

Osteopathic Approach to Children with ADHD

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Introduction:

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder that affects many children and often continues into adulthood. It is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity that include behaviors like failure to pay close attention to details, difficulty organizing tasks and activities, excessive talking, fidgeting, or an inability to remain seated in appropriate situations.^[1] It can result in performance issues in social, educational, or work settings if not addressed properly.

There are studies suggest that ADHD may be associated with following comorbidities,

- 1) Sleeping disorder^[2,3]
- 2) Periodic limb movements (PLMS) and Restless legs syndrome (RLS) ^[4]
- 3) Cervical kyphosis ^[5]
- 4) Retained primitive reflexes ^[6,7] – Moro, Galant, ATNR, STNR
- 5) Sensory processing problems ^[8,9]
- 6) balance deficits ^[10]
- 7) Anxiety and Endocrine Dysfunction ^[11]
- 8) Neuromuscular regulation problems ^[12]
- 9) gastrointestinal dysfunction ^[12]

The nervous system of the child is a dynamic, expanding and integrated system that ultimately affects all other vital system of the child's body. It is the master control of the human body, its function is dependent upon an unimpeded, physiologic and integrated structure. Impairment of this delicate structure integrity will impair function. This paper discuss osteopathic approach to facilitate children's optimal body functions.

1) Sleeping problems

Babies, children, and teens need significantly more sleep than adults to support their rapid mental and physical development. The National Sleep Foundation panel recommended the following sleep ranges for children and teen age groups.

Newborns (0 - 3 months): 14 - 17 hours each day

Infants (4 - 11 months): 12 - 15 hours each day

Toddlers (1 - 2 years): 11 - 14 hours each day

Preschoolers (3 - 5 years): 10 - 13 hours each day

School age children (6 – 13 years): 9 - 11 hours each day

Teenagers (14 - 17): 8 - 10 hours each day

One of the reasons it's so hard to know when our kids are getting insufficient sleep is that drowsy children don't necessarily slow down the way we do—they wind up. In fact, sleepiness can look like ADHD symptoms. Children often act as if they're not tired, resisting bedtime and becoming hyper as the evening goes on. All this can happen because the child is overtired. ^[14]

Neurocognitive development, cellular regeneration, and tissue and bone growth all occur during the deep sleep stage. When Children with ADHD are suffering from a chronic lack of restorative sleep, the brain switches back from deep to light sleep in order to resume normal breathing - barring the mind and body from critical restorative processes.

A healthy physiological transition from wake to sleep involves muscle relaxation, including pharyngeal dilator, intrinsic and extrinsic tongue muscles, which usually stiffen the upper airway in an awake state. This relaxation results in collapsibility of the airway and an increased resistance to airflow. These changes may result in an increase in partial pressure of carbon dioxide (pCO₂) of 3-5mmHg.

Studies shown that sleep disordered breathing (SDB), snoring, and periodic leg movements (PLM) during sleep at childhood are relatively common in children with ADHD, and they are associated with daytime sleepiness, inattention, hyperactivity, academic problems, poor temper control, and aggressive/conduct behaviors.

SDB is characterized by repeated episodes of complete or partial obstructions of the upper airway during sleep, despite the effort to breathe, This leads to reduced or absent airflow resulting in hypopnoeas (reduced airflow) or apneas (cessation of airflow) respectively, and is usually associated with a reduction in blood oxygen saturation. The increased resistance to airflow may occur anywhere from the nasopharynx to the hypopharynx and may involve multiple sites.

There are three elements that appear to contribute to the pathophysiology of SDB:

- Anatomical structure of the upper airway and jaw

- Lack of muscle tone during sleep due to neuromotor dysfunction
- Inflammation.

Osteopathic treatment can restore proper positioning of the jaw and help open blocked nasal passages, sinuses, and the throat by gently mobilizing bones within cranium and helping muscles in neck and throat regions to relax. Osteopathic treatment can help improve neuromotor function and muscle tone, increase pharyngeal stability ^[15], improve circulation and reduce inflammation, and reduces the apnoea-hypopnoea index ^[16].

2) **Restless legs syndrome (RLS) ^[4] / Periodic limb movements (PLMS) ^[17]**

Restless legs syndrome (RLS) Restless legs syndrome is a neurological condition with motor, sensory, and circadian disruption that cause an uncontrollable urge to move your legs, The sensations, which generally occur within the limb rather than on the skin, are described as crawling, creeping, pulling, throbbing, aching, itching, electric...etc. Some of the common accompanying characteristics of RLS include the following:

- **Sensations that begin after rest.**

The sensation typically begins after you've been lying down or sitting for an extended time, such as in a car, airplane or movie theater.

- **Relief with movement.**

The sensation of RLS lessens with movement, such as stretching, jiggling your legs, pacing or walking.

- **Worsening of symptoms in the evening.**

RLS symptoms are worsening in the evening.

- **Nighttime leg twitching.**

RLS may be associated with another, more common condition called periodic limb movement of sleep (PLMS) ^[17], which causes your legs to twitch and kick, possibly throughout the night, while you sleep.

Osteopathic intervention can help relax muscle, improve nerve signal transmission and restore optimal function of nervous system.

3) **Cervical kyphosis ^[5]**

Study shows shown that the cervical curve develop is a natural development in utero ^[18], babies continue to work their cervical extensor muscle after birth as they lift the head and crawling.

Cervical kyphosis is a forward curvature of the cervical spine, or neck. The following may be indicated when a child has cervical kyphosis:

- an unusual curve in the child's neck
- the child has trouble looking up or turning his or her head
- the child has neck pain

The spinal cord is the body's central communication system, the nerves branch out to every part of the body and send messages between the brain and the rest of the body. Cervical kyphosis can lead to mechanical and thus physiologic changes in the spinal cord, brainstem, and higher brain centers are related to the abnormal static postural positions of the skull relative to the thorax. Mechanical compression of nerves can also result in micro-vascular permeability changes in the endoneural capillaries and lead to neural edema and changes in impulse propagation.

Osteopathic treatment can help restore normal biomechanical structure and curvature, when abnormal stresses and strains were removed from the spinal cord, optimal body functions can be restored.

4) Retained primitive reflexes ^[6,7]

Studies show that brain growth and development occur at predetermined chronologic ages. The fundamental cause of neurologic disorganization results from a child ineffectively passing through or missing milestones at certain critical stages of neurologic and neuronal development. This may occur if there is prolonged interruption of normal infant development and stimulation. Neural disorganization can be from organic or external causes. ^[19]

Primitive reflexes are involuntary physical reactions that originate in the central nervous system and are exhibited by babies. As a child grows, primitive reflexes normally disappear within the first year of life. these infantile responses are replaced with higher-level reflexes. The primitive reflexes that were once necessary become superfluous or even inhibitory. If they persist beyond a normal developmental timeline, the child may experience clumsiness, motor difficulties, and restlessness.

Studies have found that children diagnosed with ADHD are more likely than their peers to have retained primitive reflexes.

Osteopathic treatment directed toward the autonomous nervous system improve the functional restrictions, cultivate integrated body movements e.g. arm, leg, head movement and visual tracking for re-patterning of the specific neurologic sequences and primitive reflexes integration. Osteopathic intervention can facilitate proper stimulation and neurologic feedback, help reorganize the nervous system for optimal development, integration and organization.

5) Sensory processing problems ^[8,9]

Children who are inefficient in their ability to receive, process, store, and utilize information through their 5 senses exhibit hyperesthesia (abnormal increased response to sensory stimulation, i.e. hypersensitivity) or hypoesthesia (abnormal decreased response to sensory stimulation, hyposensitivity). Sensory hypersensitivity is characterized by responses to sensory stimuli that are faster, longer, or more intense than what would be expected with typical sensory response. ^[11] For example, a child with tactile hypoesthesia may have an extremely increase pain threshold, may constantly run their hands across the carpet to receive deep joint stimulation, and may seek and be contented with various forms of vibration. Children with tactile hyperesthesia may refuse to wear certain types of clothing, exhibit extreme irritability from tags on clothing, may be adverse to any type of vibratory stimulation. Hypersensitivity and hyposensitivity hinder the optimal growth and development, these developmental inefficiencies must be overcome before proper neurologic organizations can occur.

Osteopathic treatment intercedes with sensitization states, at all levels, to affect interoceptive pathways ^[20] and improve the sensory responses.

6) Balance deficits ^[10]

Postural stability and balance are defined as the body's ability to return to a state of equilibrium. The cerebellum plays an integrative role in the balance control. Besides the role in balance and other motor functions, the cerebellum is involved in the regulation of attention, timing and anticipatory regulation. and other cognitive functions. The management of balance is mediated by the coordinated function of the visual, vestibular, proprioceptive, musculoskeletal, and central nervous systems. ^[21] Children with ADHD exhibit presence of motor deficiencies, including balance deficits, cerebellar dysfunction, and inconsistent reaction time is commonly seen in ADHD.

Osteopathic treatment restore optimal structures from the sacrum up to the cranial bones, and release impingement on spinal and/or cervical proprioceptors, and restore better reaction time by improving nerve supply and communication with the cerebellum to and from the joints. It improves the overall coordinated function of visual, vestibular, proprioceptive, musculoskeletal, and central nervous systems, and lead to improved balance control and postural stability.

7) Anxiety ^[11] **and HPA activity**

Johnson (1975) theorized that anxiety occurred because of faulty information processing, a hypersensitivity to information, and stimuli in the environment. Ayres (1972) also proposed that deficits in the ability to modulate incoming sensory stimuli lead to the manifestation of distractibility, anxiety, and other stress-related behaviors. People may demonstrate overresponsivity to any type of sensory stimuli (e.g., sound, movement, touch), and behavioral responses in the face of adverse stimuli include aggression, fear, avoidance, withdrawal, irritability, or moodiness. ^[11]

Links between anxiety and sensory responsiveness may be identified not only behaviorally but also in examination of central nervous system structural associations. The hypothalamus, amygdala, and reticular formation provide the most likely targets. Anxious behaviors are associated with activation of the autonomic nervous system and are characterized by commonly observed physiologic changes, such as increased heart rate, increased respiration, pupillary dilation, and appetite suppression.

The *hypothalamus*, which mediates the autonomic nervous system, receives input from the amygdala, which in turn has reciprocal connections with the reticular formation and the frontal cortex (Bear et al., 2007). The *amygdala* not only activates emotions in response to stimuli but is also hypothesized to store emotional memories of past experiences, thoughts, and perceptions that may inhibit the ability of the frontal cortex to moderate the amygdala and inhibit overre- action of emotional responses (Bear et al., 2007). Moreover, the *reticular formation*, which plays a key role in modulating levels of arousal, projects to the amygdala, thereby connecting emotional memory with a person's state of being and readiness to cope with incoming stimuli.

The hypothalamic-pituitary-adrenal axis (HPA axis) is an interactive neuroendocrine unit comprising of the hypothalamus, the pituitary gland, and the adrenal glands. The HPA axis plays key roles in basal homeostasis and in the body's response to stress. The ultimate result of the HPA axis activation is to increase levels of cortisol in the blood during times of stress. Cortisol is a hormonal product of the adrenal glands, main role is in releasing glucose into the bloodstream in order to facilitate the "flight or fight" response. It can be used as an indicator of HPA activity.

The endocrine's feedback system helps control the balance of hormones in the bloodstream. If there is too much or too little of a certain hormone, the feedback system signals the proper gland or glands to correct the problem. A hormone imbalance may occur if this feedback system has trouble keeping the right level of hormones in the bloodstream, or if your body doesn't clear them out of the bloodstream properly. Studies showed that higher adrenal activity and cortisol levels may be seen with aggressive/impulsive behavior.

Osteopathic treatment restores good body alignment and posture to allow better flow of neural signals and body fluid. Better alignment, communication and supply of body fluid will help promote efficient regulation and calm down the sympathetic nervous system (our flight or fight response) which is overactive in many with excessive stress, and activate the parasympathetic nervous system.

8) Neuromuscular regulation problems ^[12]

Studies suggest that motor regulation problems are indicated in children with ADHD. It is also indicated ADHD experience a significantly higher level of pain and more widespread pain compared to population with no ADHD. This might indicate that pain is a long-term secondary effect of heightened muscle tone and restricted movement associated with the ADHD condition.

The contractile activity of skeletal muscle is regulated by the central nervous system through the transmission of action potentials from motor neurons to muscle fibers. Transmission occurs at a highly specialized chemical synapse, the neuromuscular junction (NMJ) or motor endplate.

Osteopathic treatment restores optimal structural alignment and promote good flow of chemical communication for Neuromuscular regulation, it also reduce the level of pain caused by the heightened muscle tone and restricted movement associated with the ADHD condition.

9. Gastrointestinal disturbance ^[22]

Studies indicate an association between ADHD and gastrointestinal disturbance, osteopathic intervention can help improve body's digestive and elimination function, the following dietary recommendation can also help to restore optimal gastrointestinal function.

- Whole unprocessed, preferably organic foods (fruits, vegetables, whole grains, nuts, wild caught fish) to lessen the exposure to toxins and provide the best source of essential nutrients.
- If not allergic, increase the consumption of garlic, onions, and eggs in the diets, which are high in sulfur, to chelate any heavy metals.
- Consume foods high in calcium, magnesium, and zinc, e.g. dark-green leafy vegetables, whole grains, legumes, nuts.
- Balance the essential fatty acids by increasing the intake of omega-3 fatty acids (found Fatty fish like salmon, walnuts, chia seeds, flaxseeds, Omega-3 fortified foods such as eggs and milk) If adding a supplement, you can choose from fish oil, krill oil, flaxseed oil.
- Decrease intake of refined and processed foods and sugar.
- Prebiotics and/or probiotics to support the body in building and maintaining a healthy colony of bacteria and other microorganisms, which supports the gut and aids digestion. These food components help promote beneficial bacteria by providing food and creating an environment where microorganisms can flourish.

Conclusion

Osteopathy's holistic approach address overall body function responsible for attention and self regulation of impulsiveness / aggression, including nervous system, musculoskeletal system, endocrine system and digestive system. It can improve physical, emotional and cognitive functions of the children with ADHD.

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