

THE CASE FOR CHIROPRACTIC

A collection of research articles on the benefits of Chiropractic

House of the right hand
E. J. R. S. S. S.

Dear Reader,

When it comes to chiropractic, there is a lot of misinformation out there, so we wanted an opportunity to collate a series of referenced articles to discuss chiropractic and give some perspective to the science that supports the appropriate application of this unique profession.

I'd like to take the opportunity to thank you for picking this up. You could have picked up the typical trashy magazines. However, you chose to increase your knowledge, so well done. I'd also like to thank the person who has supplied you with this collection of articles. They are a loyal supporter of the *Australian Spinal Research Foundation* and you'd do well to ask them why.

All proceeds from the sales of this book go towards the important activities of the Foundation.

Chiropractic does not receive financial support from government funding or large corporations. Rather, there are only two groups of people who support the Foundation. The first is the chiropractor who wants to better help the people that they see in practice. The second is the people who directly benefit from this unique, natural, non-surgical and non-drug approach to health care.

If that sounds like you, I'd encourage you to do just two things:

1. Please show your appreciation to your chiropractor by sharing the information that you learn within this book with others, so that they too may have the opportunity to benefit from chiropractic. Please don't keep it to yourself!
2. Consider the benefits that you have received from chiropractic so far and show your chiropractor and the profession support by contributing to the *Australian Spinal Research Foundation* whether it be by donating, becoming a member or considering a bequest.

For information regarding the Foundation please visit www.spinalresearch.com.au

Dr. Craig Foote (Chiropractor)
Australian Spinal Research Foundation
President



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New Research Reveals the Intelligence of the Spinal Cord

Here in the world of chiropractic, the spine and spinal cord have always held our attention. The steady advancement of research shows us that when we adjust the spine, we change the structure and function of the brain. We may see cortical drive to the muscles and reaction times improve. We may also restore joint position sense and increase proprioception. These are documented findings in the world of chiropractic. But where does the spinal cord end, and the brain begin? To many a neurology-buff, they are but one unit.

While chiropractic researchers have had their eyes firmly fixed on what happens in the brain when we adjust the spine, the world of non-chiropractic research has made an interesting discovery that may be applicable to our field: that the spinal cord is smarter than once thought.

A recent study, titled "Spinal stretch reflexes support efficient hand control," will feature in journal 'Nature and Neuroscience' [1]. The study had participants engage with specialized robotics technology (a specific exoskeleton) and were asked to maintain their hand in a target position. The robot then bumped the hand out of position and the participants had to bring their hand back.

By measuring the latency – or 'lag' – in the response, they were able to determine whether the processing was happening in the brain or the spinal cord. In a press release from the University of Western Ontario, lead researcher Jeff Weiler said, "We found that these responses happen so quickly that the only place that they could be generated from is the spinal circuits themselves. What we can see, is these spinal circuits don't really care about what's happening at the





individual joints – they care about where the hand is in the external world and generate a response that tries to put the hand back to where it came from [1].”

The stretch reflex generated by the spinal cord was, up until this point, thought to be a lot more limited. This study offers new indications that the spine can actually control the hand in space, a fact that adds greatly to the existing understanding of neurocircuitry. This is a factor that could be significant for rehabilitation purposes, according to the study’s authors [1].

The Chiropractic Angle

While the study clearly exists outside of the chiropractic paradigm, it does provide interesting insight into the organ we are most concerned with: the brain and spinal cord. If what we do increases the health, mobility and optimal function of the spine, then it’s easy to see a potential connection between chiropractic and improving the spinal stretch reflex.

There is more research to be done, and it would certainly be interesting to see a study that brought chiropractic adjustments into the mix, but this latest research certainly provides solid rationale for us to ensure the spine and spinal cord are functioning optimally.

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Chiropractic Linked to Quicker Reaction Times

In 2016, Baarbe et al released a study investigating subclinical neck pain and patients ability to perform a mental rotation task. The study threw light on the connection between subclinical neck pain and slower reaction times when it came to performing such tasks [1]. The study followed work by Kelly, Murphy and Backhouse, which showed the impact of upper cervical adjustments (specifically chiropractic adjustments) on cortical processing [2].

Both studies were instrumental in establishing a link between neck pain and reaction times, but the world of research was not done with this issue of chiropractic and reaction times yet.

A 2019 study is the latest to add to the evidence in the field of chiropractic care and human performance. The study, a randomized controlled trial conducted at an Army Hospital, looked at the effect of “chiropractic manipulative therapy” on reaction times in special operations forces military personnel [4].

The study took in 120 eligible personnel, all of which were male, and split them into a control group and an intervention group. They were then assessed across activities involving hand and foot reaction time, choice reaction time, and Fitts law (a computer tracking activity) along with a whole-body response time. These activities were repeated at visits one and five, both pre and post adjustment (for the control group).

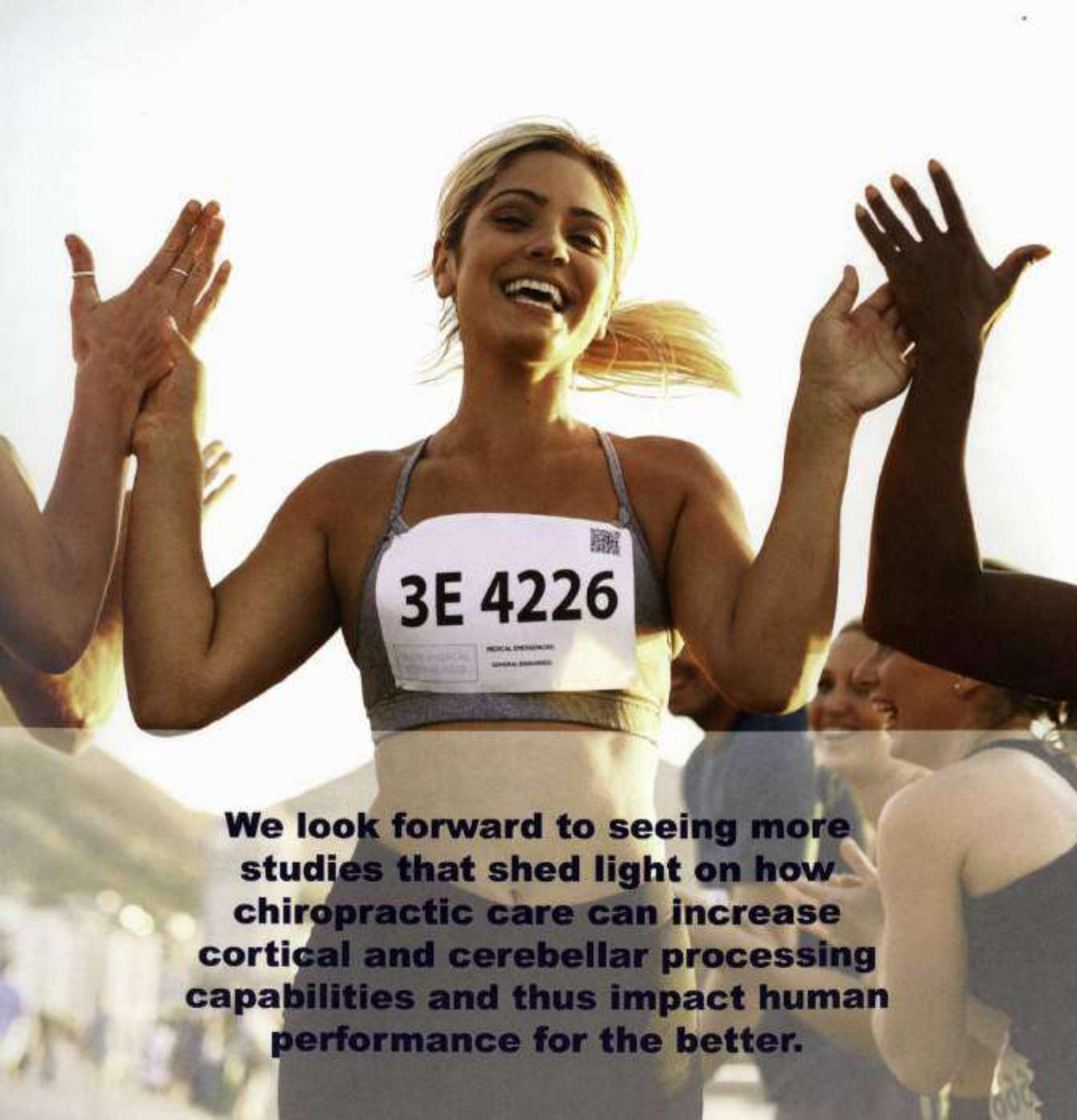
The conclusions were illuminating: A single session of CMT [chiropractic manipulative therapy] was shown to have “an immediate effect of reducing the time required for asymptomatic SOF [special operations forces] qualified personnel to complete a complex whole-body motor response task.”

Given that the participants had to be less than four on a pain intensity scale (of 0-10) and not requiring additional diagnostic procedures, the trial was looking at relatively healthy participants. It was also looking at a group for which response times could literally be life-altering.

The “chiropractic manipulative therapy” referred to in the study comprized “high-velocity low-amplitude spinal manipulation procedures consisting of manually applied thrusts to cervical, thoracic, or lumbo-pelvic areas” indicated by a range of tests typically used by chiropractors to determine adjustable areas on the spine.

While the study indicated a significant, positive and immediate effect on reaction times, it didn’t investigate a long-term effect and this is certainly a matter for further research. However, the study does once again show that chiropractic care is beneficial for people who sit low to very low on the pain scale (i.e. the subclinical level), for asymptomatic people, and also those who are in jobs or situations that demand fast reaction times.

It is exciting to see yet more research indicate that a well-tuned nervous system is one that can assess, adapt and respond to the world around it more quickly than a nervous system in which subluxations may still exist.



We look forward to seeing more studies that shed light on how chiropractic care can increase cortical and cerebellar processing capabilities and thus impact human performance for the better.

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Chiropractic and Stroke: New Study Published

A long awaited study on the effect of chiropractic care for stroke patients has been released, with the journal 'Scientific Reports' carrying Dr. Kelly Holt's latest offering. The study examined whether or not chiropractic care "could increase strength in weak plantar flexor muscles in chronic stroke patients [1]." The results are in and they are encouraging.

Chiropractic and stroke risk has long been a topic of hot debate, but by and large, the focus of those conversations has been on the risk of stroke for chiropractic patients. While research found no evidence for causation when it comes to chiropractic and cervical artery dissection (a significant cause of stroke), debate and conversation around such topics wears on [2]. However, very little discourse or research has been dedicated to how chiropractic care might help a patient recover. That is what makes this latest study so interesting.

Holt *et al* gathered 12 chronic stroke patients who were all experiencing plantar flexor muscle weakness. They used a randomized controlled crossover design, assessing participants' pre and post chiropractic care, and measuring the differences (including cortical drive to the muscle) in order to ascertain the effect of a single session of chiropractic care.

While the study was not without its limitations (which included a small sample size and the inability to ascertain how long the effect might last), the study offered up some noteworthy findings. It showed a significant increase in muscle strength and in the V-wave/Mmax

ratio when compared with the control intervention. "Plantar muscle strength increased in chronic stroke patients after a single session of chiropractic care. An increase in V-wave amplitude combined with no significant changes in H-reflex parameters suggests this increased strength is likely modulated at a supraspinal level," wrote Holt *et al*.

We know that stroke contributes greatly to mortality and the burden of disease every year. We also know that recovery is a process that often employs many modalities including "physical therapy, motor re-learning, and brain computer interface-based approaches amongst others [1]."

This evidence shows us that by adjusting the spine, we may help increase muscle strength and cortical drive to key muscles, thus indicating that the chiropractor may have a very real role in supporting stroke recovery. Of course, the impact, reach and effectiveness of this intervention is something that only further research can clarify.

This study is the latest in a growing line of research indicating an increase in cortical drive to the muscles post chiropractic adjustment. It also shows changes at a brain level rather than a spine level as evidenced by the increase in cortical drive.

Other studies (non-stroke related) have indicated similar effects in leg muscles and bite force among others [3-6]. This is the first that looked specifically at the plantar flexor, but it illustrates a similar effect regardless of muscle group. This once again illustrates the potential impact chiropractic has on the brain.

Full details can be accessed at the journal referenced on the following page [1]. We congratulate Dr. Kelly and the team on this study's publication, and look forward to seeing more research on this important topic emerge.

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Foundation Funded Study Reveals Multisensory Impacts Of Subclinical Neck Pain

As research mounts up, it is becoming increasingly clear that neck pain has impacts far beyond pain and stiffness. A recent piece of research, partially funded by the Australian Spinal Research Foundation, has become the first to reveal that people with subclinical neck pain have slower visual and multisensory response times, and the differences caused by subclinical neck pain don't improve on their own.

Emerging research has offered clear indications that neck pain has impacts on multiple areas of brain function and proprioception. Among the already-available research is work indicating: proprioceptive differences in upper limbs [1], negative impacts on cortical and cerebellar motor processing [2], and decreased mental response times for complex rotation tasks [3].

This latest study adds to that body of evidence, this time focusing on visual and auditory cues. It took place in Canada using volunteers recruited from a university student population, and saw 25 volunteers put through a 2-alternative forced-choice discrimination task.

The participants were reacting to visual, auditory and combined audio-visual cues at a baseline measurement session and again four weeks later. The study design, and tools used to measure responses, ensured that

there was minimal lag in logging response times, and that left-handed and ambidextrous participants were able to participate.

Researchers were working with the hypothesis that “individuals with SCNP [subclinical neck pain] would possess slower response times for both unisensory and multisensory conditions because of the ongoing effects of unreliable proprioceptive feedback from the neck [4].”

While the auditory stimulus data didn't reveal a notable difference, there was a statistically significant difference in response times for visual and multisensory stimuli. Researchers said:

“These differences are not simply because of slower movement times in general, because previous studies of people with SCNP reported no difference in simple response times in this population but found that the SCNP group had slower response times in more complex tasks (mental rotation) [4].”

Response times for the visual stimulus in this study were slower by 48 ms baseline and 37 ms at week four, when compared with the control group. This was found to be statistically significant, as was the multisensory stimulus response time that was slower for the SCNP group by an average of 52 ms at baseline and 47 ms at week four.

For the purpose of this study, participants were required to not seek treatment until after the 4-week check in. This allowed researchers to see if the symptoms improved on their own. They did not.

Additionally, a recent study indicated an increased reliance on visual input in people with chronic neck pain [5]. This, combined with findings of impaired mental rotation abilities in SCNP patients [3], lead researchers to state: “If patients with neck pain have an increased reliance on vision and their visual

and multisensory processing response times are impaired, as indicated in the present study, it is problematic. Our study identified worse visual and multisensory reaction times in SCNP vs asymptomatic young adults, which was not compensated for by increased multisensory gain between the two groups, for both the standard t test and CDF analysis.

The lack of change over four weeks suggests that left untreated, even subclinical neck pain can affect multisensory processing [4].”

This study has clear implications for chiropractic, which has not struggled to assert its role in assisting neck and back pain sufferers. As we saw in Kelly Holts falls risk study, there are also clear indications that chiropractic care may improve sensorimotor function and multisensory integration in older adults [6].

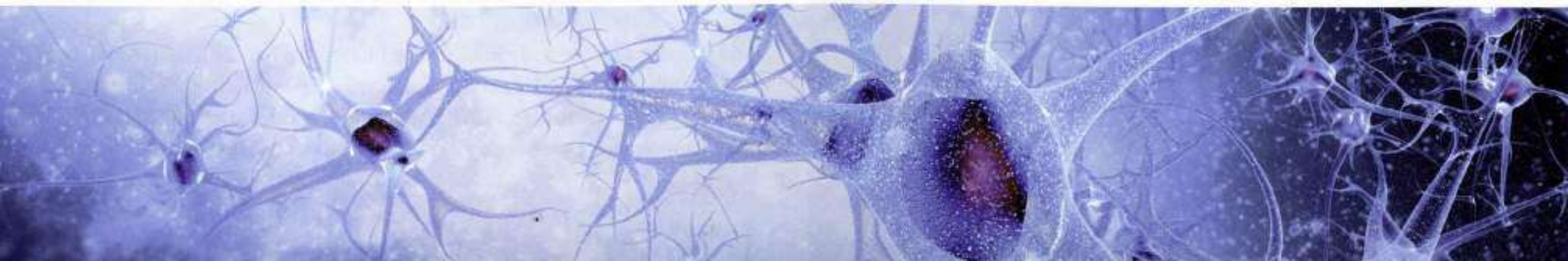
These studies are not without their limitations, and as the body of evidence continues to grow, so too will the funds for research and the larger, more technical and costly studies will be able to be funded.

We can now clearly see that the ability of the brain to integrate sensory inputs is affected in those with recurrent neck pain, and that altered sensory input from the neck appears to interfere with the ability to integrate inputs from other sensory stimuli.

All this evidence points to something remarkably simple – Don't wait for neck pain to improve on its own. Get to your chiropractor! That simple act may influence a lot more than just your neck!

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New Study Says We Can Reliably Detect Vertebral Subluxations

For almost as long as our profession has existed, debate has raged over the terminology central to our cause: the vertebral subluxation. What does it mean? Can it be measured? Is it reliable? Should we call it something else? That debate is one step closer to finished after the latest piece of research from the Centre for Chiropractic Research in New Zealand revealed some big news: we can reliably detect vertebral subluxations.

This study is a landmark study, as it answers (in part) the lack of consensus around the nature, reliability, and neurological manifestations of the subluxation. This is exciting news for us, as we continue to invest into research that removes the question marks surrounding this vital aspect of our profession.

The study used the definition of “Chiropractic subluxation” provided by the Rubicon Group as the testable model. That definition, which differs from our own Foundation definition, is as follows:

“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, resulting in ongoing maladaptive neural plastic changes that interfere with the central nervous system’s ability to self-regulate, self-organize, adapt, repair and heal [1].”

The researchers noted that the term “chiropractic subluxation” included joints outside of the spine instead of the more exclusive term “vertebral subluxations.”

The study, titled “Interexaminer reliability of a multidimensional battery of tests used to assess for vertebral subluxations,” saw researchers recruit a convenience sample from patients over the age of 18 who presented to the Chiropractic Centre. Each eligible patient was examined by two examiners who were unaware of the others findings. They assessed the patient using a multidimensional battery of tests involving “motion palpation, leg length checks, soft tissue palpation and joint play/end feel assessment [1].”

Following the examination, a research assistant measured the spinal segment that the examiner believed to have the most positive test indicators for vertebral subluxation. The examiner also indicated their level of confidence as to their findings.

The examiners undertook their assessments five minutes apart, having no clinical information about the participants and not conversing with them. Over the course of the study, seventy patients were assessed.

Whilst the test methods would be familiar to almost all chiropractors, it is the level of agreement between examiners following these blinded assessments that is most encouraging. The authors noted: “In the combined dataset, definite agreement was 63.3%, definite disagreement was 17.6% and acceptable agreement was 73.3%.”

These are high levels indeed. (For the curious, the most common levels identified were L2, T7 and C3). The results of the study “suggest that a multidimensional approach to vertebral subluxation assessment was reliable between examiners for detecting the level of vertebral subluxations

in all regions of the spine. In at least 63% of assessments the examiners agreed on the same motion segment across all regions of the spine.”

The study was not without its limitations. One of these was the possible argument that the chiropractic educators (who were both part-time in private practice) weren't indicative of chiropractors in the field. Another was that, despite the blinding process, they may have encountered a patient before and been familiar with prior findings or non-clinical cues.

While the study revealed a high level of examiner reliability for a multidimensional battery of tests to detect vertebral subluxations, it did not examine the reliability of these tests. That is work for another day.

This is an exciting study. While a lot of vital work remains on the to-do list before we can have a clear and complete picture of the subluxation, we can now say that we are a step closer. We can reliably and objectively identify a vertebral subluxation. Additionally, a high level of agreement between examiners is possible, thus removing further doubt as to its objectivity.

Congratulations to Kelly Holt and colleagues on another piece of important research.

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Chiropractic Care and Human Performance

In 2006, three researchers undertook a study looking at the effect of chiropractic adjustments on movement time [1]. They were looking specifically at Fitt's Law – a model of human movement based on pointing and manipulation tasks involving computers. The group was small, with just ten participants. But a significant change was noted in the treatment group (who received high-velocity, low-amplitude adjustments to areas of “joint dysfunction.”) There was a significant improvement in movement time with chiropractic care, which suggested that, “spinal adjustments may influence motor behavior.”

It was a pilot study, and it was small, but the results were noteworthy. For many it may have flown under the radar. For others, it represented a small but important contribution to the evidence that chiropractic had a place outside of pain and relief – that it could indeed help lift certain areas of human performance. Though it is now 13 years old, the study is still relatively new in terms of research. Still our understanding of chiropractic care and its benefits as they may apply to human performance has jumped ahead in leaps and bounds since then.

We have seen individual case reports, for example, covering the resolution of injuries or neuropathies under chiropractic care. This includes a recent one in which an 18-year old male presented with a cricket injury that caused pain, loss of strength, reduction in range of motion, as well as pins and needles [2]. In his case, at the end of a six-week course of care he reported:

- Feeling better, with less pain.
- Improvements in quality of life, including a significant improvement in physical functioning.
- Significant changes in range of motion, thermography, and sEMG readings after the progress examination.
- Significant improvements in posture and in previously abnormal neurological tests.

In his individual case, it is easy to see how chiropractic care could restore human movement. Of course, this is but one story of human performance benefiting from chiropractic care post-injury. But could it boost human performance in a more vitalistic model of care when pain and injury aren't the primary concern? When we look to the broader research for information on this topic, we see a clearer picture come together.

The Research Round-Up

Nearly 10 years after the Fitt's Law study was published, another paper hit the press. This time, Imran Khan Niazi and colleagues put the H-reflex and V-waves to the test, asking study participants to perform maximum contractions using leg muscles. What they found was fascinating [3, 4]:

- There was an increase of almost 60% in the electrical activity readings from specifically targeted muscles, a 16% increase in absolute force measures, and a 45% increase in the drive from the brain to their muscle.
- There was a change in the H-reflex happening at the spinal cord level, but it wasn't a spinal cord phenomenon. The brain was changing that reflex effect.
- The participants who received chiropractic adjustments got stronger in comparison to the control group. They did not fatigue the same way.
- The effect was almost identical to three weeks of strength training.

The study presented chiropractors with some valuable takeaways: it was now clear that chiropractic care changed the structure and function of the brain. It was also clear that it could reduce fatigue and increase drive to the muscles.

This finding alone paints a picture of chiropractic care as a valuable tool for the athlete or physical laborer. But soon research would reveal the potential for chiropractic care to aid another form of labor too – that of childbirth.

Again emerging from New Zealand, the study found that adjusting pregnant women appears to relax the pelvic floor muscles at rest [5]. This was a significant finding, as the pelvic floor muscles have active roles in pregnancy and childbirth as well as spinal stabilization.

A novel finding in this study was that the control group, made up of non-pregnant chiropractic students who are adjusted often, had pelvic floor control comparable to elite athletes. Whilst this secondary finding, and its implications on pelvic floor control (and thus stress incontinence among other issues) is not yet clear, it certainly warrants further investigation.

With damaged pelvic floor muscles contributing significantly to the burden of disease worldwide, and with birth complications remaining an issue of concern for expectant mothers and their caregivers alike, the studies indication that chiropractic care may help women to have a natural vaginal delivery (via increased ability to relax the muscles the baby needs to move through in birth) was a hopeful indication indeed.

We have also seen very recent papers showing that chiropractic care for the cervical spine could increase maximal bite force, and that chiropractic "spinal manipulation" (i.e. the adjustment) shortens the cortical silent period [6, 7]. This adds to a growing evidence bank showing many non-musculoskeletal benefits of chiropractic care – from cerebellar function and sensorimotor integration to reduced falls risk and increased ability to perform mental rotation tasks [8].

The Implications for People Under Chiropractic Care

While we are certainly a long way from research proving that chiropractic care can help athletes beat their personal bests or help academics perform at higher levels than they already do, there are some solid indications that chiropractic may have some implications in the area of human performance. It sits in the realms of hypothesis at this point, but still:

- We are increasing our understanding of how the brain drives the muscle. If the cortical silent period is shorter post-adjustment, then this means signals from the brain reach the muscles sooner.
- We know that bite force may increase post cervical-spine adjustment, and that maximal contractions to large muscles (like the leg muscles studied) increase post-spinal adjustment. Both of these have potential to impact physical and athletic disciplines.
- We also know that the increase in H-reflex happened at the brain level not the spinal cord level, and that other studies have shown changes in the prefrontal cortex (which is responsible for executive function) post adjustment.

This is slowly but surely coming together to show us the mechanisms behind why chiropractic works. We have further to go of course, but we can now see that when we adjust, we change the structure and function of the brain. We can increase some brain signals, and allow them to reach their destination sooner. We can remove distortion, which may mean less fatigue and more strength.

As we saw from our recently published consciousness series, the neuro-plastic implications of chiropractic may have many an impact on brain-related aspects

of human performance. Now it is becoming clear that a well-adjusted body is one in which muscle strength and sensorimotor integration are more efficient, and fatigue may be reduced.

As our understanding of the vertebral subluxation grows, so too does our knowledge of the flip-side – what happens when we remove it. Those results are proving encouraging indeed.

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Leg Strength and Brain Health – Why We Need to Get Checked and Get Moving

Frontiers in Neuroscience recently published an article that highlighted the links between large muscles in the leg and brain health. It has been reported that the study fundamentally alters brain and nervous system medicine “giving doctors new clues as to why patients with motor neuron disease, multiple sclerosis, spinal muscular atrophy and other neurological diseases often rapidly decline when their movement becomes limited.” [1]. Beyond the ramifications for traditional medicine, the study increases the importance of chiropractic research that also shows the links between the brain and leg muscles.

While the relationship between brain activity (especially cognitive ability) and physical activity is well referenced in literature, the study sought to take a closer look at the effect physical activity might have on neurogenesis and the levels of proliferative progenitor cells in the brain.

The study in question was an animal model examining two groups of mice: one group was able to move freely. The other was able to move only the forelimbs, which mimics the effect of being bedridden or in zero gravity.

The differences found between the two groups were quite profound. While it was an animal model, and thus the applications to humans may not be exact, rat/mice models are commonly used as predictors for how certain interventions or situations may apply to humans, and thus the findings are likely to be quite significant.

Findings included the following:

- The mice who were fully mobile had far more proliferating cells in the sub-ventricular zone than the motor deprived animals. In fact, the motor deprived animals had “70% fewer proliferating cells” than the control animals [2].
- The motor deprived animals also had significantly lower proliferation capability than the fully mobile mice.
- The motor deprived mice also showed lower differentiation and maturation capabilities than the fully mobile mice that could move their hind legs.
- The motor deprived mice showed alterations in cell cycle gene expression. These differences applied specifically to two genes: CDK5 regulatory subunit-associated protein 1 and a cyclin-dependant Kinase 6.
- There was also a significant metabolic alteration between the control group and the experimental group.

All these scientific terms spell out a simple message: a severe reduction in movement or gravity stimuli “exerts an important effect on the human body, altering the activity of many organs including the brain [2].”

Among the potential changes are “alteration in afferent signaling and feedback information from intramuscular receptors, to the cerebral cortex, due to a modification of the reflex organization in hind limb muscle groups [3, in 2]. The researchers also noted that prolonged limb suspension (as seen in bed rest) induces nervous system plastic properties in humans, and changes in the memory function, spatial learning and protein expression changes in mice.

Essentially, this means that when we reduce exercise (especially in our lower limbs), we compromise neurological health, making it difficult for our body to produce new neural cells which can help us adapt and cope with stress. We also lower the amount of oxygen in the body “which creates an anaerobic environment and alters metabolism [1]”, altering some genes which are important for the health of our mitochondria.

“It is no accident that we are meant to be active: to walk, run, crouch to sit, and use our leg muscles to lift. Neurological health is not a one-way street with the brain telling the muscles ‘lift’, ‘walk’, and so on” said Adami [1]

“Our study supports the notion that people who are unable to do load-bearing exercises — such as patients who are bed-ridden, or even astronauts on extended travel — not only lose muscle mass, but their body chemistry is altered at the cellular level and even their nervous system is adversely impacted,” lead researcher, Dr. Raffaella Adami, was quoted as saying [1].

Researchers also noted neurotransmitter changes involving glutamate receptors, and the concentration of serotonin, dopamine, GABA and epinephrine in rats, and pointed to other work that demonstrated inhibition of bone formation [2].

These findings are all significant, making it obvious how traditional medicine needs to change in order to support brain health (especially in conditions like motor neurone disease and multiple sclerosis.) But it also shines a light on the importance of exercise in general health. The more we work the muscles in our legs, the more our brain can produce new cells.

The Chiropractic-Leg Muscle Link:

Beyond these initial findings, the study appears to link seamlessly with chiropractic research showing greater muscle strength and less fatigue (to the leg muscles) once study participants were checked and adjusted [4, 5].

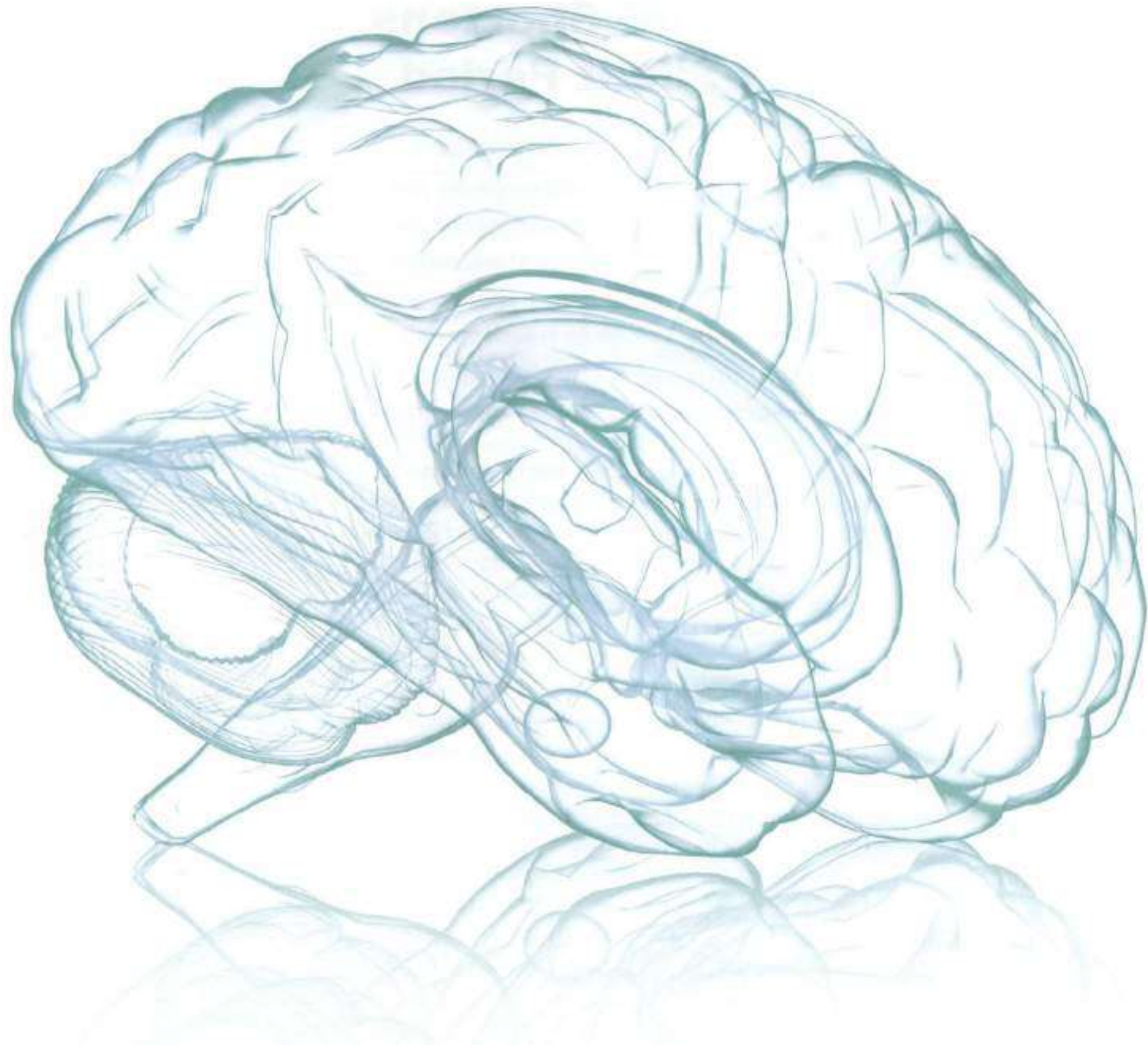
If leg muscle strength is important in brain health according to Adami *et al*, then the fact that the chiropractic adjustment has been found to increase participants ability to perform maximal leg contractions (with less fatigue over time) is a significant finding. Yes it does represent a circular effect: we boost the brains ability to drive muscles in the leg, and the use of leg muscles boosts the brains ability to create new nerve cells and maintain health throughout the body.

Together, the two studies illustrate the regenerative and mutually beneficial power of the innate intelligence that drives brain and body.

With neurological diseases representing a growing concern as the population ages, these two pieces of research (when read together) provide a powerful impetus to get checked and get moving. We often say that the aim of chiropractic is to add years to life and life to years. Now we can see one mechanism that explains how that might work.

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Chiropractic Care Shortens the Cortical Silent Period

Within the world of chiropractic care, a new stream of research is emerging that moves us further away from pain and symptoms, and more towards the affect of the chiropractic adjustment on brain and body. As we advance our understanding of the vertebral subluxation and what happens when we adjust, it becomes increasingly apparent that chiropractic care has the potential to reach far beyond the realms of the musculoskeletal. Many a chiropractor has long believed this, but in a world where research is currency, the evidence bank matters greatly.

The latest piece of evidence on the subject of how the brain drives the muscles pre and post chiropractic adjustment emerges from the New Zealand College of Chiropractic. It appeared in the most recent edition of the Journal of Electromyography and Kinesiology, and was titled “Chiropractic spinal manipulation alters TMS Induced I-wave excitability and shortens the cortical silent period” [1].

While the title of the study potentially gives away the punch-line, it is worth noting that this study is the latest in a line of research from the NZCC investigating what happens at the brain level when we adjust the spine. This stream of investigation has yielded some encouraging results for the field of chiropractic, as it is becoming increasingly clear that when we adjust, we change the function of the brain.

This is information that first emerged with Dr’s Heidi Haavik and Bernadette Murphy published a piece in the Journal Neural Plasticity

revealing a significant (20%) difference in prefrontal cortex activity pre and post-adjustment [2]. Lead researcher Heidi Haavik told Spinal Research [3]:

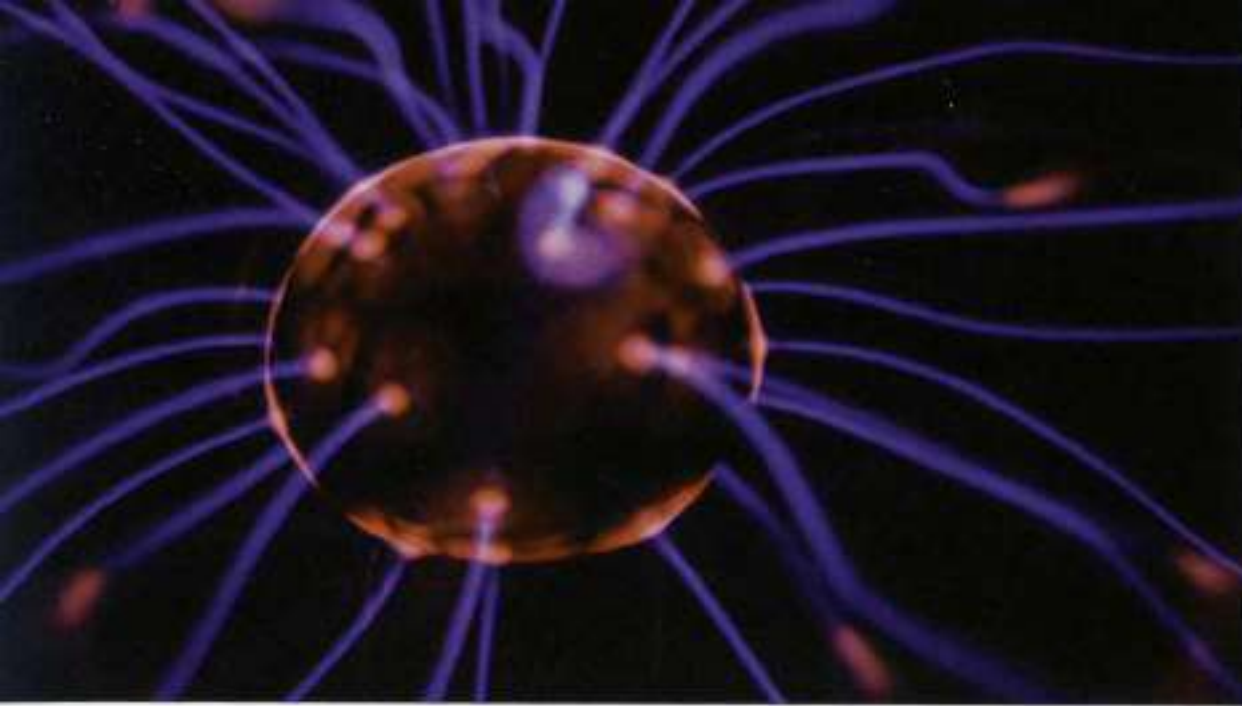
“This is solid scientific evidence that adjusting the spine changes the way the prefrontal cortex of the brain is processing information from the arm. It demonstrates we change the way the brain works and shows that spinal function impacts brain function. One of the most interesting things about the changes we observed was that the prefrontal cortex is responsible for behavior, goal directed tasks, decision-making, memory and attention, intelligence, processing of pain and emotional response to it, autonomic function, motor control, eye movements and spatial awareness.”

Since that 2016 offering, the team at the NZCC have offered up a number of further additions to that evidence bank. Among them are papers revealing the impacts of chiropractic care on cortical and cerebellar motor processing, and mental response times for complex rotation tasks [4, 5]. There is also evidence that bite force increases post chiropractic spinal manipulation [6].

These studies are in addition to earlier papers revealing altered sensorimotor integration and transient modulation of intra-cortical inhibition following chiropractic care [7, 8].

The Latest Offering: Shortening the Cortical Silent Period

This latest study took 19 participants (16 male and 3 female) aged between 23 and 39 with a history of reoccurring spinal pain or stiffness, and allocated them to either a spinal manipulation or a control intervention. All participants were pain free at the time of the trial. They underwent transcranial magnetic stimulation that measured motor evoked potentials (MEPs) for the lower leg muscles (tibialis anterior), including their resting and active motor



thresholds. MEP latency and the length of the cortical silent period (or the delay between the initiation of movement in the primary motor cortex to the muscle contraction in the leg) was measured pre and post-intervention for the spinal manipulation group and the control intervention group.

For the spinal manipulation group, the intervention included a full spine and sacroiliac joint assessment for vertebral subluxations. They were adjusted where deemed necessary by an experienced (10 years plus), registered chiropractor.

“The clinical indicators that were used to assess the function of the spine prior to and after each spinal manipulation intervention included assessing for tenderness to palpation of the relevant joints, manually palpating for restricted intersegmental range of motion, assessing for palpable asymmetric intervertebral muscle tension, and any abnormal or blocked joint play and end-feel of the joints. For this study a segment was defined as dysfunctional if at least three of these indicators were present at the same segmental level [1].”

The control intervention simply consisted of passive movements of the subject’s head, spine and body, after being assessed for vertebral subluxations and moved into spinal manipulation set-up positions.

While the study itself is rich in detail, and certainly warrants a full read, there were some key takeaways. The results for the length of the cortical silent period were significant: “Post hoc analysis revealed significant ($P = 0.002$) decrease of 19.42 ms in duration of inhibition after spinal manipulation only [1].” This effect was not present in the control group. According to the researchers, this study also yielded three novel findings:

“Firstly, this study demonstrated in human subjects the existence of individual I-waves using single motor unit recordings. The I-waves were observed in the single unit data as separated entities with significant peaks and are confirmed to be excitatory events as the discharge rate underlying them were higher than the background rate. Secondly, chiropractic manipulation significantly increased the amplitude of the first I-wave. Finally, the CSP [cortical silent period] duration was significantly reduced after spinal manipulation in lower limb muscle [1].”

It’s a study with clinical relevance as well as prompts for future research. It provides evidence that “spinal manipulation can result in a significant increase in the excitability of the motor pathways to low threshold motor units of human tibialis anterior muscle [1].”

The study was not segment-specific in its nature. That is, the chiropractor adjusted where the vertebral subluxation was found. Although this piece of research comes with plenty of opportunities for further investigation, it does give us a hint as to the effect of the chiropractic adjustment on the primary motor cortexes of the brain. When we adjust for vertebral subluxations, it changes the way the brain communicates with the muscles.

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Headaches, Migraines and Chiropractic: What the New Research Says

It would be a rare chiropractor who hasn't witnessed an apparent correlation between chiropractic care and improvements in the frequency or severity of headaches and migraines. It may happen in one patient or several, but is there a connection, and if so what are the mechanisms behind it? While it is true that headaches and migraines can have a myriad of triggers and causes, it is also apparent from a range of recent case reports that chiropractic may have something to offer.

In the past year, the Annals of Vertebral Subluxation Research have carried four separate case reports involving improvements in headaches following chiropractic care. The first featured a 59-year old male presenting with headaches, neck pain and rheumatoid arthritis. The case appeared in the Journal of Upper Cervical Chiropractic Research and hypothesized, "the upper cervical subluxation may be a contributing factor to rheumatoid arthritis-related pain [1]."

While the case-report focused more attention on the rheumatoid arthritis (the course of care lasted 12 sessions over 10.5 weeks), it is interesting to note that headaches and neck pain resolved after the first adjustment and the patient discontinued medication.

The second case report, authored by chiropractors Laura Stone and Joel Alcantara and appearing in the Journal of Pediatric, Maternal and Family

Health, looked at a fascinating and somewhat complex case. The patient was an 11-year old male with autism. He presented for care with headaches that were affecting sleep and school attendance. He also had ADHD and obsessive-compulsive disorder. His case was indeed a complex one, but among the vast improvements noted was a marked improvement in his headaches.

Again, care was focused on the reduction of vertebral subluxations, several of which were noted in the case report [2]. With this case, the chiropractor utilized Gonstead and Thompson Techniques.

A third case report involved a 13-year old who had been in a motor vehicle collision and had developed chronic neck pain along with headaches and dizziness following the accident. The case report presented with a number of interesting factors: the first being the fact that he had a significant cervical kyphosis and that resolution of the headaches occurred in tandem with a return to lordosis. The second interesting factor was a gradual return of symptoms in the year following the patient's discontinuation of care. He was cared for using Chiropractic Biophysics.

It certainly prompts the question: what happens when we allow these familiar subluxation patterns to return unencumbered for a significant length of time?

These three case reports, all of which featured literature reviews and clinical details well worth perusal, featured male patients and different chiropractic techniques. The final case report was a female patient who, at age 23, had a 10-year history of headaches and migraines.

Her current management plan was medication-based and reported as "essentially ineffective." She was cared for using Diversified, Grostic

and Thompson Techniques as well as upper cervical technique only on a number of visits. Of specific note to the headaches (as opposed to her other complaint of low back pain), the authors stated:

“For a month thereafter, the patient remained completely migraine-free after only being adjusted upper cervically on two separate visits. Her cervicalgia and low back pain continued to steadily improve as well. She was only experiencing slight headaches intermittently throughout the week that were rated as 3/10 on the VAS.

After 10 weeks of continued care like previously mentioned, the patient reported that all her presenting complaints of chronic migraines, neck pain, and low back pain had completely resolved. The patient had a quarterly check-up visit with her neurologist who had prescribed her medication for her migraines.

After a discussion with her neurologist about how uppercervical chiropractic care had resolved her migraine episodes, the neurologist agreed she could discontinue the prescription medication regime. The patient has not required the use of pharmacological intervention for migraines since then.”

Once again, her care was directed at reducing vertebral subluxations and featured a variety of techniques.

All of these are case reports and literature reviews and thus we can't generalize findings. All of them follow headaches with different etiologies. But all of them indicate a significant improvement in headaches within a short amount of time under chiropractic care.

They are not the first, nor will they be the last. But the thing that makes them refreshing is that they are focused on subluxation-based care. The reduction in headache symptoms simply follows closely on those heels.

The Neck – Headache Link

While it is perhaps entirely unsurprising, it is nonetheless noteworthy that a number of basic science research studies have linked neck pain to headaches. As chiropractic has a proven record with neck pain, and many chiropractic patients present with such complaints, it is an easy in-road to conversations about the effects of vertebral subluxation on health more broadly.

In 2017, JMPT published an article looking at the effects of upper cervical translatoric mobilization on cervical range of motion and headache symptoms. It was a randomized controlled trial involving 82 volunteers with cervicogenic headaches. The study looked specifically at pressure pain thresholds from C2-C3, suboccipital muscles, and trapezius muscles. The study found that “upper cervical translatoric spinal mobilization intervention increased upper, and exhibited a tendency to improve general, cervical range of motion and induce immediate headache relief in subjects with CEH [cervicogenic headaches.]

The trapezius muscle correlation may not be an isolated concept either, with a 2018 study indicating “a strong association between trapezius muscle tenderness and the level of intensity and the number of days with a headache among female office workers [6].” While the study was a basic science article that did not comment on vertebral subluxations, the issues of neck pain, associated muscle pain and even the effect of office ergonomics or stressors on posture, neck pain, and subluxation could be more common than we think.

After all, we have a veritable epidemic of people looking down at smartphones, laptops and handheld devices which may induce forward head posture and place huge amounts of undue stress on the cervical spine [7]. This is to say nothing of the postural ramifications of sedentary lifestyles if forward head posture and cervical hyperkyphosis is seen.

It seems the headache-neck pain connection is an easy one to argue, especially when there are cervicogenic connections. Headaches with such origins have long been a concern for post-whiplash patients, neck pain patients or even certain types of athletes [8].

The term “cervicogenic headache” is relatively new though, with diagnostic criteria including unilateral pain “starting from one side of the posterior head and neck, migrating to the front and sometimes associated with ipsilateral arm discomfort.” It may also be aggravated by “certain neck positions.”

It has been suggested that cervicogenic headaches are a “final common pathway for pain generating disorders of the neck. Bogduk has proposed that the pathophysiology of CGH [cervicogenic headache] results from a convergence of sensory input from the upper cervical spine into the trigeminal spinal nucleus, including input from: Upper cervical facets, Upper cervical muscles, C2-3 intervertebral disc, Vertebral and internal carotid arteries, Dura mater of the upper spinal cord, [and] Posterior cranial fossa [8].”

We are growing in our understanding of the implications of neck pain far beyond simple discomfort. While the links to cerebellar processing and mental response times are making themselves increasingly clear in the world of chiropractic research ([read more here](#)), basic science seems to be indicating that when there is neck pain, headaches may be lurking somewhere close.

So what’s the take-away for chiropractors? When it comes to headaches and migraines, the best thing we can do is what we are known for: removing subluxations, enabling the body to achieve optimal neurological function and letting the body do the rest. Yes, we need more research. That is always a given. But as the bank of case reports and basic science articles mount up, linking either subluxations or neck dysfunction, the road forward seems pretty clear.



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Systematic Review Examines Muscle Strength Post Spinal Manipulation

A recent systematic review published in the Journal of Manipulative and Physiological Therapeutics has taken aim at an issue that is potentially close to many a chiropractors heart: the effectiveness of spinal manipulation in increasing muscle strength in healthy people.

Following a spate of chiropractic-based studies showing increased muscle strength (or rather cortical drive to the muscles) post-adjustment, the results may not be all that surprising: they suggest that spinal manipulative therapy is superior to no intervention or sham manipulation when it comes to “augmenting the percentage change in isometric strength gain [1].”

The systemic review took in 909 identified records in a thorough database search. From here, duplicates were removed and exclusion criteria were applied leaving only three articles to assess on this topic. Due to the heterogeneity of the articles, the authors suggested the results be interpreted cautiously.

Here’s the kicker though – None of the work produced by Haavik, Murphy or the New Zealand College of Chiropractic was included in the systemic review after the exclusion criteria was applied.

This is despite investigation on muscle strength pre and post-adjustment

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Proprioception and Pain: the Link for Low Back Pain Sufferers

A recent study appearing in the Journal Manipulative and Physiological Therapeutics has examined the evidence for a correlation between lumbar proprioception and clinical low back pain. It was a systematic review that searched six major databases and returned five studies (with a total of 204 patients) eligible for inclusion. At the end of the process, researchers have been able to claim that there is a relationship between pain intensity and proprioception, albeit a complex one.

The nature of pain perception is complex and subjective. Research has revealed sex, age and ethnicity all impact on pain perception [1]. Other factors that feed into the pain experience include “genetic, developmental, familial, psychological, social and cultural variables” [2]. All considered, the reality is that two people could suffer from the same condition to the same severity, and yet have vastly different experiences of pain and pain-related disability.

While altering any of these variables may be outside the purview of the chiropractor, there is one thing we have been found to impact: proprioception [3].

That’s what makes this latest systemic review so interesting. Researchers, Ghamkhar and Kahlaee, scoured six leading medical databases for papers that recruited patients with chronic non-specific low back pain

longer than three months in duration, and that assessed proprioception and pain intensity or pain-related disability [4]. A series of exclusion criteria were set up to ensure the validity of the review.

All relevant studies defined non-specific low back pain as “lumbar pain without a specific established anatomical or neurological cause” and the sample sizes in each eligible study ranged from 15-90 participants. One study looked at women only, but the other four studies included both sexes, and pain intensity ranged from 3.3-6.3 on a 0-10 scale.

Proprioception was measured via joint repositioning errors (JRE) in four of the studies, and “threshold to detection of passive motion (TTDPM)” tests in one study. The researchers explained [4]:

“The JRE test measures how accurately a participant can actively or passively reproduce a ‘target position.’ Three common JRE parameters are (1) absolute error (AE), which is the unsigned difference between the target and the reproduced position, indicative of repositioning accuracy; (2) constant error, defined as repositioning bias, which shows the overshoot or undershoot repositioning error; and (3) variable error, indicating variability error and calculated from constant error scores.”

“The TTDPM test measures sensitivity to detection of passive lumbar spine movement at a constant velocity and indicates the earliest point the participant senses any positional change.”

Interestingly, the findings revealed that, (in CNSLBP sufferers) “pain-related disability was significantly positively correlated with flexion and extension AE [absolute error].” Furthermore, they found that there was “no correlation between pain intensity and AE in any movement directions.” In other words, impaired proprioception (regardless of the direction of movement) was



positively correlated. The researchers remarked [4]: "Although the limited evidence agrees on a fair to moderate correlation between proprioception impairment and pain-related disability, there is no consensus on such a relationship between proprioception and pain." This makes the systemic review, and further research into the matter, an important undertaking so that the limitations of such studies can be accounted for.

What we do know from this study is that proprioception impairment may be a mechanism for pain perception. Whether that is because of decreased sensory feedback, postural and muscle control, predisposition towards injury and micro-trauma or other psychological factors remains to be seen.

Again, researchers remarked that "the pain interference model suggests that, in the presence of pain or fear of pain, the CNS [central nervous system] chooses to suppress the motor activity in the pain-related region as a protective mechanism...However, in most of the recent studies, impaired proprioception could not be explained by pain."

At this point in time, there is a paucity of chiropractic-specific research into the correlation between proprioceptive impairment and pain perception. However, we do have a growing evidence bank that points to a link between chiropractic care and improved proprioception, as well as research on how the adjustment may alter the way the brain processes pain [3, 5]. Thus we have indicators that, for low back pain and other issues, chiropractic may be a more valuable piece of the pain and function puzzle than many currently think we are.

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Study: Chiropractic Patients Have Lower Levels Of Adverse Drug Reactions Than Non-Chiropractic Patients

As the conversation around the US opioid crisis continues, with claims that more than 115 people in the US die every day after overdosing on opioids, a new study has examined whether there could be any link between chiropractic care and the risk of adverse drug events (ADE's). While a topic such as this is loaded with possibilities that no single paper could rule out, the study did reveal that adverse drug reactions were 51% lower for the cohort studied. Now that is something that certainly warrants further investigation.

As you can imagine, it was a complicated research question to answer. The process saw researchers create a retrospective cohort study, sourcing all payer claims (from private and public third party payers) administered by the Department of Health and Human Services in New Hampshire, USA [2]. Their sample was significant: New Hampshire Residents aged 18-99 years old, enrolled in a health plan in 2013-14 with at least two clinic visits within 90 days for a diagnosis of low back pain.

This amounted to a sample group of more than 19,000, and the group was almost evenly divided between recipients and nonrecipients of chiropractic services. Researchers remarked:

“The cohorts did not differ by sex, but they did differ by age category, with a larger portion of young adults among chiropractic recipients. The cohorts also differed by health status; as measured by Charlson comorbidity score, nonrecipients had significantly inferior health status [2].”

While the researchers adjusted for this in their modeling, there were a number of limitations to the study. Among them were:

- the patients self-selection of care pathways
- unknown factors such as the onset, location and intensity of pain
- the retrospective and self-reported nature of the study
- inability to establish causation, just correlation

Regardless of those questions, and despite the fact that the study was constrained to the low back pain model of chiropractic, the study found a 51% reduction in risk of ADE's for chiropractic-service recipients.

“Among 9810 recipients of chiropractic services, 41 participants (0.4%) experienced 44 ADEs. Among 9 343 non-recipients, 84 participants (0.9%) experienced 94 ADEs. The adjusted likelihood of an ADE occurring in an outpatient setting within 12 months was 51% lower among recipients of chiropractic services as compared to nonrecipients (OR 0.49; $P = .0002$). The ADEs were nonspecific with regard to drug category in 84% of incidents that occurred among recipients of chiropractic services and in 82% of incidents that occurred among nonrecipients. [2]”

The study uncovered 44 ADE's in chiropractic recipients, and 94 ADE's in

nonrecipients. There were some ADE's that occurred in both sample groups, despite the number of events in the chiropractic recipient group being lower. These included drug induced dermatitis, allergies, drug induced mental disorders, and poisoning. There were also a number of ADE's that occurred only in the nonrecipient group. These included withdrawals, drug induced neuropathy and poisoning specifically from antidepressants, aromatic analgesics, hypnotics, anticoagulants, heroin and opium.

This study, whilst it does perhaps leave us with more questions than answers, suggests that “utilization of chiropractic care may be associated with reduced risk of ADE's.” No causal relationship has been established, and this in itself is fodder for future work. The researchers suggested that future work include larger databases, longer time periods and more sensitive methods of identifying ADE's.

So Where Does This Leave Us?

This piece of research places yet another question-mark over the effectiveness of some drugs to treat low back pain, whilst simultaneously suggesting that chiropractic care is a positive thing for sufferers. (Cue our collective surprise.) While the research on chiropractic and low back pain has been out for a long time, the line of investigation providing some critique of NSAIDs (nonsteroidal anti-inflammatory drugs) seems to be in its infancy.

Among the most recent contributions was an Australian study finding that non-steroidal anti-inflammatory drugs are “only a little better than placebo” for back pain. In the study, published in the *Annals of the Rheumatic Diseases*, the authors stated:

“We provide sound evidence that NSAIDs are effective, but do not offer clinically important benefits for spinal pain above those attributable to placebo, given overall pooled estimated differences were <10 points. This is crucially

important because we now know paracetamol [acetaminophen] is ineffective, and opioids only offer small benefits for spinal pain. Thus, given our results and evidence from these recent high-quality meta-analyses, it seems that there are no analgesics with clinically important effects over placebo for spinal pain.”

This research followed a 2016 study with nearly 8,000 participants that found opioids were “often ineffective for back pain [4].” It was a meta-analysis that collated placebo-controlled RCT’s, thus providing a systematic analysis on the practice of prescribing drugs for back pain. The authors of that study concluded:

“For people with chronic low back pain who tolerate the medicine, opioid analgesics provide modest short-term pain relief, but the effect is not likely to be clinically important within guideline recommended doses. Evidence on long-term efficacy is lacking. The efficacy of opioid analgesics in acute low back pain is unknown [4].”

The study landed just months after a research paper presented to the European League Against Rheumatism, found that NSAIDs could inhibit ovulation after just ten days [5]. This study, unsurprisingly, cast a critical light on the potential effects of long-term NSAID use on fertility.

Meanwhile, a 2018 study compared US military personnel who just used usual medical care for their back pain with those who used medical care plus chiropractic. It found that the latter had better results, and less pain and disability [6]. While this study, along with the latest study on chiropractic care and adverse drug reactions, looks through the limited lens of the low back pain model for chiropractic,

they still suggest something we know to be true – if you have low back pain, consider a chiropractor before you consider long term drug use.

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Is Spinal Manipulation Effective in Improving Psychological Outcomes?

What exactly does chiropractic do if it isn't a 'treatment' per se? It's a question often asked, and there are countless potential answers. While we cannot claim to treat all and sundry, and we tend to rest our claims on removing interference from the nervous system and letting the body do the rest, research is beginning to illustrate the reaches of the removal of vertebral subluxations. We have seen impacts on cortical drive to the muscles, on the structure and function of the brain, and much more. But a trip through the archives of Complementary Therapies in Medicine brought up an interesting topic: whether or not "spinal manipulation" was effective in improving psychological outcomes.

It's an interesting question; exploring the therapeutic benefit of "spinal manipulation" beyond the physical element alone. We know that chronic pain and depression often run hand in hand, so it is a reasonable question that perhaps doesn't have enough investigative thought applied to it.

Published in 2007, and easily flying under the radar of many a chiropractic research enthusiast due to its "spinal manipulation" centric language, the paper identified in 129 randomized controlled trials involving spinal manipulation. From this number, they found six trials with a verbal intervention comparator and eight with a physical treatment comparator (a total of 13 papers).

The authors of the review flagged research pointing to the psychosocial factors that are now known to be more important in the "presentation and development of neck and back pain and associated disability than biological factors." Thus, psychological benefits of manipulation (or chiropractic care as we prefer to call it) are an important consideration in terms of therapeutic benefit.

For the purpose of the review, spinal manipulation was defined as "using manipulation of mobilization techniques. Manipulation is a localized force of high velocity and low amplitude directed at a spinal segment." Psychological outcomes included [1]:

- Back pain beliefs
- Fear-avoidance beliefs
- Self-efficacy
- Depression and anxiety and;
- Generic outcome measures with a psychological component

In a review and meta-analysis spanning the breadth that this one did (with 2466 potentially relevant titles narrowed down to the 13 included trials), there was potential for a plethora of variables to complicate the mix. The researchers opted to take the track of using trials that were relatively homogenous in terms of the "region of the spine treated, profession of manipulator used, the nature of the control group, and the psychological outcome reported."

They ended up looking at the lower back, the neck, and full spine adjusting, spanning osteopaths, chiropractors, physiotherapists and physicians who performed a combination of HVLA thrusts and mobilization techniques. Control variables included verbal interventions including primary care, advice and education, and physical treatments including electrotherapy, sham manipulation, muscle relaxants, cervical collar, and surgery.

With the exception of a sham manipulation, each of these variables could be considered a significant intervention, with research backing each of them. Even cognitive behavioral therapy has appeared in the peer-reviewed literature for back and neck pain. While the original study (referenced below) carried a high level of detail pertaining to each study, the principal findings leaned toward the positive for chiropractic and manual therapies. The authors stated that:

“There was a small improvement in psychological outcomes after spinal manipulation compared with verbal interventions; a smaller improvement compared with physical treatments, although 95% confidence intervals included zero at 6—12 months [1].”

The small improvement was, with the exception of three studies, statistically significant. In two studies, a limitation was cited in that no baseline scores were taken. While there were several studies that offered up statistically significant findings and none that refuted these findings or skewed the study in the opposite direction, it is certainly an area that begs more research.

While the confidence interval at 6-12 months post-intervention may read as discouraging, it is also perhaps unsurprising given the length of interventions noted in the original study. Whatever the limitations of the review, one thing is certain; that spinal manipulation and psychological outcomes are worth considering and comparing.

As chronic pain often runs hand in hand with reduced quality of life and comorbidities like anxiety and depression, the practitioner who could deliver both a physical and a psychological benefit would be an asset to the sufferer indeed.

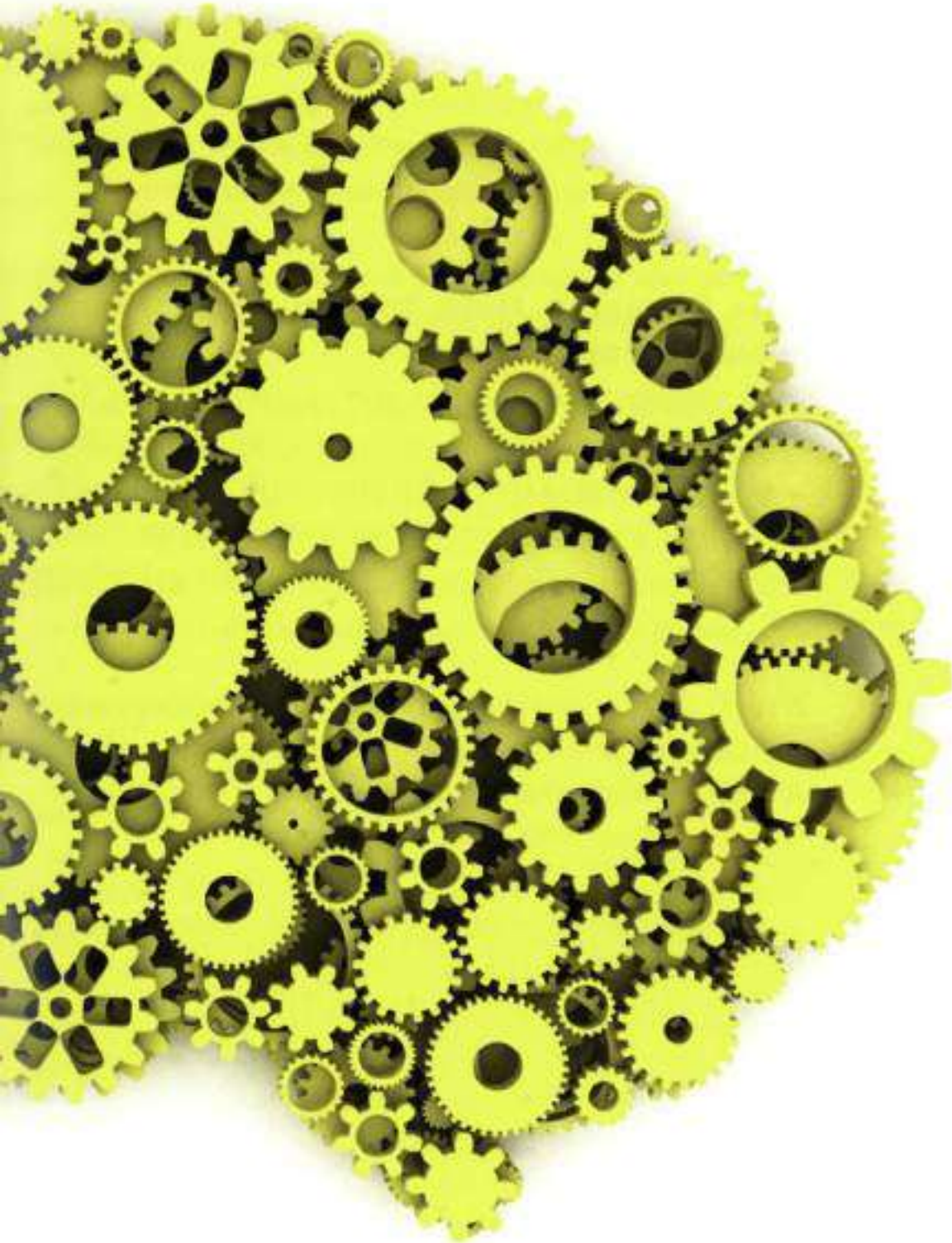
In closing out the article, the authors remarked that, “The clinical implications are that physical treatments, such as spinal manipulation, have psychological benefits, and in the words of the Chinese sage Chen Jen; “When you treat disease, first treat the mind.” Wise words, indeed.

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Can Chiropractic Help The Young, Athletic Patient?



There are many important, continuing conversations that occur around the role and effectiveness of chiropractic care at various points in the lifespan. The common ones include non-musculoskeletal conditions, older adults, and pediatric and infant care. But nestled in among these cohorts is another one that doesn't get too much of a loud shout: chiropractic care for fit, healthy people including athletes.

Occasionally chiropractic gets a shout out from the pit crew of a big name athlete: Usain Bolt, Tiger Woods and the legendary Michael Jordan are all names synonymous with sporting prowess, who have also been said to benefit from chiropractic care. But a celebrity endorsement does not equate to evidence in terms of research.

A new case report covering the resolution of lower limb neuropathy in an 18-year old cricketer has just been released, and perhaps it's a good time to revisit the evidence surrounding chiropractic care and enhanced physical functioning or performance.

First, the Case Report

The case report, published in a recent edition of the Chiropractic Journal of Australia, detailed the care of an 18-year old male who had sought out the services of a chiropractor to help with a "2-year history of low back, leg and foot pain, and associated neuropathy [1]."

He had sought other treatment over the course of 13 months and still faced worsening symptoms, before receiving chiropractic care.

His symptoms were associated with an injury he sustained as a [cricket] fast-bowler. He rated his pain as constant, stating that it could be as severe as 8/10. He reported “a stabbing sensation in his left piriformis, pain in his left calf, “pins and needles” at the front and medial side of the foot when sitting and loss of strength in the left forefoot [1].”

Unsurprisingly, this affected sleep, exercise, tasks in daily living, and quality of life (including stress, life enjoyment, and mental/emotional state). His care was not symptoms-focused, but rather focused on the correction of vertebral subluxations.

These subluxations were detected via commonly used clinical indicators including leg length inequality, static palpation, thermography and surface electromyography.

The patient was found to have subluxations and areas of hyperactivity in vast portions of his spine (see the full case report for more details). Chiropractic care, twice weekly for six weeks using Activator Methods and Torque Release Techniques, had a significant impact on his subluxations and “coincidentally” his symptoms.

At the end of the six weeks, the patient reported:

- Feeling better, with less pain
- Being the “most pain free” he had been in “ages.”
- Improvements in quality of life, including a significant improvement in physical functioning.

His chiropractor noted indicators of reduced subluxation over the course of care. Full details are available in the original report, but they do include:

- Significant changes in range of motion, thermography and sEMG readings after the progress examination

- Significant improvements in postural examination results
- Balanced leg length (prone)
- Improvements in a previously-abnormal neurological test.

This patient had shown pain and neuropathy as the result of a sport injury, and his symptoms improved concomitant with chiropractic care. But his was a class of injury not uncommon in cricketers. He is not the first, and will not be the last, athlete to seek and/or benefit from chiropractic care.

What Does the Research Have to Say About Human Performance and Chiropractic?

Recently published research indicates that chiropractic care can have an impact on the way the brain drives the muscles. These are significant findings, as they suggest change occurs at the brain level and not just the spinal cord. I.e. When we adjust and correct the subluxation, we can have an impact on the brain's ability to communicate with muscles. These landmark studies include:

- A study that showed changes to cortical drive to upper and lower limb muscles following chiropractic care [2]
- A study revealing changes in the H reflex and V waves following chiropractic care. Lead author, Dr Heidi Haavik told Spinal Research, “What we can say based on this study is that when we adjust subluxations, we improve strength, we prevent fatigue and we change the way the brain drives our muscles [3].”
- A more recent study revealing the impact of chiropractic care on bite force. Once again, this indicates an improvement in the brain's ability to drive the muscles following chiropractic care [4].

- **Research showing the effect of subclinical neck pain on cerebellar processing, and the impact of chiropractic care on this phenomenon [5].**
- **A paper indicating chiropractic care can increase sensorimotor function in older adults – shown via increased choice stepping reaction time and decreased falls risk [6].**
- **A growing bank of data showing the impact of chiropractic care on proprioception, which is essential to balance [7].**

All in all, we are slowly but surely amassing a bank of data that indicates chiropractic care has a potential role in human performance, not just pain.

Athletic pursuits will always carry the risk of injury, and the case study covered in this article indicates that even in young, athletic patients, chiropractic care has a role. But the potential impacts on drive to the muscles, proprioception, cerebellar processing is where it gets truly interesting to the chiropractor or chiropractic patient interested in furthering human performance and not just reducing pain. We are truly excited to see where subluxation-based research may take us!

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Study On Pregnant Women Under Chiropractic Care Shows Positive Results

Pregnancy is a time of massive change – mentally, emotionally, hormonally and biomechanically. It is also a time when many women look for other options in order to manage various health challenges during their pregnancy. Of course, chiropractic care rates among the many women choose during this time. Therefore a recently-published report, which examined the quality of life and visit-specific satisfaction of pregnant women receiving chiropractic care, will be of interest to chiropractors who support expectant parents during this challenging and exciting period of their lives.

The report was a quality-of-life focused project undertaken by Dr. Joel Alcantara and his colleagues for a number of reasons.

They wanted to better understand the population (pregnant women seeking chiropractic care during pregnancy) and to understand whether these women “report less problems with emotional disturbances (i.e, depression, anxiety), sleep disturbance, fatigue, pain and physical functioning before and after receiving chiropractic care [1].”

The survey-based study took place in a practice-based research network and looked specifically at the Webster Technique. This technique is often used with pregnant patients due to its goal – to reduce the effects of sacral subluxation & facilitate neuro-biomechanical function in the pelvis [2].

For the purpose of this particular paper, the PROMIS-29 questionnaire was used alongside the RAND VSQ9 (or visit-specific satisfaction instrument). The PROMIS-29 survey contains seven domains, which cover the “most relevant areas of self-reported health for the greatest majority of people with chronic illness.” Each of the seven domains contains four questions rated on a Likert scale [3].

Gaining an Understanding of the Cohort

The first part of the report focused on the important task of gleaning more understanding of the cohort. It was interesting to note that, of the 343 pregnant participants, the average age was 30.96 and the participants were found to be “highly educated with the vast majority attaining a college education or above [1].”

This education status statistic accounted for 76% of respondents with the remaining 24% having some college education or having graduated from high school. On average, they presented for care in their 25th week of pregnancy. This gives a little insight into the type of person who seeks out chiropractic care during these expectant months.

75% of respondents “indicated that their primary provider was aware of their consultation and care with a chiropractor. This includes women (N = 48; 14%) who reported that their provider was aware and referred them to chiropractic.”

The referral came from midwives (N = 28; 8%) followed by nurse-midwife (N = 11; 3%), obstetrician/gynaecologists (N = 7; 2%), and medical physicians (N = 2; <1%).” While the lowest referral types came from OB/GYN’s and medical doctors, perhaps an unsurprising fact, the researchers noted a significant relationship between the provider types and the knowledge of chiropractic.

While the full report gives a far more detailed statistical breakdown of the reasons patients presented for chiropractic care, it is a worthy note that 41% of them presented for both musculoskeletal pain and wellness care.

The study was based in America and Canada, yet it gives us an indication of where our lowest and highest referrers are likely to be, and thus where our partnership and promotion efforts would do best when it comes to getting the word out about the benefits of chiropractic care during pregnancy. More broadly speaking, the survey data captured a good picture of the “who” and “why” behind pregnant patients use of chiropractic care, making this paper an invaluable tool for chiropractic communicators.

Quality of Life Results

The quality of life results of the study also contained some revealing findings. The authors noted “This is the first study to systematically evaluate the changes in a number of domains of QoL [quality of life] among

pregnant women [1].” This alone makes the paper a significant one. Another interesting note was that the patients presented with “fairly good” quality of life across all domains, yet still there were variances. Encouragingly, the study showed significant differences between the baseline data and the data captured at re-evaluation following a course of chiropractic care. Among the significant improvements reported by participants was:

Statistically significant reductions in scores associated with fatigue, pain interference, and sleep disturbance, and; an increase in scores associated with participation in social roles following a course of chiropractic (despite a lack of evidence that anxiety and depression had changed).

The researchers noted, “Their use of the PROMIS-29 instrument demonstrated statistically significant changes in mean T scores from baseline to comparative measures suggesting that overall, the QoL of pregnant patients under chiropractic care improved [1].” The sample was a convenience sample, and the self-reported nature of it allows for some recall bias. Still the authors put a number of strategies in place to mitigate the risks associated with the study’s limitations. Their confidence in the process lead them to state that they found participants to be “highly satisfied with their visit [to a chiropractor] and following a course of chiropractic care, their QoL measures improved beyond statistical significance. [1]”

It’s a strong statement, but encouragingly, its one backed by data. The issue of chiropractic care and quality of life is one that seems to be gaining attention. While it may have been a vague construct in the past, surveys like this (along with the other studies contributing to this conversation) are helping to clear up what is meant by “quality of life” and give strong indications of how chiropractic care for the removal of subluxations can impact it. We have to say, we like where this conversation seems to be going.



Movement and sensory deficits may compromise post-natal stage of brain development

Recent findings in the field of neurobiology have elucidated that nervous system development and brain growth may be linked with movement and sensory input. The findings suggest “mobility restrictions or insufficient sensory stimuli impact the production of new brain cells and brain development...” and that “By testing whether early deficits in sensory experience similarly restrict human brain growth, our findings offer a novel approach to combatting such deficits to maintain normal brain development[1].” Below, we explore the potential relevance of these new findings to the location and correction of vertebral subluxation in the pediatric population.

These two recent studies [2, 3], exploring neurogenesis in the presence and absence of either movement restriction or visual restriction, were performed in zebrafish – a popular and well-known choice for modeling human biology in a controlled research setting. The zebrafish (*Danio rerio*) is a powerful model organism for the study of vertebrate biology, being well-suited to both developmental and genetic analysis [4] and has been used extensively to map vertebrate brain development. Therefore, while these findings have not yet been tested in humans, they clearly suggest the possibility that movement restrictions in the postnatal stage may be critical to brain development in vertebrates including humans, by potentially inhibiting neurogenesis.



In humans, the first thousand days of life are said to be a critical point in a child's development, "characterized by rapid rates of neuronal proliferation (cell numbers), growth and differentiation (complexity), myelination, and synaptogenesis (connectivity) [5]."

The first years of life for humans exhibit an elevated level of neuroplasticity compared to later stages of life, making experiences during this time period essential for cognitive, social, and physical development. These new zebrafish studies may, therefore, hold significant implications for human pediatric brain development, since this new information raises a possibility that movement and sensory input in the postnatal period may be especially important, with long-lasting impacts over the lifespan.

The studies were both undertaken by the same research group, with one team looking at the effect of movement on forebrain neurogenesis while the other looked specifically at the effect of visual sensory input on neurogenesis in the optic tectum [2, 3]. With regard to the former, the researchers remarked:

"Our results demonstrate the importance of movement in neurogenic brain growth and reveal a fundamental sensorimotor association that may couple early motor and brain development [3]."

With regard to the second, they remarked:

"Early brain development is shaped by environmental factors via sensory input; however, this form of experience-dependent neuroplasticity is traditionally studied as structural and functional changes within pre-existing neurons. Here, we found that restricting visual experience effects development of the larval zebrafish optic tectum, a midbrain structure involved in visually guided behavior, by limiting the survival of newly generated neurons.

Neurogenesis in a Nutshell

Neurodevelopment follows seven basic stages, as follows [6]:

- Neurogenesis (the birth of a neuron)
- Migration
- Differentiation
- Maturity
- Synaptogenesis (the birth of new synapses)
- Synaptic pruning
- Myelinogenesis

These two new papers suggest that should motor and sensory input be suboptimal in the postnatal stage, then the process of neurodevelopment as a whole is diminished at the first of these seven developmental stages – and the authors show evidence that if neurogenesis is compromised, the resultant deficit may never be overcome [2, 3].

Specifically, comparative examination confirmed a difference in the size of the mature brains of the zebrafish populations studied, suggesting a resultant "glass ceiling" to neurodevelopment may result from a deficit of somatosensory input at this stage.

In response to these recent research papers, Dr. Amy Haas remarked that:

"One reasonable extrapolation of this data is that, in the first critical weeks and months of a child's life when neuronal proliferation is underway, ensuring optimal motor and sensory input may be critical." She went on to explore the following:

"Movement maintains forebrain neurogenesis: what does that mean, in a practical sense? It means that if movement doesn't happen, then neurogenesis, the birth of the new neurons that will create the

circuitry of the brain, is compromised at step one of these seven stages of neurodevelopment. Without proper sensory input, those neurons literally die. If those neurons die in the postnatal period because they have not had the right motor/sensory input, then one could reasonably assume that the brain cannot develop to optimal potential.

The neurons that were pruned, that's like removing colors from a collection of crayons or markers representing the full-color spectrum. Without the full palette, any drawing produced will be missing elements, nuances – drawings will forever be limited to what is left. Maybe that can be "enough," per se... after all, the human nervous system is highly adaptable by its nature... but would it represent the optimal expression?

"The field of neurodevelopment holds that the critical period for kids is the first thousand days. These new research papers put forward a new possibility, that perhaps there is a more critical period nestled within that."

These two zebrafish studies independently show that in the absence of somatosensory input, neurons that would otherwise develop into brain networks are "pruned," they do not regenerate or proliferate. Therefore, the brain may never achieve full differentiation into its complete array of brain structures. This essentially limits brain potential from the get-go, in the neurological sense – because structure dictates function.

What if the exact same process is true in humans? Well, that's entirely possible if not probable. After all, zebrafish have long been used to study and understand the vertebrate nervous system, which includes... well, most of us.

The Chiropractic Extrapolation

Even though zebrafish are a commonly used model in biology to predict human responses and reactions, there is the obvious disclaimer: this research hasn't yet been repeated in humans. Obviously, studying neurogenesis and neuron pruning would be quite difficult to do in an ethical manner in the pediatric and infant population.

Still, the hypothesis remains that the zebrafish findings regarding neurogenesis could be very significant for human babies and their long term potential.

Keeping in mind that in the zebrafish model system, motion or sensory restriction led to neuron pruning and reduced neurogenesis, let's consider a study by Keil and Fludder that described reduced range of motion present at birth [7]. In this study, reduced range of motion was found in:

- 76.1% of infants born vaginally without intervention
- 75% of infants delivered with forceps
- 88.9% of vacuum-assisted deliveries
- 82.3% of infants born via caesarean section

While the sample may be slightly skewed given it was taken from a pediatric chiropractic clinic, it certainly shows that there is a population that suffers from reduced range of motion immediately following birth. Further, plagiocephaly, or flat head syndrome, is found in up to 46.6% of infants (according to a 2013 estimate) and this itself may result in motion restriction or motion asymmetry [8].

Dr. Amy Haas explores what motion abnormality in neonates and pediatrics may mean for chiropractors when considered in the context of these new zebrafish studies:

“When we look at the Keil and Fludder study, and other studies regarding range of motion abnormalities found directly following birth, we see that ...whether birth trauma exists and results in motion abnormality is not in question. It’s a matter of assessing the degree of birth trauma: Is there torticollis? Is there a broken shoulder? Is there shoulder distortia? What other motion abnormalities can be appreciated upon exam? Or, are there more subtle deficits?” says Dr. Amy.

“These post-birth motion abnormalities are certainly not black and white, rather more shades of grey. Some are very easily appreciated, while some are of a more subtle nature. Within that spectrum, we can include observations of a reduced range of motion due to a vertebral subluxation complex (VSC), as motion abnormality is one of the components of subluxation in the MOPI model. The findings of the zebrafish study support the philosophy that VSC may not constitute just a structural “stuckness” but rather, if it alters the somatosensory input to the brain, it may be literally interfering with brain development ipso facto via neurogenesis and neuron pruning mechanisms.

People ask why you would need to check and adjust a baby, well these papers suggest the possibility that correcting vertebral subluxation complex in a newborn with motion abnormalities may restore the potential trajectory of neurogenesis. In my opinion, that may be fairly important to human health, since we live our entire lives through our nervous systems.”

“In the human nervous system, input, when integrated, determines output. That’s the afferentation (or dysafferentation) loop. If you disturb the quality, quantity, or character of input to the brain, then you lack the appropriate input to be integrated to an appropriate and timely output.

“The findings in zebrafish establish that mobility restrictions or insufficient afferent sensory stimuli impacts the production and/or survival of new brain

cells, and thereby limit the development of the nervous system. Extrapolated to human biology, and particularly to human babies born with birth trauma, well, these findings may point to the broader potential implication of the Vertebral Subluxation Complex. VSC, particularly from birth trauma, may be literally limiting human development.”

“This potentially makes infants and pediatrics the most significant time window in terms of chiropractic care having an impact on optimal neural development across the lifespan. The existence of birth trauma and resultant motion abnormality is not refutable. It has been clearly documented. When you look at that in the context of this paper you see the possibility that motion abnormalities could, in theory, limit brain and nervous system development.

Clearly, research will be necessary to explore this potential connection... that said, my own clinical experience and that of other field docs is consistent with this possibility. In my observation and that of colleagues, babies who are checked for VSC and adjusted as necessary from birth develop faster, are more alert and interactive and meet milestones ahead of same-age cohorts who have never been adjusted. Now, that’s a big statement, and I get that. I’ll offer again, this is my personal observation and that of many other field docs, and it’s one that I find very interesting. I believe that observation merits further exploration, in the context of this recently published zebrafish research.”

Where does this leave us on sensory input?

Research conducted by Dr. Heidi Haavik, Dr. Kelly Holt and the New Zealand College of Chiropractic has illustrated over and over again that sensorimotor integration is clearly and positively impacted by the chiropractic adjustment [9,10].

Says Dr. Amy, “Published chiropractic research by multiple authors and groups has established that the chiropractic adjustment can affect afferent

input, sensorimotor integration, and efferent (motor) output. In a simpler sense, think about nociception and proprioception. When you have nociception, which is generated by an abnormally moving spinal motion segment or a nonmoving spinal joint, well, that counters proprioception. It is this proprioception that the authors are talking about (in these zebrafish studies) which enables neuronal survival. To suggest that somatosensory input directs human brain development and that its deficit (via VSC) may limit brain development is an extrapolation, but this recent research finding in the zebrafish certainly sets an interesting precedent towards that idea.”

“Taking this a step further, if kids are denied access to chiropractic care, it’s possible that they will never reach their full range of human potential – biologically and neurologically speaking. It follows that if sensory and motor problems can be corrected in newborns via the chiropractic adjustment intended to correct VSC and thereby restore somatosensory input, which would, in turn, be expected to promote normal brain development.... well, in my opinion, it makes no sense to ban chiropractic care for kids. It could actually be unethical, in fact, to restrict that form of care. Especially considering that excellent safety records support the conservative chiropractic care of children, by those specifically trained in this art [11]” said Dr Amy. “The safety of this care, when properly delivered, has been established – and the benefits may, in fact, be much greater than originally thought.”

Or, to paraphrase the conclusion of the study’s author [3], “Our results demonstrate a robust connection between motor and brain development during postembryonic development. Motor development in most vertebrates begins early in the postembryonic period... Therefore, if conserved across taxa, this close relationship between movement and neurogenesis may couple early motor and brain development. Furthermore, this relationship could help explain correlations between early physical

and mental development, such as the long-observed comorbidity of physical and mental impairments... and correlation between sedentary lifestyle and depression... which has been previously associated with impaired neurogenesis in children.”

Perhaps it’s time to reconsider the potential importance of pediatric chiropractic care to human potential in light of developmental biology and to explore this possibility with due research diligence.

The Australian Spinal Research Foundation would like to thank Dr. Amy Haas for her extensive insight and input on this article.

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Infants Delivered Via Instrument-Assisted Birth Have Lower Cervical Range of Motion – Study Finds

A new study published in the Chiropractic Journal of Australia will be music to the ears of anyone who has been asked, “why on Earth would infants need chiropractic?” The study took in data from 176 infants under 112 days old and found that vacuum-assisted delivery and Caesarean section deliveries were associated with “a higher prevalence of reduced cervical spine ROM [range of motion] when compared to a vaginal delivery without assistance [1].”

While the outcome of the study carried the standard ‘further research required’ disclaimer, it is a fascinating look at a topic very pertinent to the Australian chiropractic cohort, as it looks at our tiniest practice members.

It is a highly political area, for sure, but if the results of this study are anything to go by, it is an area where there is certainly an indication that chiropractic care may be helpful.

We need more research, but it is a solid start.

The study took its sample from a pediatric chiropractic clinic. While the number of infants studied is a potential limitation of the study, it yielded some enlightening results. Reduced cervical spine range of motion was apparent in:

- 76.1% of infants born vaginally without intervention
- 75% of infants delivered with forceps
- 88.9% of vacuum-assisted deliveries
- 82.3% of infants born via caesarean section

While vacuum-assisted and caesarean deliveries rated the highest for reduced cervical ROM, the stand-out finding was that three quarters of all infants studied had reduced ROM. The difference between the unassisted and assisted deliveries were not a statistically significant, but this fact may be largely owing to the sample size and the prevalence of reduced ROM in vaginal births.

The normal range, for the sake of the study, was a mean rotation of between 110 and 75 degrees (lateral flexion) in infants aged 2-10 months. The authors of the study noted that, “the cortical effects of altered cervical spine motion in infants has yet to be researched.” However, they did note that in adults, altering normal cervical spine motion is associated with:

- increased risk of alterations in autonomic function
- increased nociception
- cortical dysafferentation

They also noted that while this information is missing for the infant population, “afferent systems and cortical perceptions of pain are well developed by 30 weeks gestation.”

The paper included a discussion on the forces placed on the foetal head during labor, ranging from 15N at rest to 120N during a volitional contraction. With vacuum-assisted deliveries, this force raised to 132N. But the news doesn't get better from there. The authors remarked:

“A recent study by Pettersson *et al* provided more information on forces involved with vacuum extraction, demonstrating significantly higher forces involved than previously reported. Repeated attempts, posterior position or mid- cavity extractions showed much higher force involved – up to 452N, or the mass equivalence of 46 kilograms, with “33.5% of the vacuum extractions study employed a maximum traction force exceeding the suggested safe maximum force level of 216 N”.

This is concerning as the risk for injury increases above 225N of tractional force, with above 290N seen as “excessively traumatic”. Currently, 19% of vaginal deliveries require assistance and the risk of birth injury is four times higher than normal with forceps and three times higher than normal with vacuum extraction.

We know the delivery of a healthy baby is all that matters, and while vaginal deliveries without instrument assistance are preferred, they aren't always possible. However, this study certainly creates a bit of increased awareness around the forces placed on infants during birth and the resultant reduced range of motion in around 75% of cases.

This study is clearly only a beginning, as the size of the sample was a limitation, and the sample was taken from a pediatric chiropractic clinic. However, it is a study that raises some questions that, hopefully, future research will answer: what is the result of reduced cervical ROM infants? How does it impact positional preference and by virtue of this, Plagiocephaly? How does it impact development or cortical and autonomic function? We certainly hope to see more answers in the future.

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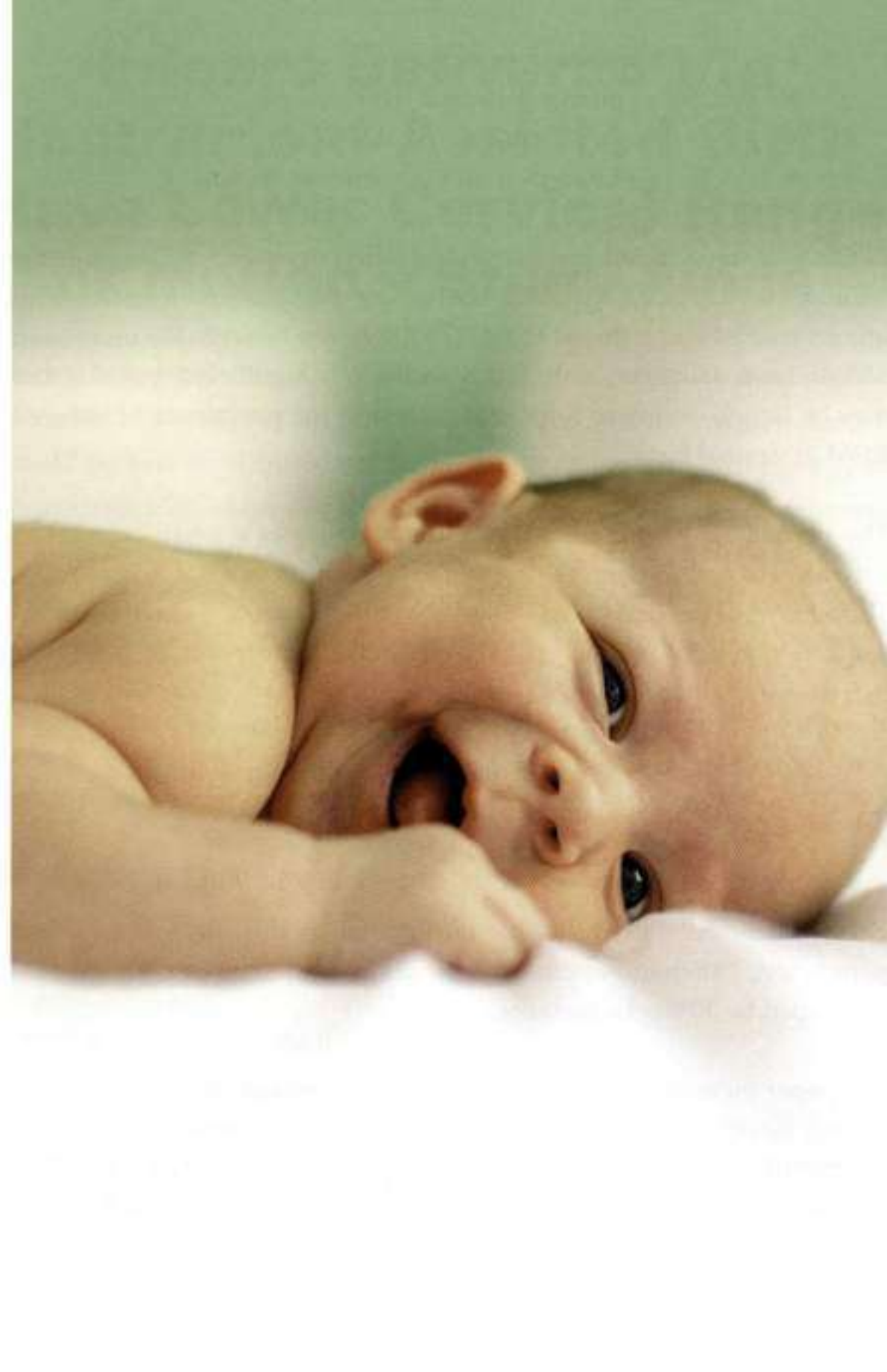
Chiropractic and the Breastfeeding Baby: New Case Report Explores Cranial Dysfunction Link

Few things are as natural as breastfeeding. Paradoxically, few things can be as challenging and frustrating on a deeply personal level as struggling to breastfeed a baby that won't latch properly. While the World Health Organization recommends that mothers exclusively breastfeed for the first six months of life, and increasingly health organizations rally to support mothers along this line, sometimes the challenges are too great and as that baby can't tell us what's wrong, we remain in the dark as to why.

Breastfeeding is no small task. It is baby's first act of multitasking – sucking, swallowing and breathing. We know that it provides advantages in terms of attachment and immunity among other things.

We also know that for some, it just doesn't work out. But what can a chiropractor do to support a mother who is facing difficulties but wants to persevere? That's where a new case report proves interesting.

The report, which emerges from private practice in Texas and was published in the Journal "Pediatric, Maternal and Family Health" looks at the case of a 4-day old infant male [1]. He was presented "for chiropractic evaluation and possible care" due to a latching problem. The mother had tried nipple shields, and was concerned as they didn't work for her and the infant



was “only able to be fed from a bottle and had to be held in very specific positions.”

This is a challenge that may indeed be shared by many a mother. From a chiropractic perspective, this particular infant’s birth was where things got interesting. Though the pregnancy was reported as non-incident, the birth was induced, the mother was Strep B positive and penicillin was given. The baby was posterior, and his heart rate would drop during the first stage of the marathon 24-hour labor. The second stage was 5.5 hours long and ended with a partial episiotomy. Breastfeeding proved an issue early on: even with lactation consultants, attempts were unsuccessful and the mother and infant were discharged with the infant feeding from a bottle (alternating expressed breast milk and formula).

It was at this point that the mother brought the baby to a chiropractor. The chiropractor’s examination turned up several noteworthy observations. While you will have to read the full report to get a detailed picture, they included [1]:

- Low right/high left occiput (with head tilted and rotated to the left)
- Prone and supine leg length checks indicating cervical and pelvic involvement
- Spinal examination (motion palpation) revealed “right C1 vertebral subluxation. Posterior vertebral subluxations were noted at T1, T2, and T4.”
- Hypertonicity was also noted in several muscles.

The patient’s mother consented to a care plan containing “chiropractic evaluations twice per week and spinal and cranial adjustments as necessary.” While the case report goes into far greater detail of examination findings

and how the care plan progressed, it should be noted that the infant began nursing at the breast (using a nipple shield) after the first adjustment. She said that “he had better range of motion of his neck and would turn both directions easier.”

By the third visit, he was able to nurse using the shield but did not have to be held in certain positions. One week later, after his next visit, he had full cervical range of motion and was continuing to thrive with no need to supplement with a bottle.

His lip and tongue-ties were treated by the local pediatric dentist at this time. The following visit included reports of feeding discomfort (for the infant) and painful latching (for the mother) on the left.

By two weeks later, there was a complete resolution of all the infant’s presenting complaints. These had included “limited range of motion, vertebral subluxations, excessively recessed jaw, inability to open wide, and cranial asymmetry.”

Interestingly, the C1 subluxation was noted all the way through to the 6th visit. Intervention procedures concentrated on correcting this and other subluxations. Parker noted (at the completion of the care plan) that, “the resolution of these challenges suggests that there is a possible connection, specifically between an upper cervical vertebral subluxation and cranial dysfunction. This case report shows the effectiveness and value of chiropractic care for infants with breastfeeding difficulties.”

Literature Review

A good literature review is a beautiful thing, and the author of this case report has gone to great lengths to ensure this one is detailed and provides a solid grounding in the neuro-physiological necessities for a successful

breastfeeding relationship. Interestingly, Parker cites a journal article from a midwifery and women's health journal and states that:

“Breastfeeding is a synchronized event requiring the infant to suck, swallow and breathe. Performing this coordinated event requires 6 of the 12 cranial nerves; 22 cranial bones articulate at 34 sutures / places; and 60 muscles that are voluntary and involuntary [2]. The infant's cranium has species-specific physical features which facilitate effective breastfeeding. The cranial bones form the outer shell to support and protect the muscular and nervous system structures.

Nerves receive information and then transmit those messages to the specific muscle needed to perform that specific movement. Optimal functioning of all these anatomical structures assists the intricate actions of breastfeeding. Every movement of the infant's head, face, and neck – whether the movement is little or big – occurs as a result of nerve stimulation.

The infant's ability to breastfeed successfully can be disturbed if there is disruption of the proper functioning of either the musculoskeletal or nervous system that supplies these structures [2]. Any disturbance can create a chain reaction with devastating consequences.

Cranial anatomy, tongue and jaw motions, sphenobasilar mechanisms, the effects of tongue ties, plagiocephaly and facial muscle implications are all covered in the thorough literature review.

The author also notes that “according to the chiropractic literature, the mechanical alterations of the joints of the spine may disrupt the nervous system so that they are unable to function optimally, resulting in latch issues.” Parker also notes that certain biomechanical problems have been shown to be responsive to chiropractic care. They included altered

tongue action resulting in an effective latch, decreased mandible excursion prevention wide mouth opening, hypotonic suprahyoid muscle group prevention wide mouth opening, displaced hyoid preventing balanced tongue activity, mechanical changes in neural function relative to cranial or cervical distortion” among others.

While the case report carries the normal limitations, plus the added limitation that if the tongue-tie revision had occurred sooner, the infant may not have required as many adjustments to achieve full resolution. Hence, more research is needed.

However, this paper has done an excellent job of laying out the potential mechanisms behind why chiropractic care appears to help with breastfeeding. Next time someone asks you why a newborn would possibly need chiropractic care; this is why.

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Maternal Report of Chiropractic Outcomes Published

The Journal of Manipulative and Physiological Therapeutics carried a paper titled "Maternal Report of Outcomes of Chiropractic Care for Infants," in its most recent edition. The study took in a sample of more than 2000 mothers, and is the first known large survey of "baseline and follow-up characteristics of infant patients presented to chiropractic practices". While the data collection methods leave a lot to be desired in terms of investigating efficacy, the sheer number of participants make the results a striking addition to the chiropractic evidence base. Best of all, the findings are clear and positive for chiropractic care.

Emerging from the UK, the study aimed to investigate "the report by mothers of their infants' condition before and after a trial of care by registered chiropractic clinicians" as well as reporting the demographic profile of the infants presenting for care. It was an observational study, so a natural level of subjectivity must be accounted for, but all in all the results spoke loudly in favor of chiropractic care for infants.

The study involved maternal reporting of her infants profile at the first presentation, and then after the trial of chiropractic care completed. Of the 2001 mothers given the original survey, 1092 submitted completed follow-up forms. Improvements were noted across a broad range of complaints including [1]:

- Feeding problems
- Sleep issues
- Excessive crying
- Problems with supine sleep position
- Infant pain
- Restricted cervical range of motion
- Time performing prone position

The researchers also noted that "maternal ratings of depression, anxiety and satisfaction with motherhood also demonstrated statistically significant improvement. [1]" They also noted that "Although the observational design makes it impossible to determine efficacy, the study's findings indicate that, on average, the changes observed by mothers were positive and may be clinically relevant."

Interestingly, the questionnaire used to ascertain all of this was the UK Infant Questionnaire that was developed to satisfy the demand for a parent-reported outcome measure [1]. The researchers also pointed to previous studies that suggested mothers were reliable reporters of their infants behavior "and therefore in the best position to provide insight into their child's clinical situation."

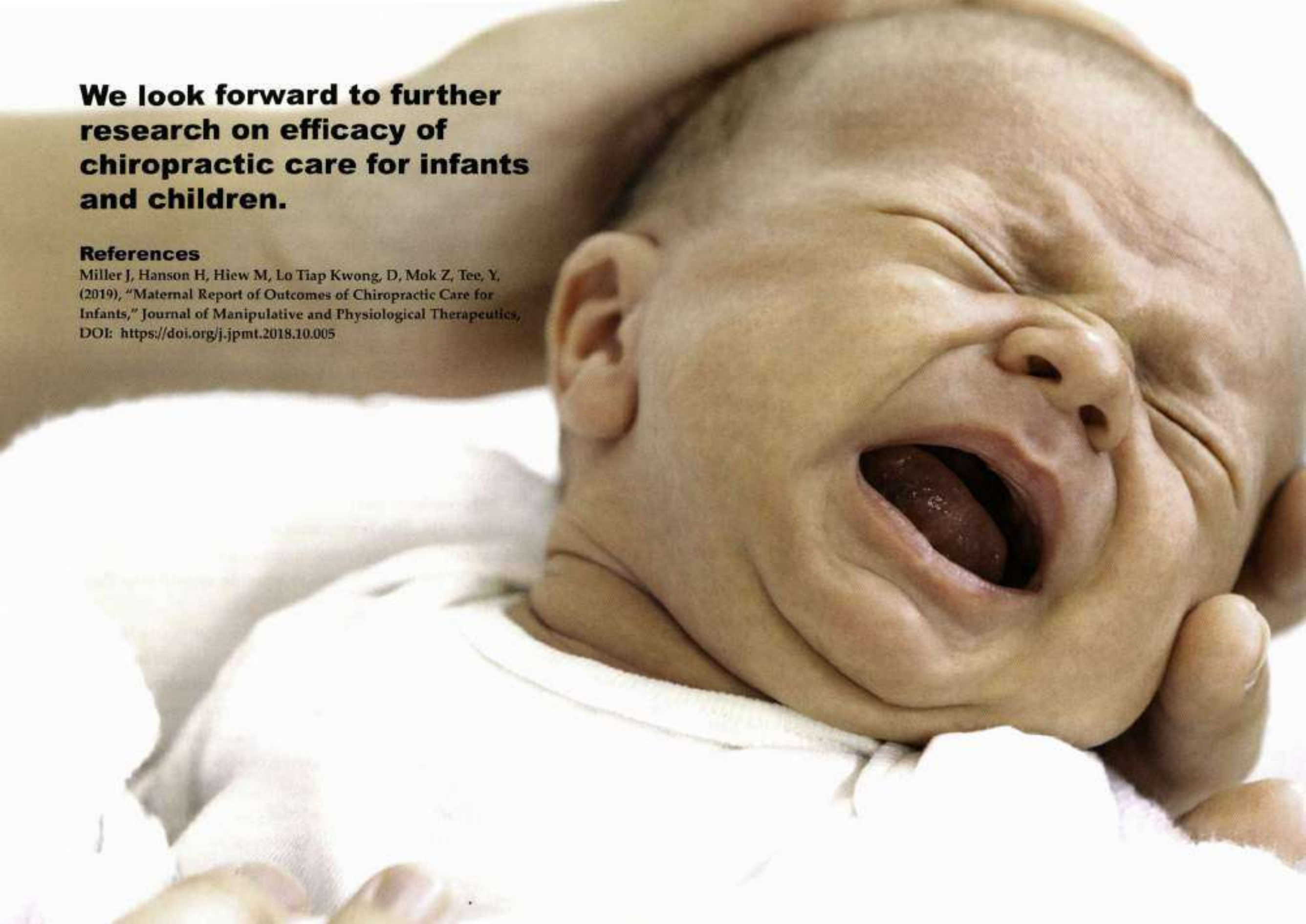
The sample was made up of 55% male infants and 45% female infants, 64% of which had required interventions at birth. 58% were referred by a health care provider. The rest were referred by friends, family or other sources. The most common age at presentation was just three weeks old, with 79.1% of study participants presenting at less than 12 weeks old.

The paper found that the mothers who completed the follow-up form all felt that chiropractic care for their infants was effective, safe and cost-effective.

We look forward to further research on efficacy of chiropractic care for infants and children.

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Infantile Colic and Spinal Manipulation: Study Puts European Medical Literature Under the Microscope

As the Government of Victoria, Australia, winds up its review of chiropractic spinal manipulation of children under 12, the Journal of Contemporary Chiropractic (based in the United States) has published a narrative review of the European Medical Literature on an issue often debated within pediatrics. It is the issue of spinal manipulation and infantile colic. The review provides a thorough look at the documented, peer-reviewed and indexed evidence surrounding the condition and the effectiveness of chiropractic care in its management.

This is perhaps a complicated undertaking, given the unclear etiology behind what is termed “infantile colic.” Even now in 2019, there is no single cause illuminated by research and hence it is still largely defined as prolonged, intense or unexplained crying [1]. When it comes to causes, we often see a list of possible contributions. They include [1]: an undeveloped digestive system, bacterial imbalance in the gut, food allergies or intolerances, overfeeding, underfeeding, gas, migraine, familial stress or anxiety.

In the recent review, the authors (Rome *et al*) flagged three potential subgroups of colic, including 1) infant colic, 2) irritable infant syndrome of musculoskeletal origin and 3) inefficient feeding crying infants with sleep disorder. They also cited Miller and Phillips (who suggested those subgroups) suggestion that, “particular regimens may be more effective for a certain subgroup [2].”

Rome *et al*'s work points out some interesting contradictions pertaining to chiropractic care and colic. One such statement lies right at the beginning of their comprehensive discourse on the matter:

“The systematic review of Carnes *et al* [3] “found moderate favorable evidence for reduction in crying time in infants receiving manual therapy.” That finding provides an understanding for the *Clinical Practice Guidelines for Unsettled and Crying Babies* from the Royal Children’s Hospital in Melbourne [4] in lieu of any guideline from the multi-discipline Victorian Pediatric Clinical Network (VPCN), [5] which is responsible to the Minister for Health: “medication is rarely indicated” and “formula changes are usually not helpful.” It then states without evidence that, “Spinal manipulation is no more effective than a placebo.”

The Mayo clinic website [6] lists parents reporting that chiropractic manipulation has been noted as “soothing crying babies,” one of the symptoms of colic.”

They go on to discuss exactly where and what type of evidence for chiropractic care for colic exists. While the etiological mystery of colic remains unsolved, and both chiropractic and medical science must advance to get a comprehensive answer on the issue, one thing is for sure: the evidence is there.

Full details are provided in the original article, but the authors remarked that “We see the problem addressed by this paper as being an ignorance of the peer-reviewed, published and indexed evidence for manipulation of infants presenting with colic in the medical literature, specifically from Europe [2].”

Interestingly, this review alone covered 45 such papers, which is a substantial number indeed. This alone confounds the oft-repeated notion that there is no evidence for chiropractic care and colic.

Another finding from the narrative report is this [2]:

“A Swiss study noted that infants younger than 6-months were the third most common pediatric patients attending 144 chiropractic clinics in that country. A 2014 UK survey by Navrud *et al* found that of infants attending chiropractors, the presenting complaint was colic in 41% of cases. We note the overall satisfaction was a rating of 75.1%.”

This was echoed in findings that, in Norway and Denmark, colic was the most common reason for infants presenting at chiropractic clinics.

It would seem that the underlying message in the paper is that:

- Australian medical opposition to chiropractic, infant manipulation, and the subluxation are in distinct contradiction to that of European counterparts.
- European medical manipulation of infants with colic is standard medical procedure in Europe.
- European medical specialists manipulate the upper cervical spine in infants.

- European medical specialists recognize “KISS” or locked vertebrae (which is basically German for something like “subluxation”).
- Skilled manipulation of infants is very safe, and;
- Chiropractic is equally as effective as medicines without any side-effects [when it comes to colic].

Rome *et al* go on to discuss particular areas for concern when it comes to colic, with the paper covering upper cervical involvement, birth trauma, gastric problems, somato-autonomic phenomena and neurophysiology specifically, as well as a broad discussion of chiropractic’s excellent safety record when it comes to children.

While the discussion on each piece of evidence and each specific area is detailed, it is perhaps the conclusion that may ring truest for many of those in the profession:

“On balance we can state with confidence that the published, indexed evidence places conventional chiropractic management of infantile colic as safe and effective in the manner clearly documented as clinical methods in the European Medical literature.”

This is music to our ears (unlike, perhaps, the prolonged, intense, unexplained crying of colicky babies).



Chiropractic Care and Quality Of Life In Older Adults

Quality of life in older adulthood is becoming a big issue as the Baby Boomer generation, and those that follow, reap the longevity benefits of advancements in healthcare. We don't just want to live long, we want to live well.

It has often been said "The aim of chiropractic is to add years to life and life to years." What does the research say about that? We are a long way from knowing if the first part of that phrase is correct, but the second part we can begin to road test by measuring quality of life.

If you are keeping an eye on the literature, you'll see that many a case report shows improvements in quality of life following chiropractic care. Generic tools like the SF36 questionnaire along with more specific pain scale measures can offer us some insight into what is going on in the life of a patient, and help communicate the improvements as they occur.

In older adulthood, quality of life becomes particularly important as it has impacts on independence, ability to perform everyday tasks, as well as social and economic wellbeing [1].

We know this, but the issue that could use a little more research-based clarity is just how chiropractic care can impact quality of life in older adulthood.

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Quality of Life's Relevance in Research and Practice

Dr Tanja Glucina, a lecturer at NZCC and current PhD Candidate with a special interest in quality of life, told Spinal Research about some of her research findings on the topic. She recalled focus group results and said, "The quality of life construct is relevant [to chiropractic]. People do talk about it, but not really explicitly. They're a bit confused about how to talk about it so they kind of talk around it [1]."

She urged more clarity around how and when to measure it and stated that, when you do start talking about quality of life, it is quite easy to assess.

One strength of communicating quality of life measures is that they can be meaningful to the patient, providing a way they can see the value in chiropractic care over time.

A recent case series has added to a number of papers illustrating changes in quality of life (QoL) for patients under care. The study, authored by Dylan Jones *et al*, followed four older adult patients receiving manual chiropractic care for the correction of vertebral subluxations [2].

It's the latest piece of published literature on the QoL construct – a term that has popped up in other larger studies, including Holt *et al*'s randomized controlled trial examining chiropractic care and falls risk in older adults [3], as well as a plethora of case reports.

As QoL involves so many aspects of health, there is a long way to go before we have RCT's or large clinical trials covering every aspect of it. Hence, every new case report is adding to the evidence that chiropractic care can have an impact on QoL.

The latest study looked at patients aged between 61 and 65 years, who had

presented for care for a variety of musculoskeletal complaints at a teaching clinic in Auckland, NZ.

The patients were initially seen 1 – 2 times per week over 4-6 weeks, with progress assessments taken between the 8th and 12th visits. Ongoing care then ranged from 18-30 weeks. There were four patients, two male and two female, and each visit contained up to three adjustments (administered to the patient based on the technique systems requirements). The techniques used on the case report patients were "Gonstead," and "Diversified" techniques.

The Outcomes

"All four patients showed an improvement in overall perceived outcomes of their care with the average physical component score improving by 7.23 and the average mental component score improving by 9.21," the study reported [2]. Among the physical ailments reported by the patients were: migraines, shoulder pain, neck pain, hip and buttock pain, depression, numbness and tingling in fingers, and low back pain. Outcomes included:

- A 65-year old female, noted "a subjective improvement in symptomology" after the second visit. This included hip and buttock pain that was bad enough to stop her from exercising. By the progress examination, she had noted a significant reduction in pain levels, being able to walk freely and reported an increase on her SF36 scores from 22.82 and 20.62 for physical and mental components to 30.55 and 47.27 for the same components.
- A 61-year old female, presented with shoulder and neck pain, and had suffered from migraines her whole life. She also reported emotional stress and depression. Her initial scores were 45.06 and 56.05 for the physical and mental components. At the re-examination, her scores had improved

to 53.74 and 60.49 respectively.

- A 63-year old male with a manual labor occupation, noted an improvement in sleep, neck and low back pain, and reported that numbness and tingling in his fingers resolved. His component scores also improved significantly at the re-examination.
- A 62-year old male, presented with low back pain. He did not report any subjective differences, but noted "an improvement in his ability to play football during the care period." However, his SF36 scores improved from 22.70 (physical) and 48.30 (mental) to 33.79 (physical) and 50.47 (mental).
- All four patients continued under chiropractic care following the study.

The SF36 is a limited tool in that it is self-reported and thus the validity of the measurement is in question. It is interesting to note that, despite this limitation and potentially the differences in the patients reporting, all noted improvements. This included the fourth patient who didn't report any subjective differences apart from the football ability. Even his scores increased.

Another limitation is that, in such case reports, it is difficult to control for confounding factors like "natural progression, unreported home care and self-medication" among others [2]. Still, the combination of subjective self-reported improvements and the improvement in SF36 scores offers up a clear indication that chiropractic care may have a role in improving the quality of life of older adults.

At the very least, it shows us that further research on quality of life for this cohort is certainly justified. We look forward to seeing this field of research

advance. In the meantime, it is encouraging to see very real improvements in the lives of these four patients under care.

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Muscle Loss in Old Age a Nerve Issue

With an aging population now a reality in many Western nations, how well we age is becoming as much of a focus as longevity itself. A new study emerging from the Manchester Metropolitan University, published in the Journal of Physiology, is bringing more clarity to the topic and it is news that nervous system and health enthusiasts will welcome. It appears that the muscle loss many have accepted as “inevitable” in old age is actually a nerve issue.

The study took 143 men, aged either 18-40 or 65-90 years old and living independently, and used MRI and EMG data to view the state of their muscles. They were looking at generally healthy young and older men to examine age-related loss of muscle, and low muscle mass known as sarcopenia.

One of the study's authors, Professor Jamie McPhee, stated that “There was a dramatic loss of nerves controlling the muscles – a 30-50% loss – which means they waste away. The muscles need to receive a proper signal from the nervous system to tell them to contract, so we can move around [1].” While the first part of that remark wouldn't surprise anyone in health-related fields, the second part (which indicates the role of the nervous system) is laden with possibilities for nervous system and health related fields.

While this research did offer up some good news in that healthy muscles can send out new branches from surviving nerves to “rescue” muscles and stop them wasting away, it is more likely to happen in fit people with large, healthy muscles [1].

The study found that “the age-related loss of muscle mass is related to the loss of innervating motor neurons and denervation of muscle fibres [2].”

However, this didn't necessarily mean that all muscle fibres were degraded.

“Some may be reinnervated by an adjacent surviving neuron, which expands the innervating motor unit proportional to the number of fibres rescued,” the study stated [2]. “These findings suggest that healthy older men reinnervate large numbers of muscle fibres to compensate for declining motor neuron numbers, but a failure to do so contributes to muscle loss in sarcopenic men.”

It is a generally accepted ‘fact’ that people become weaker in their later years (in most cases), often leading to disability and falls [3]. This study shows that general health and muscle mass in younger years matters greatly when it comes to maintaining muscle mass in older adulthood. It also shows the vital role of the nervous system in maintaining muscle mass over time.

It's a study that builds on earlier, more muscle-group specific data. One of the study's lead authors, Dr Mathew Piasecki, remarked [3]:

“One of the earliest attempts at research similar to ours showed results from a small group of older people who apparently had just a couple of surviving nerves feeding into a foot muscle.

“We were very sceptical of the old data, however, now that we have tested a couple of hundred men we think the early observation was probably correct. We have also observed some very old muscles with just a few dozen nerves left, where young and healthy adults have hundreds.”

What next?

Manchester Metropolitan University has indicated that researchers are currently looking at “whether regular exercise in middle and older-age slows the process of muscles becoming disconnected from the nervous system, or improves the success of nerve branching to rescue detached muscle fibres.” They further stated that “the goal is to identify the best type of exercise – strength training or endurance – and to understand the physiology of why the nerve-muscle changes occur as we get older [4].”

Obviously this research did not look at the impact chiropractic care could have on muscle mass. However, we do have research indicating the impact of chiropractic care on the brain's ability to drive the muscles [5,6,7,8]. As time and research marches on, we are seeing more and more evidence to back this up. We hope that in time, chiropractic research will reveal the impact of subluxation-based care on maintaining muscle mass, as well as other impacts it could have on healthy aging.

All in all, research that indicates a nervous-system role in maintaining muscle mass is good news for chiropractors indeed.

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Posture and the Cardiopulmonary System

Is there a day that goes by when a chiropractor doesn't deal with a postural concern? If we were to sit purely on the orthopaedic wagon, we would have enough to concern us. Poor posture can cause pain – headaches, pain in the shoulders or neck, problems with the gait, uneven distribution of weight resulting in referred pain (i.e. heavy backpacks slung across one shoulder for extended periods of time).

These issues are no big surprise. But beyond the banner headlines, there is a deeper story to be told when it comes to posture and the body. Science is now revealing how posture can affect more than just pain and aesthetics. From cardiopulmonary function, to digestion, pelvic floor function and even neurodegenerative diseases, the links are becoming increasingly clear.

Posture and Cardiopulmonary Function

First cab off the rank in this series is the important issue of posture and cardiopulmonary function. In recent times, heart rate variability has become somewhat of a rising topic in chiropractic. Whether this improvement in heart rate variability is due to postural correction, removal of subluxations or an improvement in the patient's state of ease (versus stress) is a matter for further investigation. What we do know, is that it's but one potential

impact of chiropractic care on the cardiopulmonary system. The power of good posture is indeed a potent thing.

In a recent series on stress (published on our website), we explored how stress impacts posture. Once the amygdala has detected a stressor, one of the primal reactions is to drop the head forward and round the shoulders so we are ready to fight or run. But posture can also be the stressor, as rounded shoulders and forward head posture can tell the brain there is something wrong. Research also shows us there is a clear link between the two.

Among the results of the stress response are elevated heart rate and increased blood pressure – neither of which is ideal if stress becomes chronic and the stress response settles in for the long haul [1].

But in the smartphone era, we are living in a world that seems bursting at the seams with cases of cervical or thoracic kyphosis. What does this do to cardiopulmonary function apart from impacting the stress response (including heart rate and blood pressure, the latter being an issue there's a lot of chiropractic research on)?

Rene Caillet MD, author and director of physical medicine and rehabilitation at USC, says "lung capacity can be reduced by as much as 30%" in individuals with a thoracic kyphosis [2]."

This thoracic kyphosis is "very closely linked with several other postural imbalances that play off each-other including: forward head posture, cervical flexion, rounded shoulders, scapular abduction and winging, internal humeral rotation and depressed ribs [2]." The latter are facts easily gleaned from basic science. Still, research is increasingly linking the thoracic kyphosis with the forward head and rounded shoulders [3].

In fact, Singla *et al* found that "Cervical lordosis values were found to be significantly associated with thoracic kyphosis values. Also, there were significant correlations between rounded shoulders and increased thoracic kyphosis [3]." They went on to link these presentations with:

- Computer use
- Carriage of backpacks
- Use of smartphones
- Headaches
- Mouth breathing
- Shoulder overuse

A growing number of research papers are indicating that cervical kyphosis can have a negative impact on tidal volumes [4,5]. In both Landers *et al* and Bishay *et al*, patients exhibited improvements in pulmonary function when they were moved from sitting to supine positions – the latter position effectively relieving the cervical kyphosis.

In the case of Landers, it was stroke patients under the proverbial microscope, and these also benefited from thoracic mobilisation [4]. In the case of Bishay, it was a wheelchair bound 22-year old with notable cervical kyphosis and low tidal volume [5].

But what does lowered tidal volume and lung capacity mean? We don't really need to view new research asserting that we need oxygen to stay alive, but just how much of a difference oxygenation makes to blood and the various tissues in the body, and then performance and concentration is another topic altogether – one scientists interested in peak human performance still investigate.

On the illness end of the spectrum, lowered lung capacity or tidal volume can play into conditions like asthma, emphysema, chronic obstructive

pulmonary disease, pulmonary oedema and bronchitis among many others. On the wellness end of the spectrum, we need good oxygenation to enjoy a broad range of activities, whether athletic, leisurely or even academic. (Who has ever tried to write a brilliant piece of academic work while feeling dizzy or foggy headed?)

Can we claim to cure any of these problems? No. But we can remove subluxations, advise stretches and help patients reclaim up to 30% in lost lung capacity and tidal volumes.

How do we measure it?

It makes sense that, if we are claiming to make a change to someone's posture and that this impacts cardiopulmonary function, we should be able to measure it. How do we do that in clinical practice? The main tool chiropractors use may be their hands, but there is a plethora of ways we can measure the impact on cardiopulmonary function without adding to or subtracting from our modality.

Heart Rate Variability

As mentioned above, Heart Rate Variability (HRV) is becoming increasingly visible in the world of chiropractic. Heart rate proper may be used as an indicator of health in other ways, but when applied to chiropractic, HRV can give us unique insight into adaptation, as it gives us a clear look at what is happening in the cardiopulmonary system pre and post adjustment. As for how we measure it, CLA (the Chiropractic Leadership Alliance) Insight Station now measures HRV. There are also some wearable wrist devices that can achieve the same thing.

Cardiac Recovery Tests

In another recent article on our website, Dr Michael Hall discussed a cardiac recovery test we can use in practice to assess how fast a patient's heart rate

comes back down to normal after physical activity. It involved taking their heart rate, getting them to march on the spot for two minutes and then timing to see how fast their heart rate came back down. For adults, a normal resting heart rate should be between 60 and 100 beats per minute, and the lower it is, the healthier a person is thought to be [8]. Dr Hall cautioned that anything over 80 should make us raise an eyebrow.

By using the simple assessment of resting heart rate followed by a simple, non-invasive cardiac recovery test, we can get some insight into a patient's level of stress and cardiopulmonary function.

Pulse Oximetry

Pulse Oximetry is another simple way of measuring cardiopulmonary function. In a 2012 edition of the Journal of Chiropractic Medicine, Hall and Jensen put forward a rationale for its use in chiropractic care, suggesting that it has the potential to be an integral part of chiropractic practice [8]:

Pulse oximetry simply gives us an indication of a patient's oxygen saturation levels. It is seen commonly in hospitals, and is as simple as placing a clip on a patient's finger in order to glean potentially lifesaving information. Hall and Jensen offered three reasons for the inclusion of pulse oximetry into chiropractic practice:

- "Pulse oximetry allows for quick and reliable retrieval of oxygen saturation and heart rate values previously not readily obtained or used."
- "Pulse oximetry allows for immediate assessment of potentially hypoxic patients."
- "Pulse oximetry allows for important changes in patient management potentially influencing outcomes and safety."

Dr. David Fletcher, of CLA, has advised that pulse oximetry is something on the horizon for new editions of the Insight Station, so this technology will soon become easier for chiropractors to get their hands on.

Spirometry

This technology is a simple way to measure tidal volumes. It simply measures how much air you can inhale and exhale quickly, giving insight into the movement of the lungs. Spirometers vary in price from a few hundred to a few thousand dollars. It's fast, easy, and gives a tangible way to demonstrate an added benefit of chiropractic care.

Measuring chest expansion

Spirometers are cheap but if you'd rather avoid the use of another device, measuring chest expansion is an option. (As an added benefit, it costs you even less and can work as a great outcome measure).

We can see from basic science that posture has a significant impact on cardiopulmonary function. We also know that chiropractors are uniquely positioned to assist patients with postural concerns. What the data should show us, now more than ever as instances of cervical/thoracic kyphosis are on the rise, is just how important this could be.

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Posture and Cerebral Spinal Fluid

In part one of our posture series, we covered the links between posture and the cardiopulmonary system, including lung function, tidal volumes and cervical/thoracic kyphosis. Now, we arrive at another important issue: how does posture affect the flow of cerebrospinal fluid, and potentially link to neuro-degenerative diseases?

Cerebrospinal fluid (CSF) is the great liquid cushion that surrounds the brain and spinal cord, protecting it both structurally and immunologically. It's a feat of nature that "maintains the electrolytic environment of the central nervous system (CNS), influences systemic acid-base balance, serves as a medium for the supply of nutrients to neuronal and glial cells, functions as a lymphatic system for the CNS by removing the waste products of cellular metabolism, and transports hormones, neurotransmitters, releasing factors, and other neuropeptides throughout the CNS [1]."

It's a big job for the 150ml of CSF that flows around the CNS at any given time (approx). But that's hardly news to chiropractors. What may be news is the potential link between posture, CSF, and neurodegenerative diseases. It all has to do with pressure gradients that may build up as a result of subluxations and/or poor posture, thus slowing the removal of brain waste material.

Sacro-Occipital Implications in CSF Flow

As practitioners of the Sacro-Occipital Technique (SOT) will happily tell us, neuromechanical dysfunction or vertebral subluxations can impede the flow of CSF. CSF moves out of the brain and spinal cord via the dural venous sinuses, taking central nervous system waste with it. It's a constant process



that is vital for health. But when we are subluxated, and experience postural changes, CSF flow is impacted.

With SOT, chiropractors are on the lookout for anything that impedes this CSF flow. If the sacroiliac joints become fixed, this may "cause compensatory changes in the hips, sacrum and remaining spine [3]." i.e. Posture can change. But when we look from the sacrum to the occiput, we can begin to see how postural change, rib excursion and subluxations in the upper spinal region are potentially a big deal for CSF flow.

Key considerations in SOT include dural attachments through the Occiput and Sacrum. A major area of focus is C1-C2 and the cervico-thoracic junction – an area also heavily impacted by forward head posture, as well as being a key focus of upper cervical care [2, 3, 4]. When it comes to CSF flow, there is evidence that the body works with respiration: i.e. the cranial nerves will flex and pump the CSF fluid as the person breathes in and out [1]. When there is wind-up in the cervical and upper thoracic region, as there is in

forward head posture and thoracic kyphosis, it can impact respiration via lung function, rib excursion and tidal volumes [5]. The temporal-mandibular joints may also start to wind up, creating jaw tension and impacting the cranial nerve system and by virtue of the latter, potentially impacting CSF flow [2].

The vital system that clears waste from the CNS is therefore impacted, and science is beginning to offer up insights into how much this matters for ongoing brain health.

If CSF flow is essential, then it's absence or impedance is detrimental.

Whedon and Glassey, in their paper on the clinical significance of CSF stasis, wrote that, "There is evidence to suggest that CSF stasis may occur commonly in the absence of pathology or symptomatology, and may have adverse systemic health effects [1]." This CSF stasis (or slowed /impeded CSF flow) could, according to Whedon and Glassey, be associated with "adverse mechanical cord tension, vertebral subluxation syndrome, reduced cranial rhythmic impulse and restricted respiratory function."

They suggested further investigation into the cause and nature of CSF stasis, but there is early research to suggest that chiropractic has a role in removing impediments to CSF flow, thus supporting a healthy system.

The Louveau Discovery: a lymphatic vessel in the brain that changed the game

In order to understand the link between posture and neurodegenerative disease, one must first look to recent developments in brain science. For years, we held the belief that the brain was a privileged organ, with an intact blood/brain barrier, and that immune responses involving the brain were highly unusual and problematic.

All that changed when Dr Antoine Louveau observed a lymphatic vessel in the brain that had eluded researchers for years. This game-changing discovery meant that, all of a sudden, it was clear that the brain did not lack a connection to the lymphatic system as previously thought. Lymphatic channels did indeed exist in the brain, and this had big implications.

Louveau remarked, in an interview, that his team's discovery meant that the brain could be seen by the immune system, and that this was highly significant [6, 7]:

"We think that this discovery is highly significant because... the brain is a privileged organ. Usually when you have an immune response in the brain it's considered to be a bad thing. What we know [sic] from several years now, is that there are immune cells in your brain under normal conditions and that is actually good for your brain but the big question we still had is



'how do those cells get in and get out of the brain?' The system we discovered is actually ... how those cells are able to get out of the brain and do what they are supposed to do.

You have a lot of neurological diseases that have this [sic] immune component. We think that our discovery might lead to new therapeutic ideas on how to address those diseases in the future."

Among those diseases were things like Alzheimer's Disease and Multiple Sclerosis. By way of example, Louveau went on to explain:

"Alzheimer's Disease might involve that structure [the lymphatic vessel in the brain] because, as we know, it's an accumulation of proteins in the brain that are supposed to be removed from the brain. We think the [lymphatic] vessel that we newly discovered might be clogged ... and that may start the disease," he remarked, speculating that faults in lymphatic drainage may be the starting point for neurodegenerative diseases, while also careful to reinforce the need for further study.

Logically, it's clear that the glymphatic system (a newly-coined term for the functional waste clearance mechanism for the CNS) has a significant role to play, because something has to get rid of the brain's waste products. What has this to do with CSF flow and posture? Again we look to the basic science that surrounds this new discovery.

There is already research noting that glymphatic drainage may be impaired in patients with Multiple Sclerosis, and that CSF biomarkers are useful in the diagnosis of neurodegenerative diseases like Alzheimer's and Parkinson's Diseases as well as Huntington's, Motor Neurone (ALS) and Machado Joseph's diseases [8, 9, 10]. But a hypothesis paper by chiropractor and



ex-Harvard scholar Dr Amy Haas begun to illustrate what this might mean for chiropractic [11].

Haas's hypothesis showed, by exploration of basic science, how pressure gradients that develop inside a subluxated spine could contribute to a compromised CSF flow, and that adjusting the spine could relieve these pressure gradients and support optimal CSF flow – thus impacting the clearance of brain waste from the central nervous system.

The Haas Hypothesis

In an earlier interview with Spinal Research, Dr Haas explained [12]:

"CNS Lymphatic drainage is a bit of an interesting subset because it drains into the deep cervical lymph nodes. Essentially, [if there are

lymphatic drainage issues] it's a plumbing problem. Drainage from the deep cervical lymph nodes is dependent on a pressure gradient," explains Haas. "While extra-cranial lymphatic drainage is assisted via muscle contraction, the cranium is a closed compartment; you don't have any muscle contraction. Therefore drainage has to depend only on a pressure gradient. Anything that backs up that pressure gradient will slow the transfer of fluid."

For Haas, it was easy to see how a subluxation could potentially impact the pressure gradient and slow the transfer of waste from the brain (this links to an emerging concept in science that neurodegenerative disease may involve a mismatch between the speed at which waste is produced in the brain, and the speed at which it is removed from the brain by the lymphatic system). By way of example, she explained:

"Let's say for example you have an atlas subluxation; you rotate the atlas and you can put pressure on the internal jugular vein. That has been shown by research and I cited in the paper [3]. An atlas subluxation may impinge drainage through the internal jugular vein.

That may in turn increase the CSF pressure because it can no longer drain quickly and freely via the cervical lymph nodes and the internal jugular vein. When the CSF pressure is increased just a little bit, that will affect the lymphatic drainage through the channels adjacent to and lining the dural sinuses because that also has to be pressure dependent. When the dural sinuses are become compressed by fluid pressure, you can no longer see the channel [the lymphatic vessel in the brain]. It is not a solid channel. That is a channel that is very changeable. So that brings up the possibility (at this point an unproven hypothesis) that if an atlas subluxation were to slow the

drainage of the venous blood out of the cranial cavity, then you develop a pressure gradient.

When you work backwards in that plumbing problem, the pressure gradient could slow the process of lymphatic drainage just by virtue of pressure. And furthermore lymphatic drainage is postulated to be the mechanism by which the lymphatic system in the deep brain tissues gets rid of cellular debris from deep brain tissues.

Louveau postulates that interference of proper drainage through the CNS lymphatic system could be the root cause of many neurodegenerative disorders [6, 7]. That is exactly what caught my eye. Louveau is a PhD scientist in a completely non-chiropractic realm saying if you don't properly drain waste out of the brain you could end up with Parkinson's."

Like the Louveau discovery, Haas's hypothesis needs further research to verify it and to extrapolate the implications for chiropractic care. Still, it's a fascinating insight into how the subluxation could impact CSF flow and then degenerative diseases.

The link back to posture

Is posture linked to subluxation? Chiropractic veterans and novices alike would agree with a resounding yes. But even outside of the SOT lens, it is obvious that postural changes can create subluxation. Perhaps this process is best illustrated in the words of by chiropractor, Dr Chris Kent [13]:

"Postural changes are mediated by receptors that monitor the dynamics of the internal and external environment, and the relationship of the individual with the environment. The receptor systems that may contribute to postural alteration include:

- Vestibular apparatus
- Vision
- Joint mechanoreceptors
- Disc mechanoreceptors
- Golgi receptors

If vertebral subluxation results in aberrant afferent input to the CNS, inappropriate motor responses may cause postural aberrations.”

It's that clear.

What is becoming increasingly clear is that the chiropractors role in the restoration of posture and the removal of subluxations may have implications for neurodegenerative diseases. We need more research, but the basic science is beginning to line the ducks up for us.

A subluxated spine may impact the flow of CSF in and around the nervous system. As the brain uses CSF to get waste from the lymphatic vessels in the brain to the body's venous circulation, thus preventing a build up of brain waste, proteins or plaque, the removal of subluxations could have significant impacts.

Only time and research will show us for sure. In the mean time, who'd want to risk neurodegeneration when postural correction and chiropractic care offer such potential benefits?

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Posture and the Pelvic Floor

The last two instalments of this series have concentrated more heavily on what happens at the northern end of the spine when posture goes awry. Here, we move to an issue that affects more than one third of women in the US, and contributes heavily to the burden of disease globally. It is the issue of pelvic floor disorders and it has some very real postural links.

While it is possible for men to experience pelvic floor dysfunction, it is an issue that is often thought of as a women's problem because the burden of pregnancy and childbirth can contribute heavily to pelvic floor problems. Such problems can include bladder or bowel control problems as well as pelvic organ prolapse. It has been reported that more than one third of US women have a pelvic floor disorder and nearly one-quarter of them have symptoms [1, 2].

Commonly, treatment options are limited to biofeedback training, relaxation techniques, medication and surgery. But one does not have to look far to discover that posture and pelvic floor function are very much linked.

Risk factors for pelvic floor dysfunction

Currently, there are a number of factors that are thought to increase a person's risk for developing pelvic floor dysfunction. They include [3]:

- Pregnancy (present, or historic)
- Menopause (past or present)
- Past gynaecological surgery such as a hysterectomy
- Elite athletic activity including running, gymnastics or trampolining
- Past prostate surgery
- Obesity
- Chronic coughs
- Regular heavy lifting
- Constipation
- Pelvic region trauma (like a fall or radiotherapy)
- Back pain

The back pain link is not where it ends in terms of pelvic floor function, posture and potentially the role of chiropractic care. In fact, it's just the beginning. Posture is a common inclusion in pelvic floor training advice. Among the commonly accepted pelvic floor realities are the following [4]:

- A slumped posture (with thoracic kyphosis) increases downward pressure on the pelvic floor.
- Correct posture and spinal alignment improves the effectiveness of strengthening exercises.
- Correct posture promotes deep abdominal activity and enhances diaphragmatic breathing, which can enhance pelvic floor muscle activity.

Maintaining the lumbar curve, avoiding thoracic kyphosis and ensuring correct hip posture and sitting posture are all thought of as a significant factor for the pelvic floor. In fact, from breathing to posture, pelvic floor dysfunction is increasingly being thought of as a whole-of-body problem [5, 6]. How? Forward head posture can cause a decreased mobility in the upper thoracic area, compromising proper breathing and decreasing muscle activation in the abdomen and pelvic floor.

This can then lead to “pelvic floor weakness, incontinence and prolapse because the pelvic floor muscles become rigid from lack of use [5].”

The pelvic-floor – posture link

In 2017, Zhooldideh *et al* published a paper titled “Are there any relations between posture and pelvic floor disorders? A literature review.” It was a review spanning four major journal databases that offered up 22 relevant studies in order to examine any potential postural, bony or muscular changes in patients with pelvic floor disorders.

The results showed “increased thoracic kyphosis, decreased lumbar lordosis, wider transverse pelvic inlet and outlet, increased contraction of pelvic floor muscles with ankle in dorsiflexion, increasing protrusion in shoulders and decreasing in the angle of head in patients with PFD’s compared to control group [7].” The authors remarked that this was true for different research papers with different methodologies.

Whilst the authors were looking at global posture changes, and even looking into bony structures vs. soft tissue as well as flat feet, it is interesting to note that the spinal curve was highlighted as an issue for attention.

“With regard to the role of intra-abdominal pressure in causing POP [pelvic organ prolapse], it should be noted that changing [sic] in normal spinal curves might cause extra intra-abdominal



pressure on to the pelvic floor. Anatomic studies showed a role of normal spinal curvatures in supporting pelvic floor from direct intra-abdominal pressures," remarked Zhooldideh *et al.* They went on to state that the normal forward and backward curves of the lumbar and thoracic region "might help in supporting abdominal viscera and absorbing downward intra-abdominal pressure" before it reaches the pelvic region.

Interestingly, there is research that shows significant increases in intravaginal pressure in a hypolordotic posture (while standing) in comparison to a hyperlordotic posture [8]. Typically, an EMG reading will reveal increased pelvic floor muscle activity during standing in comparison to lying. But we can now see (from Capson *et al's* work) that hypolordotic posture may contribute to pelvic floor dysfunction.

It is becoming increasingly clear that the lumbar curve is important in maintaining pelvic floor health, as is movement of the ribs in respiration. Therefore the thoracic/cervical curve is also important. It's also interesting to note that the Herman Wallace Pelvic Rehabilitation Institute indicates that the goal of therapy may either be to increase or decrease muscle activity and function [8]. This is where we need to take a look to our own professions research.

Chiropractic Research

In 2016, a ground-breaking study was published in the Journal of Manipulative and Physiological Therapeutics. It revealed that adjusting pregnant women appeared to relax the pelvic floor muscles at rest, an issue important for childbirth [3]. A novel finding of the study was that participants in the control group, made up of non-pregnant chiropractic students who were adjusted often, were able to contract their pelvic floor muscles to a degree previously seen only in elite athletes.

The implications of this study are yet to be fully researched and understood, but it does show us that there could quite possibly be a link between a subluxation-free spine and greater pelvic floor control. In light of the Herman and Wallace Institute's suggestion that either a decrease or an increase in pelvic muscle activity may be the therapeutic goal (depending on the case), this piece of research is interesting. In the control group, their ability to contract their pelvic floor muscles was near elite athlete level. In the intervention group (pregnant women) their ability to relax their pelvic floor muscles was greater.

We don't know why yet. More study is needed to ascertain that. We just know that chiropractic care made a difference for the pregnant women in the study, but that there was a fascinatingly high level of pelvic floor control in the non-pregnant chiropractic students who were adjusted often.

What we do know from other studies, however, is that chiropractic care can increase the brains ability to drive the muscles, and can increase the speed at which brain and body communicate with each other.

Time will tell exactly what this means therapeutically. In the meantime, we know that posture matters and chiropractic care may indeed have a role. This is encouraging knowledge indeed.

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FIG. 22.—Lateral view of the cervical and dorsal vertebrae.

1st cervical or Atlas

2nd cervical or Axis

1st dorsal

1st lumbar

