



# *Heidi's Platinum RoundTable*

## *March 2026*



**Heidi Haavik** BSc (chiropractic), PhD  
VP Research, Dean Research  
New Zealand College of Chiropractic

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## Welcome to New Platinum Members!!



- Your resources:
  - Chiroshub – for patients 
  - ChiroAcademy – for chiros 
  - LearningHub – for CAs 

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# Platinum Member on ChiroHub

- The Platinum Member also has a dedicated platinum member site on ChiroHub.com
- Next life workshop countdown
- Question for Heidi
- Next workshop link
- Prefrontal cortex poster
- Cerebellum poster

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# Outline

- <https://chirosacademy.com/the-new-brain-model-2024/>

Dec 2024 Topic  
How I present this latest science to other health care providers

Feb 2025 Topic  
How I present this latest science to the lay public

April 2025 Topic is how to explain the chiro-neuro-immune connection according to the brain model

June 2025 How, according to brain model, can chiro care impact organ function

Aug 2025 How, according to brain model, can chiro care impact anxiety & depression

Oct 2025 Chiropractic and Sports Performance

Recorded Live Zoom Sessions

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## Outline Level 1- The Brain Model of Chiropractic



ALL ONLINE

- 20 Steps for chiros
  - <https://chirosacademy.com/the-new-brain-model-2024/>
- 13 Steps for CAs
  - <https://chirolearninghub.com/enlighten-practice-members-2024/>

Plus LIVE DC workshops roughly every second months

- covers live Q&A plus a topic

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## Any Questions Regarding Membership?

Dave Woodard



[support@chiroshub.com](mailto:support@chiroshub.com)

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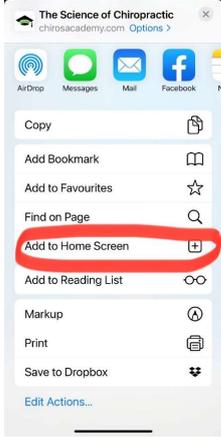
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On your smart phone click on Safari and type in ChirosAcademy.com



Click on the up arrow

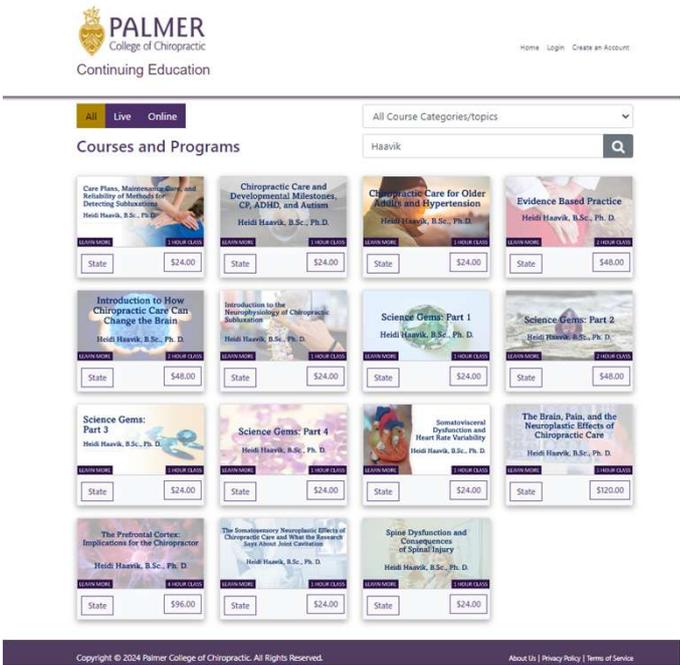


Click on 'Add to Home Screen'



ChirosAcademy will now appear as an App on your phone!

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If anyone requires USA CE credits

- Go to Palmer College Continuing Education Online Courses
- <https://palmerce.learningexpressce.com/index.cfm?eventTypeID=0&categoryID=&q=Haavik>

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**PALMER**  
College of Chiropractic  
Continuing Education

Home Login Create an Account

### Care Plans, Maintenance Care, and Reliability of Methods for Detecting Subluxations

Cost: \$24.00    Take This Course    State Approvals

In this one-hour course, Dr. Heidi Haavik will examine the evidence for chiropractic care plans and maintenance care different ways chiropractors test for subluxations and the evidence pertaining to reliability of those methods.

- Module 1
- Module 2
- Module 3
- Module 4
- Module 5
- Module 6
- Course Completion
- Course Information

Purchase Now

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Check here for which states have approved each class

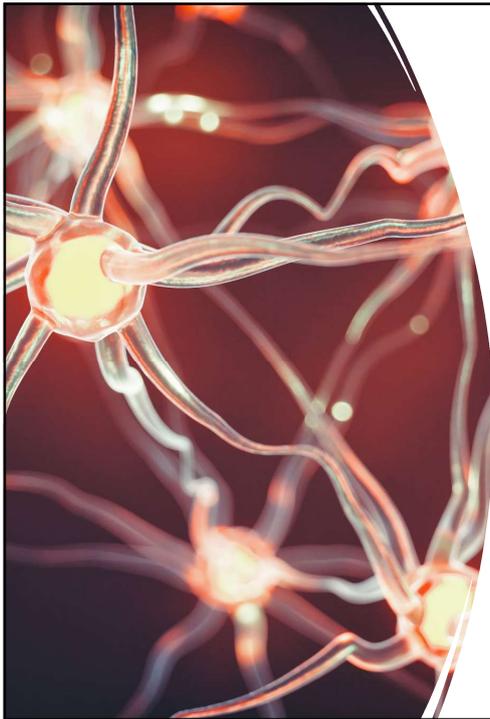
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## Outline Level 2- Neuro Integration

- BLOCK 1 Foundations: How the Nervous System Signals and Adapts
- BLOCK 2 From Signal to Perception: How the Brain Interprets Input
- BLOCK 3 Adaptation & Regulation: How Change Becomes Lasting
- BLOCK 4 From Sensation to Movement: Output Matters
- BLOCK 5 Protection, Pain & Integration: Making Sense of Complexity

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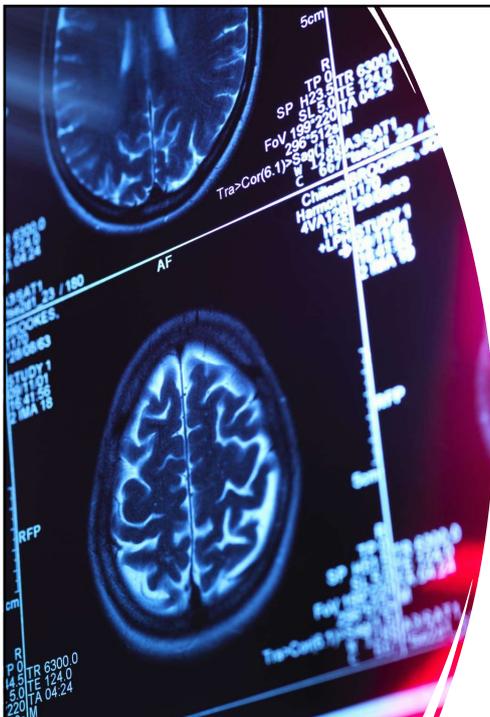


## 20 May – LIVE SESSION 1

- **The Language of the Nervous System**
- **How neural signalling, load, and timing shape adaptation**
- **Clinical focus**
  - Why some patients respond quickly and others slowly
  - Why flare-ups happen
  - What neural signalling tells us about care pacing
  - Establishing a shared neurological language

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## 16 July – LIVE SESSION 2

- **From Input to Experience**
- **Why symptoms, pain, and performance don't map neatly to tissue**
- **Clinical focus**
  - Perception versus structure
  - Why context, safety, and expectation matter
  - Why two patients with the same findings feel very different
  - How chiropractic input fits into sensory interpretation (without overclaiming)
  - Playful brain anatomy orientation

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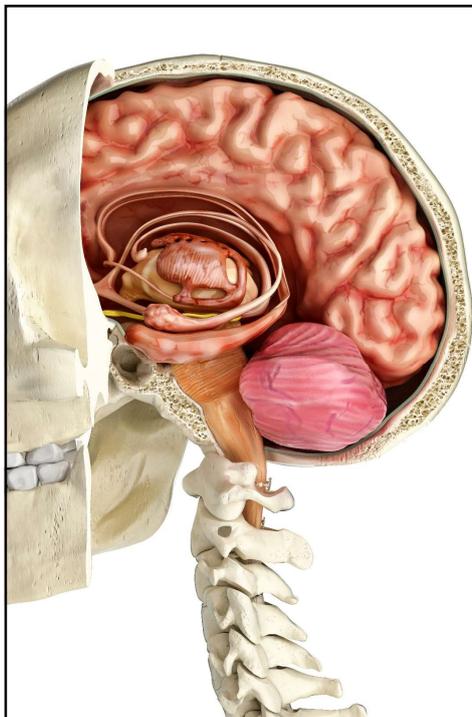


## 23 Sept – LIVE SESSION 3

- **When Change Becomes Stable**
- **Why function, confidence, and coordination often improve before pain**
- **Clinical focus**
  - Changes in coordination, clarity, confidence, and effort
  - Why patients say “I just feel better” before symptoms change
  - Cerebellar and prefrontal contributions to adaptability
  - How this aligns with common chiropractic clinical observations

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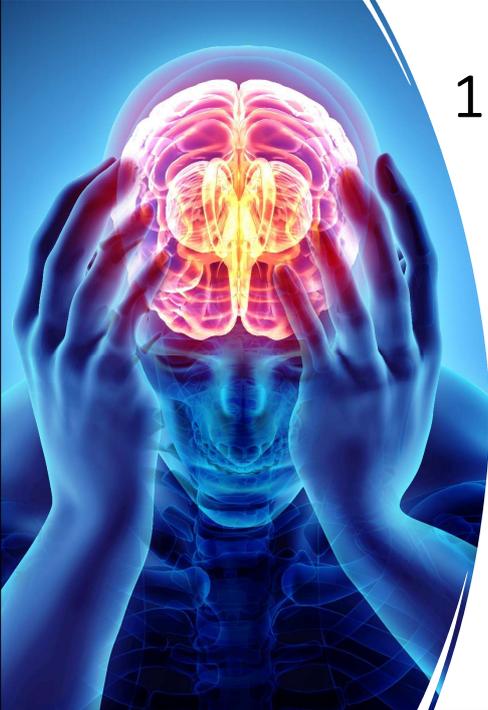


## 12 Nov – LIVE SESSION 4

- **A Deep Dive into the Subluxation**
- **Why better movement changes the brain**
- **Clinical focus**
  - Proprioception as a driver of regulation and how subluxations alter this
  - Why movement confidence matters and how this changes with ageing
  - Reflexes, coordination, and spinal input
  - Clinical reasoning around movement, adjustment, or both

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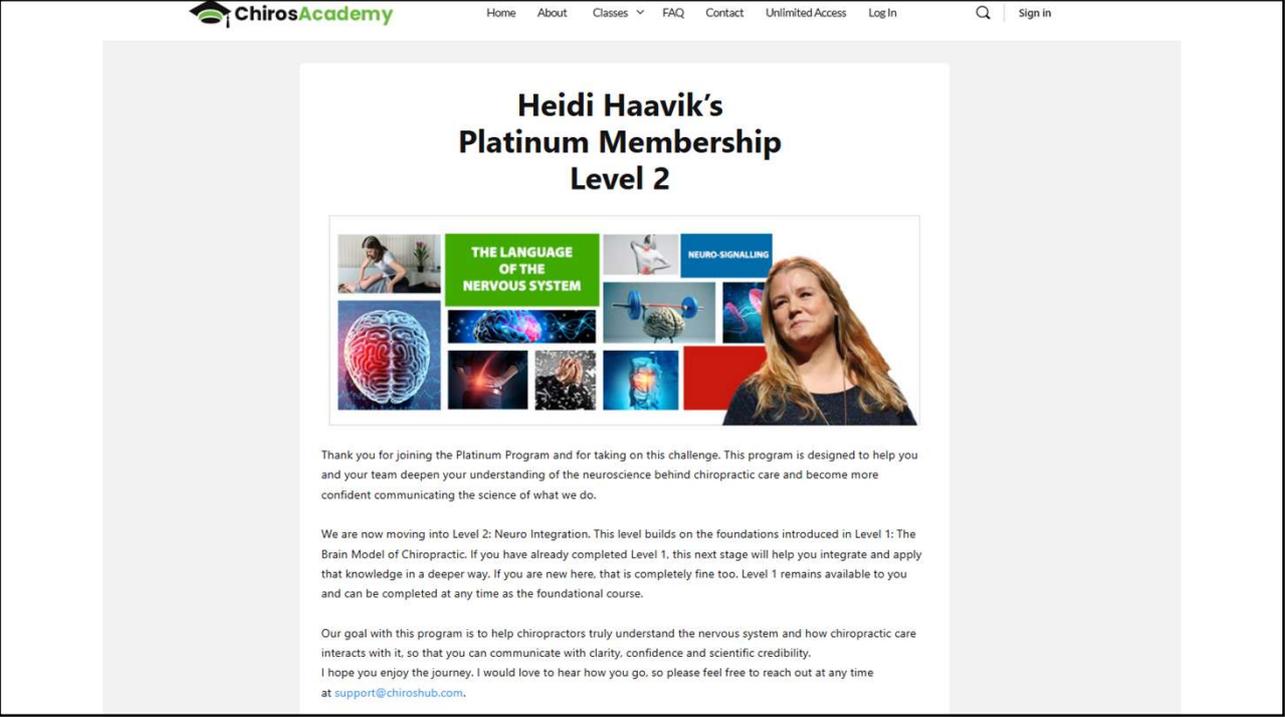


## 11 Feb 2027 – LIVE SESSION 5

- **A Neuro-Informed Chiropractic Model That Makes Sense**
- **Clinical focus**
  - How subluxation can be discussed using modern neuroscience language
  - Helping chiropractors speak confidently with patients and peers
  - Integrating nervous system, movement, pain, and adaptation into a coherent clinical model

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### Heidi Haavik's Platinum Membership Level 2

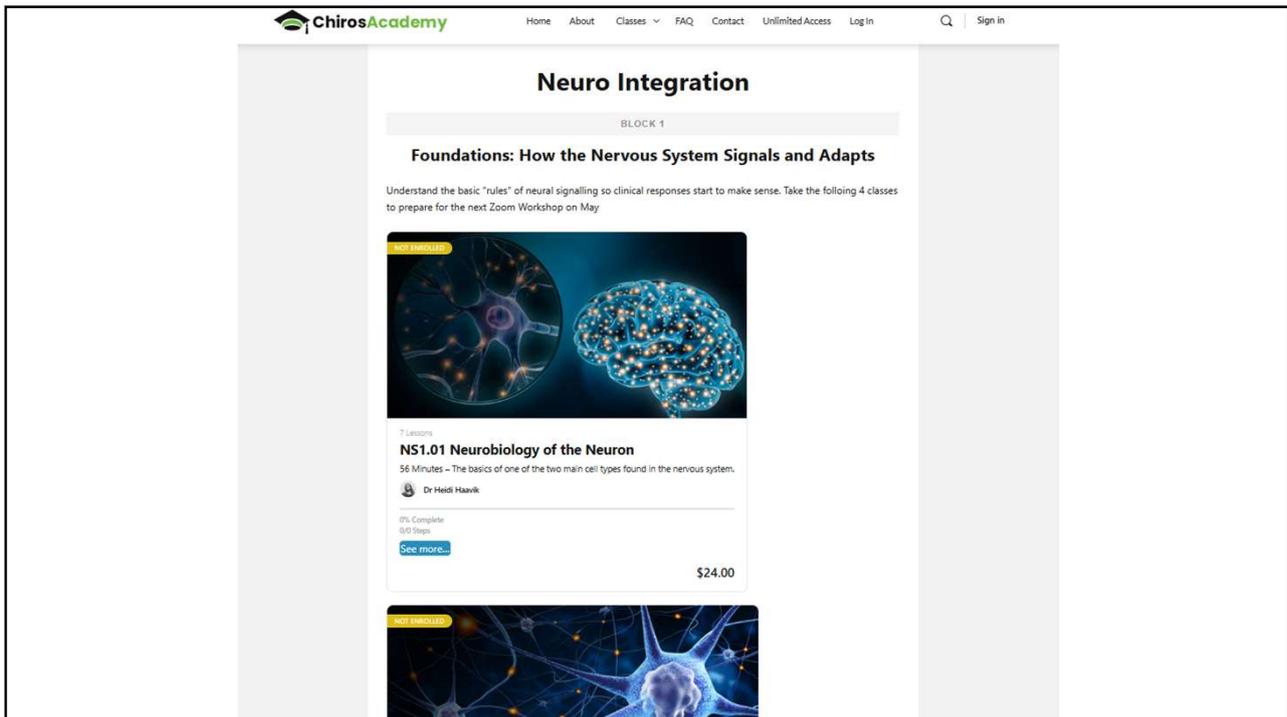


Thank you for joining the Platinum Program and for taking on this challenge. This program is designed to help you and your team deepen your understanding of the neuroscience behind chiropractic care and become more confident communicating the science of what we do.

We are now moving into Level 2: Neuro Integration. This level builds on the foundations introduced in Level 1: The Brain Model of Chiropractic. If you have already completed Level 1, this next stage will help you integrate and apply that knowledge in a deeper way. If you are new here, that is completely fine too. Level 1 remains available to you and can be completed at any time as the foundational course.

Our goal with this program is to help chiropractors truly understand the nervous system and how chiropractic care interacts with it, so that you can communicate with clarity, confidence and scientific credibility. I hope you enjoy the journey. I would love to hear how you go, so please feel free to reach out at any time at [support@chiroshub.com](mailto:support@chiroshub.com).

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## Neuro Integration

BLOCK 1

### Foundations: How the Nervous System Signals and Adapts

Understand the basic "rules" of neural signalling so clinical responses start to make sense. Take the following 4 classes to prepare for the next Zoom Workshop on May

7 Lessons

#### NS1.01 Neurobiology of the Neuron

56 Minutes – The basics of one of the two main cell types found in the nervous system.

Dr Heidi Haavik

0% Complete  
0/0 Steps

See more...

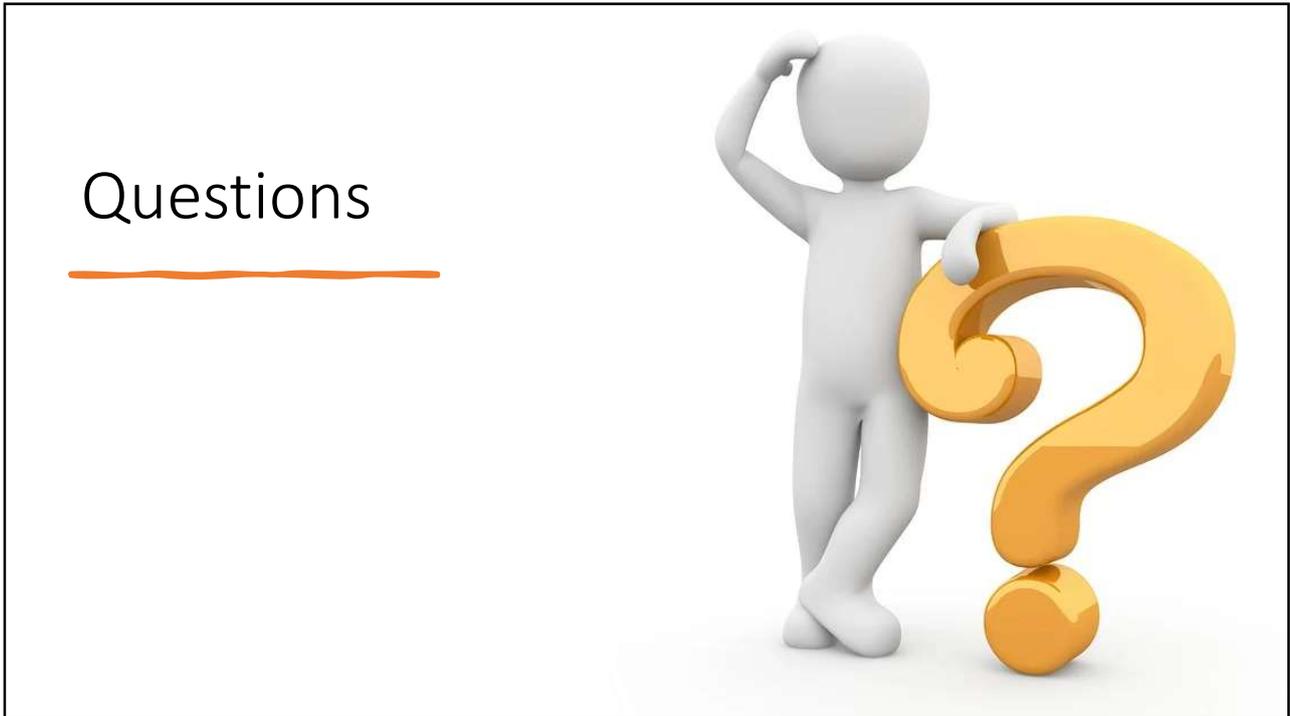
\$24.00

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<https://chirosacademy.com/neuro-integration/>

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*How might Chiropractic Care Enhance Sports Performance and Prevent Injuries?*

**Heidi Haavik** BSc (chiropractic), PhD  
VP Research, Dean Research  
New Zealand College of Chiropractic

The slide has a black background. In the top left corner is a green, stylized dragon logo. In the center, a glowing blue brain is held in two hands. In the bottom right corner is a cartoon illustration of a Viking character wearing a horned helmet and holding a sword. The title text is in yellow italics, and the presenter's name and credentials are in yellow.

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Chiropractic  
& Sport  
Topic

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Can Chiropractic Care Enhance Sports Performance? (We covered this in October) **Clinical Research**

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How might chiropractic care enhance sports performance or prevent injuries? **Basic Science**

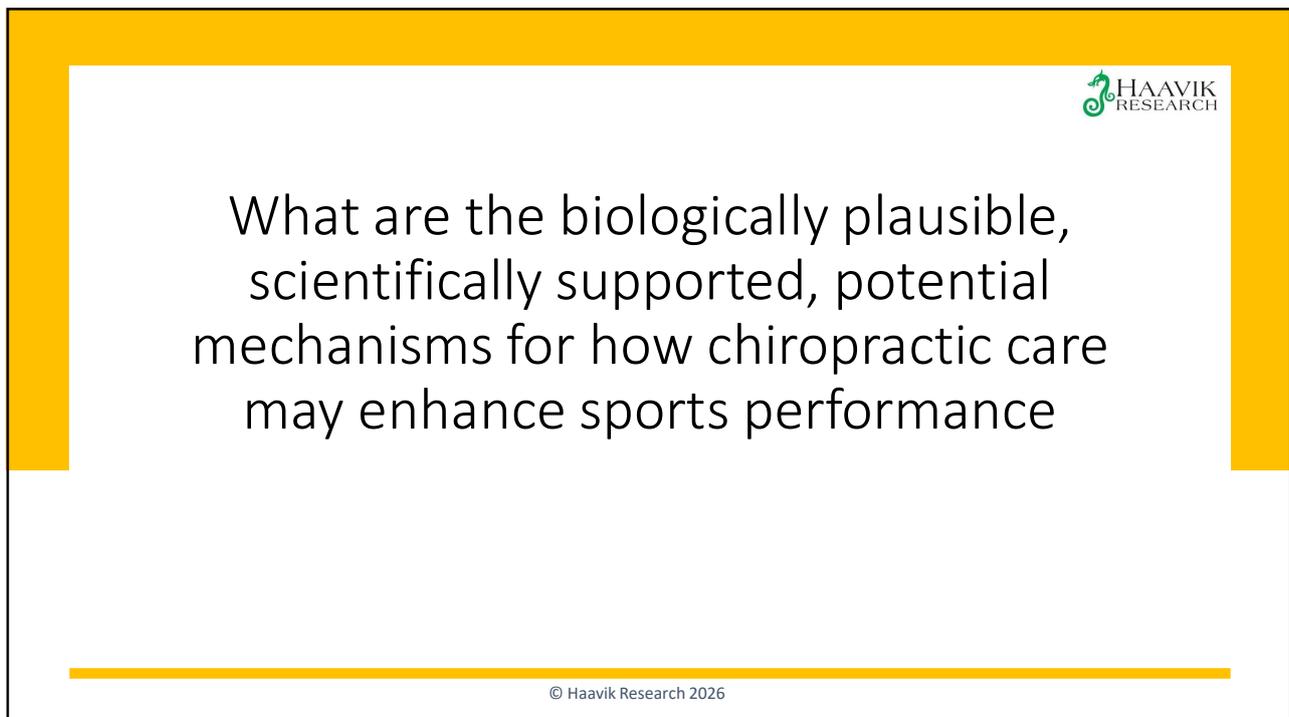
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Can Chiropractic Care Prevent Sports Injuries? And if so, How? **Basic Science**

**Clinical Research**

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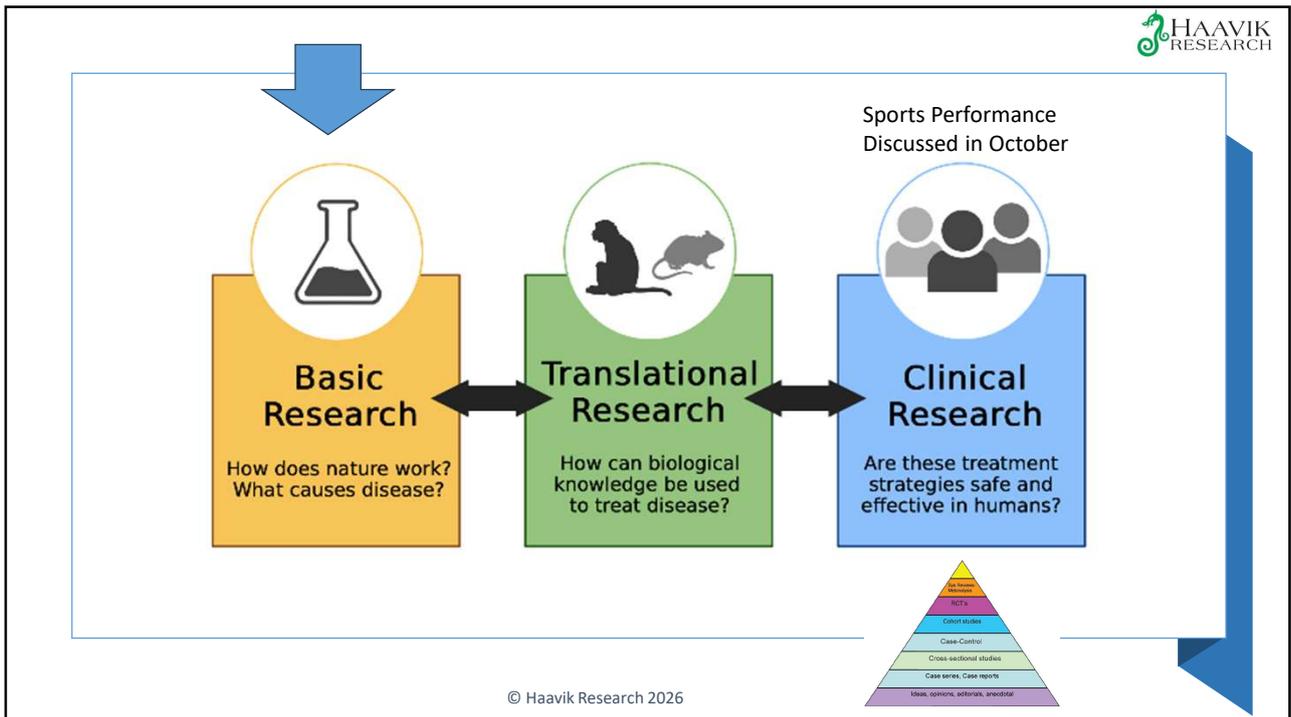




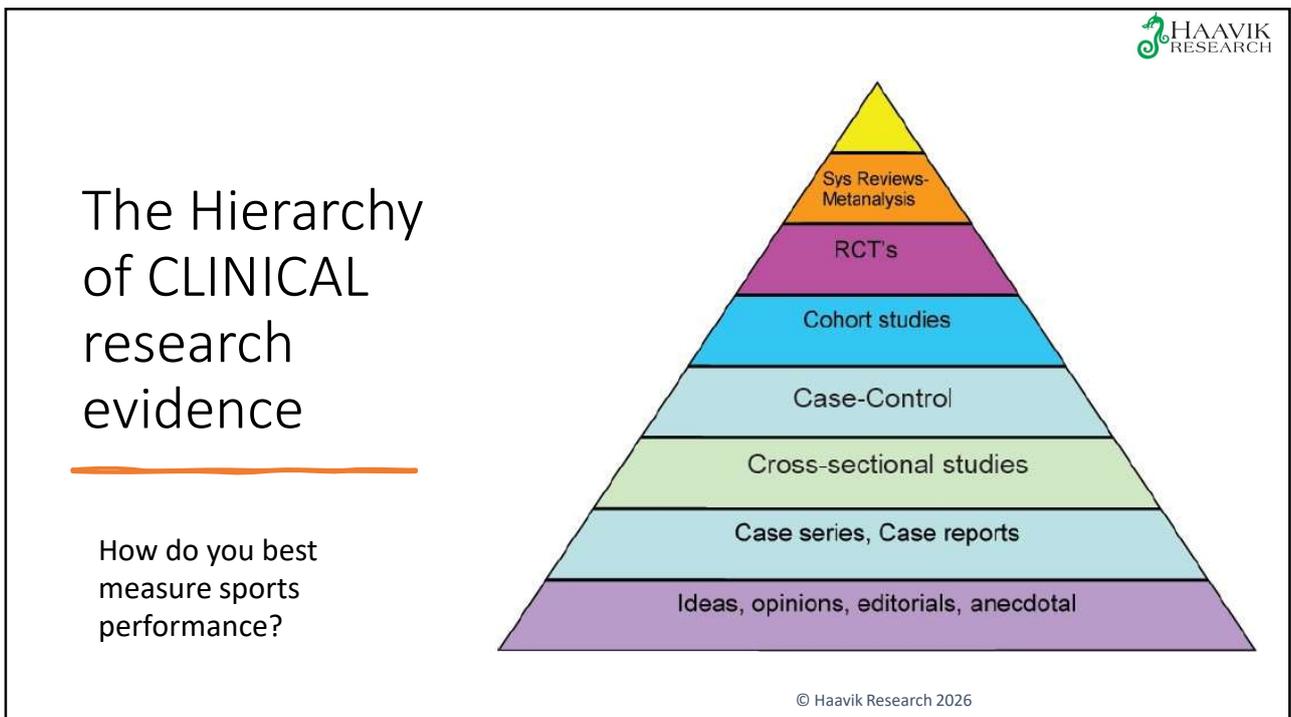
What are the biologically plausible, scientifically supported, potential mechanisms for how chiropractic care may enhance sports performance

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## How do you measure sports performance?

- What is improved sports performance?
- Is it running faster or lifting heavier weights or is it winning a game?
- Or is it something else entirely?

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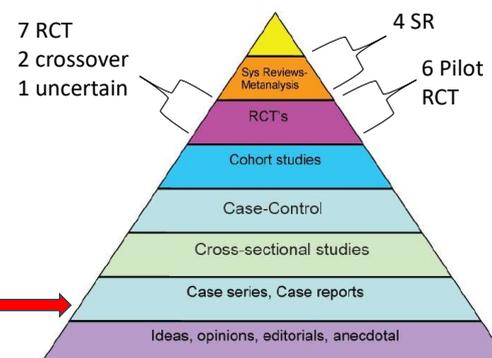
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## Chiropractic Care and Sports Performance (Discussed in October)

- 4 Systematic Reviews 2017 & 2019 (no meta-analyses)
- 1 Narrative review (2010)
- 7 RCTs
- 6 Pilot RCTs
- 1 Feasibility study
- Surveys (i.e. cross sectional)
  - 1 of athletes
  - 3 practice characteristics of sports chiros
- 1 utilization of chiro in world games 2013
- 1 Sports research agenda
- 1 Opinion review

4 Basic Science Studies that measured maximum voluntary contraction strength

I did not even look at 



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## So what can we say from the Clinical Evidence?



- Chiropractic care can influence neuromuscular and sensorimotor function
  - Multiple mechanistic studies show changes in motor-unit recruitment, conduction velocity, cortical excitability, and strength immediately after spinal manipulation.
- Short-term functional or performance benefits are possible but are inconsistent and often small in magnitude
- Benefits appear strongest in injured or symptomatic people and when dysfunctional joints are targeted
- More research is needed to make more definitive claims!

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## How do you measure sports performance?



- What is improved sports performance?
- Is it running faster or lifting heavier weights or is it winning a game?
- Or is it something else entirely?

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## How might chiropractic care enhance sports performance?

- 1 Improved Sensorimotor Integration (Brain-Body Communication)
- 2 Enhanced motor control, strength and coordination
- 3 Faster reaction times and mental rotation (object recognition)
- 4 Optimised autonomic balance and stress regulation

Reducing injury risk

Improved breathing (bottom up and top down) / respiratory efficiency (whole session in itself – to be covered another time!)

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# 1. Improved Sensorimotor Integration (Brain-Body Communication)

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## Terminology

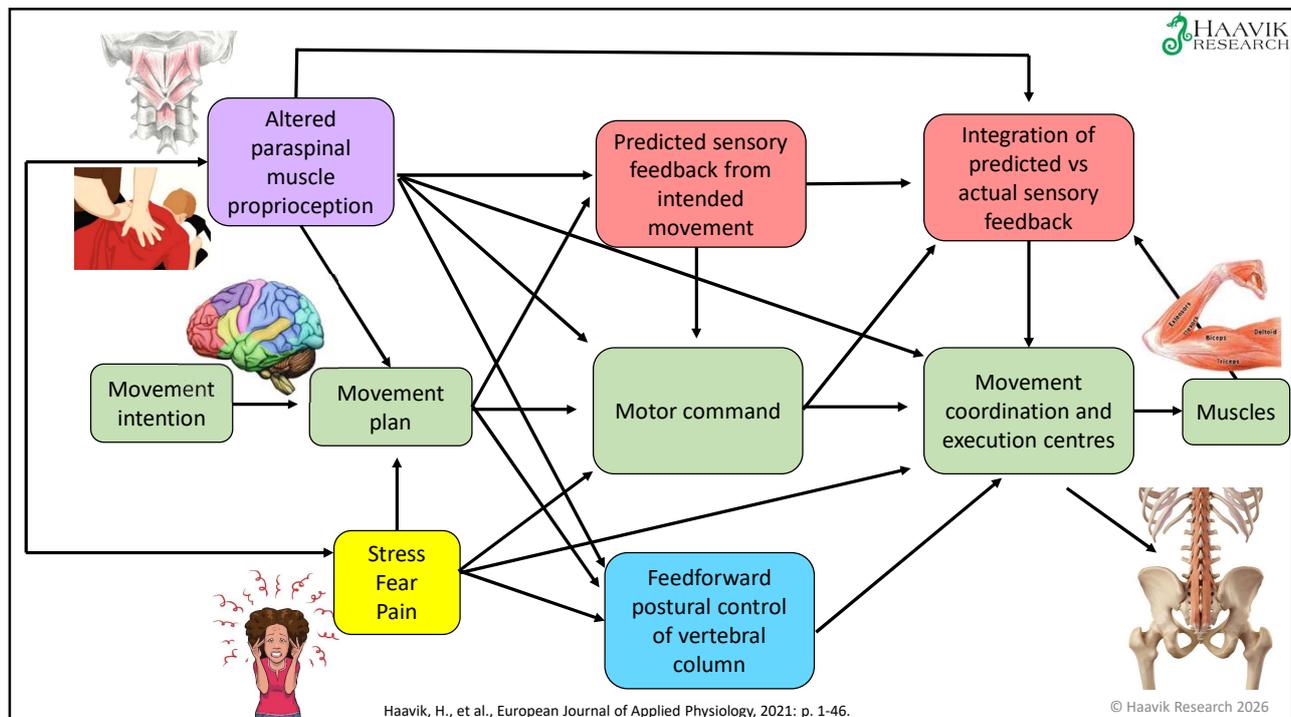
**Sensorimotor integration (SMI)** is the process where the brain combines information from the body (like touch, joint position, and muscle signals) with movement commands so that movements are accurate and coordinated.

**Multimodal integration (MMI)** is when the brain combines information from multiple senses at the same time to understand what is happening and decide how to respond. It is part of SMI

**Motor control** is how the brain plans, coordinates, and adjusts muscle activity so the body moves efficiently and safely.

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- A large body of SEP, EEG, and behavioral work shows that altered spinal afferent input (e.g., subclinical neck pain) disrupts:
- Cerebellar processing
- Cortical sensorimotor integration
- Motor learning and retention
- Spinal manipulation:
- Normalizes SEP markers (e.g., N30)
- Improves joint position sense
- Improves coordination and motor task retention
- Demonstrated in SCNP and healthy populations
- **This matters for sport:** Better coordination and motor learning underpin efficient, repeatable performance.

## Improved Sensorimotor Integration & Coordination

(Haavik et al 2021 EJAP; 2024; Haavik 2022)

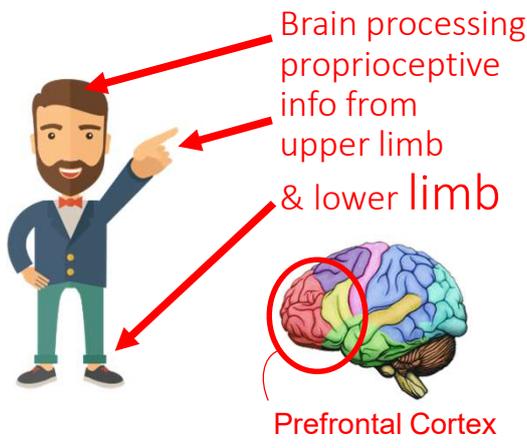
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## Proprioceptive Processing changes with adjustments





Brain processing proprioceptive info from upper limb & lower limb

Prefrontal Cortex

Lelic, D., I.K. Niazi, K. Holt, M. Jochumsen, K. Drenstrup, P. Yelder, B. Murphy, A. M. Drewes and H. Haavik (2016) *Neural Plast* 2016: 3704964.

Haavik Taylor H and Murphy B. (2010). *Journal of Manipulative and Physiological Therapeutics*, 33(3): 176-188.

Haavik Taylor H and Murphy B. (2010). *Journal of Manipulative and Physiological Therapeutics*, 33(4): 261-272.

Haavik-Taylor, H. & Murphy, B.A. (2007) *Clinical Neurophysiology*, 118 (2): 391- 402.

Haavik Taylor, H., & Murphy, B. (2011). *Journal of Manipulative and Physiological Therapeutics*, 34:88-97.

Holt, K., Haavik, H., Lee, A.C.L., Murphy, B., & Raina Elley, R. (2015) *Journal of Manipulative and Physiological Therapeutics*. May;39(4):267-78.

Haavik, H., Niazi, I.K., Holt, K., & Murphy, B. (2016). *Journal of Manipulative and Physiological Therapeutics*. <https://doi:10.1016/j.jmpt.2016.10.002>

Haavik, H., Niazi, I.K., Holt, K., Murphy, B. *Journal of Manipulative and Physical Therapeutics*. 2017; 40(3):127-138

Navid, M.S., Lelic, D., Holt, K., Mark, E.B., Drewes, A.N., Haavik, H. (2018) *Scientific Report*. 2019;9(1):6925.

Waterstone, Imran Khan Niazi, Muhammad Samran Navid, Imran Amja, Muhammad Shafique, Kelly Holt, Heidi Haavik and Afshin Samani., *Brain Sciences*. 2020, 10, 644, <https://doi:10.3390/brainsci10090644>

Navid, M.S., Niazi, I.K., Lelic, D., Nedergaard, R.B., Holt, K., Amjad, I., Drewes, A.M., Haavik, H. (2020). *Brain Sciences*, 10(5), 253. <https://www.mdpi.com/2076-3425/10/5/253>

Imran Khan Niazi, Muhammad Samran Navid, Christopher Merkle, Imran Amjad, Nilika Kumari, Robert J. Trager, Kelly Holt, Heidi Haavik., *Scientific Report*. 14(1), p.1159.

Dallagadua, J., Haavik, H., Yelder, P., Baarbe, J. & Murphy, B.A. (2013). *Journal of Manipulative and Physiological Therapeutics*. 2013;36:527-537.

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# Improved Brain–Body Communication

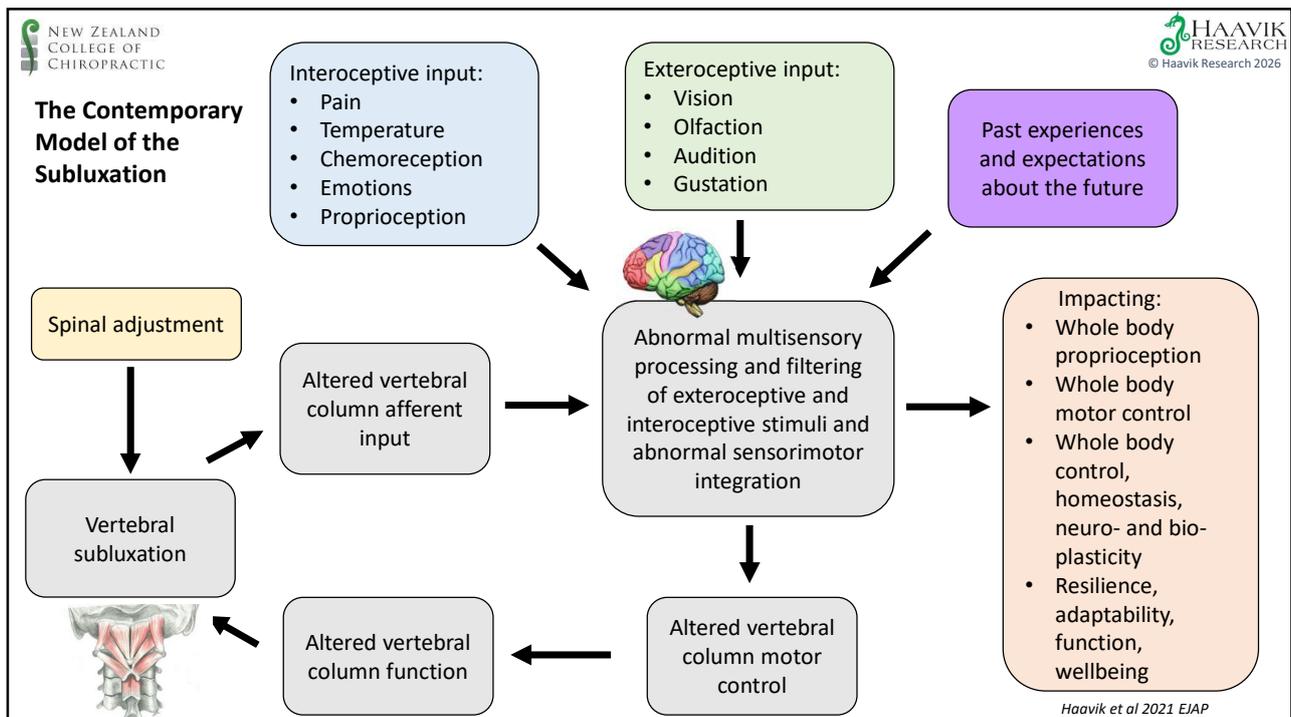
- **When spinal segments are dysfunctional:**
  - Proprioceptive input becomes noisy or inaccurate
  - The brain’s internal “map” of the body degrades
  - Movement efficiency and coordination can suffer
- **Chiropractic adjustments provide a rapid, high-quality burst of proprioceptive input, which research shows can:**
  - Improve sensorimotor integration
  - Enhance motor control and movement accuracy
  - Reduce “neural inefficiency” in movement execution
- **Why this matters for athletes:**
  - Better brain–body communication = smoother, more precise, more economical movement.



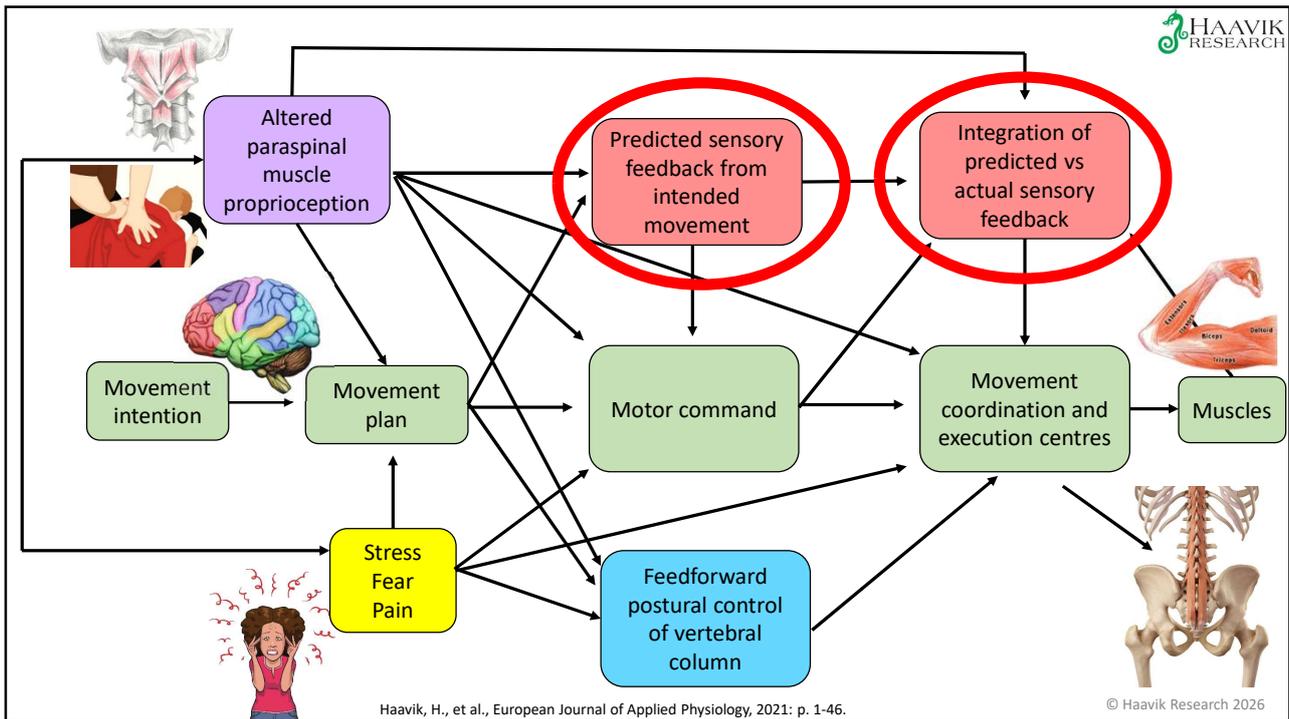
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(Haavik et al 2021 EJAP)

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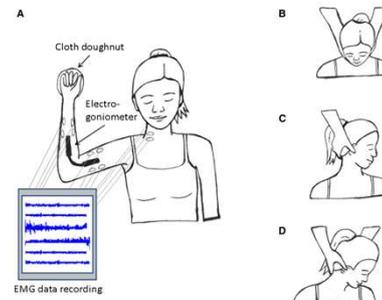
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## Chiropractic Care and Proprioception

- Elbow joint position sense measured before and after spinal manipulation
- Results:
  - SCNP worse than healthy controls
  - Significant improvement in joint position sense accuracy with adjustments
- Suggests changes in central sensorimotor processing
- Implication: Spinal adjustments can influence proprioceptive processing in the CNS from the upper limb!

(Haavik & Murphy 2011)

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## 2. Enhanced Motor Control, Strength & Coordination

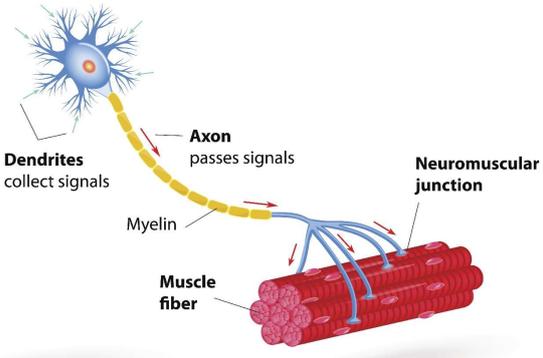
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### 3. Enhanced Motor Control, Strength & Coordination

- Studies have shown changes in motor cortex excitability and corticospinal drive following spinal adjustments resulting in **increased maximum voluntary contraction strength**, suggesting
  - More efficient production of muscle strength by recruiting more motor units
- **For athletes this can translate into:**
  - More efficient force production



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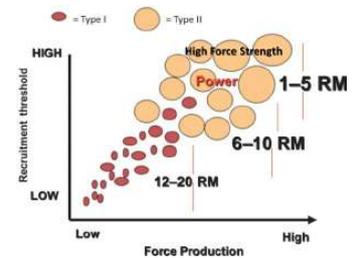
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## How can a muscle produce more force?

Studies show chiro does this!

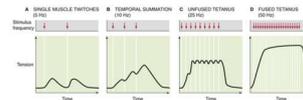
There are only a few ways!

- Recruit more motor units
- Increase motor unit firing rate
- Increasing Muscle Fiber Size (Hypertrophy)
- Improved Synchronization of agonistic muscles
- Reduce neural inhibition
- Reduce fatigue development



### Temporal Summation of Muscle Twitches

APs are grouped more closely in time (frequency summation).



- Single twitch = single muscle AP
- Contractions lasts longer than AP. Second AP can be initiated.
- In a single muscle fiber, the force developed may be increased by summing multiple twitches in time.

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## Strength Changes with chiropractic adjustments

- 18 College students, randomly allocated into a control group or adjustment group.
- Measured maximum force production as well as other measures
- Control group 13% decrease in strength and shift of median frequency (reflecting fatigue)
- Chiropractic group post-adjustments had 16% increase in strength (i.e. and no fatigue!)



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(Niazi, Türker, Flavel, Kinget, Duehr & Haavik 2015. Exp Brain Res)

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- Basic Science Study
- 11 elite Taekwondo athletes
- Outcome measures:
  - Soleus-evoked V-waves
  - H-reflex
  - Maximum voluntary contraction (MVC) of the plantar flexors
- Results
  - 8% increase in MVC strength
  - No change H-reflex
  - Large increase in V wave
- Limitations
  - Small sample
  - Basic science design (not supposed to be clinical)
  - Strength only (not sure how long it lasts)
  - Not sure if this improves Taekwondo performance

(Christiansen, Niazi, Holt, Nedergaard, Duehr, Allen, Marshall, Turker, Hartvigsen & Haavik 2018)

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## Chronic Stroke Study



- Basic Science Study
- 12 Chronic Stroke Survivors
- Outcome measures:
  - Soleus-evoked V-waves
  - H-reflex
  - Maximum voluntary contraction (MVC) of the plantar flexors
- Results
  - 64.2% increase in MVC strength
  - No change H-reflex
  - Large increase in V wave
- Limitations
  - Small sample
  - Basic science design (not supposed to be clinical)
  - Strength only (not sure how long it lasts)
  - Not sure if this improves Taekwondo performance

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Holt, Niazi, Nedergaard, Duehr, Amjad, Shafiq, Anwar, Ndetan & Haavik 2019 Scientific Reports

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## Summary so far:

- Strength Increases Are Driven by Improved Central Neural Drive
- The strongest and most consistent physiological finding across studies is an increase in corticospinal (supraspinal) drive, shown by increased MVC plus:
  - Increased V-wave amplitudes (marker of descending cortical drive)
  - Little or no change in H-reflex amplitude (spinal reflex excitability)
  - This pattern is seen in:
    - Healthy individuals (*Niazi et al 2015 EBR*)
    - Elite athletes (*Christiansen et al 2018*)
    - Stroke patients (*Holt et al 2019*)
- Interpretation: Chiropractic Adjustments improve the brain's ability to voluntarily drive muscle (not due to reflex gains or peripheral muscle properties).
- And reduces neural fatigue (not muscle endurance)

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## Increased balance strength & endurance!



- 110 active-duty military personnel with self-reported LBP
- 4 weeks chiro care vs control
- LBP-related disability, pain intensity and interference, and fear avoidance behaviour sig improved.
- Mean maximum isometric pulling strength increased by 5.08 kgs in chiro group
- Balance with eyes closed, and **Trunk Muscle Endurance** were also statistically significantly greater in chiro group

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(Vining, Long, Minkalis, Gudavalli, Xia, Walter, Coulter & Goertz 2020)

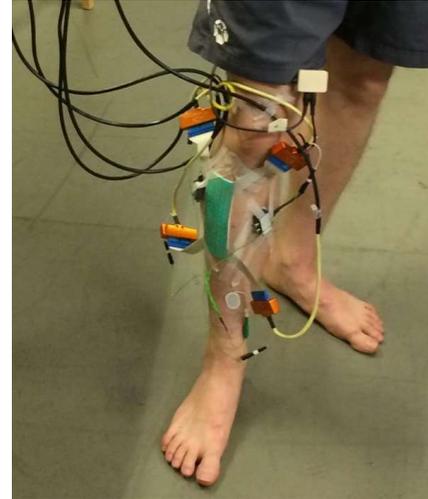


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## High-density EMG, Strength Study



- Population: 25 subclinical spinal pain
- Design: controlled cross-over design
- A single session of adjusting subluxations
- Primary outcomes:
  - Maximum voluntary contractions (MVC) of the ankle dorsiflexors
  - High-density electromyography (HDsEMG)
  - Intramuscular EMG
  - Near-infrared spectroscopy (NIRS)
- Results included
  - a significant increase in MVC ( $p = 0.02$ ; avg 18.87 28.35%)
  - A significant increase in conduction velocity
- Limitations:
  - Small sample
  - Basic science design



(Niazi, Kamavuako, Holt, Janjua, Kumari, Amjad & Haavik 2020)

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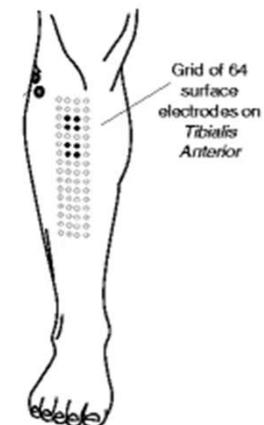
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## High-density EMG, Strength Study



### Changes in Motor Unit Recruitment & Behavior

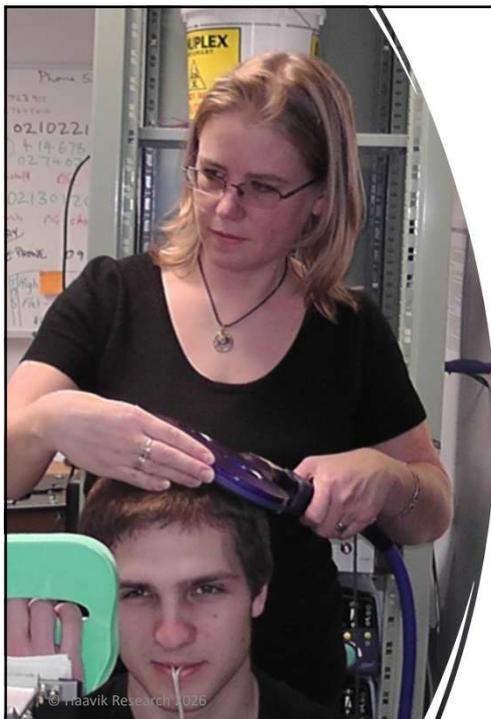
- High-density EMG and intramuscular EMG study showed that spinal adjustments altered how motor units are recruited, not just how hard muscles contract:
- Changes in motor unit conduction velocity suggests altered recruitment of motor units (after adjustments there appears to be more higher-threshold motor units recruited)
- No consistent increase in motor unit firing rate → suggests strength changes are not due to increased firing frequency or peripheral fatigue mechanisms
- Implication: Spinal adjustments appears to influence neural control of motor unit recruitment, rather than altering muscle metabolism



(Niazi, Kamavuako, Holt, Janjua, Kumari, Amjad & Haavik 2020)

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## Improved Voluntary Activation (Less “Neural Inhibition”)



- Using interpolated twitch techniques with TMS
- Study shows:
  - Reduced superimposed twitch during MVC
  - Increased voluntary activation percentages
- This demonstrates that after adjusting subluxations:
  - The motor cortex is sending a more complete signal
  - Fewer motor units are left “unused” during maximal effort
- This was also clearly demonstrated in subclinical neck pain populations
- “The muscle could always produce the force—the brain just wasn’t fully letting it.”

(Kingett et al 2019)

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## Increases in Strength Are Real

(But Neural, Not Hypertrophic!)

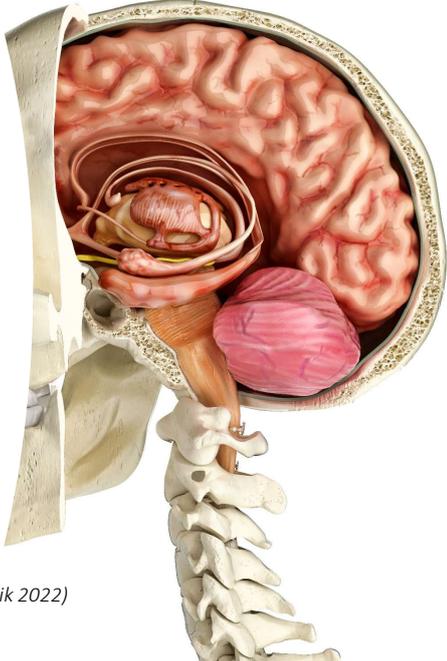
- Drive from brain to motor units improved
- Recruiting more motor units
- Preventing fatigue buildup (during repeated contractions) most likely due to altered motor unit recruitment;
  - More high-threshold (fast-twitch) motor units are accessed
- Force increases without increasing firing rate
- Evidence: increased MVC, increased V-waves, reduced interpolated twitch
- Also must be better distribution of force production across the motor unit pool
- Another reason for less fatigue is less neural inhibition (the brain’s breaks!)

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**HAAVIK RESEARCH**

## Improved Sensorimotor Integration & Coordination



- A large body of SEP, EEG, and behavioral work shows that altered spinal afferent input (e.g., subclinical neck pain) disrupts:
  - Cerebellar processing
  - Cortical sensorimotor integration
  - Motor learning and retention
- Spinal manipulation:
  - Normalizes SEP markers (e.g., N30)
  - Improves joint position sense
  - Improves coordination and motor task retention
- Demonstrated in SCNP and healthy populations
- **This matters for sport:** Better coordination and motor learning underpin efficient, repeatable performance.

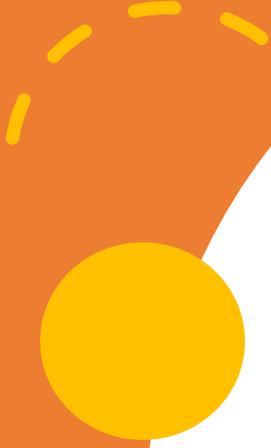
*(Haavik et al 2021 EJAP; 2024; Haavik 2022)*

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**HAAVIK RESEARCH**

## 3. Faster reaction times, and mental rotation (object recognition)



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## Effect of chiropractic manipulative therapy on reaction time in special operations forces military personnel: A randomized controlled trial

- Prospective, randomized controlled trial
- 175 Asymptomatic Active-duty US military Special Operation Forces
- 2 weeks of twice weekly chiro visits vs wait-list control
- Assessment included simple hand/foot reaction time, choice reaction time, and Fitts' Law and whole-body response time.
- *Immediate* pre- and post-changes (at visit 1 and visit 5) in favour of the chiro group in whole-body response time
- No differences were found for simple hand/foot reaction times, choice reaction time, and Fitts' Law.

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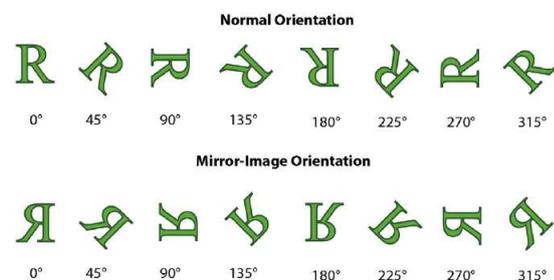
(DeVocht, Vining, Smith, Long, Jones & Goertz, 2019)



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## Mental Rotation Studies

- Kelly et al. (2000)  
Upper cervical adjustments improved mental rotation reaction times in healthy participants.  
→ Suggests spinal adjustments may influence cortical processing speed and spatial body representation.
- Baarbé et al. (2016)  
People with subclinical neck pain performed significantly worse on mental rotation tasks than healthy controls.  
→ Indicates altered cervical proprioceptive input may affect brain processing of body position and spatial awareness.
- Implication for chiropractic care: Changes in spinal function may influence how the brain represents and processes the body in space, which may contribute to improvements in sensorimotor integration and movement control.



(Kelly, Murphy & Backhouse 2000; Baarbe et al 2016)

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## 4. Optimised autonomic balance and stress regulation

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### Recreational Healthy Athletes

- A randomized, double blind, parallel groups, sham-controlled trial.
- 37 male recreational athletes
- Autonomic modulation (heart rate variability)
- Handgrip strength, jumping ability, and cycling performance (8-minute)
- A single pre-exercise SMT session induced an acute shift toward parasympathetic dominance and slightly impaired performance, i.e lower mean power output was observed during the 8min cycling
- Limitations: small male sample, single intervention, were outcomes sensitive enough?, blinding and expectation issues, etc



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(Valenzuela, Pancorbo, Lucia & Germain, 2019)

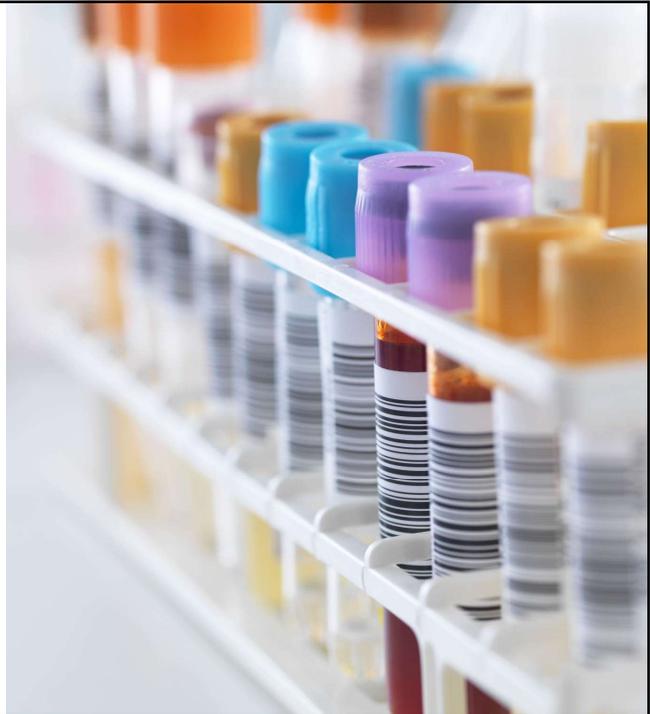
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## Emerging biological evidence

- Recent 16-week RCT measuring neuroplasticity and immune biomarkers following 12 weeks of chiropractic care have reported changes in markers related to:
  - Neuroplasticity (BDNF)
  - Inflammatory regulation (e.g., IL-6, TNF- $\alpha$ )
- These findings suggest spinal adjustments may influence brain-body regulatory systems involved in stress adaptation and recovery.

*(Amjad, et al 2025)*

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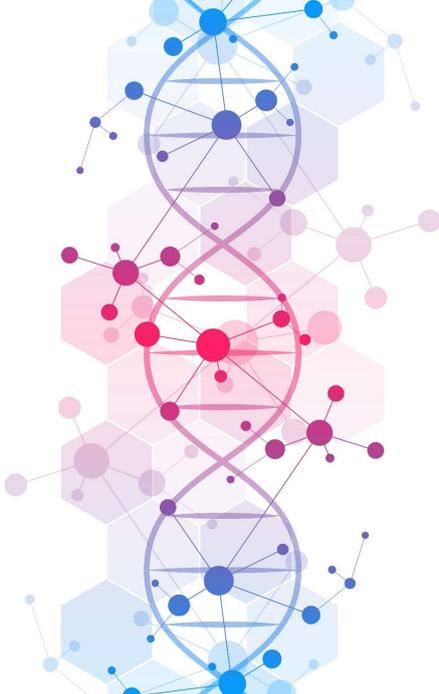
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## Genetic Study Results HOT OFF THE PRESS (NOT yet published)

“Transcriptomic analysis identified key driver genes involved in oxidative stress regulation, oxygen transport, and immune modulation. The chiropractic group’s results suggests a more adaptive and regulated physiological state following chiropractic care compared with control group.”

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- Across two independent randomized studies (1. published neuroimmune study in subclinical individuals and 2. the transcriptomic signatures in acute back pain – as of today unpublished!) we are observing convergent signals suggesting:
  - Chiropractic care may influence systemic neuroimmune regulation and cellular stress-response pathways.
  - These effects appear to involve antioxidant regulation, immune modulation, and sensory signaling pathways, consistent with a shift toward a more adaptive physiological state.

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Improved breathing  
(bottom up and top down) /  
respiratory efficiency

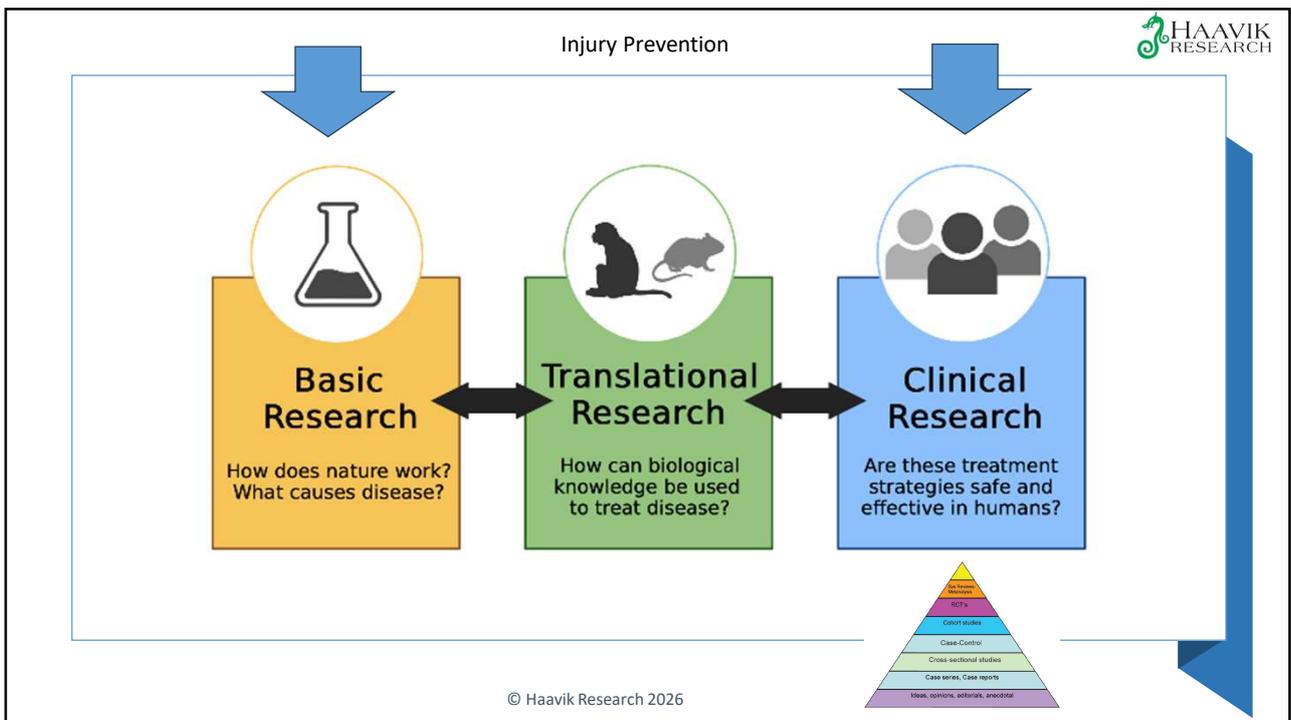
Some other time

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# Injury Prevation

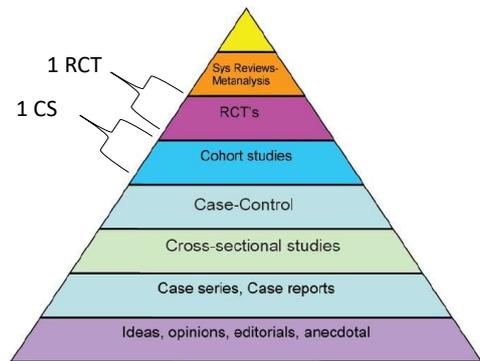
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## Chiropractic Care and Sports Injury Prevention (Clinical Research)

- 1 RCT (that was later retracted due to lack of ethics)
- 1 Retrospective cohort study using Medicare administrative claims data.
- 1 RCT that is kind of indirectly measuring recurrence of back pain (i.e. could be considered injury).....



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## Can Chiropractic Care help Prevent Injuries?

- Injury risk is multifactorial
  - Biomechanics
  - Training load
  - Previous injuries
  - Psychological factors
  - Neuromuscular control
- Previous injury = strongest predictor
- Key Question: “Can interventions that improve spinal function and neuromuscular control reduce the likelihood of future injuries?”
- Emerging research suggests spinal care may influence this system



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## Sports Chiropractic Injury Prevention RCT

- Randomized Controlled Trial
- Semi-elite Australian Rules Football players
- Chiropractic + standard care vs standard care
- Results:
  - ↓ lower limb muscle strains
  - ↓ weeks missed due to non-contact knee injuries
- However – no ethics – hence retracted

(Hoskins & Pollard 2010)

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## Chiropractic and Injury Risk

- Large Medicare cohort study
- Risk of injury within 7 days after visit
- Chiropractic visit vs medical visit
- Result: 76% lower injury risk following chiropractic visit

(Whedon, et al 2015)

NIH Public Access  
Author Manuscript

Published in final edited form as:  
J Gen Intern Med. 2015 February 11; 40(4): 264-270. doi:10.1097/BGIM.00000000000000725

**Risk of Traumatic Injury Associated with Chiropractic Spinal Manipulation in Medicare Part B Beneficiaries Aged 66-99**

James M Whedon, DC, MS,  
The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, NH  
Todd A Mackenzie, PhD,  
The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, NH  
Rand B Phillips, DC, PhD, and  
Southern California University of Health Sciences, Whittier, CA  
Jon D Lurie, MD, MS,  
The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, NH

**Abstract**

**Study Design**—Retrospective cohort study.

**Objective**—In older adults with a nonmusculoskeletal complaint, to evaluate risk of injury in the hand, neck or trunk following an office visit for chiropractic spinal manipulation, as compared to office visit for evaluation by primary care physicians.

**Summary of Background Data**—The risk of physical injury due to spinal manipulation has not been rigorously evaluated for older adults, a population particularly vulnerable to traumatic injury in general.

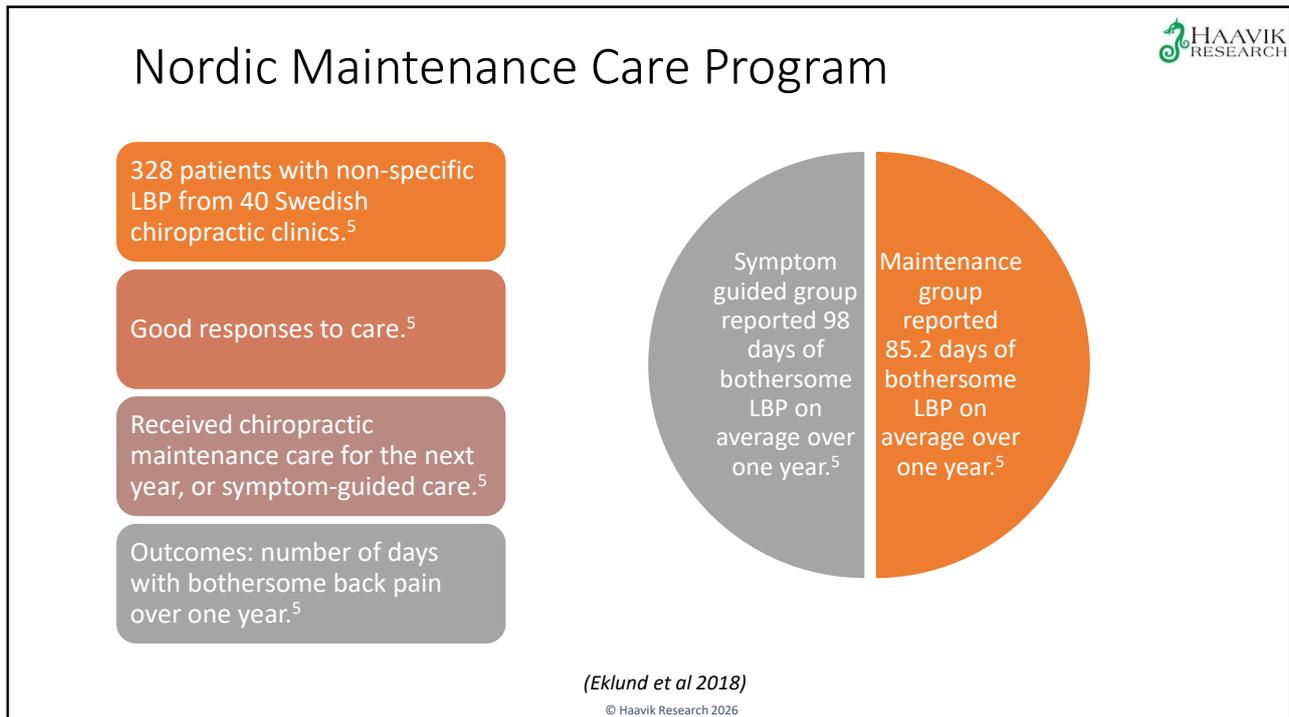
**Methods**—We analyzed Medicare administrative data on Medicare B beneficiaries aged 66-99 with an office visit in 2007 for a nonmusculoskeletal complaint. Using a Cox proportional hazards model, we evaluated the adjusted risk of injury within 7 days, comparing two cohorts: those treated by chiropractic spinal manipulation vs. those evaluated by a primary care physician. We used direct adjusted survival curves to estimate the cumulative probability of injury. In the chiropractic cohort only, we used logistic regression to evaluate the effect of specific chronic conditions on likelihood of injury.

**Results**—The adjusted risk of injury in the chiropractic cohort was lower as compared to the primary care cohort (hazard ratio 0.24; 95% CI 0.23-0.25). The cumulative probability of injury in the chiropractic cohort was 40 injury incidents per 100,000 subjects, as compared to 133 incidents per 100,000 subjects in the primary care cohort. Among subjects who saw a chiropractic physician, the likelihood of injury was increased in those with a chronic cognitive defect, inflammatory spondylopathy, osteoporosis, acute sensory and dissection, or long-term use of anticoagulant therapy.

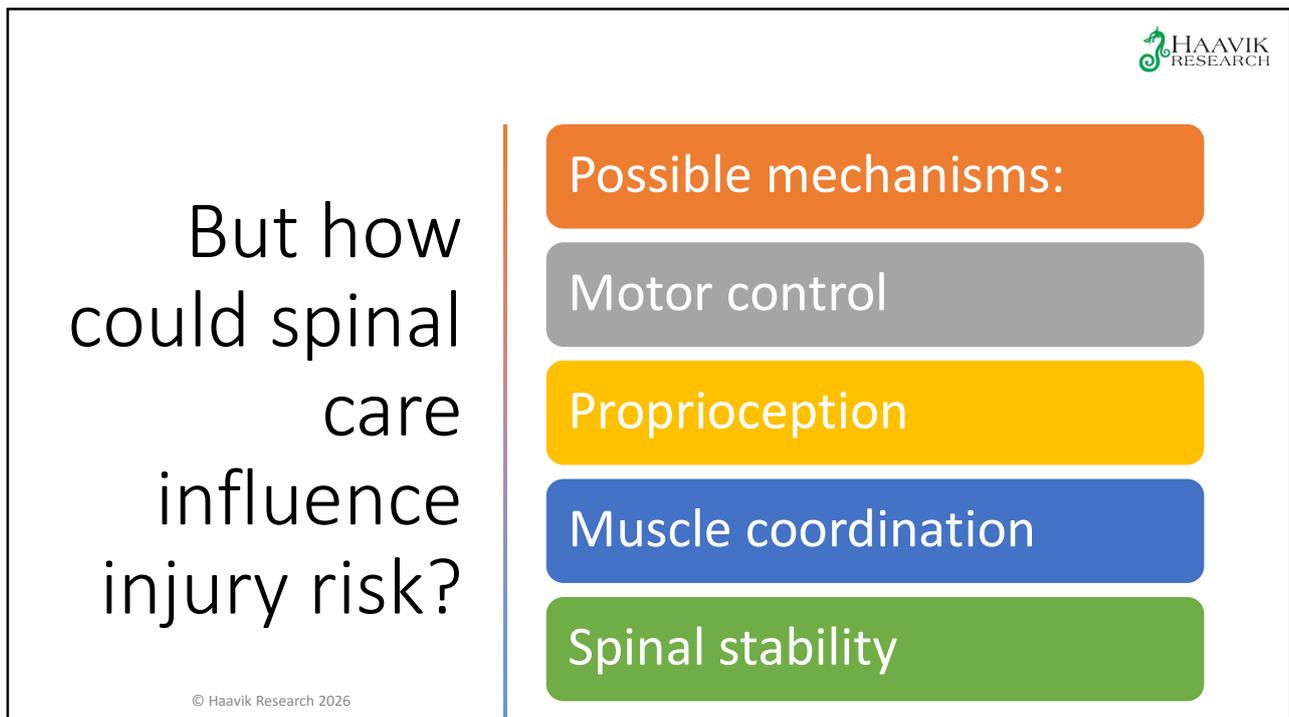
Corresponding Author: James Whedon, PhD Box 11, Grafton, NH 03747, (603) 854-4740, james\_m.whedon@dartmouth.edu  
The manuscript submitted does not contain information about medical devices or drugs.  
Relevant financial activities were disclosed with uncertainty, none.

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# Mechanistic Research

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## Basic Science

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Athletes  
rarely fail  
because  
they are  
weak

They fail because of:

- timing errors
  - coordination breakdown
  - delayed stabilisation
  - poor body awareness
  - fatigue-induced motor control drift
- Which all falls within **sensorimotor and/or multimodal integration.**

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## The Spine is Inherently Unstable

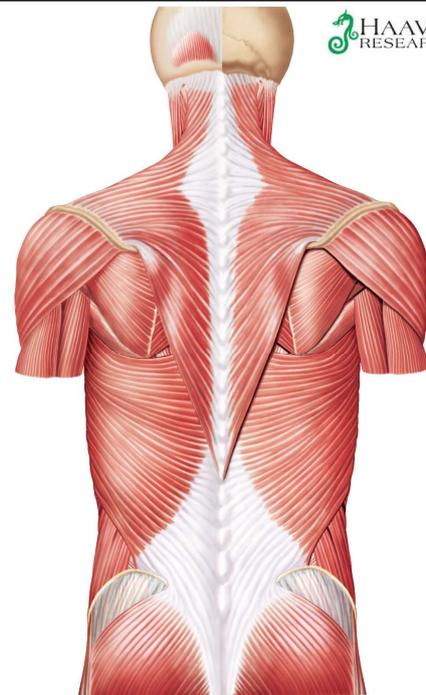
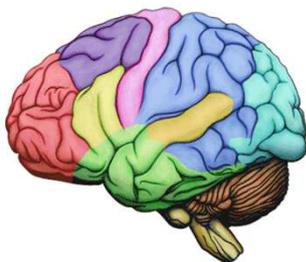
- A biomechanical synthesis paper explaining how spinal stability works and why motor control is essential to prevent instability and injury.
- The spine is mechanically unstable on its own and requires coordinated muscle activation to remain stable
- If you isolate the spine without muscle activity, it can buckle under surprisingly small compressive loads.
- Stability depends on muscle coordination across many muscles

*(McGill, Cholewicki, et al 2003)*

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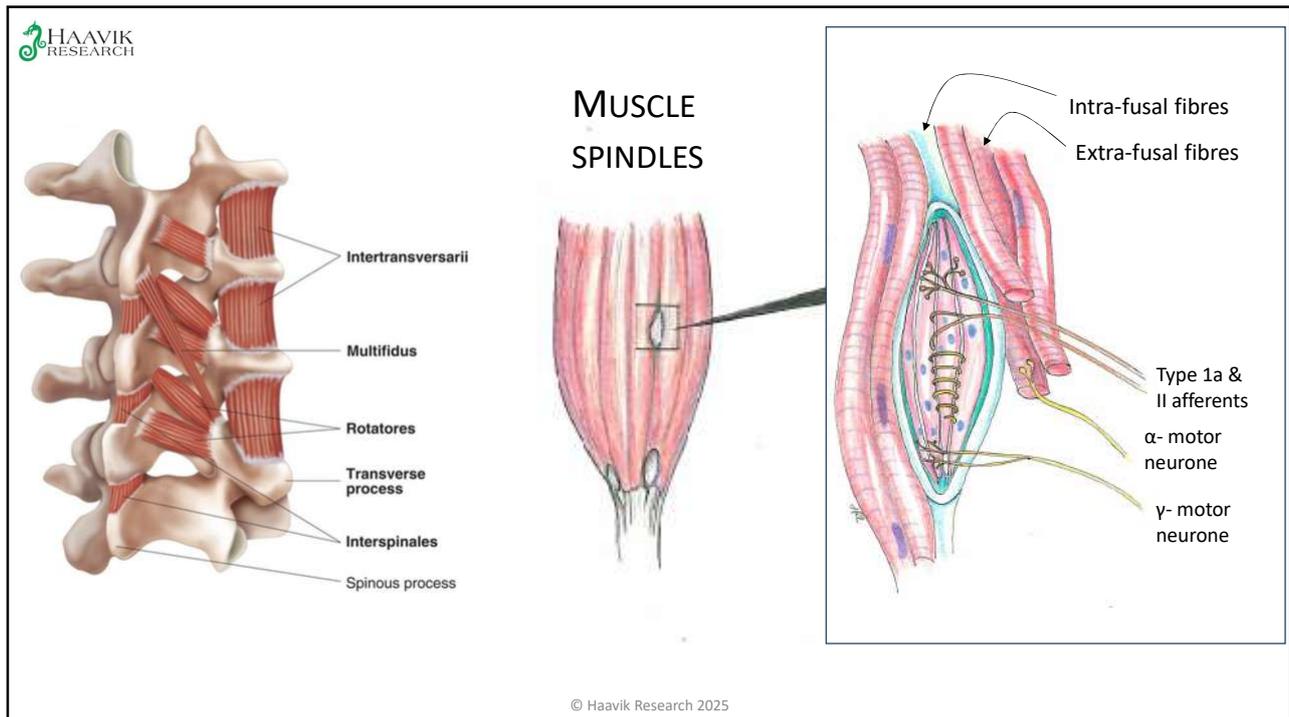
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## Bones do not move themselves



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## HAHAVIK RESEARCH

# Delayed Muscle Responses Predict Back Injury

- Prospective study of 303 college athletes (2-3 years)
- If they showed delayed trunk muscle reflexes at beginning of study, the authors predicted this would → increase risk of low back injury!
- Athletes who later developed low back injuries had **significantly slower reflex responses in trunk muscles**
- On average 14 ms longer reflex delay in injured athletes

Figure 1. A subject positioned in a multidirectional, sudden force release apparatus. Flexion (A), extension (B), and lateral bending (C) loads were applied via a system of pulleys.

(Cholewicki, et al. 2005)

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## Trunk Neuromuscular Control and Knee Injury

- Prospective cohort of 277 athletes
- Athletes were tested for trunk neuromuscular control using a sudden force-release trunk perturbation test.
- This test measured how well the trunk could control displacement when external forces were suddenly removed.
- Poor trunk control  
→ increased ACL and knee injury risk
- Core stability influences lower-limb injury risk

Athletes were followed for **3 years** to track injuries.

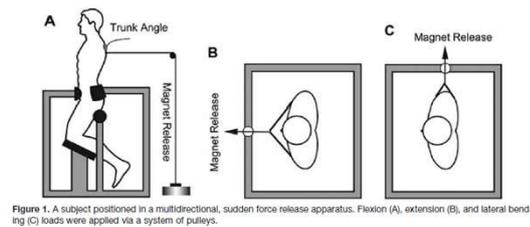


Figure 1. A subject positioned in a multidirectional, sudden force release apparatus. Flexion (A), extension (B), and lateral bending (C) loads were applied via a system of pulleys.

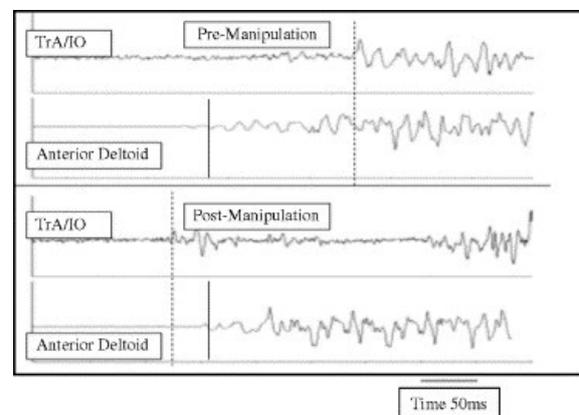
(Zazulak, Cholewicki, et al 2007)

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## Feedforward Activation of the Core Muscles with Chiropractic Care

- 19 Healthy participants with spinal dysfunction
- Measured feed-forward activation of trunk muscles upon rapid arm lift
- Examined changes before and after adjusting subluxated SI joint.
- There was a significant improvement (38.4%) in FFA times for this group when remeasured immediately after the sacroiliac joint adjustment.



(Marshall & Murphy 2006)

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## Motor Control changes with adjustments

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Brain sending  
info to  
upper limb  
and  
lower limb  
differently

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## Review on Motor control changes with chiropractic care

European Journal of Applied Physiology  
https://doi.org/10.1007/s00421-021-04727-z

INVITED REVIEW

The contemporary model of vertebral column joint dysfunction and impact of high-velocity, low-amplitude controlled vertebral thrusts on neuromuscular function

Heidi Haavik<sup>1</sup>, Nitika Kumari<sup>2</sup>, Kelly Holt<sup>3</sup>, Imran Khan Niazi<sup>4,5</sup>, Imran Amjad<sup>6</sup>, Amit N. Pujari<sup>7</sup>, Kemal Sitki Türker<sup>8</sup>, Bernadette Murphy<sup>9</sup>

Received: 13 January 2021 / Accepted: 18 May 2021  
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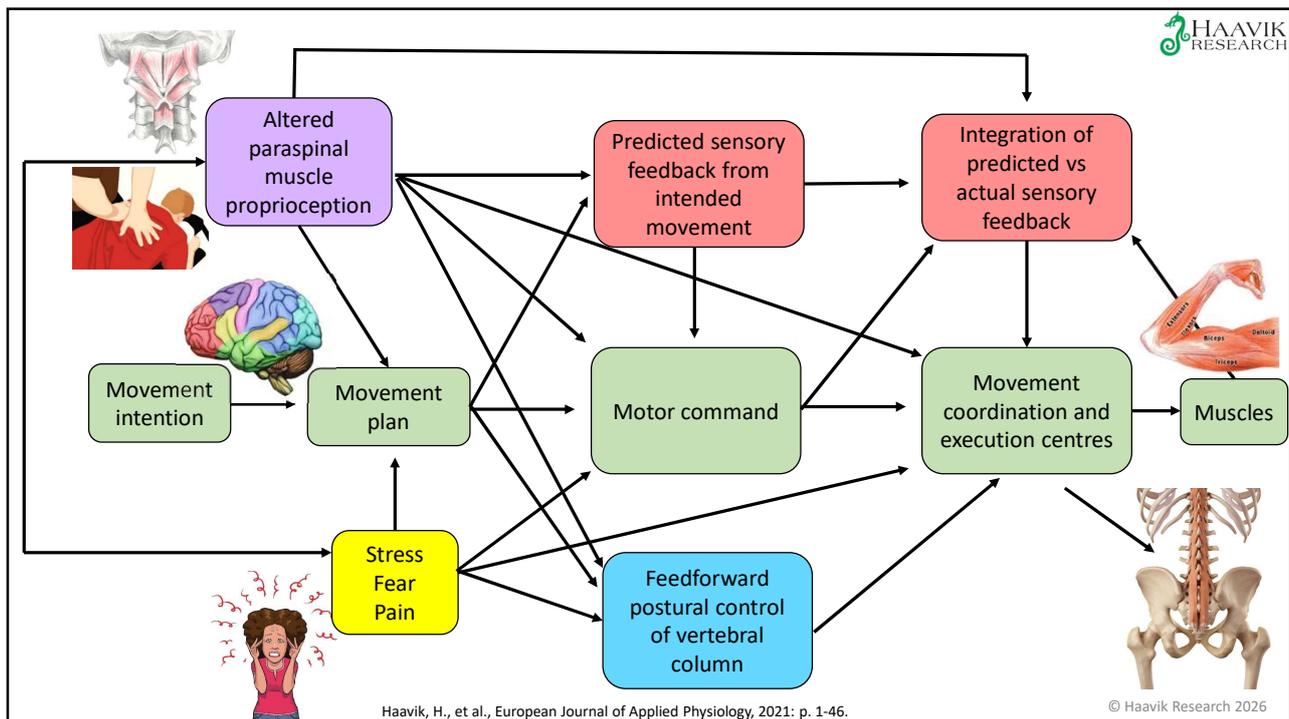
**Abstract**  
Purpose There is growing evidence that vertebral column function and dysfunction play a vital role in neuromuscular control. This invited review summarizes the evidence about low vertebral column dysfunction, known as a central segmental motor control (CSMC) problem, about neuromuscular function and how spinal adjustments, high velocity, low amplitude or HVLA thrusts, directed at a CSMC problem and spinal manipulation (SM) A thrusts directed at segments of the vertebral column that may not have clinical evidence of CSMC problems affect neuromuscular function.  
**Methods** The current review discusses the peripheral mechanisms by which CSMC problems, the spinal adjustments or spinal manipulations affect the afferent input from the corresponding tissues. In contrast to the contemporary model that provides a biologically plausible explanation for CSMC problems, the manipulable spinal tissue. This review also summarizes the contemporary, biologically plausible understanding about how spinal adjustments enable more efficient production of muscular force. The evidence showing low spinal dysfunction, spinal manipulation and spinal adjustments alter central motor drive and motor control centers will be covered for a second level of review.  
**Results** Many studies have shown spinal adjustments increase voluntary force and prevent fatigue, which likely occurs due to altered neuromuscular excitability and neuromuscular organization. The literature suggests direct effects upon inflammation and acute or chronic physiological or psychological stress can alter the vertebral column's central motor control, leading to a CSMC problem. The most gaps in the literature have been identified, along with suggestions for future studies.  
**Conclusion** Spinal adjustments of CSMC problems impact motor control in a variety of ways. They include increasing force via force generating tissues. They change neuromuscular function over time, even in the absence of neuromuscular dysfunction. The current contemporary model of the CSMC problem, and our understanding of the mechanisms of spinal adjustments, provide a biologically plausible explanation for how the vertebral column's central motor control can dysfunction, can lead to a self-perpetuating central segmental motor control problem, and how HVLA, spinal adjustments can improve neuromuscular function.

**Keywords** Chiropractic · Spinal manipulation · Muscle strength · Neuromuscular function

<p><b>Abbreviations</b></p> <p>ASMT<sup>1</sup> Active motor technique</p> <p>ASMT<sup>2</sup> Active assisted spinal manipulation therapy</p> <p>ASPT<sup>3</sup> Active passive therapy</p> <p><b>Communicated by</b> Michael Ledinger.</p> <p><sup>1</sup> Heidi Haavik</p> <p><sup>2</sup> Nitika Kumari</p> <p><sup>3</sup> Kelly Holt</p> <p><sup>4</sup> Imran Khan Niazi</p> <p><sup>5</sup> Imran Amjad</p> <p><sup>6</sup> Amit N. Pujari</p> <p><sup>7</sup> Kemal Sitki Türker</p> <p><sup>8</sup> Bernadette Murphy</p> <p><sup>9</sup> Heidi Haavik</p> <p>Responsible editor: Bernadette Murphy</p> <p>Published online: 23 June 2021</p>	<p>CSMC<sup>1</sup> Central segmental motor control</p> <p>CSM<sup>2</sup> Central motor control</p> <p>CSPT<sup>3</sup> Central spine protocol</p> <p>CSPT<sup>4</sup> Central spine protocol</p> <p>EMG<sup>5</sup> Electromyography</p> <p>EMG<sup>6</sup> Electromyography</p> <p>EMG<sup>7</sup> Electromyography</p> <p>EMG<sup>8</sup> Electromyography</p> <p>EMG<sup>9</sup> Electromyography</p> <p>EMG<sup>10</sup> Electromyography</p> <p>EMG<sup>11</sup> Electromyography</p> <p>EMG<sup>12</sup> Electromyography</p> <p>EMG<sup>13</sup> Electromyography</p> <p>EMG<sup>14</sup> Electromyography</p> <p>EMG<sup>15</sup> Electromyography</p> <p>EMG<sup>16</sup> Electromyography</p> <p>EMG<sup>17</sup> Electromyography</p> <p>EMG<sup>18</sup> Electromyography</p> <p>EMG<sup>19</sup> Electromyography</p> <p>EMG<sup>20</sup> Electromyography</p>
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Heidi Haavik, Nitika Kumari, Kelly Holt, Imran Khan Niazi, Imran Amjad, Amit N. Pujari, Kemal Sitki Türker, Bernadette Murphy. (2021a) The contemporary model of vertebral column joint dysfunction and impact of high-velocity, low-amplitude controlled vertebral thrusts on neuromuscular function. *Invited Review*. *European Journal of Applied Physiology*. <https://doi.org/10.1007/s00421-021-04727-z>

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## The Core Neuro-Biomechanical Mechanism

- Spinal dysfunction (subluxation) → altered proprioceptive input from paraspinal tissues
- Altered sensory input → altered brain maps of body and environment
- → altered sensorimotor and multimodal integration in the CNS
- → altered motor control

- Improved spinal function → improved vertebral neuromuscular coordination
- Motor control influences
  - movement efficiency (performance)
  - movement stability (injury risk)

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NEW ZEALAND  
COLLEGE OF  
CHIROPRACTIC

**INFLAMMATION**

OR

Stress

Injury

Small muscles closest to spine and skull go to sleep

Info sent to brain

Self  
perpetuating  
cycle

Poor body awareness  
Poor body control  
Poor function

So brain does NOT know accurately what is going on

Altered messages going to brain from spine

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

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# HEALTHY

Healthy muscle structure

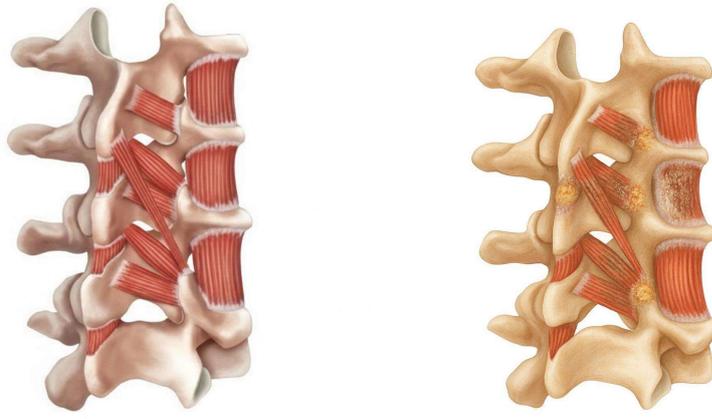
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# SUBLUXATED

Adipose tissue

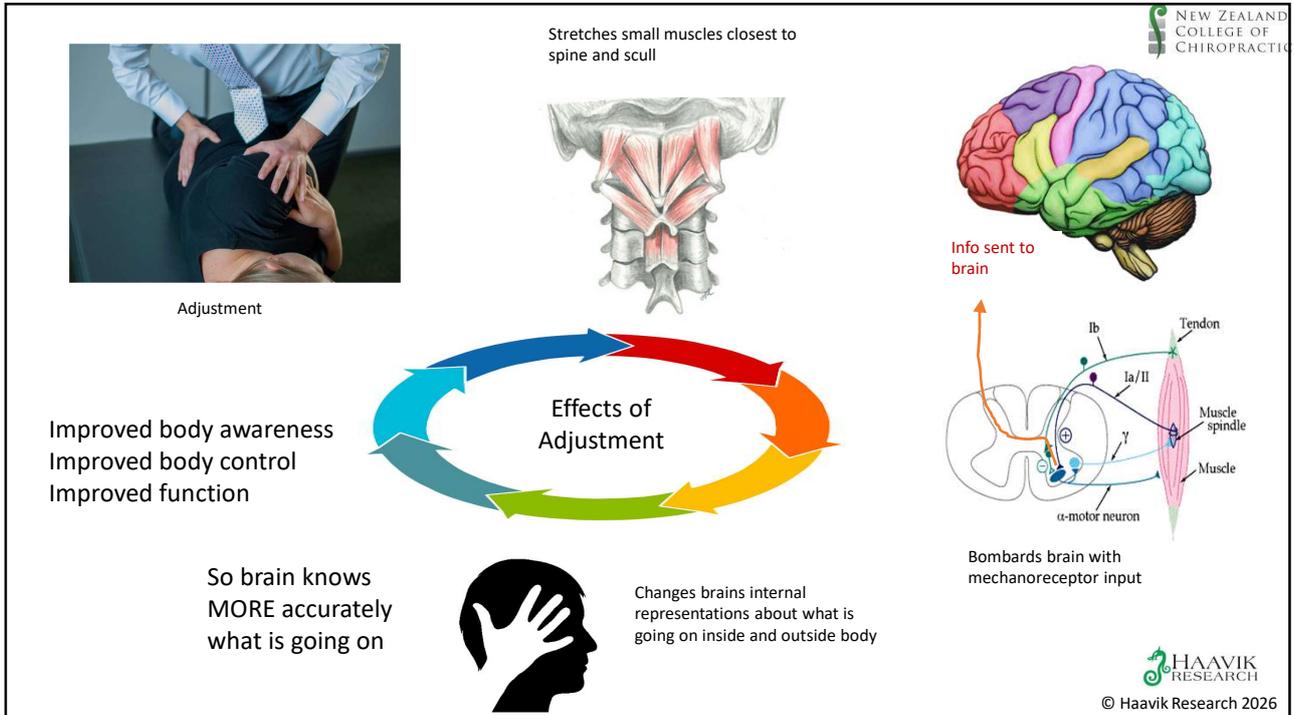
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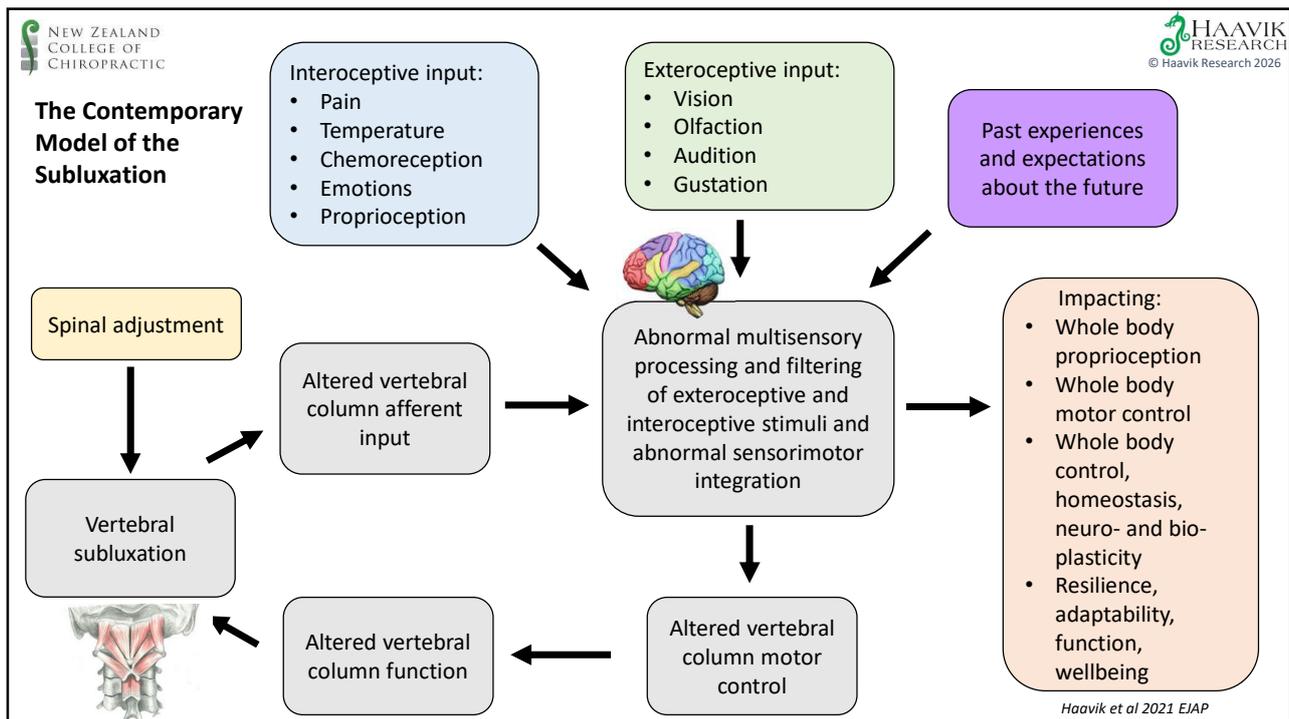


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**HAAVIK RESEARCH**

## What We Can Reasonably Claim

(regarding sports performance mechanisms)

Research suggests chiropractic adjustments can influence neuromuscular and sensorimotor function, including:

- Changes in corticospinal drive and voluntary muscle activation
- Altered motor unit recruitment patterns
- Improvements in maximum voluntary muscle strength
- Changes in sensorimotor integration and body position sense
- Small improvements in reaction time or motor response tasks

Therefore, while the evidence does not yet demonstrate direct improvements in sports performance, it does suggest that spinal adjustments can influence neural mechanisms involved in movement control (which are important components of athletic performance)

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## What we CANNOT claim (regarding sports performance mechanisms)

Current research has not yet demonstrated that chiropractic adjustments:

- Increase muscle hypertrophy or muscle size
- Increase muscle metabolic capacity (oxygen consumption, mitochondrial activity, aerobic capacity)
- Improve muscle energy metabolism or fatigue resistance through peripheral muscle mechanisms
- Increase muscle strength through muscle tissue changes (the strength increases observed appear to be neural)
- Improve cardiovascular fitness or VO<sub>2</sub> max
- Improve athletic endurance capacity (e.g., aerobic endurance or fatigue resistance of muscle tissue)\*
- Produce long-term physiological training adaptations comparable to exercise training
- Directly improve sport-specific performance outcomes

\* There is only evidence suggesting improved neural endurance, i.e., the ability of the nervous system to sustain motor output

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## What We Can Reasonably Claim (regarding injury prevention)

Research suggests that:

- Neuromuscular control of the trunk influences injury risk
- Delayed trunk muscle responses predict future low back injury
- Poor trunk control is associated with increased knee ligament injury risk
- Coordinated muscle activation is essential for spinal stability

These findings suggest that interventions influencing neuromuscular control and proprioception may affect injury risk mechanisms. However, there are currently no high-quality clinical trials demonstrating that chiropractic care directly prevents sports injuries.

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## What we CANNOT claim (regarding sports injury prevention)

- Chiropractic care prevents injuries
- Spinal manipulation reduces injury risk
- Improvements in neuromuscular control from chiropractic care have been proven to prevent injuries

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## Take Home Message Injury Risk

Evidence suggests:

- Neuromuscular control influences injury risk
- Spinal stability depends on coordinated muscle activation
- Spinal dysfunction may alter these systems
- Chiropractic care can impact neuromuscular control of the spine and limbs

Therefore, Chiropractic care may influence injury risk through neuromuscular control mechanisms.

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“When we step back and look across this body of research, a consistent pattern begins to emerge. Spinal dysfunction appears to alter the quality of proprioceptive input from paraspinal tissues.

This sensory input feeds directly into brain regions responsible for sensorimotor integration, including the cerebellum, motor cortex, and related coordination networks.

If this input is altered, the brain may not control the spine and body as efficiently. Because movement efficiency and stability depend on accurate sensorimotor processing, this provides a biologically plausible pathway through which chiropractic care could influence movement control.

Through these mechanisms, chiropractic care may influence factors relevant to both sports performance and injury risk, although further research is needed to clarify these relationships.”

Heidi Haavik

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## Questions?



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