CASE STUDY

Resolution of Intention Tremor Following Chiropractic in an Infant with Vertebral Subluxation: a Case Study and Selective Review of the Literature

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Abstract

Objective: To report on the positive health outcomes following the chiropractic management of a child with intention tremor and to review the related literature.

Clinical Features: A 20-month-old male child presented to a chiropractic office with intention tremor in his right upper extremity, wide gait, posterior and static posturing of arms, and speech articulation delay with signs of vertebral subluxations.

Interventions and Outcomes: Vertebral subluxations were addressed utilizing an Activator adjusting instrument. Indicators of vertebral subluxations were assessed using static and motion palpation findings. Cross-crawl at-home exercises were also advised as part of the care plan. Paraspinal thermal readings indicated a decrease in dysautonomia during reassessment. Frequency of intention tremor significantly decreased and parents reported a marked improvement in the patient's overall quality of life. Verbal communication skills also improved after two months of care.

Conclusion: This case reports on positive health outcomes following chiropractic in a child with intention tremor. Clinical research on chiropractic care for children with non-cerebral palsy cerebellar dysfunction is lacking, however, the proprioceptive pathway between the spine and the brain has been explored and mapped. This gap in research should be further investigated.

Key Words: *chiropractic, intention tremor, pediatric, cerebellar dysfunction, speech delay, vertebral subluxation, adjustment, gait.*

Introduction

Tremor is the most common movement disorder in the human population.[1] Kinetic tremor is a type of action tremor which is typically perceived while a limb is actually moving. If the movement is part of a goal-directed behavior, the tremor is termed an intention tremor; otherwise it is called a simple kinetic tremor.[2] Intention tremor is a condition in which the amplitude of tremor is seen to increase as the patient approaches a target with a limb. Intention tremor is due to cerebellar dysfunction and can be either unilateral or bilateral.[1]

Although there have been epidemiological surveys of adults with essential tremor and Parkinson's related tremor, there has yet to be an epidemiological survey targeted solely for children.[3] Intention tremor has not been investigated, independent of other tremor presentations. Intention tremor associated with essential tremor has been explored regarding the prevalence and association with essential tremor disease duration.[4]

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There does seem to be evidence of hereditability for patients with essential tremor who experienced onset of symptoms at an early age. In one study, 91% of patients who had tremor symptoms in the first and second decades of life had a family history of tremor, verses only 44% of those with onset after the fifth decade of life.[3] A case series dedicated specifically to childhood-onset essential tremor reported an average age of onset between three and eleven years of age.[3] Boys experience essential tremor three times as often as girls in cases of pediatric essential tremor.[3]

Diagnosis of intention tremor occurs during physical examination.[1,2] The finger-to-nose test reveals intention tremor, which arises as the finger approaches the target (nose). In children, it is important to determine the distribution of tremor with respect to which body parts are involved, and to characterize stimuli or situations, which either amplify or ameliorate the tremor.[2] Once physical examination occurs, ancillary tests are typically performed. Intention tremor should arouse suspicion of cerebellar disease, although the literature determines that this may be primary or secondary cerebellar disease. Ascertainment of the presence of other neurologic signs and symptoms, particularly other movement disorders, is of major importance, as this may help identify specific disorder of which tremor is only one component.[2]

The cerebellum has long been known to influence motor skills such as posture, gait, balance, and movement coordination.[5] Cerebellar deficits are often highly suggestive of a cerebellar pathology such as cerebellar lesions.[6] Although the primary etiology of the patient's symptoms remains unknown, the symptoms and patient history collectively point toward cerebellar dysfunction that is familial in origin.

The involved neurological circuit concerning intention tremor without postural tremor is the following: the cortico-cerebellar-cortical circuit.[7] More specifically, the dentato-rubro-thalamic or dentato-rubro-olivary pathways are involved in the loss of coordination and errors in the timing of muscle activations on the same side of the body.[7] In the instance of this patient, it may be assumed that cerebellar dysfunction is occurring on the right side of the cerebellum due to the presence of intention tremor in the right upper extremity. The proprioceptive input from the spinal column will be further examined in the discussion.

Case Report

Patient History

The patient was a 20-month old male who presented to the clinic with a chief complaint of a shaky right hand, according to his parents. The patient's mother stated that the tremors happen when reaching for toys or while eating dinner. A delay in speech was also reported by the mother, which she stated was going to be evaluated via a speech-hearing evaluation two weeks from his initial visit at the chiropractor. Patient's arms were stated to go to the "back of him" with the left arm being "mostly straight."

The patient's birth was long and complicated. He was born at 39-weeks gestation with a weight of 7 pounds 2 ounces and a length of 21 inches. The mother had protein in her urine and elevated blood pressure. The mother's water broke 3 days prior to giving birth. Pitocin was administered and an internal fetal monitor was utilized. Epidural was administered for two days while the mother was laboring in the hospital. The mother also had a balloon inserted and she stated that she felt her child was in the birth canal for a while. The patient had a tender head after birth but exhibited no bruising.

The patient was breastfed for one week but due to the mother's high testosterone level, breast milk would not produce. He was then formula fed for fourteen months. Solid foods were introduced at 14 months and no food allergies or intolerances were reported. Colic and/or reflux was also denied by the patient's mother. The patient responded to sound and visual stimuli immediately after birth. He was able to hold his head up at six weeks and able to sit up at three months. At six months the patient was able to cross-crawl and stand alone at eight months. Unassisted walking was achieved at twelve months of age. No vaccination issues were reported. His hand strength was stated to be fine as he has had no problems pulling up.

His quality of sleep was reported as "good" by the patient's mother. He was still sleeping ten or more hours per evening and napping during the day at the time of the initial visit. A "good" diet was also indicated.

The patient's mother stated that he had not been involved in any physical traumas or surgeries. An unexplained fever of 102 degrees Fahrenheit caused his parents to seek emergency medical care at the age of six months. All tests were reported to be negative.

Physical Examination

A right head tilt and a high left ear were observed during postural analysis. Normal infant head shape was also noted. Galant's/Dorsal reflex as well as the Startle/Moro reflex were still present. Moro reflex should disappear around the age of six months while Galant's reflex should disappear at the age of four months.[8] Both of these primitive reflexes should not be present in a 20 month old child. Retained primitive reflexes often indicate neurological dysfunction.[8] The Moro reflex is elicited by placing the child in a supine position and lightly dropping the head to place it into a position of extension. The appropriate response to this stimulation is abduction followed by adduction and flexion of the upper extremities.[8] The Galant reflex is provoked by scratching the skin of the child's back from the shoulder inferiorly, 2-3 centimeters lateral to the spinous processes with the infant in the prone position.[8] The appropriate response is no movement, a positive response is laterally flexing to the side of the spine that is being scratched.

Static palpation of the sub occipital, cervical and paraspinal musculature indicated muscle spasm. A reduction in mobility was demonstrated as passive range of motion was performed by the doctor rotating the patient's head from side to side, lateral flexing the head, and moving the head into flexion and extension. When the patient reached his end point of passive range of motion, he exhibited signs that he experienced pain. Pain, asymmetry of musculature and hypomobility are all indicators of subluxation.[9] Hypomobility and end point tenderness were detected at the following levels: C1 on the

right and T1 on the left.

Paraspinal thermal scans were performed using the Insight Subluxation Station® to measure temperature differentials. Temperature differences of one to two standard deviations above normal were observed at the levels of C1, T12 and L1. Temperature differences of 3 standard deviations above normal were observed at the levels of C2-T11 and L4-S1. (See Figure 1)

Changes in skin temperature patterns are thought to be associated with dysfunctions in the autonomic nervous system.[10] Neurothermal devices have been used in chiropractic since 1924 to measure the side-to-side skin temperature differences and utilized the information as a clinical indicator of a vertebral subluxation.[10,11]

No other abnormalities were noted during the physical examination. However, it should be noted that the patient was unable to focus and/or remain still for most of his examination and initial adjustment. The chiropractic office where he was seen has a large back yard. The doctor completed her examination and assessment outside where he was able to relax and focus.

Diagnosis

Vertebral subluxations at the levels of C1 and T1 were diagnosed.

Chiropractic Intervention

The patient was assessed using static and motion palpation. This was performed with the patient either lying prone, supine or in a sitting position due to the patient's age. The doctor palpates the musculature associated with each vertebral level for tonicity which includes spasm, flaccidity and hypertonicity. Consistent pressure was used at each vertebral level. Passive range of motion was then performed by the chiropractor at levels that provided indicators from the static palpation. Special attention was paid to the end ranges of motion to determine if the patient experienced any pain. In a child as young as 20 months, non-verbal clues are often used to determine pain. There appear to be many non-verbal cues to indicate pain in a non-verbal child or infant.[7] Facial expression such as bulging of the brow, eyes squeezed shut and deepening of the nasolabial furrow are indicators that most authors agree upon.[12] In this case, the child moved away from the point of contact when pain was initiated and when lack of movement of the vertebrae was detected. Adjustments using the Activator were performed at the levels of the subluxation. Although Activator Methods Chiropractic Technique (AMCT) is an instrument adjusting technique with its own unique protocol, it is often difficult to utilize that protocol in the detection of subluxation due to the age of the infant patient. Instrument adjusting is an appropriate alternative to manual, high velocity, low force adjusting in the infant population.[13]

The initial care plan for the patient was to be seen twice a week with a re-evaluation to be done at approximately the twelfth visit. The treatment goals for the patient were as follows: correct/reduce vertebral subluxation; improve functional mobility and correct posture imbalance; and reduce the occurrence of future exacerbations. On the patient's fourth visit, his parents were advised to give him omega-3 fish oils in addition to chiropractic care to reduce vertebral subluxations. The docosahexaenoic acid (DHA) present in omega-3 fish oils has beneficial effects on brain function, especially in children. Several studies have clearly indicated markedly elevated levels of intellectual capabilities in children who received omega-3 fish oil, whether in the form of fish or supplementation, during their initial years.[14]

During his seventh visit, therapeutic activities were performed in order to improve functional performance and coordination. Supervised wobble-board exercises were performed to increase core stabilization, strength and improve balance and coordination.[15] His parents were also advised to do cross-crawl exercises at home to also improve the patient's coordination and gross motor skills.[16]

Outcome

A re-evaluation was performed approximately seven weeks after care began. A paraspinal thermal scan was performed and showed marked improvement. (see Figure 2) Temperature differences of one to two standard deviations above normal were observed at the levels of C4, C7-T2, T9-T11, L2-L4 and at S1. Temperature differences of 3 standard deviations above normal were observed at the levels of C1, C5-C6, T8 and L5. The patient was able to be adjusted inside of the office at this point without being overwhelmed or overstimulated by this point in his care. His parents graded his progress with his chief complaint as a 9 on a scale of 0 to 10 with 0 being no change and 10 being completely resolved. His overall quality of life, behavior, attention, activity levels, co-ordination, appetite and number of complaints had improved significantly. Energy levels and frequency of colds/infections had improved according to his parents and there had been no change in his sleep habits, digestion and breathing. His parents also noted that he was speaking in three word sentences less than two months from beginning care. (Figure 3)

The patient continued to receive chiropractic care with his care plan being adjusted to one visit every 10 days and continued to improve.

Discussion

Review of Literature

At this time there is no research investigating non-cerebral palsy childhood intention tremor and chiropractic care. A systematic review of the literature regarding chiropractic care and nonmusculoskeletal conditions yielded 179 papers addressing 50 varying nonmusculoskeletal conditions.[17] Asthma, infantile colic, attention deficit hyperactivity disorder (ADHD), nocturnal enuresis, constipation were the pediatric conditions addressed.[17] Neither childhood essential tremor, nor intention tremor have been addressed.

Essential tremor and Parkinson related tremor have case studies in the current literature. Chiropractic management of Parkinson's disease has been reported more prevalently than other case study topics. One such case involved an 81-year-old patient with a twelve year history of Parkinson's disease. He

was treated with blue-lensed glassed, vibration stimulation therapy and spinal manipulation.[18] Within one week of treatment, the patient displayed a reduction in his resting tremor along with other symptoms.[18] Again, it should be noted that resting tremor is not similar to intention tremor.

Another case study investigated the utilization of upper cervical chiropractic management of a patient with Parkinson's disease. The patient involved in this case study showed marked improvement in both subjective and objective findings after nine months of upper cervical chiropractic care.[19] The patient involved in the aforementioned study was a sixty year old male. Another case study evaluated the chiropractic management of essential tremor and migraine. The patient was a thirty-nine year old woman with essential tremors and migraine headaches which occurred two to three times per week.[20] She received spinal manipulation in her upper cervical spine utilizing the Blair Upper Cervical chiropractic technique and protocol. The authors of the report demonstrated an improvement in both her essential tremor and migraine frequency, yet suggested the need for further investigation into the mechanism behind the improvement correlated with the technique.[20]

Symptoms of Cerebellar Dysfunction

Although the patient has not been diagnosed with having a disorder of the cerebellum, he does exhibit multiple symptoms that are associated with the same region of the brain. The cerebellar motor syndrome is characterized as impairment in gait (ataxia), extremity coordination (dysmetria), disordered eye movements, poor articulation of speech (dysarthria), impaired swallowing (dysphagia), and tremor.[21] The patient involved in this case study presented with four of the above mentioned motor dysfunctions: ataxia (wide and wobbly gait), dysmetria (upper extremity posterior posturing during gait and right arm held in flexion), dysarthria (speech articulation delay) and intention tremor.

Etiology and Neurological Anatomy

The only causative factor appears to be his familial history of essential tremor which is present in his maternal grandmother and his maternal great-uncle. The neuronal physiological correlates of clinical heterogeneity in human essential tremor are unknown, as is the age of onset of familial essential tremor.[22,23] However, it is known that some patients with essential tremor have a substantial intentional component in the absence of known cerebellar pathology, such as in the instance of the patient in this case study.[22] Research shows that we cannot yet predict the age of onset of familial essential tremor in children or adults.[23]

The role of the thalamus has been investigated in essential intention tremor and it was determined that thalamic neurons had lower firing rates in patients with essential intention tremor than in those with essential postural tremor or intention tremor caused by known cerebellar dysfunction.[22,24] The spinal cord, brainstem (specifically the inferior olivary nucleus and neurons of the basis pontis), and cerebral cortical areas involved in sensorimotor processing are linked to the anterior lobes of the cerebellum. Different subdivisions of the cerebellar nuclei target prefrontal and motor cortices.[25] Further, neurons located dorsally in the dentate nucleus project to the supplementary motor area, which in turn extends to the primary motor cortex and spinal cord.[25] Therefore, stimulation into the right side of the spinal cord will also stimulate the right side of the cerebellum.[25]

The Vertebral Subluxation

The vertebral subluxation complex model includes an osseous component, connective tissue involvement, the neurological component, and altered biomechanics.[26] The neurological component is of particular interest in this case. A spinal nerve root lesion at various levels will impact the afferent and efferent pathways to and from the brain, altering the body's ability to properly adapt. Neurological dysfunction or impediment in young children, particularly, should be resolved as soon as detected. As vertebral subluxations resolve through chiropractic care, the young nervous system matures properly. In the case of cerebellar dysfunction, it is important to look to the spine to ensure that the spino-cerebellar tract is unimpeded. Spinal misalignments have an impact on the ability of the brain to receive accurate information from the spinal cord. When the spino-cerebellar tract is dysfunctional due to a vertebral subluxation, the ability of the cerebellum to function properly is hindered and may create symptoms such as intention tremor.[22,24]

This case requires investigation into the pathway between the spinal cord and the cerebellum in order to begin understanding the relationship between the vertebral subluxation and stimulation or inhibition of the brain. During the patient's chiropractic care, vertebral subluxations were detected at the levels of C1 and T1 on the right. The chiropractor applied a light force with the use of an Activator adjusting instrument on the right side of the involved vertebrae. This is the same side as the patient's intention tremor. An attempt must be made to understand the neuronal anatomy of the line of correction involved in the treatment of a vertebral subluxation and the involved side of the brain.

In this instance, essential intentional tremors should be examined to determine if proprioceptive input into the spinal cord at levels of vertebral subluxation may decrease the symptoms of cerebellar dysfunction. Recent studies show that children with common neurological disorders were 24% more likely to use complementary and alternative medicine (CAM) services than other pediatric patients.[27] Despite this increase in utilization, there is very little research that investigates symptoms of suspected benign cerebellar dysfunction in children which are not associated with autism spectrum disorder (ASD), traumatic brain injury (TBI), or B12 deficiency and the effect of chiropractic treatment on this dysfunction.

Treatment of Tremor

Pharmacologic treatment of various tremors is quite frequent today. In the case of essential tremor, propranolol or primidone are the recommended choices.[28] If those medications are not effective, gabapentin, topiramate, or lorazepam are utilized as the next medicinal option.[28]

Parkinson's related tremor treatment includes various

medicinal options. Dopaminergic agents, anticholinergics, beta blockers are all viable treatment options for Parkinson's Disease.[28] Levodopa (l-dopa) and dopamine agonists tend to help tremor symptoms, but patients often find unsatisfactory improvement in their tremor.[28] Benzodiazepines have been found to help adult intention tremor, but this has not been explored in the pediatric population.[28]

Patterns of complementary and alternative medicine (CAM) utilization for pediatric patients with common neurological conditions such as intention tremor indicate that nutritional support is the most utilized form of CAM. One study discovered that multivitamins were used in 84% of the pediatric cases employing CAM management, vitamin C was used in 37%, homeopathic remedies were used in 24% and omega-3 fish oil were used in 22% of the pediatric patients.[27]

The most commonly used CAM practices for pediatric patients are massage therapy (47%) and chiropractic care (37%).[27] Massage therapy has shown to reduce muscle rigidity in patients with Parkinson's disease, however, it has not shown to reduce tremor.[29] General tremor CAM management also includes relaxation techniques such as meditation and deep breathing.[27,28] Minimal risk of side effects rather than the hope of a cure seems to attract patients with tremor, regardless of the etiology, toward CAM.[27]

Conclusion

Specific input into the spinal cord affects brain control over sensorimotor function. Chiropractic care focuses on the detection and treatment of the vertebral subluxation by interaction with the spinal cord.[30] It is of utmost importance for chiropractors to consider neurological symptoms, in addition to the malposition of the vertebral subluxation before determining side of input to treat the vertebral subluxation. This case provides an instance in which multiple symptoms of cerebellar dysfunction in a pediatric patient have improved because of the application of chiropractic care.

The lack of research regarding pediatric chiropractic care for benign cerebellar symptoms is unfortunate. Further investigation into benign intention tremor and the effect that proprioceptive input from the spinal cord creates is needed. With a better understanding of the proprioceptive pathway and the impact of the side of contact during a chiropractic spinal adjustment, pediatric and adult patients have a greater opportunity to achieve high neurological function without pharmacological or surgical intervention.

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Appendix

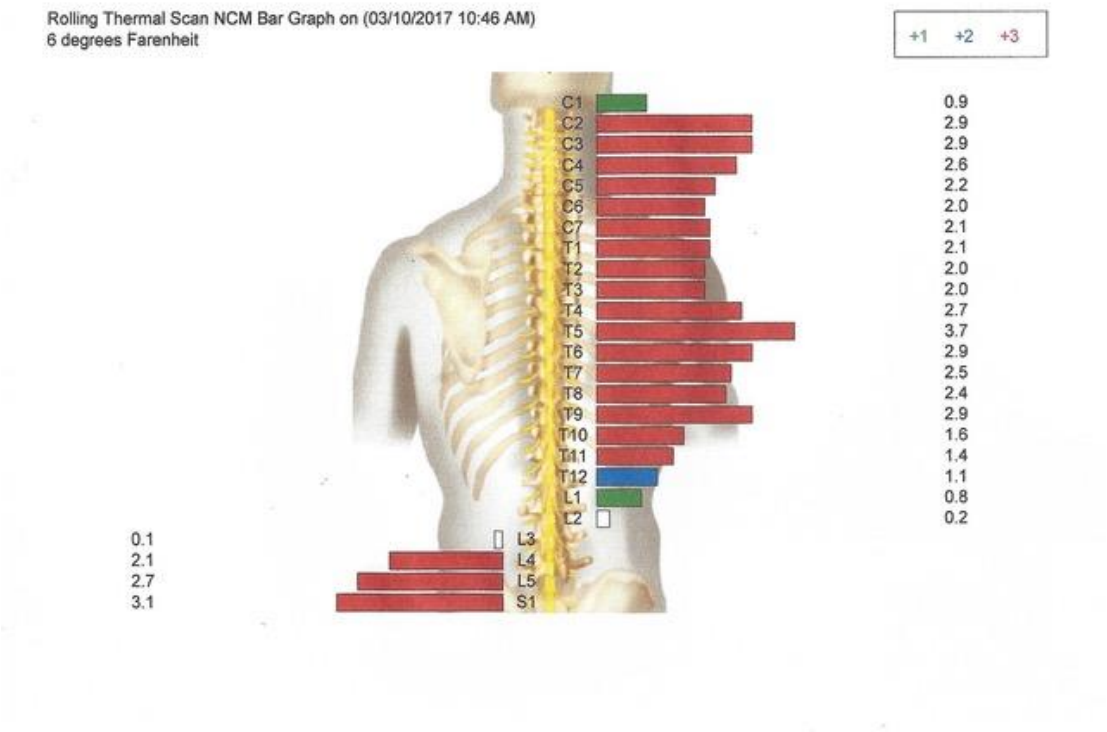


Figure 1: Initial Thermal Scan

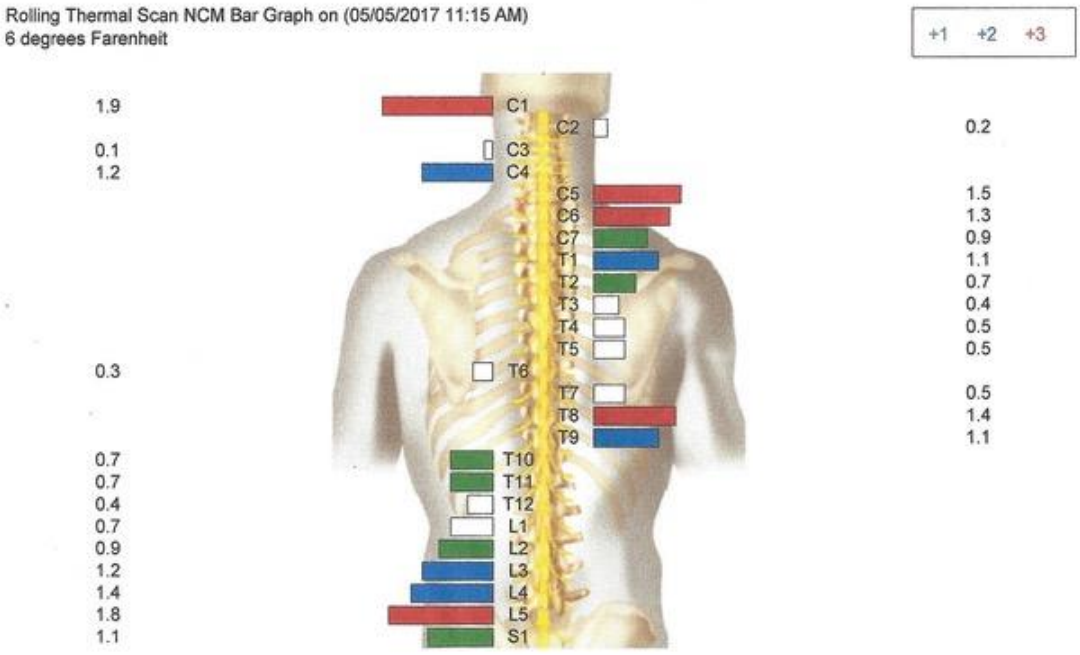
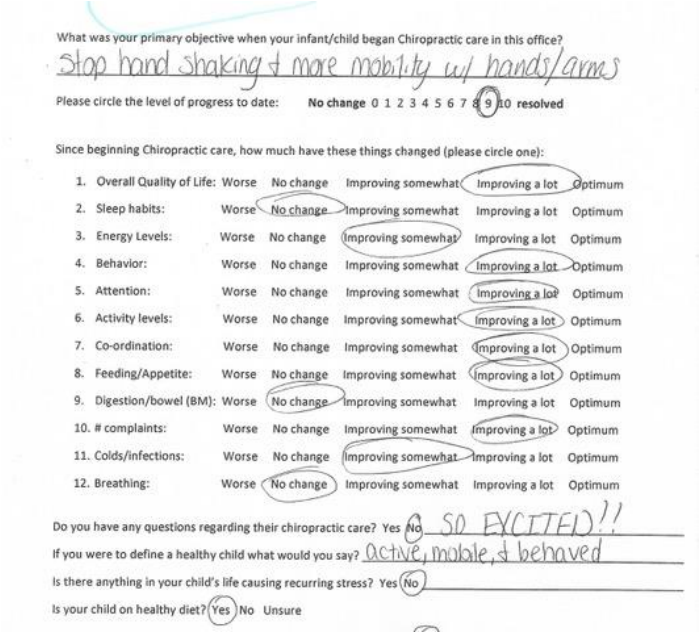


Figure 2: Thermal Scan during Reassessment, two months later.



What was your primary objective when your infant/child began Chiropractic care in this office?

Stop hand shaking & more mobility w/ hands/arms

Please circle the level of progress to date: **No change** 0 1 2 3 4 5 6 7 8 (9) 10 **resolved**

Since beginning Chiropractic care, how much have these things changed (please circle one):

1. Overall Quality of Life:	Worse	No change	Improving somewhat	(Improving a lot)	Optimum
2. Sleep habits:	Worse	(No change)	Improving somewhat	Improving a lot	Optimum
3. Energy Levels:	Worse	No change	(Improving somewhat)	Improving a lot	Optimum
4. Behavior:	Worse	No change	Improving somewhat	(Improving a lot)	Optimum
5. Attention:	Worse	No change	Improving somewhat	(Improving a lot)	Optimum
6. Activity levels:	Worse	No change	Improving somewhat	(Improving a lot)	Optimum
7. Co-ordination:	Worse	No change	Improving somewhat	(Improving a lot)	Optimum
8. Feeding/Appetite:	Worse	No change	Improving somewhat	(Improving a lot)	Optimum
9. Digestion/bowel (BM):	Worse	(No change)	Improving somewhat	Improving a lot	Optimum
10. # complaints:	Worse	No change	Improving somewhat	(Improving a lot)	Optimum
11. Colds/infections:	Worse	No change	(Improving somewhat)	Improving a lot	Optimum
12. Breathing:	Worse	(No change)	Improving somewhat	Improving a lot	Optimum

Do you have any questions regarding their chiropractic care? Yes (No) SO EXCITED!!

If you were to define a healthy child what would you say? active, mobile, & behaved

Is there anything in your child's life causing recurring stress? Yes (No)

Is your child on healthy diet? (Yes) No Unsure

Figure 3: Questionnaire filled out by the mother at the first Reassessment.