

Atlas Orthogonal Chiropractic practitioner presentations of Craniocervical Junction and Brainstem disorders: A case series and review

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Narrative: Chiari malformations, or cerebellar tonsillar ectopia (CTE), along with cranio-cervical syndromes (CCS) and cranio-cervical instability (CCI) may contribute to brainstem compression presenting as a complex clinical conundrum for physicians that treat the cranio-cervical junction (CCJ) as part of their clinical practice.

Patho-anatomical features causing the constellation of symptoms that confound efforts at diagnosis by mimicking other disorders are discussed. The lack of knowledge creating misdiagnoses, misunderstanding of how to treat, and possible dangerous treatment outcomes, in surgical and non-surgical care, is addressed as it permeates through medical and musculoskeletal physicians such as chiropractors and physiotherapists.

Discussion on where the limitations of surgery and contraindications to manual therapy fall in comparison and contrast to the oft sought out Atlas Orthogonal (AO) chiropractic approach is also given. Scores of patients accessing online information increasingly to ascertain treatments for symptoms their practitioners can neither explain nor alleviate presents a very uncertain and possibly dangerous picture for sufferers.

This report provides a structured approach to the assessment of such patients with recommendations for safe and effective clinical intervention and care. The lessons are taken from a series of 15 cases purposively selected from the clinics of 2 AO practitioners known to each other, one in Australia and the other, USA.

Indexing Terms: Chiropractic; Brainstem; Chiari malformation; upper cervical; craniocervical junction; cerebellar tonsillar ectopia; cranio-cervical instability; Atlas Orthogonal; case series.

Introduction

Patients with symptoms of brain stem craniocervical junction (CCJ) 'choke point' (1) disorders are increasingly seeking out low force, high specificity vectored instrument adjusting, in Atlas Orthogonal (AO) chiropractic care, as reflected in the author's three decades of clinical experience. AO is a technique described by the author elsewhere (2) and perceived as an option either before, after, instead of, or alongside surgical and medical options. I

... A consideration of effective care is best achieved on a case-by-case basis, with appropriate referral. Patho-anatomical changes in and around the brainstem in these cases, causing the constellation of symptoms of suffering and furthered by misdiagnoses, needs to be addressed ...'

1. Flanagan, MF. The role of the craniocervical junction in craniospinal hydrodynamics and neurodegenerative conditions. *Neurology Res Int.* 2015. <https://doi.org/10.1155/2015/794829>
2. Ierano JJ, Richards DM. Atlas orthogonal chiropractic management of trigeminal neuralgia: A series of case reports. *Explore (NY).* 2024 Jan-Feb;20(1):70-78. DOI 10.1016/j.explore.2023.06.004. Epub 2023 Jun 16. PMID: 37344335.

present a case series highlighting clinical reasoning and management of such patients. They are many and varied, but common symptoms have been identified in the literature.



Symptoms Identified

Table 1: Symptom list

Cognitive dysfunction	Weak extremities
Headache	Dizziness
Neck pain	Mood, anxiety disorders
Dizziness	Shortness of breath
numbness, tingling	Temperature regulation
Gastrointestinal issues, including throat.	Facial pain, numbness
Pain	Bladder problems
Depression	Bowel problems
Fatigue	Sweating
Insomnia	Fainting
	Scoliosis

The main differential diagnoses characterising these presentations is: Chiari malformation types 0-1, or cerebellar tonsillar ectopia (CTE), cranio-cervical syndrome (CCS), and cranio-cervical instability (CCI) symptoms which can be nebulous and confusing to the uninitiated.

Most likely the recently proposed Chiari 0 or ‘borderline Chiari’ is involved in presentations to the AO chiropractic offices. (3, 4, 5) Stoodley, et al reported on the many confounding conditions that can lead to unnecessary surgical intervention as mimicking Chiari, such as post-traumatic cranio-cervical junction arachnoiditis, dural band, spontaneous intracranial hypotension, idiopathic intracranial hypertension, and cysts. (6)

It is my experience that patients will seek the help of upper cervical chiropractic through non-medical, non-orthodox channels of referral such as internet groups on social media that provide support. This provides a ‘safe space’ for abandonment of vested interests or bias in practitioners as actual sufferers share their journey of healing experiences for conditions; albeit without ‘clear medical guidelines’. Whilst this is conducive to a merit driven market progression of choice via results and reputation, it may also meretriciously reflect the paucity of good scientific data,

3. Iskandar BJ, Hedlund GL, Grabb PA, Oakes WJ. The resolution of syringohydromyelia without hindbrain herniation after posterior fossa decompression. *J Neurosurg.* 1998 Aug;89(2):212-6. DOI 10.3171/jns.1998.89.2.0212. PMID: 9688115.
4. Kyoshima K, Kuroyanagi T, Oya F, Kamijo Y, El-Noamany H, Kobayashi S. Syringomyelia without hindbrain herniation: tight cisterna magna. Report of four cases and a review of the literature. *J Neurosurg.* 2002 Mar;96(2 Suppl):239-49. DOI 10.3171/spi.2002.96.2.0239.
5. Tubbs RS, Elton S, Grabb P, Dockery SE, Bartolucci AA, Oakes WJ. Analysis of the posterior fossa in children with the Chiari 0 malformation. *Neurosurgery.* 2001 May;48(5):1050-4; discussion 1054-5. DOI 10.1097/00006123-200105000-00016.
6. Park RJ, Unnikrishnan S, Berliner J, Magnussen J, Liu S, Stoodley MA. Cerebellar Tonsillar Descent Mimicking Chiari Malformation. *Journal of Clinical Medicine.* 2023; 12(8):2786. <https://doi.org/10.3390/jcm12082786>

leaving the online database of health information being deemed inadequate, (7) exploring only shallow links of information, and failing to declare their sources. (8) This is driven largely by inadequate, unclear information from practitioners lacking an environment conducive to asking pertinent questions. It has even been suggested that empowering the patient is the ultimate management protocol, (9) though subject to the quality of information in over 70,000 web sites providing it. (10) The following cases illuminate the need for fulfilling a gap in clear information and interaction between an increasingly specialised community in health care, leaving patients scratching for information.

After over a century since the naming of this pathology, there is still no medical consensus as to the best management of CTE, and particularly the variable presentation Chiari 0 and Type 1, (11) and reflected in rare case management articles that emphasise individual case appraisal and analysis. (12) Citing several case histories as examples we attempt to clarify management as an algorithm (in Appendix One) of patient presentation to the upper cervical chiropractor, and importantly to alert manual therapists employing techniques in excess of 20N, which can often equate to less than preload force during a manual thrust. (13)

Historical context

Arnold-Chiari malformations historically involve several protagonists in the naming and original reporting thereof. Austrian pathologist Hans Chiari (1851 – 1916), German pathologist Julius Arnold (1835 – 1915), Scottish anatomist John Cleland (1835-1925), French anatomist Jean Cruveilhier (1791-1874), and Arnold's students Ernst Schwalbe (1871-1920) and Gredig (birth and death unknown) all deserve mention.

In 1907 Schwalbe and Gredig coined the term Arnold-Chiari Malformation (Arnoldsche und Chiarische Missbildung). (14) They studied under Arnold who identified pediatric brainstem deformities as did Chiari on postmortem examinations of the cerebellum, brainstem, and spinal cord.

Earlier in 1891, Chiari (15) gave credit to other researchers including Arnold and Cleland, but Schwalbe and Gredig did not credit Cleland, (16) who wrote as early as 1883 about cerebellar

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7. Daraz L, Morrow AS, Ponce OJ, Beuschel B, Farah MH, Katabi A, Alsawas M, Majzoub AM, Benkhadra R, Seisa MO, Ding JF, Prokop L, Murad MH. Can Patients Trust Online Health Information? A Meta-narrative Systematic Review Addressing the Quality of Health Information on the Internet. *J Gen Intern Med.* 2019 Sep;34(9):1884-1891. DOI 10.1007/s11606-019-05109-0.
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 11. Guo F, Turgut M. Precise Management of Chiari Malformation with Type I. 2022. *Front. Surg.* 9:850879. DOI 10.3389/fsurg.2022.850879
 12. Sanjay N, Chandan YS, Yadav K, et al. (August 26, 2023) Basilar Invagination With Chiari Type I Malformation and Atlanto-Axial Instability: A Rare Case Report. *Cureus* 15(8): e44141. DOI 10.7759/cureus.44141.
 13. Mikhail, J., Funabashi, M., Descarreaux, M. et al. Assessing forces during spinal manipulation and mobilization: factors influencing the difference between forces at the patient-table and clinician-patient interfaces. *Chiropr Man Therap* 28, 57 (2020). <https://doi.org/10.1186/s12998-020-00346-1>
 14. <http://www.whonamedit.com/doctor.cfm/280.html>. Accessed 24 Aug, 2023.
 15. Chiari H. Ueber Veränderungen des Kleinhirns infolge von Hydrocephalie des Grosshirns. *Dtsch Med Wochenschr.* 1891; 17:1172–1175.
 16. Cleland J. Contributions to the study of spina bifida, encephalocele, and anencephalus. *J Anat Physiol (London).* 1883;17:257–291.

tonsillar ectopia. Cruveilhier described similar tonsillar ectopia fifty years earlier (17, 18) but the current nomenclature only credits two people; Hans Chiari and Julius Arnold.

'Chiari' malformations tend to refer to type 0 - 1, and Arnold-Chiari to type 2, 3 and so forth. Generically, Cerebellar Tonsillar Ectopia (CTE) is the non-eponymous terminology (19) that has been suggested.

Epidemiology

Chiari malformation is a rare condition, with number of cases diagnosed increasing with Magnetic Resonance Imaging (MRI), (20) and prevalence estimated to be 0.77% (21) to 1% of the population worldwide, (22) but current occurrence in Europe is unknown (23) with investigations of epidemiology being scarce. One study citing 1/1000 reporting symptoms accompanying the diagnosis, and 1-3.6/100 meeting imaging criteria on MRI but not necessarily symptomatic. (24) Although congenital in origin there exist traumatically acquired cases (25) and whether CTE becomes symptomatic is proposed to relate to an excess of 5mm descent of the cerebellar tonsils. (26) Females have a higher incidence, (27) and tonsil location in newborns and children can commonly situate below the foramen magnum without sequelae. (28) The mean age of onset of symptoms is 25 years. (21) Syringomyelia is a common sequelae of Chiari as well. Cranio-cervical instability (CCI) is often seen in difficult cases, and associated with Chiari 1, and Ehlers-Danlos Syndrome, which is a hereditary connective tissue disorder associated with CCI and hypermobility. (29) Retroflexed odontoid is a common feature in the following case studies and is due to laxity or damage primarily in the transverse atlanto-axial ligament. If the odontoid

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17. Pearce JMS. Arnold Chiari, or "Cruveilhier Cleland Chiari" malformation. *J Neurol Neurosurg Psychiatry*. 2000;68:13. <http://dx.doi.org/10.1136/jnnp.68.1.13>
 18. Cruveilhier J. *L'Anatomie pathologique du corps humain; descriptions avec figures lithographiées et coloriées; diverses alterations morbides don't le corps humain et susceptible*. 2 Vols. Paris: Bailliere, 1829-42.
 19. McNulty MA, Wisner RL, Meyer AJ. NOMENs land: The place of eponyms in the anatomy classroom. *Anat Sci Educ*. 2021 Nov;14(6):847-852. DOI 10.1002/ase.2108.
 20. Massimi L, Peretta P, Erbetta A, et al. International Experts - Jury of the Chiari & Syringomyelia Consensus Conference, "Milan, November 11–13, 2019". Diagnosis and treatment of Chiari malformation type 1 in children: the International Consensus Document. *Neurol Sci*. 2022 Feb;43(2):1311-1326. DOI 10.1007/s10072-021-05317-9.
 21. Meadows J, Kraut M, Guarnieri M, et al. Asymptomatic Chiari Type I malformations identified on magnetic resonance imaging. *J Neurosurg*. 2000;92(6):920-6.
 22. Ka Po Tam S, Chia J, Brodbelt A, Foroughi, M. Assessment of patients with a Chiari malformation type I. *Brain and Spine*. 2022;2. <https://doi.org/10.1016/j.bas.2021.100850>.
 23. Ciaramitaro P, Garbossa D, Peretta P, Piatelli G, Massimi L, Valentini L, Migliaretti G, Baldovino S, Roccatello D, Kodra Y, Taruscio D; Interregional Chiari and Syringomyelia Consortium; on behalf of the Interregional Chiari and Syringomyelia Consortium. Syringomyelia and Chiari Syndrome Registry: advances in epidemiology, clinical phenotypes and natural history based on a North Western Italy cohort. *Ann Ist Super Sanita*. 2020 Jan-Mar;56(1):48-58. DOI 10.4415/ANN_20_01_08.
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 26. Ross RS, Moore KR. *Diagnostic Imaging: Spine*. 2015. 3rd Ed. Elsevier. Philadelphia, PA. p54.
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 28. Meadows J, Kraut M, Guarnieri M, Haroun RI, Carson BS. Asymptomatic Chiari Type I malformations identified on magnetic resonance imaging. *J Neurosurg*. 2000;92(6):920-926. DOI 10.3171/jns.2000.92.6.0920
 29. Lohkamp L-N, Marathe N, Fehlings MG. Craniocervical Instability in Ehlers-Danlos Syndrome—A Systematic Review of Diagnostic and Surgical Treatment Criteria. *Global Spine Journal*. 2022;12(8):1862-1871. DOI 10.1177/21925682211068520

of C2 rises too high and above McRae's line, this is called Basilar Invagination, contraindicated to any form of manual treatment. In fact, Chiari in its various forms, CCI, and hypermobility syndromes are considered contraindications to cervical manipulation.

Therefore, it is with great caution I advise against any generic forms of manual manipulation in any of these case presentations, commonly aggravated into seeking further care after such procedures involving excessive force (more than around 20N) and rotation.

Pathophysiology

The crano-cervical junction (CCJ) and brainstem represents a neuroanatomical union of the brain and the spinal cord surrounded by protective skeletal structures; cranium, and spinal vertebrae, with a suggested (30, 31, 32) compromise between protection and motion that is morphologically unique in the axial skeleton. This also presents an equally unique area of potential trauma, with variable symptoms reflected in the varied morphology of the Foramen Magnum, (33) including round, egg, oval, tetragonal, hexagonal, and pentagonal. (34)

The posterior fossa of the skull in most of these cases is congenitally small, being a contributing factor to the existence of Chiari. (35) The transverse ligament contributes substantially to the stability of the CCJ, preventing the dens from folding into the midbrain during flexion. (36) Damage to the critical ligaments of the CCJ will permanently change their structure with biologically inferior tissue, (37) irreparable once torn, which makes future prognoses difficult if the extent of injury is unknown. Obesity has been investigated as a possible exacerbation of Chiari symptoms, (38) without any conclusive associations, and genetic predisposition has been suggested as a possible etiological factor. (39) Cases of concurrent Ehlers-Danlos Syndrome (EDS) and Chiari (40) are reported on Chiari Australia's web site citing an incidence of 13% for both. (41) Tethered cord is also a condition postulated to create abnormal tension on the cerebellum from as low as the filum terminale and anywhere along the spine. Occult tethered cord (where the MRI is normal in appearance) (42) has a high incidence in

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30. von Torklus D, Gehle W. The Upper Cervical Spine, New York, Grune & Stratton, pp. 10, 69.
 31. Jackson R, The Cervical Syndrome, Charles C Thomas (pub), 1978. Springfield, IL. 1977.
 32. White A.A., Panjabi MM. Clinical Biomechanics of the Spine. 2nd Ed. Philadelphia, PA. JB Lippincott. 1990.
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 34. Chethan P, Prakash KG, Murlimanju BV, Prashanth KU, Prabhu LV, Saralaya VV, et al: Morphological analysis and morphometry of the foramen magnum: an anatomical investigation. Turk Neurosurg 22:416-419, 2012
 35. Milhorat TH, Nishikawa M, Kula RW, Dlugacz YD. Mechanisms of cerebellar tonsil herniation in patients with Chiari malformations as guide to clinical management. Acta Neurochir (Wien). 2010 Jul;152(7):1117-27. DOI 10.1007/s00701-010-0636-3.
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 39. Urbizu A, Toma C, Poca MA, Sahuquillo J, Cuenca-León E, Cormand B, Macaya A. Chiari malformation type I: a case-control association study of 58 developmental genes. PLoS One. 2013;8(2):e57241. DOI 10.1371/journal.pone.0057241.
 40. Castori M, Camerota F, Celletti C, Danese C, Santilli V, Saraceni VM, Grammatico P. Natural history and manifestations of the hypermobility type Ehlers-Danlos syndrome: a pilot study on 21 patients. Am J Med Genet A. 2010 Mar;152A(3):556-64. DOI 10.1002/ajmg.a.33231.
 41. Chiari & Syringomyelia Australia. What is EDS? <https://www.chiariaustralia.org/ehlers-danlos> accessed 7 Nov 2023.
 42. Yang J, Won JK, Kim KH, Lee JY, Kim SK, Shin HI, Park K, Wang KC. Occult tethered cord syndrome: a rare, treatable condition. Childs Nerv Syst. 2022 Feb;38(2):387-395. DOI 10.1007/s00381-021-05353-y.

Ehlers-Danlos Syndrome (43) and Chiari 1. (44) All of these issues must be known and considered in these complex cases.

If head movement is compromised, either via injury, or congenital anomaly, then eye tracking and the righting reflex will trigger adaptation for survival; if protection is compromised by trauma overcoming the integrity of hard tissue on soft, then flow patterns in fluid exchange, attenuation and neurological tone will alter; either into compensations such as hydrocephalus (45) or a multitude of symptoms fore-mentioned. Patients with hydrocephalus are considered for a procedure known as 'shunting' with the alternative perhaps being decompression surgery. The solution is most effective when it is the least invasive option, (46) as is the case for management of CTE.

A major source of spinal insult, not only due to the proximal cerebral and cerebellar neurology but also unique ranges of motion unchecked by bony abutment (or interosseous locks), occurs at the cranio-cervical junction (47) housing the brainstem, and posteriorly the inferior margins of the cerebellum and its tonsils. Pathologically the brainstem can extend below the margins of hard tissue integrity, and influence the cerebellar tonsils posteriorly, causing cerebellar-tonsillar-ectopia (CTE) and define what is referred to as the Arnold Chiari Malformations. These are graded as per level of descent into the spinal column and resultant pressure on the adjacent neural structures.

Because Chiari I malformations often remain asymptomatic until later in life, or as Freeman and Rosa et al have demonstrated (48) they feature significantly in post-trauma cases, that often present to chiropractors, optometrists, or manual therapists, and may include headache or symptoms associated with brainstem compression, syringomyelia, or scoliosis. Unlike Chiari II, III, and IV malformations, which are amenable only to medical neurological specialist care.

The likelihood of becoming symptomatic is argued to be proportional to the degree of descent of the tonsils. In one study, all patients with greater than 12 mm of descent were symptomatic, whereas approximately 30% of those whose descent measured between 5 and 10 mm remained asymptomatic. (49) Venkatakrishna et al caution that the natural progression of CTE can produce a variety of different outcomes, '*including spontaneous resolution, spontaneous worsening, improvement with surgery, and even deterioration after surgery*'. (50) This represents a justifiable foray into alternatives to surgery, and an awareness on how to manage these difficult cases.

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43. Henderson Sr. FC, Austin C, Benzel E, Bolognese P, Ellenbogen R, Francomano CA, Ireton C, Klinge P, Koby M, Long D, Patel S, Singman EL, Voermans NC. 2017. Neurological and spinal manifestations of the Ehlers-Danlos syndromes. *Am J Med Genet Part C Semin Med Genet* 175C:195-211.
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 47. White A, Panjabi M. Kinematics of the Spine, *Clinical Biomechanics of the Spine*, 2e. Philadelphia: Lippincott; 1990.
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In a challenging case presentation, which eventually led to this current study, the author (JI) reported a nine-year-old female with suspicious presentation of clumsiness and ‘copper beaten skull’ appearance on an uncollimated sagittal cervical radiograph, which led to investigation of suspected raised intracranial pressure, following a prior suspicion of CTE on MRI as a toddler. (51) Wary of possible false positives being common for this condition, (52) this issue of a child presenting with subjective clumsiness can lead to complex scenarios as will be discussed in the following cases.

The question may well arise as to why the management of Chiari I and CTE ever falls into the hands of the upper cervical, AO, or any chiropractor. This is perhaps because the oft overlooked cases which do not meet the >5mm ectopia classification on MRI scan, debilitating symptoms are dismissed by general practitioners and neurologists, and the patient looks for answers to suffering deemed as ‘of no physical origin’ by medical specialists. Sekula et al state clearly that upon investigation of the dimensions of the posterior cranial fossa in patients without significant CTE, the symptoms are comparable to Chiari I, due to morphological abnormalities in the hypoplastic posterior fossa. (53) CTE alone has been demonstrated as a poor single factor for diagnosis and heretofore the Chiari 0 classification was introduced.

Diagnosis and Methods of Assessment

Available to the clinician are several important levels of assessment of Chiari, CCI and CCS that are of diagnostic value. The first study to provide a rigorous standardised protocol for four diagnostic measures of CCI was done in 2022, (54) and included agreements on basion-axial interval, basion-axial angle, basion-dens interval (BDI) and the Grabb–Oakes line (GOL).

Lohkamp et al, (55) reported ten different radiographic criteria in a systematic review and came up with the four most frequently applied: Clivo-Axial Angle, Harris measurement, Grabb–Oakes, and angular displacement of C1 on C2.

Chiari & Syringomyelia Australia (<https://www.chiariaustralia.org>) provide a more exhaustive range of measures on their web site, as listed in Table 2.

Chiari malformation can only be diagnosed on MRI (not plain radiography), which has not been around for very long since its invention by Raymond V. Damadian. (56) The degree of tonsillar descent is determined by first drawing a line from the basion to the opisthion (anterior margin to the posterior margin of the foramen magnum); this defines the plane of the foramen magnum. This is the basion-opisthion line (B-OL). A measurement is then drawn perpendicular to this plane between it and the tip of the cerebellar tonsils, either in the midsagittal image or an adjacent parasagittal image, wherever the tonsils are most low lying. Chiari Type II (AKA Arnold-Chiari malformation) involves more serious herniations requiring immediate neurosurgical referral.

51. Ierano J. A 9 year old with Headache and Clumsiness: A question of ‘what next?’ [Case Report] *Asia-Pac Chiropr J.* 2020;1:021
DOI <https://doi.org/10.46323/2021021>

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56. https://en.wikipedia.org/wiki/Raymond_Damadian accessed 20 August 2024.

Table 2: Radiographic measures

Name	Nature	Significance
Clivo Axial Angle (CXA)	A line along the clivus and a second one down on the posterior side of the axis.	Abnormal: <150 degrees in flexion and 180 degrees in extension. This angle alone can does NOT equal a diagnosis of CCI.
Basion Axial Interval (BAI)	Basion to the posterior line of axis.	Pathological: > 12 mm
Basion Dens Interval (BDI)	Distance between basion and tip of dens	Pathological: > 12 mm
Harris	BDI + BAI	Pathological: > 12 mm *Additionally, the BAI should be measured in flexion and extension. If the value varies by more than 12 mm this means that the head is sliding backwards and forward on the cervical spine.
Grabb Oakes	To diagnose brainstem compression. A line on middle sagittal MRI scans from the lowest point of the clivus to the lowest posterior point of the axis corpus. Measure in a right angle from this line to the beginning of the spinal canal.	Pathological: > 8 mm
McGregor's Line	Draw a line from the upper surface of the posterior edge of the hard palate to the posterior lowest point of the occiput.	If the tip of the dens is more than 45 mm above the McGregor's line, then a basilar invagination is likely.
McRae line	Drawn on a lateral skull radiograph or mid sagittal section of CT or MRI joining the basion and opisthion.	Abnormal tip of dens <5mm below this line
Powers Ratio	Distance between the basion and posterior arch of atlas divided by distance between opisthion and anterior arch of the atlas.	Pathological: > 1
Bulls Angle	Line drawn between the posterior and anterior arch of C1. Bull's angle is the angle between this line and the hard palate plane.	Pathological: > 13 degrees
Wackenheim's Line	Angle between clivus line and dural canal.	This line should go through the dens or be tangential to it.

Related findings that can affect or obstruct CSF flow and brainstem function are retroflexed dens and pannus formation on the dorsal surface of the dens, disruption of the tectorial membrane at the top of the dens and contributing to canal stenosis. Smith argued for the value of Upright MRI for the imaging of the skull base area, (57) highlighting increased sensitivity with utilisation of the various roentgenometric measurements such as BO-L or McRae's line, Grabbe-Oakes, clivo-axial angle, and McGregor's lines. As has Franck and Perrin, additionally adding the merits of Cervical Digital Motion X Ray (DMX), (58) particularly where surgical correction is required.

DMX is regularly utilised in the USA but is virtually absent in Australia, the author's home. A very cost effective and readily available but limited alternative is to conduct dynamic range of motion X rays on static plain radiography utilising APOM neutral and bilateral flexion for the Alar ligaments of the dens and flexion, extension views for the transverse atlantoaxial ligament. Reliability and cost efficiency is good. (59)

Intervention

A grey zone exists in the context of attempting conservative treatment of symptoms attributable to CTE and Chiari 0-1, where neither neurosurgery nor manual therapies present as safe options to sufferers.

Case studies trialing chiropractic care of CTE are rare, but commonly upper cervical specific in nature, though a manual technique case has been reported, (60) and cranial adjusting combined with upper cervical analysis and treatment for optic neuritis. (61) Upper cervical chiropractic techniques, in this study Atlas Orthogonality (AO), may offer an option for care worth considering. We present a mix of significant cases highlighting either long-term management, immediate referral, or successful co-management.

Rosa et al presented on the topics of post-traumatic neck injury, (62) intracranial cerebrospinal fluid (CSF) flow dynamics and CTE becoming symptomatic after trauma, that were formerly quiescent, (63) with demonstrable effects of mal-alignment (subluxation) and future conservative management. (64) These are commonly un- or mis-diagnosed conditions now being

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57. Smith FW. Upright Magnetic Resonance Imaging of the Craniocervical Junction. In: Smith FW, Dworkin JS (eds): The Craniocervical Syndrome and MRI. Basel, Karger, 2015, pp 48-66. DOI 10.1159/000365470
 58. Franck JI, Perrin, P. The Cranial Cervical Syndrome Defined: New Hope for Postwhiplash Migraine Headache Patients - Cervical Digital Motion X-Ray, FONAR Upright® Weight-Bearing Multi-Position™ MRI and Minimally Invasive C,-C, Transarticular Lag Screw Fixation Fusion. In: Smith FW, Dworkin JS (eds): The Craniocervical Syndrome and MRI. Basel, Karger, 2015, pp 48-66. DOI 10.1159/000365470.
 59. Hariharan KV, Terhorst L, Maxwell MD, Bise CG, Timko MG, Schneider MJ. (2020). Inter-examiner reliability of radiographic measurements from Open-mouth lateral bending cervical radiographs. *Chiropractic & Manual Therapies*. 28. 10.1186/s12998-020-00317-6.
 60. Sergent AW, Cofano GP. Chiropractic Care for Headaches and Dizziness of a 34-Year-Old Woman Previously Diagnosed with Arnold-Chiari Malformation Type 1. *J Chiropractic Med*. 2014(13);3:p192-5. <https://doi.org/10.1016/j.jcm.2014.07.004>.
 61. Cuthbert S, Blum C. Symptomatic Arnold-Chiari Malformation and Cranial Nerve Dysfunction: a Case Study of Applied Kinesiology Cranial evaluation and treatment. *J Manip Physiological Ther*. 2005;28, 4; p289.
 62. Carelton, J. Rosa, S. Sweat, R. Sweat, M. et al. Resolution of Cervical Complications Secondary to Motor Vehicle Accidents by the Application of Stereotactic Cervical Alignment (SCALE) Methods: Statistical Review of 54 Patients. *J Whiplash & Related Disorders*, Vol. 5(1) 2006 DOI 10.1300/J180v05n01_03 15
 63. Freeman MD, Rosa S, Harshfield D, Smith F, Bennett R, Centeno CJ, Kornel E, Nystrom A, Heffez D, Kohles SS. A case-control study of cerebellar tonsillar ectopia (Chiari) and head/neck trauma (whiplash). *Brain Inj*. 2010;24(7-8):988-94. DOI 10.3109/02699052.2010.490512. PMID: 20545453.
 64. Rosa S, John W Baird. The Craniocervical Junction: Observations regarding the Relationship between Misalignment, Obstruction of Cerebrospinal Fluid Flow, Cerebellar Tonsillar Ectopia, and Image-Guided Correction. In: Smith FW, Dworkin JS (eds): The Craniocervical Syndrome and MRI. Basel, Karger, 2015, pp 48-66. DOI 10.1159/000365470.

identified more often by the onset of sensitive MRI imaging. Imaging interpretation is still poorly understood in clinical practice by chiropractors and, as the patients mostly attest, by neurologists, it would seem, as most of the cases herein were diagnosed by the author treating and contributing colleague (LG). Currently, with the use of the internet, some patients are quite accurately self-diagnosing where their own doctors fail to.

Chiropractors are trained to assess and treat the cervical spine, and some corrective methods have different treatment goals, such as correction of scoliosis (65) or hypolordosis (66). Our recommendation, with extreme caution as evidenced by this case series, is for investigation into the low force chiropractic techniques being employed in the event of CTE, as a viable, safe, non-surgical intervention.

In this study I examine the care provided with chiropractic specialty upper cervical techniques, in these cases Atlas Orthogonal Technique, a specialty chiropractic technique that focuses on determining the orthogonal position of the atlas vertebra and its putative relationships to neuro-musculo-skeletal tone (67) and spinal subluxation aetiology. (68) The purpose is to remove stressors which are thought to impact negatively on the innate expression of an individual's optimal health and well-being. (69)

The practice involves directing small forces around 14N, to correcting atlas orientation via vectors measured in the three planes of angular anatomical dimension: generated from a mechanical percussion instrument impact, so that the transverse plane of the head remains orthogonal, or as closely at right angles to the mid-sagittal plane of the neck and pelvis as possible. This is in accordance with the Righting Reflex which keeps eyes level with the horizon, defined as the *'ability to resume an optimal head position when there has been departure from it'*. (70) Pre and post X ray studies conducted by Sweat et al continually show this to be reliable but needs further scrutiny to eliminate bias and introduce randomisation of subjects. (71)

Rosa and Baird reported on an enhanced technology potentiated patented Image-Guided Atlas Treatment™ which uses as its basis the AO premise, (72) but with dynamic upright MRI to guide the standard AO percussion wave instrumentation developed by father/son chiropractors Roy and Mathew Sweat in Atlanta, Georgia, USA, and modified further by Dr Scott Rosa in New York. A great advantage is held when dynamic flexion, extension and motion views can allow visualisation of alignment, motion disturbances and disc behaviour in comparison with static imaging. The future of this treatment is reflected in outcomes of case studies discussed herein.

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65. McAviney J, Mee J, Fazalbhoy A, Du Plessis J, Brown BT. A systematic literature review of spinal brace/orthosis treatment for adults with scoliosis between 1967 and 2018: clinical outcomes and harms data. *BMC Musculoskelet Disord.* 2020 Feb 8;21(1):87. DOI 10.1186/s12891-020-3095-x.
 66. Norton TC, Oakley PA, Harrison DE. Improving the cervical lordosis relieves neck pain and chronic headaches in a pediatric: a Chiropractic Biophysics® (CBP®) case report with a 17-month follow-up. *J Phys Ther Sci.* 2022 Jan;34(1):71-75. DOI 10.1589/jpts.34.71.
 67. McDowall, DA. Daniel David Palmer's heritage and his legacy of tone to chiropractic [Southern Cross University]. 2021; 115. doi.org/10.25918/thesis.121
 68. Ebrall, P. Bovine, G. A History of the Idea of Subluxation: A Review of the Medical Literature to the 20th Century. *J Contemp Chiropr* 2022, Volume 5. Pp 150-69.
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 70. Miller-Keane Encyclopedia and Dictionary of Medicine, Nursing, and Allied Health, Seventh Edition. (2003). <https://medical-dictionary.thefreedictionary.com/righting+reflex> Accessed September 20th 2023.
 71. Sweat RW, Sweat MH. Structural subluxations caused by atlas kinematic displacement (AKD). In: Structural improvements. Using chiropractic atlas orthogonality (AO). Atlanta GA: RW Sweat Foundation. 2000.
 72. Scott Rosa, John W Baird. The Craniocervical Junction: Observations regarding the Relationship between Misalignment, Obstruction of Cerebrospinal Fluid Flow, Cerebellar Tonsillar Ectopia, and Image-Guided Correction. In: Smith FW, Dworkin JS (eds): The Craniocervical Syndrome and MRI. Basel, Karger, 2015, pp 48-66. DOI 10.1159/000365470

Damadian (the MRI inventor) and Chu used similar technology to observe the role of craniocervical trauma in the aetiology of multiple sclerosis. (73) They suggested that trauma results in flow impedance and circulation issues affecting brainstem and CSF flow contributing to demyelination through antigen-antibody reactions. Damadian was keen supporter of the assertion that some neuro-degenerative diseases are caused or directly impacted by CCS. (74)

Case series

Case 1: (JI) Male 26, head Pain, neck pain, brain fog.

A 26-year-old male presented suffering chronic five-year duration of post-concussion symptoms from a history of impacts to the forehead and motor accident whiplash injuries. He described feeling a *'foggy-headed sensory overload, with head and neck pain'*.

His response to atlas orthogonal upper cervical adjustment was positive, according to his symptomatic reports of pain relief and perceived greater acuity of thinking. It is unknown if actual physical brainstem changes eventuated, as the original MRI was deemed *'normal study'* which the practitioner (JI) contested as borderline tonsillar ectopia (black line figure 2), with C2 dens pannus (red arrow figure 1) formation implicating ventral brainstem compression, defined by the measured lines, seen in Table one and corresponding figures.

At six month follow up the patient was progressing well in quality-of-life measures: work, sleep, and daily activities. Monitoring progress at this stage requires vigilance as referral will be made if symptoms and signs change or worsen (see Algorithm, Appendix One).



Fig 1: Male, 26y

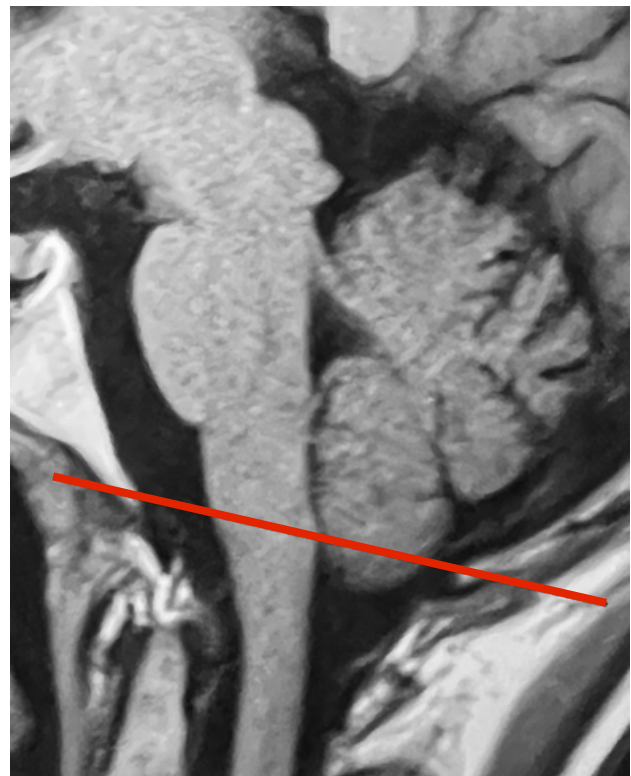


Fig 2: Male, 26y, detail

73. Damadian RV, Chu D. The possible role of craniocervical trauma and abnormal CSF hydrodynamics in the genesis of multiple sclerosis. *Physiol Chem Phys Med NMR*. 2011;41:1-17.

74. Damadian, RV. Cranio-Cervical Syndrome (CCS) Symposium - April 6, 2013. <https://www.youtube.com/watch?v=i8KGFUIPGLE&t=8s> Accessed August 20, 2024.

Case 2: (JI) Female 41, Head pressure, pain, neck pain

A Female, 41, was referred by non-upper cervical chiropractor and had consulted numerous neurological medical specialists dismissing treatment to drug therapy options for pain control. Symptoms were chronic head pain, neck discomfort, cranial tenderness, and constant pressure in the head. Onset was 6 months after traumatic surfing injury to the neck area.

Her history included unsuccessful treatments such as Botox to the neck muscles. Patient was referred to brain stem neurosurgical specialist for opinion (by JI) because after one low force adjustment the patient felt anxious about treatment. Both practitioners (JI, LG) reported retroflexion of the dens (arrow figure 4), pannus formation on dorsal dens, and axial CSF accumulation. This was not reported on the original MRI report.

We still await a report from the medical neurologist. In Australia, in JI's personal experience, medical specialists do not communicate with Chiropractors, in general. These signs were not relayed to the patient who was oblivious to any such notions of brain stem involvement and reflects a lack of education on the part of the chiropractic generalist practitioner and, moreover surprising, the specialist medical surgical practitioner.

This patient was not heard from after referral was made.



Fig 3: Female, 43y



Fig 4: Female, 43y, detail

Case 3: (JI) Male 18, Chronic headaches

A male patient, 18, with constant chronic headache presentation and medically diagnosed Chiari 1 via MRI scan dated 18 February 2020 and quoting a comparison scan from 13 February 2019; reported as CTE 'approximately 10mm below the foramen magnum'. No other abnormality was detected.

His mother chose low force chiropractic AO care after several neurosurgeons, two paediatric neurologists, one adult neurologist, review by The *Chronic Pain Multidisciplinary Clinic* at Sydney Children's Hospital, psychologist, and psychiatrist, all failed to offer symptomatic relief and with any surgical option unclear.

He has been under care for two years and reports benefit with control of symptoms related to a Chiari 1, mainly headache. Pain levels initially at 8-10/10 were at maximum 7/10 after 3 visits. Pain now regulated at around 5/10 with monthly atlas orthogonal upper cervical care and doing well under JI's care.

A new MRI was reported in February 2024 and images shown below indicate no further herniation.

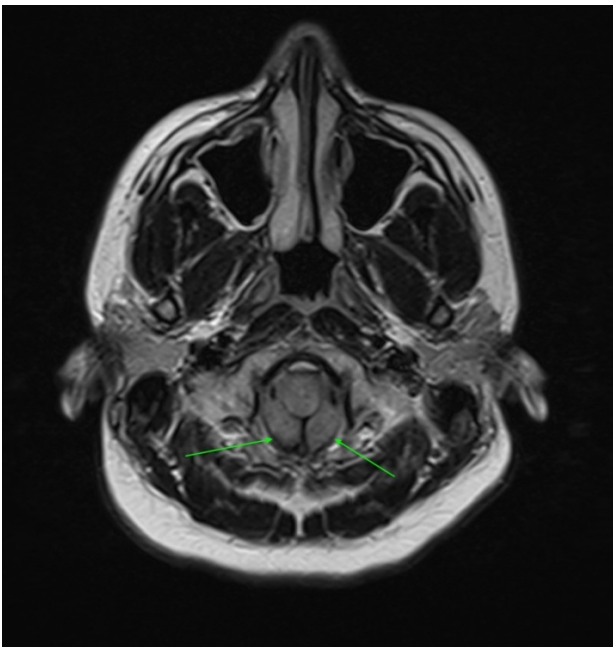


Fig 5: Male 18, tonsils in spinal canal

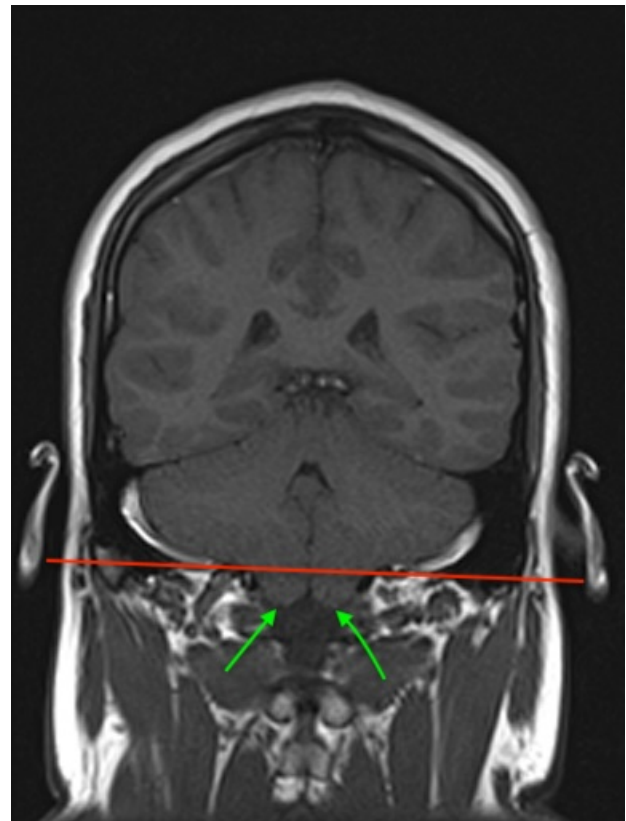


Fig 6: Male 18, CTE 10mm below red line



Fig 7: Male 18, CTE 10mm below red line

Case 4: (LG) Female 43, -ve response to HVLA

A 43-year-old female who was thrown from a horse as a child and landed on the back of her head and neck in a 'plow pose', sought care for said injuries. As an adult she received a high velocity upper cervical chiropractic thrust into C2 which immediately produced whole body neuralgia and itching.

A second high velocity thrust produced the following:

- ▶ sudden severe anxiety and panic attacks
- ▶ severe burning pain down left side of neck to middle back
- ▶ left arm weakness; left shoulder weak in internal rotation; loss of left arm abduction
- ▶ bilateral paraesthesia in hands and feet
- ▶ 'zinging' pains up and down spinal cord while walking
- ▶ autonomic dysfunction: elevated respiration and heart rate, significant increase in urination and bowel movement frequency; paraesthesia in left ear and left side of throat
- ▶ Hyper sensory – all senses felt exaggerated, body felt over stimulated by sound and light
- ▶ She described not being able to pinpoint the bounds of her 'being/energy'.
- ▶ The patient reported having to sleep with a weighted blanket and with her head out the window to sync with nature
- ▶ Loud swooshing in left ear
- ▶ occipital headaches
- ▶ light headedness
- ▶ brain fog.

The patient was unable to work for two weeks and spent the next six months struggling with these symptoms. Non-manipulative low force Chiropractic techniques helped alleviate some of the initial nervous system dysfunction and helped the patient to be able to return to work. At the time of Atlas Orthogonal intervention, remaining symptoms included pulsatile tinnitus on the left, brain fog, cognitive changes, and light headedness.

Practitioner reported Chiari 1, retroflexed dens with pannus and ventral brainstem compression, especially on flexion and extension, vertebrasilar flattening and deformation of the ventral pons, and syrinx formation at C2/C3.

Adjustment with the Atlas Orthogonal instrument by Dr Scott Rosa of Rock Hill, NY, USA caused no inflammatory response and provided relief of all remaining symptoms for the patient. She was able to return to a normal life.

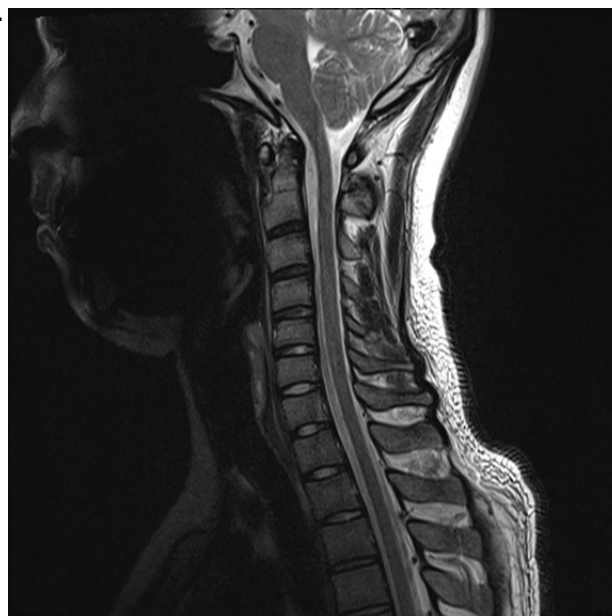


Fig 9: Female 43, MRI C-spine

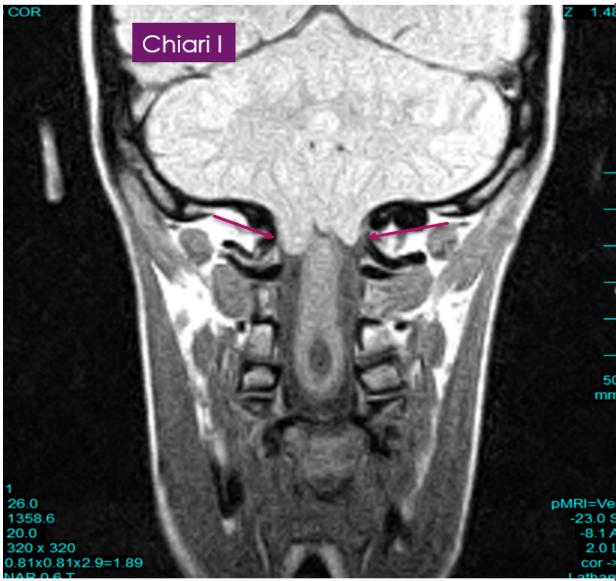


Fig 10: Female 43, MRI C-spine frontal

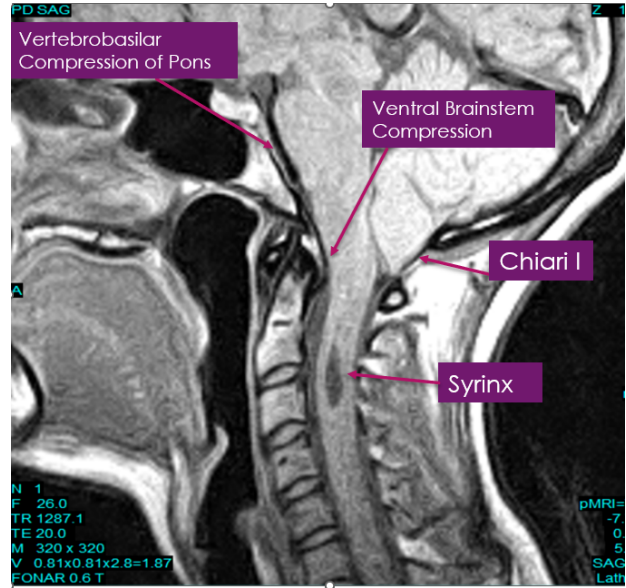


Fig 11: Female 43, MRI C-spine sagittal

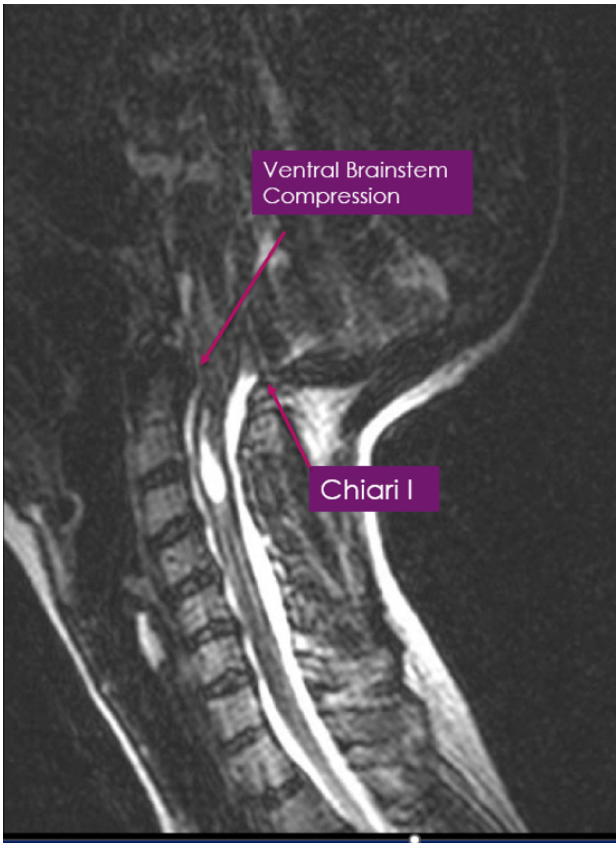


Fig 12: Female 43, MRI brainstem compression

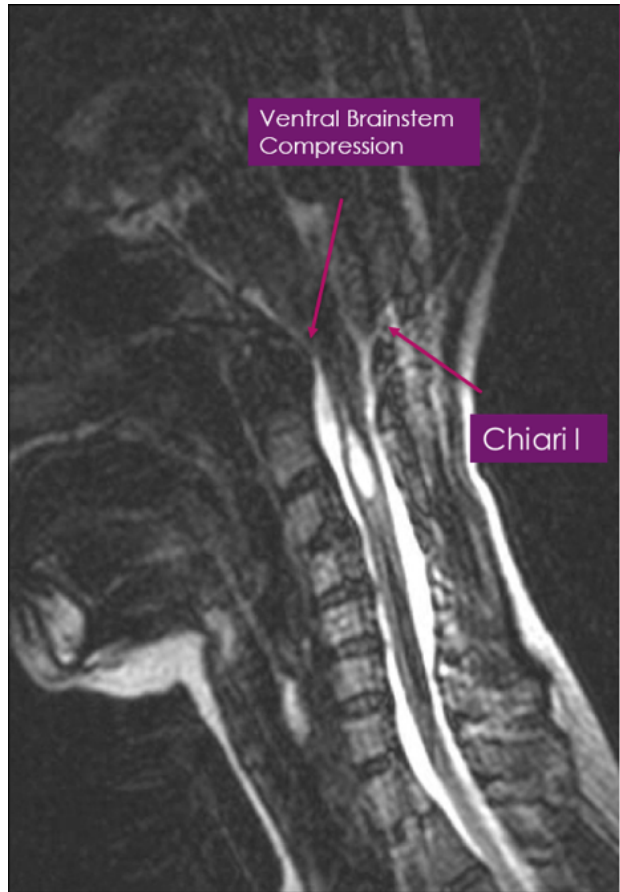


Fig 13: Female 43, MRI brainstem



Fig 14: Female 43, showing CSF flow

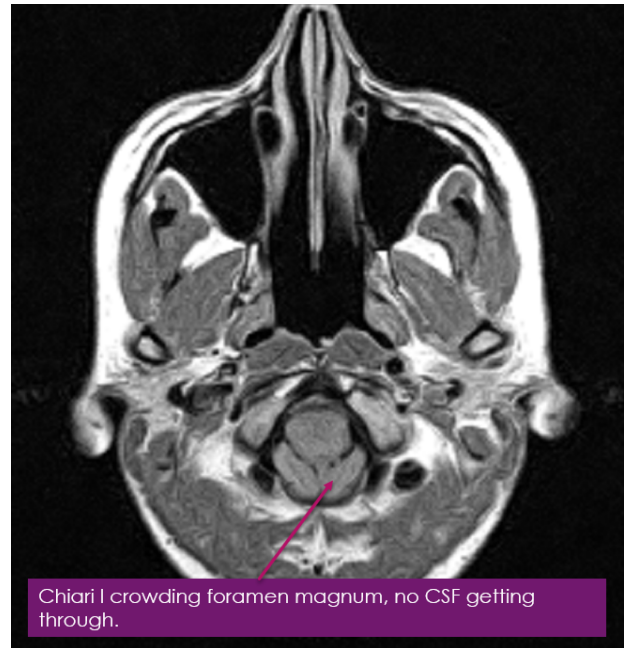


Fig 15: Female 43, showing CSF flow

Case 5: (LG) Chronic pain, injuries

A 45-year-old female presented with chronic constant headaches, migraines, photophobia, sharp neck pain and pressure, upper back pain and nausea following being hit by a car as a pedestrian in 1997. A four month long intractable migraine was reported in 2017. All symptoms exacerbated after a physical assault that involved high velocity lateral flexion of the head and neck in 2019, peaking at 8/10 neck pain and 9/10 migraine pain with shooting pain from occiput to the crown of the head and intermittent 9/10 icepick like stabbing pains at the crown.

The patient felt a pinching pain in the right scapular region and experienced intermittent numbness in her right hand. Prior to presenting at the chiropractic clinic, a neurologist ordered a standard brain MRI and MRA. The practitioner (LG) took Atlas Orthogonal X-rays and ordered recumbent MRI of the craniocervical junction. This joint was not included in previous imaging. Medical radiology report indicated Chiari 1 with 9mm descent and mild degenerative changes of the cervical spine without nerve root impingement. LG observed the following on the MRI:

- ▶ Right and anterior displacement of brainstem. Likely multi-factorial: Chiari 1 causing displacement, and dentate ligament torsion from mechanical mal-position of C0/C1 and C1/C2
- ▶ Flow artefact anterior to brainstem, turbulent CSF flow seen at this level
- ▶ Counter rotation of C1/C2 motion segment
- ▶ Left vertebral artery compressing and deforming the ventral medulla

The patient received complete relief from Atlas Orthogonal care and remains symptom free when she is, as she describes, '*in alignment*', post AO adjustment.



Fig 16: Female 45, showing Chiari I

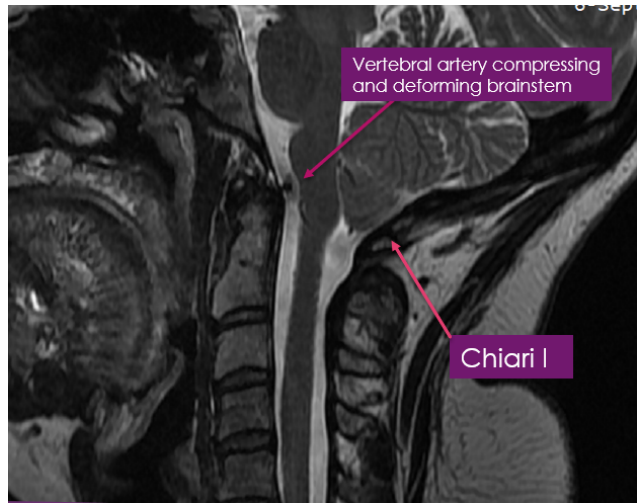


Fig 17: Female 45, showing VA compression

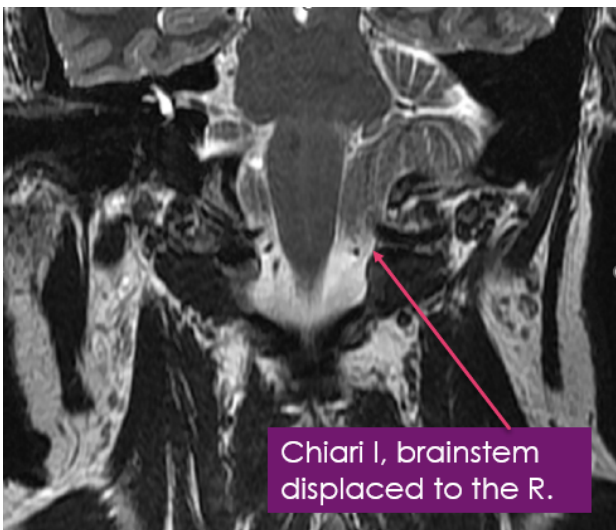


Fig 18: Female 45, showing brainstem displacement

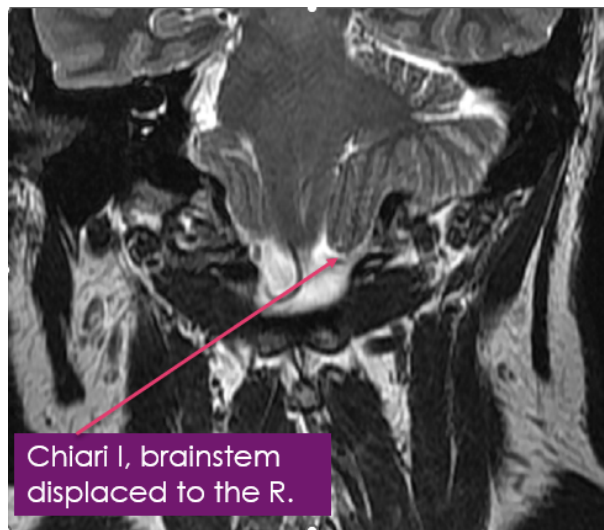


Fig 19: Female 45, again showing brainstem displacement

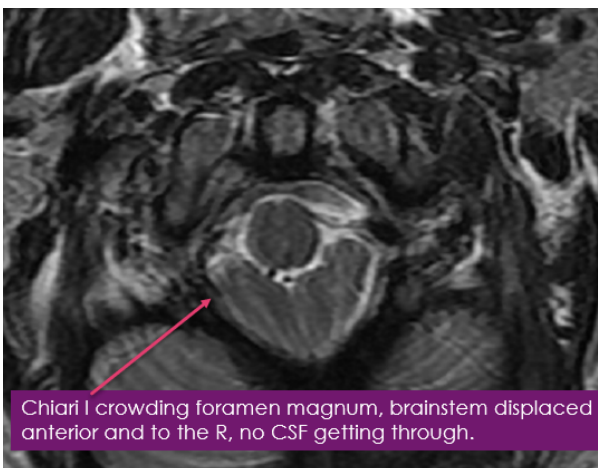


Fig 20: Female 45, showing CSF blocked

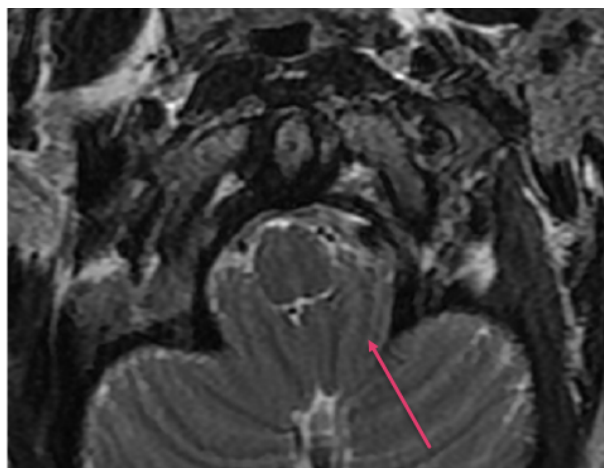


Fig 21: Female 45, showing CSF flow

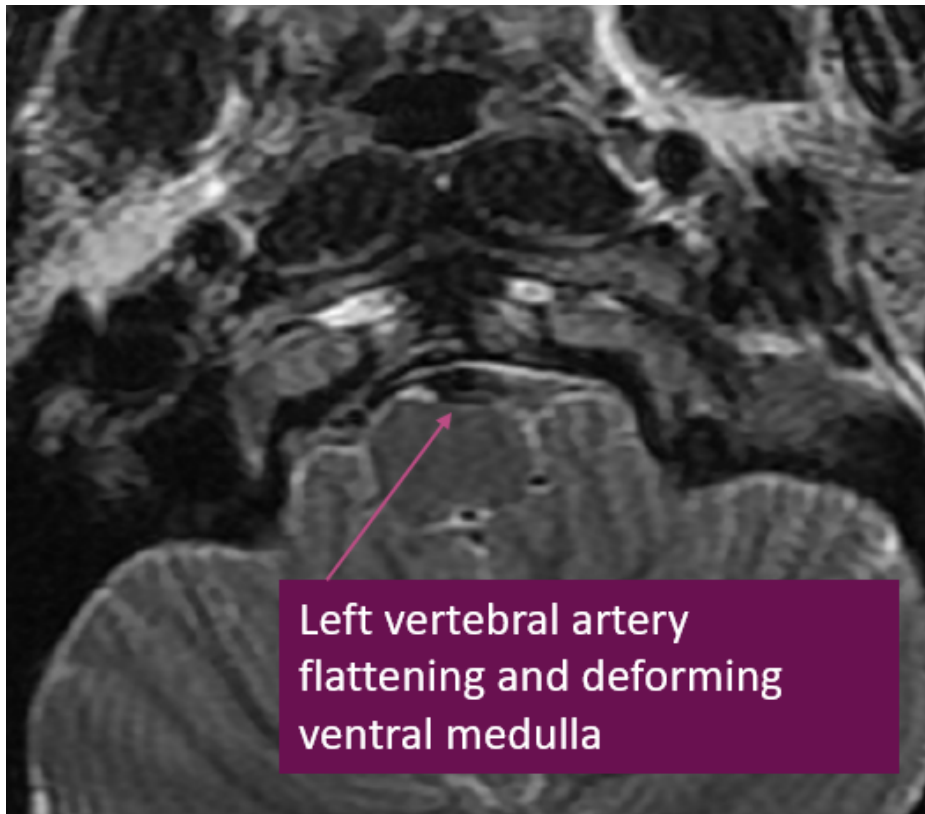


Fig 22: Female 45, showing compression of vertebral artery

Case 6: (JI) Dizziness, Migraine

A male, 25 years old, presented with persistent dizziness and migraines for five years. He reported that his symptoms were aggravated by a forceful manual manipulation. He then discovered the prospect of AO care online and improved by low force atlas adjustment.

The CTE was missed on the original MRI he presented with. Benefits in headache reduction and dizziness was reported with AO adjustment. We have referred for an upright MRI scan for further examination under gravity. Results are forthcoming, at the time of writing.

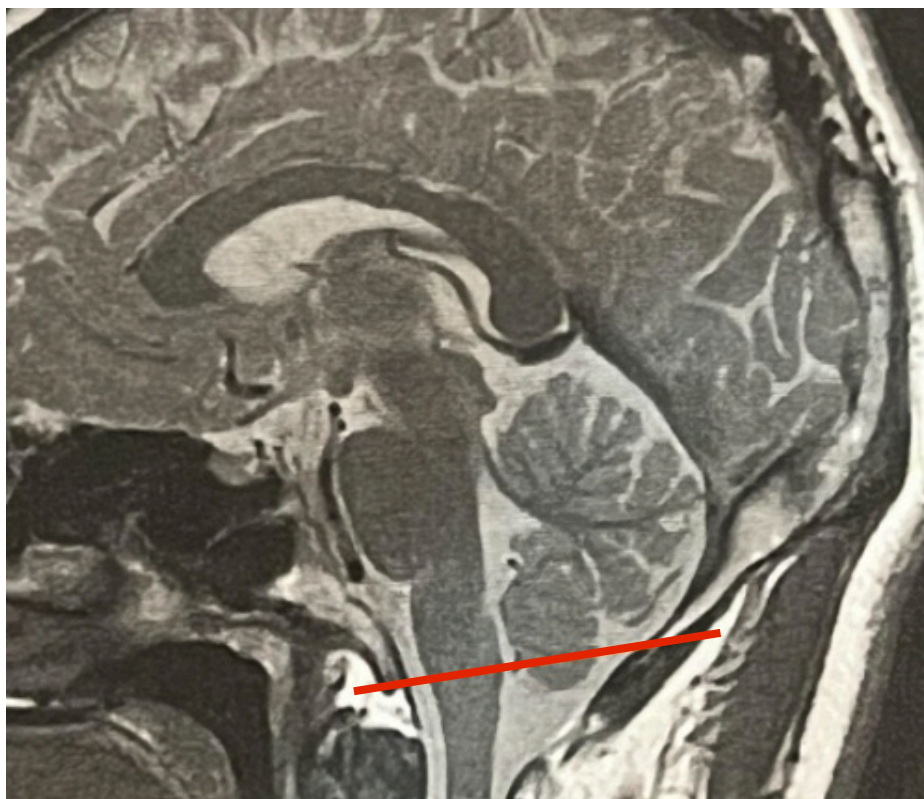


Fig 23: Male 25, showing tonsillar displacement

Case 7: (JI) Female 43, neck pain and dizziness

A female patient, 43 years of age, presented with neck pain and dizziness, which allegedly commenced after forceful upper cervical manual manipulation several months prior. Additionally, it caused instant nausea reaction, pain, *'drunk feeling and dizziness'*.

The patient continued to improve under AO care, but the practitioner suspected that resolution was not satisfactory and requested access to prior MRI. Images were analysed and a suspected CTE was visualised. A new MRI was deemed unremarkable by neurosurgeon.

Management continues under chiropractic non-manipulative care as patient denied any surgical interventions and was nonetheless denied as any form of Chiari by the neurosurgeon.



Fig 24: Female 43, PRE MRI shows CTE deemed insignificant

Fig 25: Female 43, borderline CTE in post MRI study



Case 8: (JI) Female 30, chronic neck pain and instability

A female presented at age 30, with chronic neck pain, heavy head, and unsteady feeling in the neck. Past trauma included a traumatic fall while pregnant. I (JI) assessed and suspected CCI and/or Chiari after placing her under AO care, and noticing signs of instability:

- ▶ short-term recovery
- ▶ inadequate symptomatic relief, and
- ▶ notably unchanged objective markers such as X ray improvements, palpatory findings and desired leg length changes. The C2 spinous, on all examinations, appeared in a rotatory subluxed position.

This case has the hallmarks of the journey a patient with a combination of multiple manifestations of CTE, CCI and CCS, must go through due to not only the complexities, but ignorance of the nature of these conditions. In addition, can be seen the phenomenon of *Eagle's Syndrome*, or calcified stylohyoid ligaments, forming an impingement syndrome. This was visually confirmed by Three-Dimensional Computed Tomography scan. (75)

Her history included a traumatic fall whilst eight months pregnant in 2020 that injured her neck, with a traumatic birth to follow, it is hypothesised that this caused the failure of upper cervical ligaments, atlanto-axial rotary subluxation, upon an already compromised connective tissue due to *Ehlers-Danlos Syndrome* (EDS). Visits to general practitioner, chiropractor, neurosurgeon, orthopaedic surgeon (who ruled out instability by reportedly laughingly dismissing the patient's concern when questioned) and advised her to do Tai Chi. This lack of resolution led to the following order of practitioners: Another Chiropractor, an Osteopath, a Physiotherapist, Sports and Exercise Physician, two Physiotherapists. The turning point was when she consulted with an Upper Cervical Atlas Orthogonal Chiropractor due to her own online search, who arranged for specific radiographs and added the seldom utilised A-P open mouth side bend x-ray. These views demonstrated ligament laxity and atlantoaxial rotational subluxation depicted in the figures below. JI advised the patient to seek a Neurosurgeon's opinion regarding concerns about possible CCI.

The patient's experience is now so extensive that it is valuable knowledge beyond most medically trained doctors; her words are worthy of note:

'In my journey I also found out that I have Hypermobility Ehlers Danlos Syndrome via a Geneticist. And that I also have Mast Cell Activation Syndrome [diagnosed by] immunologist. What's interesting is these conditions go hand in hand together and most people with CCI have MCAS, EDS, POTs etc. I think it's really important to acknowledge that there are only a few specialists who take interest in these conditions despite a growing increase of people presenting with the same symptoms. These people get misdiagnosed for years. GPs also don't have a great deal of knowledge with these conditions and patients find themselves navigating their own care. Patients also have numerous scans which come back 'normal'. **The scans are not normal, they are just not being read by the right people.** I hope that awareness is spread so that people can get the help they deserve. It's also imperative to see specialists who understand these conditions as patients will see themselves getting lost in the medical system and suffering severely financially trying to get a diagnosis'.

The patient has undergone three sessions of Percutaneous Implantation of the Cranio-cervical Junction Ligaments (PICL): experimental injections in USA (travelling from Australia) through the

75. Searle E, Searle A. An overview of Eagle's syndrome. Br J Pain. 2021 Nov;15(4):388-392. DOI 10.1177/2049463720969741.

novel treatment protocols of Centeno-Schultz clinic in Colorado. (76) She continues to have AO care on a supportive basis of symptom relief. She is still in constant pain and has departed for another round of PICL, six months after choosing surgery to alleviate bilateral styloid process jugular vein compression causing intracranial pressure and compression between the styloid processes and the C1 lateral mass. The result of this surgery can be viewed below on the CT renderings; note the bony encroachment of the C1 transverse process into the jugular vein.

Figures 30, 31, and 32 demonstrate usefulness of dynamic radiographs in the absence of Digital Motion X rays, as do pre- and post-adjustment studies within the AO protocol to ascertain correction or not. Failure of ligaments such as the alar and transverse will leave motion unchecked and dangerously close to brainstem str and restrict CSF flow.

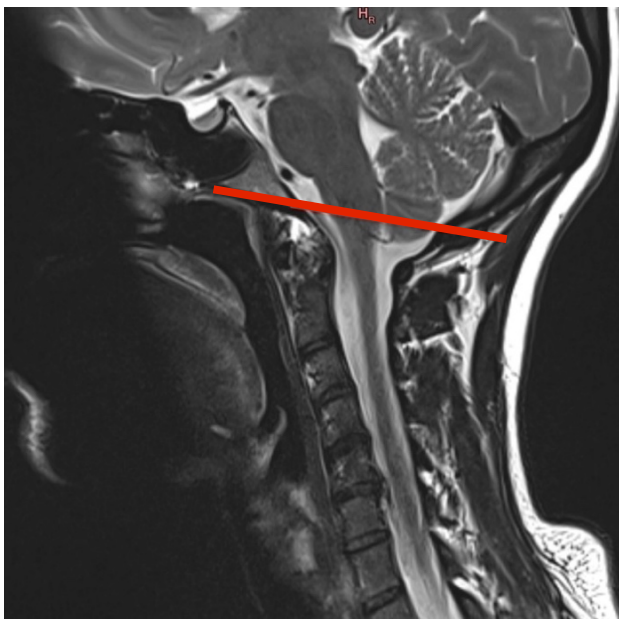


Fig 26: Female 30, MRI study 2024



Fig 27: Female 30, MRI study 2022

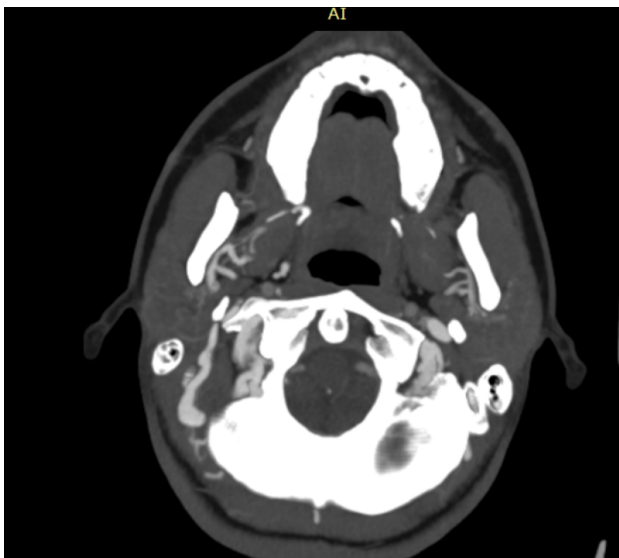


Fig 28: Female 30, Horizontal section showing rotatory C2 subluxation



Fig 29: Female 30, coronal section showing Alar ligament involvement

76. <https://centenoschultz.com>. Accessed 11 Apr 24

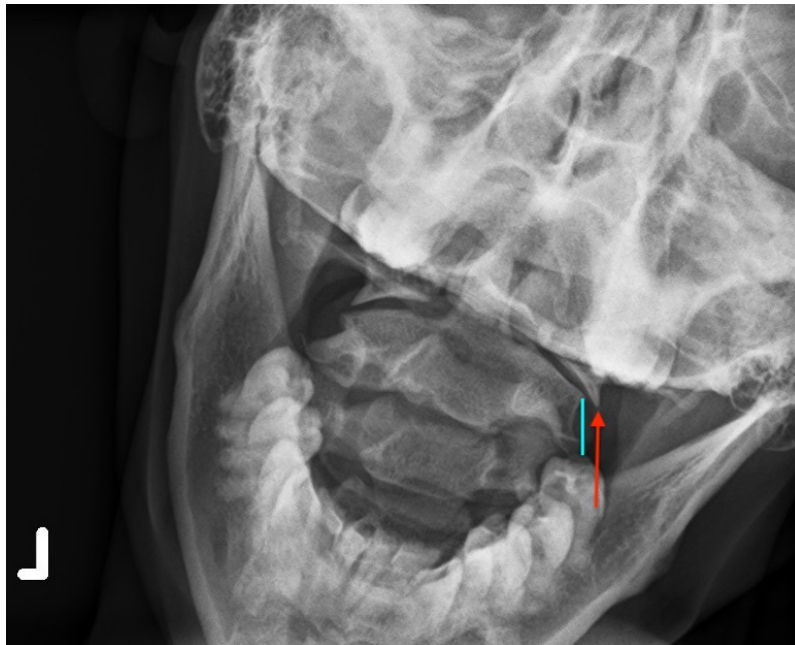


Fig 30: Female 30, APOM right lateral flexion showing C1 overhang on C2

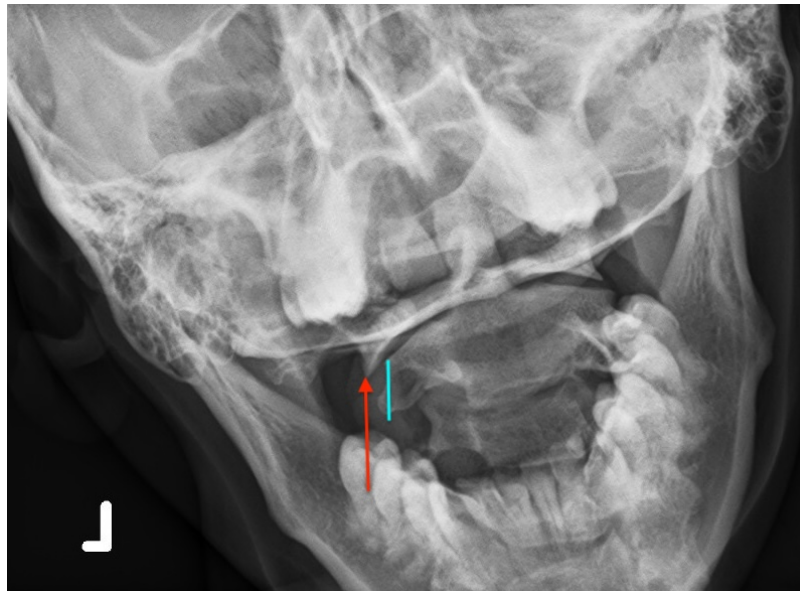


Fig 31: Female 30, APOM left lateral flexion C1 overhang due to unchecked alar ligament



Fig 32: Female 30, APOM neutral showing overhang in neutral position due to Alar ligament damage.

3D reconstructions post Styloid Surgery:

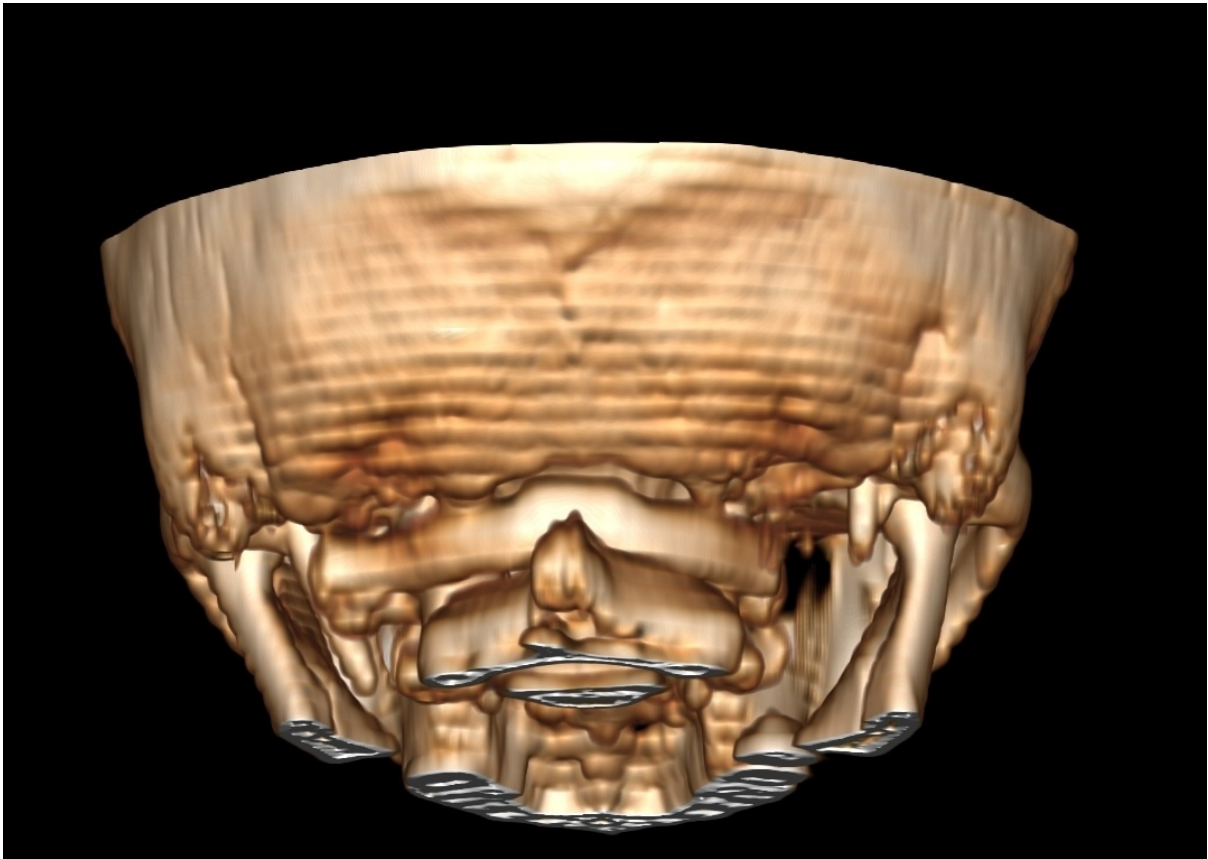


Fig 33: Female 30, reconstruction showing right C1 transverse excisions



Fig 34: Female 30, reconstructions with vascular studies can show congestion



Fig 35: Female 30, reconstructions demonstrating vascular congestion

Case 9: (LG) Male 29, daily headaches

A 29-year-old male presenting with daily headaches ranging from 2/10 to 8/10, intermittent migraine headaches, visual snow syndrome, sensation of pain and pressure behind the eyes, light sensitivity, feeling of internal body tremors, brain fog, memory struggles, constant neck and trap pain ranging from 2/10 to 8/10, intermittent stabbing pain in left upper back region, constant tinnitus with varied intensity.

Sudden onset in March of 2022 after forcefully vomiting. There was significant head/neck trauma history of several concussions. The patient presented for Atlas Orthogonal care with the practitioner (LG) In August of 2022, and noted the following on MRI:

- ▶ Tonsillar ectopia with restriction of CSF flow
- ▶ Left vertebral artery compressing and deforming the brainstem.

Symptoms for this patient were managed with Atlas Orthogonal protocols and reportedly while the patient is following a care plan, he is often asymptomatic.

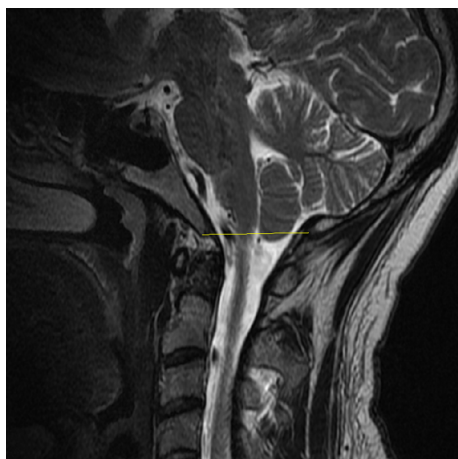


Fig 36: Male 29, showing CTE

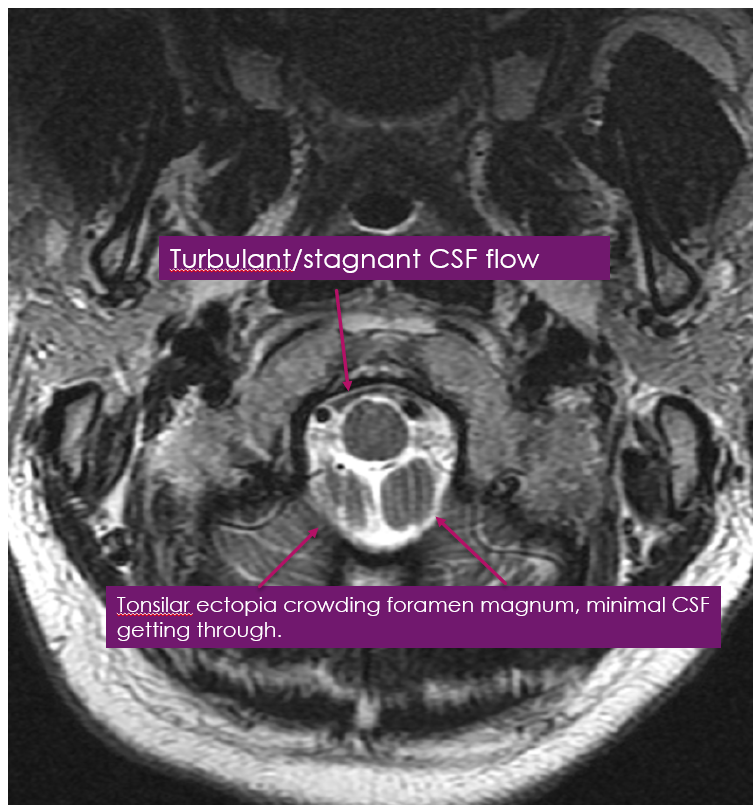


Fig 37: Male 29, showing CSF changes

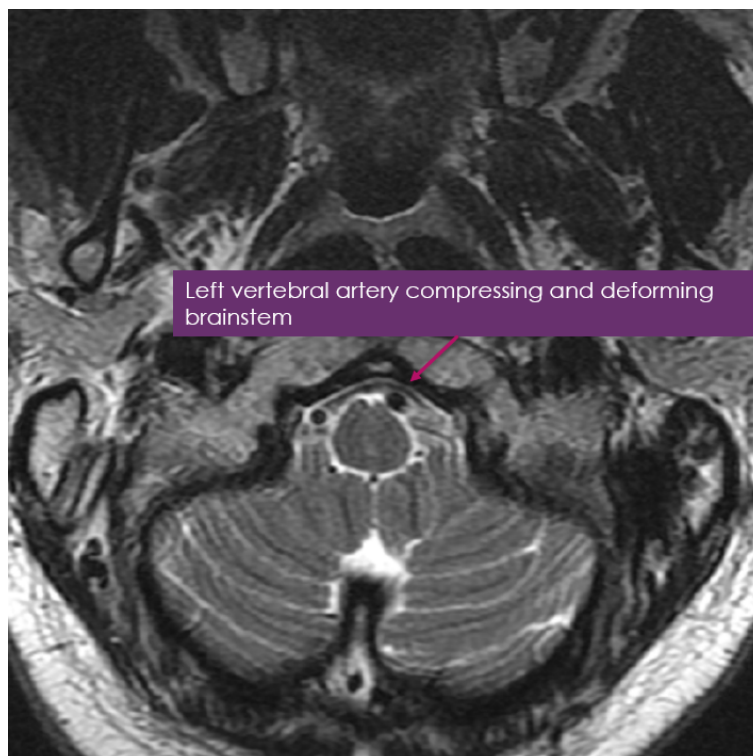


Fig 38: Male 29, showing vertebral artery changes

Case 10: (LG) Female 35, constant neck pain

A 35-year-old female presented with constant neck pain, TMJ pain and dysfunction, jaw clenching, frontal and occipital headaches with nausea at least once a week 7/10, brain fog and memory loss. The AO practitioner observed the following on cervical spine MRI:

- ▶ Marked pannus with significant narrowing of the spinal canal anterior to brainstem.
- ▶ Mild reactive bend in the brainstem.

It is noted that there is no CCJ series available on this patient and that the available imaging was done recumbent. Significant improvement is noted with frequent asymptomatic periods under Atlas Orthogonal treatment.

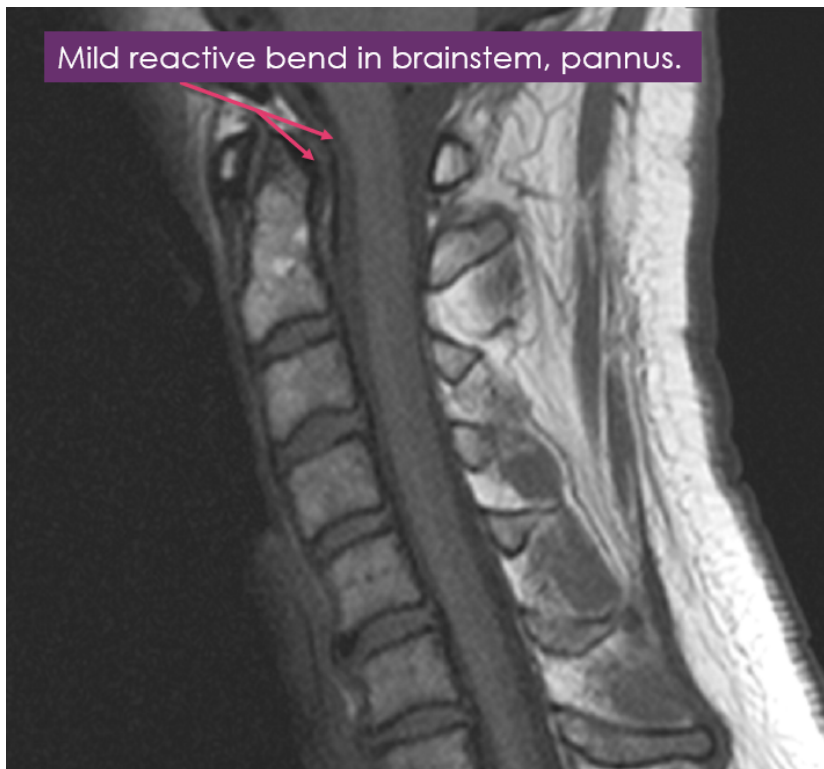


Fig 39: Female 35, showing brainstem changes

Case 11: Female 48, daily headaches

A 48-year-old female complained of daily headaches, frequent migraine headaches since the age of two, often triggered by flexion of the head/neck, occipital neuralgia, constant neck pain ranging from 3/10 to 9/10, hands would go to sleep if arms held overhead, C1 region will burn then hands will go numb if she extends head/neck, dizziness, and vision changes. No change with traditional chiropractic care or physical therapy.

Practitioner LG observed the following on MRI:

- ▶ Retroflexed dens with pannus
- ▶ Tonsillar ectopia with 'corked' foramen magnum and limited CSF flow
- ▶ Extra axial collection of CSF
- ▶ Eye morphological changes (flattening)

The patient finds significant improvement of all symptoms with Atlas Orthogonal care accompanied by extended periods of time that are asymptomatic.

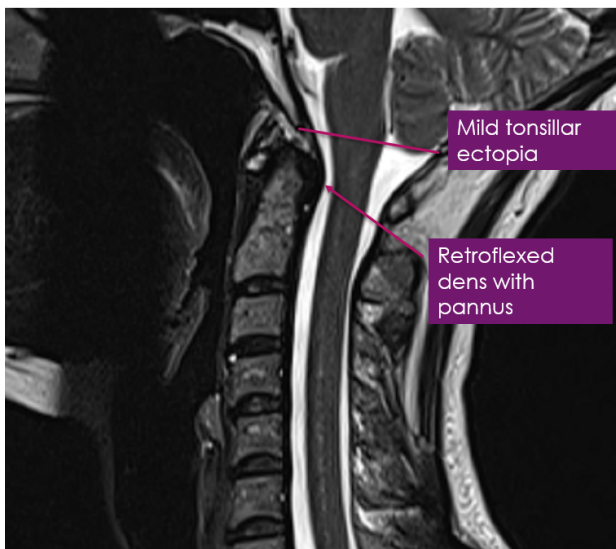


Fig 40: Female 48, annotated CTE

Fig 41: Female 48, CSF features

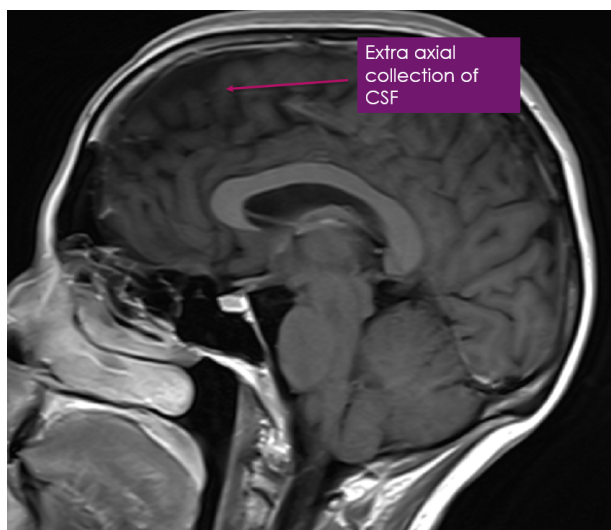


Fig 42: Female 48, showing changes to the eyes

Case 12: (LG) Male 60, headaches and vision changes

A 60-year-old male presented with constant severe frontal headaches, migraine headaches with tunnel vision, blurred vision, perceived eye pressure, bilateral neck pain, nausea, dizziness, and perceived cognitive struggles.

The patient first presented to his medical physician, who prescribed various medications that did not help his symptoms.

After an MRI and a hospital emergency room visit, the patient was referred by a family member to an Atlas Orthogonal care practitioner (LG) who observed the following on MRI:

- ▶ C2 Pannus
- ▶ Ventral brainstem compression
- ▶ Bilateral vertebral arteries compressing and deforming upper brainstem
- ▶ Extra axial collection of CSF

After treatment, the patient reported virtually nonexistent symptoms at time of writing. A letter was provided by the patient's doctor acknowledging the success of Atlas Orthogonal treatment for this patient .

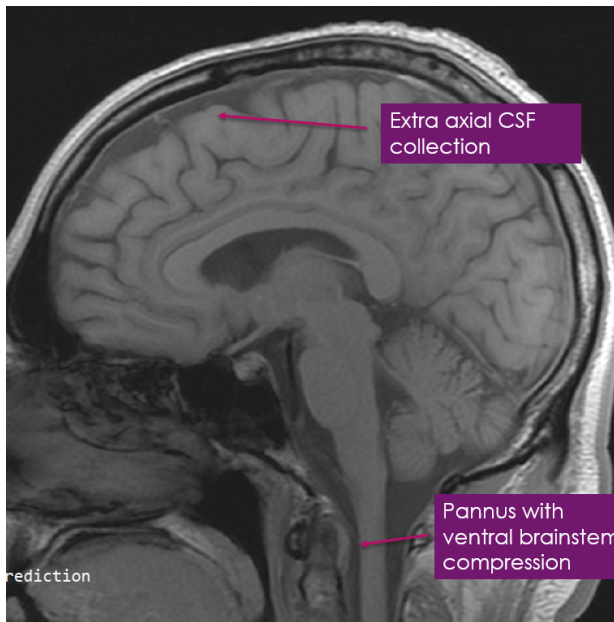


Fig 43: Male 60, showing annotated features

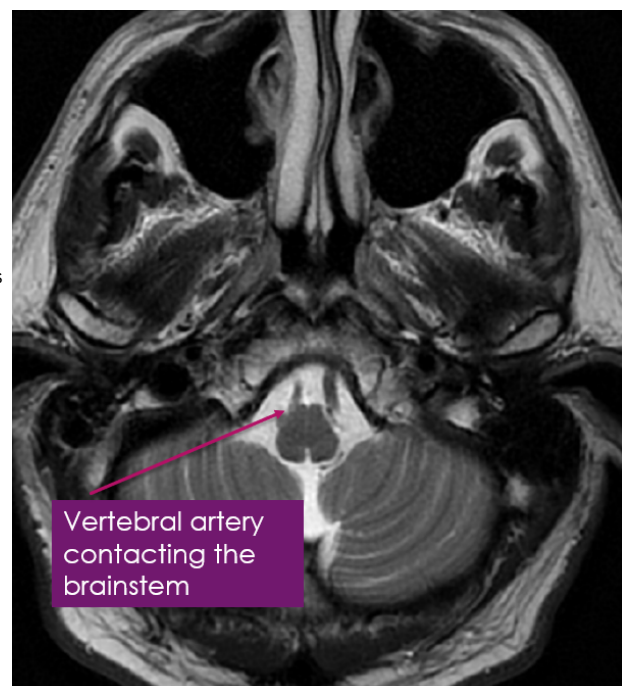


Fig 44: Male 60, showing brainstem features

Case 13: (LG) female 46, altered arm sensations

A 46-year-old female presented with numbness and tingling in left hand, altered sensation in entire left arm, mild generalised neck ache bilaterally. The practitioner (LG) noted the following on MRI:

- ▶ Tonsillar ectopia
- ▶ Pannus
- ▶ C7/T1 disc bulge

The patient felt immediate resolution of numbness, tingling, and altered sensation in her hand following her first Atlas Orthogonal. Her neck ache subsided.

We expect her to continue to do well if alignment of the C0/C1, C1/C2 is maintained.

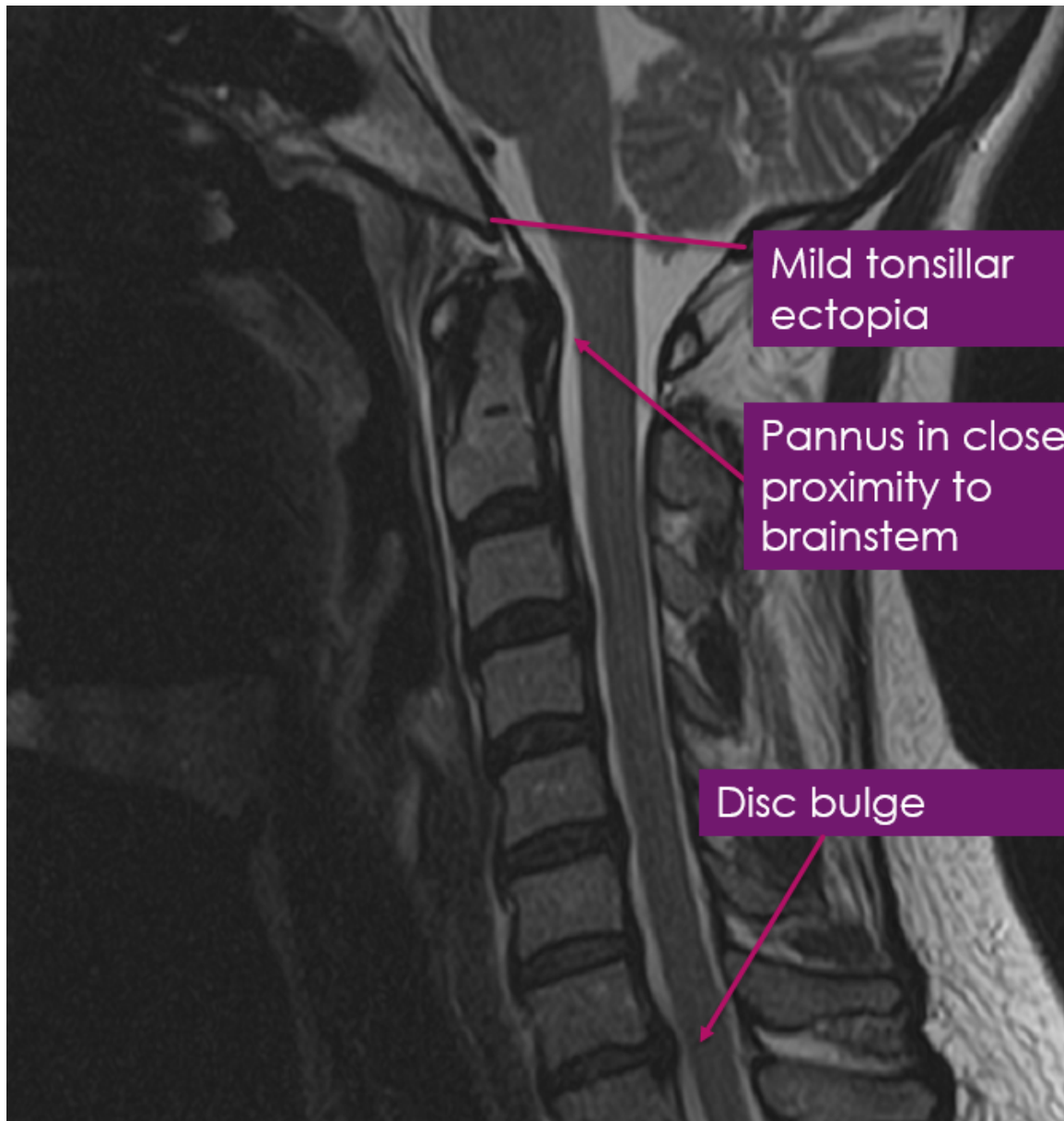


Fig 45: Female 46, annotated features

Case 14: (JI) Female 52, 'brain fog and disorientation

A Female patient, 52 years old, presented with symptoms she described as arising immediately following an AstraZeneca vaccine consisting of 'brain fog and disorientation'.

The patient suspected (via online internet searching) that her symptoms related to an atlas subluxation and she searched for the AO atlas specific technique in Sydney.

To rule out brainstem compromise the practitioner (JI) read and consulted on the provided MRI scans of the CCJ and ordered radiological analysis of APOM (antero-posterior open mouth) views to left and right which demonstrates an apparent unchecked motion of C1 on C2, or atlantoaxial instability.

The conclusion was that possibly a formerly asymptomatic Chiari 0-1 had been escalated by a case of post-vaccine encephalitis, which is well documented in the literature. (77, 78, 79) The patient was unresponsive to AO care and referred on with advice and counsel.

It appears that, as evidenced through numerous literature reports, traumatic neuro-immunological inflammation may have been the trigger.

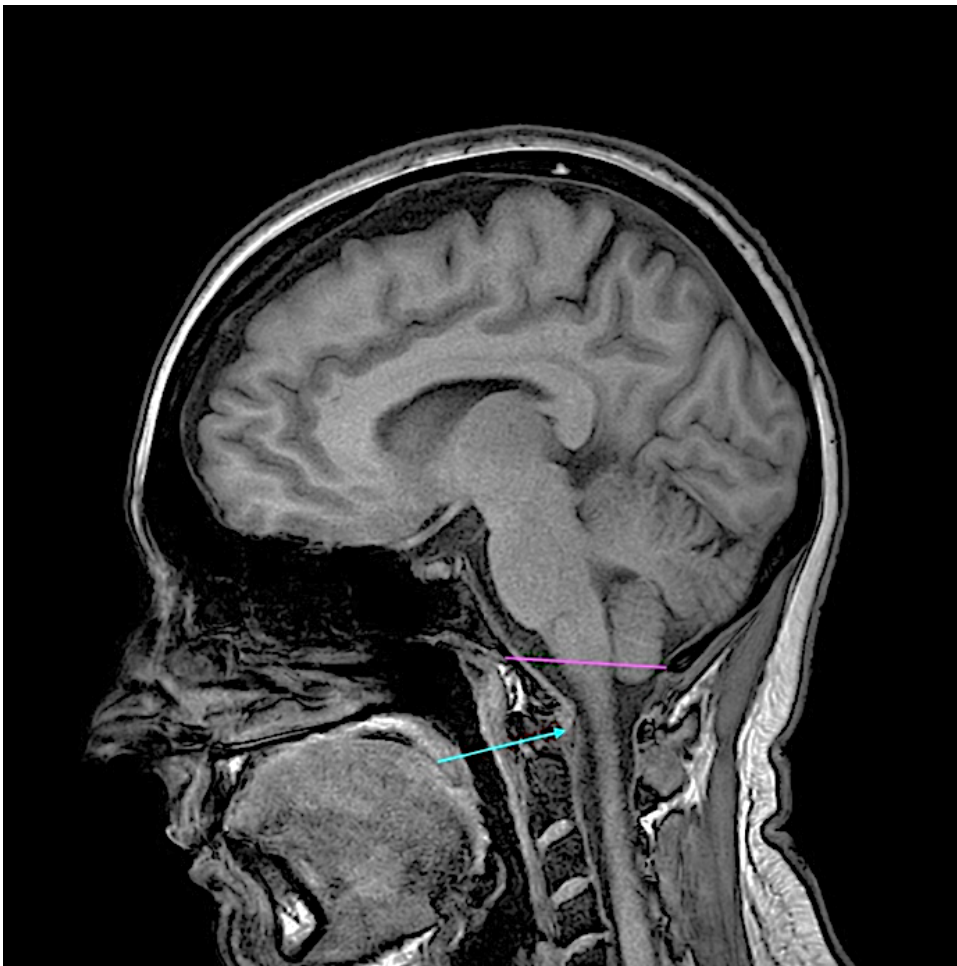


Fig 46: Female 52, Green arrow, C2 pannus, Red line CTE

77. Chatterjee A, Chakravarty A. Neurological Complications Following COVID-19 Vaccination. *Curr Neurol Neurosci Rep.* 2023 Jan;23(1):1-14. DOI 10.1007/s11910-022-01247-x.
78. Abdelhady M, Husain MA, Hawas Y, Elazb MA, Mansour LS, Mohamed M, Abdelwahab MM, Aljabali A, Negida A. Encephalitis following COVID-19 Vaccination: A Systematic Review. *Vaccines (Basel).* 2023 Mar 2;11(3):576. DOI 10.3390/vaccines11030576.
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Fig 47: Female 52, APOM left lateral flexion showing C2 overhang



Fig 48: Female 52, APOM right lateral flexion showing C2 overhang

Case 15: (JI) Male 56, dizziness

A 56-year-old male presented with extreme *Meniere's* disease-like symptoms immediately after a high velocity manipulation to the cervical spine via a sports physiotherapist.

Two years early the patient had been treated by the author (JI) for mild dizziness and low back pain. The patient was event and symptom free for two years until he had an onset of upper extremity paraesthesia and decided to ask a local physiotherapist who was attending a sports team to have a look at his neck, upon which he performed a bilateral rotational manipulation on his cervical spine.

This cascaded into a relapse of *Meniere's* symptoms but also two separate presentations to emergency hospital care and many days of bedridden incapacity. The patient's wife called the former practitioner (author JI) for advice, upon which, seeing the transmitted MRI images (figures 49, 50) advised specialist consultation for apparent disc irritation. Some relief had been gained from injection of cortisone.

After another neurosurgical consult advised against surgery, to continue with non-manipulative AO chiropractic, and possible cortisone injection to both levels of disc involvement as viewed on the MRI.



Fig 49: Male, 56, sagittal MRI



Fig 50: Male, 56, showing suspicion of CTE

The question remains as to whether this is a Chiari 0 with enough low-lying tonsillar excursion and a possible exacerbation via rotational forces and a restriction of cord movement at the mid cervical levels? (Figure 50) Specific AO x rays were taken, and the atlas was adjusted per protocol to which he responded well as greater number of days between bouts of dizziness were reported.

Co-management was coordinated by the chiropractor (JI) organising the neurologist consult, recommending a brain stem specialist (Chiari surgeon) and daily contact and monitoring via SMS communication with patient and wife. Borderline cases like this; where surgical intervention is uncertain, manual manipulation is traumatic, demonstrate a clear case for management within AO standards of care. A highlight of which is non-manipulative, non-rotational and of zero amplitude. Weekly care under the AO protocol has yielded, no further dizziness.

Discussion

A 2003 case report described two jet fighter pilots who were asymptomatic during training but subsequently developed neck, head, and dis-equilibrium symptoms. (80) They were then diagnosed with Chiari 1 presentation, stimulating discussion of whether cases are acquired or

80. Akin A, Canakci Z, Sen A, Tore HF. Chiari-I malformation in two fighter pilots. *Aviat Space Environ Med.* 2003 Jul;74(7):775-8.

silent, spontaneous, or not until head or neck trauma is experienced. (81) Complicating the discussion further, is the alleged low level of reported catastrophic injuries in athletes despite the presence of Chiari malformations; nonetheless, a case-by-case appraisal is suggested as prudent in evaluation. (82) In supportive evidence, novel research by Freeman and Rosa et al, demonstrated for the first time a neuroradiographic difference between neck pain patients with (n=600) and without (n=600, the control group) a recent history of whiplash trauma and the incidence of CTE. (83)

Each case has a nuance of variability found in the ratio of space occupied in the foramen magnum by the neural structures that should or should not be there. It may indeed be this population that find their way into Chiropractic (especially upper cervical) offices. The cases we present are evidence of patient benefit associated with conservative management by two trained AO Chiropractors who have engaged in lengthy postgraduate and clinical experience, with, in some cases, long-term follow-up reporting, whether the atlas procedure 'helped them' or not, the management is nuanced and complex.

CTE presentations

CTE presentations to the chiropractic office benefit from practitioner knowledge of the condition and its symptoms, the options available, and the best practice for the patient at hand after they have exhausted options or recommended no intervention with ongoing observation. MRI studies with findings of CTE, whether incidental, less than 5mm, or asymptomatic have probably led to a tendency of neglecting certain patients with unrelenting chronic neck pain or headaches that would benefit greatly with analysis on an individual basis as best practice, (84) and they simply do not do well with empty reassurances.

Conversely, the immediate referral to appropriate care-givers and treatment options must be made where either progress is poor or presentation dictates. In many cases of true cranio-cervical instability (CCI) no amount of Chiropractic intervention will be helpful, but sound counsel is invaluable.

Chiari malformation is medically controversial, and chiropractic hypotheses concern specific structural spinal and cranial alignment methods that are non-surgical and implicate benefit in a small number of reported cases. (85, 86) Chiropractic theoretical models of causation of

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81. Wan MJ, Nomura H, Tator CH. Conversion to symptomatic Chiari I malformation after minor head or neck trauma. *Neurosurgery*. 2008 Oct;63(4):748-53; discussion 753. DOI 10.1227/01.NEU.0000325498.04975.C0.
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 83. Freeman MD, Rosa S, Harshfield D, Smith F, Bennett R, Centeno CJ, Kornel E, Nystrom A, Heffez D, Kohles SS. A case-control study of cerebellar tonsillar ectopia (Chiari) and head/neck trauma (whiplash). *Brain Inj*. 2010;24(7-8):988-94. DOI 10.3109/02699052.2010.490512.
 84. Meadows J, Kraut M, Guarnieri M, Haroun RI, Carson BS. (2000). Asymptomatic Chiari Type I malformations identified on magnetic resonance imaging. *Journal of Neurosurgery*, 92(6), 920-926. <https://doi.org/10.3171/jns.2000.92.6.0920>
 85. Drury R, O'Keefe C. Resolution of Symptoms from Arnold-Chiari Malformation in a 6-Year-Old Male Following Reduction of Vertebral Subluxation with Knee-Chest Upper Cervical Care: Case Report & Selective Review of the Literature. *J Upper Cervical Chiropractic Res*. 2017:12-21.
 86. Hock S, Kelly A. Reduction of Headaches in a Patient with Type I Chiari Malformation and Ehlers-Danlos Following Chiropractic Care to Correct Vertebral Subluxation: A Case Study. *Annals Vertebral Subluxation Res*. 2021:18-23.

headaches, dizziness, (87) optic nerve neuritis, (88) vertigo, hearing loss, (89, 90) and subsequent responses to upper cervical care in low-level evidence case reports demonstrate that on an individual case basis chiropractic management is worth consideration. (91)

However, there is not near enough of a credible body of evidence to exclude that great caution is exercised, as post traumatic presentation in conjunction with symptoms of brain stem ischaemia and raised intracranial pressure often present to the chiropractor (92) in contraindication to manual therapy, (93) due to potential for aggravation. (94)

Chu et al have surveyed the use of '*thrust cervical spinal manipulative therapy for complicated neck pain*' and its diligent avoidance in the presence of potential contraindications was common, (95) and indeed prudent. In important contrast is considerable argument for the skilled chiropractor playing a role in the assistance of non-surgical intervention, with highly specific and uniquely considered vectored adjustments to the cervical spine. (96) Particularly when surgery may be risky or predicted to worsen the condition and little option remains. Also, several of the cases presented to us post chiropractic or physiotherapist manipulation. AO care is not akin to manipulation in any way.

The cases presented in this report were managed in a clinical setting and in no way reflect the suggestion that Atlas Orthogonal chiropractic care is an adequately researched cure for brainstem pathologies. However, when more invasive medical options are exhausted, clinical and imaging parameters are borderline indicators and the response to treatment is positive, then trial of care is worthy of discussion, as it is certainly going on in the information world.

Cervical spinal manipulation is certainly contraindicated in most of these cases, but all of these cases have components of symptomatology that may attract them to chiropractors, osteopaths, physiotherapists and manual medicine.

Limitations of this case series

Even though all cases had extensive and sensitive imaging, the case reports were brief and subjective accounts of the patient's experience in a clinical environment without any controls or random allocation. The outcome measures were purely descriptive in relation to the patient's

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87. Sargent AW, Cofano GP. Chiropractic care for headaches and dizziness of a 34-year-old woman previously diagnosed with Arnold-Chiari malformation type 1. *J Chiropr Med*. 2014 Sep;13(3):192-5. DOI 10.1016/j.jcm.2014.07.004.
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 91. Chu EC, Trager RJ, Ng GSN, Shum JSF. Neck pain and Headache Complicated by Persistent Syringomyelia After Foramen Magnum Decompression for Chiari I Malformation: Improvement with Multimodal Chiropractic Therapies. *Am J Case Rep*. 2022 Oct 31;23:e937826. DOI 10.12659/AJCR.937826..
 92. Leong WK, Kermonde AG. Acute deterioration in Chiari type 1 malformation after chiropractic cervical manipulation. *J Neurology, Neurosurgery & Psychiatry*. 2001;70:816-817.
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 94. Mäkelä JP. Arnold-Chiari malformation type I in military conscripts: symptoms and effects on service fitness. *Mil Med*. 2006 Feb;171(2):174-6. DOI 10.7205/milmed.171.2.174.
 95. Chu EC, Trager RJ, Lee WT. Use of Thrust Cervical Spinal Manipulative Therapy for Complicated Neck Pain: A Cross-Sectional Survey of Asia-Pacific Chiropractors. *Cureus*. 2022 Dec 12;14(12):e32441. DOI 10.7759/cureus.32441.
 96. Murphy DR, Goldstein D, Katz M. Chiropractic adjustment to the cervical spine and the Arnold-Chiari malformation. *J Manipulative Physiol Ther*. 1993 Oct;16(8):550-5.

complaint and outcome recorded as they felt at any point in the clinical encounter. Judgement of was totally via the practitioner's experience and competency levels completely subject to personal bias. Further studies should include rigorous outcome measures. Comparisons of referral patterns and outcomes is also of interest, as would be the patient's experience of dealing with the debilitating clinical constellation and professional confusion in this realm.

Conclusions

MRI is the gold standard for visualising CTE. As per Damadian's *Fonar*[®] MRI, the next frontier is the dynamic flow MRI visualising CSF as well as blood vessel flow, which is rare and unattainable in most of the world. CCI can be usefully imaged with Digital Motion X Ray, which is almost non-existent in Australia but exists in-house in some USA private clinics. Although comparatively inferior, static functional X rays of cervical flexion, extension and APOM (open-mouthed) bilateral side-bending have been used in some of these cases.

CT venous and arterial flow studies may be of use also in mapping out any areas of cerebral compromise, blood vessel compromise, or bony encroachment. Software now easily acquired, enables useful three-dimensional reconstructions of images, to fine tune care, management and refine the input of any vectored adjustments.

A consideration of effective care is best achieved on a case-by-case basis, with appropriate referral. Patho-anatomical changes in and around the brainstem in these cases, causing the constellation of symptoms of suffering and furthered by misdiagnoses needs to be addressed.

Chiropractic and manual therapies were frequently initial, or eventual points of primary care contact for sufferers in this series who could not find answers. Manual manipulation should never be used in our opinion and is relatively contraindicated in these cases where knowledge is paramount. Surgery is commonly of high risk or not indicated for Chiari 0-1, as is spinal physiotherapy or osteopathic manipulation and chiropractic in its generic form due to force used, a lack of scientific rigour and shortfalls in the practitioner knowledge base.

Chiropractic non-manipulative techniques (now approaching a century of clinical imprint) like upper cervical specific instrument adjusting are worthy of further study and consideration for symptomatic care, when they employ advanced imaging diagnostics and knowledge, and specificity of low-force delivery (under 20N) well within the limits of anatomical integrity, with consideration to ligamentous injury and subsequent compromise. This was demonstrable in this current case series, as was the timing of cessation of treatment, and appropriate referral.

There is a lack of consensus among neurologists, particularly in that grey area in CTE where descent causes symptoms and dysfunction.

Key take-away

Patients with brainstem choke points will present to chiropractic offices. Due to '*online self-education*' by patients taking control of their health, due to lack of medical knowledge by their existing practitioners, so practitioner education is key for this enigmatic presentation and the fact that little consensus on treatment has been achieved it is the individual informed case appraisal that will yield best practice until further research, especially when the patient knows more than the well-meaning doctors, who clearly need a freely communicated conjoint effort.

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About the chiropractor

Dr Ierano is a 1997 graduate of Palmer Davenport and is a certified instructor in Atlas Orthogonal Technique, via the Sweat Foundation in Atlanta, USA.

He teaches 'upper cervical specific' in Australia and now practices in Sydney.

Appendix One: Algorithm for chiropractic management of CTE presentations

