

# JCCCP

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## JOURNAL OF CLINICAL CHIROPRACTIC PEDIATRICS



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# JCCP JOURNAL OF CLINICAL CHIROPRACTIC PEDIATRICS

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# JCCP JOURNAL OF CLINICAL CHIROPRACTIC PEDIATRICS

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# Editorial

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This issue of *JCCP* includes a series of case reports spanning the neonate to the active teenager, as well as a commentary on nutritional factors affecting women and the very important issue of postpartum depression.

Case reports from clinicians in practice are important to the literature as they help to build an infrastructure of knowledge from which research protocols may be devised and developed as academicians and researchers conduct larger scale studies. Case reports also provide the field practitioner with details of the many different aspects of the “real” patient who presents in their office, ranging from history and physical exam findings to psychosocial aspects and concomitant care.

Another offering to the field practitioner by Miller and Green, with data collection and large scale analysis in mind, is a one page Questionnaire for Unexplainable Infant Crying (QUIC), a short and easily administered instrument presented as a new tool “to assess infant irritability, parental distress, consolability and any improvement over time in a clinical setting and to calculate concurrent validity with the daily diary.”

In the current healthcare climate demanding documentation of evidence-based practices, data collection and accountability are essential. Data collection is the process of collecting and recording data for a self evaluation or improvement of a therapeutic protocol. There are several data collection techniques including observation, interview and written questionnaires.

Observation is the cornerstone of any good clinician’s intake process. Interviewing, likewise, is an important technique for research data collection. Written questionnaires are less expensive compared to other procedures and the collected information is more trustworthy because it’s not influenced by the examiner and is easily accessible.

Questionnaires are an inexpensive way to gather data from a potentially large number of respondents. Often they are the only feasible way to poll a large enough sampling to allow statistical analysis of the results. The technique of using a questionnaire is a multi-stage process beginning with definition of the aspects to be examined and ending with interpretation of the results. Although a potentially inexpensive method of gathering information, the questionnaire requires expensive design time and interpretation.

This is where practitioners, whose resources are their patient populations, and the researchers, who have the skills to provide the design, collate and statistically analyze the data, can join hands to gather and analyze data that serves to build an evidence based foundation to support chiropractic care for the pediatric population.



Sharon A. Vallone, D.C., F.I.C.C.P.  
Co-Editor





# QUIC: Initial Validation of an Instrument to Measure Infant Crying

Joyce Miller, DC, FACO, FCC, FEAC(Peds) and Amanda Green, DC, MSc

## ABSTRACT

**Purpose:** In an evidence-based climate, clinicians seek to track outcomes during the care of infants with crying and sleeping problems. The 24 hour behavior diary is the most widely established and validated method of recording infant behaviors. However, it is time-consuming for the parents to complete and for the clinician to analyse. A one page questionnaire that accurately assesses the infant's patterns is a useful tool for pediatric clinicians and researchers. The Questionnaire for Unexplainable Infant Crying (QUIC) is a short and easily administered one page questionnaire for the assessment of infant irritability, parental distress, consolability and any improvement over time. The objective of this study was to present a new tool to assess these issues in a clinical setting and to calculate concurrent validity with the daily diary.

**Methods:** Parents of 30 excessively crying infants who presented consecutively were given a 7 day 24 hour behaviour diary to complete. The infants received chiropractic treatment and on the 7th day they were given the QUIC to complete. Pearson's correlation coefficient was used to assess concurrent validity between the QUIC form and the daily diary.

**Results:** Concurrent validity was found between the daily diary and the QUIC form in the domains of parental perceptions of the amount of infant irritability, parent distress levels, total crying and parental perceptions of consolability and changes in night-time crying.

**Conclusion:** This was initial step toward formal validation of the QUIC form which may be a useful instrument for pediatric practice and for large-scale survey studies.

## Introduction

There are no practical validated outcome instruments for use in clinical care of the crying infant. In an evidence-based practice, clinicians are expected to provide evidence that their treatment provides benefits to the patient. The validation of a questionnaire for unexplained infant crying may provide the clinician with a quick and easy way to document the outcomes of treatment of the crying baby.

There are varied measures of persistent crying complaints in the literature with 24 hour behavior diaries, parental recall, vocalisation recordings, questionnaires, observations, interviews and polygraph recordings being used to quantify the problem. The most commonly accepted and used measure is the 24 hour behavior diary as it is inexpensive and capable of being used to observe large numbers of infants over long periods of time. The diary's validity in measuring infant fussing and crying has been demonstrated in previous studies.<sup>1,2</sup>

Although the 24 hour behavior diary is an accurate representation of the infant's behaviour, there is a downside. The diary is time-consuming for the parents to complete, resulting in substantial sample attrition. For example, previous studies have resulted in selective data loss of particular subgroups in the community such as ethnic minorities, large families and low educational and socioeconomic status groups.<sup>3,4</sup> In addition, the diaries are time consuming for the clinician or researcher to explain to the parents initially and to analyse after completion. Two studies had 17 drop outs in their colic trial and 18% of mothers failed to complete diaries, respectively, stating the dropouts were due the demands of diary keeping.<sup>5,6</sup> This creates a problem of sample attrition for researchers as well as biased samples with participants tending to be mature, well educated and in stable relationships, with large families or families of lower socioeconomic groups and ethnic minorities frequently unrepresented.<sup>1,4</sup>

If a one page questionnaire could accurately assess the impact of the infant's persistent crying, it would potentially be a valuable tool for any pediatric clinician or researcher. The simple Questionnaire for Unexplained Infant Crying (QUIC) (*Figure 1*) can be completed by the parent in a matter of seconds, the clinician does not need to be present; there is more compliance than with a diary as it can be completed at a routine patient visit and the results can

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immediately be observed and compared over time.

There are two fuss and crying questionnaires (a fussiness rating scale and a crying patterns questionnaire (CPQ)) but neither have been validated.<sup>7,8</sup> Most studies utilise the 24 hour behavior diary instead. While the diary method is likely to be the most accurate for documenting infant behavior, there is also a need for a questionnaire that quickly allows the clinician to gauge the nature of the infant's sleep and crying behavior from the parent's perspective.

For any measure to be useful in a clinical or research setting it has to be reliable, valid and responsive to clinically significant change.<sup>9</sup> The QUIC was designed at the Anglo-European College of Chiropractic (AECC) and has been in use at the teaching clinic since July 2006. The QUIC prospectively assesses an infant's crying and sleep behavior and the effect that has on the parent. Item selection was guided by reviewing the literature, and in particular by the outcomes recorded in the 24 hour behavior diary. In infants it is essential to know how much they are crying, whether they are easy to console, how restfully they are sleeping and the level of distress this is causing the parent. The QUIC is given to parents prior to any treatment and at the end of the infant's therapeutic trial of chiropractic care so the final measure may reflect any improvement. The QUIC attributes were represented by a global scale based on the validated Bournemouth Questionnaire<sup>9</sup> thereby removing the need for long-form multiple items. The wording of each item is intended to be clear and unambiguous with a 10-point numerical rating scale.

The main objective of this study was to determine the concurrent validity of the QUIC against any change in recordings on the crying diary, which is considered the "gold standard" in documentation of infant behavior.

### Methodology

This was designed as a validation study. The QUIC was used to discover the parent's perception of their infant's crying and sleep habits over the current day and previous week and the effect the infant's behavior has had on them. The validated 24 hour behavior diary (*Figure 2*) was used as the established method of measuring infant crying and sleep patterns to ascertain the concurrent validity of the QUIC.

All infants presenting to two clinics, a chiropractic teaching clinic in Bournemouth, England and a private chiropractic clinic in Tamworth, England in April 2008 who fulfilled the inclusion and exclusion criteria were in-

cluded to participate in the study. All parents gave informed consent and all subjects were identified only by number. The study was approved by the Subcommittee on Ethics at AECC.

The parents were given the 24 hour behavior diary to complete daily beginning on the day they initially presented and finishing 7 days later. The parents were given the QUIC (Day 1) on presentation and again 7 days after their initial presentation (QUIC, end of treatment; *Figure 3*).

The 24 hour behavior diary and QUIC for each infant were collated for data analysis. All the raw data were transcribed to a Microsoft Excel database. The continuous data were analyzed using Stat view. Pearson's product-moment correlation was used to correlate the total crying, the total daily crying (7am to 7pm) and the total night time crying (7pm to 7am) for days 1-7 in the diary with questions 1, 2 and 4 of the QUIC. The total sleep, the total daily sleep and the total night time sleep for days 1-7 in the diary were correlated with question 3 of the QUIC. The differences in total crying, daytime crying and night-time crying from day 1 to day 7 and the differences in total sleep, daytime sleep and night-time sleep from day 1 to day 7 were correlated with question 5 of the QUIC.

### Results

Thirty Infants (14 girls, 16 boys) aged from 2 to 19 weeks old with a mean age of 7.5 weeks (SD + 4.075) were involved in the study. The mean birth weight of the infants was 7 lbs 10 oz (3,460 grams) and their mean gestational age at birth was 39 weeks. Seventeen of the infants were first-born; eleven were second, one third and one the fourth child of the family. Mean total crying steadily decreased throughout the study, a decrease of 1 hour 43 minutes by day 7. Mean total sleep increased by 1 hour 7 minutes from day 1 to day 7 of the study. There was a sudden peak of 37 minutes in mean daytime sleep on day 2 of the study; all infants had their first chiropractic treatment on day 1. This peak was associated with a decrease of 31 minutes in mean night-time sleep on the same day. However by day 7 the infant's sleep patterns had changed for the better with mean night-time sleep increasing by 29 minutes from day 1 to day 7 and mean daytime sleep decreasing by 4 minutes.

The correlation calculations between questions 1, 2 and 4 of the QUIC and the total time crying over 24 hours, daytime crying (7am to 7pm) and night-time crying (7pm to 7am) during days 1 to 7 can be seen in *Table 1*. The correlations indicate that there is concurrent validity between the QUIC and the crying diary on all questions regarding

Figure 1.

**QUIC form**

**Day 1**

**Questionnaire for Unexplained Infant Crying**

Date \_\_\_\_\_

On average (during the past week), please rate the daily **AMOUNT** of irritable behavior in your child.

<b>1 - Rare</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10 - Much of the time</b>

On average (during the past week), please rate how **DISTRESSED** you feel with your child's irritable behavior.

<b>1 - Not at all</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10 - Extremely</b>

On average (during the past week), please rate how restfully your baby **SLEEPS**.

<b>1 - Sleeps deeply and restfully most of the time</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10 - Restless, difficult to settle or stay asleep or does not sleep deeply</b>

On average (during the past week), please rate how easy is it to **CONSOLE** your child when (s)he is crying.

<b>1 - Very easy and quick to console</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10 - Difficult or cannot be consoled</b>

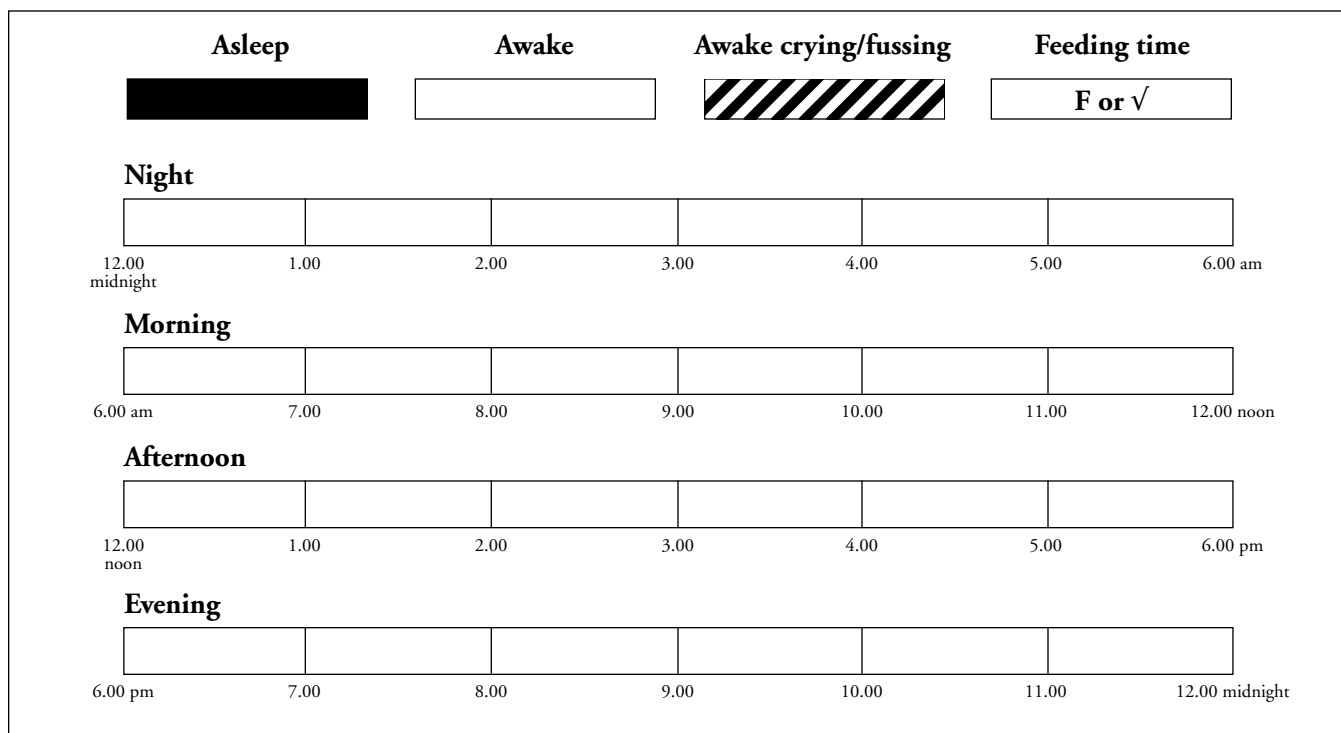
The birth date of my child is \_\_\_\_\_

**Office Use:**

**Type of treatment:** \_\_\_\_\_

**File No.** \_\_\_\_\_ **Study No.** \_\_\_\_\_ **J Miller@AECC 2009 / Tan**

Figure 2. Crying Diary



crying, infant consoling, parental stress and improvement in the infant’s crying. Only total sleep was significantly correlated with the parent’s distress level.

**Discussion**

This aim of this study was to validate a more practical outcome measure for recording infant crying and sleep problems than the 24 hour behaviour diary.

Good concurrent validity was found between parental perceptions of the amount of irritability (QUIC question 1) and parental distress (QUIC question 2) and the 24 hour behavior diary measures of total crying and total night-time crying during the week. A statistically significant concurrent validity was found between total crying and parental perceptions of consolability (QUIC question 4) and parental distress (question 2). These findings are supported by research that discovered a significant relationship between parental stress (and even depression) and persistent infant crying.<sup>10</sup>

A good correlation was found between parental improvement scores (QUIC question 4) and changes in night-time crying over the week. This relationship is also noted in the literature with a decrease in night-time crying being a marker for a better parent-infant relationship.<sup>11</sup>

There was good concurrent validity between the QUIC and the crying diary. However, there were differences depending on the question. The finding of moderate concurrent validity (statistically significant) with question 1 may be due to parents taking into account the quality of distress in their infant’s cry. Parents in this study rated their infant’s irritability higher on the QUIC than the total minutes of crying recorded in the 24 hour behaviour diary. A diary measure can only record the time period of crying or fussing not the quality or the character of the cry. An hour of fussing that is more to do with grumpiness or general disquiet is not the same as an hour of high pitched screaming due to pain, but in the diary it will be marked the same. Parents may take these differences into consideration when answering this question and include how distressed their infant may be during normal activities such as dressing, nappy changes and feeding, distress which may be demonstrated non-verbally.

Significant reductions in mean infant crying and increases in mean infant sleep were shown from day 1 to day 7 in this study. The infant’s sleep redistributed throughout the week to less day time and more night time sleep, a parental preference, no doubt. The change in sleep pattern may have contributed to the parent’s perception of the success of the treatment but this was mostly based upon the

Figure 3.

## QUIC form

### Questionnaire for Unexplained Infant Crying

Date \_\_\_\_\_

Release from Care Visit No. \_\_\_\_\_

On average (during the past week), please rate the daily AMOUNT of irritable behavior in your child.

1 - Rare	2	3	4	5	6	7	8	9	10 - Much of the time

On average (during the past week), please rate how DISTRESSED you feel with your child's irritable behavior.

1 - Not at all	2	3	4	5	6	7	8	9	10 - Extremely

On average (during the past week), please rate the improvement (if any) your child has shown with chiropractic treatment.

1 - Very easy and quick to console	2	3	4	5	6	7	8	9	10 - Difficult or cannot be consoled

On average (during the past week), please rate the improvement (if any) your child has shown with chiropractic treatment.

1 - None at all	2	3	4	5	6	7	8	9	10 - Completely better

The birth date of my child is \_\_\_\_\_

Office Use:

Type of treatment: \_\_\_\_\_

File No. \_\_\_\_\_ Study No. \_\_\_\_\_ J Miller@AECC 2009 / Tan

**Table 1: Correlations between crying diary and questions 1 to 4 on the QUIC†**

	PQ1 <sup>a</sup> (r)	PQ2 <sup>b</sup> (r)	PQ3 <sup>c</sup> (r)	PQ4 <sup>d</sup> (r)
Total crying	0.580**	0.570**		0.376*
Total sleep		-0.374*	-0.100	
Total crying at night	0.593**	0.475*	0.330	
Total sleep in the day			-0.122	
Total sleep at night			0.047	

r = Pearson's correlation      \*\* p < 0.01 \* p < 0.05

PQ1<sup>a</sup> Please rate the daily amount of irritable behaviour in your child.

PQ2<sup>b</sup> Please rate how distressed you feel with your child's irritable behavior.

PQ3<sup>c</sup> Please rate how restfully your baby sleeps.

PQ4<sup>d</sup> Please rate how easy is it to console your child when (s)he is crying.

†QUIC is the questionnaire for unexplained infant crying

improvement in the infant's crying. This is corroborated in the literature that it is the crying patterns which parents find most distressful.<sup>11</sup>

Limitations: The choice of the 24 hour behavior diary as the external criteria to evaluate the validity of the QUIC was based on it being the accepted, established and validated "gold standard" method of recording cry and sleep patterns in infants. However the QUIC and the 24 hour behaviour diary are completely different outcome measures and there have been some issues in correlating them. As such, there are some discrepancies between crying duration verses the quality and character of crying and the duration of sleep verses the restfulness and ease of settling to sleep. Also, the parent's response to a single question of being better or not may be biased by their sense of what the practitioner wanted to hear or what they thought the answer ought to be. It also may have been based on a lowering of stress levels relative to their infant having on-going care rather than actual improvement. However, this argument is less likely considering the significant decrease in mean crying over the week suggesting it is an additional rather than an alternative factor in parental improvement scores. Further, we did not analyze the instrument to determine whether any questions could be eliminated and this next step should be taken as well as undertaking reliability studies. This was also a relatively small sample size and larger samples should be studied.

Finally, the QUIC should be completed in the reception of any clinic with complete confidentiality explained to the parents so the clinician is blinded to the results removing any bias caused by parents wishing to please the practitioner.

### Conclusions

The QUIC is a short and easy-to-administer instrument, providing valid information about infant crying. It provides additional insights into how parents perceive the infant's improvement and provides valid information regarding infant night crying patterns. As such it is a useful tool for paediatric practice and a useful additional instrument for large-scale survey studies where the crying diary is impractical to use.

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# Nutritional Factors Affecting Postpartum Depression

Lia M. Nightingale, PhD

## ABSTRACT

Pregnancy and lactation represent a period of substantial physiological changes for the mother and increased nutritional requirements to meet these adjustments. A number of nutritional depletions occur during pregnancy. Serum concentrations of iron and folate take months before they normalize to pre-pregnancy levels. Additionally, many micronutrients required during pregnancy interfere with each other, making absorption difficult. Postpartum depression is the primary complication of childbirth, possibly caused by several nutritional and non-nutritional factors. The current review highlights the impact nutrition may have on the etiology of this debilitating disorder, most notably on prevention of inflammation and maintenance of a healthy central nervous system. The most notable nutritional deficiencies associated with postpartum depression include omega-3 fatty acids, folate, iron, and zinc; however, supplementation trials for prevention of postpartum depression are severely lacking. Practical recommendations are given to minimize micronutrient interference and reduce the risk of postpartum depression.

**Keywords:** postpartum depression, nutrition, diet, folate, essential fatty acids, iron, zinc

## Introduction

Depression is the second leading cause of disability for those of reproductive age.<sup>1</sup> Although all forms of depression are devastating, postpartum depression (PPD) has long-lasting consequences for all family members involved. Postpartum depression is the most common complication of childbirth, defined as having major or minor depressive episodes that occur within 12 months after delivery.<sup>2,3</sup> Postpartum depression has been associated with impaired mother-child interactions, poorer child development, and more violent behavior in children with mothers displaying PPD.<sup>4-6</sup>

Pregnancy is a time of increased nutritional requirements to support fetal growth and development. There are several lines of thought concerning the cause of PPD, including the link between nutritional intake and risk of depression. Therefore, the goal of this review is to examine maternal depletion of nutrients, assess whether these nutritional factors may play a role in PPD, and summarize simple recommendations to implement in practice.

## Prevalence

According to the Agency for Healthcare Research and Quality (AHRQ), PPD prevalence peaks around 12 weeks post delivery with 12.9% of new mothers having bouts of

major and minor depression.<sup>3</sup> The same study estimated that up to 19.2% of new mothers may have major or minor depression in the first 3 months postpartum, with 7.1% having a major depressive episode. Interestingly, international prevalence rates of PPD are higher than those reported in the United States. Published rates include 27.6% in Japan,<sup>7</sup> 34.7% in South Africa,<sup>8</sup> and 40% in Costa Rica.<sup>9</sup>

## Screening

Nearly 50% of mothers with this affective disorder are not diagnosed;<sup>10</sup> thus, screening is essential to diagnosis. Many self-reporting tools have been designed and evaluated to identify PPD including the Postpartum Depression Screening Scale (PDSS), Edinburgh Postpartum Depression Scale (EPDS), 9-item Patient Health Questionnaire (PHQ-9), and 2-item Patient Health Questionnaire (PHQ-2).

The first screening tool developed was the PDSS, a 35 question survey each assessed on a 5 point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree.<sup>11</sup> A cutoff score of 80 out of a possible 175 points indicates a positive result for PPD. Using the cutoff of 80, the PDSS has a sensitivity of 94%, indicating a high rate of identifying true positive cases, and a specificity of 98%, suggesting a very low false-positive rate identified by this method.<sup>12</sup> These results validate the use of the PDSS as a highly selective diagnostic tool.

The most widely studied diagnostic tool for PPD is the

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EPDS, a 10 question survey formatted on a Likert scale. Although the EPDS is similar to the PDSS, the questions posed on the EPDS are better suited to assess depression in general. Cox et al. calculated the sensitivity and specificity as 86% and 78%, respectively.<sup>13</sup> Although, the sensitivity and specificity are still high, the EPDS identified less true positives and more false positives than the PDSS making the PDSS a more rigorous diagnostic tool.

More recently, the PHQ-9 has been used to diagnose PPD. The PHQ-9 is a 9-item questionnaire constructed on a Likert scale. In a large trial containing 6,000 patients at 8 primary care facilities and 7 obstetrics/gynecology clinics, the PHQ-9 was found to have a sensitivity and specificity of 88%.<sup>14</sup>

The PHQ-2 is a 2-item screening tool using the first 2 questions from the PHQ-9, but instead of a Likert scale, yes/no responses are used. The PHQ-2 questionnaire was found to have a sensitivity of 96% and specificity of 57-78%.<sup>15,16</sup> Adding a help question asking if “this is something with which you would like help,” actually increased specificity to 94%.<sup>16</sup> Similarly, changing the yes/no answer to a Likert scale improved sensitivity/specificity from 100%/44% to 84%/79%.<sup>17</sup>

There is no consensus as to whether these diagnostic tools should be used at postpartum or well-child visits. Postpartum visits to the obstetrician occur at 6 weeks postpartum, prior to the peak prevalence rate for PPD. Therefore, well-child visits seem timelier for PPD diagnosis; although more research is needed in this area, as well as possibly more training for pediatricians. This lack of standardized screening of mothers represents a unique opportunity for the chiropractic community to intervene, as many women visit their chiropractor more frequently than their obstetrician or general practitioner.

### Nutritional Depletions during Pregnancy

Maternal nutritional status not only profoundly affects pregnancy outcome, but may influence pathology of PPD. Nutrient requirements are greatly increased during pregnancy and lactation. Twin pregnancies require even higher daily caloric and micronutrient intakes to support growth of multiple fetuses. Contrary to earlier studies, the fetus does not have parasitic activity and does not leech nutrients from the mother under most circumstances. There are a few exceptions to this concept, such as iron, omega-3 fatty acids, and calcium. In general, plasma lipid concentrations increase, while water-soluble components decrease throughout the course of the pregnancy.

For example, serum triglyceride concentrations increase 20% by the end of the first trimester and nearly triple by term.<sup>18</sup>

Protein metabolism also changes throughout pregnancy. Women in the later stages of pregnancy have been found to retain nearly 4 times as much nitrogen compared to their nonpregnant counterparts. Nitrogen excretion and plasma amino acid concentrations decrease in late pregnancy, favoring nitrogen conservation and enhanced placental uptake of nitrogen.<sup>19</sup> There is no evidence to suggest that protein is stored early in the pregnancy for use later in gestation; as a result, dietary protein requirements are greatly increased to support fetal demand during late pregnancy.<sup>20</sup>

Essential fatty acids are lipids that cannot be made by the body and are only acquired through dietary intervention. Essential fatty acids include omega-3 (n-3) and omega-6 (n-6) fatty acids. The most important essential fatty acid for fetal growth and brain development is the omega-3 docosahexaenoic acid (DHA), found in high concentrations in fatty, coldwater fish, fish oils, and algae. The fetus accumulates 67 mg/day of DHA during the third trimester.<sup>21</sup> If dietary intake of DHA is insufficient the fetus takes preference, stealing the essential fatty acid from storage in the brain and retina of the mother. Therefore, n-3 fatty acid intake may have a profound impact on PPD, as will be discussed in length later.

Published guidelines for ‘normal’ or ‘deficient’ serum vitamin or mineral levels during pregnancy do not exist. Longitudinal studies have shown that serum concentrations of many vitamins and minerals decrease throughout pregnancy, though most normalize to nonpregnant status following delivery including: zinc, vitamin A, vitamin B<sub>6</sub>, Vitamin B<sub>12</sub>, and thiamin.<sup>22-24</sup> During pregnancy, plasma volume increases by 40-50% in singletons and up to 70% in multiple pregnancies; while only a 20-25% boost in red blood cell synthesis was found in both singletons and multiples.<sup>25,26</sup> This hemodilution effect may impact plasma micronutrient concentrations, especially iron. Maternal iron stores are depleted during pregnancy and remain low for months following delivery.<sup>27</sup> Iron is required for fetal growth, placenta formation, increased red blood cell synthesis, and blood loss during delivery. Iron deficiency anemia is associated with poor maternal and neonate outcomes.<sup>28</sup> Iron is also an important cofactor for many enzymes; thus, iron deficiency may impact risk of PPD.

Calcium requirements during pregnancy are the same as nonpregnant women (1000 mg/day), even though the fetus

accumulates nearly 30 g of calcium in the third trimester or ~300 mg/day.<sup>26</sup> Although, intestinal absorption of calcium doubles early in gestation, urinary calcium excretion rate nearly parallels the absorptive rate.<sup>29</sup> If nutritional requirements are not met through dietary means, then calcium mobilization from bone occurs. It has been estimated that a woman's bone mineral density decreases 3-10% during pregnancy and lactation, which is recouped within months of weaning.<sup>30</sup> Interestingly, supplementation with 1,500 mg/day of calcium in pregnant women with low dietary calcium intakes actually increased bone loss, as indicated by diminished bone mineral content, bone area, and bone mineral density of the hip, and increased biomarkers of bone mobilization through 12 months lactation compared to pregnant women taking a placebo.<sup>31</sup> Hence, calcium supplementation alone may not be sufficient to prevent the decrease in bone mineral content associated with pregnancy. Vitamin D has been shown to increase intestinal calcium absorption and decrease urinary calcium excretion through synthesis of specific calcium-binding proteins.<sup>29</sup> Recent research has suggested that vitamin D deficiency occurs in 35.8% of mothers and 58.0% of infants. Furthermore, 30% of pregnant women taking prenatal supplements were still deficient in vitamin D.<sup>32</sup> Additional studies are warranted to determine if the addition of vitamin D supplementation during pregnancy affects bone mineral content or biomarkers of bone mobilization.

Both plasma and erythrocyte folate decline throughout pregnancy and take at least 6 months postpartum to normalize to prepregnancy levels.<sup>24-33</sup> Folate requirement is increased from 400 µg/day to 600 µg/day during pregnancy and lactation, as folate is essential for rapidly proliferating cells, DNA formation, and synthesis and secretion of breast milk.<sup>34</sup> Insufficient folate intake prepartum has been associated with neural tube defects, preterm birth, and small for gestational age infants.<sup>35</sup> Folic acid fortification of enriched grain products began in the United States in 1998 as a mechanism to prevent neural tube defects. Following fortification, rates of neural tube defects decreased by 26%.<sup>36</sup> While this difference is significant, data from the National Health and Nutrition Examination Survey (NHANES) shows that serum folate concentrations in women of childbearing age increased 65% immediately following fortification, but has since declined 16% post-fortification.<sup>37</sup> Folic acid intake from fortified foods was found to be a mere 128 µg/day in women of childbearing age, according to the 2001-2002 NHANES data. Furthermore, only 40% of women of childbearing age consumed at least 400 µg/day of folic acid or folate from dietary and supplemental sources.<sup>38</sup> Therefore, folate represents a public

health concern as most women do not consume adequate quantities of this critical micronutrient, maternal depletion during pregnancy is evident, and insufficient levels have profound effects on the mother and fetus.

### Nutrient Interactions

Many micronutrients interact with each other, often decreasing absorption of nutrients using similar absorptive mechanisms. In general, divalent minerals (those with a 2+ charge) will interact with each other. Supplemental doses are more likely to cause these interactions than dietary sources, as supplements contain higher concentrations of micronutrients than normally found in the diet. As stated previously, calcium requires vitamin D for absorption, but calcium can decrease iron, zinc, magnesium, and phosphorus absorption;<sup>39,40</sup> thus, calcium and iron should not be taken together. Hallberg recommends that when calcium supplements are necessary, they should be taken separately from a meal.<sup>39</sup> The most common source of calcium found in supplements is as calcium carbonate, which has been known to require an acidic environment, such as with a meal, in order to be properly absorbed.<sup>41</sup> Other dietary and supplemental forms of calcium (citrate, malate, lactate, etc.) can be easily absorbed on an empty stomach.

Iron absorption is enhanced when taken with vitamin C, but only with meals.<sup>40</sup> Thus, addition of citrus fruits or fruit juices may increase absorption of supplemental iron, while dairy products or calcium-fortified juices may inhibit iron absorption. Iron also interferes with intestinal absorption of copper and zinc.<sup>42</sup> The Institute of Medicine (IOM) recommends an additional 20-25 mg/day of zinc during pregnancy when ≥30 mg/day of supplemental iron is taken to compensate for these interactions.<sup>43</sup> Folic acid and zinc also compete for absorption at the small intestinal membrane.<sup>44-46</sup>

The majority of these micronutrients are found together in prenatal multivitamins and can compete for absorption or decrease availability of others. Ideally, iron and folate supplements can be taken together shortly after a meal containing vitamin C to limit dietary interactions, while zinc should be taken separately on an empty stomach. Calcium supplements should be taken separate from iron with a meal if taken as calcium carbonate, while all other calcium salts can be taken on an empty stomach.<sup>41</sup> Calcium absorption is absorbed at a maximum dose of 500 mg/serving.<sup>41</sup> In general, micronutrients are absorbed at a higher rate when consumed in smaller doses spaced throughout the day, such as with eating a healthy, well balanced diet.

### Birth Spacing

Although many micronutrients normalize shortly after delivery, several maternal depletions remain for months. For this reason, it is hypothesized that having short intervals between pregnancies does not allow the mother to adequately replenish her nutrient stores, putting herself and the fetus at risk for severe nutritional deficiencies and adverse outcomes. Birth intervals include the period of time between weaning of one child and conception of the next. Several recent meta-analyses have correlated a birth spacing <18-24 months with an increased risk of preterm labor, low birth weight, and an infant that is small for gestational age, although the risk was mitigated with folic acid supplementation.<sup>44,45</sup> Currently, no evidence exists on the effect of birth spacing on rates of PPD. Although we could hypothesize that nutrient deficiencies, seen in short birth intervals, may lead to PPD.

### Nutrients of Concern in Postpartum Depression

Maternal nutritional depletions caused by pregnancy and lactation may play a large role in the development of PPD, though very few single nutrients have been studied related to this disorder. The most widely studied nutrient deficiencies and their potential impact on PPD includes: n-3 and n-6 essential fatty acids, folate, and the trace minerals (iron, zinc, and selenium). The following summarizes the current state of evidence in relation to PPD.

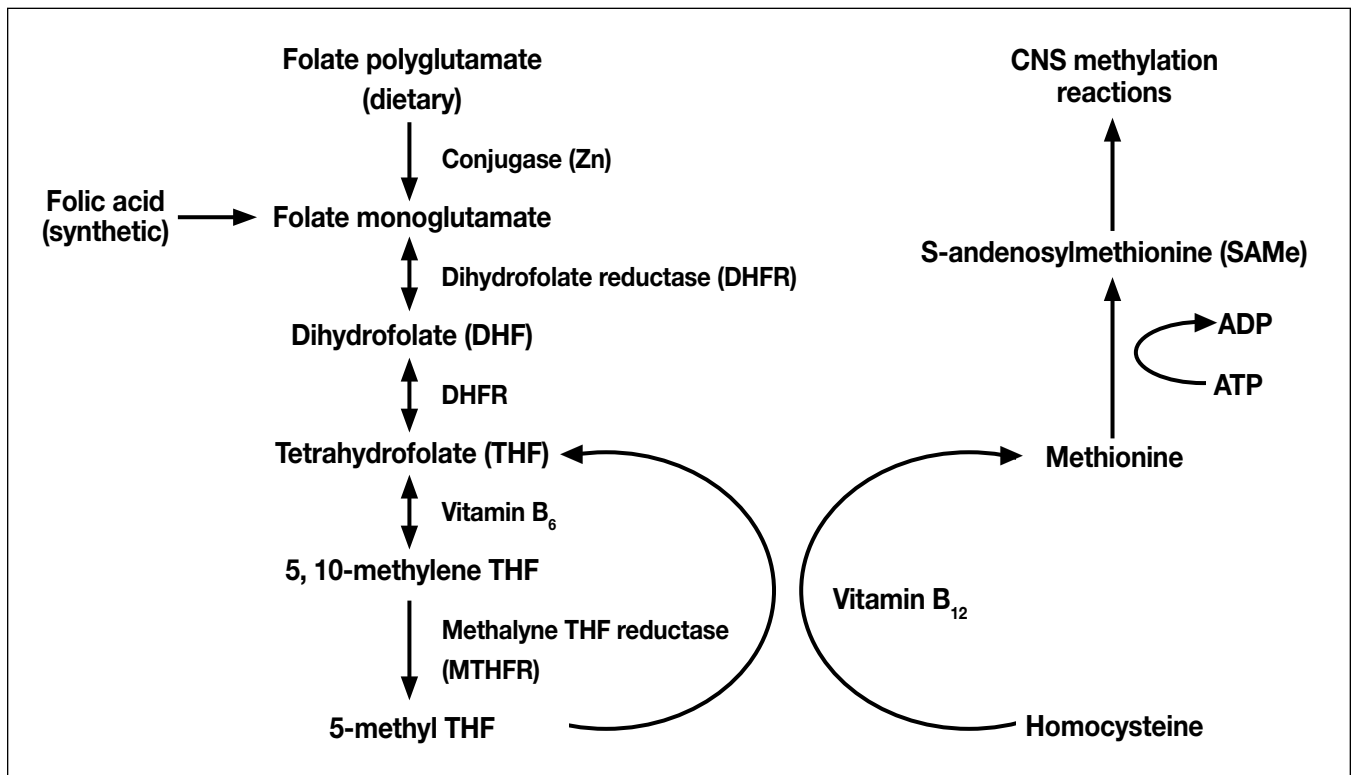
### Essential Fatty Acids

The most widely studied nutrients in relation to PPD are the essential fatty acids. Linoleic acid (18:2n-6) is the most widely consumed n-6 fatty acid found in vegetable oils and is the precursor for the bioactive arachidonic acid (ARA; 20:4n-6); while  $\alpha$ -linolenic acid (18:3n-3) is the most prevalent dietary n-3 found in seeds and nuts. Alpha-linolenic acid must be converted to eicosapentaenoic acid (EPA; 20:5n-3) and docosahexaenoic acid (DHA; 22:6n-3) using  $\Delta$ -5 desaturase (D5D) for use in the body; while ARA is made from linoleic acid using  $\Delta$ -6 desaturase (D6D).<sup>46</sup> Both D6D and D5D activities have been shown to be modulated by dietary and lifestyle factors. For example, both D5D and D6D are inhibited during polyunsaturated fatty acid consumption;<sup>47,48</sup> while saturated fat induced D6D and down regulated D5D.<sup>49</sup> Poor diet and sedentary lifestyle combine to influence rates of obesity and inflammation. Interestingly, liver D6D and D5D activities were diminished 87% and 66%, respectively, in obese patients.<sup>50</sup> As a result, production of the bioactive ARA, EPA, and DHA were reduced in obese individuals. A recent pilot study determined that women with a single nucleotide

polymorphism in the FADS2 gene encoding D6D had lower activity levels, higher plasma linoleic acid concentrations, and were at risk for PPD.<sup>51</sup>

ARA, EPA, and DHA are required for cell signaling and regulation of the fluidity of cell membranes, as they are highly concentrated in phospholipids.<sup>52</sup> Approximately 14% and 17% of fatty acids found in the human brain are n-3 and n-6, respectively, predominantly as DHA and ARA.<sup>53</sup> Impaired membrane fluidity can affect serotonin, epinephrine, and norepinephrine signaling and metabolism, thus influencing mood and behavior.<sup>54,55</sup> Other signaling compounds produced directly from ARA and EPA include the eicosanoids: prostaglandins, leukotrienes, and thromboxanes. The n-6 eicosanoids produced from ARA stimulate the synthesis of proinflammatory cytokines. The n-3 fatty acids can decrease production of the n-6 eicosanoids, thus potentially decreasing inflammation by preventing cytokine synthesis.<sup>56</sup> Patients presenting with all forms of depression, including PPD, have been shown to have elevated levels of the proinflammatory cytokines interleukin (IL)-6 and tumor necrosis factor (TNF)-alpha and the inflammatory initiator nuclear factor kappa B (NF- $\kappa$ B).<sup>57</sup> Cytokines are able to access the brain and interfere with several mechanisms possibly leading to depression, including decreased serotonin production and dopamine release, increased synthesis of corticotrophin-releasing hormone (CRH), cortisol, and adrenocorticotrophic hormone (ACTH), and impaired neural plasticity.<sup>58-63</sup> Chronic stress associated with caregiving increased concentrations of IL-6 and C-reactive protein (CRP), a biomarker of inflammation.<sup>64,66</sup> New mothers often struggle with interrupted sleep patterns and sleep deprivation, which has been shown to activate NF- $\kappa$ B, thus initiating the inflammatory cascade.<sup>67-68</sup> Lastly, patients with high baseline levels of inflammation tend to be less responsive to antidepressants, which could account for the 30-50% of patients that fail to benefit from antidepressant therapy.<sup>69-72</sup> Hence, the stress associated with caring for a newborn, combined with the effects of interrupted sleep patterns causes chronic inflammation and nutritional depletions puts the mother at significant risk for developing PPD.

EPA inhibits the inflammatory response by 2 mechanisms: 1) decreased expression of TNF-alpha by preventing NF- $\kappa$ B activation and 2) competition of eicosanoid producing enzymes curbing production of inflammatory n-6 eicosanoids.<sup>73</sup> Since DHA is essential for normal brain functioning and EPA is important for diminishing inflammation, one could hypothesize that increasing dietary n-3 fatty acids would decrease risk of PPD. Patients with major

**Figure 1. The importance of folate on methylation reactions.**

depression have higher n-6:n-3 ratios and more specifically, serum concentrations of EPA, DHA, and total n-3 fatty acids are lower in depression.<sup>74-77</sup> Fish consumption and risk of PPD have resulted in mixed findings. Hibbeln found a positive correlation between seafood consumption, DHA concentration in breast milk, and reduced risk of PPD across 23 countries.<sup>78</sup> This study also determined that the risk of PPD was 50 times higher in countries with limited fish consumption. Negative trials occurred in countries where fish consumption is higher than average or PPD prevalence was extremely low in the general population.<sup>79,80</sup>

Several n-3 supplementation trials have been conducted, mostly in patients with major depression or bipolar disorder. Supplementation studies for prevention of PPD are very limited. Nearly all analyses have used pure DHA or a combination of DHA and EPA. Supplementation in this manner has not been shown to prevent or treat PPD.<sup>81-88</sup> An updated meta-analysis showed no benefit for omega-3 supplementation on overall mood disorder, but the effect of DHA and EPA were not differentiated.<sup>89</sup> Another meta-analysis of randomized controlled trials was able to separate out the effects of pure DHA, pure EPA, or combined EPA and DHA on general depression.<sup>90</sup> Results indicated that

pure EPA or supplements containing substantially more EPA than DHA were beneficial in alleviating symptoms of major depression and bipolar disorder. Due to insufficient studies using higher levels of EPA than DHA in trials for PPD, no efficacy was determined for perinatal depression.<sup>90</sup> Further studies are warranted to determine the effect of EPA supplementation prior to conception or during pregnancy on risk of PPD. Furthermore, 1 g/d of EPA has been shown to be an effective adjuvant to antidepressant therapy in resistant unipolar and bipolar depressed patients.<sup>91-94</sup> Peet and Horrobin determined that addition of low-dose EPA to standard antidepressant therapy in moderately to severely depressed patients achieved a 50% improvement compared to a paraffin placebo with minimal side effects.<sup>91</sup> Therefore, addition of EPA supplementation may be beneficial for the 30-50% of patients resistant to standard depression treatment.

## Folate

Synthetic folic acid and dietary folate are required in methyl transfer reactions throughout the body. Dietary folate is found attached to several glutamate structures, most of which must be removed prior to absorption by the intestinal zinc-dependent enzyme called conjugase.

Several factors may decrease folate absorption, including zinc deficiency, chronic alcohol consumption, and overconsumption of conjugase inhibitors commonly found in legumes, lentils, cabbage, and oranges.<sup>95</sup> Synthetic folic acid does not require digestion prior to absorption. Following absorption, folate and folic acid are eventually converted into 5-methyl tetrahydrofolate (THF) in the irreversible reaction catalyzed by methylene THF reductase (MTHFR) as shown in *Figure 1*. Homocysteine, an amino acid derivative thought to cause oxidative stress, is converted back to methionine with the aid of 5-methyl THF and vitamin B<sub>12</sub>.<sup>96</sup> Methionine is then converted into S-adenosylmethionine (SAME), the compound responsible for numerous transmethylation reactions in the body, including synthesis of membrane phospholipids, metabolism of neurotransmitters (serotonin, epinephrine, norepinephrine, and melatonin), DNA synthesis and repair, and formation of myelin.<sup>96-97</sup> Recent animal data suggests that low folate diets during pregnancy decreases synthesis of myelin basic protein in the cerebral cortex.<sup>98</sup> Thus, maternal folate depletion may have profound effects on neuronal signaling and production of neurotransmitters.

Serum folate concentrations and dietary folate intake have consistently been inversely associated with depressive symptoms.<sup>99-102</sup> A recent meta-analysis determined that low folate status was associated with a 55% increased risk of depression, regardless of whether the population was subject to mandatory folic acid fortification or the method of folate assessment (dietary intake by food frequency questionnaire vs. serum folate levels).<sup>103</sup> Low serum folate concentration combined with depressive symptoms during pregnancy was significantly correlated with shorter gestational age and lowest birth weight infants.<sup>104</sup> Folate studies related to PPD have not been conducted, but it can be hypothesized that folate depletion caused by pregnancy and inadequate folate repletion between pregnancies may increase the risk of PPD.

Folate metabolism requires the rate-limiting MTHFR enzyme, which has been shown to contain several genetic polymorphisms. The most widely studied of which is the C677T genetic variant which may contain either the normal cytosine (C) or the variant thymine (T) at the 677th nucleotide position. Three possible genotypes exist depending on which nucleotides are found in both alleles (CC, CT, or TT). The 677CC genotype retains normal MTHFR activity, the 677CT polymorph has 65% of the activity, and the 677TT variant has only 30% of the MTHFR activity; thus, daily folate requirements are increased in order to maintain normal serum folate concentrations.<sup>105</sup>

Carrying the homozygous 677TT MTHFR variant has been positively correlated with depression, schizophrenia, and bipolar disorder.<sup>106-111</sup> Therefore, a genetic component exists that, when combined with folate depletion caused by pregnancy, may exacerbate the risk of PPD in susceptible populations.

Limited studies exist for the use of folic acid supplementation alone for treatment of depression. Older trials suggest a benefit, but most use 50 times the tolerable upper intake level for folate.<sup>112-114</sup> A recent study suggests that a prenatal supplement containing folic acid was not beneficial for decreasing depressive episodes during pregnancy.<sup>115</sup> Patients with low folate status were shown to be less likely to respond to antidepressant therapy.<sup>116,117</sup> Several studies have shown an improvement on depression measures when folic acid is taken in combination with antidepressant medications.<sup>118-121</sup> Hence, improving folate status through dietary or supplemental interventions may be beneficial for decreasing depressive symptoms and is an effective adjuvant for patients not responding well to antidepressant treatment. More research is warranted to determine the effect of folate status, genetic polymorphisms, and folic acid supplementation on the risk or prevention of PPD.

### Trace Minerals

Iron is an essential component of hemoglobin in red blood cells (RBC), whose primary responsibility is to carry oxygen. Iron-dependent enzymes are found in the pathways that generate and catabolize neurotransmitters and promote myelination of white matter and the spinal cord.<sup>122</sup> Iron deficiency can lead to anemia and inefficient oxygen delivery to cells. Twelve percent of all females of childbearing age in the U.S. have iron deficiency anemia.<sup>123</sup> Maternal iron requirements are markedly increased during pregnancy due to enhanced RBC synthesis, fetal requirement, and blood loss during childbirth. An established prenatal iron deficiency coupled with increased iron requirements may further impair proper brain signaling. Maternal iron deficiency or diminished concentrations of markers of iron status, such as hemoglobin and storage ferritin, have been associated with increased risk of PPD.<sup>124-126</sup> Low ferritin concentrations detected immediately after delivery were associated with a 273% increased risk of PPD at 32 weeks postpartum.<sup>126</sup> Iron deficiency anemia associated with low hemoglobin concentrations significantly increased the risk of general depression in an older population in a dose-dependent manner, such that the lowest hemoglobin concentration was associated with the most severe depression.<sup>127</sup> Future studies are required to assess doses of iron supplements during pregnancy that are effective for treatment of PPD.

and safe for the mother and fetus.

Next to iron, zinc has the second highest concentration of all transition metals in the brain. Zinc is a required cofactor for more than 300 different enzymes in the body; whereas zinc deficiency leads to enzyme dysfunction.<sup>128</sup> Zinc is required for normal neuronal synthesis and has been shown to be essential in modulation of inhibitory and excitatory receptors for neurotransmitters.<sup>129,130</sup> Serum zinc concentrations have been inversely correlated with depressive symptoms.<sup>131-134</sup> A pilot study conducted by Wójcik et al. determined that serum zinc concentrations decreased during pregnancy reaching their lowest immediately after delivery, but rebounding within a month postpartum.<sup>135</sup> Patients diagnosed with PPD using the EPDS as a screening tool had 24% lower serum zinc concentrations 3 days following delivery compared to those not diagnosed with PPD. Very few studies have used zinc supplementation as an intervention for depression. A recent pilot study gave young women a multivitamin with or without an additional 7 mg of zinc.<sup>136</sup> Additional zinc supplementation was shown to increase serum zinc concentrations and significantly decreased anger and depression scores compared to the multivitamin alone. The addition of zinc to antidepressant therapy has been shown to significantly decrease scores on depression inventories as compared to standard antidepressant therapy alone.<sup>137</sup> Effects of serum concentrations on zinc supplementation seem to be modulated by inflammation. Patients with chronic inflammation subjected to high dose zinc supplementation did not show an increase in serum zinc concentrations.<sup>138</sup> As discussed previously, PPD is associated with higher levels of inflammation, which may first need to be remedied prior to zinc supplementation.

Copper, magnesium, and selenium are also minerals important in brain chemistry. Minimal research has been conducted on these micronutrients. Current research that does exist suggests an elevation in serum copper, as occurs during pregnancy, is associated with PPD in women with a family history.<sup>139</sup> The association of magnesium deficiency during pregnancy leading to PPD has garnered mixed results.<sup>135,140-141</sup> Recent research in nursing home residents has discerned an association between low serum selenium and depression, which was improved through selenium supplementation.<sup>142</sup> Another study showed that selenium supplementation during pregnancy decreased EPDS scores 8 weeks postpartum.<sup>143</sup> More double-blind placebo-controlled trials are required to determine the effects of micronutrient deficiencies and subsequent supplementation on the risk of PPD before recommendations

can be made.

### Non-Nutritional Risk Factors

Numerous other factors have been implicated to increase the risk of PPD. Several meta-analyses have determined that the following non-nutritional factors significantly increase the risk of PPD: prenatal depression, socioeconomic status, marital status, child care stress, social support, infant temperament, multiple births, and unexpected pregnancy.<sup>144-147</sup> Recent research has also implicated sleep quality and employment status as other risk factors. Miyake et al. determined that having a full-time job decreased the risk of PPD by 48% compared to those unemployed.<sup>148</sup> Pregnant women holding a professional or technical position further decreased risk of PPD by 71%. Poor sleep quality was associated with recurrence of PPD in women with previous history of depression.<sup>149</sup> For each 1 point change in sleep quality score, a 25% increased risk of PPD was indicated.

Lack of exercise and postpartum weight retention have also been implicated as potential risk factors for PPD. The risk of PPD increased 154% in women who had retained at least 5 kg (11 lb.) of pregnancy weight.<sup>150</sup> The odds of retaining at least 5 kg in the first year postpartum increased 24% for every hour spent watching television/day and 33% for every 0.5% increment of daily caloric intake as trans fat, which is representative of an unhealthy, processed diet.<sup>151</sup> The same study also determined that for every hour spent walking per day the odds of retaining pregnancy weight decreased by 34%. Interestingly, women with greater knowledge in nutrition retained significantly less pregnancy weight than their uneducated counterparts.<sup>152</sup> Therefore, nutritional education may be an important factor in reducing weight retention and thus, decreasing the risk of PPD.

### Summary and Practical Recommendations

PPD is a disorder that will affect a significant number of pregnant and lactating women coming into our offices; therefore, it is important to understand some of the factors that may increase PPD risk and general recommendations to make to your patients. The current review highlights the impact nutrition may have on the etiology of this debilitating disorder, most notably on prevention of inflammation and maintenance of a healthy central nervous system. Protein, essential fatty acids, and numerous vitamins and minerals are depleted during pregnancy when dietary intake is insufficient. Folate and iron have been shown to take several months for repletion to occur.

Birth spacing between weaning of one child and conception of the next should ideally be >18 months; although some of the negative pregnancy outcomes associated with closer spacing was reduced in women supplemented with folic acid. Many of the nutrient deficiencies found to be associated with an increased risk in PPD are also depleted during normal pregnancy and lactation, such as n-3 fatty acids, folate, iron, and zinc. Although several of these nutritional factors are present in prenatal supplements, they compete for absorption in the digestive tract. Ideally these micronutrients should be taken separately, but if the patient prefers not to take multiple pills daily, a single prenatal multivitamin supplement is better than nothing. Tips for maximizing absorption of single nutrient supplements are as follows:

1. Iron and folic acid supplements can be taken simultaneously shortly after a meal.
2. Vitamin D, n-3 as pure or primarily EPA, and calcium can be taken together at a meal containing at least 5-10 g of fat to increase absorption of the n-3 and lipid-soluble vitamin D.
3. Zinc should be taken alone and on an empty stomach, 1 hour prior to a meal or 2 hours following a meal.

Depressed patients not responding to antidepressant therapy may benefit from supplementation of folate, zinc, or EPA. Female patients of childbearing age may also benefit from an encouraging discussion on the advantages of healthy eating and exercise in preventing PPD. Overall, there are several nutritional and non-nutritional risk factors for PPD. Screening for PPD is not standardized and many women with PPD are not diagnosed; therefore, adding the PDSS or EPDS surveys to your diagnostic toolbox may provide an added service to patients not currently being assisted in other healthcare realms.

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# Kinetic Chain Dysfunction in a 16-Year-Old Soccer Player with Ankle Pain

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## ABSTRACT

**Objective:** The objective of this case report is to discuss the clinical course of a 16-year-old female soccer player who sought care for ankle pain during soccer practices.

**Clinical Features:** A 16-year-old female soccer player had ankle pain of 3 weeks duration. The pain was subjectively described as achy, but also sharp and “tingly” after 15 minutes of running, and would ease if she stopped or rubbed the area. Evaluation revealed postural imbalances, weakness of the core musculature and lower kinetic chain, a 30° toe-out foot flare, and subluxation in the lumbopelvic region and lower extremity.

**Intervention and Outcome:** The patient was treated with full spine and extremity adjusting and a functional rehabilitation program focused on the muscle imbalance/weaknesses of the core musculature and lower kinetic chain. She responded well, was able to return to play, and her foot flare decreased to 20°.

**Conclusion:** Adolescent patients with sport injuries may benefit from chiropractic and rehabilitation to assist them in improving joint mechanics that can return them to play sooner as well as aid in improving postural distortions.

**Key Indexing Terms:** Chiropractic; Rehabilitation; Ankle Pain; Foot Flare; Soccer

## Introduction

Sixty percent of youth soccer injuries involve the lower extremities, with the ankle and knee being most commonly involved.<sup>1,2</sup> In addition to typical diagnoses such as ankle sprain, tibiotalar impingement syndrome, and chronically subluxating peroneal tendons, other considerations should include medial tibial stress syndrome (shin splints), exertional compartment syndrome, and stress fracture.<sup>3</sup>

A patient who has been diagnosed with medial tibial stress syndrome (MTSS) will have pain along the distal two-thirds of the posteromedial or anterolateral tibia. MTSS is common in repetitive activities such as running, walking, and jumping, and is believed to be related to bone remodeling inadequately adapting to external stress forces. There are several risk factors which can contribute to MTSS, including genu valgus, overpronation, femoral neck anteversion, and external rotation of the hip.<sup>4</sup>

Exercise-induced ischemia of the lower leg compartment is difficult to differentiate from other conditions causing lower leg pain. Anterior compartment syndrome

is the most common type, with painful passive stretch of the tibialis anterior, extensor hallucis longus, and extensor digitorum longus (plantar flexion). The pain occurs during activity at a set point in training. It may progress to pain with walking. Neurologically, the patient has tingling or numbness in the first web space, and there may be weakness of toe extension and foot dorsiflexion. In exercise-induced cases, increased capillary permeability leads to increased swelling and pressure, and can eventually lead to ischemia. Predisposition to this condition can be related to foot shape and biomechanics, muscle imbalance, and being overweight.<sup>5,9</sup>

If a clinician is suspicious of exercise-induced leg pain of the lower leg compartment, it can be conservatively cared for up to 6 weeks since this is the first step in its management; however, a clinician must ensure it is not an acute compartment pain from an injury or traumatic event.

Rotational abnormalities of the lower extremity are the most common reasons for parents to take a child for an orthopedic consultation. Foot flare is generally caused by tibial or femoral rotation rather than a foot deformity, and are therefore considered a cosmetic problem rather than a surgical concern.<sup>6</sup> Normally, the foot axis is in a position of 10-15° of exorotation.<sup>7</sup> Excessive external foot flare can be caused by femoral torsion, tibial torsion, or hip contracture.<sup>7,8</sup> It may also be a result of a change in the body's center of gravity due to obesity and weak core musculature.

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Femoral external rotation of the femur is more common in older children and obese children, and when unilateral, is more common on the right side.<sup>6</sup> The torsion of the hip and/or tibia can lead to pain in any of the joints of the lower extremity, as well as gait dysfunction.

In all of the syndromes, there can be various intrinsic and extrinsic contributing factors to the leg pain: poor running mechanics, inappropriate footwear, foot shape and biomechanics, lower limb structural abnormalities, muscle tightness and imbalance, poor conditioning, obesity, inadequate warm-up and training errors, terrain and training surfaces, environment and diet.<sup>9</sup> The differentiation among the causes begins with a thorough history and examination.

## History

A 16-year-old female patient had pain along the right medial tibio-talar and subtalar ankle region. Her parents had taken her to an orthopedic surgeon when she was younger concerning gait difficulties and right foot flare. She stated that the orthopedic surgeon's opinion was that she would outgrow it.

The patient stated the ankle pain had been present for 3 weeks. Its onset was approximately the same time that spring soccer practice began. The pain was described subjectively as an ache upon dorsiflexion. She also noted a sharp, "tingly" quality after about 15 minutes of running. The pain ceased when she stopped running and she noted that massaging the calf and ankle also helped. She had decreased her practice time and was still unable to run comfortably due to the pain. She rated the pain 6 on a 0-10 scale. Quad VAS outcome measure was 37%. The Foot and Ankle Outcome Survey (FAOS) revealed mild foot/ankle pain with ankle twisting/pivoting, bending of the foot/ankle fully, and jumping. Severe pain was noted when running. All quality-of-life questions were mildly affected. Radiographs of the right ankle were performed, which included the AP, lateral, and oblique views. No pathology or abnormality was detected.

## Exam

The patient's vital signs were normal. She stood 64" tall and weighed 184.5 lbs (obese). Her body mass index was 31.7. On static palpation, she had hypertonic piriformis and lumbar erector spinal muscles. Motion palpation revealed decreased right ilium and talus. Neurological evaluation of lumbo-pelvic and lower extremity revealed no abnormalities in sensory and reflex testing.

Strength testing revealed 4/5 of the right quadriceps and abductor muscles. The right adductor muscle was shortened. Orthopedic evaluation revealed positive Trendelenburg, Hibbs', Thomas, Patrick's and Ober's on the right.

The patient's functional evaluation involved gait, postural and movement assessment. Gait evaluation revealed a right knee valgus with bilateral subtalar pronation and a right foot flare (right foot 30°, left foot 15°). On standing balance, she demonstrated a right pelvic shift with right knee valgus and excessive bilateral calcaneal eversion. Postural evaluation noted left pelvic obliquity, right knee valgus and bilateral foot pronation. During movement testing, she had difficulty on the right with the 1-leg squat/lunge, and squat jump test. She showed muscle inhibition of the right gluteus medius and maximus, and internal obliques. She had decreased gluteus medius firing and premature firing of the lumbar extensors. She demonstrated excessive knee valgus on the right during step down. Her right knee internally rotated during the sit-to-stand/squat test. Core stability testing revealed side-bridge endurance of 14 seconds (left), 10 seconds (right), and trunk extension endurance of 45 seconds.

## Treatment

When determining a treatment plan for the patient, we recognized several key factors that could be contributing to the patient's postural distortions and functional deficits. Our treatment consisted of full spine and extremity adjusting with a functional rehabilitation program. We recognized that her obesity was contributing to her kinetic chain dysfunction. Dietary analysis was performed and discussion concerning her weight and dietary changes recommended. Due to her excess weight and its potential structural impact on her feet, orthotics were discussed with the parents who decided not to utilize them at this point in care.

The rehabilitation program included stretching, strengthening, plyometric and balance activities, as this leads to the most favorable outcomes.<sup>10,11</sup> For proprioception, she did the 1-leg stand on an unstable surface up to 30 seconds/foot. The goal was be able to build up to 30 seconds per foot and alternate feet for a total of 5 minutes. Stretching the quadriceps, hamstrings, iliotibial band, and gastrocnemius/soleus was repeated 2-3 times for a 3-5 second hold. Strengthening consisted of 3 sets, 8-12 repetitions, of isometric contraction of the quadriceps, 10 repetitions of hip flexion/extension/abduction/adduction utilizing tubing, 5-10 repetitions of a modified vastus

medialis oblique (VMO) leg lift and a gluteus medius “clamshell” abduction lift, and 10 repetitions of single then double leg slide board with adduction, abduction, and internal rotation. She also did 3 sets, 8-12 repetitions of the following: mini squats with ball on wall, and front and lateral step-downs. Due to her improvement on the re-evaluation, additional plyometric exercises were added to her treatment plan, including squat jumps and jump-over-stick (front-back and side-side) for 1 set each, 8-12 repetitions. Earlier exercises progressed from tubing to weights, and 3 sets of 10-12 repetitions of quadriceps dips on a step were added.

### Outcome

After 7 weeks of treatment, she was able to return to play with no complaint. She was working on dietary changes and had lost .5 pounds. The functional deficits found on initial examination had improved, and most notably, the foot flare the patient had experienced since early childhood had improved. Initially she showed foot flare measurements of 30° right and 15° left. At the end of treatment, her foot flare measured 20° right and 18° left.

### Discussion

Repetitive sporting activity can overload an athlete’s musculoskeletal system and continually impact the muscular imbalances and postural distortions. Many times, injuries are a result of biomechanical deficits removed from the specific site of injury, therefore, one must evaluate the kinetic chain and consider any intrinsic and extrinsic factors which may be involved.<sup>12,13</sup>

In a study of gender differences in runners, female subjects demonstrated greater hip adduction, knee abduction, hip rotation, and tibial rotation during the stance phase of running, and that these kinematic demands placed greater demands on the core musculature.<sup>14</sup> The proximal stability of the pelvis and trunk dictates distal function of the lower extremities in functional movements.<sup>15</sup> Additionally, we felt that her dysfunctions were placing her at risk for a potential ACL injury. Females are at greater risk of ACL injury than males, in part due to neuromuscular responses, joint laxity, hormonal influences, hip weakness, and quality of pattern of movement. There is a so called “point of no return,” which places the ACL at risk and which involves the leg in pronation and rotation, with the knee in valgus angulation.<sup>3</sup> With this information in mind, our patient was given a treatment plan consisting of low-force chiropractic adjustments to the pelvis and

lower extremities, and a functional rehabilitation program addressing core strength and endurance and the postural and muscular imbalances in the lumbopelvic-hip region and lower extremities.

These factors can place additional stress on the soft tissue or bony structure in an athlete who overpronates or who is obese and may predispose one to MTSS.<sup>9</sup> Compartment pressures can be a result of a mild inflammatory reaction and can lead to intermittent exercise-induced compartment syndrome. An athlete may experience exercise induced pain, numbness, muscle weakness, or palpatory pain as a result. Finally, proximal stability dictates distal function; therefore the clinician must also consider and address core stability deficits as a contributing factor in lower extremity pain presentations.

### Conclusion

It’s important for the clinician to complete a thorough history and examination in order to differentiate the cause(s) of leg/ankle pain. Consideration must be given to the intrinsic and extrinsic risk factors, as well as core stability issues which may be contributing to the condition. This will allow the clinician to develop a more individualized treatment program, including both proximal and distal joints. In this case, chiropractic adjustments in both proximal and distal locations, combined with a comprehensive functional rehabilitation program, allowed for better outcomes and a quicker return to play, as well as improvement in a long-standing foot flare problem.

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# Resolution of Vomiting in a 9-Month-Old Following Chiropractic Care

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## ABSTRACT

**Objective:** To describe how a 9-month-old child with emesis improved after chiropractic spinal adjustments and craniosacral therapy.

**Clinical Features:** A 9-month-old boy with a history of gagging and projectile vomiting since birth.

**Intervention and Outcome:** The patient received low-force chiropractic spinal adjustments to his upper cervical spine. There was improvement in his emesis later that night. His symptoms of projectile vomiting occurred once after initial treatment and have not returned during the following 10 months.

**Conclusion:** This case report suggests there may be a role for the use of chiropractic spinal adjustments for emesis resulting from a hyperactive gag reflex. Controlled studies are necessary to aid our understanding of this finding.

**Key words:** Emesis, chiropractic, spinal manipulation, Logan Basic, Gonstead, Craniosacral Therapy.

## Introduction

Vomiting is a reflex-coordinated response to various stimuli to the central nervous system as well as a frequent symptom in childhood related to a wide range of conditions. The most common causes of vomiting in the neonate are overfeeding and gastrointestinal reflux related to an immature lower esophageal sphincter. Vomiting is often associated with a viral illness but may be secondary to other conditions such as physical obstruction of the gastrointestinal tract.<sup>1</sup> In many cases, the cause of vomiting is unknown.

## Case Report

A 9-month-old male presented with a chief complaint of gagging and projectile vomiting when attempting to eat any kind of textured food. His mother reported that he had a hyperactive gag reflex since birth and that initially, vomiting occurred any time he over-filled his stomach. His initial diet consisted only of breast milk. Breast and bottle nipples did not stimulate the gag reflex nor did the mother's letdown and milk ejection reflex. At 4 months of age he began eating rice cereal and applesauce, neither of which made it past his tongue and induced gagging and projectile vomiting. At 6 months of age he was ingesting

approximately 60% breast milk and was supplemented with Similac infant formula. At this time he began consuming pureed vegetables which made him vomit if it contained any texture beyond a thin, smooth, puree. By 8 months of age, oatmeal and finger foods were attempted all of which induced the same response. At the time of his initial examination the only textured food tolerated was infant formula and a thin puree of fruits and vegetables.

His mother had a normal pregnancy, labor was assisted by administration of pitocin due to lack of contractions, and delivery was vaginal without complications or the use of forceps. Birth weight was 8 pounds 7 ounces, length 20 inches, and APGAR scores were 9 at 1 minute and 10 at 5 minutes. The infant was reported to be mildly jaundiced after birth but this resolved shortly thereafter without incident. His temperament was relatively happy and his sleep habits were good. Bowel movements were described as soft and regular. No serious illnesses were reported and the current chief complaint was not accompanied by fever, lethargy, apparent stomach pain, or weight loss.

The infant was the younger of 2 children in the family with no report of similar symptoms in the sibling. Stress was not reported to be an issue in the home and the infant's mother did not have any known allergies. Therefore, allergens in the breast milk were not investigated. The infant did, however, have a history of dry skin and eczema which caused him to scratch frequently.

## Exam

The infant was a healthy looking, well-nourished male

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in no distress. His vital signs were within normal limits with a blood pressure of 108/69, pulse rate of 126 beats per minute, tympanic temperature of 97° F, respirations of 28 breaths per minute, length of 31 inches, weight of 20 pounds, head circumference of 46.5 cm, and chest circumference of 45.0 cm. Examination of eyes, ears, nose and throat revealed pupils equal, round, and reactive to light. Extraocular movement was within normal limits. Tympanic membranes were within normal limits, oropharynx was normal and without erythema or exudate, and the neck was supple and without lymphadenopathy. Lungs were clear on auscultation with no rales, rhonchi, or wheezing. Cardiac examination demonstrated normal heart sounds without any murmurs or gallops and with regular rhythm. The abdomen was soft and nondistended with no indication of tenderness, mass or hepatosplenomegaly. Bowel sounds were within normal limits. Extremities were warm with good capillary refill and normal distal pulses. Skin was free of rashes or other lesions. Neurologic exam was grossly intact, however, mild shoulder girdle weakness was noted on vertical suspension.<sup>2,\*</sup>

Gag reflex was not performed due to the history of an exaggerated response with projectile vomiting. Hyperactivity of this reflex was assumed.

### Chiropractic Evaluation and Care

There was a right head tilt without sternocleidomastoid spasm, normal facial and cranial symmetry, and decreased occipital motion on the left when attempting to glide from posterior to anterior and superior to inferior. Increased dural tension was present when flexing the head and pelvis simultaneously and caused the patient to arch backwards in protest with a cry at the onset of motion. Also present was increased tension on the right sacrotuberous ligament when palpated from an inferior to superior and medial to lateral direction with the thumb tip using Logan Basic Technique protocol.<sup>3</sup>

With the mother's consent this child was treated with chiropractic adjustments to the sacrum and occiput. The sacrum was adjusted first and Logan Basic Technique was used to correct a right anterior and inferior sacral misalignment. This was accomplished by using the doctor's thumb

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\* Vertical suspension is performed by suspending the baby with the examiner's hands under the axillae. This test is used to look for scissoring or spasticity of the legs. However, one can also get a general sense of shoulder girdle strength by the ease of which the baby suspends in this position. A baby with poor upper body tone or weakness will not contract shoulder girdle muscles as strongly and the examiner will tend to feel as though the baby is slipping through his hands.

tip to contact the patient's right sacrotuberous ligament at its attachment to the sacral apex and at the ligament's anterior inferior border. The line of correction was anterior to posterior and inferior to superior. A gentle contact and hold, ending with a quick, shallow thrust was utilized to bring about correction.<sup>3</sup>

The occiput was adjusted in a seated position using Gonstead technique with appropriate modifications made for the size, age, and skeletal maturity of the patient. This technique was applied to correct a left posterior and superior misalignment. The doctor's left thumb pad was used to contact the baby's left supramastoid groove. The baby's head was placed in left lateral flexion just enough to influence the atlanto-occipital articulation and the doctor's right hand and index finger was used to stabilize the lower cervical spine. A shallow, gentle thrust in a posterior to anterior, superior to inferior, and left to right line of correction was used to release the occipital misalignment.<sup>4</sup>

After the adjustments to the sacrum and occiput, dural tension was reassessed. When flexing the head and pelvis simultaneously, the baby was able to move into the flexed position to a greater extent and with improved ease without crying. Initially, dural tension and apprehension to this motion was noted at the onset of motion. Following the adjustment to the sacrum and occiput, dural tension and apprehension was noted when the head was at full flexion with the pelvis flexed to approximately 45°.

Continued release of dural tension was accomplished utilizing craniosacral therapy with the patient supine and the doctor's hands placed with one under the occiput and the other under the sacrum. In this position gentle traction was applied with the finger tips alternately in a cephalad and caudad direction until the dural tube was free of restriction.<sup>5</sup> This was assessed by the ease of which the dural tube was able to glide while being tractioned followed by flexing the head and pelvis simultaneously while observing for apprehension and improved range of motion.

Immediately following the adjustment and dural tension release this patient was able to hold his head in an upright position without any signs of lag to either side and shoulder girdle strength was markedly improved on vertical suspension. Later that day he began smacking his lips and chewing, something he had not done previously. He was given a cracker which he ate without incident. He also began pulling himself up to a standing position and began moving his legs in an attempt to walk for the first time as reported by his mother.

At his second visit 9 days later his mother reported that there had been a significant improvement in her son's ability to tolerate textured food. She reported only 1 incident of projectile vomiting, very little gagging, and that her son was eating "anything and everything." No adverse events were noted by the mother after the previous adjustment. On evaluation, dural tension was improved, and occiput and sacrum were found to be subluxated. Occiput was adjusted with Gonstead technique and the sacrum with Logan Basic, both of which have been described previously. During a follow-up by phone 10 months later, this patient's mother reported no further episodes of gagging or vomiting and no adverse reaction to treatment.

## Discussion

This infant was also under the care of a pediatrician. He was evaluated medically and found to be healthy with the exception of intermittent projectile vomiting episodes since birth. A barium swallow study was performed and no physical obstruction of the gastrointestinal tract was found. This case is unique in that his specific presentation does not fit into the established categories of functional gastrointestinal disorders<sup>6,7</sup> and the condition is not consistent with gastroesophageal reflux disease (GERD) or colic behaviors.<sup>8</sup> As the infant became exposed to textured foods in his diet, this appeared to become the trigger of vomiting episodes. Aversion to textured foods can lead to behavior problems associated with food refusal later on in childhood if left untreated.<sup>9</sup>

A review of the literature was conducted by searching the Index to Chiropractic Literature (ICL), PubMed, and Ebscohost's databases. The following keywords were input in various combinations: chiropractic, vomiting, emesis, hyperemesis, projectile vomiting, hyperactive gag reflex, gastrointestinal disorders, pediatric, and vertebral subluxation with peer-reviewed articles only as a limit. Articles were selected upon review of the abstract. As of November 2009, there was only one case report<sup>10</sup> involving the successful chiropractic care of a patient with projectile vomiting. This case differs from the current one in the patient's age of 3-months-old versus 8-months-old and a primary medical diagnosis of colic, which the subject of this case did not have. Due to the fact that only one other case report involving projectile vomiting and chiropractic care of an infant was found, it is therefore a benefit to present this case report showing unexpected results for chiropractic care of projectile vomiting.

The vagus nerve is the tenth cranial nerve and often known as "the Wanderer" because of the extensive course

and distribution traversing the neck, thorax, and abdomen. The gastrointestinal tract is heavily innervated by afferent and efferent neurons of the vagus nerve. Branches of the vagus nerve are distributed throughout the gut providing a bi-directional link with the brain to regulate food intake, nausea, feelings of satiety, sensations of bloating and epigastric discomfort, secretion, motility and vomiting.<sup>11</sup> Vagal afferent nerves consist mostly of unmyelinated C-fibers that arise from the gastrointestinal mucosa of the GI tract from the esophagus to the colon. The wide distribution of these afferent neurons has become an interest to researchers in the area of gastrointestinal dysfunction and a target of many therapeutic agents.<sup>11</sup> Afferent fibers of the vagus nerve unite as they ascend through the abdominal and thoracic cavities joining vagal fibers from other visceral structures including the heart, thymus, lungs, pancreas, liver, adrenal glands, and uterus to name a few. The body of the vagus nerve travels in close proximity to the cervical spine along with the common carotid artery, internal carotid artery, internal jugular vein, glossopharyngeal and spinal accessory nerves within the carotid sheath.<sup>12</sup> It has direct connections with the superior cervical ganglion at the level of the second cervical vertebrae posterior to the carotid sheath. It further ascends finally entering the cranium via the jugular foramen of the occipital bone. These afferents predominately terminate in the nucleus tractus solitarius of the dorsal brainstem and are distributed to autonomic motor nuclei and other regions of the brain.<sup>11</sup>

The close proximity of the vagus nerve to the atlanto-occipital articulation leaves it vulnerable to irritation when segmental dysfunction exists. Segmental dysfunction of the atlanto-occipital articulation may place torsion on the carotid sheath containing the common carotid artery, internal carotid artery, internal jugular vein, glossopharyngeal, vagus, and spinal accessory nerves.<sup>12,13</sup> Secondly, it may cause torsion on the superior cervical ganglion posterior to the carotid sheath.<sup>12,14</sup> Pickar states there is evidence demonstrating that chiropractic manipulative technique (CMT) evokes paraspinal muscle reflexes and alters motor neuron excitability.<sup>15</sup> He also states that biomechanical changes caused by spinal manipulation are thought to have physiological consequences by means of their effects on the inflow of sensory information to the central nervous system and may alter end-organ function.<sup>15</sup> Noxious paraspinal sensory input, which may be caused by the segmental dysfunction, appears to have an excitatory effect on autonomic outflow. Correcting the segmental dysfunction through CMT may normalize the sensory input, thus having an inhibitory effect on the somatovisceral reflexes.<sup>15</sup>

Andrews and Sanger state that abdominal vagal afferents have been indicated in physiologically inappropriate responses such as retching and vomiting triggered by stimuli other than food poisoning. They are also responsible for inadequate or exaggerated relaxation of the stomach, leading to disordered emptying and aberrant sensations of nausea or discomfort. Each of the aberrant responses discussed could arise from chaotic vagal afferent input or central processing.<sup>11</sup>

Traditional medical treatment of childhood gastrointestinal disorders has been limited to drug therapy or surgery involving implantation of a vagal nerve block and/or vagotomies. Andrews and Sanger also state that the vagus has been the target of many therapeutic agents due to its easy accessibility via the oral mucosa. Also, the region of the brain where the neurons terminate, the dorsal medulla, has a relatively permeable blood-brain barrier.<sup>11</sup> Medical evaluation before and after CMT yielded no medical diagnosis but established a lack of physical obstruction. We believe that irritation to vagal nerve afferents may have been the underlying problem in this case. Andrews and Sanger's article, which established a link between vomiting episodes and vagal nerve afferents was geared more towards finding therapeutic drugs which target the vagus nerve. More studies should be conducted on the effects of CMT in cases of infant and childhood gastrointestinal disorders.

### Conclusion

This case does not fit into any previously established medical diagnoses of gastrointestinal dysfunction, though aversion to textured foods has been documented in the literature.<sup>9</sup> We believe the underlying cause of the hyperactive gag reflex was related to irritation of the vagus nerve by segmental dysfunction of the upper cervical area. This case suggests the possibility of other patients with similar symptoms of gastrointestinal distress benefiting from chiropractic care.

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# External Coxa Saltans in a 17-Year-Old Female Competitive Equestrian Rider: A Chiropractic Approach

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## ABSTRACT

**Purpose:** External coxa saltans or “snapping hip” is a rare, debilitating condition for athletes. Coxa saltans is an audible and possibly painful snap localized to the hip. The cause is often a diagnostic and management conundrum. The purpose of this case report is to add to the understanding of this condition and treatment options.

**Case:** A 17-year-old equestrian rider, had pain and snapping of the tendon with an audible cavitation of the joint with both weight-bearing and non weight-bearing movements. The condition interfered with athletics and daily living.

**Methods:** She was treated with low force chiropractic techniques, lifestyle management and rehabilitation to restore normal movement and weight-bearing capacity to the pelvic joints, hip joints, foot and normalize the resting length and tone to muscle groups.

**Outcomes:** Treatment was monitored over 16 weeks. Using these methods the patient was able to successfully resume competition at the highest level, markedly improve posture and gait function.

**Discussion:** Compared to other hip conditions, coxa saltans is an uncommon cause of hip pain and dysfunction. Some athletes performing repetitive movements may develop symptomatic snapping of the hip leading to pain and impaired function. Chiropractic techniques address underlying causes and may help correct the dysfunctional biomechanics

**Conclusion:** The patient responded favorably to chiropractic management, soft tissue therapy, home care, exercises and orthotics. She regained full range of motion and capacity for activities of daily living and sport participation.

**Keywords:** Coxa saltans, chiropractic, hip

## Introduction

Hip injuries are a relatively uncommon adolescent athletic injury, most commonly affecting runners, dancers and soccer players.<sup>1</sup> Coxa saltans is an uncommon cause of hip pain<sup>2</sup> which involves an audible and sometimes painful snap localized to the hip. A review of the literature found only one other recorded case study which reported complete resolution of the athlete's difficulties through nonsurgical, conservative measures.<sup>3</sup> Z-plasty of the ilio-tibial band is considered a successful treatment, however the research done was performed on a very small group of subjects, one person was left with persistent groin pain.<sup>4</sup>

## Case Report

In this case, the patient, a 17-year-old equestrian rider, had pain and snapping of the tendon concomitant with an audible cavitation of the joint upon standing (planting the foot on the ground in a weight-bearing stance) as well as during non weight bearing range of motion. The

condition was interfering with her activities of daily living as well as sporting activities. Her medical history included three major falls in the 18 months prior to onset of symptoms.

The patient reported pain, which she rated as 8 out of a possible 10 on a numerical rating scale with 0 being no pain and 10 being the worst pain. She had been through 10 months of treatment which had included intensive physiotherapy, physical therapy, sports medicine with cortisone injections and clinically specific Pilates. There was also a consult with a pediatric orthopedic surgeon at the Royal Children's Hospital in Melbourne who recommended performing a Z-plasty operation that had only been performed once by that surgeon and on a much less extreme case.

## Examination

A chiropractic examination was performed including neurological, orthopedic and postural evaluation. Lumbopelvic ranges of motion were assessed. The subject exhibited a positive Tredelenburg sign, marked imbalance of the adductor and abductor muscles of the left leg and disturbance to the normal movement of the pubic sym-

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physis, sacro-iliac joints bilaterally and left hip joint. There was weakness of the deep stabilizer muscles consistent with such disruption of normal joint function. Posture was poor with increased thoracic kyphosis and lumbar lordosis was also noticed. Generalised hypermobility of all joints, by performing range of motion and joint play randomly of the upper and lower limb bilaterally was noted and could be a contributing factor. Of note was a genu valgum on the affected side accompanied by subtalar pronation of the left ankle. The patient was unable to even place the plantar surface of the foot on the ground when standing still without eliciting the painful snap. Supine passive internal and external ROM of the hip joint would also elicit an audible and painful snap.

### Intervention

The diagnosis had been determined medically and excluded any possible internal pathological causes via CAT and MRI pelvic scans which were all normal. The assessment that the tendon of the iliotibial band was snapping over the greater trochanter of the femur appeared to be consistent with the examiners findings. The authors hypothesis was that if there was an ability to re-establish normal movement of the lumbopelvic joints and support the left arch with an orthotic device then any soft tissue work on the affected and antagonistic muscles had a greater potential of disrupting the dysfunctional fibrotic changes that were potentially limiting motion and would facilitate functional soft tissue repair thus resulting in a restoration of normal function.

The patient had received ultrasound and cortisone injections to no avail so a treatment plan of adjustments using pelvic blocking<sup>5,6</sup> and Thompson technique<sup>7</sup> in conjunction with ligament release and muscle trigger point therapy began. The left sacroiliac joint was blocked as a category two left upper fossa left short leg. The pubic symphysis was adjusted using the pelvic drop-piece or the activator instrument and the psoas was released with Nimmo technique.

### Outcome

Over the course of the next few weeks as the pelvis started to regain some normal balance and function more specific Nimmo and Active Release Technique was performed on the adductor, abductor, iliotibial band and peroneal muscles. This was conducted twice a week for 4 weeks. Examination also revealed pronation of the foot and referral for orthotics was recommended. At the commencement of treatment the patient could not plant her foot flat

on the ground for a normal stride but would walk on the toe and metatarsal heads of that foot. Normal gait (heel strike toe off) was not being accomplished as she basically limped on the metatarsal heads with each stride. The left leg also showed reduced stride length. The Quebec Pain Disability Scale<sup>8</sup> score was 30.8.

After 4 weeks of treatment, the improvement was minimal and visits continued twice a week for an additional 2 weeks. Her mother reported that her 'seat' and ability to ride with appropriate posture had noticeably improved, as had her control of the horse. Upon observation, the patient appeared to be putting more weight on the involved leg for normal ambulation. The Quebec Pain Disability Scale had fallen to 28.

After six additional visits (two weeks of twice a week and then two weeks of once per week) further Active Release Technique<sup>9</sup> was applied to the ilio-tibial band and an adjustment to the left knee in a McMurray type maneuver performed. (To perform the maneuver, the knee is held by one hand, which is placed along the joint line and flexed to 90 degrees while the foot is held by the sole with the other hand. The examiner then places one hand on the lateral side of the knee to stabilize the joint and provide valgus stress. The other hand rotates the leg externally while extending the knee. This is generally performed to move the medial knee cartilage more centrally in the joint.) This maneuver needed to be performed after the orthotic had been inserted in the shoe.

After 15 weeks of chiropractic care the subject had progressed sufficiently to be given further core stabilization exercises. These included basic pelvis floor and transverse abdominus exercises. Although sitting or walking for extended periods still elicited some pain, she reported great improvement to her level of pain.

No adverse events were reported throughout the treatment period.

Postural examination revealed marked improvement of the anterior to posterior curves of the spine and gait had normalized to a point that the patient could walk with the whole foot striking the ground. In the non weight-bearing supine position no snapping of the hip could be elicited and upon active or passive range of motion and upon examination the patient could put the foot to the ground standing and no audible snap could be heard, although the subject reported that it did still sometimes occur. Her back pain was alleviated and she incidentally reported that

her menstrual cycle had normalized and she no longer experienced pain with it.

The patient chose to continue treatment so as to maintain optimal function and performance. She had just come first in a major national three-day equestrian event and consequently was named 'Young Equestrian Rider of the Year' in Australia.

## Discussion

The ITB is a long non-elastic collagen based band of fibers that crosses both the knee and hip joints. It originates from the iliac crest, is joined by the fascia of the gluteus maximus, the tensor fascia latae and the gluteus medius indirectly. It inserts to the linea aspera of the femur and into the lateral aspect of the tibia at Gerdy's tubercle with some possible insertions also to the lateral retinaculum and the patella. Repetitive motions due to high level training increase the tension of the fascial band which it turn leads to a thickening of the tissue. This can produce friction over the greater trochanter and further fibrosis. As the patient goes through the swing phase of gait the thickened band swings anteriorly and as the stance phase initiates it must move quickly posteriorly.<sup>10-13</sup> The movement of the thickened band over the bony prominence causes the snap or clicking of the hip. Most cases are not painful. More women than men seem to develop the condition into a syndrome due to the different angle of the female pelvis.<sup>14</sup>

When compared to other hip conditions, coxa saltans is considered an uncommon cause of hip pain and dysfunction. Some athletes who perform repetitive movements may over time develop symptomatic snapping of the hip leading to pain and insufficiencies of function.

There is very little published material to guide the practitioner and the surgery of choice is still very much in the experimental phases. Chiropractic techniques to address underlying dysfunctions that are either asymptomatic or overlooked as unimportant may help to correct the biomechanics in which the condition originated. Correction of the pronation of the foot is also important in being able to release the tension of the various muscles involved and strengthen their antagonists.

## Conclusion

Restoring a young athlete to active participation and optimizing their performance has a significant influence on both their physical and mental health. It is prudent to exhaust all conservative measures before considering more

invasive procedures. As a result of the aforementioned treatment, surgery was postponed indefinitely for this patient. Chiropractic care appears to have been more effective for this subject than any other conservative therapy previously tried and therefore it is this author's contention that chiropractic care should be given a trial before surgery is considered in such cases. It also appears that the treatment plan may require consistency and a length of care based on the nature and chronicity of the complaint. It is this author's hope that this case report will contribute to the clinical body of knowledge pertaining to this particular diagnosis as well as encourage further observation and research in the field.

All procedures have conformed to the ethical standards of the New Zealand College of Chiropractic.

Informed consent was obtained for the creation of this report.

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# The Restoration of Optimal Breastfeeding after Chiropractic Care in a Neonate with Breastfeeding Difficulties: A Case Report

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## ABSTRACT

**Objective:** To present the case of a neonate with breastfeeding difficulties and report how her condition changed following chiropractic care.

**Design:** A case report.

**Clinical features:** A 4-week-old neonate with refusal to feed from her mother's right breast or turn her head to the right presented for chiropractic care.

**Intervention and outcome:** The neonate was given a chiropractic adjustment and was immediately placed on mother's right breast, where she fed with no perceived difficulty. A follow-up visit in one week confirmed that resolution was attained.

**Conclusions:** This case reveals that chiropractic care was followed by an immediate improvement in the breastfeeding of a neonate who refused to feed from her mother's right breast. Very few studies have been performed or reported on this topic, however it is this author's view that further studies should be conducted to explore the importance of the role of chiropractic in the management of infants experiencing suboptimal breastfeeding.

**Keywords:** neonate, breastfeeding, chiropractic, chiropractic adjustment

## Introduction

This report explores the case of a 4-week-old neonate whose suboptimal breastfeeding was resolved with an adjustment to a subluxation that was discovered at the level of C1 in the upper cervical spine. It is the author's experience that upper cervical joint dysfunction is a relatively common finding amongst newborn patients.

## Case history and examination

Baby X presented at 4 weeks of age, and mother complained that she was refusing to feed on the right breast. She was quite concerned that mastitis may follow, as baby X had not been able to feed at all on the right breast since birth, and she was finding it difficult to continue expressing milk from only one breast.

Baby X was born via planned c-section at gestational age of 38 weeks. The birth of the mother's first child revealed that her pelvic outlet was too narrow to allow a natural vaginal birth, following x-ray assessment and pelvimetry performed by the gynaecologist. The baby's APGAR scores were reported as 7 and 9 at 1 and 5 minutes

respectively, and mother stated that there were no other reported complications or perceived problems at the time of the birth. There was no use of oxygen at the birth, nor were there any reported hypoxic episodes. History also revealed that there was no jaundice.

On examination, primitive reflexes tested intact and revealed no abnormality. Orthopedic and neurological testing also revealed no abnormality. Motion palpation of the spine revealed subluxation at the level of C1 (left posterior listing), the most obvious symptom of which was baby's refusal to rotate her head to the right. Passive range of motion of the baby's cervical spine revealed reduced right rotation. Whilst attempting to move the baby's head to the right, she became extremely agitated and began to scream and cry, after having been calm and content for the examination up to that point. She appeared to have no retained head or body postures, as well as no major cranial distortions. No diagnostic imaging was performed.

## Treatment

An activator adjustment was applied to C1 at the left transverse process in an anterolateral direction with no superior or inferior component, with the baby lying supine on the adjusting table. Care was taken to ensure that the activator was on a very low setting (approximately  $\frac{1}{2}$  turn from the minimum setting), and that the technique

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was modified appropriately for the age and anatomy of the neonate.

## Results

Immediately following the adjustment the baby was placed at mother's right breast, where she had previously refused to feed, and was able to feed with no obvious discomfort or difficulty. Passive range of motion performed at this point revealed full rotation to both the left and right equally, and active range of motion showed unrestricted movement in bilateral rotation. A follow up visit was recommended in one week, which both mother and baby attended. Mother reported that breastfeeding since the last adjustment had been unremarkable, that she no longer needed to express milk from the right breast.

## Discussion

Breastfeeding has been found in different studies to be beneficial to babies for many reasons, including an analgesic effect in the feeding newborn,<sup>10</sup> decreased risk of fever after immunization,<sup>11</sup> and a reduced risk of SIDS.<sup>3</sup> With this in mind, anything that can be done to promote optimal breastfeeding in the infant is beneficial not only to the infant, but also to the family of the infant and the community at large.<sup>6</sup>

There is not a great deal of research available regarding chiropractic care helping to resolve suboptimal breastfeeding. The author, to determine the number of articles published on this subject, conducted a literature search online. The search included not the chiropractic and manual medicine literature but also the medical literature. Due to the small body of literature available on this subject, there was no restriction implemented in terms of publication year.

Several databases were searched with the keywords "chiropractic AND breastfeeding". The MANTIS database revealed 7 articles, all of which were relevant.<sup>1,5-9,13</sup> Of the 7 articles that were found, 4 were case series<sup>1,6,7,9</sup> and 3 were case reports,<sup>5,8,13</sup> all of which outlined cases in which pediatric patients experiencing feeding difficulty were helped by chiropractic care. The EBSCO database gave 1 article that was irrelevant to this case report. Search of the JMPT database revealed 2 articles, one of which was relevant,<sup>1</sup> and had already been found in the search of the MANTIS database. The other article is a report outlining best practices for chiropractic care of pediatric patients, but is not directly relevant to this case, and so was not included for this case report. The Gale database revealed 1 article,<sup>1</sup> which had already been found in the MANTIS and JMPT searches.

Murdoch University Library Portal (MEDLINE, SCOPUS, SPORTDiscus, Health Collection and Current Contents Connect are available here) was searched and revealed 25 articles. The search repeated some titles as they were found through more than one search engine, meaning that of the 5 relevant articles, only 2 titles were actually found,<sup>1,8</sup> and both of these were found in other searches. A manual search of JCCP was also conducted, revealing 5 articles, 4 of which were already discovered in the MANTIS database search.<sup>5-7,13</sup> The article that had not yet been found was a report regarding the role of chiropractors in the management of breastfeeding infants.<sup>2</sup> The Index to Chiropractic Literature was also searched, revealing 7 articles which were all relevant to this case report,<sup>1,2,5-8,13</sup> and had all been found in searches conducted in other search engines.

In order to be thorough, a search of medical literature was also conducted. This required different keywords to be used, as chiropractic research is not commonly published in medical journals. The criteria for inclusion for medical articles was that the article outlined a direct, positive effect on the infant due to breastfeeding. The publication *Pediatrics* (Journal of the American Academy of Pediatrics) was searched by first using the keyword "breastfeeding", yielding 1,273 articles, of which the author found 4 to be both relevant to the topic and pertinent to this case report.<sup>3,4,10,11</sup> Of these 4 articles, 1 was a case-control study,<sup>3</sup> 1 was a prospective randomized controlled trial,<sup>10</sup> 1 was a cohort study<sup>11</sup> and 1 was a cost analysis report.<sup>4</sup> To attain a more relevant group of articles, a more specific search was then conducted using the key words "breastfeeding AND difficulty", yielding 338 articles of which 2 were found to be relevant by the author. One of these articles was already found in the search using the keyword "breastfeeding",<sup>11</sup> and the other was a prospective, community-based study.<sup>12</sup> While these articles are not directly related to chiropractic helping suboptimal breastfeeding, they have been included as references in this case report as they paint a clear picture of the importance of optimal breastfeeding to the individual, as well as the community.

In summary, a thorough search of the literature revealed 3 case reports, 4 case series, 2 reports, 1 case-control study, 1 prospective, community based study, only 1 cohort study and only one prospective randomized controlled trial. This suggests that further research needs to be done to explore chiropractic as a possible therapy for infants experiencing breastfeeding difficulties.

## Conclusion

This case report demonstrates that chiropractic was

effective in the restoration of optimal breastfeeding in this case. It is as important for clinicians to recognize and address simple biomechanical reasons for breastfeeding dysfunction as it is to recognize more complex cases with multiple concomitants (for example, subluxation, tongue tie, developmental delay, and cranial deformation). Chiropractic and other forms of manual medicine may be the only direct therapeutic approach available to these infants. More complex cases may require appropriate referral and co-management with other health care providers.

More research needs to be conducted in this area to explore the benefits of chiropractic care to the paediatric members of the population.

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# Visual Recovery from Diplopia in a 13-Year-Old Following Chiropractic Intervention

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## ABSTRACT

**Objective:** To discuss the case of a patient with resolution of diplopia following spinal manipulation.

**Clinical Features:** A 13-year-old boy with intermittent diplopia was referred by his optometrist for chiropractic care. Mild over convergence was noted on optometric examination.

**Intervention and Outcome:** Full resolution of symptoms was achieved after one chiropractic treatment session with follow-up optometrist's examination finding correction of over convergence.

**Conclusion:** This case adds to previous accounts of recovery of visual disturbance following chiropractic manipulation.

**Key Words:** Diplopia, visual disturbance, chiropractic manipulation

## Introduction

The resolution of visual disturbances via chiropractic manipulation has been reported in published case reports.<sup>1-8</sup> These visual disturbances have varied from complete loss of vision<sup>2</sup>, to concentric narrowing of the visual fields and blurred vision.<sup>1,3</sup> This case describes the resolution of apparent double vision and the correction of over convergence following chiropractic manipulation.

Diplopia is a condition in which a single object appears as two objects. It may be monocular diplopia, which is active only when one eye is open, or binocular diplopia which disappears when either eye is closed. Diplopia may result from impairment in any part of the vision system including the cornea, eye muscles, lens, nerves or brain. The most common cause of diplopia is misalignment of the eyes which may be caused by accommodative/convergence insufficiency, Grave's disease, medication side effects, migraine, brain tumour, head injury, brain aneurysm, multiple sclerosis, strabismus, cataracts or stroke.<sup>9</sup>

This case of binocular diplopia was caused by accommodative/convergence insufficiency. Accommodative insufficiency (AI) is characterized by an inability to focus or sustain focus at near distance. Convergence insufficiency (CI) is an eye "teaming" problem in which the eyes have a strong tendency to drift outward when reading or performing close work. To prevent double vision the individual exerts extra effort to make the eyes turn inward (towards

the bridge of the nose) — i.e. over convergence. Two non-matching images will be sent to the brain. If the brain accepts and uses these two non-matching images — double vision will result.<sup>10</sup> Detection of convergence insufficiency requires not only a basic eye exam (a person can still pass the 20/20 test and still have convergence insufficiency) but evaluation for binocular vision.<sup>9</sup>

## Case History

A 13-year-old boy was referred to our clinic by an optometrist for reported intermittent double vision when reading. The double vision had been present for 1 year (insidious onset) on a weekly basis — usually in school, and had been worse since starting high school 7 months earlier. The patient also complained of intermittent headaches but did not find the headaches and double vision to coincide. He did not recall any history of head trauma and normal development was reported.

The optometrist's findings included:

- normal unaided visual acuity
- normal eye health, healthy optic nerves and fundi right & left
- normal pupil responses
- no significant refractive error
- normal near point of convergence (8cm)
- difficulty clearing a -2D focusing demand on normal print
- binocular eye co-ordination findings within normal range for age, with only mild over convergence at near distance when given a focusing demand of -2D.

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## Chiropractic Exam and Treatment

The optometrist's conclusions were that these findings showed a very mild focusing problem at near distance but no ophthalmic cause for the double vision. At this stage a referral was made to our office for chiropractic evaluation.

Chiropractic examination revealed normal cervical range of motion, unremarkable cranial nerve and upper limb neurological examination. Multiple areas of vertebral dysfunction were identified, specifically at C1, C2, C6, mid-thoracic, L4 and bilateral sacroiliac joints. Muscle hypertonicity was noted in the rhomboid musculature bilaterally.

A diagnosis of mechanical neck and back vertebral dysfunction was made. Treatment involved rotary and lateral thrusts to the cervical spine, followed by posterior-anterior dorsal spine manipulation and manipulation of the lumbopelvic spine via an activator adjustment tool in the line of the correction. The patient reported full resolution of symptoms after 1 visit. He was seen on 2 more occasions over a 2 week period whereby by the 3rd visit it was ascertained that the vertebral dysfunction in the neck had corrected. There were no adverse events reported after any of the 3 visits. The patient was then reviewed by the optometrist who found similar findings to her previous assessment except that the tendency to over converge at near with focusing demand was no longer there and he displayed a slightly more exophoric posture on the binocular vision testing.

## Discussion

Although patients have reported having visual changes following chiropractic care, it is challenging to document this with independent evaluation.<sup>4</sup> The independent optometric evaluation, both pre and post chiropractic treatment, is what makes this case unique. The optometrist noted an improvement in examination findings following chiropractic care. After performing a literature search, several theories have been offered by chiropractors in published literature to explain the improvement of visual disturbances by chiropractic.

The first hypothesis involves the integrity of the upper cervical vertebral segments. A vertebral subluxation of the first 4 cervical segments influences neural input via the visual system resulting in a diminution in their function. The importance of this is that the first 4 cervical nerves form the superior cervical ganglion, fibres of which

form the internal carotid nerve. The internal carotid nerve branches off to the internal carotid artery and the abducens, trochlear, oculomotor and ophthalmic nerves all of which supply the eye structures.<sup>2,6,11</sup> These authors hypothesize that a chiropractic adjustment can remove this impairment in neural integrity.

Secondly, cervical subluxation affects the sympathetic innervation to the blood vessels of the optic nerve.<sup>2,6</sup>

Thirdly, Stephens, Pollard, Gorman et al<sup>4</sup> theorize that a vertebral subluxation causes a reduction in vertebral artery flow resulting in neuronal ischemia to the occipital lobes. The vertebral arteries join together to form the basilar arteries from which the posterior cerebral arteries arise. These arteries supply most of the occipital visual cortex.<sup>11</sup> Gorman proposes that this "spinal derangement" causes cerebral vasospasm which results in low blood flow to neuronal tissue and thus low levels of oxygen. If this oxygen level falls too low, cell death occurs and function is permanently lost. However, if this oxygen level falls within a certain range (between normal blood flow and that which results in irreversible tissue damage) it is possible for the neuronal tissue to enter a state of "ischemic penumbra" whereby the tissue is functionally inactive but will resume function with correction of oxygen levels. Gorman has noted that the recovery of visual disturbance occurs in gradual stages called the "step phenomenon" which he believes is the gradual increase of oxygen to the inactive ischemic tissues.<sup>1</sup> In one case study of a 53-year-old woman with loss of vision after a facial fracture from a fall, Stephens et al (including Gorman)<sup>4</sup> were able to quantify multiple areas of cerebral ischemia from a single photon emission computerized tomography. However this was not re-performed post chiropractic treatment after the patient's vision had returned.

And finally, Terrett<sup>8</sup> extends Gorman's vascular hypothesis with his theory of hibernation. Dysfunctional vertebrae (i.e. vertebrae which are misaligned or malfunctioning) may cause stress to the vertebral arteries as the arteries are guided through them. This results in constriction of the lumen of the artery which causes a decrease in cerebral blood flow (CBF). If this CBF falls below a critical level the cells remain alive but do not function. This cerebral artery insufficiency affects sophisticated brain function (those not essential to our existence eg vision, concentration, memory, auditory) and can persist indefinitely. Cerebral artery insufficiency does not cause a loss of function in brain functions that are involved in our existence (eg eating, walking, and talking), however as the degree of ischemia increases, the number

of functioning cerebral cells decrease and the disability becomes more severe. Terrett suggests that these areas of the brain that are affected by decreased blood flow are in fact “hibernating” until normal blood flow is restored via chiropractic manipulation. He also states that it is not known by what exact mechanism the CBF may increase.

### Conclusion

This case adds to the few documented cases where there appears to be a link between chiropractic manipulation and the resolution of some visual abnormalities. Further measureable research in both visual deficit and cerebral ischemia needs to be performed to ascertain the benefit of chiropractic treatment in cases of visual disturbance.

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# Chiropractic Management of a Combined Neonatal Brachial Plexus and Facial Nerve Palsy: A Case Report

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## ABSTRACT

**Introduction:** Chiropractic clinics serving the neonatal population need to be prepared for patients presenting with traumatic birth-related injuries. There are a multitude of potential injuries a neonate can present with. This case study highlights two such injuries, Obstetric Brachial Plexus Palsy (OBPP) and Facial Nerve Palsy (Bell's Palsy).

**Case Presentation:** This report details an incomplete obstetric palsy of the brachial plexus and facial nerve in a 2-week old male child presenting to a chiropractic clinic in Victoria, Australia. Other symptoms included plagiocephaly.

**Intervention and outcomes:** Conservative management, involving chiropractic craniosacral technique and massage, took place over a 4-month period. There was a gradual reduction in plagiocephaly and improvement in facial symmetry, upper limb posture and movement.

**Conclusion:** There are few documented cases of birth trauma resulting in both brachial plexus and facial nerve palsies in the neonate. This case documents mild and transient examples of both palsies, where conservative chiropractic care was initiated and appeared successful. Practitioners should be aware that where trauma is sufficient to cause one birth injury, it is capable of causing multiple obstetric injuries. Severe cases risk long-term disability and require medical referral.

**Key Words:** chiropractic, neonate, birth trauma, facial nerve palsy, forceps birth, shoulder dystocia, Bell's palsy, infant, facial nerve palsy, Erb's palsy, torticollis, wry neck, plagiocephaly, VBAC, cephalhematoma, neuropraxia, brachial plexus

## Introduction

Pediatric patients can present to chiropractic clinics with traumatic birth-related injury. There may be one or multiple injuries to account for presenting symptomatology. Birth-related brachial plexus palsy (Obstetric Brachial Plexus Palsy, OBPP) occurs in approximately 1/1000 live births.<sup>1</sup> It is widely recognized that the majority of such injuries occur in association with shoulder dystocia.<sup>2</sup> Unilateral upper plexus nerve root lesion (C5-C6, Erb's Palsy) is the most common presentation.<sup>3</sup>

Paralysis of the facial nerve (Bell's Palsy), occurs in approximately 4/1000 births,<sup>4</sup> and may be seen in conjunction with or separate to other birth injuries. It is likely due to the associated traction and compressive forces of instrumentation (Bell's palsy is seen in 9/1000 forceps births)<sup>4</sup> and difficult delivery.<sup>5</sup>

There are few documented cases of obstetric trauma involving neuropraxias (incomplete paralysis) to both the

facial nerve and brachial plexus in neonates.<sup>6</sup> This case features a pediatric patient who presented to a chiropractic clinic in Australia following a complicated vaginal birth after Caesarean (VBAC) delivery.

## Case Report

**History:** A 2 week-old male child presented with his mother to a private family chiropractic clinic for assessment of facial asymmetry, following a forceps-assisted vaginal birth after Caesarean (VBAC) delivery at 37 weeks' gestation. Delivery was induced due to maternal pre-eclampsia. The patient's birth presentation was occiput-anterior, however as the delivery progressed, he presented with a right shoulder dystocia. At birth, he weighed 9.4 lb (4.3 kg), was 20.4 in. (52 cm) in length, with head circumference of 13.3 in. (34cm). APGARS were 5 & 7. His mother reported a history of feeding difficulty (poor latch) and facial and upper limb postural asymmetry present since birth. A hospital pediatrician assessed the patient within 24 hours of birth, with no long-term health concerns.

At the time of first consultation, his feeding had reportedly spontaneously normalized, however the facial and upper limb postural asymmetry remained. The

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**Figure 1. Patient at age 2 weeks with right-sided facial nerve palsy.**

mother described his facial expressions as ‘normal except for his droopy lip’ on the right side. She described his limb movements as bilateral and symmetrical, however his right arm would assume a waiter’s tip posture (wrist and fingers are flexed and faced backwards) at rest. He was otherwise thriving, happy and alert.

**Physical Examination:** On observation, a right deformational plagiocephaly, and left occipito-parietal cephalohematoma was noted. There were asymmetrical nasolabial folds, with lack of crease on right side and drooping lip (*see Figure 1*). Facial nerve motor function was diminished on the right side. Cranial nerve exam was otherwise normal. Superficial forceps bruising and abrasion was seen at the right TMJ and angle of the mandible.

Spontaneous movement of upper and lower limbs was bilateral and symmetrical. Postural exam revealed right shoulder internal rotation, right elbow extension, with right wrist flexion, which was persistent at rest. Regional spine and upper limb passive range of motion was within normal limits. There was a restricted quality of movement within passive right cervical rotation, and motion of the right upper limb. Primitive and Upper limb reflexes were normal. Dermatome assessment of the face and upper limb was unremarkable. On palpation, there were hypotonic right masseter; hypertonic and tender right scalenes; relatively hypertonic right shoulder internal rotators, elbow extensors, and wrist flexors; bilateral hypertonic suboccipital, and SCM muscles. Examination of the clavicle and upper limbs was unremarkable.

General tone was otherwise good. Chiropractic examination revealed cranial moulding with parietal overlap, right occiput extension, bilateral temporal extension, right sphenoid extension and right TMJ compression. Subluxation listings were noted at S1 (posterior) and C1 (right posterior).

**Treatment:** This patient was diagnosed with an acute mild muscle strain of the right scalenes (anticus, medius, posterior), and cranio-vertebral (cervical and sacral) subluxation complex; associated with mild traumatic right brachial plexus neuropraxia (involving 5th & 6th cervical nerve roots), and traumatic right-sided facial nerve palsy; right positional plagiocephaly and associated left occipito-parietal cephalohematoma.

Initial in-office management: Chiropractic craniosacral techniques were utilized in the care of this patient. These low-force static hold adjustments were made to the listed temporal and sphenoid bones, TMJ, cervical and sacral segments. Soft tissue therapy was performed on the scalene, suboccipital, and SCM muscles. Mobilization to the right shoulder, wrist and hand was performed.

**Initial in-home management:** The patient’s mother was instructed to perform light massage to scalene and masseter muscles. Daily prone playtime was encouraged, to take mechanical pressure off the plagiocephaly and avoid progression. Gentle mobilization of the upper limbs was also addressed.

**Follow-up in-office management:** Following resolution of the cephalohematoma and TMJ bruising at age 4 weeks, craniosacral techniques were introduced to the occiput and parietal bones. Soft tissue therapy was introduced to the masseter muscles bilaterally. Static hold craniosacral techniques were continued on the listed sacral, cervical and cranial structures. Mobilization and soft tissue therapy was continued for the right upper limb, and cervical spine.

**Follow-up in-home management:** The patient’s mother was coached on gentle bilateral cervical passive rotation stretches, suboccipital massage and appropriate activities to encourage active use of the upper limbs and cervical rotator and extensor muscles.

## Outcome

The patient’s attachment and breastfeeding had normalized spontaneously within 1 week of birth. Chiropractic care was initiated at 2 weeks. The cephalohematoma and TMJ abrasion resolved within 4 weeks of age, as noted on progress examination, and consistent with the natural history. Consistent gradual improvement in facial symmetry and upper limb posture was noted on observation, palpation, and neurological assessment during the first 3 months of management. Deformational plagiocephaly reduced over

a management period of 4 months. No adverse effects of management were reported.

Consultations were spaced initially twice per week for two weeks, then weekly to every other week for a period of 12 weeks.

## Discussion

There are few documented cases of obstetric trauma involving neuropraxia or palsy to both the facial nerve and brachial plexus in neonates.<sup>6</sup> This report appears to be the first documented case presenting to a chiropractic clinic. Individually, Erb's palsy occurs in approximately 1/1000 births,<sup>1,7</sup> and facial nerve palsy occurs in approx 4/1000 births (9/1000 births in which forceps are used).<sup>4</sup> These rates indicate a combined palsy involving both brachial plexus and facial nerves is relatively rare.

An open literature search covering PubMed, Medline, Proquest, Index to Chiropractic Literature, Informit, Cochrane Library, Metlib, Science Direct, Australian Bureau of Statistics, CINAHL, and Google search engine was performed. This yielded one other case of neonatal presentation. De Chalain, Clarke and Curtis<sup>6</sup> reported a case in 1997, of a patient diagnosed with 'coexistent Erb's and incomplete unilateral facial nerve palsy'. Their literature search found only 3 other documented cases in 30 years (1967-1997).<sup>6</sup> There were no apparent similar cases documented as presenting to a chiropractic office.

The proposed mechanisms of injury to the brachial plexus in neonates is a depressive traction to the shoulder away from the neck, most commonly associated with shoulder dystocia during vaginal delivery.<sup>6,7,8</sup> We know that shoulder dystocia occurs in approximately 1% of vertex deliveries<sup>2</sup> and up to 14% of these will result in brachial plexus neuropathy.<sup>6</sup> Other risk factors for brachial plexus injury are high birth weight (greater than 8.8 lb)<sup>9</sup>, and instrument-assisted delivery.<sup>10</sup> The most common brachial plexus injuries involve the upper cervical nerve roots (C5-6, Erb's palsy), producing the classic 'waiter's tip' upper limb posture. It produces a paralysis of the shoulder abductors, external rotators, elbow flexors and wrist extensors. Reflexes are often diminished, and there may be sensory deficit over the C5 dermatome.<sup>11</sup>

This patient's birth weight, 9.4 lb (4,310 grams), was greater than the Australian national average of 7.4 lb (3,370 grams),<sup>12</sup> and he suffered a shoulder dystocia, and a forceps delivery; increasing his risk of injury. The brachial plexus palsy resulting was less severe than the

classic flaccid paralysis, the waiter's tip posture was not fixed, and reflexes remained normal. This presentation was an incomplete paralysis. Plexus injury may simply cause a temporary conduction deficit leading to partial paralysis called a neuropraxia.<sup>2,13</sup>

Facial nerve palsy is most likely associated with the compressive forces of forceps instrumentation during the birth process. Cranial and facial asymmetry has a high correlation with forceps delivery, a bigger baby and birth trauma.<sup>5</sup> The need for forceps in this case was dictated by the complicated second stage of delivery due to shoulder dystocia. Bell's palsy typically presents as lack of facial expression on the involved side, including loss of the nasolabial fold, incomplete closure of the eyelid and inability to draw back the corner of the mouth. In this case the patient was able to almost completely close his right eye, but right side of his mouth drooped. As with de Chalain, Clarke and Curtis' case, the "TMJ and mandible grazing suggests the forceps were responsible for facial nerve palsy".<sup>6</sup> The use of forceps and vacuum extraction techniques increase the risk of craniofacial lesions,<sup>14</sup> which also accounts for the cephalhematoma in this case.<sup>15</sup>

Differential diagnoses of brachial plexus and facial nerve neuropraxia include, but are not limited to, spinal cord lesions, avulsion of cervical nerve roots, neuroma, syringomyelia, herpes zoster, and fracture of the humerus or clavicle. These conditions often produce more severe, fixed, progressive or systemic signs and symptoms, which may be investigated with EMG, radiography or MRI.<sup>16,3,11</sup>

The prognosis for brachial plexus lesions is generally good.<sup>3,13,17</sup> Zafeririou reported "70-95% of infants born with OBPP recovered complete function with physical therapy only within 12 months."<sup>3</sup> In severe cases, especially those involving lower cervical nerve roots, avulsion, or Horner's syndrome, surgical intervention may be required. Permanent upper limb weakness is a serious complication of severe cases (.5/1000 births),<sup>10</sup> and not all respond favorably to surgery.<sup>3</sup>

The prognosis for Bell's palsy is excellent. One study found that "21 out of 28 neonates with facial nerve palsy recovered fully after an average period of 24 days."<sup>4</sup> Peitersen's research supports this, finding that "85% of patient function was returned within 3 weeks of sustaining Bell's palsy injury."<sup>17,18</sup> In neonates, injury to the jaw or mandible, coupled with paralysis of facial muscles seen with Bell's palsy, may have an adverse impact on the early establishment of breastfeeding. This patient showed steady



improvement in facial nerve function over the course of the 3 months following birth, despite initial problems latching during breastfeeding (lasted no longer than 7 days).

Healing time was slightly longer than compared with the literature on isolated palsies of the facial nerve and brachial plexus. However it is feasible that complicated cases involving more than one palsy may indicate significant trauma that requires more tissue regeneration than an isolated injury.

Appropriate management of both palsies is dependent on sufficient neonatal history and examination. Severe cases require surgery, although the vast majority may be managed conservatively with manual therapy.<sup>13</sup> Therapy is aimed at maintaining upper limb and cervical range of motion (to prevent muscle contracture through soft tissue therapy and stretches) and improve strength in affected muscle groups through exercise.<sup>11,3,13</sup>

In a search of the chiropractic literature, there did not appear be any other cases featuring both obstetric-related facial nerve and brachial plexus involvement. This case documents mild and transient examples of both palsies, where a trial of conservative chiropractic care was initiated. If the patient's condition had failed to show any improvement over 4 weeks, or if their symptoms had progressed, referral to a neurologist would have been necessary.<sup>11</sup>

**Conclusion**

This case reports on a rare, combined obstetric palsy in a neonate presenting to a chiropractic clinic. The patient suffered a mild and incomplete palsy of the brachial plexus and facial nerve on the right side. Signs and symptoms in this case were mild and self-limiting, however practitioners should be aware that severe cases might result in long-term disability. Close monitoring of the patient's signs and symptoms is recommended in order to determine whether continuing to manage conservatively is appropriate.

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# Resolution of Hypertonicity in a Pediatric Patient Undergoing Chiropractic Care: A Case Report

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## ABSTRACT

**Objective:** To present a clinical case that reviews how chiropractic care may have benefited a pediatric patient who presented with hypertonicity of the extremities.

**Design:** A case report

**Setting:** Private practice

**Clinical Features:** A four month old female infant presented to a chiropractic office with a history of hypertonicity of the musculature of the extremities since birth. The infant also demonstrated delayed motor development.

**Intervention and Outcome:** Full spine adjustments and cranial adjustments were administered over a period of six months. Resolution of the infant's hypertonicity occurred after seven visits and was maintained for the six month period the infant was under chiropractic care. Improvement was also noticed in the infant's behaviour and motor development. No other treatment modalities were introduced during the course of chiropractic care.

**Conclusion:** It is the author's hypothesis that chiropractic spinal and cranial adjustments contributed to the resolution of this infant's hypertonicity and aided in the development of her motor skills. Little research has been cited on this topic and further investigation is needed.

**Key Words:** chiropractic, adjustment, subluxation, hypertonicity, pediatric

## Introduction

Abnormalities in muscle tone are a common component of motor disorders in children. They are commonly classified as either hypertonic or hypotonic and symptoms range from mild, to severe and disabling.<sup>1</sup> Hypertonicity is marked by an abnormal increase in muscle tension and reduced ability of a muscle to stretch from its resting position.<sup>1</sup> Hypertonicity occurs without conscious control and can only be determined when the patient is attempting to maintain a relaxed state of muscle activity while the examiner attempts to put the joint through passive range of motion. The resistance felt to movement is not velocity dependant and may be so severe that movement about that joint cannot occur.<sup>1,2</sup> At rest the muscle's tone may appear either increased or decreased.<sup>1</sup>

Motor disorders result from injury to the developing motor pathways in the cortex, basal ganglia, thalamus, cerebellum, brainstem, central white matter, or spinal cord.<sup>1,2</sup> The most common cause of neonatal hypertonicity is intra-uterine injury to the corticospinal tract or extrapyramidal system causing hypoxic-ischemic lesions.<sup>2,3</sup> Other causes include oxygen deprivation during birth more commonly seen in assisted delivery with excessive cervical traction,

stroke in utero, meningeal inflammation (secondary to bacterial meningitis or haemorrhage) and severe bilateral cerebral injury or basil ganglia injury.<sup>2,3,4</sup>

Diagnostic criteria for infant hypertonicity are as follows:

- In the first two months of life the infant can sustain a fully elevated head when prone
- The infant prefers to lie on their side or arch backwards extending their legs, rather than rest in the normal flexed position
- Excessive hand fisting or more sustained fisting
- The infants muscles feel firm, decreased voluntary movements in their extremities, reduced joint range of motion
- Overactive deep tendon reflexes, maintained primitive reflexes, and clonus may be present
- Grasp reflex is sustained and increased
- Moro reflex is excessive and prolonged
- Sustained tonic neck reflex
- Primitive reflexes last beyond expected age<sup>5</sup>

Hypertonicity, among other things, can delay or restrict an infant's motor development. Each motor skill learned by the infant is essential for both brain development and their ability to master the next skill level. An infant must master

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head control before they can sit up, crawl before they can stand and stand before they can walk. An infant with muscle hypertonicity may appear to master head control at a very early age, but be delayed or unable to roll over or sit due to lack of voluntary muscle control. The motor pathways that are connecting at a young age have been shown to influence sensory integration and behaviour.<sup>1,6</sup>

### Case History

A four-month-old female infant presented to the chiropractor with primary parental concerns of hypertonicity of the musculature of the arms and legs bilaterally.

Pertinent history reported by the mother revealed the pregnancy was without incident and the infant was delivered vaginally in hospital. The mother was chemically induced and an epidural was administered. The infant was posterior presentation and both forceps and suction were utilized during the birthing process.

The infant weighed 2.82 kg at birth and measured 46cm. She was exclusively breastfed for the first month of life, after which formula was introduced.

The mother reported that her daughter had high muscle tone in her arms and legs since birth. Her limb movements were stiff and jerky; however, she did not appear to be in any discomfort at rest or with movement. The mother also reported that she had difficulty burping the infant and that she consistently cried when placed on her stomach to play. The mother had been giving her daughter an oral medication used to alleviate gas and colic. This had been used with limited success to assist with burping. The mother denied administering any other medication or antibiotics, but stated that her daughter had been fully immunized to date on the routinely recommended immunization schedule.

### Physical Exam

A thorough physical exam was performed that included vital signs, neurological, orthopedic, extremity, cranial and spinal assessment for signs of vertebral subluxation. The infant had noticeable tension in her arms and legs, preferring to keep her elbows, hips and knees locked into an extension position when lying supine. She did not show any discomfort on her face when the joints of her upper and lower extremities were moved passively through range of motion, however her legs were very difficult to flex at the hip and knee and required considerable strength to do so. There were no abnormal clicks felt during motion of

her extremities. Orthopedic examination was difficult to perform due to the infant's muscle tension.

Primitive reflexes (acoustic blink, atonic neck reflex, palmer grasp, Moro) were present as a normal finding of infant automatisms; however, these reflexes appeared sustained and exaggerated. Patella reflex was symmetrical and appeared normal. Babinski reflex was initially asymmetrical with her right foot producing a flexor response.

Chiropractic examination revealed increased muscle tension in the right upper cervical area at C1 and decreased right rotation at C1. Palpation revealed atlas to be subluxated superiorly and laterally to the right. Increased muscle tension and right posterior rotation was also noted at T6 level. Range of motion in the pelvis showed reduced manual extension of the left sacrum and reduced joint play of the left sacroiliac joint consistent with a left posterior sacrum. Cranial examination revealed dysfunction of the sphenoid, temporal and occipital bones.

Developmentally the infant was able to support her head independently and make facial expressions (smile, grimace, etc), but was not able to support her head and shoulders with her forearms when placed prone, reach for familiar objects, or hold objects when placed in her hand. These milestones would be expected of an infant three to four months old. The infant's developmental age was more consistent with a two month old.<sup>7</sup>

### Chiropractic Care

The infant's initial care plan included chiropractic spinal and cranial adjustments on a weekly basis for six weeks to address subluxations. The frequency of visits was then reduced to fortnightly for two visits, three weekly for two visits, followed by monthly for three visits. This care schedule was determined by the ability of the infant to integrate and retain function at the vertebral levels that were adjusted, as well as continued monitoring of developmental progress.

The infant presented with different levels of spinal involvement over the six month period she was under chiropractic care; however, the main areas of subluxations continued to be in the upper cervical spine and pelvis.

The infant's subluxations were addressed using sustained light fingertip pressure in the cervical spine, and low setting activator adjustments for the thoracic spine, lumbar spine, and pelvis. Cranial misalignments were released using light pressure applied through the chiropractor's

fingertips into the direction of ease until a release was felt (15-30 seconds).

The most consistent subluxation findings were adjusted as follows:

- The atlas subluxated laterally and superiorly to the right and was corrected with the infant lying supine. Using an index finger contact sustained light pressure was applied to the transverse process of atlas in a lateral to medial line of correction.
- T6 was adjusted using the activator on low setting with the contact point on the right transverse process in an anterior, superior and slightly medial line of correction.
- The sacrum was corrected using the activator on a contact point just lateral to the second sacral tubercle on the left, in a straight posterior to anterior direction.

The mother was given instructions to flex the infant's limbs when she is lying supine, bringing her alternate arm and leg together to encourage movement and cross motor patterning. The mother was also advised against putting her daughter in a 'Jolly Jumper' (a swing suspended by springs from a door jamb) and encouraging her to stand up, both of which she was doing on a regular basis.

At each visit subluxations were adjusted as they were clinically indicated. During this six month period no additional therapies were introduced and no adverse events as a result of the adjustments was reported.

## Results

The infant's improvement was monitored by the mother and chiropractor over the course of six months. The hypertonicity in her shoulders was the first symptom to resolve. This was significantly reduced by the third visit with the infant actively flexing her upper extremity and now able to support herself on her forearms when prone. The mother also reported it was easier to move her arms when dressing and undressing her. Her upper extremity muscle tone appeared normal on the fourth visit and she no longer had difficulty burping. The hypertonicity in her legs showed minor improvement over the first four visits, was significantly reduced by the sixth visit, and resolved by the seventh visit. The infant was now initiating hip and knee flexion regularly, something that she was not doing previously. There was no longer resistance to passive hip and knee flexion at this or subsequent visits. At seven-months-old she had integrated her primitive reflexes. No further neurological abnormalities were detected.

At the infant's final visit her biological and developmental age were consistent. At ten-months-old she was using two syllable words, cross-crawling, and beginning to pull up to a standing position using objects around the room.

## Discussion

At the most primary level hypertonicity results from interference to the negative feedback loop of the simple spinal reflex.<sup>8</sup> Research by Seaman and Winterstein hypothesizes that subluxations result in aberrant mechanoreceptor input from spinal joints, resulting in dysafferentation, which may cause abnormal neural activity within the cerebellum, brainstem, and higher cortical centres.<sup>8</sup>

Many motor disorders of childhood have underlying abnormalities in muscle tone. The most common is cerebral palsy with an incidence of 2-5/1000 births.<sup>1,5</sup> The diagnosis of cerebral palsy is often not fully characterized, and therefore diagnosed, until 12 to 24 months of age when the child's development can be more accurately be assessed.<sup>9</sup>

There are no studies in the literature citing the use of chiropractic care in infants with muscle hypertonicity, however there are studies that explore the link between infant hypertonicity, developmental delay and learning disabilities.<sup>1,6,10,11</sup> The most apparent delays were in speech and language development, fine motor control, and behavioural difficulties.<sup>6,10,11</sup> There is increasing evidence that children with motor disorders are more likely to have abnormal sensory integration, in particular, difficulty with proprioception and tactile sensation.<sup>1</sup> A study by Baker et al suggested that children with delay in motor development are three times more likely to have behavioural problems than children that develop normally.<sup>6</sup>

Developmental and behavioural problems are often not diagnosed until five years of age; however, early signs may be picked up at two years of age.<sup>10,11</sup>

## Conclusion

Chiropractic management of extremity hypertonicity using a combination of spinal adjustments, cranial adjustments, and home care exercises produced positive responses in an infant. In this author's opinion, this response indicates the need for further study and documentation of chiropractic care on children and infants with muscular hypertonicity.

## Patient Consent

Consent has been obtained from the patient's mother to publish information pertaining to her child without divulging personal identifiers.

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# Abstracts of Interest

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Wang J, Liu AH. Food Allergies and Asthma. *Curr Opin Allergy Clin Immunol* 2011; 11(3): 249-254.

**PURPOSE OF REVIEW:** To consider the possible links between food allergy and asthma. Recent findings: Food allergy and asthma coexist in many children, and recent studies demonstrate that having these comorbid conditions increases the risk for morbidity. Children with food allergies and asthma are more likely to have near-fatal or fatal allergic reactions to food and more likely to have severe asthma. **SUMMARY:** Although a causal link has not been determined, increased awareness of the heightened risks of having both of these common childhood conditions and good patient/parent education and management of both conditions can lead to improved outcomes.

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Saricoban HE, Ozen A, Harmanci K, Razi C, Zahmacioglu O, Cengizlier MR. Common behavioral problems among children with asthma: is there a role of asthma treatment? *Ann Allergy Asthma Immunol* 2011 Mar;106(3):200-4. Epub 2011 Jan 6.

**BACKGROUND:** An increased prevalence of behavioral problems has been described among children with asthma. **OBJECTIVE:** To investigate those associations between common behavioral problems and asthma, with an emphasis on the roles of medications used for asthma. **METHOD:** We studied 409 children who had been followed-up in pediatric allergy clinics and 157 age-matched healthy controls. A diagnostic and statistical manual disorder-referenced symptom inventory was used to assess "attention deficit-hyperactivity disorder" (ADHD), "attention deficit" (AD), "hyperactivity and impulsivity" (HI), and "oppositional defiant disorder" (ODD) behavioral problems. **RESULTS:** The study group consisted of 409 patients (male: 251, female: 158), with a mean age of  $9.0 \pm 2.67$  years, and the control group consisted of 157 children (male: 75, female: 82), with a mean age of  $9.0 \pm 2.86$  years. Prevalences of AD, hyperactivity, ADHD, and ODD were not significantly different between the study and control groups. Among those patients receiving leukotriene antagonist (LA) drugs adjunctive to inhaled corticosteroids (ICS), duration of treatment was correlated with total scores calculated for hyperactivity ( $P = .035$ ,  $r = 0.432$ ), AD ( $P = .044$ ,  $r = 0.414$ ), ADHD ( $P = .042$ ,  $r = 0.418$ ), and ODD ( $P = .032$ ,  $r = 0.439$ ). Among patients with asthma, children with ODD had a significantly longer duration of LA+ICS use ( $P = .024$ ) compared with those

with no ODD. Patients with hyperactivity had a longer duration of ICS+LA use compared with those with no hyperactivity ( $P = .009$ ). Patients with asthma receiving LA+ICS treatment had a higher risk for oppositional behavior (4.282 times compared with the control group [ $P = .042$ , confidence interval (CI): 1.542-15.949]) and 8.3 times compared with patients with asthma not using any drug ( $P = .021$ , CI: 1.419-48.543). **CONCLUSION:** Rather than asthma itself, adjunctive use of ICS+LA therapy appears to be related with symptoms of common behavioral problems, including hyperactivity, AD, ADHD, and ODD and to increase the risk of ODD.

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Tibosch MM, Verhaak CM, Merkus PJ. Psychological characteristics associated with the onset and course of asthma in children and adolescents: a systematic review of longitudinal effects. *Patient Educ Couns* 2011;82(1):11-9.

**OBJECTIVE:** to systematically review all available studies that investigated the longitudinal relationships between the psychological characteristics of children and adolescents suffering from asthma and those of their caregivers, and the onset and course of the asthma. **METHODS:** relevant studies were identified using Medline, PubMed, and PsychINFO between 1970 and September 2009. **RESULTS:** twenty studies matching inclusion criteria were reviewed. Six studies focused on child-specific psychological characteristics in relation to the onset and course of asthma. No compelling evidence was found for an association with asthma onset, but there was some evidence that the child's psychological characteristics can contribute to the subsequent course of asthma. Fourteen studies considered the effects of the psychological characteristics of the caregivers. Eleven studies found significant relationships between the psychological problems of caregivers and the subsequent onset and unfavorable course of the asthma in the child. **CONCLUSION:** In pediatric asthma both the psychological characteristics of the affected children and their caregivers appear to contribute to the course and possibly also to the onset of the condition.

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Chen J, Sadakata M, Ishida M, Sekizuka N, Sayama M. Baby massage ameliorates neonatal jaundice in full-term newborn infants. *Toboku J Exp Med* 2011; 223(2):97-102.

Neonatal jaundice is a common physiological problem affecting over half of all full term and most preterm infants.

Thus, newborn infants must be monitored for signs of hyperbilirubinemia to prevent acute bilirubin encephalopathy or kernicterus. Evidence exists supporting the benefits of baby massage as a form of mild hand to skin contact, to increase neonatal physical and mental development. In the present study, the effects of gentle baby massage on neonatal jaundice in full term newborn infants were evaluated by a controlled clinical trial. The inclusion criteria of newborn neonates were as follows: (1) gestational age of 37-41 weeks, (2) birth weight of 2,800-3,600 g, (3) Apgar score at birth of 8-10, and (4) being a healthy neonate without neonatal asphyxia and hemolytic condition. Breastfed newborns without phototherapy were included: 20 in the massage group and 22 in the control group. We found the mean stool frequency of the massaged infants on day 1 and day 2 (4.6 and 4.3) was significantly higher than that of the control group (3.3 and 2.6) ( $p < 0.05$ ). The transcutaneous bilirubin levels on the second to fifth day and serum total bilirubin levels on fourth day were significantly decreased in the massage group, compared to the control group. In conclusion, baby massage at an early stage after birth could reduce neonatal bilirubin levels. We suggest baby massage is beneficial for ameliorating neonatal jaundice.

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**Eppl A. Infant massage for children with disabilities and special needs. *Pract Midwife* 2011 Feb;14(2): 30, 32.**

Baby massage is a wonderful way for parents to use positive touch. This gives the opportunity for special time together, incorporating not only the massage but also therapeutic hugs and holds, fun with nursery rhymes and music. Baby massage is also a fantastic way for parents to learn how their baby communicates with them, enabling parents to understand what their baby wants and comfort them with loving touch.

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**Reedy J, Krebs-Smith SM. Dietary Sources of Energy, Solid Fats, and Added Sugars among Children and Adolescents in the United States. *J Am Dietetic Assoc* 2010 Oct; 110(10) ;1477-1484.**

**OBJECTIVE:** The objective of this research was to identify top dietary sources of energy, solid fats, and added sugars among 2- to 18-year-olds in the United States. **METHODS:** Data from the National Health and Nutrition Examination Survey, a cross-sectional study, were used to examine food sources (percentage contribution and mean intake with standard errors) of total energy (data from

2005-2006) and energy from solid fats and added sugars (data from 2003-2004). Differences were investigated by age, sex, race/ethnicity, and family income, and the consumption of empty calories — defined as the sum of energy from solid fats and added sugars — was compared with the corresponding discretionary calorie allowance. **RESULTS:** The top sources of energy for 2- to 18-year-olds were grain desserts (138 kcal/day), pizza (136 kcal/day), and soda (118 kcal/day). Sugar-sweetened beverages (soda and fruit drinks combined) provided 173 kcal/day. Major contributors varied by age, sex, race/ethnicity, and income. Nearly 40% of total energy consumed (798 of 2,027 kcal/day) by 2- to 18-year-olds were in the form of empty calories (433 kcal from solid fat and 365 kcal from added sugars). Consumption of empty calories far exceeded the corresponding discretionary calorie allowance for all sex-age groups (which range from 8% to 20%). Half of empty calories came from six foods: soda, fruit drinks, dairy desserts, grain desserts, pizza, and whole milk. **CONCLUSIONS:** There is an overlap between the major sources of energy and empty calories: soda, grain desserts, pizza, and whole milk. The landscape of choices available to children and adolescents must change to provide fewer unhealthy foods and more healthy foods with less energy. Identifying top sources of energy and empty calories can provide targets for changes in the marketplace and food environment. However, product reformulation alone is not sufficient — the flow of empty calories into the food supply must be reduced.

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**Li S, Yu B, Lin Z, Jiang S, He J, Kang L, Li W, Chen X, Wang X. Randomized-controlled study of treating attention deficit hyperactivity disorder of preschool children with combined electro-acupuncture and behavior therapy. *Complement Ther Med* 2010 Oct;18(5):175-83.**

**OBJECTIVE:** To study the effectiveness of electro-acupuncture with behavior therapy on preschool children with attention deficit hyperactivity disorder (ADHD). **METHODS:** 180 preschool children with ADHD diagnosed by DSM-IV were classified into three subtypes: predominantly inattentive subtype (PI subtype, 60 cases), predominantly hyperactive-impulsive subtype (HI subtype, 60 cases) and combined subtype (CT subtype, 60 cases). In each subtype, the patients were recruited randomly into experimental group, which received electro-acupuncture and behavior therapy; and control group, which received sham electro-acupuncture and behavior therapy. The treatment efficacy was evaluated by measuring the change in core symptoms of ADHD according to the standard enacted by the national traditional Chinese medicine committee

after 12 courses of treatment (lasted 12 weeks) and relapse rate was evaluated after a half-year follow up. **RESULTS:** (1) In PI subtype, 11 cases showed effectiveness with treatment and 12 cases showed improvement with treatment among experimental group, while five cases showed effectiveness and 12 cases showed improvement among control group; in HI subtype, 10 cases showed effectiveness and 17 cases showed improvement among experimental group, while four cases showed effectiveness and 14 cases showed improvement among control group; in CI subtype, 12 cases showed effectiveness and 12 cases showed improvement among experimental group, while five cases showed effectiveness and 12 cases showed improvement among control group; The overall comparison manifested that the efficacy of experimental group was better than that of control group ( $p < 0.05$ ). (2) The core symptoms of experimental group were significantly decreased than that of control group at half-year follow up ( $p < 0.05$ ). **CONCLUSION:** The treatment of ADHD in preschool children with electro-acupuncture combining behavior therapy has positive effect in reducing symptoms of ADHD. Adverse events are mild to patients. It is recommendable for this combined therapy, while multi-center RCT needs to be further studied.

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**Miller J. Demographic Survey of Pediatric Patients Presenting to a Chiropractic Teaching Clinic. *Chiropractic & Manual Therapies* 2010 (Dec 15); 18: 33.**

**BACKGROUND:** Considering the increasing use of alternative therapies for children, it is appropriate to determine the demographic profile of pediatric patients entering a chiropractic clinic. **METHODS:** Collection of demographic data including age, gender, condition at presentation, previous clinicians consulted and medical referral rates of pediatric patients presenting to a chiropractic teaching clinic between 2006 and 2010. **RESULTS:** Over-all, 20.5% of patients were aged between two days and 15 years and classified as pediatric patients. The most common presenting complaint was musculoskeletal (35%). Excess crying (30%) was the most common complaint in the largest presenting age group which was under 12 weeks of age (62.3%). All children had previously presented for medical care for the same condition. Most (83%) of the infant patients under 12 weeks of age were referred for care by a medical practitioner. **CONCLUSION:** Parents commonly presented their child for care at this chiropractic clinic with a recommendation from a medical practitioner. The most common complaints were musculoskeletal and excessive crying conditions and the most prevalent age group was under 12 weeks of age.

**Lund GC, Edwards G, Medlin B, Keller D, Beck B, Carreiro JE. Osteopathic manipulative treatment for the treatment of hospitalized premature infants with nipple feeding dysfunction. *J Am Osteopath Assoc* 2011 Jan;111(1):44-8.**

Premature newborns and infants are usually required to successfully transition from gavage to nipple feeding using breast or bottle before discharge from the hospital. This transition is frequently the last discharge skill attained. Delayed acquisition of this skill may substantially prolong hospital length of stay. The authors describe a case of hospitalized premature twins who had considerable delays in attaining nipple-feeding skills. Because of their inability to take all feedings by nipple, preparation for surgical placement of gastrostomy tubes was initiated. Before the surgeries were scheduled, the inpatient osteopathic manipulative medicine service was consulted, and the twins received a series of evaluations and osteopathic manipulative treatment (OMT) sessions. During the OMT course, the twins' nipple feeding skills progressed to full oral feeding, which allowed them to be discharged to home without placement of gastrostomy tubes. The authors also review the literature and discuss the development of nipple feeding in premature newborns and infants and the use of OMT in the management of nipple feeding dysfunction.

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**Dollberg S, Botzer E. Neonatal tongue-tie: myths and science. *Harefuah* 2011 Jan;150(1):46-9, 67.**

Anatomical restraining of tongue movement (tongue-tie, ankyloglossia) has been known for centuries and the subject of dozens of articles. The heated debate persists on its clinical significance and indications for treatment. Most authorities in the field of infant feeding and Lactation agree that breastfeeding problems, such as nipple pain and latching difficulties, are common signs of clinically significant tongue-tie and indications for performing a frenotomy, while the sole presence of a visible lingual frenulum is not. In contrast, the lack of a visible frenulum does not rule out the diagnosis of clinically significant tongue-tie since submucosal ties, also called "posterior tongue-tie", may interfere with efficient breastfeeding. Whether tongue-tie interferes with speech articulation to a significant extent is currently unknown. Theoretically, articulation of some consonants (e.g., /s/, /th/, /r/) would be affected by impeded tongue movement. These articulation problems are, however, less common than tongue-tie itself, and children and adults characteristically use various compensatory techniques of mouth opening and tongue movements. When it



is indicated, frenotomy is performed by lifting the tongue and snipping the frenulum with scissors. Complications of frenotomy are rare and consist mainly of self-limited minor bleeding. The significance of posterior tongue tie and the long-term effects of frenotomy performed during early infancy are unresolved issues.

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**Post ED, Rupert AW, Schulpen TW. Problematic breastfeeding due to a short frenulum. *Ned Tijdschr Geneeskd.* 2010;154:A918.**

Ankyloglossia (tongue tie) in the neonate can be a cause of breastfeeding problems. Frenotomy (cutting of the frenulum linguae) had fallen into disrepute, but has regained its place as a standard medical procedure in Anglo-Saxon countries, though not in the Netherlands. We present two neonates, both boys, presenting with breastfeeding problems caused by ankyloglossia. The first baby described did not drink enough and hence did not gain any weight. The mother of the second patient experienced a great deal of pain and had cracked nipples, caused by an abnormal suckling action. Both boys underwent frenotomy with good result. Recent ultrasound studies reveal that frenotomy immediately normalizes the suckling action in babies with ankyloglossia. Randomized controlled trials show that 95% of breastfeeding problems disappear. There is sufficient evidence to state that frenotomy is a very safe and useful procedure in neonates.

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**Edmunds J, Miles SC, Fulbrook P. Tongue-tie and breastfeeding: a review of the literature. *Breastfeed Rev* 2011 Mar;19(1):19-26.**

In Australia, initial exclusive breastfeeding rates are 80%, reducing to 14% at 6 months. One factor that contributes to early breastfeeding cessation is infant tongue-tie, a congenital abnormality occurring in 2.8-10.7% of infants, in which a thickened, tightened or shortened frenulum is present. Tongue-tie is linked to breastfeeding difficulties, speech and dental problems. It may prevent the baby from taking enough breast tissue into its mouth to form a teat and the mother may experience painful, bleeding nipples and frequent feeding with poor infant weight gain; these problems may contribute to early breastfeeding cessation. This review of research literature analyses the evidence regarding tongue-tie to determine if appropriate intervention can reduce its impact on breastfeeding cessation, concluding that, for most infants, frenotomy offers the best chance of improved and continued breastfeeding. Furthermore, studies have demonstrated that the procedure does not lead to complications for the infant or mother.

**von Piekartz H, Lüdtke K. Effect of treatment of temporomandibular disorders (TMD) in patients with cervicogenic headache: a single-blind, randomized controlled study. *Cranio* 2011 Jan;29(1):43-56.**

The present study was comprised of 43 patients (16 men) with cervicogenic headaches for over three months, diagnosed according to the International Classification of Diagnostic Criteria of Headaches (ICDH-II). The patients were randomly assigned to receive either manual therapy for the cervical region (usual care group) or additional manual therapy techniques to the temporomandibular region to additionally influence temporomandibular disorders (TMD). All patients were assessed prior to treatment, after six sessions of treatment, and at a six-month follow-up. The outcome criteria were: intensity of headaches measured on a colored analog scale, the Neck Disability Index (Dutch version), the Conti Anamnestic Questionnaire, noise registration at the mandibular joint using a stethoscope, the Graded Chronic Pain Status (Dutch version), mandibular deviation, range of mouth opening, and pressure/pain threshold of the masticatory muscles. The results indicate in the studied sample of cervicogenic headache patients, 44.1% had TMD. The group that received additional temporomandibular manual therapy techniques showed significantly decreased headache intensities and increased neck function after the treatment period. These improvements persisted during the treatment-free period (follow-up) and were not observed in the usual care group. This trend was also reflected on the questionnaires and the clinical temporomandibular signs. Based on these observations, we strongly believe that treatment of the temporomandibular region has beneficial effects for patients with cervicogenic headaches, even in the long-term.

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**O'Sullivan PB, Smith AJ, Beales DJ, Straker LM. Association of biopsychosocial factors with degree of slump in sitting posture and self-report of back pain in adolescents: a cross-sectional study. *Phys Ther.* 2011 Apr; 91(4): 470-83. E pub 2011 Feb 24.**

**BACKGROUND:** Conflicting evidence exists regarding relationships among sitting posture, factors that influence sitting posture, and back pain. This conflicting evidence may partially be due to the presence of multiple and overlapping factors associated with both sitting posture and back pain. **OBJECTIVE:** The purpose of this study was to determine whether the degree of slump in sitting was associated with sex and other physical, lifestyle, or psychosocial factors. Additionally, the relationship between the report of back pain made worse by sitting and the degree of slump in sit-

ting and other physical, lifestyle, or psychosocial factors was investigated. **DESIGN:** This was a cross-sectional study. **METHODS:** Adolescents (n=1,596) completed questionnaires to determine lifestyle and psychosocial profiles and the experience of back pain. Sagittal sitting posture, body mass index (BMI), and back muscle endurance (BME) were recorded. Standing posture subgroup categorization was determined. **RESULTS:** Multivariate analysis revealed that the most significant factor associated with the degree of slump in sitting was male sex, followed by non-neutral standing postures, lower perceived self-efficacy, lower BME, greater television use, and higher BMI. Multivariable analysis indicated poorer Child Behavior Checklist scores were the strongest correlate of report of back pain made worse by sitting, whereas degree of slump in sitting, female sex, and BME were more weakly related. **LIMITATIONS:** Causality cannot be determined from this cross-sectional study, and 60% of sitting posture variation was not explained by the measured variables. **CONCLUSIONS:** Slump in sitting was associated with physical correlates, as well as sex, lifestyle, and psychosocial factors, highlighting the complex, multidimensional nature of usual sitting posture in adolescents. Additionally, this study demonstrated that a greater degree of slump in sitting was only weakly associ-

ated with adolescent back pain made worse by sitting after adjustment for other physical and psychosocial factors.

**Source:** School of Physiotherapy, Curtin University of Technology, GPO Box U1987, Perth, Western Australia 6845, Australia.

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**Kotlow L. Diagnosis and treatment of ankyloglossia and tied maxillary fraenum in infants using Er:YAG and 1064 lasers. *Eur Arch Paediatr Dent* 2011 April; 12(2):106-12.**

**BACKGROUND:** Newborn babies often present oral conditions of ankyloglossia and tied maxillary fraena (lip-ties) associated with problems that can be related to breastfeeding. Many breastfeeding problems experienced by mothers and their babies may be attributed to abnormal attachments of the tongue and/or maxillary lip-tie. **REVIEW:** The various types of both lip and tongue ties are reviewed. The diagnostic tools for dental practitioners are evaluated and treatment options for these affected infants using either a 1064 InGaAsP semiconductor (diode) laser or a 2940 Er:UAG laser are described. **CONCLUSION:** This approach provides treatment without the need for hospitalization or general anaesthesia.



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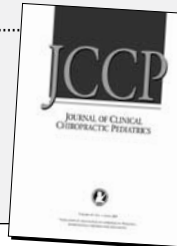


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