Why don't our adjustments "hold"? A chiropractor's perspective on the importance of the vagus nerve and adjusting the cranium

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ABSTRACT

Despite the evidence that chiropractic care can benefit the pediatric population, the burden of responsibility continues to be with the pediatric chiropractor to perform the groundwork to identify a credible diagnosis and appropriate treatment plan as well as to monitor and possibly suggest not only ancillary interventions but to monitor the outcomes of their treatment plan and interventions employed and make appropriate referrals in an attempt to optimize the child's progress. This includes continuing education in pediatric diagnosis and management as well as in chiropractic adjusting techniques to include the cranium, spine/pelvis and extremities.

KEYWORDS: pediatric, chiropractic, vagus nerve, chiropractic adjustment, cranial technique.

Although there is good evidence that most parents who present their children for chiropractic care report almost instant benefits,[1] there is a small percentage who ask:

"But, Doctor, why do we have to keep bringing our child back?"

There may be many reasons chiropractors find themselves adjusting their young patients week after week without seeing improvement or an increase in resilience and ability to retain the correction orchestrated the previous week. In those cases, the treatment may be addressing a symptom (the subluxation) and the the root cause of the problem. In research, these reasons for not "holding" their adjustments, would be called confounding variables. "Confounding variables are those that may compete with the exposure of interest (eg, treatment — *your adjustment*) in explaining the outcome of a study."[2] DD Palmer would have identified the confounding variables as the causes of subluxation: *trauma, toxin and thought*.[3]

Subject to stimuli as early as in the womb, the infant continues to assimilate and differentiate input from both their own internal physiologic processes and from a myriad of external stimuli. Movement, for example, drives proprioceptive (location of the body in space) development.

"In this period, the nervous system is being shaped and organized by innate activation of neural circuitry and environmental interaction. These processes will result in the elimination of inefficient synaptic connections, preserving the most efficient neural networks. This organization concurs with a gradual change in the quality of motor behavior, changing from a clumsy pattern with co-contractions, into fluent, precise, and well-coordinated motor performances."[4]

But is movement always a positive driver for development? A hyper-reflexive startle response (sympathetic) might result in an inability to enter a restorative state of sleep (parasympathetic) contributing to constant fussiness, refusal to eat and poor weight gain. To remedy this situation, many parents have turned to the ancient art of swaddling their infant. Beginning with a systematic review in 2007,[5] followed by an integrative review[6] published in 2017 and a systematic review and narrative synthesis[7] published in 2022, the authors all concluded that with appropriate safety precautions to minimize the risks of hyperthermia, hip dysplasia and SIDS deaths, swaddling was "associated with increased duration of quiet sleep in infants and a significantly reduced number of sleep state changes among infants naïve to the intervention."[7]

Yes, there are pros and cons of swaddling.[8] Constant swaddling decreased the infant's ability to move and some clinicians have proposed that it thus decreases proprioceptive input and consequently, primitive reflex integration and motor development. Another study suggests that swaddled babies cry less and are fed less frequently than un-swaddled babies. In the case of breastfed babies, by reducing feed frequency swaddling may impede maternal milk production and thereby infant growth.[9] Just as swaddling tightly around the hips has been linked to hip dysplasia,[8] this author proposes that swaddling might also result in vertebral subluxation if the infant persists in fighting the restricting garment.

But if an infant is overstimulated by their external environment, could deep pressure stimulation of joint mechanoreceptors provided by short term, supervised swaddling have a regulating effect on the nervous system with the infant calming faster when offered the swaddle in an overstimulating environment? Chiropractors who care

for crying infants need to ask probing questions, listen to parents' answers and process each child's presentation accordingly to give the best individualized treatment and home care advice on safety for our youngest patients.

An example of internal data being processed by an infant is hunger. Hunger will stimulate oral motor activity or "hunger cues" for the mother to know it is time to feed the infant. These cues include head turning to look for the breast (rooting), becoming more alert and active, opening and closing their mouth, fists moving to mouth, sucking on their hands or lip smacking. As the hunger becomes more urgent, rapid head turning back and forth accompanies by whimpering or protests may ensue before the infant begins to cry eliciting parental attention. A mother may not know that crying is not the only sign that an infant is hungry. Rather it's a sign of distress as hungry babies will show signs of hunger before they begin to cry. Once crying, they have engaged their sympathetic nervous system and their heart and respiratory rates increase, stress hormones are released, they swallow air and disrupt their gastrointestinal motility. They will initially be more disorganized at breast and if they can latch and feed, they are more prone to hiccups, intestinal cramping, and reflux. If a delay in feeding becomes a repetitive practice (having been given poor advice to feed a newborn on a schedule of every 3-4 hours, for example) the processing of these uncomfortable internal signals may ultimately result in inability to effectively coordinate suckling, swallowing and breathing once brought to breast to the extreme case of developing an aversion to feeding.[10,11]

Dysfunctional breastfeeding can result from a myriad of causes among them tight suboccipital muscles and subluxation at the C01 junction resulting in an inability to extend at the cranial base, an inability to gape widely, a restricted hyoid bone, a posterior tongue tie or pain from a subluxated or fractured clavicle. "Try and try again!" behaviors like repeated attempts to latch onto a breast when there is a biomechanical restriction or pain may eventually lead to frustration in the infant, possibly even panic as their hunger is not satiated (engaging the sympathetic nervous system). However, in most cases neuroplasticity lends to the process of regulating their feeding behaviors or adopting compensatory behaviors to achieve their ultimate goal of transferring milk. This could result in damage to a mother's delicate breast tissue from clamping or grinding on the nipple or appear as a developing torticollis because of postural compensation. This adaptive pattern, for example, may improve their ability to remove milk at the breast but may chronically compromise cervical vertebral mobility with resultant neurologic consequences ranging from hypertonic musculature, nociceptive input and autonomic dysregulation to somatovisceral effects (physiologic changes occurring in organ systems as a result of musculoskeletal dysfunction's effect on the nervous system). And if their inability to feed at breast is due to a true anatomical restriction, like ankyloglossia, the infant will regress to their compensatory posture despite the frequency of adjustments.[12,13]

Likewise, if the treatment has not addressed the cranial and or cranio-cervical subluxation successfully, there will be a persistence of the retrognathic mandible, narrow elevated or tipped palate, elevated and retracted hyoid all contributing to the tongue's inability to extend and elevate to cradle the nipple and draw it along the palate while nursing. A frenotomy will be an inappropriate intervention and will not result in normalized oral motor function and the compensations will still persist.[14,15]

Autonomically dysregulated infants (or "cry babies") often cry unceasingly, adopt a rigid habitus, may be slow to reach developmental milestones, are not sleeping restfully (nor are their parents), may fail to feed at breast or on bottle without struggling, and may ultimately present to you with the diagnosis of "failure to thrive."[16] Again, as suggested in the earlier study, if parents have resorted to interventions like swaddling, it could possibly have worsened the situation by reducing arousal time and again limiting the infant's milk intake.[9]

When evaluating an infant who is failing to feed efficiently, for example, a complete history should include pre-gestational, gestational, labor and delivery and postpartum details including all interventions employed that might have contributed to the infant's presenting circumstance and importantly, may also be contributing to the persistence of the chief complaint despite compliance to all the recommendations the parents have received thus far from other healthcare providers, family and friends (including social media). Then, the physical evaluation which normally includes muscular tone as well as articular dysfunction of the spine and extremities, will be more thorough if the movement of the cranial bones and tension and restrictions within the connective tissues of the body are also evaluated. These would include the transverse and sagittal diaphragms (starting at the falx cerebri and tentorium cerebelli to the pelvic floor), as well as the dural membranes and fascia supporting individual joints and muscles that could have been influenced by in utero constraint or birth trauma.[12,15] It should also include a neurologic assessment including infant responsiveness and primitive reflexes. Is the tone of the oral musculature intact? Are the primitive reflexes associated with feeding intact?[17] Is there symmetry bilaterally? Are these reflexes hyper or hypo-reflexive?

There are multiple cranial nerves involved in infant feeding which would suggest the importance of understanding cranial anatomy and the exodus of the cranial nerves via

the foramen of the cranial base and techniques to treat effectively. One of these cranial nerves, the tenth cranial nerve, the vagus nerve, provides motor pathways to the palatoglossus muscle and modulates the gag reflex (both critical in an infant's ability to breastfeed) and is involved in the infant's ability to integrate sucking, swallowing and breathing simultaneously when feeding.[18] It also provides general sensory afferent fibers to the dura mater of the posterior cranial fossa, so it would be prudent to include an evaluation of cranial mobility as restriction may result in an alteration in the activity of the vagus nerve resulting in a dysregulated infant.[19]

When the examination is thorough and structural findings are coupled with other physiologic markers, the reduction of vagal dysfunction by applying appropriate cranial and cervical techniques (thus restoring balance to the autonomic nervous system) may be key as it can deleteriously affect oral motor competency as well as many of the bodily systems that maintain homeostasis. For example, gastrointestinal integrity, including motility, sensitivity, secretion, permeability, immunity and diversity of the microbiome, are all heavily influenced by vagal function.[20]

GI function can also be influenced by a somatovisceral feedback loop (subluxation resulting in GI dysfunction) as well as a viscerosomatic effect (for example, disrupting the gastrointestinal environment with antibiotic administration may result in nociceptive input via the sensory component of the vagus nerve causing a change in fascial integrity, musculoskeletal dysfunction or subluxation). An in-depth analysis of the situation to determine the root of the problem will prevent our adjustment from being applied repeatedly as an amelioration rather than determining the diagnosis is a subluxation with the goal of the adjustment to restore normal mobility and reduce altered neurologic function.

The older child is not immune from these issues. Dysregulated preschool and school age children (mirroring perhaps the dysregulated adults around them) may suffer from sensory overload, behavioral outburst and or an inability to focus and learn. Any alteration in the function of the vagus nerve may impair the child's ability to modulate their own autonomic nervous system leaving them in a hyper-sympathetic state and leaving them incapable of smoothly transitioning into parasympathetic or "rest and digest" and back again when necessary to run or defend once again.

Focus and learning suffer when children are dysregulated. Researchers have found that there is a direct connection between the vagus nerve, the cholinergic system that regulates certain aspects of brain function, and motor cortex neurons that are essential in learning new skills.[21]

In this age group, more than one factor may constitute a stressor (toxins like processed foods and sugar, traumas like a fall, or thoughts like bullying or watching TikTok six hours a day or being disciplined harshly by stressed authority figures). With each of these stressors, the autonomic nervous system "lights up" and the physiologic responses of the sympathetic nervous system are engaged. The one we are most familiar with is the Fight or Flight (behaviors like hiding or bolting (flight), aggression, tantrums or tearfulness (defensiveness) or the "deer in headlights" (freeze) response. Stimulation of the hypothalamic/pituitary/adrenal axis and release of initially helpful but over time, harmful, chemicals are triggered over and over again during the 24 hours of a child's day.

The vagus nerve is responsible for modulating the "fight or flight" response and enables social connection. The vagus nerve provides the network that influences heart rate and blood pressure, controls temperature through sweating, regulates digestion, keeps inflammation in check and supports a healthy immune system. The physiologic and neurologic dysregulation presenting daily to chiropractors' clinics may be the result of vagal compromise. Whether that compromise is structural requiring the application of specific cranial and spinal techniques or related to other stressors as outlined, the chiropractor is in an excellent position to evaluate and offer guidance and referrals as appropriate to help families move out of the spiral of care that can occur when the healthcare provider cannot think "outside of the box" and dig deeper for an answer.

Besides mastering the art of differential diagnosis, and that of providing a specific chiropractic adjustment with a well-defined treatment plan, an appreciation of the appropriate and safe use of ancillary interventions and supportive education offered to parents during the developmentally vulnerable years should be a prerequisite to caring for children. The chiropractor's ability to support the dyad to successfully breastfeed is priceless as the current research on the effect of breastfeeding, the first "natural intervention" on the infant physiology, could be an important part of education and treatment planning for our patient's parents.

A study published in 2022 investigated autonomic regulation during feeding in six-month old infants with a history of excessive crying (EC) and their social-behavioral development at 12 and 24 months. Bottle fed excessively crying infants demonstrated atypical autonomic regulation, while breastfed excessively crying infants had patterns of autonomic regulation similar to non-crying infants. Their behavioral data suggested that while a history of excessive crying was related to social-emotional behaviors at 12 and 24 months, breastfeeding may buffer the behavioral effects of excessive crying on sociability at 24 months.[22]

In conclusion, chiropractor's work with children has shown very good results very quickly. Guidelines as a result of a Delphi Consensus process can help guide clinicians in their decision making process.[23] When a clinician learns that the child is not recovering at the anticipated rate, a re-evaluation with particular attention to involvement of the cranium and the vagus nerve or an appropriate referral to collaborate with another health care provider is a reasonable way forward to avoid disappointment for the parents, child and doctor.

Despite the evidence that chiropractic care can benefit the pediatric population, the burden of responsibility continues to be with the pediatric chiropractor to perform the groundwork to identify a credible diagnosis and appropriate treatment plan as well as to monitor and possibly suggest not only ancillary interventions but to monitor the outcomes of their treatment plan and interventions employed and make appropriate referrals in an attempt to optimize the child's progress. This includes continuing education in pediatric diagnosis and management as well as in chiropractic adjusting techniques to include the cranium, spine/pelvis and extremities.

References:

1. Keating G. Parent reports of chiropractic care for children: A preliminary report from 22,043 parents in Australia. *Journal Clinical Chiropractic Pediatrics* 2021; 20(1): 1731-2. Accessed on 12/2/2023: https://jccponline.com/keating20-01.pdf.

2. Skelly AC, Dettori JR, Brodt ED. Assessing bias: the importance of considering confounding. *Evid Based Spine Care J*. 2012 Feb;3(1):9-12. doi:10.1055/s-0031-1298595. PMID: 23236300; PMCID: PMC3503514. Accessed on 12/2/2023: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3503514/.

3. Palmer DD. The Chiropractic Adjuster: A Compilation of the Writing of DD Palmer. Des Moines IA. Palmer School of Chiropractic; 1921.

4. Kuiper MJ, Brandsma R, Lunsing RJ, Eggink H, Ter Horst HJ, Bos AF, Sival DA. The neurological phenotype of developmental motor patterns during early childhood. *Brain Behav*. 2019 Jan;9(1):e01153. doi:10.1002/brb3.1153. Epub 2018 Nov 28. PMID: 30485703; PMCID: PMC6346655. Accessed on 12/2/2023: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6346655/.

5. Nelson AM. Risks and Benefits of Swaddling Healthy Infants: An Integrative Review. *MCN Am J Matern Child Nurs*. 2017 Jul/Aug;42(4):216-225. doi:10.1097/NMC.0000000000000344. PMID: 28394766. Accessed on 12/2/2023: https://pubmed.ncbi.nlm.nih.gov/28394766/.

6. van Sleuwen BE, Engelberts AC, Boere-Boonekamp MM, Kuis W, Schulpen TW, L'Hoir MP. Swaddling: a systematic review. *Pediatrics*. 2007 Oct;120(4):e1097-106. doi:10.1542/peds.2006-2083. PMID: 17908730. Accessed on 12/2/2023 https://pubmed.ncbi.nlm.nih.gov/17908730/.

7. Dixley A, Ball HL. The effect of swaddling on infant sleep and arousal: A systematic review and narrative synthesis. *Front Pediatr*. 2022 Nov 30;10:1000180. doi:10.3389/fped.2022.1000180. PMID: 36533224; PMCID: PMC9748185. Accessed on 12/2/2023: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9748185/.

8. Nelson AM. Risks and Benefits of Swaddling Healthy Infants: An Integrative Review. *MCN Am J Matern Child Nurs*. 2017 Jul/Aug;42(4):216-225. doi:10.1097/NMC.0000000000000344. PMID: 28394766. Accessed on 12/2/2023: https://pubmed.ncbi.nlm.nih.gov/28394766/.

9. Dixley A, Ball HL. The impact of swaddling upon breastfeeding: A critical review. *Am J Hum Biol*. 2023 Jun;35(6):e23878. doi:10.1002/ajhb.23878. Epub 2023 Feb 14. PMID: 36787374.

10. Hodges EA, Wasser HM, Colgan BK, Bentley ME. Development of Feeding Cues During Infancy and Toddlerhood. *MCN Am J Matern Child Nurs*. 2016 Jul/Aug;41(4):244-251. doi:10.1097/NMC.0000000000000251. PMID: 27710994; PMCID: PMC5057392. Accessed on 12/2/2023: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5057392/.

11. Zhao F, Sun Y, Zhang Y, Xu T, Wang N, Yan S, Zeng T, Zhang F, Gao J, Yue Q, Rozelle S. Comparison of mothers' perceptions of hunger cues in 3-month-old infant under different feeding methods. *BMC Public Health*. 23, Article number: 444 (2023). Accessed on 12/2/2023: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-15325-3#citeas.

12. Tow J, Vallone S. Development of an integrative relationship in the care of the breastfeeding newborn: lactation consultant and chiropractor. *Journal of Clinical Chiropractic Pediatrics*. June 2009. 10(1):626-632. Accessed on 12/2/2023: https://jccponline.com/jccp_v10_n1.pdf.

13. Vallone S. Evaluation and treatment of breastfeeding difficulties associated with cervicocranial dysfunction: a chiropractic perspective. *Journal of Clinical Chiropractic Pediatrics*. 2016; 15(3), 1301-1305. Accessed on 12/2/2023: https://jccponline.com/Vol15no3.pdf.

14. Vallone S, Carnegie-Hargreaves F.The infant withdysfunctional feeding patterns -the chiropractic assessment. *Journal of Clinical Chiropractic Pediatrics*. 2016; 15(2): 1230-1235. Accessed on 12/2/2023: https://jccponline.com/Feeding2016.pdf.

15. Dorough A, Vallone S. Differentiating the impact of biomechanical forces of labor and delivery vs. the effect of a posterior tongue tie on neonatal and infant feeding dysfunction: a clinical evaluation . *Journal of Clinical Chiropractic Pediatrics*. 2022; 21(2): 1893-1901. Accessed on 12/2/2023: https://jccponline.com/Dorough21-02.pdf.

16. Miller J. Cry babies: A framework for chiropractic care. *Clinical Chiropractic*, 2007; 10(3):139-146. ISSN 1479-2354, Accessed on 12/2/2023: https://www.dcscience.net/miller-2007-cry-babies.pdf.

17. Colson SD, Meek JH, Hawdon JM. Optimal positions for the release of primitive neonatal reflexes stimulating breastfeeding. *Early Hum Dev*. 2008 Jul;84(7):441-9. doi:10.1016/j.earlhumdev.2007.12.003. Epub 2008 Feb 19. PMID: 18243594.

18. Watson Genna C. *Supporting Sucking Skills in Breastfeeding Infants*. Fourth Edition. Massachusetts: Jones and Bartlett Learning; 2023.

19. Byrne M. Vagus Nerve, KenHub Anatomy. 2023 Oct. Accessed on 12/2/2023: https://www.kenhub.com/en/library/anatomy/the-vagus-nerve.

20. Bonaz B , Sinniger V , Pellissier S . Therapeutic Potential of Vagus Nerve Stimulation for Inflammatory Bowel Diseases. Frontiers in Neuroscience. 2021; 15:1-16. doi:10.3389/fnins.2021.650971 ISSN=1662-453X Accessed on 12/2/2023: https://www.frontiersin.org/articles/10.3389/fnins.2021.650971.

21. Bowles S, Hickman J, Peng X, Williamson WR,Huang R, Washington K, Donegan D, Welle CG. Vagus nerve stimulation drives selective circuit modulation through cholinergic reinforcement. *Neuron*. 2022 Sept 7; 110: 2867—2885. https://doi.org/10.1016/j.neuron.2022.06.017 Accessed on 12/2/2023: https://www.cell.com/neuron/fulltext/S0896-6273(22)00555-4.

22. Heilman KJ, Zageris DM, Keir D, Aylward SA, Burkhardt T, Gilkerson L, Boukydis Z, Gray L, Porges SW.Breastfeeding is related to atypical autonomic and behavior regulation in infants with a history of excessive crying. *International Journal of Psychophysiology*, 2022;175:119-128. ISSN 0167-8760, Accessed on 12/2/2023: https://doi.org/10.1016/j.ijpsycho.2022.03.012 or https://www.sciencedirect.com/science/article/pii/S0167876022000848.

23. Keating G, Hawk C, Amorin-Woods L, Amorin-Woods D, Vallone S, Farabaugh, Todd A, Ferrance R, Young J, O'Neill-Bhogal, Sexton H, Alevaki H, Miller J, Parking-Smith G, Schielke A, Robinson A, Thompson R. Clinical practice guideline for best practice management of pediatric patients by chiropractors: results of a delphi consensus process. *Journal of Integrative and Complementary Medicine*. 2023, Oct 30; 0(0): pp. 1—17. doi:10.1089/jicm.2023.0010. Accessed on 12/2/2023: https://www.liebertpub.com/doi/10.1089/jicm.2023.0010.