BLAIR TECHNIQUE

Craniocervical Neurokinematics

On Adjusting Atlas & Axis

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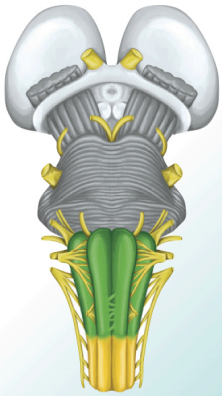
Opening Thoughts

What's at stake here.

Somatovisceral Efferents & Afferents

- Medullary Nuclei
  - RVM Nucleus
  - Nucleus Tractus Solitarius
  - RVL & DMotor Nuclei
- Craniocervical Nuclei
  - V, VIII, IX-X, XI, XII
  - C1-C4
- Superior Cervical Sympathetic Ganglion
  - Vascular Branches
  - Lymphatic Branches

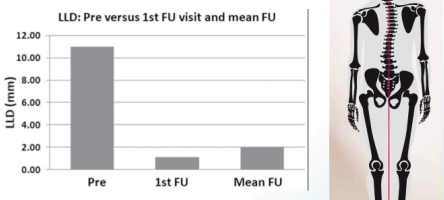


Where the head goes …

Pain, Pressure & Proprioception

Descending Tracts
- Pyramidal
- Extrapyramidal
- Vestibulospinal

Ascending Tracts
- Anterolateral
- PCML
- Spinocerebellar



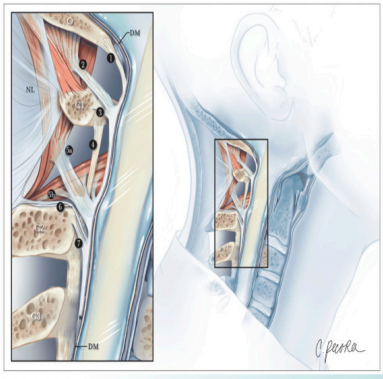
Brunette J, Gélinas L, Chankowsky J (2021) Functional Leg Length Discrepancy among Pediatric Scoliosis: A Reversible Neuromuscular Compensation from Craniocervical Junction Misalignment. J Musculoskelet Disord Treat 7:105. doi.org/10.23937/2572-3243.1510105

Meningo-myovertebral Complex

Craniocervical Neurocanal

- Flexibility vs Stability
- No Intervertebral Disc
- Dentate Ligament Structure
- Myodural Bridges

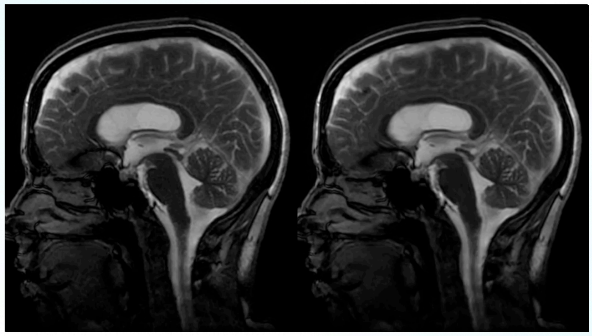
Reduced Cord Compliance
Cerebellar Tonsillar Ectopia
Craniocervical Syndrome



Scali F, Ohno A, Enix D, Hassan S. The Posterior Atlantooccipital Membrane: The Anchor for the Myodural Bridge and Meningovertebral Structures. *Cureus*. 2022;14(5):e25484. Published 2022 May 30. doi:10.7759/cureus.25484

Enix DE, Scali F, Pontell ME. The cervical myodural bridge, a review of literature and clinical implications. *J Can Chiropr Assoc*. 2014 Jun;58(2):184-92.

Normal Cord Movement



Phase-based Amplified MRI (aMRI)

Terem, WW Ni, M Goubran, M. Salmani Rahimi, G. Zaharchuk, KW Yeom, ME Moseley, M Kurt, S.J. Holdsworth. Revealing sub-voxel motions of brain tissue using phase-based amplified MRI (aMRI). Magnetic Resonance in Medicine (Being released, 2018). Video available at: https://youtu.be/m9pGG9zh2yk

Cord Compliance

Mechanical Deformation & Hydrostatic Pressure

- **10mm Hg ↓60% in 15 min**
- Stenosis stretches ↕ 30mm
- Stretch Thresholds
  - Lower Cervical = 10mm
  - **Upper Cervical = 3mm**
    (Cervical Kyphosis 50-70mm)
- **3mm stretch**
  = 30-40 psi
  = 1500-2000mm Hg

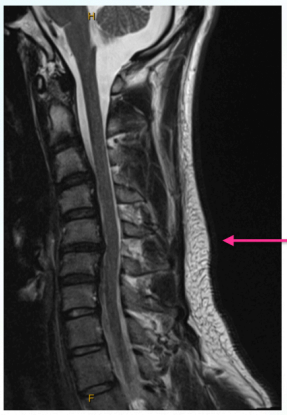
JF Grostic 0.75° = 38-50 mm Hg
WG BLAIR 0.5MM = 25-33MM HG
… 2MM IS VERY COMMON

Sharpless SK. Susceptibility of spinal roots to compression block. The Research Status of Spinal Manipulative Therapy. NINCDS monograph 15, DHEW publication (NIH) 76-998:155, 1975.

Reid JD. Effects of flexion-extension movements of the head and spine upon the spinal cord and nerve roots. J Neurol Neurosurg Psychiatry. 1960 Aug;23(3):214-21. doi: 10.1136/jnnp.23.3.214. PMID: 13740493; PMCID: PMC497411.

Wolf K, Reisert M, Beltrán SF, Klingler JH, Hubbe U, Krafft AJ, Egger K, Hohenhaus M. Focal cervical spinal stenosis causes mechanical strain on the entire cervical spinal cord tissue - A prospective controlled, matched-pair analysis based on phase-contrast MRI. Neuroimage Clin. 2021 Feb 1;30:102580. doi: 10.1016/j.nicl.2021.102580. Epub ahead of print. PMID: 33578322.

Cord Compliance



Findings: Cervical vertebral alignment is normal. Bone marrow signal is normal for age. The imaged paravertebral soft tissues and posterior fossa structures are unremarkable. Both vertebral artery flow voids are present.

No abnormality is seen at the skull base, C1 or C2 articulations.

At C2/3, no abnormality is seen, the disc is preserved and there is no central or foraminal stenosis. The facets are within normal limits.

At C3/4, mild anular uncovering the disc with a small right foraminal stenosis due to a focal disc. Facet alignment is adequate.

At C4/5, no abnormality is seen, the disc is preserved and there is no central or foraminal stenosis. The facets are within normal limits.

At C5/6, minimal anular uncovering the disc, disc height preserved. No inflammatory endplate change for or impingement.

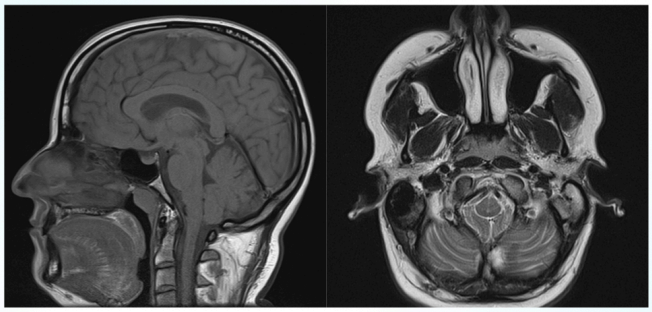
At C6/7, no abnormality is seen, the disc is preserved and there is no central or foraminal stenosis. The facets are within normal limits.

At C7/T1, no abnormality is seen, the disc is preserved and there is no central or foraminal stenosis. The facets are within normal limits.

The upper thoracic levels are within normal limits.

CONCLUSION: Mild spondylosis at multiple levels without impingement. No active inflammatory endplate change.

Cerebellar Tonsillar Ectopia (CTE)

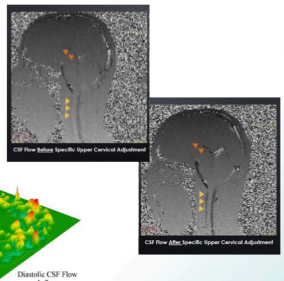


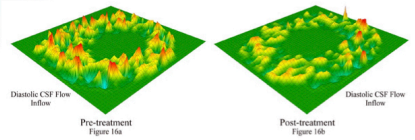
NON-TRAUMA GROUPS - CTE IN 5.7 AND 5.3% OF CASES RECUMBENT *VS* UPRIGHT.
TRAUMA GROUPS - CTE IN 9.5 AND 23.7% OF CASES RECUMBENT *VS* UPRIGHT.

Smith FW. Upright Magnetic Resonance Imaging of the Craniocervical Junction. Smith FW, Dworkin JS (eds): The Craniocervical Syndrome and MRI. Basel, Karger, 2015, pp 1–8 DOI: 10.1159/000365464

Hydrodynamics

VERTEBROBASILAR ARTERIES
CEREBROSPINAL VEINS
CEREBROSPINAL FLUID



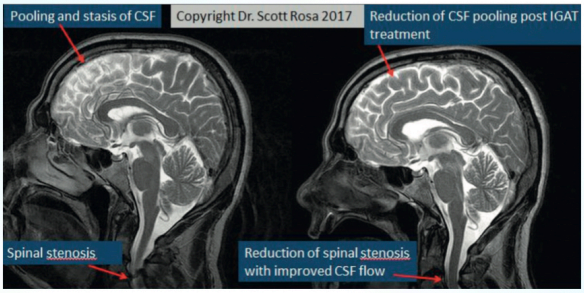


Gisolf J, van Lieshout JJ, van Heusden K, Pott F, Stok WJ, Karemaker JM. Human cerebral venous outflow pathway depends on posture and central venous pressure. J Physiol. 2004;560(Pt 1):317-327. doi:10.1113/jphysiol.2004.070409

Rosa S, Baird JW. The craniocervical junction: observations regarding the relationship between misalignment, obstruction of cerebrospinal fluid flow, cerebellar tonsillar ectopia, and image-guided correction. Smith FW, Dworkin JS (eds): The Craniocervical Syndrome and MRI. Basel, Karger, 2015, pp 48-66 (DOI:10.1159/000365470).

Rosa, S et al. "Craniocervical Junction Syndrome: Anatomy of the Craniocervical and Atlantoaxial Junctions and the Effect of Misalignment on Cerebrospinal Fluid Flow." (2018). https://pdfs.semanticscholar.org/a831/771f5152d1a536d66ab7d9a1cf3224856c0c.pdf

Myalgic Encephalomyelopathy

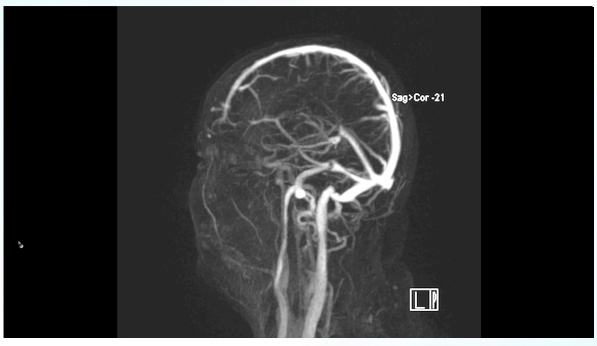


↑50% CCJ/AA HYPERMOBILITY
↑83% INTRACRANIAL HYPERTENSION
↑56% CHIARI MALFORMATION
↑80% OBSTRUCTION (CCJ STENOSIS)

Bragée B, Michos A, Drum B, Fahlgren M, Szulkin R, Bertilson BC. Signs of Intracranial Hypertension, Hypermobility, and Craniocervical Obstructions in Patients With Myalgic Encephalomyelitis/Chronic Fatigue Syndrome. Front Neurol. 2020;11:828. Published 2020 Aug 28. doi:10.3389/fneur.2020.00828

Hulens M, Rasschaert R, Vansant G, Stalmans I, Bruyninckx F, Dankaerts W. The link between idiopathic intracranial hypertension, fibromyalgia, and chronic fatigue syndrome: exploration of a shared pathophysiology. J Pain Res. 2018 Dec 10;11:3129-3140. doi: 10.2147/JPR.S186878.

Cerebrospinal Venous Insufficiency



MAGNETIC RESONANCE VENOGRAPH (MRV)

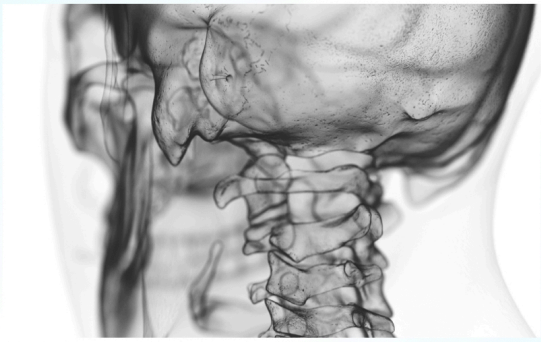
Meniere's Syndrome

Attanasio G, Califano L, Bruno A, et al. Chronic cerebrospinal venous insufficiency and Menière's disease: Interventional versus medical therapy. Laryngoscope. 2019 Nov 11. doi: 10.1002/lary.28389.

Burcon MT. Health Outcomes Following Cervical Specific Protocol in 300 Patients with Meniere's Followed Over Six Years. Journal of Upper Cervical Chiropractic Research ~ June 2, 2016 ~ Pages 13-23.

Jain, Shraddha et al. "Revisiting "Meniere's Disease" as "Cervicogenic Endolymphatic Hydrops" and Other Vestibular and Cervicogenic Vertigo as "Spectrum of Same Disease": A Novel Concept." Indian journal of otolaryngology and head and neck surgery : official publication of the Association of Otolaryngologists of India vol. 73,2 (2021): 174-179. doi:10.1007/s12070-020-01974-y

"Instability" & Dysafferentation



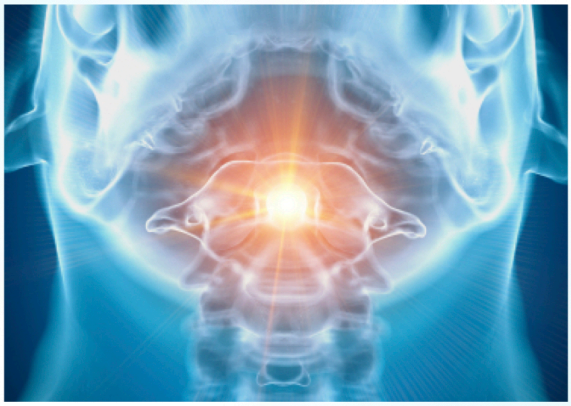
Kulkarni V, Chandy MJ, Babu KS. Quantitative study of muscle spindles in suboccipital muscles of human foetuses. Neurol Indfa, 2001;49(4):355-9.

Labuda R, Nwotchouang BST, Ibrahimy A, et al. A new hypothesis for the pathophysiology of symptomatic adult Chiari malformation Type I. Med Hypotheses. 2022;158:110740. doi:10.1016/j.mehy.2021.110740

Lohkamp LN, Marathe N, Fehlings MG. Craniocervical Instability in Ehlers-Danlos Syndrome-A Systematic Review of Diagnostic and Surgical Treatment Criteria [published online ahead of print, 2022 Feb 23]. Global Spine J. 2022;21925682211068520. doi:10.1177/21925682211068520

Steilen D, Hauser R, Woldin B, Sawyer S. Chronic neck pain: making the connection between capsular ligament laxity and cervical instability. Open Orthop J. 2014;8:326-345. Published 2014 Oct 1. doi:10.2174/1874325001408010326

Halftime Thoughts



Pop Quiz

1. The principle action of C0-C1 is

a. Flexion-Extension (±θX)
b. Axial Rotation (±θY)
c. Lateral Flexion (±θZ)

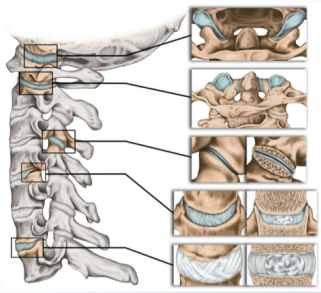
2. The principle action of C1-C2 is

a. Flexion-Extension (±θX)
b. Axial Rotation (±θY)
c. Lateral Flexion (±θZ)

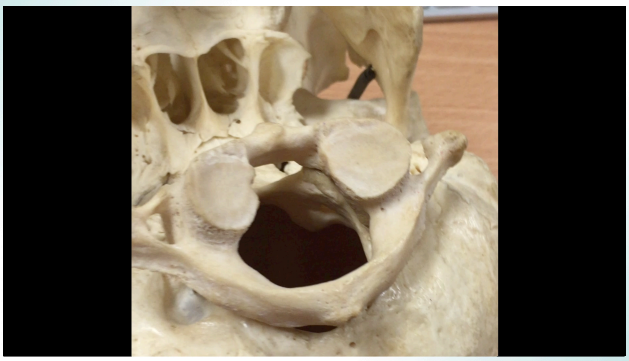
3. The principle actions of C2-C3 are

a. Flexion-Extension (±θX)
b. Axial Rotation (±θY)
c. Lateral Flexion (±θZ)

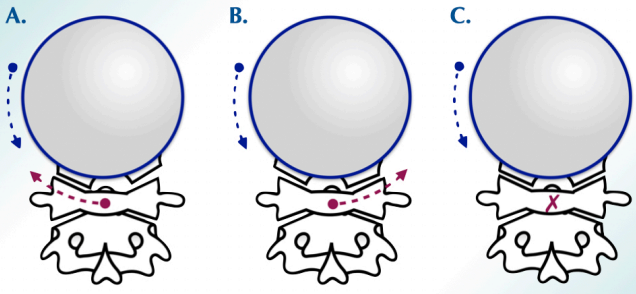
THE MOVEMENT OF THE JOINTS IN THE SPINE ARE DEFINED & LIMITED BY THE CHARACTER OF THE ARTICULAR SURFACES.



Principles of Biomechanics: C0-C1



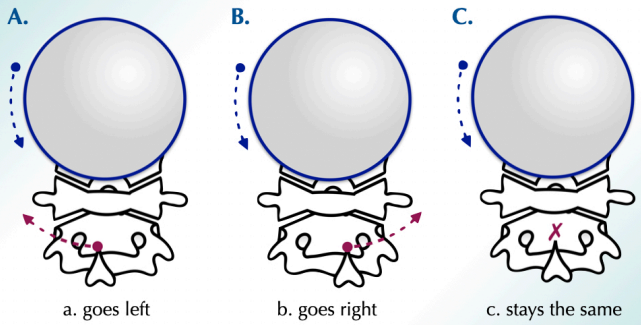
Pop Quiz



a. goes left b. goes right c. stays the same

With **LEFT LATERAL FLEXION**, **ATLAS** _____.

Pop Quiz

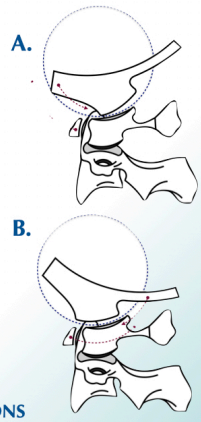


a. goes left b. goes right c. stays the same

With **LEFT LATERAL FLEXION**, **AXIS SPINOUS** _____.

Pop Quiz

IF THE REFERENCE POINT IS THE C1 ANTERIOR TUBERCLE RELATIVE TO THE OCCIPITAL CONDYLE …



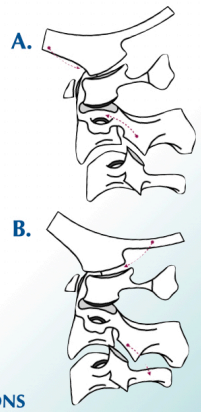
1. *Figure A* shows atlas moving (pick two)
   a. Anterior (+ΔZ) c. Superior (+θX)
   b. Posterior (-ΔZ) d. Inferior (-θX)

2. *Figure B* shows the atlas moving (pick two)
   a. Anterior (+ΔZ) c. Superior (+θX)
   b. Posterior (-ΔZ) d. Inferior (-θX)

UNIT OF MOTION ARE THE C0-C1 ARTICULATIONS

Pop Quiz

IF THE REFERENCE POINT IS THE C2 SPINOUS PROCESS RELATIVE TO THE C3 SPINOUS PROCESS …



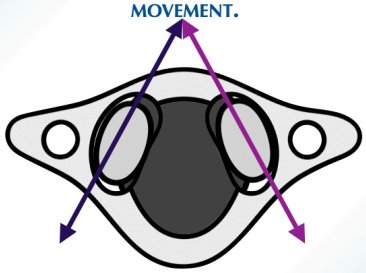
1. *Figure A* shows axis moving (pick two)
   a. Anterior (+ΔZ) c. Superior (-θX)
   b. Posterior (-ΔZ) d. Inferior (+θX)

2. *Figure B* shows the axis moving (pick two)
   a. Anterior (+ΔZ) c. Superior (-θX)
   b. Posterior (-ΔZ) d. Inferior (+θX)

UNIT OF MOTION ARE THE C2-C3 ARTICULATIONS

The NORMAL Axle of Motion

EACH ARTICULATION HAS ITS OWN "AXLE" THAT GUIDES C1 MOVEMENT.

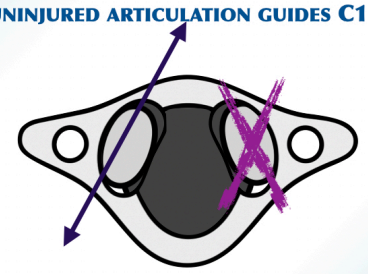


Normal Biomechanics

- The **L** & **R** axles produce a combined movement through a **central axle** that allows C1-C0 to move like a **ROCKING CHAIR**

Sliding & Tracking

IF ONE JOINT IS INJURED, THE CENTRE OF GRAVITY SHIFTS, AND ONLY THE UNINJURED ARTICULATION GUIDES C1 MOVEMENT.

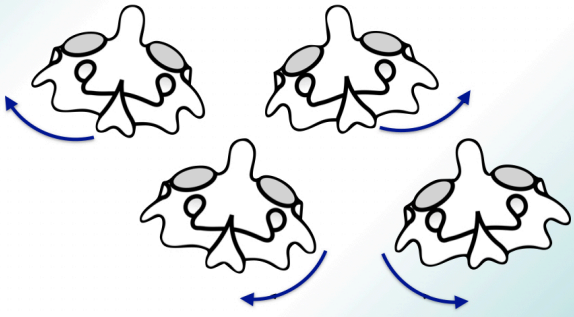


Abnormal Biomechanics

- The **L Joint** will move normally along its own axle (*aka* **TRACKING**).
- The **R Joint** has been bumped "off its track" and no longer contributes to the overall movement of the C1 motion (*aka* **SLIDING**).

Slipping & Pivoting

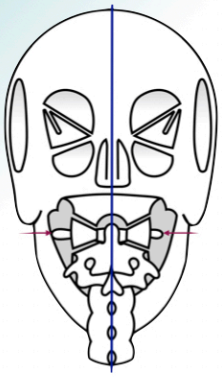
IN A NON-FRACTURED, NON-DISLOCATED MISALIGNMENT OF C2-C3, THE AXIS PIVOTS (EITHER ↻ OR ↺) ALONG ONE ARTICULATION, AND SLIDES LONGITUDINALLY ON THE OPPOSITE SIDE (EITHER AS OR PI).

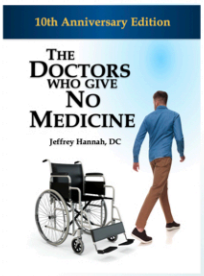


Why does it have to be the articulations?

Asymmetry is the Rule

Asymmetry #1 - Short C1 TVP

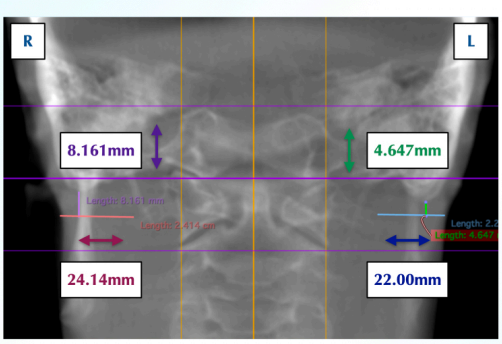


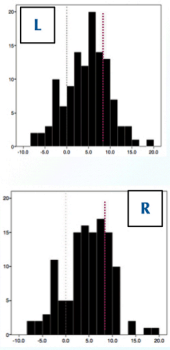


??? - C1 "Laterality"

Jarocka E, Pruszynski JA, Johansson RS. Human Touch Receptors Are Sensitive to Spatial Details on the Scale of Single Fingerprint Ridges. J Neurosci. 2021;41(16):3622-3634. doi:10.1523/JNEUROSCI.1716-20.2021

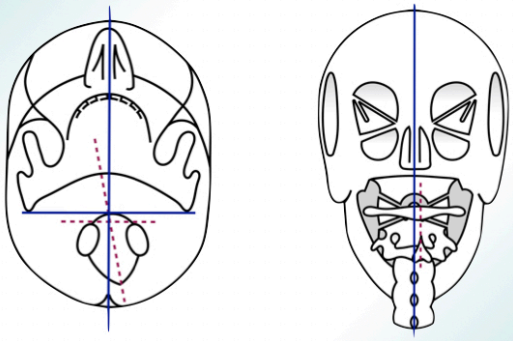
TVP Accessibility





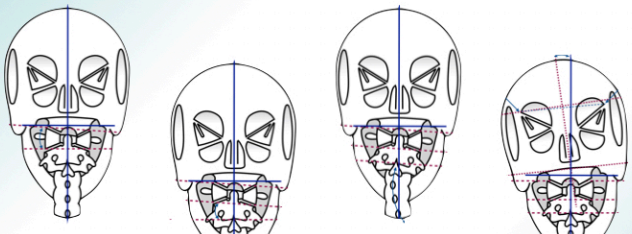
Hubbard TA, Pickar JG, Lawrence DJ. Radiographic analysis of the anterior to posterior open mouth (APOM) cervical spine view: frequency of atlas transverse process overlap of the inferior tip of the mastoid process [published correction appears in J Manipulative Physiol Ther. 2012 Sep;35(7):578]. J Manipulative Physiol Ther. 2012;35(6):477-485. doi:10.1016/j.jmpt.2012.07.007

Asymmetry #2 - FM & C2 Spinous



77% - C2 "Rotation"

Asymmetry #3 - Short Condyle



Enlarged C1 Lateral Mass

Enlarged C2 Body

Lateral Neck Curve

Cranial Asymmetry

64% - "Head Tilt" / Compensatory Misalignments

Asymmetry is the Rule

	Percent Asymmetrical	1 Standard Dev	2 Standard Devs	Palpation	Lat/AP X-Ray
Anterior Condyle	79%	+/-1.9mm	+/-3.1mm	C1 Rotation	
Small Condyle	83%	+/-2.3mm	+/-3.8mm		C1 Rotation
Short Condyle relative to ...					
Jugular Process	64%	+/-1.1mm	+/-1.8mm		C1 Laterality
Foramen Magnum	56%	+/-0.9mm	+/-1.4mm		C1 Laterality
Ocular Orbits	77%	+/-1.7mm	+/-2.8mm		C1 Laterality
Orthogonal Skull Plane	66%	+/-1.1mm	+/-1.8mm		C1 Laterality
Uneven Occipital Bone	56%	+/-0.9mm	+/-1.4mm	Occiput Sup/Inf	
Uneven Foramen Magnum	70%	+/-1.3mm	+/-2.1mm		C1 Laterality
Turned Foramen Magnum	77%	+/-1.7mm	+/-2.8mm	C2 Rotation	C2 Rotation
Offset Odontoid	57%	+/-0.9mm	+/-1.4mm	C2 Rotation	C2 Rotation
Offset Foramen Magnum	62%	+/-1mm	+/-1.6mm		C2 Rotation
Convergence Angulation	???			Occiput Ant/Post	C1 Rotation
C1 Transverse Process Length	???			C1 Laterality	

Blair WG. Primary and adaptative malformations and Procedures for solving malformation problems. Research Thesis. Palmer College of Chiropractic. May 1968.

Analysis of Articular Mechanics

Palpation

- Static
- Motion
- Muscle
- Tonal

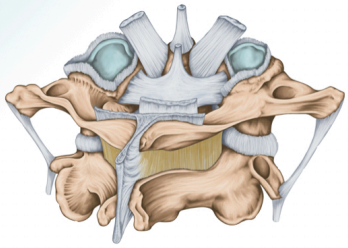
Upright Imaging

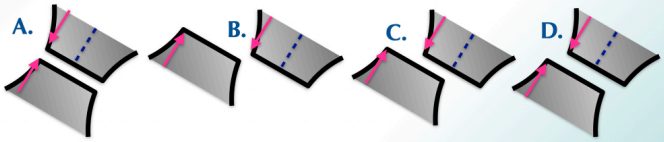
- Davis Series
- DMX
- EOS
- Articular Series
  - Plain Film
  - Cone Beam

DIGITAL MOTION X-RAY (DMX)

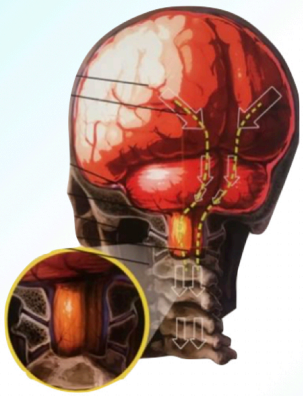
Hubbard T. Blair Upper Cervical Chiropractic Society.

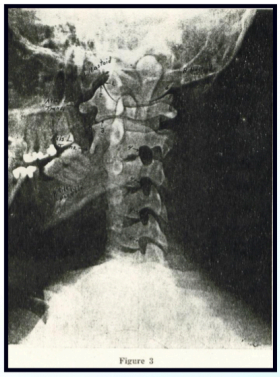
Pop Quiz



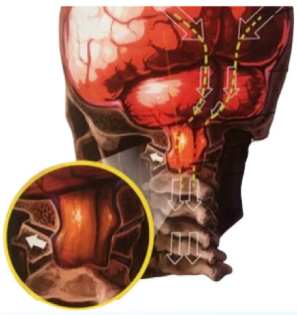


Articular Misalignment



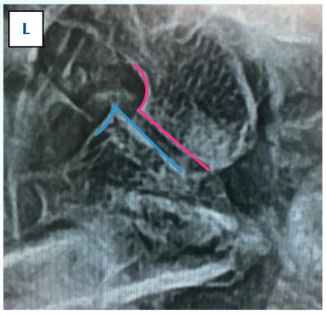


Blair Customised Oblique Nasium

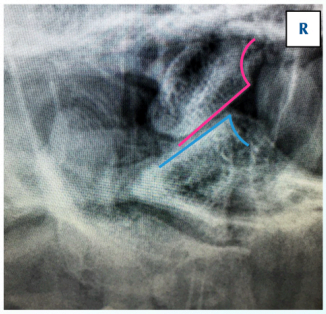


Blair Customised Oblique Nasium

OVERLAP

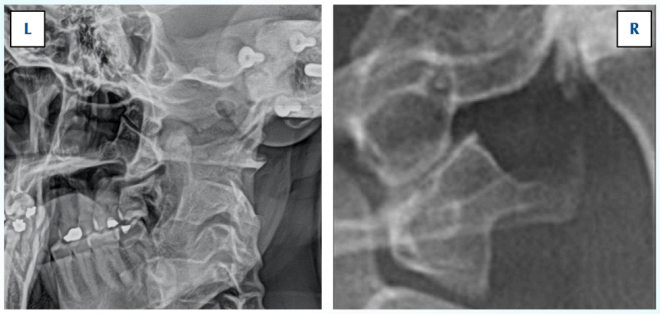


UNDERLAP

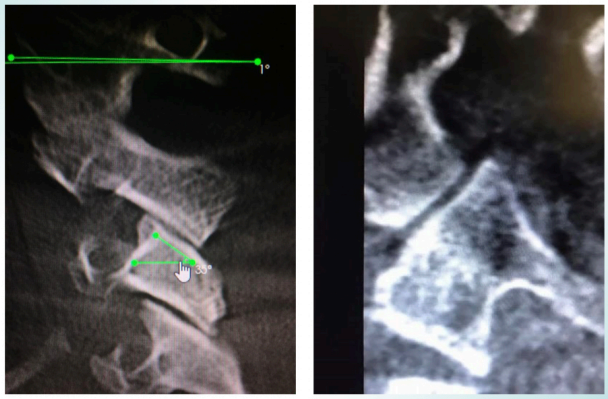


NOT THE SAME AS ATLANTO-AXIAL OVERHANG (Σ7MM)

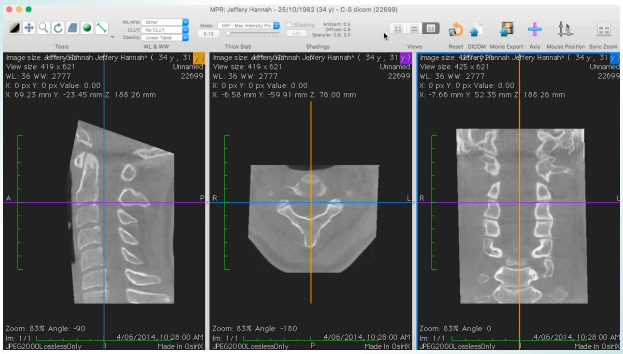
Blair CBCT Articular Imaging



Blair CBCT Articular Imaging

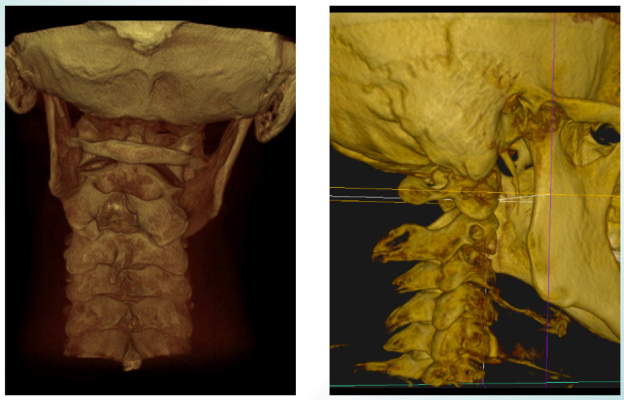


BLAIR CBCT ARTICULAR IMAGING

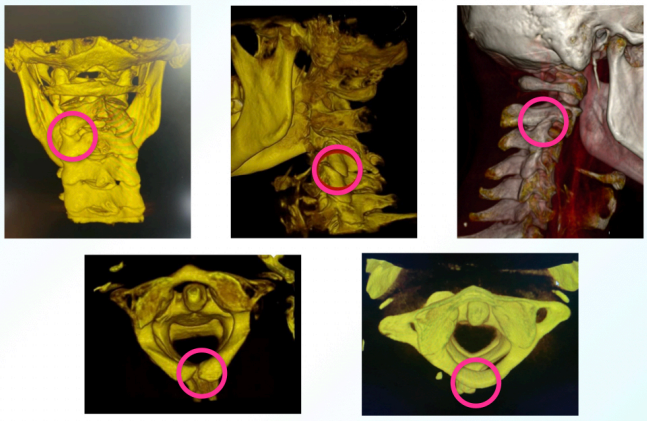


Open Source Software: Carestream (PC) & Horos (Mac)

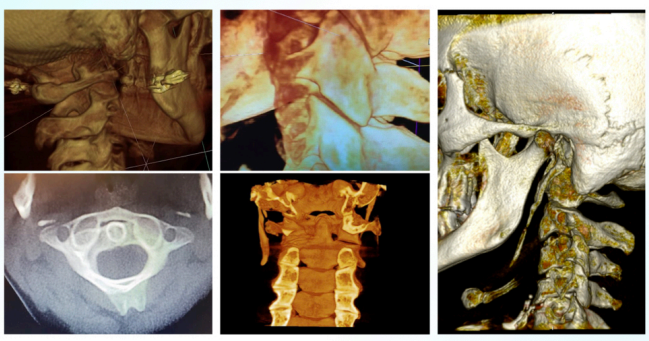
Blair CBCT Articular Imaging



Blair CBCT Articular Imaging

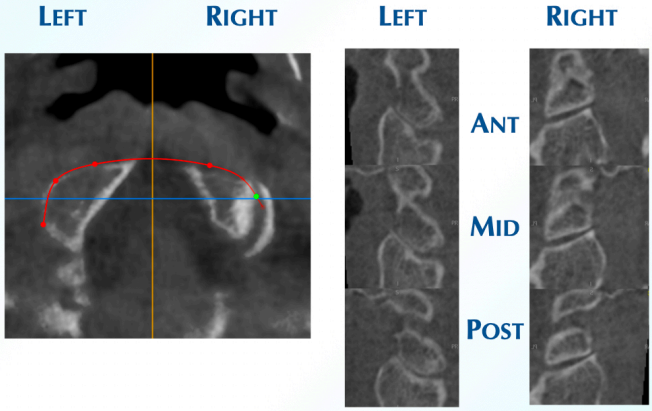


Blair CBCT Articular Imaging

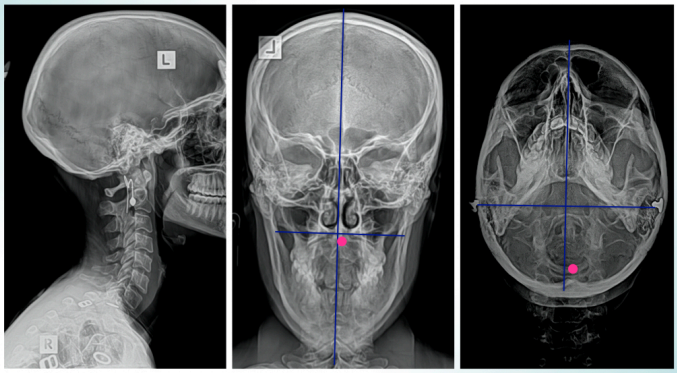


"The chiropractic vertebral subluxation complex is an historical concept but it remains a ***theoretical model****." -* ***Gen Cx Counc (UK)***

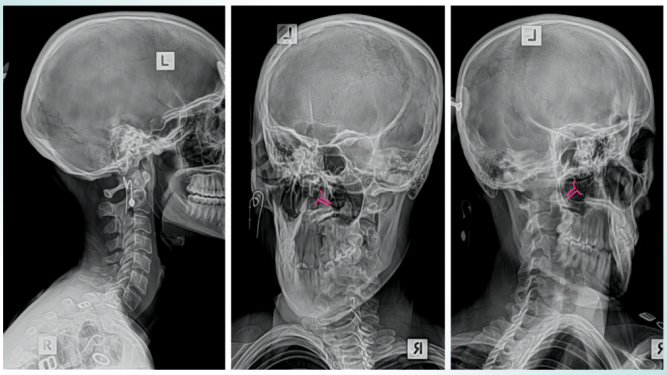
Curved Multiplanar Reconstruction (MPR)



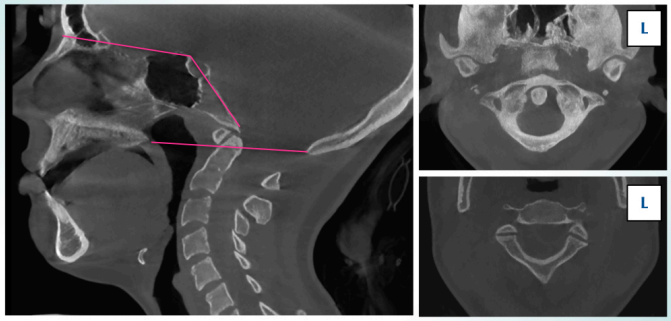
Case #1 - Chiari Malformation



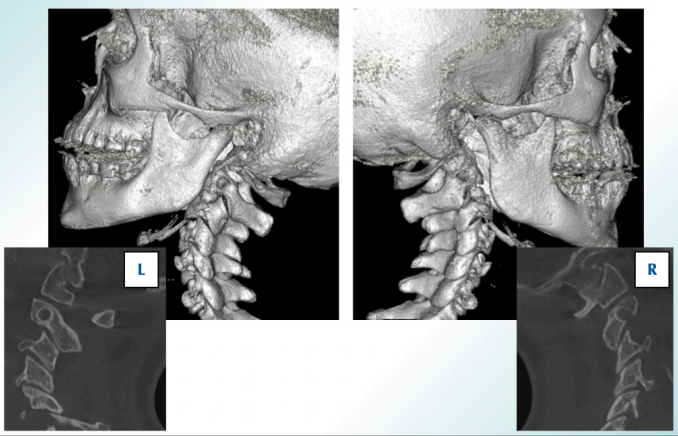
Case #1 - Chiari Malformation



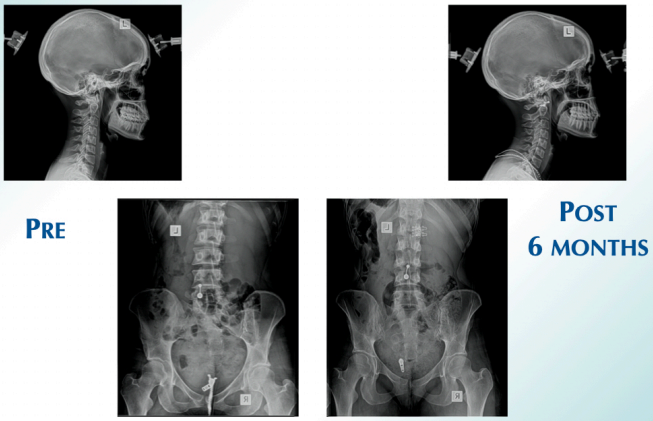
Case #2 - Basilar Impression



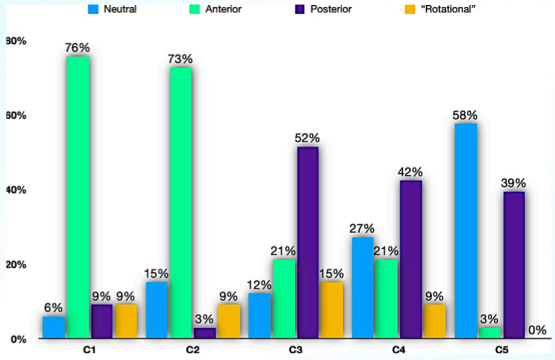
Case #2 - Basilar Impression



Case #3 - Wish they were all like this!



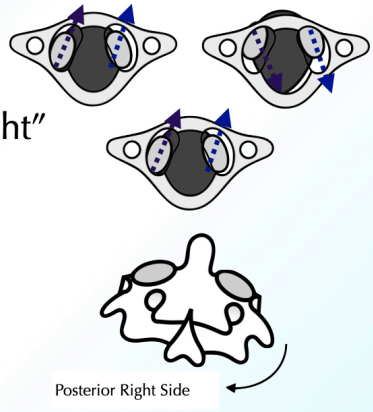
Clinical Research



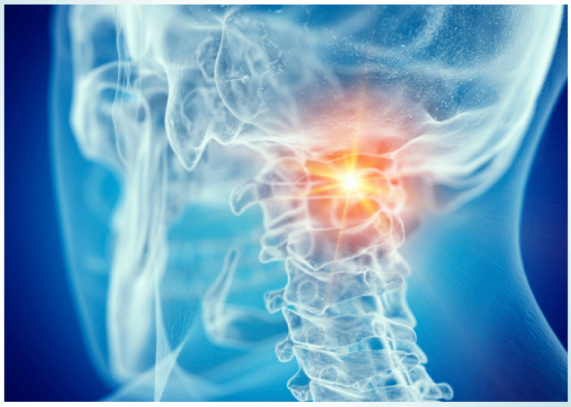
Hannah J. Private Practice. Sept 2020 - Oct 2022.

Thought Experiments

1. "C1 Right"
2. "C1 Anterior Right"
3. "C2 Body Right"
4. "C2 PLI-L/RPI"
5. "C2 RAS-PLI"



Closing Thoughts



Questions?

BLAIR TECHNIQUE

THANK YOU.

Dr Jeffrey Hannah
Doctor of Chiropractic (Palmer, USA);
Advanced Blair Certified Instructor

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