

Best Practices/Practice Guidelines

Best Practices for the Chiropractic Care of Children

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RECOMMENDATION

Rating: Established

Evidence: E, L

Since vertebral subluxation may affect individuals at any age, chiropractic care may be indicated at any time after birth. As with any age group, however, care must be taken to select adjustment methods most appropriate to the patient's stage of development and overall spinal integrity. Parental education by the chiropractor concerning the importance of evaluating children for the presence of vertebral subluxation is encouraged as are public health initiatives geared toward screening of children for vertebral subluxation beginning at birth.

Introduction

Since its inception, the chiropractic care of children has been an integral part of the practice of chiropractic.¹ Today, the chiropractic care of children remains an important aspect in chiropractic practice. In 2007, Barnes and colleagues² estimated the complementary and alternative medicine (CAM) use among U.S. adults and children from the 2007 National Health Interview Survey (NHIS), conducted by the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). Barnes and colleagues² found that approximately one in nine children used some type of CAM therapy with children having a greater likelihood of using biologically based therapies, mind-

body therapies or manipulative and body-based therapies than other alternative healthcare approaches. Of the practitioner-based CAM therapies, the investigators found that chiropractic was the most popular form of non-allopathic healthcare for children. Overall, CAM therapies were used by children to address complaints associated with the musculoskeletal complaints, head or chest colds, anxiety or stress and ADHD/ADD. In a follow-up study, Black et al.³ found similarly among 4-17 year-olds in terms of motivation for care and the utilization of chiropractic by parents for their children. In 2000, Lee et al.⁴ characterized the chiropractic care of children in a survey of Boston chiropractors. Lee et al.⁴ examined socio-demographics, practice characteristics, and fee structures involved in the care of children. In addition, chiropractor responders were asked about their recommendation of childhood vaccinations and their approach to care in a child with a fever. Based on the response of 90 predominantly white male chiropractors, Lee et al.⁴ found an average weekly visit of 122 patients of which 11% involved the care of children and adolescents. The average visit fees were \$82 and \$38 for the initial and follow-up visits, respectively with only 49% of the fees covered by 3rd party payors.

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Approximately 30% of the chiropractor responders actively recommended childhood vaccinations and with a hypothetical 2-week-old neonate with a fever, 17% would care for the infant rather than immediately refer the patient to an MD, a DO, or an emergency facility. Lee et al.⁴ estimated that approximately 420,000 pediatric chiropractic visits were made in the Boston metropolitan area, costing approximately \$14 million.

Extrapolating the data to the entire US, Lee et al.⁴ estimated that approximately 30 million pediatric visits were made in the United States in 1997 at a cost of \$1 billion with \$510 million paid out-of-pocket. Lee et al.⁴ concluded that children and adolescents constitute a substantial number of patients in chiropractic practice and is a disparate approach to the care of children when compared to medical care (i.e., inconsistent with recommended medical guidelines). To the extent that Boston chiropractors reflect or represent the chiropractic of children is questionable.

Alcantara et al.⁵ characterized the practice of pediatric chiropractic within a Practice-based Research Network (PBRN) with chiropractors from the United States followed by Canada and Europe. A majority of the responders were female with an average practice experience of 8 years. The chiropractor responders attended to an average of 133 patient visits per week, with 21% devoted to the care of children and adolescents. Practice income was derived primarily from out-of-pocket reimbursement with charges of an average of \$127 and \$42 for the first and subsequent visits, respectively. These visits were made by parents and their children primarily for the purpose of wellness care and to address a number of common conditions of childhood (i.e., asthma, ear infections, etc.).

The indicated primary approach to pediatric care by the PBRN chiropractors was spinal adjustments augmented with adjunctive therapies such as herbal remedies, exercises, rehabilitation. Fifty-eight percent of the PBRN chiropractors indicated an established relationship with an osteopathic or medical physician for collaborative care approach and 80% indicated referring patients to medical practitioners. However, only 29% of the chiropractors indicated receiving a referral from a medical/osteopathic physician. Alcantara et al.⁵ estimated that 87 million pediatric visits were made in 2009 to Doctors of Chiropractic in the United States. Alcantara et al.⁵ concluded that the chiropractic care of children is a significant aspect of the practice of chiropractic and children's care in general.

From an evidence-informed perspective⁶, where clinical decision making takes into account the research evidence, clinical expertise and experience and the needs and wants of the parent for their child, the chiropractic care of children is congruent with the needs and wants of parents in terms of a non-allopathic approach to the care of their child.

Clinical Expertise

The assumptions and beliefs underpinning chiropractic's theoretical and clinical framework necessarily influences the actions taken by chiropractors in the care of their patients. Towards these efforts, clinical strategies employed by chiropractors in identifying, preventing, arresting, reducing and correcting vertebral subluxation must be performed in a

competent manner. Nowhere is this true than in the care of children as pediatric chiropractic is simply not a scaled-down version of the care of adults. We are aware of best practices recommendations⁷ and core competency statements⁸ on the chiropractic care of children. With best practices recommendations, there is the assumption that the prescribed or recommended procedures is the correct or most effective intervention following the principles of evidence-informed practice.

We respectfully disagree that best practice recommendations or core competency statements based on a consensus panel of a select few, regardless of their clinical and/or academic expertise is lacking in terms of evidence-informed and not necessarily universally accepted in the profession. Furthermore, the core competency statements put forth by Hewitt et al.⁸ for certified pediatric chiropractors is not necessarily universally accepted and minimizes the role of dully licensed chiropractors that care for children. Furthermore, much of the competency statements made by Hewitt et al.⁸ reflect meta-competencies as outlined by the Council on Chiropractic Education.⁹

We chose to address and acknowledge the clinical expertise of chiropractors involved in the care of children by acknowledging the unique biomechanics of the pediatric spine in the context of pediatric spinal adjusting and the magnitude of forces (i.e., magnitude and direction) employed in applying a judicious spinal adjustment for this patient population.

Unique Biomechanics of the Pediatric Spine

The judicious application for a safe and effective spinal adjustment in the care of children is predicated upon a working knowledge of the unique biomechanics of the pediatric spine. The following describes these unique features.

Growth

To the extent that this is truly unique in children, the process of growth in children requires special consideration given that pediatric spinal and extraspinal adjusting must take into account their unique architecture of the pediatric patient relative to the developmental stages of growth and relative to the adult. This consideration requires changes in contact points and thrust vectors (i.e., direction and amount of force) in addition to a working knowledge of the possible dysmorphic growth processes that may lead to or concomitant with the pathology of the vertebral subluxation complex (VSC).¹⁰

In infants, it is generally accepted that their articulating surfaces are small and their facet joints are relatively more steeply aligned when compared to adults. A consequence of this is that infants are more predisposed to increased segmental instability and provide evidence on the vulnerability of children to trauma that involves large magnitude of force such as from motor vehicle collisions and relatively not so large in magnitude of force such as from repetitive trauma as when an infant is learning to walk. The vertebral bodies in younger children are wedge-shaped with incomplete uncinat process that on the one hand confers greater adaptability to the demands of the birth process (i.e., pulling and rotating the head and neck) but when considered in combination with the immature neuromusculoskeletal system, children are more prone to

developing spinal subluxations. Furthermore, given the axial angle at the C₀-C₁ articulation is relatively flatter compared to adults, there is a greater propensity for lateral subluxation of the atlas. On lateral flexion, the C₁ vertebral body deviates towards the convexity as opposed to the concavity as observed in adults. The pivot point for the adult is at C₅-C₆ and in the infant cervical spine is at C₂-C₄. Traumas occurring to the cervical spine typically occurs superior to the pivot point. As such, infants and children are typically at risk for incurring greater neurological loss compared to the adult. On forward flexion, the C¹ vertebral body moves ventrally and referred to as the paradoxical tipping of the atlas.¹¹

Hypermobility

It is acknowledged by all that children have relatively greater range of motion (ROM) at all articulations when compared to adults. This relative hypermobility may be attributed to ligamentous laxity, a shallow and angled facet joints, underdeveloped spinous processes, and the physiologic anterior wedging of the vertebral bodies.¹¹ As such, great care must be taken when applying spinal adjustments on children. Another consideration in the context of the relative hypermobility in children is the observation that in 40% of children less than 8 years of age, a pseudo-subluxation of C₂ on C₃ occurs while in 14% of children in this age group, a pseudo-subluxation of C₃ on C₄ may occur. This may be demonstrated on flexion and extension radiographs of the cervical spine and should be clinically taken into consideration in the detection and elimination of the VSC.¹²

Changing Spinal Contours

Intuitively, based on our discussions thus far, one would assume that the sagittal configuration of the pediatric spine should change with growth. Although segmental plane analyses of adults have been thoroughly studied, normative data for children have not been well reported. This is owed in part to the reasoning that children should not be considered as a single homogenous population. The spine of the neonate (i.e., less than 1 year of age) is different from that of the 3-year-old or the 6-year-old or the adolescent.

The work by Oakely and Harrison¹³ examining cervical lordosis highlights the inappropriateness of applying adult normative values of cervical lordosis to the pediatric patient population. One of the first studies to address the issue of sagittal alignment in children was by Cil and colleagues.¹⁴ Based on lateral radiographs of asymptomatic children aged 3 to 15 years of age, the investigators measured segmental angulations, lordotic and kyphotic assessments in the lumbopelvic and thoracic spine. The investigators found that sagittal spinal alignment was changing as a child grows. Cil and colleagues¹⁴ found a statistically significant difference among different age groups in terms of certain biomechanical parameters, especially at the cervicothoracic, thoracolumbar, and lumbosacral junctions.

The position of the sacrum (inclination and translation), and spatial orientation, as well as the global magnitude of thoracic kyphosis, and lumbar lordosis was found to also change with growth. Furthermore, the change in sagittal curvature did not necessarily change incrementally with time. These findings should be taken into consideration when considering vectors

(i.e., direction and magnitude) for the spinal adjustment of infants and children.

Changing Applied Forces

According to Mac-Thiong and colleagues¹⁵ the growing child requires constant adaptations to dynamic forces or changing applied forces within and external to the pelvis that affect pelvic morphology and orientation and ultimately to maintain an adequate and appropriate sagittal confirmation to withstand skeletal loads, address muscle fatigue, and energy expenditure. As such, chiropractors must acknowledge that spinal adjusting should reflect these dynamic forces (i.e., changing forces in spinal adjusting to correct spinal subluxations) so as to avoid injury in the patient.

Malleability

As defined, from a pediatric chiropractic perspective, malleability is the ability to alter shape or form. A consequence of malleability is deformational plagiocephaly. Since the recommendation by the American Academy of Pediatrics that infants be placed on their backs to sleep to reduce the risk of sudden infant death syndrome (SIDS), this asymmetrical head shape has been on the rise.¹⁶ In reviewing the work by Singh and Wacogne¹⁷, Carter¹⁸ noted that there is a lack of research (i.e., class 1 evidence) on the efficacy of helmet moulding for plagiocephaly. Conversely, there is also little, if any, class 1 evidence that helmet moulding for plagiocephaly does not work for positional plagiocephaly. As Carter¹⁸ argued the medical perspective, the lack of evidence of effect is not the same as evidence of lack of effect. Given the state of the evidence for medical care in addressing plagiocephaly, the success of chiropractic care in babies with deformational plagiocephaly¹⁹⁻²⁴ makes chiropractic an alternative choice for the care of children with plagiocephaly.

Adaptability

As defined, the pediatric spine has adaptability in terms of the amount of forces applied to it before failure or the child's demonstration of great functionality despite underlying structural deformities. For the chiropractor, this is a caveat when caring for infants and children, particularly in the context of absolute and relative contraindications with chiropractic care. Consider the findings by O'Neill et al.²⁵ that the prevalence of occult spinal dysraphism identified with modern high-resolution MRI screening is significantly higher than that reported with US screening, particularly in highly functional and asymptomatic infants.

Immature Neuromusculoskeletal System

In the biomechanical world, it is often said that the differences observed between adults and pediatric subjects is the strength of correlation for spinal biomechanical parameters due to the presence of "immature" control mechanisms. No more is this also true than in the pediatric chiropractic arena. The care of the pediatric patient is simply not a scaled-down version of the adult. What has been made abundantly clear thus far is that there are unique and special considerations to spinal adjusting and caring for the child. Due to an immature neuromusculoskeletal (NMS) system, we must always judiciously apply our chiropractic adjustments so as not to cause harm. We must

balance the hypermobility and malleability of the pediatric spine with an immature NMS wherein certain guarding mechanisms are not established in the child as well as the fragility of the associated soft-tissue elements of the pediatric spine. Consider the publication by Holla and colleagues²⁶, where in the care of an infant, a cranio-sacral therapist was not appreciative of the unique biomechanical features of the pediatric spine. According to Holla and colleagues²⁶, a 3-month-old female was presented by her parents to a “craniosacral therapist” to address “motor disorder.” Insofar as one can interpret from the Dutch article, the patient was placed on her side and with both hands, the craniosacral therapist forcefully proceeded to “fold the baby” by inducing a forward flexion maneuver involving the head and neck and lumbosacral spine. Lessons learned from this case obviously involve the avoidance of applying a forceful maneuver. There are no indications that the “therapist” was a chiropractor. A similar technique (i.e., occipito-sacral decompression) has been applied by chiropractors in the care of infants with colic without adverse outcomes and beneficial for the infant patients.²⁷

Forces of Spinal Adjustments in Children

In addition to modified contact points and patient/doctor positioning, the application of a judicious spinal adjustment also necessarily acknowledge that chiropractors must modify the forces applied in children.²⁸ Thus far, studies point to the safety of chiropractic care in the pediatric population. In 2008, Miller and Benfield²⁹ performed a 3-year retrospective study of pediatric case files from the Anglo-European College of Chiropractic (AECC) (Bournemouth, England) teaching clinic. All files (n = 781) of pediatric patients younger than 3 years of age were selected manually in sequential order from current files stored in the AECC clinic.

Most (73.5%) patients presenting were 12 weeks of age or younger (n = 574). The authors found six hundred ninety-seven children receiving a total of 5242 chiropractic treatments, with 85% of parents reporting an improvement. According to the investigator criteria of follow-up parental report of excessive crying in their child, Miller and Benfield²⁹ found 7 parents reporting an adverse effect. Miller and Benfield²⁹ commented that they found an adverse reaction rate of approximately 1 child in 100, or one reaction reported for every 749 treatments. There were no serious complications resulting from chiropractic treatment (reactions lasting >24 hours or severe enough to require hospital care).

The retrospective file review by Miller and Benfield²⁹ may have lesser number of infants if they considered that 5 of the 7 children presented for chiropractic care for infantile colic. The same year, Vohra et al.³⁰ published their systematic review of the literature on reported adverse events associated with pediatric SMT. Examining over 100 years of literature, Vohra et al.³⁰ found 13 studies consisting of 2 randomized trials, 11 observational reports that documented adverse events with pediatric SMT. The authors identified 14 cases of direct adverse events involving neurologic or musculoskeletal events with 9 cases involving serious adverse events (eg, subarachnoid hemorrhage, paraplegia), 2 moderately adverse events that required medical attention (eg, severe headache), and 3 involved minor adverse events (eg, midback soreness). Another 20 cases of indirect adverse events involved delayed diagnosis (eg, diabetes, neuroblastoma) and/or inappropriate provision of

spinal manipulation for serious medical conditions (ie, meningitis, rhabdomyosarcoma). Not surprisingly, the majority of the reports involved chiropractic care. Unfortunately, Vohra et al.³⁰ failed to critically appraise their reported data given that in a number of the cases reported, the children had a pre-existing condition and/or suffered from neurological trauma that provides biological plausibility that places into question whether chiropractic care was the cause of the adverse event.³¹ Furthermore, Vohra et al.³⁰ violated their inclusion criteria in terms of the documented delayed diagnosis and/or delayed care due to chiropractic as their references were nothing more than Letters to the Editor or from a textbook against chiropractic.³¹

Alcantara et al.³² characterized the chiropractic care of children, including its safety and effectiveness in a PBRN. Alcantara et al.³² found a prevalence of adverse events of 3 per 5,438 office visits or a prevalence of 3 per 577 children (0.52%) based on chiropractor responders. The parent responders indicated two adverse events per 1,735 office visits or a prevalence of 0.84% based on 239 children.

Todd et al.³³ essentially updated the systematic review of the literature by Vohra et al.³⁰ Todd et al.³³ found 31 articles documenting an adverse event with pediatric manual therapy. Todd et al.³² found a total of 12 articles reporting 15 serious adverse events with 3 deaths under the care of a physical therapist, an unknown practitioner, and a craniosacral therapist. Twelve serious injuries were reported attributed to 7 chiropractors, 1 medical practitioner, 1 osteopath, 2 physical therapists, and 1 unknown practitioner. According to Todd et al.³³ high-velocity, extension, and rotational spinal manipulation was reported in most cases, with 1 case involving a forcibly applied craniosacral dural tension maneuver and another involving the use of a hand-held spinal adjusting instrument. In congruence with the commentary by Alcantara³¹, Todd et al. commented that an underlying preexisting pathology was identified in a majority of the cases reported.

With respect to the forces applied by chiropractors in pediatric spinal adjusting, the published evidence thus far lead to conclusions that the forces applied to children are of insufficient magnitude to cause fractures or dislocations. This is contrary to those reported in the medical literature that a chiropractor caused a posterior rib fracture³⁴ or Hangman’s fracture in an infant.³⁵

Triano et al.³⁶ evaluated the transmitted peak forces of common procedures for the cervical, thoracic, and lumbar spine and sacroiliac joint to mannequins of different stature for younger and older children to estimate variability by a single experienced practitioner and educator in pediatric manipulation attempting to modulate for childhood category. The transverse forces applied for the cervical, thoracic and lumbar spine and sacrum from the neonate to the adolescent ranged in value of: cervical (11.1-124.5N), thoracic (3.1-67.4N), lumbar (3.7N-120.4N), sacrum (9.6-165.0N). These magnitudes of applied forces are somewhat consistent with estimates of Todd et al.³⁷ based on their review of the literature of forces of commonly used chiropractic techniques for children.

Alcantara et al.³⁸ presented their data on the measured forces applied by a chiropractor in the care of pediatric patients in clinical practice. Alcantara et al.³⁸ found that for children <5 years of age and between 5-10 years, peak forces at the cervical,

thoracic and lumbar/SI level were the same, while peak forces for children >10 years and adults at the cervical spine level were significantly smaller than the peak forces at the thoracic and lumbar/SI levels. In terms of magnitude of force, for children < 5 years of age, the mean maximum force applied in the cervical, thoracic and lumbosacral spine were: 74.17N, 81.48, and 72.50N, respectively. For children 5-10 years, the mean maximum force applied in the cervical, thoracic and lumbosacral spine were: 121.24N, 145.02N and 145.52N, respectively. For children 10-17 years, the mean maximum force applied in the cervical, thoracic and lumbosacral spine were: 138.47N, 251.46N, 242.38N, respectively.

When one considers that the tensile force required to cause bipedicular (Hangman's) fractures in isolated porcine C₂ specimen requires 3259.1±148.5N³⁹, the magnitudes of forces applied by a chiropractor point to the implausibility that a Hangman's fracture was caused by a chiropractic adjustment.³⁵ As a follow-up to the case involving a chiropractor accused of causing a Hangman's fracture, the infant had a congenital arch defect of the C₂ vertebra.⁴⁰ As van Rijn et al.⁴¹ pointed out, the differentiation between a congenital C₂ arch defect and a hangman's fracture is precarious.

With respect to the 21-day-old infant with healing posterior rib fractures noted following visits to a chiropractor for infantile colic.³⁴ The infant was cared for using the Activator Instrument. As Alcantara et al. noted the assertion that chiropractic care caused the posterior rib fractures lacks coherence with the forces applied by an Activator Instrument (range=116-140N) provided and what is known about the mechanisms of injury leading to a posterior rib fracture in infants.⁴² The amount of force applied to cause a dynamic bend of the posterior ribs in children 14 years and younger is 234N.⁴³

The Published Literature on the Chiropractic Care of Children

Before we embark on an examination of the published literature on the chiropractic care of children, we wish to re-visit the principles of evidence-informed practice. We are motivated in part by the incorrect assumption within and outside the chiropractic profession that evidence-informed practice rests solely on the published literature. Furthermore, as defined by evidence-based practice⁶, there is a hierarchy of evidence such that randomized controlled clinical trials (RCTs) (i.e., as characterized by randomization of subjects, presence of a control group and manipulation of the independent variable).

As such RCTs and their meta-analysis have greater weighting than case reports or case series in terms of the strength of the evidence. This is based on the post-positive paradigm of research with an ontology of materialism and epistemology of objectivity.⁴⁴ However, other research paradigms exist to answer the many questions regarding the safety and effectiveness of any healthcare system. Consider the research philosophy of constructivism. This approach to research is based on an ontology that reality is constructed by individual perception and its epistemology is based on the human experience. Constructivism proposes that there is more than one way of generating knowledge. Rightly so as many questions regarding the care approach of chiropractors cannot all be addressed with a RCT. And as we will realize with further discussions, there are inherent challenges and many pitfalls in

designing an RCT in chiropractic. As Shlonsky and Mildon⁴⁵ pointed out, despite controversies on the nature of "evidence" and its application in the clinical setting, scientific knowledge evolves over time and as in chiropractic, we found that different types of evidence serve different purposes. Therefore, in the interest of evidence informed practice, look to the majority of the published evidence described herein beyond the post-positivist paradigm and glean from the individual clinical scenarios to inform clinical practice.

Published Evidence

Towards efforts to update the published literature on the chiropractic care of children, our updated review will begin with 4 common conditions addressed by chiropractors: asthma, infantile colic, otitis media and nocturnal enuresis and then other cases published. Our literature search utilized the databases Pubmed (2008-2017), Index to Chiropractic Literature (2008-2017) and MANTIS (2008-2017). Inclusion for this review included: (a) articles written in the English language, (b) the patient or patients were 0-8 years of age and (c) chiropractic care (i.e., spinal adjustments and/or adjunctive therapies) was provided. Given these search parameters, we acknowledge the limitation that manuscripts published in non-English languages may also exist but not acknowledged here.

Asthma

In the United States, more than 7.1 million children suffer from asthma with overall healthcare expenditures for asthma estimated at more than \$50.1 billion per year. Reported prevalence of asthma worldwide indicates a wide variation with studies of both children and adults revealing low prevalence rates (i.e., 2%–4% in Asian countries - particularly in China and India) and high prevalence rates (i.e., 15%–20% in the United Kingdom, Canada, Australia, New Zealand and other developed countries.⁴⁶ In the United Kingdom, the economic cost of asthma has been estimated at \$1.8 billion and for Australia \$460 million. Worldwide, the economic burden of asthma exceeds those of HIV/AIDS and TB combined. The pathogenetic sources of asthma remains largely unknown and although genetic, environmental, and epigenetic factors have been identified, an effective medical therapeutic intervention is yet to be established.⁴⁷

To date, 7 systematic reviews of the literature have been performed on the chiropractic care of asthmatic patients.⁴⁸ Yet only three clinical trials examining the effects of chiropractic care with asthmatic patients have been published. Nielsen et al.⁴⁹ randomized adult asthmatics into an active spinal manipulative therapy (SMT) group and to a sham SMT group. The active SMT was drop-table technique. The sham SMT was a modified version of the active SMT such that the force applied to release the drop piece was made by the "free hand" rather than the contact hand of the chiropractor. Nielsen et al.⁴⁹ found no clinically important or statistically significant differences between the active and sham SMT on any of the main (i.e., FEV₁) or secondary outcome measures from baseline to comparative measures.

The validity of the sham SMT as a true sham in this study is placed into question as it was never validated prior to the implementation of the clinical trial. Therefore, a strong

argument exists that the study by Nielsen et al.⁴⁹ is a comparison trial comparing the effects of chiropractic care via drop table technique versus a variant of drop table technique. The second RCT by Balon et al.⁵⁰ randomized 91 children with mild to moderate asthma to receive active SMT or simulated SMT for four months. The active SMT involved applied high velocity, low amplitude (HVLA) thrusts (i.e., Diversified Technique) while the sham or simulated SMT involved applying an HVLA thrust without causing cavitation. This was based on the assumption by Balon et al.⁵⁰ that what differentiated a “real” SMT from a simulated SMT was the presence of cavitation with the thrust.

Prior to applying the simulated SMT, the subjects also received soft-tissue massage to the subjects’ back. Balon et al.⁵⁰ found no significant changes in spirometric measurements or airway responsiveness in both groups of patients and concluded that the addition of chiropractic to usual medical care in asthmatics provided no benefit. Despite this clinical trial being rated of the highest methodological quality⁵¹, the fault in the design lies not in the execution of the clinical trial but in the assumptions made by the investigators.

First, the assumption that what differentiates a “real” SMT from a simulated SMT is arguably not the absence or presence of cavitation.⁴⁸ A number of chiropractic techniques with documented effectiveness do not require or result from cavitation with the SMT applied.⁵²⁻⁵⁴ Second, the simulated SMT as applied was never validated as a true sham SMT.⁴⁸ Third, the simulated maneuver as described is arguably a maneuver that incorporates a number of chiropractic and osteopathic techniques.⁵⁵ Fourth, the application of soft-tissue massage to the patients prior to SMT has been shown to benefit asthmatics.⁵⁶

The last published clinical trial was performed by Bronfort et al.⁵⁷ These investigators performed a prospective clinical case series combined with an observer-blinded, pilot randomized clinical trial with a 1-year follow-up period. During a 3-month intervention phase, patients were randomly assigned to receive either active SMT or sham SMT (i.e., 20 chiropractic sessions) in addition to their standardized ongoing medical management. The active and sham SMT protocol was similar to the Nielsen study (i.e., drop table technique versus sham drop table technique) except that one clinician provided both the active and sham SMT. At the end of 12-weeks of care, objective lung function tests and patient-rated day and nighttime symptoms based on diary recordings showed little or no change. Of the patient-rated measures, a reduction of approximately 20% in β_2 bronchodilator use was observed. The quality of life scores improved by 10% to 28%, asthma severity ratings showed a reduction of 39% and there was an overall improvement rating corresponding to 50% to 75%. The study by Bronfort et al.⁵⁷ suffered from similar flaws as the Nielsen et al.⁴⁹ study.

Our updated review of the literature found 11 case reports and one case series (see Table 1).⁵⁸⁻⁶⁸ involving a number of successful care approaches in the care of children with asthma as presenting complaints. Chiropractic care involved manually assisted hand-held instrumentation such as Activator Methods, Orthospinology, and Koren Specific Technique to Applied Kinesiology, SOT, Chiropractic Biophysics Protocol, the Pierce Results System to those characterized as high velocity,

low amplitude thrust type spinal adjustments (i.e., Diversified Technique and Gonstead Technique). The patients range in age from 19 months to 15 years of age consisting of 16 males and 5 females.

Infantile Colic

Defined by Wessel et al.⁶⁹ as paroxysms of excessive crying in an otherwise healthy baby lasting more than 3 hours per day, occurring > 3 days in any week for 3 weeks, aged 2 weeks to 4 months, infantile colic is one of the common reasons parents seek medical advice for their baby in their first 3-4 months of life. Worldwide, infantile colic affects 10-30% of newborns and is more common in males than females with a peak prevalence at 2 weeks to 4 months of age. Infantile colic has been linked to adaptive problems in preschool as well as with early weaning, maternal anxiety and depression, attention deficit hyperactivity disorder, and other behavioral problems.⁷⁰ Prescribed medications and behavioral interventions have not been proven effective.⁷¹

To date, a handful of clinical trials have investigated infants with colic under chiropractic care. Wiberg et al.⁷² randomized 41 infants diagnosed with infantile colic to a chiropractic SMT group (i.e., Diversified Technique performed by one chiropractor) or medical care with Dimethicone. Changes in daily hours of crying based on parental diary was the main outcome measure. By trial days 4-7, the mean hours of crying was reduced by 1 hour in the Dimethicone group and 2.4 hours in the chiropractic group. On days 8 through 11, mean hours of crying was reduced by 1 hour for the Dimethicone group and 2.7 hours in the those receiving chiropractic SMT. From trial day 5 onward, the infants in the chiropractic group responded significantly better than the medical group. Olafsdottir et al.⁷³ randomized colicky infants to receiving chiropractic SMT or no treatment.

Prior to the clinical trial, the authors claimed that 14 chiropractors convened in a consensus process to create a chiropractic protocol to be used in the clinical trial. With 46 infants receiving chiropractic care and 40 infants with no treatment, the investigators found that the mean number of hours of crying at baseline and at comparative 8 days later were not statistically different. The investigators concluded that chiropractic SMT was “no more effective than placebo.”

Unfortunately, this conclusion was incorrect as this was a study comparing active chiropractic/SMT versus no treatment, which determines the effect of natural history-not placebo. Such an obvious mistake on the part of the investigators questions the veracity of this study. Also at issue with this study was the lack of documented effectiveness of the chiropractic protocol utilized prior to implementing in a clinical trial. Furthermore, as described, the SMT applied cannot be duplicated.

Interestingly, Miller et al.⁷⁴ performed an observational cohort study over an 8-month period in a chiropractic clinic. The excessively crying infants were categorized into three subgroups: (a) infant colic, (b) irritable infant syndrome of musculoskeletal origin (IISMO) and (c) inefficient feeding crying infants with disordered sleep (IFCIDS). Mothers completed questionnaires which rated their own and their child’s characteristics prior to and at the end of the study. The study enrolled 158 infants with no significant differences in

demographic profile between groups or any significant differences in infant crying or level of maternal stress at baseline. Only the putative subgroups were significantly associated with differences in outcomes. In general, the investigators found that colic babies improved the most in consolability and crying. The authors concluded that babies with excessive crying should not be viewed as a homogenous group and the outcomes may be improved by targeting appropriate subgroups for an effective care approach.

Miller et al.⁷⁵ investigated the efficacy of chiropractic care for infants with unexplained crying behavior and if there was any effect of parental reporting bias. Over approximately a 2-year period, 104 infants with colic were recruited and randomized to 1 of 3 groups: (i) infant treated and the parents were aware of the treatment; (ii) infant treated and the parents were blinded; and (iii) infant not treated and the parents were also blinded. The primary outcome was a daily crying diary completed by parents over a period of 10 days. Treatments were pragmatic, individualized to examination findings, and characterized as Diversified Technique. Using 2 or less hours of crying per day to determine a clinically significant improvement in crying time, the increased odds of improvement in treated infants compared with those not receiving treatment were statistically significant at day 8 and at day 10. In contrast, the odds of improvement in treated infants were not significantly different in blinded compared with non-blinded parents. The investigators concluded that knowledge of treatment by the parent did not appear to contribute to the observed treatment effects.

Our update of the literature found 11 publications describing the successful chiropractic care of children with infantile colic (see Table 2).^{27, 76-84} The children (ranging in age from 2 weeks to 15 months) received spinal adjustments utilizing Diversified Technique, Logan Basic and craniosacral therapy, occipito-sacral decompression, and the International Upper Cervical Chiropractic Association (IUCCA) Protocol.

Otitis Media

According to Ramakrishnan et al.⁸⁵, acute otitis media is the most common motivation for antibiotic prescription for children in the United States. Direct and indirect costs of treatment and time lost from school and work for this condition has been estimated at approximately \$3 billion in 1995. Acute otitis media is commonly diagnosed in children 6-24 months of age and by age 3 years, >80% of children have received this diagnosis.

Otitis media with effusion is middle ear effusion in the absence of an acute infection. Annually, approximately 2.2 million children are diagnosed with otitis media with effusion in the United States. Chronic suppurative otitis media is a persistent ear infection and resultant perforation of the tympanic membrane. With acute otitis, antibiotics is recommended to not be routinely prescribed initially for all children. For recurrent otitis media, watchful waiting is recommended prior to the use of antibiotics. For parents, concerns of pain and disturbed sleep in their child and on their ability to attend work⁸⁶ lead them to seek chiropractic care for their child.

Froehle et al.⁸⁷ performed a retrospective file review in a single

practitioner chiropractic practice for children 0-5 years of age presenting with ear discomfort or ear infection to determine if: (a) patients improved while under chiropractic care; (b) how many treatments were needed to reach improvement; and (c) which factors were associated with early improvement. The technique utilized by the practitioner was SOT pelvic blocking and Applied Kinesiology. A total of 46 patients with 95 episodes of ear discomfort/ infection comprised the study population. Factors associated with the fewest chiropractic visits were if the child had a younger age, no history of antibiotic use, an initial episode (vs. recurrent) and whether the designation of an episode as discomfort rather than ear infection.

To date, the findings by Froehle et al.⁸⁷ remains supported by the published literature and empirical data, particularly in consideration of the medical guidelines recommendation of "wait and see." Fallon⁸⁸ performed a survey of the parent/guardian of children with otitis media to determine historical data with respect to previous bouts of otitis media, age of onset, feeding history, history of antimicrobial therapy, referral patterns, and birth history.

The average number of adjustments administered by types of otitis media were as follows: acute otitis media (4.1±1.03); chronic/serous otitis media (5.1±1.53; for the mixed type of bilateral otitis media (5.3±1.35) and with those with a history of OM (5.88±1.87). The number of days required to normalize the tympanographic examination was as follows: acute otitis media (6.67±1.9); chronic/serous otitis media (8.57±1.96); for the mixed type of bilateral otitis media (10.13±3.39) and with those with a history of OM (10.9±2.02). Overall recurrence rates over a 6-month period from initial presentation were for: acute OM (11.02%), for chronic/serous OM (16.34%); for mixed (30%); and with those with a history of OM (10.9%). The author concluded that there is a strong correlation between chiropractic adjustments and the resolution of otitis media for the children in this study.

Sawyer et al.⁸⁹ performed a pilot study the to assess the feasibility of conducting a full-scale RCT to examine the efficacy of chiropractic SMT in children with chronic otitis media with effusion. Twenty children were randomized into an SMT group and a sham group (i.e., manual static and motion palpation and light touch of spinal segments to simulate SMT without the HVLA thrust). Due to the limited sample size and missing data (i.e., tympanometric and otoscopic data could not be obtained or was of questionable quality in 25% of the visits), the investigators cautioned that no conclusions regarding the efficacy of SMT can be drawn due to the small sample size. The collection of tympanometric and otoscopic data proved to be challenging but compliance with the parent diary was exceptional, with all 20 parents completing diaries for the treatment period.

Our updated review found 13 published manuscripts on the successful chiropractic care of children with otitis media (see Table 3).⁹⁰⁻¹⁰³ The case reports described the care of children ranging in age from 9 months to 10 years. The techniques described were Diversified Technique, Activator Methods, CBP, MC2 Technique utilizing an Integrator Instrument, Applied Kinesiology to the Pierce Results System.

Nocturnal Enuresis

Nocturnal enuresis (defined as intermittent involuntary voiding

during sleep in the absence of physical disease in a child aged 5 years or more) is the most common type of urinary incontinence in children. Depending on definition, the prevalence of nocturnal enuresis is thought to be similar worldwide with prevalence placed at 8-20% among 5 year olds, 1.5-10% in 10 year olds, and 0.5-2% for adults.¹⁰⁴ Alarm therapy remains the first-line medical treatment modality for primary nocturnal enuresis. However, problems with compliance and false alarms, affordability of the alarm and relapse lead parents to seek alternative treatments options.⁹⁵

Leboeuf et al.¹⁰⁶ in a prospective cohort study examined the response of 171 enuretic children aged 4 to 15 years. The number of wet nights as monitored by their parents was the primary outcome measure. The median number of wet nights per week was 7.0 at baseline and by the end of the trial was 4.0 wet nights per week. According to the investigators, these results were less favorable than the therapeutic success of other common types of therapy (i.e., alarm therapy). The only variable which predicted treatment outcome was the initial estimate of bed-wetting; the more severe the condition at the onset, the less likely was the child to improve by the end of the study. Reed et al.¹⁰⁷ evaluated 46 nocturnal enuretic children receiving high velocity, short lever adjustments of the spine consistent with the Palmer Package Techniques (N=31) or a “sham adjustment” using an Activator instrument (N=15) at a non-tension setting administered to the examiner’s underlying contact point. The post-treatment mean wet night frequency of 7.6 nights/2-weeks for the group receiving HVLA SMT was statistically different when compared to the baseline mean wet night frequency of 9.1 nights per 2-weeks.

For the “sham” Activator group, no change in the mean wet night frequency from the baseline to the post-treatment was observed (i.e., 12.1 to 12.2 nights/2-weeks). However, the mean change in wet night frequency for the HVLA group compared with the Activator group did not reach statistical significance. Twenty-five percent of the children receiving active SMT had 50% or more reduction in the wet night frequency from baseline to post-treatment while none among the control group had such a reduction. The authors concluded that there is a strong suggestion on the effectiveness of chiropractic care for primary nocturnal enuresis.

van Poecke and Cunliffe¹⁰⁸ performed a retrospective file review of 33 consecutive children aged 3-18 years old presenting for chiropractic care with primary nocturnal enuresis over a 3-year period. The chiropractic care was characterized as the NeuroImpulse Technique - a technique integrating elements of Logan Basic and Toggle Recoil. All patient records were analyzed for a baseline wet night frequency and at 3, 6, 9, and 12 months after commencement of care. Of the 33 patient records analyzed, 22 demonstrated resolution of primary nocturnal enuresis 12 months after initiating chiropractic care. The mean number of treatments in the responders group was 2.05 +/- 1.33. Ten responders presented with constipation and a further 8 with a positive family history of primary nocturnal enuresis. There was a 66.6% resolution rate within 1 year in the 33 subjects.

Our update of the literature found 10 publications describing the successful chiropractic care of children with nocturnal enuresis (see Table 4).¹⁰⁹⁻¹¹⁸ Successful chiropractic care

utilized a variety of techniques from HVLA-type thrusts such as Diversified and Gonstead Techniques, SOT, upper cervical NUCCA Technique, Drop Table and Thompson Technique and Activator Methods and Torque Release Technique.

Neurodevelopmental Disorders.

Neurodevelopmental disorders are a group of conditions with onset during a child’s developmental period and characterized by impairments in personal, social, academic, or occupational functioning. The range of deficits varies and commonly co-occur from very specific limitations in learning or control of executive functions to global impairments in social skills or intelligence.¹¹⁹ Studies have found that up to 60% of children with neurologic conditions have tried some form of alternative therapies. Of the practitioner-based alternative therapies, chiropractic is highly utilized by this pediatric patient population.¹²⁰⁻¹²¹

Recently, Holuszko et al.¹²² performed a systematic review of the literature on the chiropractic care of children with neurodevelopmental disabilities. Additionally, Kronau et al.¹²³ and Karpouzis et al.¹²⁴ performed a systematic review of the literature on the chiropractic care of children with Autism Spectrum Disorder and ADHD, respectively.

Holuszko et al.¹²² found 51 articles consisting of 3 RCTs, 7 reviews of the literature, 3 case series, 34 case studies and 3 surveys/commentaries. The authors found that neurodevelopmental disabilities are a series of disorders each with their own etiology, pathophysiology and treatment standard protocol. According to Holuszko et al.¹²², ADHD and ASD were the most common clinical presentations of the neurodevelopmental disabilities presenting to chiropractors with positive outcomes. However, they noted that there was a significant lack of research into other subcategories of neurodevelopmental disorders.

Kronau et al.¹²³ examined the clinical benefits of manual therapy of the musculoskeletal system in children diagnosed with ASD along with utilization of the Downs and Black checklist¹²⁵ for methodological quality for any clinical trials. Kronau et al.¹²³ found one randomized clinical trial (uncontrolled), one case series, and 11 case reports describing the use of manual therapy. The methodological quality of the RCT was rated as poor while reporting in the case series and case reports were also insufficient in terms of their quality. All included studies utilized SMT with indicated improvement in autistic symptoms after the manual therapeutic intervention. In the 2010 review by Karpouzis et al.¹²⁴ found 58 citations with 22 intervention studies found from database inception to 2009. Of these, only three studies were identified for paediatric and adolescent ADHD cohorts. According to the Karpouzis et al.¹²⁴, the methodological quality (i.e. Jadad scoring¹²⁶ and CONSORT checklist¹²⁷) was poor and none of the studies qualified using inclusion criteria for Levels I, II, III studies involving children (i.e., 0-17 years old) with medically diagnosed ADHD.

An update of the literature from 2015 on neurodevelopmental disabilities found only two studies. A case report by Scroggin¹²⁸ involving an 11-year-old male medically diagnosed with ASD, oppositional defiant disorder, bipolar disorder, and attention-deficit/hyperactivity disorder presents with a chief complaint of

upper thoracic pain. A chiropractic examination revealed abnormal asymmetrical posture, poor balance, and disorganized ambulation and leg control. The patient was analyzed for subluxation using a Tytron C-5000 thermography scanner, supine leg length analysis, and upper cervical x-rays, which indicated an upper cervical subluxation. The patient received eight weeks of care utilizing Grostic upper cervical protocol. Frequency of care was once per week with the patient receiving spinal adjustments at each visit. The patient received no other treatment or lifestyle modifications during this time period and after each spinal adjustments, the patient's indicators for subluxation were no longer present. At the patient's 8-week reassessment, the patient's abnormal and asymmetrical posture was almost completely symmetrical and his balance improved. His upper thoracic pain resolved within four weeks.

The other a case reported by Komarek et al.¹²⁹ involved a 2-year old male who suffered with seizures, behavioral disturbances and cognitive developmental delays following head trauma. The experienced 1-3 seizures per week and on some occasions up to three seizures per day. The patient was combative, angry and uncooperative with his parents. The patient also had a developmental impairment in language. The parents sought chiropractic care one year and three months after an injury. The patient received knee-chest upper cervical chiropractic care for a period of 5½ months, which amounted to a total of seven visits. Improvement and eventual cessation of his seizure activity was observed following chiropractic care. Improvement was also observed in the patient's behavior and cognitive development.

Musculoskeletal Care

Musculoskeletal (MSK) complaints in children are common with a wide spectrum of causes.¹³⁰⁻¹³¹ MSK pain is a common presenting complaint in primary care as well as in chiropractic practice.^{2,3,131} Our review of the literature of children with MSK conditions reveals a great deal of heterogeneity in their clinical presentations with successful outcomes under chiropractic care (see Table 5).¹³²⁻¹⁵² The approach to patient care utilized spinal adjusting and adjunctive therapies.

Gastrointestinal Disorders

Angus et al.¹⁵³ provided a narrative review of the literature (1980-2012) of studies describing the care of individuals with gastro-intestinal (GI) tract disorders using "chiropractic therapy" defined by the authors as SMT, mobilizations, soft tissue therapy and other modalities. The authors found 21 articles that varied from case reports to clinical trials to review articles. According to Angus et al.¹⁵³, the majority of articles reported mild to moderate improvements in their GI symptoms. Furthermore, no adverse side effects were reported suggesting that chiropractic care can be considered as an adjunctive therapy for patients with various GI conditions providing there are no co-morbidities.

Specific to constipation; in the United States, estimates place the prevalence of chronic constipation in children and adolescents at 10% whereas in Europe the prevalence rates range from 0.7% in infants and young children in Italy to 15% among children in Greece. In Brazil, the prevalence rate among 1-10 year olds has been estimated at >20%. Worldwide,

functional constipation has a high prevalence ranging from 0.7% to 29%. The biopsychosocial risk factors for children sufferers include psychological stress, poor dietary habits, obesity and child maltreatment. Many pediatric clinical trials have poor methodological quality, and drugs for adults have been found ineffective in relieving symptoms in children. A significant proportion of children continue on to suffer as adults.

Not surprisingly, constipation is now seen increasingly as a public health concern globally with a significant healthcare, social and economic impact.¹⁵⁴ In 2014, the brothers Alcantara¹⁵⁵ performed a systematic review of the literature on the chiropractic care of children with constipation and found 14 case reports, one case series, and one review of the literature. All documented success or advocated for chiropractic care for this patient population. Their review highlighted a number of chiropractic techniques associated with successful care (i.e., chiropractic adjustments and adjunctive therapies) varying according to the diagnosis, chief complaint and age of the patient. Since their review, an additional 5 papers have been published documenting the benefits of chiropractic of chiropractic care in children with constipation and varying co-morbidities (see Table 6).¹⁵⁶⁻¹⁶⁰

Breastfeeding Difficulties

The Surgeon General of the United States set a goal for 2010 that included a goal to have 75% of women initiate breastfeeding upon giving birth and 50% to continue breastfeeding through 6 months of age of their child.¹⁶¹ The American Academy of Pediatrics (AAP) recommends exclusive breastfeeding until 6 months of age and breastfeeding until 12 months of age.¹⁶² Unfortunately, American women are not meeting these goals due to a number of reasons that include being overweight resulting in embarrassment while nursing in public, mechanical issues such as larger breasts or nipples that may affect latching by the child¹⁶³ and from a chiropractic perspective, subluxations in the infant involving the cranium and cervical spine making breastfeeding difficult.

Advocating on the benefits of breastfeeding and given the realized and potential role of chiropractors in the care of infants with breastfeeding difficulties; Alcantara et al.¹⁶⁴ performed a review of the literature on the subject to inform clinical practice. The authors found 8 case reports, 2 case series, and 3 cohort studies documenting the successful care of infants with breastfeeding difficulties in addition to 5 case reports and a case series that involved breastfeeding difficulties as a secondary complaint. All reported successful outcomes. Alcantara et al.¹⁶⁴ concluded from their review of the literature that the theoretical and clinical framework based on the detection of spinal and extraspinal subluxations involving the cervico-cranio-mandibular complex in children with breastfeeding difficulties was an effective approach to patient care.

Since their review, two new publications have described the benefits of chiropractic in infants with breastfeeding difficulties. Ferranti et al.¹⁶⁵ described a 2-week-old male presenting with an attached frenulum, fixed right rotation of the head and cranial plagiocephaly. Cervical, thoracic and sacral subluxations along with cranial dysfunction were addressed using digital "touch and hold" adjustments resulting in

resolution of breastfeeding difficulties and cranial deformation. Collins et al.¹⁶⁶ described the care of 7-month-old fraternal twin males with chronic reflux, breastfeeding difficulties, irritability, excessive crying, plagiocephaly, and scaphocephaly. The children received spinal and cranial adjustments using Sacro Occipital Technique and Neuro Emotional Technique protocols. After 8 weeks of chiropractic care the patients' mother reported a decrease in severity of the twins acid reflux, breastfeeding difficulties and irritability. At 16 weeks of chiropractic care, the twins reflux had ceased and their cranial symmetry had markedly improved.

Headaches

In 2012, Ndetan et al.¹⁶⁷ performed a secondary data analysis of the National Health Interview Survey 2007, Child Alternative Medicine as well as the Child Core Sample estimate the use of chiropractic or osteopathic manipulation by children for specific health conditions. In addition to common complaints like back and neck pain, children presented for care for other musculoskeletal conditions, sinusitis, allergies, and non-migraine headaches. The popularity of headache as a clinical presentation in the pediatric chiropractic population was also reflected in the study by Weber-Hellstenius et al.¹⁶⁸ In a controlled comparison study in a convenience sample of 131 students aged 10-13 years, cervical joint dysfunction was a significant finding among pre-adolescents complaining of neck pain and/or headache compared to those who did not.

In 2010, Alcantara and Pankonin¹⁶⁹ described the chiropractic care of an 11-year-old male with a chief complaint of recurrent headaches of four-years duration. After 5 visits over a 4 week period consisting of spinal adjustments (i.e., Diversified Technique), the patient reported experiencing only one "mild" headache attack during the period of care. In the second month of care at one visit per week, the patient did not experience any headache attacks. The patient returned for care nine months later, with the patient reporting only a "couple of mild headaches but no migraine-type headaches." The patient underwent a course of care at a frequency of once every week for another four weeks. Follow-up evaluation six months later revealed the patient to be symptom free. In their review of the literature (1966-2008), Alcantara and Pankonin¹⁵⁹ found 9 case reports, 2 case series and one clinical trial successfully describing the chiropractic care of children with headaches. The authors noted that regardless of headache diagnosis, spinal adjustments with adjunctive therapies was an effective approach to caring for this pediatric population. An update of the published literature on the chiropractic care of children with headaches is provided in Table 7.¹⁷⁰⁻¹⁷⁶

Plagiocephaly

To synthesize from the current research evidence on the prevalence, risk factors, and natural history of positional plagiocephaly, Bialocerkowski et al.¹⁷⁷ found the point prevalence of positional plagiocephaly appears to be age-dependent and may be as high as 22.1% in children 7 weeks of age. Point prevalence tends to decrease with age and may be as low as 3.3% at 2 years of age. When compared with historical data, the prevalence of positional plagiocephaly appears to have remained stable over the last four decades. Assisted delivery, first born child, male sex, cumulative exposure to the supine

position, and neck problems may increase the risk of positional plagiocephaly. To reduce the risk of positional plagiocephaly, infants should experience a variety of positions, other than supine, while they are awake and supervised, and early treatment may be warranted for infants with neck problems and/or strong head position preferences.

The impact of plagiocephaly was explored by Martiniuk et al.¹⁷⁸ when they examined the association between plagiocephaly and developmental delay to guide clinical practice. Their search involved 1315 articles of which 19 meeting their inclusion criteria. The investigators found a positive association between plagiocephaly and developmental delay in 13 of the 19 studies examined, including 4 of 5 studies with "strong" methodological quality. Developmental delay was more frequent in studies with children ≤ 24 months of age (i.e., based on 9 of 12 studies) compared with >24 months of age (i.e., based on 3 of 7 studies). Motor delay was the most commonly affected domain reported in high-quality papers (i.e., based on 5 of 5 studies). Our review of the literature documents the effectiveness of chiropractic care in children with deformational plagiocephaly and other cranial deformities (see Table 8).¹⁷⁹⁻¹⁸⁷

Scoliosis

The prevalence and distribution of scoliosis is said to depend on various scoliotic parameters such as age, gender, curve magnitude, curve type, and curve side and race.¹⁸⁸ Among Caucasians and African-Americans, Kebaish et al.¹⁸⁹ found the prevalence of scoliosis at 11.1 % and 6.5 %, respectively. Zavatsky et al.¹⁹⁰ found that curve magnitude was greater in black patients than in white patients (i.e., 33^o vs. 28^o Cobb angle). A study found that the prevalence of scoliosis in Chinese girls was significantly higher than in Malay and Indian girls aged 11 to 12 and 16 to 17 years.¹⁹¹

Czaprowski¹⁹² commented that although few papers support the efficacy of manual therapy (i.e., chiropractic and osteopathy) in the treatment of idiopathic scoliosis, Czaprowski¹⁹² acknowledged that further research based on appropriate methods (prospective, randomized, controlled studies) are needed in order to reliably assess the usefulness of manual therapy in the treatment of idiopathic scoliosis. According to Weiss and Goodall¹⁹³, there is some evidence supporting the conservative treatment for adolescent idiopathic scoliosis. Conversely, according to the authors, no substantial evidence has been found in terms of prospective controlled studies to support surgical intervention. Due to the unknown long-term effects of surgery, more research is necessary. In the meantime, conservative care in the form of chiropractic remains a viable option for children with scoliosis. Our update of the literature on the chiropractic care of children with scoliosis is provided in Table 9.¹⁹⁴⁻²⁰¹

Syndromes

Defined as a group of signs and symptoms that occur together and characterize a particular abnormality or condition²⁰², children medically diagnosed with a syndrome have presented for chiropractic care with improvements in their presenting complaints, typically associated with their medically-diagnosed syndrome (see Table 10).^{172,194, 203-212}

Tic Disorder

Tic disorders are common neuropsychiatric disorders in children characterized by repetitive, involuntary, non-rhythmic, sudden movements, or vocalizations. They include transient tic disorder, chronic motor or vocal tic disorder, and Tourette syndrome.²¹³ A meta-analysis of the worldwide prevalence of tic disorders found a prevalence of 2.99% with the prevalence of Tourette syndrome at 0.77% and the prevalence of chronic tic disorders at 1.61%.²¹⁴ Our review of the literature found children presenting for chiropractic care with tic disorders and successfully cared for with the subluxation-based approach to patient care (see Table 11).²¹⁵⁻²¹⁹

Torticollis

In 2008, Roy²²⁰ described the successful care of a 4-month old female with congenital torticollis with a history of unsuccessful physical therapy, craniosacral therapy and myofascial release. The patient received chiropractic adjustments, stretching and trigger point therapy with successful outcomes. In addition to the clinical case report, the authors provided a review of the literature. We note also from our updated review of the literature the number of infants presenting with plagiocephaly with torticollis as a co-morbidity^{183, 185} (see Table 8). Our update from 2008-2017 found 4 additional manuscripts documenting successful outcomes with chiropractic care (see Table 12).²²¹⁻²²⁴

Other Presenting Complaints

In addition to the above-categorized conditions, children present for chiropractic care with other presenting symptoms. Noteworthy in our review is the heterogeneity of presenting complaints successfully addressed with chiropractic care. These are summarized in Table 13.²²⁵⁻²⁵⁵

Closing Remarks

We presented the chiropractic care of children from an evidence-informed perspective. Based on healthcare utilization data; of the practitioner-based non-allopathic approach to children's care, chiropractic is highly utilized by parents and/or their children. In terms of clinical expertise, we gave due consideration to the unique biomechanical features of the pediatric spine and the forces involved in the judicious/safe application of the chiropractic adjustment. Finally, we examined the published literature beyond the prevailing paradigm of the post-positivist perspective and embrace the constructivism perspective. With this approach, we again reiterate that generation of chiropractic knowledge comes from many sources beyond the RCT and meta-analysis. We learn from our individual and collective experience as chiropractors to better care for our patients. From this approach, we endeavored to provide a guiding principle to the chiropractic care of children.

Methodology

Several years ago the Foundation for Vertebral Subluxation (FVS) embarked on an ambitious effort to develop a clinical practice guideline/best practices project that would search, gather, compile and review the scientific literature going as far

back as January 1998. The FVS saw a crucial need to develop this project because other practice guidelines that included the management of vertebral subluxation were about to become outdated including the Council on Chiropractic Practice's (CCP) *Vertebral Subluxation in Chiropractic Practice* and the *International Chiropractors Association's Best Practices* document.

The Foundation's project covers twelve topic areas:

- History and chiropractic examination
- Instrumentation
- Radiographic and other imaging
- Clinical impression, assessment and recordkeeping
- Reassessment and outcomes assessment
- Modes of adjustive care
- Duration of care for correction of vertebral subluxation
- Chiropractic care for children
- Maternal chiropractic care
- Vertebral subluxation and well being
- Behavioral and mental health issues
- Patient safety, privacy and advocacy

The Foundation established a Guidelines Committee with experts in guidelines and best practices development, Project Managers and a team of researchers who established the methodology and then search, gathered and organized the literature over a period of several years.

The Project Manager developed training modules for the researchers responsible for searching and gathering the literature in order to establish continuity. This continuity is necessary for an ongoing best practices project that includes Fellowship students in order to develop the infrastructure for an ongoing best practices initiative.

Guidelines and best practices development within the subluxation focused faction of chiropractic has historically been hampered by a lack of interest, funding and talent since guideline development first came into being in the late 80's and early 1990's. Making the task even more challenging is the need to update best practices every five years. Reconvening committees, panels and training the next set of researchers to update the literature and recommendations only serves to delay or stop the process. This initiative creates an ongoing process with an ideally seamless team so that the related literature is updated regularly and then the recommendations can be updated as the evidence changes.

This initiative is currently housed at Sherman College of Chiropractic and is overseen and funded by the Foundation. One of the goals of the project is to train students and others in the development of best practices as the related attitudes, knowledge and skills for such endeavors is in short supply within the faction of the profession that manages vertebral subluxation.

The project involved establishing a database, reviewing the literature, establishing a writing team, developing draft documents of those reviews and circulating the reviews through the Guidelines Committee which developed recommendations based on the reviews. Once a draft document including recommendations is complete the document is released for peer

review with those reviewers asked to provide comments and references. This is the process followed for each of the topic areas.

This Chapter on the chiropractic care of children was peer reviewed and approved by 196 chiropractors from several countries and included chiropractors specializing in pediatric and maternal care such as Diplomates and others certified in such care.

Acknowledgements

This document is dedicated to the life and memory of Jeanne Ohm, DC whose tireless efforts on behalf of chiropractic, women and children will never be forgotten.

References

The Foundation for Vertebral Subluxation's Best Practices initiative is part of an ongoing process and as such this Guideline is a living document with references supporting the Recommendations continually updated as new research is published.

For references prior to 2008 we incorporate those references utilized by the Council on Chiropractic Practice (CCP) beginning with their *Clinical Practice Guideline Number One* published in 1998. Those references prior to 2008 are available in **APPENDIX 1**.

This current document and its related Recommendations were originally compiled using references from searches conducted 2007 through 2017 and this current document includes those 255 references within the document itself.

The literature in support of the recommendations made in this document that have been published since 2017 and through 2020 can be found here [\[LINK\]](#)

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Appendix 1

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Table 1. Summary findings of the systematic review of the literature on the chiropractic care of infants and children with asthma.

References	Age/Sex	Chiropractic Care	Commentary
Cuthbert ⁵⁸	Case series of 10 patients (i.e., 7 males, 3 female) between the ages of 3 and 22 years.	Applied Kinesiology (AK)	The patients received a multi-modal approach consisting of chiropractic SMT, cranial manipulative therapy, and muscle therapies aimed at strengthening the muscles of respiration. In addition, nutritional evaluation using the methods developed in AK. Outcome measures demonstrating benefit of care based on VAS scoring for respiratory impairment, improvement in exercise-induced asthma symptoms, reduction of respiratory distress with daily activity, reduction in the frequency of coughing during the day and night, and ease of breathing. These assessments were based on self-reports and parent/guardian proxy measures. In addition, each patient was not dependent on their asthma medications within 3-6 visits without relapse of asthma symptoms. At follow-up period ranging from 3 months to 4 years, all patients did not return to their medications.
Alcantara et al. ⁵⁹	A 7-year-old male	Activator Methods	In addition to asthma, the patient presented with chronic colds and allergies since the age of 5 months. At the time of initial evaluation, the patient was on a once/day dose of prescription Alavert for allergies and Albuterol for asthma. The patient's illness caused him to miss approximately 1-2 days a month of school due to colds and symptoms of asthma. His parents also indicated that his health problems resulted in monthly visits to his medical doctor. Within two weeks of initiating chiropractic care, the patient was able to discontinue his allergy and asthma medications (as decided upon by his parents) and the use of his nebulizer. In the first 5 months after beginning chiropractic care, the patient only had wellness checkups with his MD. In the past school year, the patient has not missed any days of school due to illness.

Postles and Haavik-Taylor ⁶⁰	A four-year-old male	Sacro-Occipital Technique (SOT)	In addition to asthma, the infant had a history of allergies, bedwetting and disrupted sleep. After 32 weeks of chiropractic care, the child no longer suffered from asthma and ceased his bedwetting.
Whittle-Davis and Czegus ⁶¹	23-month old female	Diversified Technique and Activator methods	In addition to asthma, the infant suffered from gastrointestinal complaints and frequent colds. The patient was prescribed a series of asthma medications and under constant monitoring by her pediatric pulmonologist. Within approximately 11 months of chiropractic care, the patient's parents reported a 90% improvement of their child's overall condition with discontinued use of all medications.
Zonarich and Aubin ⁶²	A 6-year-old male	Koren Specific Technique	The patient was diagnosed at 4 years of age with asthma. The child attended 6 visits that included Ω -3 supplementation and probiotics. With care, the patient no longer needed his daily inhaler dose of Albuterol with reported improved sleep.
Kachinsky and Kachinsky ⁶³ .	A 3-year-old male	Diversified Technique	In addition to asthma and chronic ear infections, this child was diagnosed with Neurofibromatosis Type I. He was having frequent asthmatic episodes requiring emergency department visits two times per month. The patient received care at a frequency of 2-3 times per week. Within one month of care, the patient no longer had severe asthma attacks and was able to sleep through the night and decrease his rescue inhaler use.
Davis and Byrley ⁶⁴	A 2-year-old male	Activator Methods	The patient suffered from asthma in addition to chronic colds and respiratory issues since birth. The patient was taking two medications: Flovent and Singulair, daily. Within approximately two weeks involving 4 visits, the patient's mother reported improvement in her son's condition.
Fedorchuk and Opitz ⁶⁵	11-year-old female	Chiropractic Biophysics Protocol	In addition to asthma, the patient suffered from chronic allergies, sinus problems, dry skin and leg cramps. Within 1½ months of care consisting of 27 visits, the patient was able to discontinue her medications, no longer suffered

			from her allergic symptoms and can breathe normally. Her sinus, skin problems and leg cramps also resolved.
Rectenwald ⁶⁶	19-month old male	Orthospinology Technique	This patient began experiencing asthma at age 9 months. By age 18 months, he had been treated 4 times at the hospital emergency room for episodes of acute respiratory distress. He suffered from constant wheezing and cough and was not responding well to pharmacological interventions. Chiropractic care involved 6 visits over a 7-month period. After 9 weeks, the patient's breathing improved.
Jaszewski and Willard ⁶⁷	15-year-old male	Pierce Results System	In addition to asthma, the patient suffered from headaches. Following his second visit, the patient noticed decreased difficulty in breathing and ceased to take his medications after 3 months of care, totaling 7 visits.
Brozovich ⁶⁸	A 5-year-old male	Gonstead Technique	The patient began experiencing difficulty breathing, gasping for air, nasal flaring and chest retraction when he was 16 months old. Medications were theophylline, steroids, and an albuterol inhaler. He had been hospitalized multiple times for 3-4 day periods over his lifetime. With care, the patient was able to reduce all of his medication over the next few months with the exception of a rescue inhaler of albuterol, which he needed only infrequently.

Table 1. Summary findings of the systematic review of the literature on the chiropractic care of infants and children with asthma.

Table 2. Summary findings of the systematic review of the literature on the chiropractic care of infants and children with infantile colic.

References	Age/Sex	Chiropractic Care	Commentary
Browning and Miller ²⁷	Forty-three infants of less than 8 weeks of age	Occipito-Sacral Decompression and Diversified Technique	Forty-three infants were randomized to receive SMT (N=22) or Occipito-Sacral Decompression (OSD) (N=21) with change in hours of daily crying as the main outcome measure. At day 7 of the trial, the mean hours of crying per day were significantly reduced in both groups (i.e., SMT group by 2.1 hrs/day; OSD group by 2.0 hrs/day). At day 14, crying in the SMT group was reduced by 3.1 hrs/day and the OSD group by 2.5 hrs/day. At day 14, the mean hours of sleep per day significantly increased in both groups (SMT group by 1.7 hrs/day; OSD group by 1.0 hrs/day). Four weeks after completion of the treatment trial, colic had resolved in 82% of the SMT group and 67% of the OSD group.
Elster ⁷⁶	7 Infants with colic	International Upper Cervical Chiropractic Association (IUCCA) Protocol	Sixteen infants were medically diagnosed with acid reflux (N=9) or colic (N=7). Ten of the 16 mothers reported difficulty in their child's birth leading to suspicions of birth trauma. Upper cervical subluxations were found in all 16 infants using the IUCCA Protocol. In the 16 infants, acid reflux and infantile colic resolved with upper cervical chiropractic care.
Miller and Phillips ⁷⁷	Comparison trial of 117-post colicky infants versus 111 infants in a non-treatment group	Diversified Technique described as low-force chiropractic manual therapy	A survey of parents with infants previously receiving chiropractic care for infantile colic (N=117) and parents of children never receiving chiropractic care (N=111) was performed. Based on the survey responses, infants who received chiropractic care for colic were twice as likely to not experience long-term sequelae of

			infant colic such as temper tantrums and frequent nocturnal waking when compared to those that did not receive chiropractic care.
Batte ⁷⁸	A 2-week-old male	Logan Basic Technique	The patient presented with excessive crying, abdominal distension, constipation, gas and disordered sleep. With chiropractic care, the infant experienced a bowel movement immediately following the first adjustment with regular schedule of bowel movements commencing after the 16th adjustment. Excessive crying additionally resolved around this same time period and his sleep improved.
Wiberg and Wiberg ⁷⁹	Retrospective review of infants (N=749) receiving chiropractic care in Denmark.	Diversified Technique	Infants from birth to 3 months of age fulfilling the diagnostic criteria for infantile colic were cared for. The main outcome measure parental report of improved, uncertain, or non-recovered. Slightly “older age” infants were found to be linked to excessive crying and experienced clinical improvement.
Williams-Frey ⁸⁰	A 4-month-old male	Diversified Technique characterized as low-force, soft tissue stretching and light touch cranial manipulative therapy	This male infant presented with excessive crying and associated head malposition, disturbed feeding and sleeping patterns, all of which started one-and-a-half months previously. Upper cervical, mid thoracic and cranial dysfunction as well as suboccipital musculature hypertonicity was recorded in this case. Care was provided over a 4-week period, twice weekly and included supportive care (i.e., advice about emotional disturbances and coping mechanisms in times of overwhelming feelings were given to the parents). Complete

			resolution of all presenting symptoms was reported by the author.
Guliani and Rubin ⁸¹	A 15-month-old female	Infant Toggle Headpiece and Logan Basic protocol	The infant was suspected of developmental delays by her mother. The infant presented with acid reflux and infantile colic. Following 18 visits, improvements were noted with the patient able to walk unassisted and speak 3-4 words in Greek and English. Her acid reflux and colic resolved with care.
Rollette and Monroe ⁸²	A one month old male	Diversified Technique	The infant suffered from acid reflux and infantile colic since birth and unresponsive to medical care (i.e., prescribed medication). Six chiropractic visits over a three-week period resulted in the child's acid reflux abating with increased feeding and resolution of infantile colic and improved sleep.
Castellucci ⁸³	An 8-week-old female	Diversified Technique	The infant was cared for over 4 weeks consisting of 8 visits with successful outcomes. At 1 year follow-up, the patient remained symptom-free from infantile colic and is a healthy, thriving one year old.
Rubin and Istok ⁸⁴	A 3-month-old male	Diversified Technique (i.e., touch and hold) and craniosacral therapy	Chiropractic adjustments (i.e., touch and hold) along with craniosacral therapy, resulted in resolution of the infant's colic, torticollis and feeding difficulties by the 4 th visit.

Table 2. Summary findings of the systematic review of the literature on the chiropractic care of infants and children with infantile colic.

Table 3. Summary findings of the systematic review of the literature on the chiropractic care of infants and children with otitis media

References	Age/Sex	Chiropractic Care	Commentary
Brown ⁹⁰	A 3-year-old female	Diversified Technique	With chiropractic care, the patient reported an increase in hearing and the child's mother reported her child had less ear pain, was less irritable, and improved speech. Medical audiology reports document speech and hearing improvements after a course of chiropractic care
Fedorchuk and Cohen ⁹¹	An 8-year-old female	Chiropractic Biophysics	The patient presented for care with persistent headaches, neck pain, sinus infections and chronic otitis media. With care, the patient reported a decrease in headaches, sinus, and ear pain. The patient also demonstrated a significant improvement in her cervical curve upon review of a follow-up radiograph.
Cuthbert and Rosner ⁹²	A 6-year-old male	Applied Kinesiology	The patient experienced painful earaches on a monthly basis since the age of 4-months. Antibiotics were ineffective. Chiropractic care resolved her ear complaints with 2 year follow-up revealing continued resolution.
Stone-McCoy and Boutilier ⁹³	A 9-month-old male	Webster toggle headpiece, the Activator instrument, cranial adjusting and sinus work	The patient had recurring ear infections with antibiotics being ineffective. Myringotomy and tympanostomy tubes were recommended by the patient's ENT physician. Both ears were reported clear within a week of initiating chiropractic care and no ear infections have been reported on longterm follow-up.
Marino and Butt ⁹⁴	A 24-month-old female	Diversified Technique	The patient experienced her first ear infection at age one-month and respiratory syncytial virus (RSV) at age 9 months with medical treatment of oral antibiotics and bronchodilator via nebulizer, respectively. Following chiropractic care at a frequency of 3x/week for three months, the patient's mother discontinued use of oral antibiotics due to no recurrence of otitis media by her daughter. By the end of three months of care, nebulizer treatments for RSV ceased.
Dwyer and Boysen ⁹⁵	A 6-year-old male	Diversified Technique and	The patient had measured conductive hearing loss on pure-tone audiometry, fluid in both ears, and chronic recurrent otitis media. Previous care

		Craniosacral Therapy	included use of antibiotics starting at 14 months of age and myringotomy at age 3 years. After 6 chiropractic adjustments, the child was asymptomatic, and remained free of otitis media symptoms on long-term follow-up. A repeat audiogram was performed 19 months since initiating chiropractic care revealing normal hearing in both ears.
Lanjopoulos and Lanjopoulos ⁹⁶	A 2-year-old female	Activator Methods	The patient presented for care with complaints of chronic otitis media, inability to sleep through the night, and skin sensitivities/tactile hypersensitivity to clothes and touch. The patient also had episodes of temper tantrums and violence towards her older sister. After three patient visits, the patient slept through the night for the first time. After four months of care, the patient no longer experienced ear infections, was consistently sleeping through the night, was less irritable, able to wear clothes without discomfort, and much more willing to hug and be held.
Stone-McCoy and Korn ⁹⁷	A 16-month-old male	Activator instrument, touch and hold spinal adjusting, cranial adjusting, sinus work, and soft tissue effleurage of SCM muscles.	The patient presented with recurrent ear infections that began at the age 14 months and non-responsive to antibiotic therapy. The patient's mother elected chiropractic care to avoid tympanostomy tubes recommended by the child's pediatrician. During the fourth week of care, an appointment with the pediatrician revealed resolution of his bilateral ear infections.
O'Connor and Schneider ⁹⁸	A 9.5-year-old female	Diversified Technique	The patient was medically diagnosed with chronic otitis media and scheduled for tympanostomy tube surgery. At a frequency of care of 3 times per week for three weeks, the patient no longer experienced episodes of headache and neck pain with her otolaryngologist reporting a 95% improvement in previous diagnosed hearing loss. Accordingly, the myringotomy tube procedure was cancelled.

Dunn-Sigouin ⁹⁹	A 23-month-old female	Diversified Technique with myofascial release of cervical muscles and effleurage of the frontal and maxillary sinuses	The patient experienced 6 episodes of acute otitis media since age 6 months. Prescribed antibiotic therapy proved ineffective. The patient attended 6 visits over the course of one month. Treatment protocol was then changed to 1 visit per 2 weeks, 1 visit per month and lastly for wellness visits at 1 visit per 2 months or based on need. The patient's otitis media resolved with no recurrence.
Feranti and Alcantara ¹⁰⁰	A 4-year-old male	Activator Instrument	A four-year old male presented for care with a history of failed tympanostomy tube surgery with a scheduled repeat tympanostomy surgery. On the patient's third visit, the patient's mother opted out of her son's scheduled surgery. The patient attended care with the recommended frequency of 2-3 times for the first two weeks, followed by once a week for eight weeks, for a duration of 12 weeks.
Steinberg and Doerr ¹⁰¹	A 2-year-old male	MC2 Technique utilizing an Integrator Instrument	The patient's first episode of otitis media was at one month of age. Since then her ear infections have been recurrent with regular antibiotic use. The patient was presented for chiropractic care in hopes of avoiding tympanostomy tubes. Following 36 visits, the patient's otitis media resolved without recurrence.
Stone-McCoy and Natori ¹⁰²	A 13-month-old male	Activator Methods	The patient was born premature and delivered through Caesarean section with vacuum extraction. At birth, the patient's blood contained opiates, methamphetamine and other amphetamines. The patient experienced chronic recurrent otitis media since three months of age and managed medically with antibiotics and nasal saline. The patient's mother reported that the child's otitis media had resolved the following week of initiating care.
Cooper and Howell ¹⁰³	A 10-year-old male	Pierce Results System	The patient presented for care with fluid filled ears (bilaterally) along with allergies & sleep disturbances. The patient was prescribed Flonase and Zyrtec for his allergies. After the first adjustments, the ear drained and continued the next two days. After two weeks of care, the child's otitis media resolved.

Table 4 Children under chiropractic care with nocturnal enuresis as a presenting complaint

References	Age/Biological Sex	Chiropractic Care	Commentary
Postles and Haavik-Taylor ¹⁰⁹	A 4-year-old	Sacro Occipital Technique	In addition to a diagnosis of asthma, a history of allergies and disrupted sleep, the patient presented for chiropractic care with a complaint of bedwetting. After 32 weeks of care, the child was symptom-free of asthma and night-time bedwetting.
Rodnick and Rodnick ¹¹⁰	11-year-old male	Gonstead Technique and Activator Methods	The patient had a history of nocturnal enuresis and attention problems. With chiropractic care, the patient's bedwetting dramatically improved from 7 days per week to one time every two-three weeks. The patient attended a total of 33 visits.
Weisberg ¹¹¹	A 9-year-old male	Diversified Technique	Unsuccessful medical care motivated this patient's parents to seek chiropractic care for their child. By the seventh visit, the patient had been enuresis free for two weeks which continued to be the case at 4 months follow-up.
Noriega, Chung and Brown ¹¹²	A 6-year-old male	National Upper Cervical Chiropractic Association (NUCCA)	The patient was diagnosed on the autism spectrum disorder (ASD) in addition to suffering from nocturnal enuresis. Over a 15-week period of care, the patient's bedwetting resolved.
Milano ¹¹³	10-year-old male	Diversified Technique	The patient attended care a total of 15 visits, resulting in a decrease in nocturnal enuresis from 2-3 times per week to once in an eight week time period.
Luscombe, Alcantara, Holmes and Holt ¹¹⁴	10-year-old male	Drop Table Technique	The patient suffered from bedwetting at a frequency of at least fortnightly episodes and had never gone for more than two to three weeks without an episode of bedwetting. Behavioral modification and alarm therapy were unsuccessful. After four weeks of chiropractic care the child's bedwetting ceased. At the end of 2 months of care, the patient's mother reported no episodes of bedwetting the previous 4

			weeks.
Hafer and Alcantara ¹¹⁵	A 10-year-old male	Activator Methods and Torque Release Technique	The patient suffered from nocturnal enuresis of 6 years duration that began after a urinary tract infection was treated with multiple courses of antibiotics. Chiropractic care at twice per week for a total of 5 patient visits resulted in improvement in the patient's nocturnal enuresis.
Neally and Alcantara ¹¹⁶	A 10-year old male and 9-year-old male	Diversified Technique and Logan basic	The patient was diagnosed with Asperger's at 6 years of age, presented for care with neck pain. Additionally, the patient suffered from nocturnal enuresis nightly since age 2 years. The second patient was a 9-year-old male also diagnosed with Asperger's Syndrome with nocturnal enuresis every night since age 5 years. The 10-year-old was cared for with Diversified Technique resulting in cessation of bedwetting following the first visit. The 9-year-old was cared for with Diversified Technique for 9 visits with minor improvements. On the 10th visit, Logan Basic was utilized resulting in cessation of bedwetting. On long-term follow-up, both patients continued to be free from nocturnal enuresis.
Instebø and Lystad ¹¹⁷	An 8-year-old female	Diversified Technique	The patient experienced nocturnal enuresis nightly. Pharmacotherapy (i.e., desmopressin) and behavioral interventions such as fluid deprivation, scheduled wakening, and alarms were unsuccessful. At the 2nd visit one week later, the patient was reported as not wetting her bed. Nine days later, however, the nocturnal enuresis relapsed, and the patient experienced 8 subsequent wet nights before again presenting to the chiropractic clinic. The patient attended another 2 visits, 8 days apart, and the bedwetting ceased once again after the second treatment. Follow-up phone calls to the patient's mother at one and 3 months after the last visit revealed only 4 subsequent episodes of nocturnal enuresis.
Cunningham and Shtulman ¹¹⁸	10-year-old female	Thompson Technique	The patient presented with a history of four-day constipation and nocturnal enuresis.

			Previous attempts of fecal disimpaction with the use of probiotics, castor oil and flax seeds were unsuccessful. On the third visit, the patient's mother revealed that a lifetime of nocturnal enuresis had resolved following a course of chiropractic care.
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Table 4 Children under chiropractic care with nocturnal enuresis as a presenting complaint

Table 5. Children under chiropractic care presenting with MSK complaint(s).

Reference	Age/Sex	Presenting Complaint	Chiropractic Care	Clinical Commentary
Flory, Chung and Ozner ¹³²	A 10-year-old male	Facial Neuralgia	NUCCA	The patient presented for care with a medical diagnosis of trigeminal neuralgia and suffered from intense bouts of headaches, earaches, neck pain and extreme facial pain for nearly 4 months. Prescribed medications provided no overall relief. During the patient's initial phase of care, the patient's symptoms improved significantly. After 7 months, the patient reported complete resolution of his main complaint, as well as significant reduction in the associated symptoms. Follow up appointments at 1 year after the initial exam revealed that the patient was still symptom free.
Pavia, Fischer and Roy ¹³³	Case Series	Temporomandibular Dysfunction	Activator Methods	This is a retrospective case series of 14 patients, including 13 adults and 1 child. The majority of the patients were undergoing chiropractic care for spine-related conditions when they presented with additional TMD signs and symptoms. With care, a reduction in the patients' pain scores from the initial visit of 8.3 ± 1.6 to the last visit at 1.4 ± 1.1 indicated an $80.9\% \pm 15.4\%$ improvement. The average number of visits was 13.6 ± 8.2 .
Carter, Floyd, Richardson and Alcantara ¹³⁴	A 9-year-old male	Low back pain	Diversified Technique	Lumbar spine radiographic examination revealed 6 non-rib bearing segments due to the absence of T ₁₂ ribs. MRI examinations noted tethering of the spinal cord with an ill-defined conus medullaris that extended to the L4 vertebral level, a small syrinx cavity within the

				attenuated conus of the cord limited to the L ₂₋₃ and dysraphism of the dorsal arches of the L ₅ and S ₁ vertebra without evidence of lipomyelomeningocele. Over the course of twice per week for 3 weeks and then one visit per week for 6 weeks with recommended physical stretching and exercises to be continued daily at home, the patient's complaint of low back pain resolved.. At one-year follow-up, the patient was able to play several high school sports without any complications.
Welk ¹³⁵	A 12-year-old male	Aneurysmal bone cyst	None- the case report was diagnostic in nature and lossed to referral.	The patient presented for care at a chiropractic teaching clinic with a 1-week history of neck pain and stiffness following a helmet-to-helmet collision in football practice. Cervical spine radiographs revealed a pathologic fracture through a lytic and an expansive lesion in the posterior arch of C ₇ vertebral body. On computed tomography, the C ₇ lesion showed medullary destruction, cortical thinning and expansion, and a horizontally oriented fracture through the spinous and lamina. Magnetic resonance imaging studies for sagittal T ₂ and contrast-enhanced T ₁ -weighted MRI revealed fluid/fluid levels in the C ₇ spinous and peripheral enhancement with contrast. The patient was referred to a local hospital for treatment. Resection of the posterior arch was performed and an aneurysmal bone cyst was confirmed histologically. The patient developed a kyphotic deformity at the site of resection and cervical instability. A subsequent fusion was performed.

Cofano et al. ¹³⁶	A 10-year-old male	Acute low back pain and incidental finding of spina bifida occulta	Diversified Technique	The patient suffered from low back pain after a fall 3 days prior. Examination and medical records revealed the patient also had spina bifida occulta at the L ₅ vertebral level. The patient's lower back pain resolved after 6 visits. No adverse effects were reported.
Ferguson et al. ¹³⁷	A 13-year-old female	right ankle pain	Myofascial release, extremity mobilization/manipulation and cold laser therapy	The patient presented to a sports chiropractic clinic with non-traumatic onset of right ankle pain of 2 weeks duration. The patient underwent a course of treatment including myofascial release of lower leg muscles, mobilization/manipulation of the ankle mortise joint and Tanda laser therapy. The patient was seen weekly for 4 weeks. After failed conservative management, radiographs and MRI were obtained exhibiting a bony lesion of the distal tibia resembling osteomyelitis. The patient was non-responsive to antibiotics, which lead to the diagnosis of Chronic Recurrent Multifocal Osteomyelitis
Daniels and Morrell ¹³⁸	A 10-year-old	Pediatric plantar fasciitis	Diversified Technique, Graston Technique and home exercises.	The patient presented with bilateral plantar heel pain at the origin of the plantar fascia of 3 weeks duration. After 6 treatments, the patient reported resolution of foot pain bilaterally and improvements in activities of daily livings. Three months later, the patient reported no further complications and the absence of pain.
Willis ¹³⁹	7-year-old female	Adductor Muscle Strain	SOT and Activator Methods, effleurage massage, Proprioceptive Neuromuscular	The patient presented with pain with activity and associated restricted abduction of her right thigh that resolved immediately following the patient's second visit. The patient was able to fully abduct the

			Facilitation and dynamic stretching	previously painful thigh.
Gordon ¹⁴⁰	A 2-week-old male	Incomplete obstetric palsy of the brachial plexus and facial nerve	Chiropractic craniosacral technique and massage	The patient presented with incomplete obstetric palsy of the brachial plexus and facial nerve along with plagiocephaly. Chiropractic care over a 4-month period resulted in a gradual reduction in plagiocephaly and improvement in facial symmetry, upper limb posture and movement.
Alcantara and Davis ¹⁴¹	A 2¾-yr-old female and 3½-yr-old male	Growing pains	Diversified Technique	Following a trial of care (i.e., 3 visits scheduled over a 3-week period and 4 visits over a period of 14 weeks), the patients' symptoms resolved and were released from care.
Briscoe and McIntyre ¹⁴²	A 2-year-old male	Tibial fracture	Drop Table Technique and Activator Methods	The patient presented with altered gait pattern and disrupted sleep as a result of a tibial fracture and gait compensation two weeks after cast removal. With chiropractic care, normal gait and sleep patterns were restored.
Schenkel et al. ¹⁴³	A 15-year-old female	Talocalcaneal coalition	None – the case report was diagnostic in nature	The patient's plain films were incorrectly read as normal and a CT scan revealed bilateral osteoarthritis.
Pfeffer et al. ¹⁴⁴		significant neck and upper back pain and difficulty turning his head	Diversified Technique, Activator Methods and Graston Technique	The patient presented with neck and upper back pain due to a sports injury. The patient improved dramatically after one visit with 75% improvement in active extension along with significant reduction in pain. The patient was pain free with normal active range of motion after 3 visits in a 1 week period and

				maintained this pain free report at the end of week 2.
Rubin ¹⁴⁵	Case Series: A 3, 7 and 8-year-old male and a 9-year-old female	“Wii-it is”	Activator Instrument	These children presented with cervicalgia, spinal dysfunction/chiropractic subluxation, and upper extremity pain and referred to as “Wii-itis.” Patients were cared for with spinal and extra-spinal adjustments and advice to refrain from video games for 48 hours and ice the affected areas. Immediately after their treatment, each patient reported improvement, most notably in their neck and thoracic regions. The following visit a week later revealed all had full resolution of all complaints.
Borcean ¹⁴⁶	A seven-year-old female	Ataxia	Diversified Technique with Neuro-rehabilitative exercises at home and/or during an office visit.	Spinal adjustments to the spine along with right cerebellar rehabilitation exercises were given during the office visits as well as at home. Within four visits there was marked improvement of gait patterns and resolution of the ataxia.
Roberts and Wolfe ¹⁴⁷	A 6-year-old female	Neck pain; headaches; hand, leg, and foot pain; and other non-musculoskeletal symptoms	Activator Methods	The patient presented with complaints of “neck and brain hurting” along with hand, foot, and occasional leg pain. The patient also had long history of unexplained fatigue, vomiting, and coughing spells. After the 5 th chiropractic visit, the patient's symptoms was reported as improved. A complete return to normal activity and spinal stability occurred after 9 visits. Follow-up at 19 weeks since initiating care revealed the patient as

				asymptomatic.
Lakrkin-Thier et al. ¹⁴⁸	A 14-year-old male	osteochondrosis dissecans	None – diagnostic case report with medical referral	The patient presented with knee pain. Radiographic studies revealed a large defect of the femur’s lateral condyle consistent with advanced osteochondrosis dissecans. The patient was referred to an orthopedist who recommended surgical intervention.
Hanson and Linaker ¹⁴⁹	An 18-month-old male	Fractured Clavicle	Diversified Technique with efflurance of the SCM muscles.	The infant had fallen off an aerobic step resulting in a clavicular fracture. The patient was referred to an orthopedist who recommended an arm sling. The patient received chiropractic adjustments in addition to efflurance for lymph pumping to stimulate draining of deep and superficial lymph nodes in the SCM. Evaluation at 6 and 12 months revealed fracture healing.
Alcantara et al. ¹⁵⁰		Erb’s Palsy	Gonstead Technique, soft-tissue manipulation and myofascial release	The patient received care utilizing the Gonstead Technique to sites of spinal and extraspinal suluxations along with soft-tissue manipulation and myofascial release of the right upper extremity. Following 3 months of care, the patient achieved full range of motion on the affected side.
Alcantara and Kleijjan ¹⁵¹	A 17-month-old male	Inability to stand upright in a weight bearing position following an injury to his right foot following a jump	Toggle Recoil and Activator Methods	The patient could not stand upright in a weight bearing position on his right foot following a jump from his father’s back. The patient stopped walking, favored his right foot and crawled for mobility. Medical care was recommended “rest.” After 4 visits, the patient was able to stand weight bearing only by holding himself up on the furniture and walk with a limp. With continued care and following 9 office visits, the patient was able to walk and run unassisted.

Stone-McCoy et al. ¹⁵²	A 4-month old female	Congenital Torticollis	Diversified Technique and trigger point therapy.	Previous physical therapy, cranial-sacral therapy and myofascial release therapy resulted in limited improvement. The patient received chiropractic adjustments, stretching and trigger point therapy with successful outcomes
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Table 5. Children under chiropractic care presenting with MSK complaint(s).

Table 6. Children under chiropractic care with constipation as a presenting complaint

Reference	Age/Sex	Chiropractic Care	Clinical Commentary
Eulitt and Giannakakis ¹⁵⁶	An 8-year-old male	Diversified technique	The patient suffered from chronic constipation since birth. Bowel movements were once a week with an associated involuntary release of fecal material. The patient also experienced severe abdominal pain due to constipation. Scheduled care was 3 times a week for two months. After 12 visits, the patient experienced regular/daily bowel movements and no longer suffered from abdominal pain. He also no longer had symptoms of fecal incontinence and reports from his school of such “accidents” had ceased.
Mills and Alcantara ¹⁵⁷	Case Series: A 3-year-old male and female	Diversified Technique	The boy had only one bowel movement per week since birth whereas the girl had experienced only one or two bowel movements per week. The girl attended a total of 6 visits over a period of 1½ month and the boy attended a total of 11 visits over a 2½ month period with resolution of constipation.
Miceli and Alcantara ¹⁵⁸	An 8-month-old male	Gonstead Technique.	The infant had not made a bowel movement for five days at clinical presentation. Increase fluid intake was unsuccessful. Following his first spinal adjustments, the infant proceeded to have a very large bowel movement while sitting in his car seat. Two hours later, additional bowel movements occurred.
Steinberg and Doerr ¹⁵⁹	A 2-year-old female	MC2 Technique utilizing an Integrator hand held adjusting instrument	In addition to ear infections and sleep disturbance, this patient also suffered from constipation. After 36 visits, the patient’s presenting complaints resolved.
Swaminathan and Hanson ¹⁶⁰	A 5-month-old female	Diversified Technique	The infant presented with complaints of gastroesophageal reflux, constipation and plagiocephaly. Medical care was ineffective. The patient attended 19 visits over a 6-month period. At 6-month reassessment, the infant no longer was on anti-reflux medication, was regularly having 1 to 2 bowel movements per day.

Table 6. Children under chiropractic care with constipation as a presenting complaint

Table 7 Children under chiropractic care with headache as a presenting complaint

Reference	Age/Sex	Chiropractic Care	Clinical Commentary
Laferrière ¹⁷⁰	A 6-year-old female	Activator Methods with hands-on spinal manipulation techniques, massage and sinus lymphatic drainage.	The patient suffered from migraine without aura, sleep bruxism and chronic sinus congestion. In addition to the use of Activator Methods, the child was cared for with hands-on manipulation techniques, massage and sinus lymphatic drainage. After 4 visits, her migraine pain NRS reduced from 5/10 to 2/10 and frequency of attacks reduced from 3 times per week to once a week without the use of medication. In addition to chiropractic care, elimination of migraine triggers (i.e., sun exposure) and rest periods with naps in the afternoon along with cardiac coherence training exercises before bedtime proved to be effective care.
Alcantara and Simmons-Stone ¹⁷¹	An 8-year-old female	Diversified Technique	The patient presented with complaints of re headaches and neck pain of four months duration. Medical care consisting of Tylenol as needed proved ineffective. Following 4 chiropractic visits, the patient's neck pain and headaches resolved.
Maroon et al. ¹⁷²	A 13-year-old female	Diversified Technique	The patient suffered from Dandy Walker Syndrome. A stroke at age 9 years resulted in right-sided hemiplegia. She presented with neck pain and headaches of 6 months duration. The patient was on multiple medications (i.e., Lyrica, Keppra, Naproxen, Adderall and Zyrtek) taken daily. Scheduled at 2 times a week for 2 weeks abated to 1 time a week for 4 weeks. Improvements in her symptoms were based on subjective reports and the use of the Bournemouth Neck Disability Index and Headache Disability Index questionnaires.
Heagy and Warren ¹⁷³	A 10-year-old female	CBP® and Gonstead Technique	The patient suffered from recurring headaches and parasomnia (i.e., night terrors) negatively affecting her academic and sports performance and social life. With one month of care, the patient

			reported a reduction in headache symptoms and complete resolution of parasomnia and night terrors.
Jaszewski and Sorbara ¹⁷⁴	A 7-year-old female	Pierce Results System	The patient was born with paralysis of the right side of her face and was issued a moulding helmet to address cranial deformity. She also suffered from ADHD with difficulty concentrating, vomiting, and light sensitivity from intense migraine headaches since the age of 2. She had scoliosis with a Cobb angle measuring 13 degrees. Along with improvement of subjective complaints, comparative radiographs demonstrated a 62% improvement in Cobb angle after just one month of care.
Cuthbert and Rosner ¹⁷⁵	A 10-year-old male	Applied Kinesiology	The child suffered from asthma, neck pain and reading disability in addition to headaches. Specific to his headache complaints, with 3 visits over 10 days, his headaches remained at the NRS pain level of 1/10 located at the suboccipital area. After 5 visits over a 3-week period, all of his symptoms resolved with the score of “0 of 10” on the head and neck NRS. The patient remained symptom free at follow-up 2 years later.
Marchand et al. ¹⁷⁶	Case Series: infants ranging in age 2 days to 8.5 months. Seven males and 6 females.	Diversified Technique and chiropractic cranial technique	The focus of care was predicated on the sites of subluxations. Most received fullspine care whereas others received care focused to the cranium and cervical spine.

Table 7 Children under chiropractic care with headache as a presenting complaint.

Table 8. Children under chiropractic care with cranial deformity as a presenting complaint

Reference	Age/Sex	Chiropractic Care	Clinical Commentary
Leighton ¹⁷⁹	A 15-week-old male	Chiropractic manual therapy and advice for “active counter-positioning” and “tummy time” with appropriate infant placement in car seats, bouncers, etc.	At baseline measures, the infant’s cephalic index (CI) was 101.2% and his oblique cranial length ratio (OCLR) was 106.1%. By the 7 th visit (i.e., 16 days into care) the patient’s mother reported her child’s excessive crying had resolved, there was improved sleep and complained less. At 7 months of age, the patient’s CI was 89.9% and his OCLR was 104.5%. At one year of age, the CI had dropped to 95.1% and his OCLR dropped to 101.3%
Alcantara and Doucet ¹⁸⁰	A 3-week-old female	Diversified Technique and craniosacral therapy.	The infant presented with a diagnosis of craniosynostosis (i.e., the posterior fontanelle was fused and the anterior fontanelle as small and diamond-shaped with a slight bulging that measured approximately 1 cm in diameter). Following 6 visits, the patient’s cranial diameter measured 39.2 cm compared to 34.5cm at birth with the anterior fontanelle remaining open. Long term follow-up revealed the patient’s cranial development progressing without the need for surgery.
Fairest ¹⁸¹	A 6-week-old female	Diversified Technique and Activator Methods.	The patient experienced resolution of deformational plagiocephaly along with improved sleep and regurgitation following 10 chiropractic visits to address vertebral subluxations.
O'Neil and Stewart ¹⁸²	A 2-week-old and 9-week-old infants	Not described	The 2-week old presented with left lambdoid craniosynostosis and the 9-week-old with atypical palpation at the lambdoid suture. Both were referred for medical care to address their plagiocephaly. The 2-week-old infant was described as receiving corrections to shoulder, upper cervical and cranial regions with chiropractic care in addition to the medical referral.

Humphris et al. ¹⁸³	A 6-month-old female	Diversified Technique	The patient suffered from mild non-synostotic plagiocephaly and infant torticollis. Additional complaints included failure to latch and feed on the right breast, unsettled sleep patterns and regurgitation after breast-feeding. Following the first adjustment to C ₁ , immediate improvement of global and segmental range of motion was noted. No signs of patient irritability remained with passive motion. Instantaneous engagement in active head rotation to the less favored side was also observed following the adjustment. After the 2 nd visit, The infant was also described as sleeping regularly, lack of irritability and competently latching onto the right breast without regurgitation. After 3 months, the patient and mother returned for the third visit. The resolution of non-synostotic plagiocephaly and infant torticollis was noted.
Hash ¹⁸⁴	A two-month old girl	Chiropractic cranial therapy with Diversified Technique	The infant attended a total of 9 visits receiving cranial therapy and spinal adjustments mainly to the atlas vertebra. The infant's plagiocephaly improved.
Tutt and Mesidor ¹⁸⁵	An 8-month-old male twins	Activator Methods and chiropractic cranial therapy	Prior to chiropractic, the patient received one month of physical therapy for torticollis and plagiocephaly. After his 2 nd visit, the patient's torticollis had reduced by 75% and his skull asymmetry was reduced by 25%. He had a reduced left head tilt, and an increase in head circumference. At his third visit, the patient's torticollis resolved, and the patient no longer needed to wear his moulding helmet.
Collins et al. ¹⁸⁶	7-month-old fraternal male twins	Sacro-Occipital and Neuro Emotional Technique	After 8 weeks of chiropractic care, the infant's mother reported a decrease in severity of the twins acid reflux, breastfeeding difficulties and irritability. At 16 weeks of chiropractic care the twins acid reflux had ceased

			and their cranial symmetry had markedly improved.
Gordon ¹⁸⁷	Case Series: 23 infants with mean age of 12.5 weeks	“Touch and hold” technique to address cranial, spinal, shoulder, pelvic and/or sacral subluxations. Specific muscle release techniques of the sub-occipital muscle groups, sternocleidomastoid and upper trapezius was also applied as necessary	Over a 19-month period, the care of infants presenting at 2 chiropractic clinics with deformational plagiocephaly was documented. Diagonal skull measurements were analyzed from 23 infants (average age =13.1 weeks). Overall, there was a 47.7% improvement in cranial vault asymmetry index (CVAI) from initial presentation to final measurement following an average of 6.9 chiropractic visits.

Table 8. Children under chiropractic care with cranial deformity as a presenting complaint.

Table 9 Children under chiropractic care with scoliosis as a presenting complaint.

Reference	Age/Sex	Chiropractic Care	Clinical Commentary
Wittman and Vallone ¹⁹⁴	A 7-year-old female	Activator Methods, cranial therapy and physical rehabilitation	Initial care was set at twice weekly for 4 weeks with modified Activator Methods and nutritional intervention. At the end of 4 weeks, the patient was scheduled once weekly for chiropractic and cranial therapy. Movement therapy was eventually added. Over the course of 3 years of care, the patient's scoliosis decreased to 4-5 ⁰ Cobb angle measurement from a 15 ⁰ Cobb angle.
Waldrop et al. ¹⁹⁵	A 10-year-old female	Spinecor bracing	The patient presented with adolescent idiopathic scoliosis (i.e., right thoracic curve) measuring 36 ⁰ Cobb angle. The dynamic Spinecor bracing system was worn for 20 hours per day. At one month in-brace, a Cobb angle of 8 ⁰ from T7-L2 was measured. At 5 months into bracing treatment, her Cobb angle from T7-L2 was 2 ⁰ . At 8 months of care, her Cobb angle was found to be 0 ⁰ . This was maintained at one year follow-up.
Chung and Salminen ¹⁹⁶	A 10-year-old female	Upper cervical (i.e., atlas vertebral body) adjustments	The patient presented for care with a chief complaint of migraine headache and juvenile idiopathic scoliosis (i.e., a 35 ⁰ Cobb angle the thoracolumbar spine). Six upper cervical adjustments were delivered over a period of 11 visits over 25 weeks duration. A 10 ⁰ Cobb angle reduction in scoliotic curve was found and confirmed by an independent medical radiologist.
Bowler and Conlen ¹⁹⁷	A 4 year old male	The patient received an interdisciplinary approach using Hole-in-One chiropractic technique, Cranial Orthodontia, Craniosacral Therapy and Raindrop Technique™	The patient presented with a diagnosis of craniosynostosis, mild Chiari malformation and a 25 ⁰ Cobb angle scoliosis. Of the 19 total chiropractic visits over a 4 year and 5 month period, 8 chiropractic adjustments were delivered. The other 11 visits focused on parental education or assessment and addressing the craniosynostosis. An orthopedic surgeon noted from the patient's x-ray at age 10 years that his scoliosis had reduced in spinal curvature.
Wendland-Colby and Addison ¹⁹⁸	An 11-year-old female	Diversified Technique and traction	The patient had a 22 ⁰ Cobb angle thoracolumbar curvature. She was cared for on a weekly basis for a total 31 visits over a three month period. Follow-up radiographs revealed a 3 ⁰ reduction in the Cobb measurement.

Jones ¹⁹⁹	A 14-year-old female	Thompson Protocol with mirror image exercises and associated stretching and strengthening exercises	The patient presented with a scoliotic Cobb angle of 17.2°. After approximately 3 months of care, comparative radiographs revealed a reduction in the scoliotic curve to 13.5° Cobb angle.
Siegenthaler ²⁰⁰	Two males aged 6 and 10 years	Diversified Technique in conjunction with physical therapy.	The 6-year-old male received adjustments to the C ₁₋₂ functional spinal unit (FSU) and right sacro-iliac joint consisting of 7 visits over a 3-week period. Within 3 weeks, full ROM in the cervical spine as well as normal joint play at the C ₁₋₂ and right sacro-iliac joint. After chiropractic care, a physical therapist provided a series of physical therapy exercises for improving coordinative motor skills. Long-term follow-up was every 6 months until the boy was 9 years old found no regression of the symptoms. The 10-year-old male received care consisting of 10 visits over 5 weeks with adjustments to the C ₁₋₂ FSU. Simultaneously, a physical therapist provided exercises for improving coordinative motor skills. After 5 weeks, full ROM in the cervical spine was achieved along with improved joint play at the C ₁₋₂ FSU. There was no change in plagiocephaly and facial scoliosis. Long-term follow-up every 6 months until the boy was 12 years old found no regression of the cervical ROM and worsening of the spinal lesion or delay in gross motor skills.
Dovorany et al. ²⁰¹	Twin females at 14-years of age	Flexion-Distraction with specialized scoliosis bracing, Diversified Technique consisting of manual, instrument-assisted, and drop table techniques. Lubmar exercises along with proprioceptive balancing on a vibration platform	Care consisted of multiple daily office visits (i.e., three per day) for a total of 10 days (i.e., 5 days per week for two consecutive weeks). Thereafter, the patients were instructed to perform 30 min a day utilizing a scoliosis traction chair, followed by 20 min of proprioceptive balancing with follow-up visits every 3 months.

Table 9 Children under chiropractic care with scoliosis as a presenting complaint.

Table 10. Children under chiropractic care presenting with a medically-diagnosed syndrome

Reference	Age/Sex	Chiropractic Care	Clinical Commentary
Heinecke ²⁰³	A 4-year-old female	Initially utilized Diversified Technique followed by Activator Methods, and lastly, SOT Technique.	In addition to a medical diagnosis of <i>Aicardi syndrome</i> , this infant also had right ear deafness, blindness, cleft palate, and sacral spina bifida vera. The patient had a bifurcated right thumb and also presented with circulatory disorders of the lower extremities, hypertension, renal dysfunction, food allergies and esophageal reflux. The infant's presenting chief complaint was irritability which included prolonged crying, general dislike of touch and self-injurious behavior (SIB). Chiropractic care consisted of 46 visits over 23 months. During care, the patient increased in weight. She also ceased to exhibit SIB, demonstrating greater periods of calm. Also noted was a decrease in stress in the life of the child's caregiver.
Sinnott and Truter ²⁰⁴	A 4-year-old male	Gonstead Technique	The patient had Down's Syndrome and suffered from convergent strabismus of approximately 15°, bilaterally. After surgical intervention, the left eye was corrected to its neutral position. The patient presented with an internally rotated right eye of approximately 15°. After 2 months of care, both eyes abducted 15°, which meant that the right eye corrected and was now in a central position, whereas the surgically repaired left eye was now divergent by 15°.
Herman and Amilcar ²⁰⁵	A 13-month-old male	NUCCA and Activator Methods	The patient was diagnosed with Paroxysmal Tonic Upgaze (PTU) Syndrome, torticollis, and neurological issues secondary to birth trauma. The patient received care over a 4-month period consisting of 9 visits. After the first visit, his parents noted his sleep improved. Care continued weekly for one month and parents reported improvement in symptoms associated with PTU and torticollis.

Maroon et al. ¹⁷²	A 13-year-old male	Diversified Technique	The patient suffered from Dandy Walker Syndrome. A stroke at age 9 years resulted in right-sided hemiplegia. She presented with neck pain and headaches of 6 months duration. The patient was on multiple medications (i.e., Lyrica, Keppra, Naproxen, Adderall and Zyrtek) taken daily. Scheduled at 2 times a week for 2 weeks abated to 1 time a week for 4 weeks. Improvements in her symptoms were based on subjective reports and the use of the Bournemouth Neck Disability Index and Headache Disability Index questionnaires.
DeMaria et al. ²⁰⁶	A 14-year-old male	Pierce Results System.	The patient presented with motor tics, migraine headaches and severe “fatigue.” The patient was experiencing 1,000 “violent” motor tics a day and was medicated with 6 Ibuprofen pills, 10 mgs of Abilify, and 1mg of ORAP (Pimozide) per day. Over the course of 30 patient visits in a period of 5 months, dramatic reductions were reported in the number of tics experienced daily from 1,000 to 30-35 tics per day. The patient’s dependence on Ibuprofen was eliminated and his medication dosage (i.e., Abilify and Pimozide) was reduced by his medical provider.
Daruwalla ²⁰⁷	A 9-year-old male	Thompson Drop Technique for the pelvis, Diversified Technique for the thoracic region, and Activator instrument when addressing the cervical spine due to presumed C ₁ -C ₂ instability.	The infant was diagnosed with Down’s Syndrome and suffered from ear, nose and throat infections. After one month of care, the child had a reduction in nose and throat infections, decreased antibiotic use, improvement in quality and duration of sleep and had noticeable improvements in concentration as observed by his teachers. Initially scheduled for care at 2 times per week and after 3-4 visits, the child showed improvement in the duration of his sleep. At his 13th and 19th visit, he was reported to have a cold and felt achy. During that time, the patient attended twice a week and

			in 3 visits was doing well again. After the 19th visit, the patient no longer had episodes of sinusitis, colds and was no longer on antibiotics.
Millman et al. ²⁰⁸	A 10-year-old male	Blair upper cervical technique	The patient had Complex Regional Pain Syndrome. Over a 10-month period, noted decrease in symptoms associated with CRPS Type 1 was documented in terms of frequency, severity and duration with chiropractic care.
Kuperus et al. ²⁰⁹	A 6-day-old female	Diversified Technique, cranial sacral therapy and kinesiotaping	The child had Down's Syndrome and presented for care due to failure to gain weight and thrive, as well as dysfunctional breastfeeding. After one year of care, the child had achieved her developmental milestones on the higher range of predicted normal for Down Syndrome infants. Her height and weight were consistently around the 50th percentile for infants with Down's Syndrome.
Salminen and Chung ²¹⁰	A 3-year-old male	NUCCA	The infant had Joubert Syndrome and presented with tachypnea, occasional apnea, hemifacial spasm, nystagmus, strabismus, delayed motor skill development and hypotonia. The mother's main concern was a hemifacial spasm that occurred three to four times a week. After his first adjustment, the patient did not have a hemifacial spasm for nine days, which was the longest interval between spasms since birth. The spasms completely disappeared after 31 months of care. Except for slightly improved coordination, no other significant change was reported as a result of the chiropractic care.
Wittman and Vallone ¹⁹⁴	A 7-year-old female	Activator Methods, cranial therapy and physical rehabilitation	In addition to improved scoliosis, improvements in immune function and a reduction in anxiety type behaviors were

			documented by her parents over her course of chiropractic care
Beck ²¹¹	An 8-year-old male	Diversified Technique, nutritional supplementation and rehabilitation.	Over a 12-week course of care, the patient was able to regain full control of her legs and full weight bearing after 3 weeks of care.
Alcantara and Anderson ²¹²	A 3-month-old female	Diversified Technique	The patient presented with complaints of frequently interrupted sleep, excessive intestinal gas, frequent vomiting, excessive crying, difficulty breastfeeding, plagiocephaly and torticollis. Her diagnosis was gastroesophageal reflux disease, fuss-cry-irritability with sleep disorder syndrome and irritable infant syndrome of musculoskeletal origin. Previous medical care consisted of Prilosec prescription medication. Notable improvement in the patient's symptoms was observed within 4 visits and total resolution of symptoms within three months of care.

Table 10. Children under chiropractic care presenting with a medically-diagnosed syndrome.

Table 11 Children presenting for chiropractic care with tic disorder.

Reference	Age/Sex	Chiropractic Care	Clinical Commentary
Alcantara et al. ²¹⁵	6-yr-old female	Gonstead Technique and Toggle Recoil	The patient was medically diagnosed with “transient motor tic disorder” of 6 months duration. She presented with repetitive eye blinking and rolling of the eyes in multiple directions every 3 to 5 seconds, bilateral shoulder shrugging and arching back of the head and neck with an open mouth. Optometrist and ophthalmologist examinations were unremarkable, including contrast MRI of the brain. Following 6 visits over a period of 5 weeks, the patient’s tic disorder resolved. The patient returned for care 2 ½ months later with complaints of eye blinking and rolling following an ice-skating fall. The patient was cared for similarly with resolution of her tic disorder.
McReynolds ²¹⁶	A 7-year-old male	Diversified Technique and Activator Methods	The patient sought chiropractic care for neurological tics described as head jerking, grunting, and eye blinking and clearing of the throat. Four months of care (i.e., set at 1 visit per month) resulted in no improvements. Activator Methods followed by Diversified Technique again resulted in unsatisfactory results. Using the Activator instrument to adjust only Atlas yielded positive noticeable improvements in the patient. The improvements included dramatic reduction in frequency and intensity of the neurological tics, which later progressed to complete resolution.
Alcantara and Adamek ²¹⁷	A 11-yr-old female	Diversified and chiropractic cranial therapy	The patient presented with uncontrollable tremors of both arms and right leg. Conversion disorder was diagnosed following negative medical examination for an organic etiology. Prior to institutionalization, her parents requested a “second opinion” from a clinical psychologist that eventually led to chiropractic referral. Following 12 chiropractic visits, the patient’s symptoms resolved. Long-term follow-up revealed continued resolution of the symptoms of tremors.
Drobbin ²¹⁸	A 7-year-old female	Thompson Technique for analysis and Diversified Technique for	The patient’s motor tics began at age 5 years and progressively worsened over time. Complete resolution of the patient’s tics was achieved after 3 chiropractic visits.

		delivery of spinal adjustments.	
Shreeve and Momplaisir ²¹⁹	An 8-year-old male	Grostatic Technique	The patient's tics began at age 5 years of age consisting of head nodding and twisting of the head. The patient received care over a 7-month period consisting of 12 visits with spinal adjustments twice at the atlas. Complete resolution of the tic disorder was observed at 1-year follow-up.

Table 11 Children presenting for chiropractic care with tic disorder.

Table 12. Chiropractic care of children presenting with torticollis

Reference	Age/Sex	Chiropractic Care	Clinical Commentary
Stone-McCoy ²²¹	A 4-month-old female	Webster Toggle Headpiece and Activator Methods	Previous physical therapy, cranial-sacral therapy and myofascial release therapy resulted in limited improvement. On the 5 th chiropractic visit, the patient exhibited improved cervical rotation, reduced head tilt as well as increased flexion of the left arm. On the 9 th visit, the patient's condition was continuing to show improvement.
Alcantara et al. ²²²	A 10-yr-old male	Torque Release Technique along with adjunctive therapy (i.e., heat, interferential and proprioceptive-neuro-facilitation, icing)	The patient presented with torticollis and complaints of neck pain as a result of muscle spasms in the cervical spine. Medical care was ineffective. The patient was cared for at a frequency of 3 times per week for 4 weeks. Following 12 visits, the patient was pain-free with improved posture and full range of motion in the cervical spine
Siegenthaler ²²³	23-month-old male	Diversified Technique with massage and stretching of the cervical spine	The patient presented for care with torticollis (noticeable at 7 months of age) and abnormal fixation of the right eye (noticeable at 18 months of age). Medical examination ruled out neoplasms of the cervical spine or posterior fossa. The orthopedist sent the baby for chiropractic evaluation and treatment. Chiropractic care consisted of spinal manipulative therapy of the cervical spine along with massage and stretching of the neck muscles. Within a period of 4 weeks consisting of 3 visits, the patient's torticollis nearly resolved and the abnormal fixation of the right eye was no longer apparent. No relapse was observed at follow-up consultation.
Brousseau ²²⁴	A 31-month-old male	Described as gentle soft tissue and cervical and pelvic joint mobilization	The patient presented with acquired torticollis of possible traumatic origin. The patient attended a total of 6 visits over a three-week period. Complete resolution of the infant's torticollis resulted.

Table 12. Chiropractic care of children presenting with torticollis