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Case Study

Is the cervical lordosis a key biomechanical biomarker in cervicogenic headache?: a Chiropractic Biophysics® case report with follow-up

Miles O. Fortner, DC[1], Thomas J. Woodham, DC[1], Paul A. Oakley, DC, MSc[2]*, Deed E. Harrison, DC[3]

[1] *Private Practice, USA*
[2] *Private Practice: Newmarket, ON, L3Y 8Y8, Canada*
[3] *CBP NonProfit, Inc., USA*

Abstract. [Purpose] To present the successful structural improvement in cervical lordosis in a patient suffering from cervicogenic headache having cervical kyphosis. [Participant and Methods] A 26 year old female presented with the primary complaint of headache. Radiography demonstrated a cervical kyphosis. Chiropractic BioPhysics® methods were used to restore the cervical spine alignment. Twenty-five treatments were given over 8 weeks. A 2.5 year follow-up was also reported. [Results] Radiography showed a dramatic increase in cervical lordosis following initial treatment. The patient also reported substantial reductions in headache frequency and severity as well as other bodily improvements, reduced disability and improved quality of life. The long-term follow-up showed a maintenance of lordosis correction and patient wellness. [Conclusion] A cervical kyphosis was reversed back to a normal lordosis in 8 weeks and coincided with dramatic resolution of cervicogenic headache in a young female. The cervical lordosis may be a key biomechanical biomarker in cervicogenic headache.

Key words: Cervical lordosis, Cervicogenic headache, Biomechanical biomarker

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INTRODUCTION

Cervicogenic headache (CGH) is defined as a "secondary type of headache caused by disorders of the cervical spine or any of its components"[1]. The treatment of CGH also has no universally accepted treatment protocol[2] which is problematic for manual therapists who are challenged by treating such patients. Better diagnostic biomarkers are needed in the understanding of the pathognomonic processes related to CGH; this should lead to improved treatment approaches.

There has been much interest in the structural shape of the cervical spine as it has been implicated as a key biomechanical biomarker for cervical spine disorders. The Harrison group have modelled the shape of the cervical spine as a portion of a circle[3–5], and have shown that patients having a deviated cervical spine alignment (subluxation) have a substantial increased likelihood of suffering from neck pains[5, 6]. McAviney et al., for example, determined that patients having a cervical kyphosis had an 18 × increased likelihood of suffering from neck pain than those with a lordosis[6].

Simultaneous with the evolution in the understanding of the cervical spine subluxation (hypolordosis, kyphosis, etc.) being implicated in cervical spine disorders, was the evolution of Chiropractic BioPhysics® (CBP®) methods showing the improvement of cervical lordosis via non-surgical cervical extension traction (CET)[7–9]. Indeed, several recent randomized controlled clinical trials have demonstrated that patients who receive multi-modal physiotherapy treatments that include

*Corresponding author. Paul A. Oakley (E-mail: docoakley.icc@gmail.com)

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CET have better long-term outcomes versus patients who get the same treatment less the CET[10–15]. A recent pilot trial has also shown that CET was effective in treating CGH[12]. The cervical spine alignment may be an important biomarker in those suffering from CGH.

The purpose of the present case is to profile a dramatic reversal in cervical kyphosis to a lordosis in a patient suffering from CGH.

PARTICIPANT AND METHODS

A 26 year old female presented with a primary complaint of chronic headaches causing nausea. The patient also reported suffering from thoracolumbar pain on the left, upper back and neck pains. There was no known cause of immediate trauma. The patient had just changed jobs to a desk job where she was seated the majority of the time. Previous trauma included a bicycle accident where she had hit her head in 2008.

Pain, disability and health-related quality of life (QOL) questionnaires indicated the patient scored a 66% (30/52 emotional; 36/48 functional) on the headache disability index (HDI)[16], a 40% on the neck disability index[17], a 44% on the Oswestry low back pain disability questionnaire (ODI)[18], and scored below normal on multiple QOL short form-36 categories[19] (Table 1).

Physical examination showed the patient had some minor postural issues including a lower pelvis on the right. Palpation of the spine revealed hypertonicity of the paraspinal muscles, point tenderness and motion restriction at C2, T3, T7 and L3. Orthopedic tests of foraminal compression, Jackson compression and Maximal compression were positive with localization to the left. Cervical distraction relieved the neck pains. Cervical range of motion (ROM) showed restriction on extension with pain. Left and right lateral flexion of the trunk were also restricted with pain elicited when bending to the left below the left shoulder blade. Lumbar ROM was restricted on extension with pain. Muscle testing of head movement showed weakness on cervical flexion, left cervical rotation and left lateral bending. Deep tendon reflex (DTR) testing was normal. Sensory testing showed bilateral hypoesthesia at the T5-T9 and S1 dermatomes as well as on the left at L5.

The patient was assessed radiographically to screen for biomechanical spinal deformity[20–22]. A full spine radiographic series was performed with the patient in the standing position. Biomechanical analysis was performed using the PostureRay EMR system (PostureCo., Trinity FL, USA) which uses the repeatable and reliable Harrison posterior tangent line drawing method[23, 24] to evaluate sagittal spine contours. Lines are drawn along the posterior vertebral body margins to assess inter-segmental (e.g. C2-C3 relative rotation angle-RRA) and regional angles (e.g. C2-C7 absolute rotation angle-ARA). Relevant findings included a cervical kyphosis from C2-C6 of +6.8° and an overall C2-C7 lordosis of −7.5° (normal −31 to −40°[6]), a forward head position of 6.6 mm (normal <15 mm[5]), and an atlas plane line (APL) of −25.5° (normal −29°[5]) (Fig. 1). The patient also displayed a shorted left leg which created an upper lumber kink of 8° at the level of L2 (Fig. 2).

The treatment consisted of CBP technique to restore the cervical lordosis[25–28]. All procedures were to emphasize hyper-extension of the cervical spine including cervical extension exercises, manual adjusting techniques and CET.

Specifically, the corrective exercises consisted of neck extension exercises using the Prolordotic (Circular Traction LLC., Huntington Beach, CA) (Fig. 3). The patient would perform 5 second held repetitions extending the head backwards while extending the arms forwards to create a resistance in the tension band for a total of 2 minutes while standing on a PowerPlate to intensify all movements[29]. Exercises were also prescribed for general hip mobility (ROM movements) and single leg lifts while on the PowerPlate for 8–10 minutes each in-office session.

Manual therapy including high velocity, low amplitude manipulations were performed to the entire spine as well as mechanical paraspinal muscle stimulation via a handheld percussive instrument (Neuromechanical Innovations LLC., AZ) to loosen tight muscles and release tension within trigger points. A CET using the 'Pope's 2-way' method was performed to increase the lordosis[8]. The front weight started at 25 lbs and increased to 45 lbs throughout the treatment, the posterior-superior pull was fixed to the traction frame and performed for 20 minutes per session (Fig. 4). The patient was prescribed a home treatment protocol including use of a medium sized cervical Denneroll orthotic to be used daily for 20 minutes as well as 100–200 repetitions of the neck extension exercise previously described.

The patient received 25 total treatments over an initial 2 month treatment period. Thereafter, the patient remained under stabilization care, receiving approximately one treatment per month as well as continuing her home program about 4–5 days per week. A 2.5 year follow-up assessment was done after the patient had received 43 further treatments including extra treatments for acute issues unrelated to her headaches but related to changing jobs. Due to the patient having a pelvic imbalance due to a leg length inequality, a 9 mm heel lift was prescribed for her left leg which rebalanced the pelvis; a 7 mm lift is shown in Fig. 2. A 12 mm ischial lift was also prescribed for the patient to place under the left buttocks when performing prolonged seated tasks. The patient consented to the publication of these results including all pictures and X-rays.

RESULTS

An assessment after 25 treatment sessions over 8-weeks demonstrated a 90% reduction in headache severity and frequency. The patient also scored a 16% on the HDI (versus 66%). There was also a 70% decrease in neck pain, an improved NDI (14% vs. 40%), an 80% reduction in mid back and upper back pains, a decrease in ODI (8% vs. 44%), and a 100% improvement in nausea resulting from the pains. There were also improvements in the SF-36 scores (Table 1). She reported

Table 1. Short Form-36 health-related quality of life scores

Date	Health perception	Physical functioning	Role-physical	Role-emotional	Social functioning	Mental health	Bodily pain	Energy/ Fatigue
Normal	72	84	81	81	83	75	75	61
Mar. 20, 2018	87	80	50	33	75	64	35	45
May. 24, 2018	82	100	100	100	100	72	68	75
Dec. 3, 2020	92	95	100	100	100	88	80	80

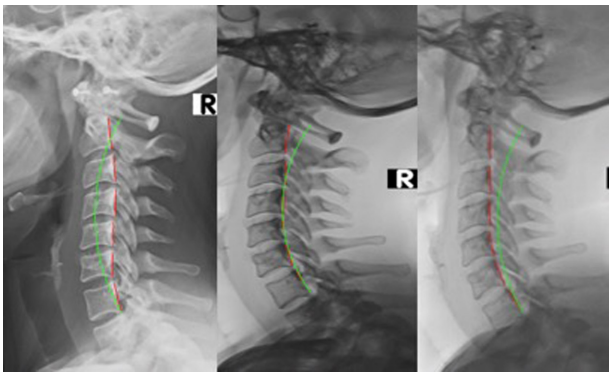

Fig. 1. Lateral cervical radiographs. Left: Initial image showing cervical kyphosis from C2-C6 of +7° (−7.5° C2-C7); Middle: 8 week post-treatment image showing reversal of kyphosis to normal lordosis of −36°; Right: Follow-up showing maintenance of the lordosis (−33°) with minimal treatment after 2.5 years.

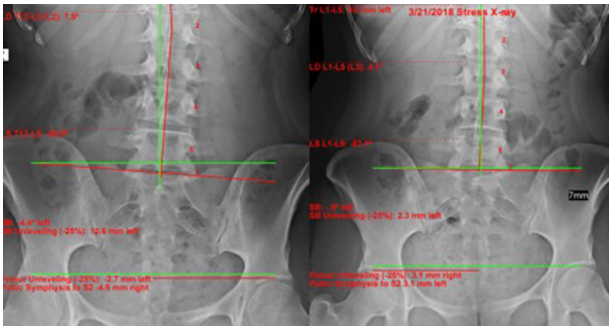

Fig. 2. Anterior-posterior lumbopelvic radiographs. Left: Initial view showing shorted left leg causing an upper lumbar kink of 8° at the level of L2, and asymmetry of the sacral plate lower on the left; Right: A 7 mm heel lift rebalanced the pelvis and reduced the upper lumbar deviation to straight.

Fig. 3. Cervical extension corrective 'mirror image' exercises performed on the PowerPlate.

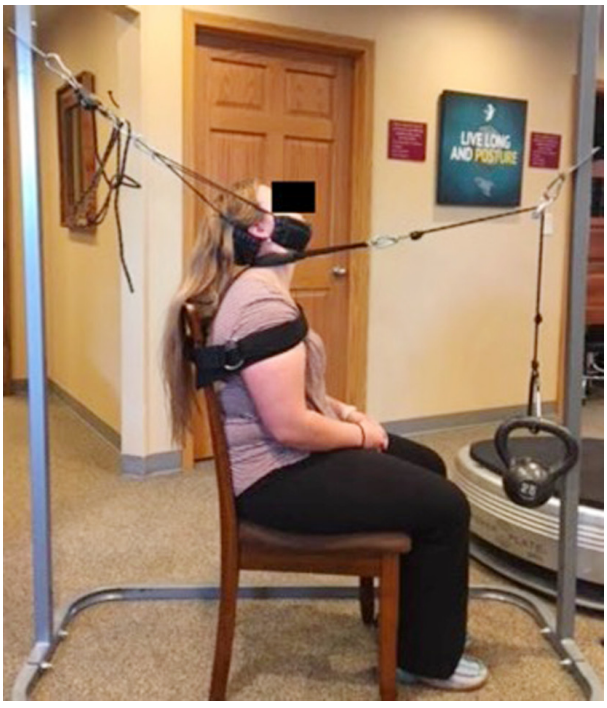

Fig. 4. Pope's 2-way cervical extension traction.

being able to sit longer and have an easier time performing her job after treatment and continued using the ischial support while performing seated work. All orthopedic tests were negative. Cervical ROM was normal, thoracic lateral bending was restricted bilaterally with no pain, and lumbar ROM was normal with the exception that extension was limited. All muscle testing and DTRs were normal. Skin sensory testing showed bilateral hypoesthesia along the S1 dermatome only. The post-treatment lateral cervical radiograph showed a dramatic improvement with an overall C2-C7 lordosis of −36°, including a 13.9° reduction of the original C2-C6 kyphosis (Fig. 1). The APL increased to −32.9° (vs. −25.5°), the forward head position remained normal at 9.6 mm.

An assessment at 2.5 years showed relative stability of the original lordosis correction with C2-C7 measuring −33.3° and the APL measuring −28.2° (Fig. 1). There was slight loss of the upper cervical curve, though this was minimal. Physical exam demonstrated that all ROM were normal and pain free. Sensory testing for upper and lower dermatomes were normal. Muscle testing was normal except for head flexion was rated a 4/5. DTRs were normal. The patient scored a 2% on the HDI, a 10% on both the NDI and ODI and reported to be well with headaches only on the rare occasion. All SF-36 scores were now WNL (Table 1).

DISCUSSION

This case demonstrates that significant reversal of a cervical kyphosis to a lordosis may occur over an 8-week program of CBP care. The restoration of the lordosis coincided with relief in the patients CGH symptoms. A 2.5 year follow-up with minimal in-office as well as a regular home treatment program successfully maintained the original correction achieved.

Recent randomized trials[10–15] show an average of 14° cervical lordosis improvement over 30 treatments over 10 weeks[30]. The total lordosis improvement in this case was 28.5° after 25 treatments over an 8 week period. The reason for the dramatic improvement may be due to the home traction program practiced daily as well as the Pope's 2-way method of CET which used a weight range of 25 lbs progressing to 45 lbs. One of the issues needing addressed with recent trials on CET methods is that none involve patient home traction to compliment in-office treatments[10–15]; this, logically, should lead to increased lordosis improvements.

As mentioned, a recent pilot trial showed that increasing the cervical lordosis in patients with hypolordosis suffering from CGH provided substantial relief in headache frequency, HDI, headache impact test-6, and daily defined dose that persisted at a 2 year follow-up. The treatment group achieved an average 13.4° improvement in lordosis versus the comparison group that had no lordosis increase and only showed a short-term symptom relief that regressed following the cessation of treatment. This trial along with the current case suggests that improving the cervical lordosis in those suffering from CGH may provide long-term positive clinical outcomes for this type of headache. Future research is required to verify these findings and whether the cervical lordosis is a key biomechanical biomarker in those with CGH.

Limitations to this report is that it is a single case. Although a strength to this case is that there was a 2.5 year follow-up, it is unknown for how long the positive outcomes for this patient would ultimately last. Further, since multiple procedures were performed, it is not known which aspect may have contributed the most towards increasing the cervical lordosis, however, as discussed recently[28], the lordosis increase has been definitively shown to result from CET procedures based on the results of the Moustafa et al. research group[10–12, 14, 15]. A final limitation includes the fact that a case report is limited in its generalizabillity; as stated, more research is needed to validate whether the cervical lordosis is in fact, a key biomechanical biomarker in cervicogenic headache.

Conflicts of interest

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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