ORIGINAL RESEARCH

Cone-beam Computerized Tomography for the Bio-mechanical Assessment of the Occipito-atlanto-axial Articulation in a 75-year-old Woman with Migraines Undergoing Blair Technique

Jonathan Verderame DC[1] & Jake Hollowell DC[2]

ABSTRACT

Objective: To describe the use of cone beam computerized tomography (CBCT) in the management of a patient with migraine headache, evaluated with the Blair Chiropractic Technique.

Clinical Features: A 75-year-old female patient had chronic migraine headaches. At her initial visit, she reported taking anti-inflammatory drugs and painkillers, with only a mild reduction in the severity and frequency of her headaches.

Interventions and Outcomes: After case history and physical examination, the patient was evaluated using CBCT, and a HVLA (high-velocity low-amplitude) thrust to the atlas vertebra was administered, following the Blair chiropractic technique protocols. CBCT was utilized in place of standard radiography to analyze the biomechanical structure of the occipito-atlantal joint. She reported a decrease from 8/10 to 3/10 on the visual analog scale after 5 months of care.

Conclusion: Headaches are a common and burdensome occurrence in the population, and chiropractic care has become a common form of intervention. Blair chiropractic technique protocols require imaging of the cervical spine, and CBCT may aid in the radiographic analysis of persons with headaches, by providing better detail of the atlanto-axial articulation.

Introduction

Migraine headaches are common and disabling, with an estimated 35 million US citizens experiencing a migraine in 2005.[1] Epidemiological evidence indicates that "migraine is one of the most burdensome of the primary headache disorders."[2-4] The economic impact has been estimated to cost American employers 13 billion dollars per year in lost productivity.[5]

Many investigations suggest that chiropractic care may be of benefit to patients suffering with headaches including migraines.[6-19] This article describes the use of cone-beam computerized tomography (CBCT) for the bio-mechanical assessment of the occipito-atlanto-axial articulation, in a 75-year-old woman with migraine headaches.

The purpose of this case report is to describe the use of CBCT instead of standard radiographs, using the Blair chiropractic technique, for a potentially faster and more accurate analysis of the occipito-atlanto-axial articulation. The Blair technique is a manual correction, of a misaligned vertebra of the upper cervical spine using a high velocity low amplitude (HVLA) thrust.[20] To date, the utilization of CBCT in a clinical chiropractic setting has not been explored.

Case Report

History

A 75-year-old female had been diagnosed by her medical doctor with chronic migraine headaches in 1950. The initial

1. Private Practice of Chiropractic, Telemark, Norway
2. Private Practice of Chiropractic, Trapani, Italy

episode began when she was a teenager with insidious onset. Her migraines are without aura and are unilateral. The patient experienced both light sensitivity and nausea, and the average intensity of the migraine headaches was 8 out of 10 on the visual analog scale (VAS). The patient had never received chiropractic intervention prior to her care.

Examination

Upon initial chiropractic evaluation she reported taking numerous anti-inflammatory drugs and painkillers, but the patient could not specify the dose or names except for 50mg of Difmetre™ taken daily. These medications resulted in a mild reduction in severity of her migraine headaches. In addition she was taking Silvastin™ to control her cholesterol levels.

Upon physical examination, active and passive cervical and lumbar ranges of motion, including flexion, extension, right and left lateral bend, right and left rotation, were all within normal limits. Cervical compression did not reproduce the symptomatology of the chief complaint, and Hallpike test was performed without dizziness. The cranial nerve examination indicated an inability to look superior and to the left, as well as superior and to the right, indicating a potential alteration of CN IV and VI. Hypertonic scalene and sternocleidomastoids muscles were also noted with palpation on the right, as well as aberrant posture (head tilt, shoulder and pelvic unleveling).

Intervention

The Blair upper cervical chiropractic technique protocols were used to evaluate the patient. This includes dual probe paraspinal digital infrared thermography of the cervical spine, for symmetrical heat distribution, a supine and prone leg check for leg length discrepancy, and eight radiographic views to determine the potential misalignment of the occipital atlanto-axial joint, which includes a base posterior, A-P open mouth, A-P cervical, lateral cervical, left and right lateral stereo cervical, and both left and right oblique nasium.[20] For this case, a CBCT study was used in place of the traditional eight radiographs to determine the potential misalignment.

The volumetric 3D CBCT by SCANORA SOREDEX® produced 571 images, which together reconstructed a three dimensional image of the vertebra of the neck (figures 1 and 2). This 3D image was then divided into slices in a multitude of planes, similar to those taken from the 8 traditional radiographic views. Currently most practitioners' who utilize the Blair technique use a two film stereograph unit to produce a three dimensional image (Figure 3).

The CBCT study indicated a P.I.L. (posterior, inferior, left) misalignment of the C1 vertebra lateral mass in relation to the lateral most edge of the occipital condyles (Figure 4). The CBCT showed the angulations of the posterior aspect of the atlanto-occipital articulation to measure 38^0 on the left, and 31^0 on the right. The anterior aspect of the atlanto-occipital (C0-C1) joint was also found to be 55^0 on the left, and 56^0 on the right. The normal range is 124^0-127^0. [21] In this case, with consideration of the direction of the misalignment, the posterior superior portion of the posterior arch of atlas was approximately contacted with the doctor's pisiform, located via palpation, and a high velocity low amplitude (HVLA) thrust, along the angle of the articulation was administered with the patient side lying on a toggle table. The toggle table uses a drop mechanism on the headpiece that is activated with a HVLA thrust when a patient is being adjusted.

Outcome

The patient was re-examined 14 times over the course of 10 weeks, and received 2 adjustments based on paraspinal digital infrared thermography and functional leg length inequality indicators.[20] When the patient's thermographic scans showed a repeating pattern, [22] and her left leg was short 4-8mm, the Blair protocol recommends that the patient receive the adjustment to the atlas vertebra.[23] She reported 1 migraine after the first atlas adjustment throughout the course of her 10 weeks of care duration. No additional therapies or interventions were employed.

The patient stated that she had fallen on her hands during week 5 of her treatment plan, but denies any surface contact with her head. At the end of her 10 week treatment plan, her follow-up examination showed a VAS measuring the average pain of her migraine headache to have decreased from 8 to 3, her functional leg length was even, and the thermographic scans were not in a repeating pattern, which may indicate that vertebral subluxation is not present. [22] Upon re-evaluation with the patient's medical doctor, the patient stated an improvement in the overall frequency and duration of migraines, as well as a reduction of her medications, but the exact dosages was not given.

Discussion

Diagnostic radiology has been transformed by computed tomography (CT). The advent and inception of CT in the 1970's led to a rapid increase in utilization, with 62 million CT scans conducted in the United States every year, one third of which are of the head and related structures.[24] While CT is said to be "an extremely valuable tool" that is a "widely available noninvasive modality for evaluating abnormalities of the spine," [25] it has never been used for bio-mechanical assessment of the occitpital-atlanto-axial misalignment for chiropractic analysis.

Although the use of CT for general screenings has been questioned because of the exposure to ionizing radiation,[26] the exposure can be reduced,[27] but should only be used if indicated. The 3D CBCT by SCANORA SOREDEX® uses 80-90KV of pulsed emission x-ray and has a scan time of 10-26 seconds with a total exposure time of 3.5 seconds, which may be faster than taking the traditional eight Blair radiographs.[28]

The CBCT has a significant reduction in radiation dose between 98.5% and 76.2% compared to traditional CT.[29-31] The estimated dose is 0.035 to .10 mS, which is comparable with the effective dose of 2 traditional orthopantomography films.[32] Makimoto et el. have even suggested that CBCT may take the place of conventional x-ray tomography.[33] The main limitation with standard roentgenographic studies is that the structures overlap, [34-37] thus, CBCT is preferred when assessing spinal alignment by visually removing structures.

Radiographic analysis is used to determine the misalignment of the occipito-atlantal-axial articulation, and to determine the direction of thrust during the HVLA thrust. Therefore, radiographs are essential to the Blair technique to deliver this particular type of chiropractic intervention, [38] because statistical analysis of the morphology of the superior and inferior articular facets typically show significant asymmetry.[39]

The Blair technique modifies each adjustment based on the structure and asymmetry of the occipital condyles and atlas lateral masses.[37] While standard chiropractic radiographic analysis compares the left spinal structure to the right, assuming symmetry; the Blair radiographic analysis allows the chiropractor to view the left and right occipito-atlantal articulation independent of one another. [38,40] This is presumed to give a more accurate analysis of the true articulation alignment.

The CBCT may allow the chiropractor to determine the occipito-atlantal-axial misalignment with more precision than the traditional Blair radiographic series, due to the ability to isolate the upper cervical articulation without overlapping anatomy, obscuring the articulation in question. Although Lewis and Dorbad questioned CT as an adequate way to diagnose migraine headaches in children through the identification of maxillary pacification, a mucous retention cyst, or an occult vascular malformation, [41] Wiesel stated it is an extremely valuable tool to assist clinicians who assess the spine,[25] and the previously described case may offer an additional use for clinicians.

While primary headaches can usually be diagnosed through a detailed history and a general physical examination, [26] this report suggests that CBCT may aid in the biomechanical analysis of the occipito-atlantal-axial articulation. The positive results obtained in this report add to the previous case reports on the chiropractic management of migraine patients with upper cervical involvement.[42,43] Subsequent studies investigating the cost, risks and benefits of chiropractors using CBCT in a clinical setting to assess the alignment of the upper cervical spine should be explored.

Limitations

Limitations of this case report are that the follow-up was limited and both the outcome measure and the pre-treatment data collected were minimal. A Headache Disability Index could have been used to better quantify the subjective outcome. It is unknown whether the patient's improvement was influenced by her medications, and it is possible that the improvement was not due to the Blair technique. The radiation dose was not compared to the 8 eight traditional radiographs, but is recommended for future studies.

Conclusion

This case report suggests that a patient with chronic migraine headaches may respond to a HVLA thrust using the Blair protocol and CBCT.

References

1. Diamond S, Bigal ME, Silberstein S, et al. Patterns of diagnosis and acute and preventive treatment for migraine in the United States: results from the American migraine prevalence and prevention study. Headache 2007;47(3):355–63
2. Ferrari MD. The economic burden of migraine to society. Pharmacoeconomics 1998;13(6):667–76.
3. Hamelsky SW, Lipton RB, Stewart WF, et al. An assessment of the burden of migraine using the willingness to pay model. Cephalalgia 2005;25(2):87-100.
4. Lipton RB, Stewart WF, Von Korff M, et al. The burden of migraine. A review of cost to society. Pharmacoeconomics 1994;6(3):215–21.
5. Hu XH, Markson LE, Lipton RB, et al. Burden of migraine in the United States: disability and economic costs. Arch Intern Med 1999;159(8):813–8.
6. Vernon HT. The effectiveness of chiropractic manipulation in the treatment of headache: an exploration in the literature. J Manipulative Physiol Ther. 1995;18(9):611-17.
7. Astin JA, Ernst E. The effectiveness of spinal manipulation for the treatment of headache disorders: a systematic review of randomized clinical trials.Cephalalgia 2002;22(8): 617–623
8. Bronfort G,Assendelft WJ,Evans R,Haas M,Bouter L.Efficacy of spinal manipulation for chronic headache: a systematic review. J Manipulative Physiol Ther 2001;24(7):457-66.
9. Biondi DM. Physical treatment for headache: a structured review. Headache 2005;45(6):738.
10. Fernandez-de-las-Penas C, Onso Blanco C, San-Roman J, Miangolarra-Page JC. Methodological quality of randomized controlled trials of spinal manipulation and mobilization in tension-type headache, migraine, and cervicogenic headache. J Orthop Sports Phys Ther 2006;36(3):160-9.
11. Chaibi A, Tuchin P, Russell MB. Manual therapies for migraine: a systematic review. J Headache Pain 2011;12(2):127-33.
12. Tuchin PJ, Pollard H, Bonello R. A randomized controlled trial of chiropractic spinal manipulative therapy for migraine. J Manipulative Physiol Ther 2000;23(2):91-5.
13. Nelson CF, Bronfort G, Evans R, Boline P, Goldsmith C, Anderson AV. The efficacy of spinal manipulation, amitripty- line and the combination of both therapies for the prophylaxis of migraine headache. J Manipulative Physiol Ther 1998;21(8):511-9.
14. Parker GB, Tupling H, Pryor DS. A controlled trial of cervical manipulation of migraine. Aust N Z J Med 1978;8(6):589-93.
15. Cattley P, Tuchin PJ. Chiropractic management of migraine without aura. A case study. Australas Chiropr Osteopathy 1999;8(3):85-90.
16. Tuchin PJ. A case series of migraine changes following a manipulative therapy trial. Australas Chiropr Osteopathy 1997;6(3):85-91.
17. Tuchin PJ. The efficacy of chiropractic spinal manipulative therapy (SMT) in the treatment of migraine. A pilot study. Australas Chiropr Osteopathy 1997;6(2):41-7.
18. Tuchin PJ. A case of chronic migraine remission after chiropractic care. J Chiropr Med. 2008;7(2):66-70.

19. Chaibi A,Tuchin PJ. Chiropractic spinal manipulative treatment of migraine headache of 40-year duration using Gonstead method: a case study. J Chiropr Med 2011;10(3):189-93.
20. Hubbard, T. Blair upper cervical specific technique. Palmer College of Chiropractic; Davenport (Iowa): 2005.
21. Dähnert W. Radiology Review Manual. Lippincott Williams & Wilkins. Seventh Edition. 2011. 199
22. Owens EF, Hart JFm Donofrio JJ, Haralambous J, Mierzejewski E. Paraspinal skin temperature patterns: an interexaminer and intraexaminer reliability study. JMPT. 2004; 27(3):155-9.
23. Blair, Wm. G. For evaluation: for progress. Intl. Rev. Chiro. 1968; 22 (12): 8-11.
24. What's NEXT? Nationwide Evaluation of X-ray Trends: 2000 computed tomography. (CRCPD publication no. NEXT_2000CT- T.) Conference of Radiation Control Pro- gram Directors, Department of Health and Human Services, 2006.
25. Wiesel S. The reliability of imaging (computed tomography, magnetic resonance imaging, myelography,) in documenting the cause of spinal pain. JMPT. 1992;15(1):51-3.
26. Evans RW. Diagnostic Testing for Migraine and Other Primary Headaches. Neurol Clin 2009;27(2):393-415.
27. Smith JC, Daniel HJ, Greg EW, Theadore RM, Jeffrey GK, UDO EO. Ultra-low-dose protocol for CT-guided lung biopsies. Journal of Vascular and Interventional Radiology 2011;22(4):431-436.
28. Sordex. Scanora 3D brochure. Printed in Finland. Retrevied from: http://www.soredex.com/Upload/3D/207083_1_SCANORA%203D_Brochure_ENG.low.pdf
29. Schulze D, Heiland M, Thurmann H, et al. Radiation exposure during midfacial imaging using 4- and 16-slice computed tomography, cone beam computed tomography systems and conventional radiography. Dentomaxillofac Radiol 2004;33:83–6.
30. Scaf G, Lurie AG, Mosier KM, et al. Dosimetry and cost of imaging osseointegrated implants with film-based and computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83:41–8.
31. Dula K, Mini R, van der Stelt PF, et al. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci 1996;104:503–10.
32. Williams J, Montgomery A, Measurement of dose in panoramic dental radiology. The British Journal of Radiology 2000;73:1002-1006.
33. Makimoto Y, Matsuzaki K, Yoshida S, Nishitani H. Early clinical experience on cone-beam CT. Journal of Digital Imaging 1998;11(1):211-213.
34. Rinaldi I, Mullins W, Delaney W, Fitzer P, Tornberg D. Computerized tomographic demonstration of rotational atlanto-axial fixation Case report. Journal Neurosurgery 1979; 50(1):115-9
35. Lukhele M. Atlanto-axial rotatory fixation. SAMJ 1996;86(12):1549-52.
36. Fielding J, Hawkins R. Atlanto-axial rotatory fixation. J Bone Joint Surg Am 1977;59:37-44.
37. Fielding J, Stillwell W, Chynn K, Spyropoulos E. Use of computed tomography for the diagnosis of atlanto-axial rotatory fixation. A case report. J Bone Joint Surg Am. 1978;60:1102-1104.
38. Hubbard T, Vowles B, Forest T. Inter and intra-examiner reliability of the Blair protracto-view x-ray: Examination of a chiropractic technique. J Chiropr Med 2010;9(2):60-68.
39. Meseke CA, Duray SM, Brillion SR. Principal Components Analysis of the Atlas Vertebra. Journal of Manipulative and Physiological Therapeutics.2008;31(3):212-216
40. Owens EF,Jr. Line drawing analyses of static cervical X ray used in chiropractic. J Manipulative Physiol Ther 1992;15(7):442-449.
41. Lewis DW, Dorbad D. The utility of neuroimaging in the evaluation of children with migraine or chronic daily headache who have normal neurological examinations. Headache 2000;40(8):629- 32.
42. Cattley P, Tuchin PJ. Chiropractic management of migraine without aura. A case study. Australas Chiropr Osteopathy 1999;8(3):85-90.
43. Stodolny J, Chmielewski H. Manual therapy in the treatment of patients with cervical migraine. Man Med 1989;4(2):49-51.

Figures

Figure 1. Three-dimensional reconstruction of the vertebra of the neck, viewed from left posteriorolateral to anterior.

Figure 2. Three-dimensional reconstruction of the vertebra of the neck, viewed from posterior to anterior.

Figure 3. Radiographic Stereograph view box that uses two plain film opposing views to create a 3D image.

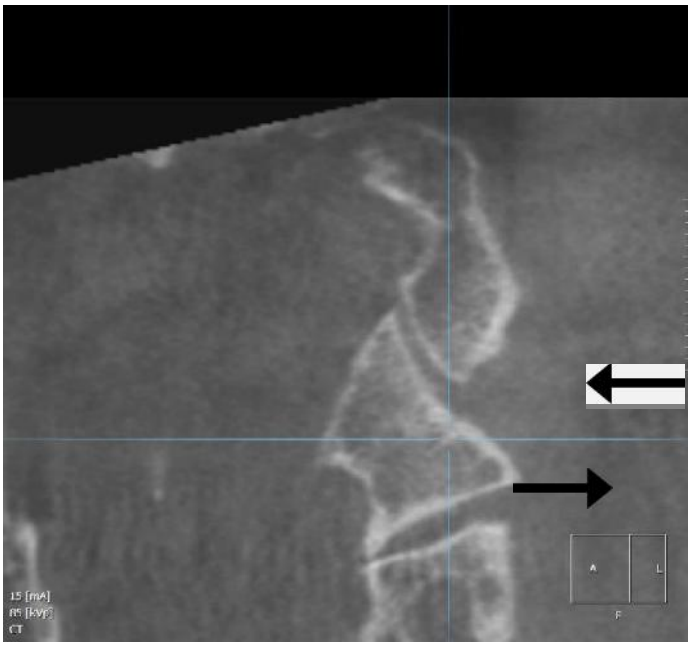

Figure 4. Right oblique anterolateral CBCT image slice. This is labeled as a misalignment of the occipitoatlantal articulation, that has occurred posterior, inferior and to the left. The white box with black arrow represents the lateral most edge of the occipital condyle, and the black arrow represents the lateral most edge of the lateral mass of the atlas.