Back To Chiropractic CE Seminars

CERVICAL SPINE: X-RAY Case Presentations ~ 6 Hours

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This course counts toward your California Board of Chiropractic Examiners CE.
(also accepted in other states, check our website or with your Chiropractic State Board)

The California Board requires that you complete all of your CE hours BEFORE the end of your Birthday month. We recommend that you send your chiropractic license renewal form and fee in early to avoid any issues.

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I'm always a phone call away... 707.972.0047 or email: marcusstrutzdc@gmail.com

Marcus Strutz, DC
Back To Chiropractic CE Seminars

CERVICAL SPINE: X-RAY

Case Presentations

Jennifer Pedley, MS, DC, CCSP, DACBR

Chiropractic Radiologist

www.jprad.com

Outline

- Radiology positioning
- Evaluating your xrays
  - ABCs
- Case studies of the cervical spine
  - Topics of congenital anomalies, degenerative changes & trauma.

Cervical Spine Views

3 Views-

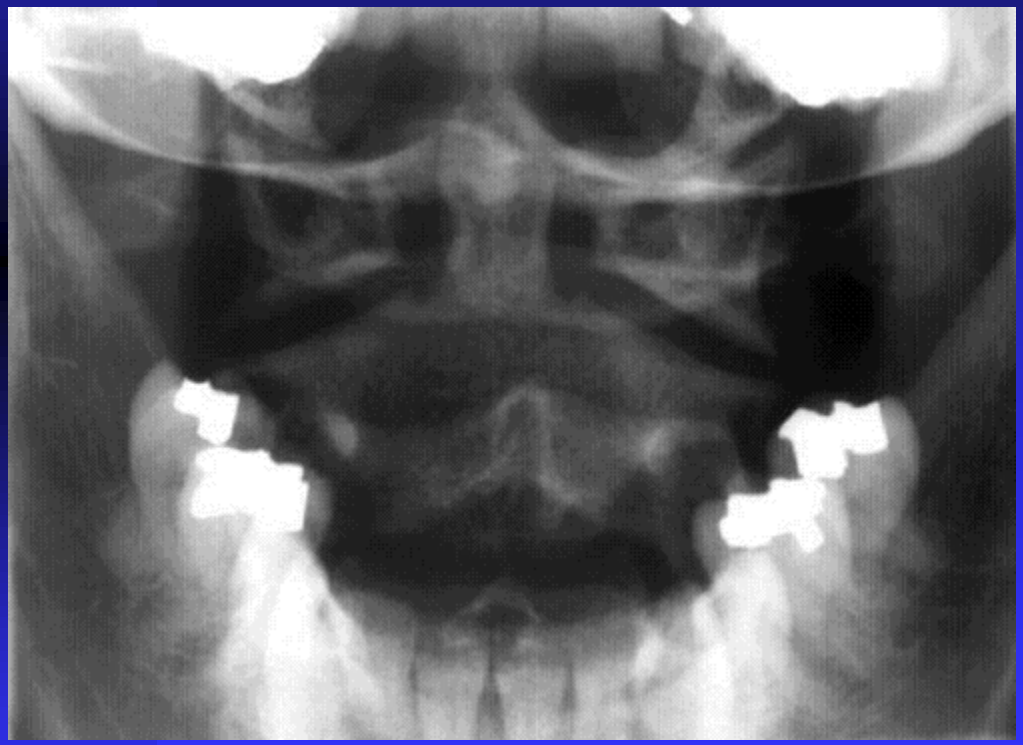
- APOM, AP lower cervical, and neutral lateral performed first; standard views

- Followed by extended and flexed lateral views>>> evaluate for ligamentous laxity and/or instability
  - Oblique views are helpful in evaluating the intervertebral foramina

APOM

- **FFD** 40”
- **CR** uvula; 5 degree cephalad tube tilt
- **Collimate** 5x5

AP OPEN MOUTH



Structures Visualized:

- Dens
- C1 lateral masses
- Occipital Condyles
- C2 body
- C2 SP

AP Lower Cervical

- **FFD** 40-3”
- **Tube Tilt** 15° cephalad
- **CR** C3/4 (thyroid cartilage)
- **Collimate** 7x10

Tube Tilt Rule

- For every 5 degrees of tube tilt, move xray tube one inch closer to the patient
- 15 degree tube tilt= move tube closer by 3 inches (40 inches to 37 inches)

AP LOWER CERVICAL

Structures Visualized

- **Vertebral Bodies**
- **TP's**
- **SP's**
- **Upper Ribs**
- **Upper Lung Fields**
- **Uncinate Processes**
- **Tracheal Air Shadow**

NEUTRAL LATERAL

- **FFD** 72”
- **CR** C3
- **Collimate** 7X10

LATERAL CERVICAL

Structures Visualized

- **Vertebral bodies C2-T1**
- **Disc Spaces**
- **ADI**
- **SP's, Lamina, Pedicles,**
- **Articular Pillars and Facets**
- **Tracheal Air Shadow**
- **George's Line & Spino-laminar line**
- **Sella Turcica**
- **C1 Arches**

LATERAL EXTENDED

- **FFD** 72”
- **CR** C3
- **Collimate** 8x10
- May need to be landscape in patients with greater range of motion

LATERAL FLEXED

- **FFD** 72”
- **CR** C3
- **Collimate** 8x10
- May need to be landscape in patients with great range of motion

Posterior vs. Anterior Obliques

Posterior

- Visualize the opposite IVF's
- Example: Left posterior oblique radiograph, visualizes the right IVF.

Anterior

- Visualize the same side IVF's
- Example: Right anterior oblique radiograph, visualizes the right IVF.

LEFT ANTERIOR OBLIQUE

- **FFD** **72”**
- **CR** **C3**
- **Tube tilt caudad**** **15 °**
- **Collimate** **7-8x10**

LEFT POSTERIOR OBLIQUE

- **FFD** 72-3”
- **CR** C3

- **Tube tilt** 15 ° cephalad***

- **Collimate** 7-8x10

CERVICAL OBLIQUE

Structures Visualized

- IVF's
- Vertebral Bodies
- C1 arches
- Ribs
- SP's
- Facets

Evaluation

- Cervical Gravity Line: Vertical line through apex of odontoid, should intersect C7

Evaluation

- Cervical Lordosis Angle: Normal 35-45 degree
  - This case, anterior shift in weightbearing

Yochum, T & Rowe, L. 2005.

Radiographic Signs of Instability

- Vertebral body displacement >3-3.5mm
- Greater than 11 degree angulation
- Widened interlaminar & interspinous space
- Widened facet joints
- Widened interpediculate distance (AP view)
- Atlanto-dental interspace>3mm adults; >5mm in children

These findings indicate skeletal, ligamentous and articular disruption.

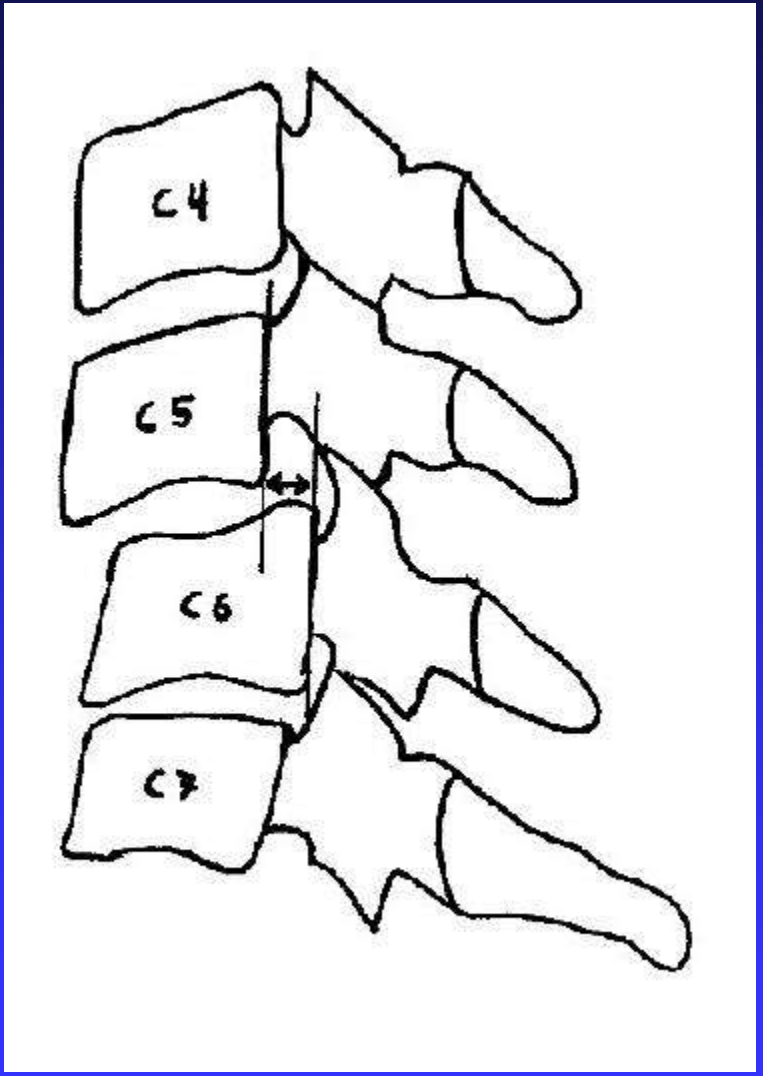
AMA Guides, 5th ed.; Resnick D. Diagnosis of Bone and Joint Disorders, 4th ed. 2002; 2936.

www.radiologyassistant.nl

Measuring Intersegmental Translation

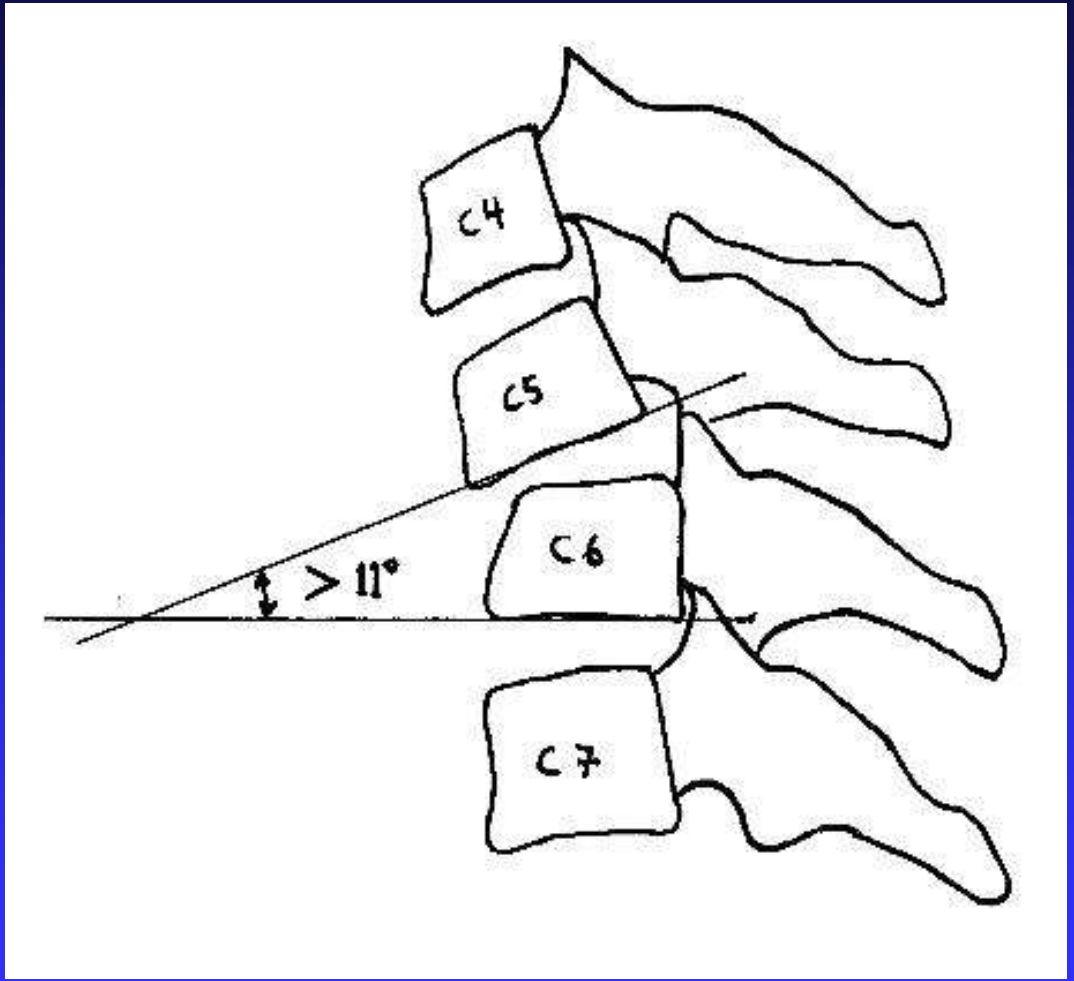
Greater than 3-3.5 mm of vertebral body displacement= ligamentous instability

Need to compare flexed and extended to the neutral lateral xray.



Measuring Angulation

- Lines drawn on the Inferior endplates.
- Greater 11 degrees



Radiographic Signs of Instability

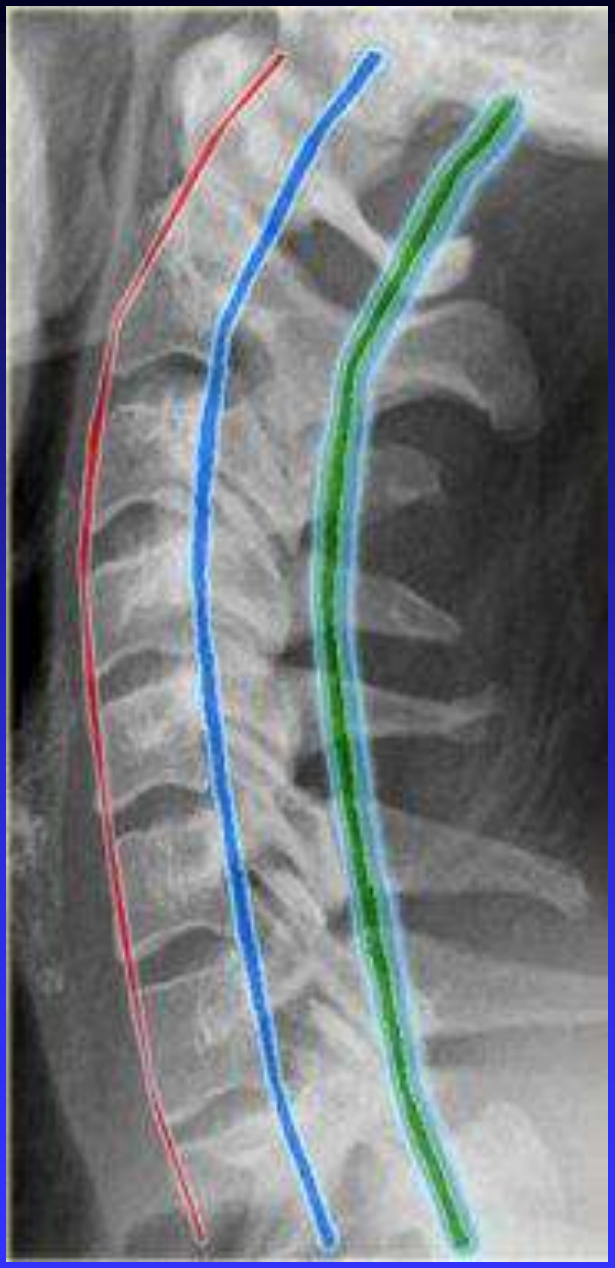
- Vertebral body displacement >3-3.5mm (ligamentous instability)
- Greater than 11 degree angulation (ligamentous laxity)
- Widened interlaminar & interspinous space
- Widened facet joints
- Widened interpediculate distance (AP view)
- Atlanto-dental interspace>3mm adults; >5mm in children

These findings indicate skeletal, ligamentous and articular disruption.

AMA Guides, 5th ed.; Resnick D. Diagnosis of Bone and Joint Disorders, 4th ed. 2002; 2936.

Lines of Interest

- Line should be drawn in a smooth arc. If not, then it requires further evaluation of the region
- Spinolaminar line (green)
- Posterior cervical line (blue)
- Anterior cervical line (anterior)



Other Evaluation Tips

- Spinous processes should be equidistant
  - If widening or increased distance, indicator of interspinous ligament injury/disruption.
- Facet joints- no gapping or perched facet joints.

More Evaluation

- ADI-atlantodental interspace
- V-shaped is normal
- Indicator of ligamentous instability (Transverse Ligament) with widening of the ADI on the Neutral lateral, or on the Flexed lateral, or on the Extended lateral.
  - Greater than 3mm in children & greater than 5mm in adults

Lateral cervical spine

- Evaluate the anterior and posterior soft tissues
- Prevertebral (anterior) soft tissues:
  - Retropharyngeal: >7.0-mm
  - Retrotracheal: >22.0-mm

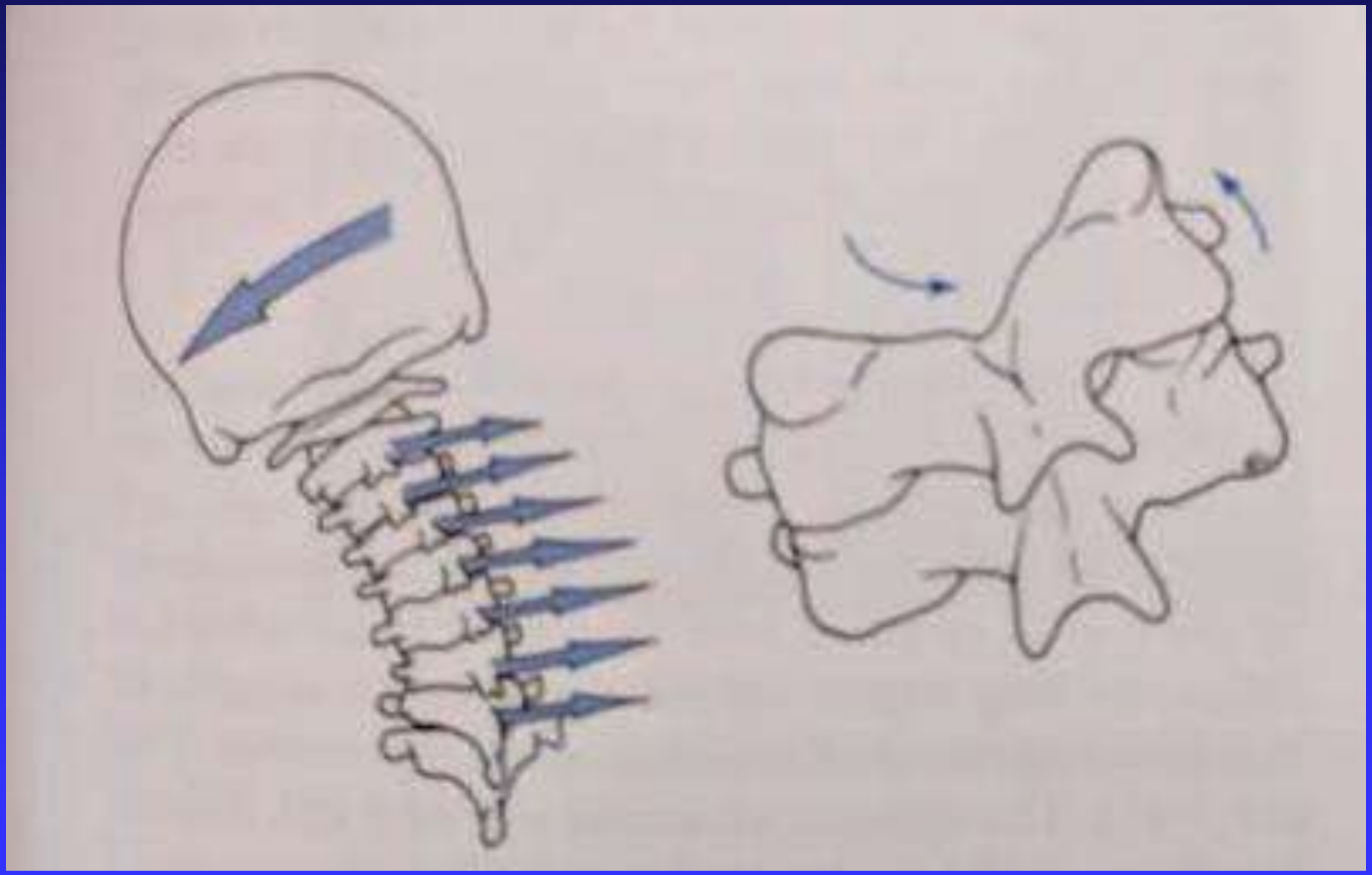
Prevertebral Soft Tissues

- Why do we need to look at them?
  - Widening of the soft tissue and/or increased density= Differential diagnosis is edema due to trauma, infection, or a mass/tumor.

Evaluation

- Normal coupling pattern with right and left lateral bending, ipsilateral rotation (spinous process deviates to the opposite side of lateral flexion).
  - Right lateral flexion= right vertebral body rotation, spinous process deviates to the left.
  - Left lateral flexion= left vertebral body rotation, spinous process deviates to the right.
    - Upper thoracic spine is same.

Normal Coupling



Case Study Approach

Case

www.mypacs.net

Diagnosis

- Straightening and reversal of the cervical lordosis- flexion malposition of C2
- Multilevel degenerative disc disease & facet arthrosis
- Congenital cleft of C1 with hypertrophic, sclerotic anterior tubercle

Congenital Cleft

Aka synostosis, spondyloschisis, SBO

- Posterior neural arch of C1 fuses by 3-4 yoa (anterior arch fuses by 7 yoa)

Secondary Findings:

- Hypoplastic posterior arch
- Hypertrophy of the anterior tubercle

- **Stable**

Case

- Neck pain following motor vehicle accident.

Findings/Diagnosis

- Hypolordosis of cervical spine with anterior shift in weightbearing
- Cervical spine tilts to the left.

- Congenital block vertebrae at C2-C3, C4-C5 & C6-C7.
  - Need xrays to evaluate for contraindication or indication for treatment.

Case

History: 38 year-old male with chronic neck pain.

What is your differential diagnosis & How are you going to manage this patient?

Donated by Dr. Christopher Watkins, DACBR

Findings

- Generalized osteopenia
- Multilevel facet arthrosis

- Multilevel degenerative disc disease with anterior intercalary bone at C5-C6 level
- Degenerative retrolisthesis at C3

Donated by Dr. Christopher Watkins, DACBR

Diagnosis

- Calcification of the annular fibers= Intercalary Bone
- Sign of degenerative disc disease versus inflammatory disease

Donated by Dr. Christopher Watkins, DACBR

Follow-Up

- More xrays! More history!
  - Lumbar and pelvic radiographs
    - Evaluate SI joints for erosive changes to indicate inflammatory process.
- Laboratory studies
  - HLA-B27

Chiropractic Treatment

- If inflammatory, need to assess the upper cervical spine for laxity

Case

50 year-old male; distance runner with chronic neck pain

Findings

- Thick ossification of the anterior longitudinal ligament
- Mild facet degeneration.
- Disc narrowing at C5-C6
- Hypolordosis with anterior shift in weightbearing.

Diffuse Idiopathic Skeletal Hyperostosis- DISH

- Common in thoracic and lumbar spine.
  - Right sided in the thoracic spine.

- **Associated with diabetes mellitus**
- Complications- cervical spine
  - Dysphagia

Diffuse Idiopathic Skeletal Hyperostosis- DISH

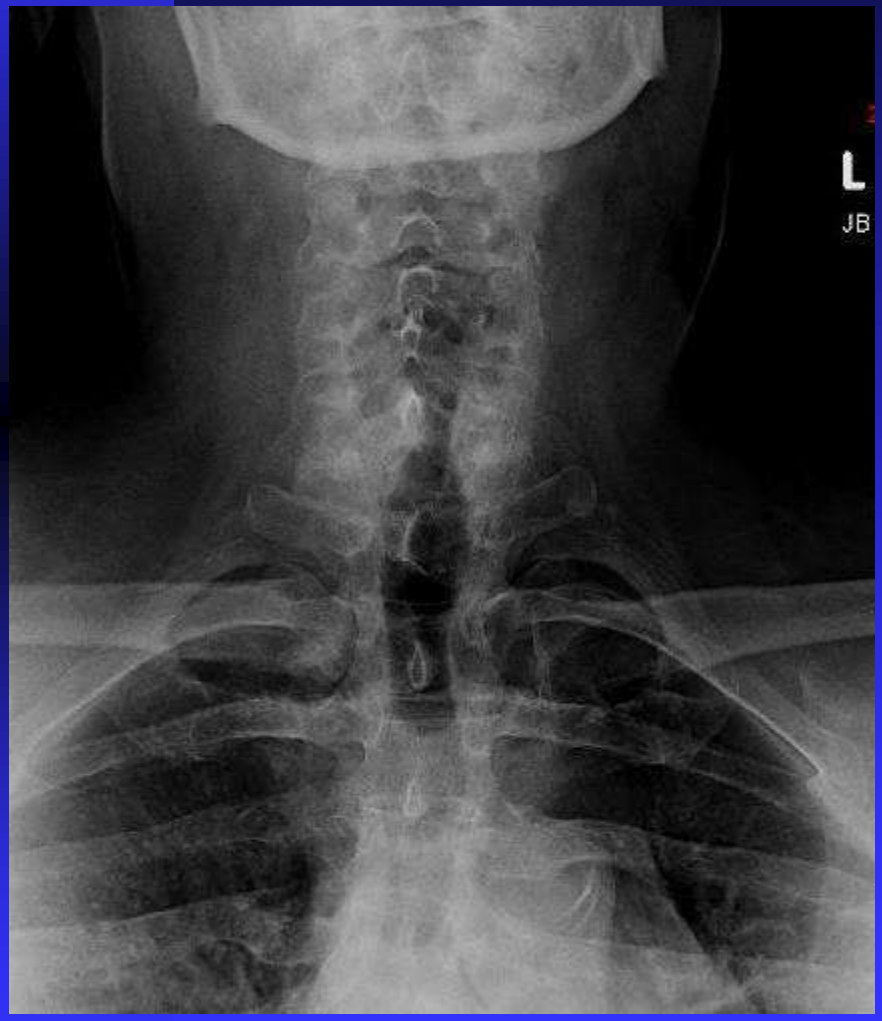
- Complication- dysphagia
- Common in thoracic and lumbar spine.
  - Right sided in the thoracic spine.

- OPLL- ossification of the posterior longitudinal ligament is possible
  - Can result in spinal canal stenosis

Case

- Chronic pain

Misdiagnosed as DISH—what is it?



Findings/Diagnosis

- Severe osteopenia
- Anterior shift in weightbearing
  - Cervical & upper thoracic tilt to the left

- Facet fusion
- Anterior spinal fusion, thin ossification of the annulus fibrosus.

AP open mouth

- Fusion at the C1 lateral masses to C2.
- Occiput low on right; rotation of C2.

2 years ago-Lumbar Spine Xrays

L5-transitional

Findings

- Transitional segment at L5 (Sacralization)

- Degenerative changes of lumbar spine
- Bilateral hip arthrosis
- Atherosclerosis of abdominal aorta

Findings

- Fusion of bilateral sacroiliac joints>>>>Ankylosing Spondylitis

Ankylosing Spondylitis: Follow-up

- Rheumatologist & Laboratory studies
  - HLA-B27

Case

History: pain, stiff neck, muscle spasms; trauma with hyperextension

Findings

Radiopacity subjacent to the anterior tubercle of C1

There is extension of the upper cervical spine; there is no fusion or occipitalization. Mastoid air cells overlies C1.

Hydroxyappatite Deposition Disease of the anterior longus colli tendon

Aka calcific tendinitis

- Occurs due to trauma
- **Self limiting 1-2 weeks; it will reabsorb and go away.**

Sagittal Reformatted CT and Sagittal T2 weighted MR images

Calcific Tendinitis of Cervical Spine

- The calcific matrix will absorb and disappear. It is made of a toothpaste consistency.

- No need for CT or MRI
  - CT: shows bony detail
  - MRI: shows what's inside the bone and soft tissue pathology

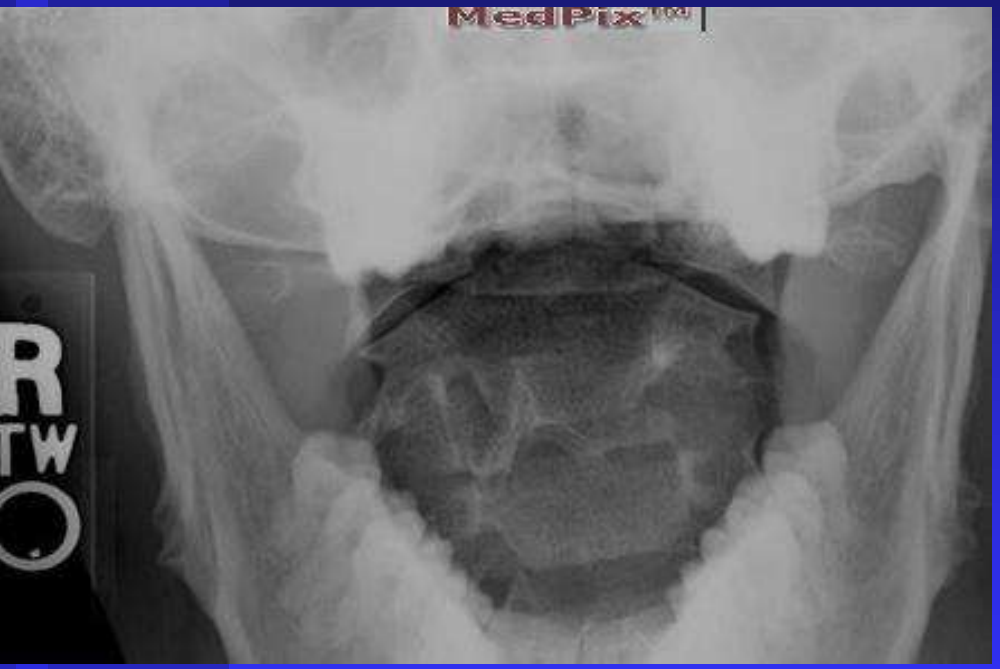
Case

Hx: suboccipital pain, headaches, and neck stiffness.


MedPix™

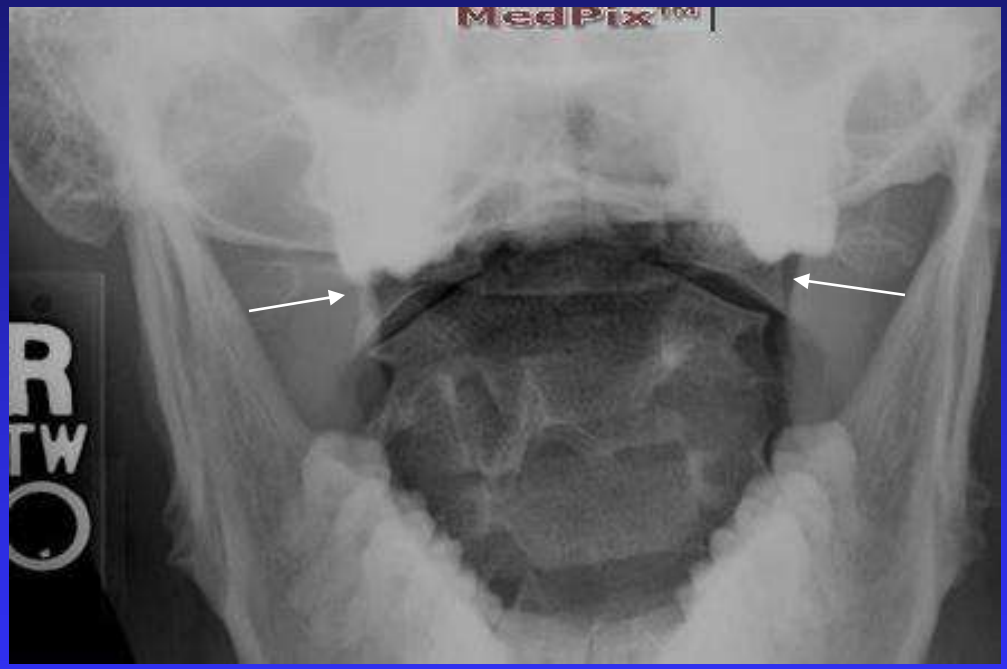
- **Posterior arch fracture** at C1
- **Type 2 odontoid fracture**
- Moderate prevertebral soft tissue swelling, overlying the dens
- Associated with rupture of the transverse ligament

APOM & Lateral Flexed Views



AP open mouth

Lateral masses of C1 bypass the lateral margins of C2= Burst fracture of C1



Jefferson Burst Fracture of C1

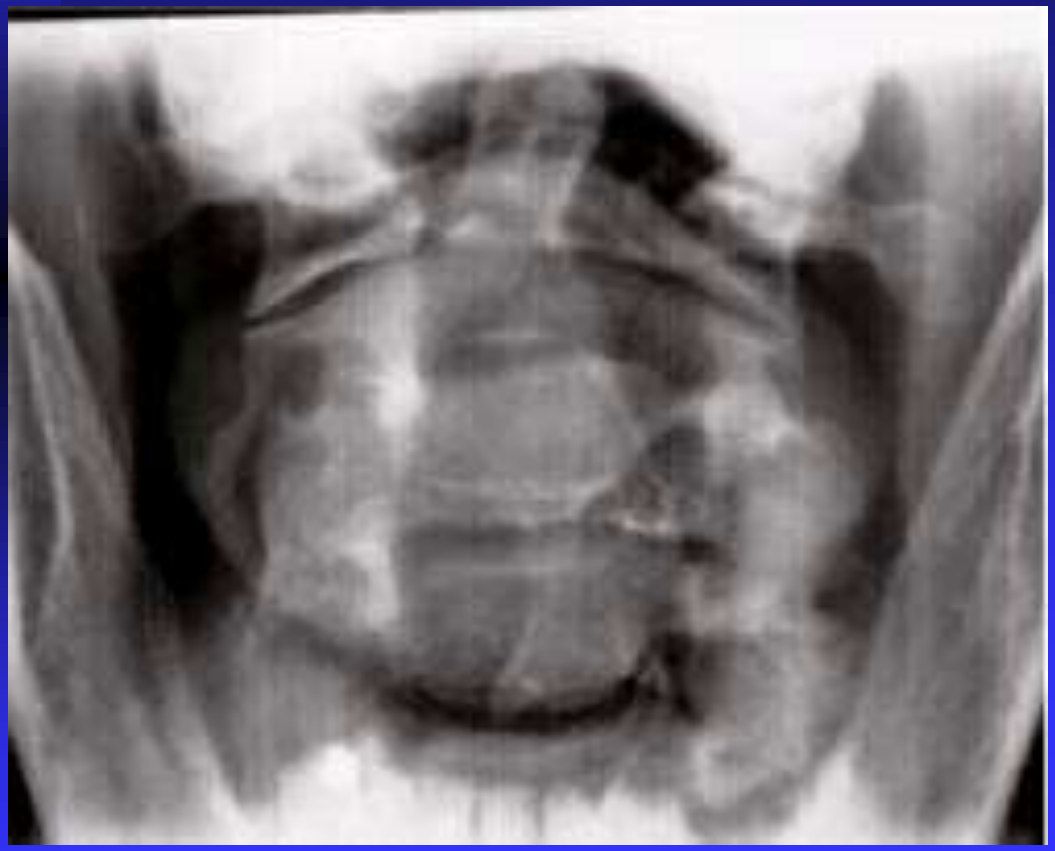
- 2 or more breaks of the ring of the atlas
  - Most common to fracture adjacent to the lateral masses; bilateral>unilateral and the fracture is anterior and posterior to the lateral masses.
- Mechanism of Injury: Compressive injury

Case

I know this is not the best xray…ignore everything below C4. Patient had trauma.

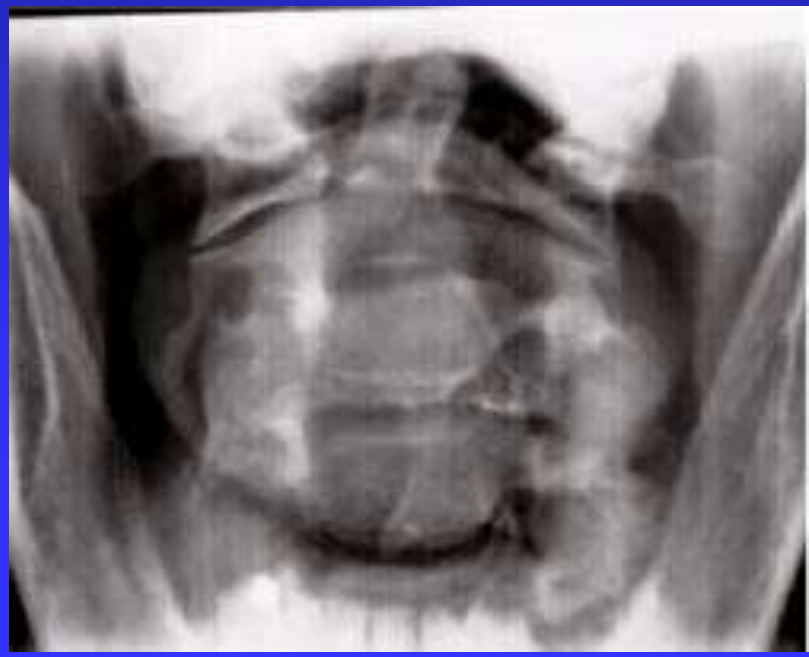
Where is the fracture?

APOM & Lateral Neutral Views



Findings

- Straightening of the cervical lordosis
- Generalized osteopenia
- Degenerative disc disease & Facet arthrosis
- Fracture and Angulation of the dens
- Soft tissue swelling of upper cervical>>>This is NOT a gigantic earlobe☺



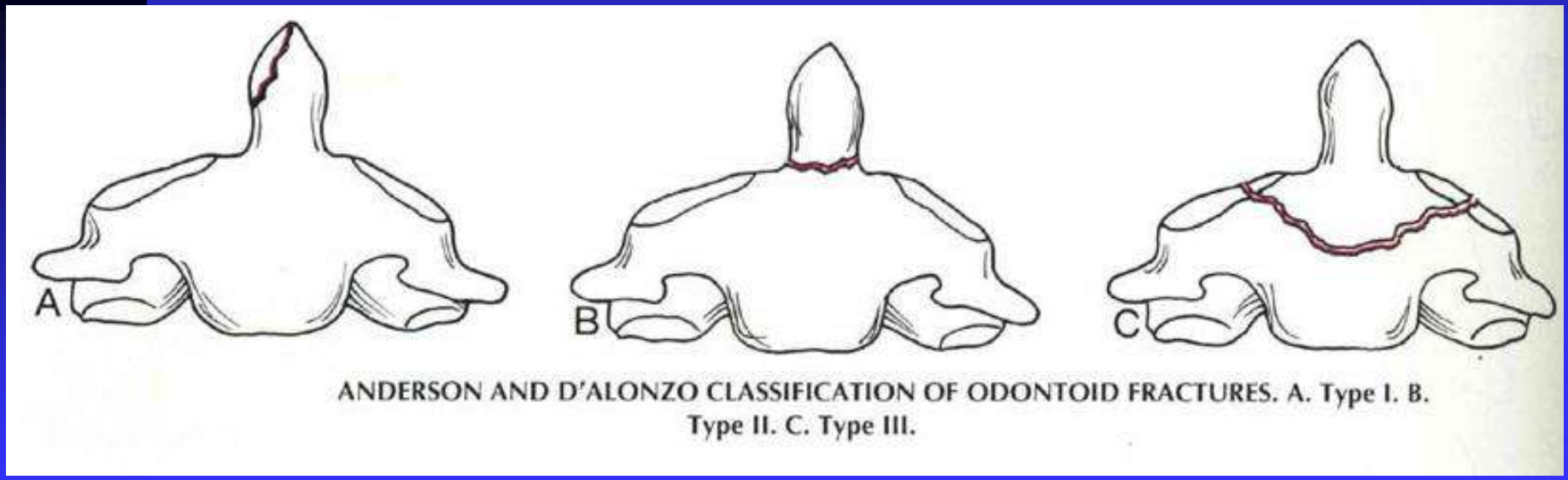
Findings

- Soft tissue edema
- Widened Atlantodental interspace

Odontoid Fracture: Type 2

- Type 2: fracture at the junction of the **base** of the dens and body of the axis
- **Lateral tilt of the dens**
- Most common fracture of C2 & Complication is **non-union**
- **Note: Lateral masses are intact and do NOT bypass the C2 body**

- Type 1- Avulsion; majority are stable
- Type 2- Nonunion complication
- Type 3- Vertical fracture through the body of C2; heals rapidly.

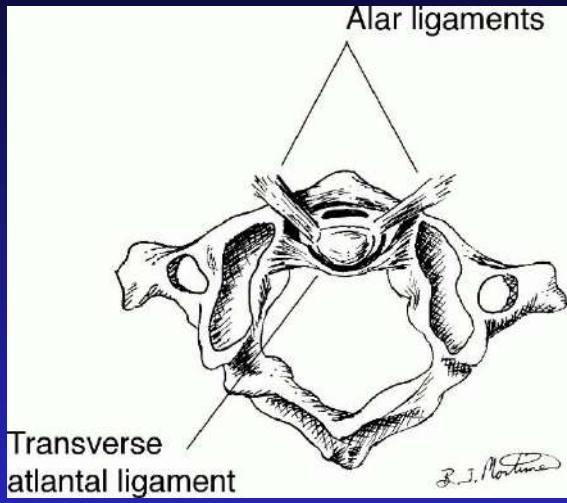


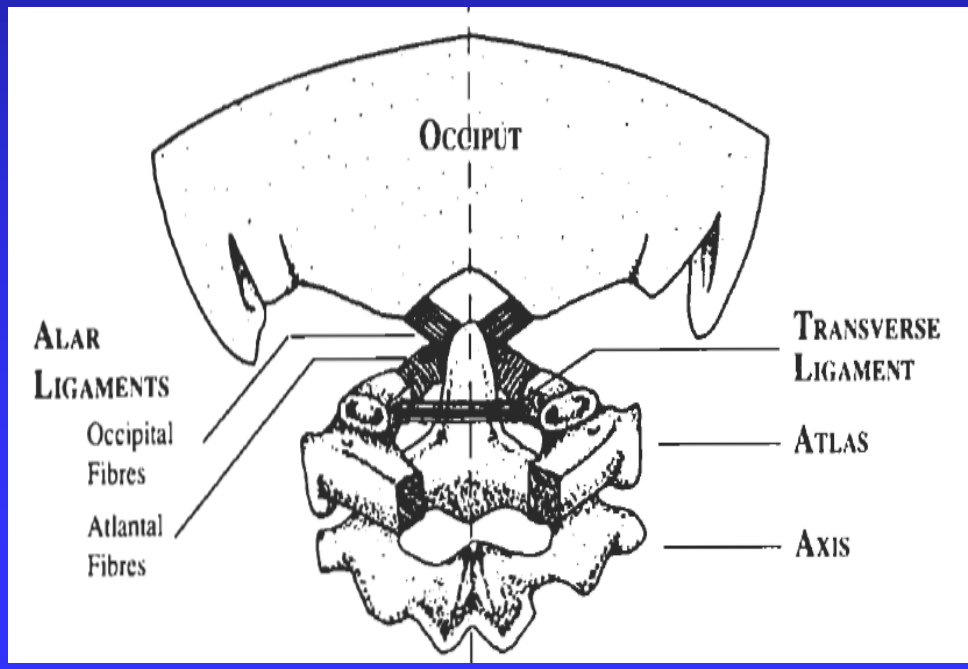
ANDERSON AND D'ALONZO CLASSIFICATION OF ODONTOID FRACTURES. A. Type I. B. Type II. C. Type III.

Yochum T and Rowe L. Essentials of Skeletal Radiology, 2nd ed.; 1996.

Type 1 Odontoid Avulsion Fracture

- Type 1= oblique fracture/avulsion of the odontoid by the alar ligament
- Associated with rotation and whiplash forces
- Alar ligament limits rotation and lateral flexion, ***contralateral*** side of the craniovertebral complex.





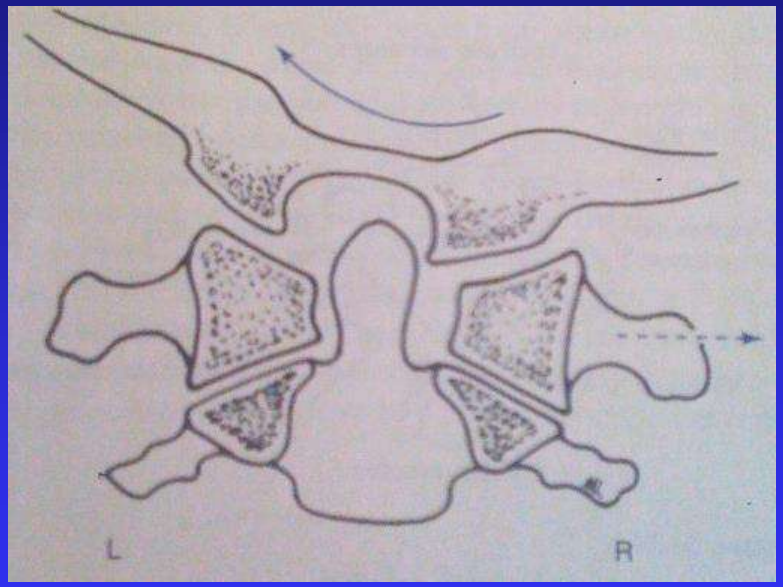
JOSPT, July 1992; Vol 1, No 16

Radiographic Evaluation of the Alar Ligament

- Alar ligament attachment sites are the occipital condyle and superior-lateral aspect of the dens.
- APOM view
  - Majority are normal
- **Evaluate Alar ligaments** by AP open mouth with right and left lateral flexion/bending
  - Right lateral flexed position= evaluates the left alar ligament
  - Example: In right lateral flexion, C1 displaces laterally away from dens on the right pass the C2 vertebral body margins= **left alar ligament disruption**.

Making Sense of It

- Normal motion: right lateral flexion of CO-C1 & C1-C2, approximate right condyle to dens and increased ADI on the right
  - Opposite slide & roll due to convex condyles and concave lateral masses of C1.
- Disrupted alar ligament on the left would allow more rolling of the condyle to the left and more right lateral sliding of C1 pass the C2 margins.
- Intact alar ligament would rotate the C2, deviating the spinous process away from lateral flexed side.

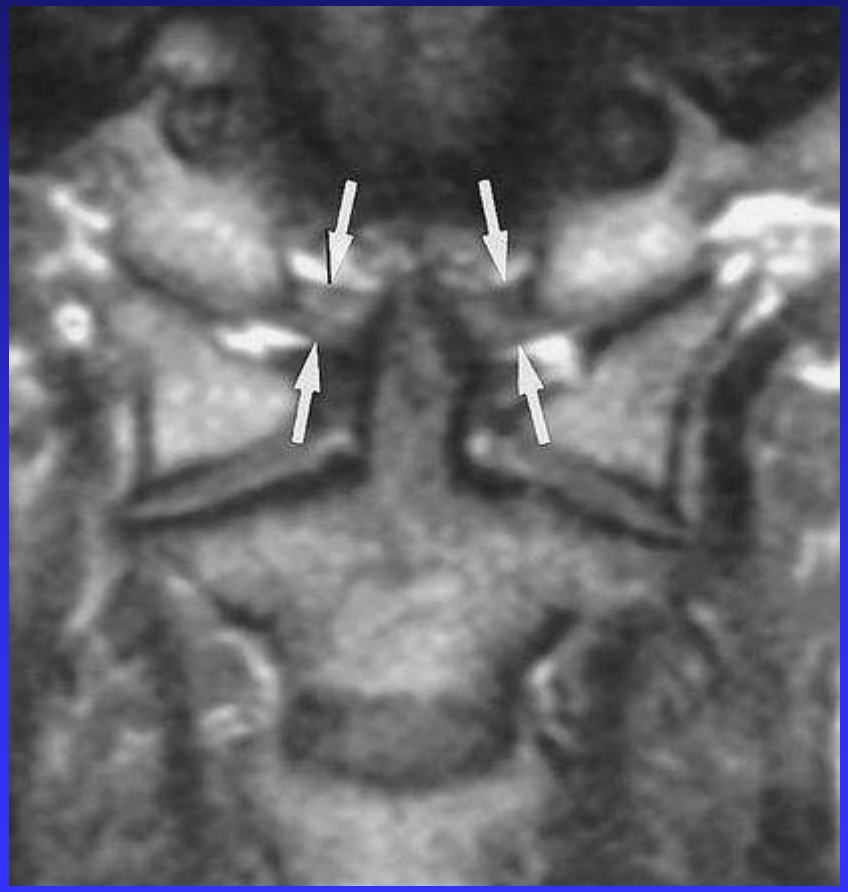


Bergmann & Peterson, Chiropractic Technique,2nd Ed; 2002

Alar Ligament Rupture

- Atlanto-occipital instability
- MRI: evaluate the upper cervical spine ligaments (separate protocol from the cervical spine MRI by the imaging center)

Normal Alar Ligaments on Coronal T1 weighted MR image



Protocol:

Coronal, axial and sagittal images; 2.0-mm slice thickness

Alar ligament attachment sites are the occipital condyle and superior-lateral aspect of the dens.

Pfirrmann, et al. Radiology. Jan 2001; 218 (1). 133-137

Case #6 36 yom neck pain

Rodallec M H et al. Radiographics 2008;28:1019-1041

Findings

- C6: Compression fracture, with osteolytic lesion within the vertebral body, lamina, and indistinct margins of the spinous process.

- What is the next imaging
  - MRI

Differential diagnosis

- Mets or
- Primary bone tumor

- Dx: After MR and bone scan, etc…..renal cell carcinoma with metastases to the spine.

Case

Whiplash: Hyperflexion and hyperextension mechanism of injury

www.medpix.com

Findings

- Straightening of the cervical spine
- Posterior ponticle
- Fracture or avulsion of the C7 spinous process; and avulsion at the anterior, inferior corner of C2.

www.medpix.com

Clay Shoveler's Fracture & Teardrop Fracture

Clay Shoveler's at C7

- Avulsion of trapezius and rhomboid tendon on the spinous process
- Cause: abrupt flexion or direct trauma.
- **Fragment typically displaces caudally**; **stable**

www.medpix.com

Clay Shoveler's Fracture & Teardrop Fracture

Teardrop Fracture at C2

- Avulsion of annulus fibrosus
- Cause: Hyperextension of upper cervical spine
- **Fragment is stable; Tear of the disc at C2-C3**

www.medpix.com

Follow-up

- CT imaging for evaluating for more fractures; evaluate the visible fractures seen on the xrays.
- Eventually, MRI to evaluate the disc and soft tissues.

Clay Shoveler's Fracture at C7 Sagittal Reformatted CT Image

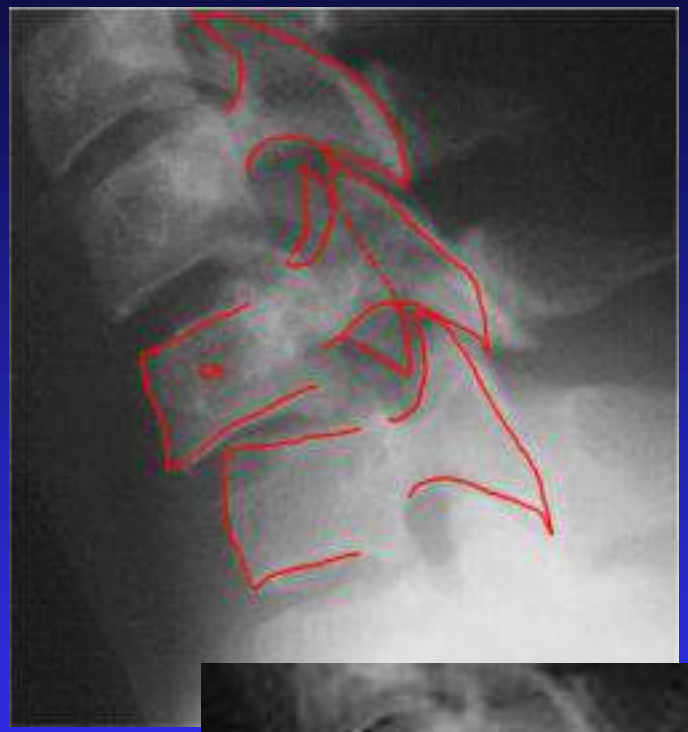
Case

Findings

- Anterior head carriage
- Anterior translation and flexion angulation of the C6 body
- **Widened Interspinous Distance, C6 to C7= injury or disruption of the Interspinous Ligament.**
- Facet dislocation at C6-C7.

Unilateral Facet Dislocation

- Mechanism of Injury: Flexion & Rotation
- Anterior displacement of body
- Bow tie sign with dislocated articular mass/pillars



Unilateral Facet Dislocation

- Rupture of interspinous ligament and capsule
- Mild injury to posterior longitudinal ligament and anulus fibrosus
- Bilateral oblique views to identify the dislocated facet joint

Treatment for Facet Dislocation

- Surgical reduction and spinal fusion

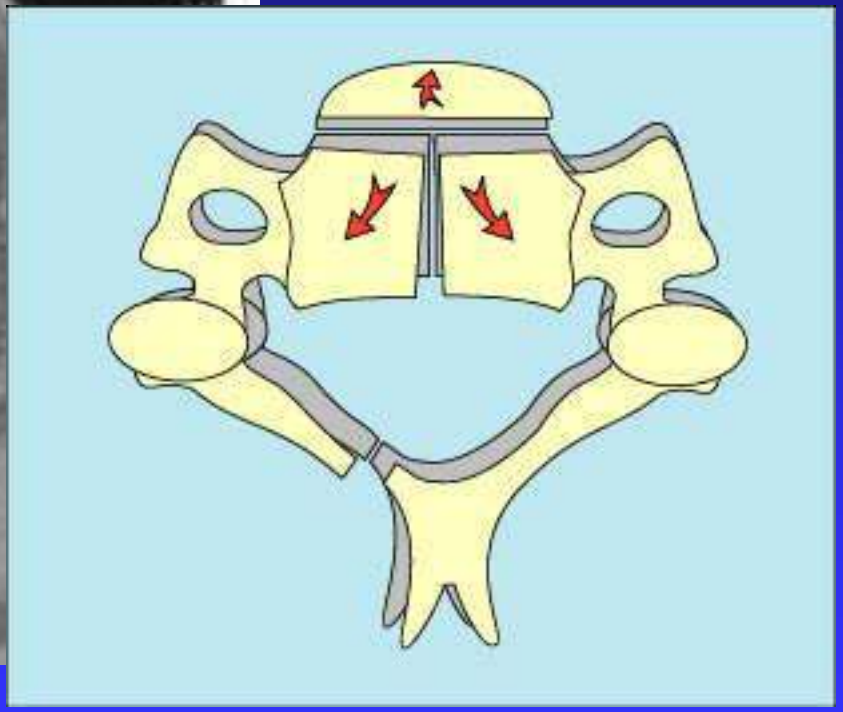
Case

Findings

- Angulation of the cervical spine
- Vertical fracture & compression fracture of C5 body
- Mild perched C5 facet joint
- Degenerative changes

Burst Fracture

- Widening of interpediculate distance (AP view)
- **Posterior displacement of the fracture fragment**
  - **Compromise of the spinal canal**



Case: Trauma

Findings and Diagnosis

- Anterior head carriage & Postural alterations
- Uncovertebral arthrosis; Facet arthrosis
- Widened interspinous distance
- Teardrop fracture of anterior margin of the C6
- Compression fracture of superior endplate of C5

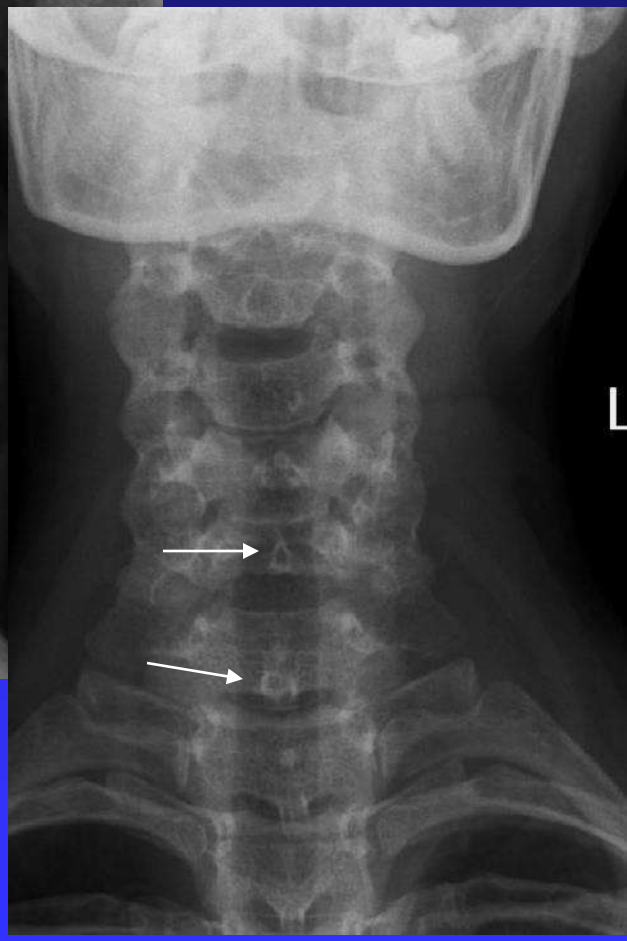
Teardrop Fracture at C6

- Mechanism of Injury: Hyperflexion plus compressive force

Hyperflexion Teardrop Fracture

- Triangular fracture fragment along the anteroinferior margin of C6; compression fracture at C5.

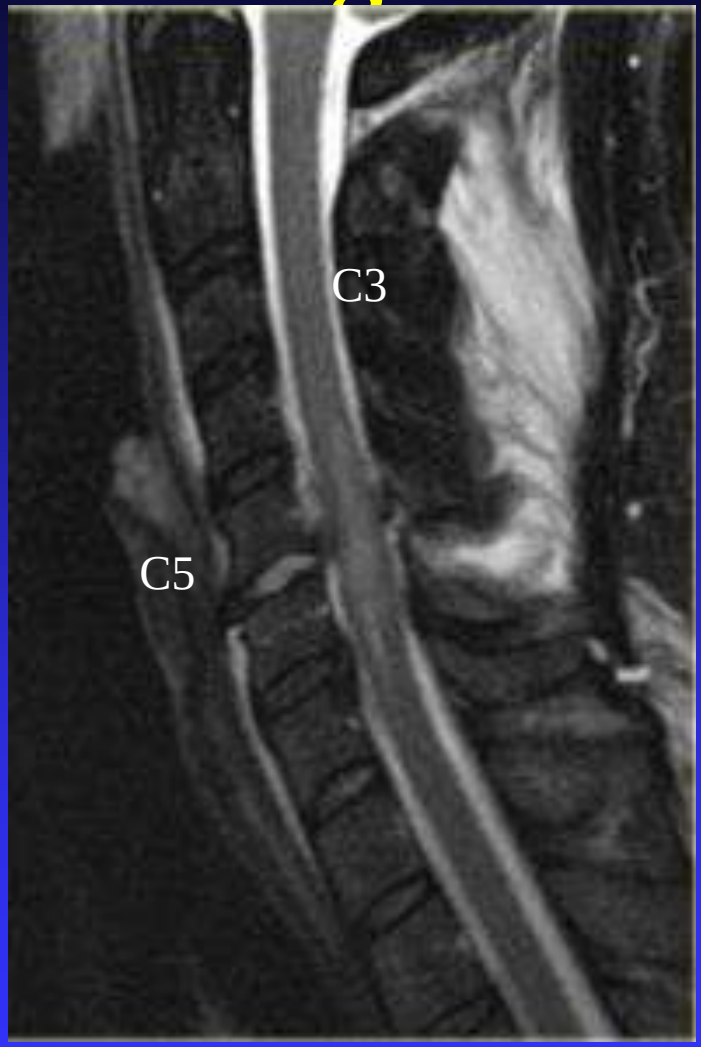
- **Rupture** of the interspinous ligaments
  - Widened interlaminar and interspinous



Sagittal T2 Weighted Images

(Different Case of Hyperflexion Injury)

- C5-C6 level
  - Disruption of disc with increased signal within the disc (too bright)
- Increased signal within the posterior soft tissues and spinal cord due to edema and interspinous ligament disruption



www.radiologyassistant.nl

Case- Trauma

Findings

- Pedicle fracture of C2
- Facet dislocation & body displacement of C2
- Disruption of spinolaminar line, C1 & C2
- Osteopenia
- Degenerative disc disease & Facet arthrosis

ANOTHER PATIENT-
Skateboarder hit by a car;
Diagnosis missed at Urgent Care.

Findings

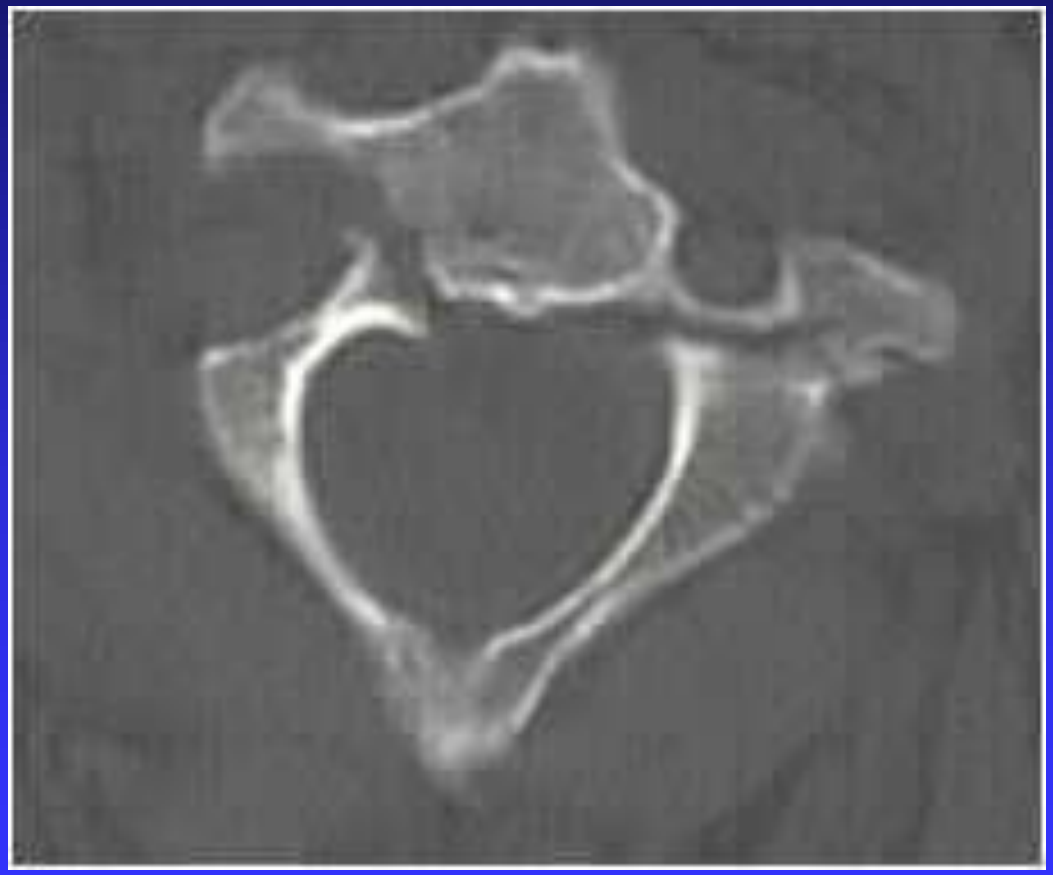
- C2 appears to be in extension with the anterior, inferior portion of C2 consisting of anterolisthesis

Hangman's Fracture

- Also known as Traumatic Spondylolisthesis of C2.
- Hyperextension and compression Injury

Donated by Dr. Christopher Watkins, DACBR

Axial CT of Hangman's Fracture



Donated by Dr. Christopher Watkins, DACBR

Case

Patient had trauma, whiplash mechanism of injury. The neutral lateral view appears normal.

Findings

- Straightening of the cervical lordosis
- Mild facet arthrosis of C4-C5 and C5-C6
- Mild degenerative disc disease
- Mild soft tissue swelling
- **What other views are necessary due to history and clinical findings?**

www.maitrise-orthop.com

Flexed Lateral View

Facet joint at C5-C6 dislocates with flexion.

Follow-up

Treatment

- Surgical reduction and fusion is required to eliminate re-dislocation and injurying the spinal cord.

Case

Patient was experiencing fullness and tension at the base of the skull

Findings

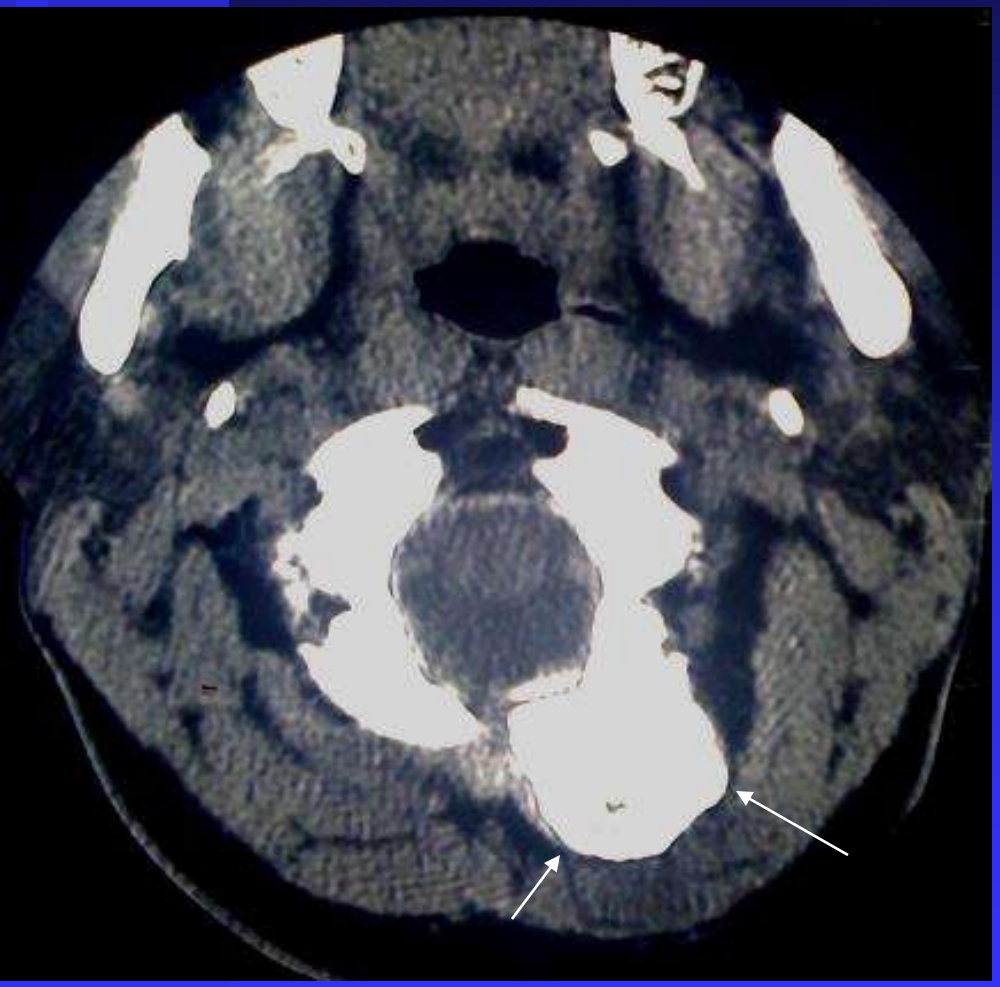
- Osseous mass either from C1 or occiput
- Differential: Osteoblastoma, or possibly bone cyst

- Degenerative disc disease at C3-C4, C4-C5 and C5-C6
- Postural alterations.

Osteoblastoma

- Base of the left occiput
- Most common benign, posterior tumor of the spine.
- Referral: Neurosurgeon for resection

CT & MR of Osteoblastoma



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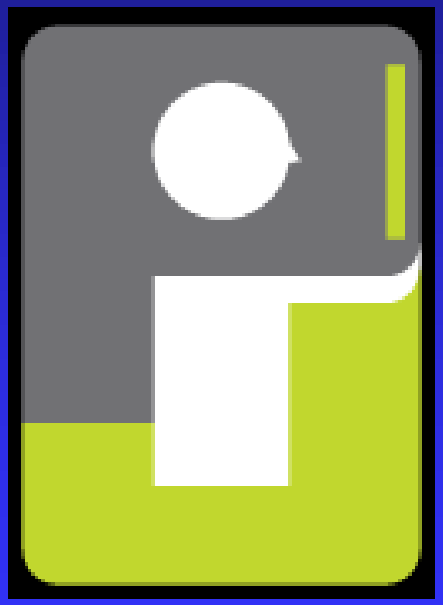
The End



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