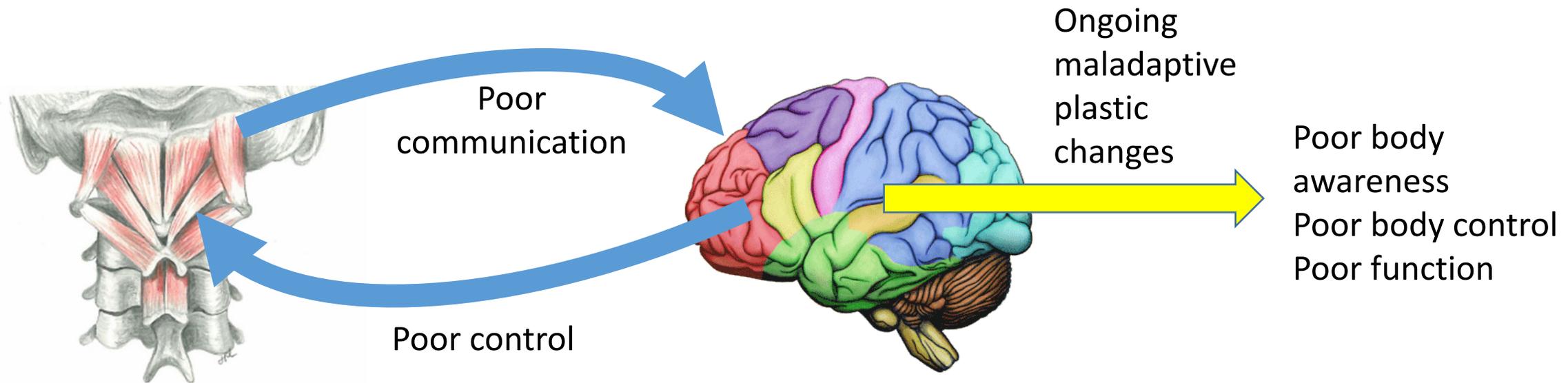
Ongoing, maladaptive, neural plastic changes reinforce the problem, adding to the self-perpetuating nature of the situation and providing corrupted input to the CNS about the state of the body.

The hallmark of the chiropractic subluxation is the confusion it creates within the CNS and how it causes the body to misinterpret itself and its status in the environment.

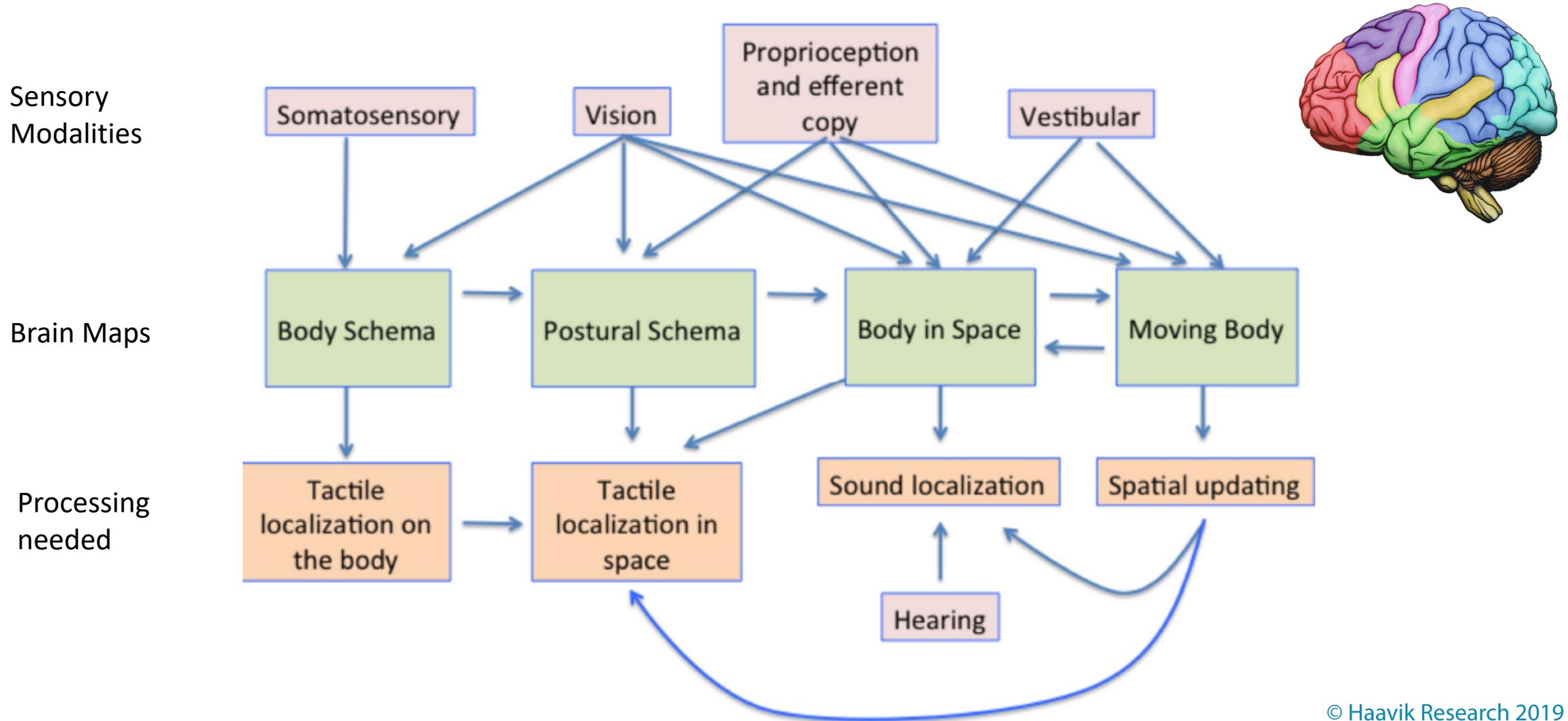
A chiropractic subluxation is most commonly associated with the spine but may also occur in other joints.

The Chiropractic Subluxation

- Neurophysiologically is a change in spinal segmental movement pattern
- Changes communication from deep paraspinal muscles to brain
- Causing ongoing maladaptive neural plastic changes



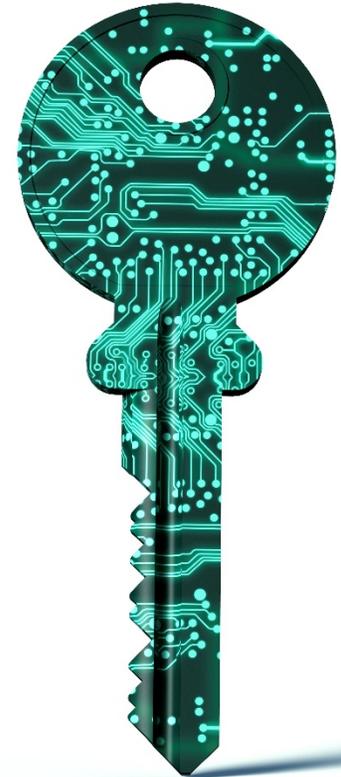
Multisensory Integration: Inner body and external world maps



© Haavik Research 2019

Adjustment improve spine-brain communication
which improves brains ability to know what is
going on in your body and the world around you

COMMUNICATION IS KEY



So what could cause an abnormal segmental movement pattern?



Trauma/injury



Stress

Biologically plausible mechanisms for how you get subluxated

STRESS (emotional, chemical or structural)

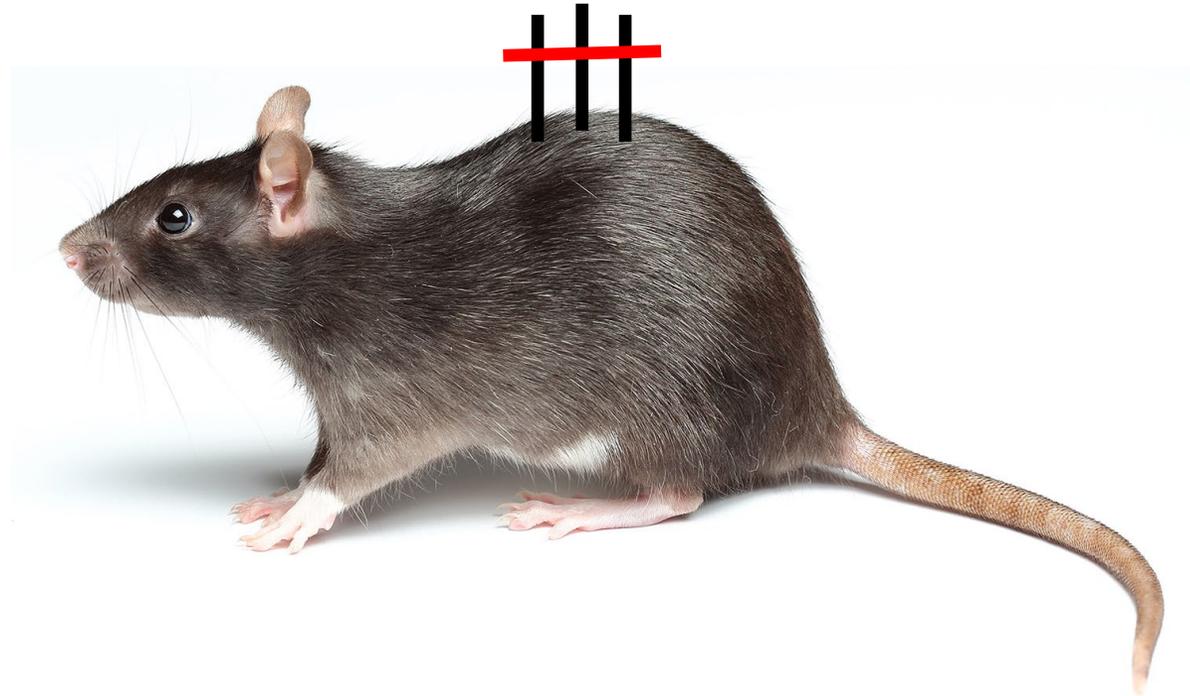
“However, if the long muscles are turned on, the shorter ones, for example the stabilizing muscles between vertebrae, ***go to sleep*** – there is no need for them if you are trying to avoid danger.”

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



So what do we know from research studies about what happens neurophysiologically when the spine is injured or not moving properly?

Spinal fixation causes hypo-mobility and DJD

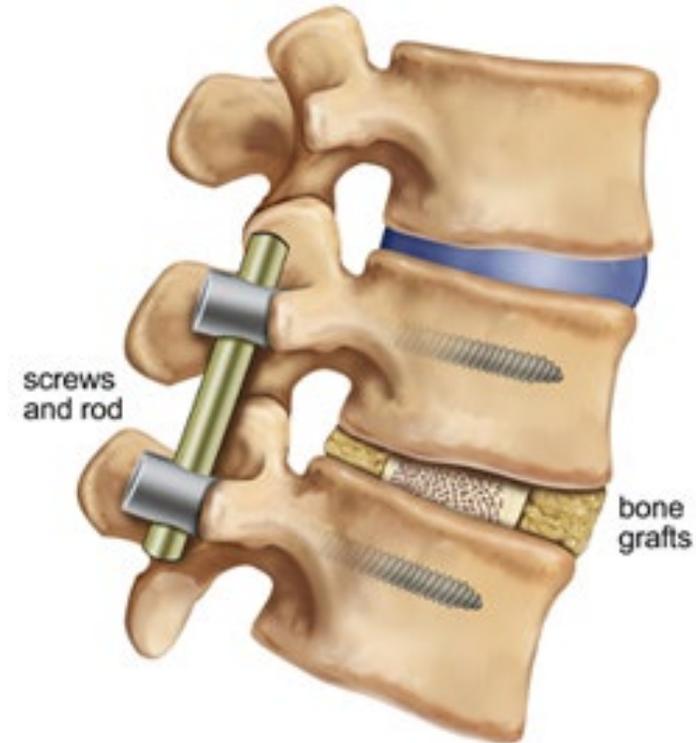


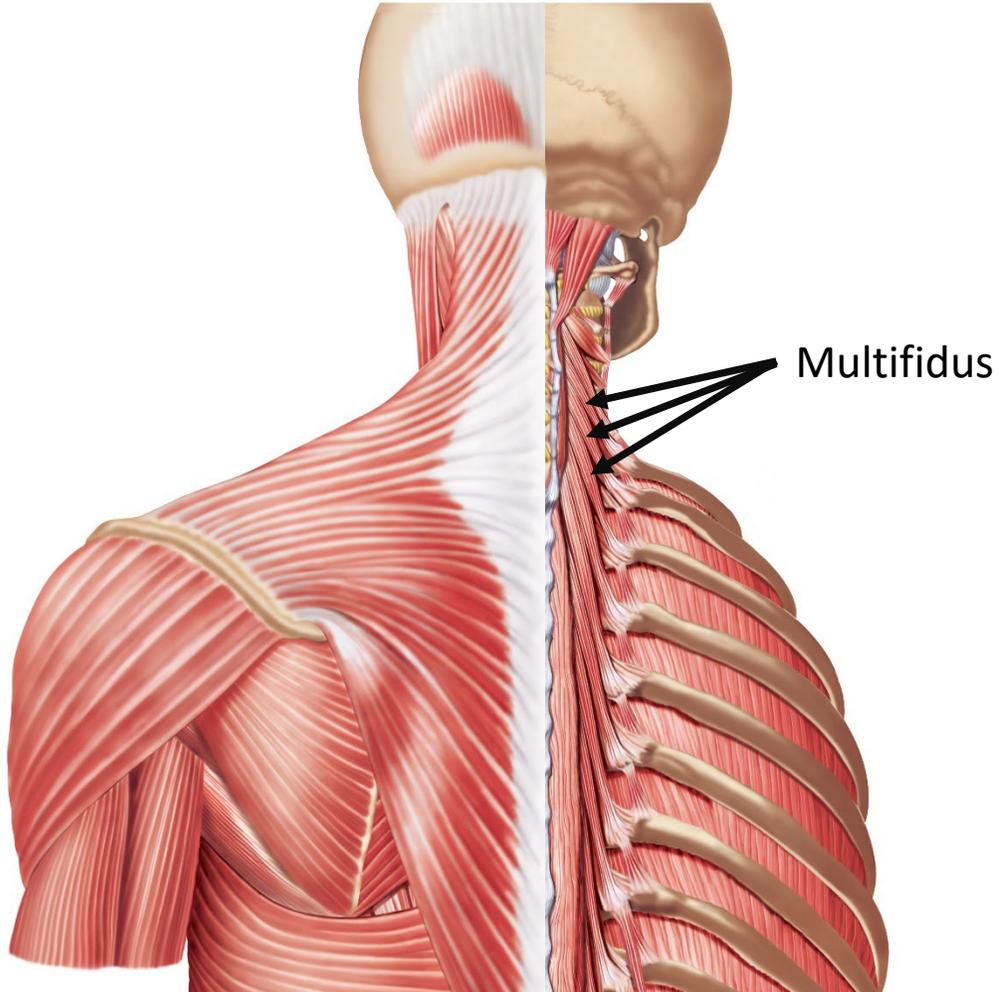
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Henderson CN. The basis for spinal manipulation: Chiropractic perspective of indications and theory. *J Electromyogr Kinesiol.* 2012. Henderson CN, Cramer GD, Zhang Q, DeVocht JW, Fournier JT. Introducing the external link model for studying spine fixation and misalignment: part 2, Biomechanical features. *J Manipulative Physiol Ther.* 2007;30(4):279-94. Cramer GD, Fournier JT, Henderson CN, Wolcott CC. Degenerative changes following spinal fixation in a small animal model. *Journal of Manipulative & Physiological Therapeutics.* 2004;27(3):141-54.

Increased rates of disc degeneration at levels adjacent to spinal fusion

- Over 25% of disc fusion patients end up with symptomatic adjacent segment disease
- Cadaver studies show disc fusion causes
 - Increased intra-discal pressure
 - Increased range of motion
 - At adjacent segments to fused segment





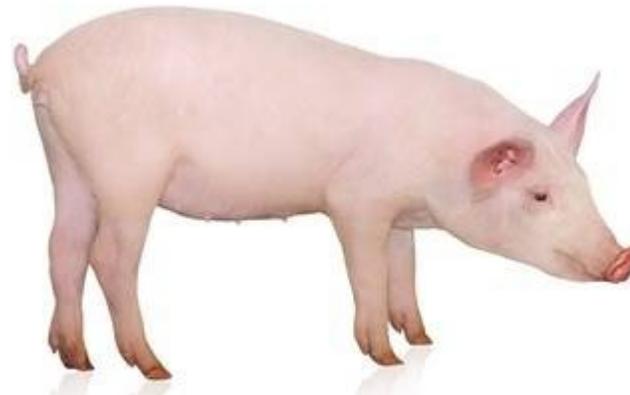
Intervertebral disk (IVD) lesion and its subsequent degeneration have a profound effect on the multifidus muscles

Acute (within 3 days) changes after IVD injury

Measured multifidus cross-sectional in 21 pigs from L1 to S1 with ultrasound

Multifidus undergoes rapid atrophy due to neural inhibition

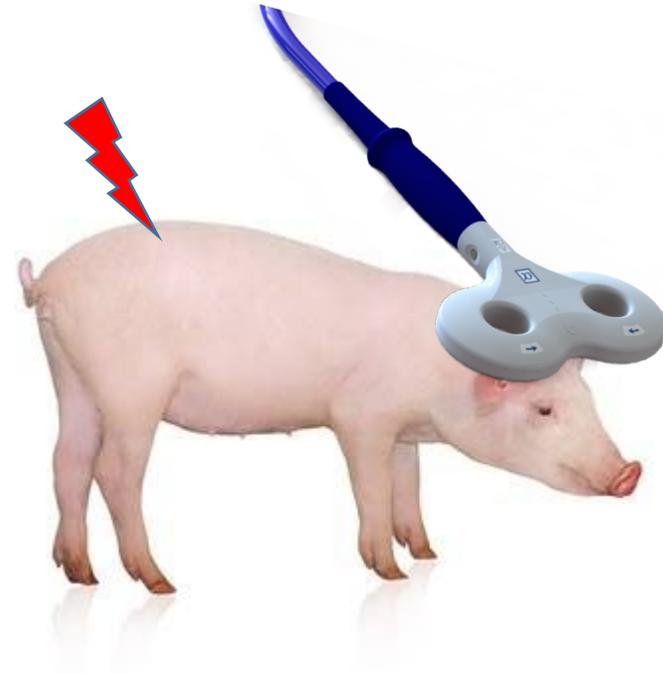
Can be localized to a single lumbar level



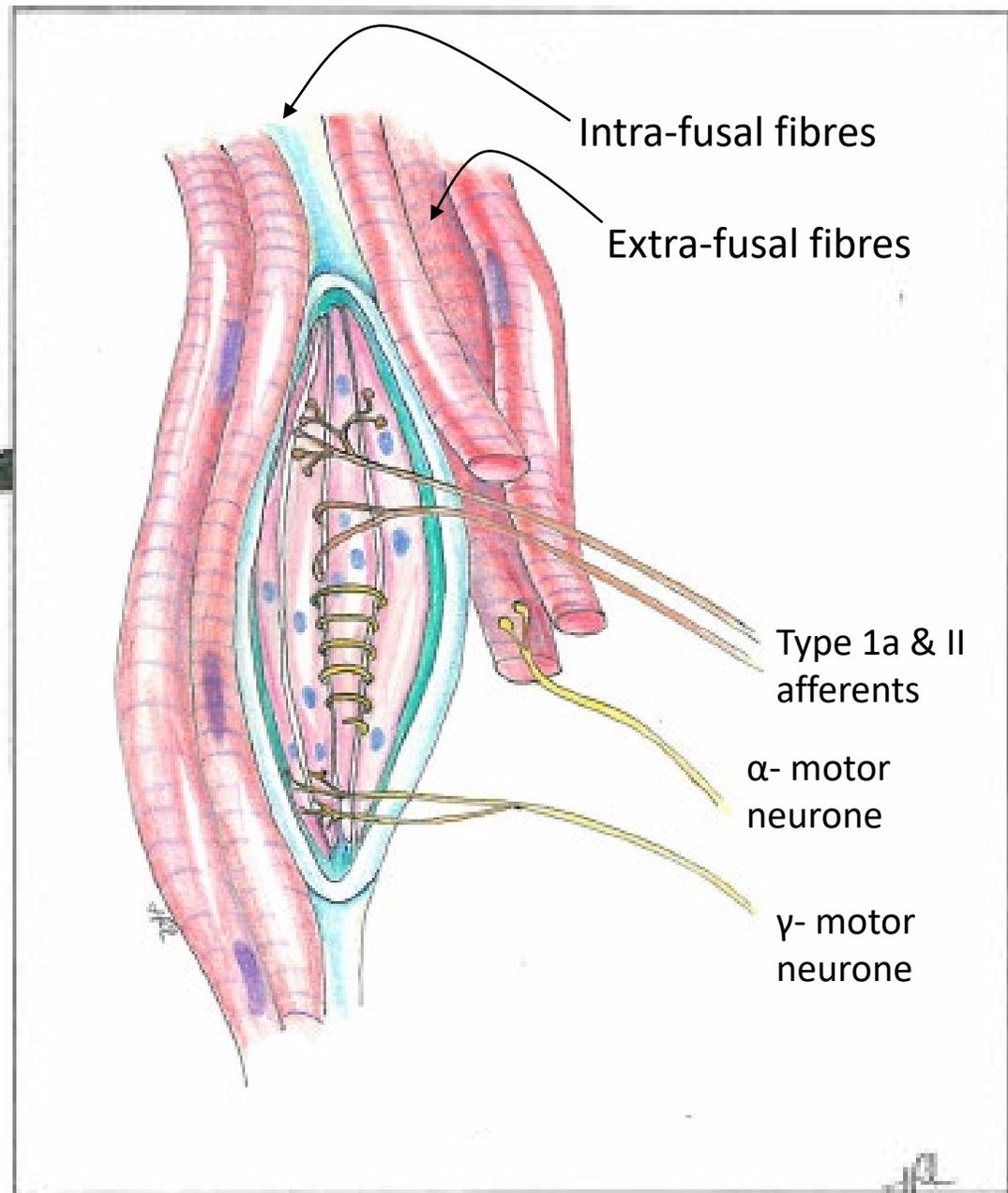
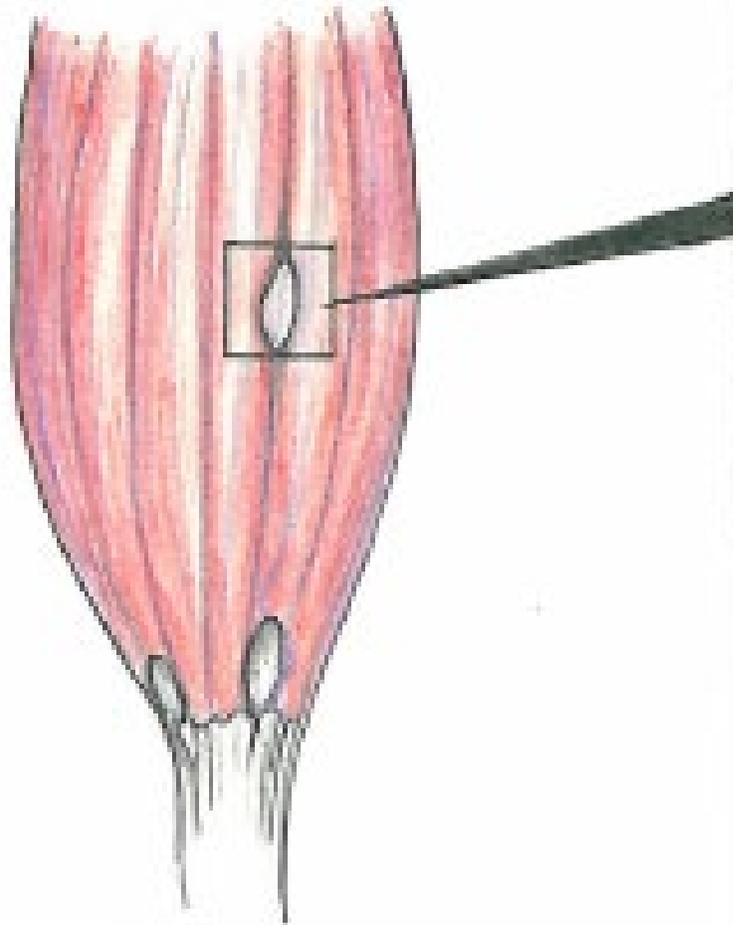
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Acute (within minutes) changes after IVD injury

Increased corticospinal
excitability to multifidus muscles
that cross injured IVD within 15
minutes after injury



MUSCLE SPINDLES



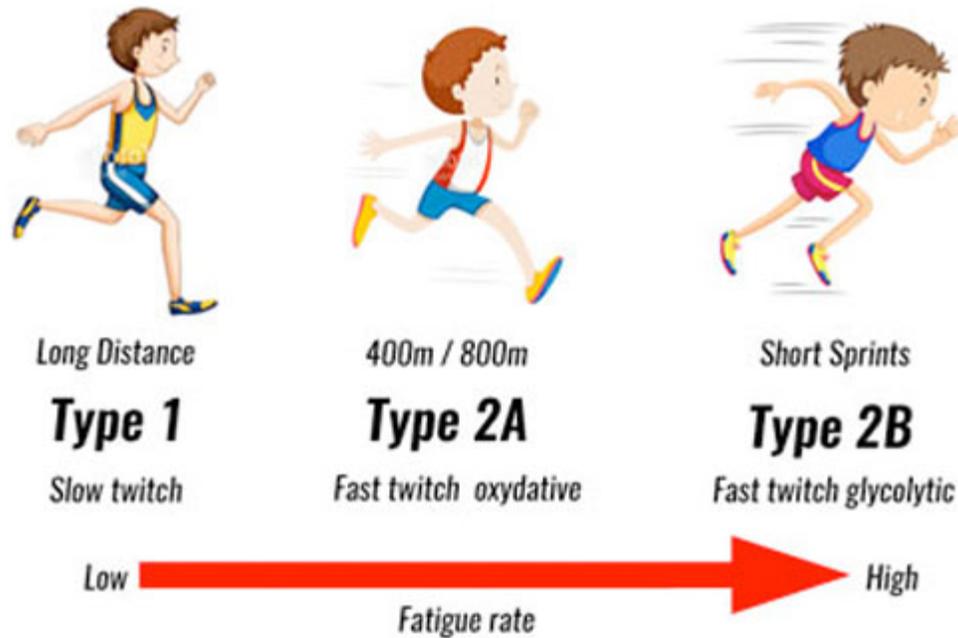
Subacute/early chronic period (3-6 months) changes after IVD injury

Multifidus becomes stiffer (Brown et al 2011)

No atrophy of multifidus muscle

Multifidus muscle fibrosis, fatty infiltration
and changes in muscle fiber types from
slow-to-fast twitch types





- Slow-twitch (Type I) fatigue resistant fibers, mainly tonic in activity and play a consistent postural role
- fast-twitch (Type II) fibers are active during rapid recruitment for short periods and provide the intersegmental stability of the spine during rapid/sudden movement and loading.

In human studies

- Early multifidus muscle atrophy has been shown in acute LBP (1-60 days after LBP onset) (Hides et al, 1994)
- Later fat infiltration can be found (Alaranta et al 1993; Fortin et al 2016; Kjaer et al 2007; Sun et al 2017)
- In herniated disc patients multifidus muscle atrophy is found (most were 12+months) (Zhao et al 2000)



Hides et al (1994). Evidence of lumbar multifidus muscle wasting ipsilateral to symptoms in patients with acute/subacute low back pain. *Spine (Phila Pa 1976)*, 19(2), 165-172; Alaranta et al (1993). Fat content of lumbar extensor muscles and low back disability: a radiographic and clinical comparison. *Journal of Spinal Disorders*, 6(2), 137-140; Kjaer et al (2007). Are MRI-defined fat infiltrations in the multifidus muscles associated with low back pain? *BMC Med*, 5, 2. doi:10.1186/1741-7015-5-2; Sun, D., Liu, P., Cheng, J., Ma, Z., Liu, J., & Qin, T. (2017). Correlation between intervertebral disc degeneration, paraspinal muscle atrophy, and lumbar facet joints degeneration in patients with lumbar disc herniation. *BMC Musculoskelet Disord*, 18(1), 167.; Zhao et al (2000). Histochemistry and morphology of the multifidus muscle in lumbar disc herniation: comparative study between diseased and normal sides. *Spine (Phila Pa 1976)*, 25(17), 2191-2199.

ACUTE PERIOD

SUBACUTE/EARLY
CRONIC PERIOD

CHRONIC PERIOD

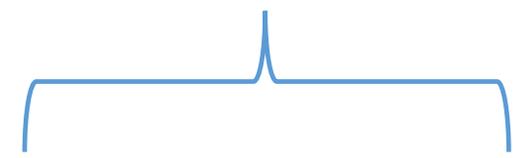
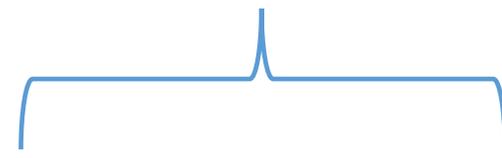
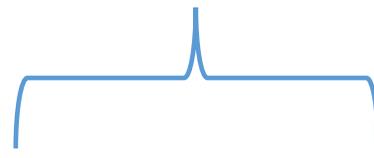
Injury happens

MINUTES

DAYS

3-6 months

12 months +



Increased corticospinal drive to Multifidus

Localised Multifidus atrophy due to neural inhibition

Multifidus muscle fibrosis

Fatty infiltration

Slow-to-fast twitch fiber type change

Hypomobility
DJD around joint

Multifidus atrophy

TIME

Why is all this important to understand?

Review

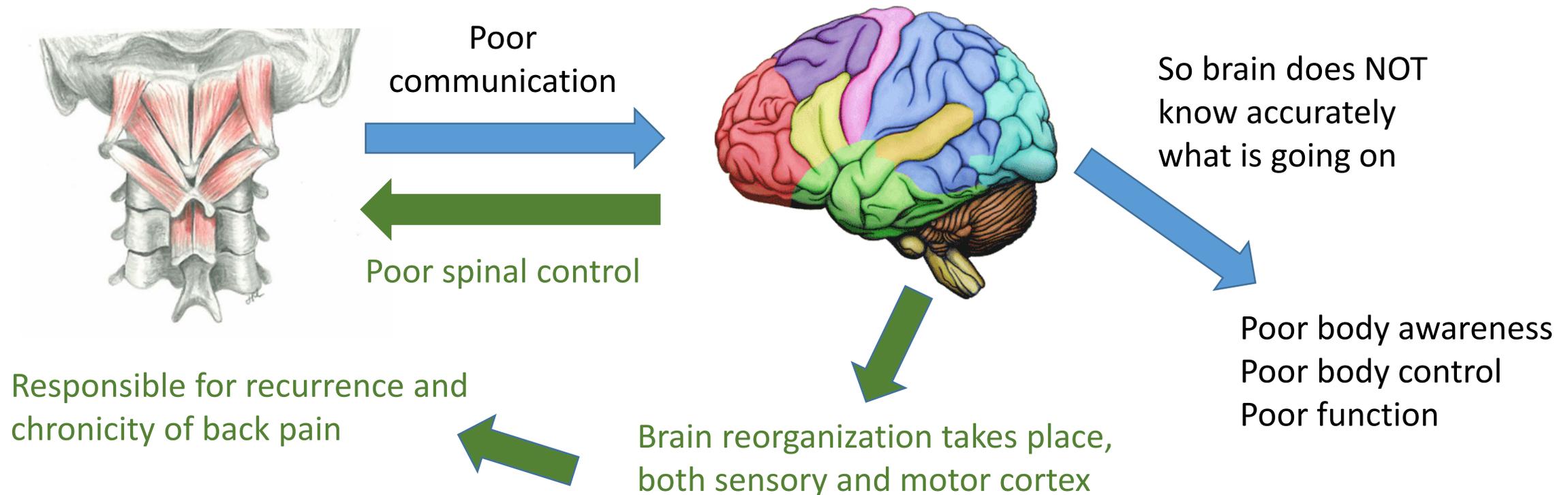
The Neuroscientist
1-14

Low Back Pain: The Potential

Abstract

Motor control, which relies on constant communication between motor and sensory systems, is crucial for spine posture, stability and movement. Adaptions 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.

- Neurophysiologically is a change in spinal segmental movement pattern
- Changes communication from deep paraspinal muscles to brain
- Causing ongoing 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.

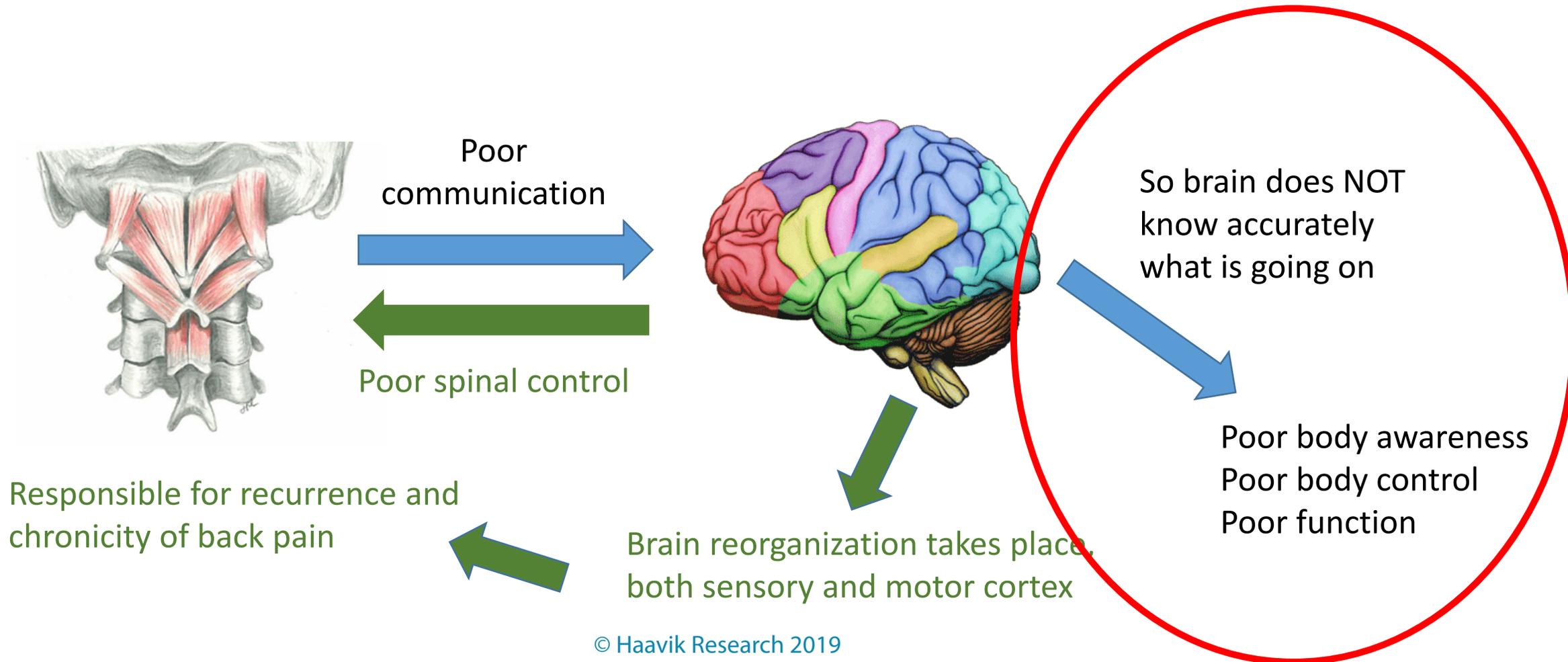
Keywords: Musculoskeletal disorders, Chronic low back pain, Osteoarthritis, Neuroplasticity, Periaqueductal grey, Rostral ventromedial medulla, Rehabilitation, Primary somatosensory cortex, Primary motor cortex, Limbic, Pre-frontal, Pain

Pain may fully or partially be in the brain

Pain may be coming from here more than from here



So what are the effects of spinal dysfunction on the brain?



Why are these functions important?



But do we know for sure we reduce car accident?

A person comes in and you discover they have recurring mild ache pain or tension in their spine...

What MIGHT be going on for this person:	How MIGHT this be expressed for this person ? What questions could you ask?
Poor shoulder proprioception	Might bump into things
Poor elbow proprioception	Might knock elbow on door frames
Poor multimodal integration of sound and visual information	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
Poor arm movements	May be clumsy, miss objects they are trying to grasp, put cup down so falls off table (as missed table edge), etc
Poor cerebellar-cortex communication	Clumsiness, poor motor learning, struggling to learn instrument, sport, work tasks, shaky, poor fine motor control,
Neck muscle fatigue	Gets sore neck, feels head is too heavy for their body, needs to rest often

COMMUNICATION IS KEY





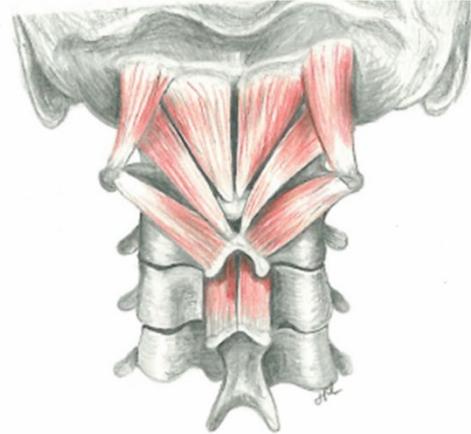
Stress

OR

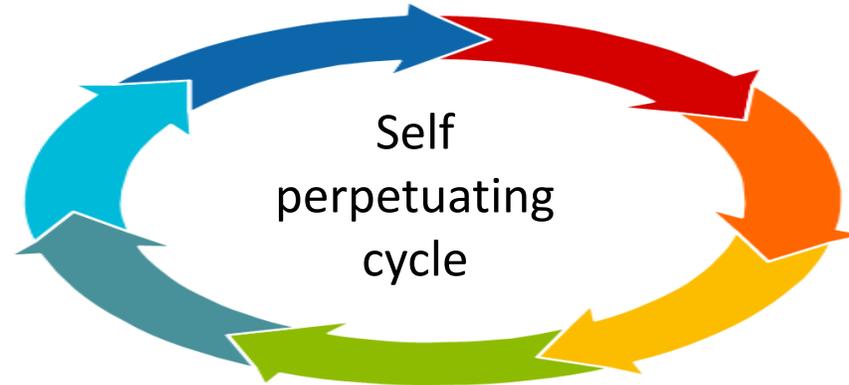


Injury

Small muscles closest to spine and skull go to sleep



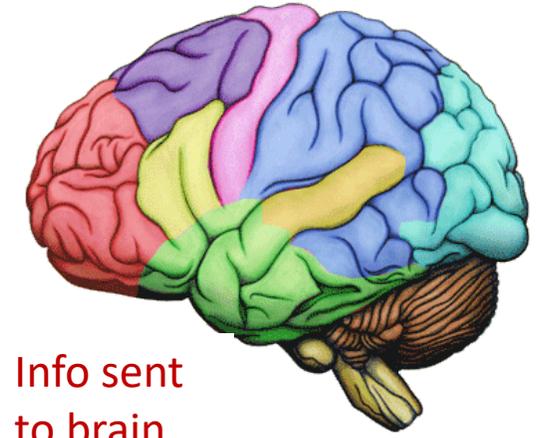
Poor body awareness
Poor body control
Poor function



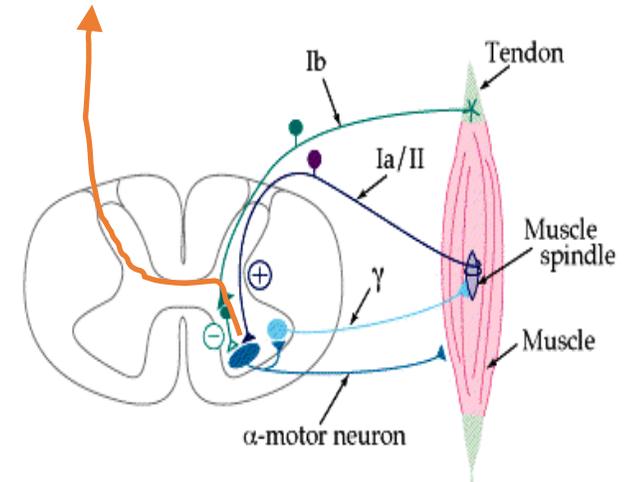
So brain does NOT know accurately what is going on



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



Info sent to brain



Altered messages going to brain from spine

Thank You



DR. HEIDI HAAVIK

ENLIGHTENING THE
WORLD ABOUT THE
SCIENCE OF CHIROPRACTIC



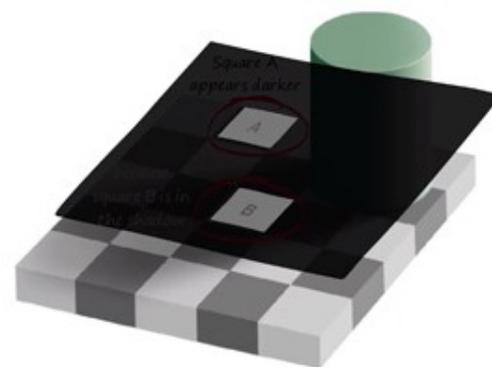
Introduction to Chiropractic Care

The introduction to chiropractic video series is the perfect way to gain an understanding of why chiropractic care may help you and your family.



The Beginners Guide to Chiropractic

In this first introductory video we explore what chiropractic is all about, and how it works, then we briefly explore the evidence informed effects of chiropractic care.

[View video >](#)

How the Brain Perceives the World

Did you know that your brain and central nervous system are constantly changing? It's quite amazing - from one day to the next your brain is not the same.

[View video >](#)

The Beginners Guide to Chiropractic

The Beginners Guide to Chiropractic

The word chiropractic derives from the Greek words "cheir", meaning hand, and "praktikos" meaning skilled in or concerned with. The origin of the word chiropractic can be traced back to [D.D. Palmer](#) who coined it in 1895 when he founded chiropractic.

Chiropractic care is really about total health and wellbeing

What does a Chiropractor do?

A chiropractor is a healthcare professional who specializes in the health and [function of the spine](#) and nervous system. Because of this focus on the spine, many people think chiropractors can only help with problems such as [back pain](#), [neck pain](#) and [headaches](#). They can often help with these issues but there is much more to chiropractic than just pain.

This is the first video in our animated series "Introduction to Chiropractic". In this video, we outline what a chiropractor does, then we briefly explore the effects of care. It is a perfect one to watch for anyone that is curious about chiropractic care, and how it can help their family.

Video References

1. Rosner AL. Chiropractic Identity: A Neurological, Professional, and Political Assessment. *J Chiropr Humanit* 2016;23(1):35-45.
2. de Souza R, Ebrall P. Understanding wellness in a contemporary context of chiropractic practice. *Chiropr J Aust* 2008;38(1):12-16.
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5. Haavik H, Murphy B. The role of spinal manipulation in addressing disordered sensorimotor integration and altered motor control. *J Electromyogr Kinesiol* 2012;22(5):768-76.
6. Haavik Taylor H, Holt K, Murphy B. Exploring the neuromodulatory effects of the vertebral subluxation and chiropractic care. *Chiropr J Aust* 2010;40(1):37-44.
7. Herzog W, Zhang YT, Conway PJ, et al. Cavitation sounds during spinal manipulative treatments. *Journal of Manipulative & Physiological Therapeutics* 1993;16(8):523-6.

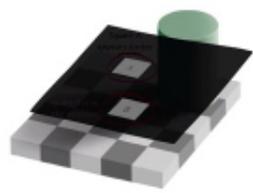




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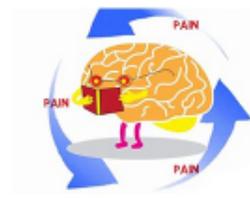
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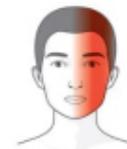
[View video >](#)



Break the Pain Cycle

Did you know that pain is created in your brain to let you know that something is not ok within your body? Feeling pain is good because it is actually helpful and informative.

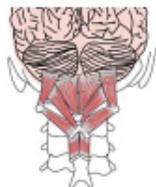
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Chiropractic Care and Migraines

Did you know that 1 in 6 people in the world experience migraines regularly? The World Health Organisation consider them to be the most debilitating of all neurological disorders.

[View video >](#)



Chiropractic Affects your Brain

Your brain receives information about your body from the environment and your organs. Did you know that the muscles in your body are also sensory organs?

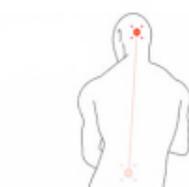
[View video >](#)



What is that Pop?

If you have been adjusted before by a chiropractor you may have noticed a strange popping sound. Don't worry - it is just the formation of gas within a joint.

[View video >](#)



Lower Back Pain

Scientists have worked out that at any one time, over 500,000,000 people around the world are suffering from low back pain and it is now the leading cause of disability worldwide.

[View video >](#)



Growing Pains

We've all heard of growing pains right? But did you know that what we call growing pains aren't associated with growing? So they're not actually growing pains at all.

[View video >](#)



Pain and the Immune System

Research studies have shown that the way you feel pain all depends on what's going on for you - and most importantly - what you think and feel about the situation.

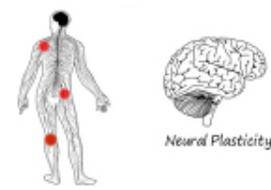
[View video >](#)



Chiropractic and Headaches

Headaches are a sign that something is not right. Your brain will create for you the sensation of pain if it thinks there is something wrong or if there is a potential problem.

[View video >](#)



Pain is Created in Your Brain

Did you know that the scientists now know that the feeling of pain is something your brain decides that you should experience - if it believes that there is a problem?

[View video >](#)



Chronic Pain

Chronic pain is the second-most common reason people see a doctor and miss work. More than one-third of people with chronic pain become disabled by their pain to some degree.

[View video >](#)

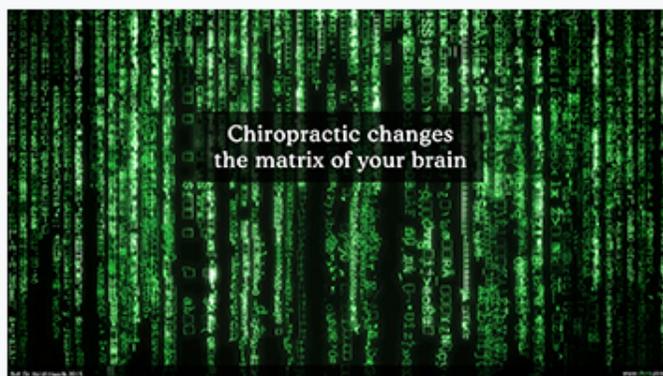
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To download the digital assets, simply click on the corresponding button below the image.

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 Screensaver Image

 Facebook

 Instagram

 A4 Print

 A3 Poster

3.



 Screensaver Image

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 Instagram

 A4 Print

 A3 Poster

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Bilder med høy oppløsning, A4-trykte brosjyrer og plakater i A3-størrelse som du kan laste ned og dele.



For å laste ned de digitale eiendelene, klikker du bare på den aktuelle knappen under bildet.

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 A4-utskrift  A3-plakat

2.



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 A4-utskrift  A3-plakat

3.



 Bilde  Facebook  Instagram

 A4-utskrift  A3-plakat

Chiropractic Research

Research summary articles to read, download and print (members only) all backed by the latest scientific research studies.



Chronic Pain

Chronic pain that has persisted for more than 3 months is no longer protective, nor informative. So, what is chronic pain and what can you do about it?

[Read more »](#)

Pain is in the Brain

Sometimes pain persists long after tissue damage has actually healed. When pain persists for more than three months we call this chronic pain.

[Read more »](#)

Neck Pain

Up to half the world's population suffers from neck pain at some stage. For some, one big problem is that it just keeps coming back, or becomes chronic.

[Read more »](#)



UNDERSTANDING PAIN



Dr. Kelly Holt

BSc, BSc(Chiro), PGDipHSc, PhD

Dr. Heidi Haavik

BSc(Physiol), BSc(Chiro) PhD

Experiencing pain is normal. Everyone experiences pain now and then.¹ Pain is supposed to be protective to make you stop doing things that may be dangerous.² But chronic pain that has persisted for more than 3 months is no longer protective, nor is it informative.³ So, what is chronic pain and what should you do about it if you suffer from it?

PAIN IS CREATED IN THE BRAIN



Dr. Kelly Holt

BSc, BSc(Chiro), PGDipHSc, PhD

Dr. Heidi Haavik

BSc(Physiol), BSc(Chiro) PhD

Did you know that scientists now know the feeling of pain is something your brain decides you should experience if it believes there is some tissue damage in your body?¹ In fact, your brain can decide that you should feel pain even if it only thinks there is a potential threat of tissue damage!!!²⁻⁵

It may seem strange, but it's totally up to your brain to decide whether you should feel pain or not. Your brain may decide you should experience pain even if you have no actual tissue damage yet,⁶ or your brain may not create the feeling of pain for you when tissue damage has actually occurred!^{7,8}

heals the problem.¹ This pain is helpful and informative.¹ If we listen to our body these pain experiences can be a good thing.

But for some people, pain can persist even after the initial injury that caused it has healed.^{9,11,12} And for some people, the pain in areas that are not injured at all, become non-



brain danger that tissue are ill,



types of pain is the 100% of the time, not mean it's not itself is created in you can get rid of on what you think important you u

Your pain experience is decided by creating the ce.⁵ It can

NECK PAIN AND FALLS RISK



Dr. Kelly Holt

BSc, BSc(Chiro), PGDipHSc, PhD

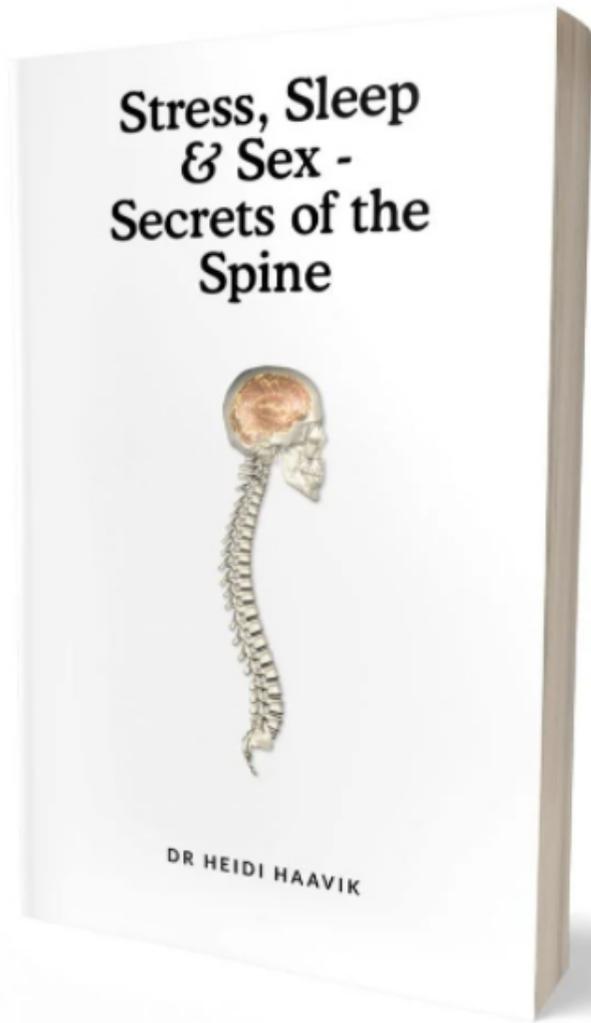
Dr. Heidi Haavik

BSc(Physiol), BSc(Chiro) PhD

Neck pain is very common throughout the world.¹ Up to half of all people around the world suffer from neck pain at some stage each year.²⁻⁵ For some people, one big problem with neck pain is that it just keeps coming back, or becomes chronic, and may even increase their risk of suffering from a fall.^{2,4,6,7}

Scientists know that your brain uses sensory information from your muscles and joints around your spine to help control your balance and posture and to make sure you're moving properly.^{1,2} When your brain takes sensory information and uses it to help guide movements and control muscles we call this sensorimotor function.⁸ One particular study looked at whether neck pain has an impact on proper sensorimotor function in older people.⁷ In this study, the researchers ran a whole lot of tests of sensorimotor function, like how well the study participants controlled the movement of their eyes and how good their balance was, and they took into account their age and other conditions that they suffered from.





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