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Increasing the cervical lordosis in paediatrics:

A Chiropractic Biophysics© case series.

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Abstract: This case series describes the increase in cervical lordosis and resolution of symptoms in two pediatric males, aged 5 and 6-years of age. Both patients presented with neck symptoms and cervical hypolordosis. Both patients were treated using Chiropractic Biophysics technique including full-spine spinal manipulative therapy, mirror image drop-table adjustments with daily home cervical extension traction on the pediatric cervical Denneroll orthotic. Both received 18 treatments over 6.5- and 7.5-weeks, respectively. Both patients attained relief of symptoms and had a significant increase in cervical lordosis.

Indexing Terms: pediatrics; cervical lordosis; cervical spine.

Introduction

The cervical lordosis represents normal anatomy and is a requisite for having a full range of motion, optimized joint loading, protection of the cord and nerve roots, and the preservation of upright horizontal gaze. (1, 2, 3, 4, 5, 6) Traditionally, the cervical lordosis was thought to evolve after birth, during early development when the infant crawls, holding the head up, however, Bagnall et al. has determined that in the majority of fetuses studied (83%), the cervical curve is established as early as 7-9.5 weeks in-utero. (1)

There is little debate about the normal cervical alignment as being lordotic, in fact, a recent systematic review of 21 studies determined that even in asymptomatic cohorts, a cervical lordosis is the norm. (7) Regarding the precise shape of the cervical lordosis, Harrison et al. have published a circular cervical spine model for the adult. (8, 9) This model has been validated in a subsequent study using statistical methods to successfully differentiate between patients having acute or chronic symptoms versus asymptomatic participants based on lordotic or hypolordotic alignment. (10) Other studies have also verified that a normal lordosis in an adult should be in the range of about 31-42° as measured by the posterior tangent method (C2-C7). (11)

There is much less studied about the cervical lordosis in children. However, what is known is that the cervical lordosis in pediatrics is less established than in adults. Kasai et al. presented data on the pediatric

> *... we hypothesize that traumatic injury to the cervical spine by caesarian birth and other traumas may be an initiating factor for cervical subluxation leading to symptom evolution and progression during growth in children. Regardless, it may be prudent for routine radiologic screening of pediatrics presenting with cranio-cervical complaints who report having recent trauma and/or caesarean birth.*

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cervical lordosis from the ages of 2 to 18 years. (12) Converting to C2-C7 posterior tangents, their data shows that the lordotic curve in a 2-year old is about 31.7° and this gets straighter as the child ages to 9-years (21.1°) and then increases again until the age of 18-years, where it approaches the normal adult magnitude of curve (28.0°). (13)

In the chiropractic literature there are not many reports on the successful increase in pediatric lordosis. Oakley and Harrison presented a review of techniques that showed improvements in lordosis in the pediatric population. (13) They determined that as of September, 2015 there were only 10 located papers on restoring pediatric lordosis, of these only 6 included post-treatment X-ray measurements, and of these only 4 used reliable measurements. All 4 papers utilized CBP technique. (14, 15, 16, 17) There is an obvious need for more reports detailing improvements in cervical lordosis and health improvements as part of the chiropractic treatment involving children.

The purpose of this paper is to describe the successful use of CBP technique to improve the cervical lordosis and reduce symptoms in two pediatric patients who had various cranio-cervical complaints and who both had caesarian births and cervical subluxation.

Cases report

Two male pediatrics presented with cervical spine hypolordosis and/or kyphosis and various cranio-cervical complaints. Both patients had a caesarean birth. The patients received radiographs of the cervical spine that were analyzed using PostureRay (PostureCo Inc., Trinity, FL, USA). The method of measurement is the Harrison posterior tangent method which uses lines drawn contiguous with the posterior vertebral body margins. (18) A global measurement between C2-C7 is used for standard lordosis quantification. Anterior head translation (AHT) is measured as the horizontal distance between a line drawn vertically from the posterior-superior C2 body corner and the posterior-inferior C7 body corner. The atlas plane line (APL) is measured by the best fit line made between 3 points representing the anterior tubercle of C1, the mid-height of the posterior margin of the dens, and the anterior portion of the posterior spinous process. These lines are repeatable and reliable and have a standard error of measurement of approximately 2° and 2mm. (18, 19) A brief summary of relevant findings regarding each of the two patients are presented.

Patient A

A 5-year old male patient presented with his parents on 16 July 2017. The main complaint was reported to be recent neck pain and stiffness after neck trauma from a fall. The patient had a history of caesarean birth. Physical assessment showed normal range of motion and normal reflexes. The Adam's forward test was negative. Gait was normal. A visual posture examination showed a slight right lateral flexion of the head. Palpation revealed slight paraspinal tendernous bilaterally at the levels of C2-3 and C3-4. Lateral cervical radiography showed a loss of C2-C7 lordosis (-5.4°), AHT of 2.4mm and an APL of -20.1° (Figure 1).

Patient B

A 6-year old male patient presented with his parents on 04 August 2017. The primary complaints were reported to be neck stiffness and trouble concentrating. This patient also had a history of a caesarean birth. Visual assessment of gait was normal, range of motion was normal, reflex testing was normal and the screening orthopedic tests including Kemp's, Adam's, straight leg raiser, and Millgram's were all negative. Palpation revealed bilateral joint fixations with tenderness at the levels of C3-4 through C5-6. Visual posture assessment showed an AHT and right lateral flexion of the head. The patient had a military neck (0.7°), minimum AHT (3.4mm) and an APL of -5.8° (Figure 2).

Figure 1 Patient A: Lateral cervical images. Left: Initial image showing a -5.4° lordosis; Right: Post-treatment image showing a -29.1° lordosis.

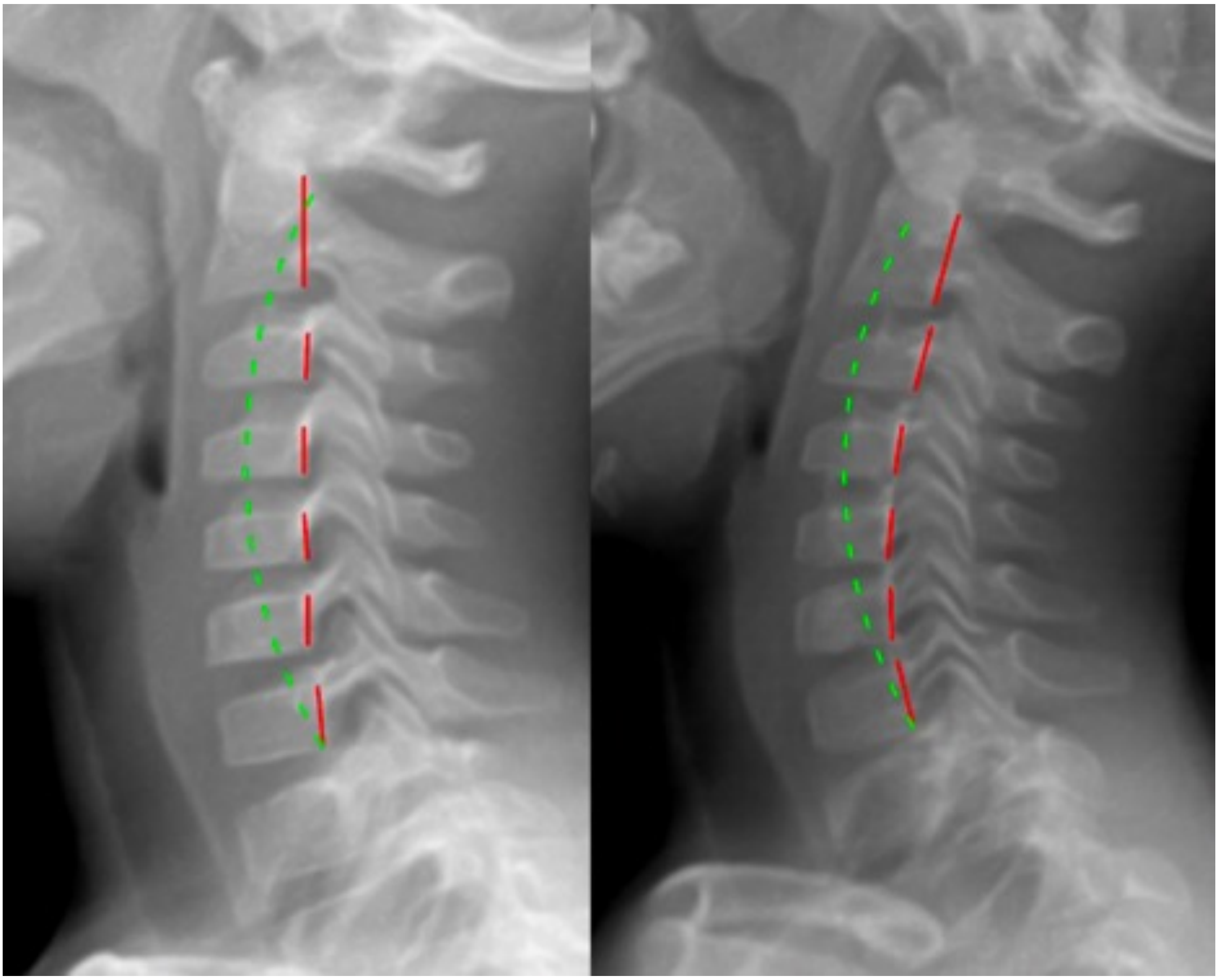

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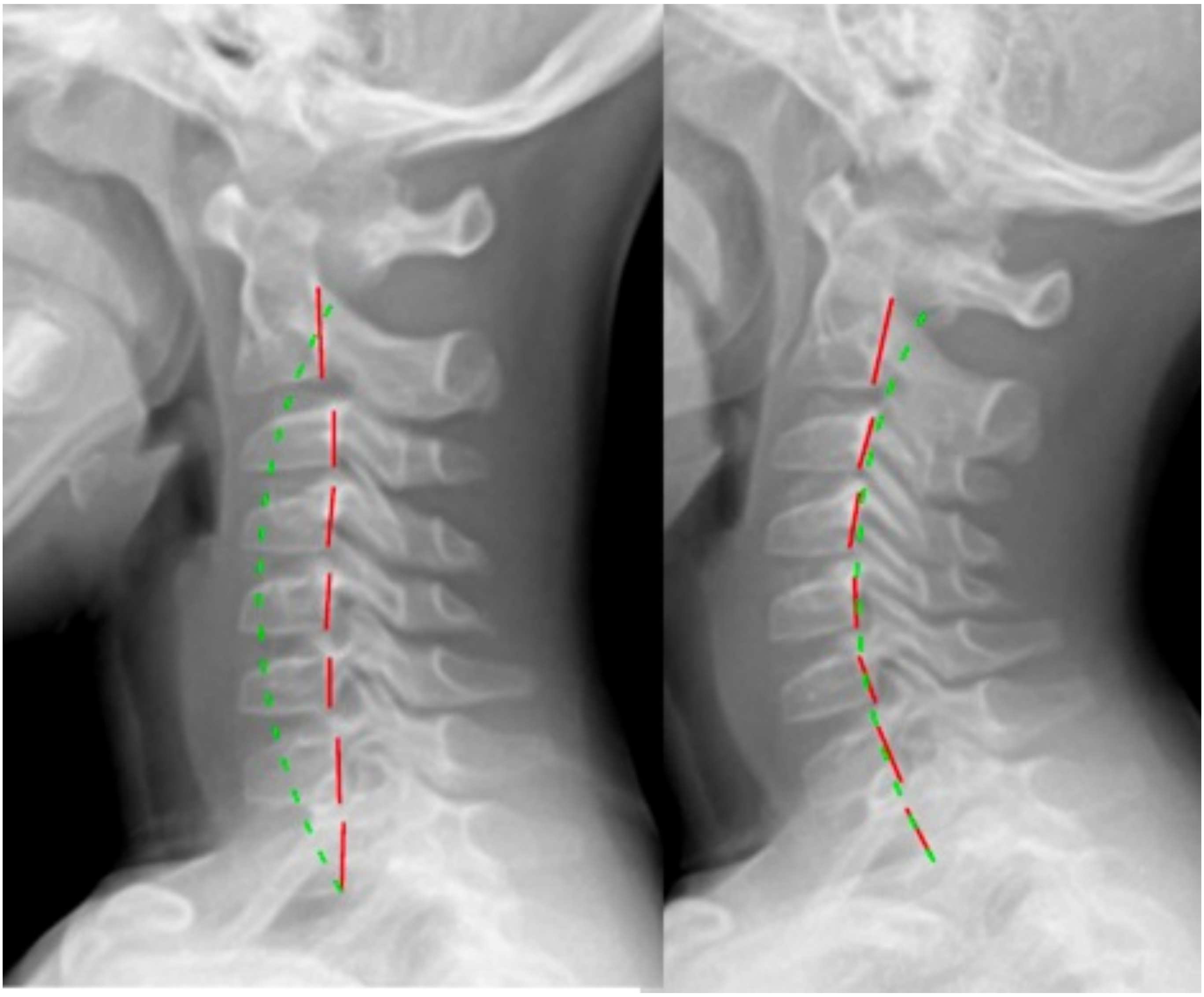
Figure 2 Patient B: Lateral cervical images. Left: Initial image showing a 0.7° lordosis; Right: Post-treatment image showing a -34.8° lordosis.



Intervention and outcome

Both patients were treated by TCN who practices CBP technique methods. (20-23) CBP is a full-spine and posture correcting program that uses the concept of mirror image® to stress the spine and related tissues towards the unique opposite to achieve the goal of improving the spine alignment to more ideal/normal. Regarding improving the cervical lordosis, CBP has a unique cervical extension traction method that has been proven effective for increasing the adult lordosis in many clinical trials. (24, 25, 26, 27, 28, 29)

All patients received mirror image postural adjustments on an Omni drop table as well as mirror image postural adjustments using an Impulse hand-held adjusting instrument (Neuromechanical Innovations Inc., Chandler, AZ, USA). Specifically, the instrument was used to stimulate the upper cervical and sacroiliac joints while the patient was placed in their unique mirror image posture while laying prone on the adjusting table. All patients were also shown how to properly perform the pediatric Denneroll traction orthotic so that it could be done at home safely on a daily basis during the treatment duration.

Patient A

CBP treatment included mirror image adjusting, diversified spinal manipulation and the pediatric Denneroll Orthotic. The goal was to reduce abnormal postures, improve neck pain and stiffness and improve the cervical lordosis. The patient received 18 treatments over approximately 6.5-weeks (03/16/17 to 04/26/2017), as well as performed daily home traction on the Denneroll from 03/24/2017 to 04/26/2017. Treatment resolved the neck pain and the stiffness as well as improved the cervical lordosis. A post-treatment radiograph showed a 24° increase in lordosis (-29.1° vs. -5.4°), with relative rotation angles (RRA) at C2/C3 +2.4 degrees and C5/C6 +4.8 degrees initially kyphotic corrected to be lordotic (C2/3= -0.1°; C5/6= -8.0°) (Table 1). The normal lordosis in a 5-year old should be about 27.4°. (13)

Patient B

CBP treatment included mirror image adjusting, diversified spinal manipulation and the pediatric Denneroll orthotic. The goals were to reduce abnormal postures, improve neck stiffness and increase the cervical lordosis. The patient received 18 treatments over a 7.5-week duration (07/28/17 to 09/20/17) as well as daily home traction on the Denneroll from 08/04/17 to 09/20/17. Treatment resolved all neck stiffness and improved concentration as reported by the parents. There was a 34° increase in cervical lordosis (-34.8° vs. 0.7°) with a 5.7° upper cervical kyphosis corrected to lordotic alignment (Table 1). The normal lordosis for a 6-year old should be about 26.2°, therefore, there was a slight over-correction. (13)

Table 1: Cervical spine alignment parameters from the pre- and post-radiographs for two pediatric patients (Patients A = 5yo, B = 6yo).

	Pre-treatment	Post-treatment
Patient A		
Lordosis	-5.4°	-29.1°
AHT	2.4mm	-5.7mm
APL	-20.1°	-27.9°
Patient B		
Lordosis	0.7°	-34.8°
AHT	3.4mm	1.5mm
APL	-5.8°	-23.0°

Discussion

This case series documents the successful increase in lordosis and improvements in health in two pediatric males who presented with cervical hypolordosis/kyphosis subluxation patterns.

As mentioned, there is ample evidence for increasing the cervical lordosis in the adult population by CBP extension traction methods. (24, 25, 26, 27, 28, 29) In the trials using the Denneroll orthotic, (24, 25, 26) the range of lordosis improvement was 13-14° over 30-36 treatment sessions. The average lordosis improvement in these two cases was 29.6° (23.7°; 35.5°) over approximately 5-weeks of daily home traction (traction was started 1-week after beginning treatment). Thus, 5-weeks of daily traction equates to about 35 traction sessions. The pediatric change in lordosis is therefore estimated to be about twice as large versus for an adult after the same number of Denneroll traction sessions.

Why would structural spine changes be easier attained in a pediatric versus an adult? As discussed in a recent report by Fedorchuk et al. (30) in a case of increasing the cervical lordosis in a 9-year old, the reason why a pediatric spine may change quicker than an adults may be due to '*the younger pediatric spine is less stiff as well as a smaller spine being weaker and more amenable to change from external forces.*' An adult spine is certainly larger and often stiffer than a pediatric spine. This highlights the importance of performing re-assessments earlier in the treatment of children and also after less treatments than the protocols typically used for the adult patient performing CBP treatment programs (i.e. 36 treatment sessions). (21, 22, 23)

Quicker spine changes in pediatrics also highlights the importance of considering age appropriate norms. As mentioned, Kasai et al. (12) presented average normal values for the pediatric cervical lordosis for the ages of 2 to 18-years. Kasai et al presented the data in Cobb angles measured from C3-C7. These Cobb values can be extended to include C2 by adding 2.7°, (31) and also converted to posterior tangents by adding 9°. (22) A table of the Kasai et al. values converted to posterior tangents from C2-C7 is presented by Harrison et al. (22) and Oakley and Harrison. (13) These values serve as the current best available data on the normative cervical lordosis in children and should be used by clinicians who rehabilitate the cervical lordosis in pediatrics.

Another important consideration in increasing the cervical lordosis in pediatrics is the very real possibility of 'over-correction.' As reported by Oakley and Harrison, (13) in 3 out of 4 reported case studies, there was overcorrection of lordosis in pediatric patients. The implications of this are not known, but no adverse reports were documented in the discussed cases. In this situation, it would be prudent in these cases to not recommend traction as a maintenance practice, only chiropractic adjustments. It was highlighted by Oakley that the possibility of over-correction could be substantial if the Harrison adult ideal value of 42.2° is applied as the goal of care to a 9-year old. (32) This is because Kasai et al.'s (12) converted normal value for a 9-year old equates to 21.1° lordosis, exactly half that of the 'ideal' adult curve of 42.2°. (32) This again highlights the importance of performing a repeat X-ray earlier than in treating the typical adult, a re-assessment with radiograph seems warranted after about 6 to 8-weeks after initiating treatment as was performed in these two patients. This recommendation only applies to patients who are performing procedures proven to increase the lordosis.

It is noted that one patient presented with a recent trauma to the cervical spine, and both had a history of caesarean birth. Cervical spine trauma by caesarian birth or other physical traumas to a small and weak cervical spine may very likely lead to subluxation. It is possible that cervical spine subluxation in young children may go undetected and lead to the development of symptoms during growth. Bastecki et al., for example, determined that after correcting the cervical lordosis in a 5-year old, a reversal of attention deficit/hyperactivity disorder was documented. (17) Katz et al. (33) recently found that when a lordosis is forced into a hypolordotic spine, an immediate increase in brain blood circulation was shown to occur. This may have implications in explaining the reduction in symptoms in patients who get their cervical spine lordosis increased from CBP treatment methods. This may also explain why in patient B, an improvement in concentration occurred after treatment.

It must be reiterated that the CBP incorporation of cervical extension traction is an evidence-based chiropractic procedure and it is a practice guided by X-ray. Thus, similar to the essential radiographic screening of the spine by spine surgeons, (34) the radiographic screening by CBP chiropractors and others that incorporate spine traction methods to correct spine alignment is mandatory. (35, 36) It is also safe to routinely screen patients with X-ray. (35, 36, 37)

Limitations to this case series include that there were only two patients. Further, there was no follow-up after treatment as neither of the two patients (parents) could be contacted. It was also assumed, according to parental declarations, that the home traction protocol was closely followed for each of the cases. Although since a multimodal treatment program was administered, theoretically it is not known which part of the treatment led to the increase in lordosis, however, in the carefully planned trials by Moustafa et al. it was definitively shown that cervical extension traction increases cervical lordosis. (24, 25, 26) Also, spinal manipulative therapy has never been shown to routinely increase the cervical lordosis. (29, 38, 39) The cases reported here were not randomly chosen or consecutively treated, but were selected as they demonstrate that CBP treatment for children can be effective for certain cases. There were no reports of adverse side effects from the treatment for either of the two cases. This is the first reported case series of improving the cervical lordosis in the pediatric population. Much more research into treating pediatrics is needed, particularly for the improvement of the cervical lordosis.

Conclusion

Chiropractic Biophysics technique with the use of the pediatric Denneroll orthotic was shown to be an effective treatment for improving symptoms and cervical lordosis in two pediatric males. Although only speculative, we hypothesize that traumatic injury to the cervical spine by caesarian birth and other traumas may be an initiating factor for cervical subluxation leading to symptom evolution and progression during growth in children. Regardless, it may be prudent for routine radiologic screening of pediatrics presenting with cranio-cervical complaints who report having recent trauma and/or caesarean birth.

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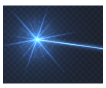

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Declaration

The *Journal* has sighted the patients consent. Dr. Paul Oakley (PAO) is a paid consultant for CBP NonProfit, Inc.; Dr. Deed Harrison (DEH) teaches chiropractic rehabilitation methods and sells products to physicians for patient care as used in this manuscript.

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