Hypermobility/CCI/AAI/Craniocervical Junction Misalignment...? *The Importance of diagnosis and staging in managing Craniocervical Syndromes*

An introduction to craniocervical junction/cervical spine instability and its potential implications on human health

A proposed approach to management -- from least to more invasive interventions

Dr Iain G Smith, DC, CC, BCAO

AONM Webinar 27th January 2021

The Craniocervical Junction (CCJ)

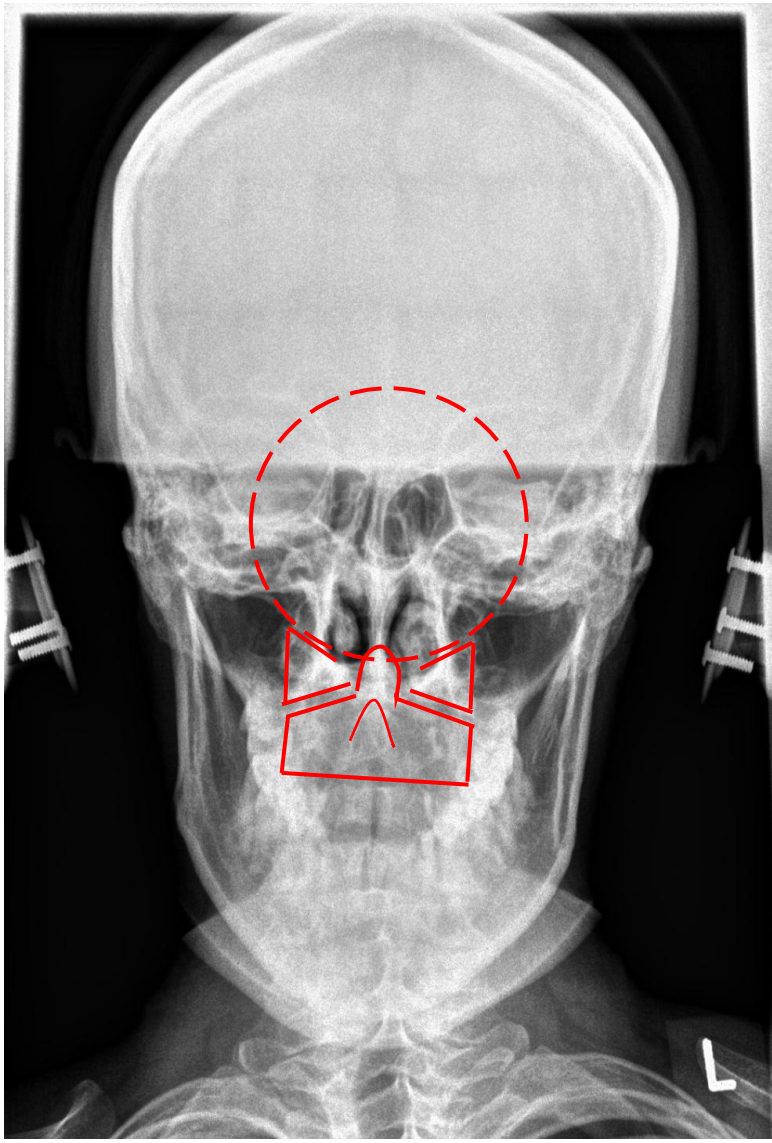
Skull base (C0)

Atlas (C1)

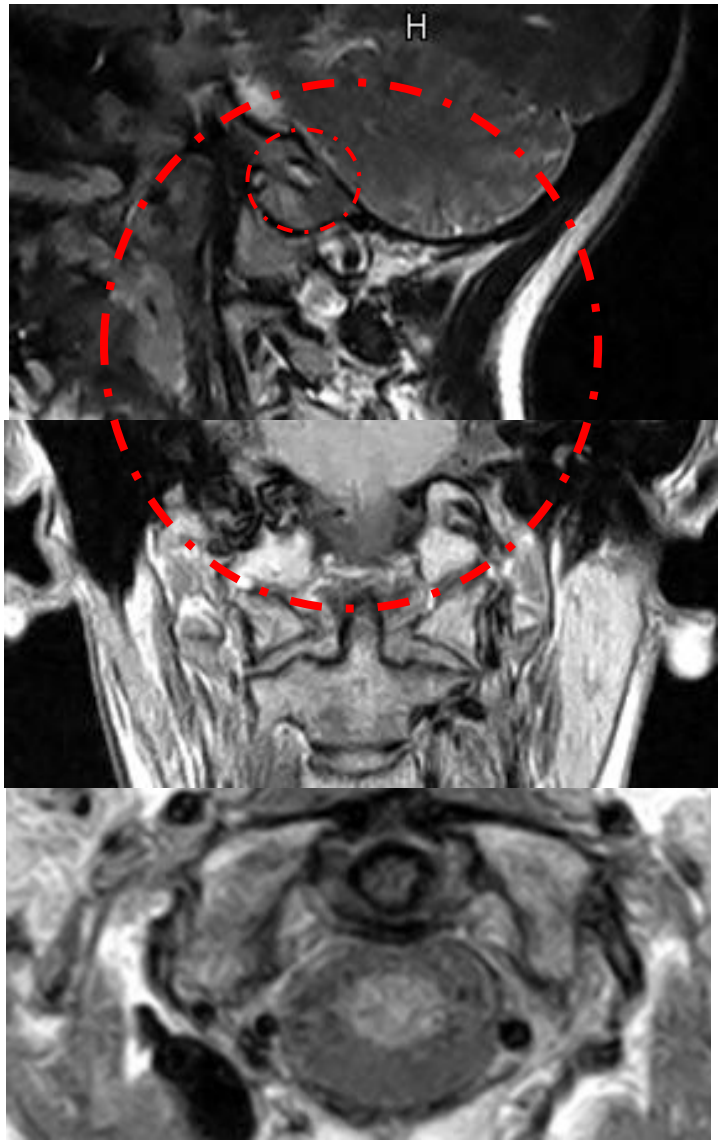
Axis (C2)

Connective tissue

Muscles



The Craniocervical Junction (CCJ)



Atlanto-occipital joint

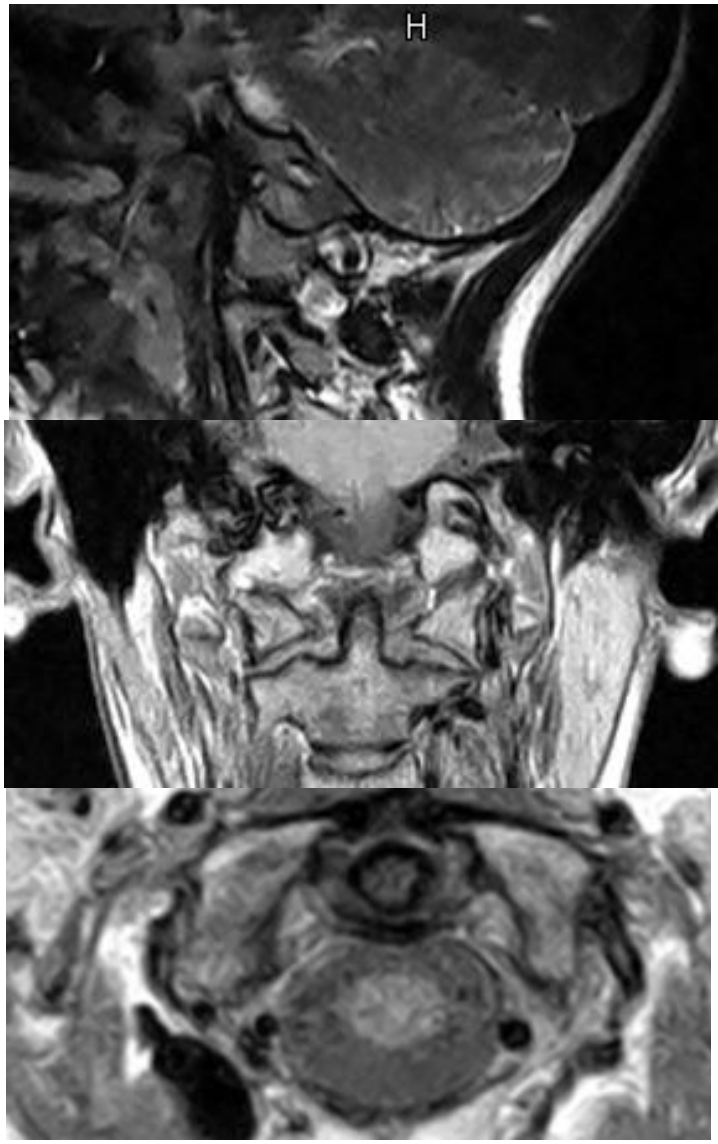
"The C1 lateral masses contain the occipital condyles in a cuplike fashion, facilitating flexion and extension. The condyles of these paired joints in sagittal direction are arcuate & thus due to this anatomy, motion about the vertical axis is not possible. Thus, this joint has movement only around the transverse & A-P axes. These joints allow forward or backward bending (nodding of head) & a slight lateral tilting motion to either side. ***They do not permit rotation*****."**

Saxena A (2017) ***Cranio-Cervical Trauma Eidemiology, Classification, Diagnosis and Management****. J Spine Neurosurg 6:5. doi: 10.4172/2325-9701.1000284*

The Craniocervical Junction (CCJ)

Atlanto-axial joint

"Rotation of atlas occurs around the odontoid process .... The superior facet of the axis is convex & the inferior facet of the atlas is either horizontal or slightly convex with horizontal orientation of the articulation. Because of this, these facets slide forward & backward on each other with rotation. The Atlanto-axial joints allow less flexion and extension motion than rotation ."



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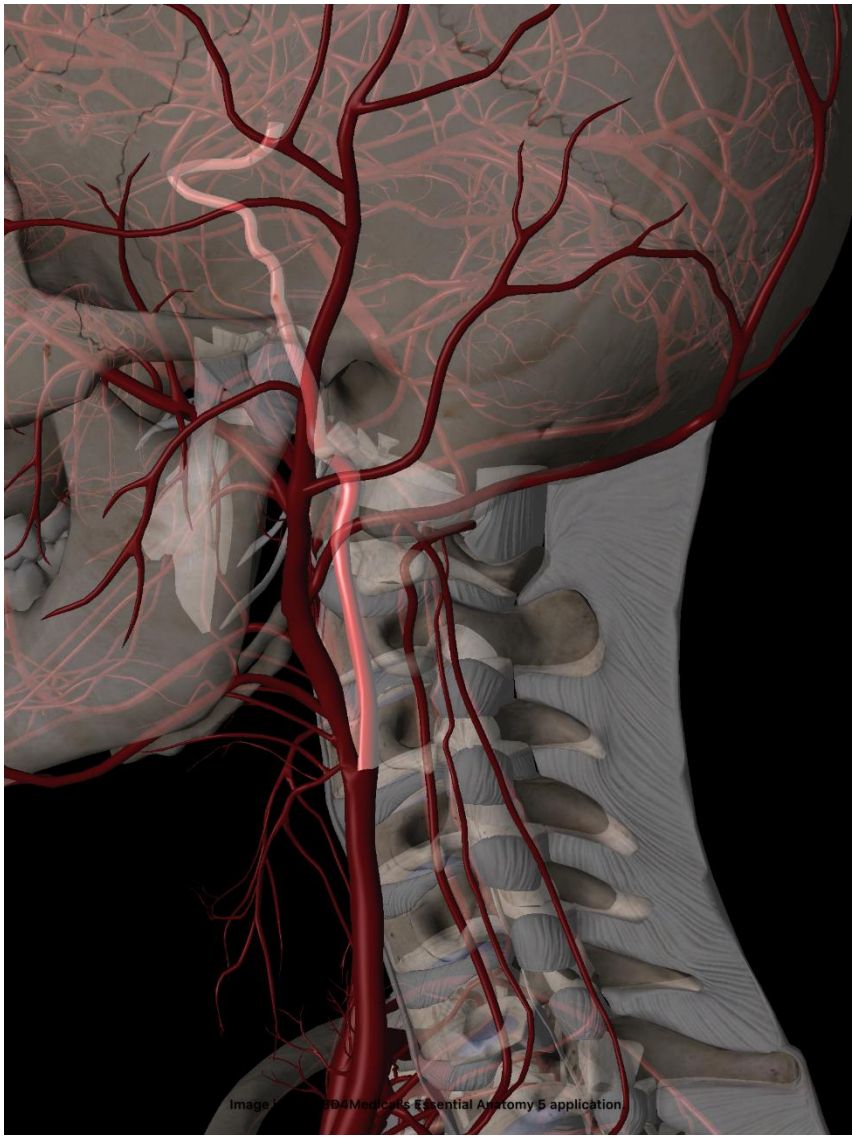
CCJ misalignment/deformation

"Malformations and misalignments of the CCJ cause deformation and obstruction of blood and CSF pathways and flow between the cranial vault and spinal canal that can result in faulty craniospinal hydrodynamics and subsequent neurological and neurodegenerative disorders."

The Role of the Craniocervical Junction in Craniospinal Hydrodynamics and Neurodegenerative Conditions
Michael F. Flanagan (Neurology Research International: Volume 2015, Article ID 794829)

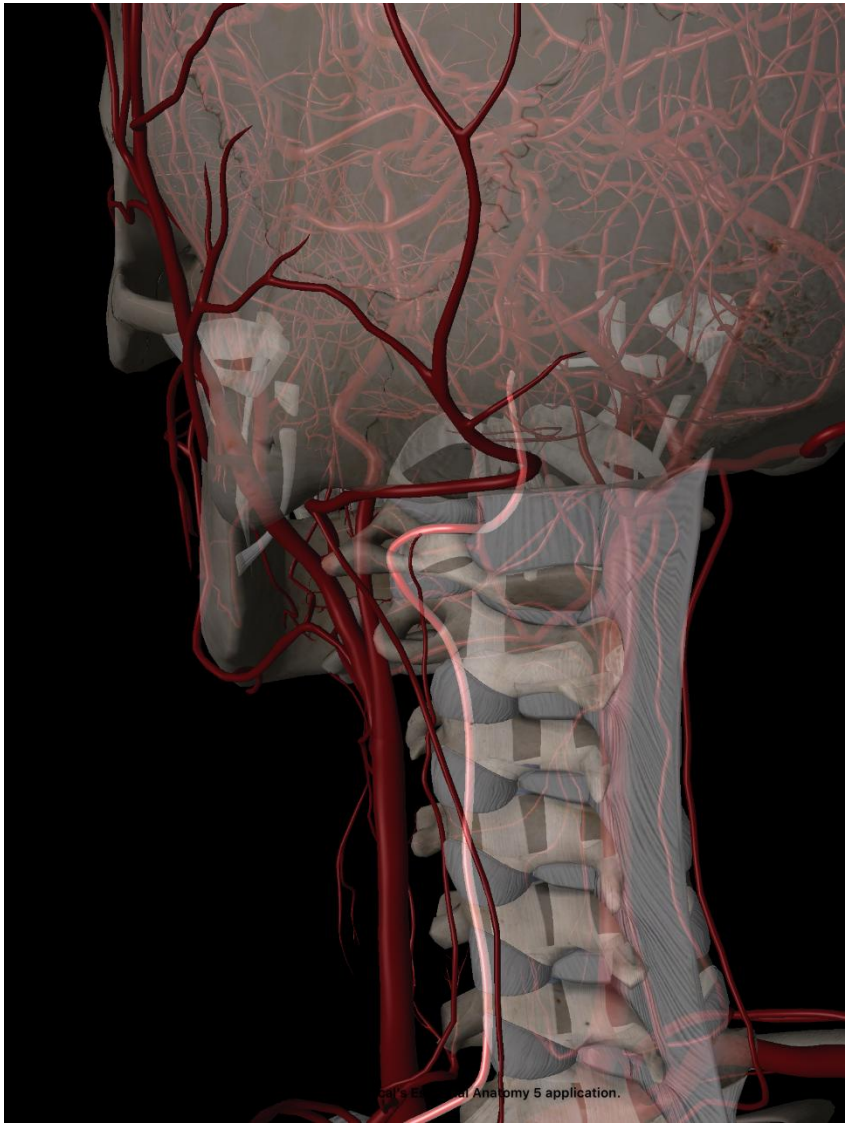
Brain Arterial Supply

Anteriorly: internal carotid arteries (75 – 80%)



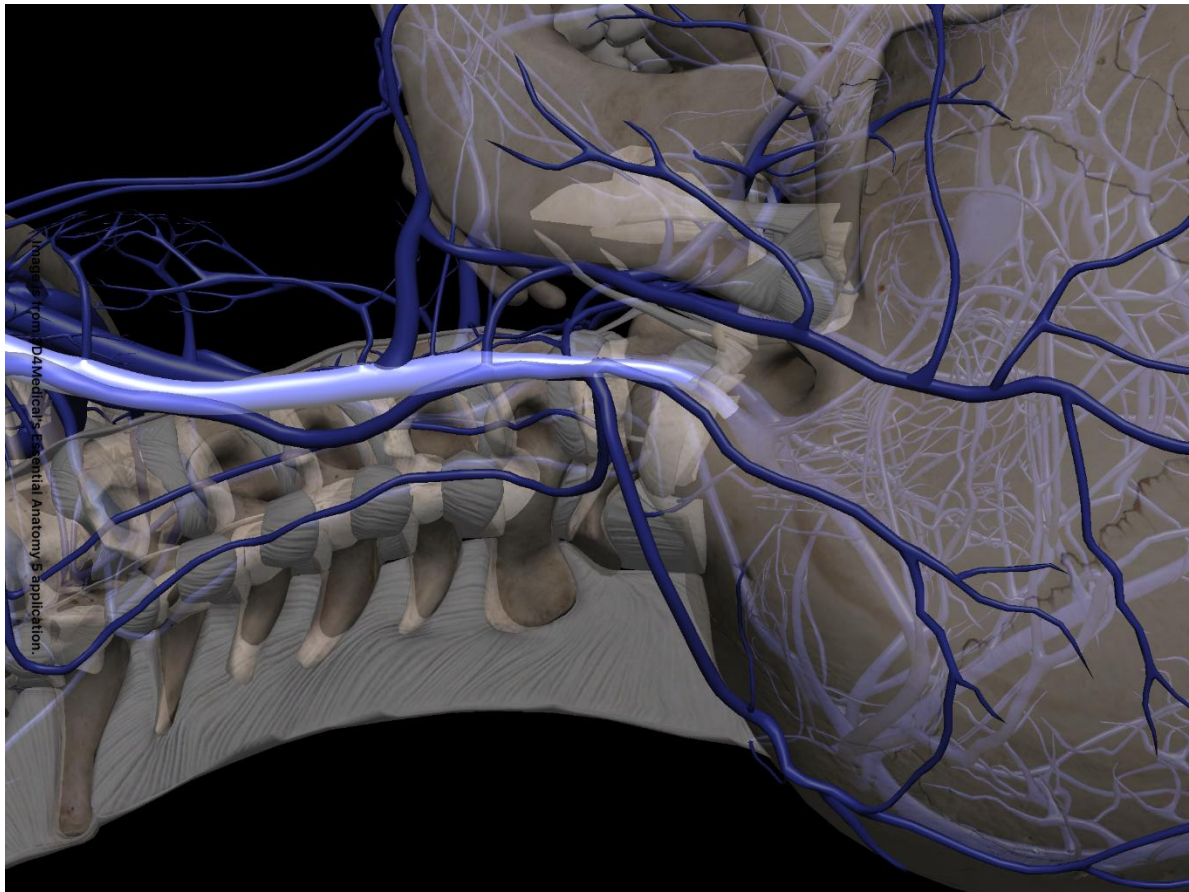
Brain Arterial Supply

Posteriorly: vertebral arteries (20-25%)



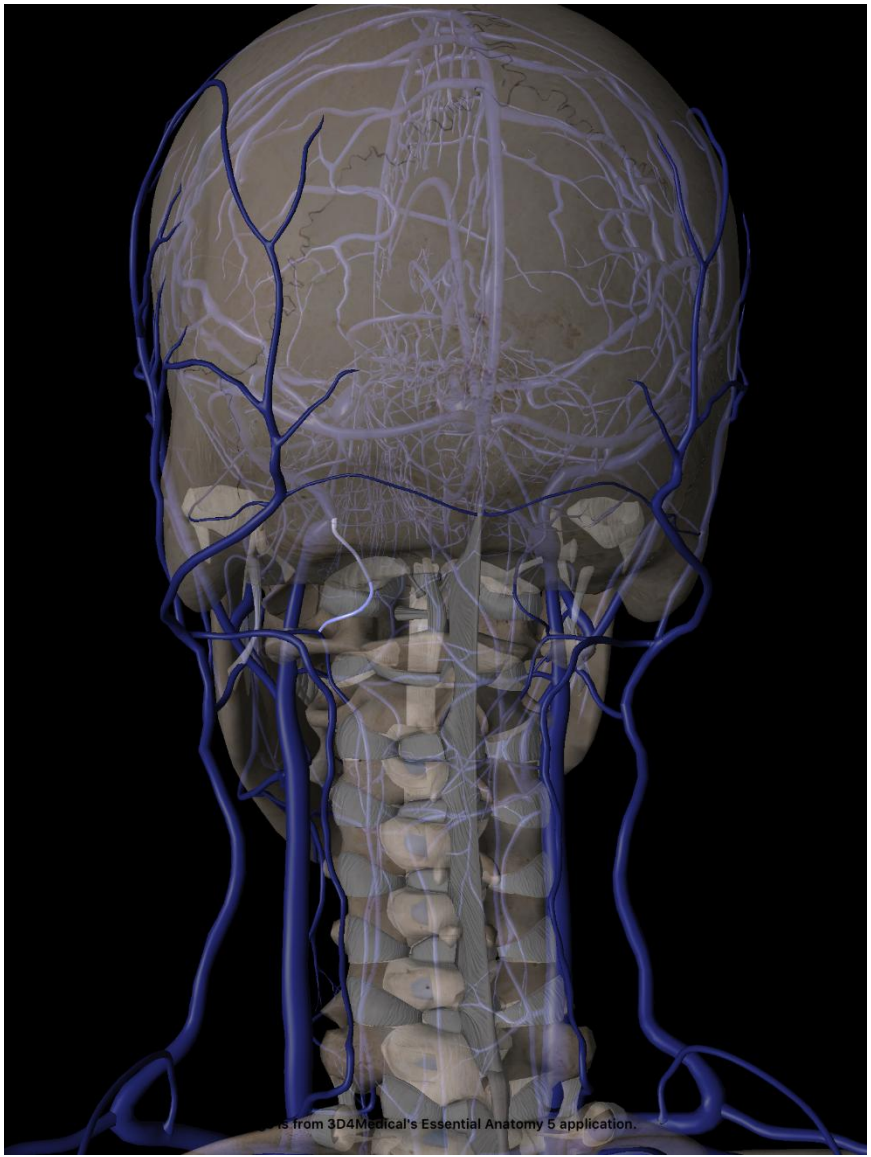
Primary Venous Return Pathway

When recumbent: primary venous outflow is via the transverse, sigmoid sinus, JF, internal jugular vein



Primary Venous Return Pathway

When erect: re-directs to the accessory posterior emissary return pathway i.e., primarily the occipital marginal sinus system to the suboccipital cavernous venous plexus and vertebral venous plexus (important in brain temperature control)



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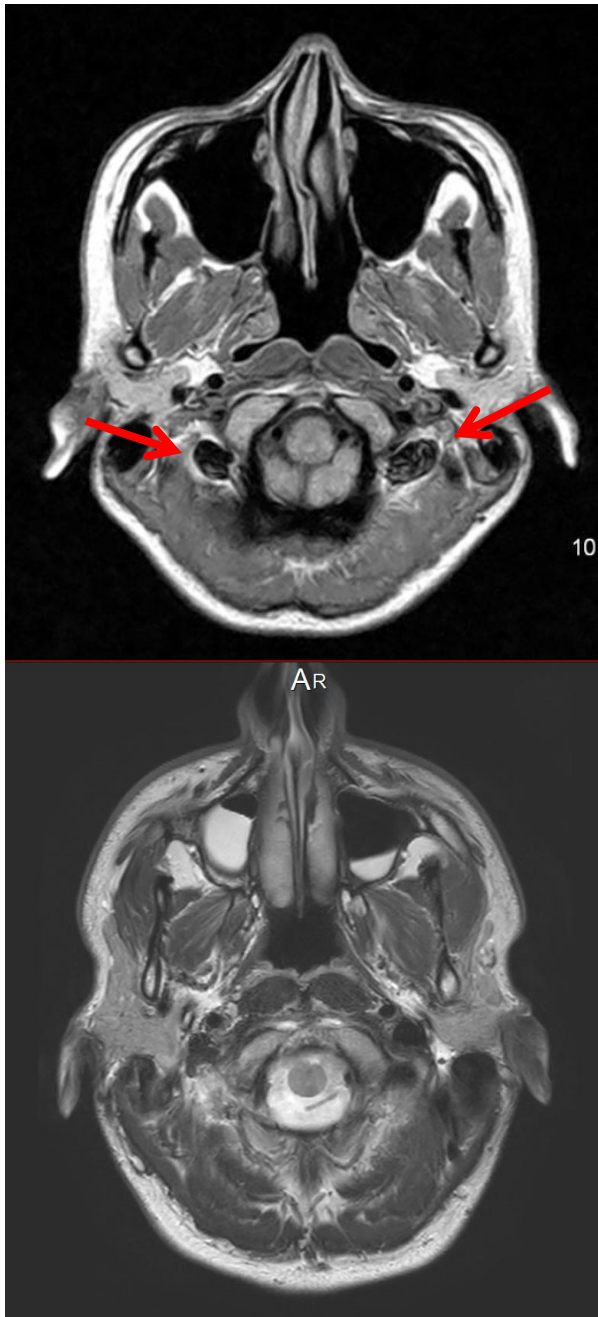
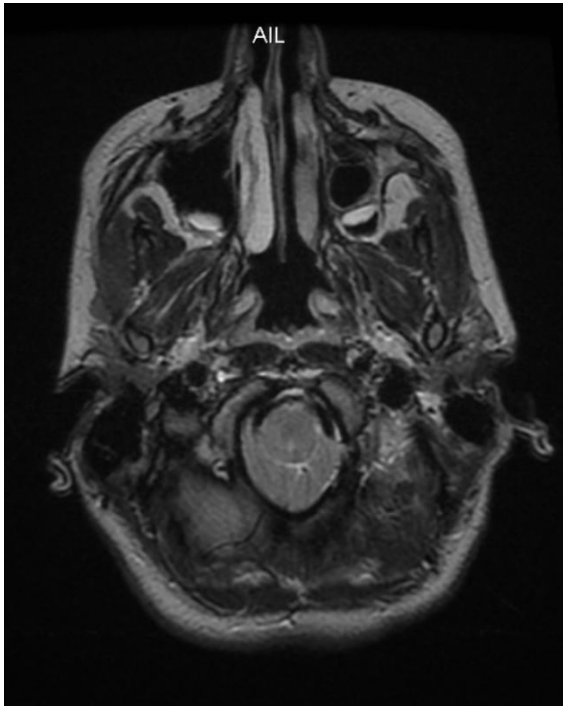
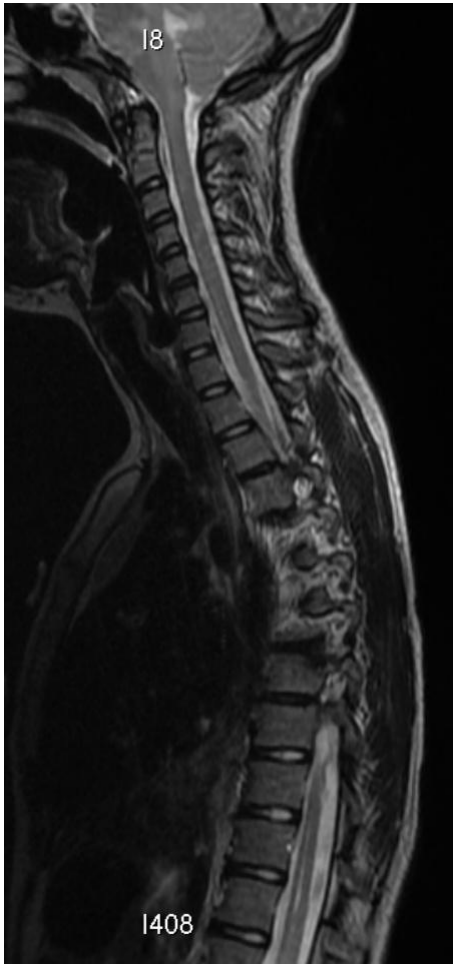


Cerebrospinal Fluid (CSF)

500ml produced per day

Approx. 150ml constant volume (brain, cord, lumbar cistern)

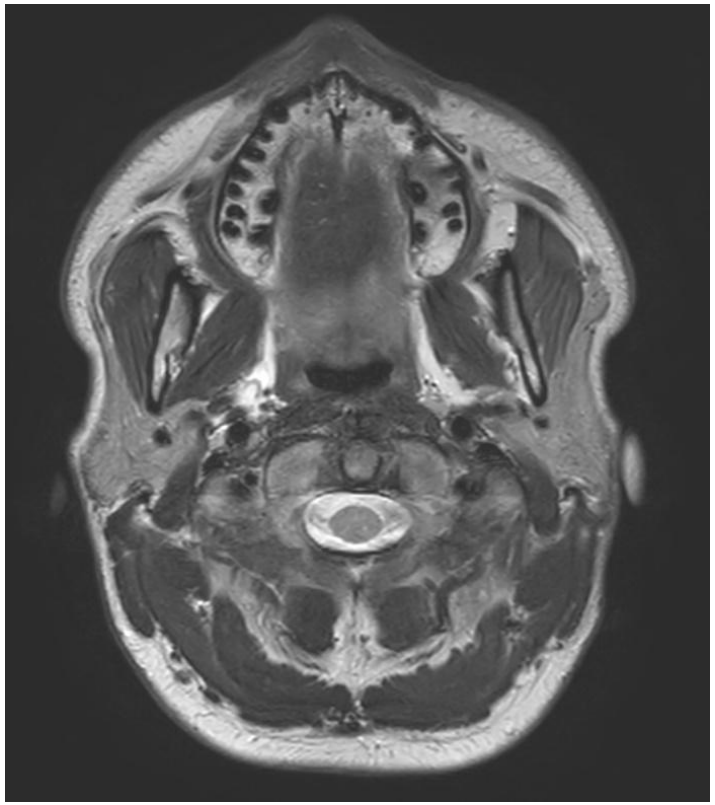




Dentate Ligament-Cord Distortion Hypothesis

Dr John Grostic Jr.

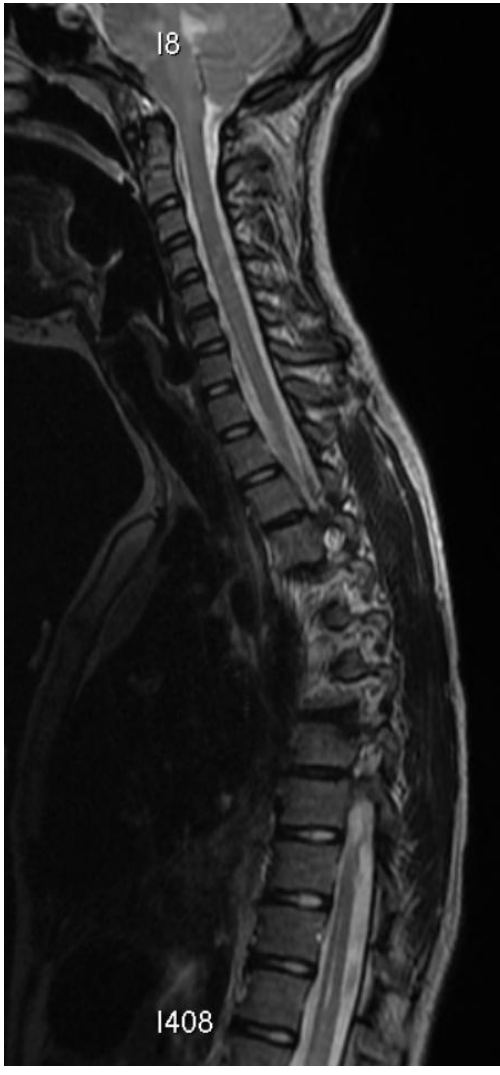
Neurological dysfunction can occur either by direct mechanical insult and/or by ischemic changes affecting the metabolic status of the cord.



Dentate Ligament-Cord Distortion Hypothesis

Dentate ligament cord distortion:

- cord ischaemia
- altered postural reflexes
- caudal tension on the brainstem worsening CTE



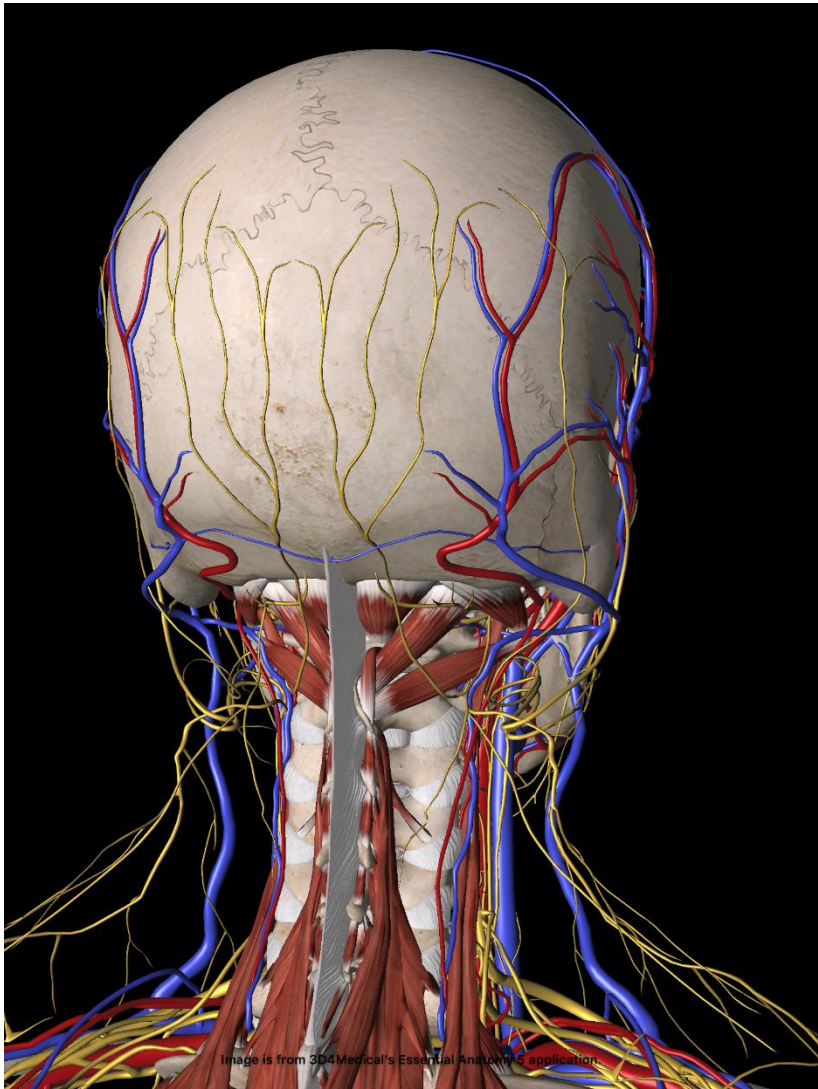
The Craniocervical Junction (CCJ)

Major anatomical junction

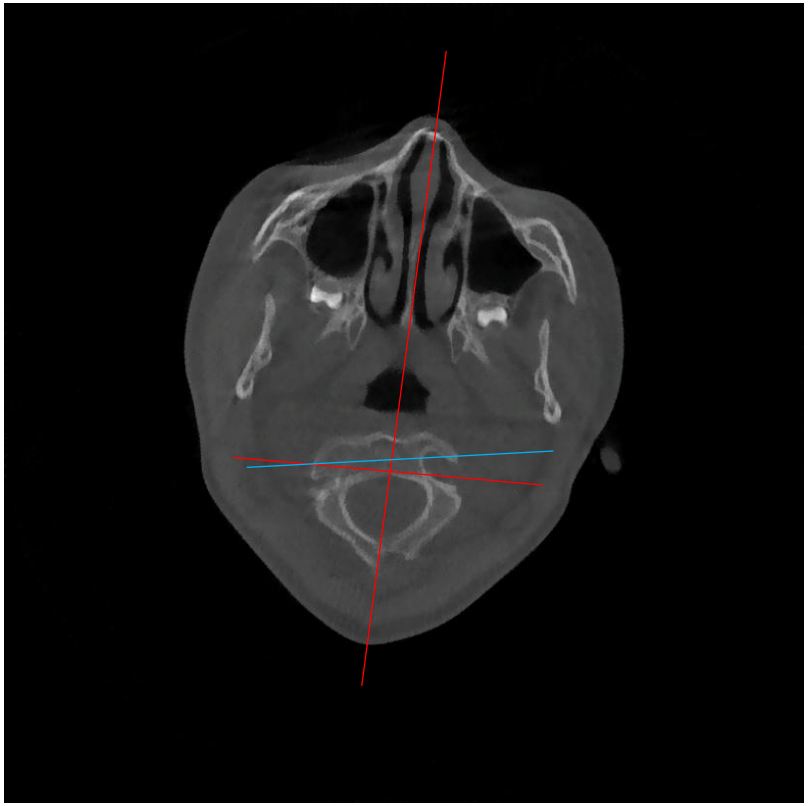
“Physiological choke point”

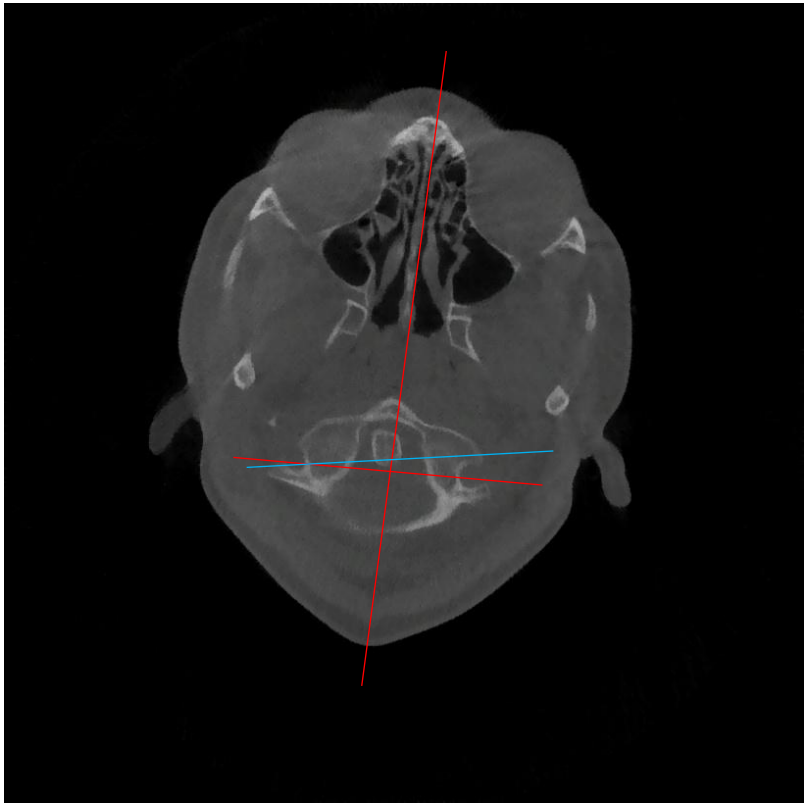
“Animals go to the base of the skull to kill prey, not L5.”

- Dr Roy Sweat, DC, BCAO (Founder of Atlas Orthogonal Upper Cervical Specific Procedure)



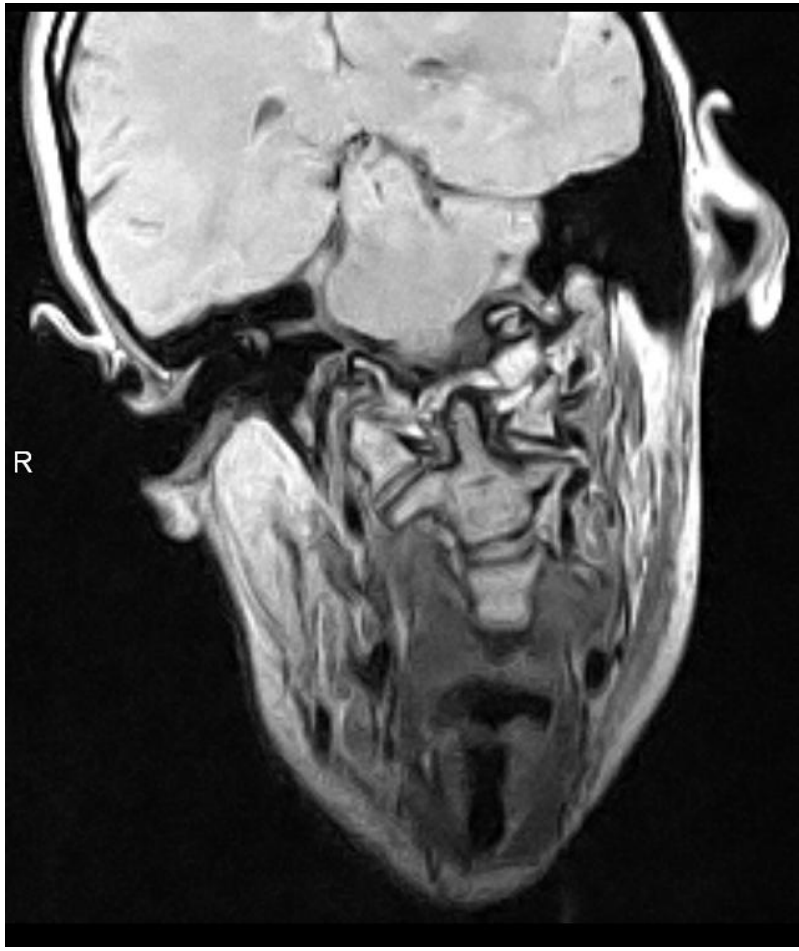
CCJ misalignment/deformation



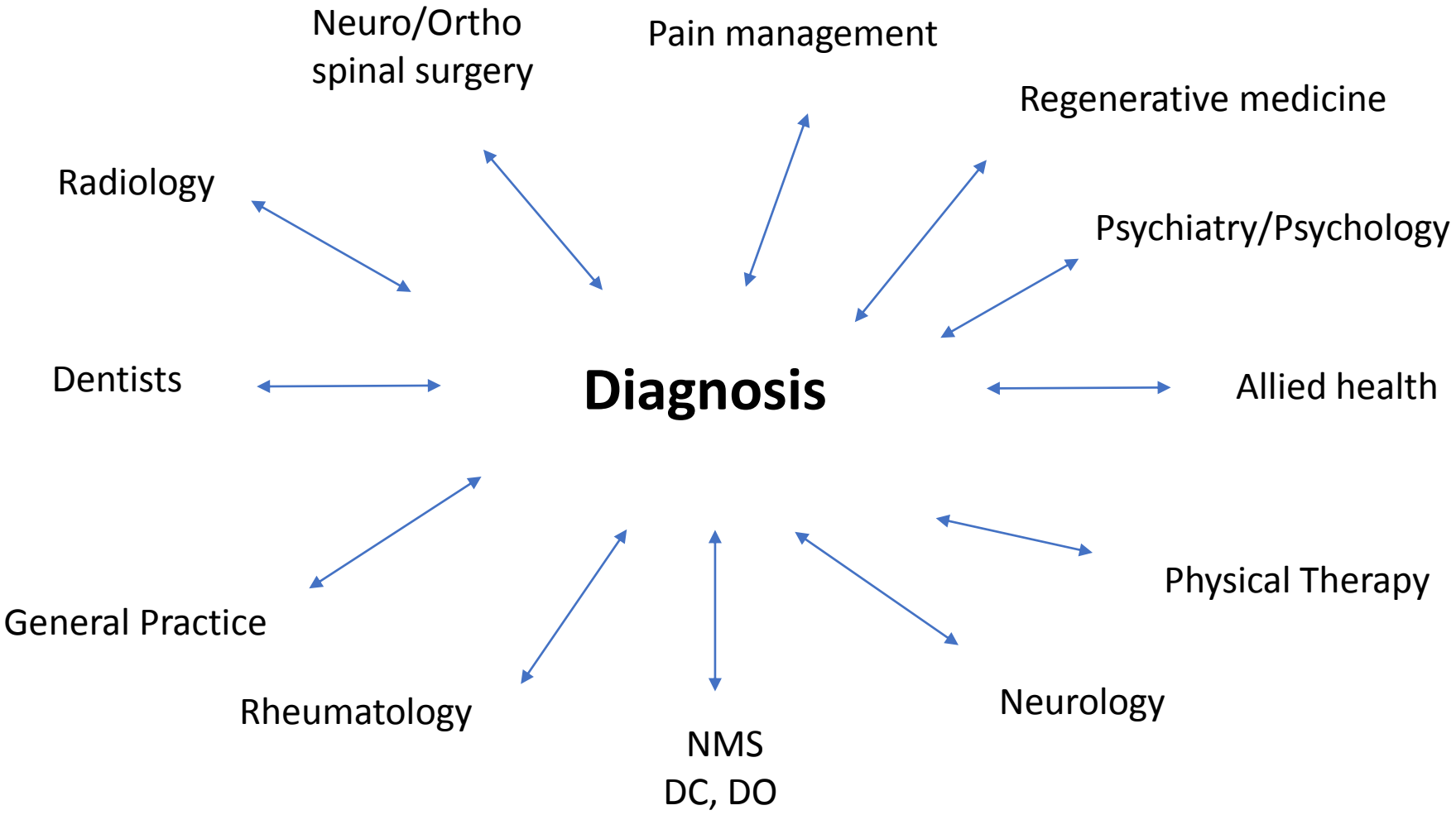


CCJ misalignment/deformation

Collectively the sequelae of CCJ compromise, and its concomitant signs and symptoms – regardless of aetiology - can be broadly classified as '**Cranio-Cervical Syndrome'**



Cranio-Cervical Syndrome



Cranio-Cervical Syndrome

Clinical Presentation

Neuromusculoskeletal

Neurovascular

Craniospinal Hydrodynamics

Cranio-Cervical Syndrome

Signs/Symptoms:

- **Pressure HA is often the primary symptom** (described as 'hatband too tight'; 'feels like head is going to explode')
- **Migraine HA/Cephalgia/neuralgia/TN/NDPH**
- **Head feels 'too heavy for the neck'** (may be associated with head tremor)

Cranio-Cervical Syndrome

Signs/Symptoms:

- **'Cog fog'** (poor concentration, irritability, low mood/depression/anxiety, early cognitive decline, dysphasia)
- **Sleep disturbance** (can wake on fairly consistent cycles; sometimes sleeping as little at 15-20mins at a time)
- **Dizziness/Disequilibrium/Vertigo/Tinnitus** (sound like Meniere's?)

Cranio-Cervical Syndrome

Signs/Symptoms:

- **Visual** (blurring, double vision, floaters, sensitivity to light, altered colour vision, poor convergence, divergent/convergent strabismus, anisocoria)
- **Gait & Station/Coordination disturbances** (involuntary movements, myoclonus, ataxias, titubation, foot drop, choreiform athetosis)
- **'Drop attacks'** (near-syncopal & syncopal episodes [fainting])

Cranio-Cervical Syndrome

Signs/Symptoms;

- **Bilateral hip pain** (trochanteric bursitis, GTPS, bilateral posterior, lateral or anterior thigh pain)
- **Paraesthesia** (unilateral or bilateral and transient; worse after prolonged periods without moving i.e., bed rest, driving distances, sitting in a theatre/cinema)
- **Unable to sit, stand, or lay still for extended periods** (failed craniospinal hydrodynamics?)

Cranio-Cervical Syndrome

Signs/Symptoms;

- **Fatigue** (Chronic Fatigue Synd., Adrenal Fatigue)
- **Unstable hypertension** (typically elevated diastolic pressure)
- **Altered/Lowered immune response** (SNS driven, atopic disorders; prone to infection, skin conditions)
- **Dysautonomia** (IBS/GI,, POTS, tachycardia, dyspnoea/SOB, dysphagia, dysmenorrhoea, urinary urgency/incontinence, loss libido)
- **Cervical, Dorsal, Lumbar pain** (can appear to be hypersensitive to palpation – 'everything hurts')

CCS investigation/diagnosis

Examination:

Neuro exam for the CCS patient can be misleading and often results in the presumption of FND

Cranio-Cervical Syndrome

Symptoms considered "functional," "psychogenic," "medically unexplained," or "hysterical" account for up to one third of new referrals to neurology outpatient departments.

Stone J, Zeman A, Sharpe M
Functional weakness and sensory disturbance
Journal of Neurology, Neurosurgery & Psychiatry 2002;73:241-245.

Cranio-Cervical Syndrome

Complaints of weakness or difficulty walking, often in combination with sensory disturbance, represent a significant subgroup of these symptoms.

Stone J, Zeman A, Sharpe M
Functional weakness and sensory disturbance
Journal of Neurology, Neurosurgery & Psychiatry 2002;73:241-245.

Cranio-Cervical Syndrome

Despite their frequency in clinical practice, descriptions of the diagnosis and management of these problems are not easily found in textbooks of neurology.

Stone J, Zeman A, Sharpe M
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Cranio-Cervical Syndrome

Always bear in mind the possibility that your patient may have both a functional and an organic disorder.

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Functional weakness and sensory disturbance
Journal of Neurology, Neurosurgery & Psychiatry 2002;73:241-245.

Cranio-Cervical Syndrome

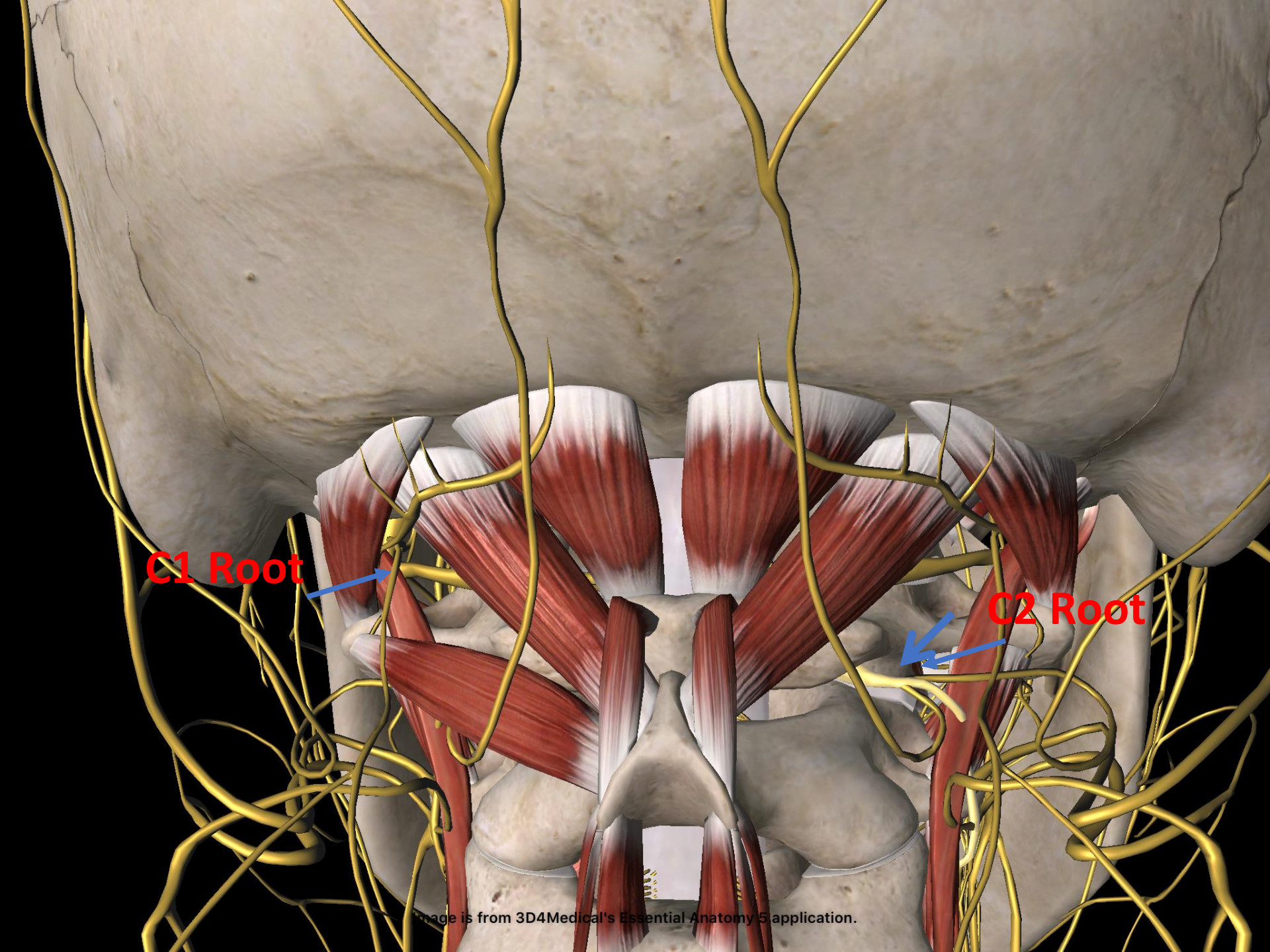
Examination Findings

- **DTRs**
- **Hemiparesis/paresis**
- **Gait and Station tests**
- **Tremors/Coordination tests**

Cranio-Cervical Syndrome

Examination Findings

- **Pain to palpation at the CCJ**
- **Four Quadrant Weakness** *(psoas, opponens pollicis and digiti minimi)*
- **Apparent Leg length discrepancy** *(supine)*


C1 Root
C2 Root
Image is from 3D4Medical's Essential Anatomy 5 application.

Cranio-Cervical Syndrome

Examination Findings

- **Craniocervical Stomatognathic Stress Test (CST) is positive**
- **Tenderness to palpation sutures** (OM, Sag)

Diagnostic Imaging

- Upper cervical X-ray
- Dynamic UMRI/CSF flow study
- CBCT/DMX
- MRA/MRV
- CTV

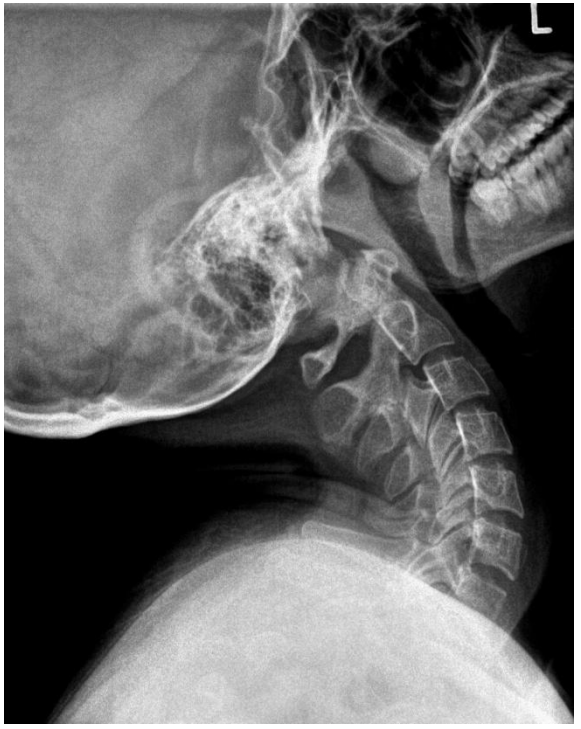
Diagnostic Imaging

- **Upper cervical X-ray** (Lateral, APOM, Frontal, Horizontal: additional views flex/ext, APOM lat flex)

Diagnostic Imaging

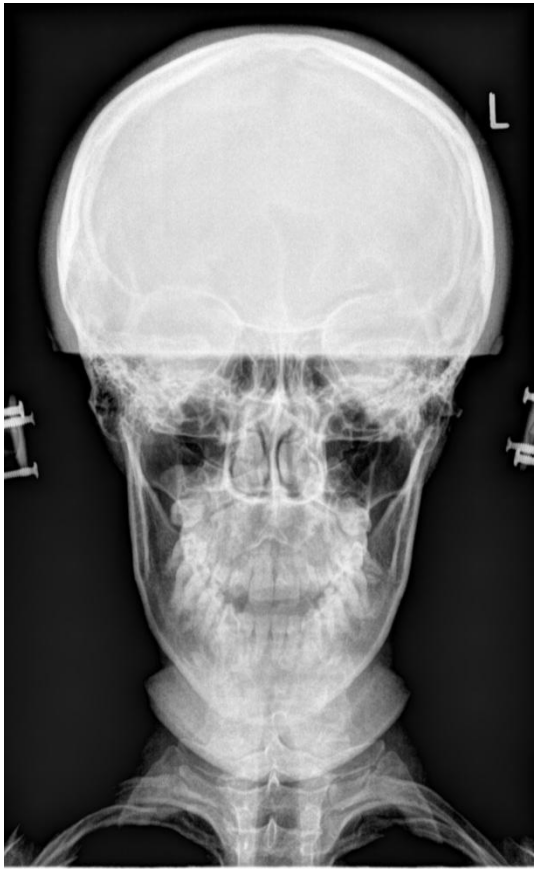
- **Upper cervical X-ray** (Lateral, APOM, Frontal, Horizontal: additional views flex/ext, APOM lat flex)





Diagnostic Imaging

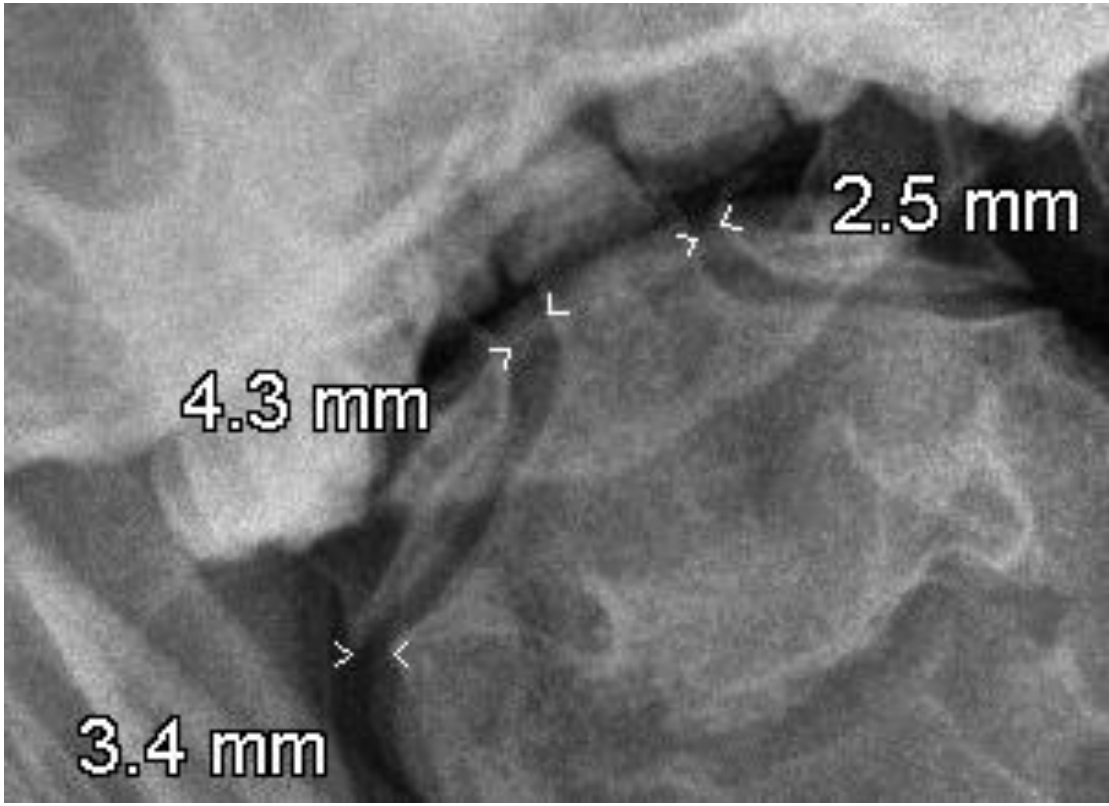
- **Upper cervical X-ray** (Lateral, APOM, Frontal, Horizontal: additional views flex/ext, APOM lat flex)



Diagnostic Imaging

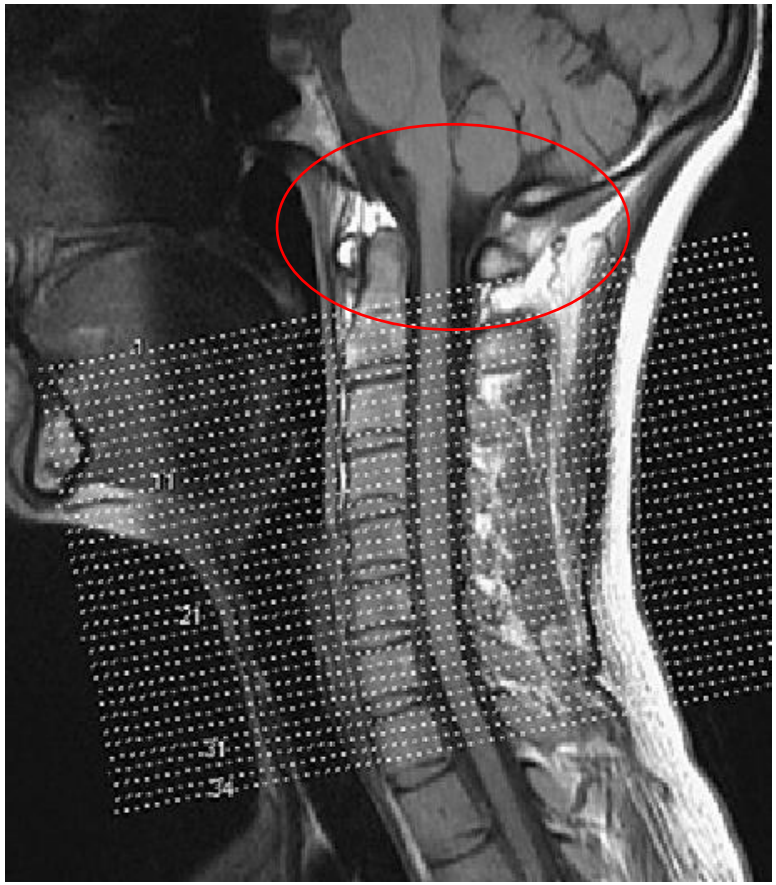
Imaging Findings

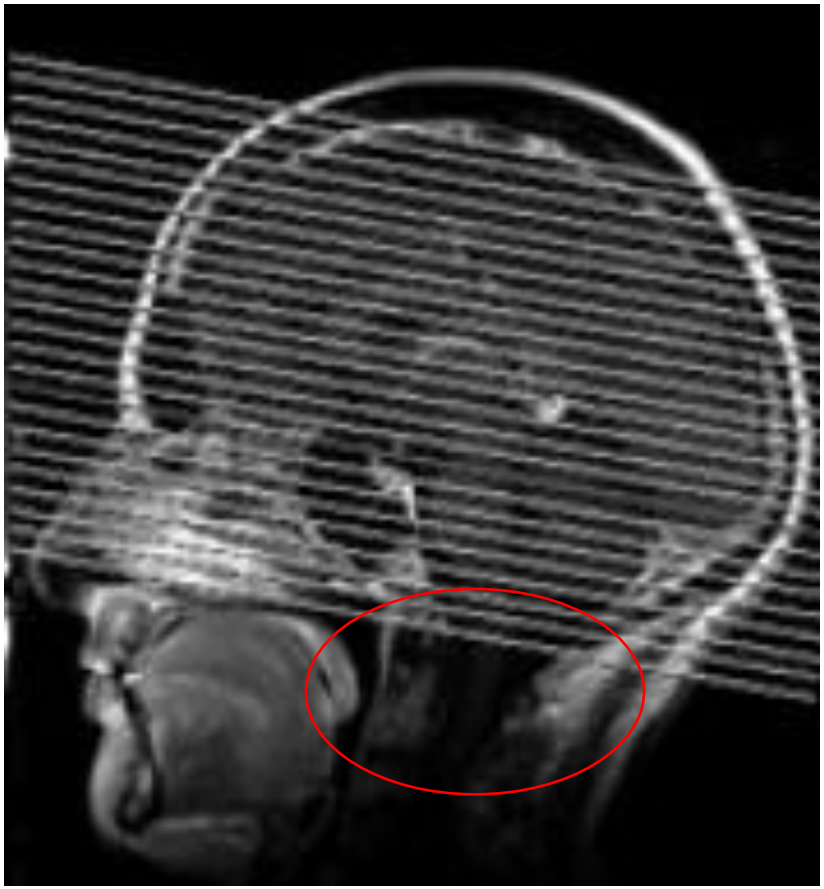
- Overhang of the lateral mass of C1 >2mm
- Asymmetry of the paraodontoid space



*'**Diagnostic Accuracy of Video fluoroscopy for Symptomatic Cervical Spine Injury Following Whiplash Trauma**' Michael D. Freeman1,*, Evan A. Katz2, Scott L. Rosa3, Bryan G. Gatterman4,Ellen M. F. Strömmer1and Wendy M. Leith; Int. J. Environ. Res. Public Health2020,17, 1693*

The CCJ….?

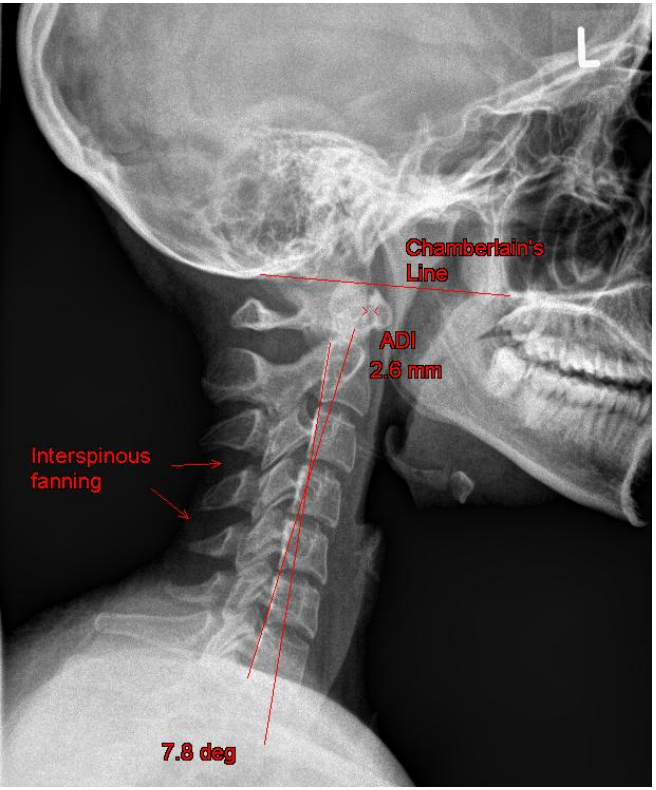


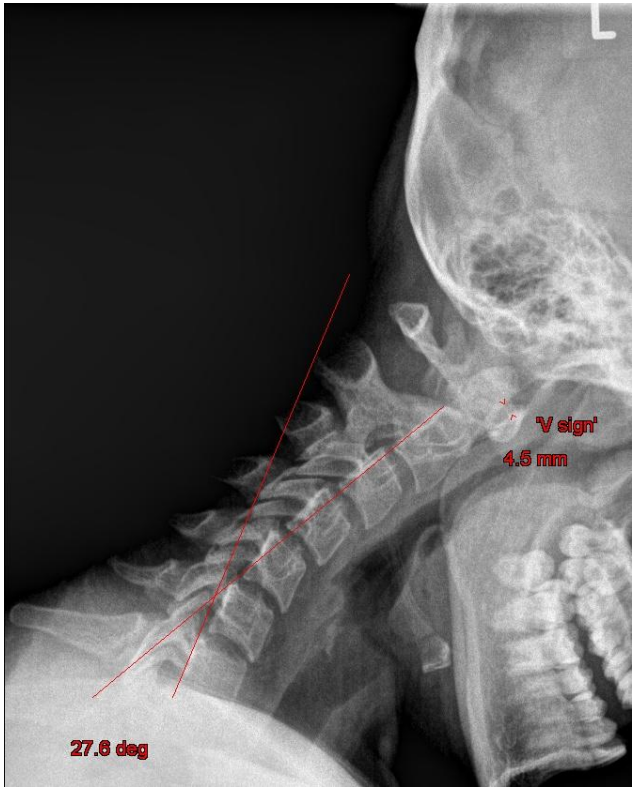


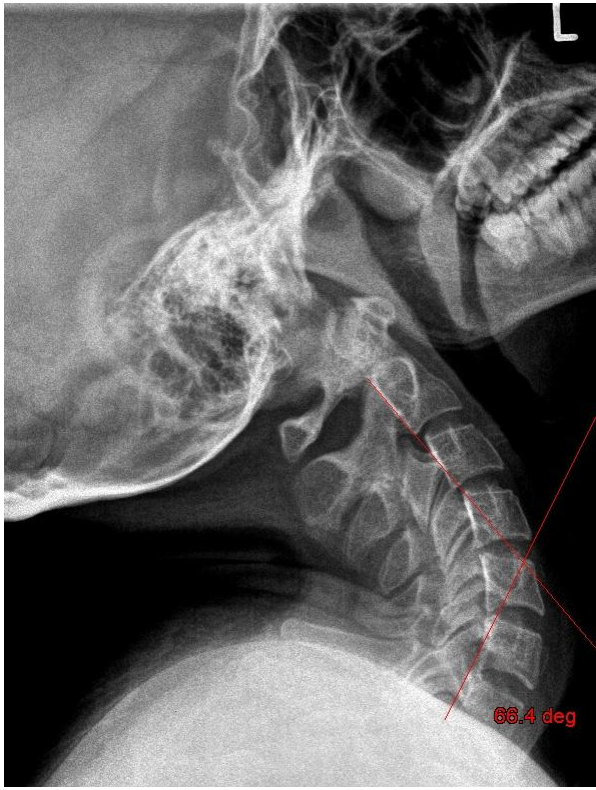
Hypermobility/CCI/AAI/CCJ misalignment…?

The importance of diagnosis and staging in management

Acquired...? Inherited...? Congenital...? Disease...?

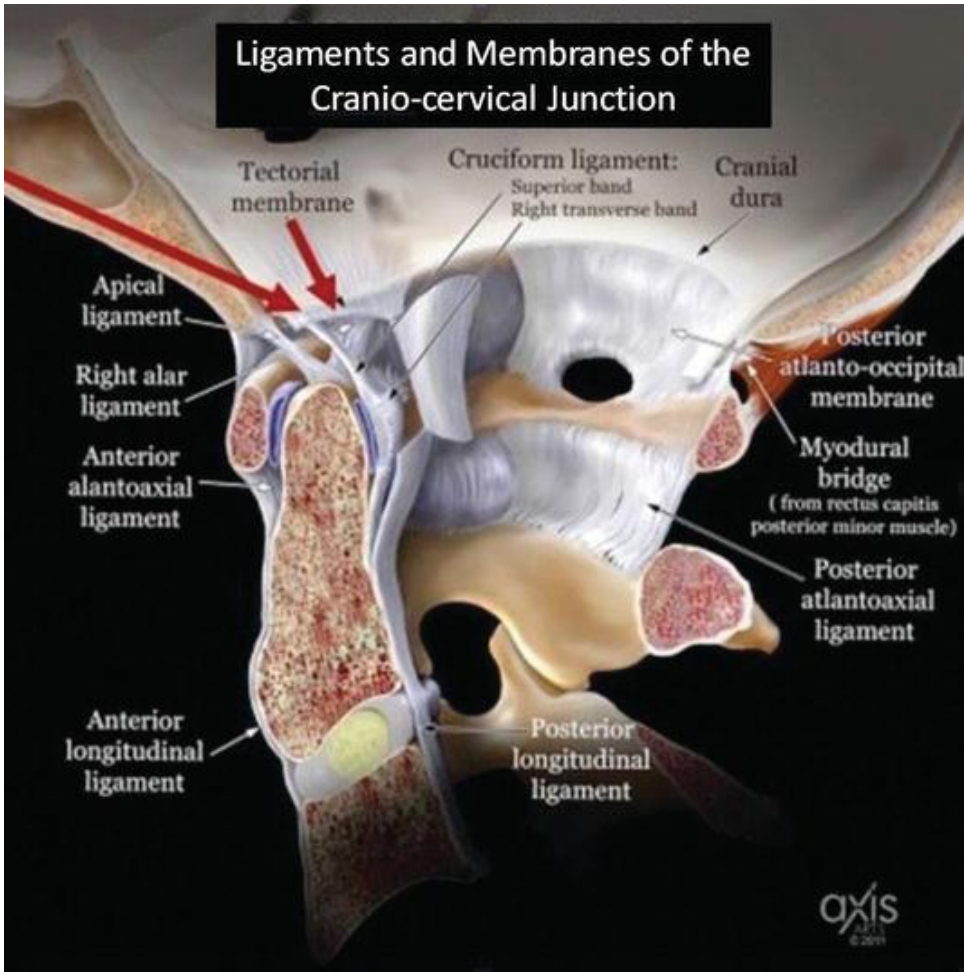






The Craniocervical Junction (CCJ)

"Hyperextension is limited by tectorial membrane and lateral flexion and Rotation by alar ligaments. Excessive flexion is limited by Anterior arch C1 contacting the basion and Anterior translation is limited by transverse ligament."



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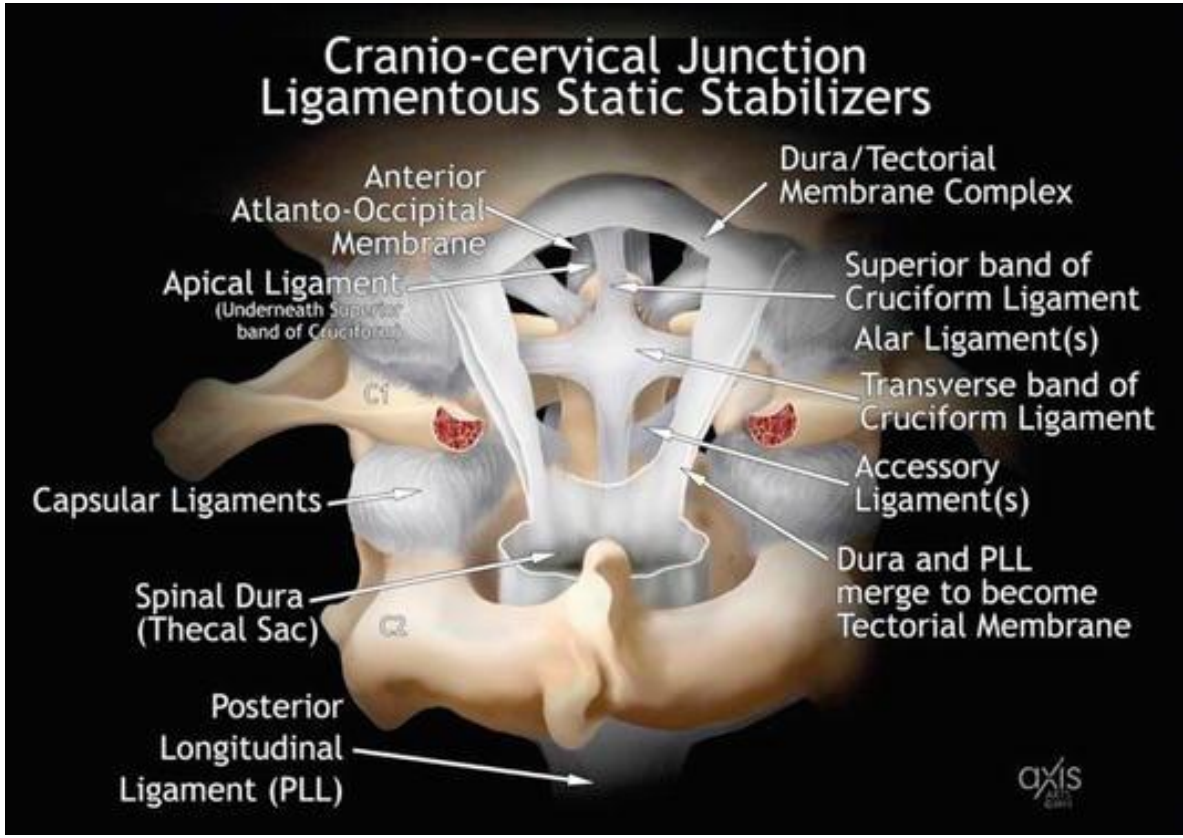

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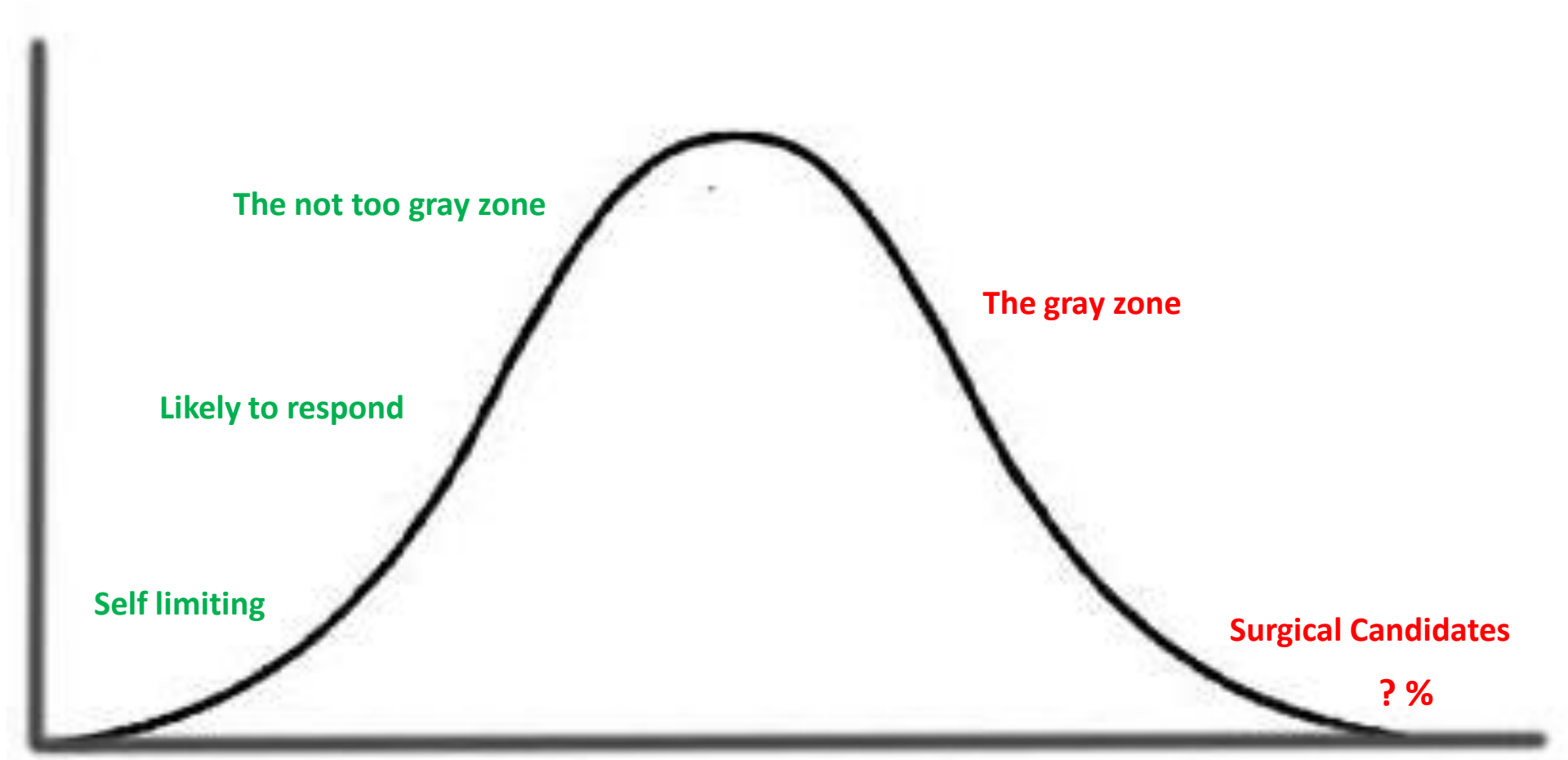
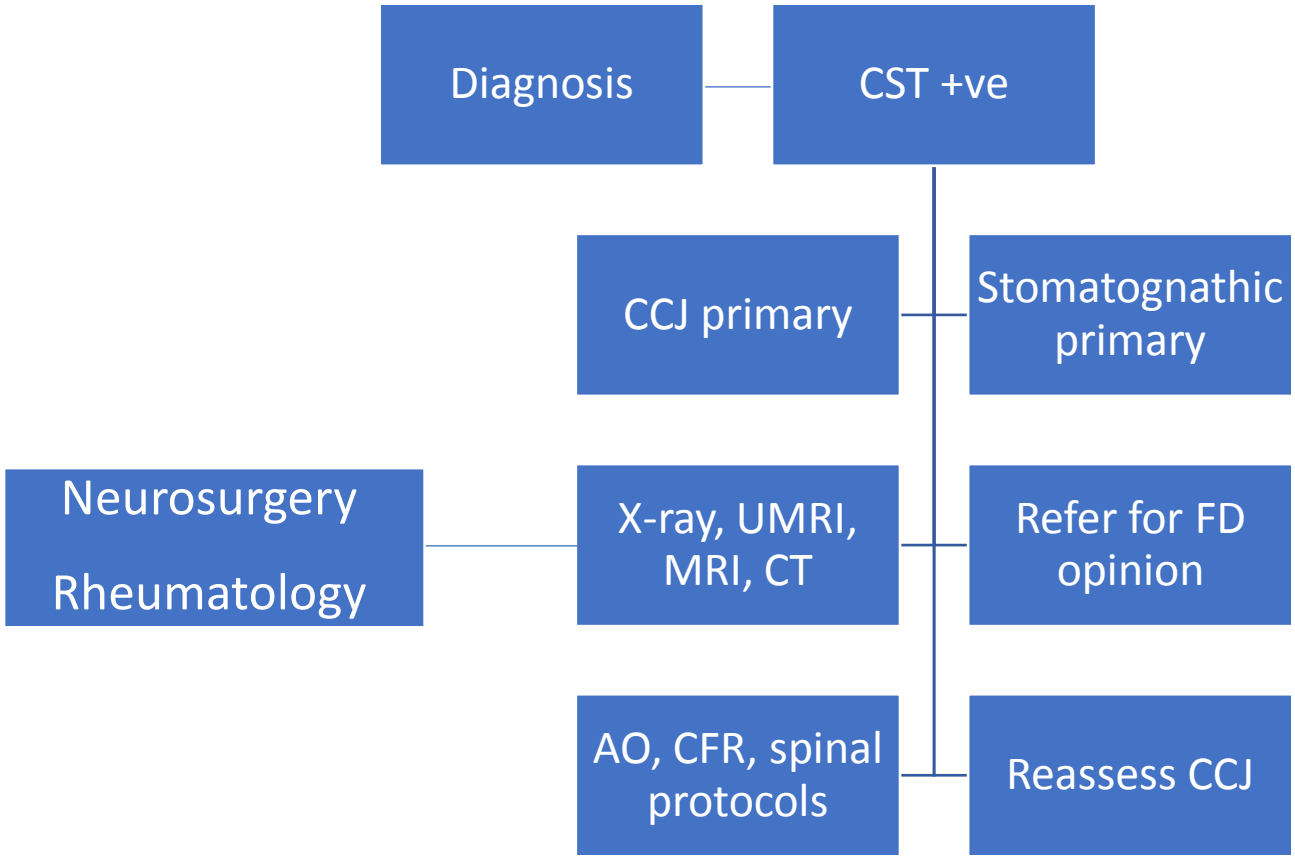
Hypermobility/CCI/AAI/CCJ misalignment…?

The importance of diagnosis and staging in management



Management CCS



Atlas Orthogonal Procedure

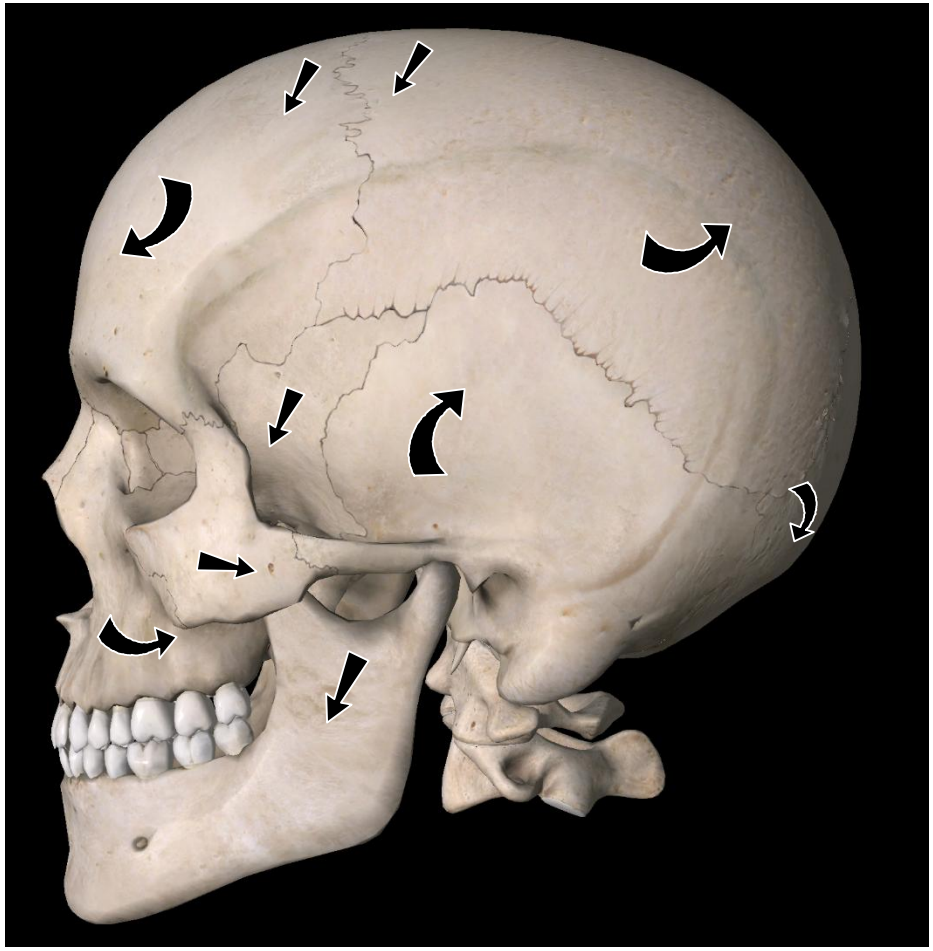
Image guided, upper cervical specific technique utilizing a non-manipulative compression wave (average 25N) from a calibrated, floor mounted instrument to correct misalignments of the CCJ.

Patient is side lying, in a relaxed neutral position, with no neck rotation.

Atlas Orthogonal Procedure

Craniofascial Release (CFR)

- **Inter / intra cranial bone motion:** cranial bone motion has been demonstrated by several studies over the last 40 + years. (Inter bone movement being shown to be of greater amplitude than intra bone).

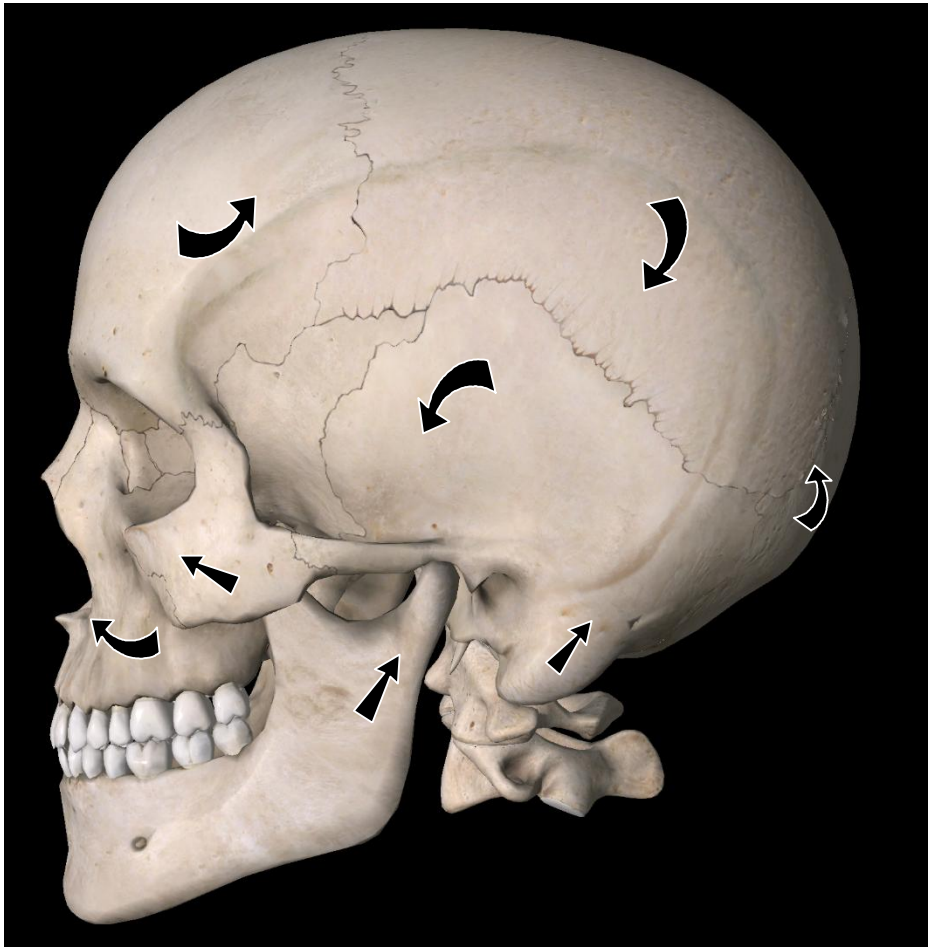


Cranial Flexion

Craniofascial Release (CFR)

Craniopathy:

- focuses on enhancing the movement of CSF around the brain and spinal cord
- facilitating the venous return pathway
- Influences the reciprocal tension membranes
- Influences the cranial fascia

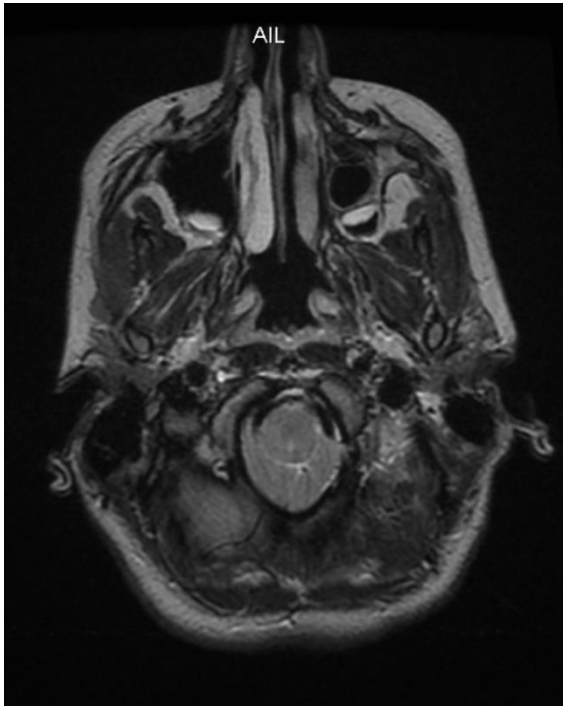


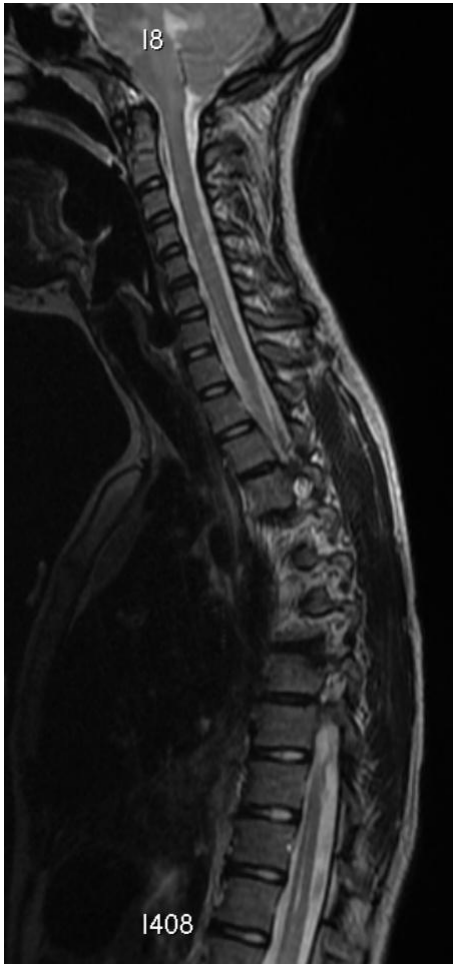
Cranial Extension

Craniofascial Release (CFR)

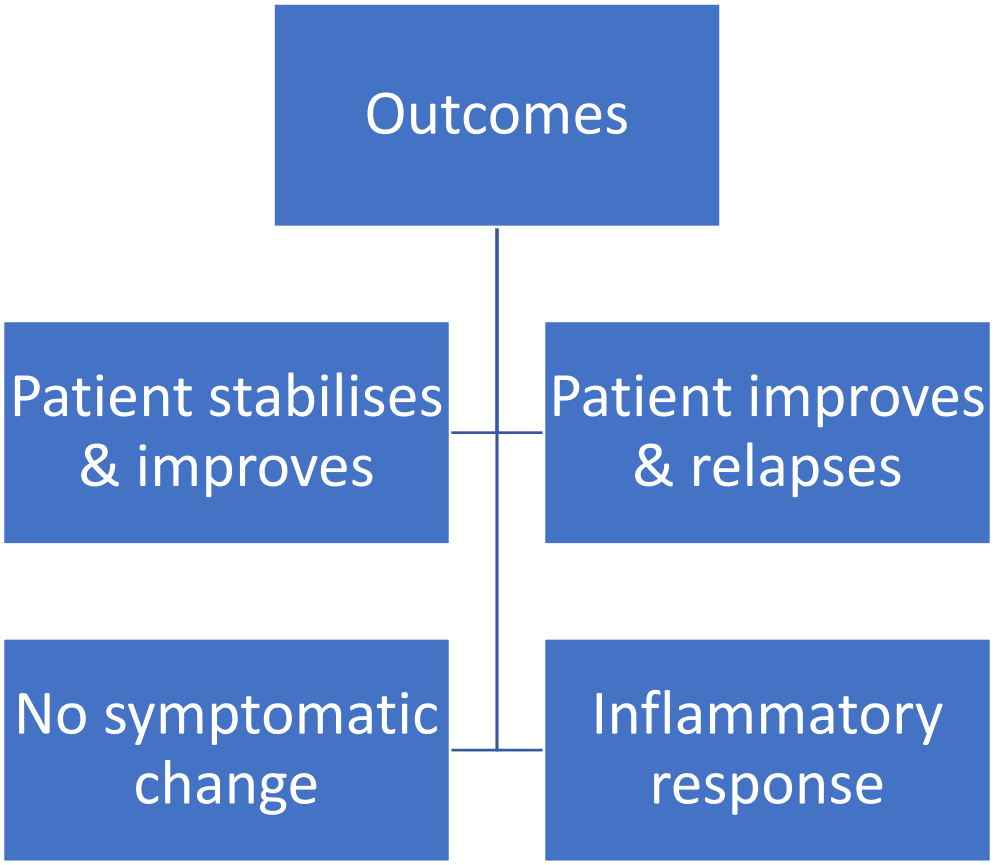
500ml produced per day

Approx. 150ml constant volume (brain, cord, lumbar cistern)





Cranio-Cervical Syndrome



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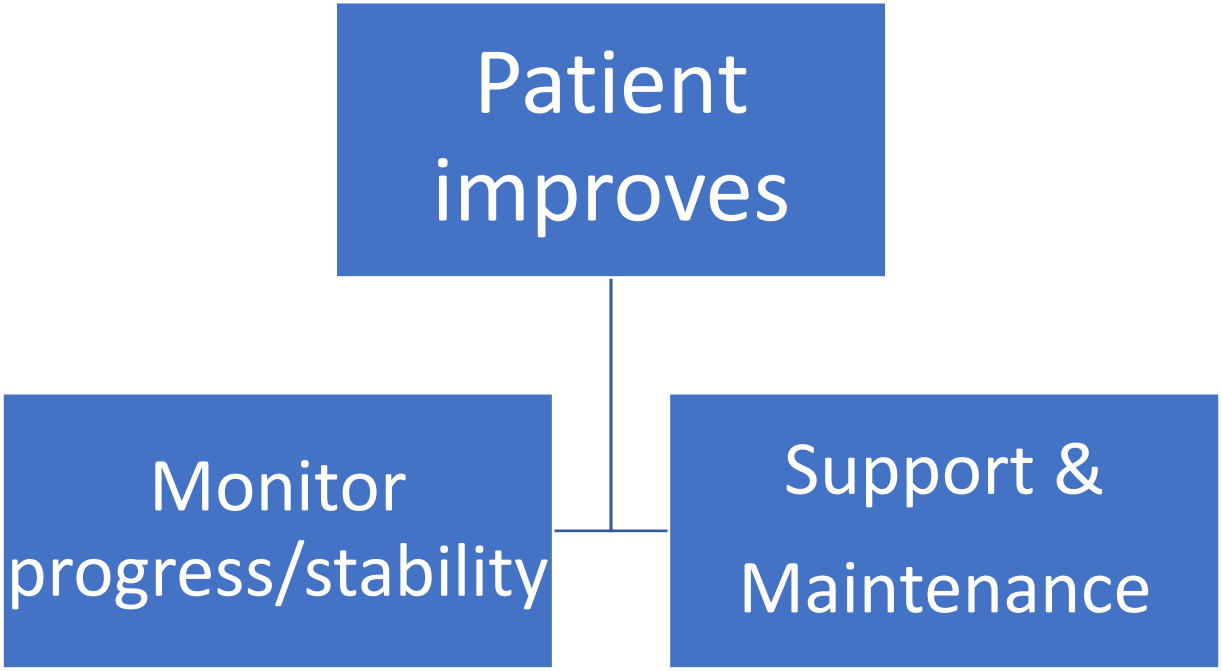

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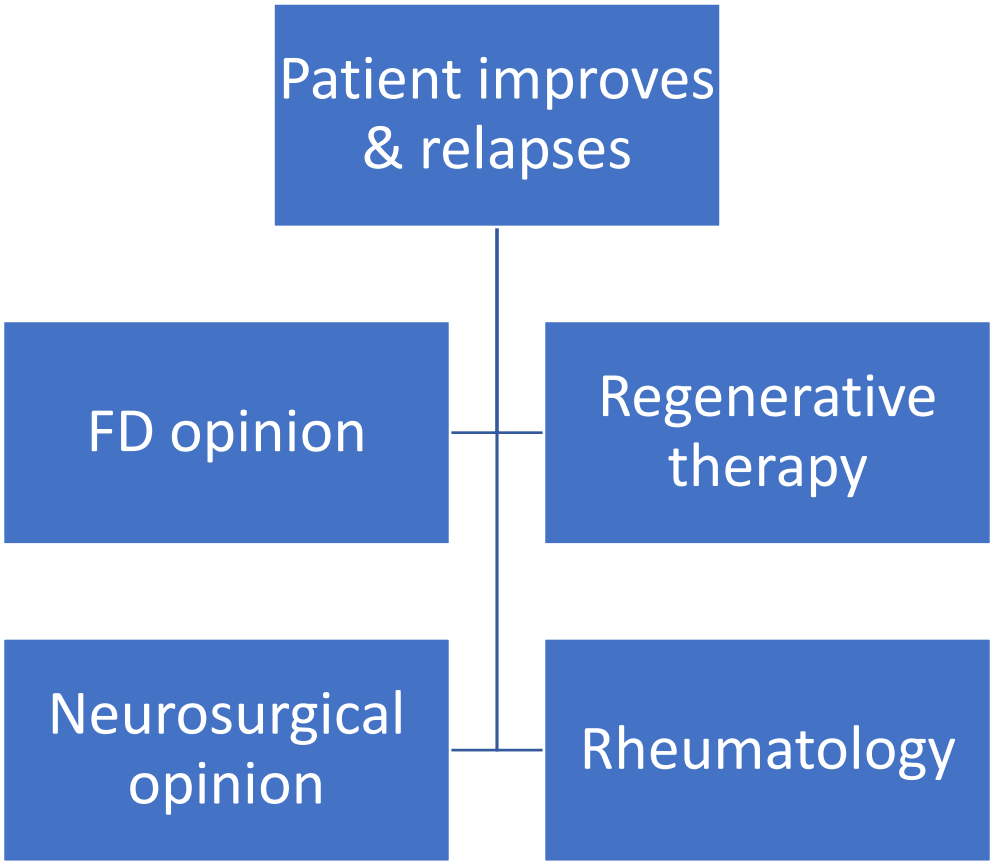
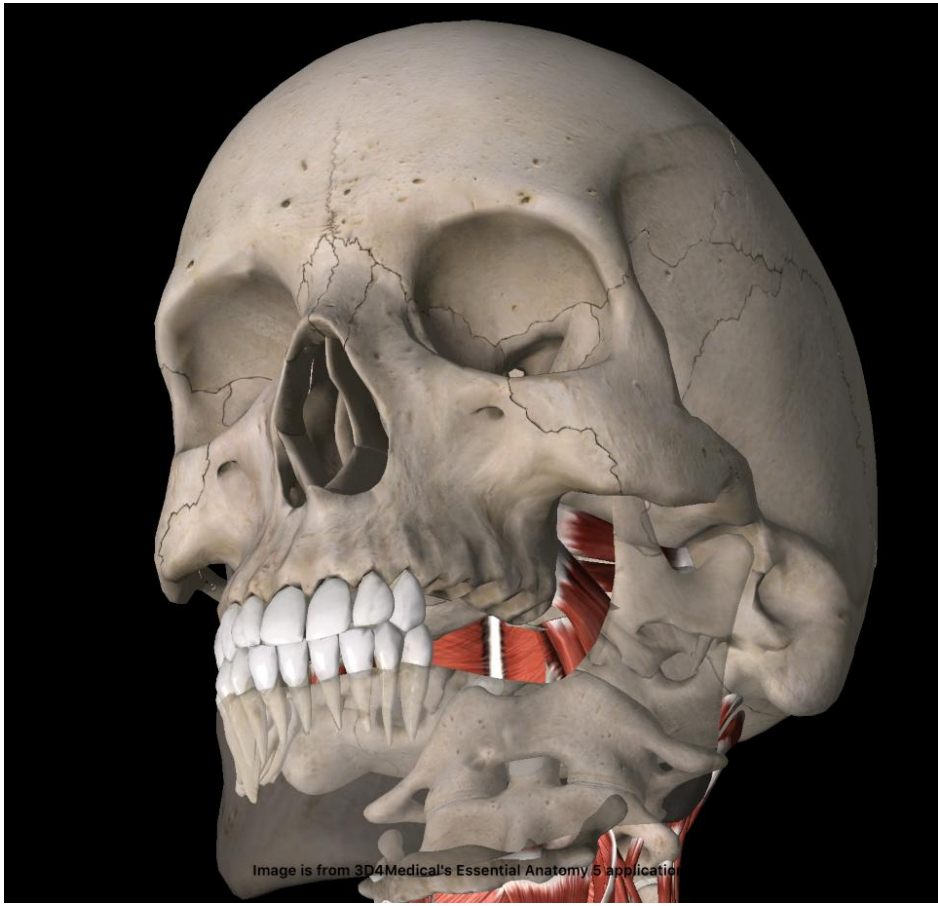


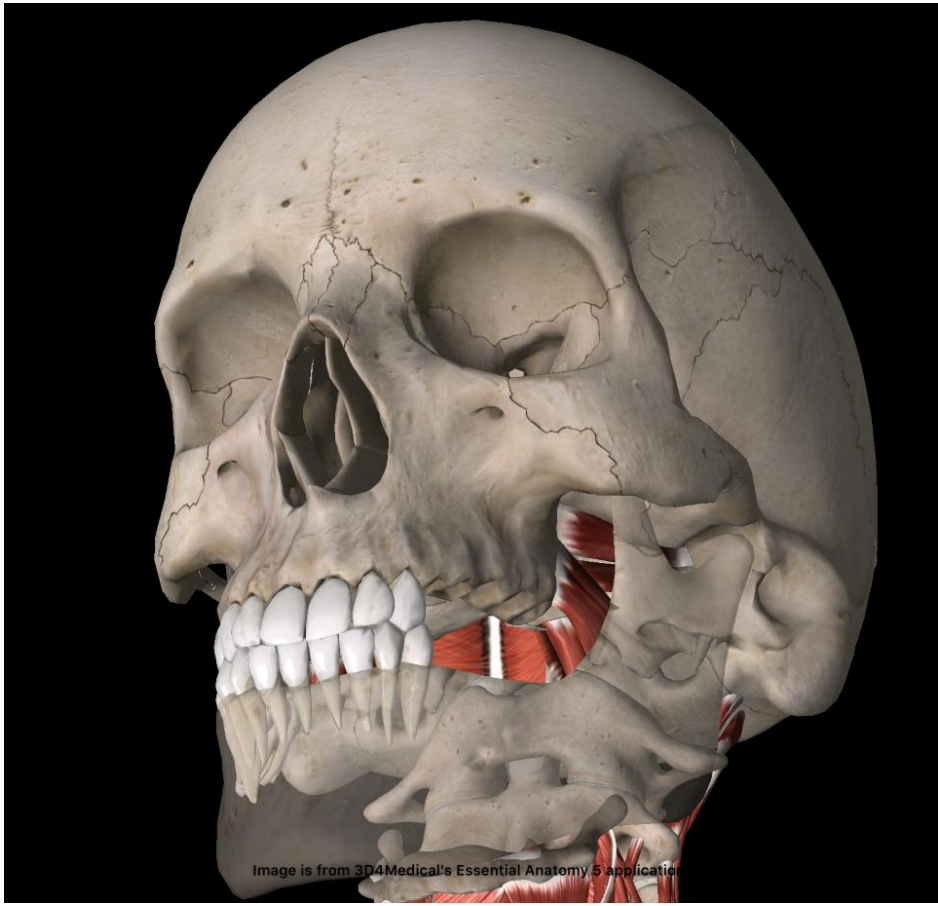
Stomatognathic / Occlusal Dysfunction

- The functional occlusal relationship plays a major role in the normal head on neck reflexes
- As does the mechanism of swallowing

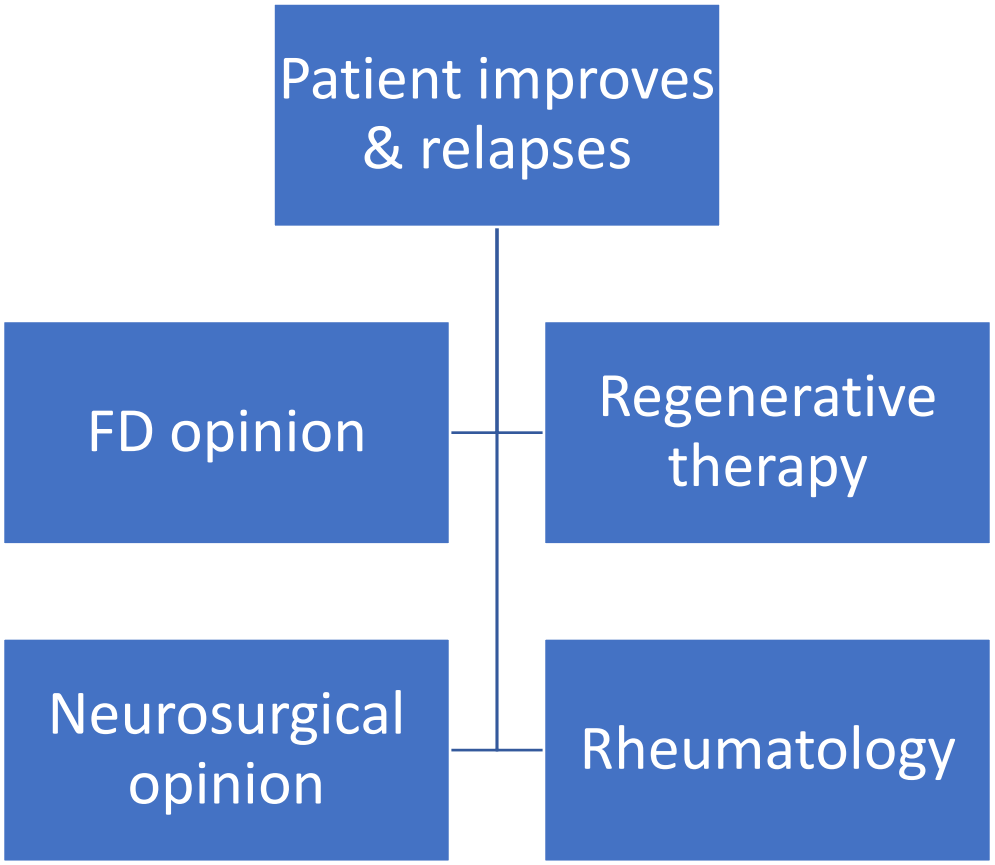


Stomatognathic / Occlusal Dysfunction

- Splint therapy i.e., Tanner Mandibular Appliance (TMA)
- Occlusal balancing
- Bite restoration
- Craniopathy
- Swallow reflex exercises

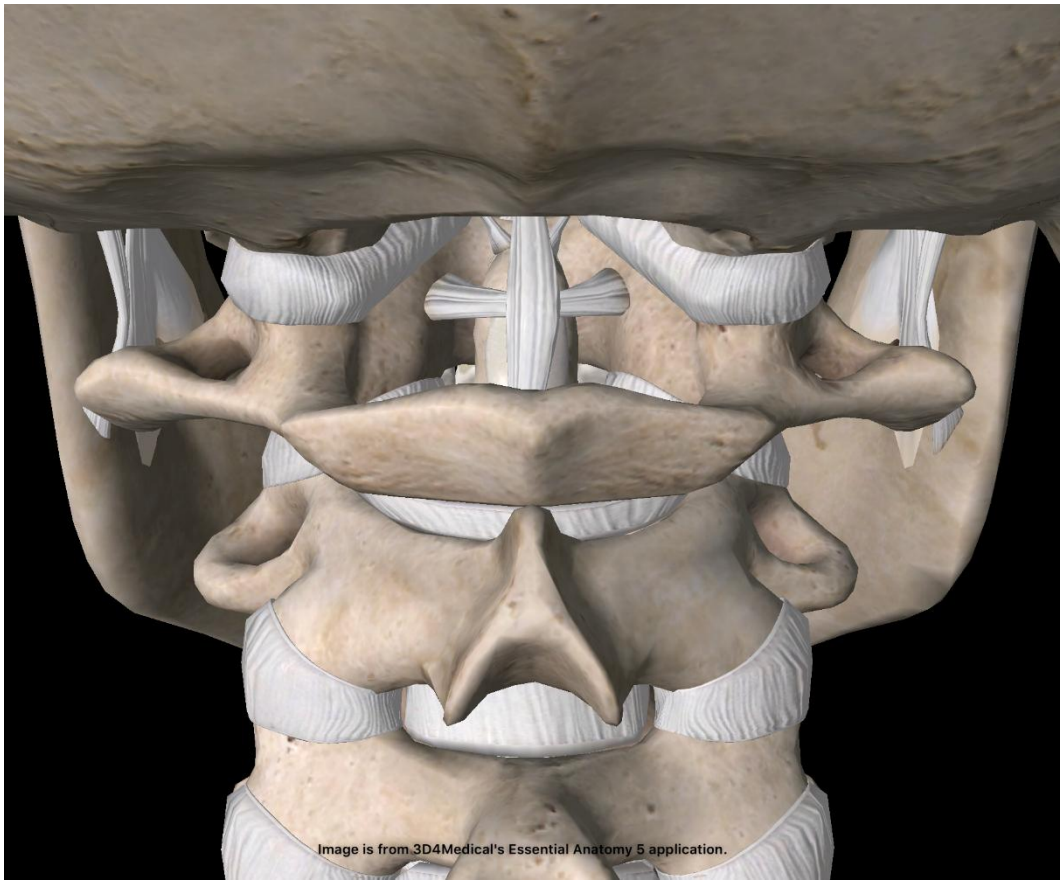


Cranio-Cervical Syndrome



Regenerative Therapy

- Platelet Rich Plasma (PRP) injections are initially administered to the posterior facets



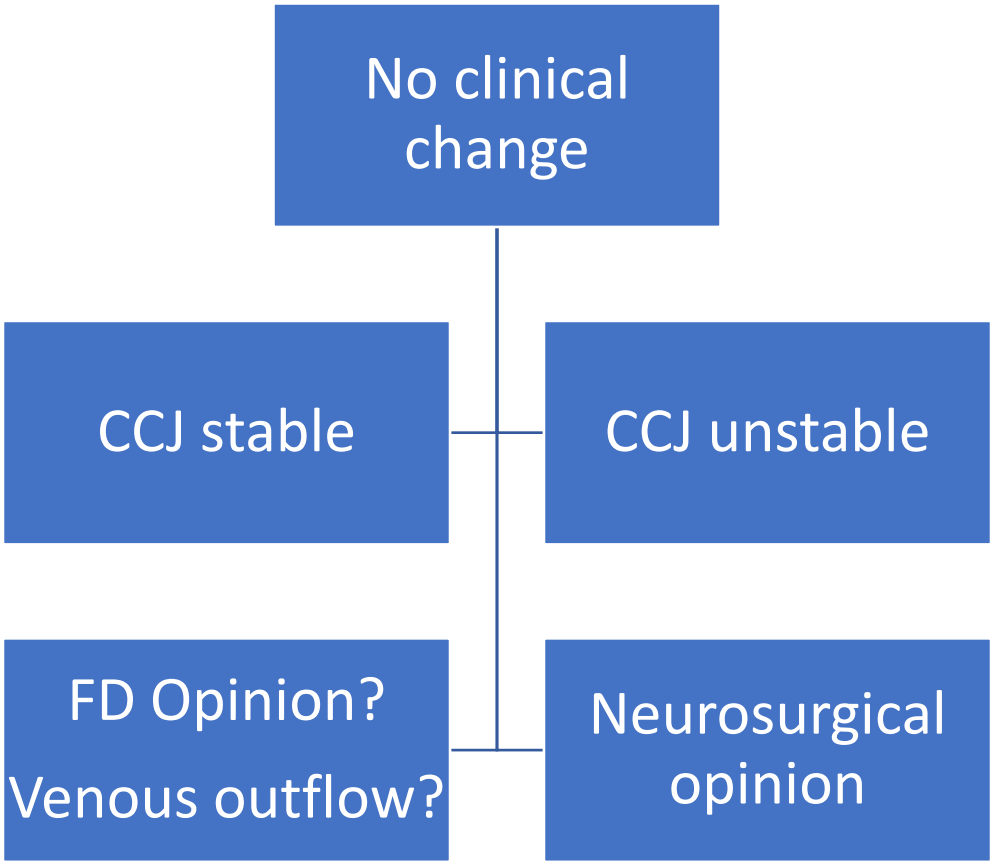
Regenerative Therapy

- Stem cell injections

to the CCJ ligaments (Alar and Transverse)

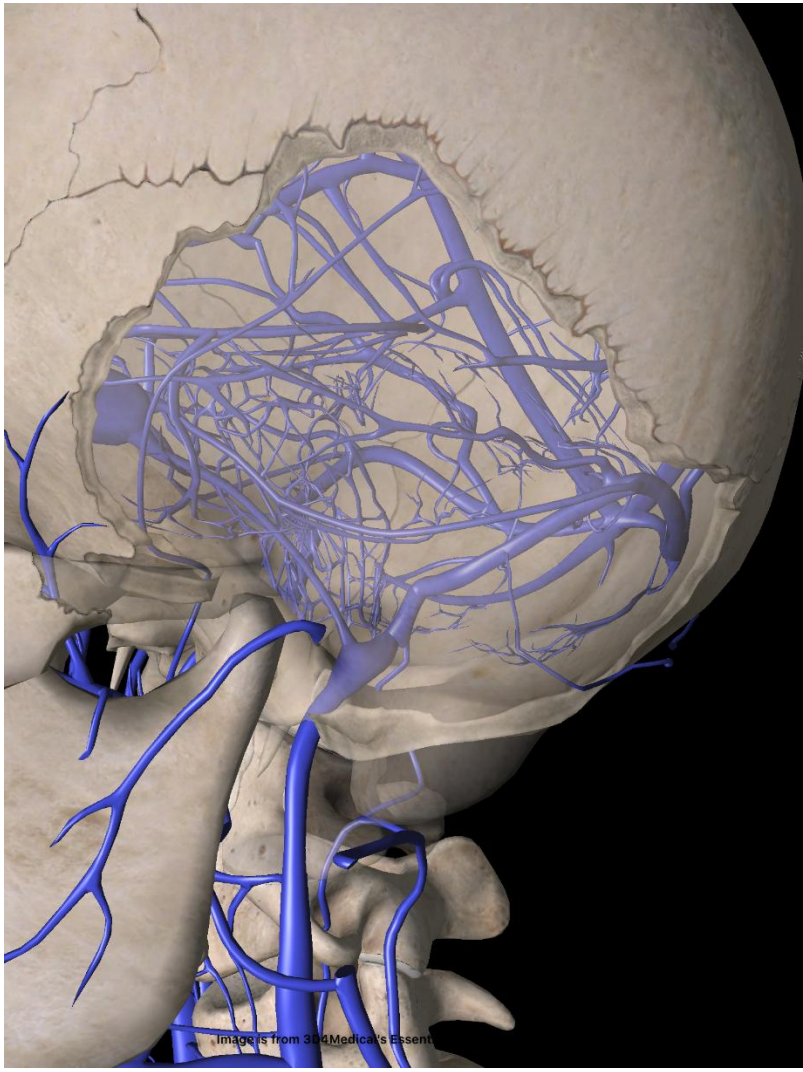
- PICL (**P**ercutaneous **I**mplantation **C**CJ **L**igaments)
- Under GA and VF guided

Cranio-Cervical Syndrome

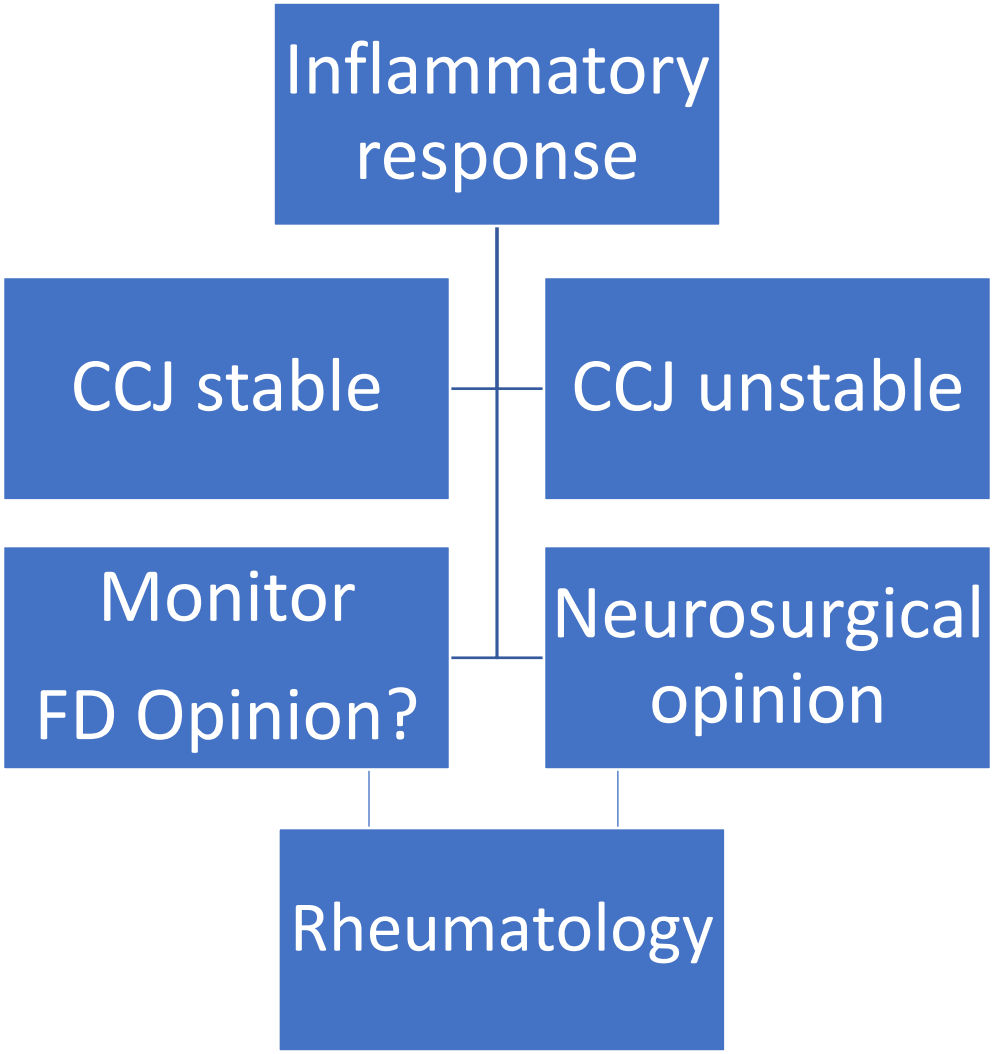


Venous Outflow Insufficiency

- Dural venous sinus stents
- Internal Jugular Vein (IJV) stents



Cranio-Cervical Syndrome



Spinal Fusion/Decompression Surgery

- Patient improved initially but fails to stabilise despite exhausting conservative options
- Patient has inflammatory response and shows no signs of stabilising or is deteriorating
- Presents with significant CJJ deformity/instability/progressive s/s of cervicomedullary syndrome
- C1-C2 ? ; C0-C2 ? ; C0-T1 ?

THE END