Cervical Spine Trauma

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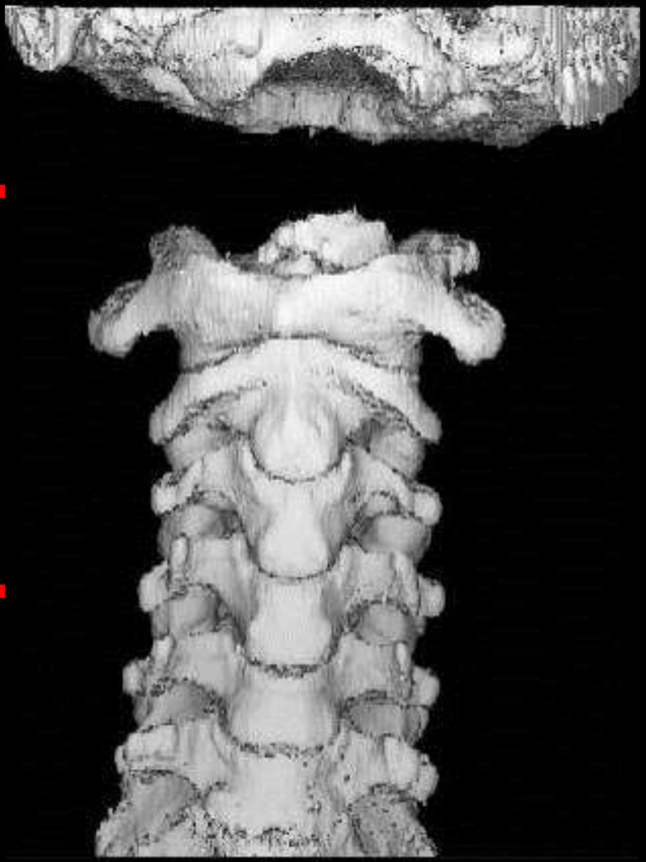


Trauma Cx Spine Protocols

- Issues
  - The clinically negative Cx-spine
  - Does everyone need a CT
  - Flex/Ext
    - Acute Flex/Ext in alert patients with a painful neck, negative x-rays
    - Supine
    - Fluoro Flex/Ext in obtunded patients
  - What is Instability

Who to Image

- CCR and Nexus
  - CCR more sensitive and specific
  - CCR criteria more complicated

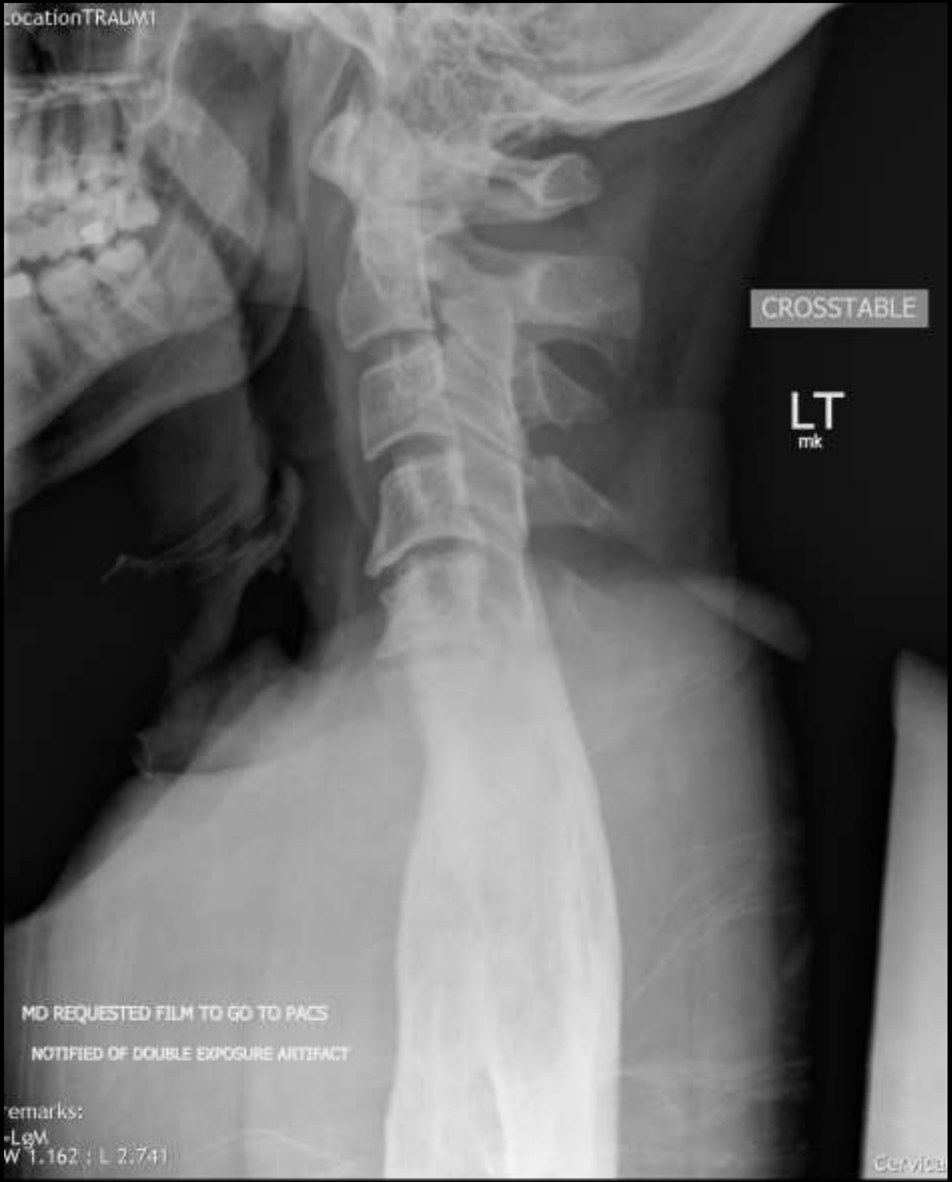
Canadian C spine rule - CCR

National Emergency X-Radiographic Utilization Study - NEXUS

How to Image

- Alert, but tender
  - 3 view Cx spine
    - +/- Swimmers, Fuchs, Trauma obliques
- 39% of Cx spine injuries not seen on plain films - NEXUS
- Head injury – having head CT
  - CT Cx
    - 1.25mm cuts (or less) base of skull to T1
    - Minimal reconstructions prior to reformats
    - Bone and ST algorithms
    - Reformats in sagittal and coronal planes

Technique

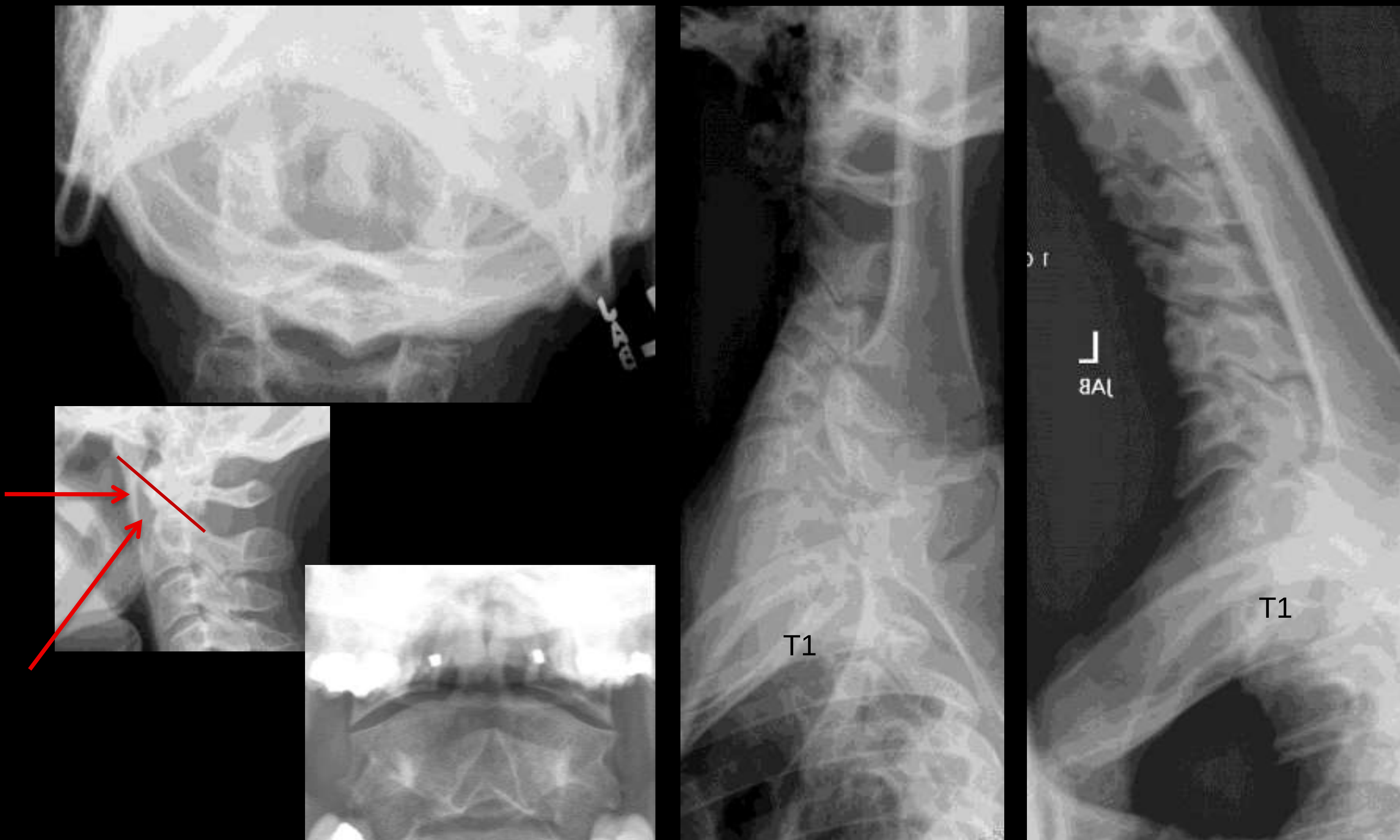


Double exposure Cx spine

Technique - Routine

36M Normal Cx Spine

Technique - Routine



36M Normal Cx Spine, Fuch's and Swimmers

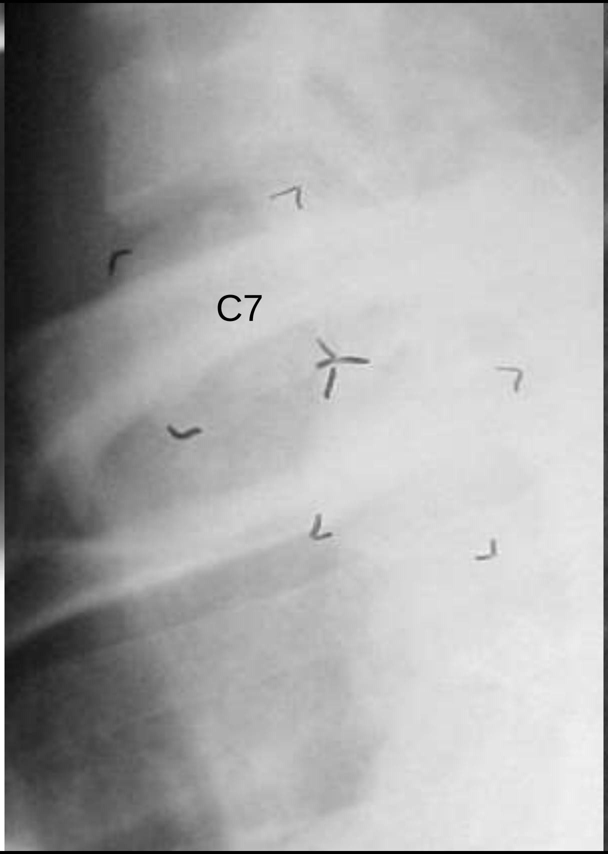
Technique - Fuch's

Jefferson and floating lateral mass 26M

Technique - Trauma

30M MVA Thought to be paraplegic

Need to see T1



C7-T1 Fracture Dislocation

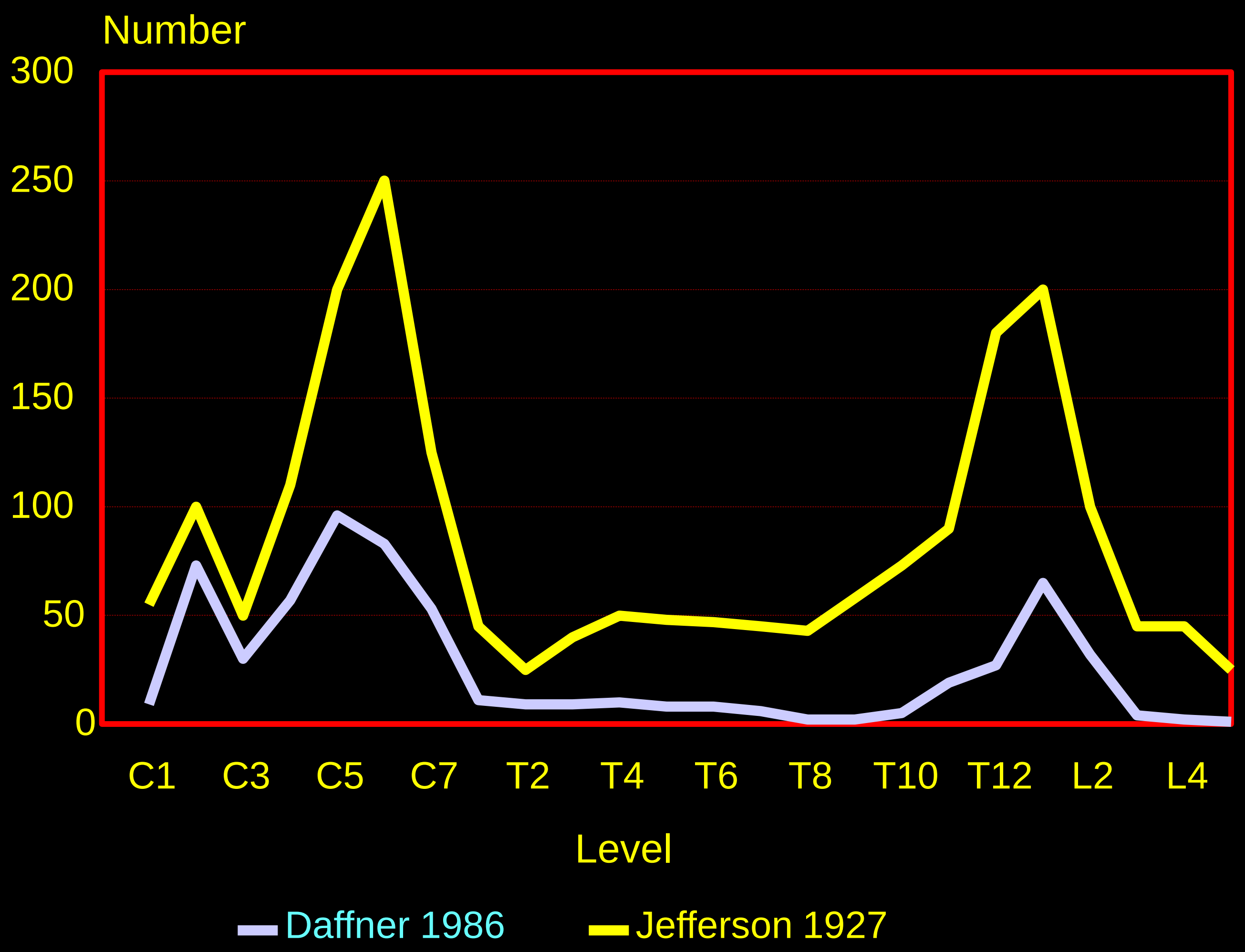
30M MVA Thought to be paraplegic

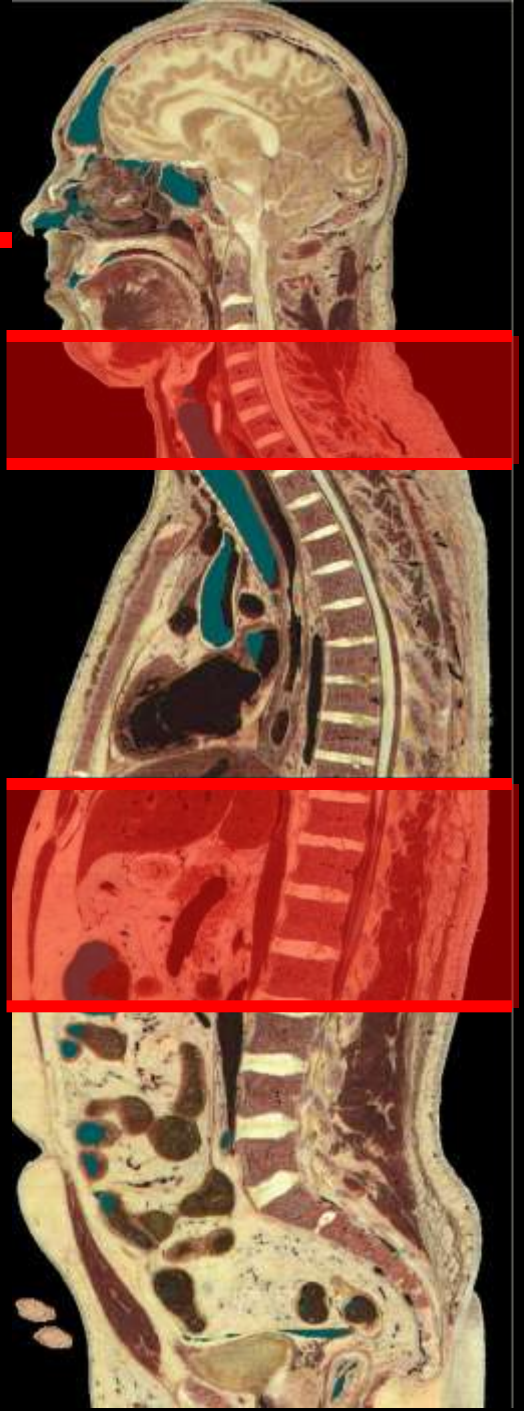
Top 10 Missed Fractures

- 1. Base of skull
- 2. Odontoid process
- 3. Zygomatic arch and orbit
- 4. C7 Fracture dislocation
- 5. Posterior dislocation of humerus
- 6. Scaphoid, lunate and perilunar dislocation
- 7. Sacroiliac fractures
- 8. Undisplaced neck of femur
- 9. Dislocated hip with ipsilateral femoral fracture
- 10. Tibial plateau fractures

Fulde GWO (1994) Emergency Medicine

Spinal trauma





Technique - Swimmers View

Technique - Routine

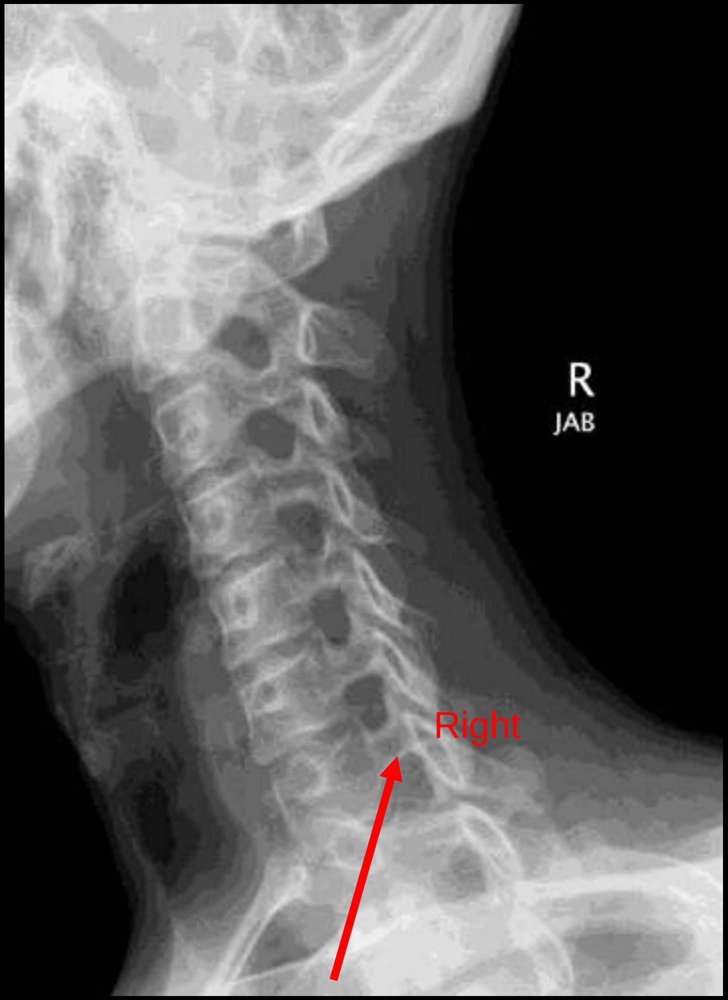
LAO or LPO

RAO or RPO

36M Normal Cx Spine, Routine obliques

Technique - Routine

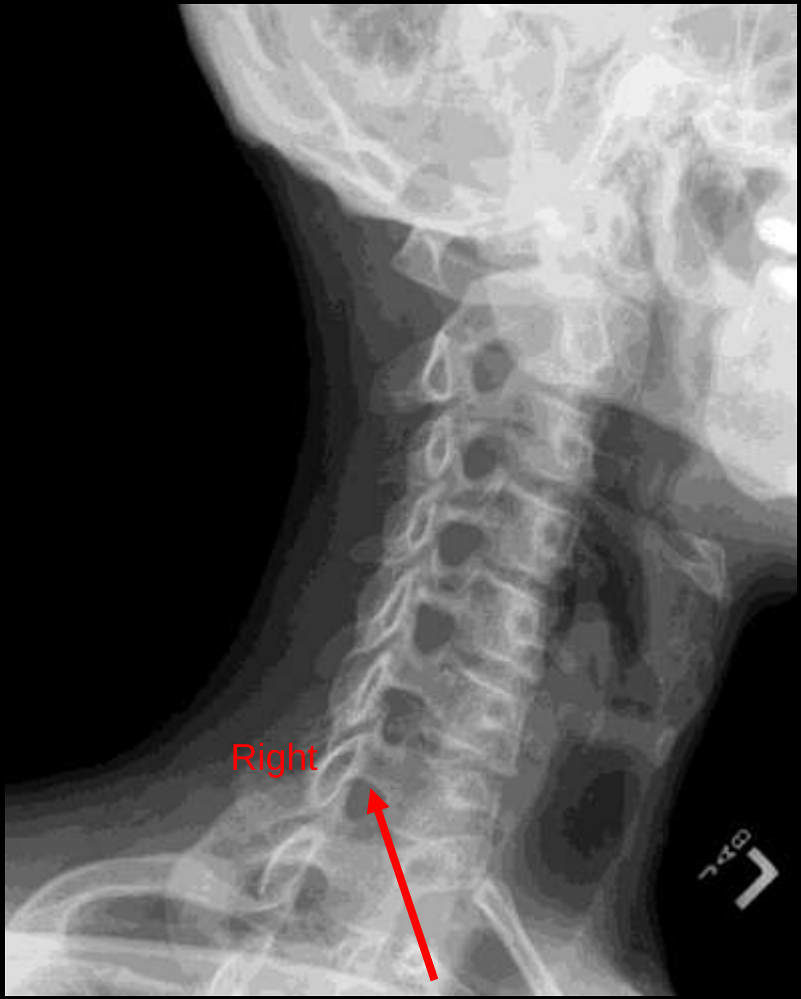
LAO or LPO



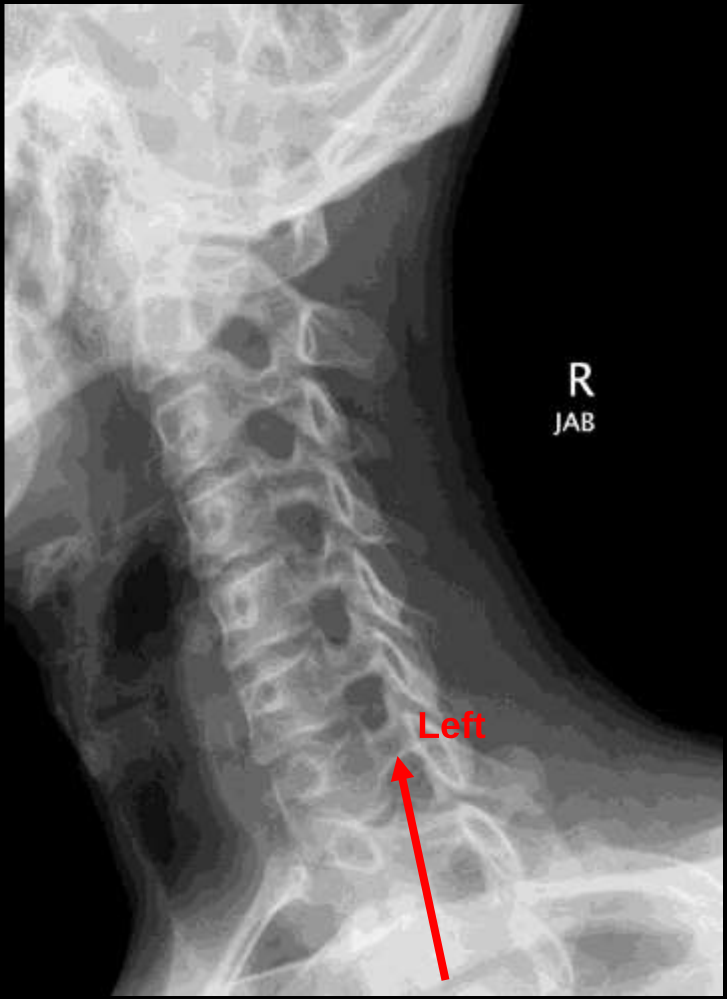
RAO or RPO

36M Normal Cx Spine, Routine obliques

Technique - Routine



LAO or LPO



RAO or RPO

Lead or digital

36M Normal Cx Spine, Routine obliques

Trauma Obliques

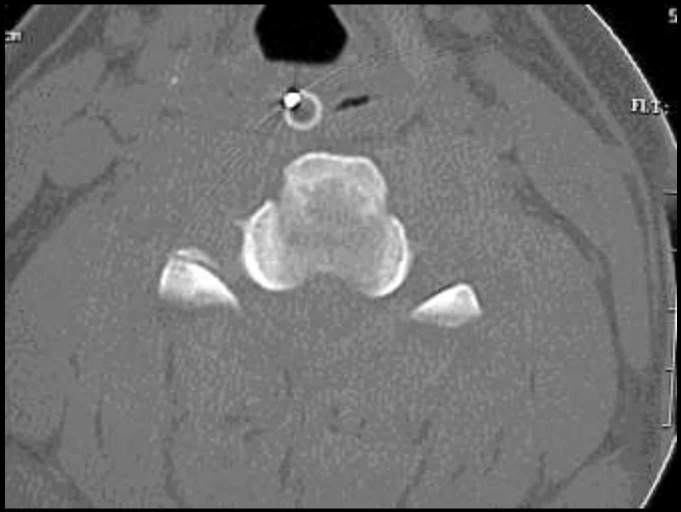
Bi-facet dislocation C6-7

Technique - Tomography

Technique - CT

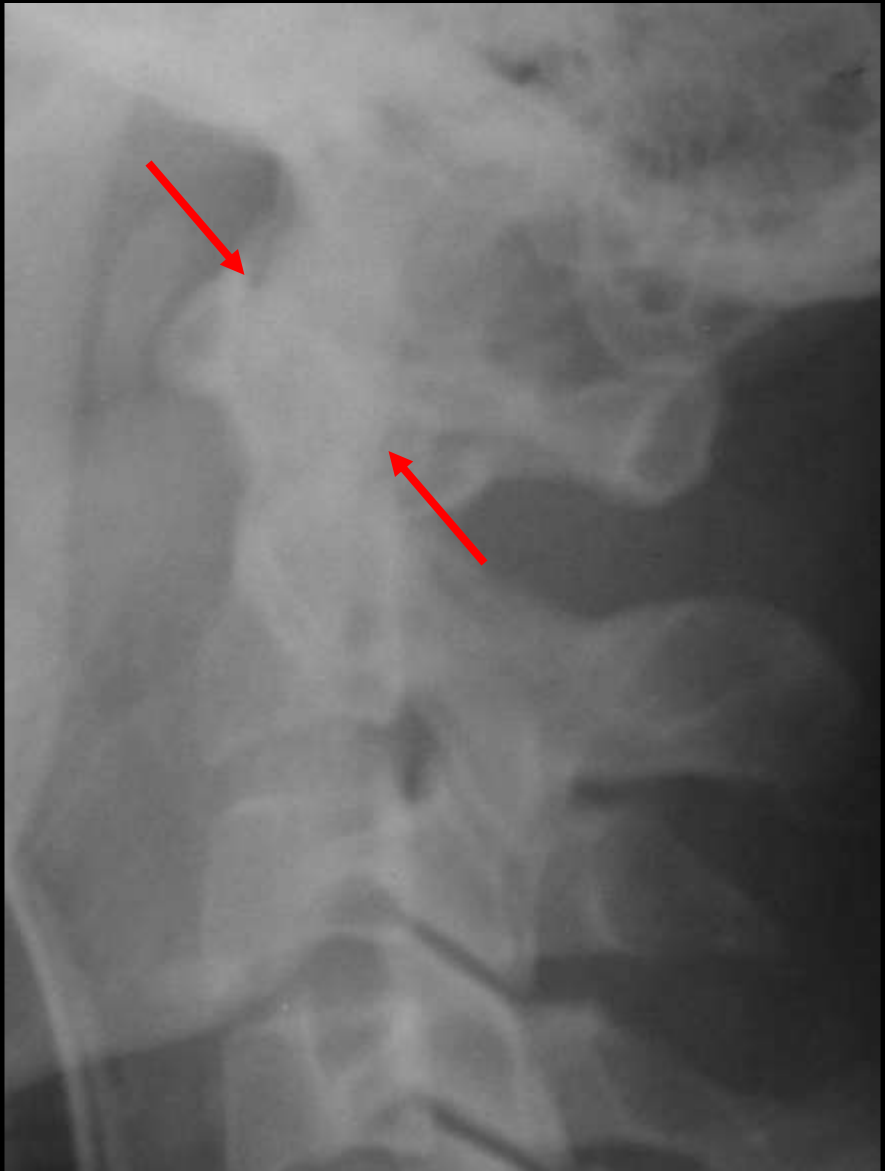
- Excellent visualization of fractures

- Must be optimized
  - Volumetric acquisition
  - Thin slices 0.5 - 0.625 - 1.25mm
  - Bone and soft tissue algorithm / window
  - Orthogonal planes
    - Thin recons
  - Use workstation
  - 3D for alignment

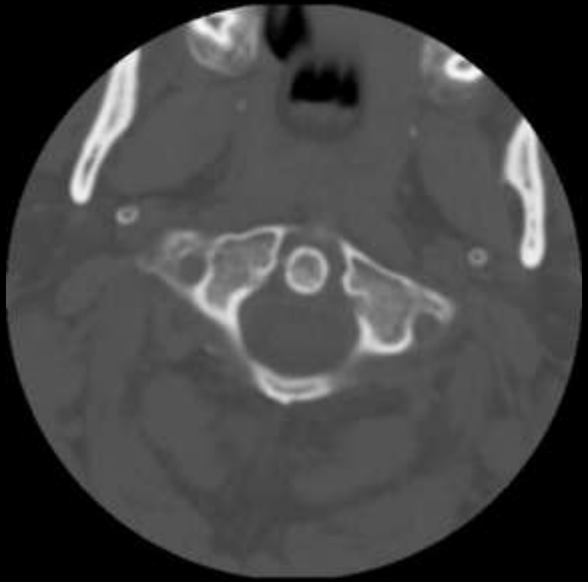


Bifacet Dislocation

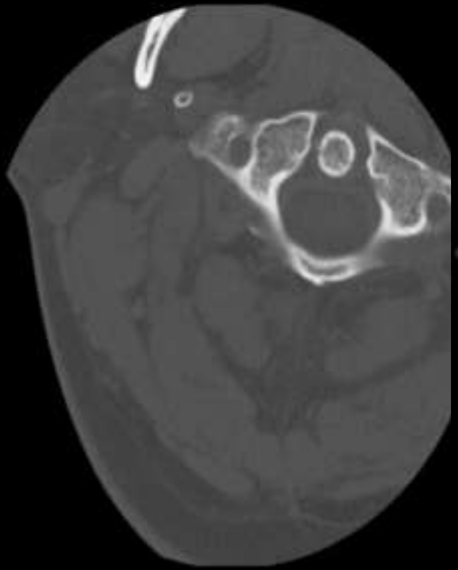
Optimizing CT
Type II Odontoid Fracture



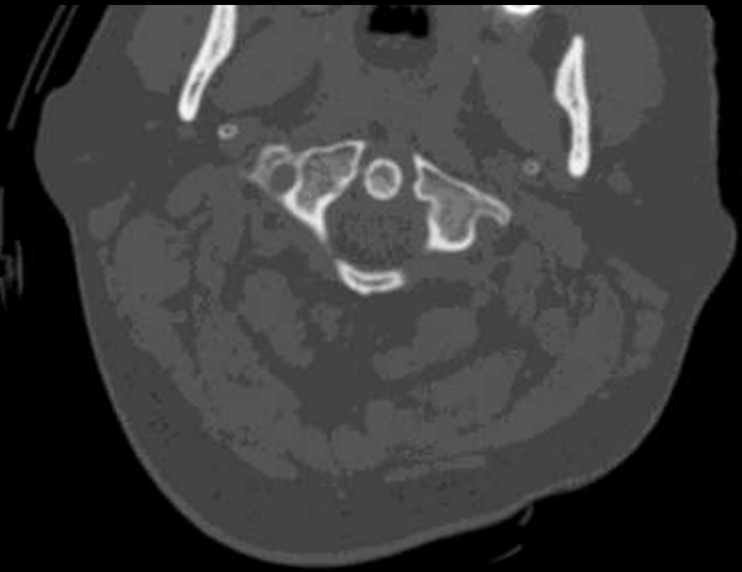
Optimizing CT
Type II Odontoid Fracture



2.5mm Standard algorithm

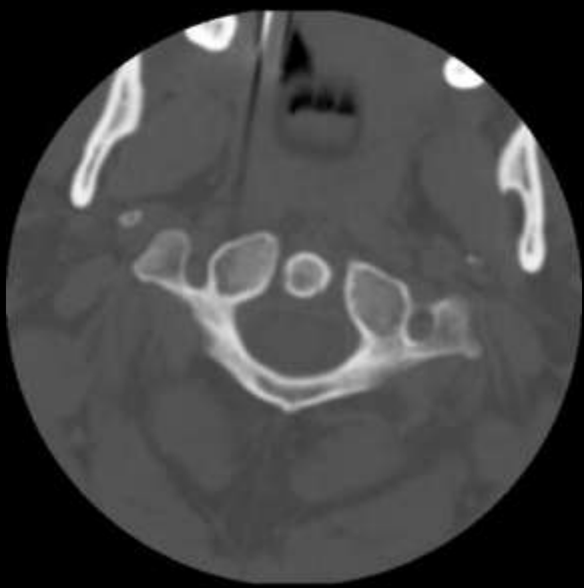


2.5mm Bone

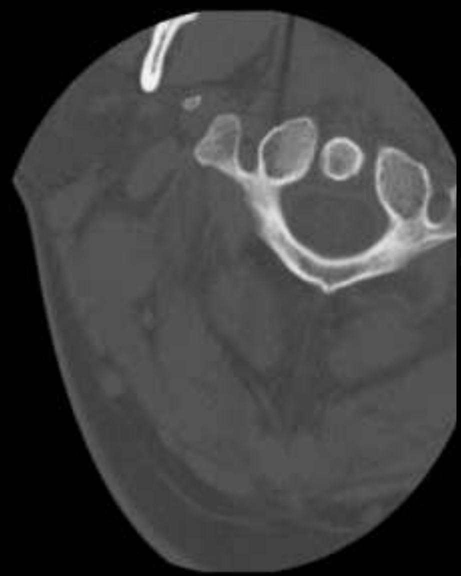


1.25mm Bone

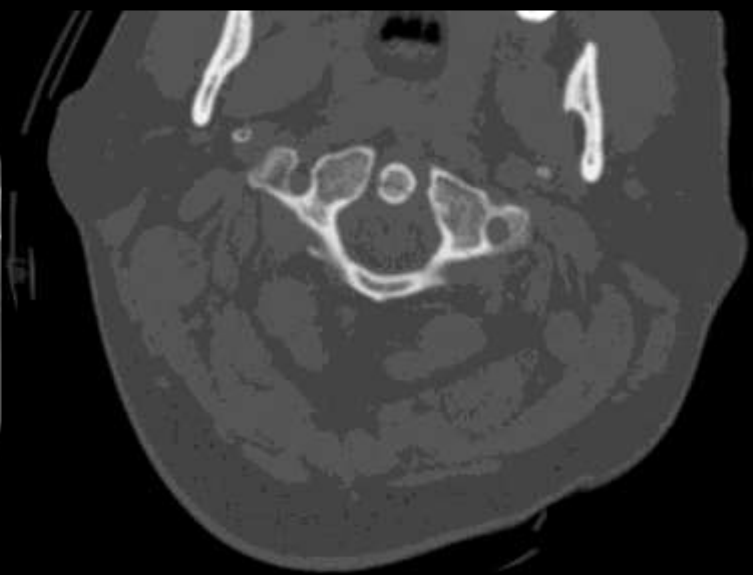
Optimizing CT
Type II Odontoid Fracture



2.5mm Standard algorithm

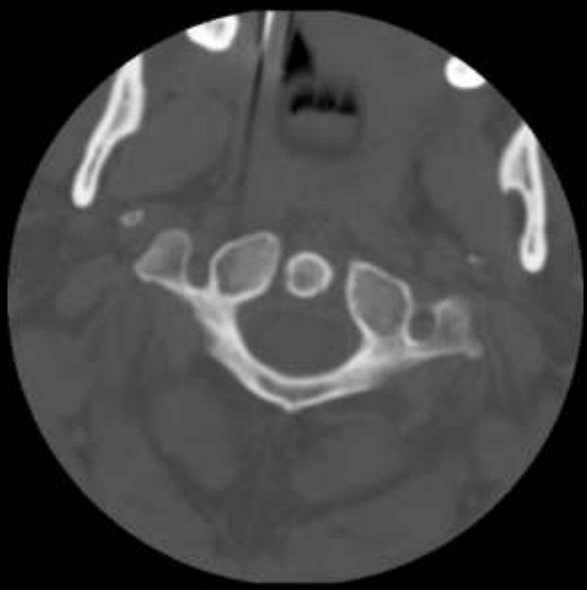


2.5mm Bone



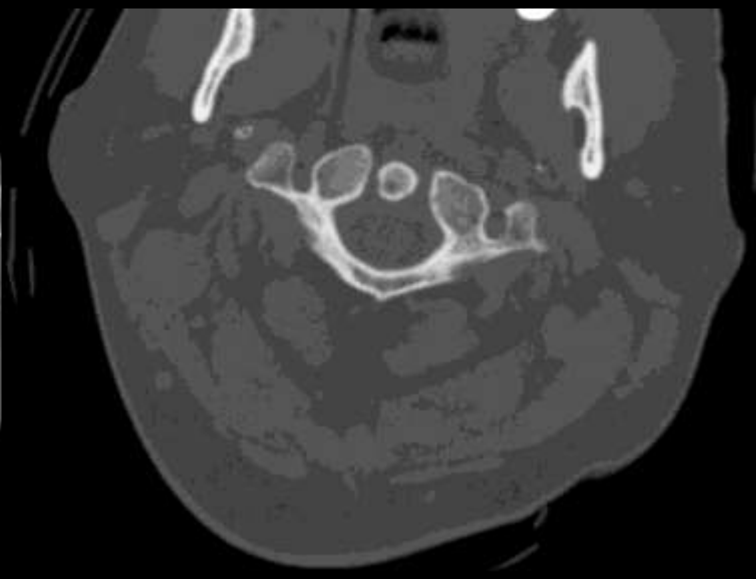
1.25mm Bone

Optimizing CT
Type II Odontoid Fracture



2.5mm Standard algorithm

2.5mm Bone

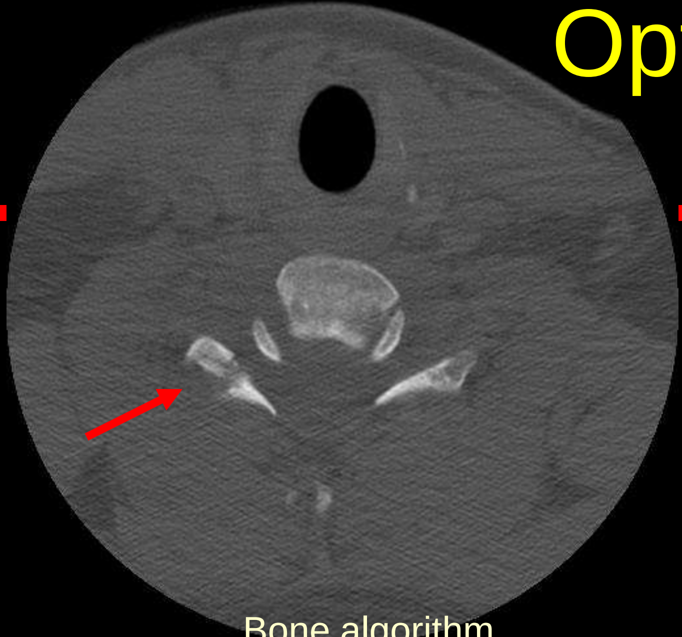


1.25mm Bone

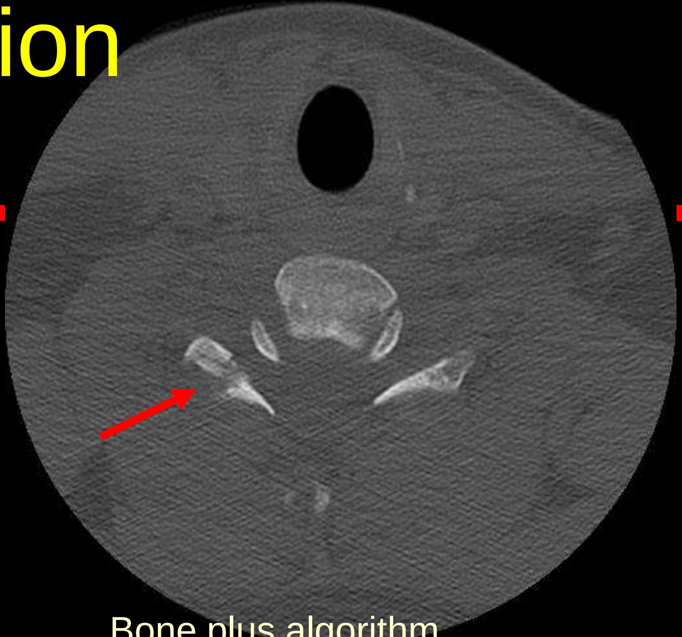
Optimizing CT
Type II Odontoid Fracture

Made from 1.25mm standard algorithm

Optimization
C7 Fx



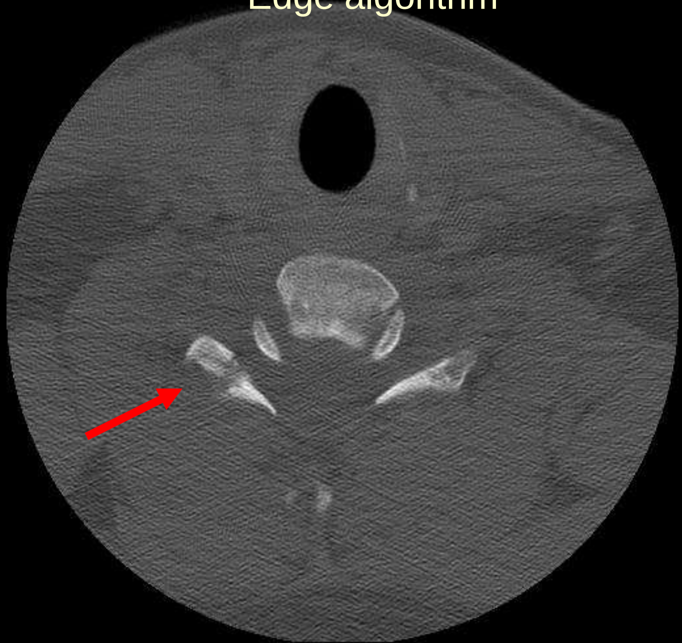
Bone algorithm



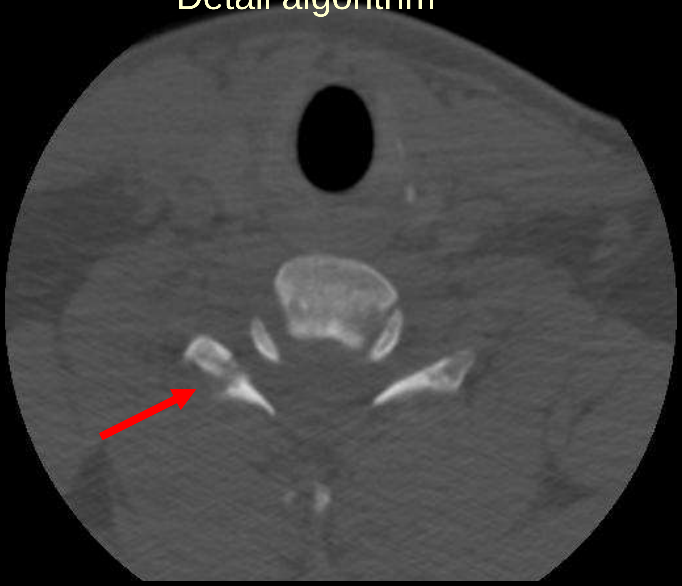
Bone plus algorithm

All bone window/level 2000/500 and 1.3mm thick

Edge algorithm

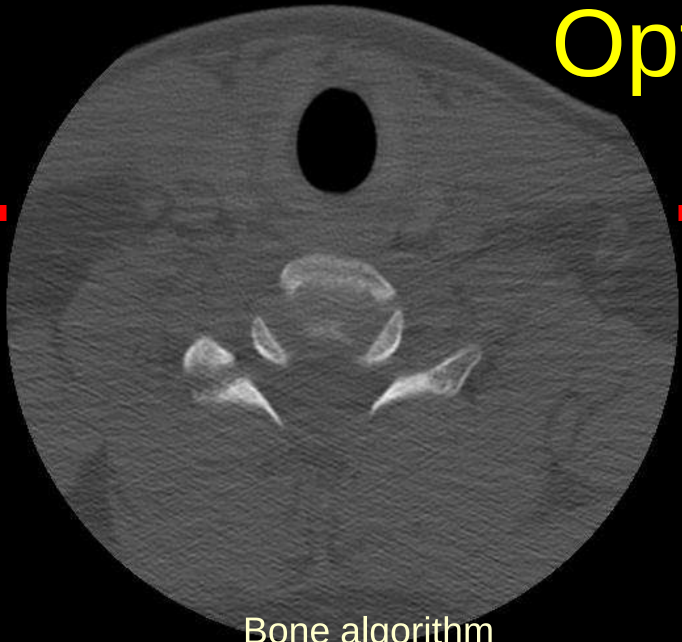


Detail algorithm

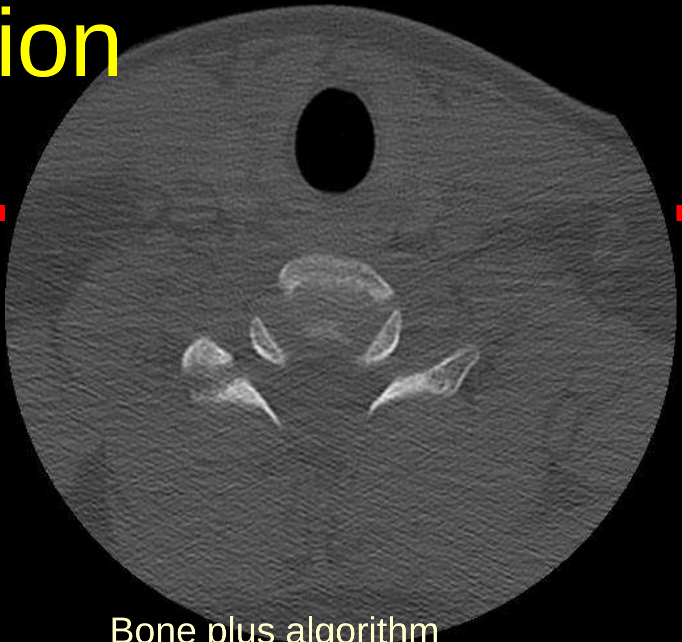


Rt C7 superior facet and transverse process fracture

Optimization
C7 Fx



Bone algorithm



Bone plus algorithm

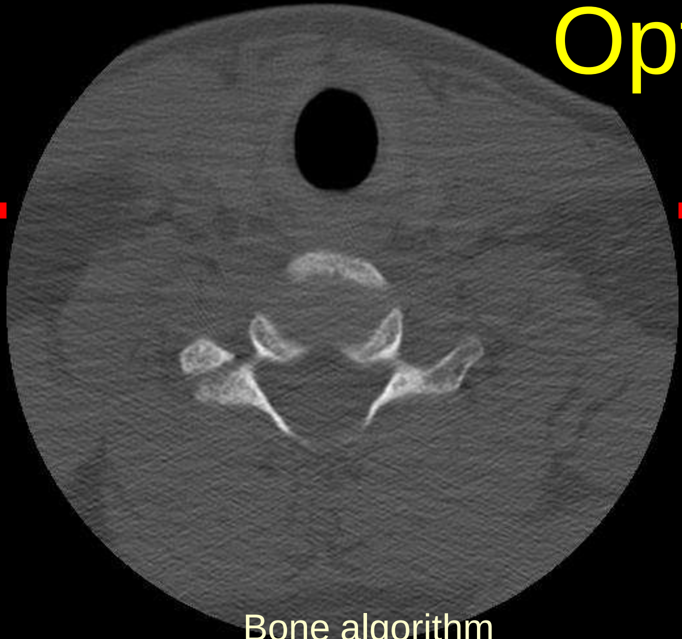
All bone window/level 2000/500 and 1.3mm thick

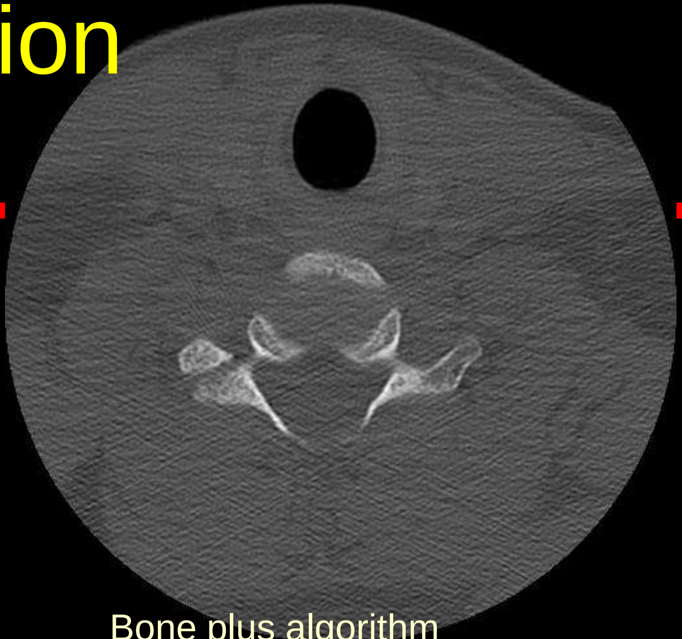
Edge algorithm

Detail algorithm

Rt C7 superior facet and transverse process fracture

Optimization
C7 Fx


Bone algorithm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All bone window/level 2000/500 and 1.3mm thick

Edge algorithm

Detail algorithm

Rt C7 superior facet and transverse process fracture

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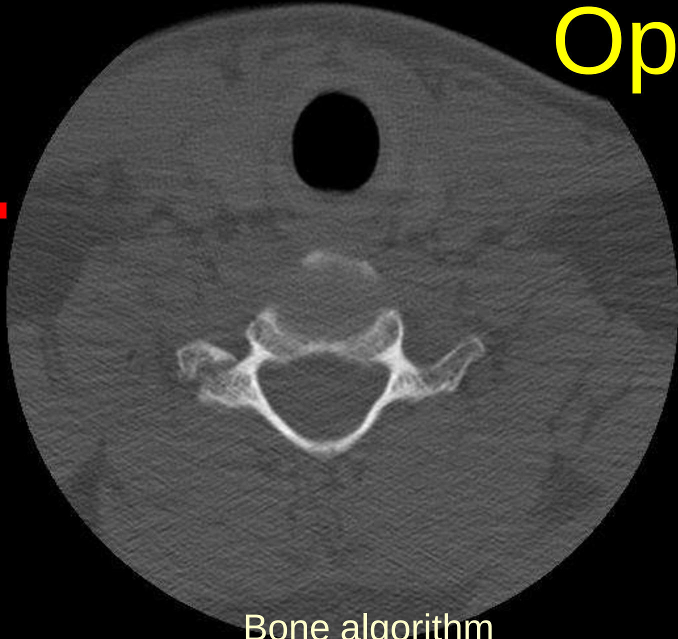
C7 Fx



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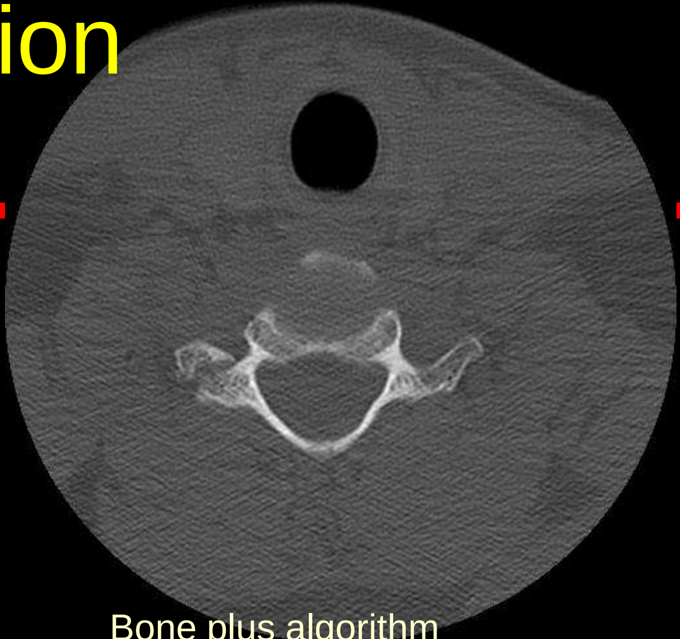

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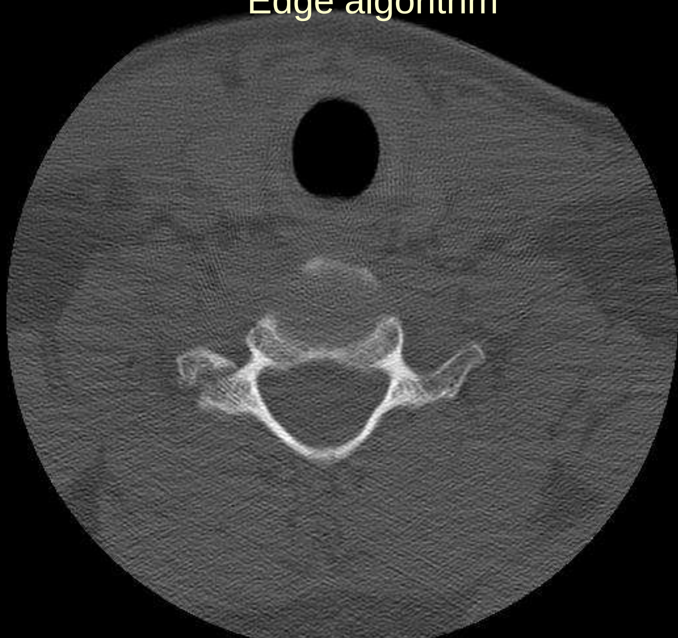
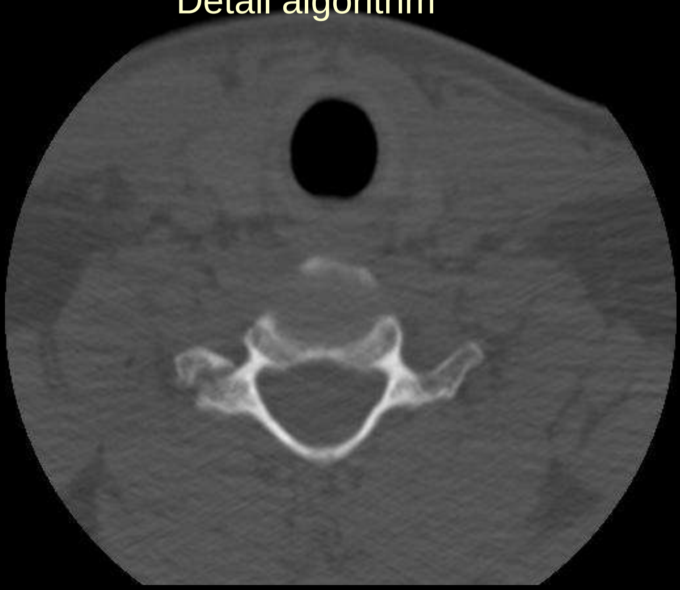
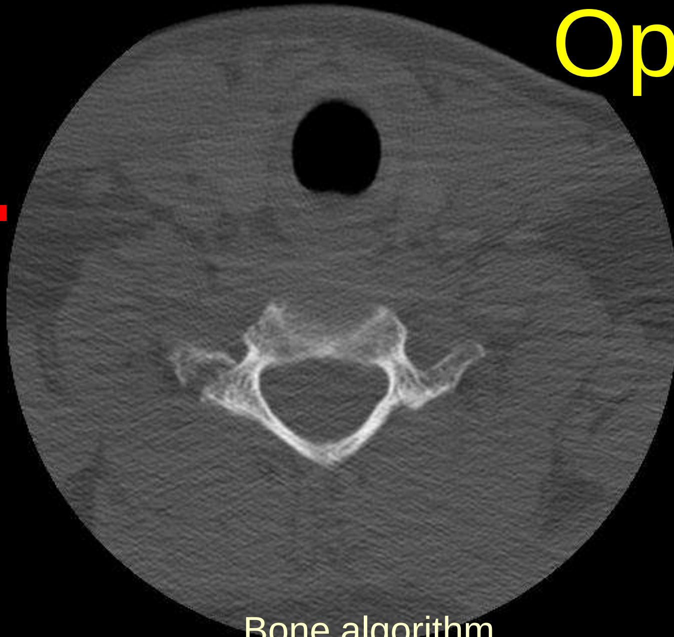


Detail algorithm



Rt C7 superior facet and transverse process fracture

Optimization
C7 Fx



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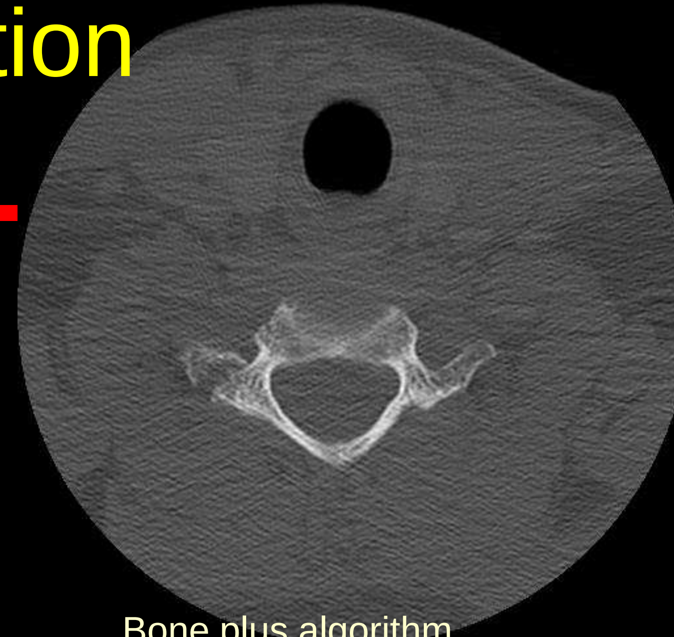

Bone plus algorithm

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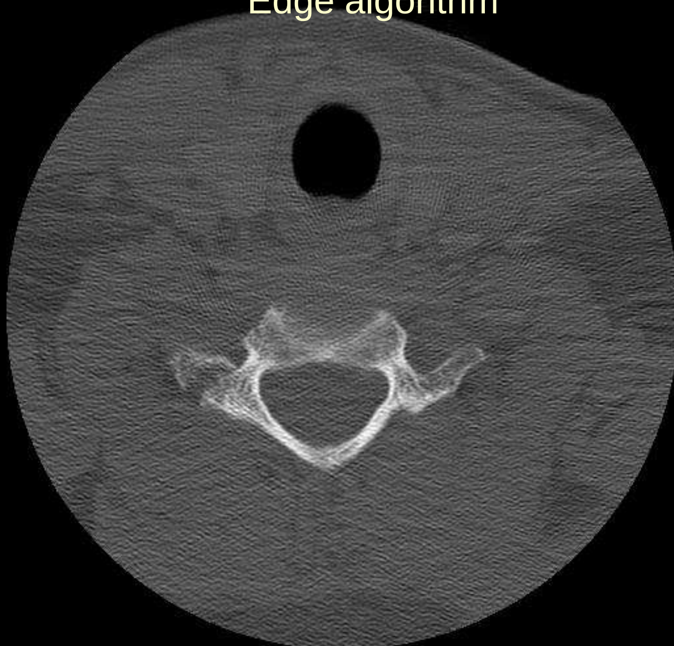
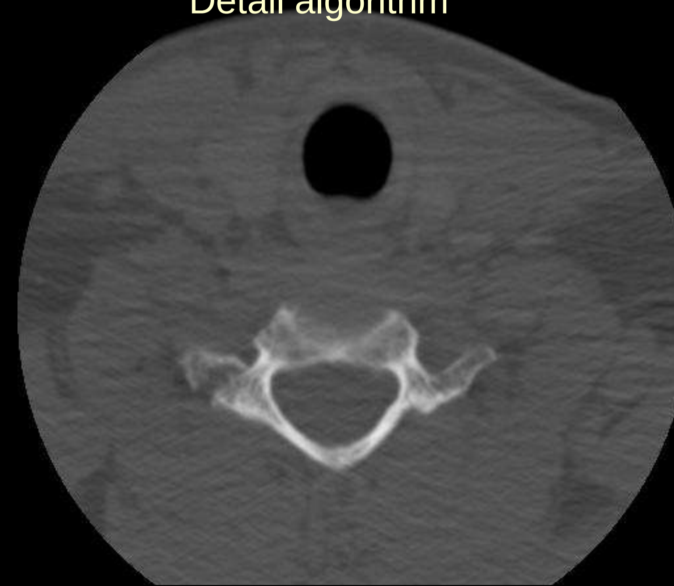
Edge algorithm



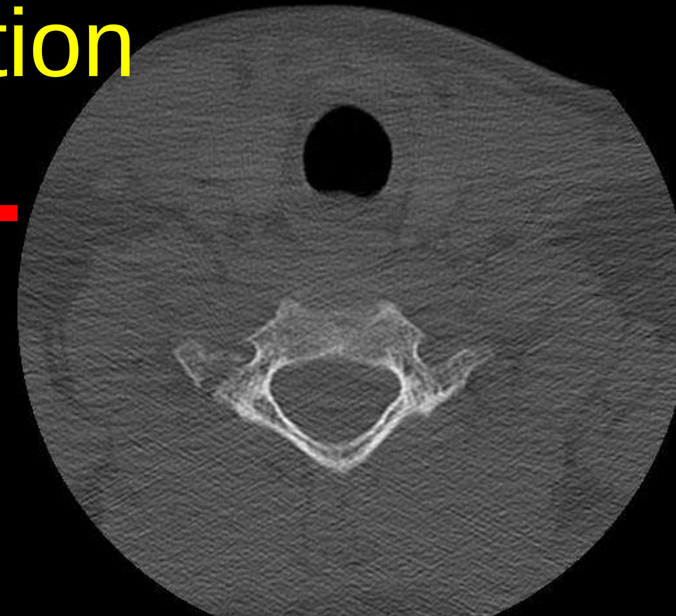
Detail algorithm



Rt C7 superior facet and transverse process fracture

Optimization
C7 Fx

Bone algorithm



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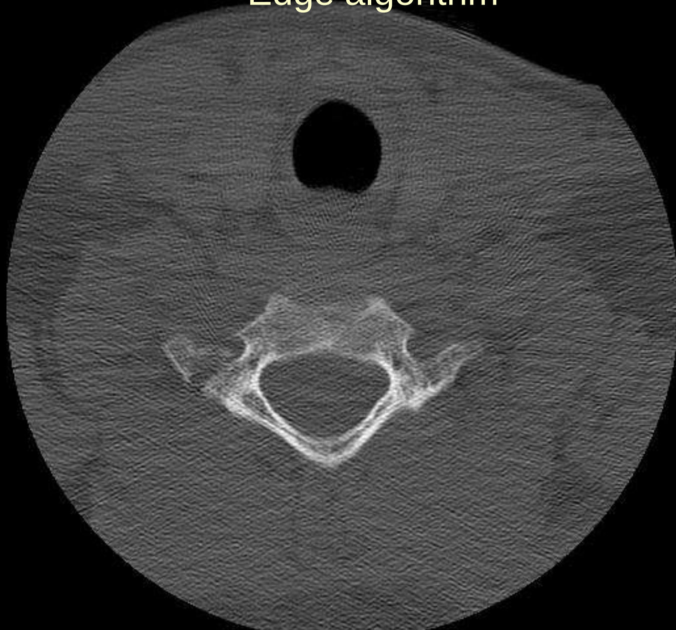
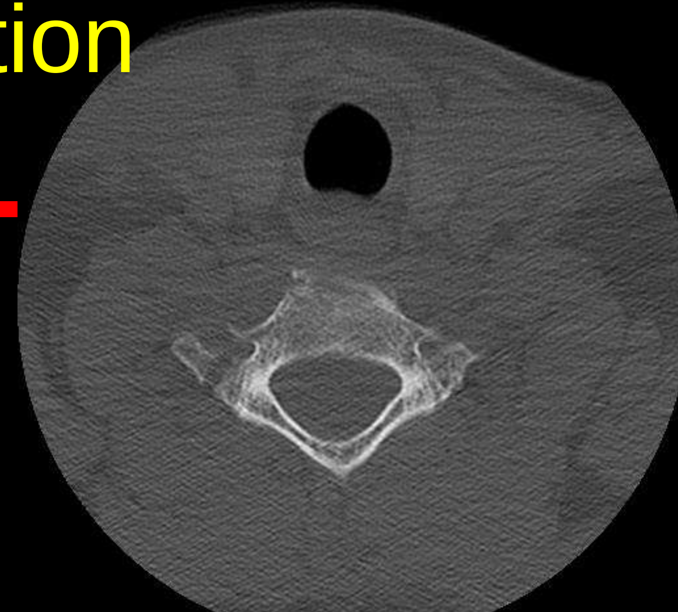


Detail algorithm

Rt C7 superior facet and transverse process fracture

Optimization
C7 Fx

Bone algorithm



Bone plus algorithm

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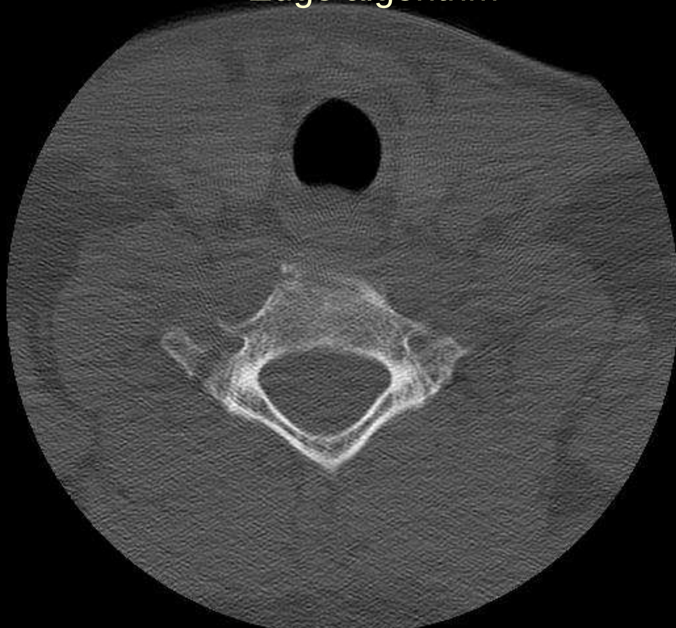

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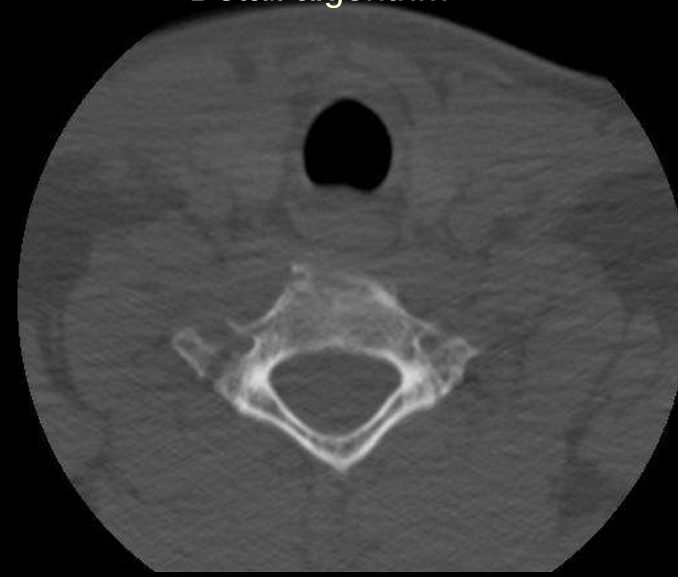
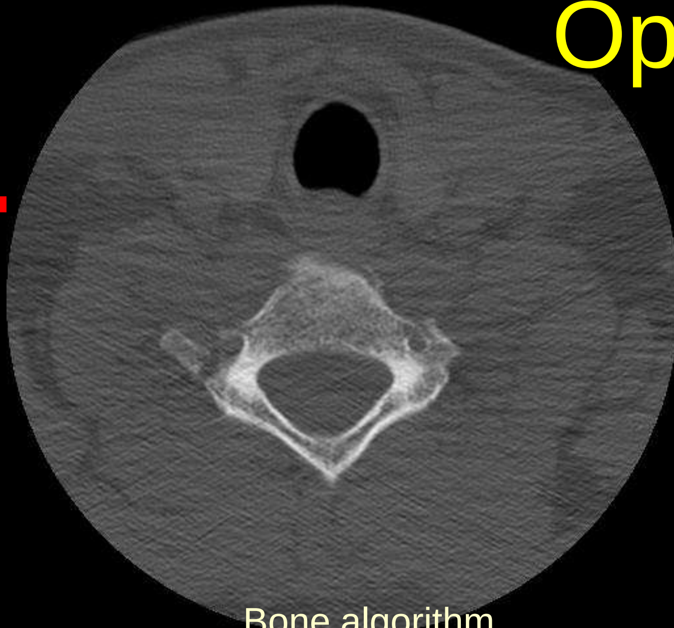


Rt C7 superior facet and transverse process fracture

Optimization
C7 Fx



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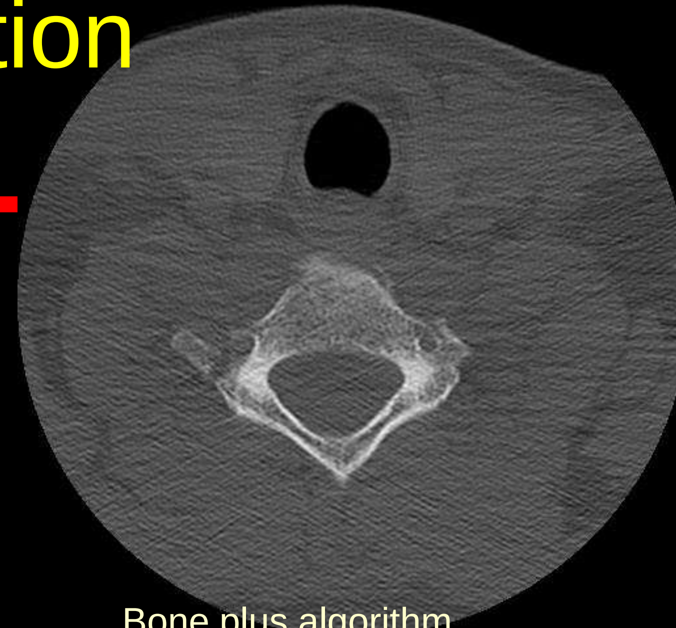

Bone plus algorithm

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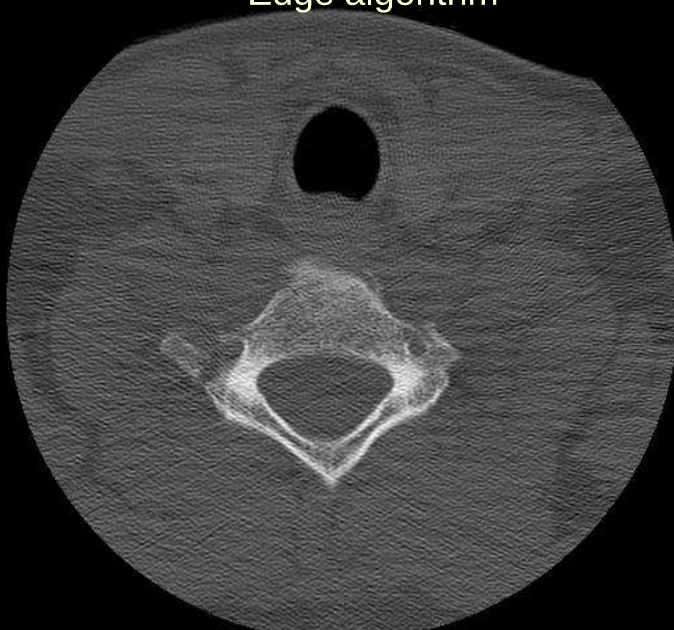

Detail algorithm

Rt C7 superior facet and transverse process fracture

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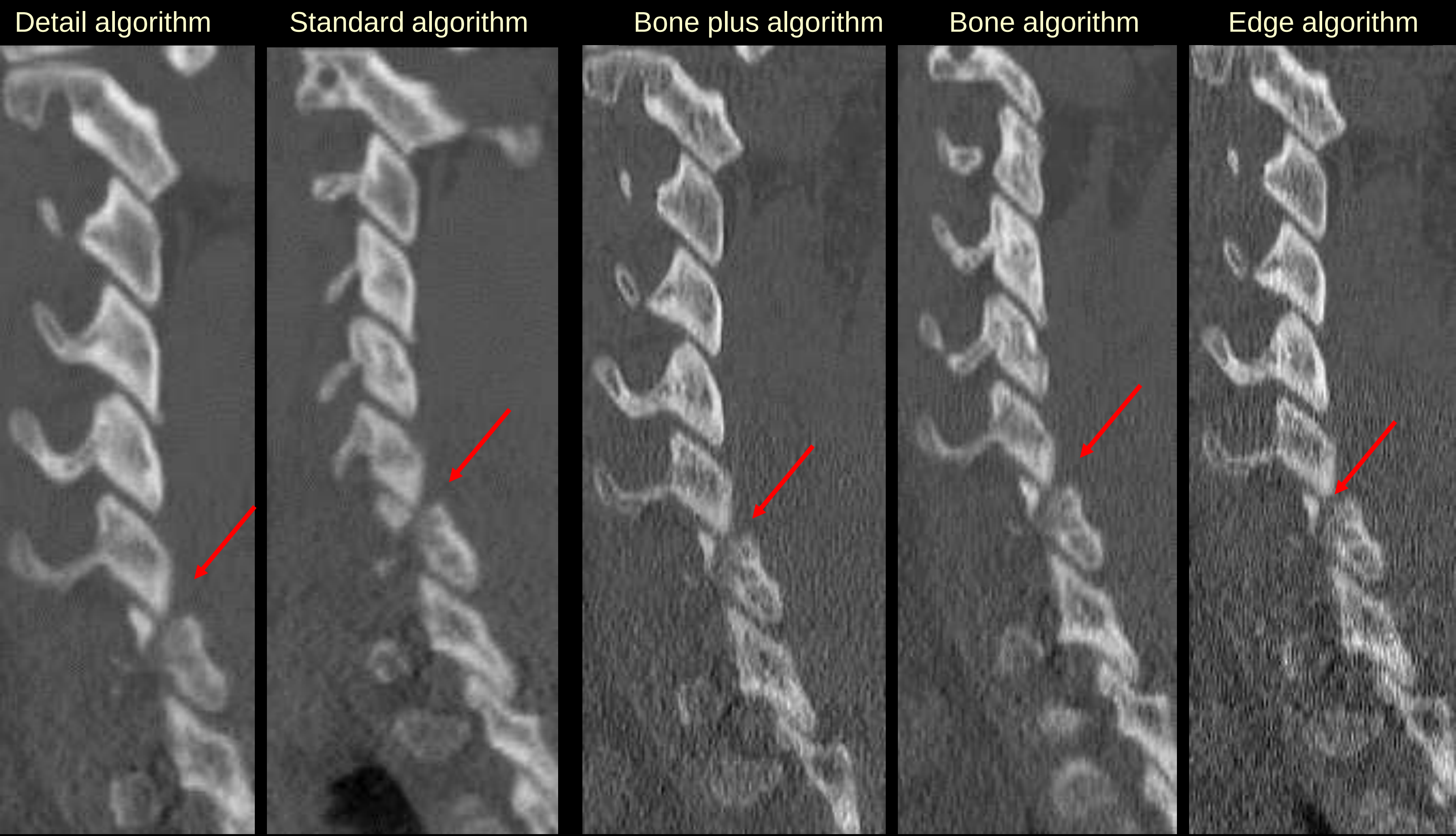


All bone window/level 2000/500 and 1.3mm thick

Respiratory motion on CT

Respiratory motion on Cx CT 24M

Technique - MRI

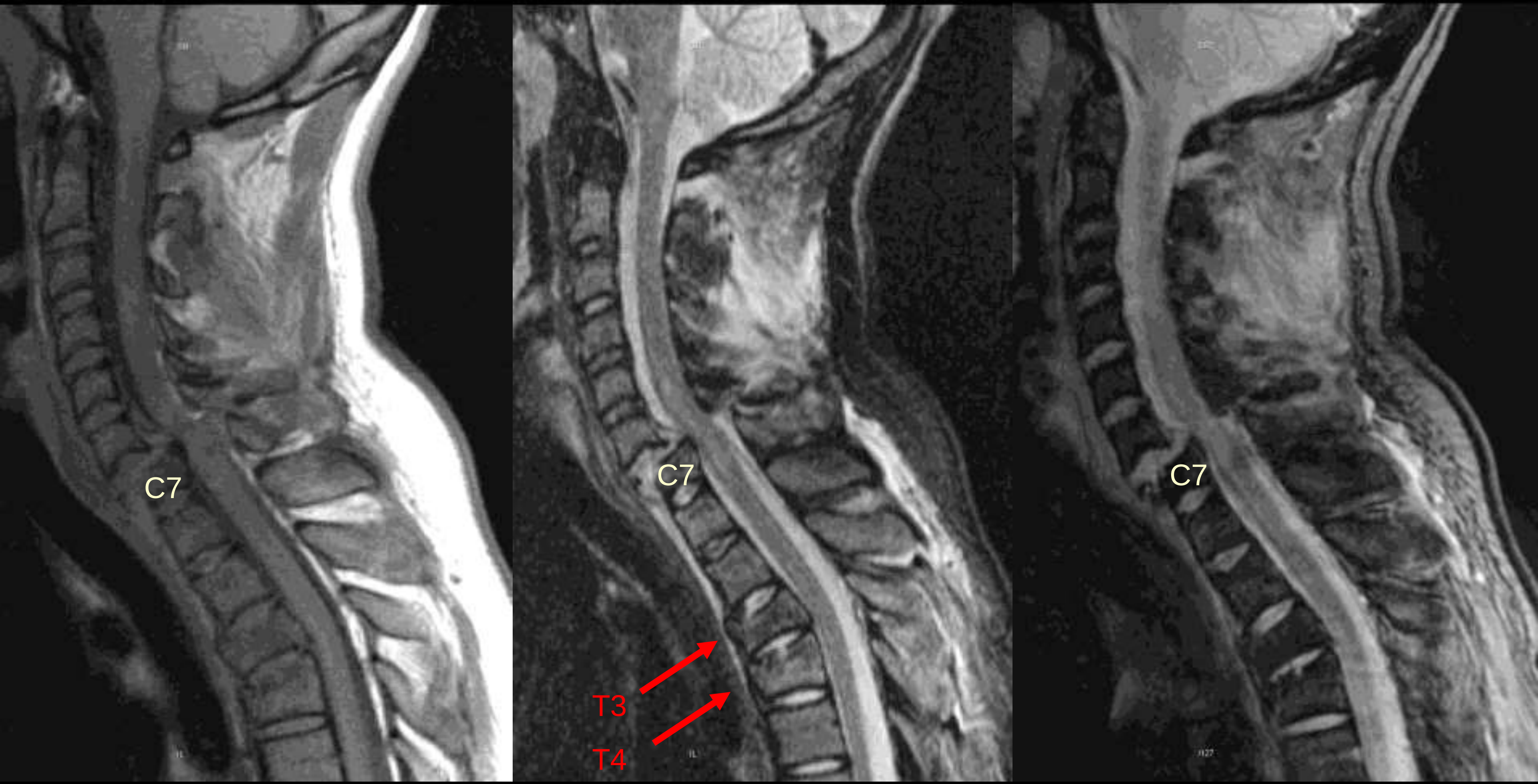
- Poor visualization of fractures
- Good for soft tissue injury
- Good for spinal cord injury assessment
- Good for spinal cord injury prognosis
- Good for root avulsion

Ankylosing spondylitis fracture

Technique - MRI

17M C6-7 Hyperflexion Injury

Technique - MRI



Sag T1 Sag T2FS Sag STIR

17M C6-7 Hyperflexion Injury

Technique - Flexion / Extension

Open C1 posterior arch

Technique - Flexion / Extension

30F post trauma acute films

Technique - Flexion / Extension

30F post trauma 8d later

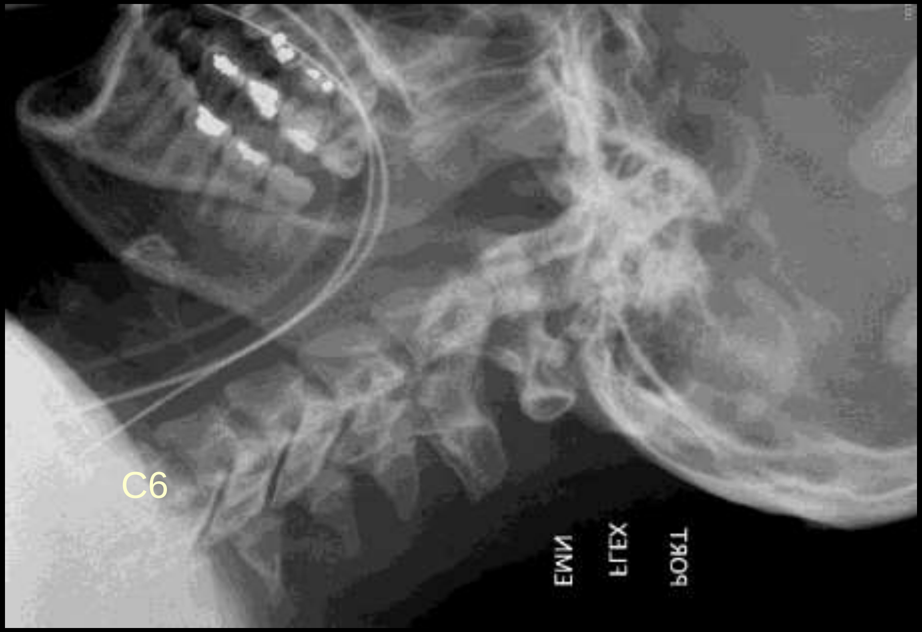
Flexion Extension - Supine

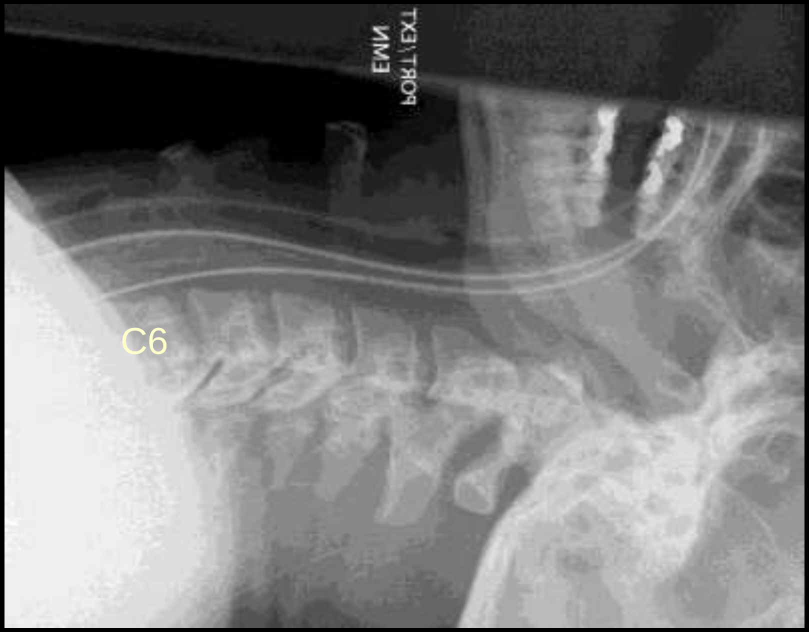
- All radiographic texts describe obtaining F/E views with the alert patient standing or sitting.

- There are no articles on obtaining flexion extension views in a supine patient.

Technique - Flex/Ext

Technique - Flex/Ext





34M Obtunded Passive Flex / Ext

Obtunded
Flexion - Extension

- Do no harm

Obtunded Flexion – Extension Dangers

- Causing paraplegia/quadraplegia
  - Can only see part of Cx spine
  - Could be causing a disc herniation
- Rise in ICP
  - I have seen rise to over 80 mmHg
- Rise in BP
  - I have seen rise to over 200 systolic

Obtunded
Flexion - Extension

Obtunded
Flexion - Extension

Obtunded
Flexion - Extension

Obtunded
Flexion - Extension

Obtunded
Flexion - Extension

Obtunded
Flexion - Extension

Obtunded
Flexion - Extension

- I cannot find any reference to fluoroscopic passive flexion/extension studies finding an unstable ligamentous injury, without fracture, that needed to be surgically fixed.

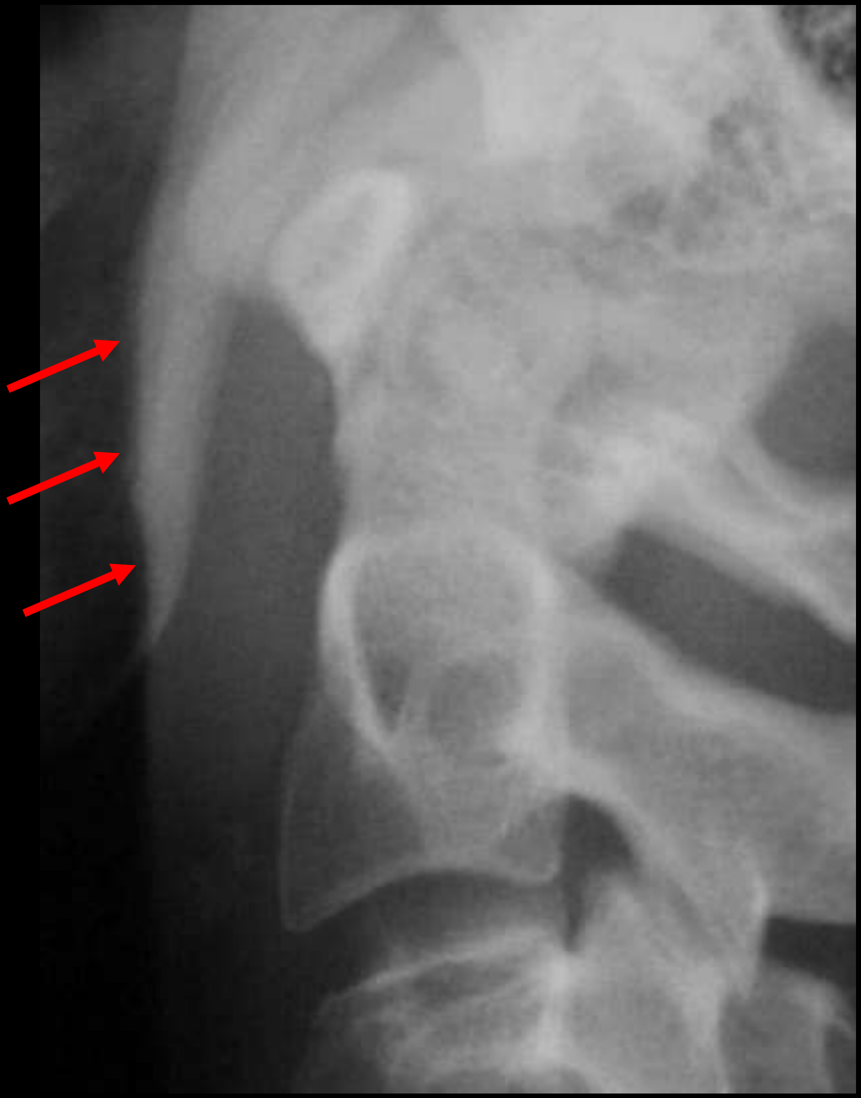
Unconscious Patient

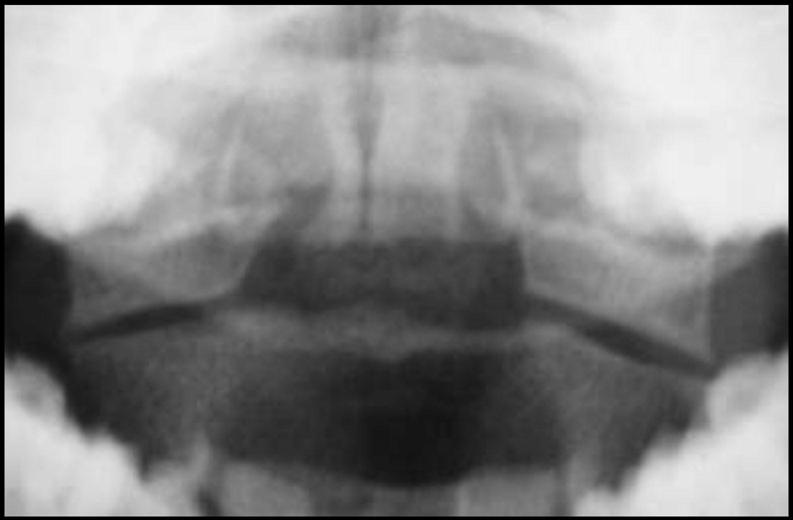
- In persons with decreased mental status, flexion/extension views in experienced hands can probably exclude instability in adults. This can be done at the bedside even in ITU. However, this method does not exclude significant soft tissue or spinal cord injuries, and manipulation and mobilization can cause secondary spinal cord trauma. On this basis the practice is not recommended.

[Imaging of acute cervical spine injuries: review and outlook](#)

B.J. Tins and V.N. Cassar-Pullicino, Clinical Radiology Volume 59, Issue 10 , October 2004, 865-880

Technique - Flex/Ext





Peg # hard to see 37M

Technique - Flex/Ext

Extension

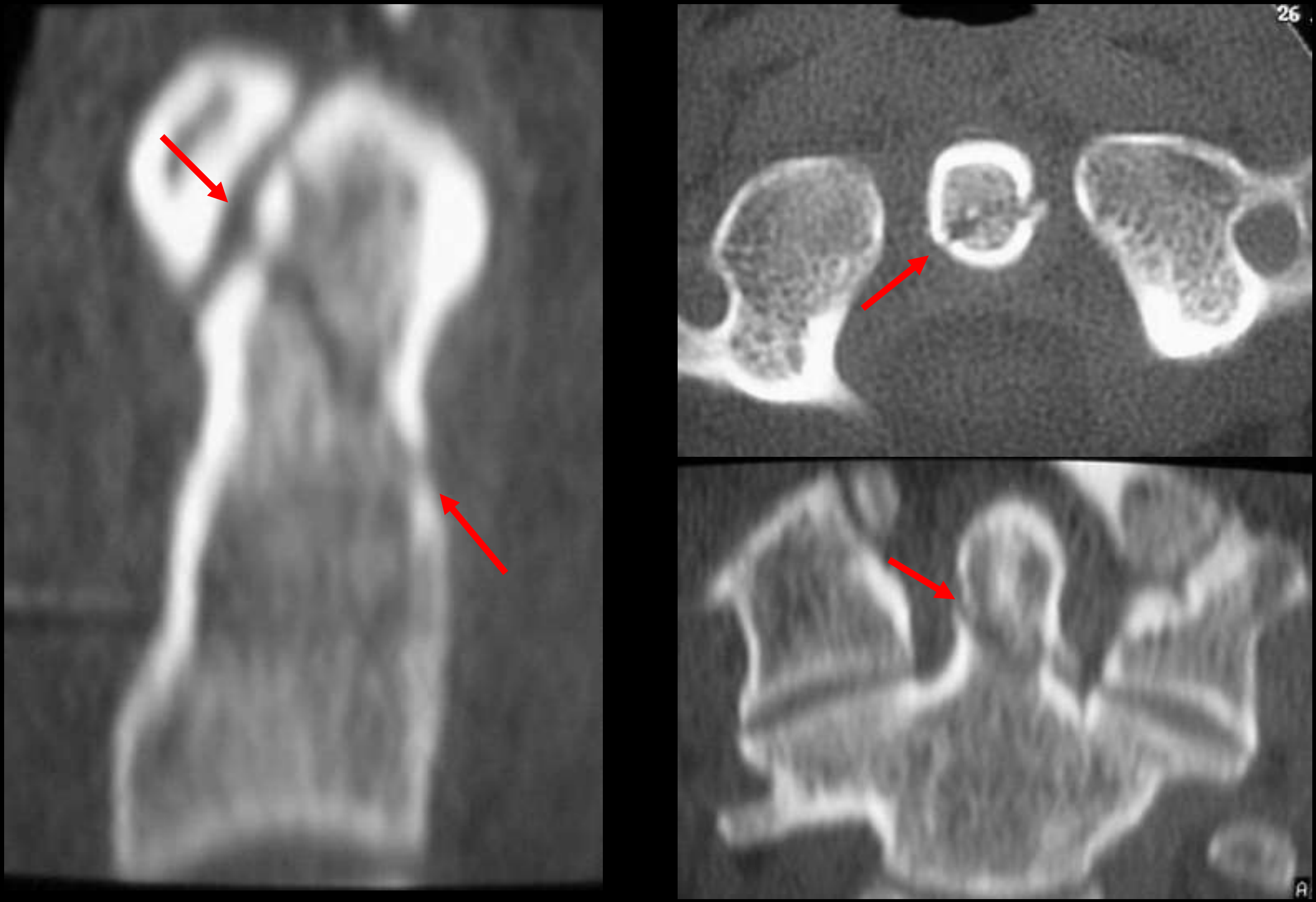
Peg # hard to see 37M

Technique - Flex/Ext

Flexion

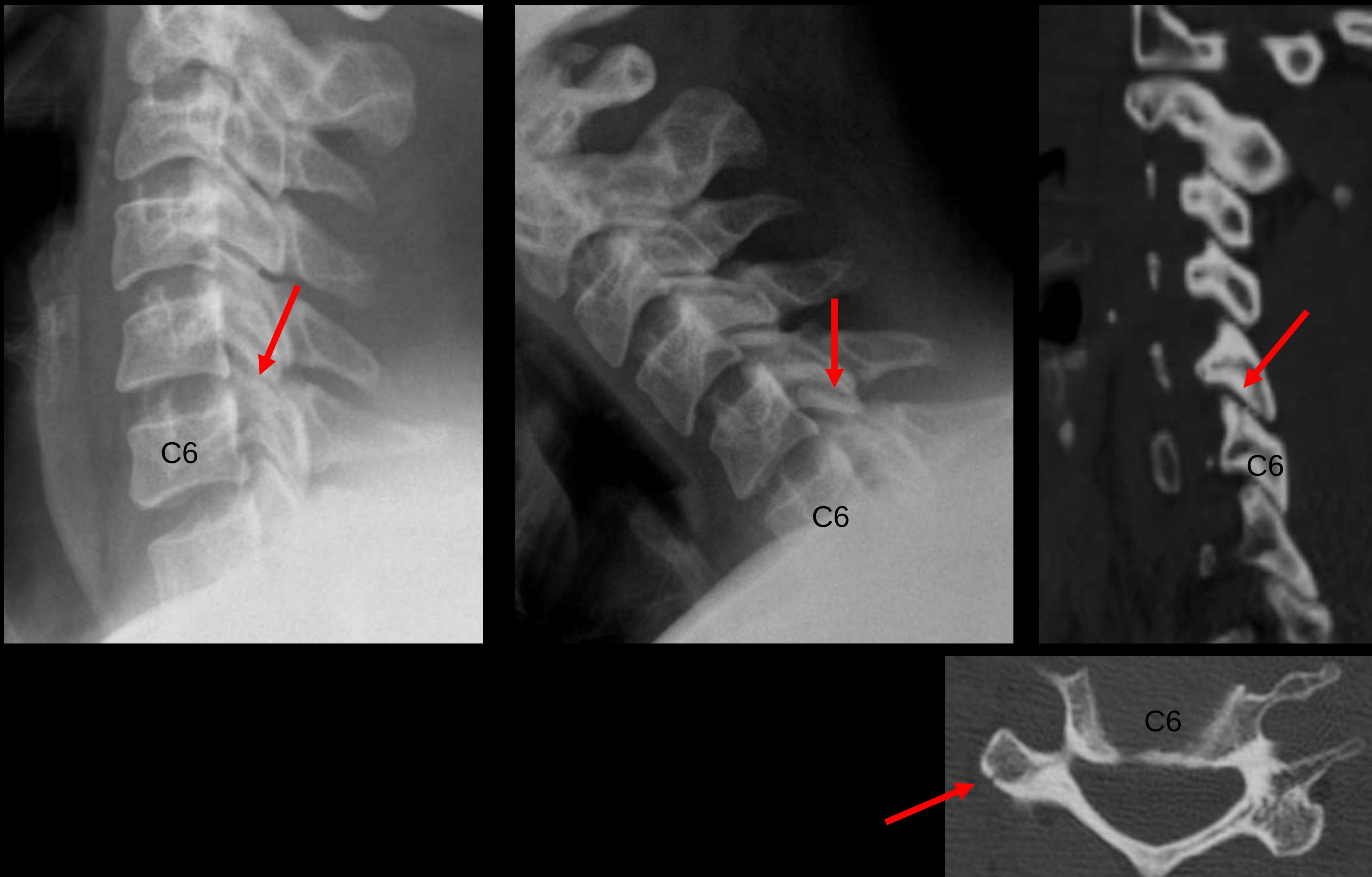
Peg # hard to see 37M

Technique - Flex/Ext



Peg # hard to see 37M

C6 fx with no motion on flex ext



C6 fx with no motion on flex ext 31M

Fixed C 5-6 alignment

FE Cx fixed C5-6 34F

Cx-Spine - Stability

- Instability is a function of ligamentous injury, or fracture pattern
- Can be inferred from radiographs for certain fracture patterns
- Not 100% accurate
  - Eg. Delayed flexion subluxation

Cx-Spine Stability

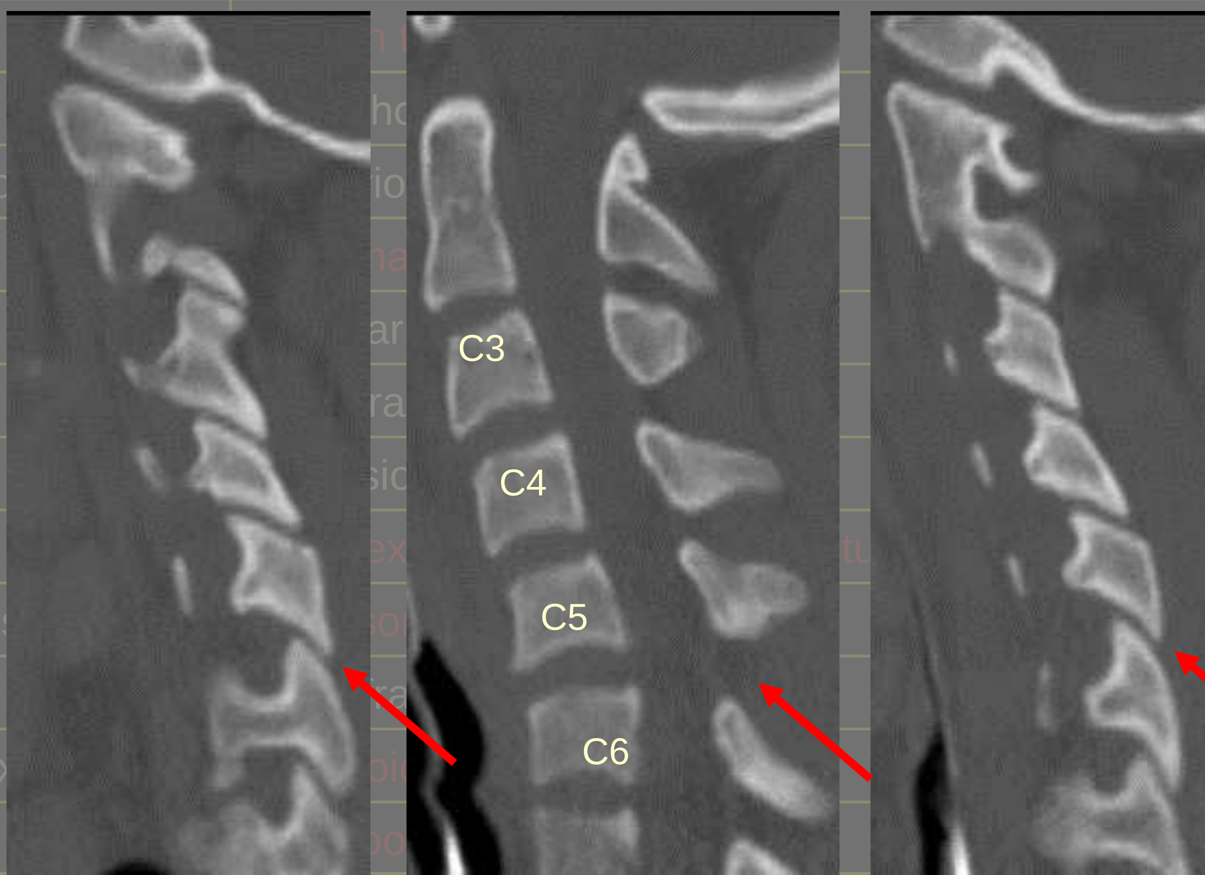
An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Clay-shoveler's fracture	Stable
Extension	Posterior arch C1 fracture	Stable
	Hangman's fracture	Unstable
	Laminar fracture	Stable
	Pillar fracture	Stable
	Extension teardrop fracture	Stable
	Hyperextension dislocation fracture	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	n t	Unstable
	ho	Stable
Extensio	io	Stable
	na	Unstable
	ar	Stable
	ra	Stable
	sio	Stable
	ex tu	Unstable
Compres	so	Unstable
	ra	Stable
Complex	pi	Unstable
	po	Unstable

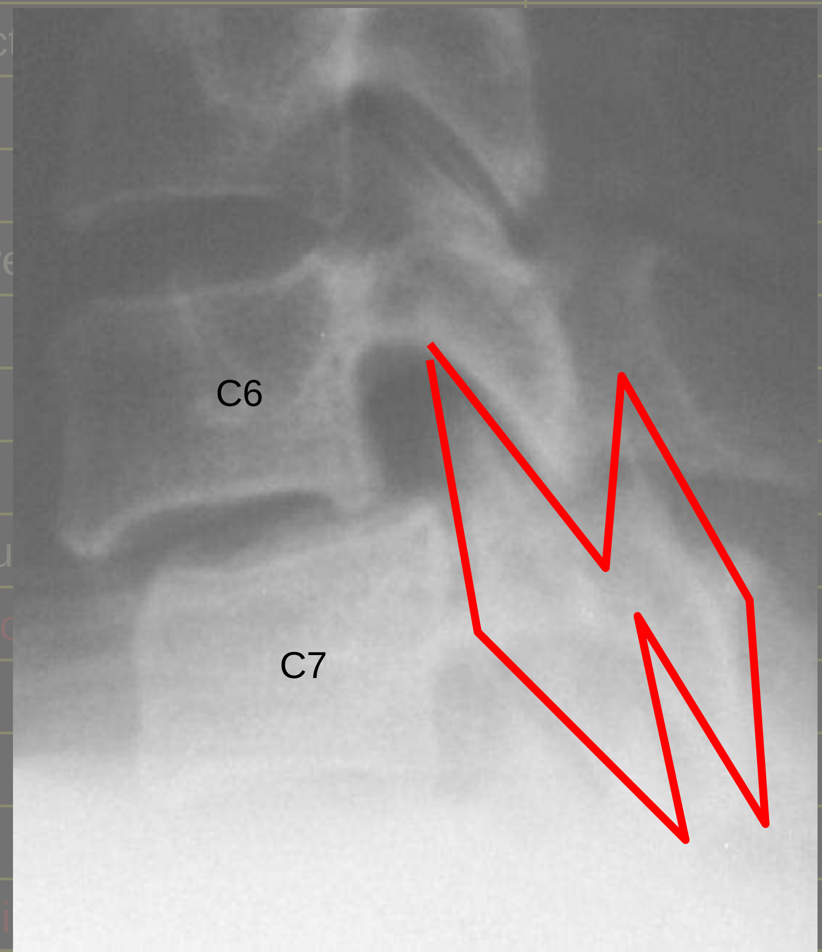


19M

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

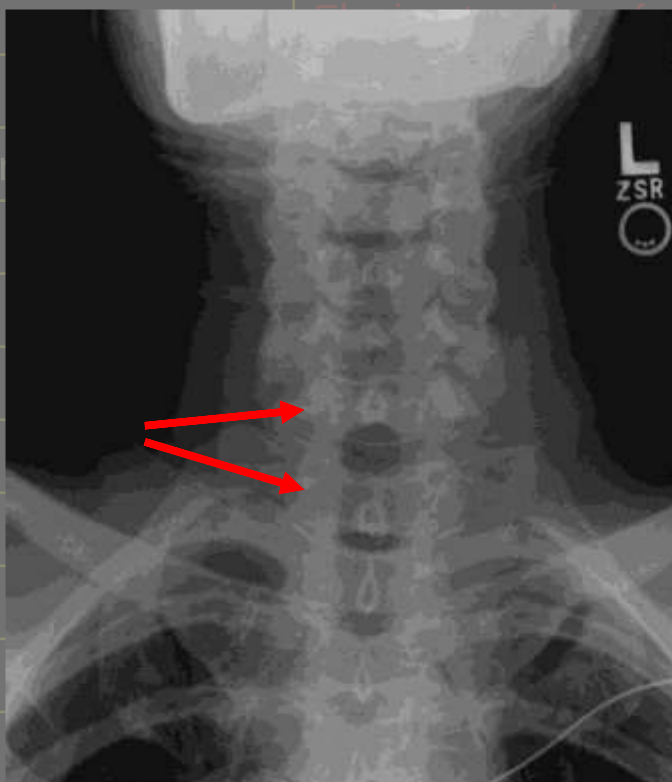
Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	ompression fract	
	ardrop fracture	
	eler's fracture	
Ex	arch C1 fracture	
	's fracture	
	racture	
	ture	
	teardrop fractu	
	ension dislocatio	
Co	fracture	
	ture	
Co	fractures	
	cipital disassoci	

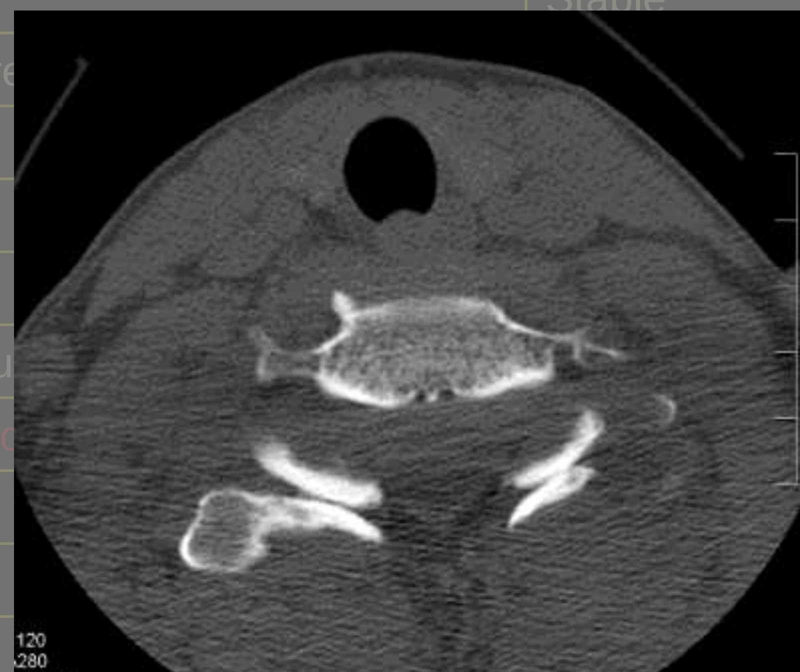


Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	**Unstable**
	Wedge compression fracture	Stable
	acture	Unstable
	cture	Stable
Exter	racture	
	fractu	
	locatio	
Com		
Com		
	Atlantooccipital disassociation	





C7-T1 Bifacet dislocations

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Atlantooccipital dissociation	Unstable

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Clay-shoveler's fracture	Stable
Extensi		Stable
		Unstable
		Stable
		Stable
		Stable
	fracture	Unstable
Compre		Unstable
		Stable
Comple		Unstable
	Atlantooccipital disassociation	

C5 flexion teardrop 38M

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Clay-shoveler's fracture	Stable
Extensi		Stable
		Unstable
		Stable
		Stable
		Stable
	fracture	Unstable
Compre		Unstable
		Stable
Comple		Unstable
	Atlantooccipital disassociation	

C5 flexion teardrop 38M

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

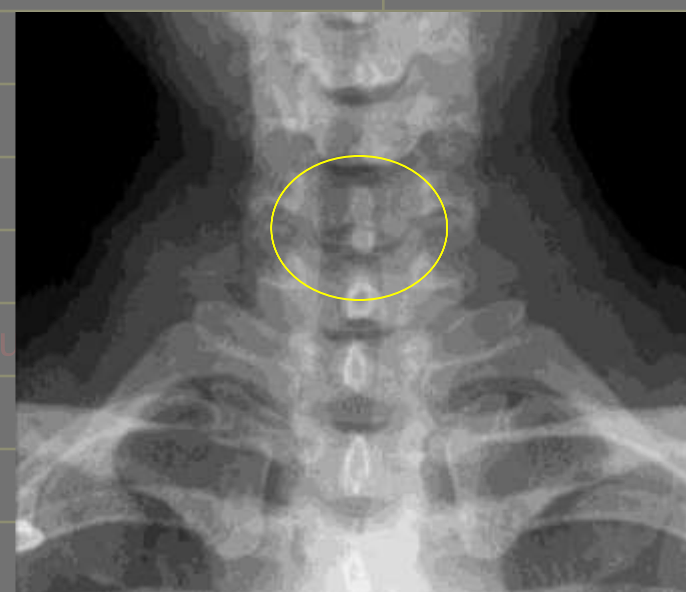
Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Clay-shoveler's fracture	Stable
Extensi		Stable
		Unstable
		Stable
		Stable
		Stable
	fracture	Unstable
Compre		Unstable
		Stable
Comple		Unstable
	Atlantooccipital disassociation	

C5 flexion teardrop 38M

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Clay-shoveler's fracture	Stable
Extension	Posterior arch C1 fracture	Stable
	e	
	o fracture	
	slocation fractu	
Co		
Co	s	
	Atlantooccipital disassociation	Unstable



Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Clay-shoveler's fracture	Stable
Extension	Posterior arch C1 fracture	Stable
		Unstable
		Stable
		Stable
		Stable
	ture	Unstable
Com		Unstable
		Stable
Com		Unstable
	Atlantooccipital disassociation	

18 y.o s/p MVA Hit head on windshield

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

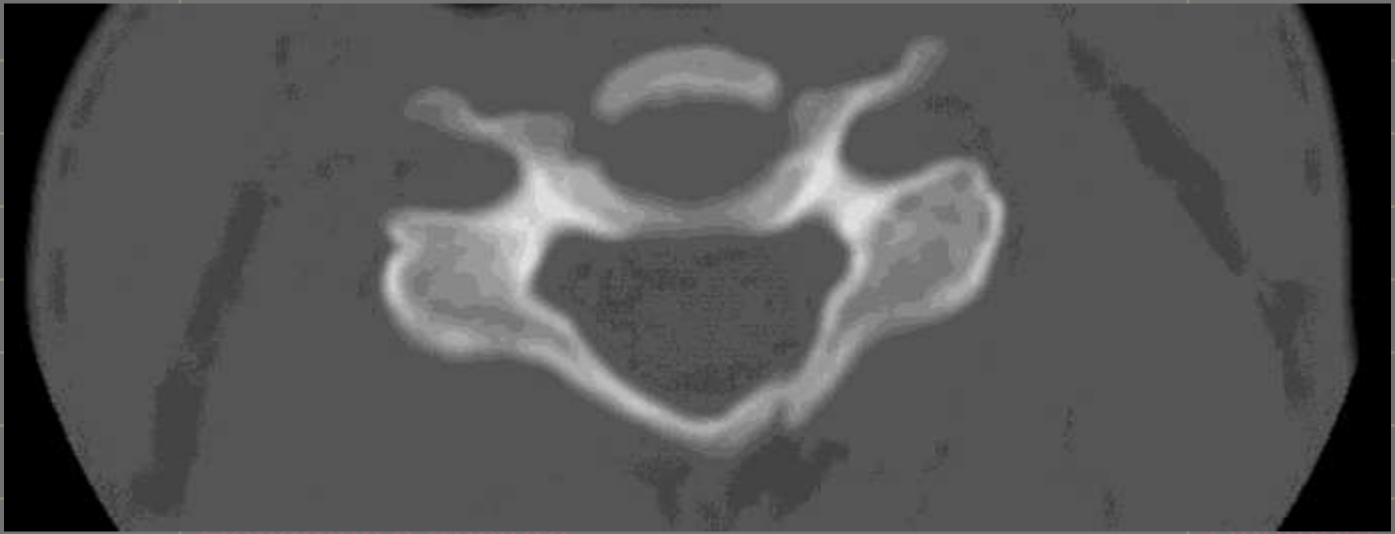
Also C2 teardrop and C1 posterior arch suggesting hyperextension

Flexion	Anterior Subluxation	Stable
	islocation	Stable
	location	Unstable
	sion fracture	Stable
	fracture	Unstable
	racture	Stable
E	1 fracture	Stable
	Hangman's fracture	Unstable
	Laminar fra	Stable
	Pillar fractu	Stable
	Extension t	Stable
	Hyperexten	Unstable
Compression	Jefferson f	Unstable
	Burst fractu	Stable
Complex	Odontoid f	Unstable
	Atlantoocc	Uns

Posterior arch C1 Fx

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.



Flexion		
Extension		
	Hangman's fracture	Unstable
	Laminar fracture	Stable
	Pillar fracture	Stable
	Extension teardrop fracture	Stable
	Hyperextension dislocation fracture	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

20M

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
Extension		
	Laminar fracture	Stable
	Pillar fracture	Stable
	Extension teardrop fracture	Stable
	Hyperextension dislocation fracture	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

37M MVA Neck Stiffness

Cx-Spine Stability

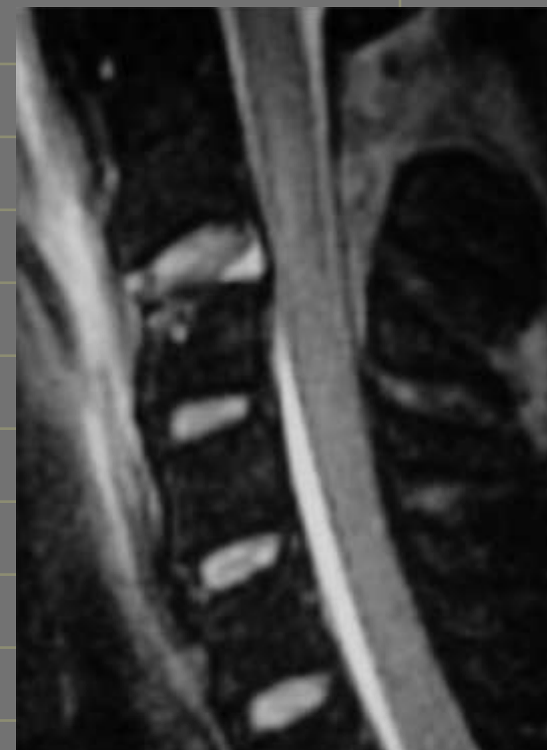
An unstable injury, is one which can progress and cause cord injury.

F		
	cation	
	ation	
	fracture	
	cture	
	ture	
E	acture	
	Pillar fracture	Stable
	Extension teardrop fracture	Stable
	Hyperextension dislocation fracture	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	

C3 hyperextension avulsion

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.



Flexion	n	
	ocation	
	ation	e
	n fracture	
	cture	e
	ture	
Extension	acture	
		e
	Extension teardrop fracture	Stable
	Hyperextension dislocation fracture	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	tion	
	fract	
	ture	
	ure	
E	cture	
	Pillar fracture	Stable
	Extension teardrop fracture	Stable
	Hyperextension dislocation fracture	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	

18 y.o s/p MVA Hit head on windshield

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Ante	Stable
	Unil	Stable
	Bila	Unstable
	Wed	Stable
	Flex	Unstable
	Clay	Stable
Extension	Pos	Stable
	Han	Unstable
	Lam	Stable
	Pilla	Stable
	Exte	Stable
	Hyp	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	**Stable**
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexio		
Exten		
Comp		
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

22M MVA

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	n	
	ure	
Ex		
	re	
	n frac	
Co		
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

28M MCA

Cx-Spine Stability

An unstable injury, is one which can progress and cause cord injury.

Flexion	Anterior Subluxation	Stable
	Unilateral facet dislocation	Stable
	Bilateral facet dislocation	Unstable
	Wedge compression fracture	Stable
	Flexion teardrop fracture	Unstable
	Clay-shoveler's fracture	Stable
Extension	Posterior arch C1 fracture	Stable
	Hangman's fracture	Unstable
	Laminar fracture	Stable
	Pillar fracture	Stable
	Extension teardrop fracture	Stable
	Hyperextension dislocation fracture	Unstable
Compression	Jefferson fracture	Unstable
	Burst fracture	Stable
Complex	Odontoid fractures	Unstable
	Atlantooccipital disassociation	Unstable

Cx-Spine - Stability

- MRI
  - Shows
    - Edema of soft tissues
    - Paravertebral hematoma
    - Ligamentous disruption

  - Still does not indicate instability
  - Negative study does not indicate stability

ALL rupture C6-7

Cx-Spine - Stability

- Flexion Extension views
  - Patient should be erect
  - Should wait 2w for spasm to resolve
  - Must see to T1
  - Must move > 30 degrees

Ligament injury

- Increased interlaminar distance
- Facet joint widening
-
- Focal kyphosis >24º on F/E
- Kyphosis > 11º compared to adjacent levels
- Incongruent disk space, posterior widening
- >3.5 mm anterolisthesis

White and Panjabi, Berquist

Ligament injury

- Increased interlaminar distance
- Facet joint widening.
-
- Focal kyphosis >24º on F/E
- Kyphosis > 11º compared to adjacent levels
- Incongruent disk space, posterior widening
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White and Panjabi, Berquist

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White and Panjabi, Berquist

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- Increased interlaminar distance
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White and Panjabi, Berquist

Ligament injury

- Increased interlaminar distance
- Facet joint widening
-
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- >3.5 mm anterolisthesis.

White and Panjabi, Berquist

Ligament injury

- Increased interlaminar distance
- Facet joint widening
-
- Focal kyphosis >24º on F/E
- Kyphosis > 11º compared to adjacent levels
- Incongruent disk space, posterior widening
- >3.5 mm anterolisthesis

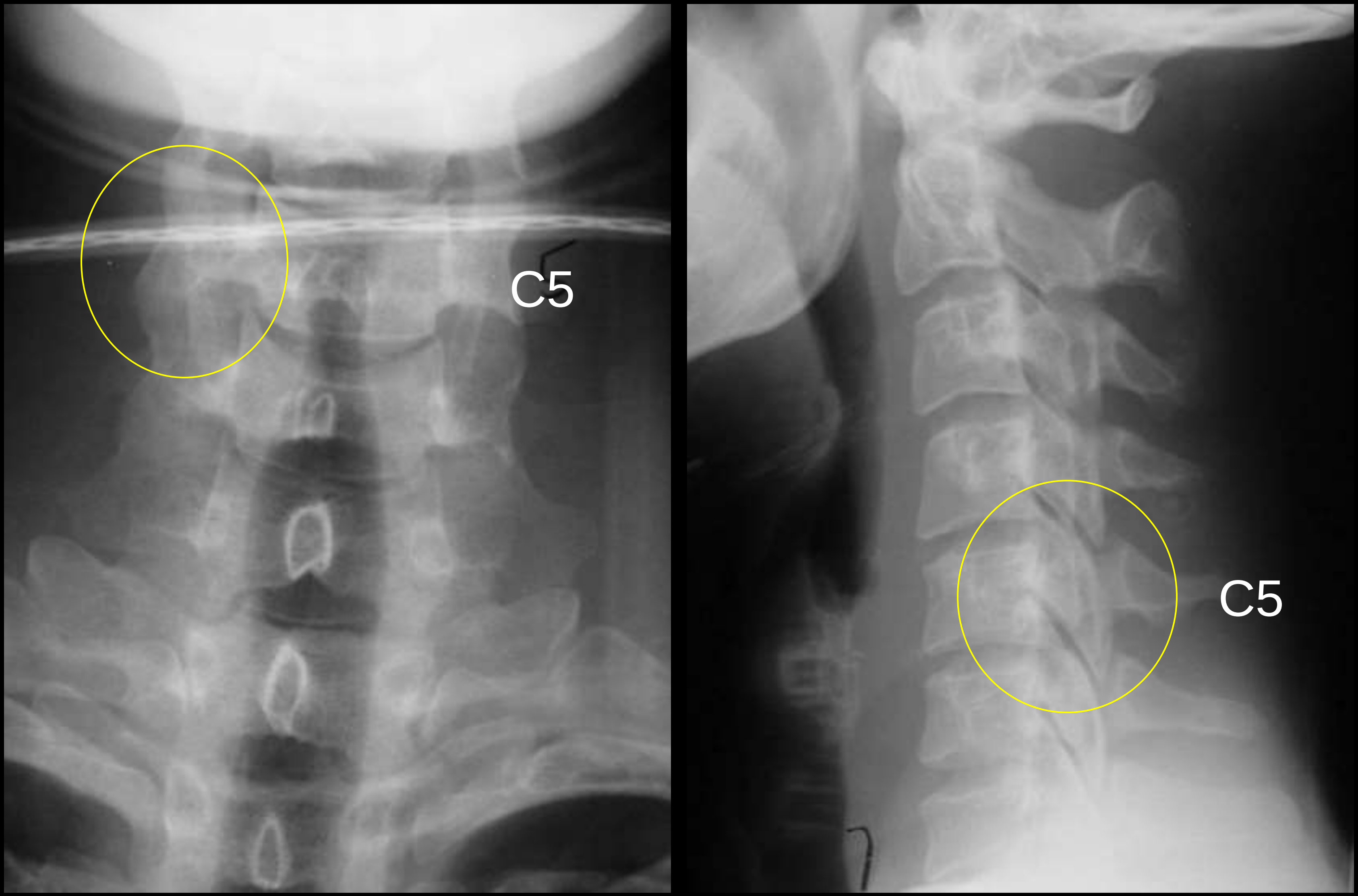
White and Panjabi, Berquist

White/Panjabi - C-spine Instability

- White & Panjabi criteria:
  - Anterior elements destroyed = 2
  - Posterior elements destroyed = 2
- Flexion/Extension
  - Sagittal translation > 3.5 mm or 20% of vertebra = 2
  - Sagittal plane rotation >24º =2
- Resting x-rays
  - Sagittal translation > 3.5 mm or 20% of vertebra = 2
  - Sagittal rotation > 11º = 2
  - Abnormal disc narrowing = 1
  - Narrow canal <13mm or Pavlov's ratio <.8 =1
  -
    - Positive stretch test = 2
    - Cord damage = 2
    - Root damage = 1
    - Dangerous loads anticipated = 1
- Unstable if total score > 5

Atlantooccipital subluxation

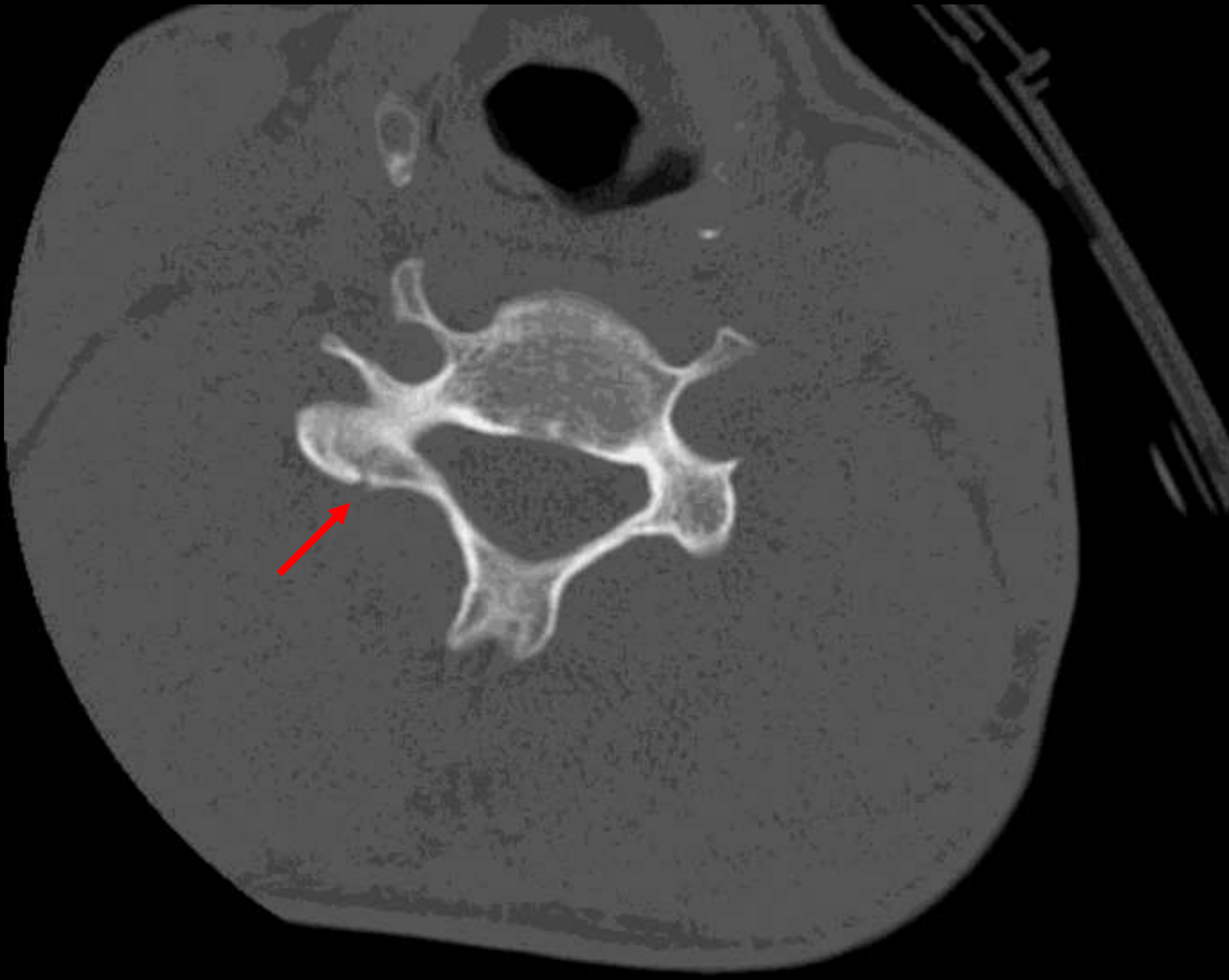
Comparing Techniques



1+5+5+5

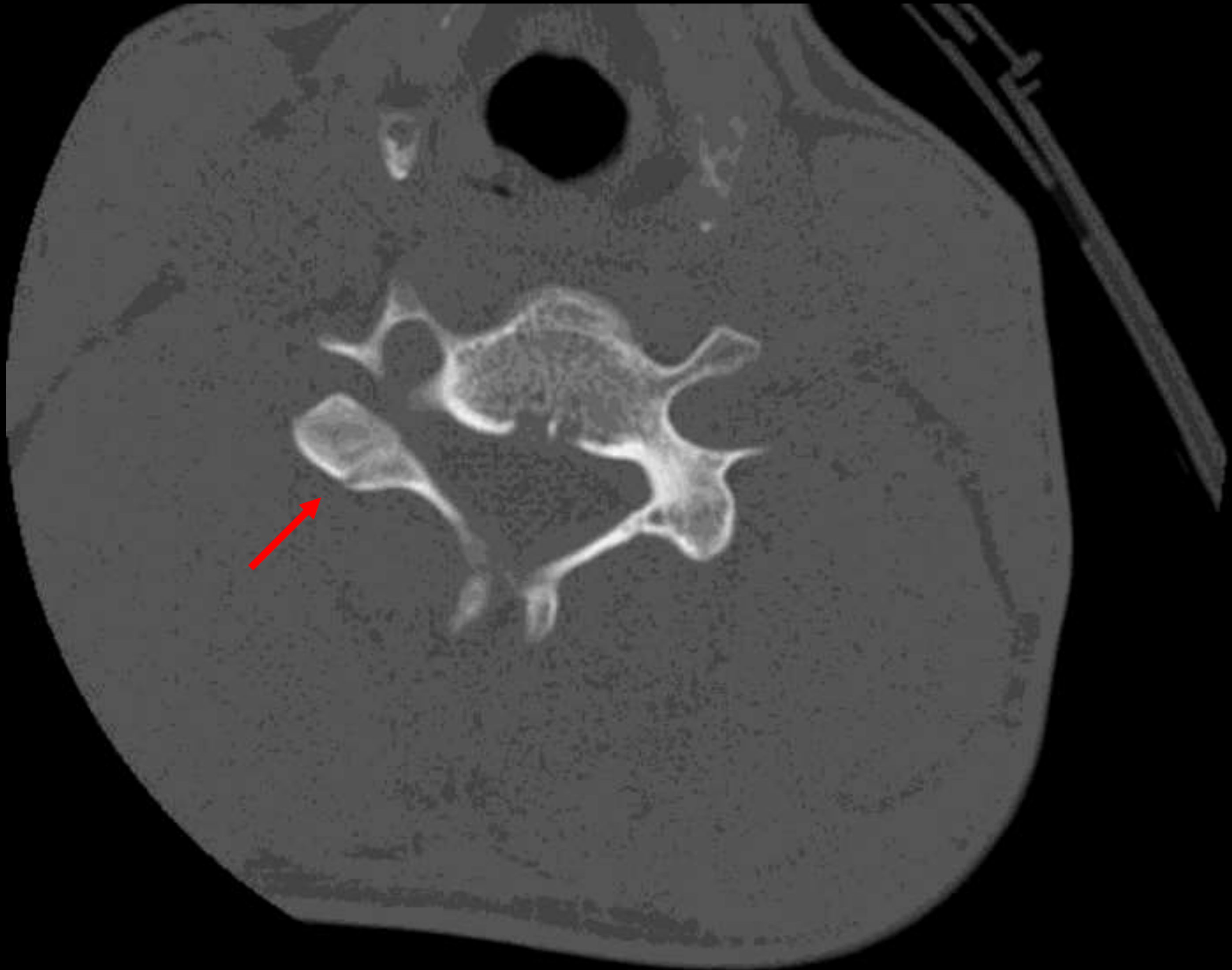
C5 inferior facet Fracture not seen on X-ray

Comparing Techniques



C5 inferior facet Fracture not seen on X-ray

Comparing Techniques



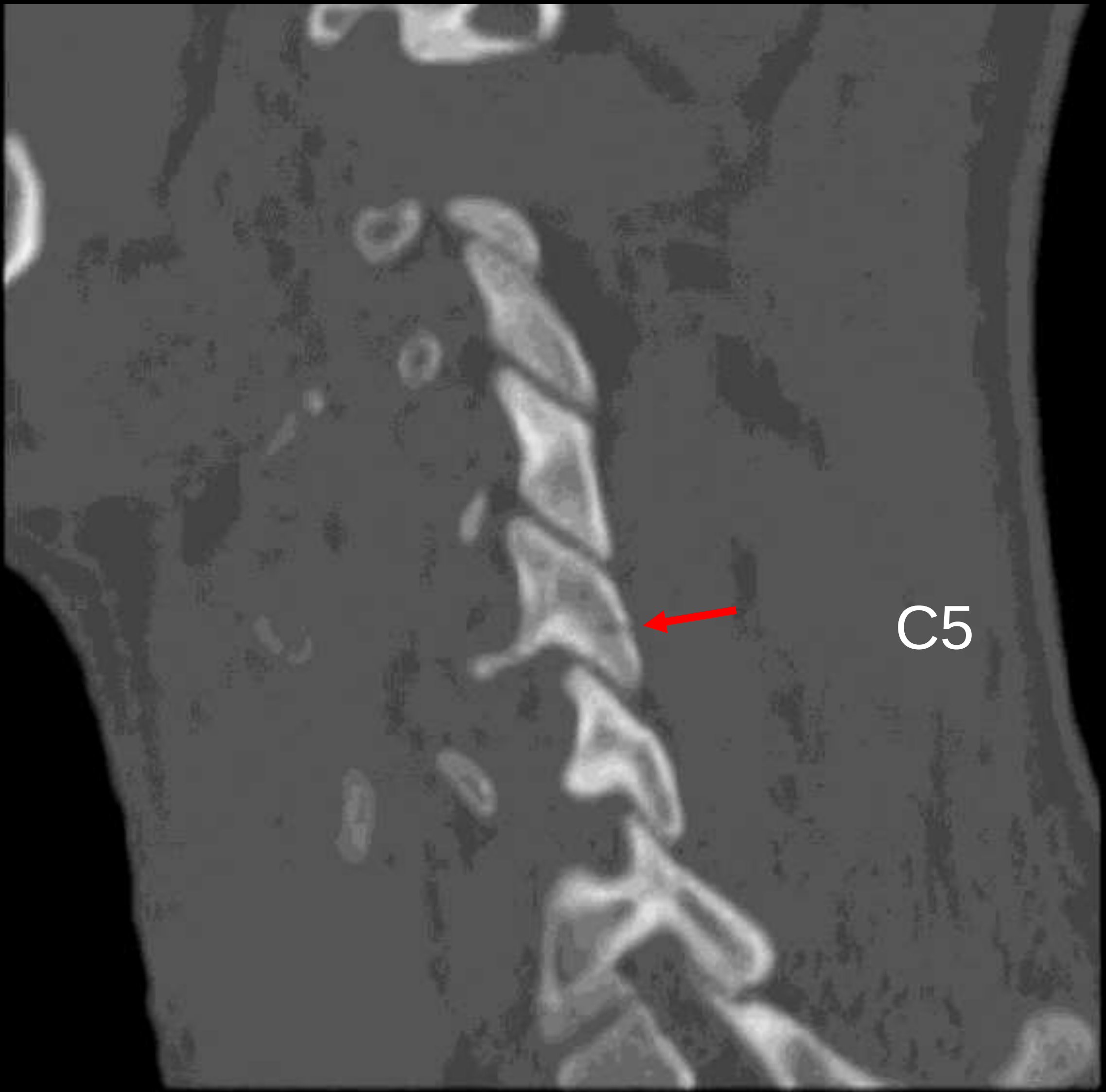
C5

C5 inferior facet Fracture not seen on X-ray

Comparing Techniques

C5 inferior facet Fracture not seen on X-ray

Comparing Techniques



C5 inferior facet Fracture not seen on X-ray

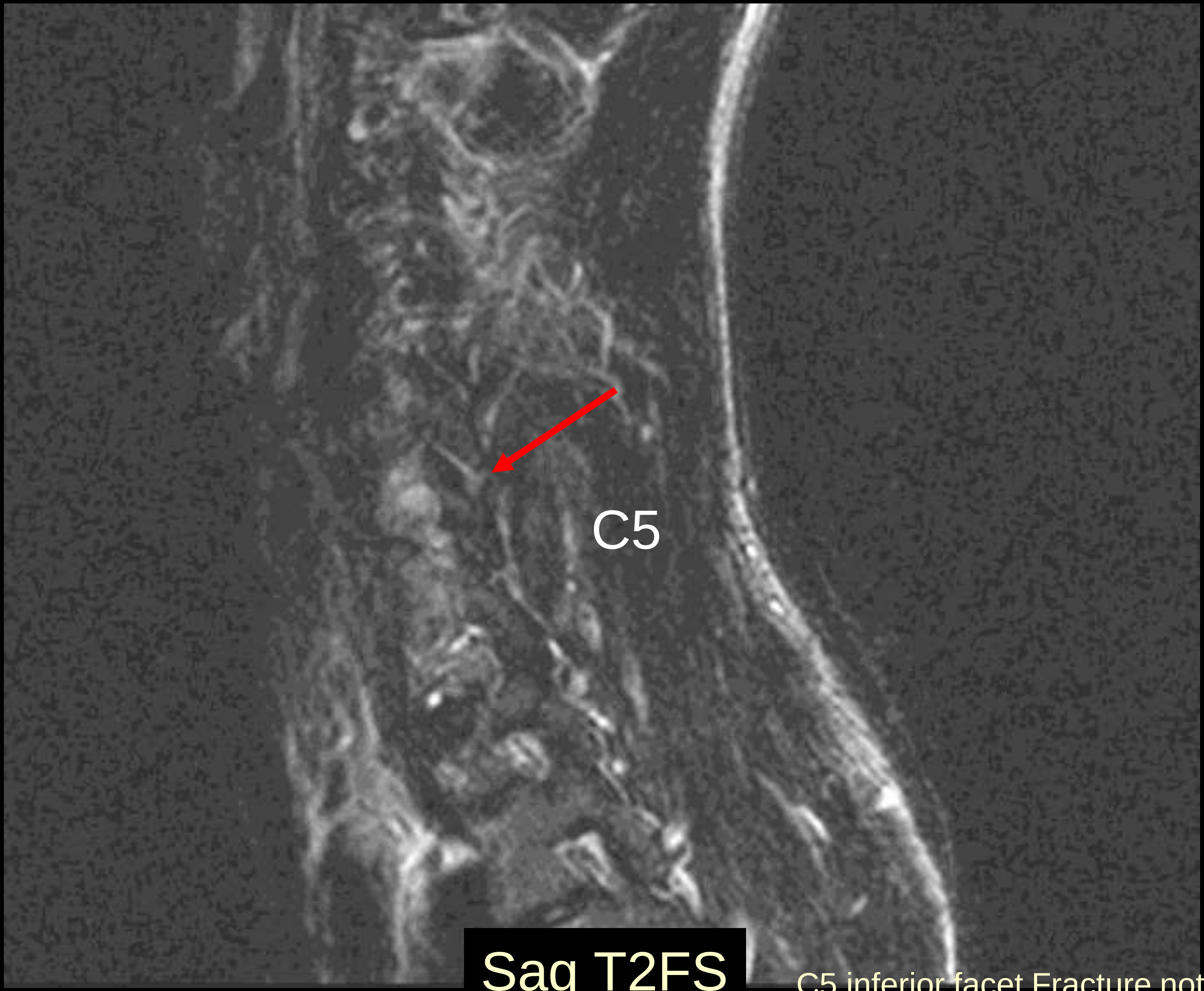
Comparing Techniques

C5 inferior facet Fracture not seen on X-ray

Comparing Techniques

C5 inferior facet Fracture not seen on X-ray

Comparing Techniques



C5 inferior facet Fracture not seen on X-ray

Comparing Techniques

Sag T2FS

C5 inferior facet Fracture not seen on X-ray

Comparing Techniques

Sag T2FS

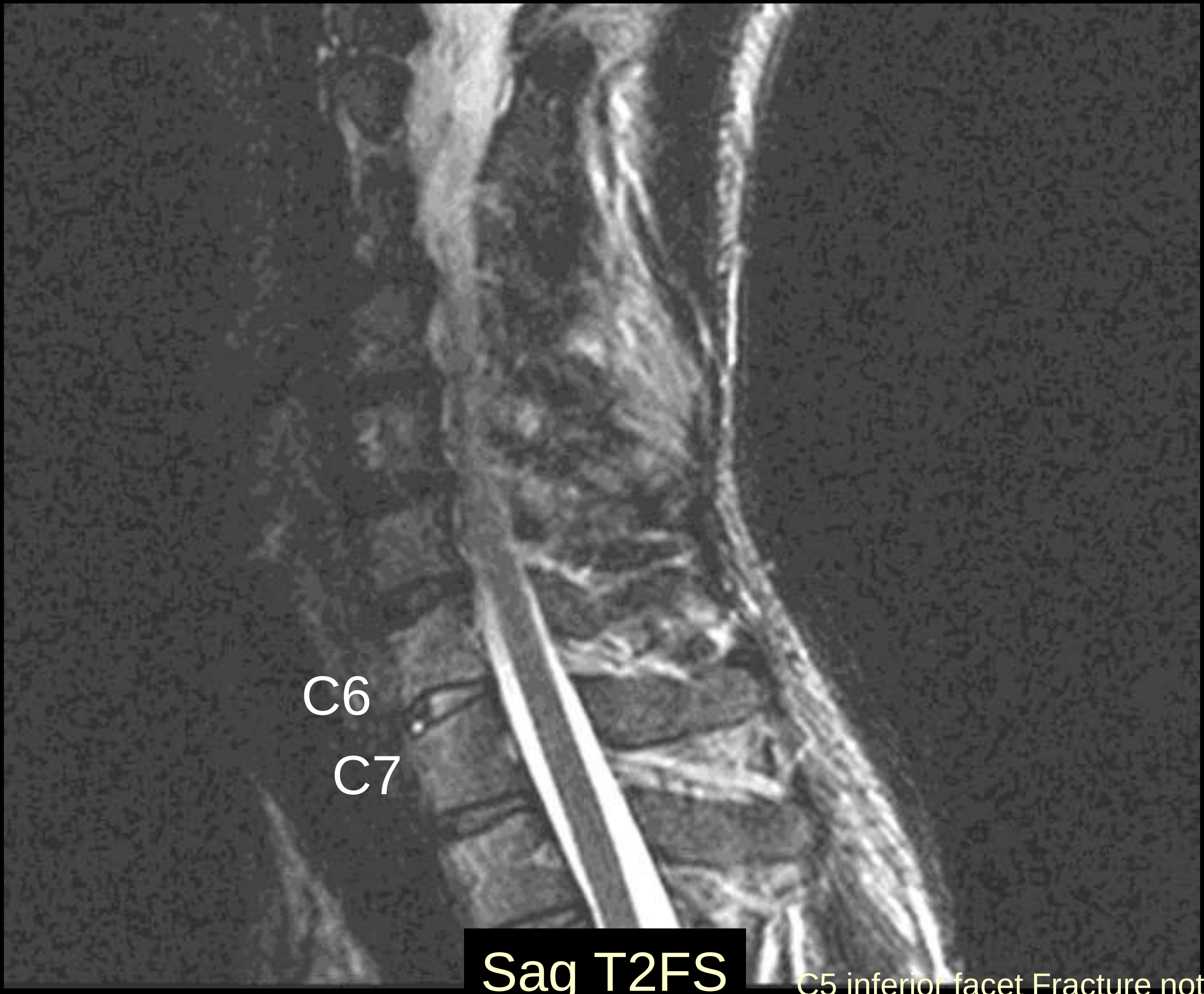
C5 inferior facet Fracture not seen on X-ray

Comparing Techniques

Sag T2FS

C5 inferior facet Fracture not seen on X-ray

Comparing Techniques



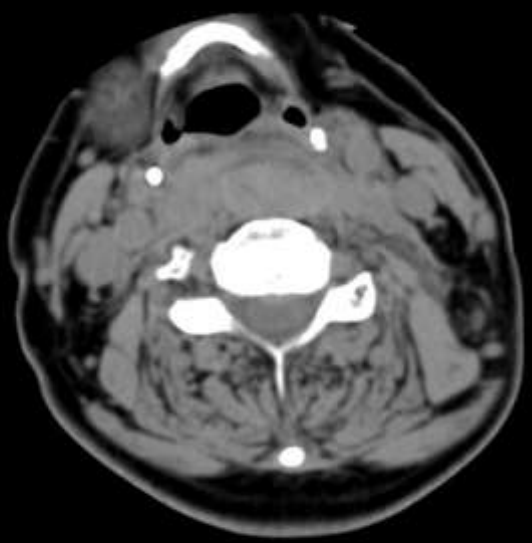
C5 inferior facet Fracture not seen on X-ray

Comparing Techniques

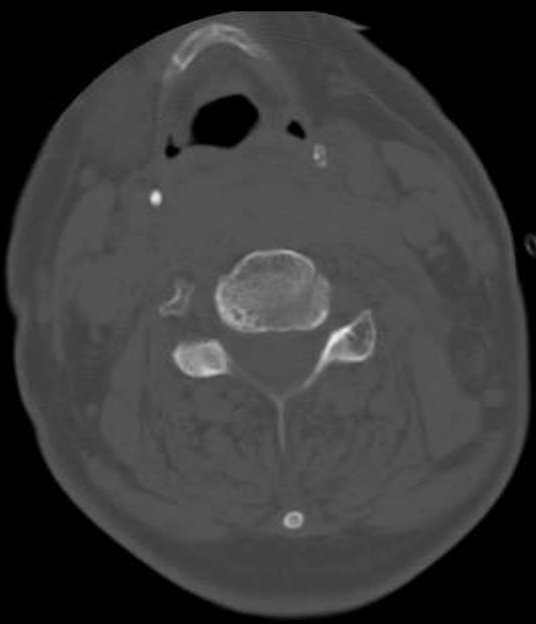
1+7+3

66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

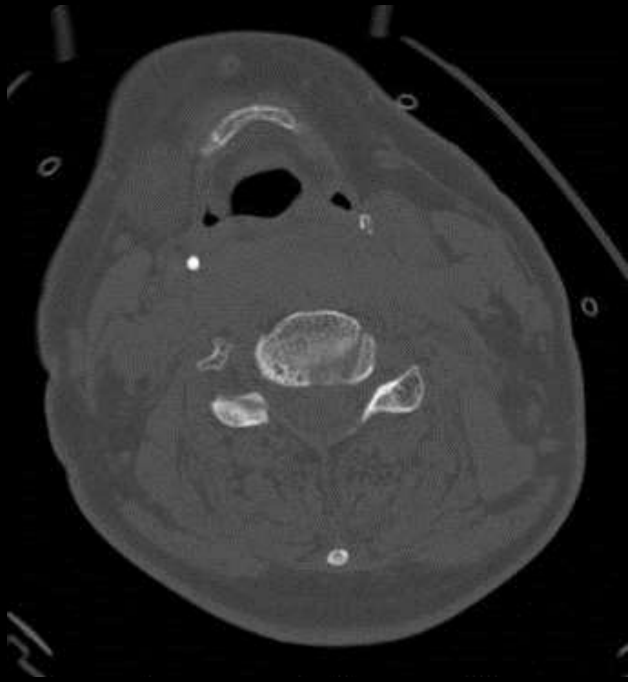
Comparing Techniques



2.5 Soft tissue window



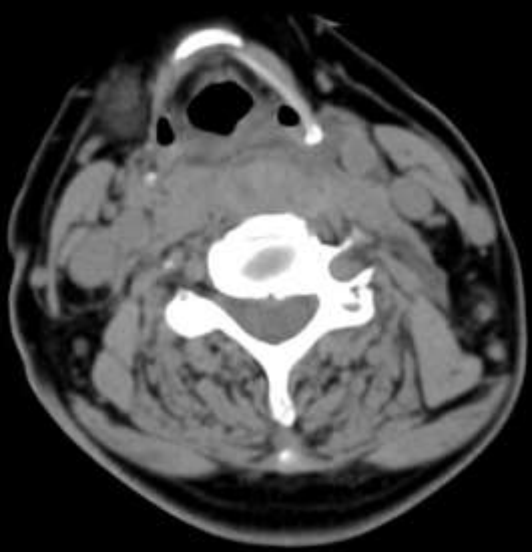
2.5 bone



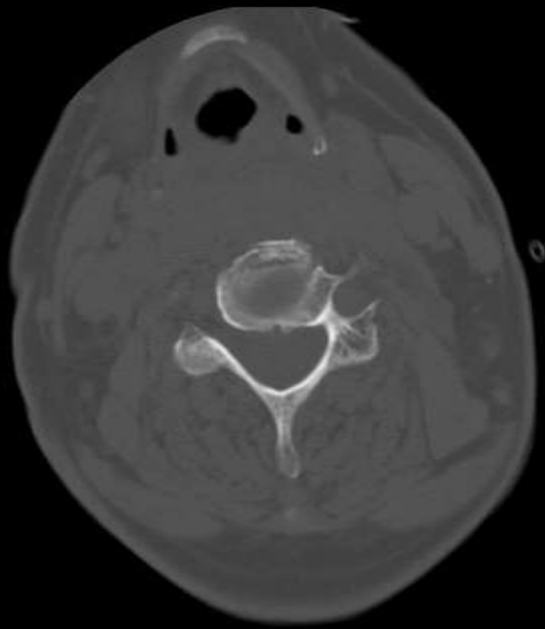
1.25 bone

66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

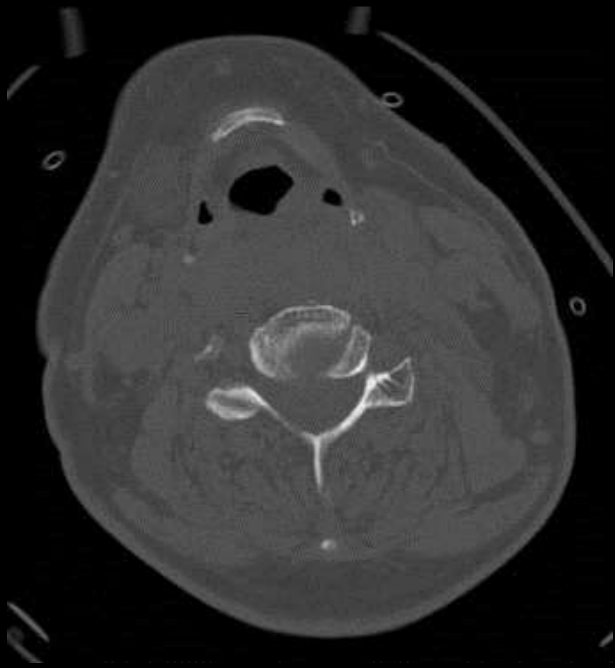
Comparing Techniques



2.5 Soft tissue window



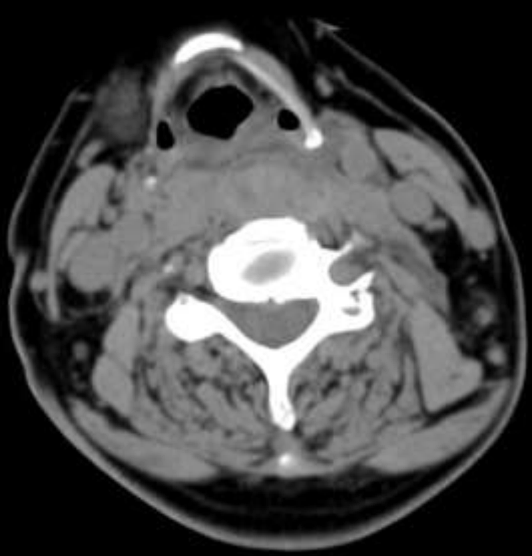
2.5 bone



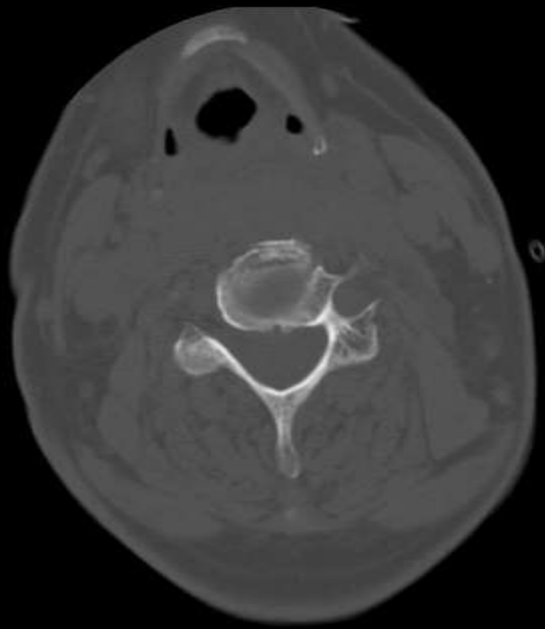
1.25 bone

66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

Comparing Techniques



2.5 Soft tissue window

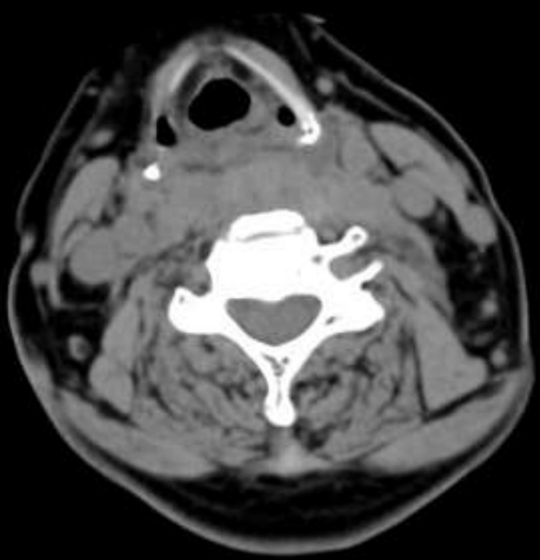


2.5 bone

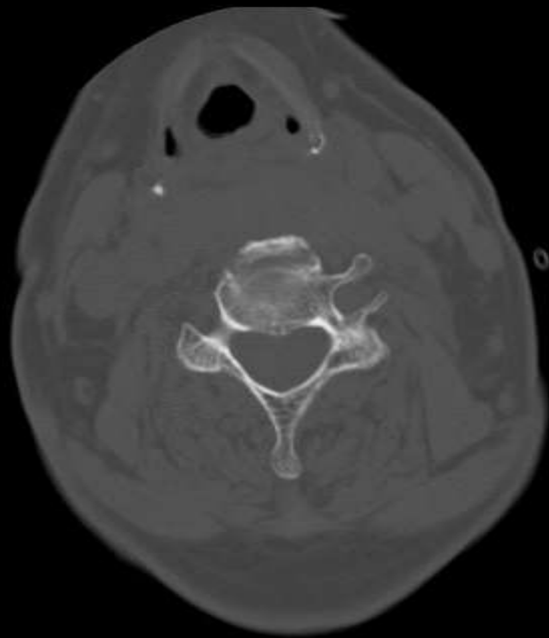
1.25 bone

66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

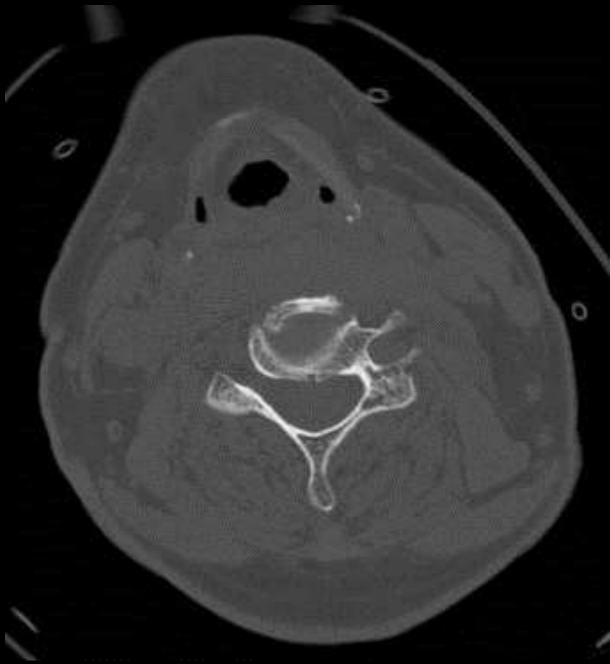
Comparing Techniques



2.5 Soft tissue window



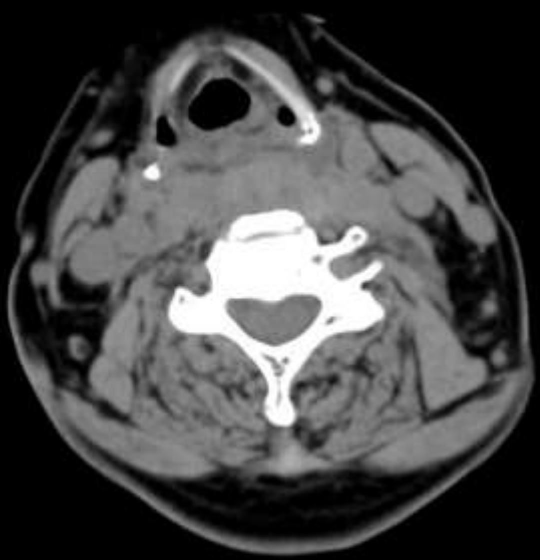
2.5 bone



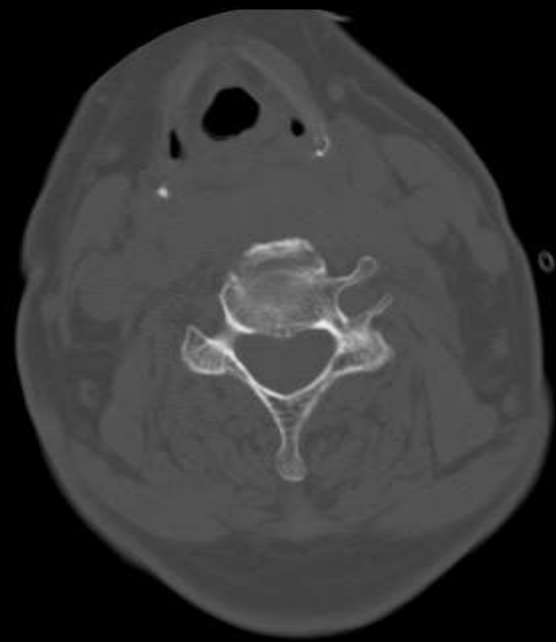
1.25 bone

66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

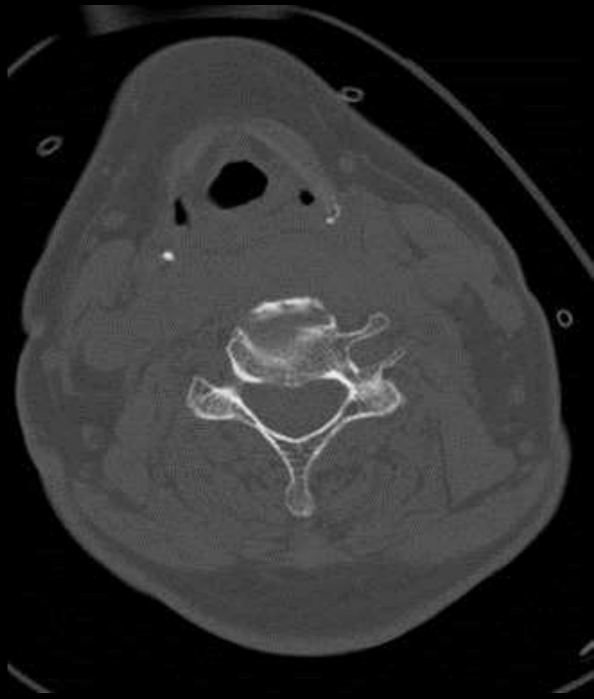
Comparing Techniques



2.5 Soft tissue window



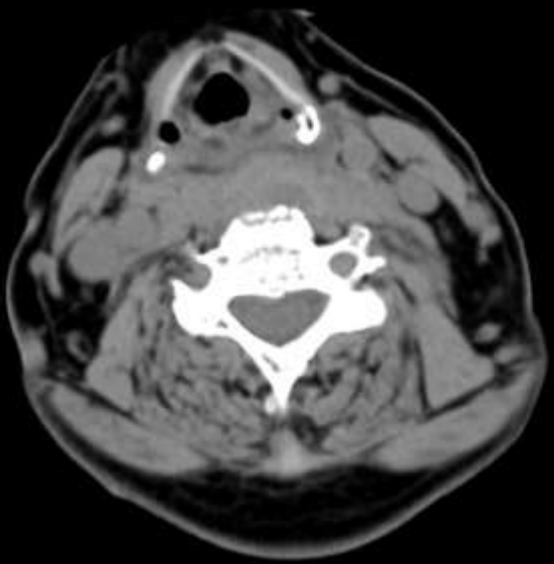
2.5 bone



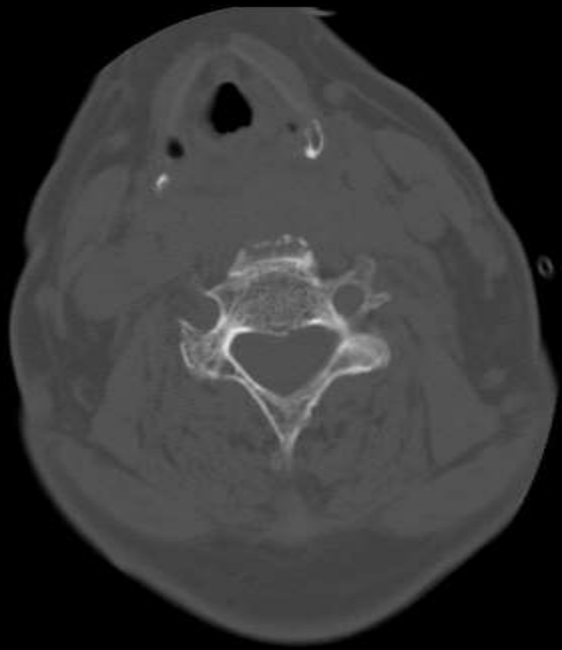
1.25 bone

66F Whiplash.   C4 Extension Teardrop, Best seen on Plain Films

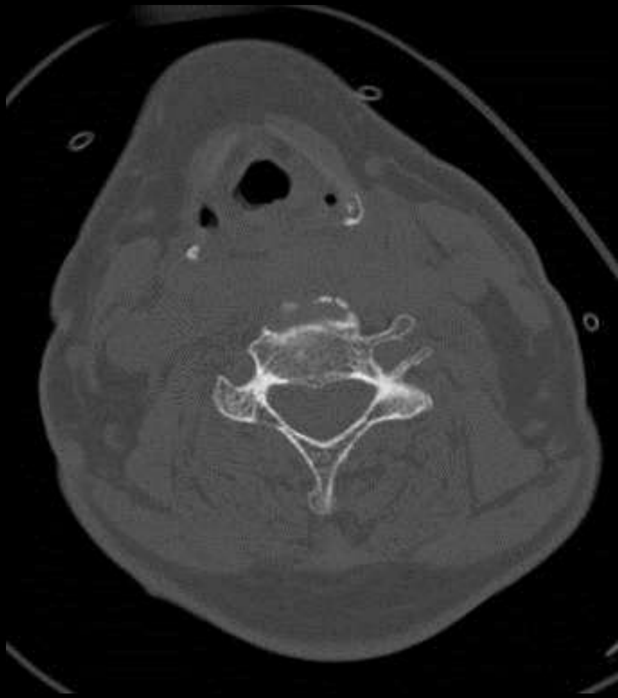
Comparing Techniques



2.5 Soft tissue window



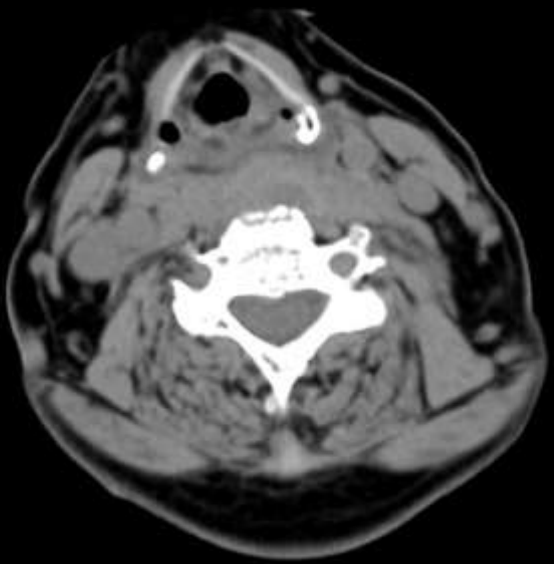
2.5 bone



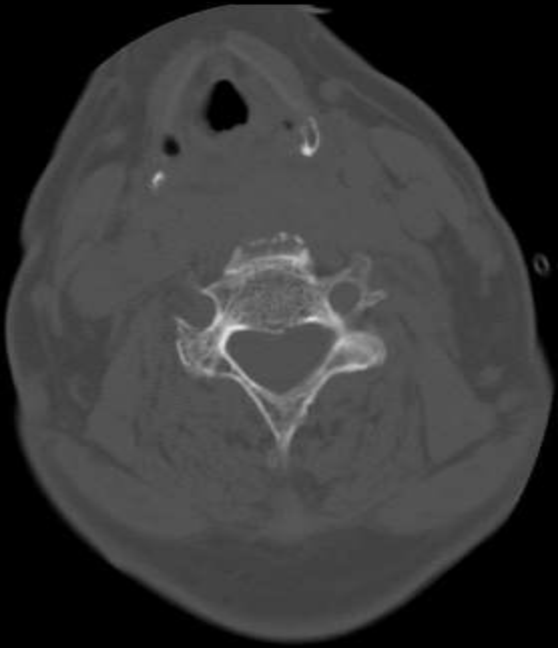
1.25 bone

66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

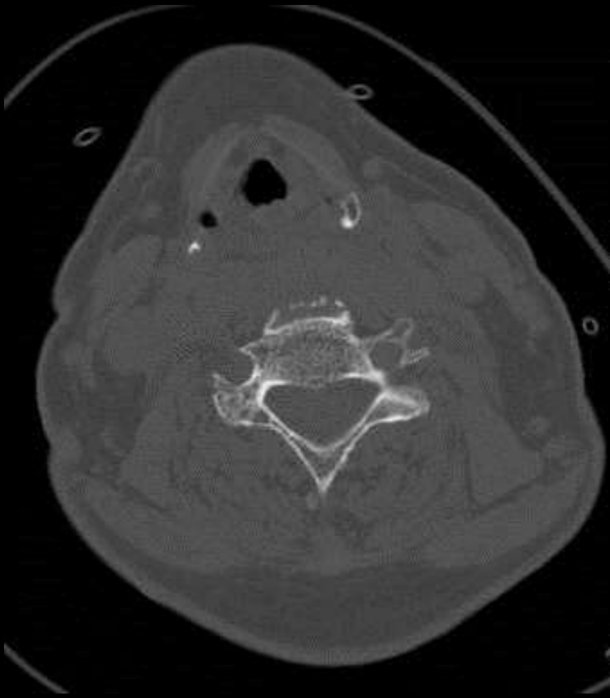
Comparing Techniques



2.5 Soft tissue window



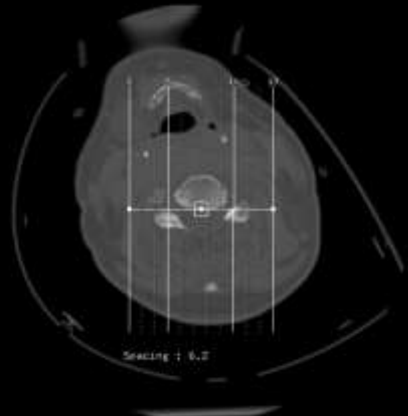
2.5 bone



1.25 bone

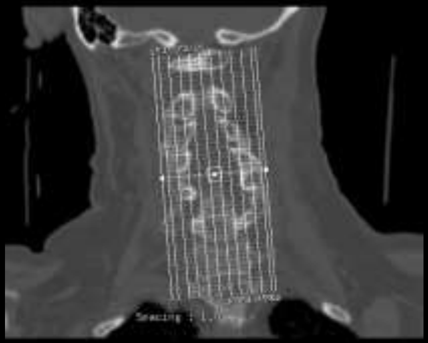
66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

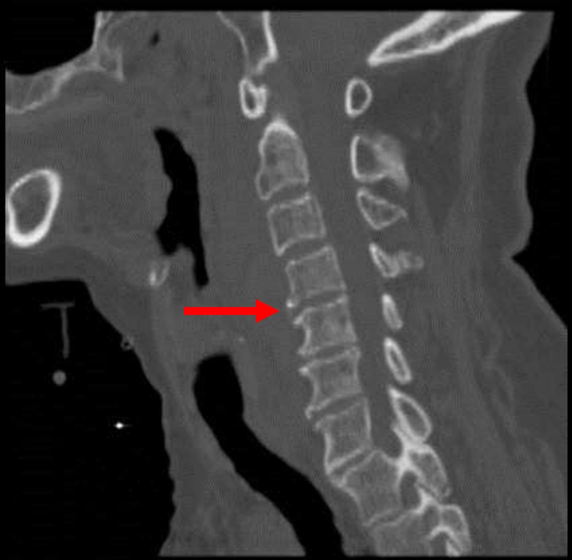
Comparing Techniques



6.2mm

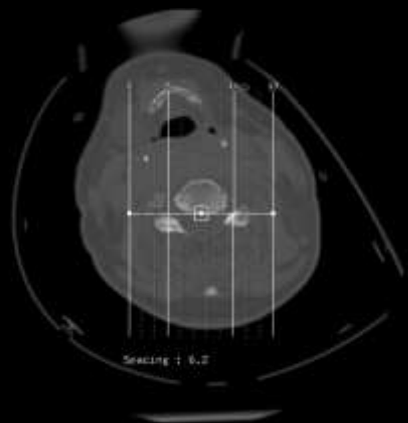
1mm





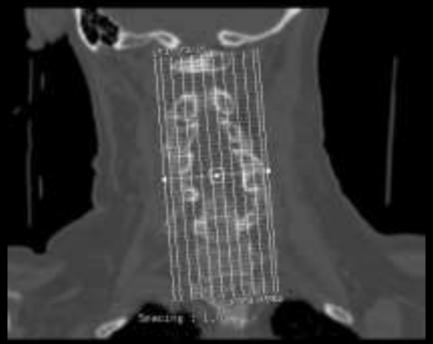
66F Whiplash.   C4 Extension Teardrop, Best seen on Plain Films

Comparing Techniques



6.2mm

1mm

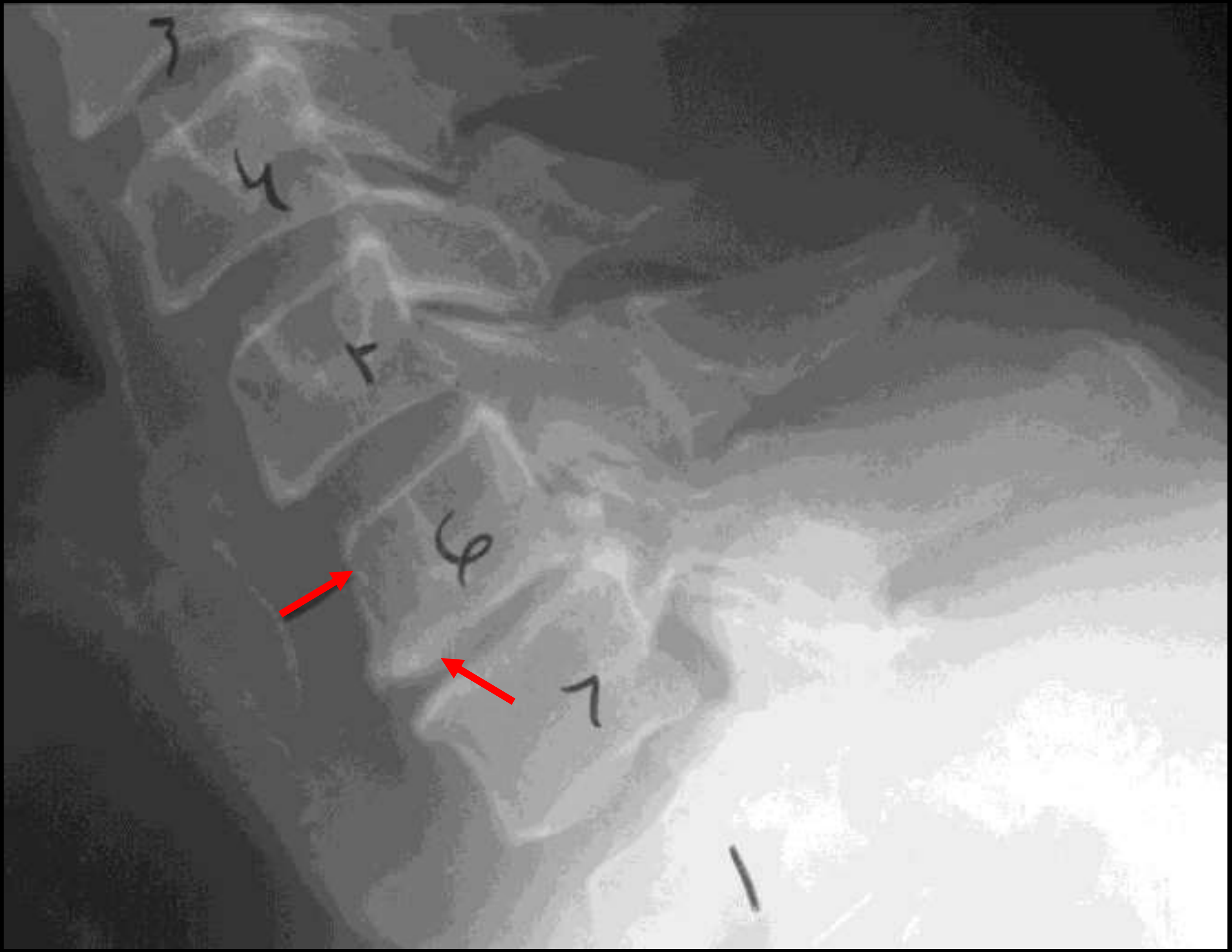


66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

Comparing Techniques

66F Whiplash. C4 Extension Teardrop, Best seen on Plain Films

Comparing Techniques



1+5+4+3+1

58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques

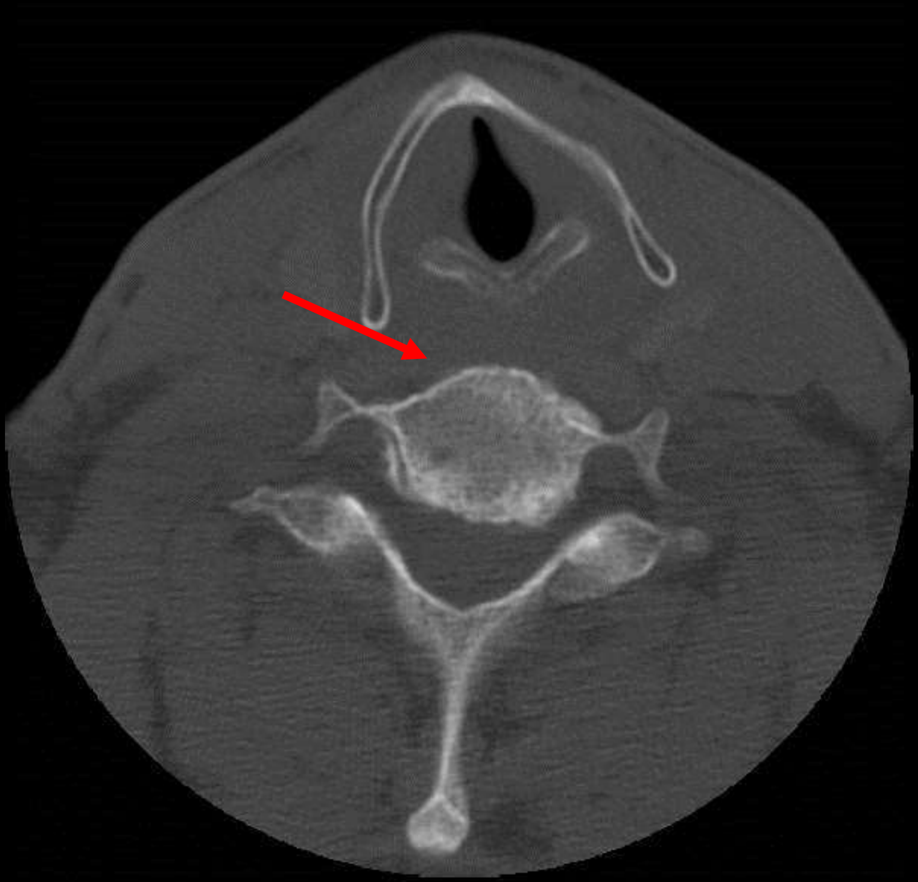
C6

3/1mm

5+4+3+1

58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques

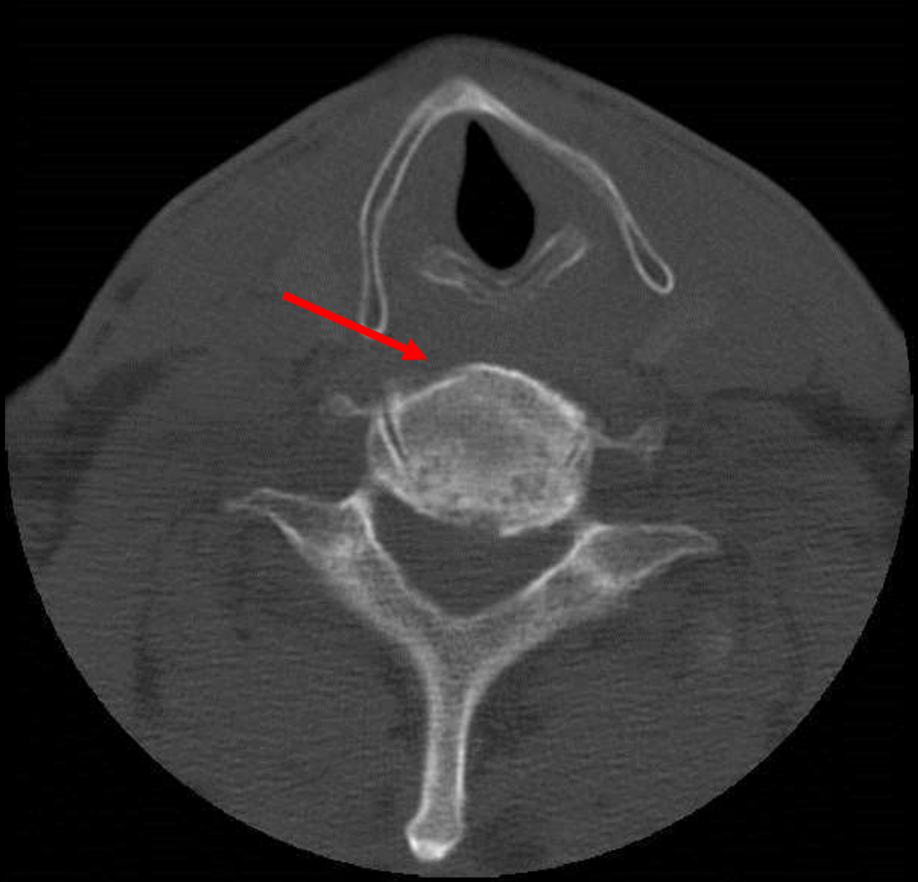


C6

4+4+3+1

58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques

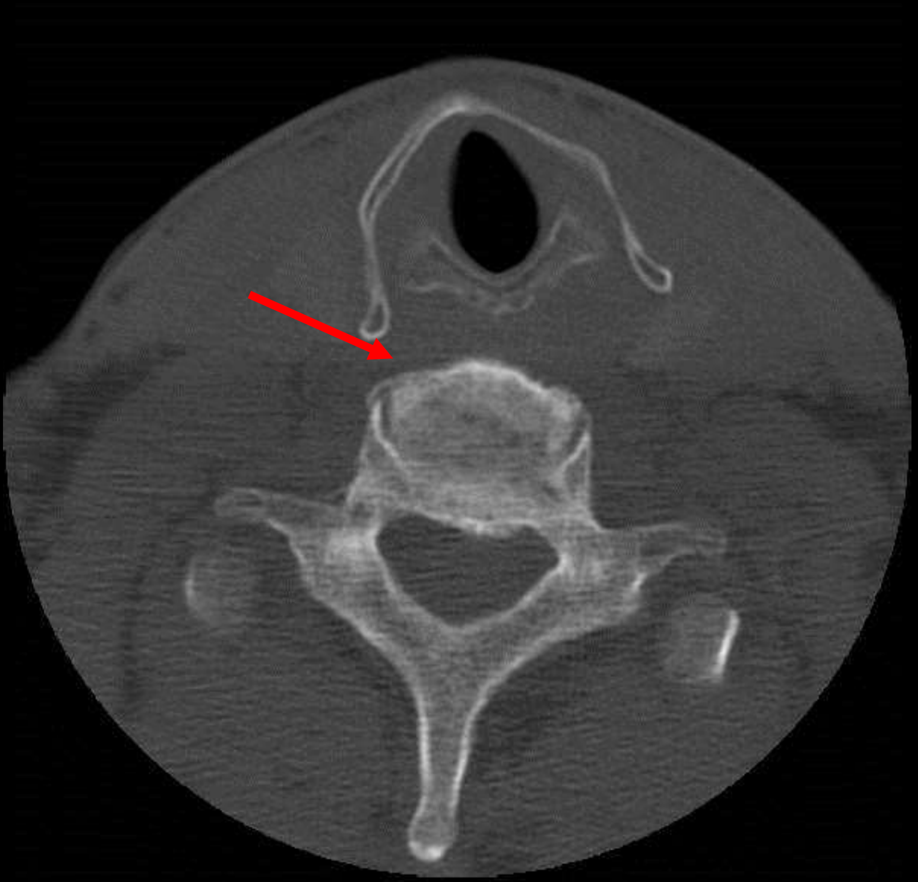


C6

3+4+3+1

58M Trauma.   C6 Fx poorly seen on CT

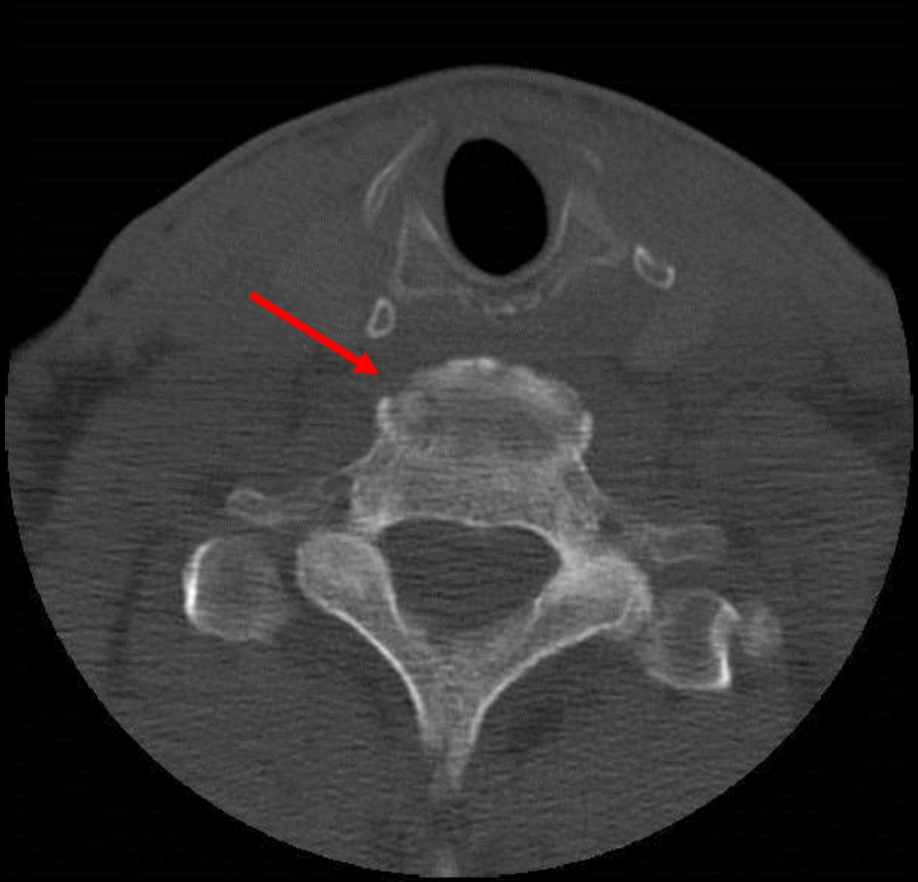
Comparing Techniques



C6

58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques

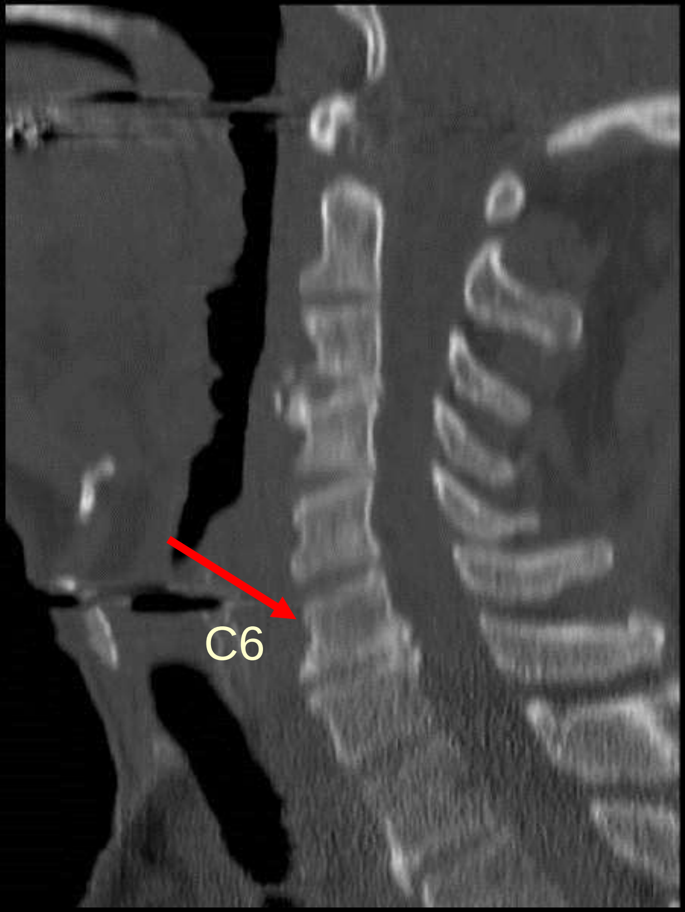


C6/7

1+4+3+1

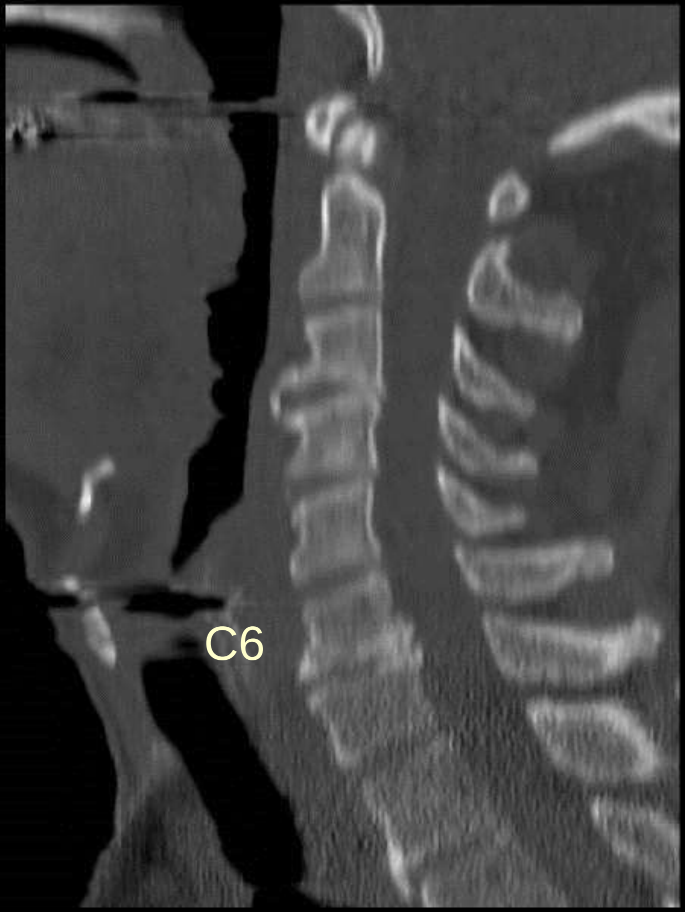
58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques



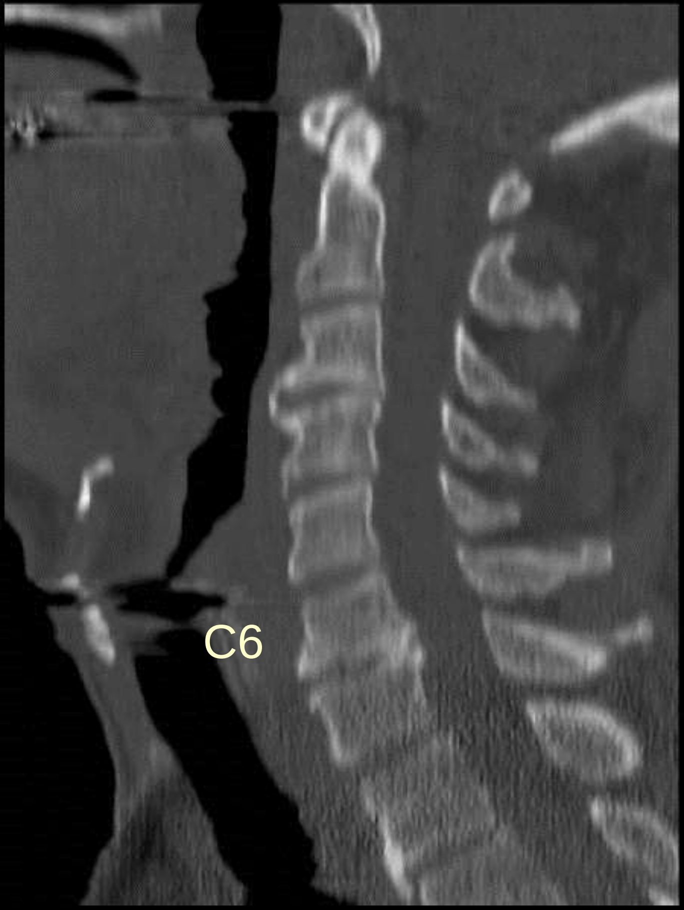
58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques



58M Trauma. C6 Fx poorly seen on CT

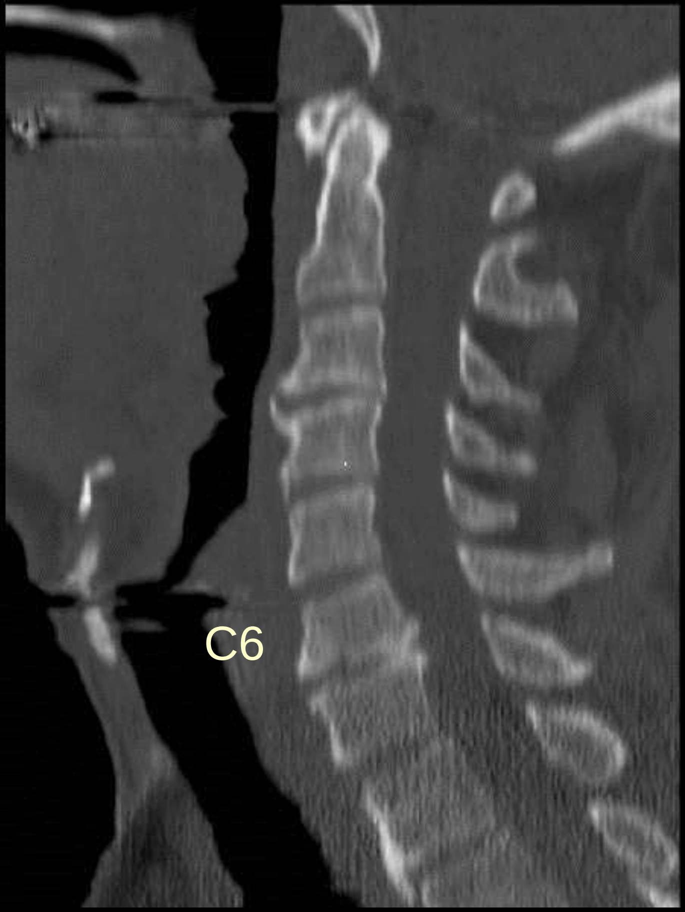
Comparing Techniques



2+3+1

58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques



58M Trauma.   C6 Fx poorly seen on CT

Comparing Techniques

58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques

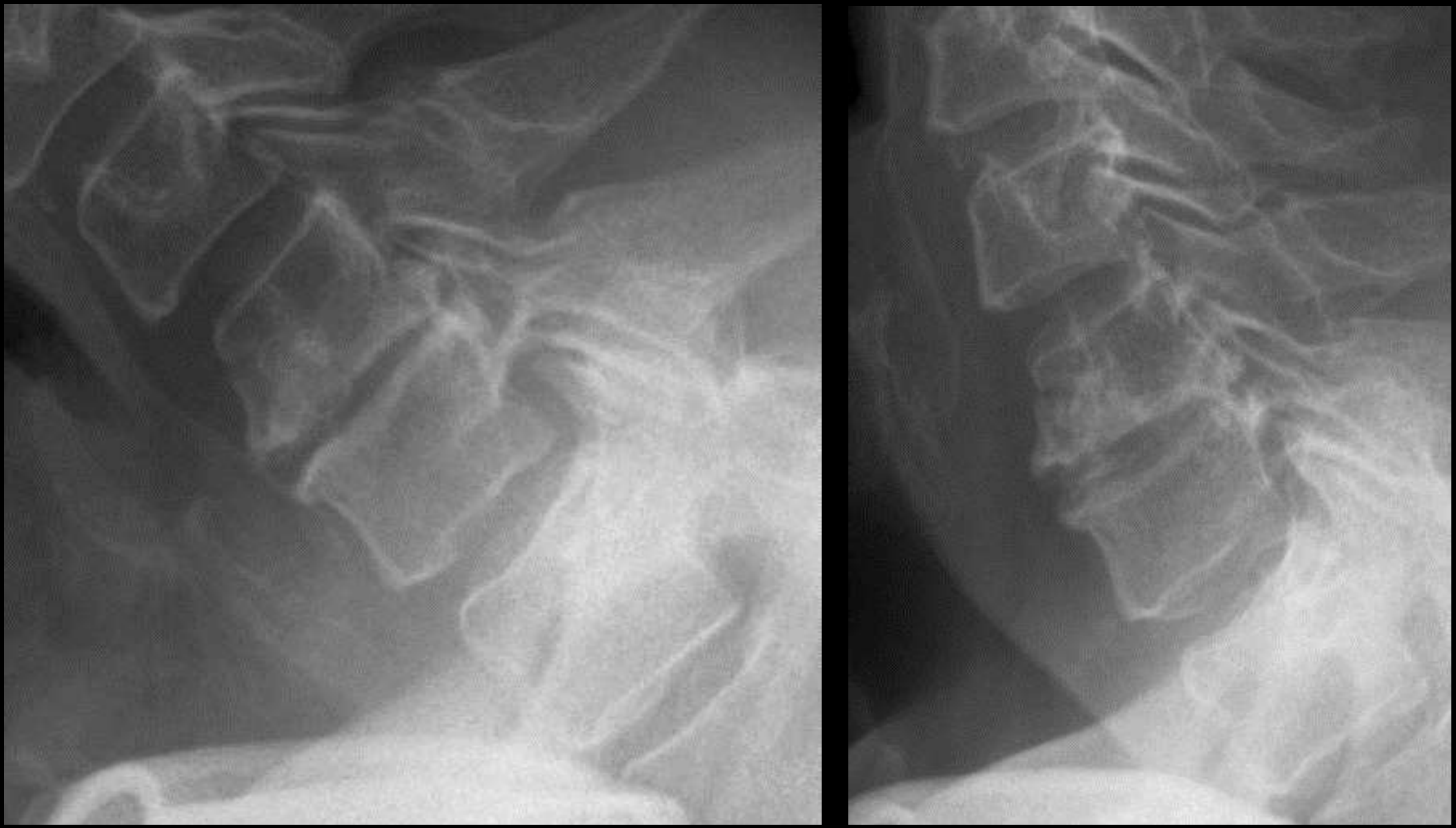
58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques

1+1

58M Trauma.   C6 Fx poorly seen on CT

Comparing Techniques



6w later

58M Trauma. C6 Fx poorly seen on CT

Comparing Techniques

Effendi II easier to see on X-ray

Comparing Techniques

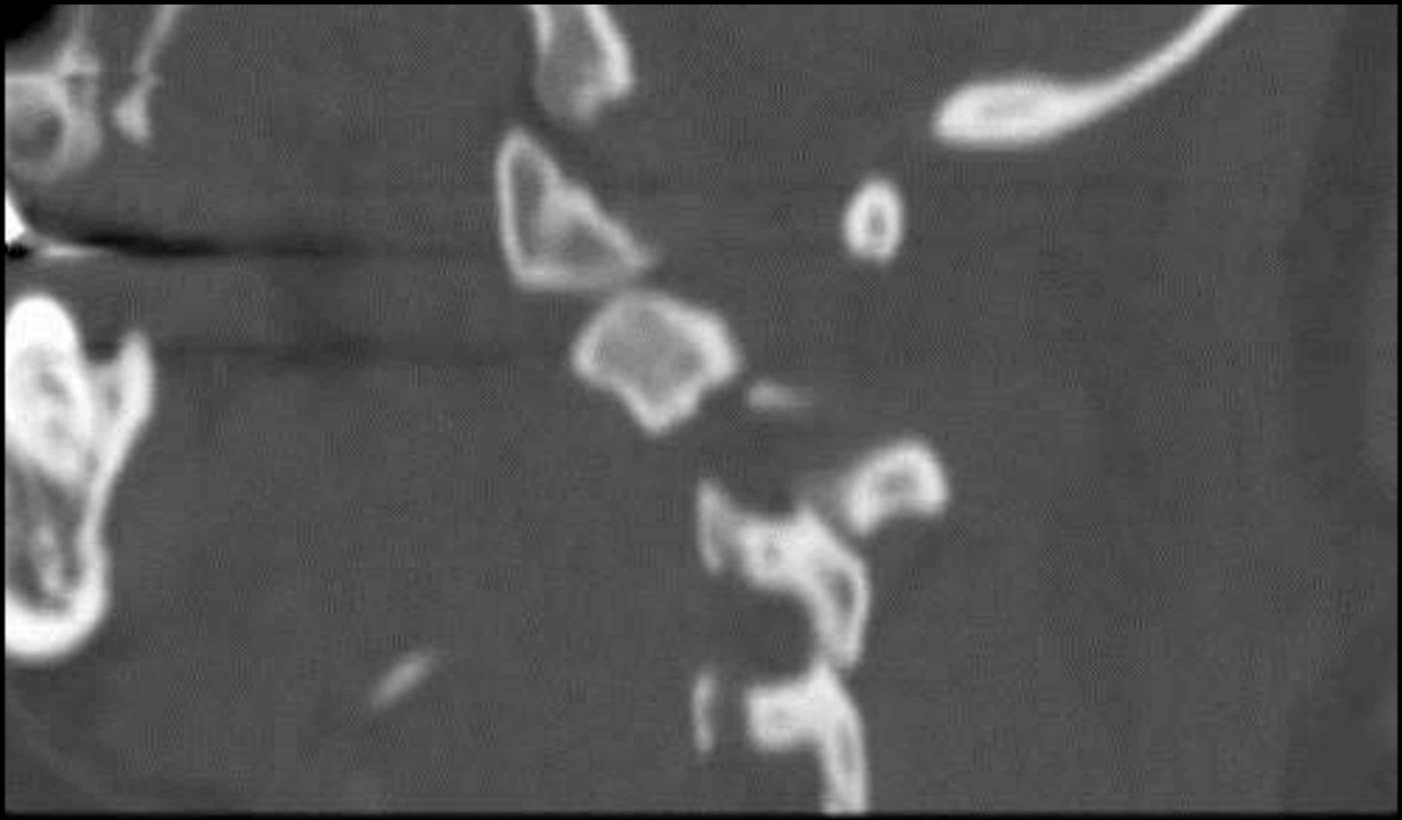
Effendi II easier to see on X-ray

16+9+7+5

Comparing Techniques

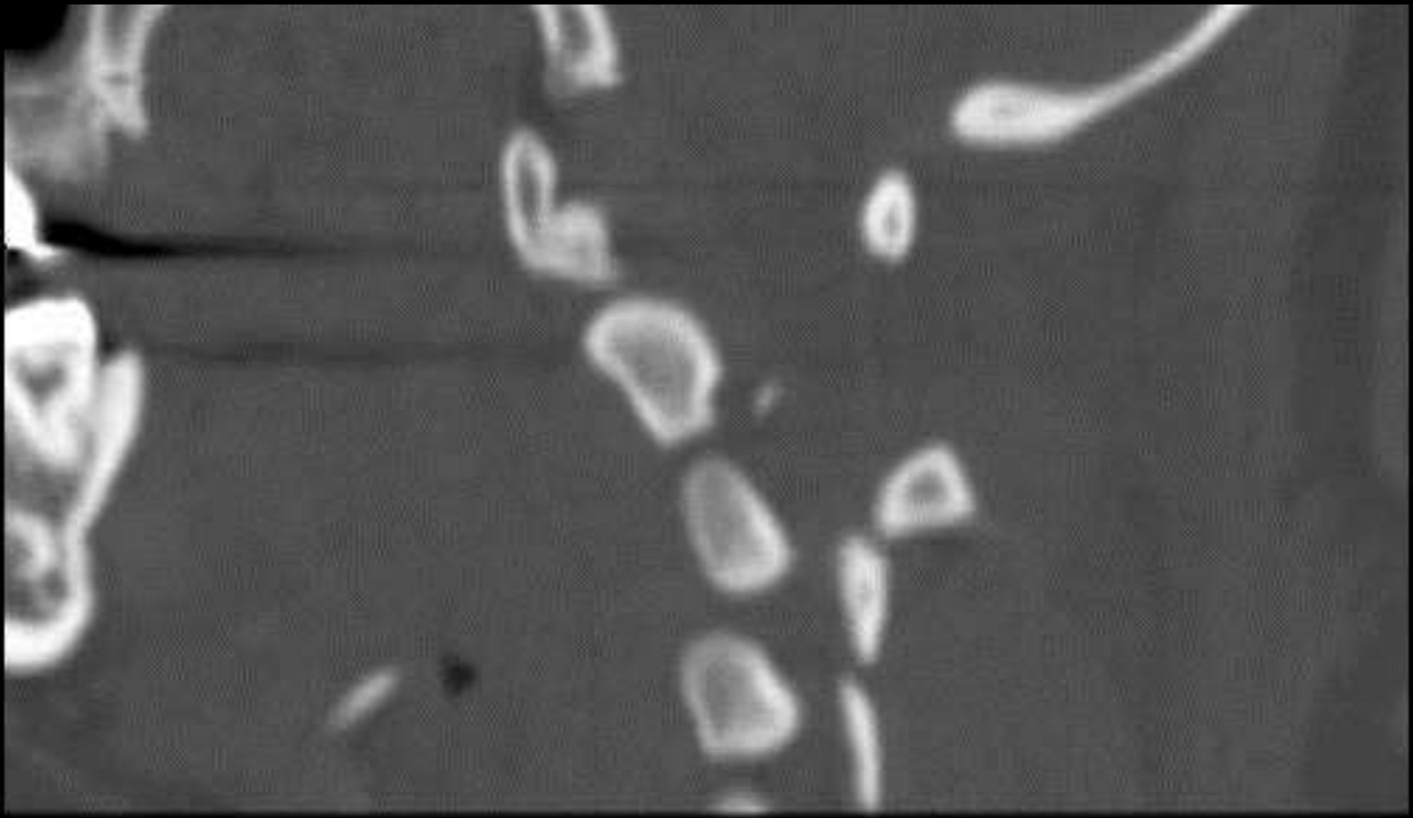
Effendi II easier to see on X-ray

Effendi II easier to see on X-ray



Comparing Techniques

Effendi II easier to see on X-ray



Comparing Techniques

Effendi II easier to see on X-ray

Comparing Techniques

Effendi II easier to see on X-ray

Comparing Techniques

Effendi II easier to see on X-ray

Comparing Techniques

Effendi II easier to see on X-ray

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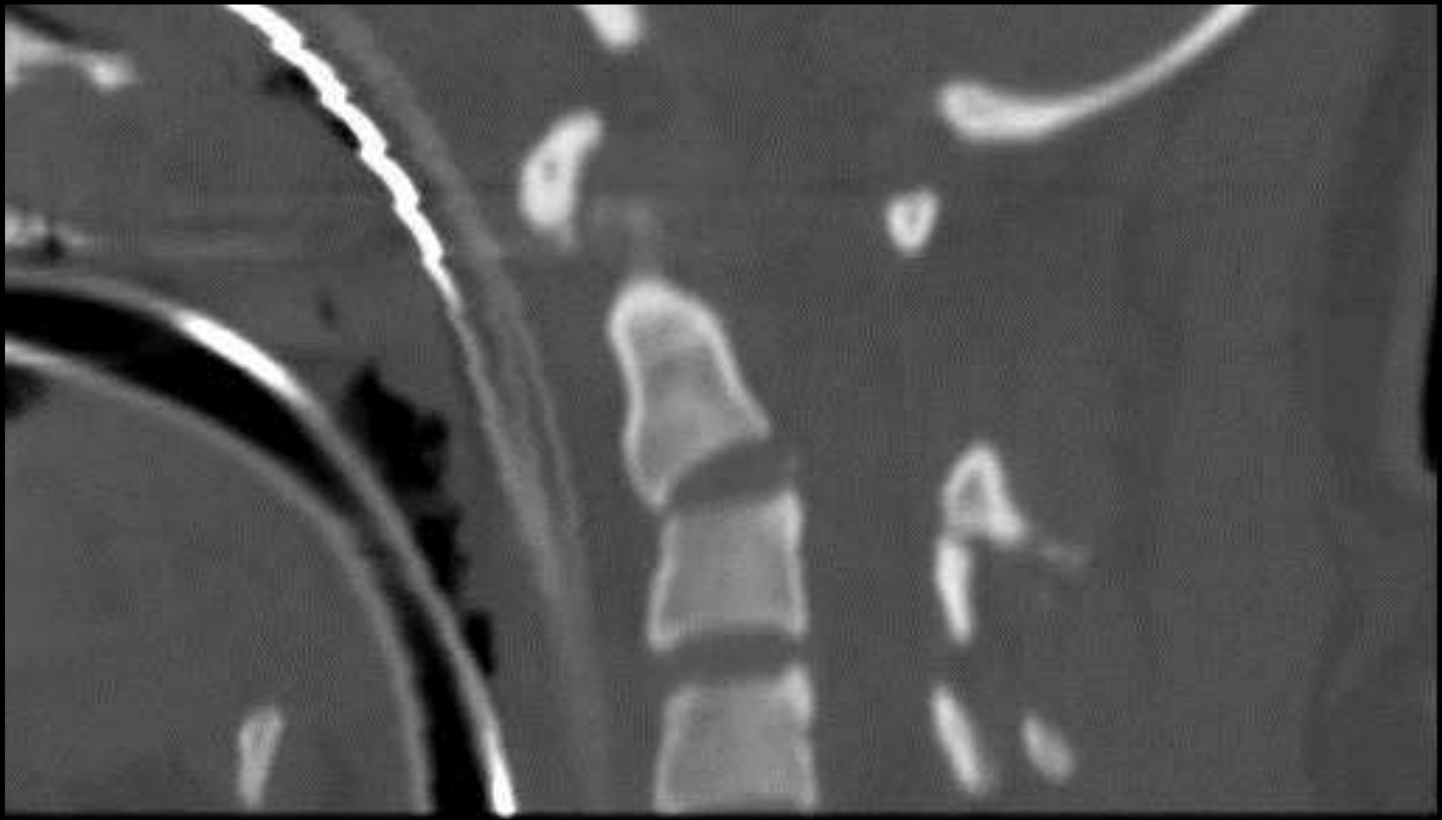
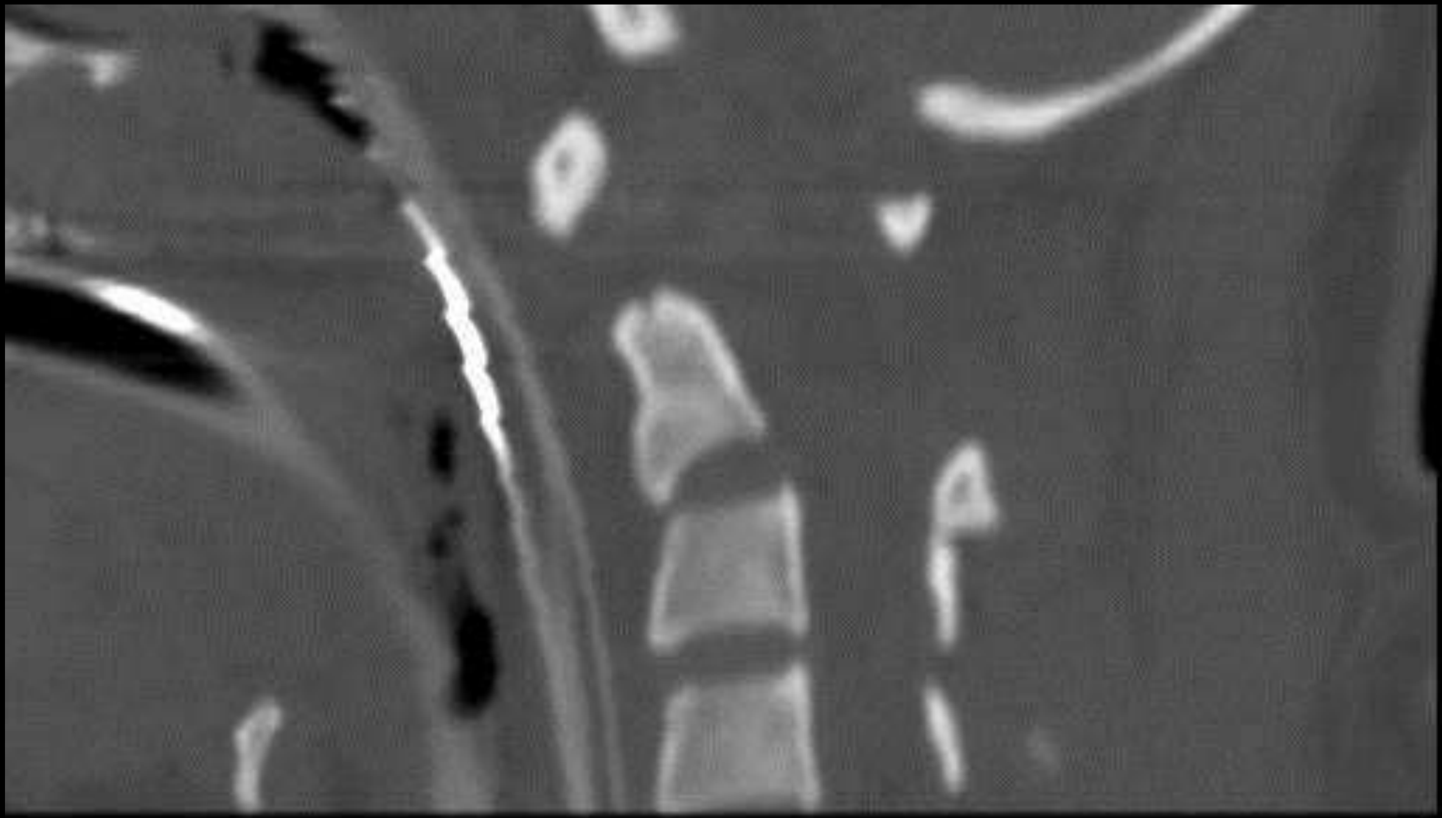
Comparing Techniques

Effendi II easier to see on X-ray



Comparing Techniques

Effendi II easier to see on X-ray



Comparing Techniques

Effendi II easier to see on X-ray

Effendi II easier to see on X-ray

Effendi II easier to see on X-ray

Comparing Techniques

Effendi II easier to see on X-ray

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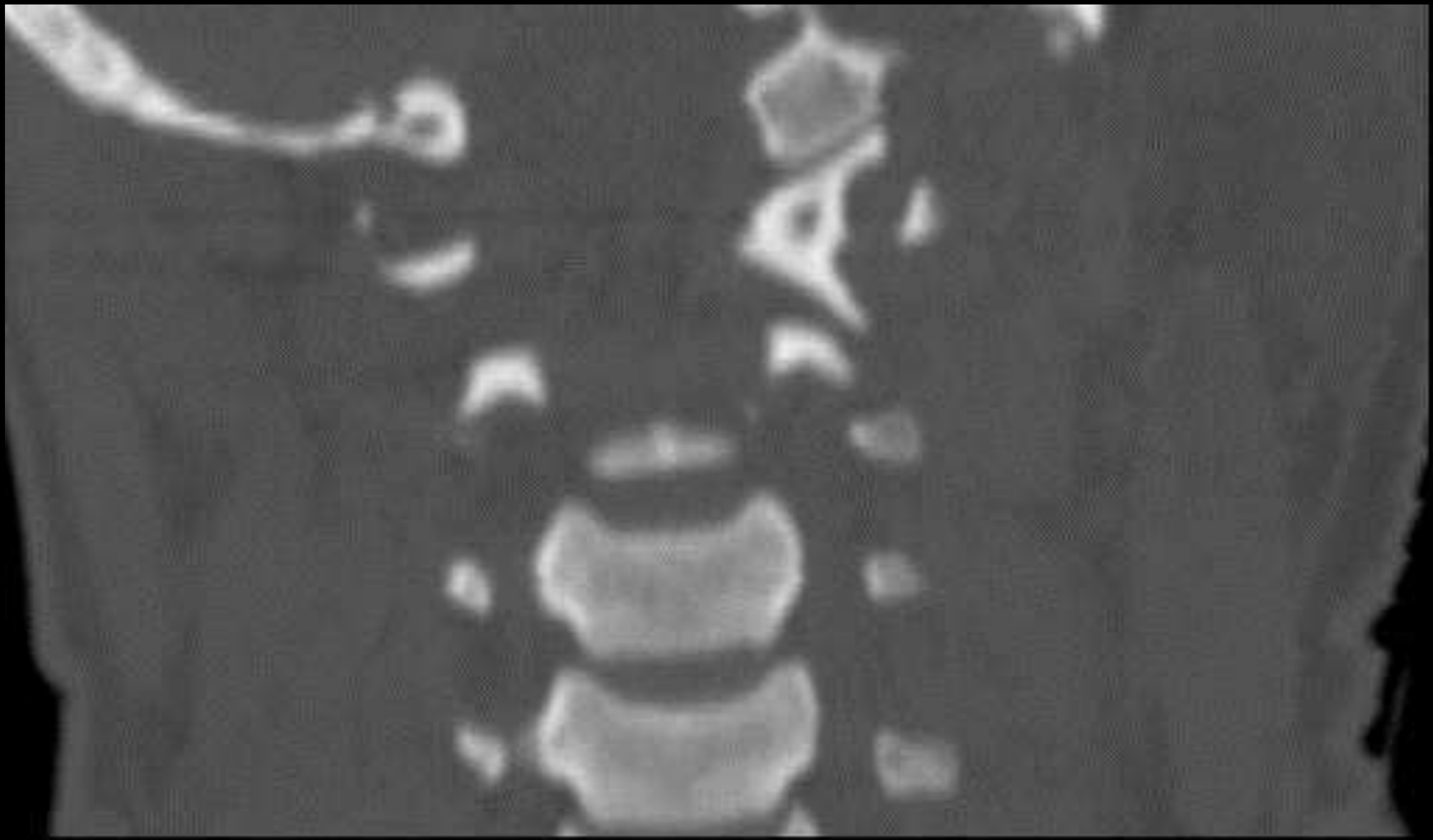
Comparing Techniques

Effendi II easier to see on X-ray



Comparing Techniques

Effendi II easier to see on X-ray

Effendi II easier to see on X-ray

Effendi II easier to see on X-ray

Comparing Techniques

Effendi II easier to see on X-ray

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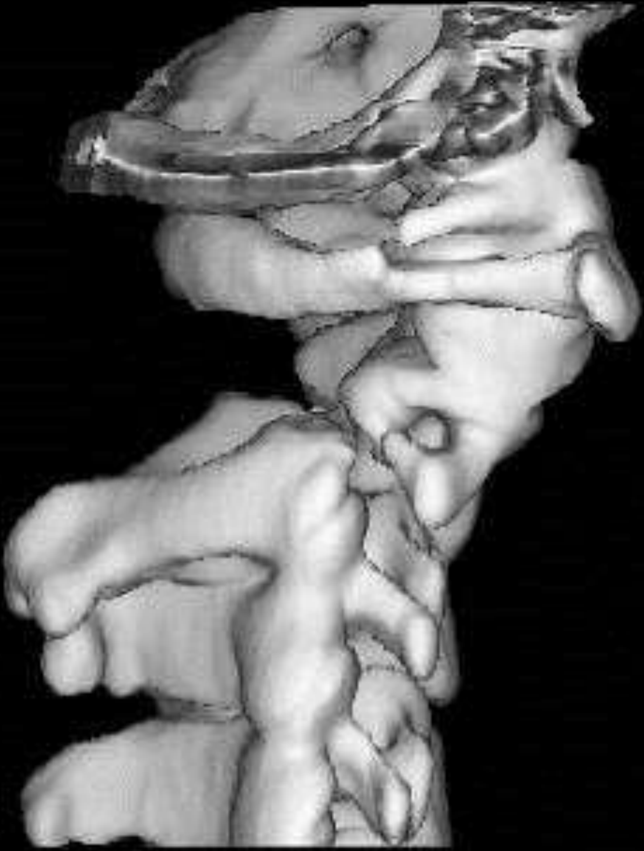
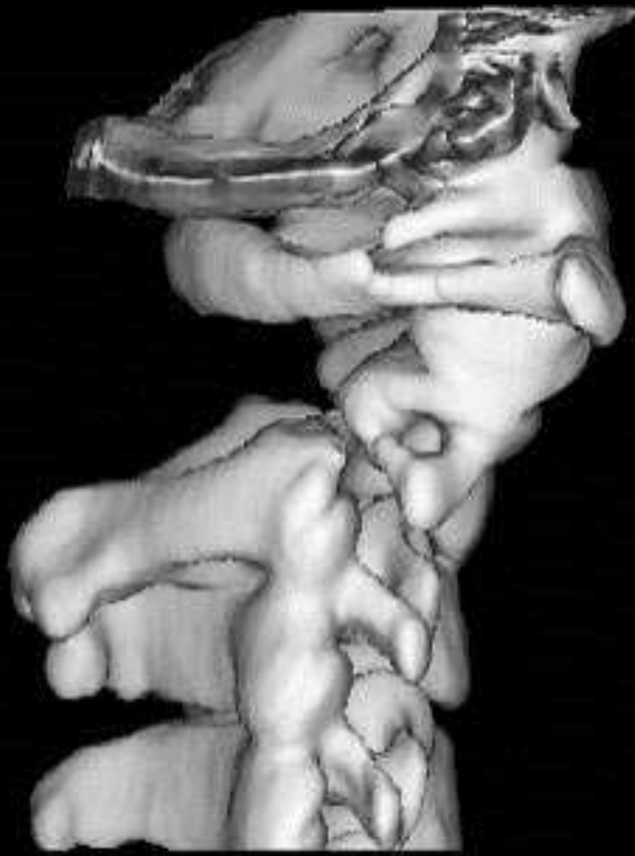
Comparing Techniques

Effendi II easier to see on X-ray



Comparing Techniques

Effendi II easier to see on X-ray



Comparing Techniques

Effendi II easier to see on X-ray

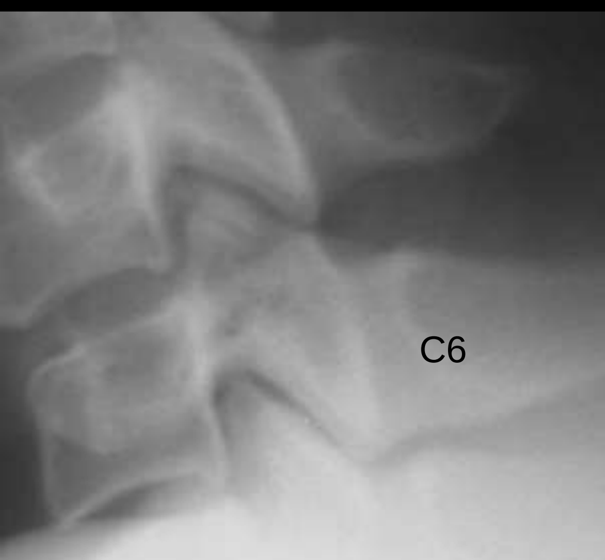
Comparing Techniques

Effendi II easier to see on X-ray

Comparing Techniques

Effendi II easier to see on X-ray

Technique
Follow up



Oct 20

Ext

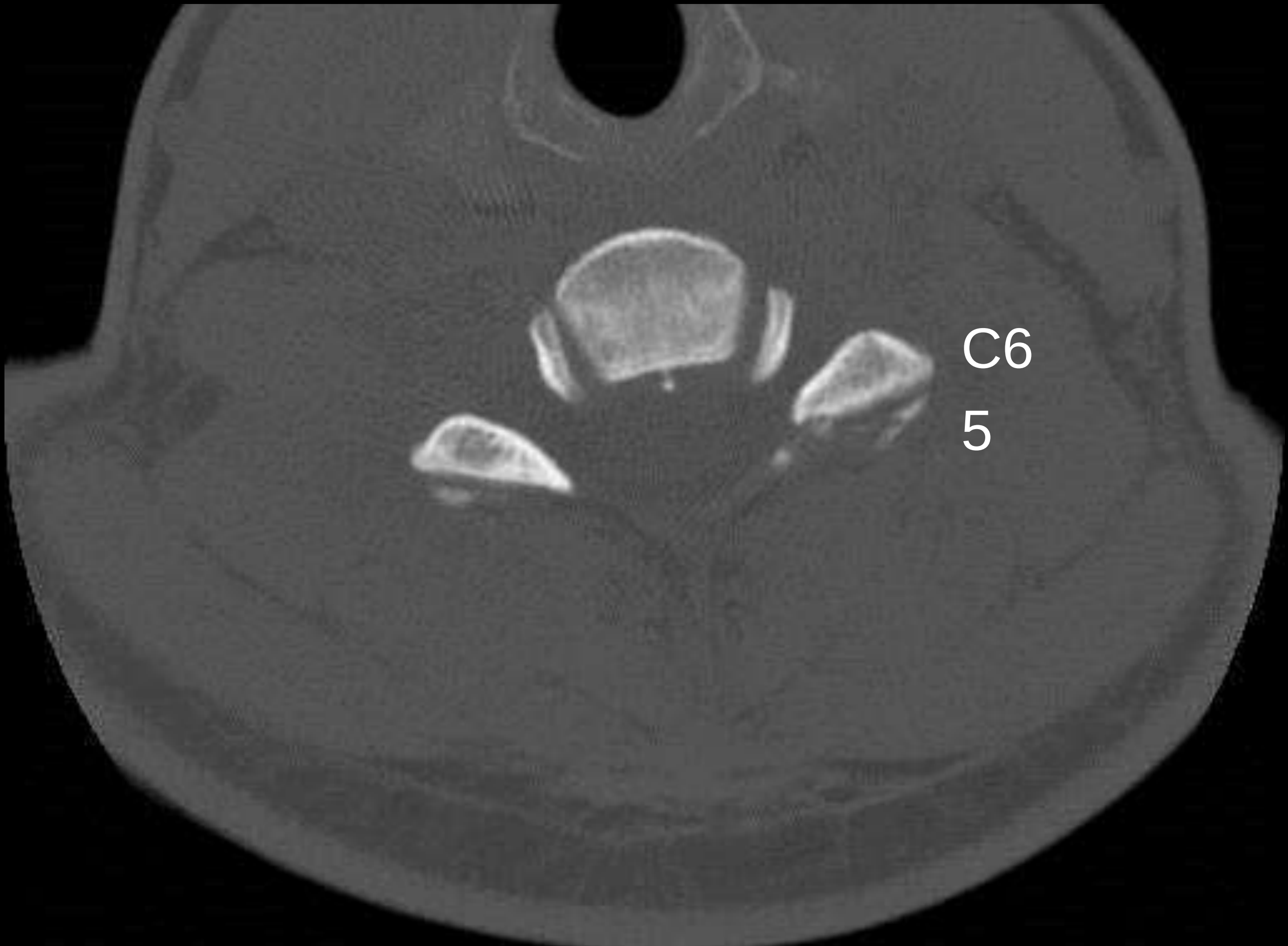
Nov 14

Flex

1+6+5

28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up

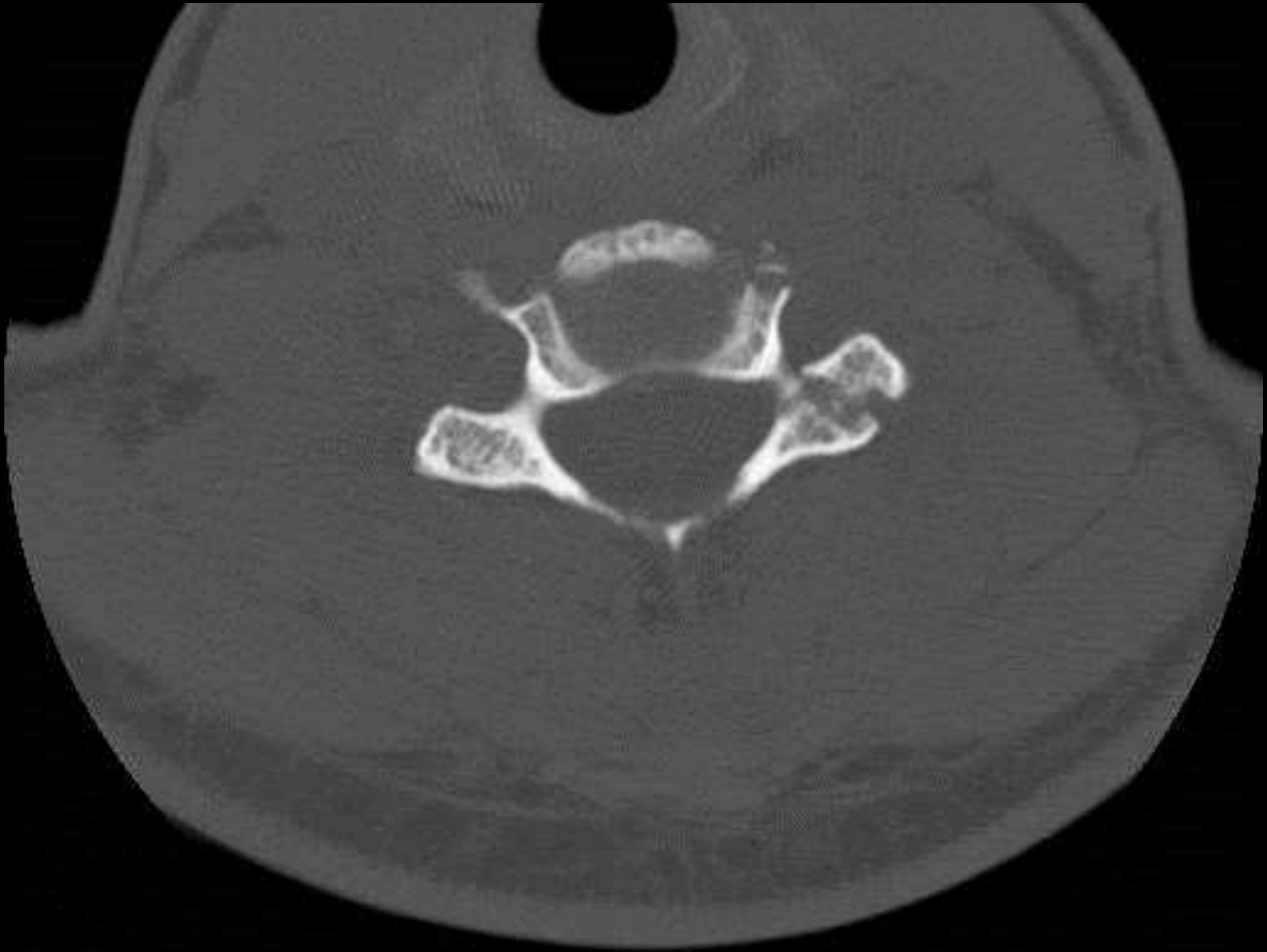


28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up

28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up



28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up

28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up

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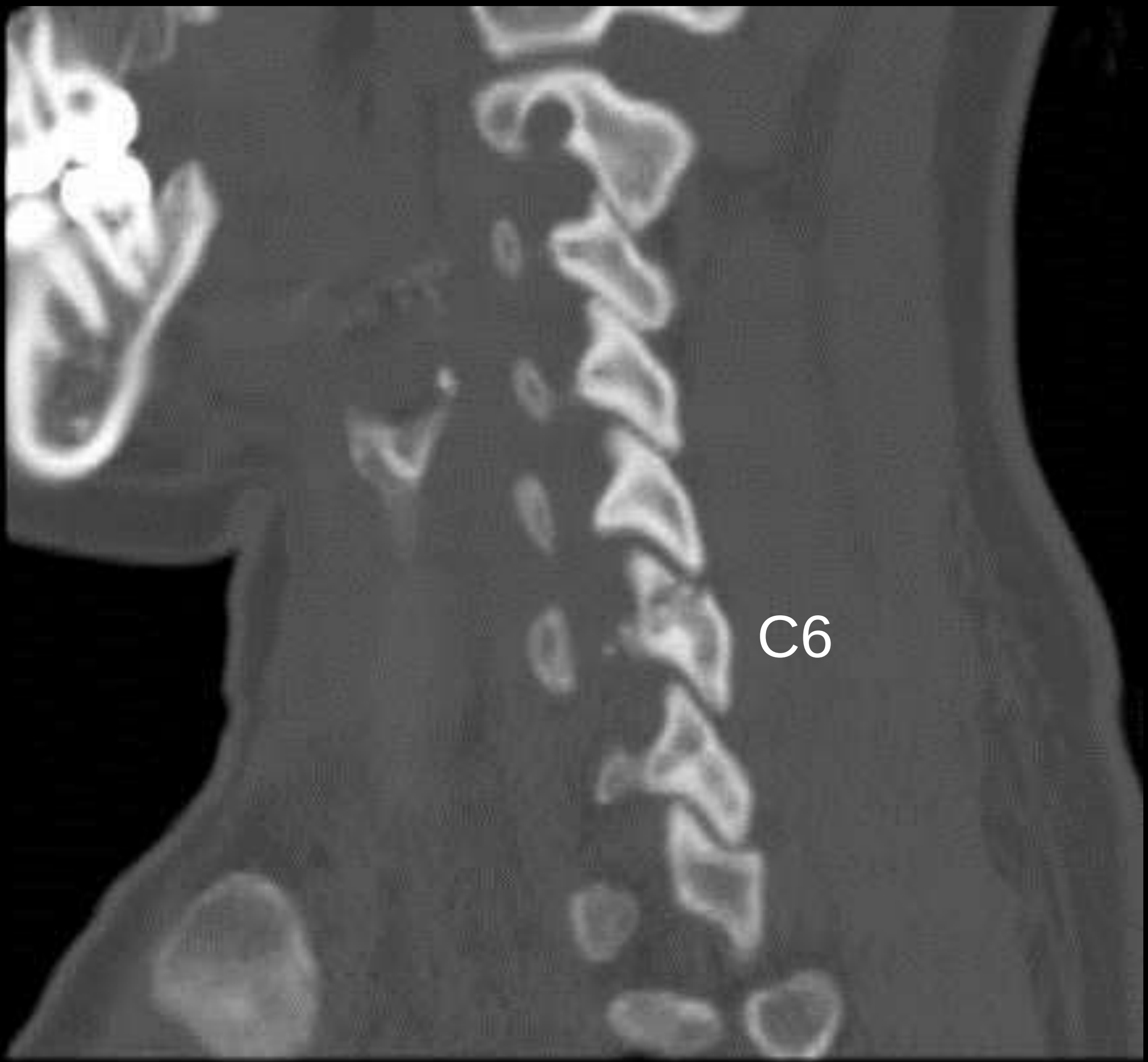
Technique - Follow up

28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up



28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up

28F Left C6 superior facet fracture seen on F/U F/E

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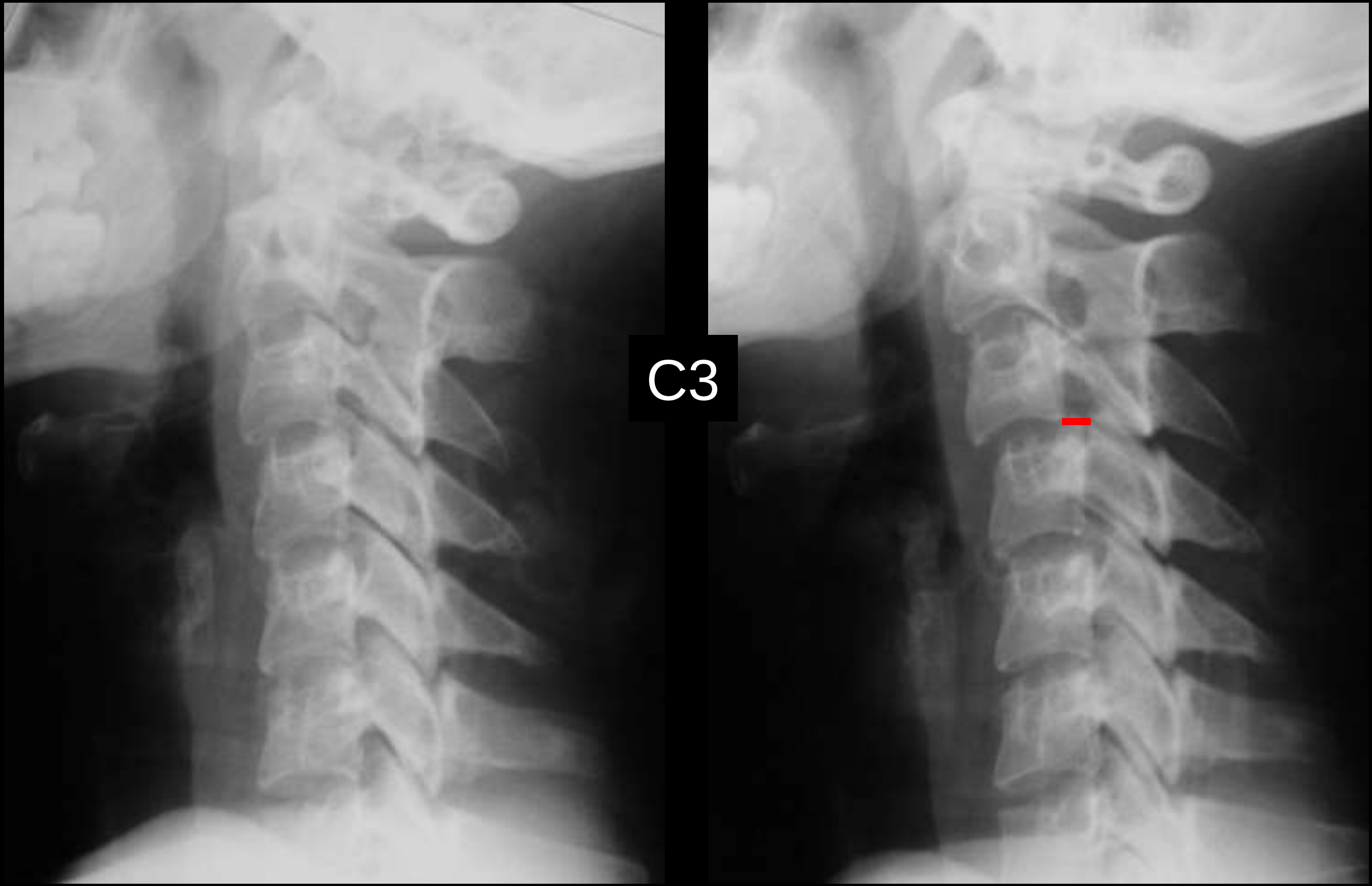
Technique - Follow up

28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up

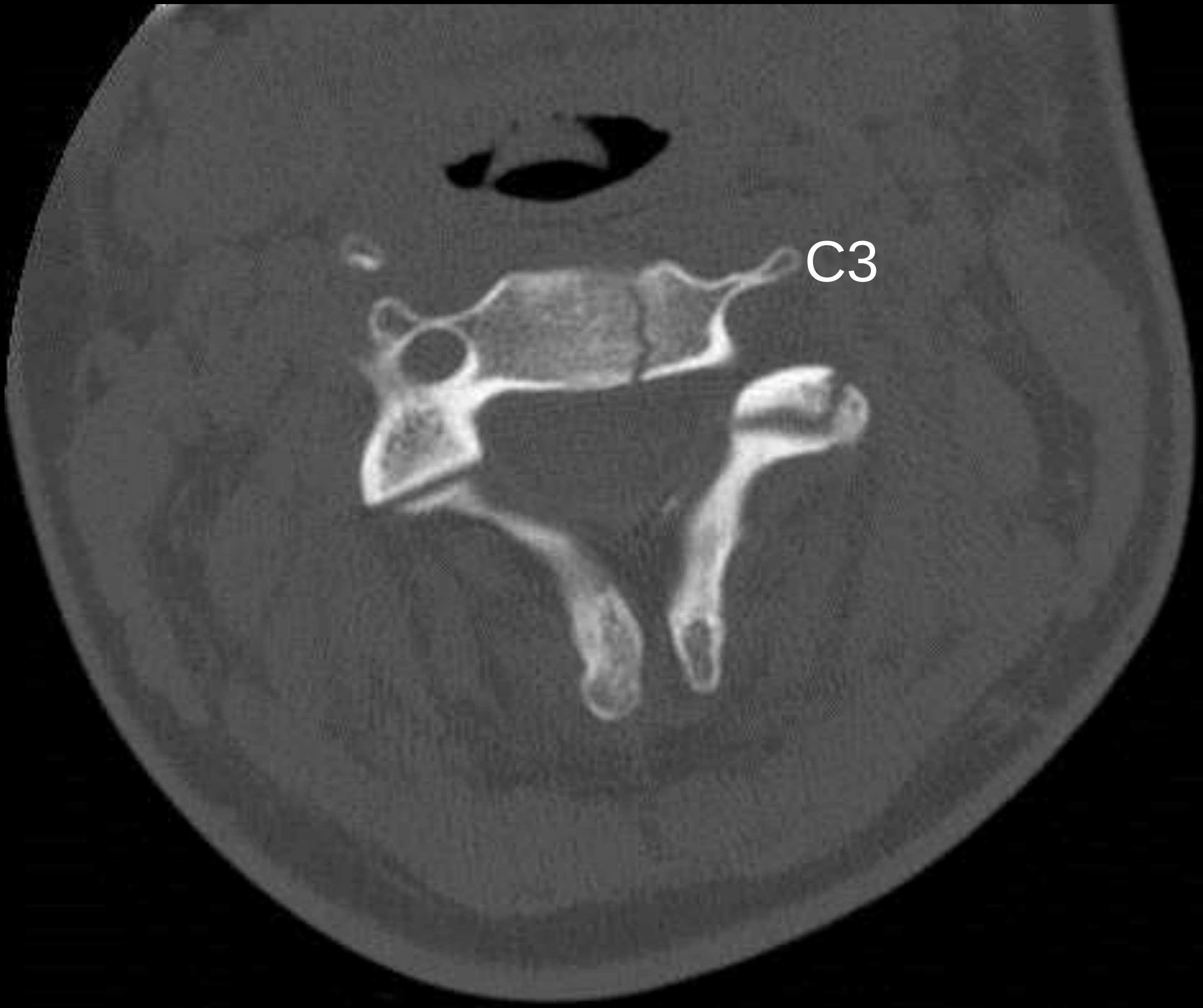
28F Left C6 superior facet fracture seen on F/U F/E

Technique - Follow up

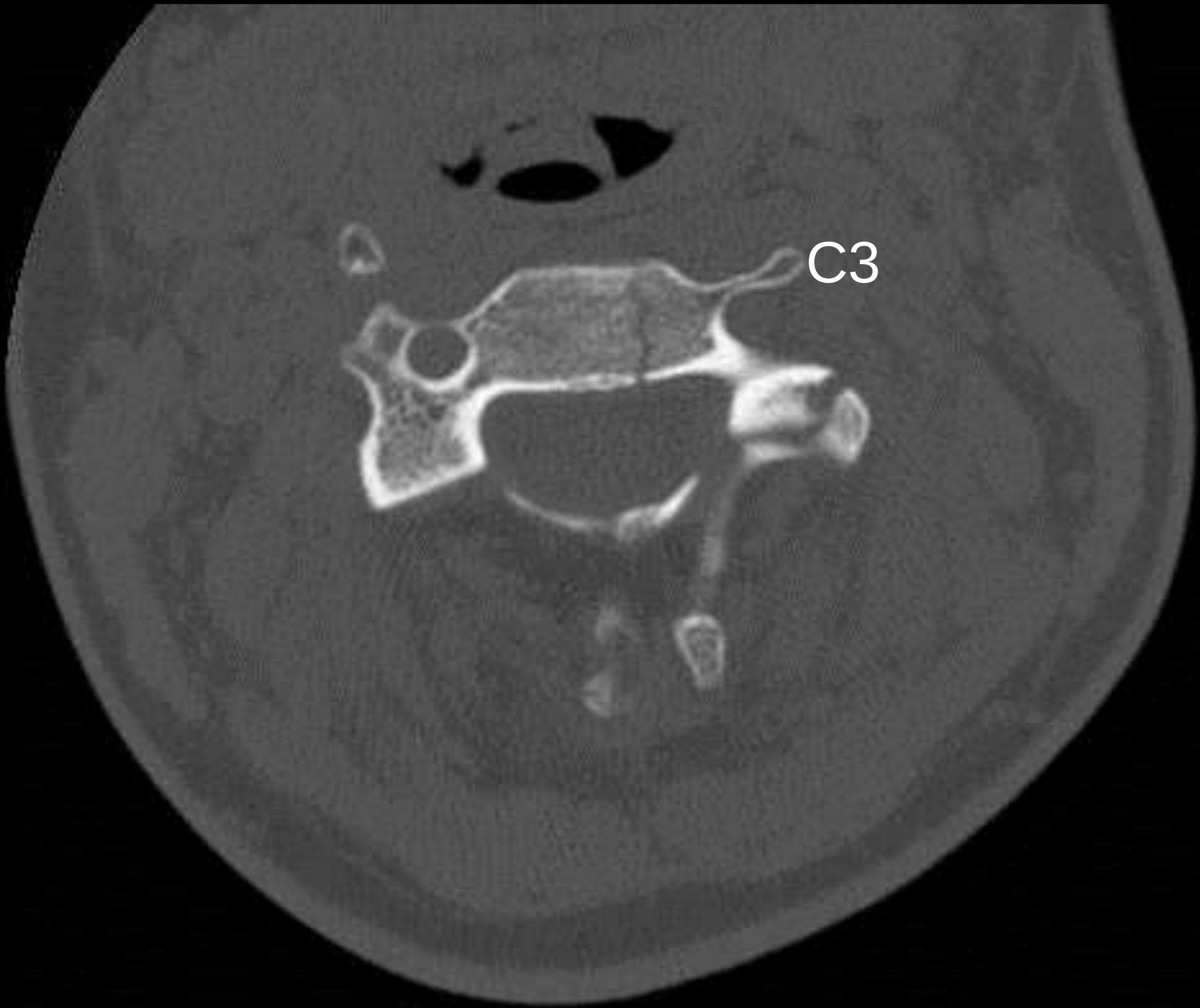


Nov 21 Dec5

Technique - Follow up



Technique - Follow up



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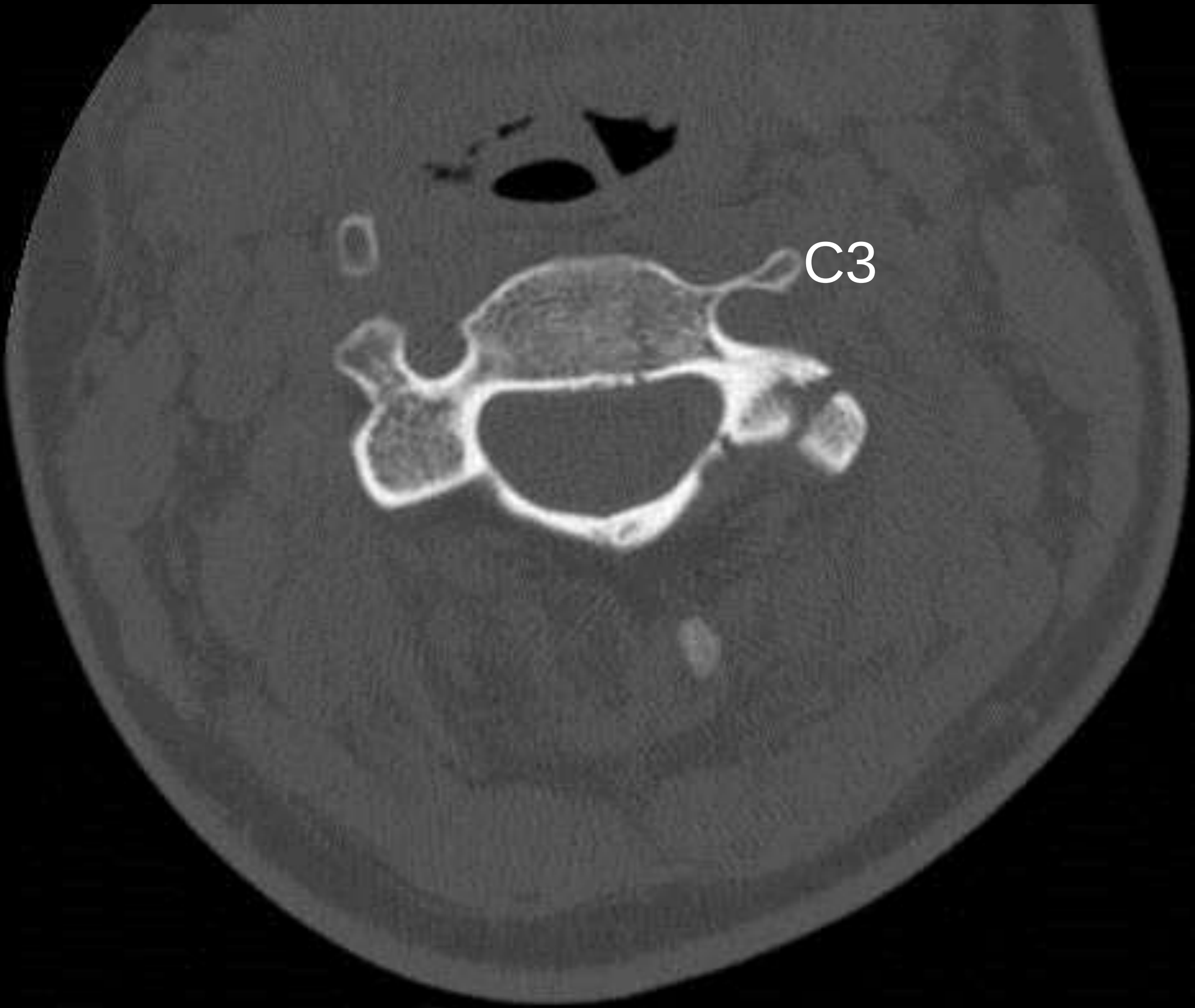

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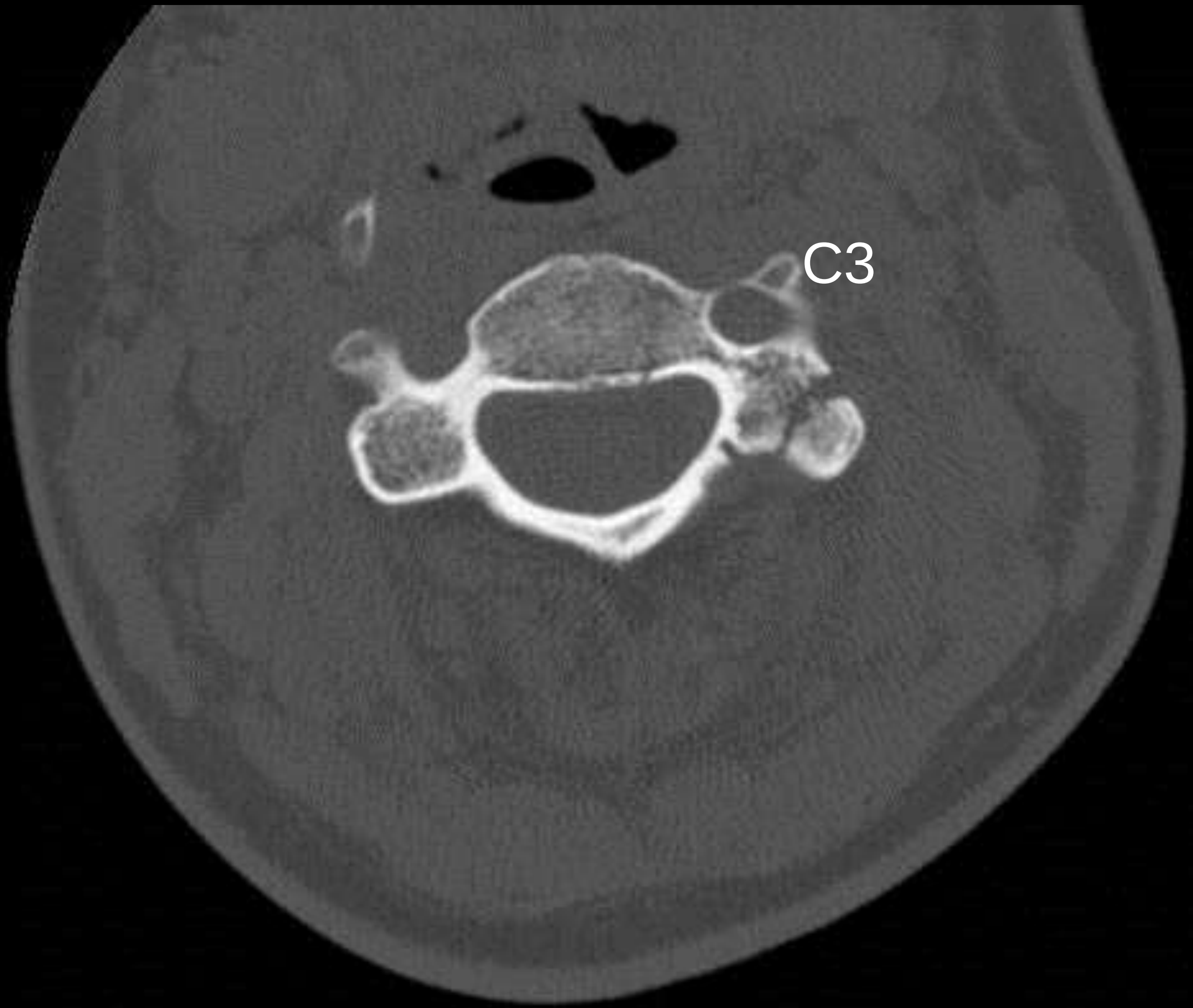
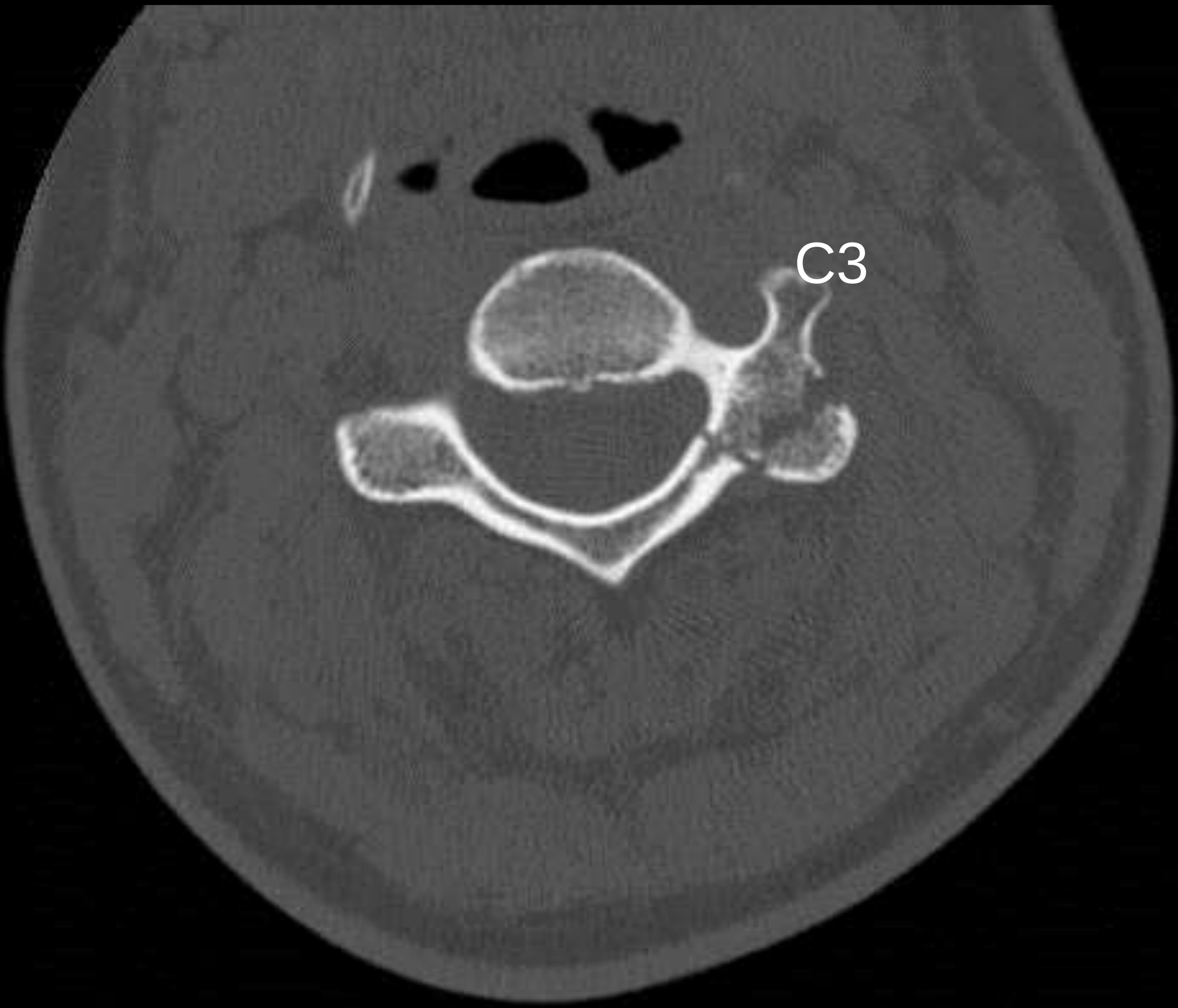


Technique - Follow up

Technique - Follow up



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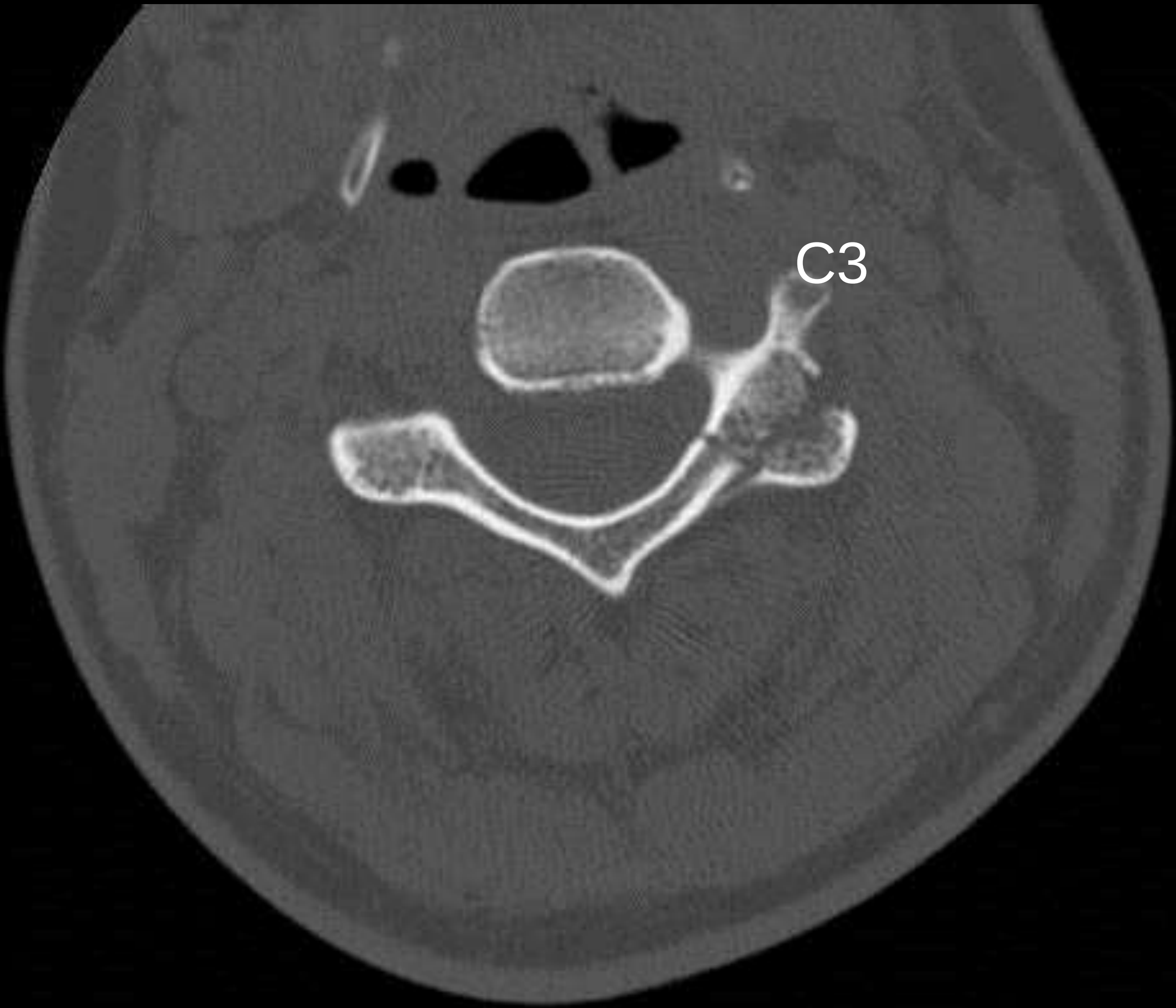

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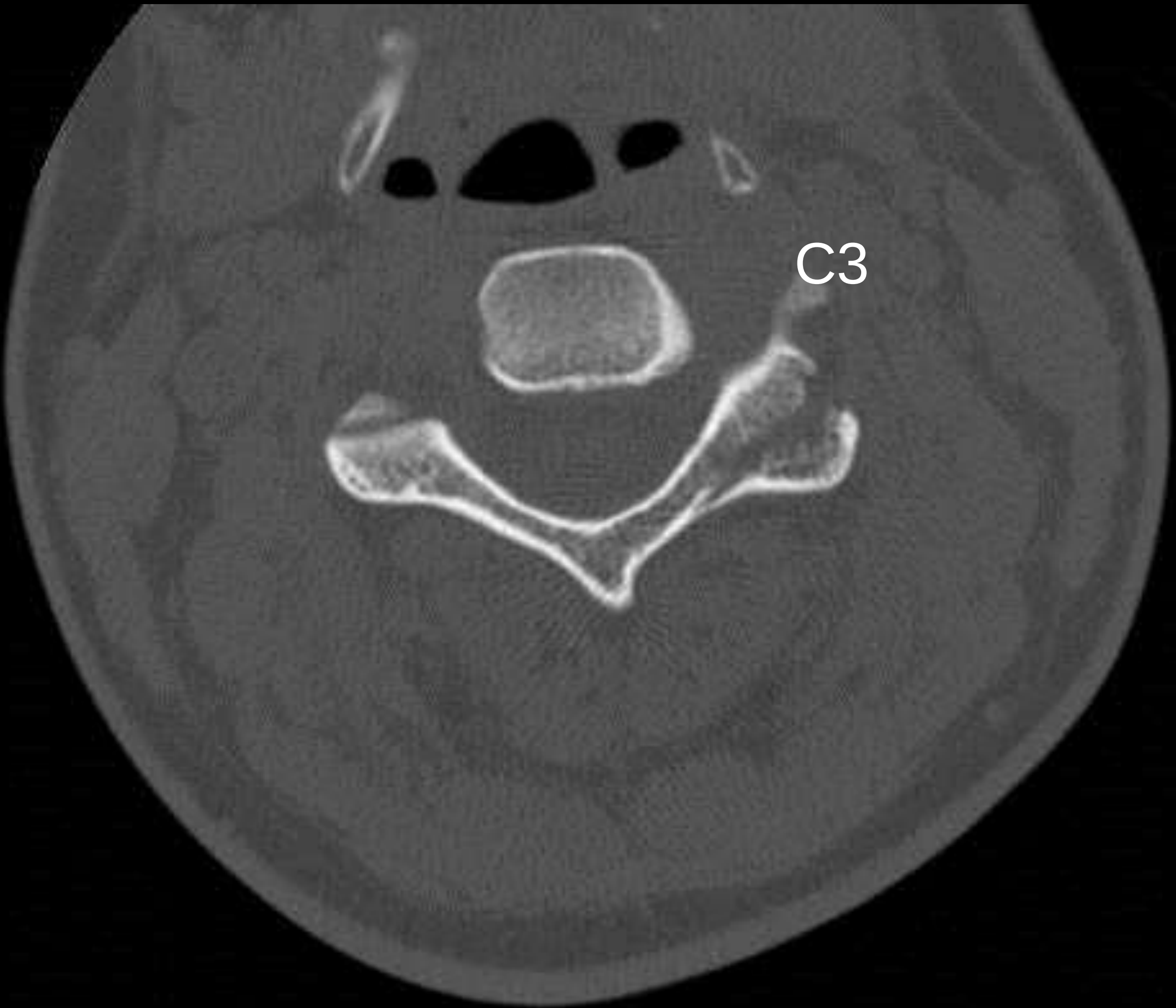
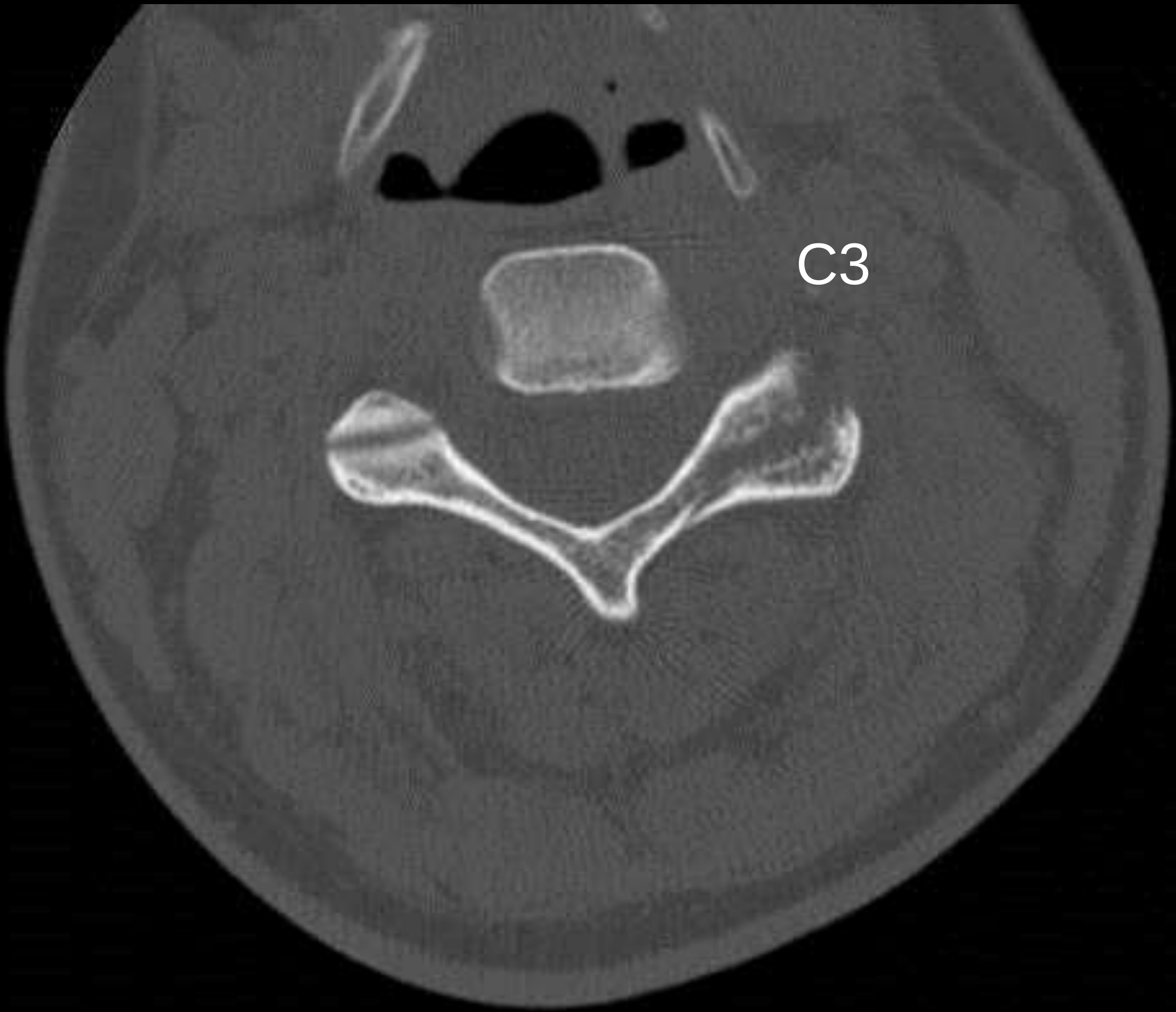
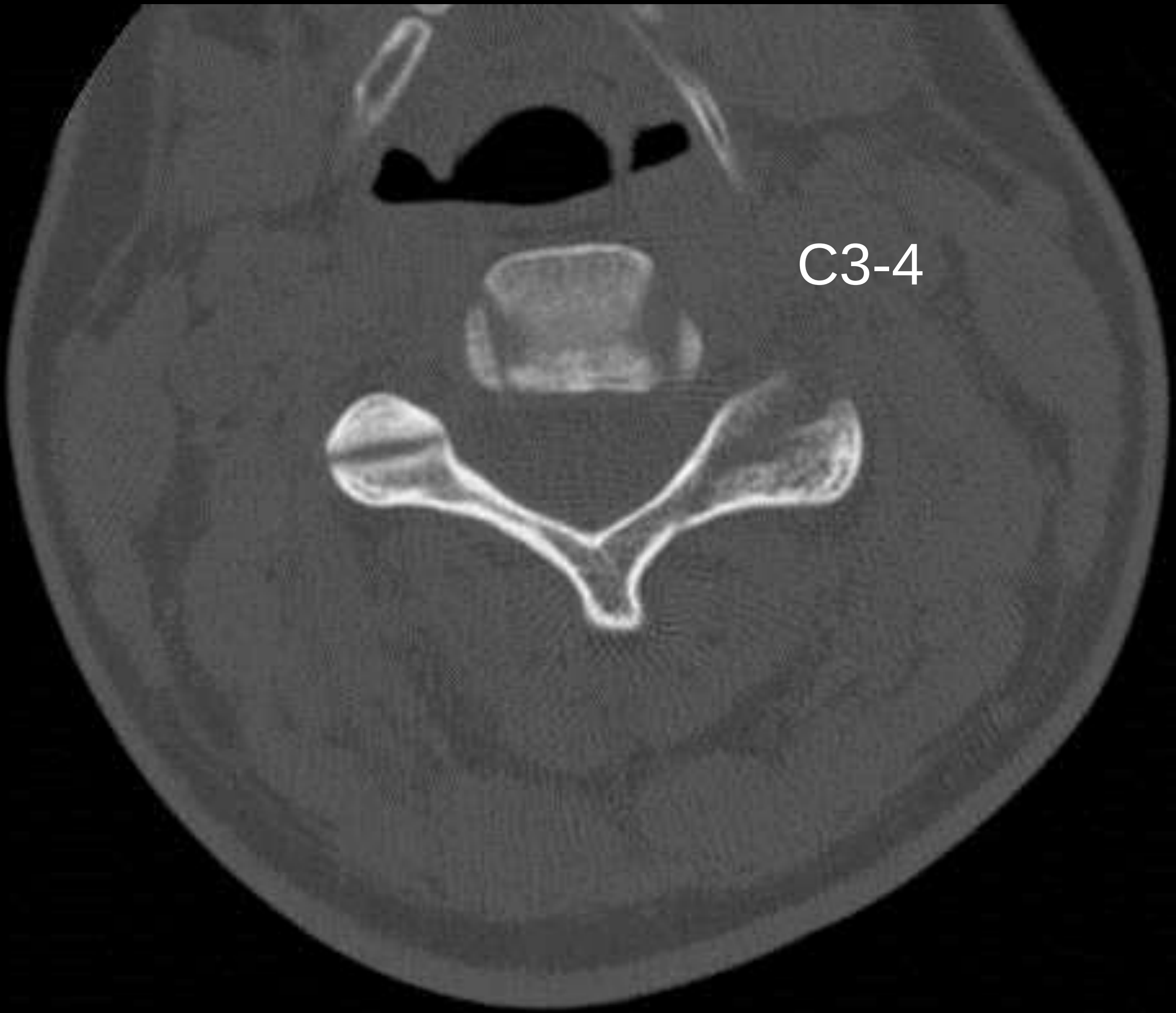


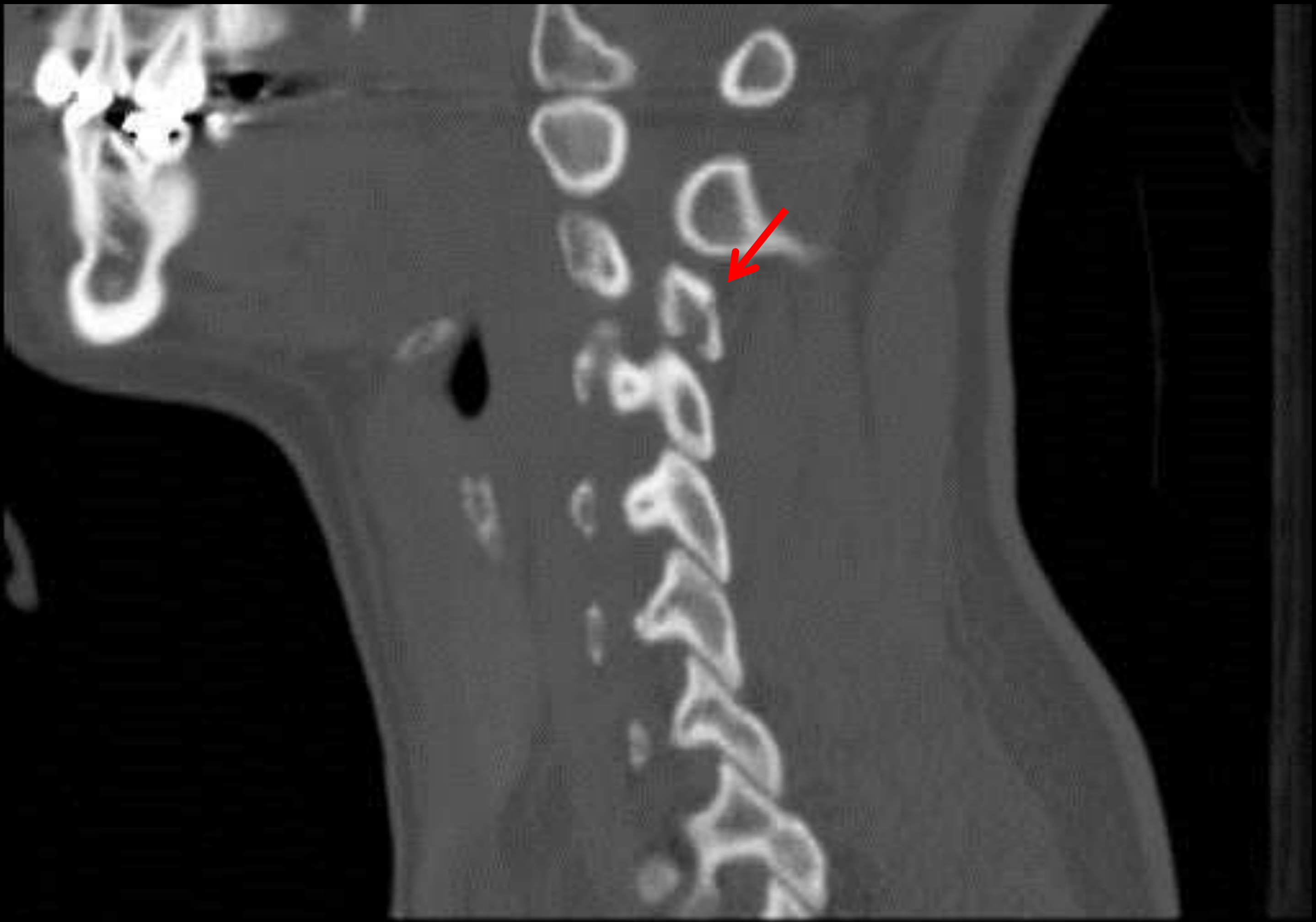
Technique - Follow up



Technique - Follow up



Technique - Follow up



Technique - Follow up

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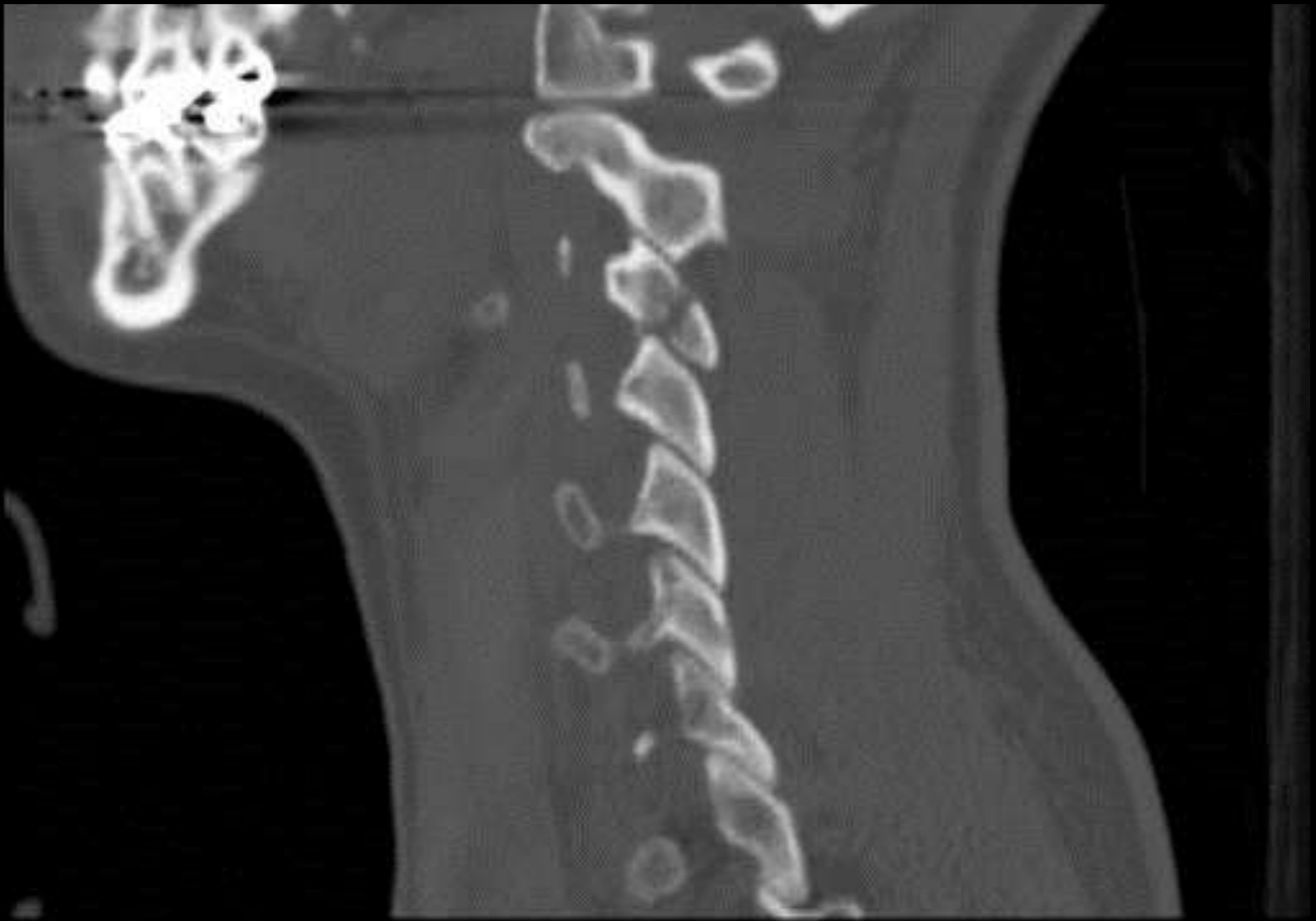


21F

Technique - Follow up

Technique - Follow up

Technique - Follow up

Technique - Follow up

Lake Wanaka NZ

Reading Algorithm

- Soft tissues first, so you don’t forget
- Bony alignment
- Facet joint alignment
- Look at common sites of fractures
- Find the second fracture
- Fluid levels
- Ribs, skull, clavicles etc
- Lines and tubes

Reading Algorithm

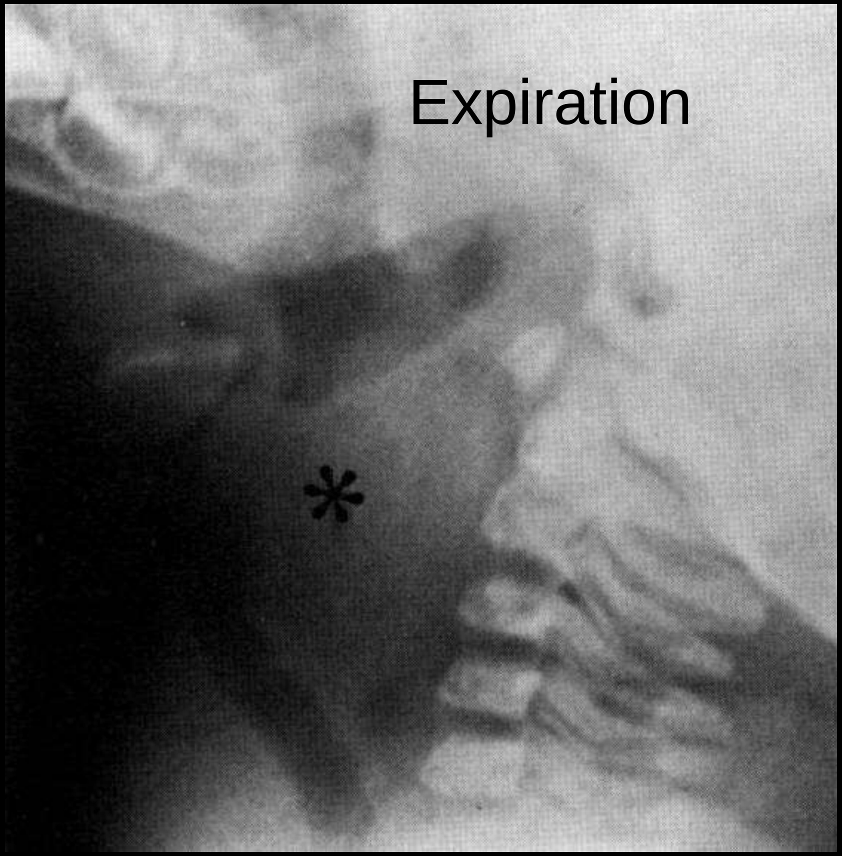
Soft Tissues

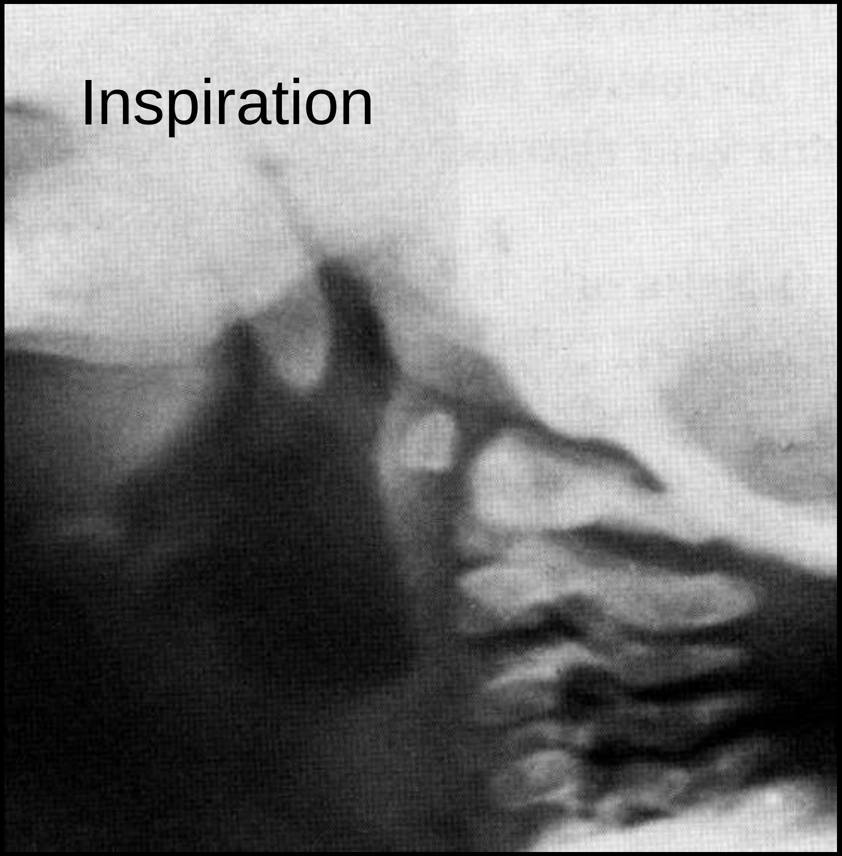
Maximum Allowable Thickness

- Nasopharyngeal space (C1) - 10 mm (adult)
- Retropharyngeal space (C2 - C4) - 5-7 mm
- Retrotracheal space (C5 - C7)
  - 14 mm (children)
  - 22 mm (adults)

Adenoids

Retropharyngeal Soft Tissues





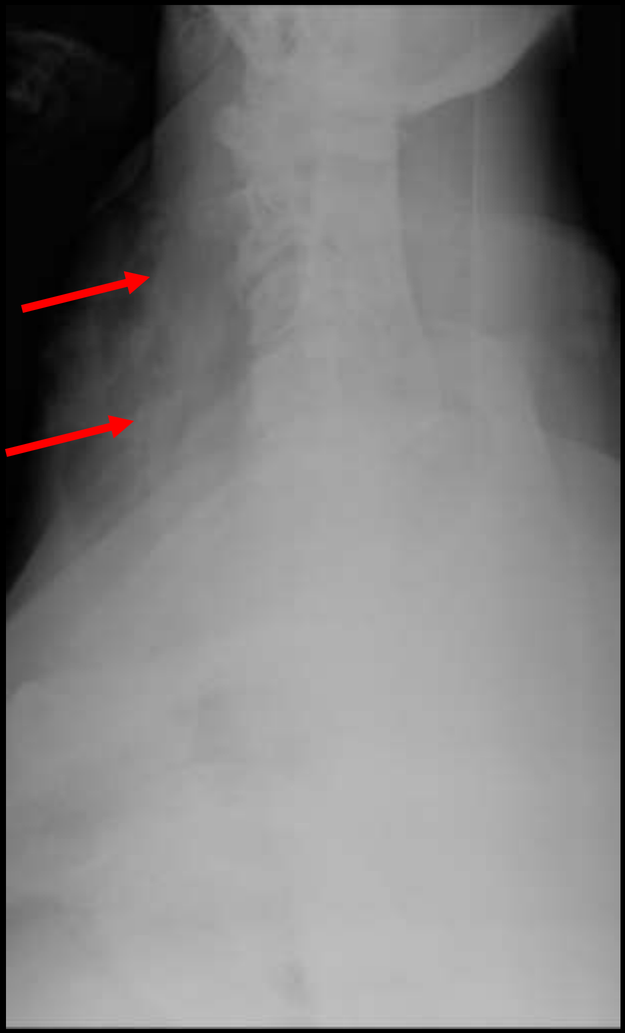
Reading Algorithm - Soft Tissues

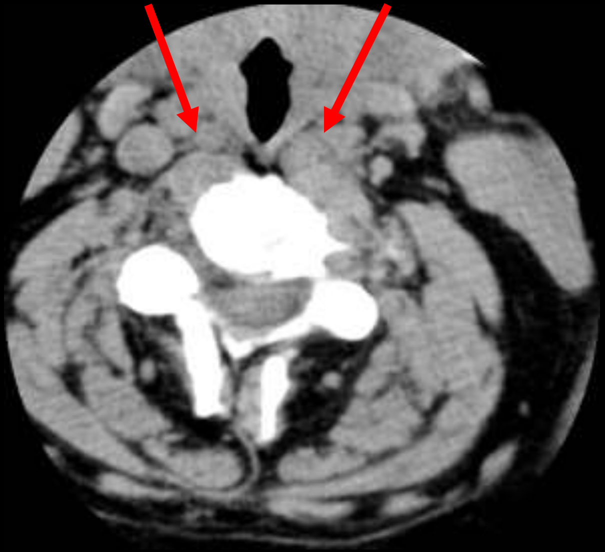
Cx hematoma

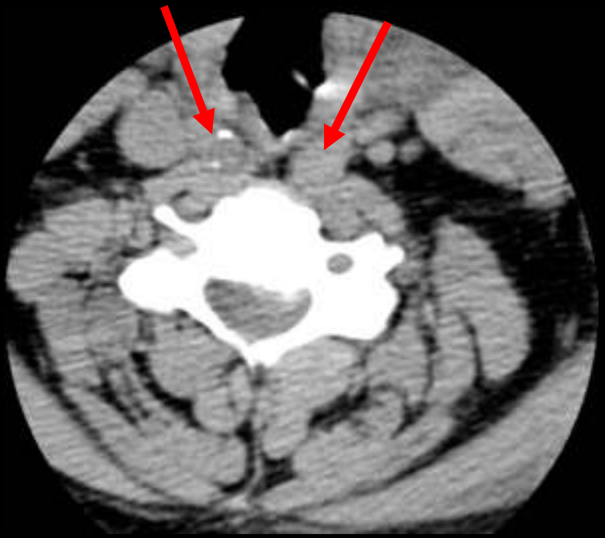
55M, Tripped and fell, SOB, Difficulty swallowing

Retropharyngeal Abscess

Prevertebral carotids

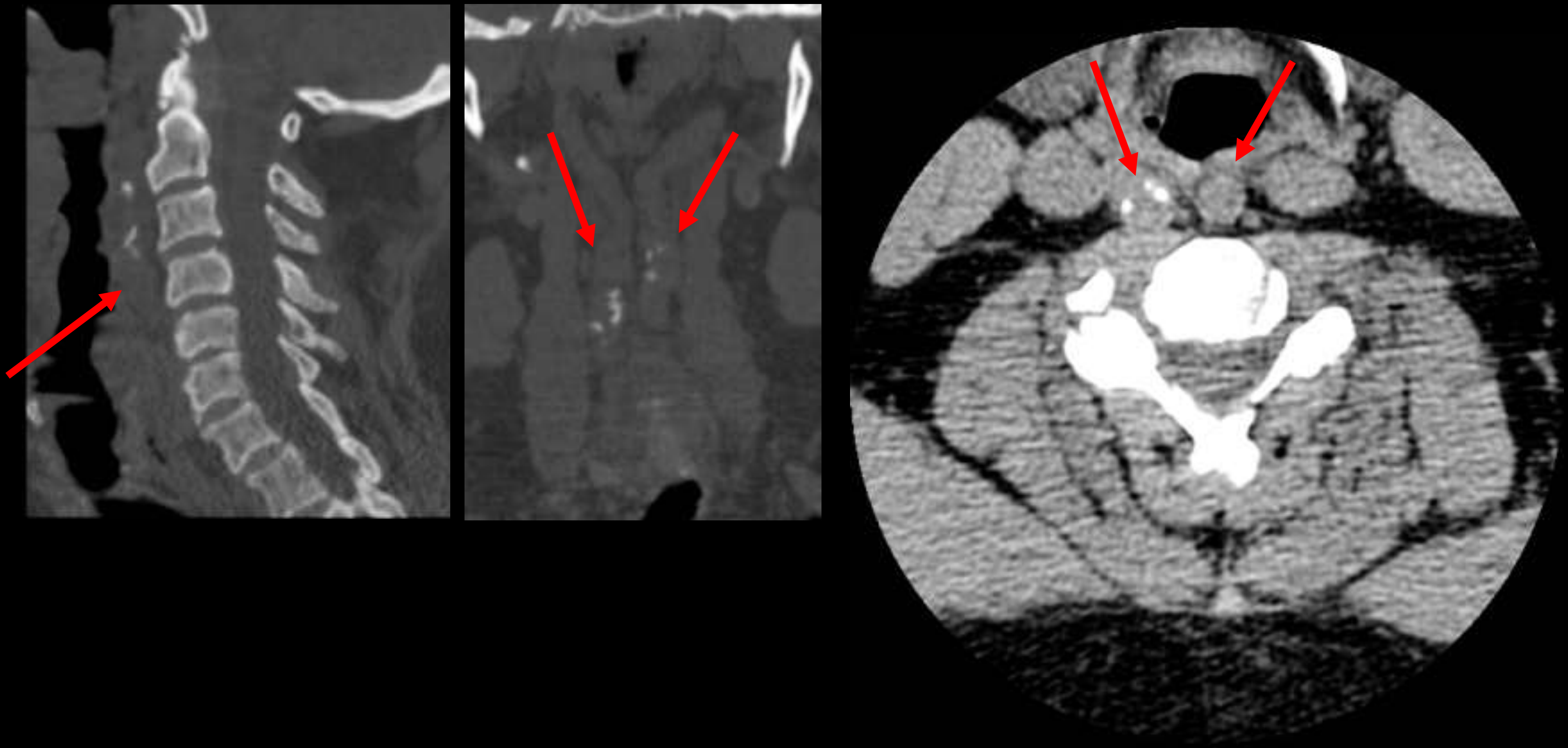






Prevertebral carotids 48M

Prevertebral carotids



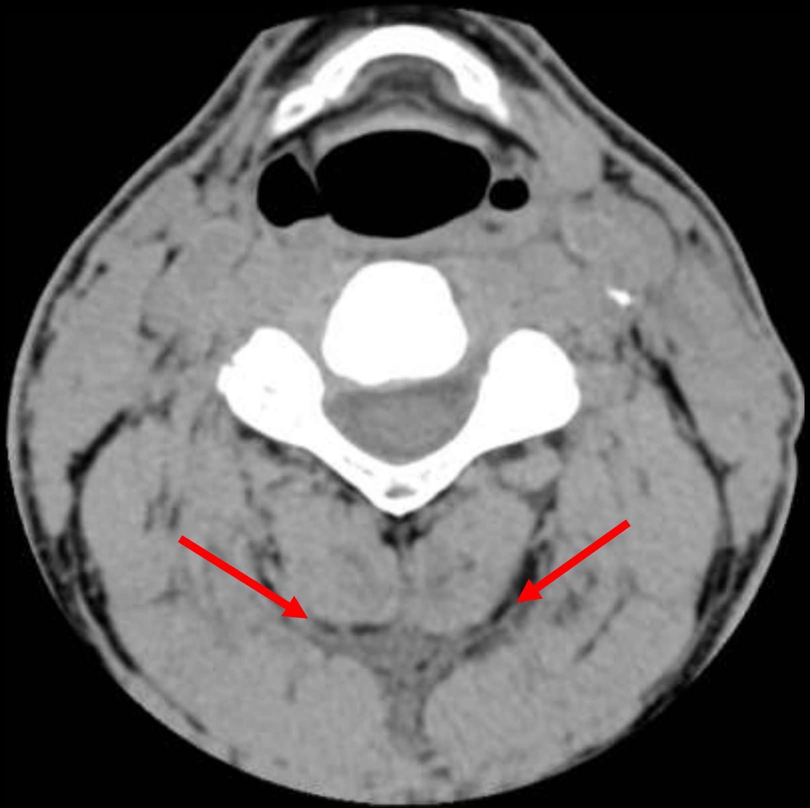
Prevertebral carotids 74M

Reading Algorithm - Soft Tissues

Prevertebral carotids

Retropharyngeal carotids 64F

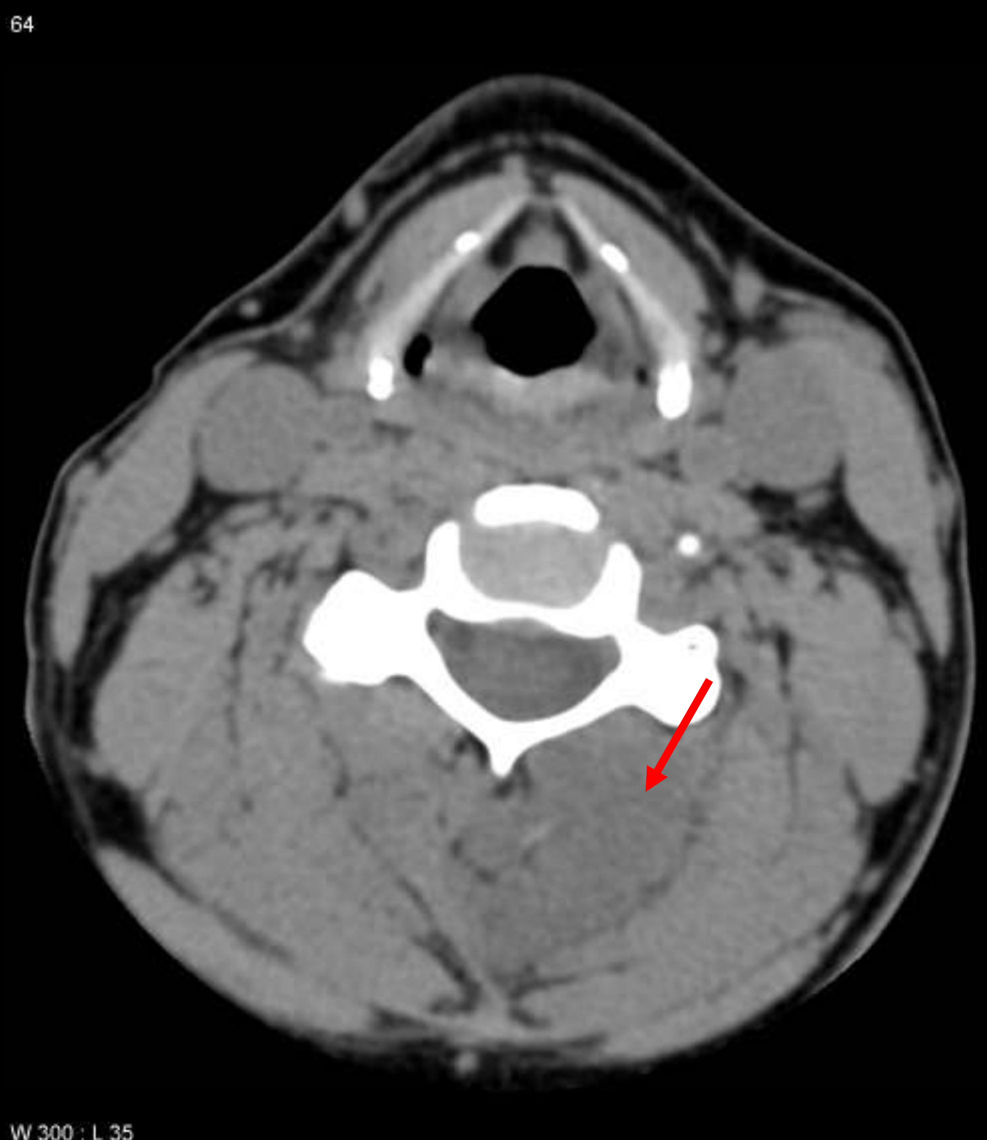
Paraspinal muscle hematoma



Multiple Cx spinous process fractures 42M

Reading Algorithm - Soft Tissues

Semispinalis muscle hematoma



3+1+3

Reading Algorithm - Soft Tissues

Semispinalis muscle hematoma

Semispinalis muscle hematoma

1+1+3

49F

Semispinalis muscle hematoma

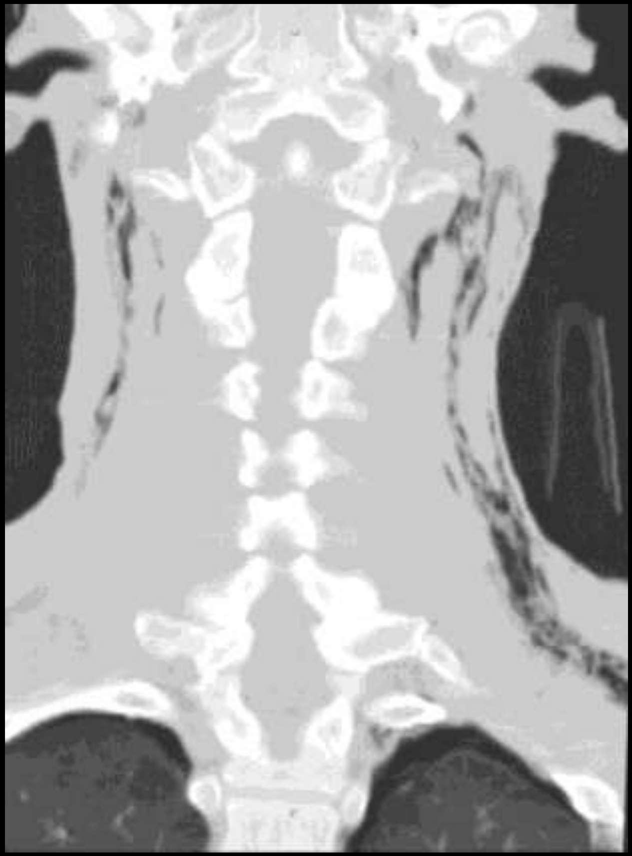
Right

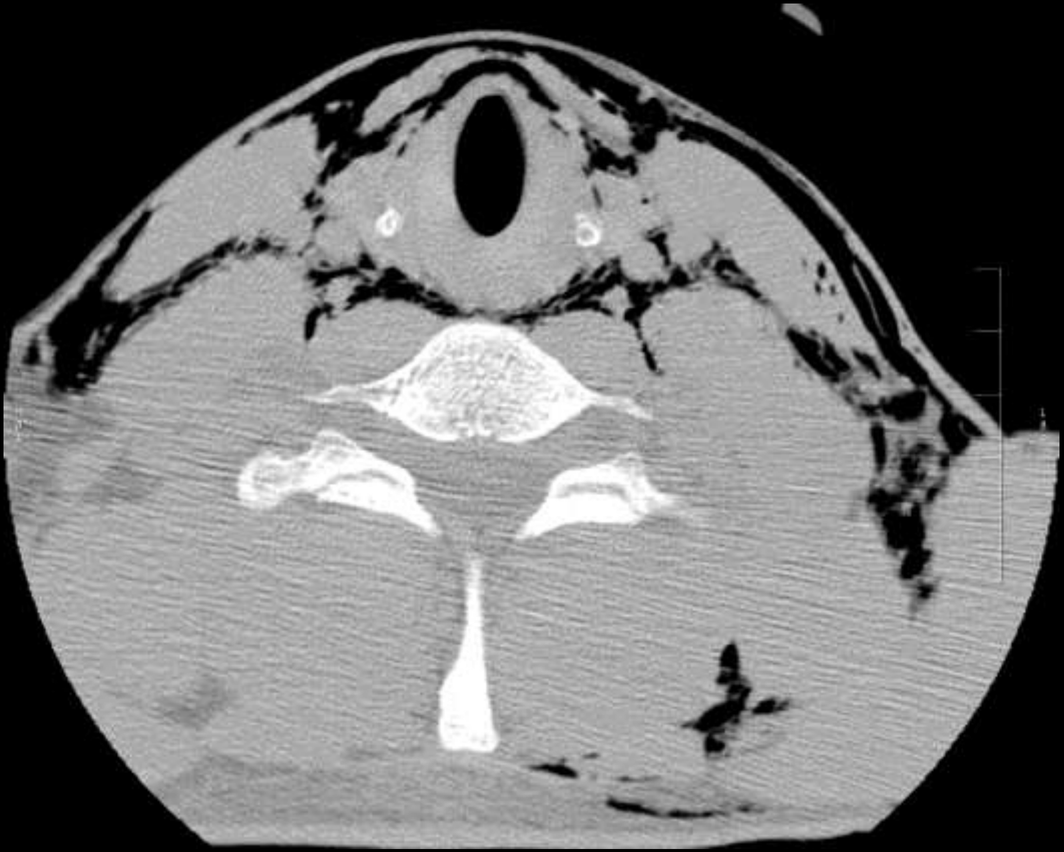
Left

Soft Tissue Gas

From pneumomediastinum

Pneumothorax and ST emphysema

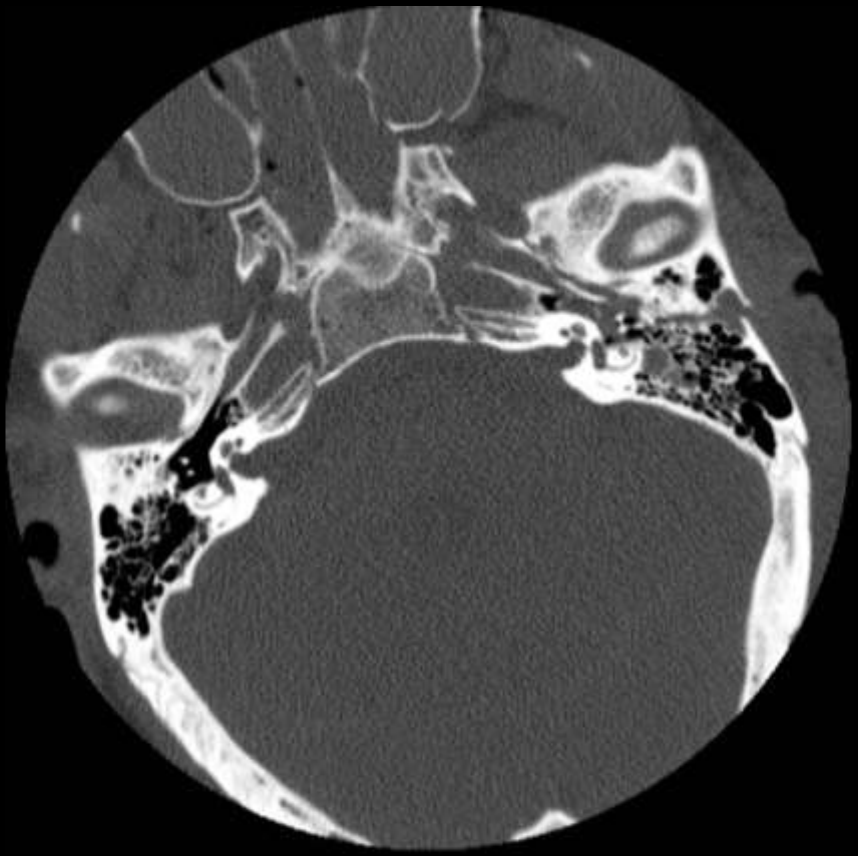




Neck emphysema ptx 27M

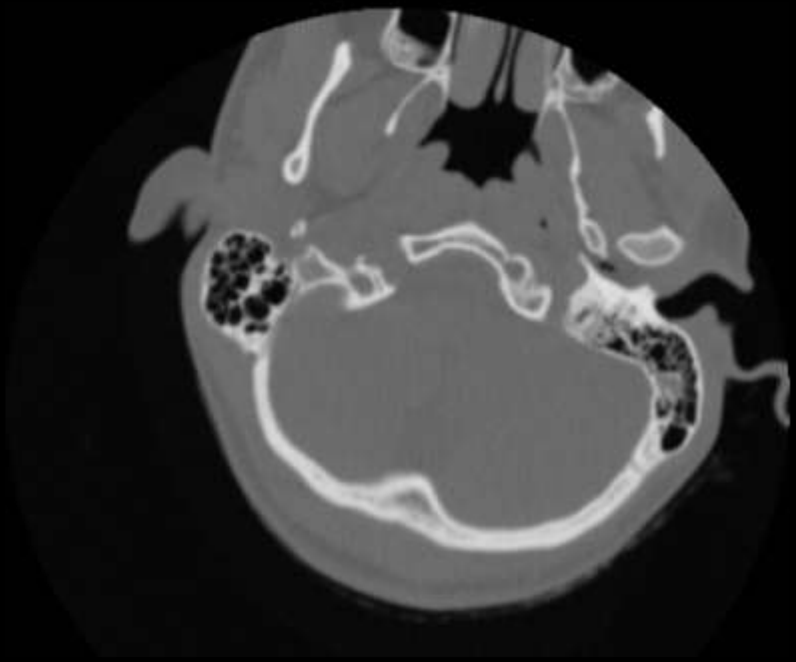
Always check for Pneumothorax

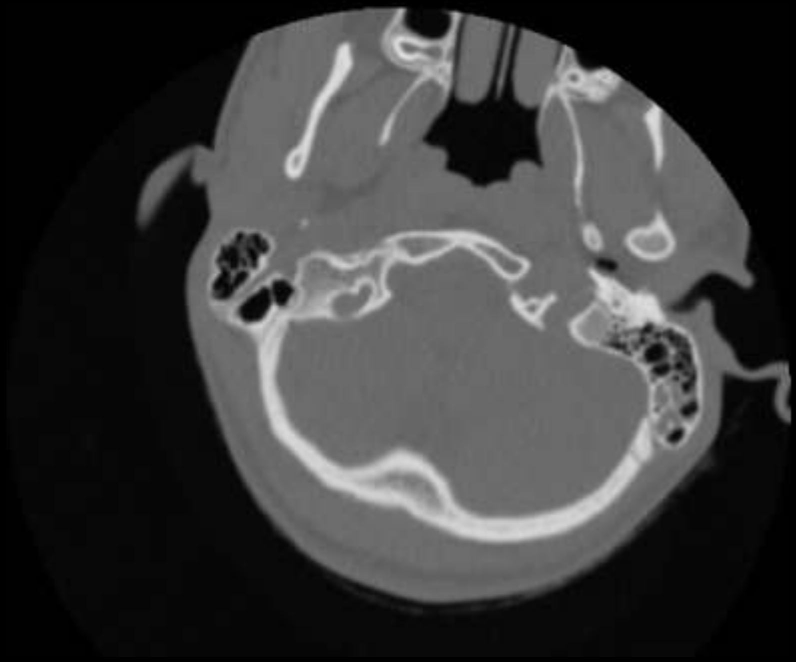
Skull Fracture ST emphysema



Petrous fx with gas 33M

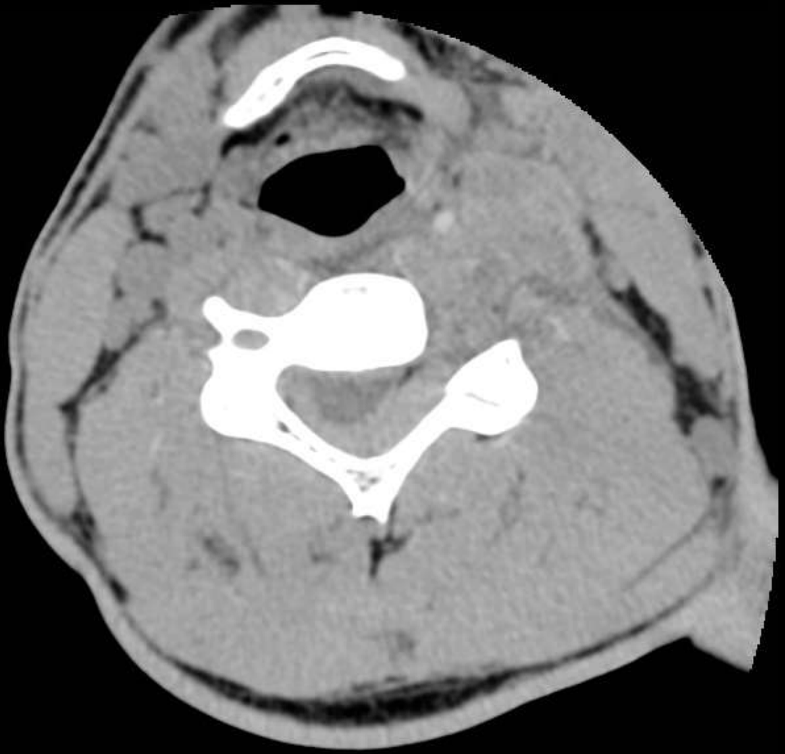
Skull Fracture ST emphysema





Base of skull fx air and fluid 16M

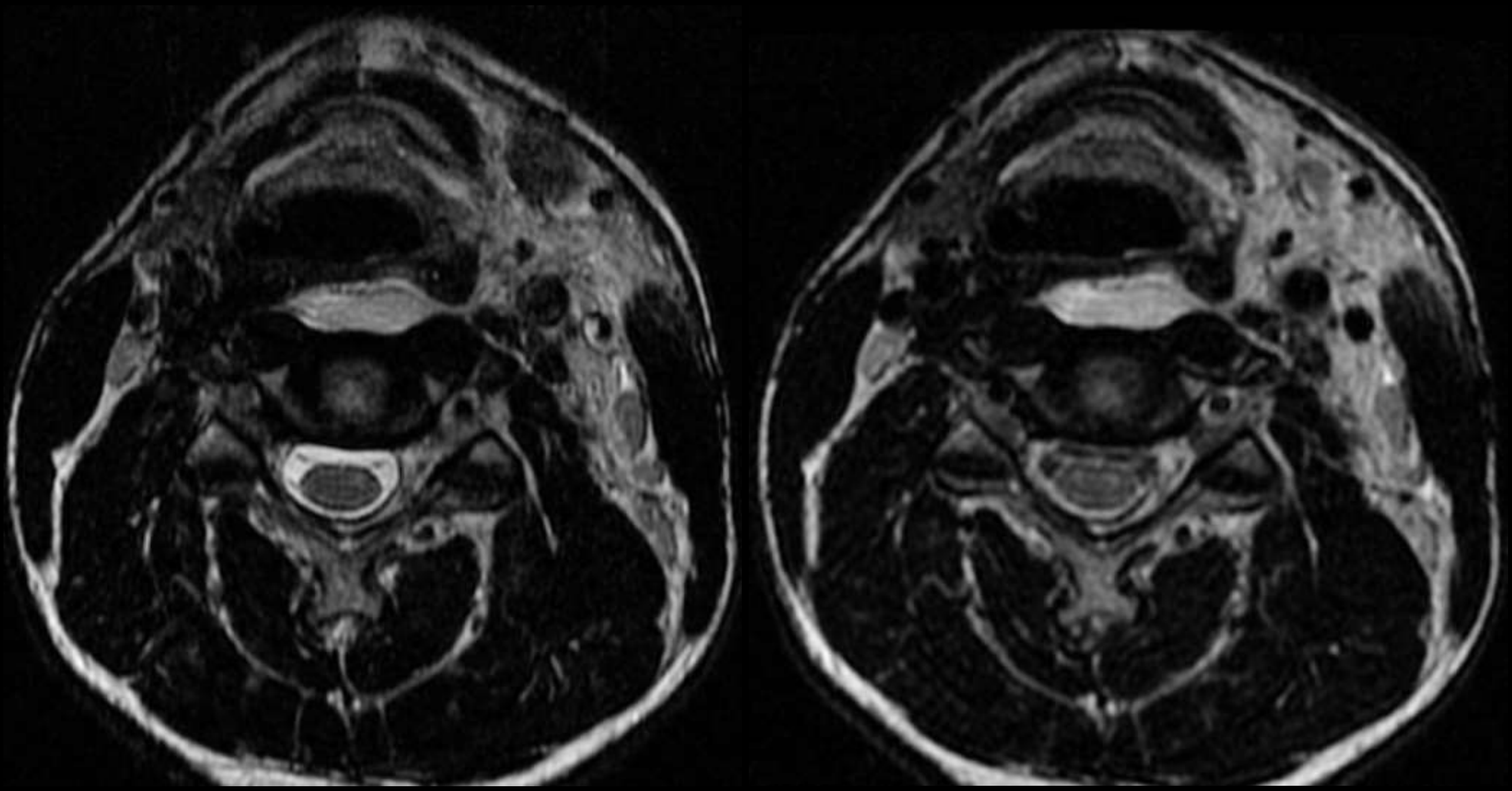
Epidural blood



Epidural blood CT Cx 21M stabbed in left chest

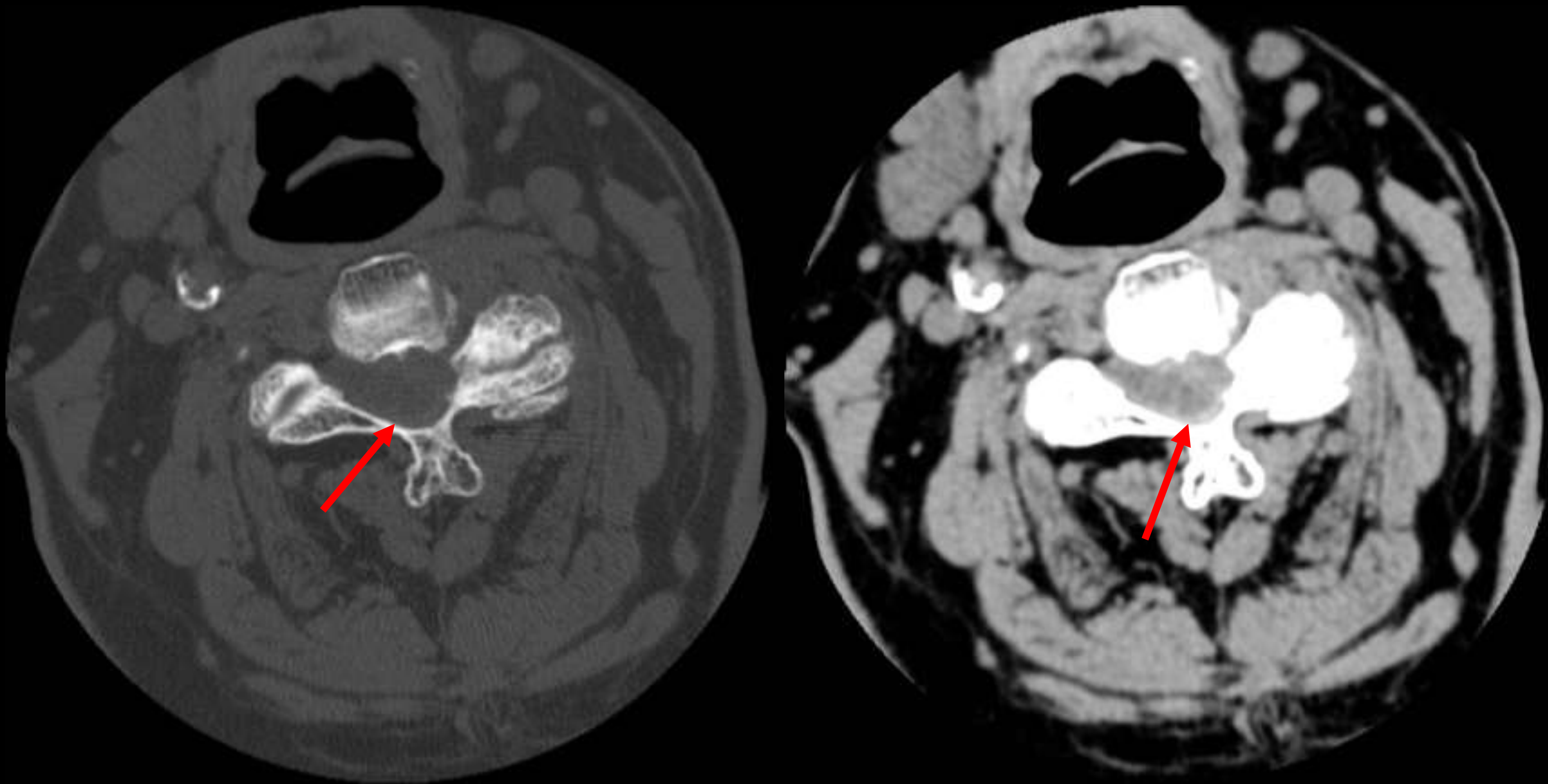
Reading Algorithm - Soft Tissues

Epidural blood



Epidural blood CT Cx 21M stabbed in left chest

C3-4 synovial cyst



C3-4 synovial cyst 87M

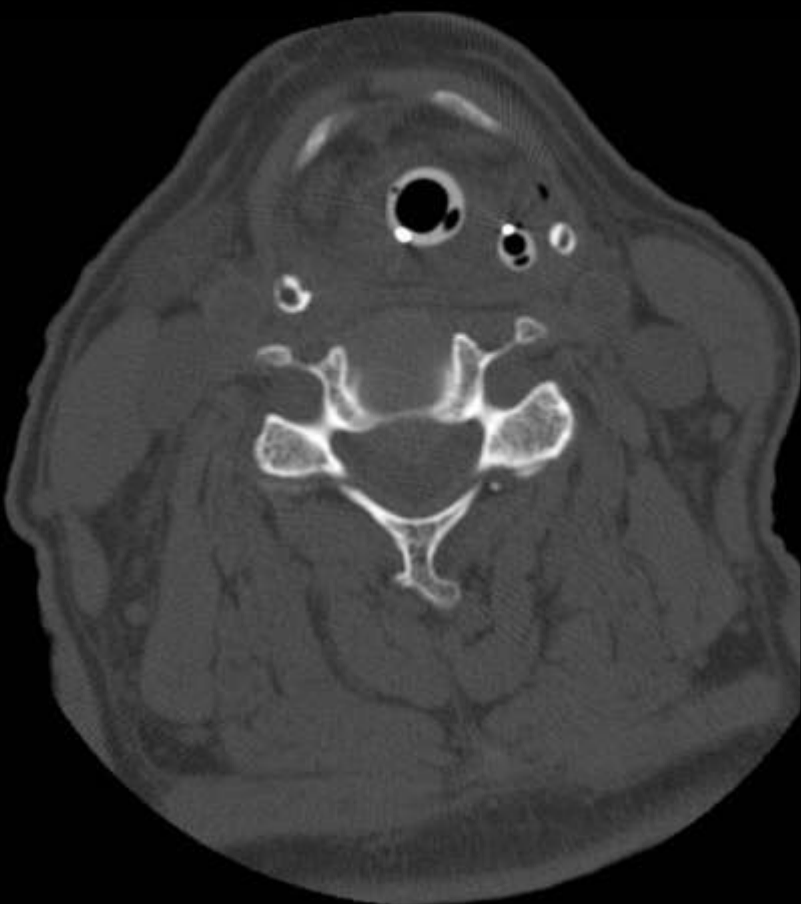
Reading Algorithm - Soft Tissues

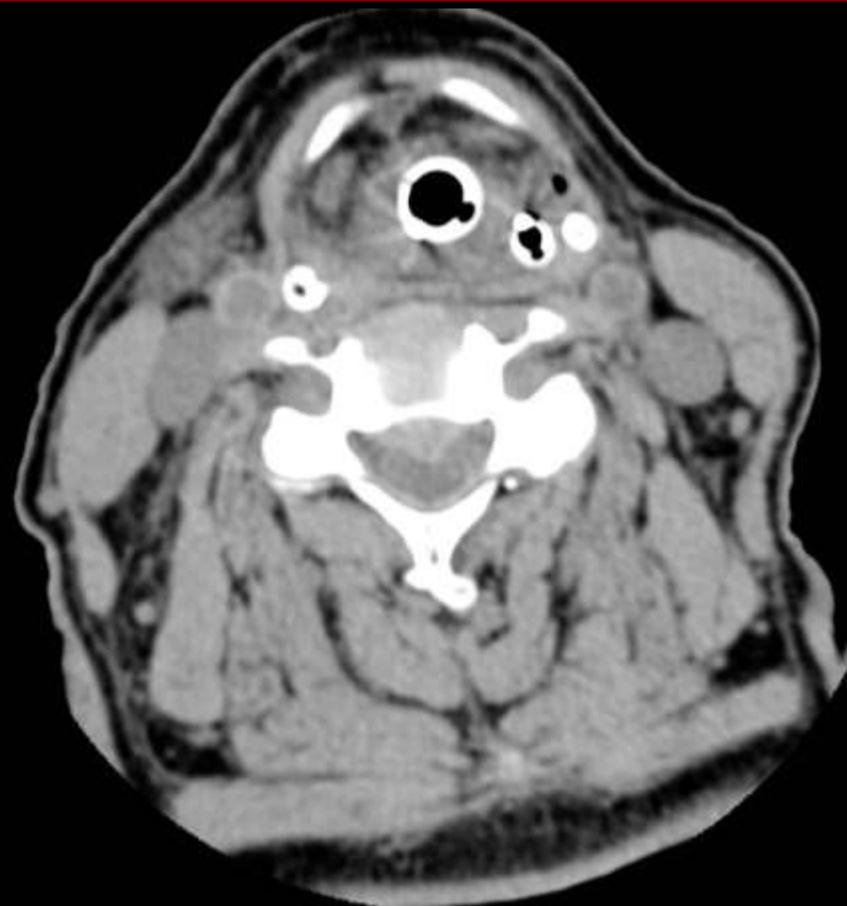
C3-4 synovial cyst

C3-4 synovial cyst 87M

Reading Algorithm - Soft Tissues

C4-5 disc extrusion





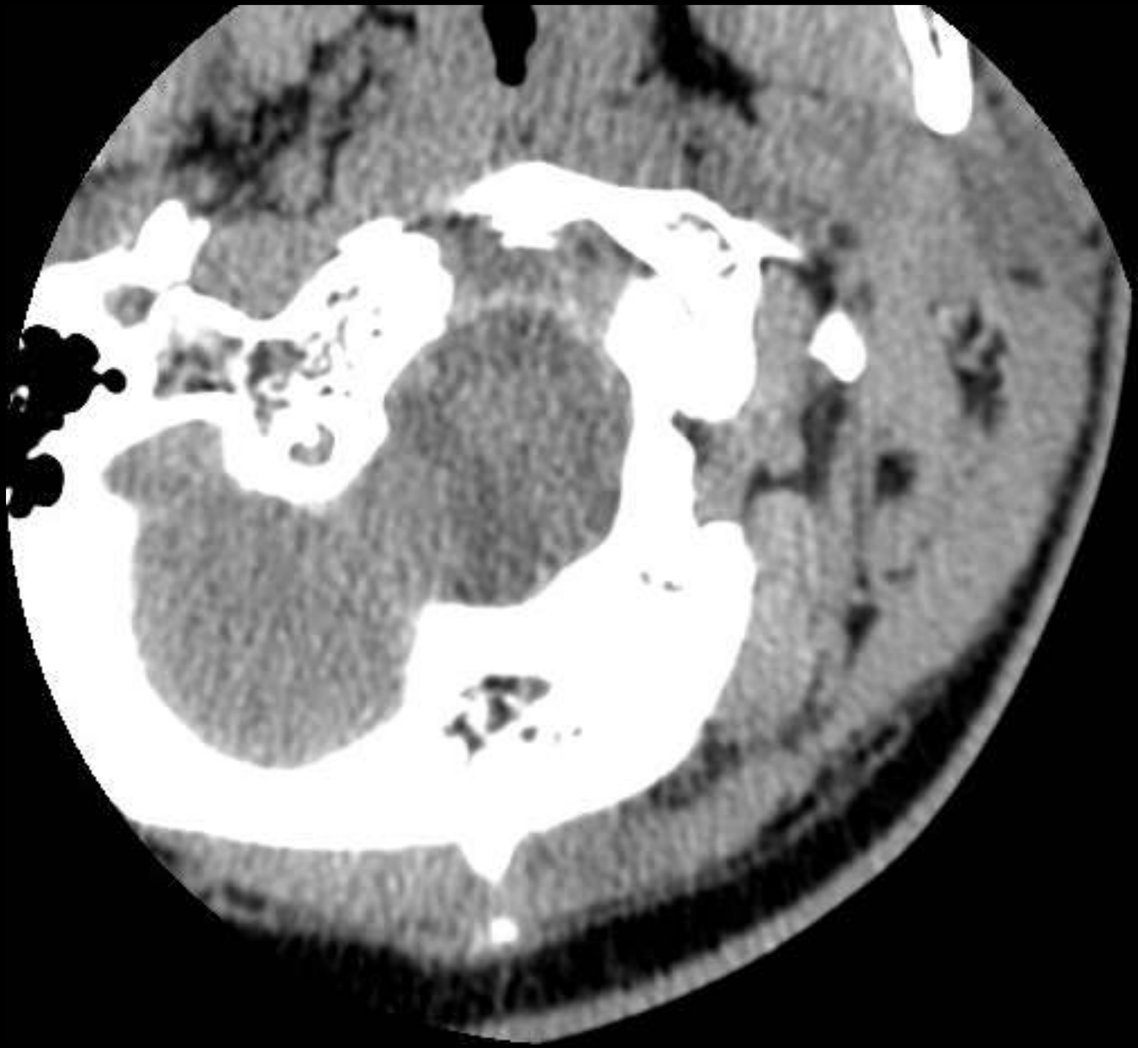
C4-5 disc extrusion on CT 75F

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

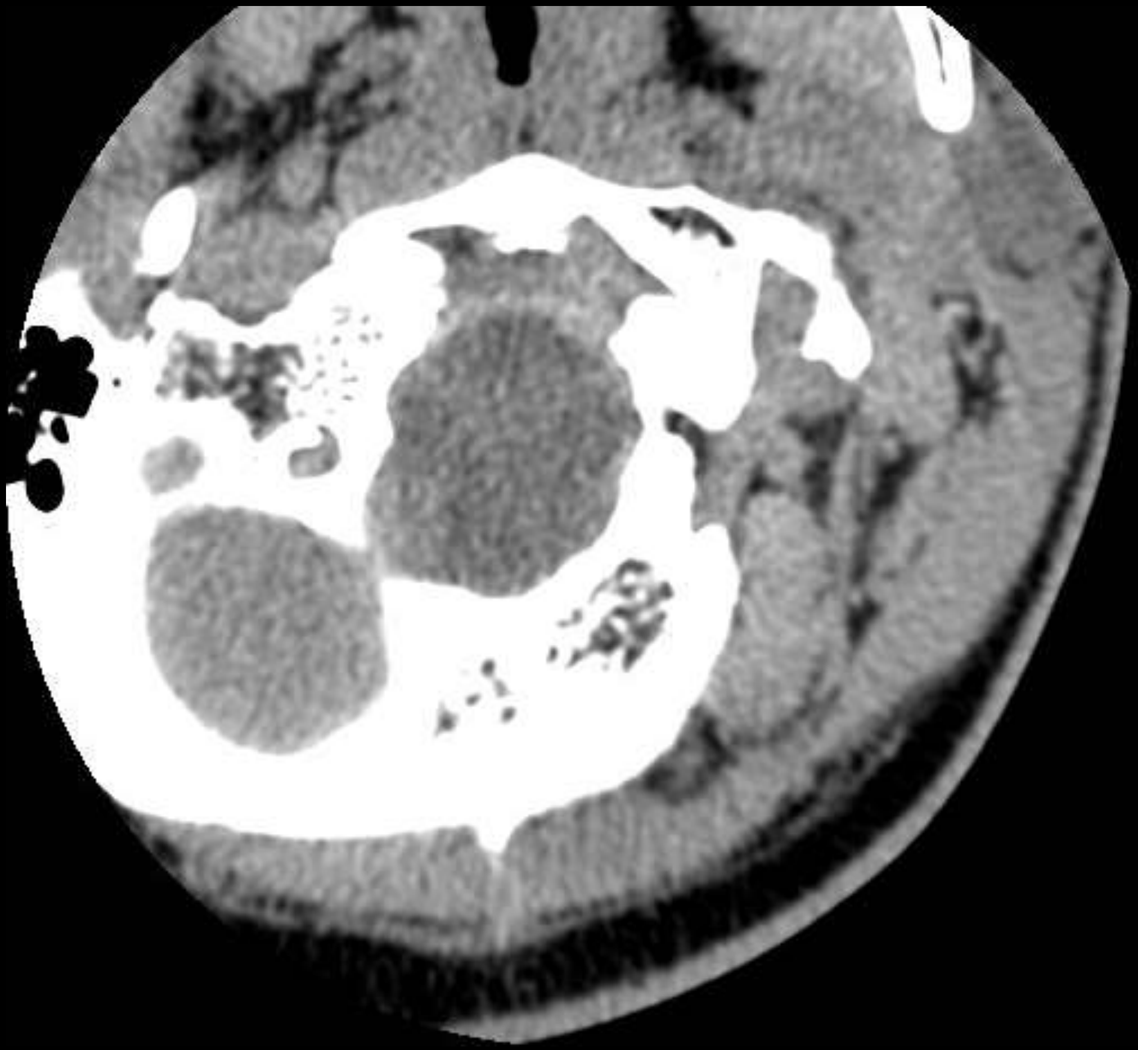
Syrinx



Syrinx on CT 51M multiple falls

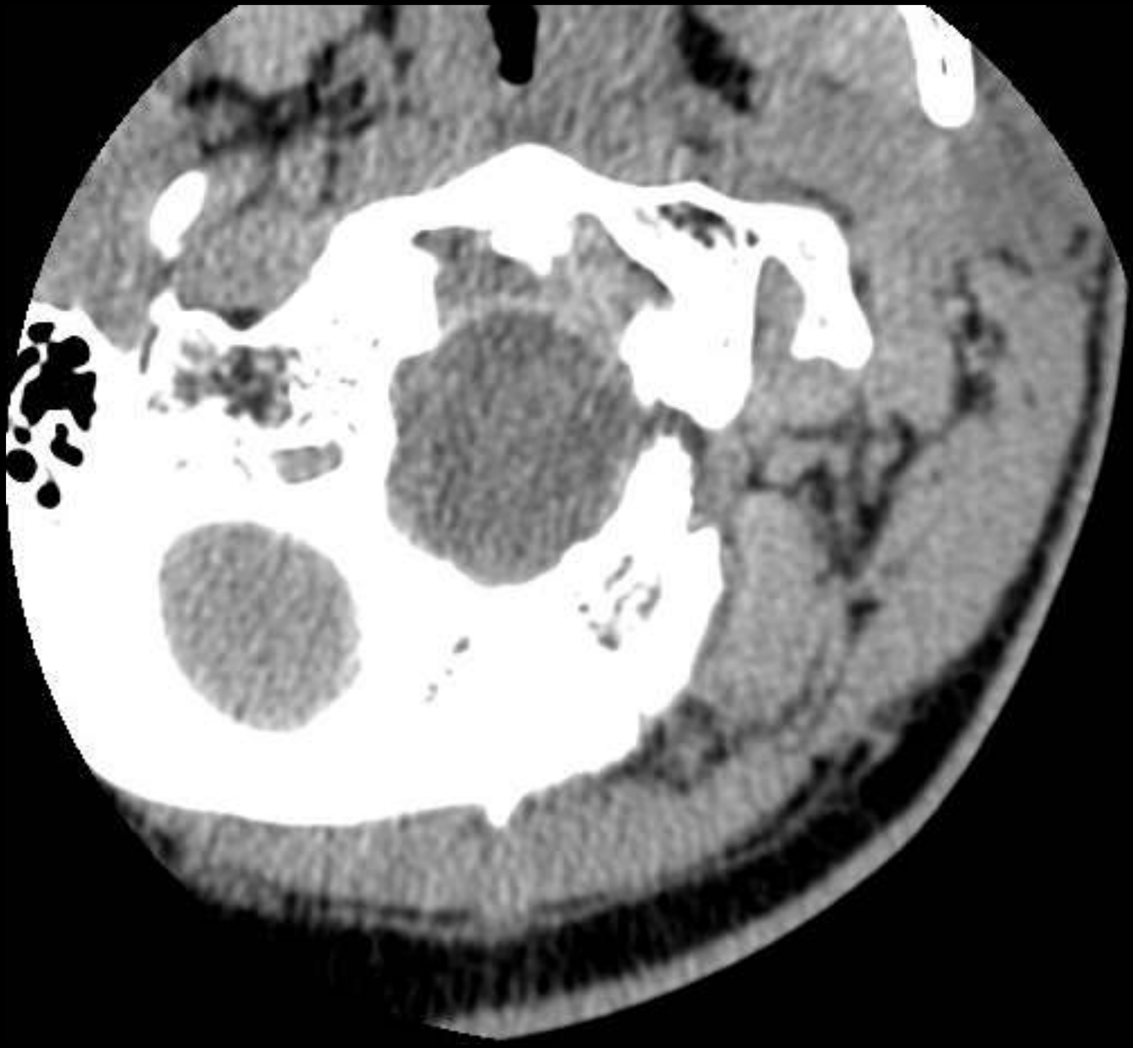
Reading Algorithm - Soft Tissues

Syrinx



Syrinx on CT 51M multiple falls

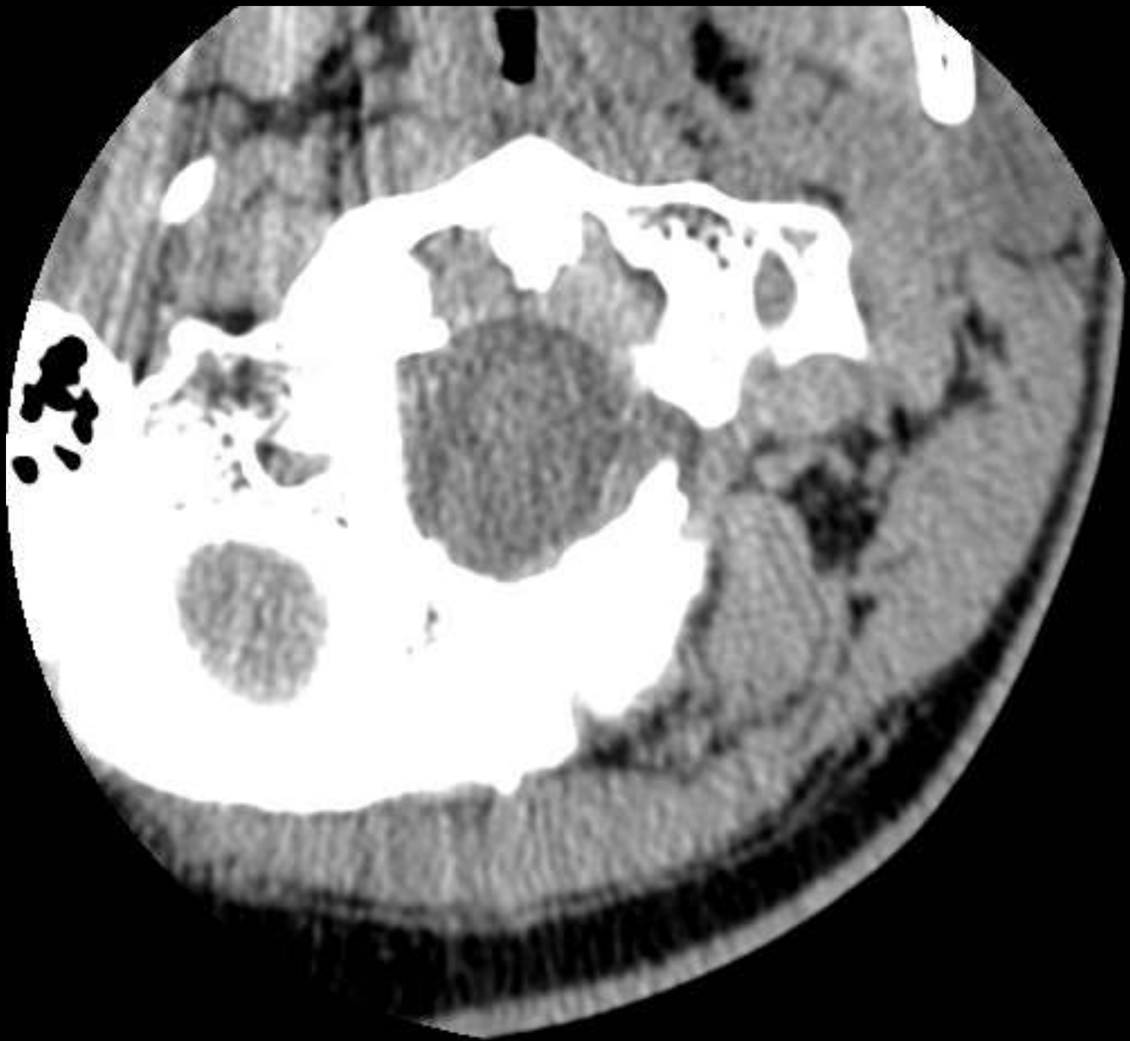
Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

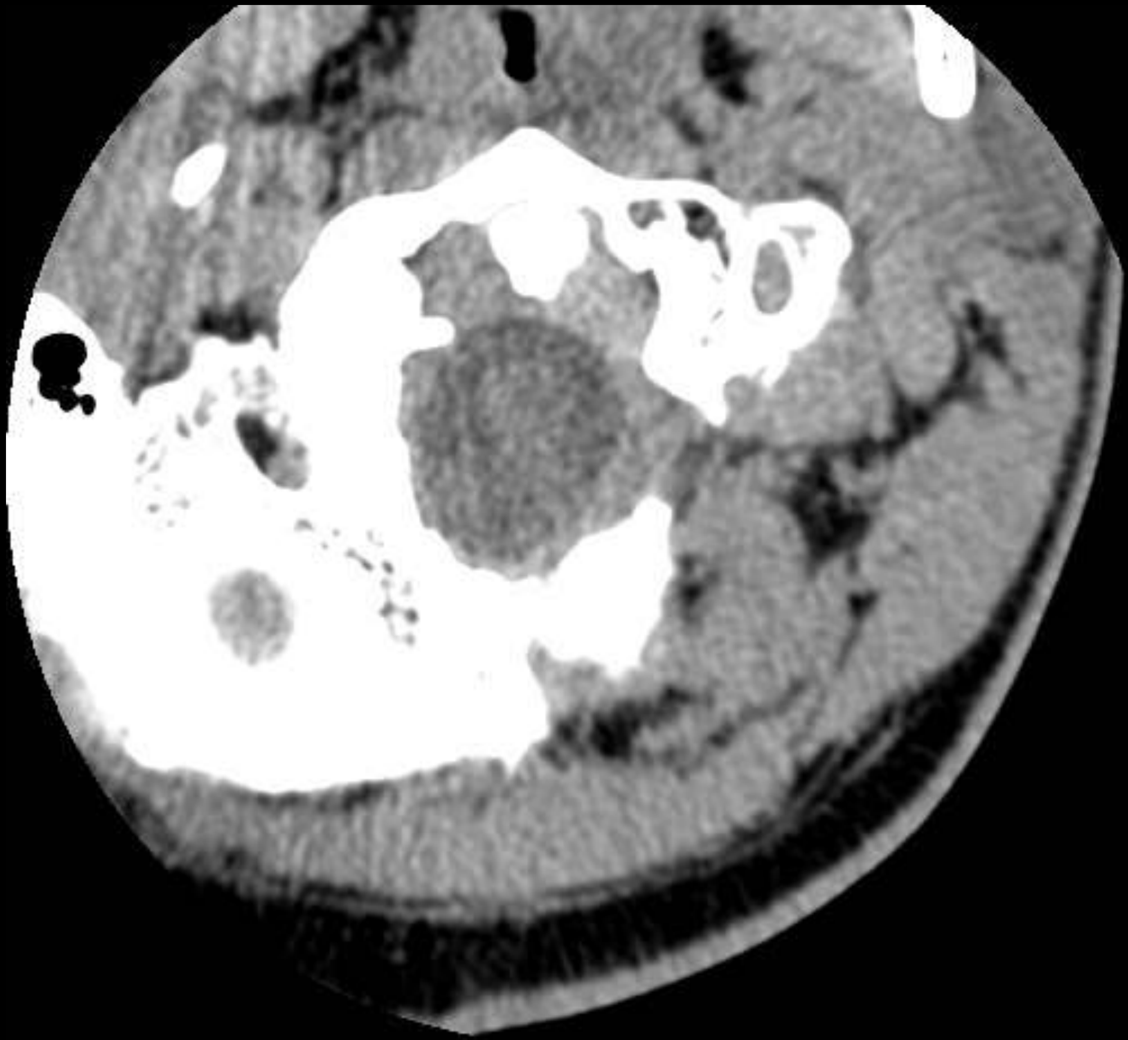
Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

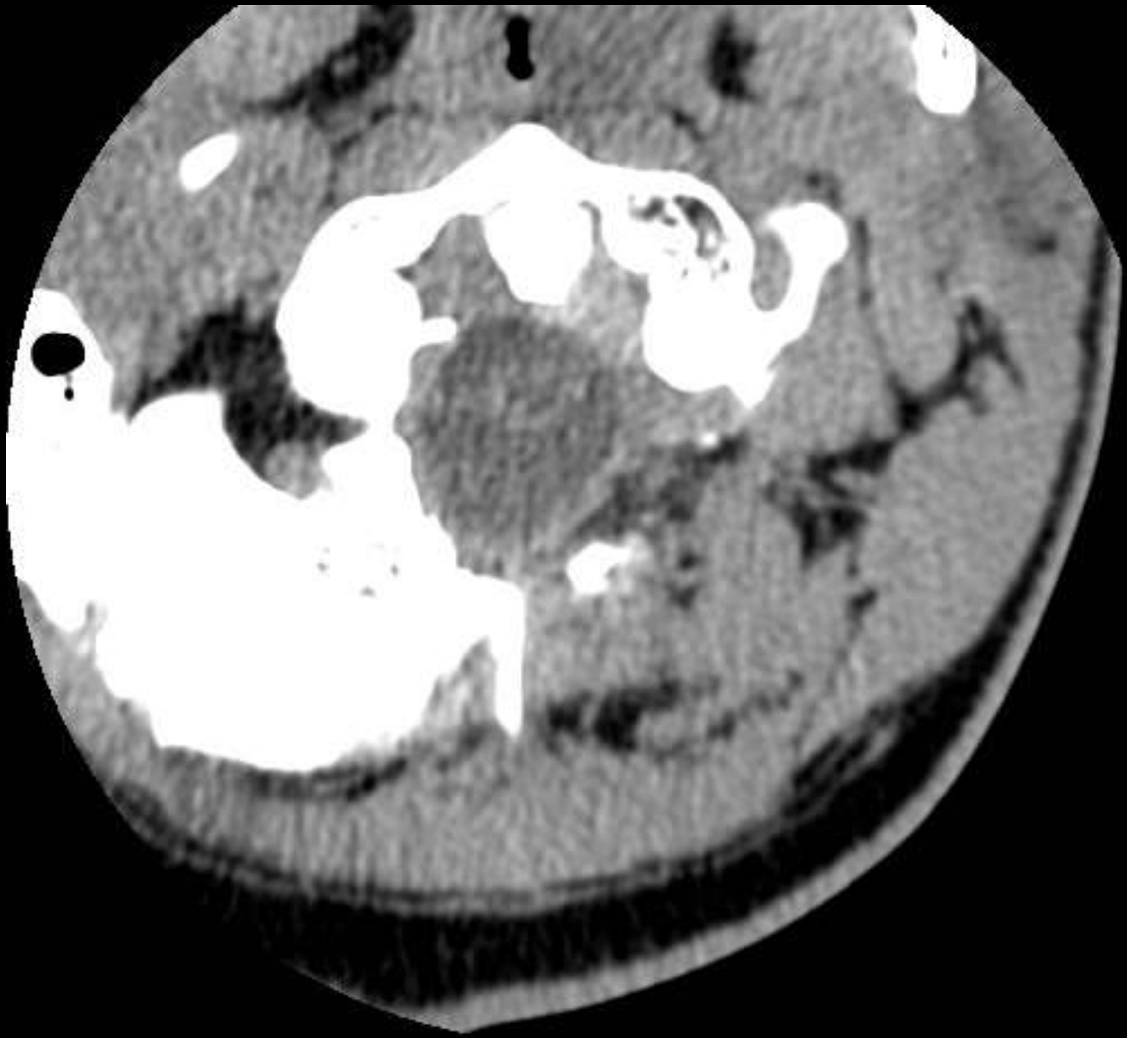
Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

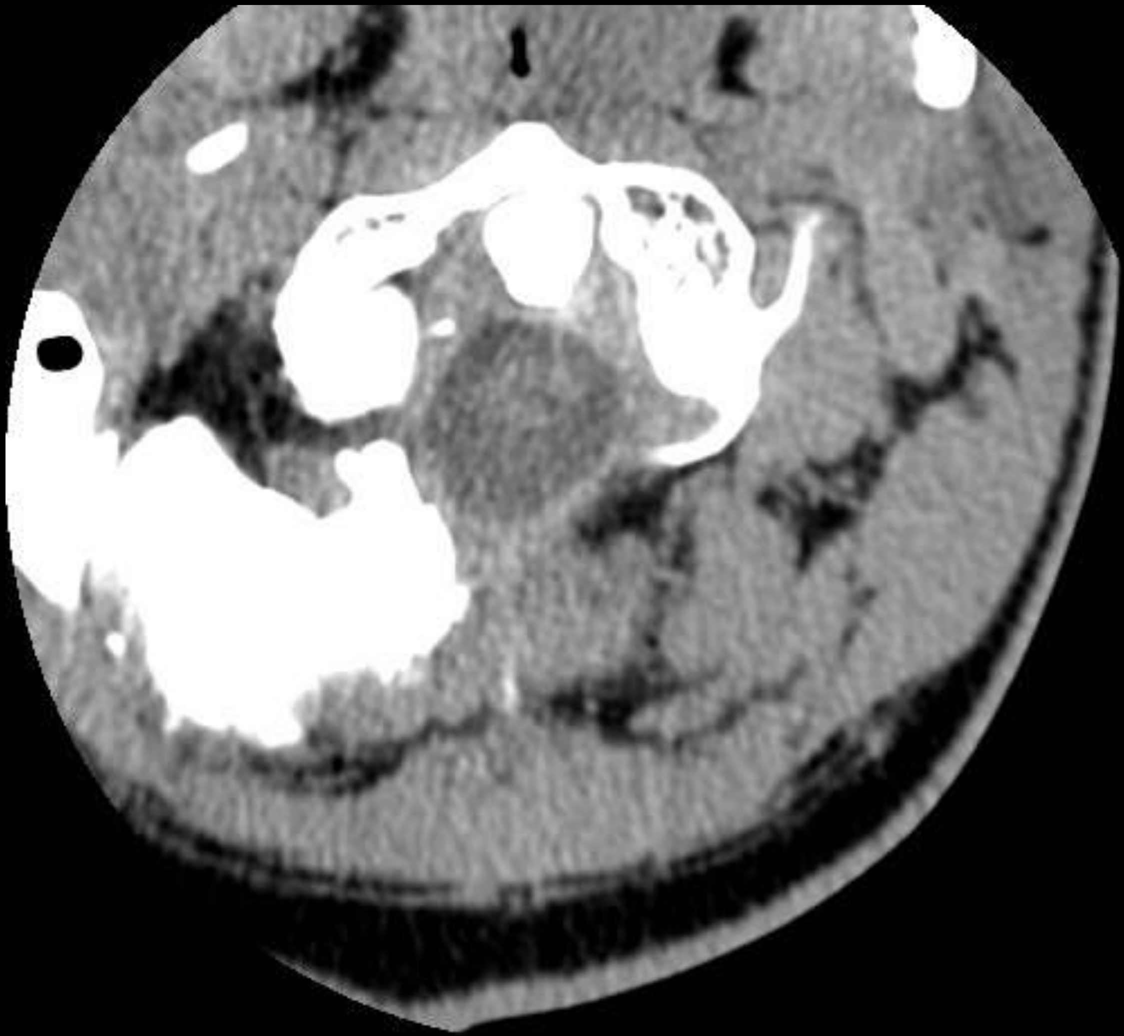
Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

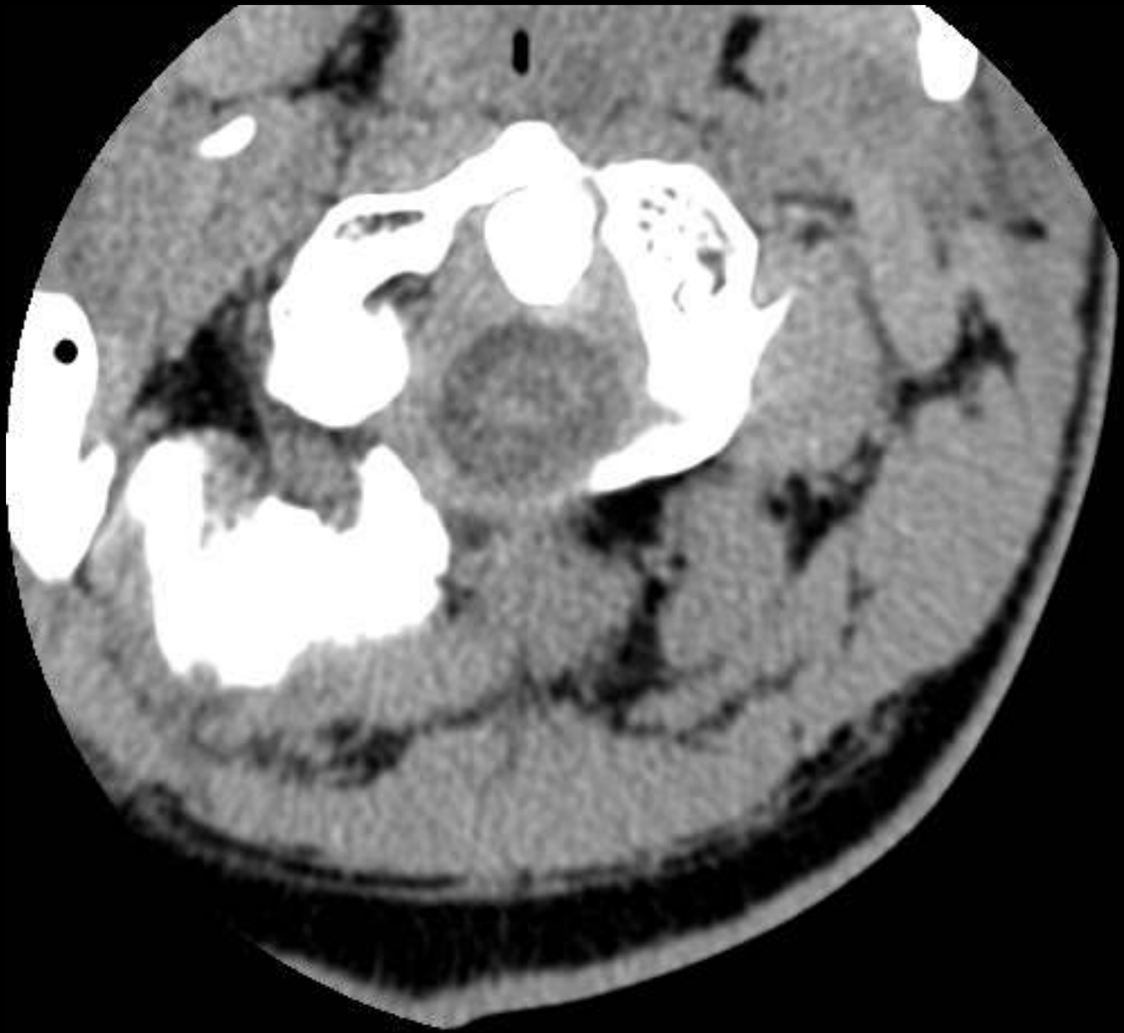
Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

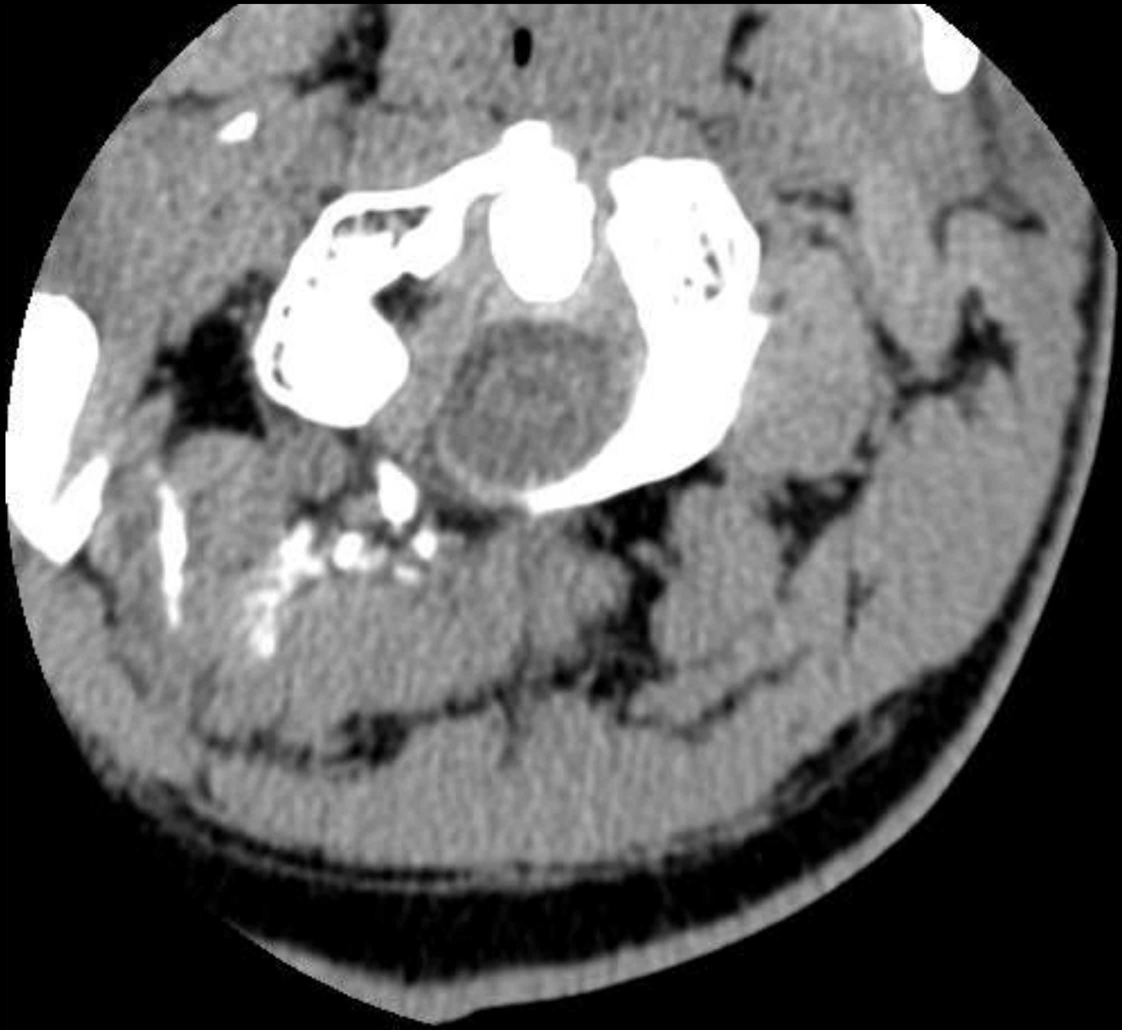
Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx



Syrinx on CT 51M multiple falls

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

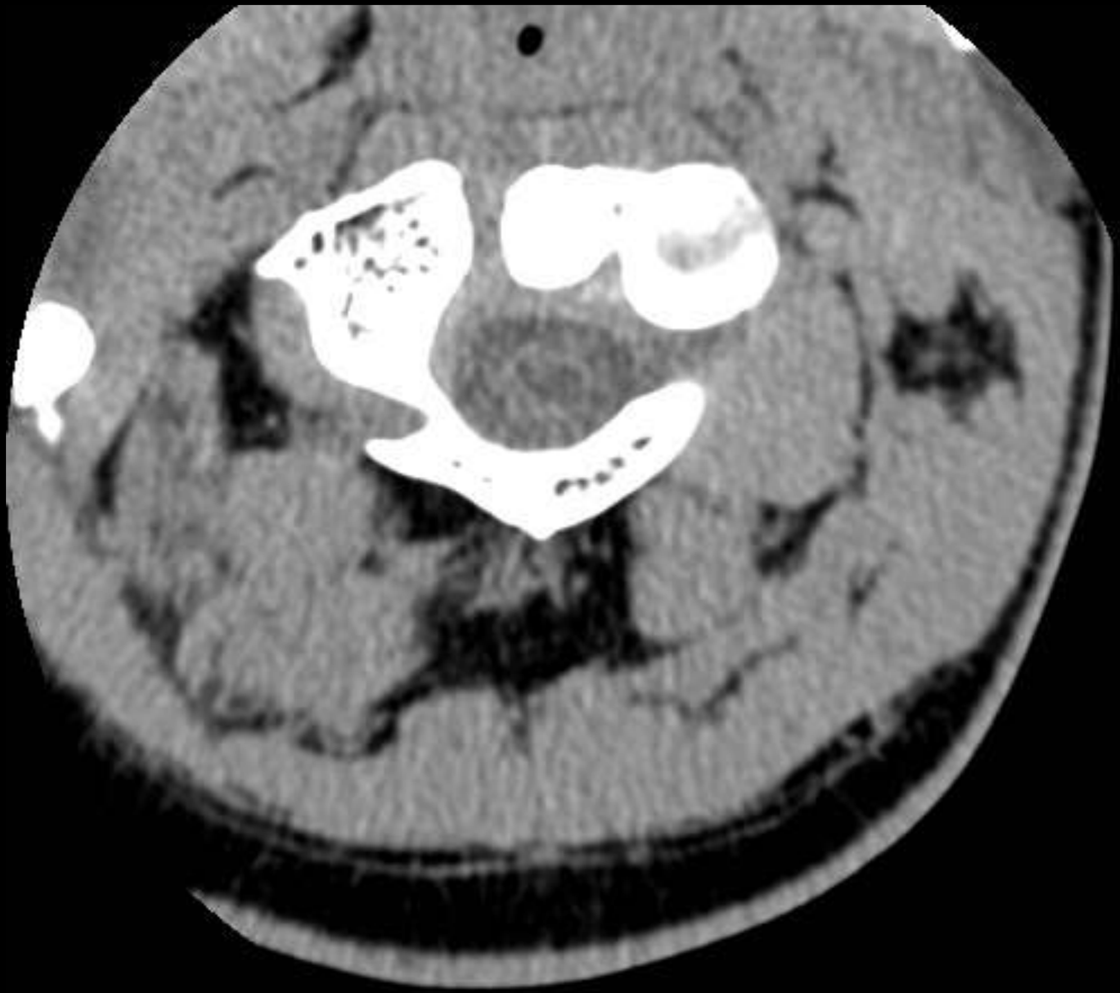
Syrinx on CT 51M multiple falls

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Syrinx

Syrinx on CT 51M multiple falls

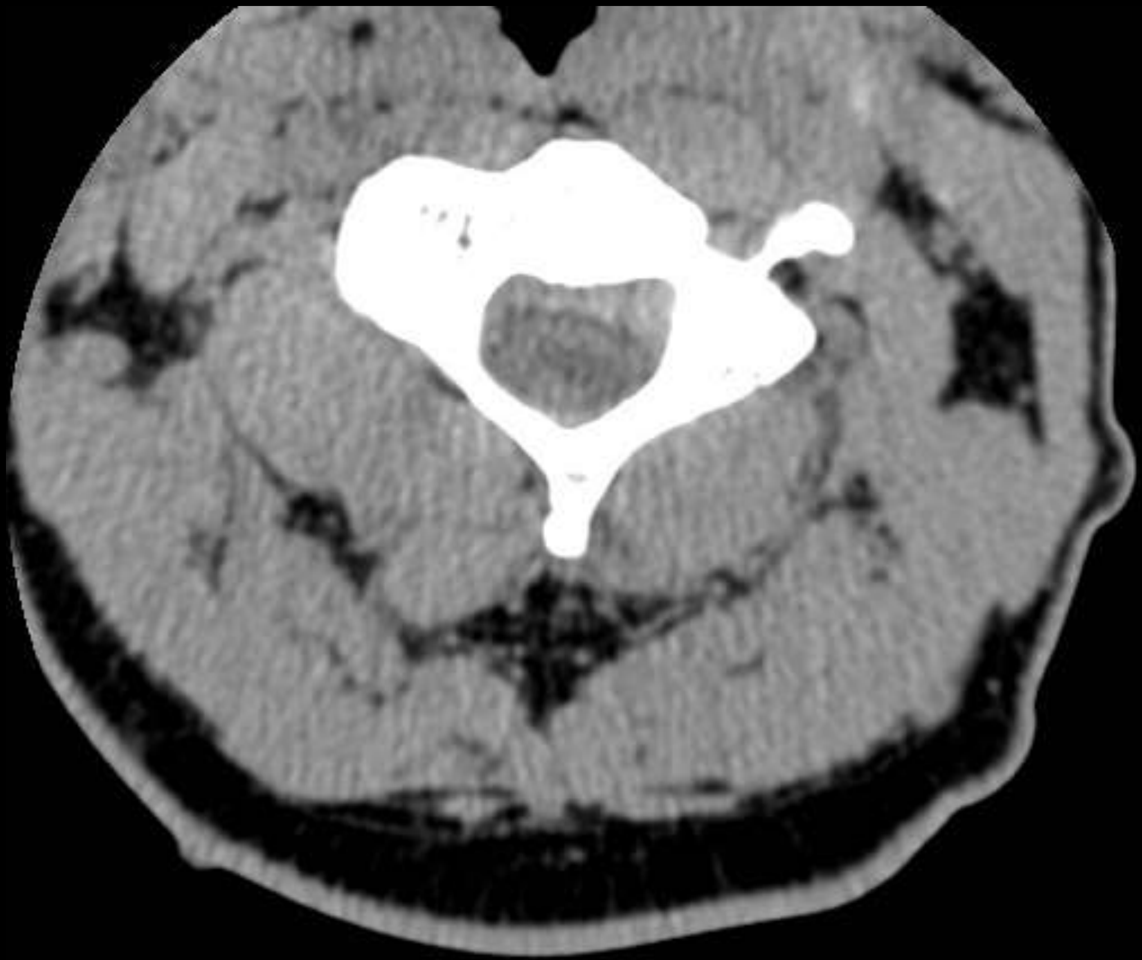
Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx



Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

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Syrinx

Syrinx on CT 51M multiple falls

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Syrinx

Syrinx on CT 51M multiple falls

Reading Algorithm - Soft Tissues

Pharynx

Blakemore tubing in pharynx 53M

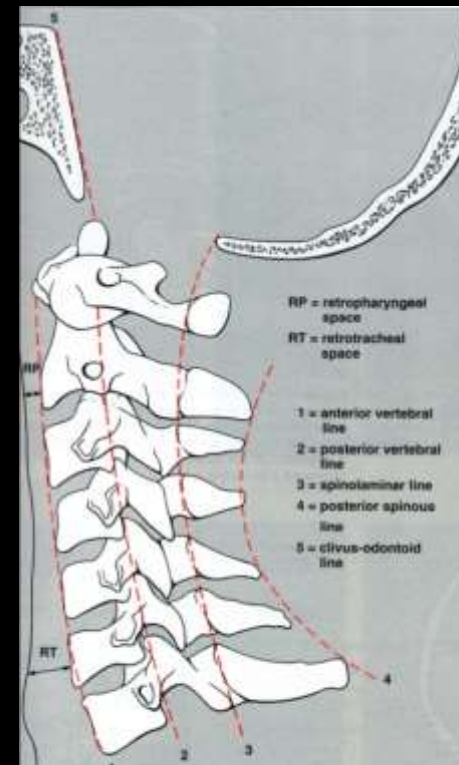
Reading Algorithm - Soft Tissues Laryngopharynx

ETT in larynx

Reading Algorithm – Bony alignment

Life Lines

1. Anterior vertebral body line
2. Posterior vertebral body line
3. Spinolamina line
4. Posterior spinous process line



Evaluate C1-C2 Area

Adults: <3mm

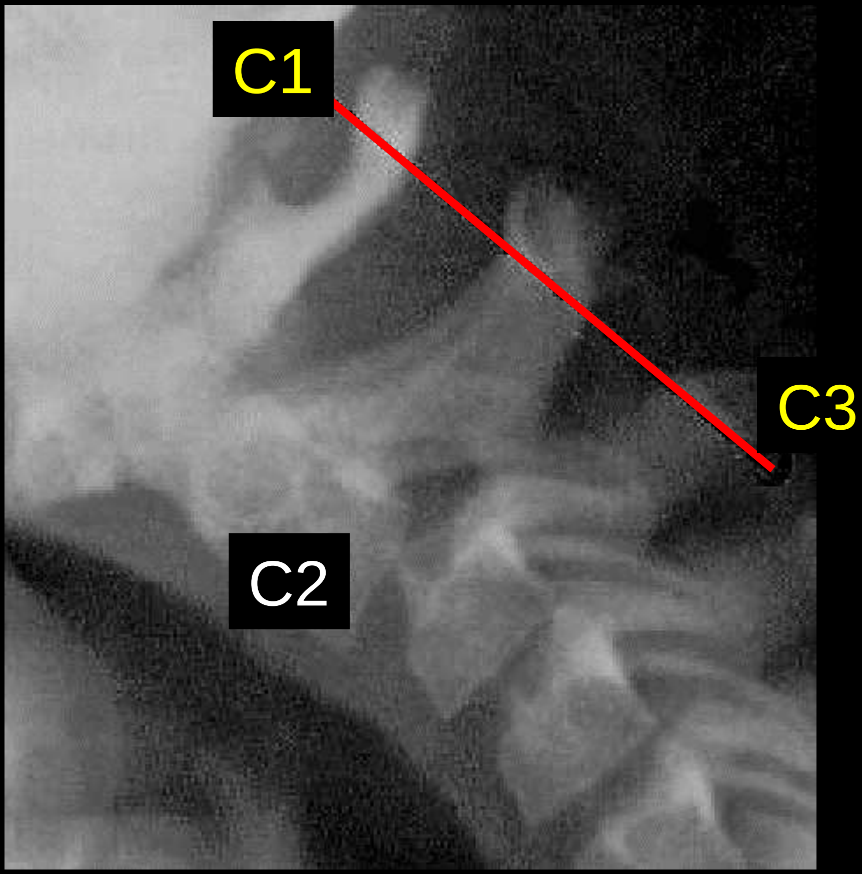
Child: <5mm

Greenspan

Reading Algorithm – Bony alignment

Pseudo (physiologic) Subluxation

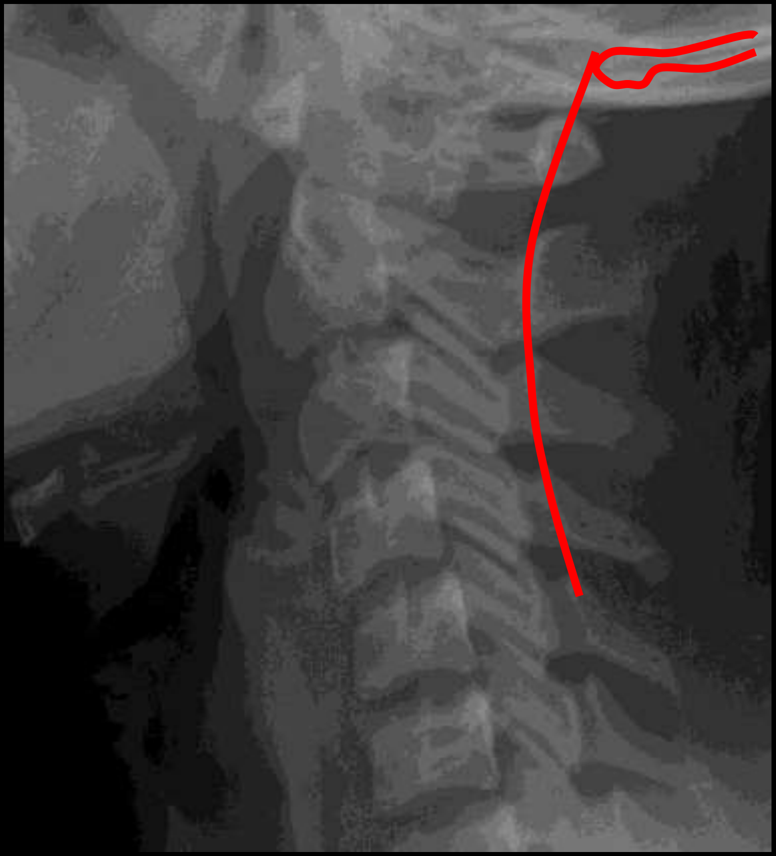
- In children
- Ligament laxity
- Check Posterior Spinal (cervical) Line
- More than 2-3mm offset (C2 SLL anterior to PSL) must be considered traumatic.



Caffey and Swischuk

Pseudo (physiologic) Subluxation

- In children
- Ligament laxity
- Check Posterior Spinal (cervical) Line
- More than 2-3mm offset (C2 SLL anterior to PSL) must be considered traumatic.



Normal spine C2-3 13F

Reading Algorithm – Bony alignment

Pseudo (physiologic) Subluxation

- In children
- Ligament laxity
- Check Posterior Spinal (cervical) Line
- More than 2-3mm offset (C2 SLL anterior to PSL) must be considered traumatic.

Normal spine C2-3 13F

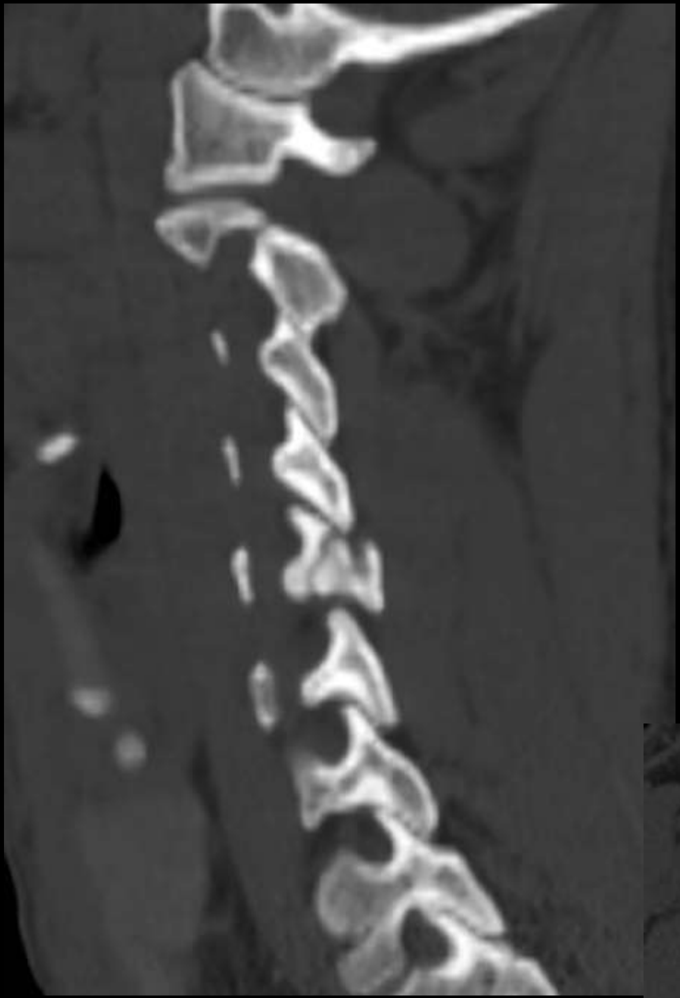
Reading Algorithm – Bony alignment

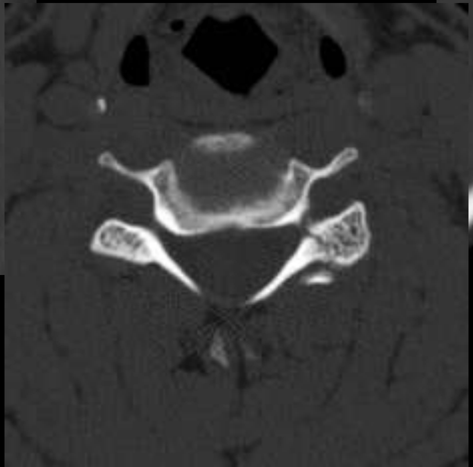
Life Lines

Cx spine C5 Fx 27M malaigned facets

Reading Algorithm – Bony alignment

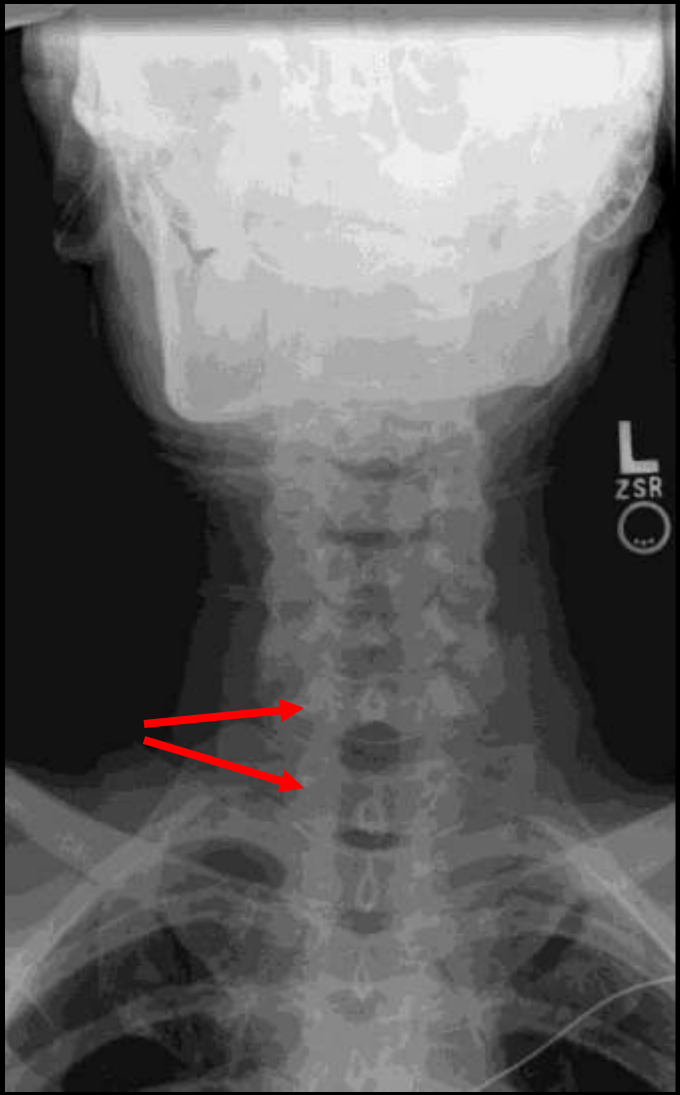
Life Lines





Cx spine C5 Fx 27M malaigned facets

Life Lines



Reading Algorithm – Bony alignment

Life Lines

46F C7-T1 Bifacet dislocations

Reading Algorithm – Find the second fracture

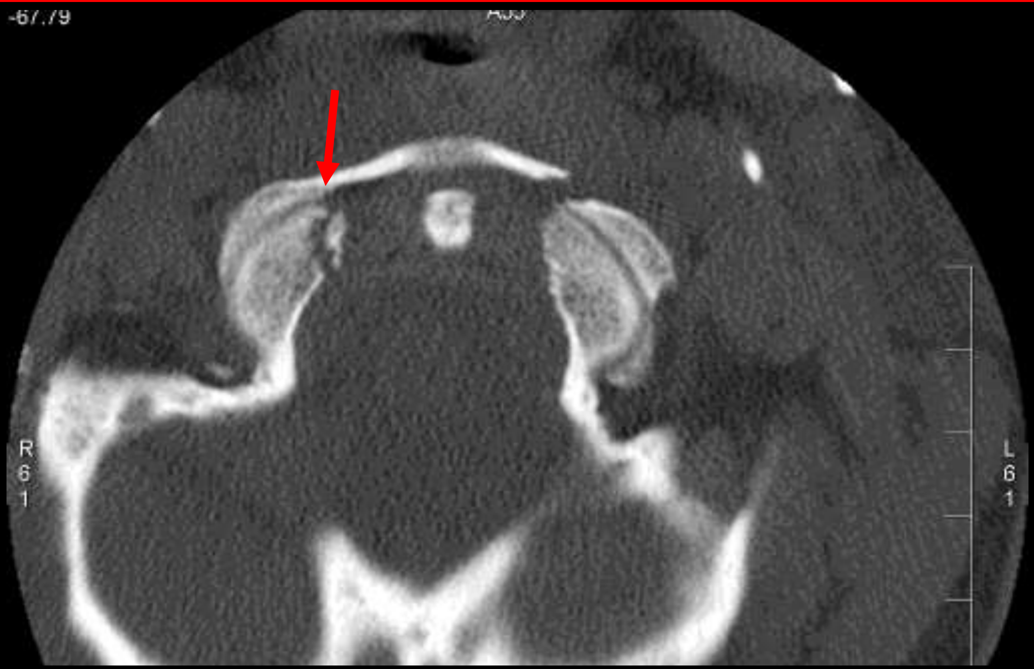
Occiput, C1, C2 and C6-7 fxs

1+4+1

22M

Reading Algorithm – Find the second fracture

Occiput, C1, C2 and C6-7 fxs



Occiput Fx

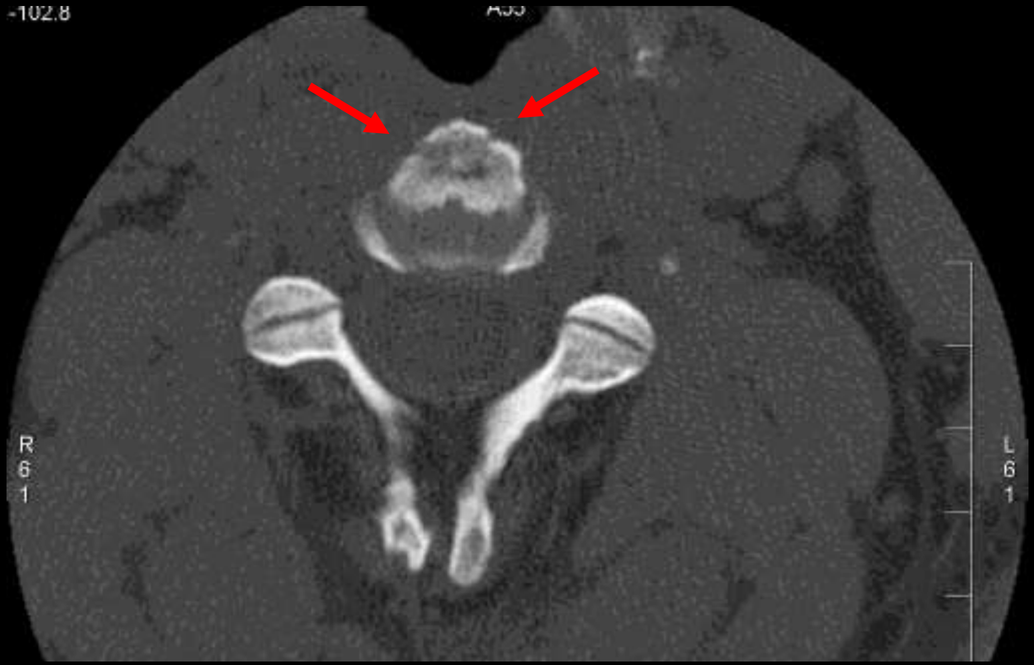
Reading Algorithm – Find the second fracture

Occiput, C1, C2 and C6-7 fxs

C1 Fx

Reading Algorithm – Find the second fracture

Occiput, C1, C2 and C6-7 fxs



C2 Fx

Reading Algorithm – Find the second fracture

Occiput, C1, C2 and C6-7 fxs

C6-7 Fx Dis

Reading Algorithm – Find the second fracture

Occiput, C1, C2 and C6-7 fxs

22M

Reading Algorithm – Find the second fracture

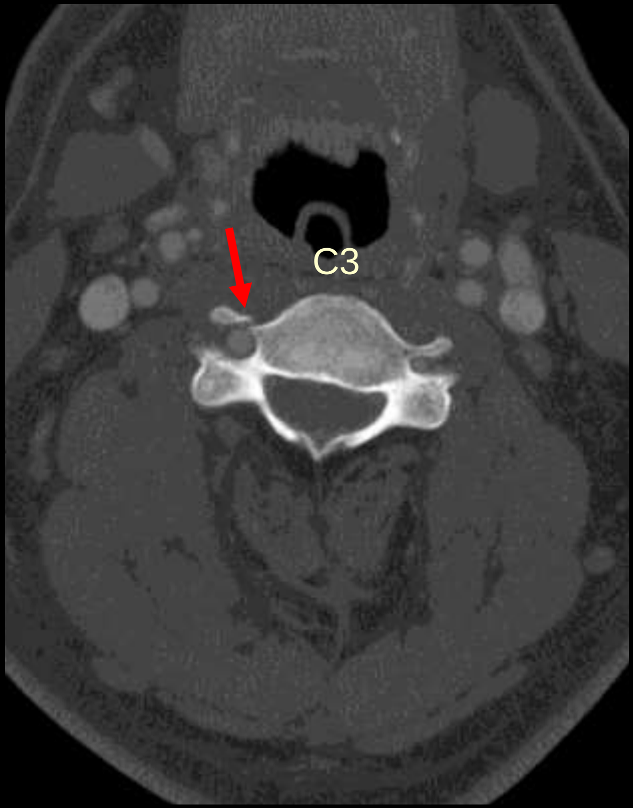
C3,4,5,6,7 fxs

1+36

42M

Reading Algorithm – Find the second fracture

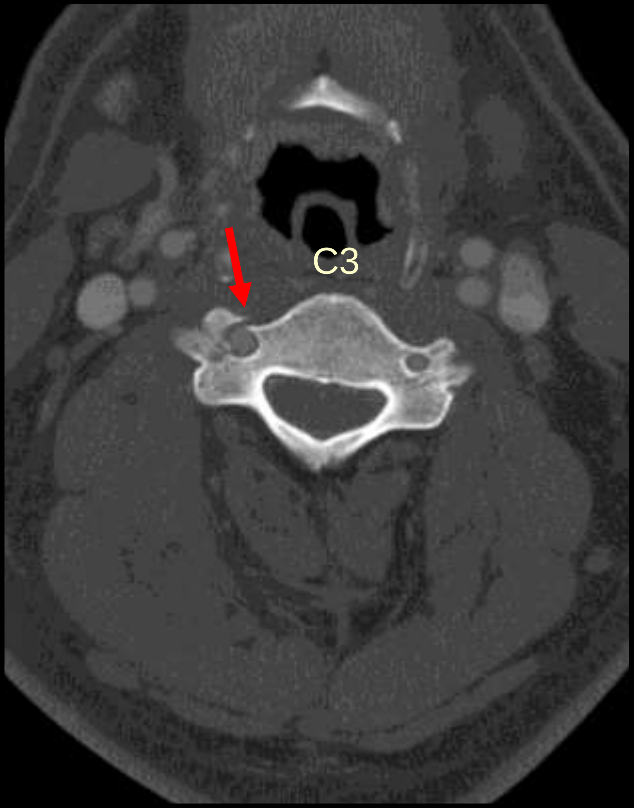
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

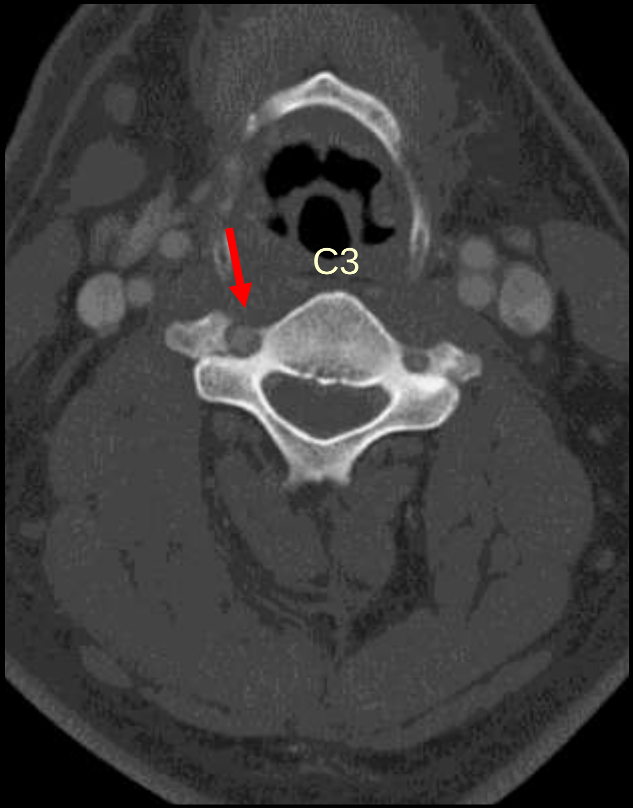
C3,4,5,6,7 fxs



42M

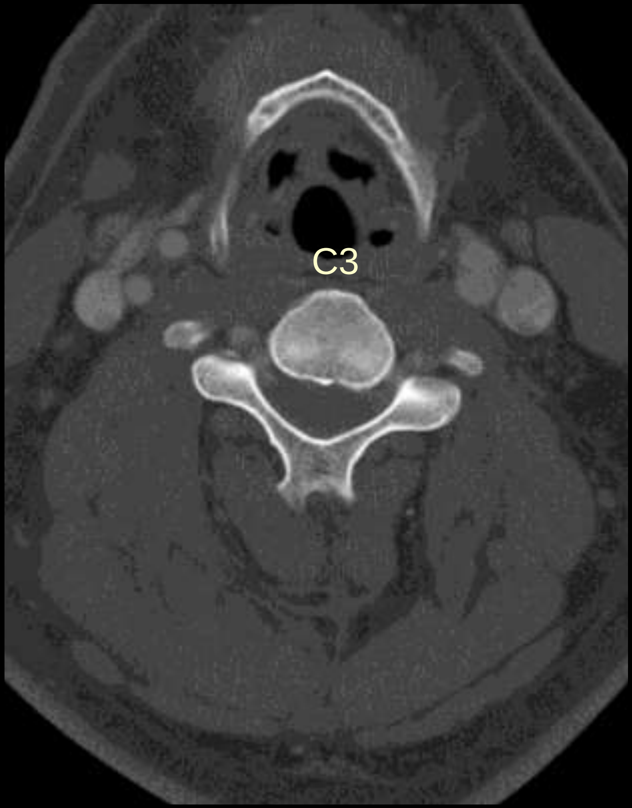
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



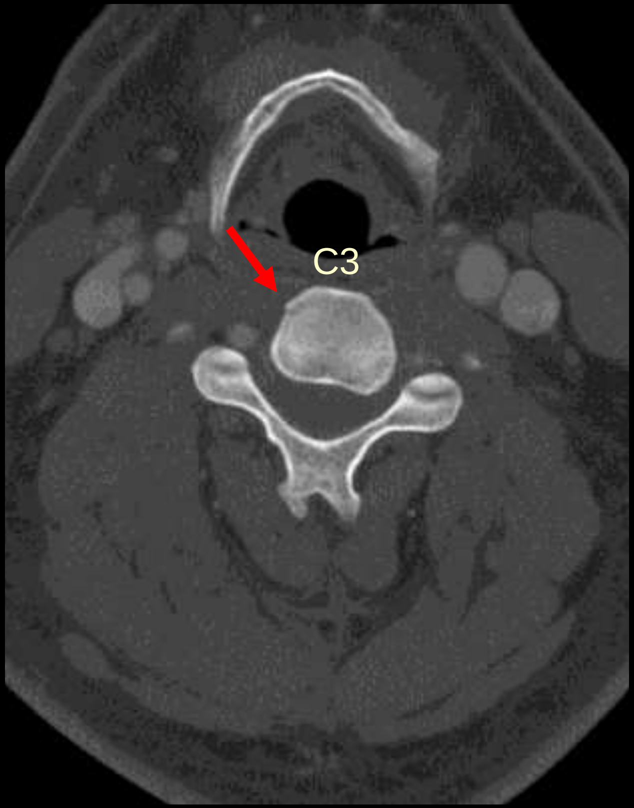
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



Reading Algorithm – Find the second fracture

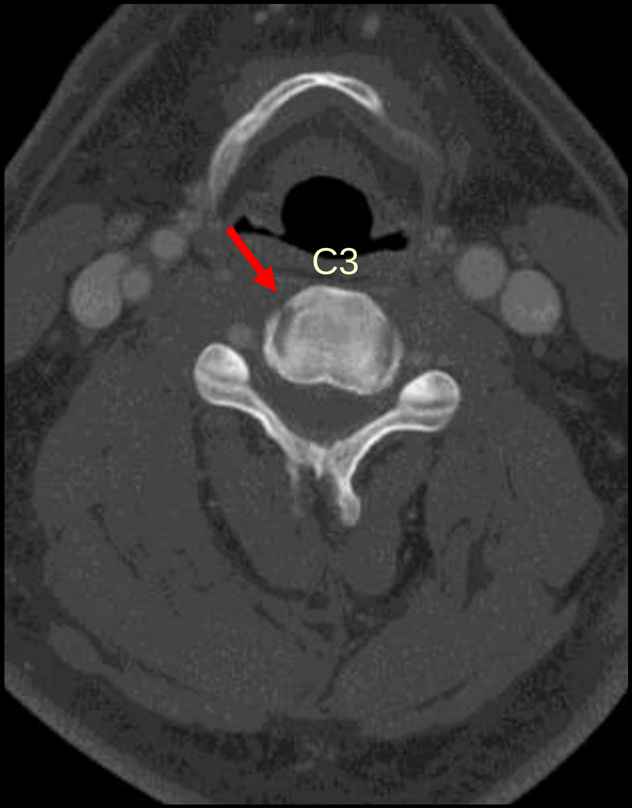
C3,4,5,6,7 fxs



42M

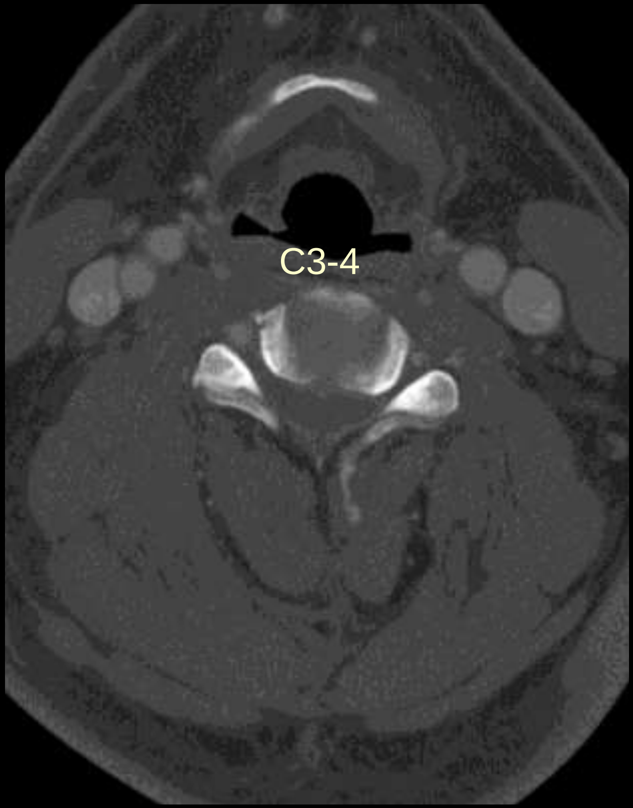
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



Reading Algorithm – Find the second fracture

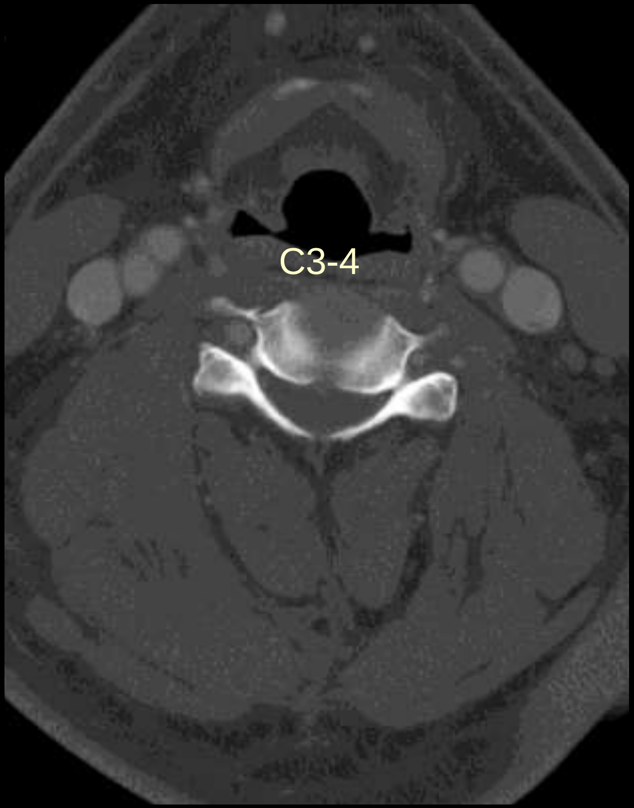
C3,4,5,6,7 fxs



42M

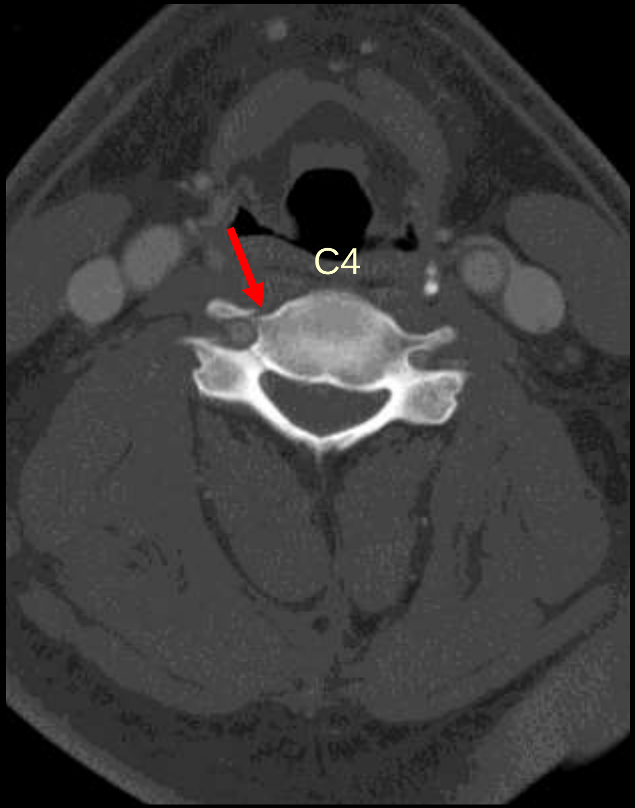
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



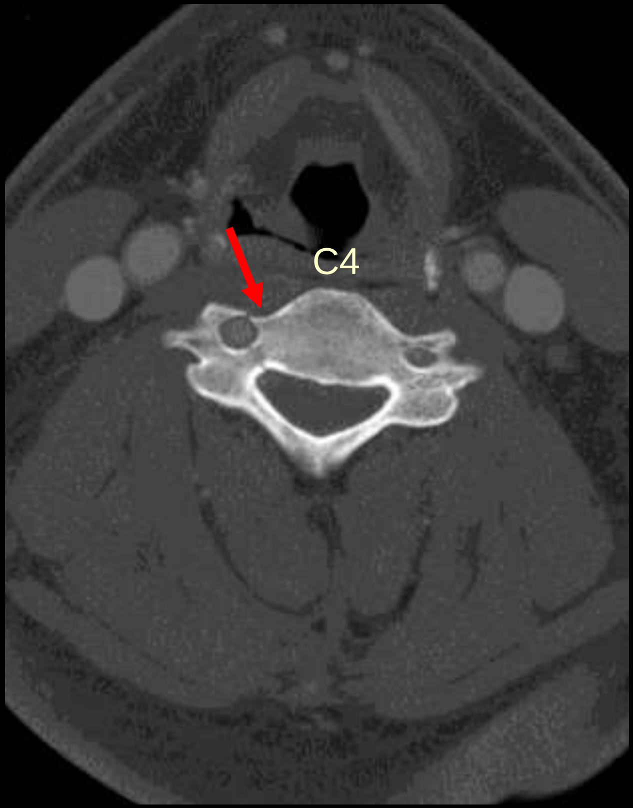
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



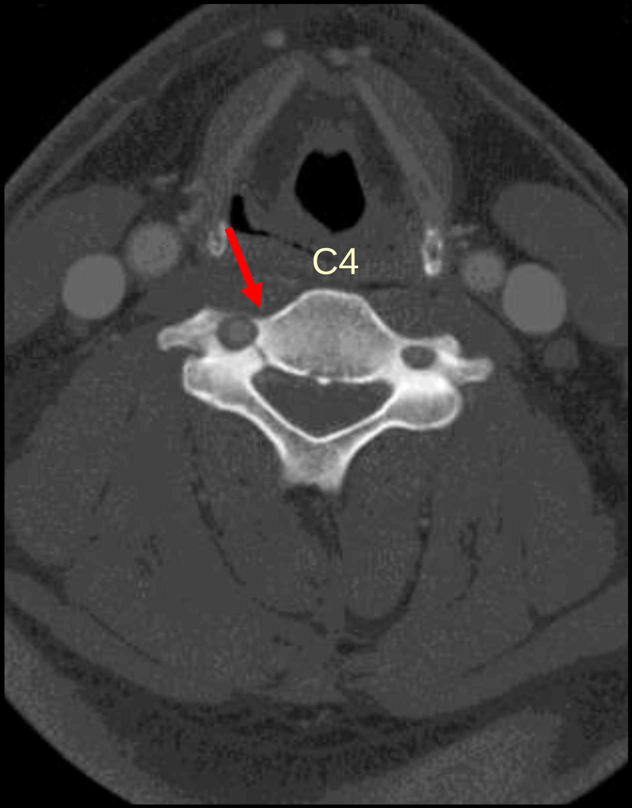
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



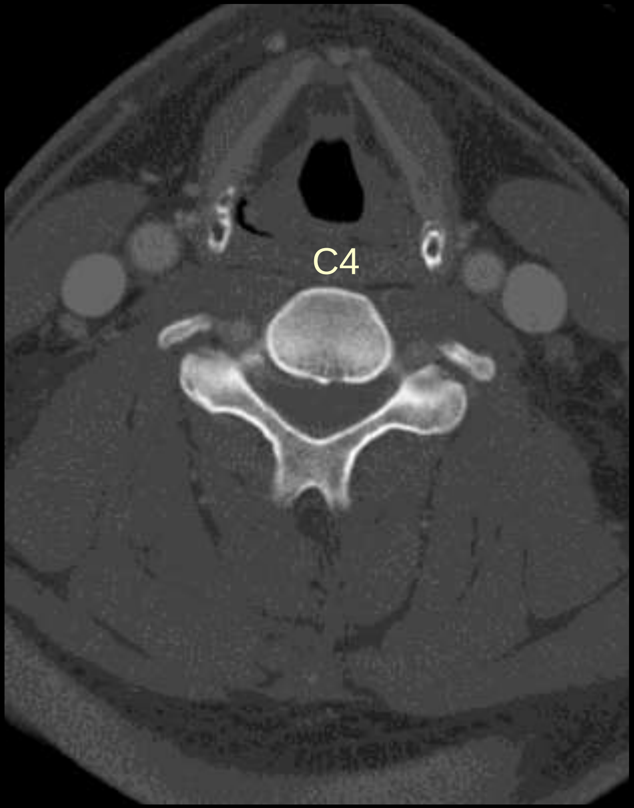
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



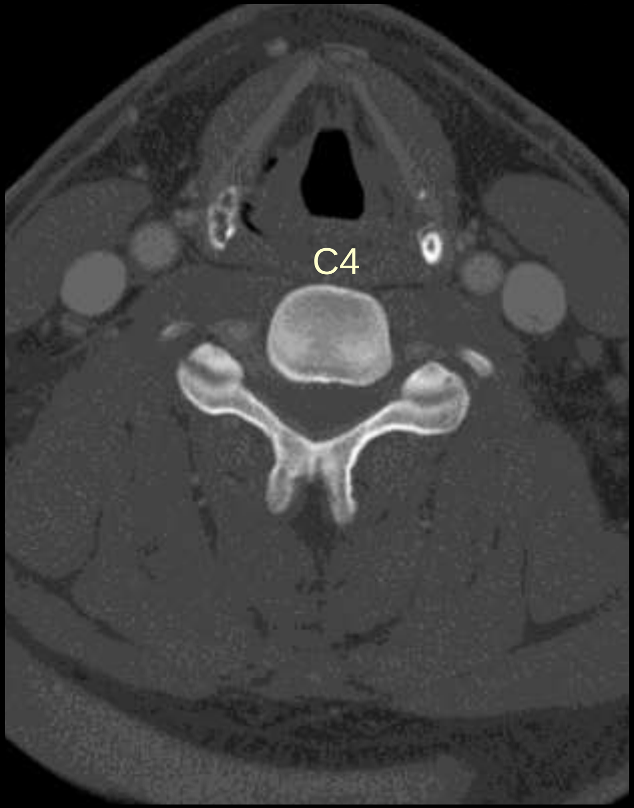
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



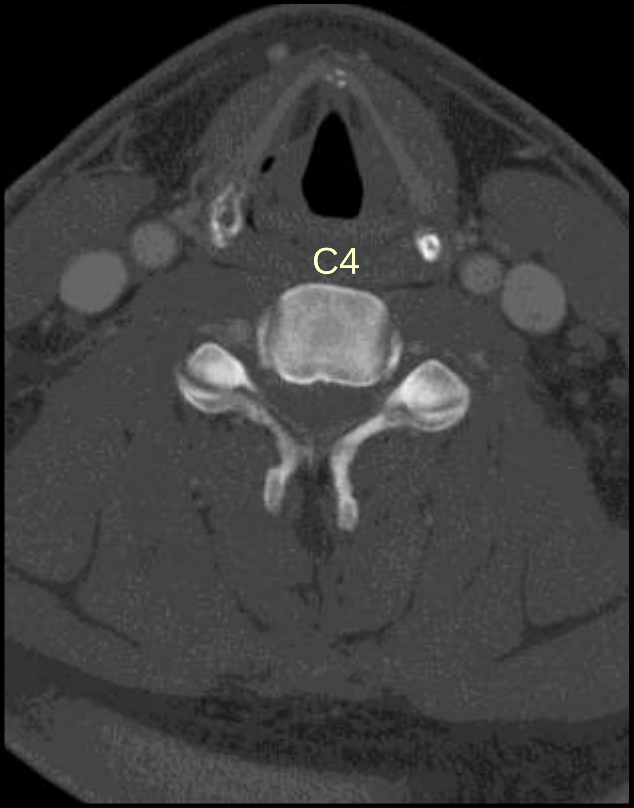
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



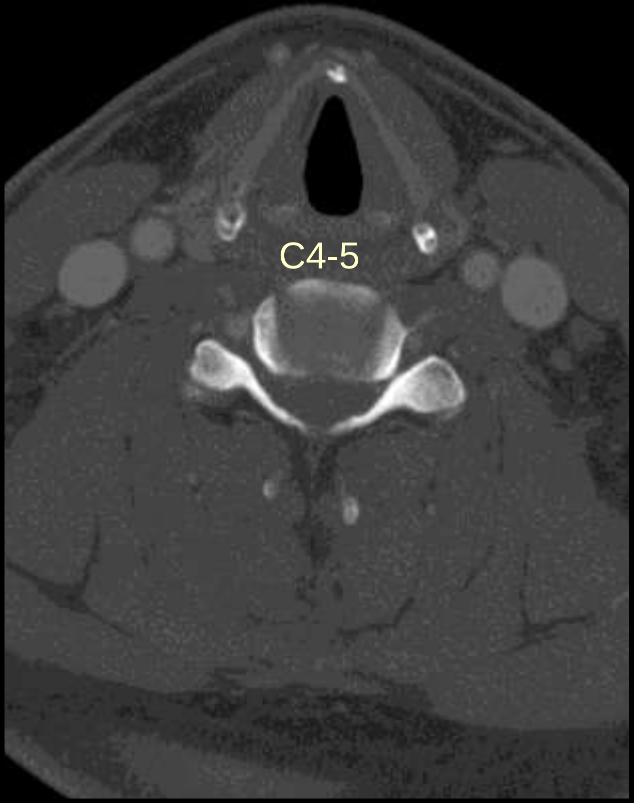
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



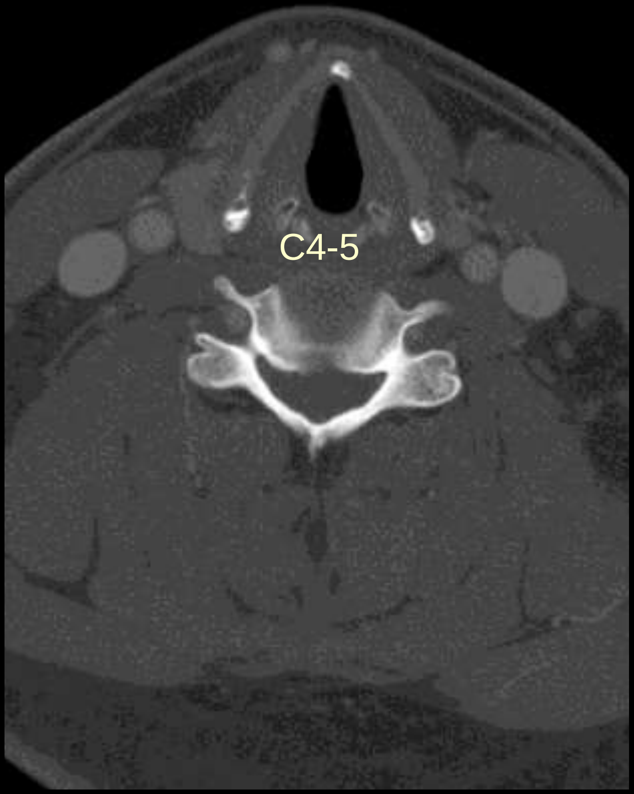
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



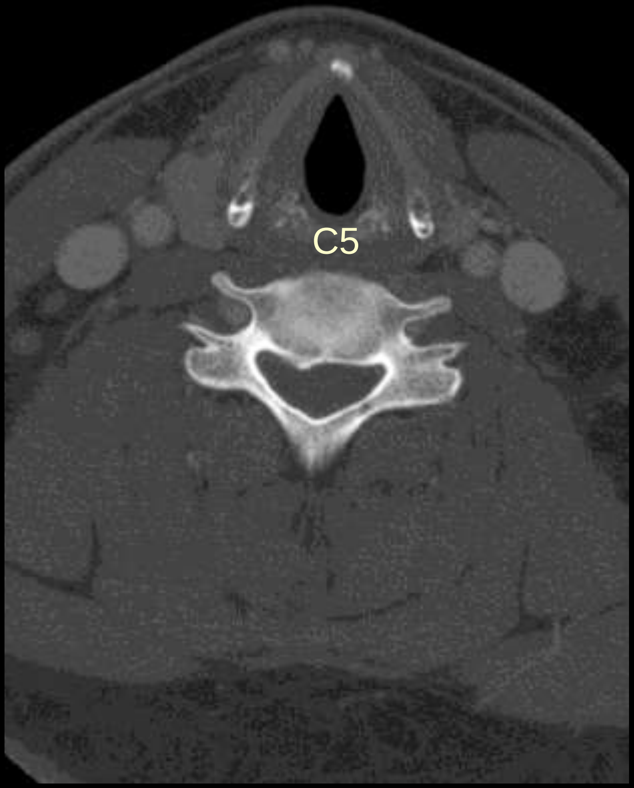
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



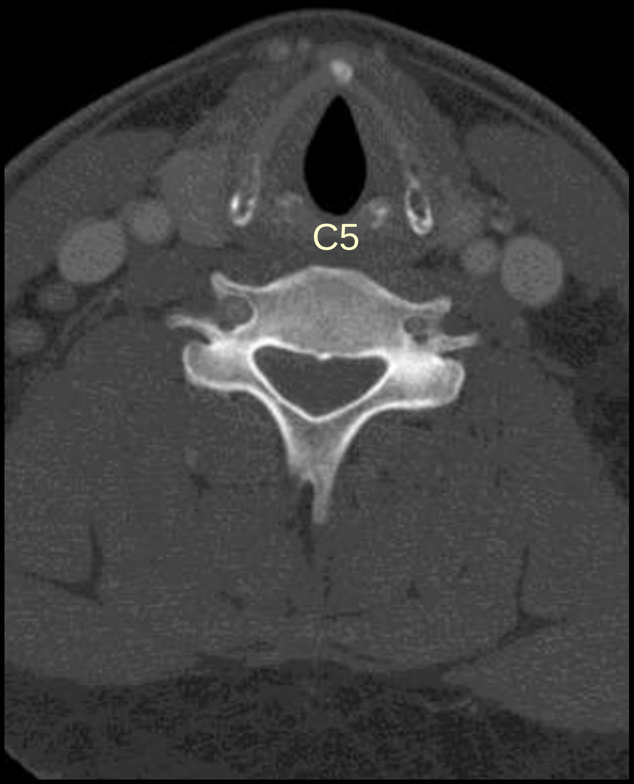
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



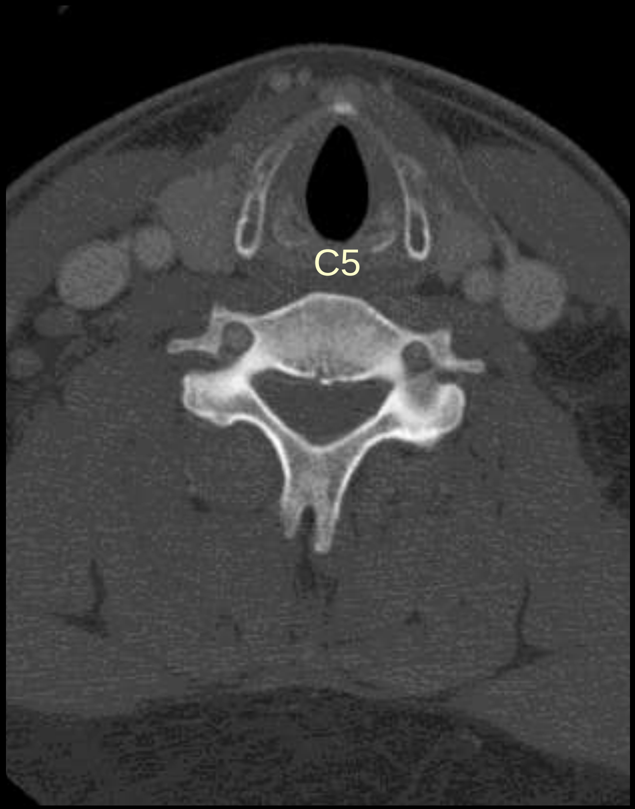
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



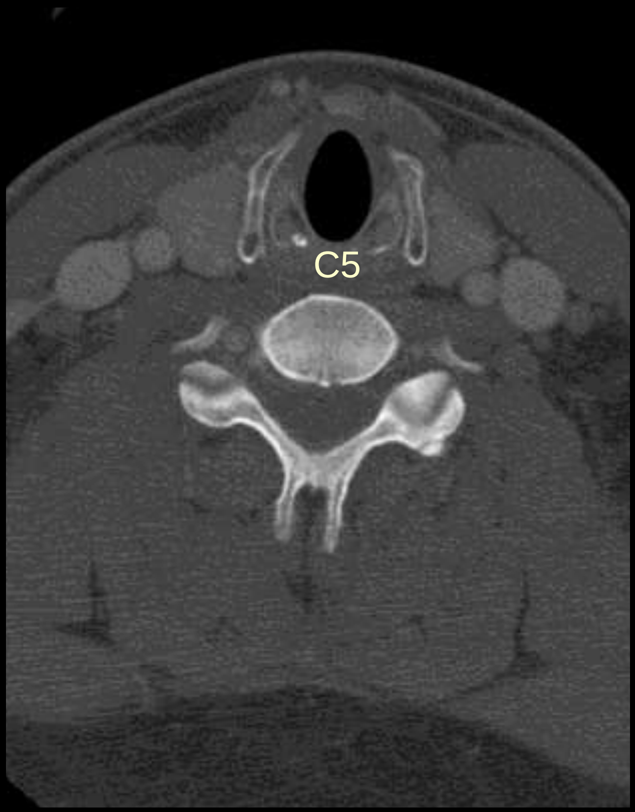
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



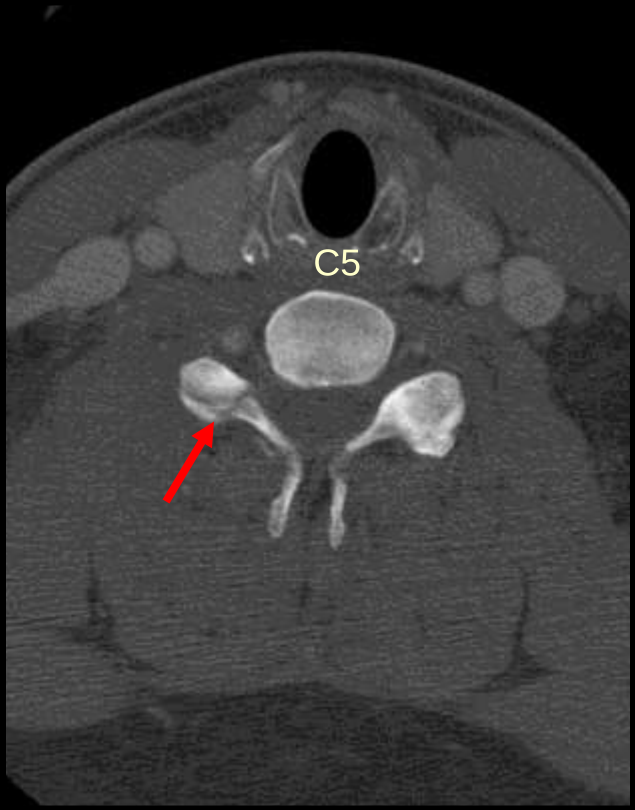
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



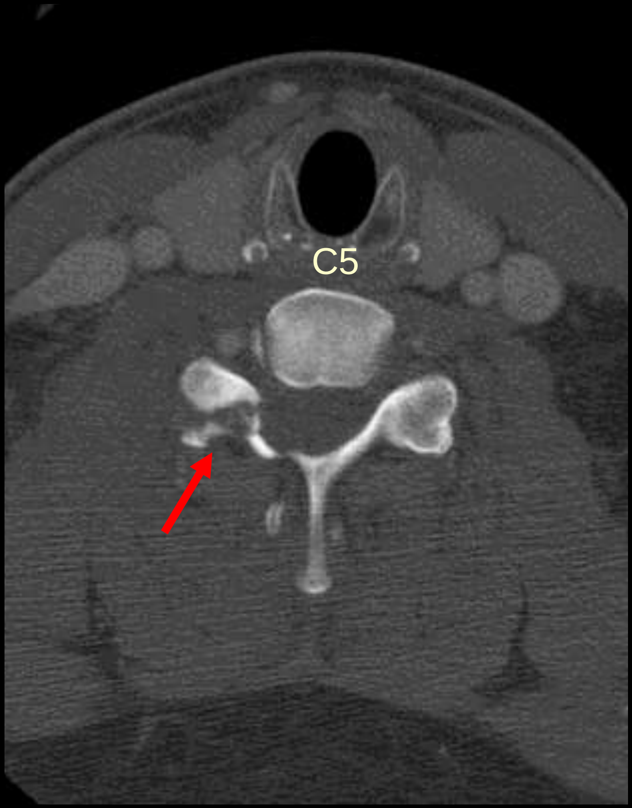
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



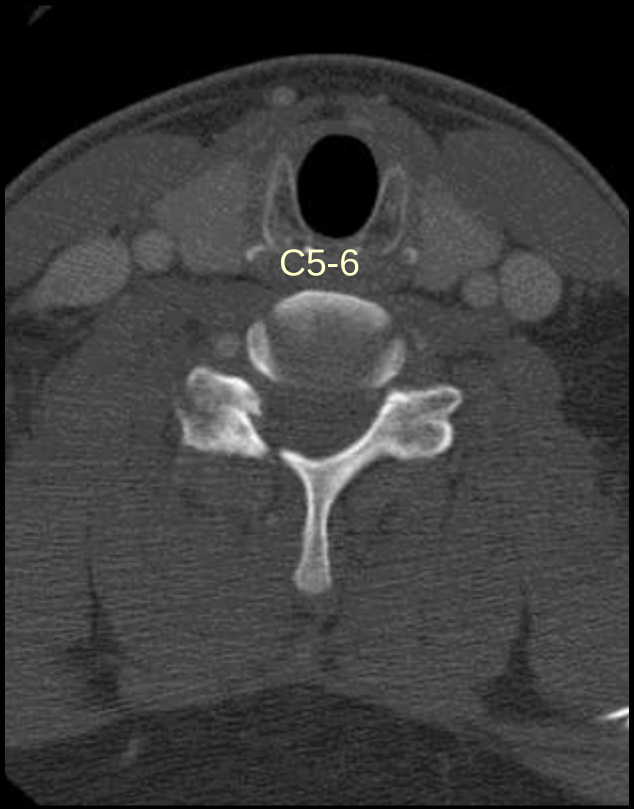
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



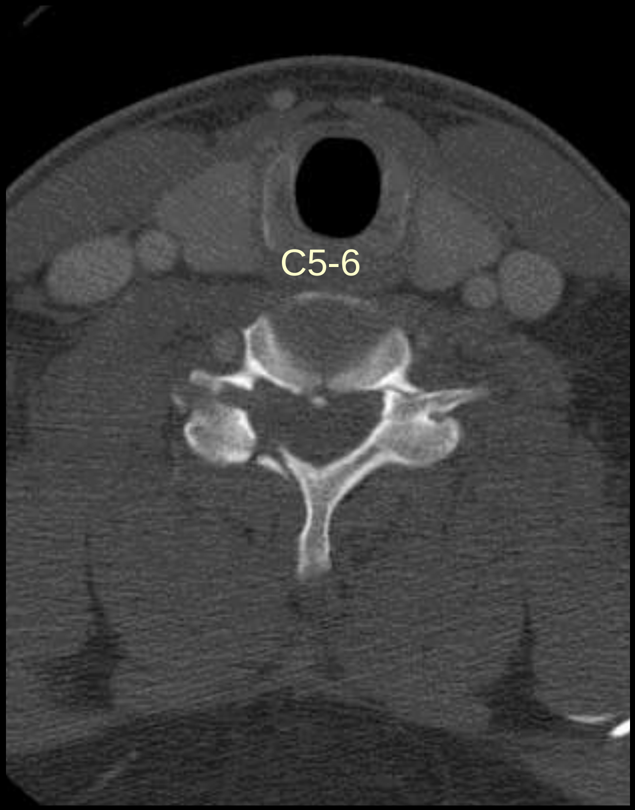
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



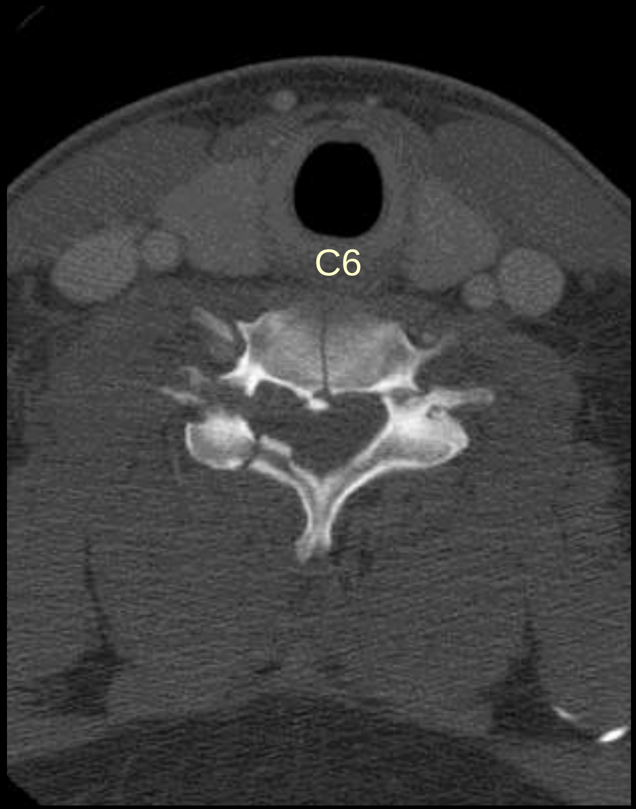
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



Reading Algorithm – Find the second fracture

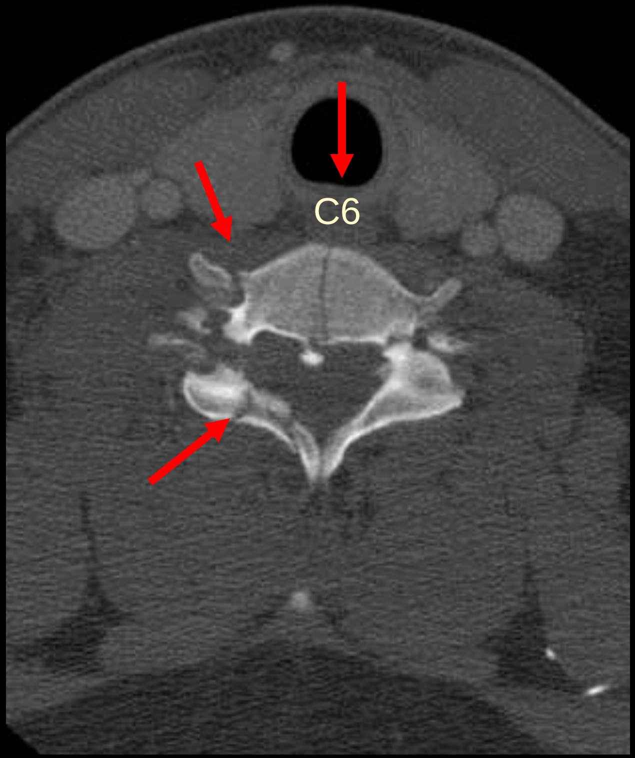
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

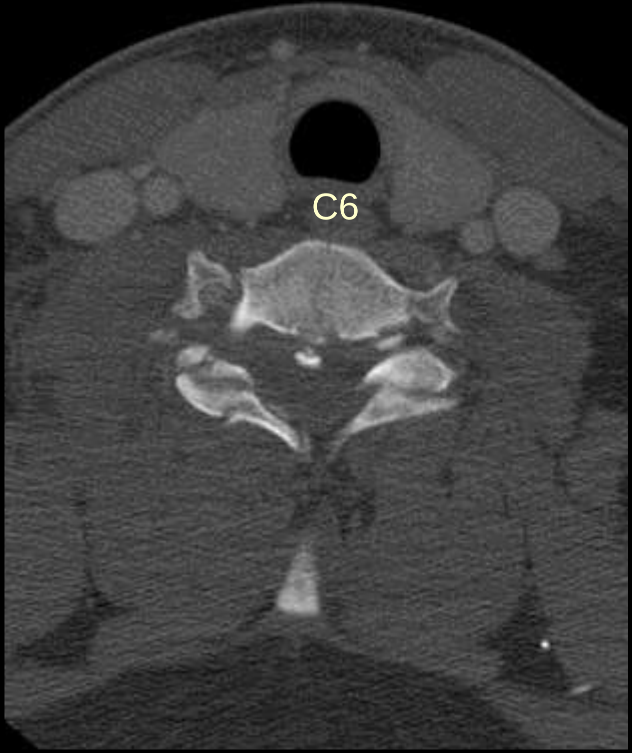
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

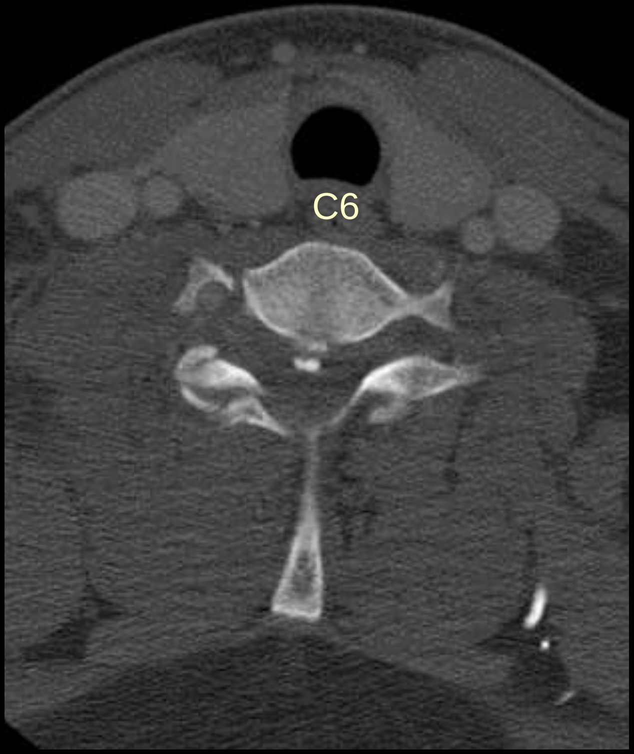
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

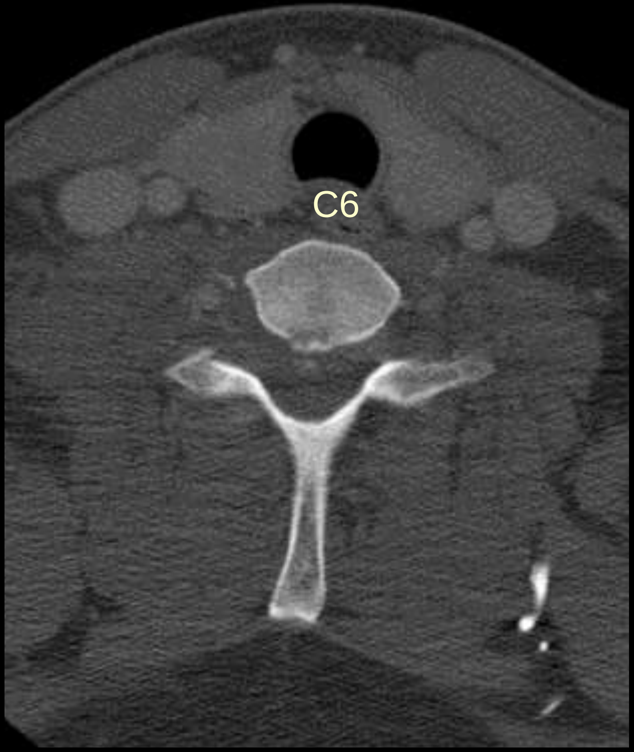
C3,4,5,6,7 fxs



42M

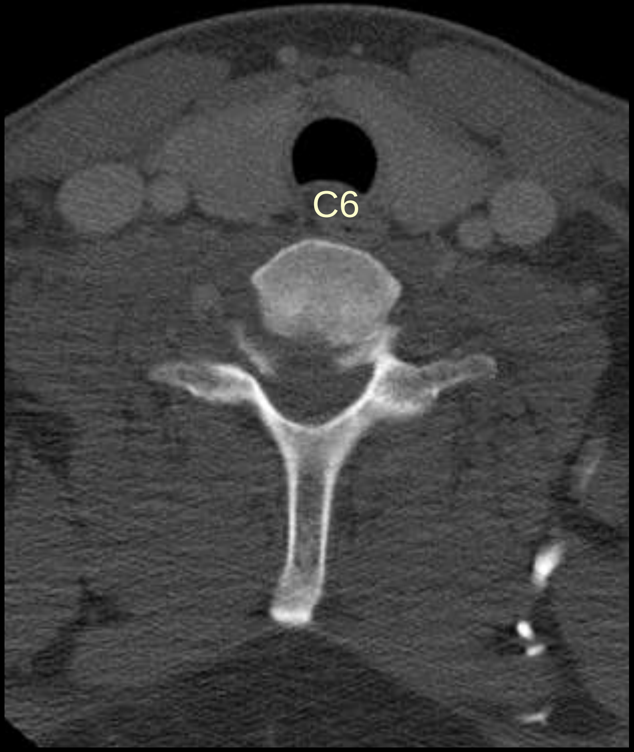
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



Reading Algorithm – Find the second fracture

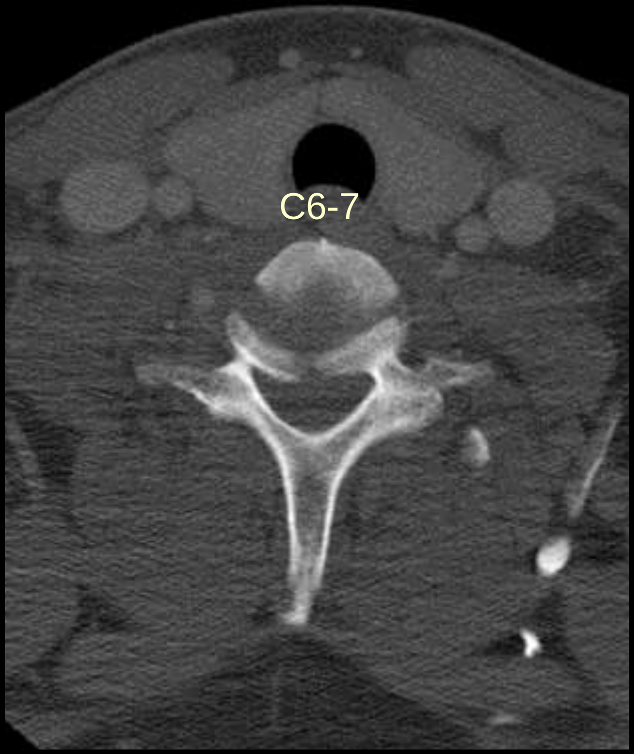
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

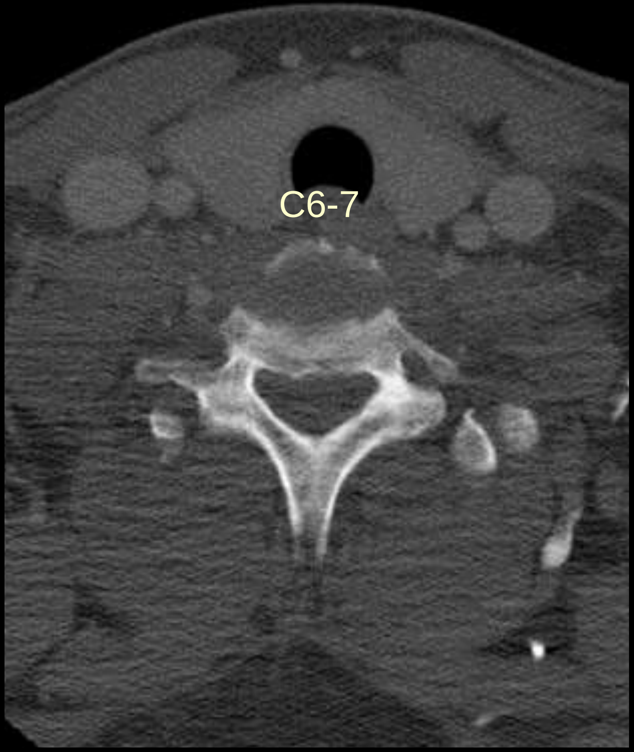
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

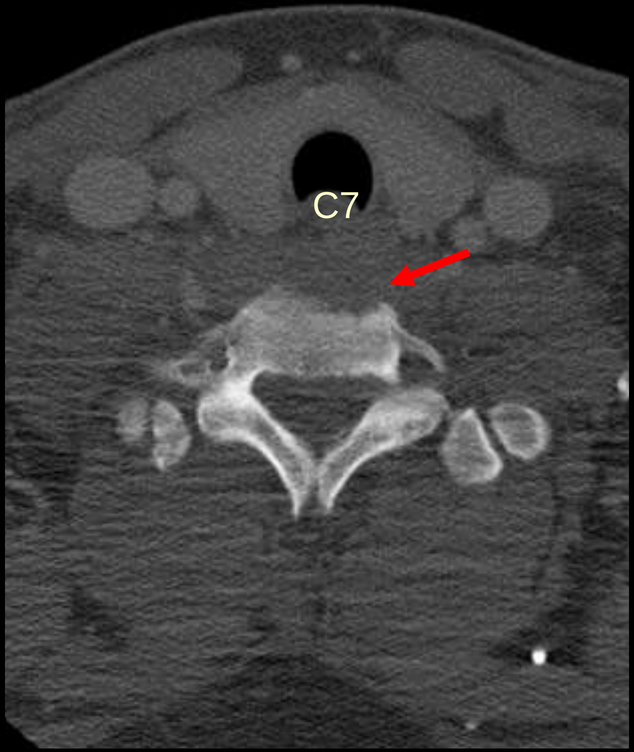
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

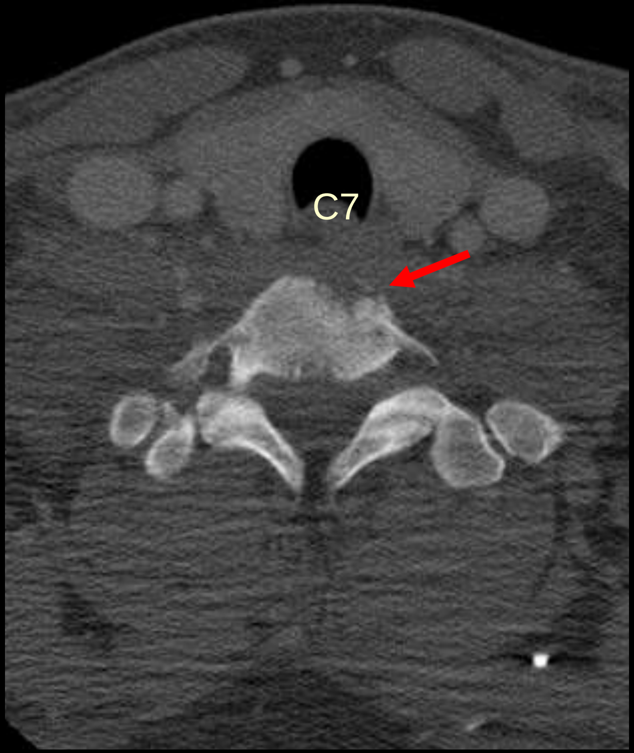
C3,4,5,6,7 fxs



42M

Reading Algorithm – Find the second fracture

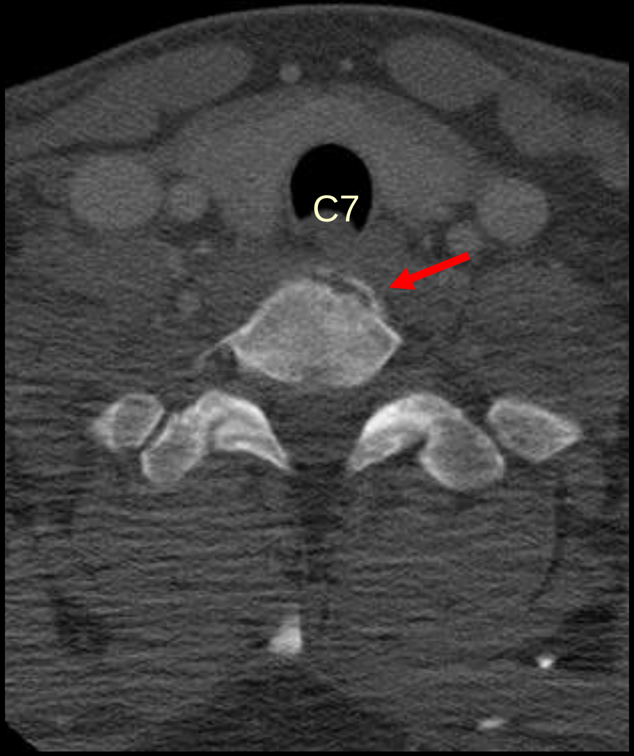
C3,4,5,6,7 fxs



42M

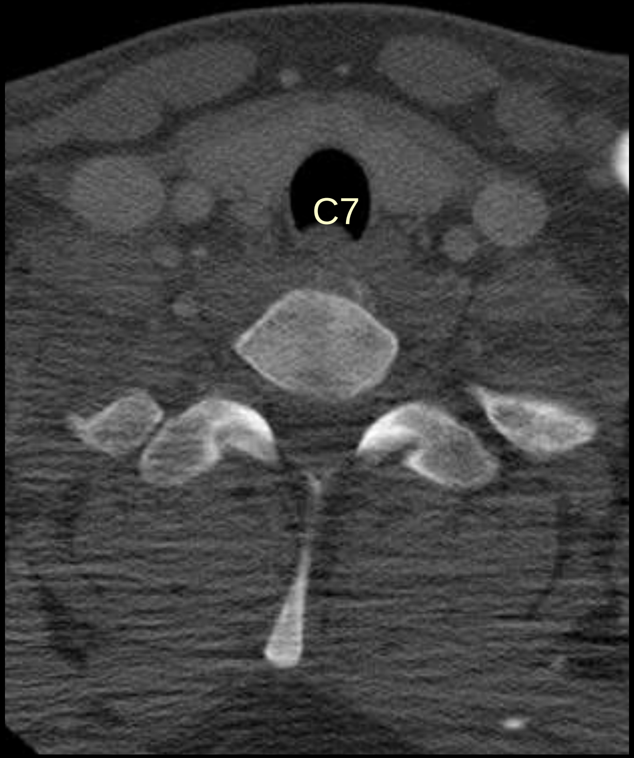
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs



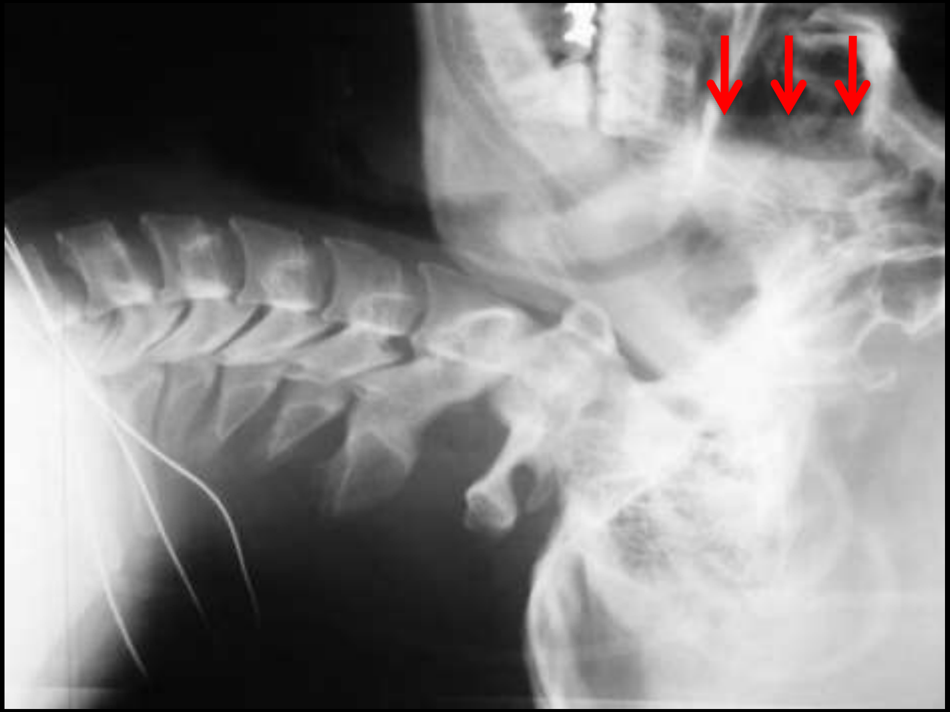
Reading Algorithm – Find the second fracture

C3,4,5,6,7 fxs

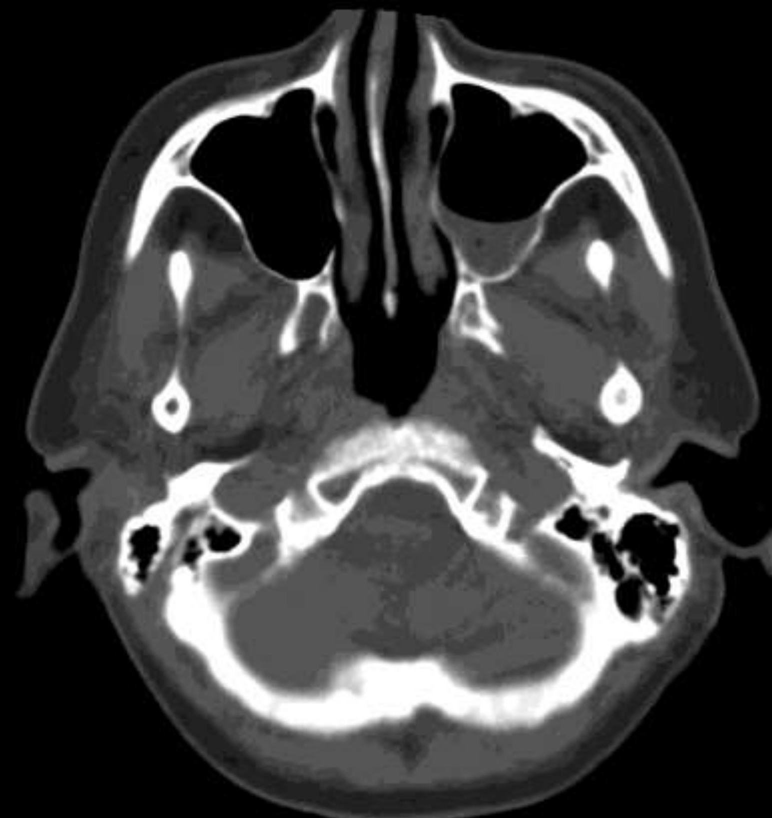


42M

Facial Fx with fluid level on Cx spine



Antral Fluid level on Cx spine

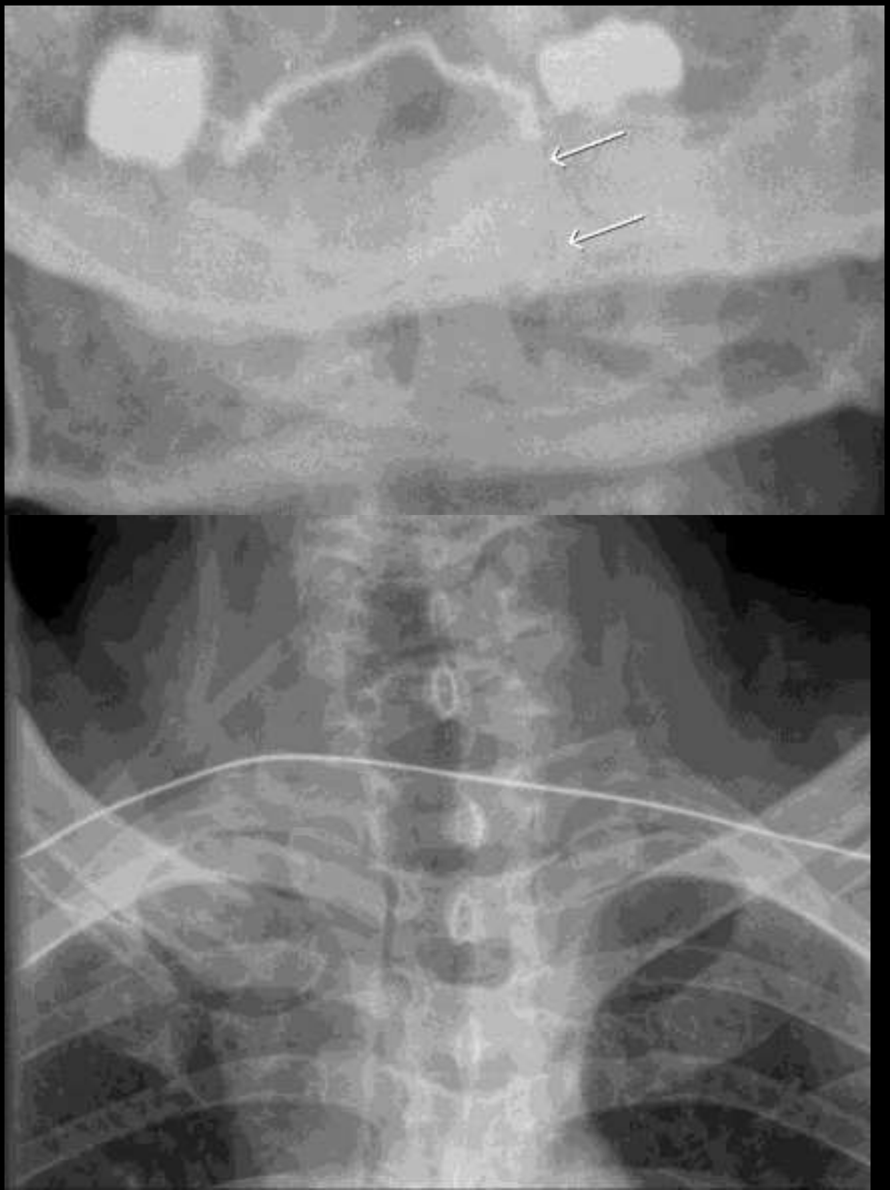


Reading Algorithm

Adjacent Structures

Reading Algorithm

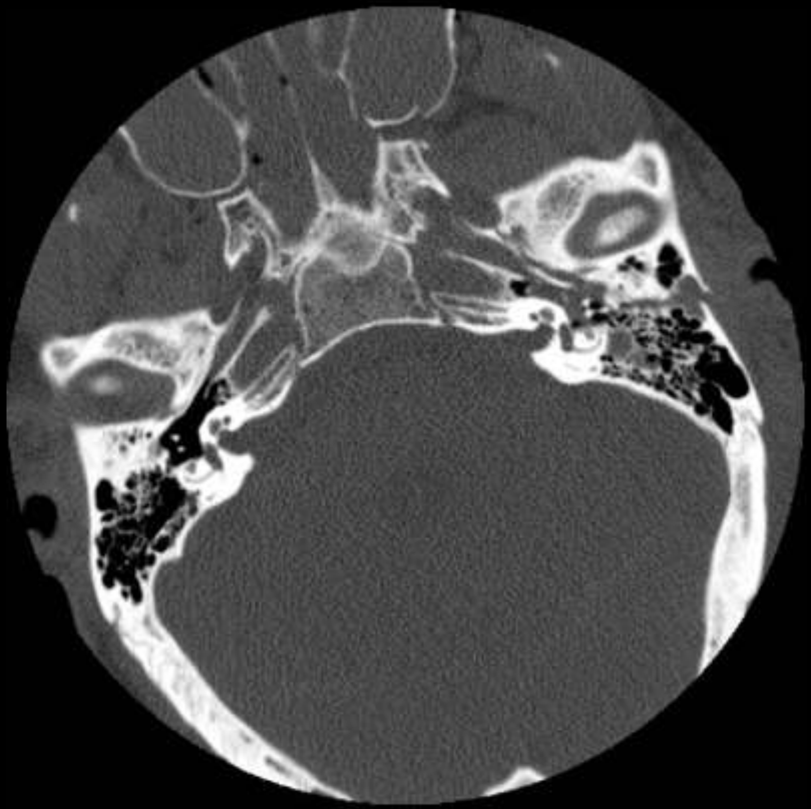
Adjacent Structures



51M Base of skull fx on Cx spine view

Reading Algorithm

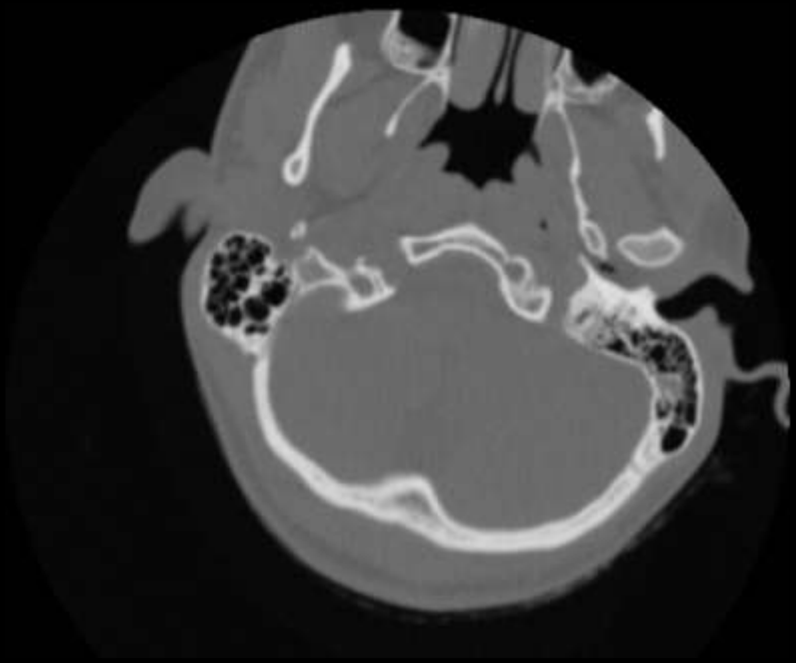
Adjacent Structures

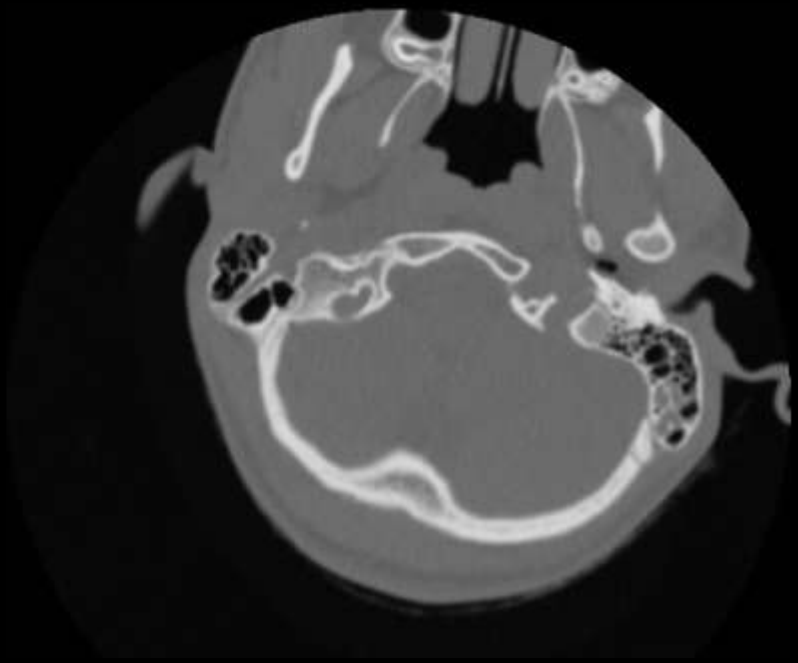


Petrous fx with gas 33M

Reading Algorithm

Adjacent Structures





Base of skull fx air and fluid 16M

Reading Algorithm

Adjacent Structures

Reading Algorithm

Adjacent Structures

Hyoid fx 46m assault

Atlantooccipital subluxation

Lake Wanaka NZ

Predisposing Factors

18M Spinal stenosis Hyperasthesia

Predisposing Factors

Congenital Fusion

Presentation

Follow up

Rx

Delayed flexion subluxation C4-5

Predisposing Factors

Klippel Feil

KF with sublux 67M

Predisposing Factors

DISH

Predisposing Factors

OPLL

Predisposing Factors

Post Traumatic Fusion

1971

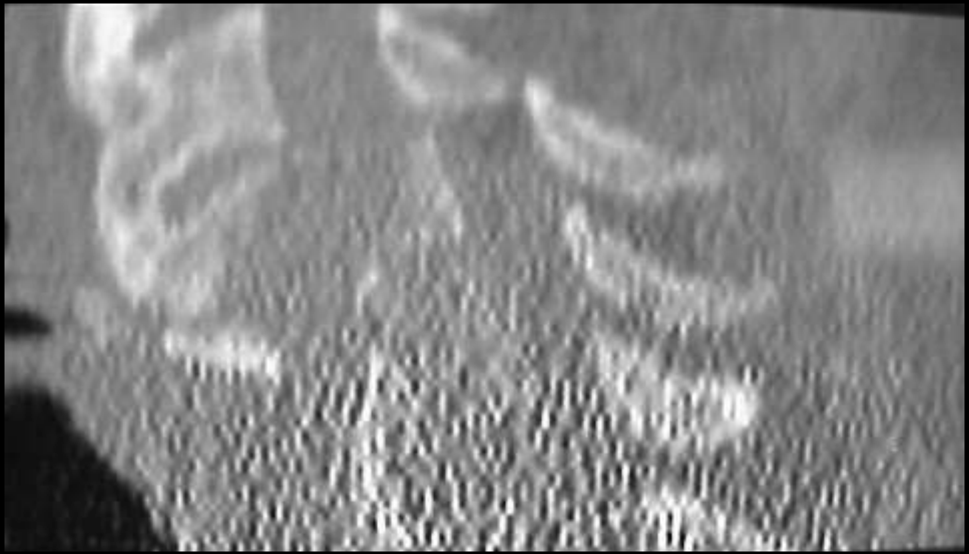
1972

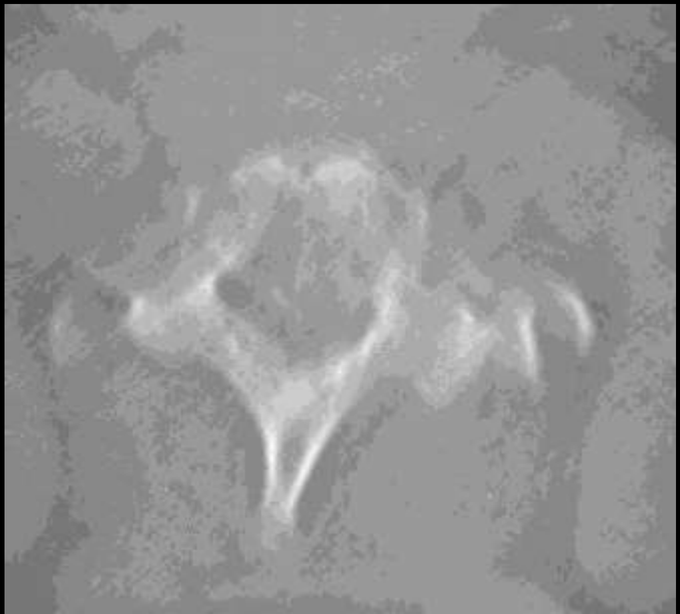
2000

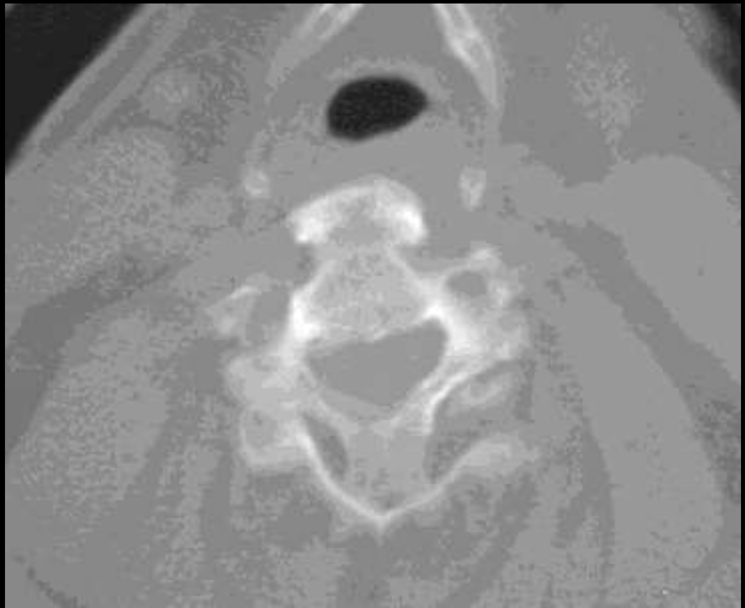
51M

Predisposing Factors

Post Traumatic Fusion







51M

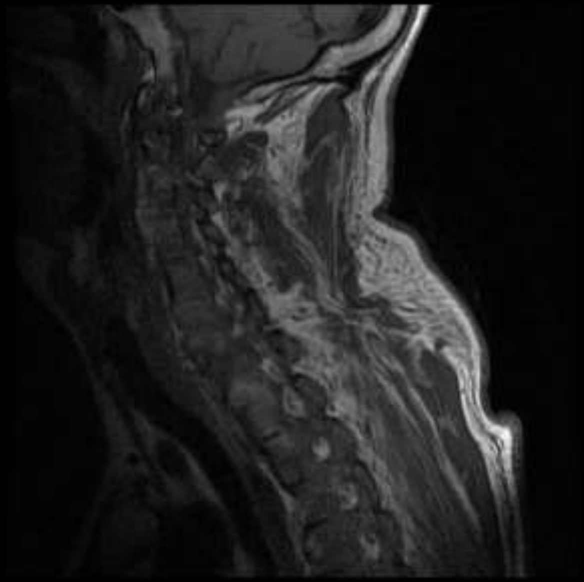
Predisposing Factors

Post Traumatic Fusion

51M

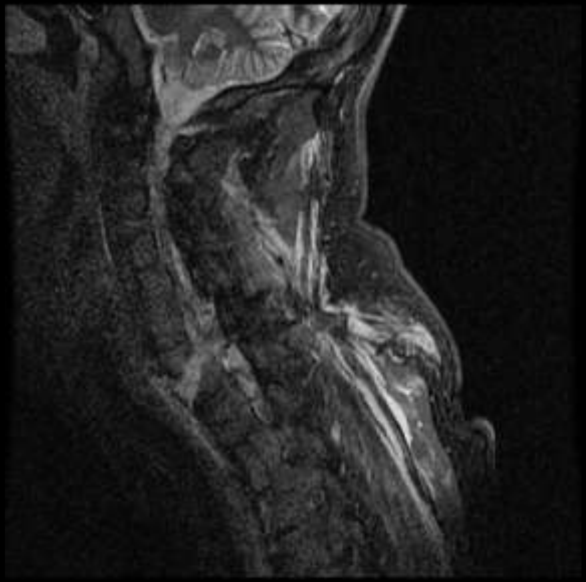
Predisposing Factors

Ankylosing Spondylitis



Sag T1

Sag T2

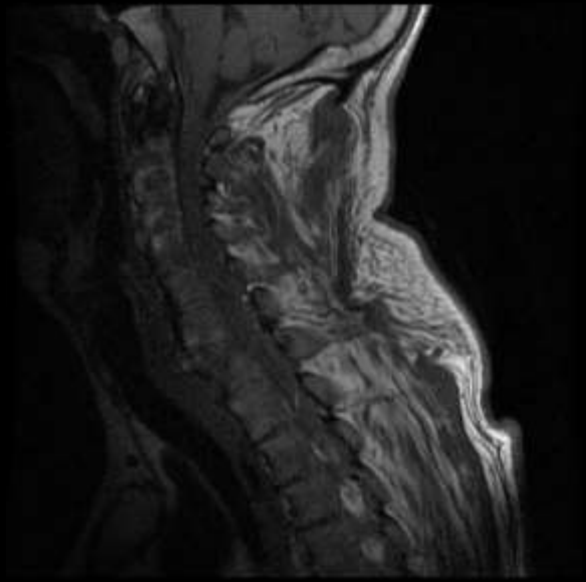


Sag T2FS

44M

Predisposing Factors

Ankylosing Spondylitis



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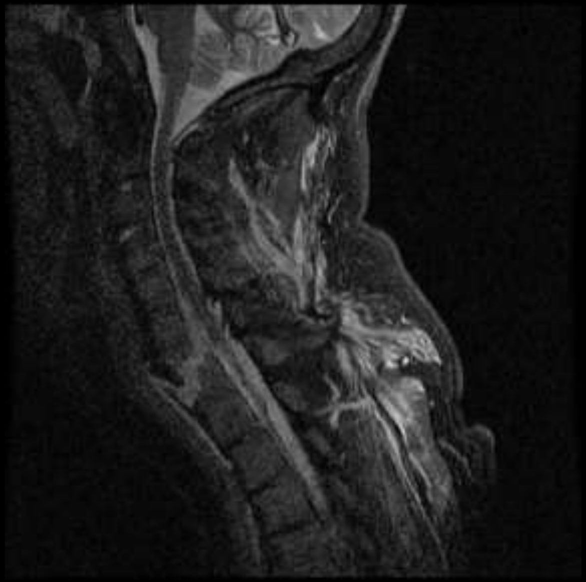
Sag T2

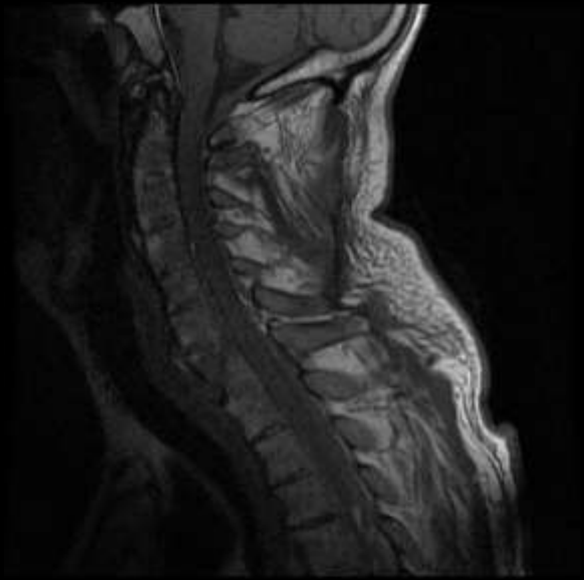


Sag T2FS

44M

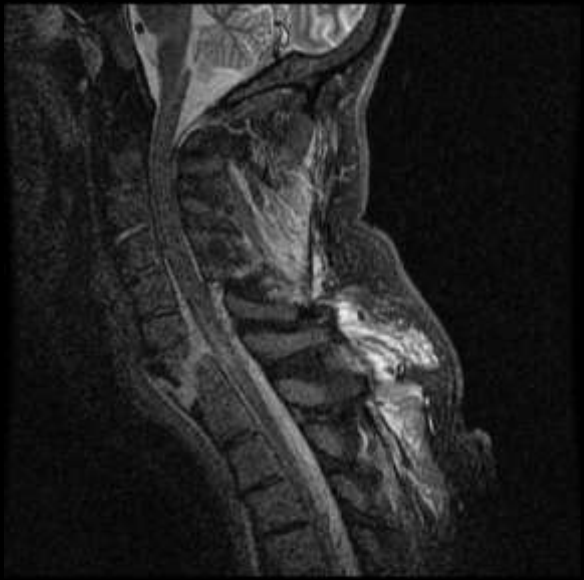
Predisposing Factors

Ankylosing Spondylitis



Sag T1

Sag T2

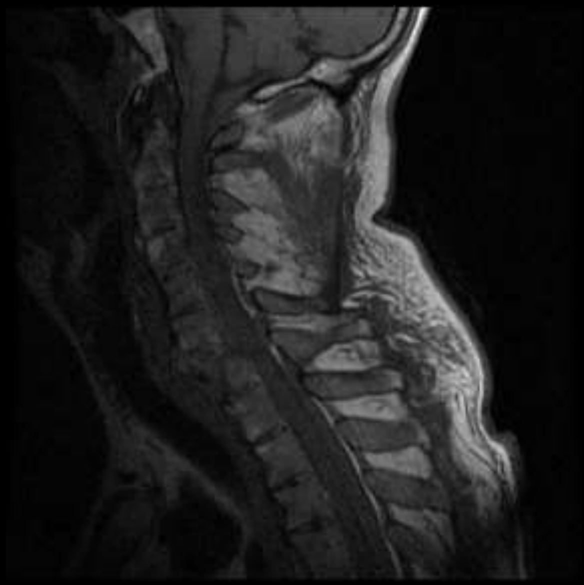


Sag T2FS

44M

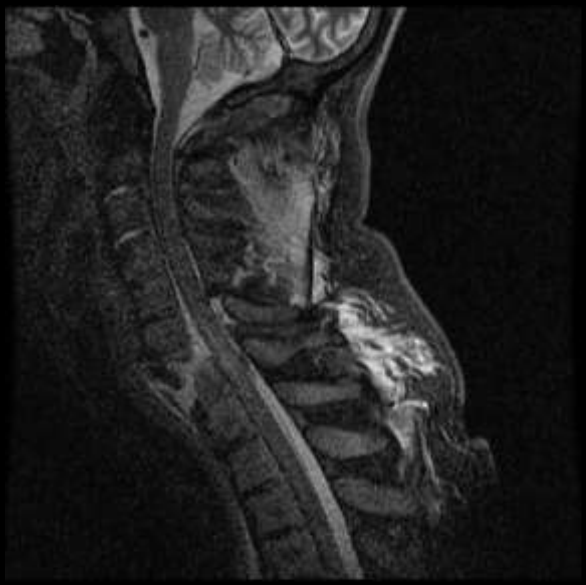
Predisposing Factors

Ankylosing Spondylitis



Sag T1

Sag T2

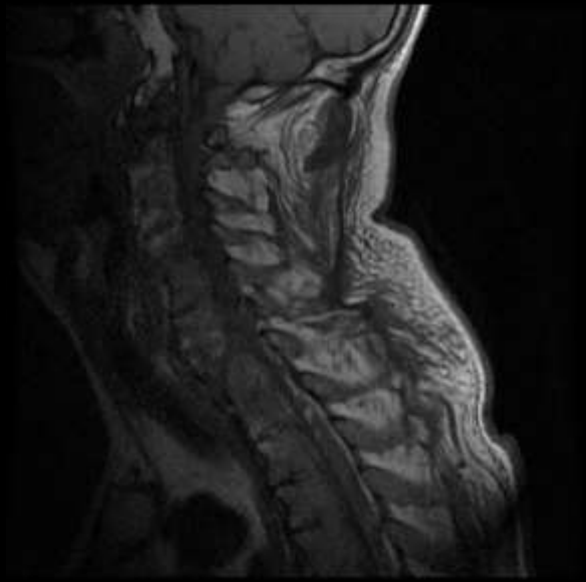


Sag T2FS

44M

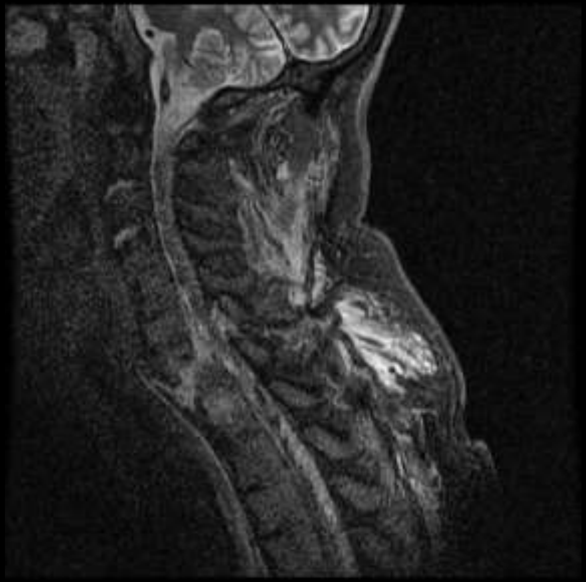
Predisposing Factors

Ankylosing Spondylitis



Sag T1

Sag T2



Sag T2FS

44M

Predisposing Factors

Ankylosing Spondylitis

Sag T1 Sag T2 Sag T2FS

44M

Predisposing Factors

Ankylosing Spondylitis

44M

Predisposing Factors

Ankylosing Spondylitis

44M

Predisposing Factors

Ankylosing Spondylitis

44M

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Predisposing Factors

Ankylosing Spondylitis

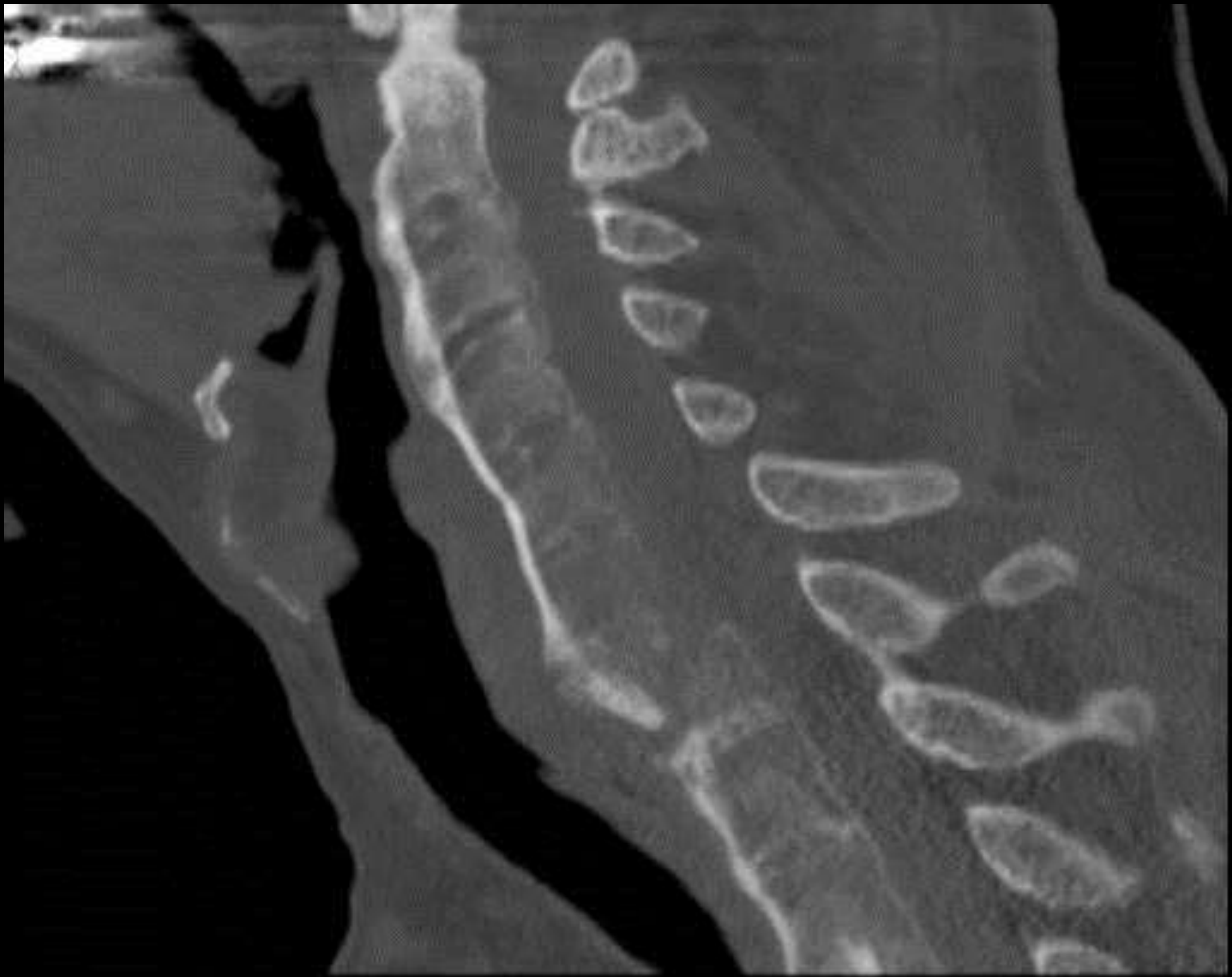
44M

Predisposing Factors

Ankylosing Spondylitis

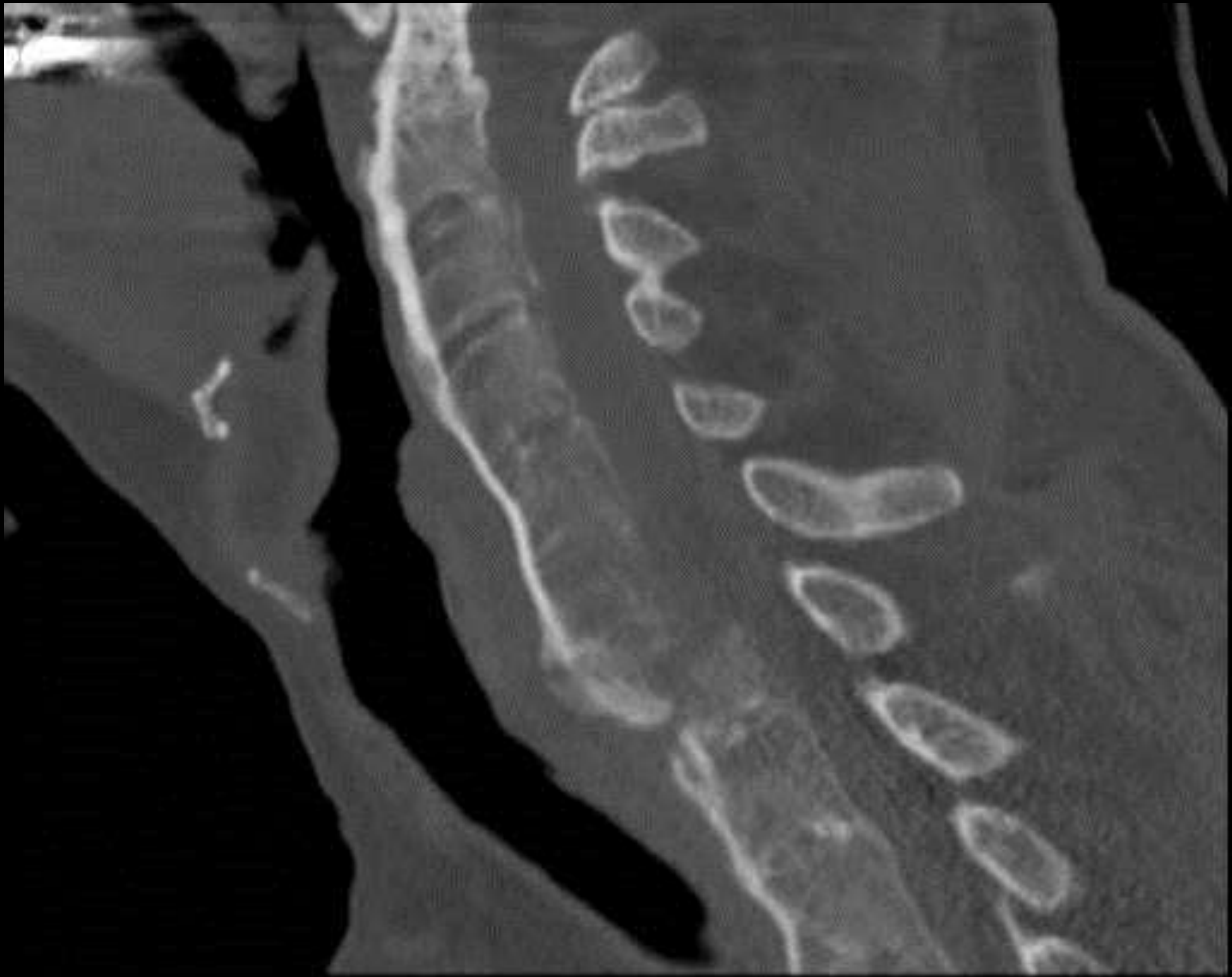
44M

Ankylosing Spondylitis



44M

Ankylosing Spondylitis



44M

Predisposing Factors

Ankylosing Spondylitis

44M

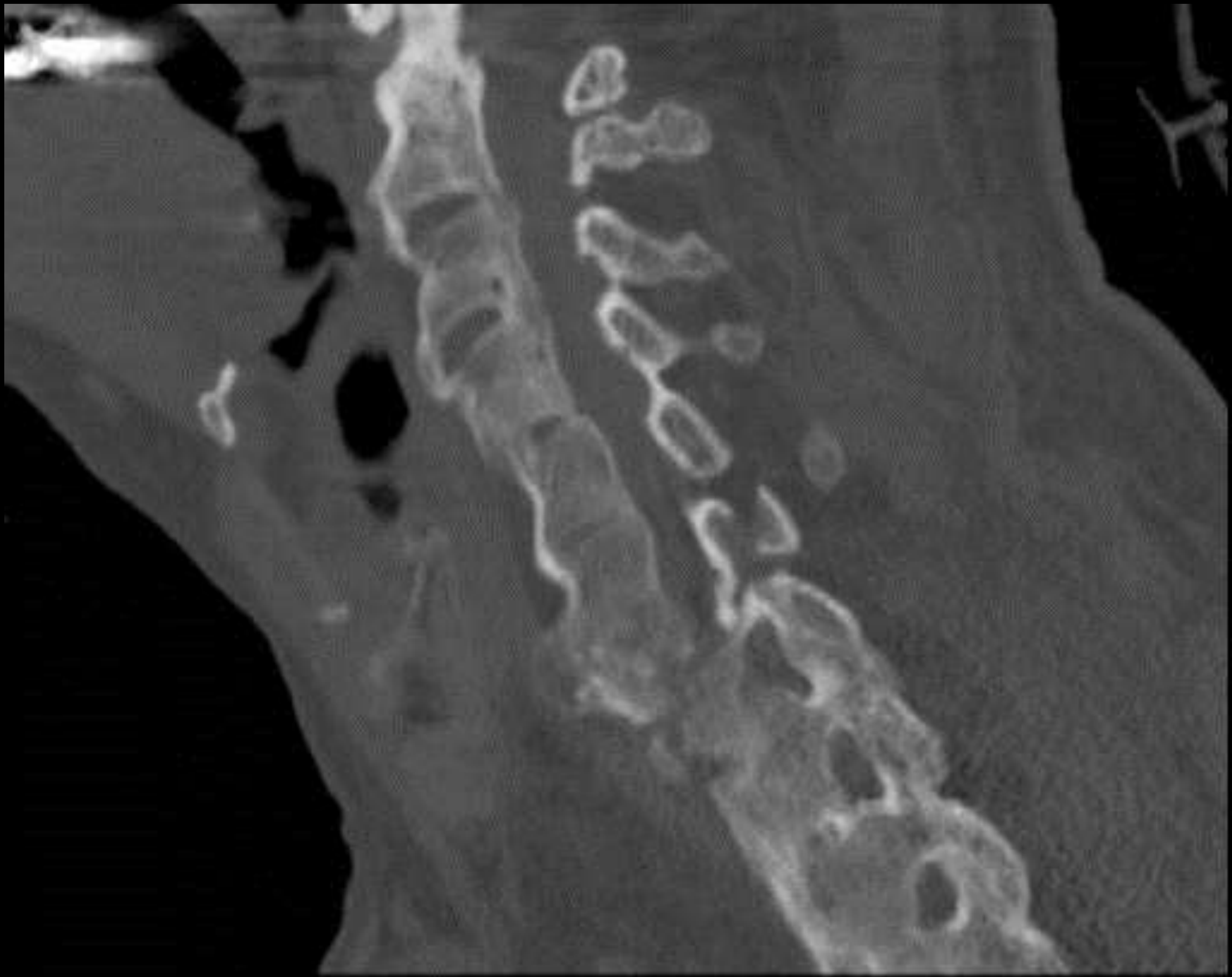
Predisposing Factors

Ankylosing Spondylitis

44M

Predisposing Factors

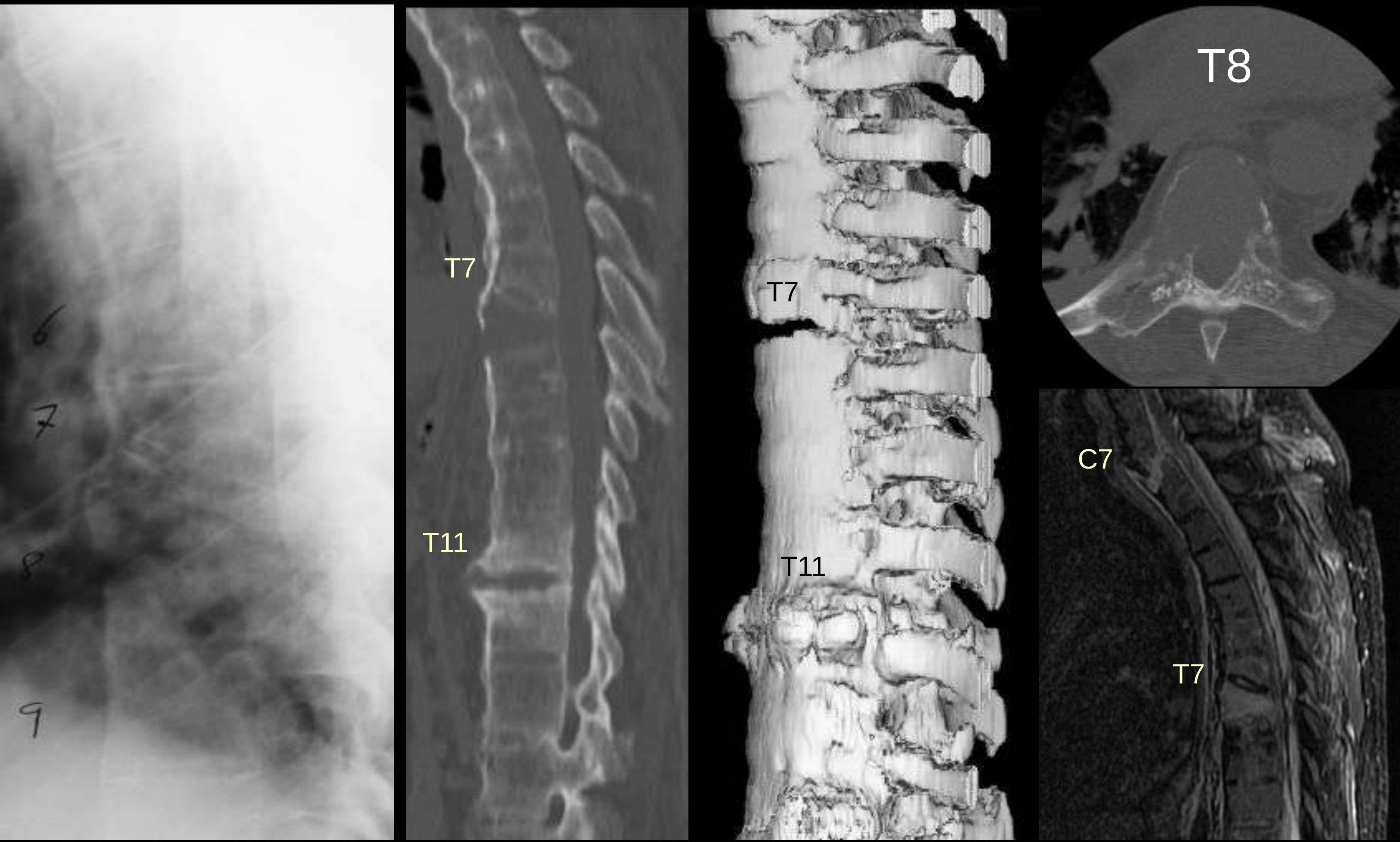
Ankylosing Spondylitis



44M

Predisposing Factors

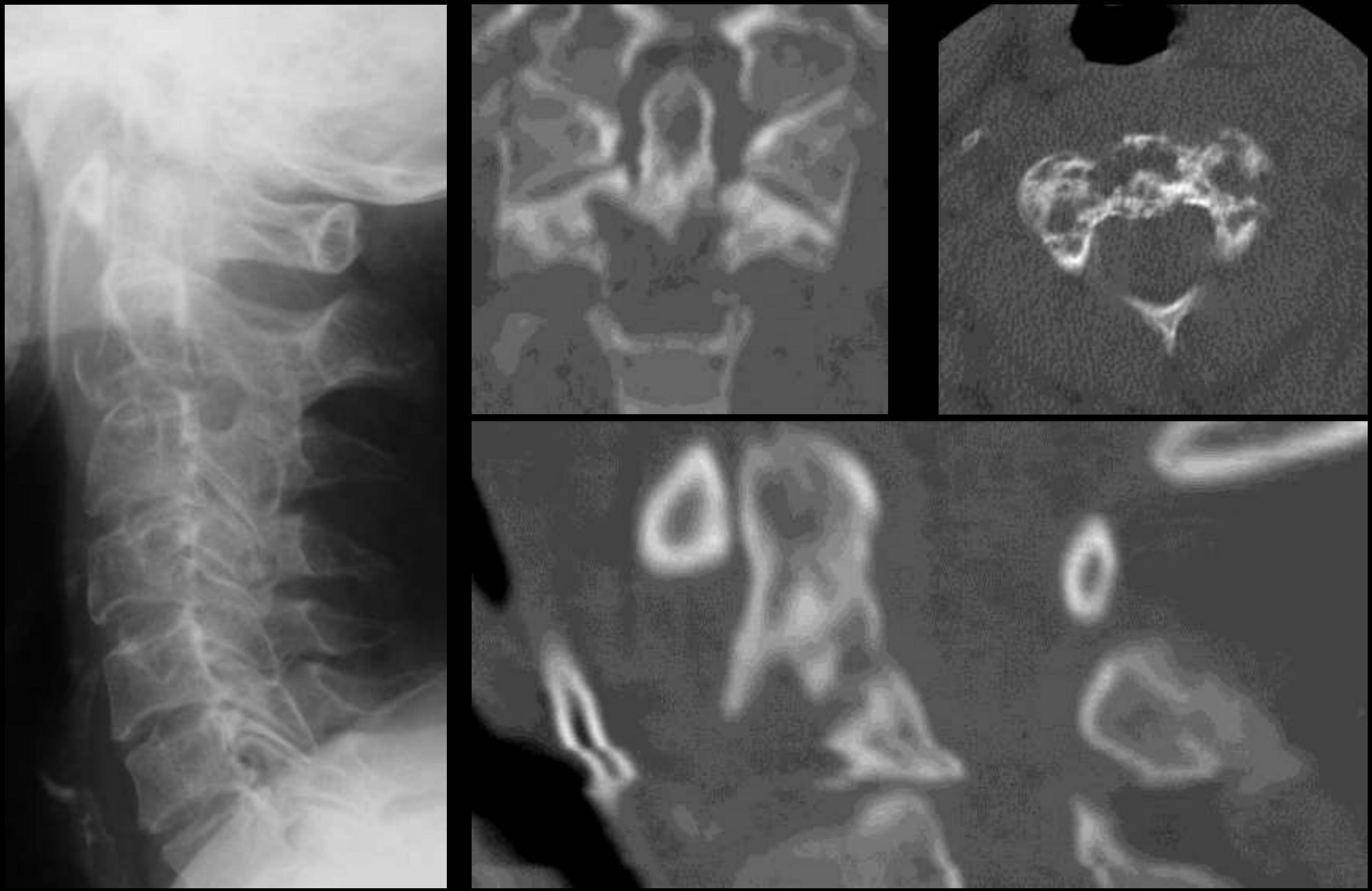
Ankylosing Spondylitis



44M

Predisposing Factors

C2 Pathologic Fracture



Multiple Myeloma

Cervical Spine Trauma

Dr. Tudor H. Hughes M.D., FRCR
Department of Radiology
University of California School of Medicine
San Diego, California

Occipitoaxial subluxation

Atlantooccipital Subluxation

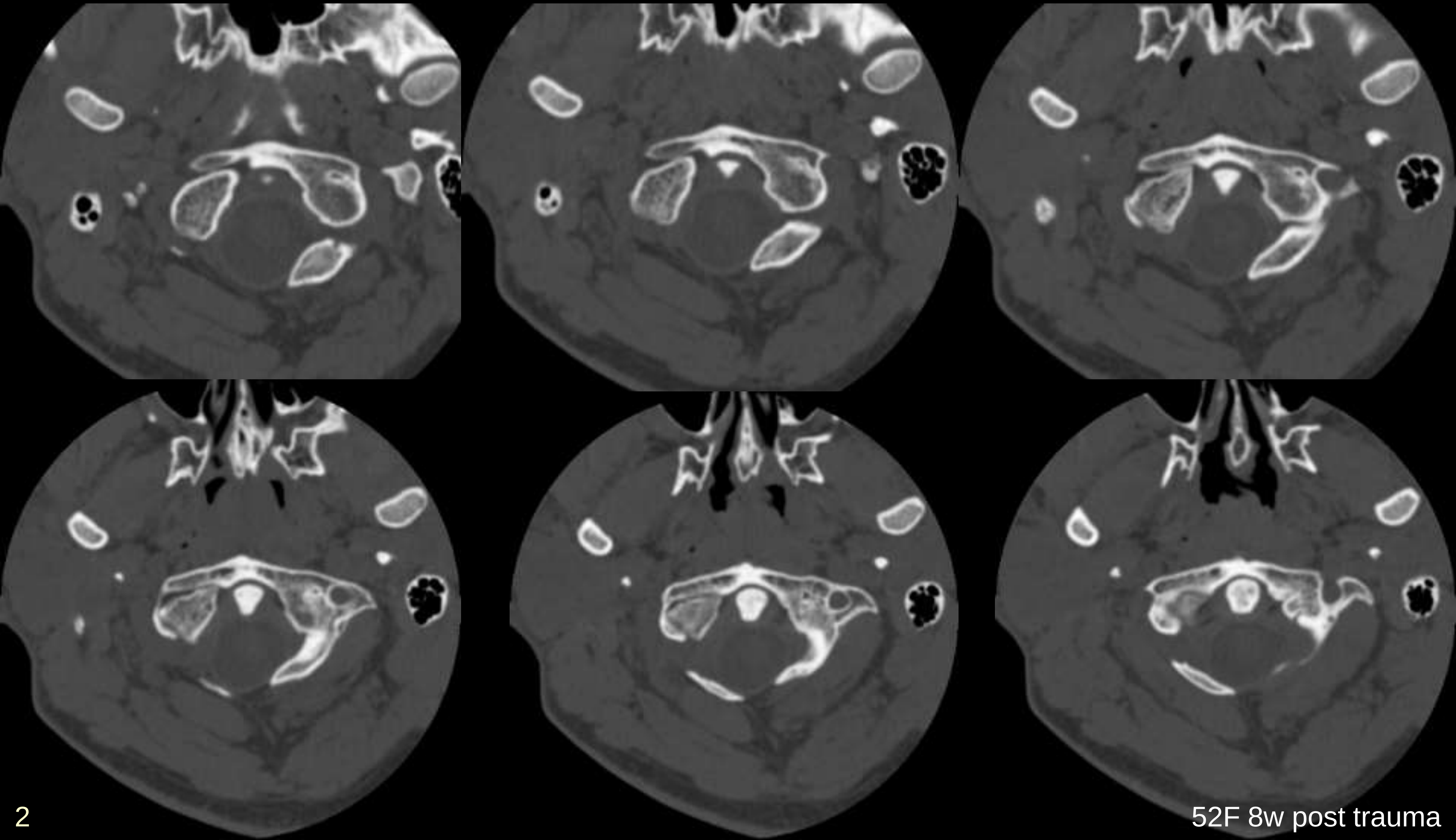
Occipitoatlas

- Fusion
- Fractures
  - Occipital condyles
- Subluxation / Dislocation
- ST injuries

CranioAtlas Assimilation

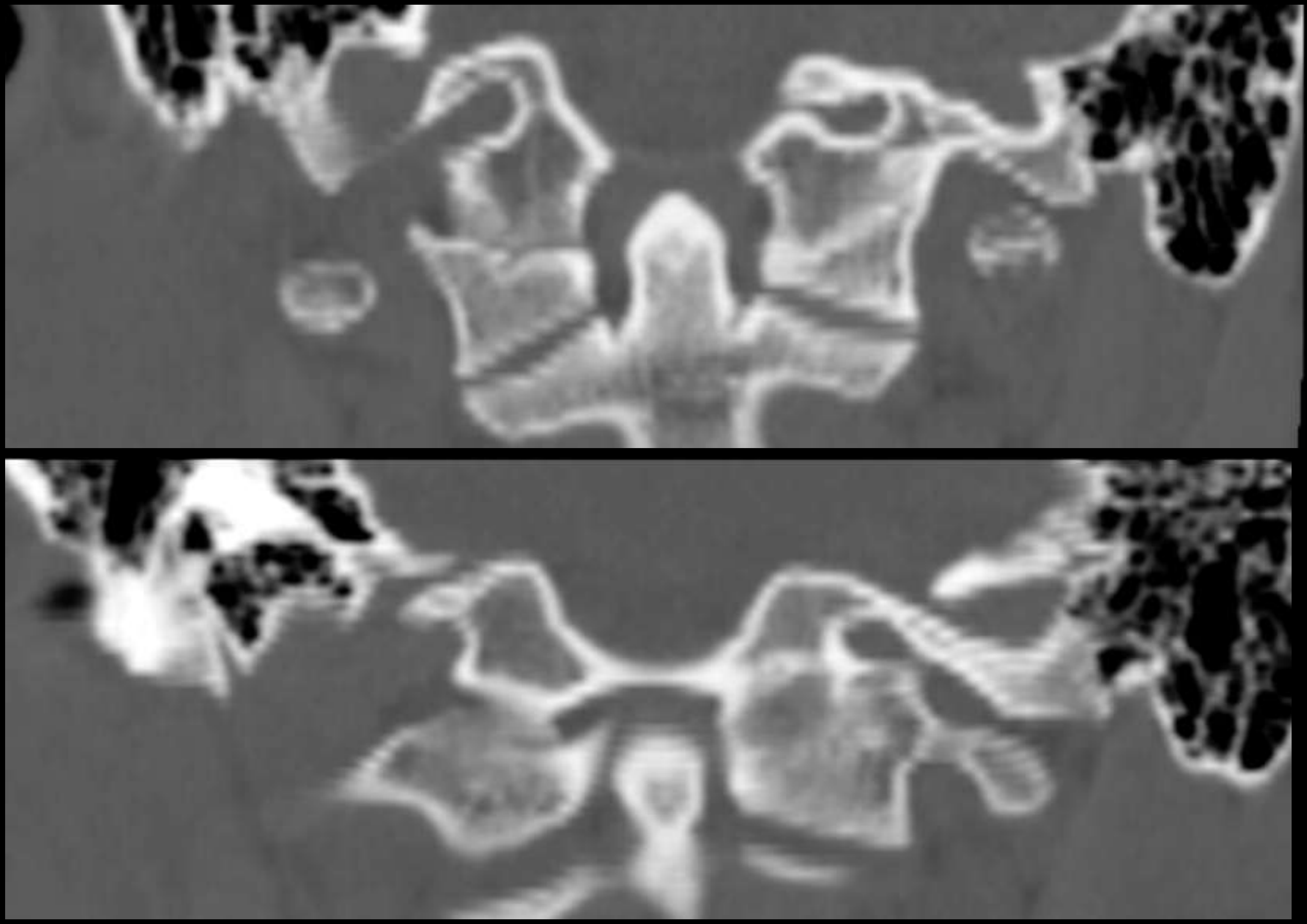
- Occipitalization of the atlas
- 0.75% of population
- Usually asymptomatic
- Usually anterior arch fusion
- 50% have C2-3 fusion
- Associated anterior atlantoaxial subluxation
- Associated middle ear anomalies
- Associated Chiari 1

CranioAtlas Assimilation



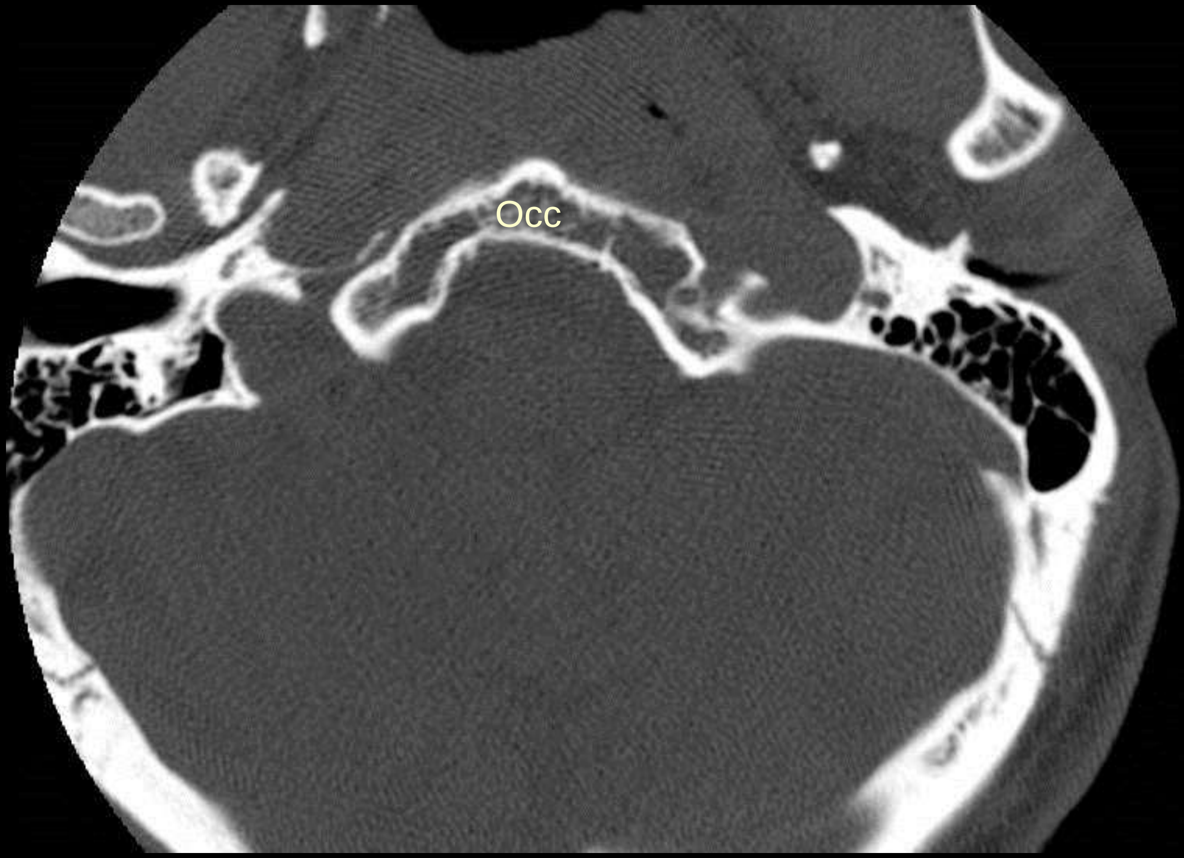
52F 8w post trauma

CranioAtlas Assimilation



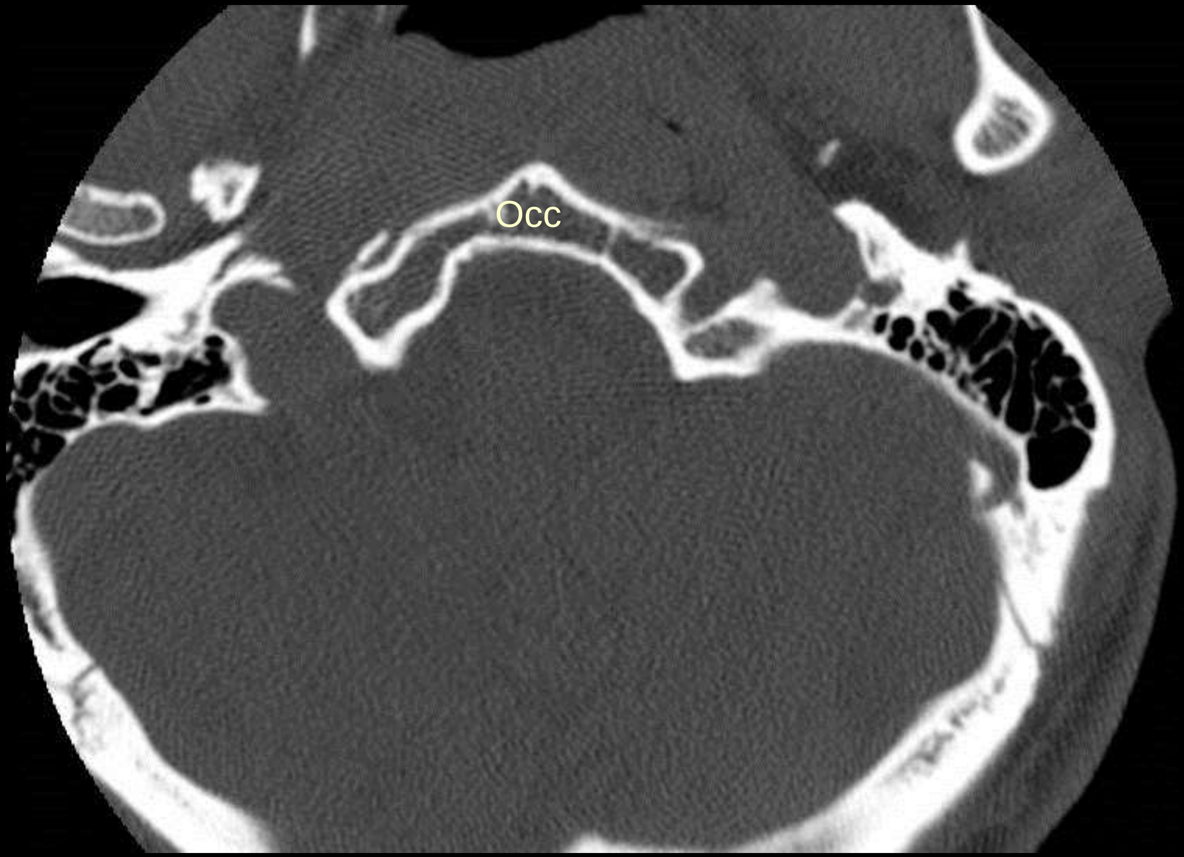
52F 8w post trauma

Occiptito-axial and C2-3 Fusions



42M Cycling trauma

Occiptito-axial and C2-3 Fusions

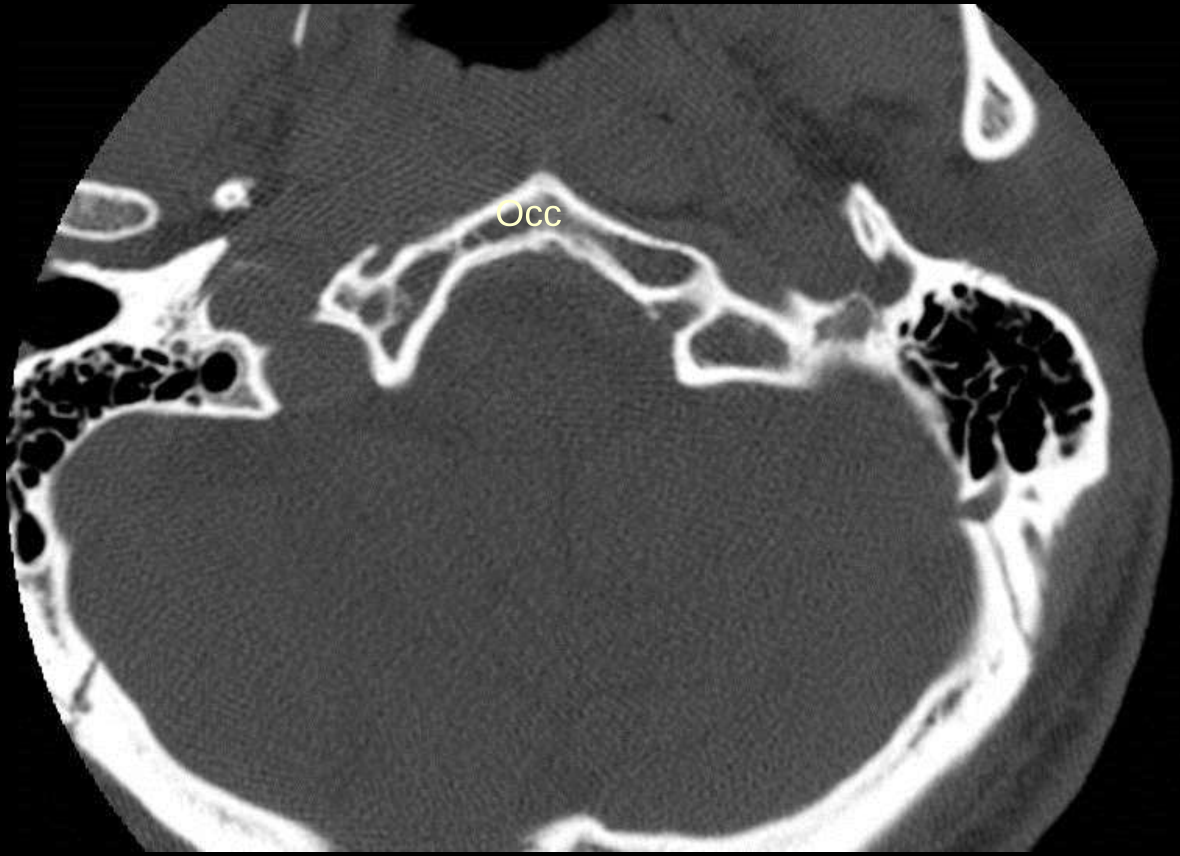


42M Cycling trauma

Occiptito-axial and C2-3 Fusions

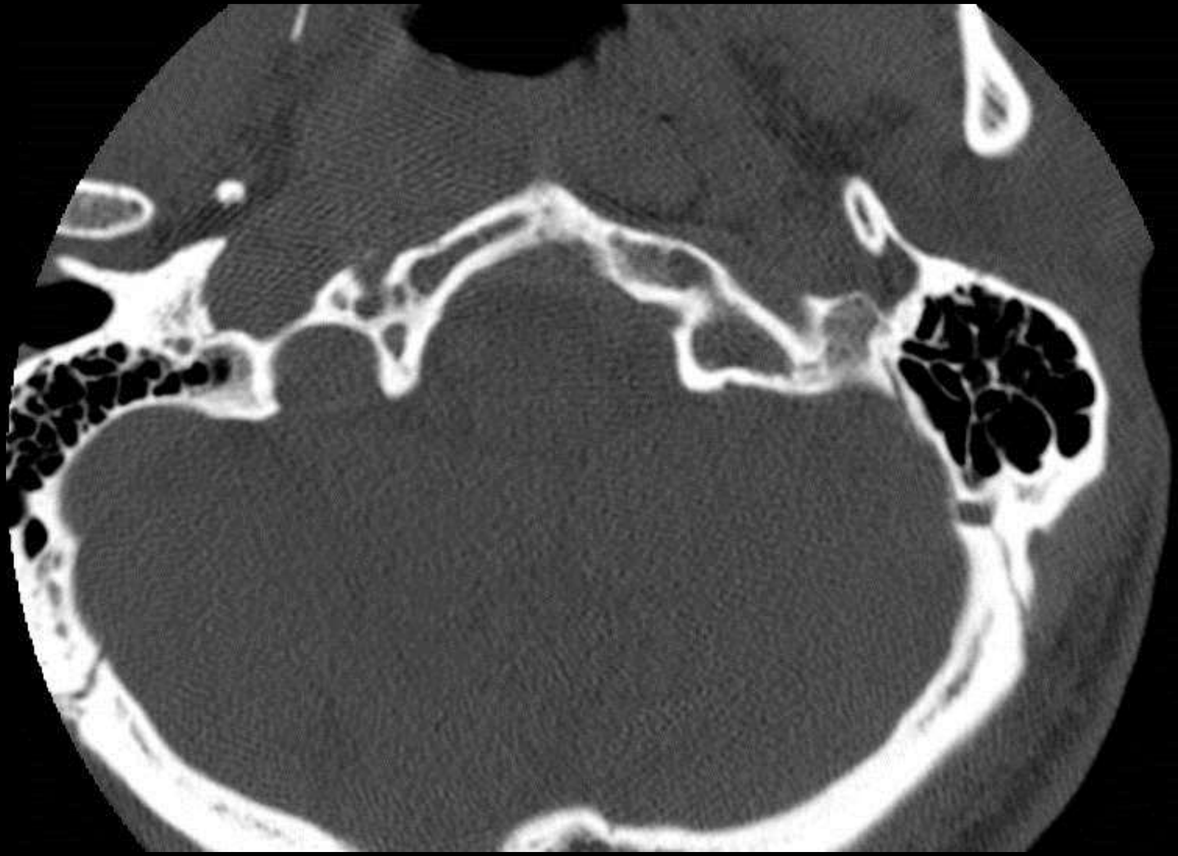
42M Cycling trauma

Occiptito-axial and C2-3 Fusions



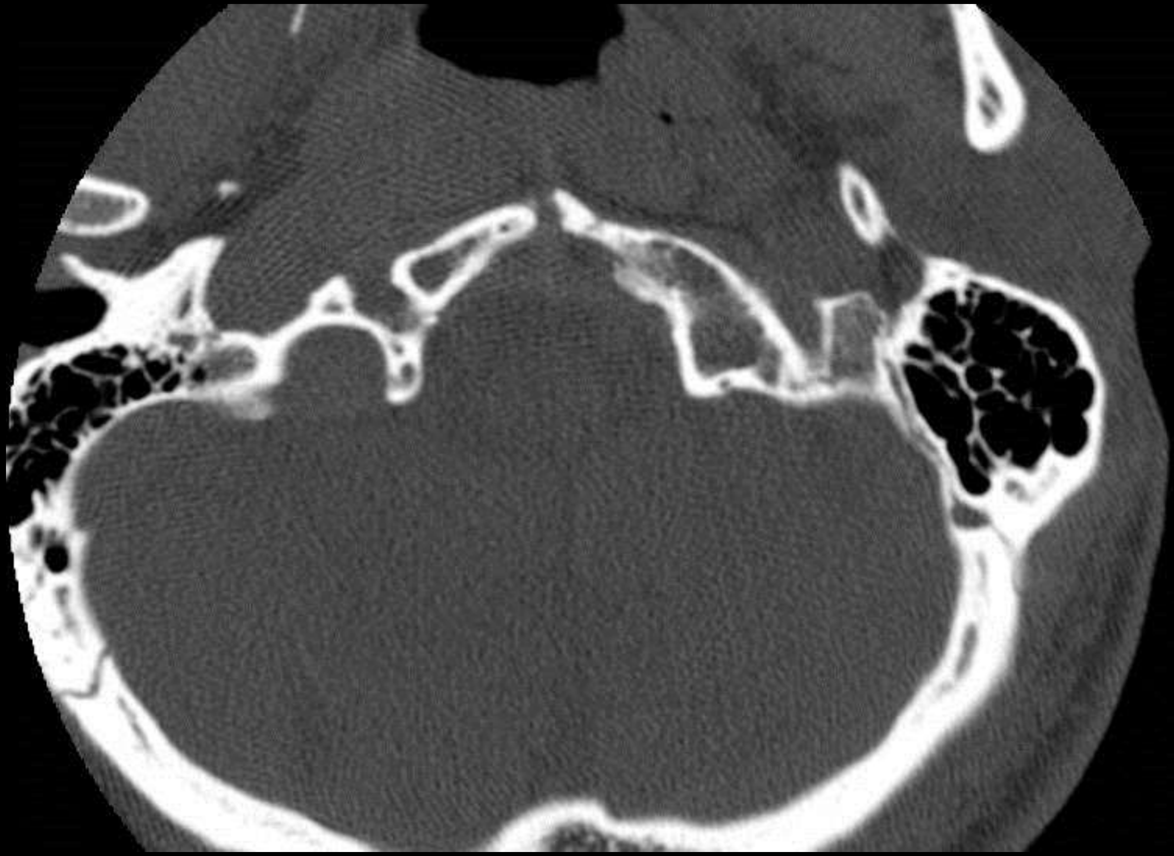
42M Cycling trauma

Occiptito-axial and C2-3 Fusions



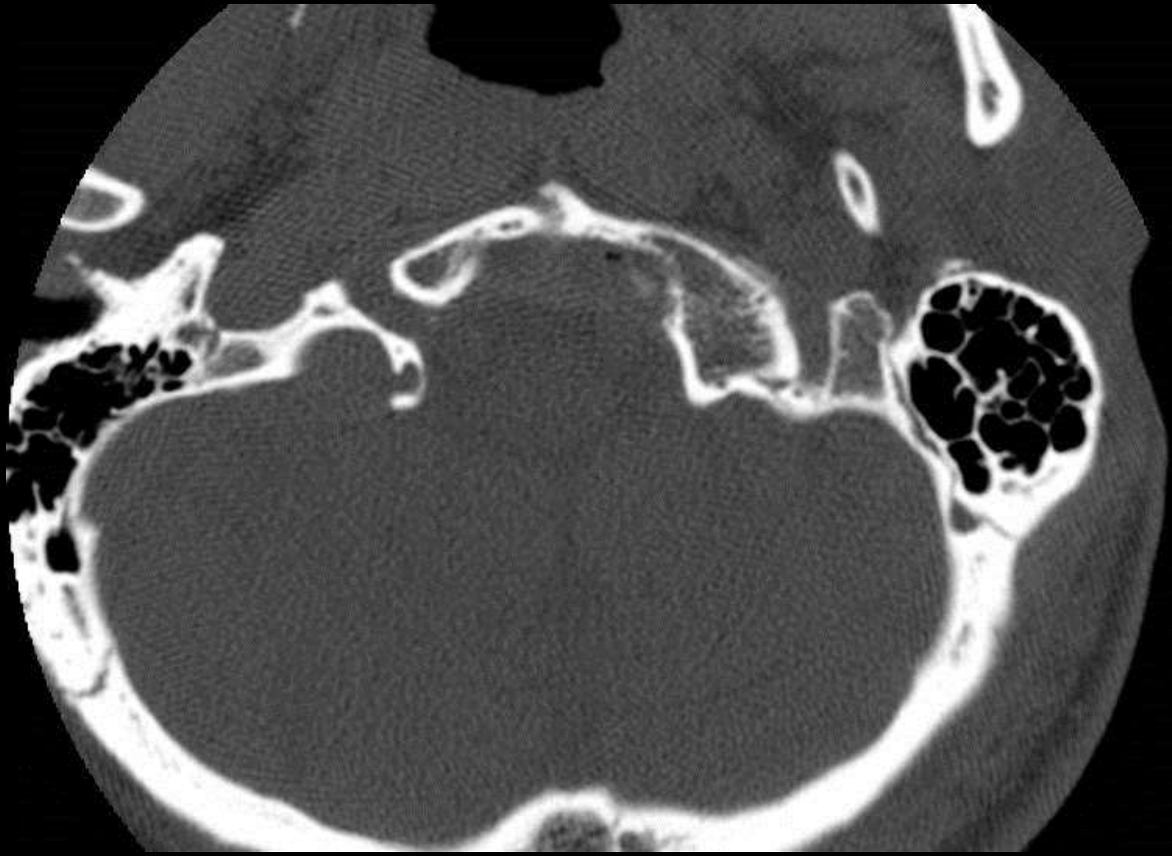
42M Cycling trauma

Occiptito-axial and C2-3 Fusions



42M Cycling trauma

Occiptito-axial and C2-3 Fusions



42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

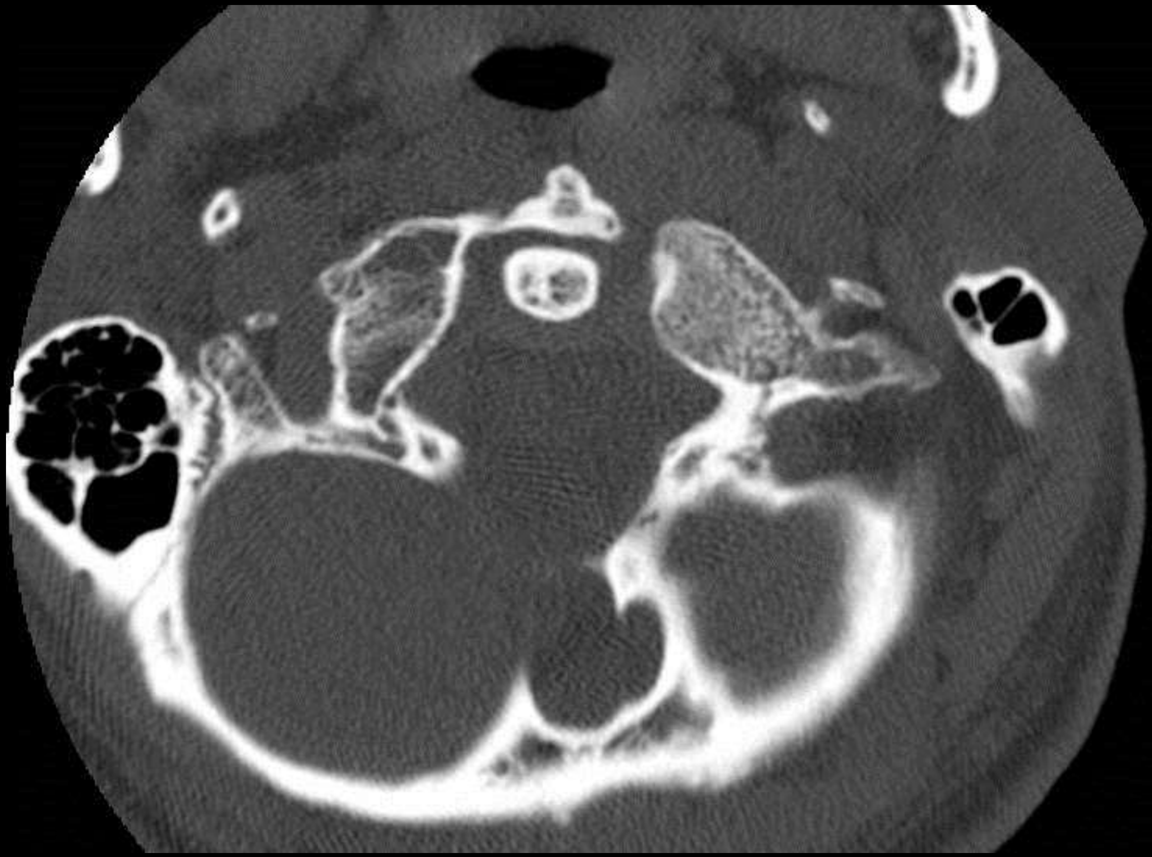
Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions



42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

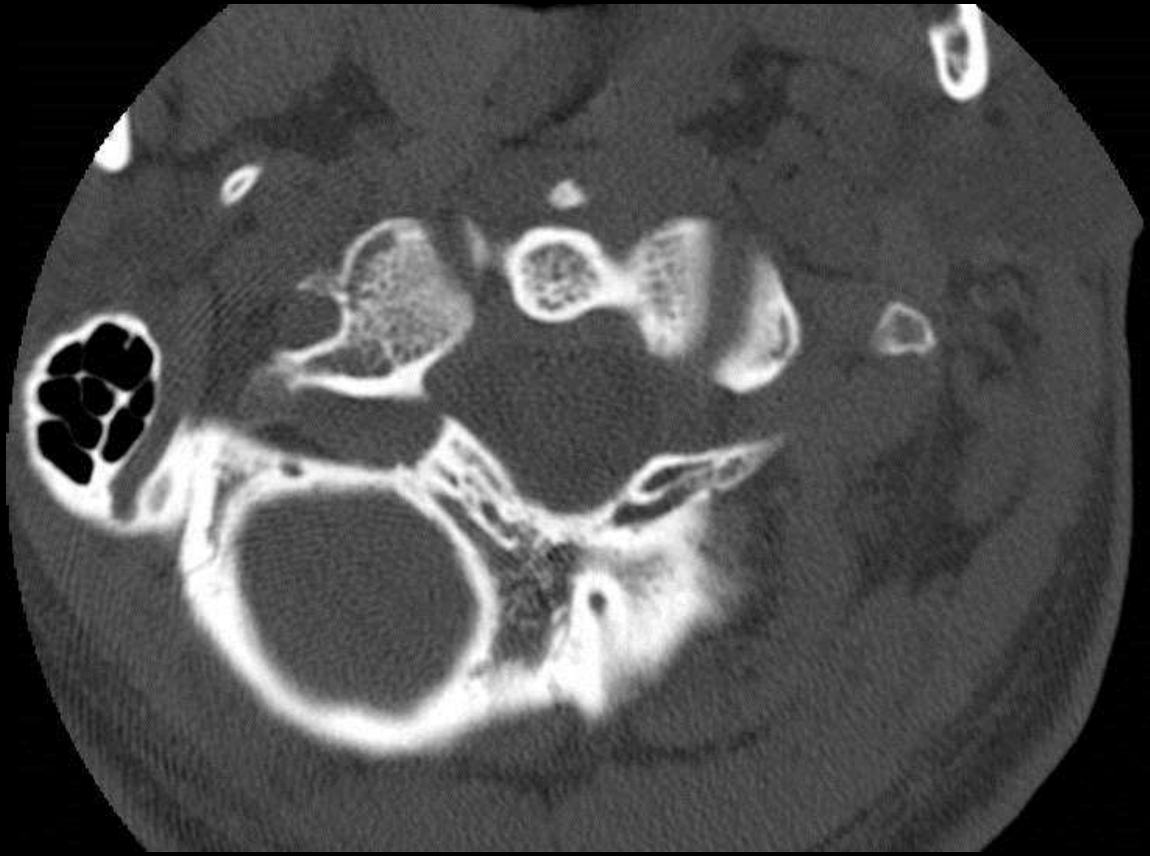
Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

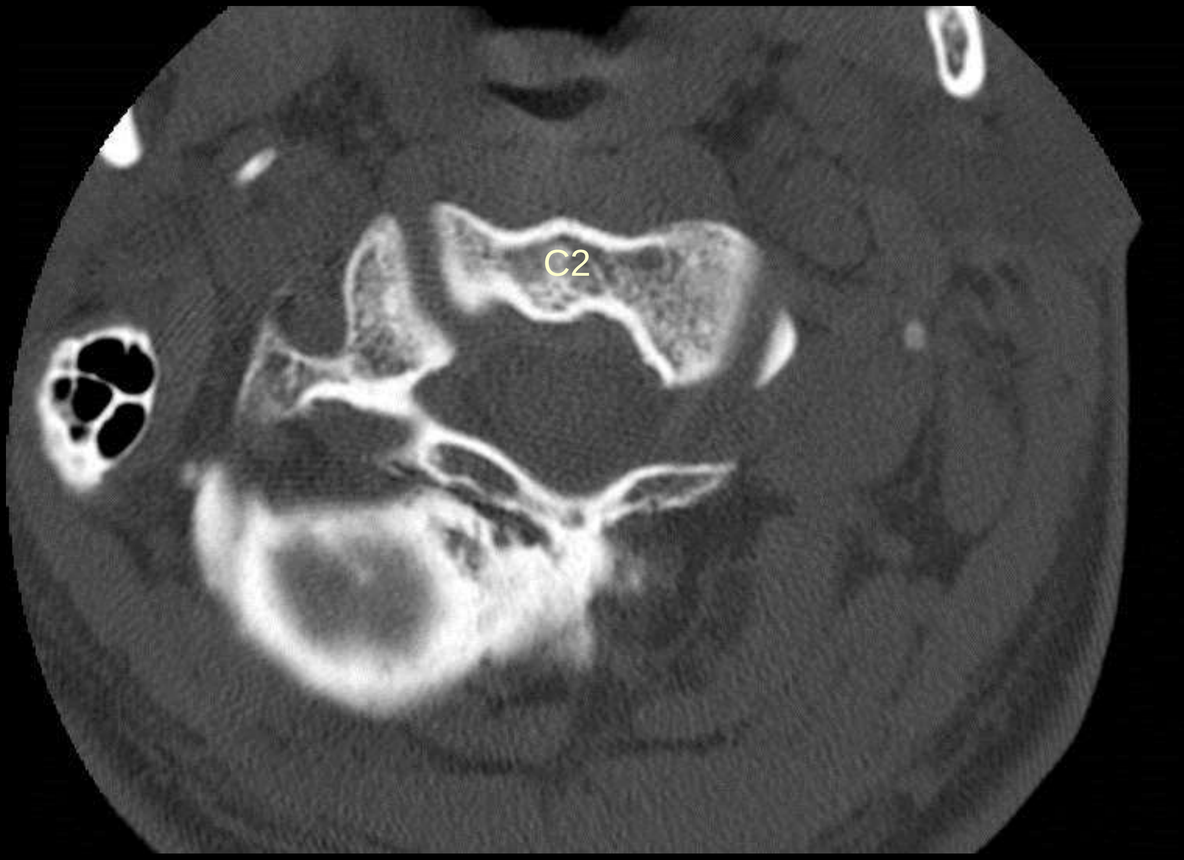


42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions



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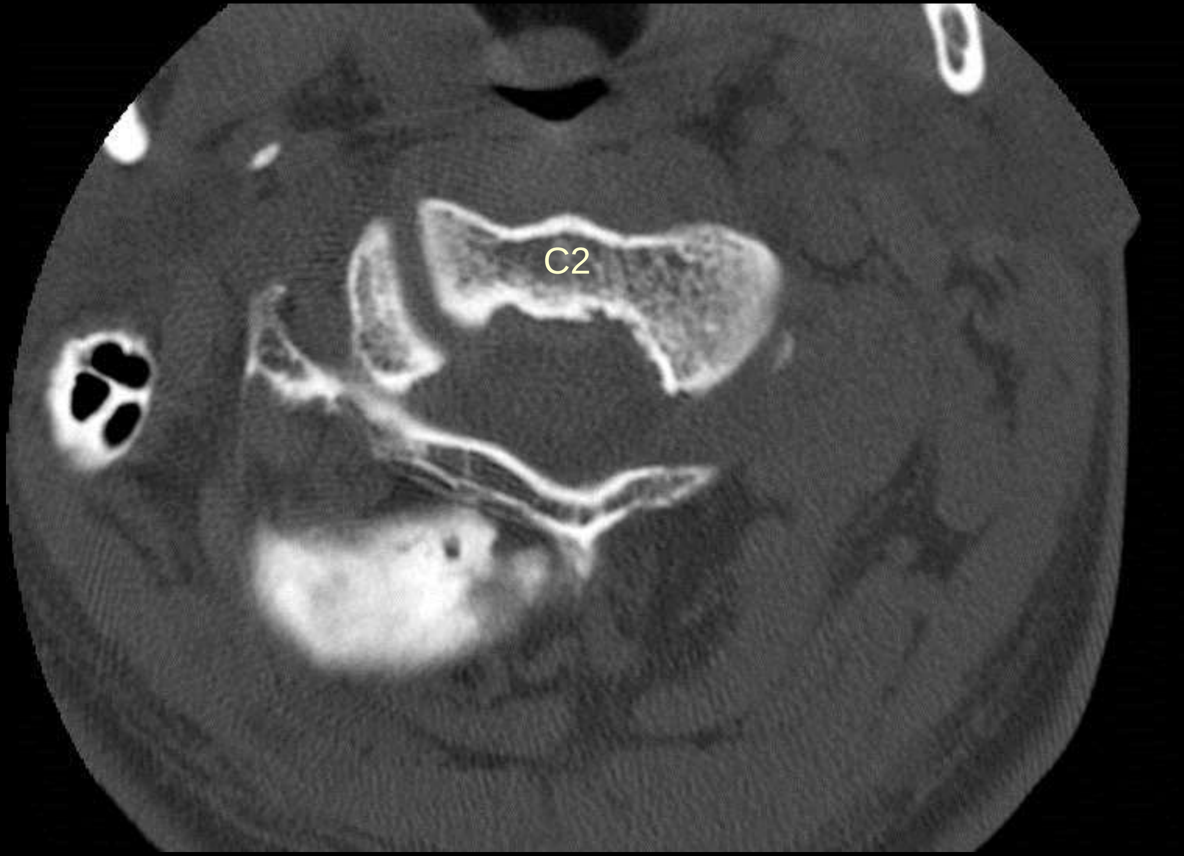
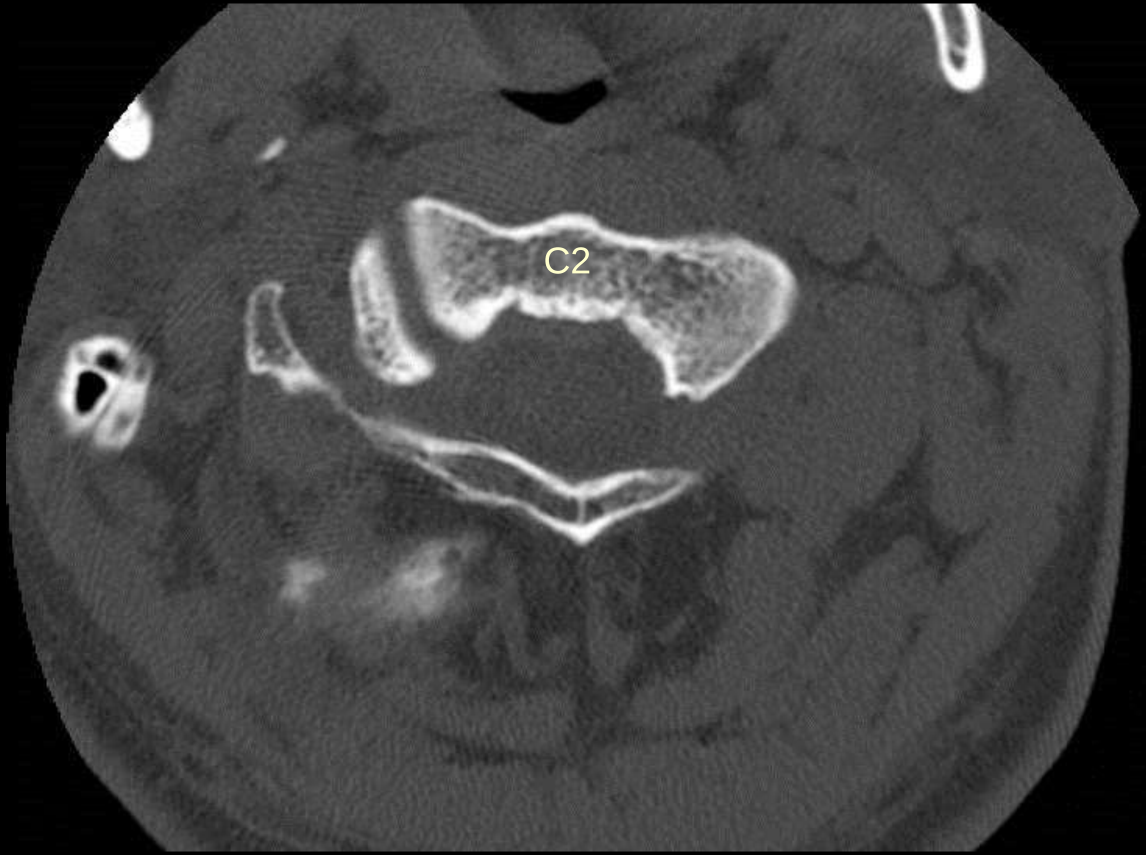
Occiptito-axial and C2-3 Fusions



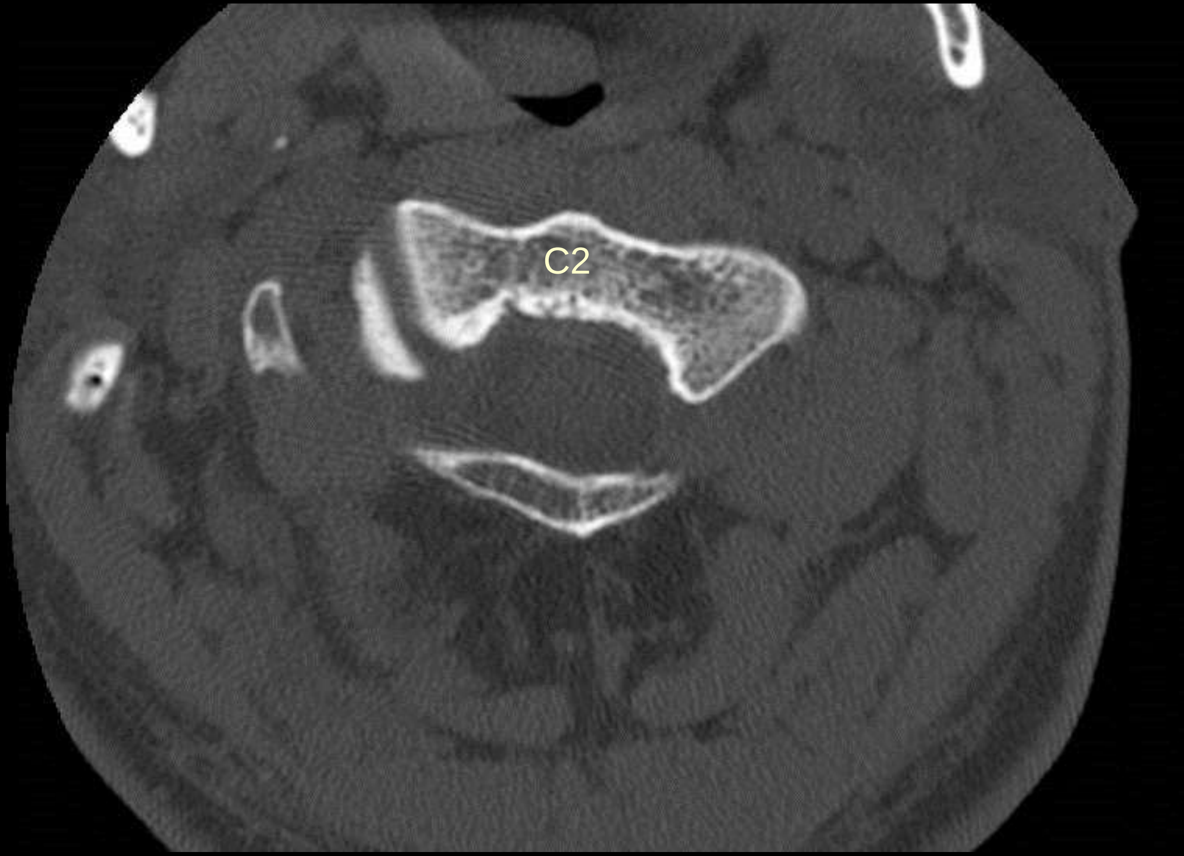
42M Cycling trauma

Occiptito-axial and C2-3 Fusions



42M Cycling trauma

Occiptito-axial and C2-3 Fusions

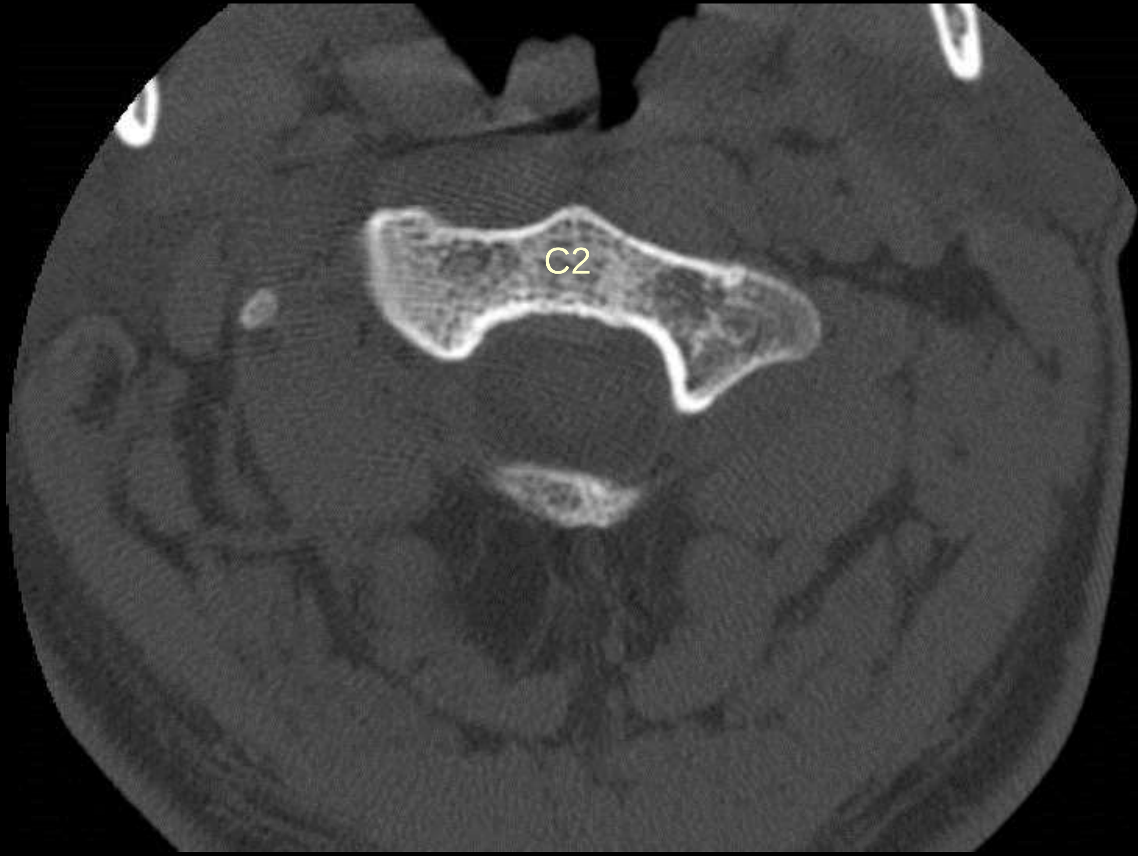


42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions



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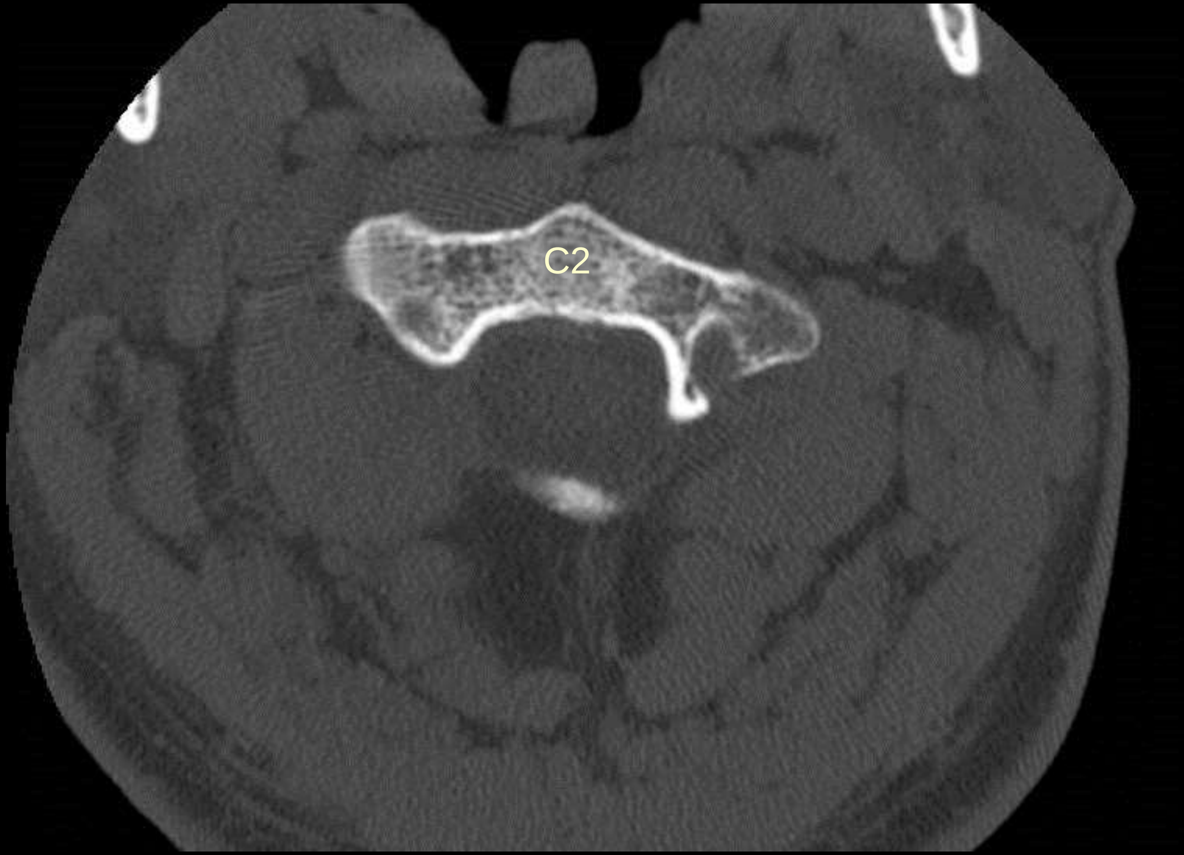
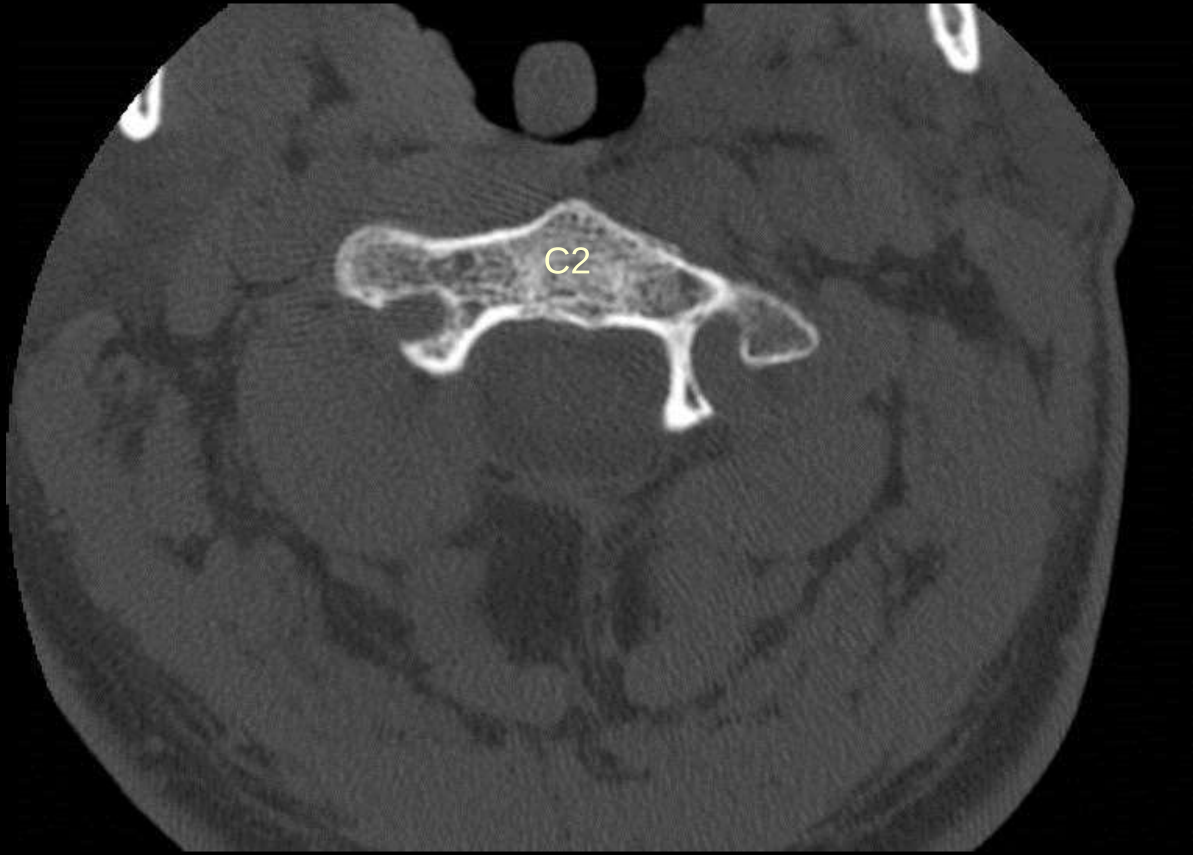
Occiptito-axial and C2-3 Fusions



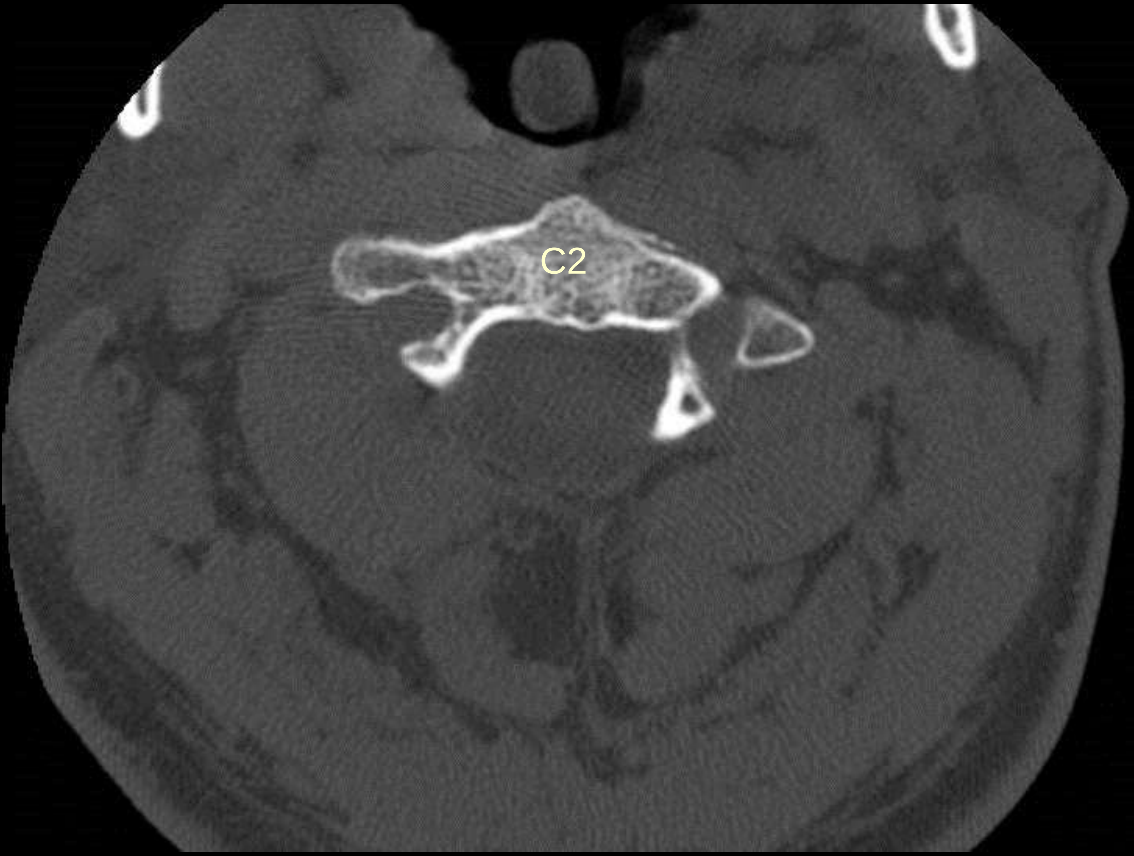
42M Cycling trauma

Occiptito-axial and C2-3 Fusions



42M Cycling trauma

Occiptito-axial and C2-3 Fusions



42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

42M Cycling trauma

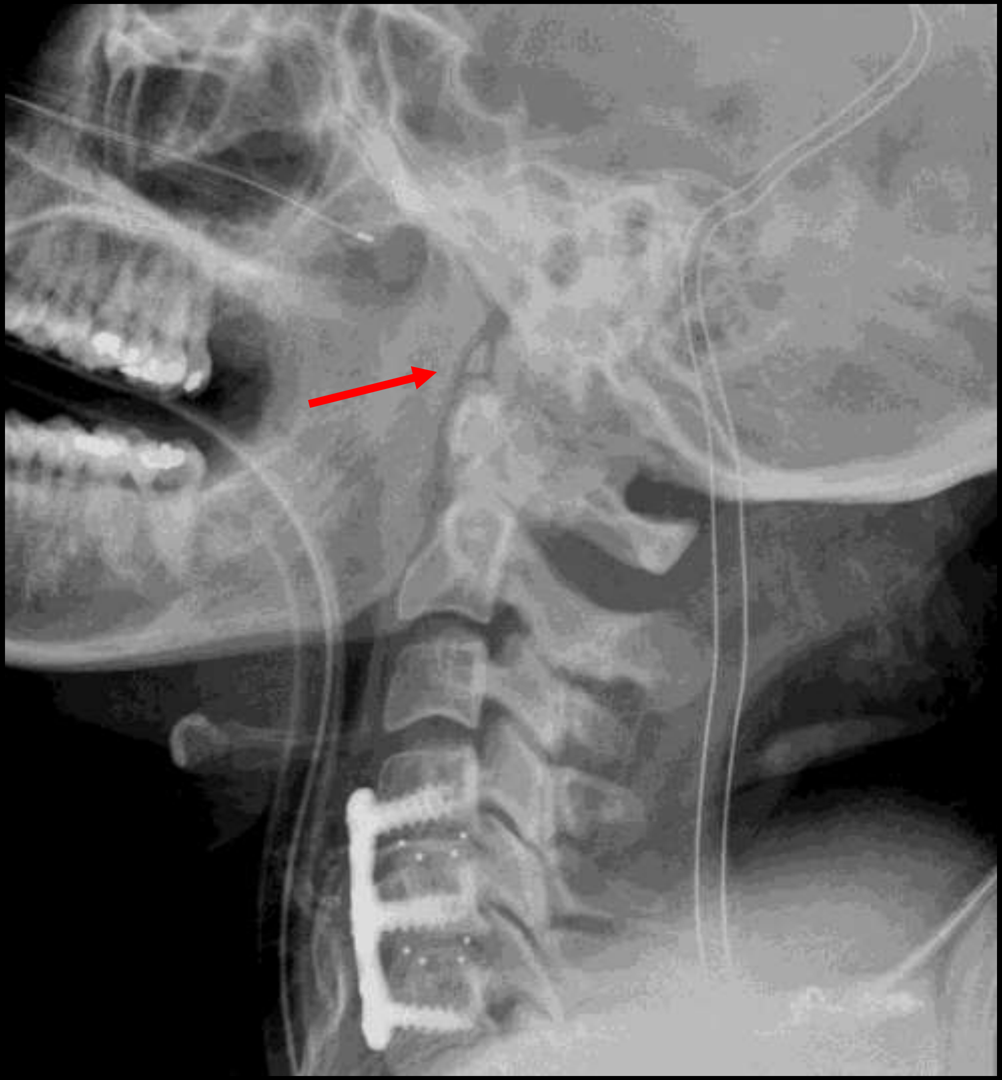
Occiptito-axial and C2-3 Fusions

42M Cycling trauma

Occiptito-axial and C2-3 Fusions

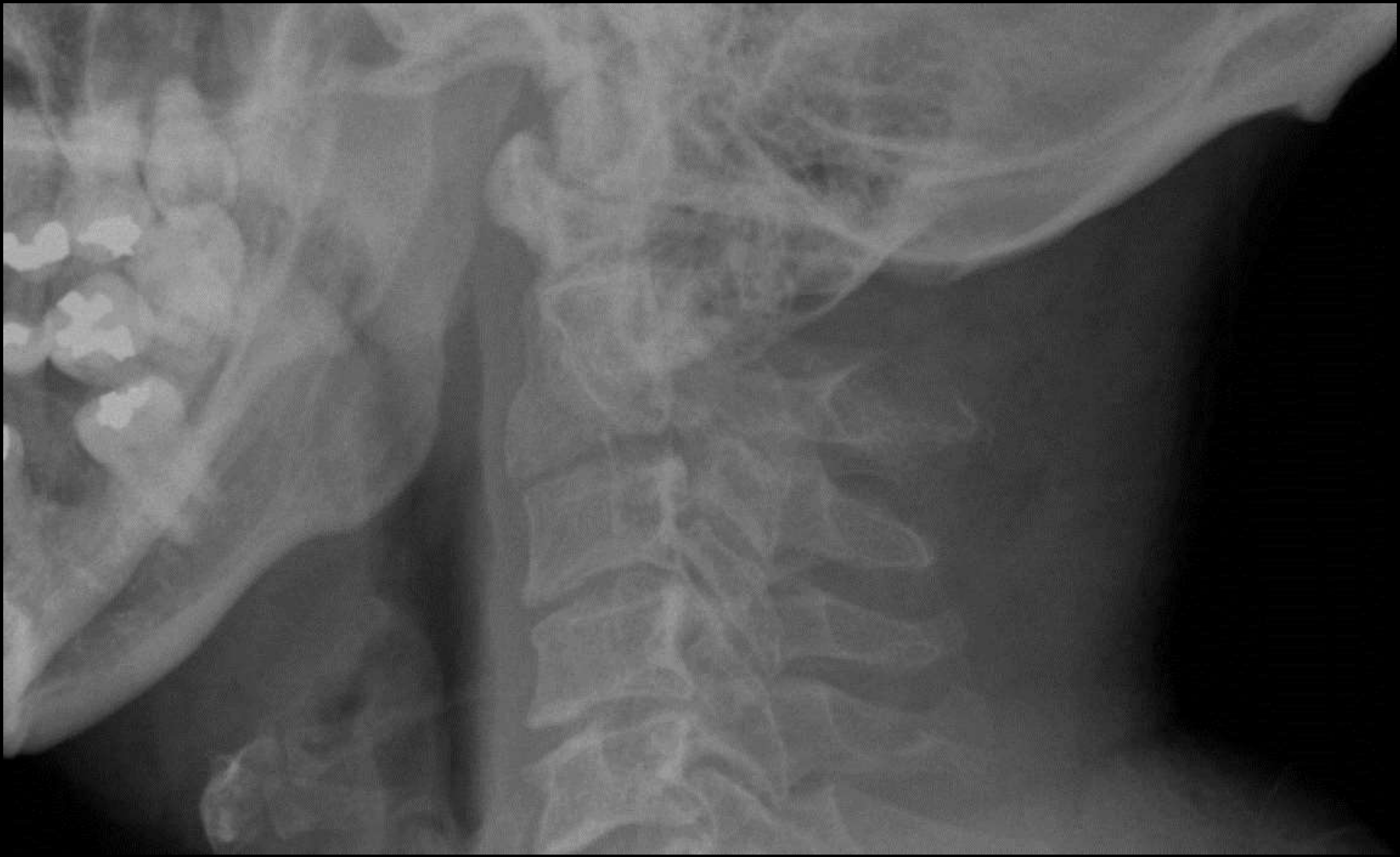
42M Cycling trauma

Occipital Vertebrae



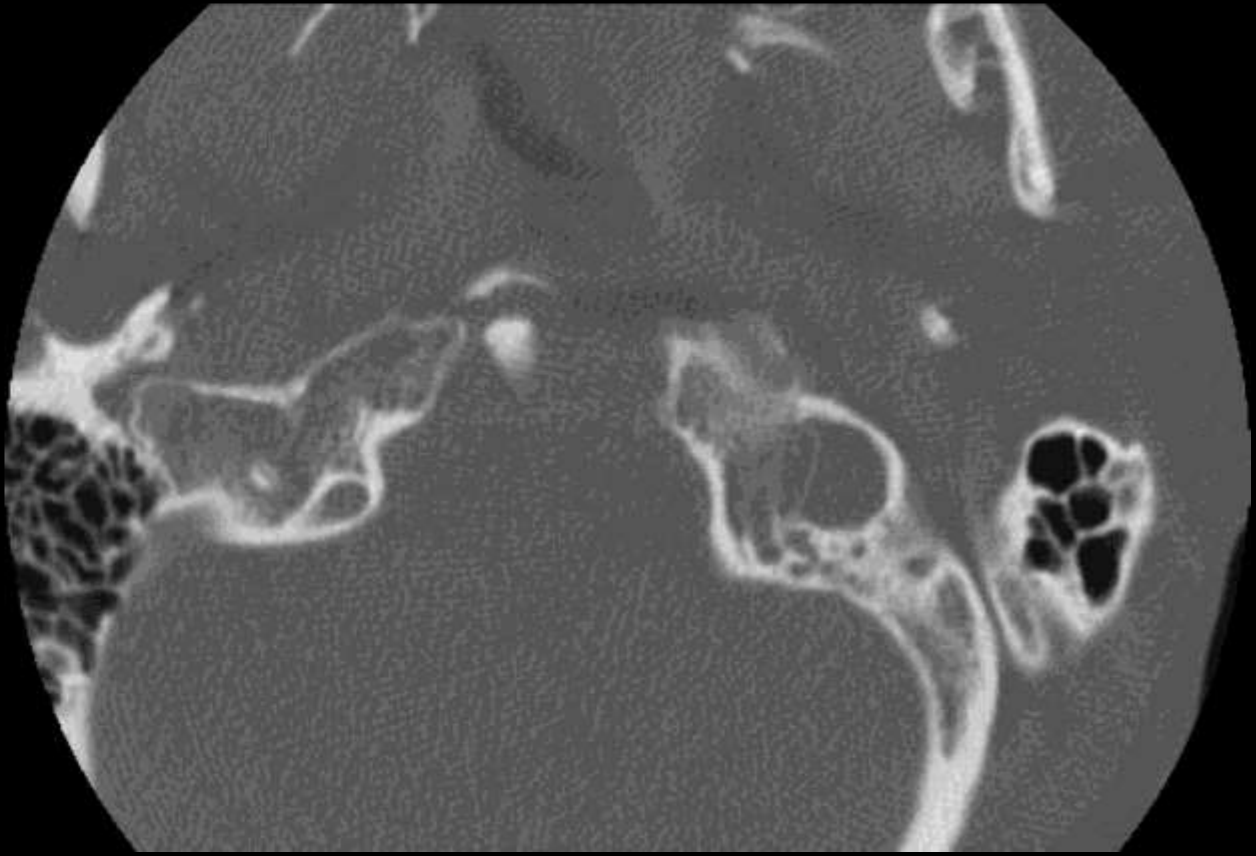
Occipital vertebrae 32F

Occipital Vertebrae

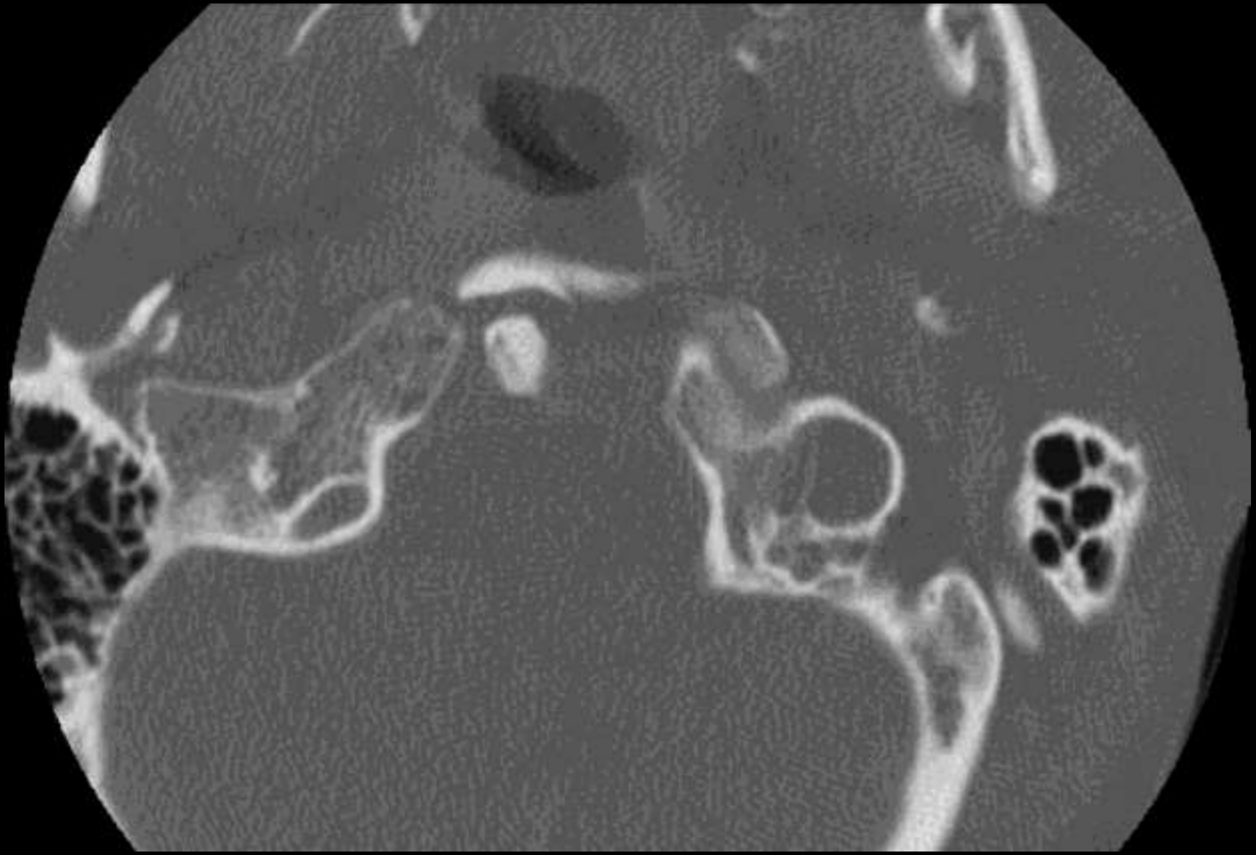


Occipital Vertebrae

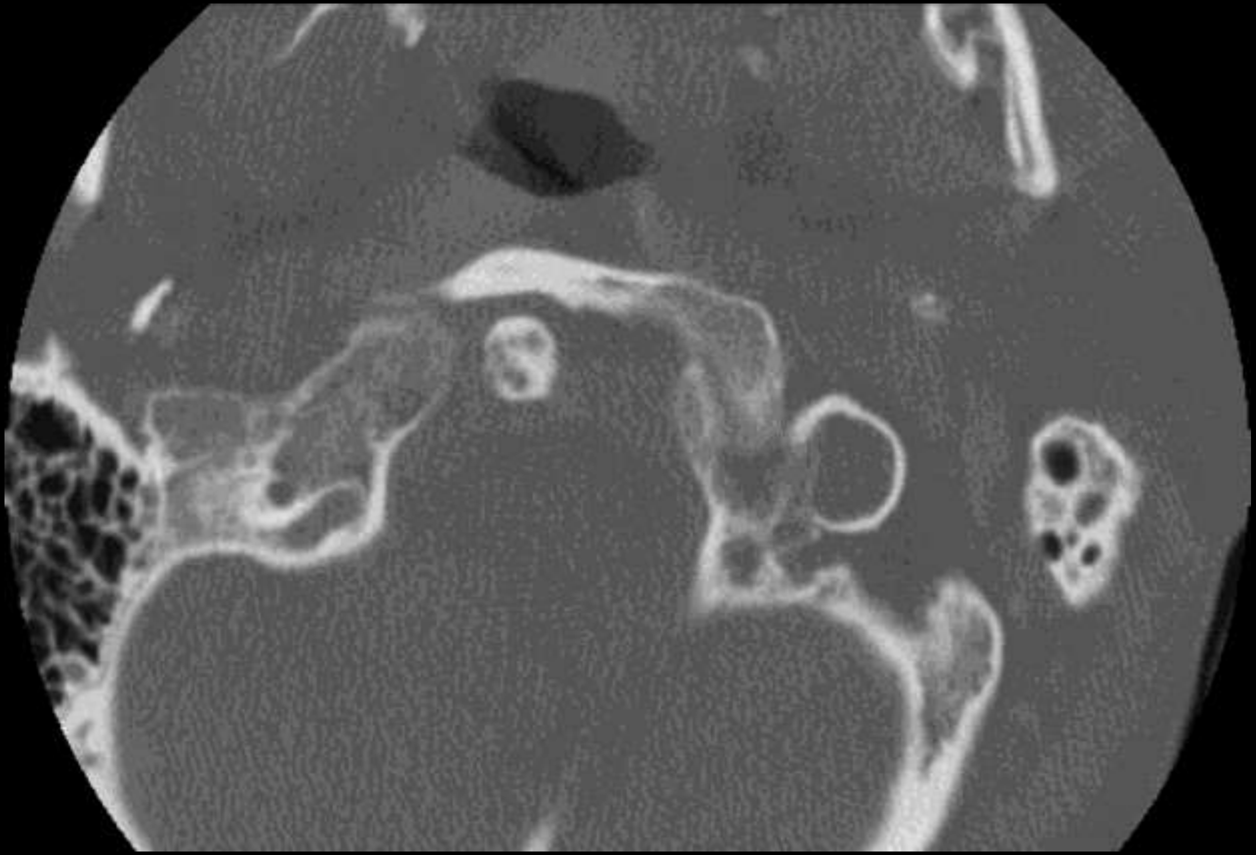
Occipital Vertebrae



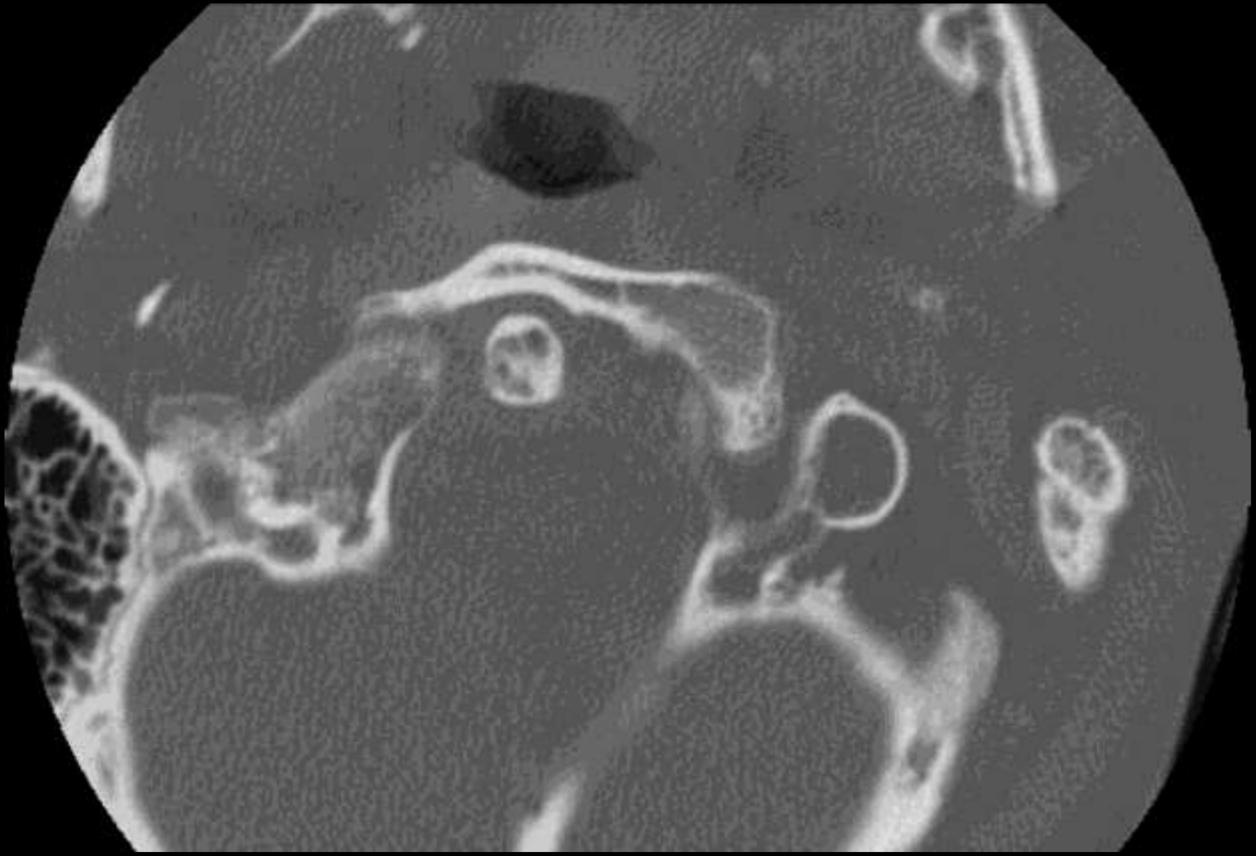
Occipital Vertebrae



Occipital Vertebrae



Occipital Vertebrae



Occipital Vertebrae

Occipital Vertebrae

Occipital Vertebrae

Occipital Vertebrae

Occipital Vertebrae

Occipital Vertebrae

Occipitoatlas transitional vertebrae

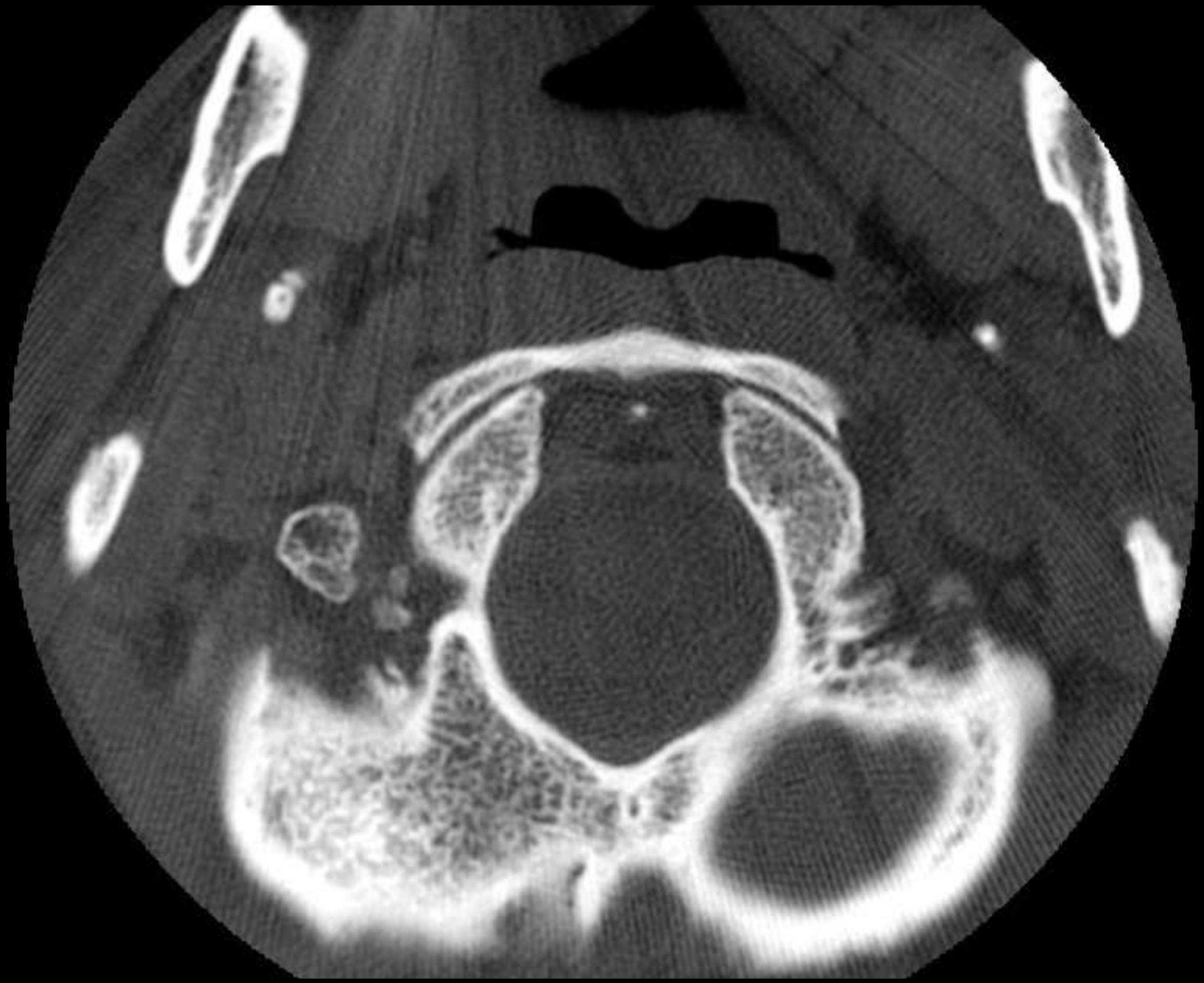
Occipital Vertebrae

Occipital vertebrae 55M

Occipital Vertebrae

Occipital vertebrae 55M

Occipital Vertebrae

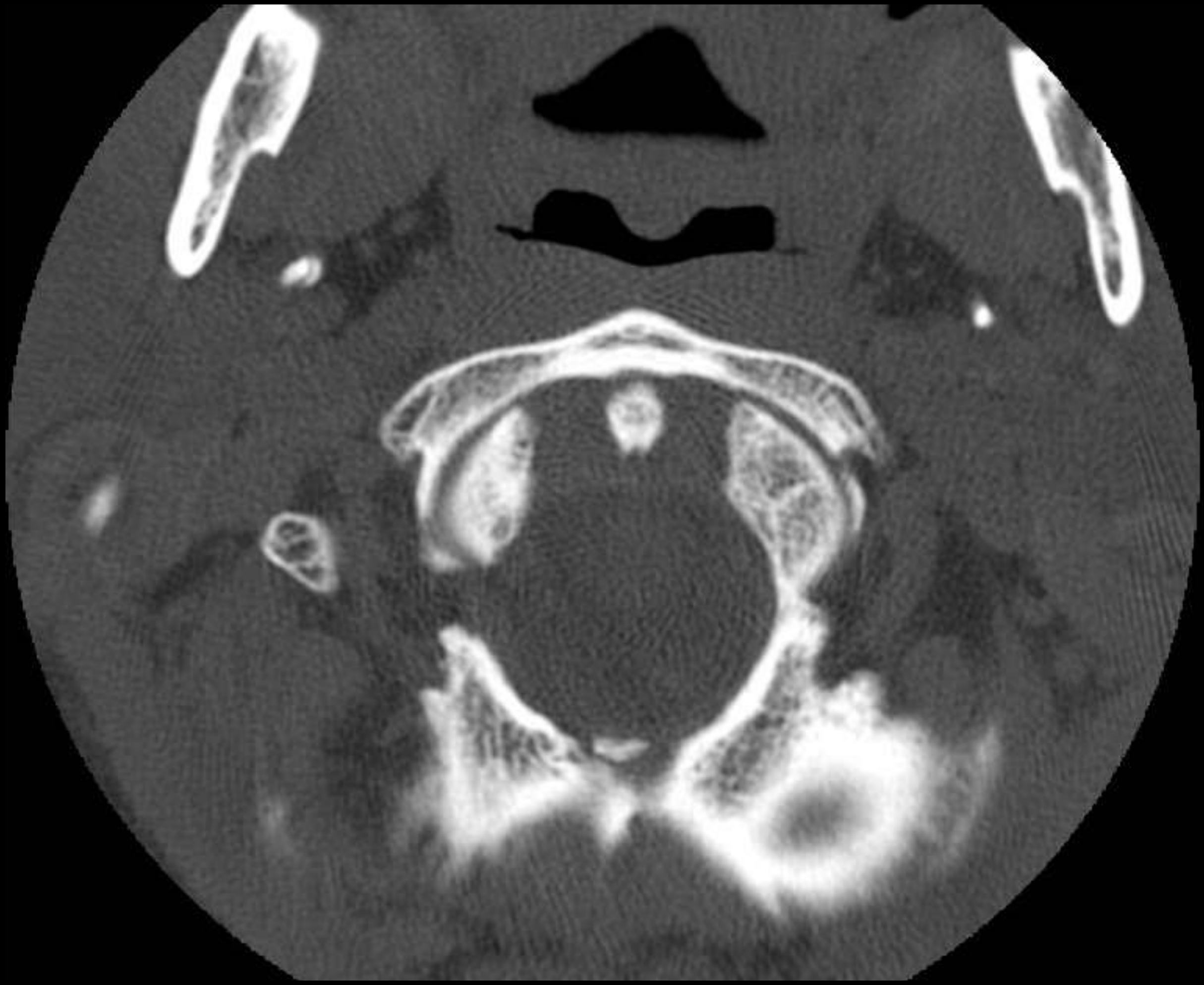


Occipital vertebrae 55M

Occipital Vertebrae

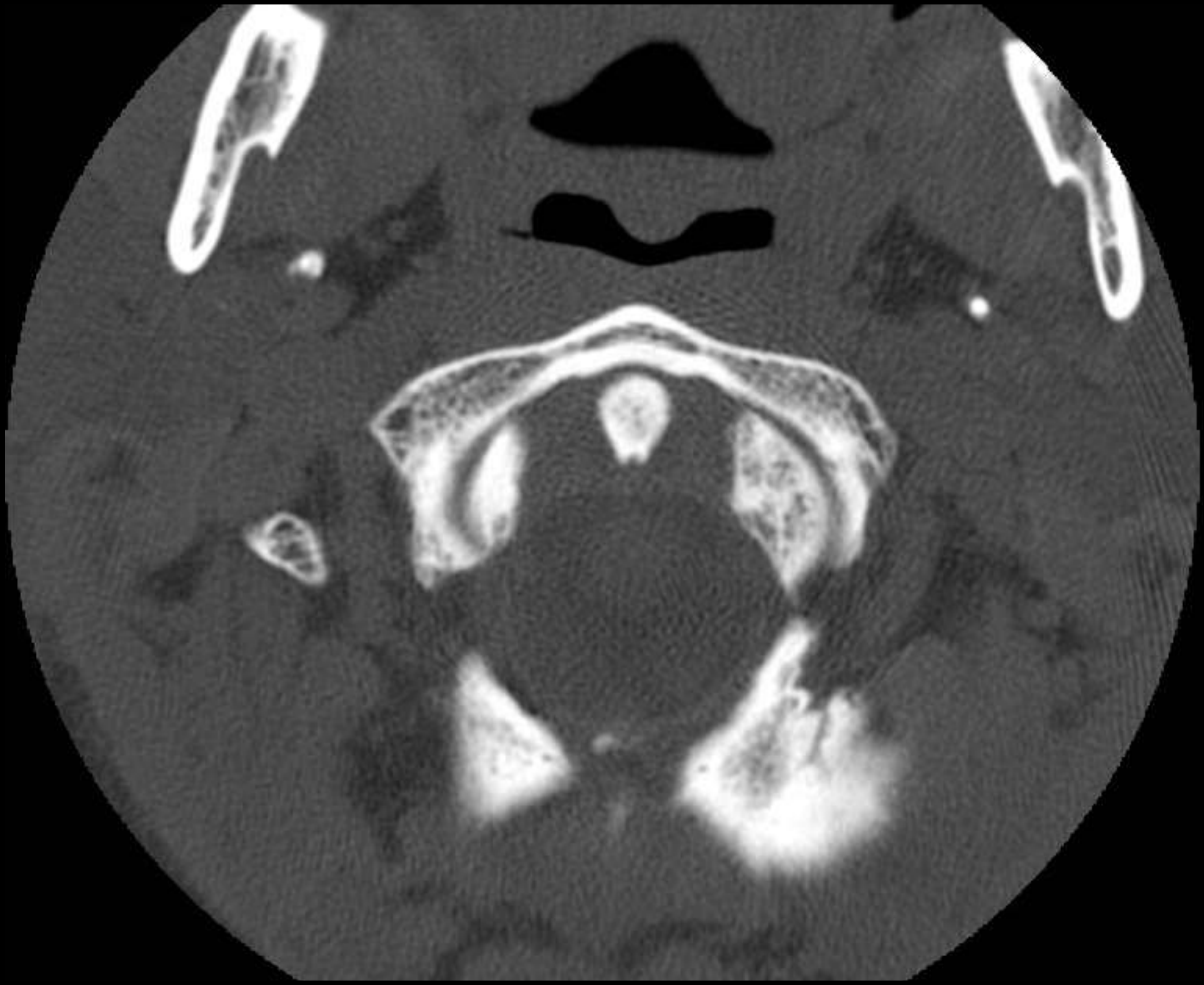
Occipital vertebrae 55M

Occipital Vertebrae



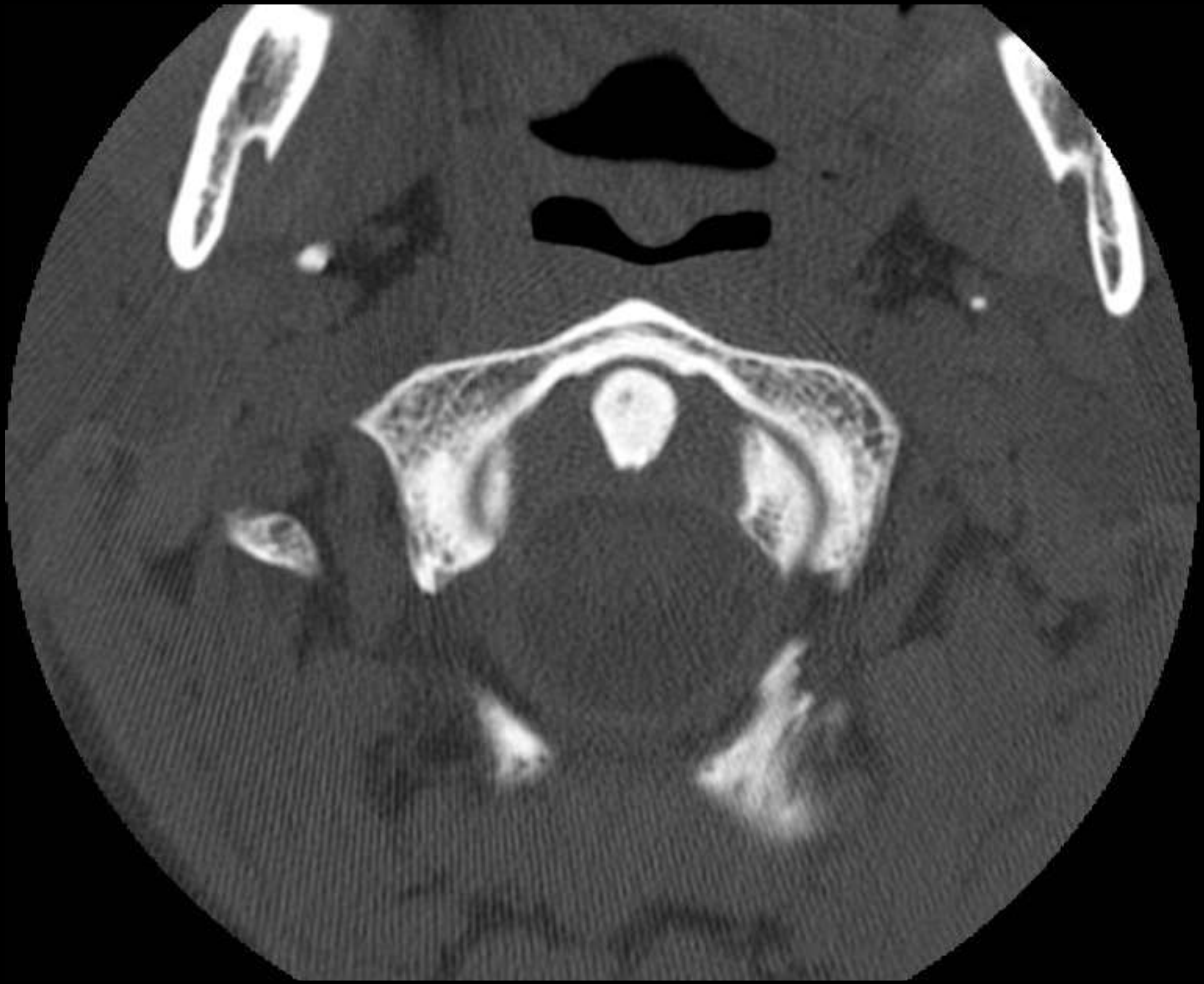
Occipital vertebrae 55M

Occipital Vertebrae



Occipital vertebrae 55M

Occipital Vertebrae



Occipital vertebrae 55M

Occipital Vertebrae

Occipital vertebrae 55M

Occipital Vertebrae

Occipital vertebrae 55M

Occipital Vertebrae

Occipital vertebrae 55M

Occipital Vertebrae

Occipital vertebrae 55M

Occipital Vertebrae

Occipital vertebrae 55M

Occipital Vertebrae

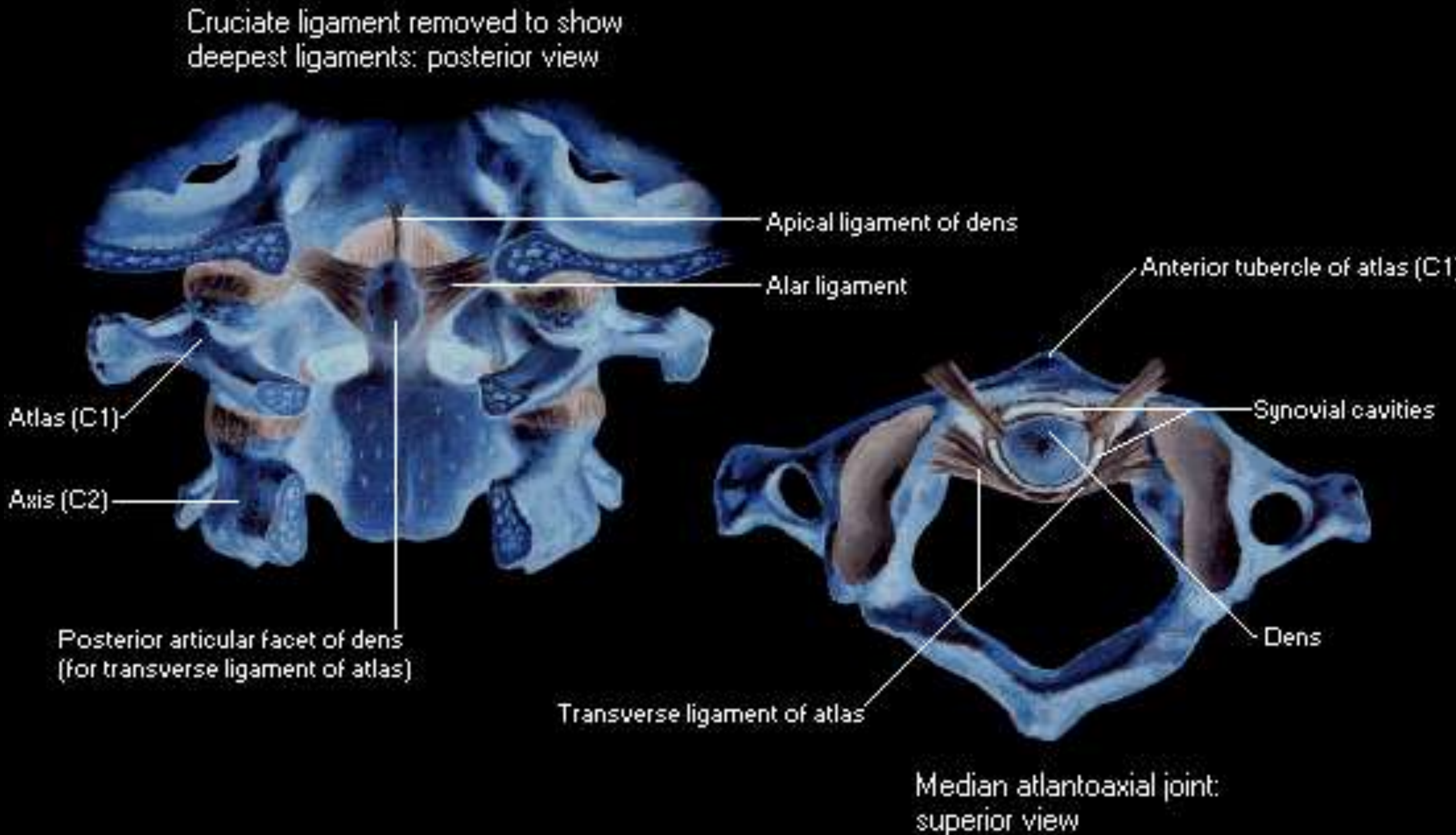
Occipital vertebrae 55M

Occipital Vertebrae

Occipital Vertebrae

Occipital vertebrae 55M

Craniocervical Ligaments



Netter

Alar avulsion occipital condyle

Forced lateral flexion

Hematoma

Look for second fracture

Occipital and C6 Fxs

Occipital and C6 Fxs

3+1

28M

Occipital and C6 Fxs

2+1

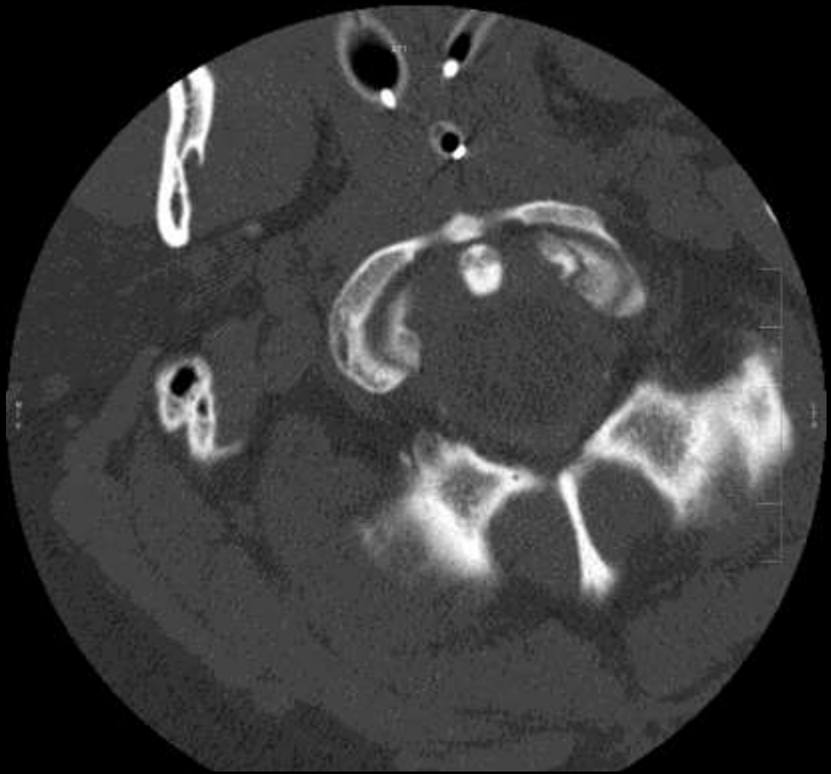
28M

Occipital and C6 Fxs

1+1

28M

Occipital and C6 Fxs

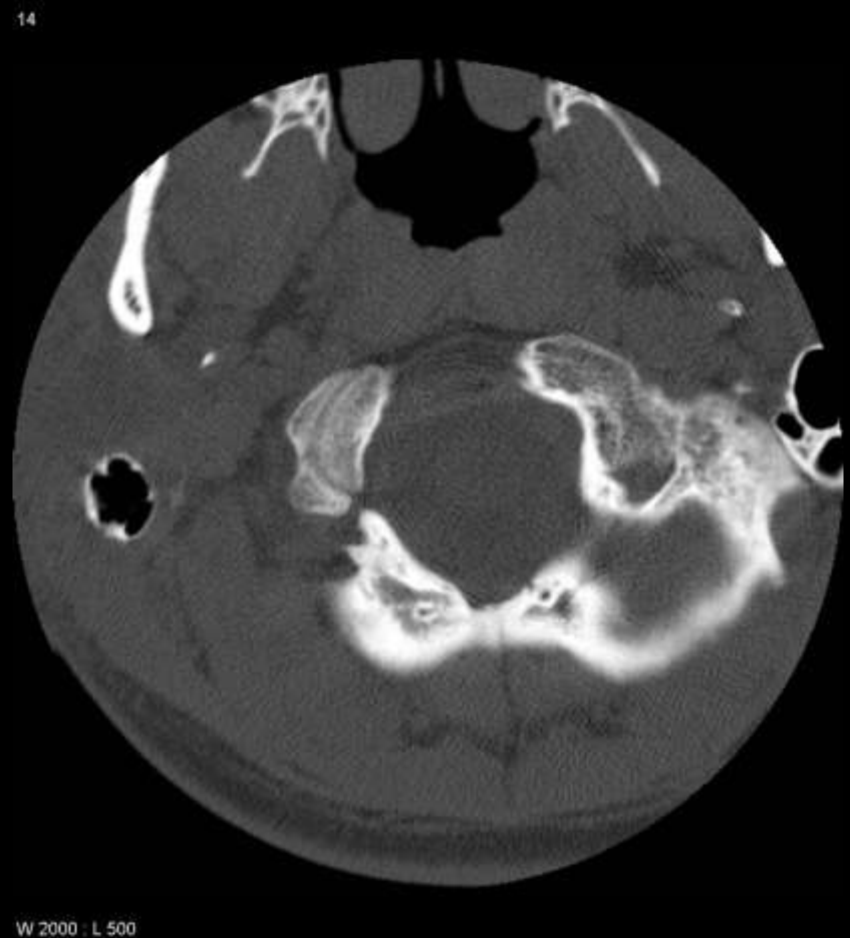


Left Occipital condyle Fx

C6 burst Fx

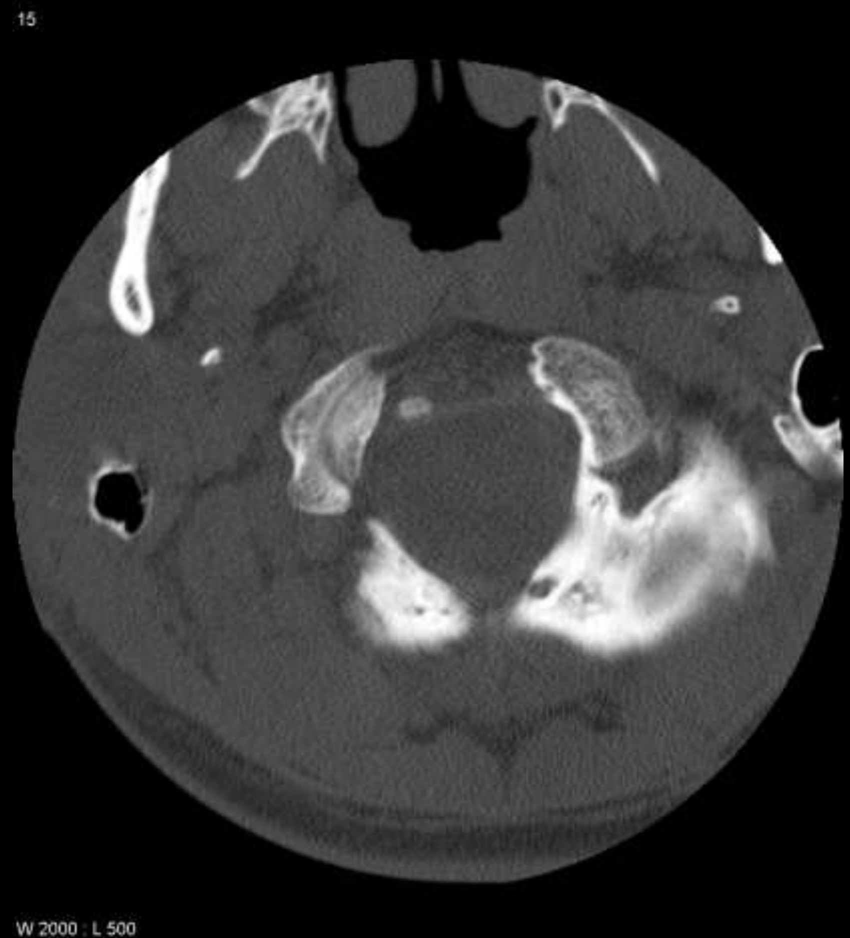
28M

Chronic alar lig avulsion



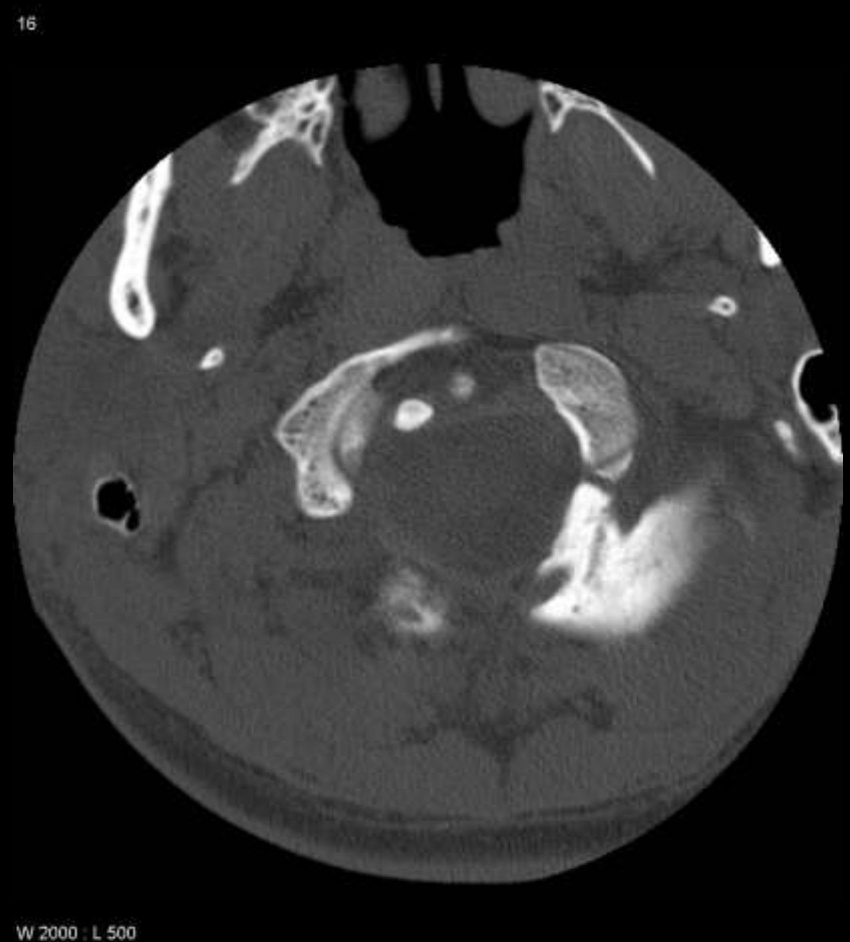
Chronic alar lig avulsion 36M

Chronic alar lig avulsion



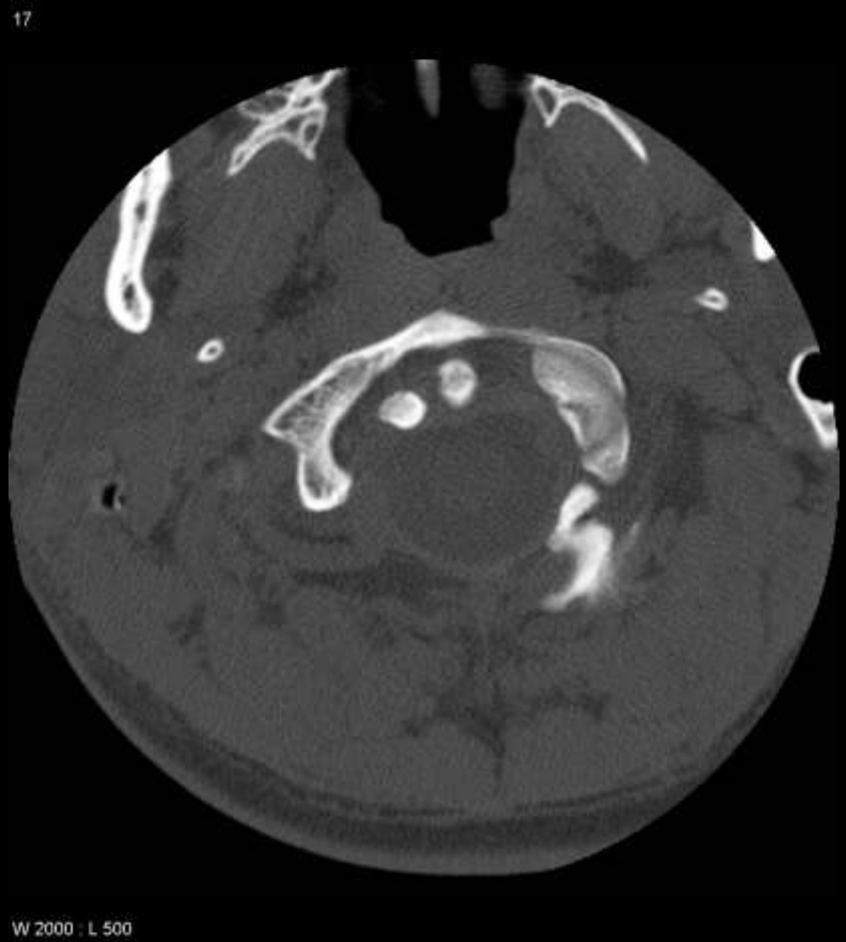
Chronic alar lig avulsion 36M

Chronic alar lig avulsion



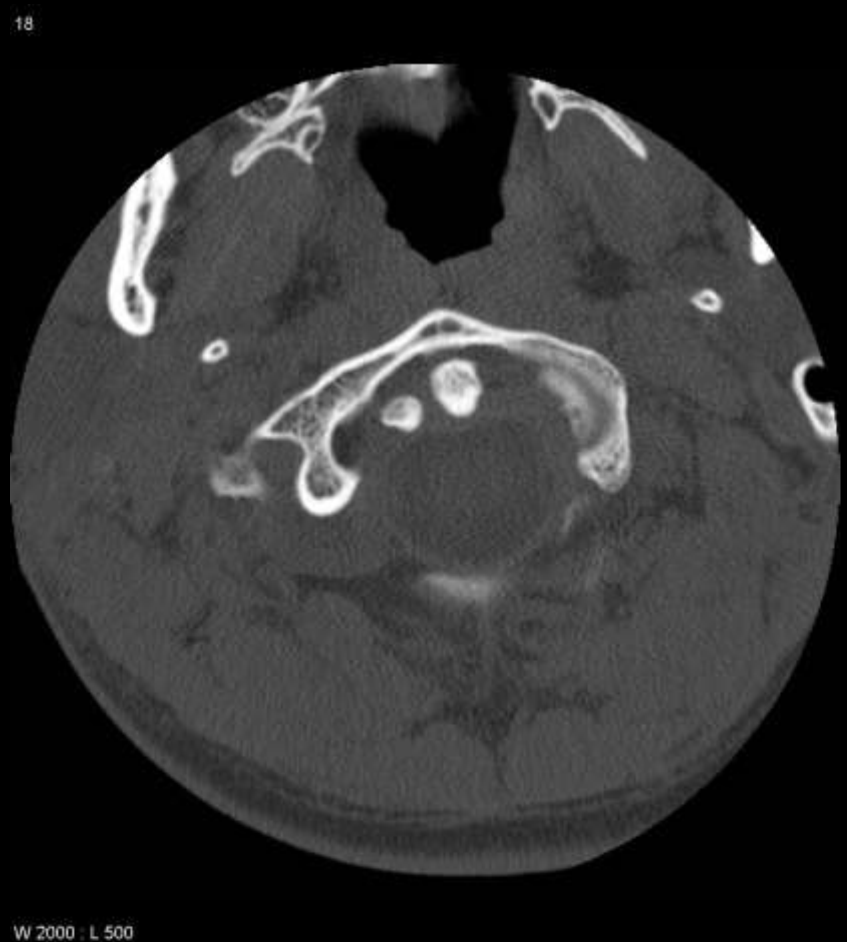
Chronic alar lig avulsion 36M

Chronic alar lig avulsion



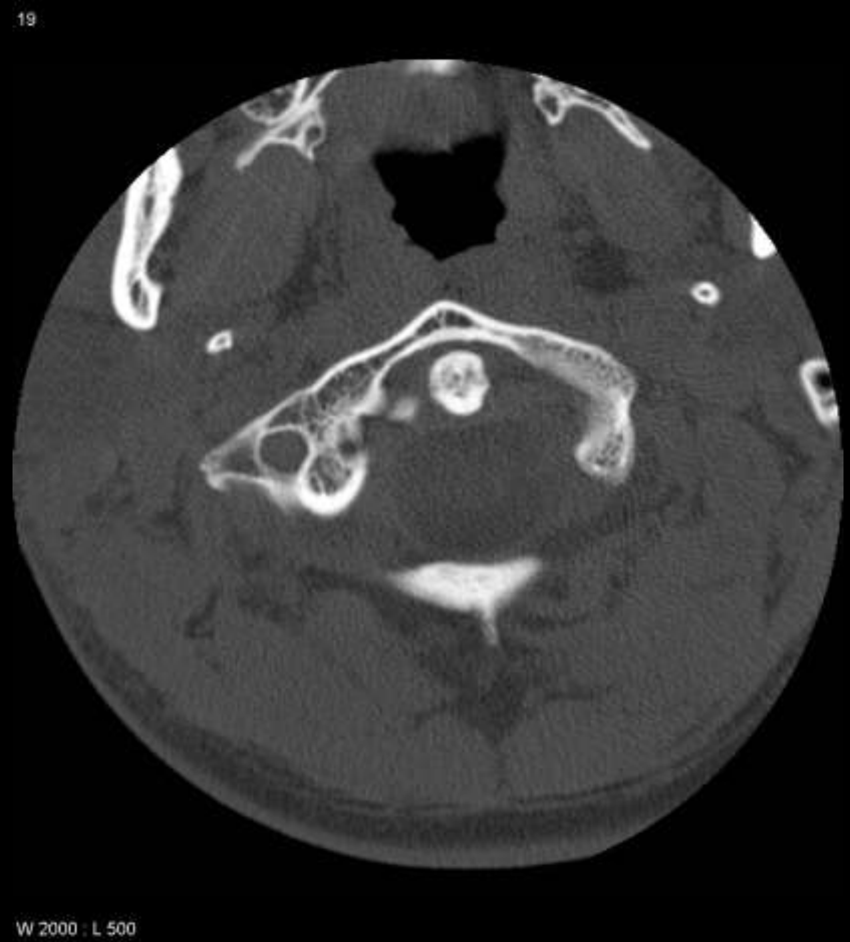
Chronic alar lig avulsion 36M

Chronic alar lig avulsion



Chronic alar lig avulsion 36M

Chronic alar lig avulsion

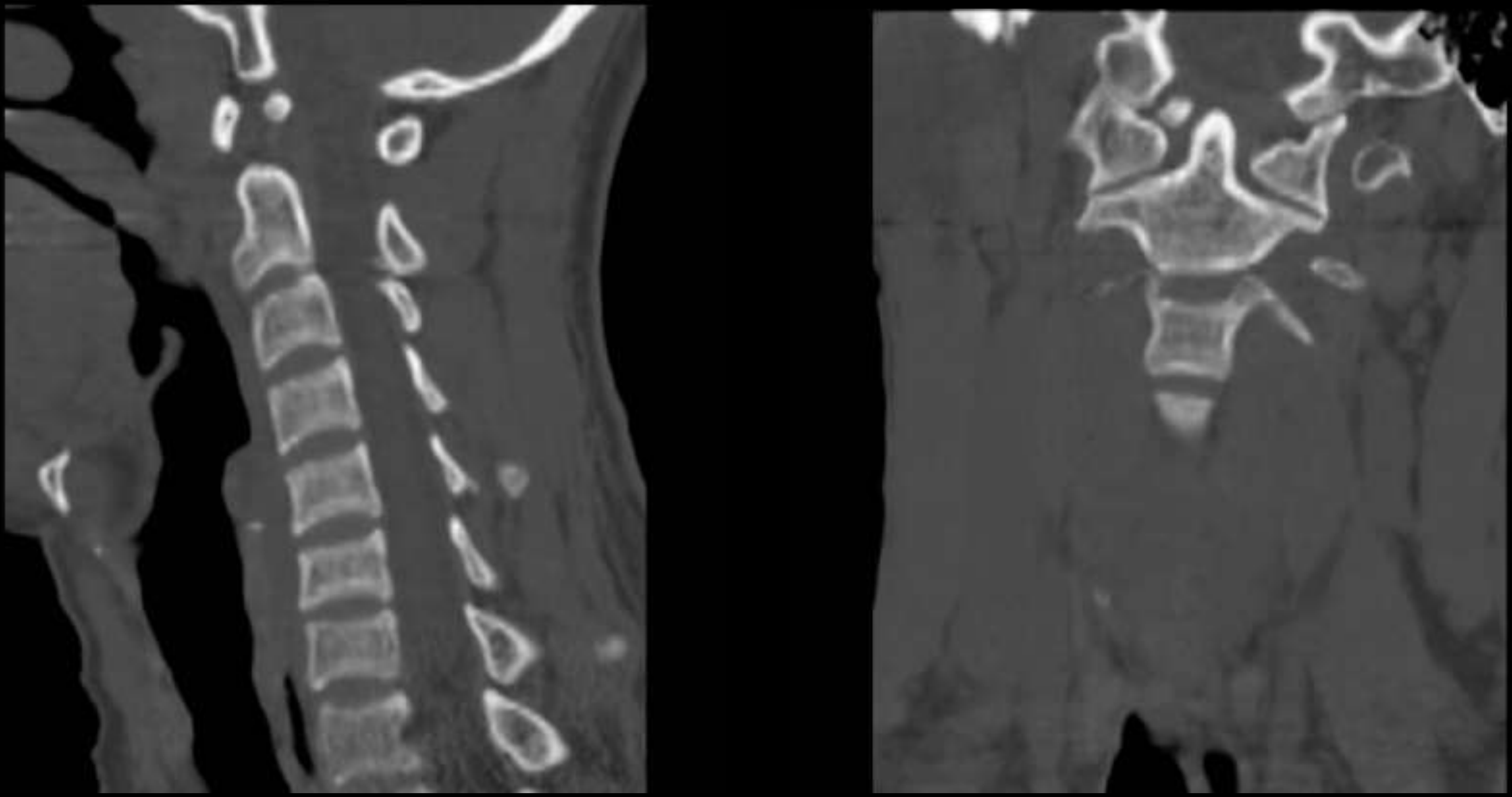


Chronic alar lig avulsion 36M

Chronic alar lig avulsion

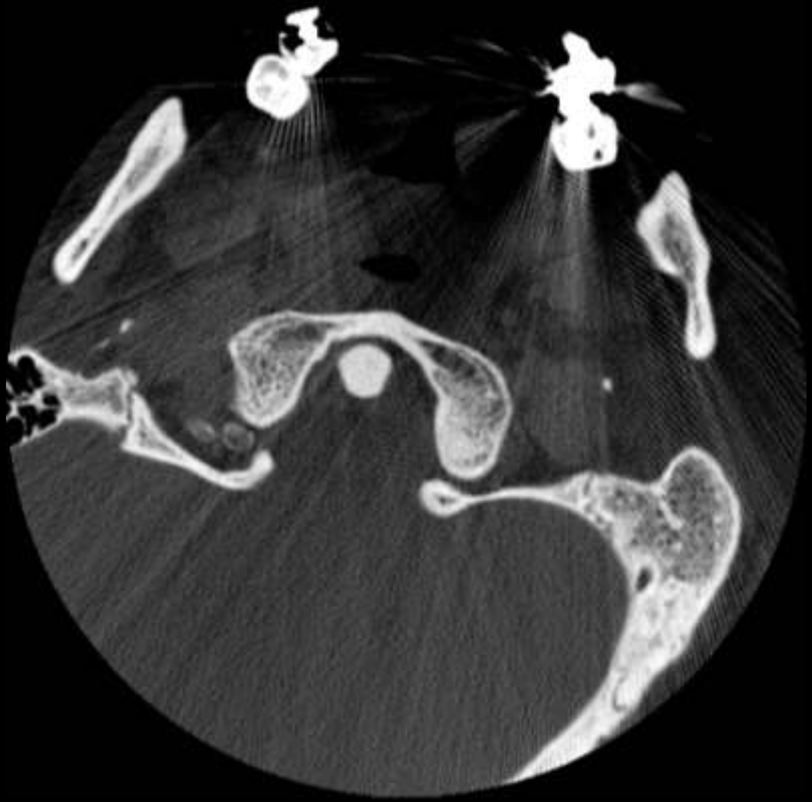
Chronic alar lig avulsion 36M

Chronic alar lig avulsion



Chronic alar lig avulsion 36M

Posticus Ponticus remnants

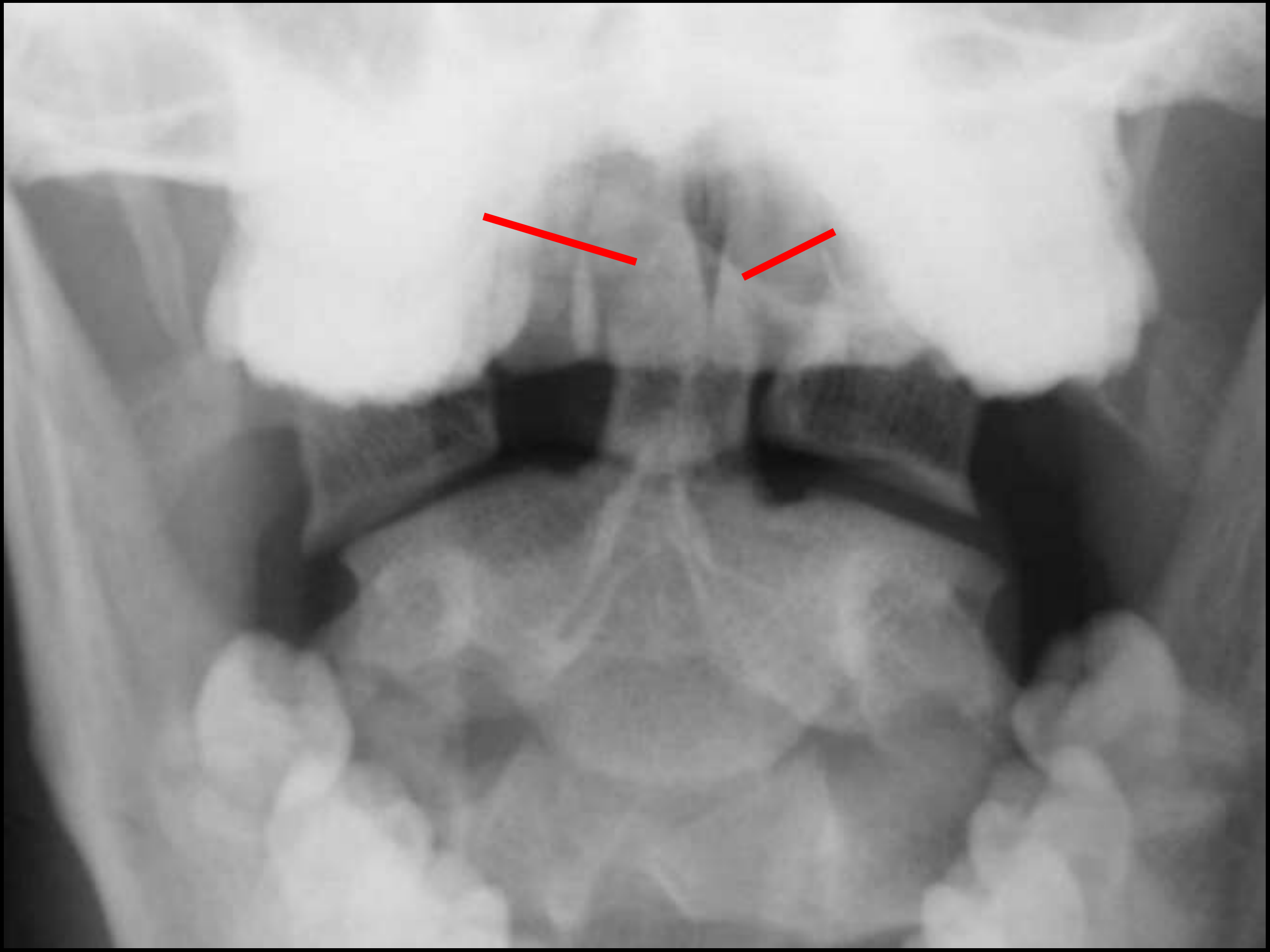


Seat belt injury Cx spine

Occipital condyle cleft

37M

Right Alar ligament rupture

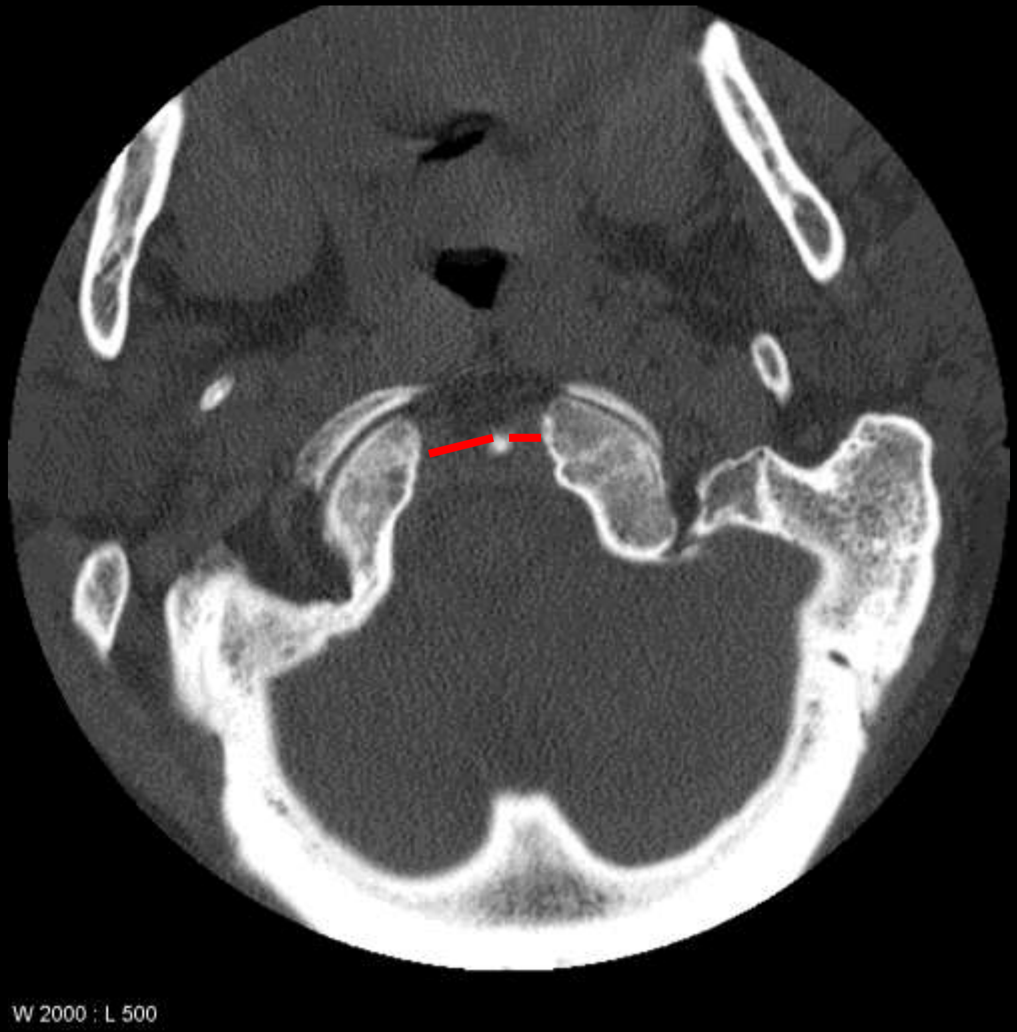


Right Alar ligament tear

1+4+6+5+4

47M

Right Alar ligament tear



4+6+5+4

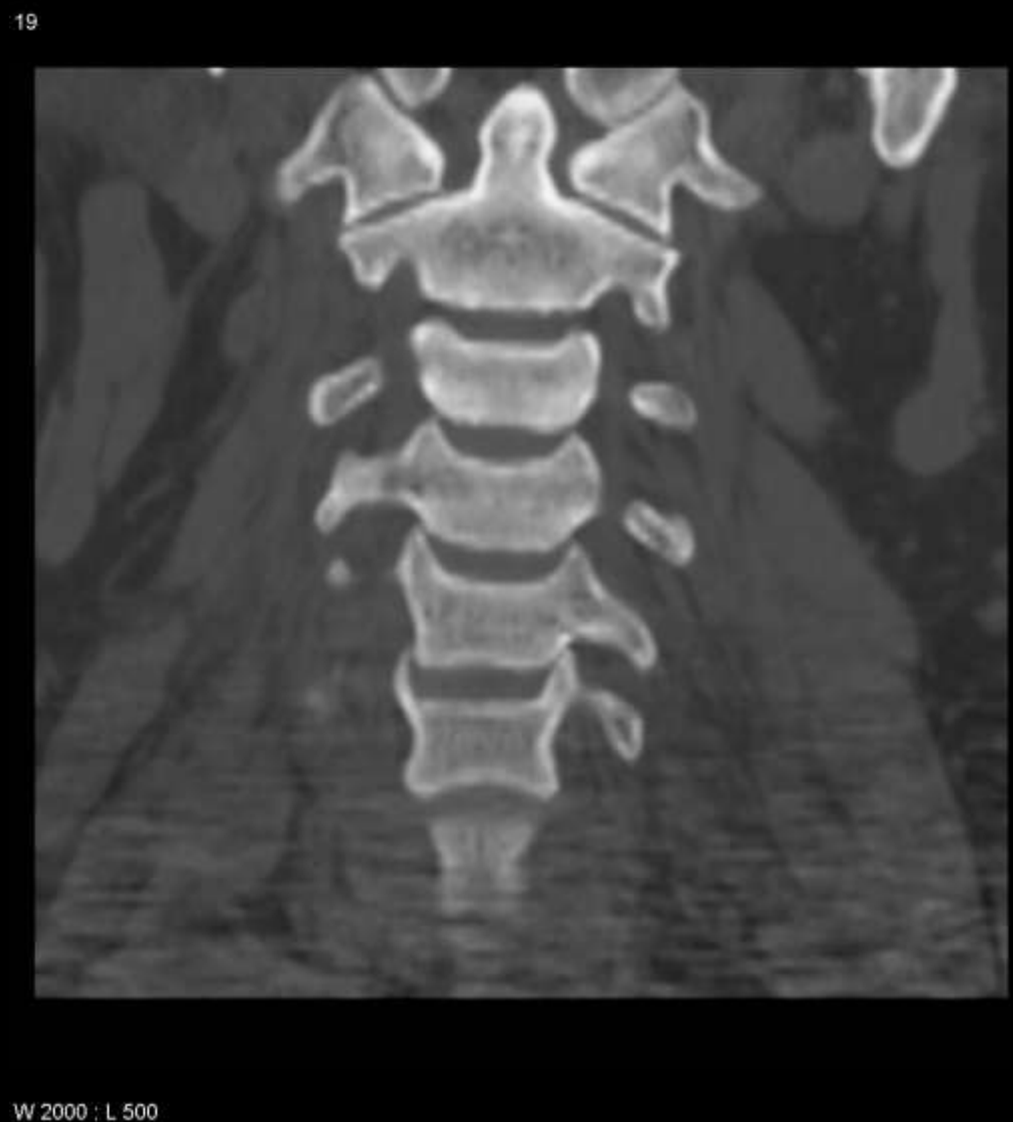
47M

Right Alar ligament tear

Right Alar ligament tear

Right Alar ligament tear

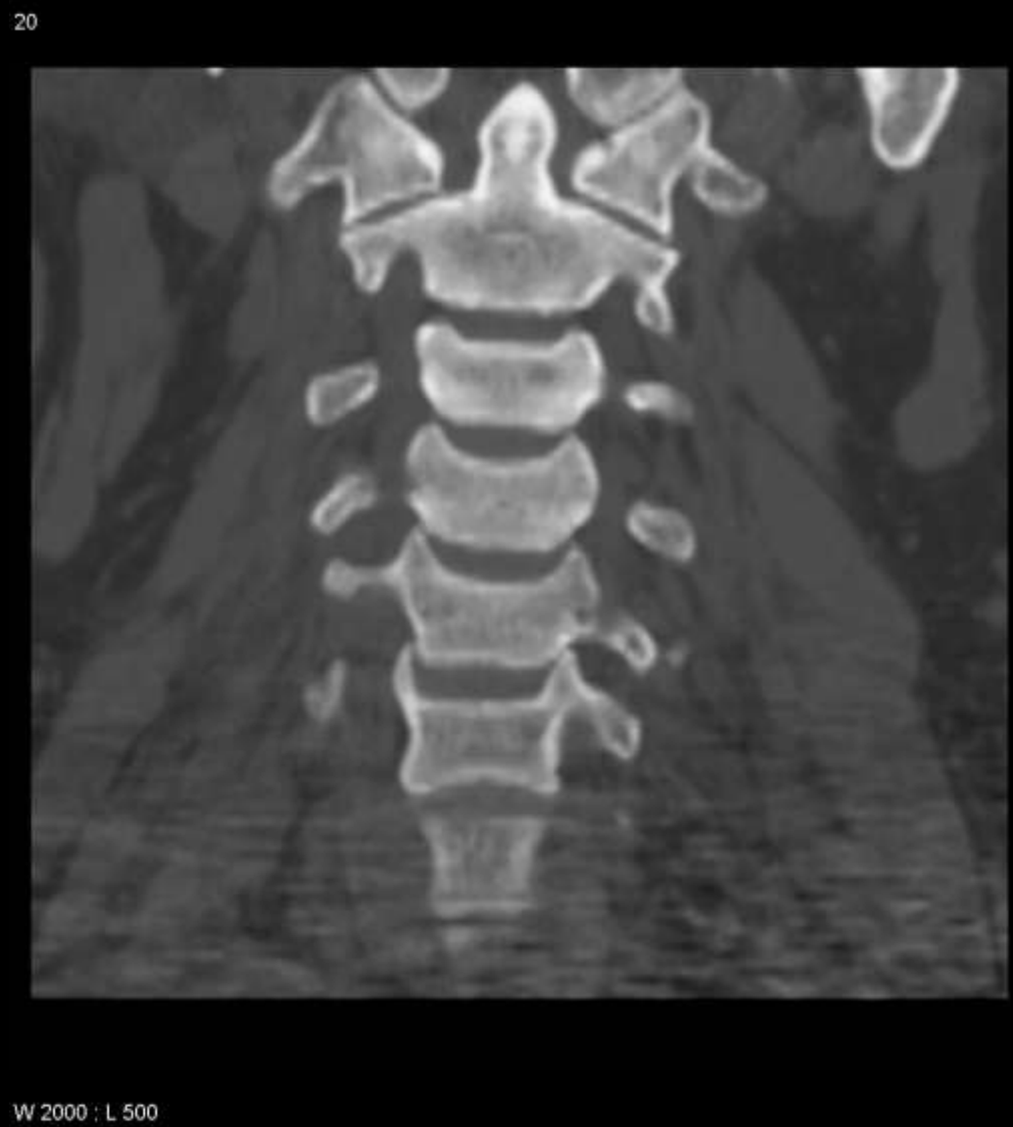
Right Alar ligament tear



6+5+4

47M

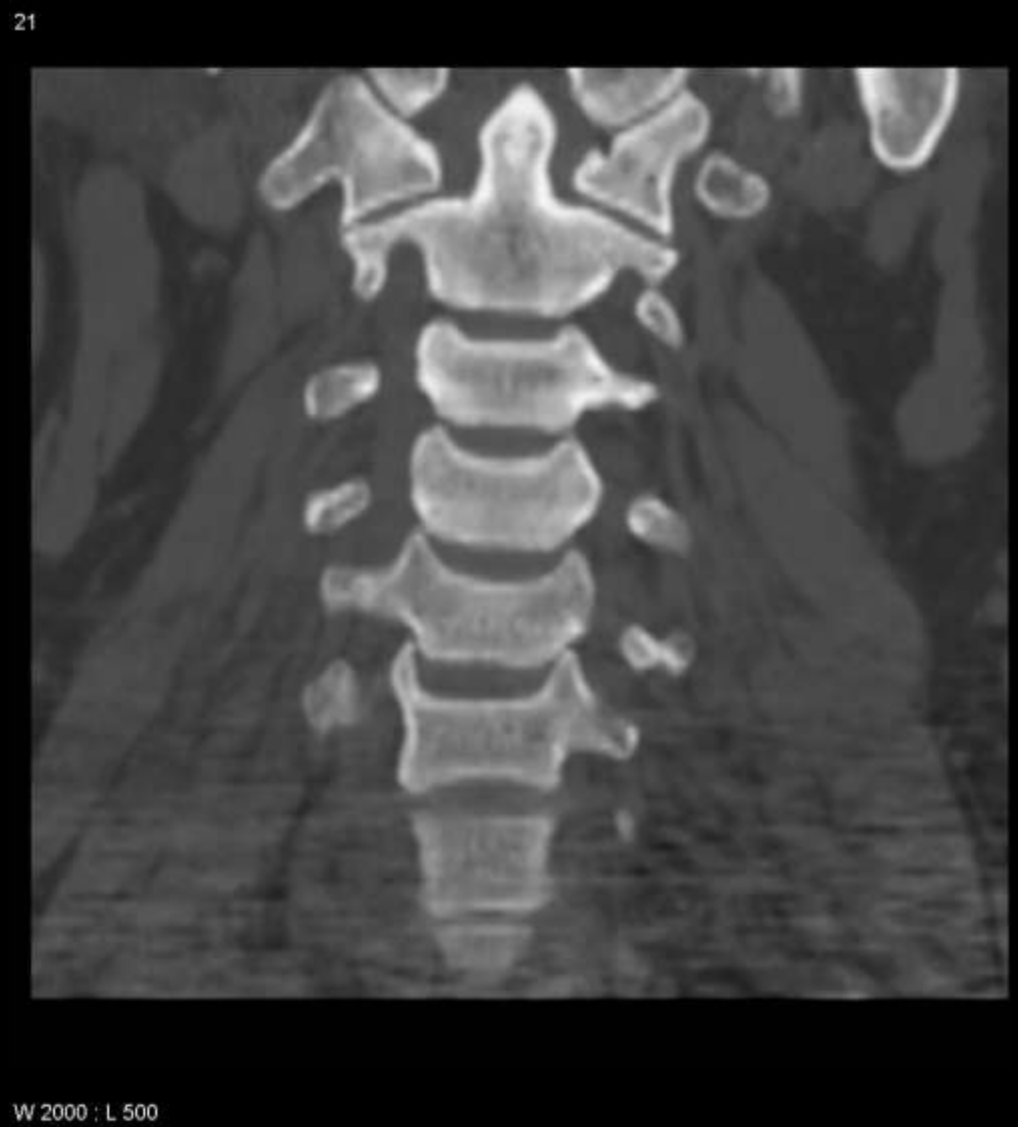
Right Alar ligament tear



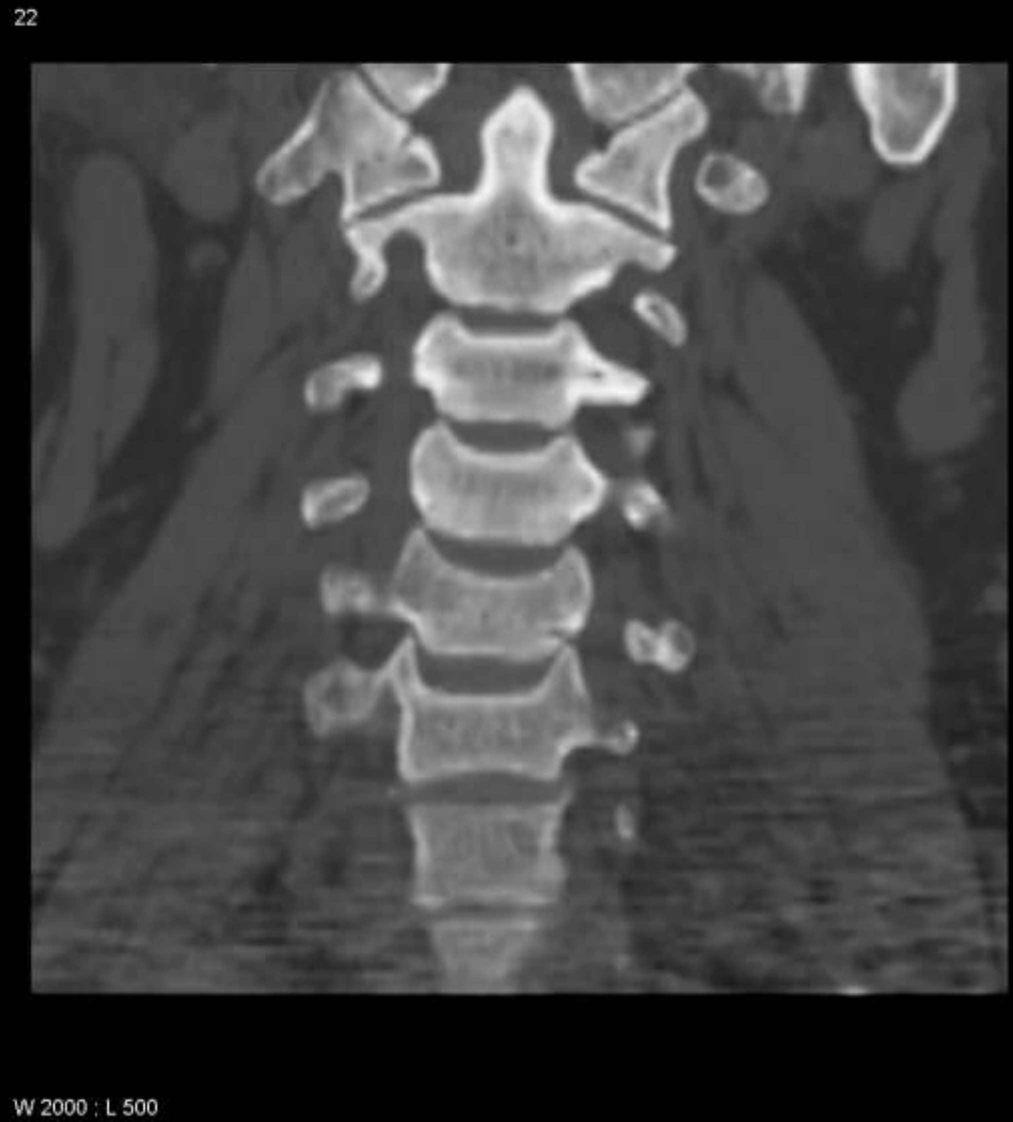
5+5+4

47M

Right Alar ligament tear



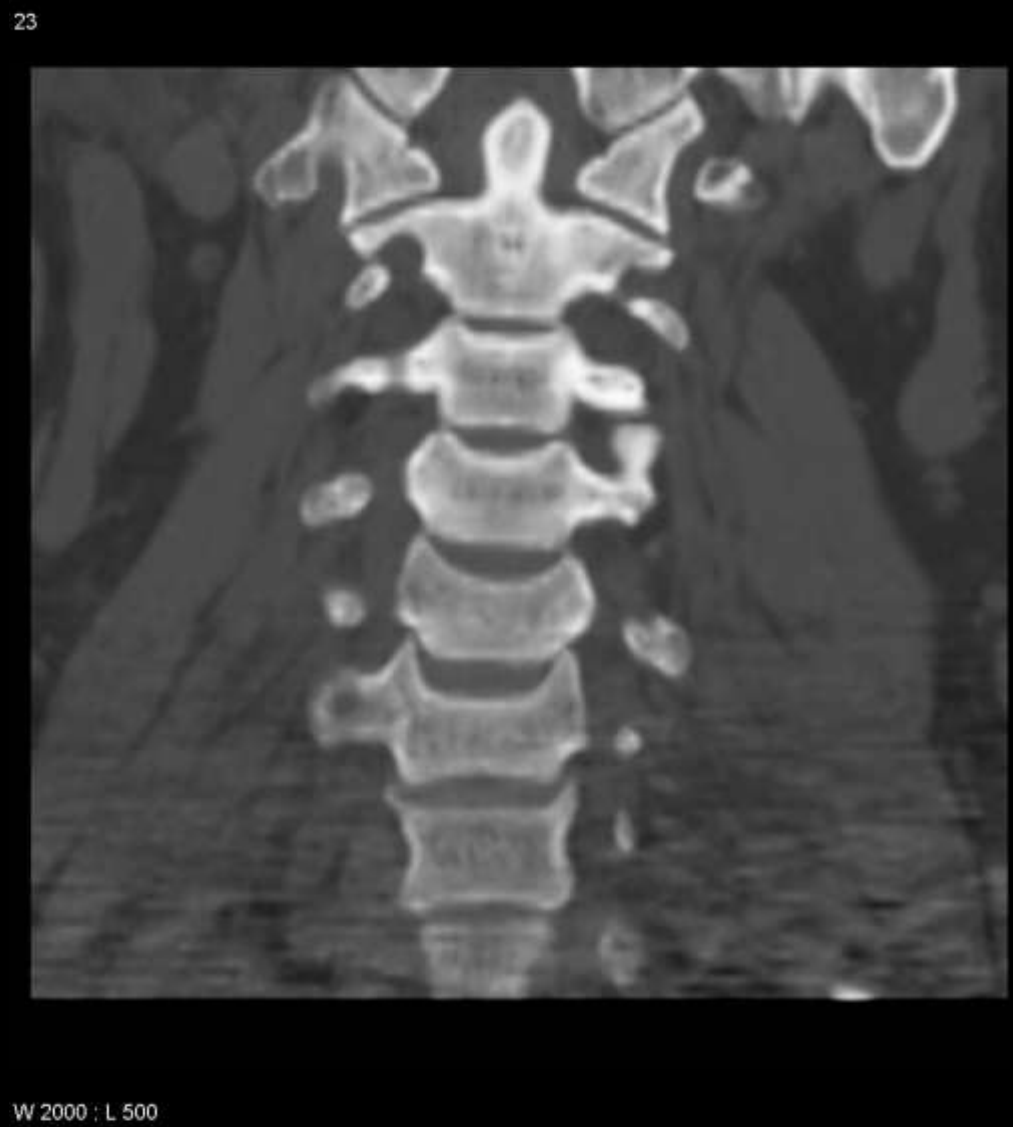
Right Alar ligament tear



3+5+4

47M

Right Alar ligament tear

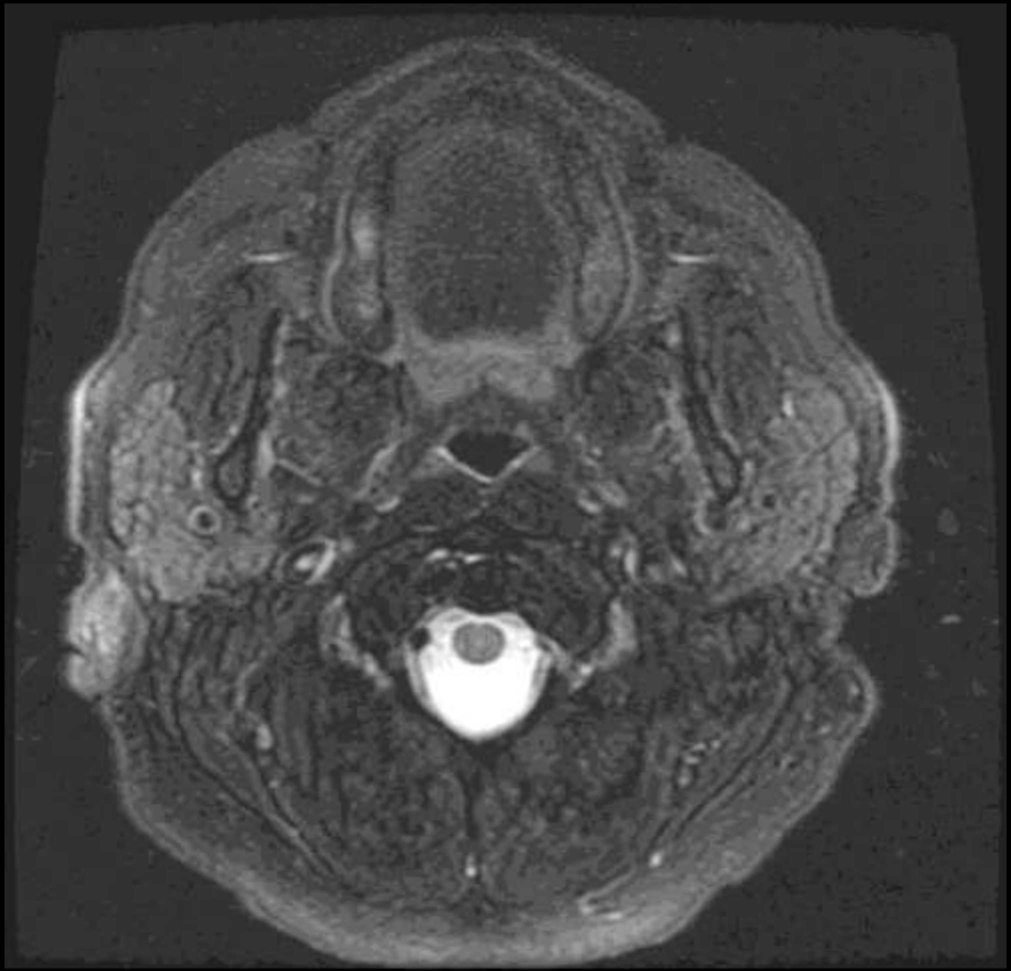


47M

Right Alar ligament tear

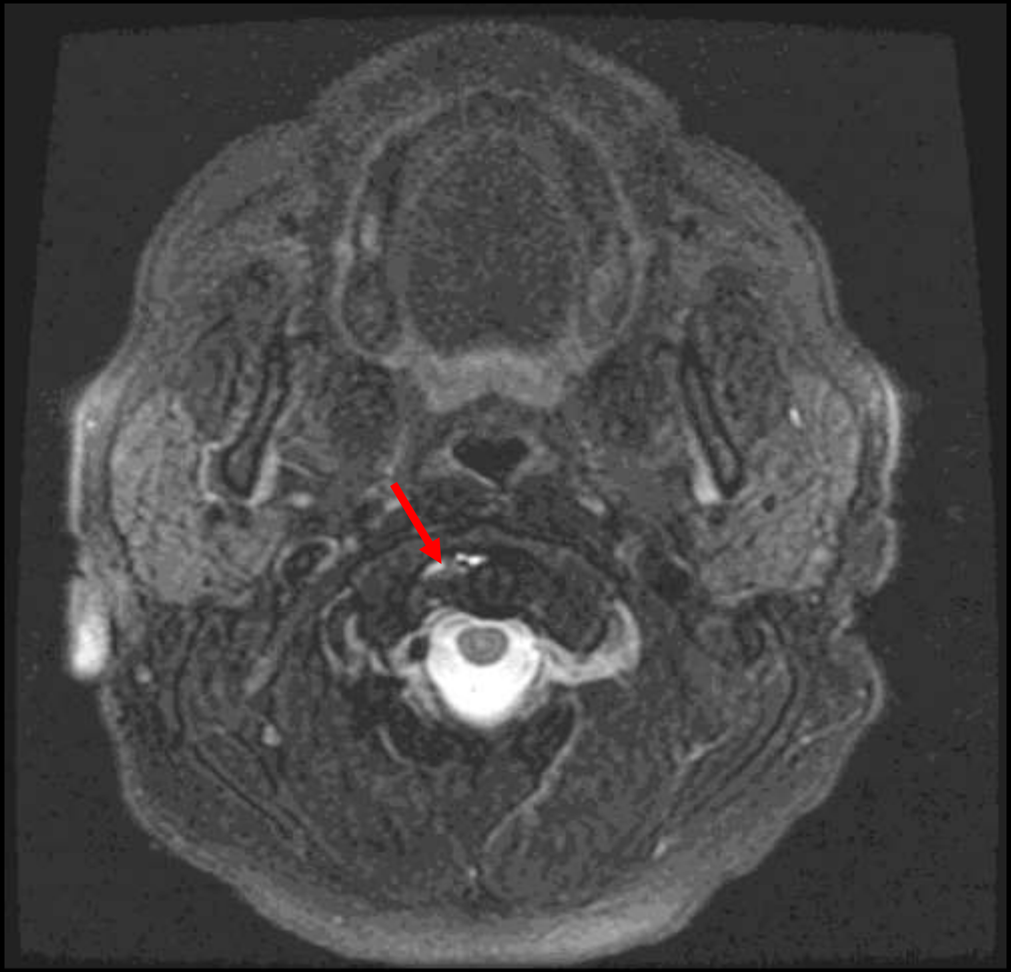
47M

Right Alar ligament tear



W 654 : L 204

Right Alar ligament tear



W 654 : L 204

2+4

47M

Right Alar ligament tear

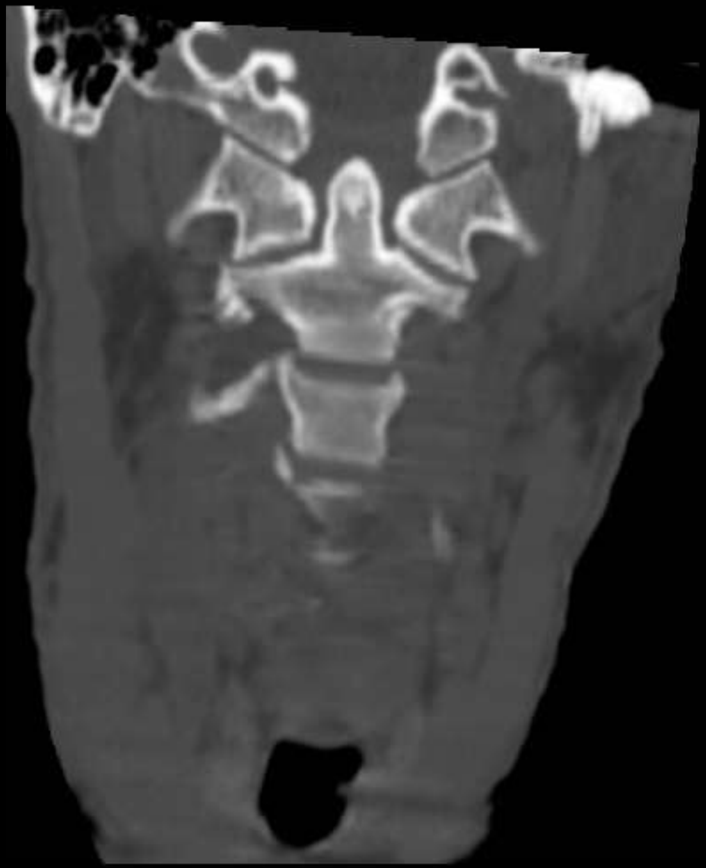
Right Alar ligament tear

47M

Right Alar ligament tear

47M

Left Alar ligament tear

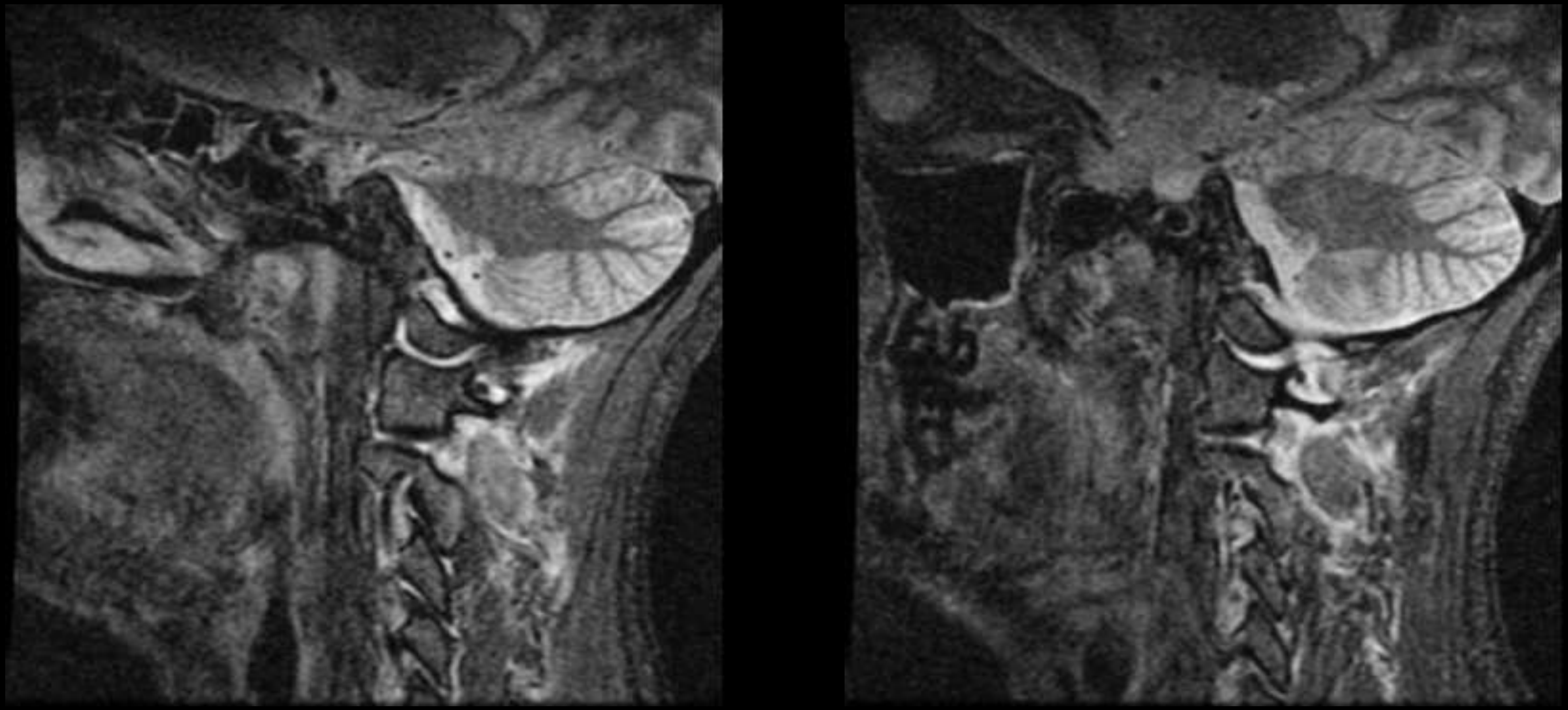


Alar ligament inj 46M

Left Alar ligament tear

Alar ligament inj 46M

Left Alar ligament tear



Alar ligament inj 46M

Atlanto Occipital Dislocation

- 40% missed dx at presentation
- STS +/- Retropharyngeal air
- Avulsion fractures occipital condyle or lower tip of clivus
- Classification:

Normal I II III

Atlanto Occipital Dislocation

Causes:

- Traumatic

- Nontraumatic
  - RA
  - Congenital Skeletal Abnormalities
  - Down's
  - Infection
  - CPPD

- Prognosis not good
  - (but 20% may have no deficit!)

Atlantooccipital subluxation

- Powers ratio:
  - Basion to C1 Posterior lamina line / Opisthion to posterior cortex of the anterior C1 tubercle <1
- X method of Lee
- Clival line
- BAI (Basion Axial Interval)
  - Anterior distance of basion from PSL -4 – +12 mm
- BDI (Basion Dental Interval)
  - Vertical distance of basion above dens <12 mm

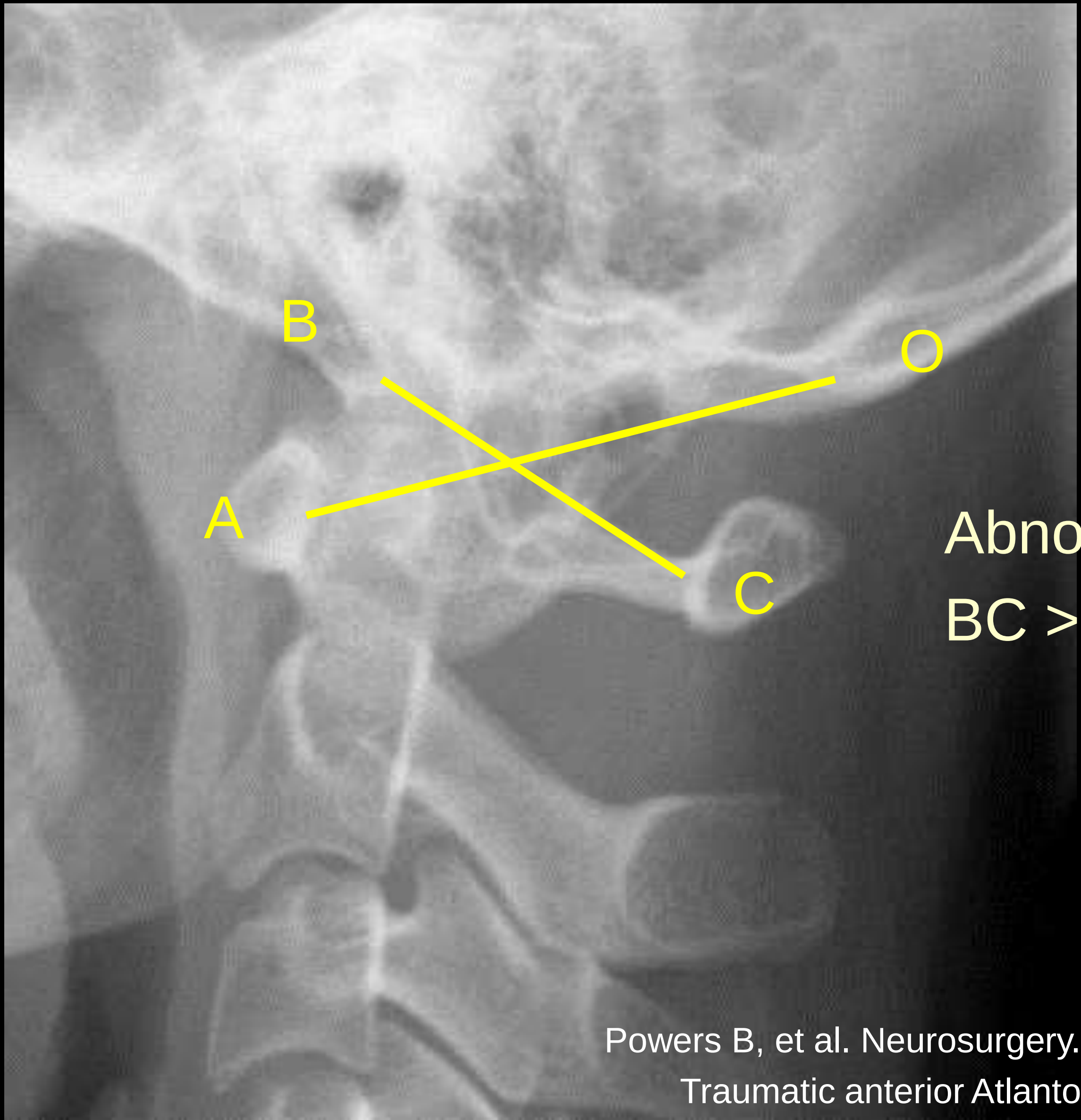
Occipito atlas separation

Power's ratio

Powers B, et al. Neurosurgery. 1979 Jan;4(1):12-7.
Traumatic anterior Atlanto-occipital dislocation.

Occipito atlas separation

Power's ratio - Normal



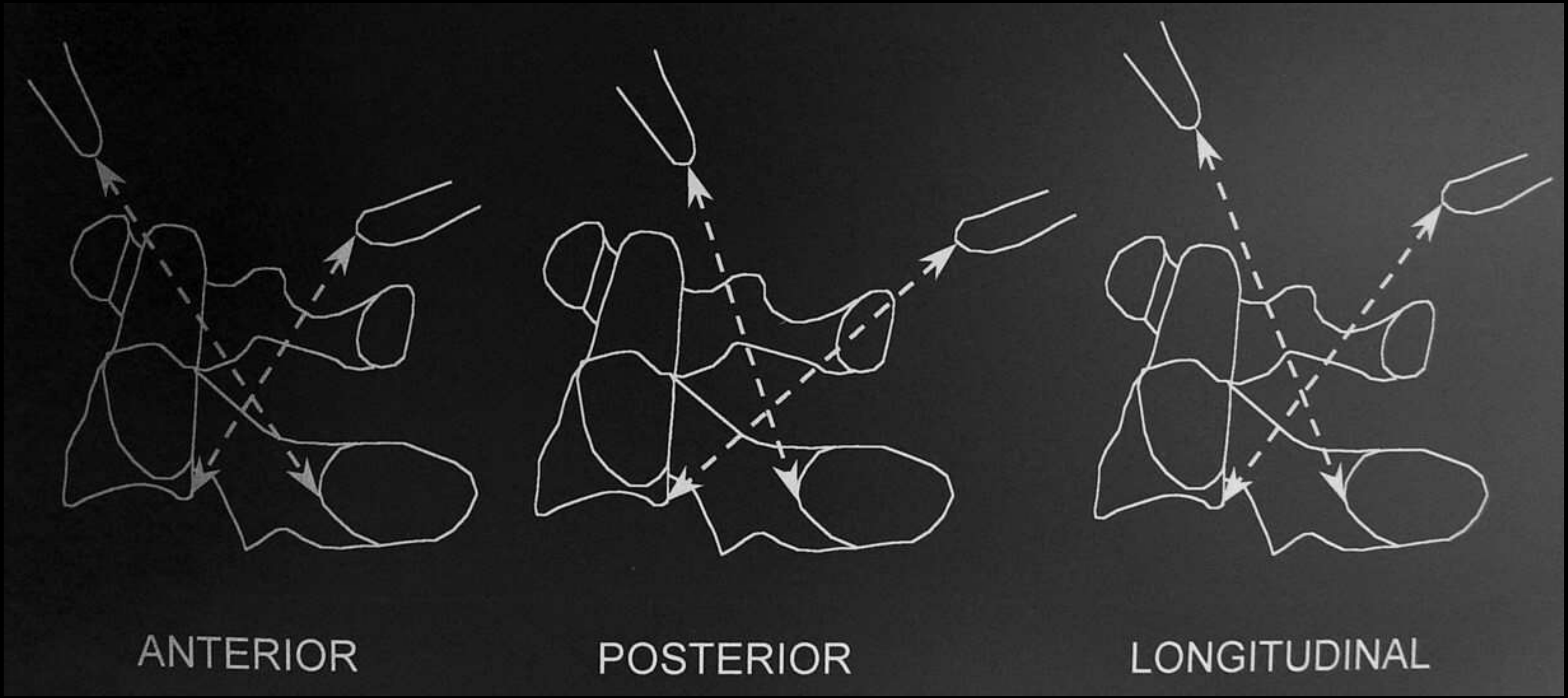
Abnormal

BC > AO

Powers B, et al. Neurosurgery. 1979 Jan;4(1):12-7.
Traumatic anterior Atlanto-occipital dislocation.

Occipito atlas separation

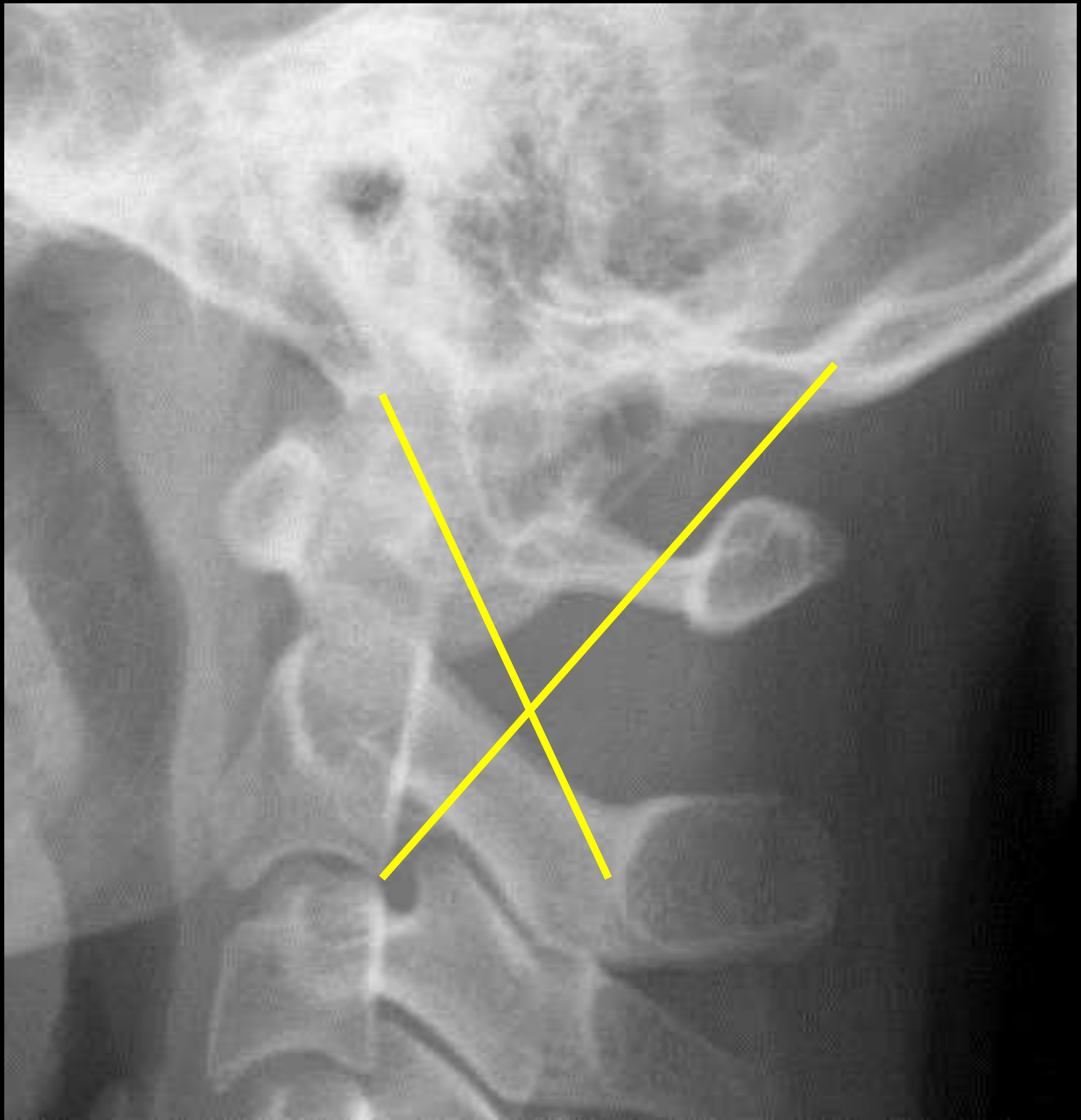
X Line



Lee C, et al AJNR Am J Neuroradiol. 1994 May;15(5):990.
Evaluation of traumatic atlantooccipital dislocations.

Occipito atlas separation

X Line - Normal



Occipito atlas separation

Clival Line - Normal

Occipito atlas separation

Basion Axial Interval

Basion / Posterior axial line interval

- Vertical line along posterior aspect of C2
- Basion should <12mm anterior or <4mm posterior to this line

Harris JH Jr Radiologic diagnosis of traumatic occipitovertebral dissociation: AJR Am J Roentgenol. 1994 Apr;162(4):887-92.

Occipito atlas separation

Basion Axial Interval - Normal

Occipito atlas separation

Basion Dental Interval

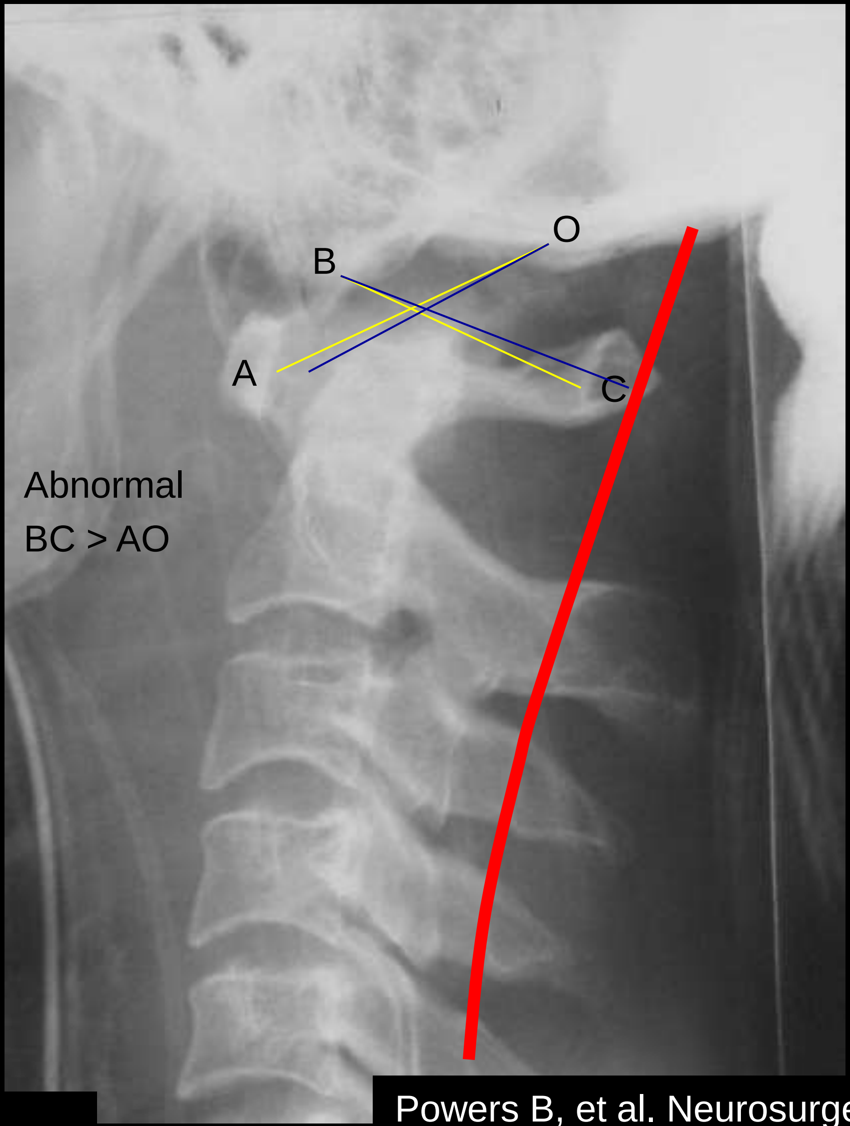
Basion dens interval

- Tip of basion to dens
- <12mm

Occipito atlas separation

Basion Dental Interval

Anterior Atlanto-occipital Dislocation.

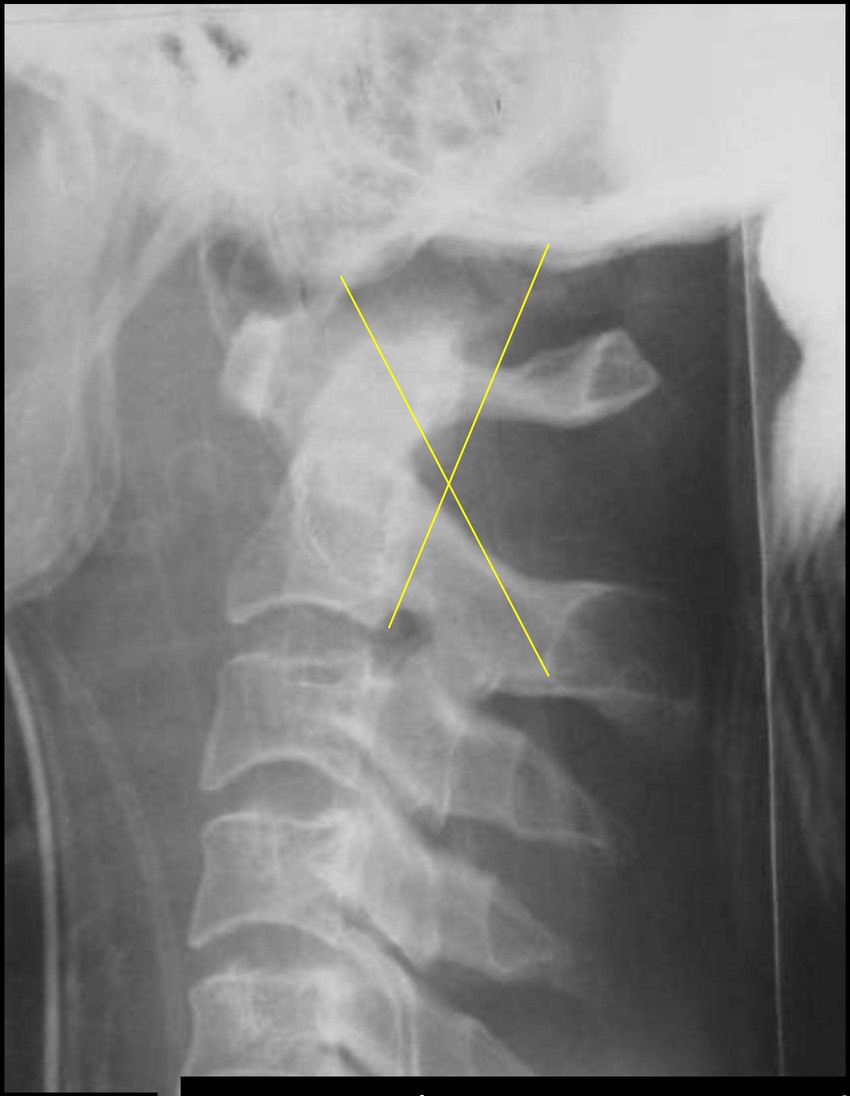


Powers

Powers B, et al. Neurosurgery. 1979 Jan;4(1):12-7.
Traumatic anterior Atlanto-occipital dislocation.

Atlanto axial and cranial
atlas separation 32M

Anterior Atlanto-occipital Dislocation.

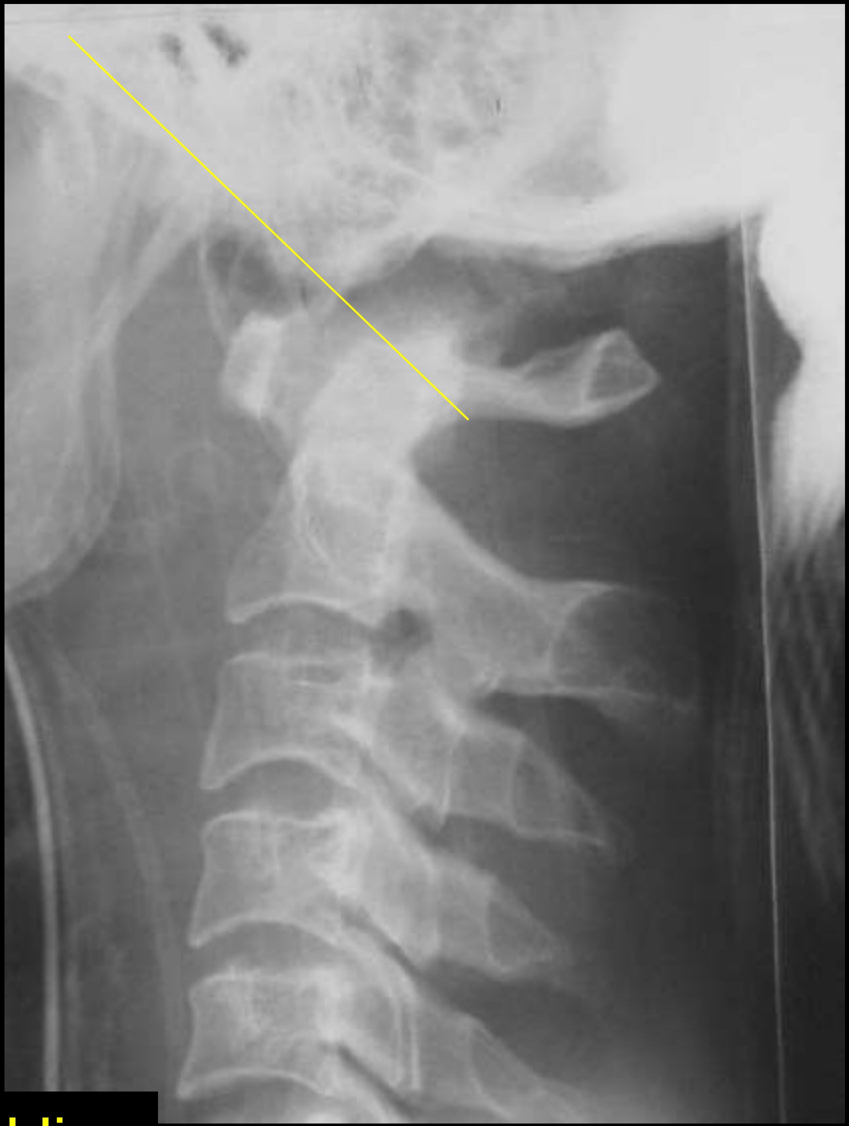


X method

Lee C, et al AJNR Am J Neuroradiol. 1994 May;15(5):990.
Evaluation of traumatic atlantooccipital dislocations.

Atlanto axial and cranial atlas separation 32M

Anterior Atlanto-occipital Dislocation.



Clival line

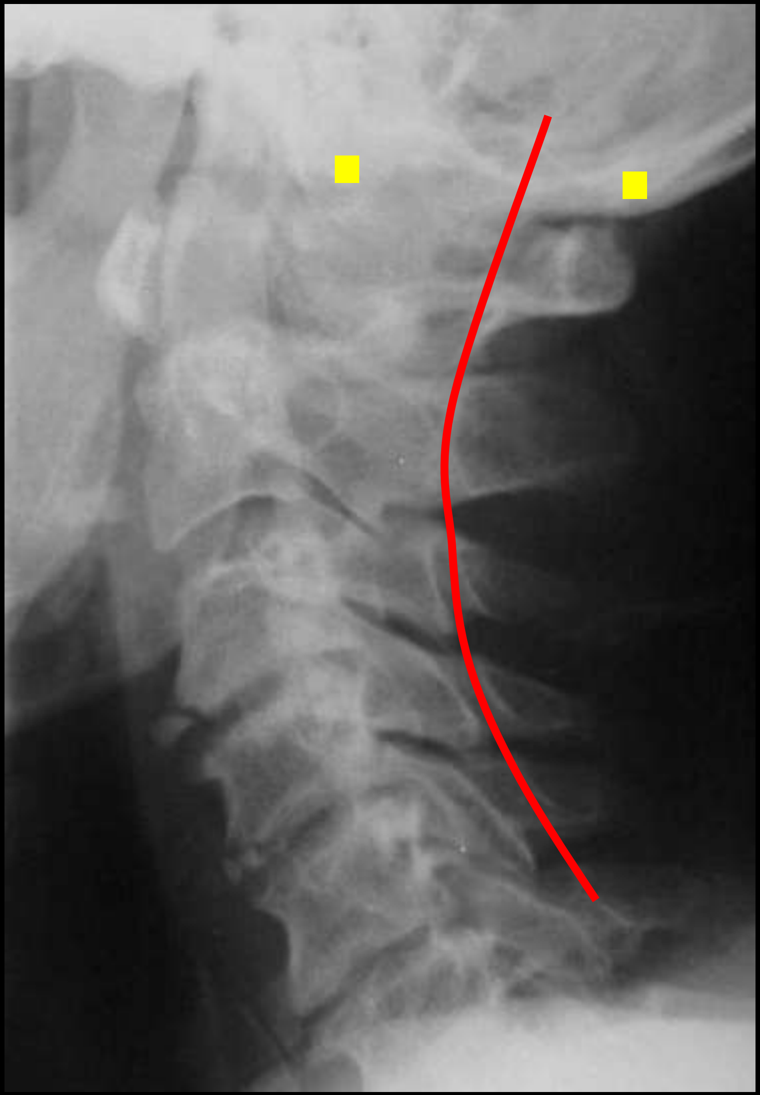
Atlanto axial and cranial atlas separation 32M

Anterior Atlanto-occipital Dislocation.

Basion Dens interval

Harris JH Jr AJR Am J Roentgenol. 1994 Apr;162(4):887-92.
Radiologic diagnosis of traumatic occipitovertebral dissociation:

Posterior Occipito atlas separation and Fx atlas



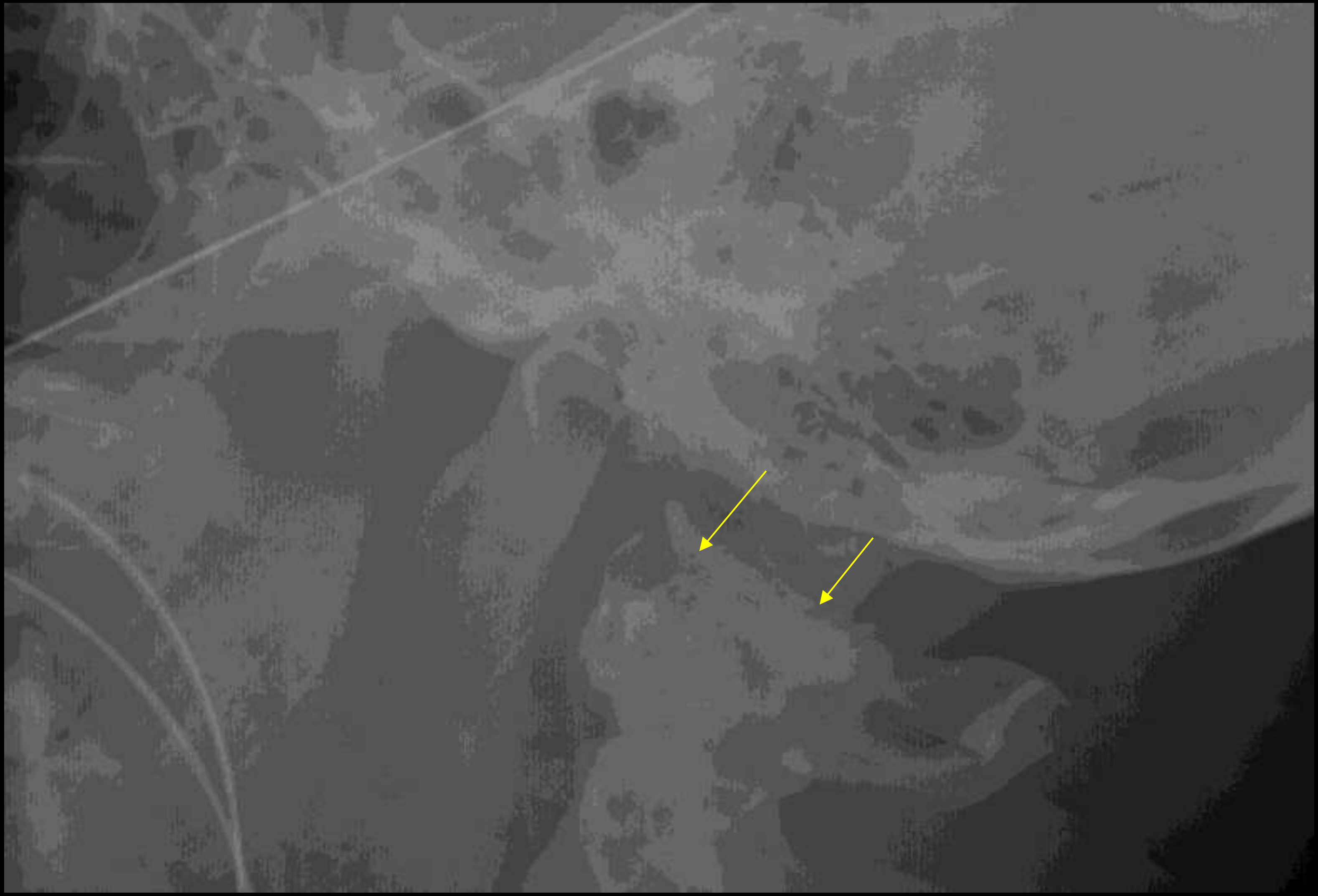
53F

Posterior Occipito atlas separation and Fx atlas

Post reduction

53F

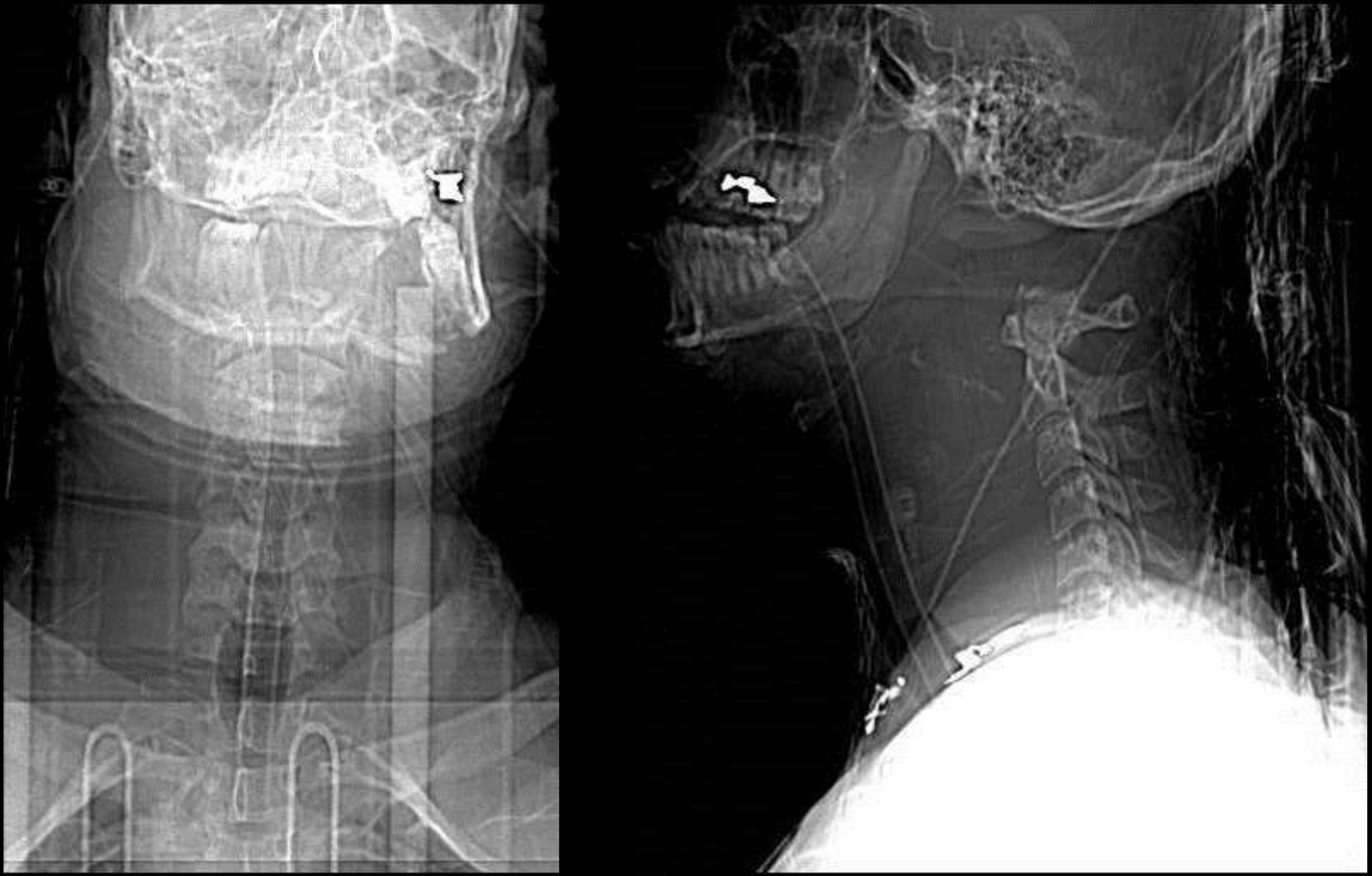
Superior Atlanto-Occipital Dislocation



Superior Atlanto-Occipital Dislocation

Child

Superior Atlanto-Occipital Fracture Dislocation

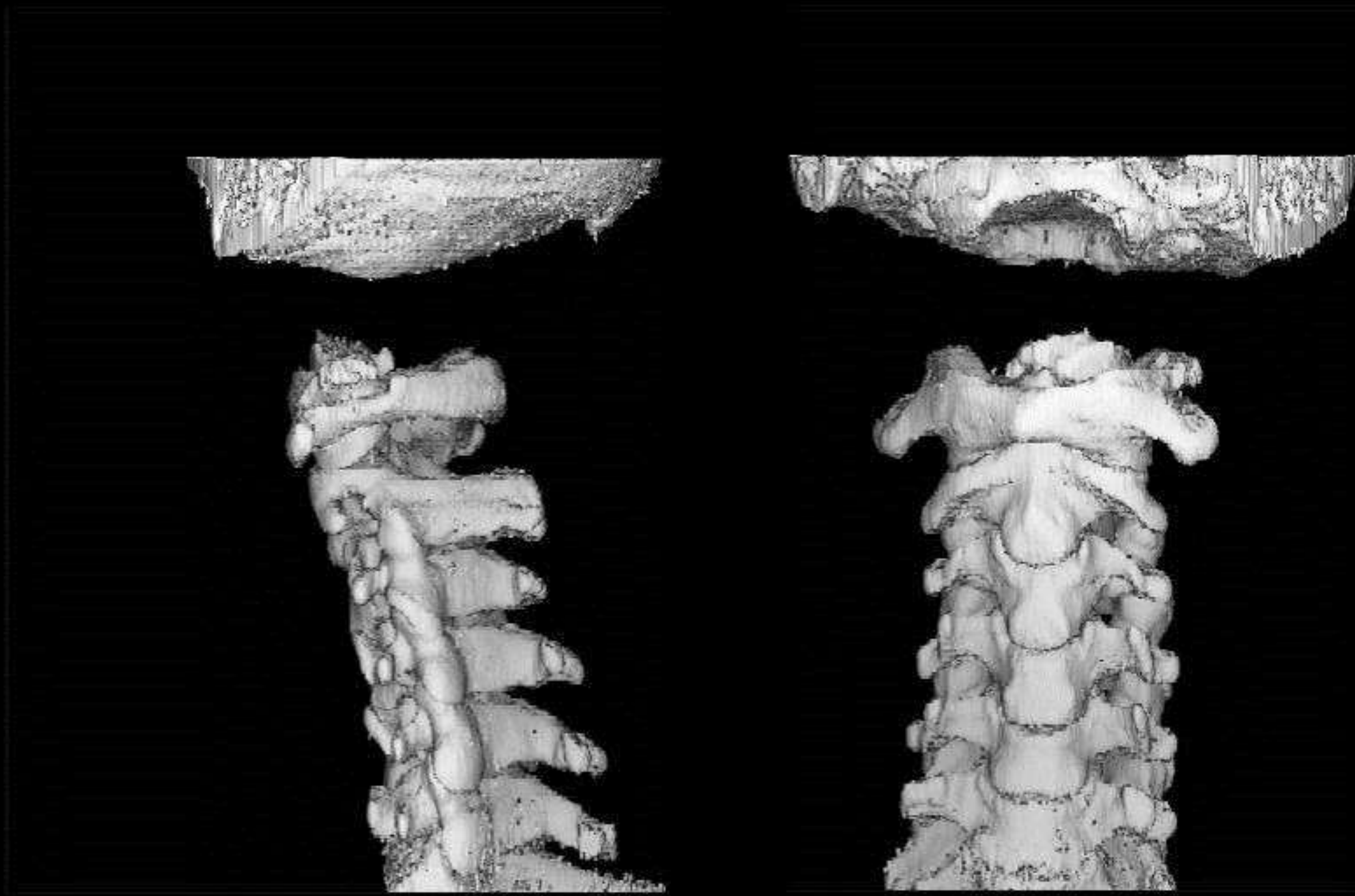


28M MCA

Superior Atlanto-Occipital Fracture Dislocation

28M MCA

Superior Atlanto-Occipital Fracture Dislocation



28M MCA

Atlantoaxial Dislocation

1+22+23+1+1+26

34M MVA

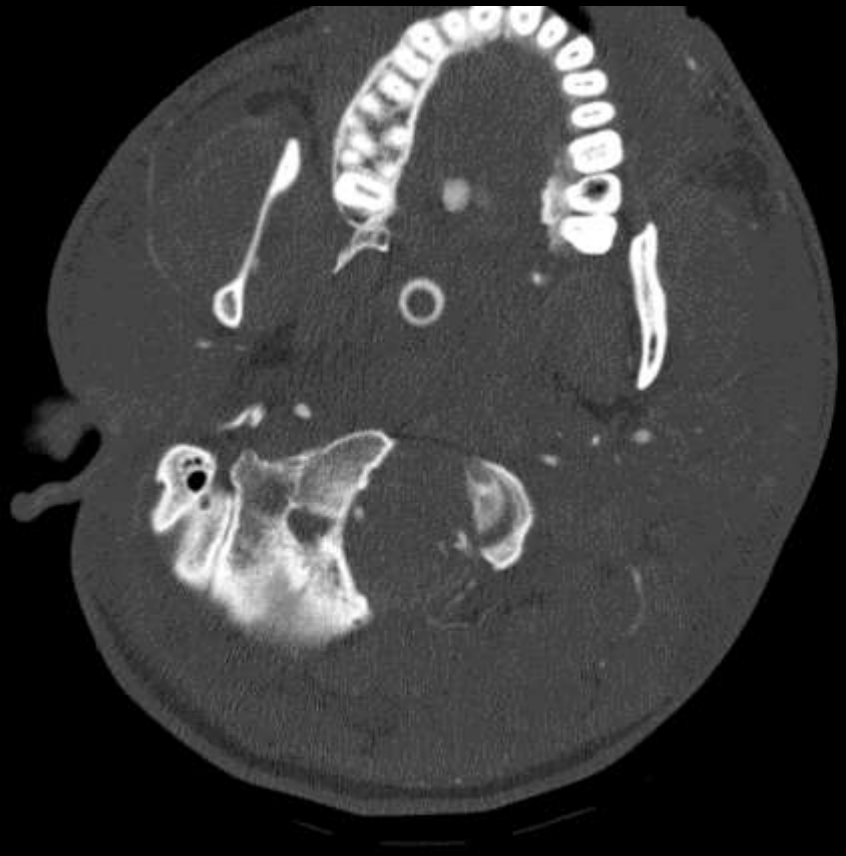
Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation



20+1+1+26

34M MVA

Atlantoaxial Dislocation

34M MVA

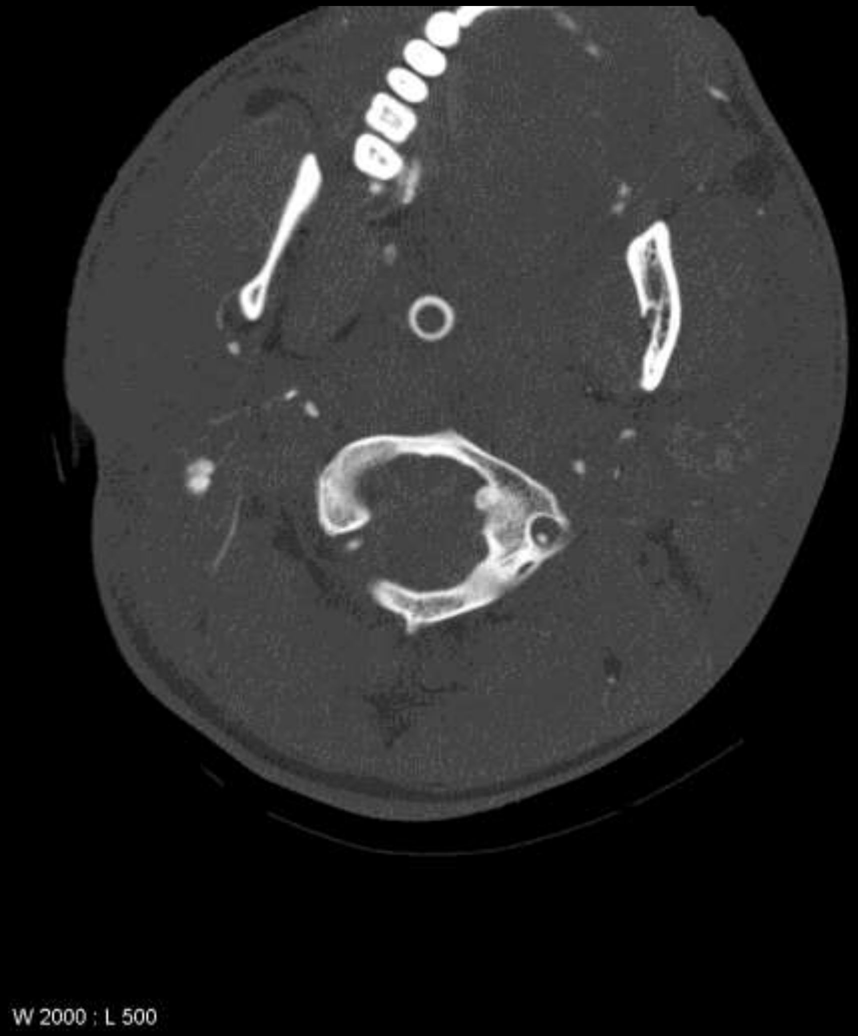
Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation



16+1+1+26

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

13+1+1+26

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

7+1+1+26

34M MVA

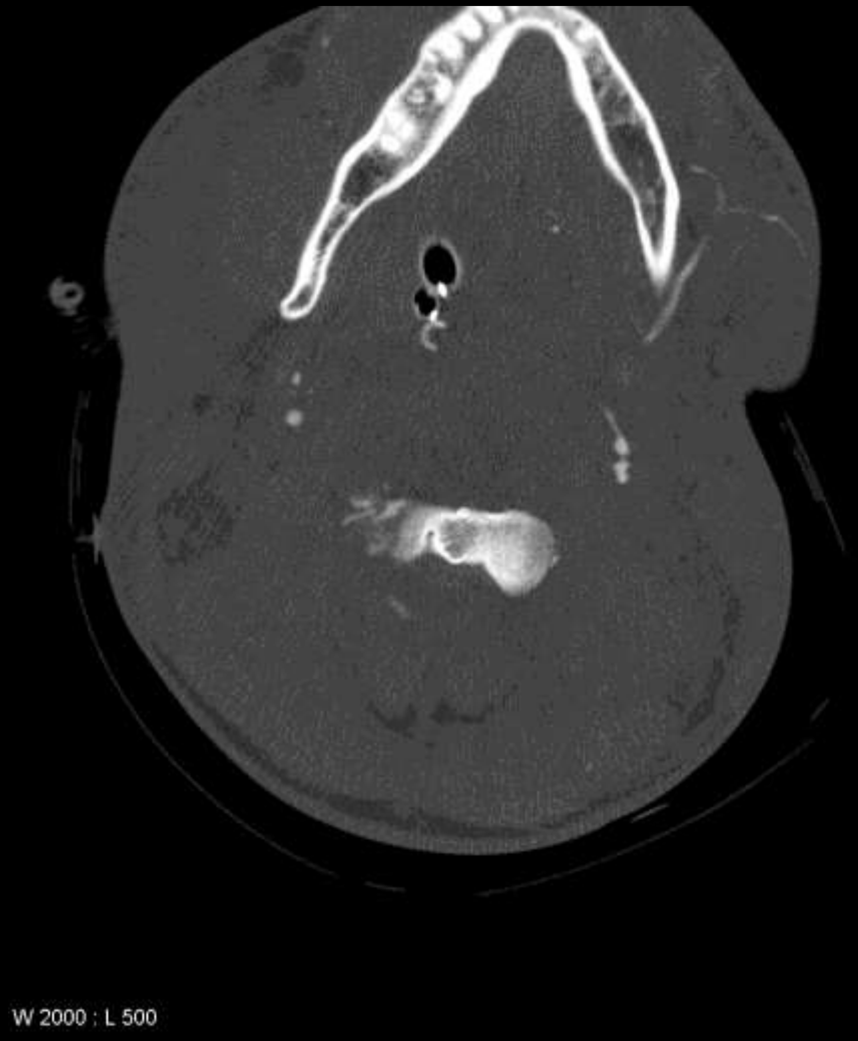
Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation



34M MVA

Atlantoaxial Dislocation

3+1+1+26

34M MVA

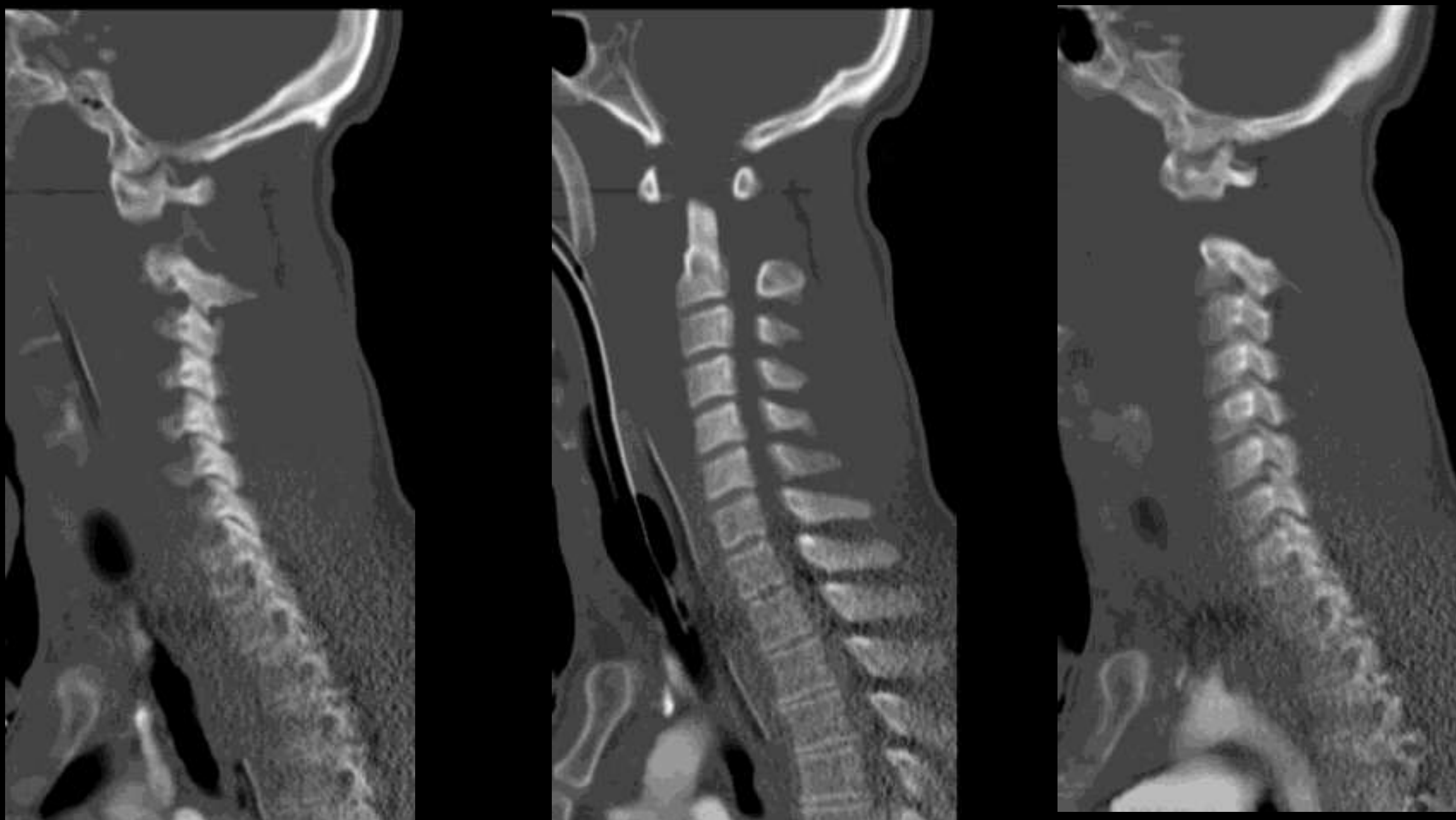
Atlantoaxial Dislocation

2+1+1+26

34M MVA

Atlantoaxial Dislocation

Atlantoaxial Dislocation



1+1+26

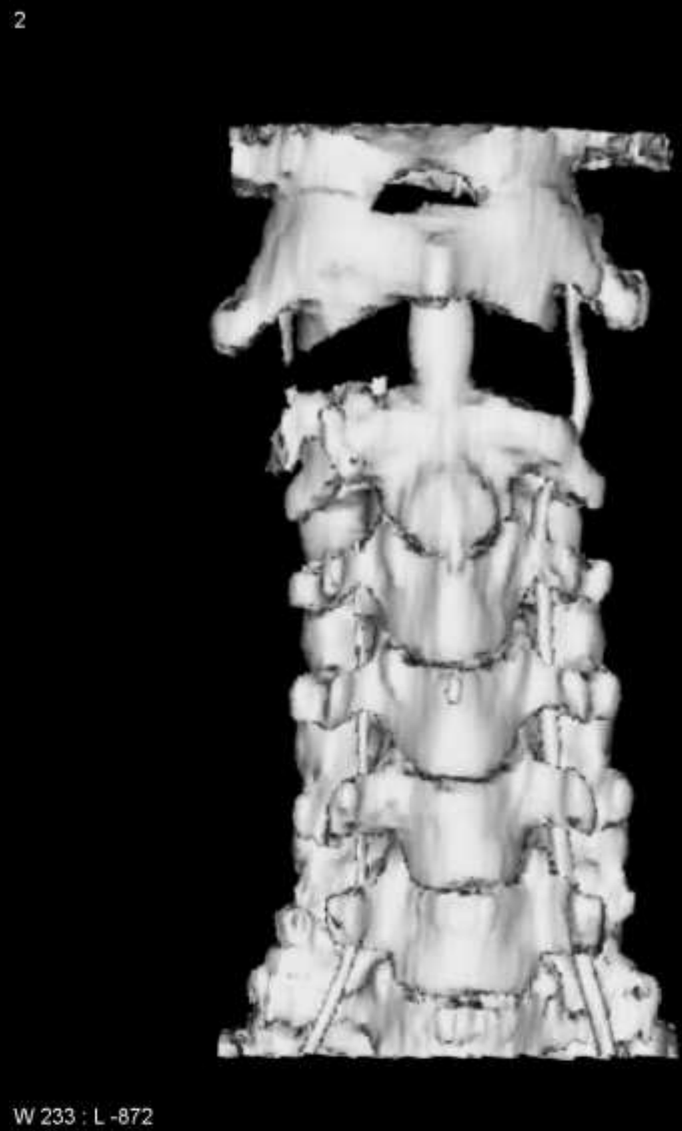
34M MVA

Atlantoaxial Dislocation

1+26

34M MVA

Atlantoaxial Dislocation

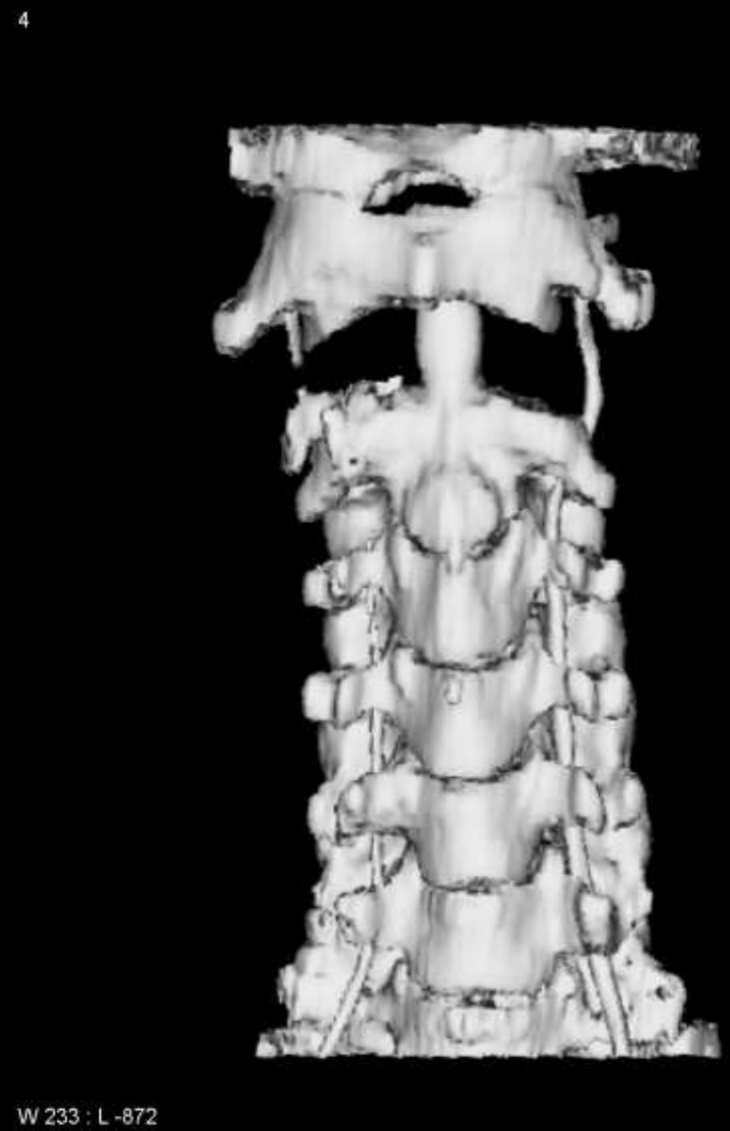


34M MVA

Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

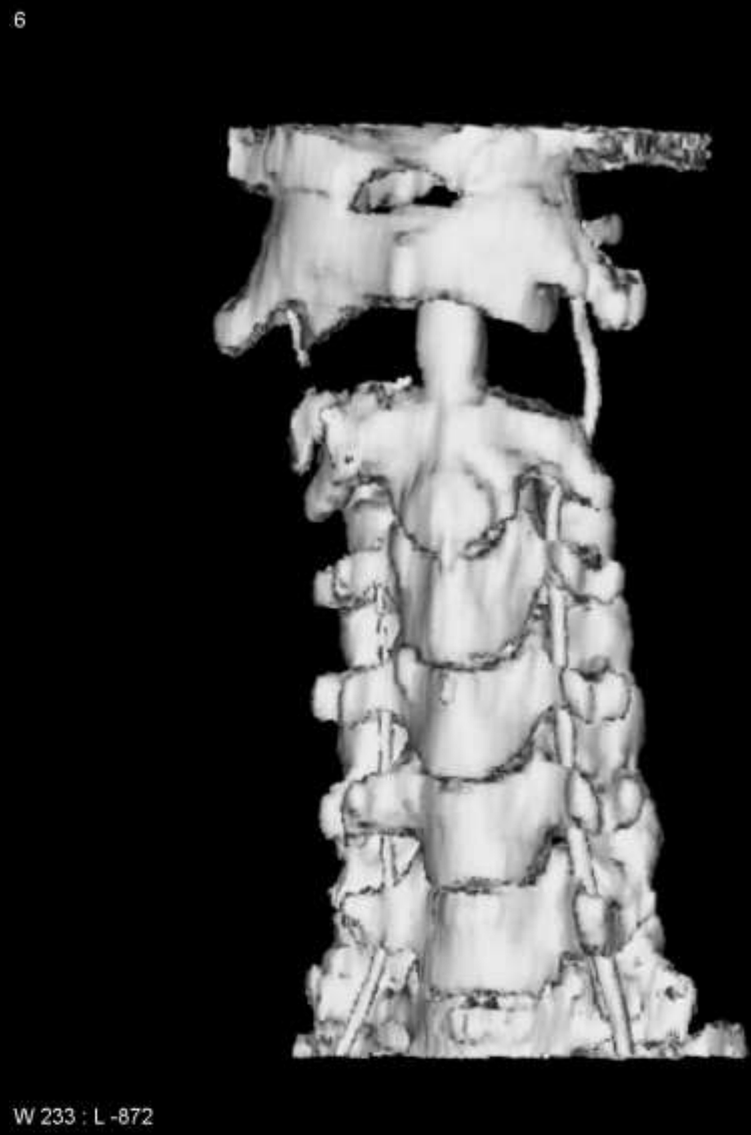


34M MVA

Atlantoaxial Dislocation

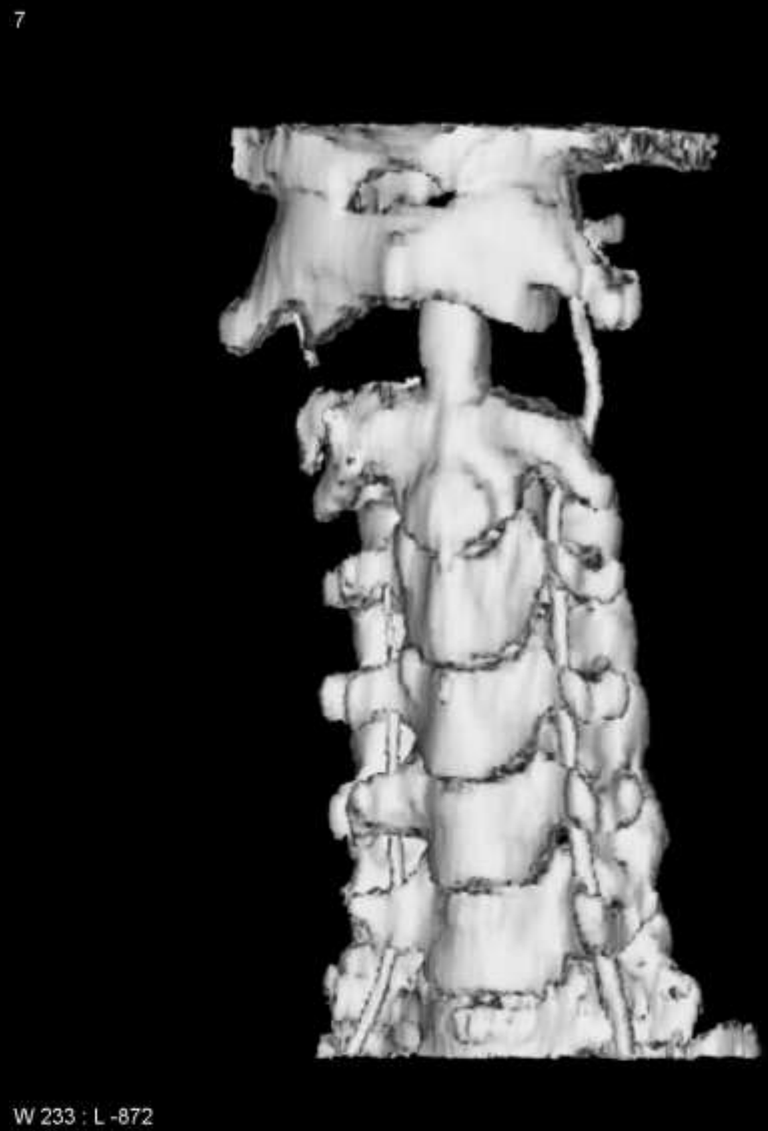
34M MVA

Atlantoaxial Dislocation



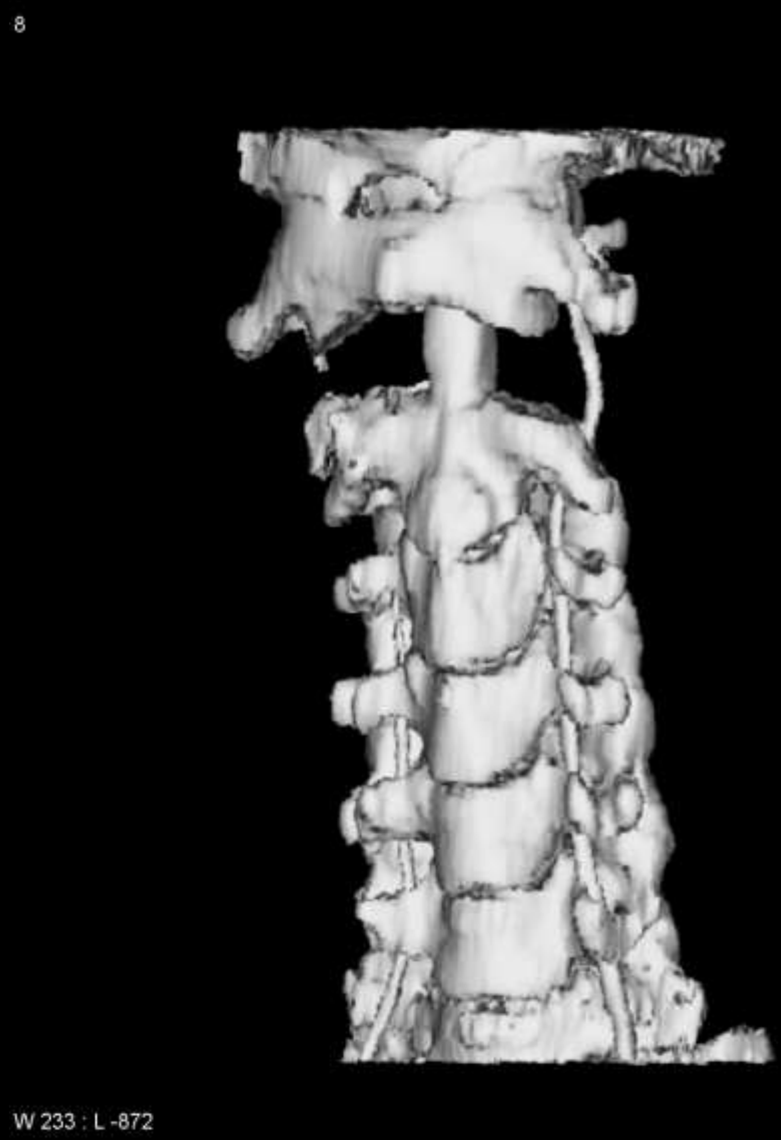
34M MVA

Atlantoaxial Dislocation



34M MVA

Atlantoaxial Dislocation



34M MVA

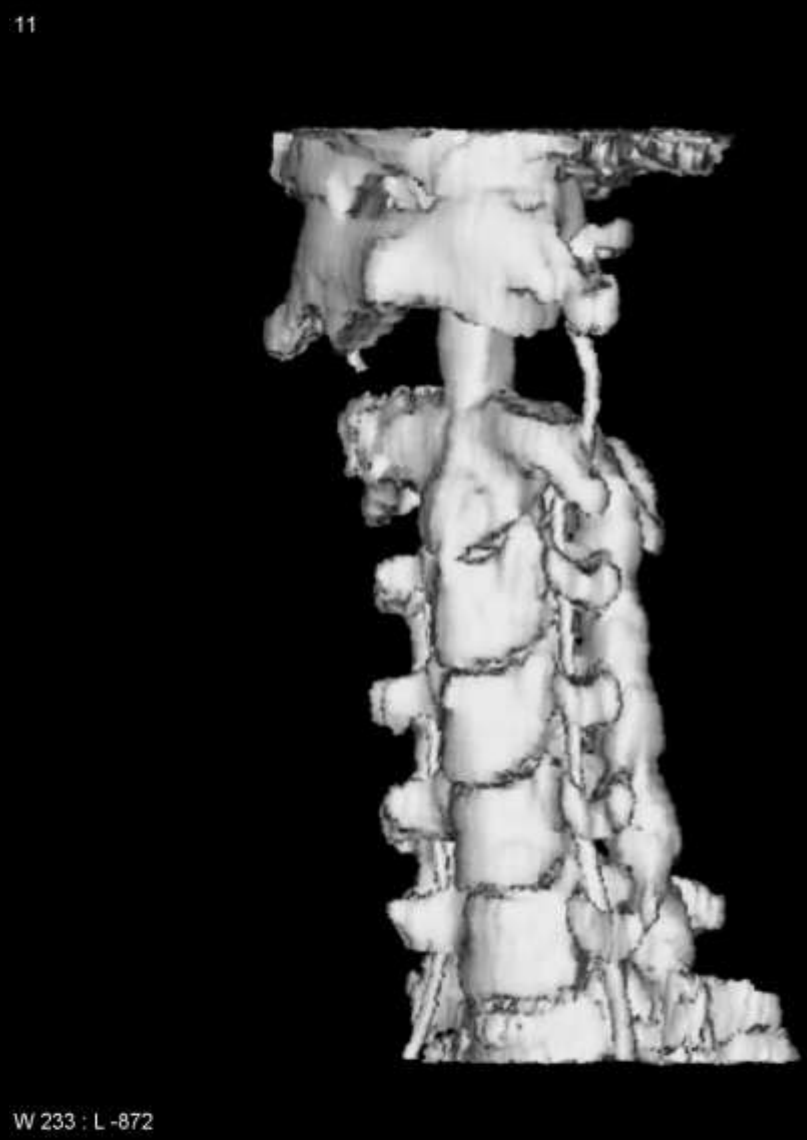
Atlantoaxial Dislocation

34M MVA

Atlantoaxial Dislocation

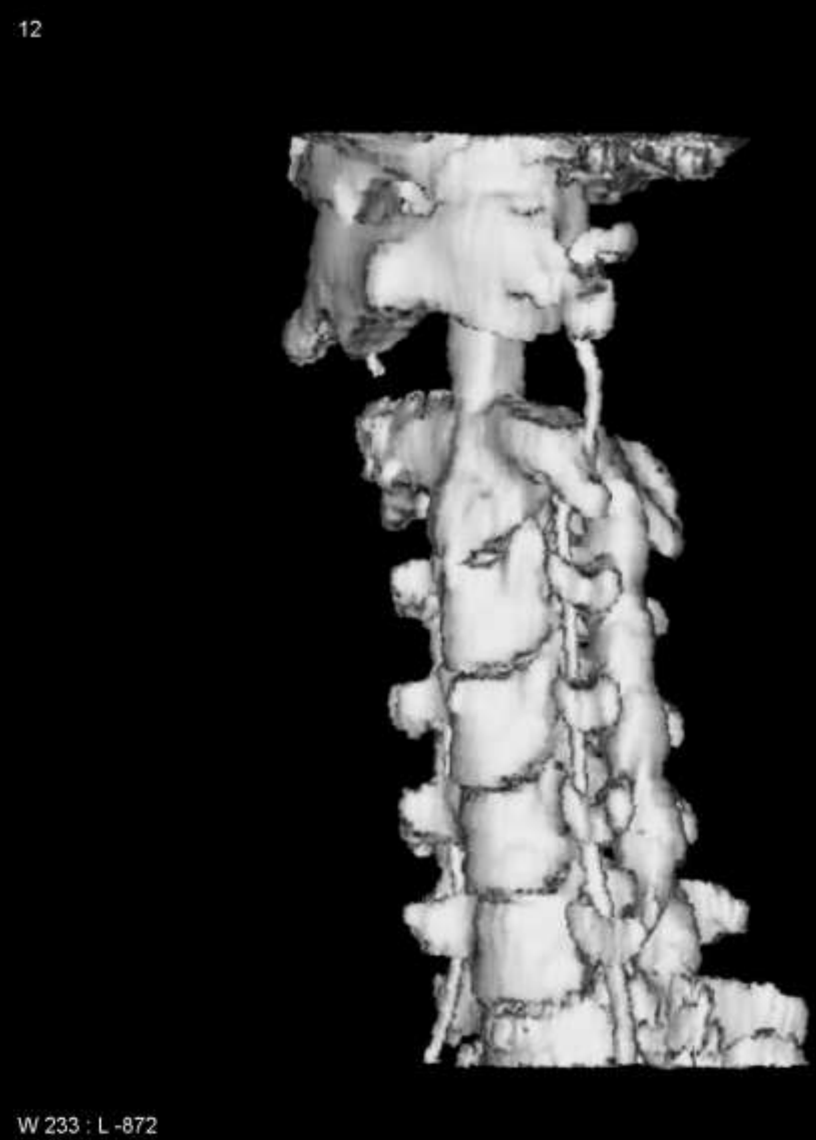
34M MVA

Atlantoaxial Dislocation



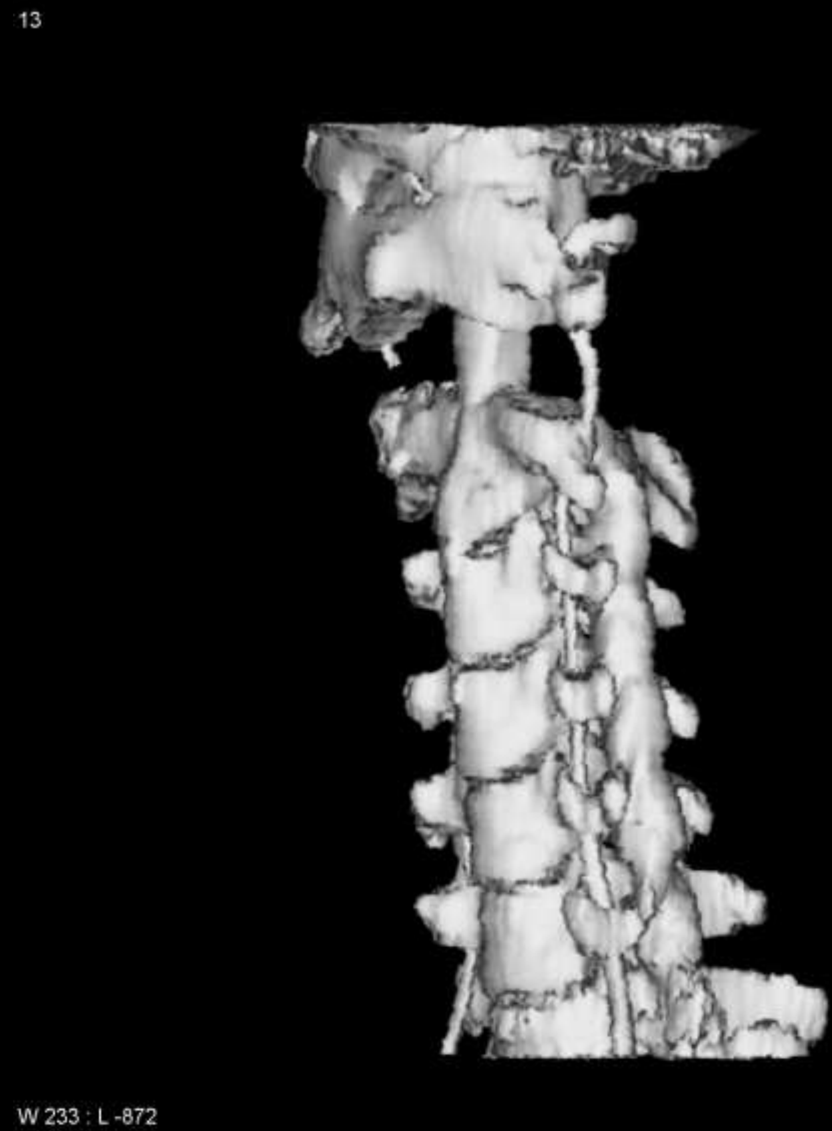
34M MVA

Atlantoaxial Dislocation



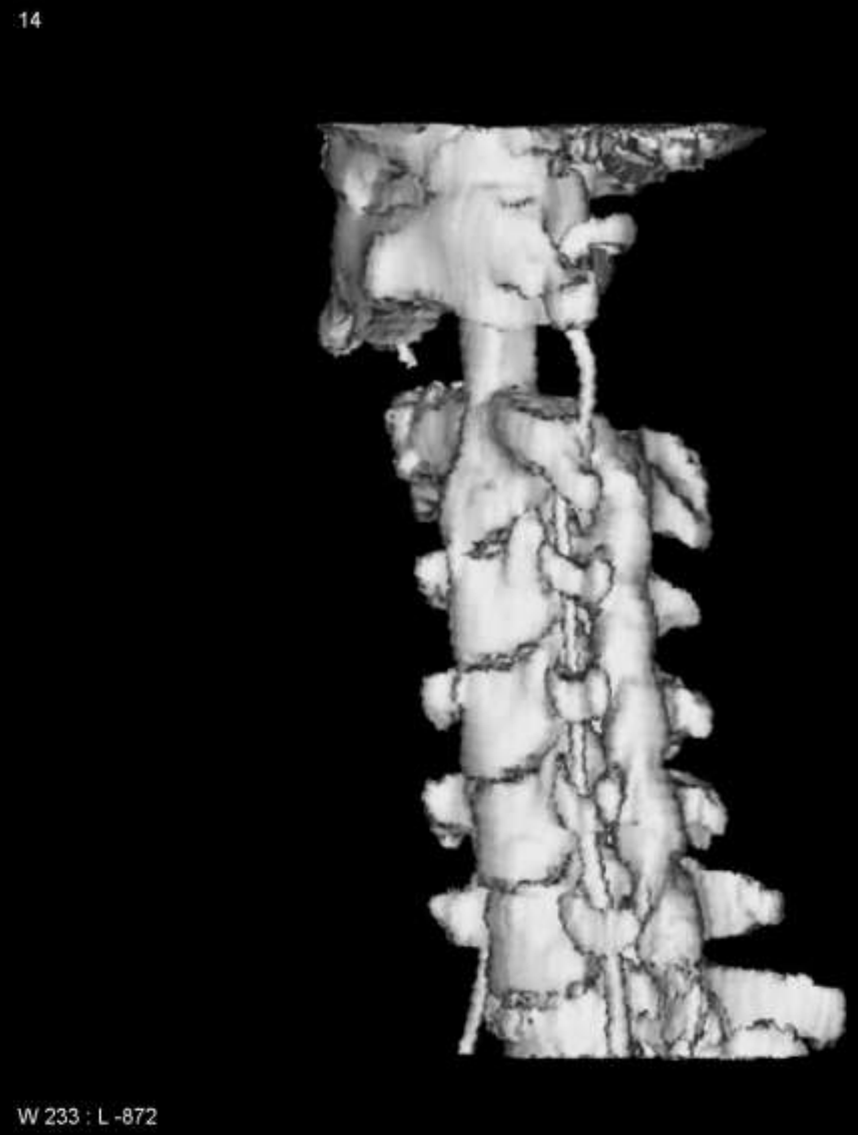
34M MVA

Atlantoaxial Dislocation



34M MVA

Atlantoaxial Dislocation

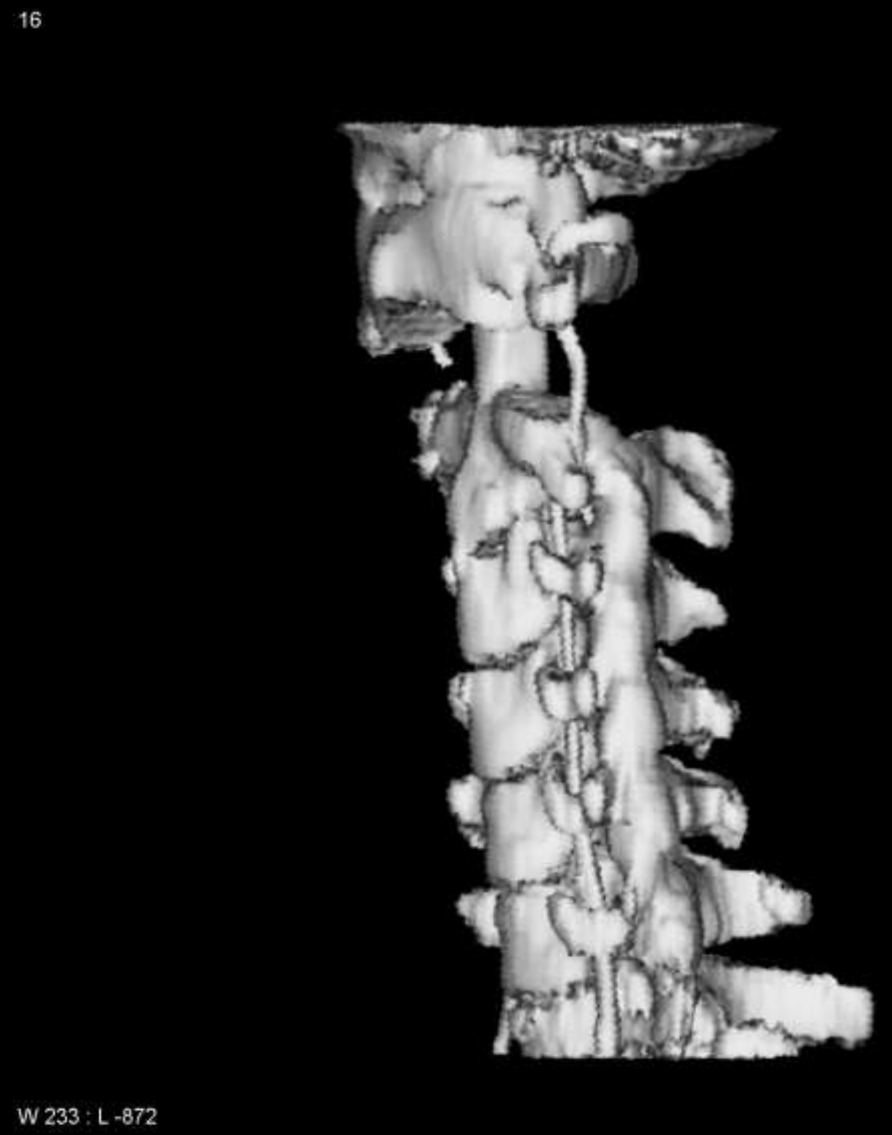


34M MVA

Atlantoaxial Dislocation

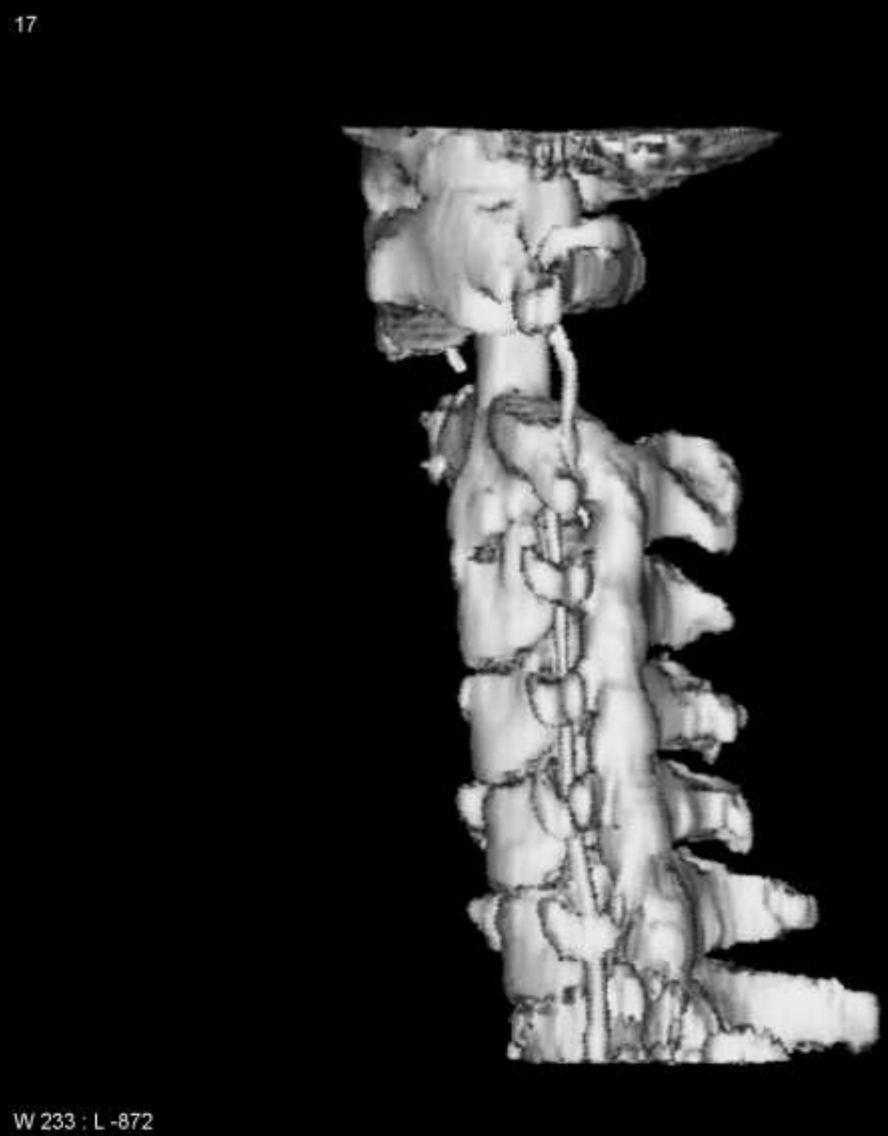
34M MVA

Atlantoaxial Dislocation



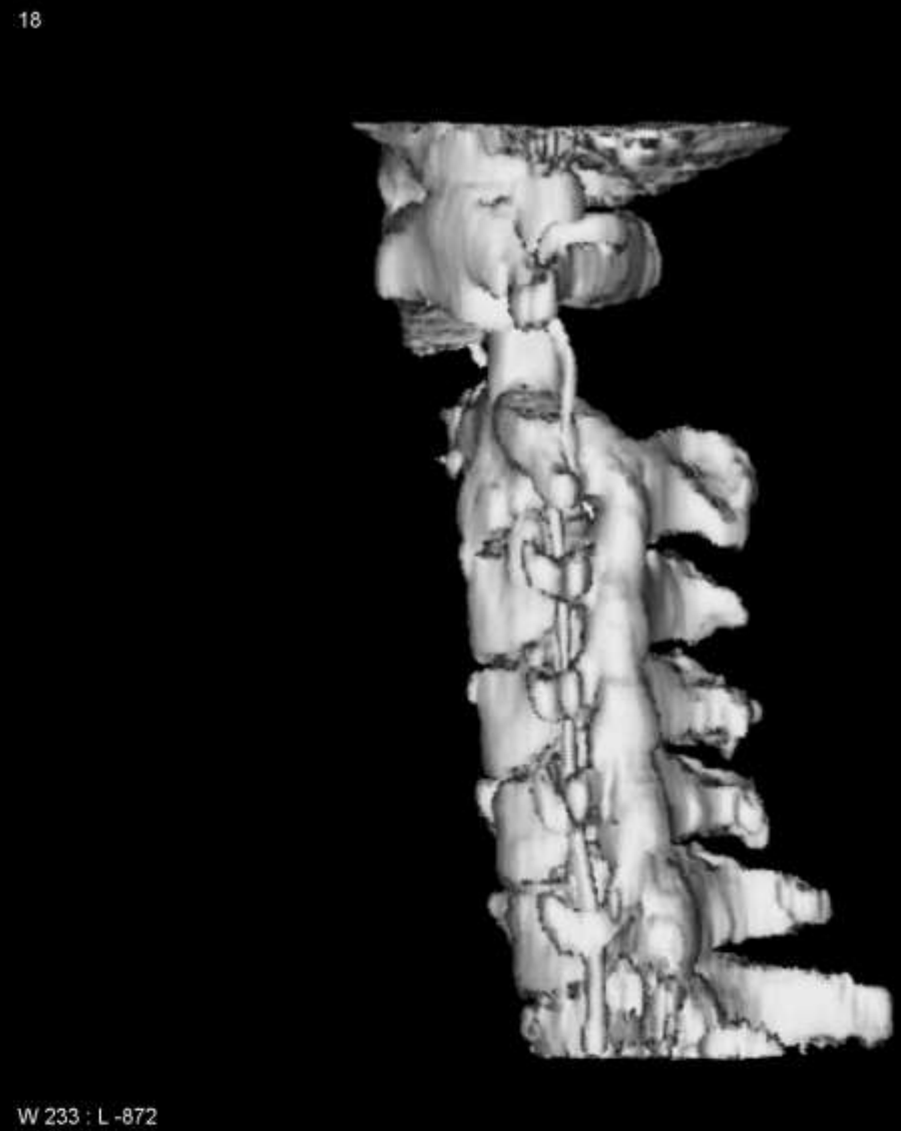
34M MVA

Atlantoaxial Dislocation



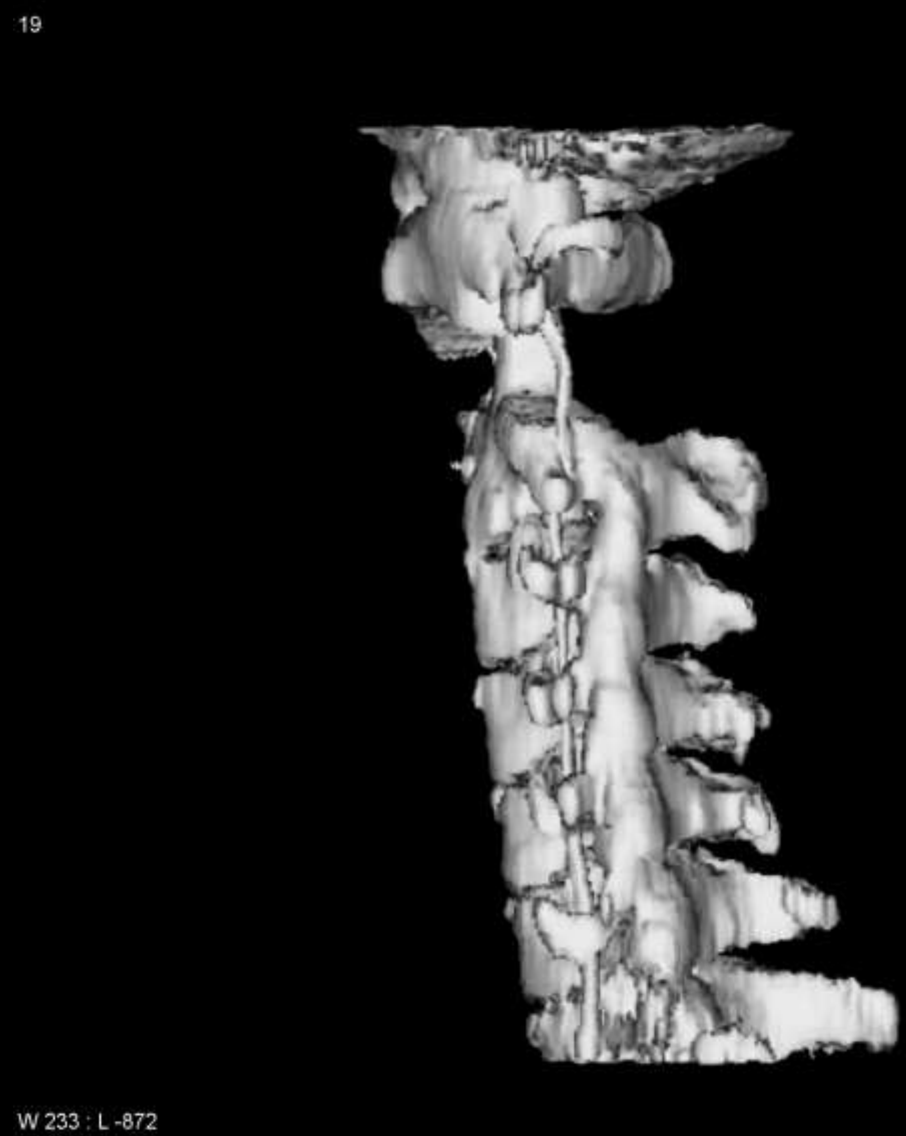
34M MVA

Atlantoaxial Dislocation



34M MVA

Atlantoaxial Dislocation

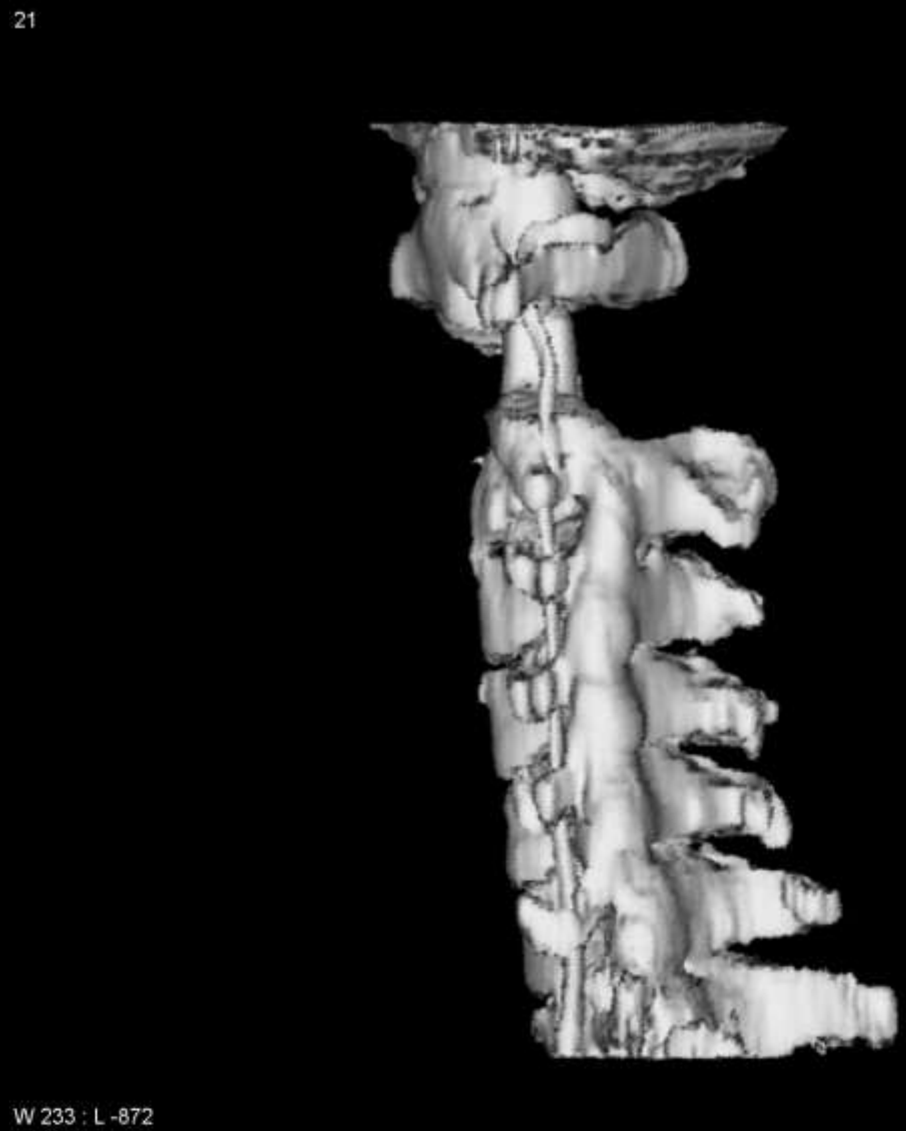


34M MVA

Atlantoaxial Dislocation

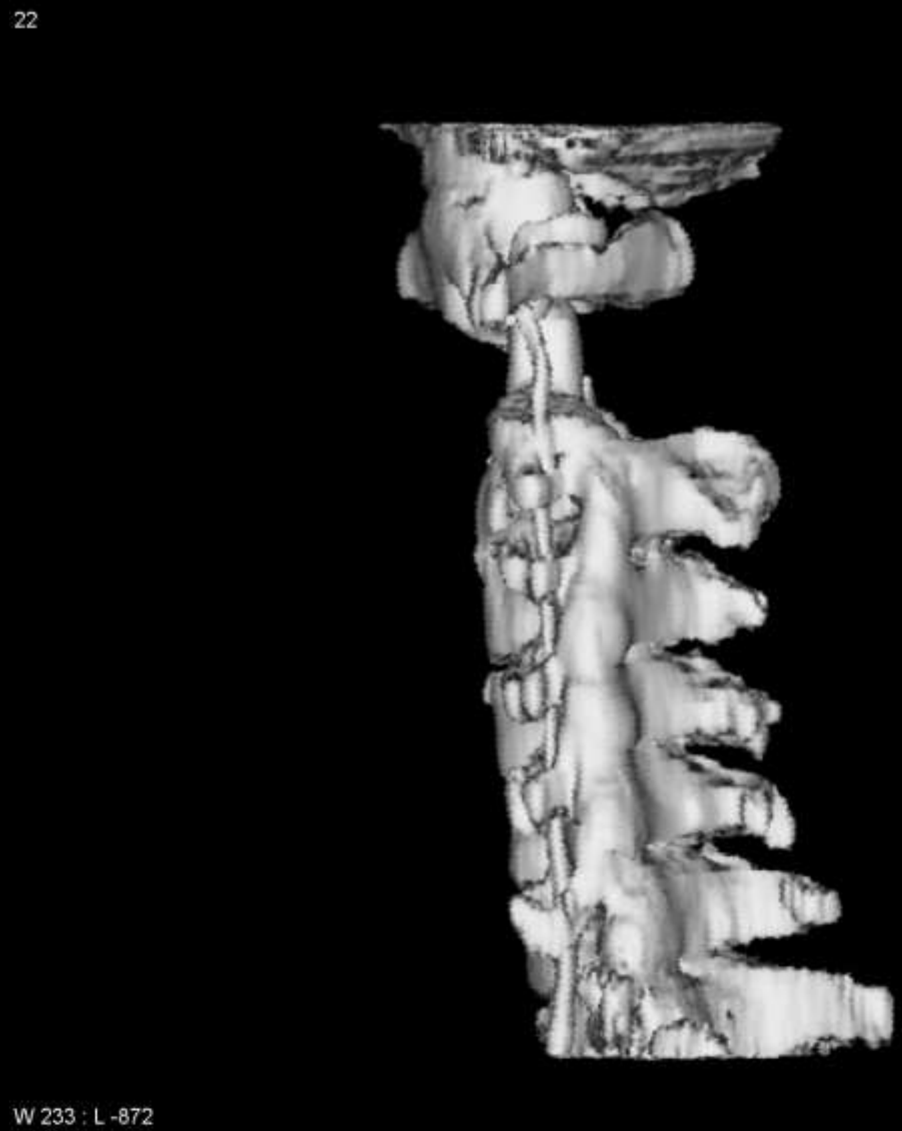
34M MVA

Atlantoaxial Dislocation



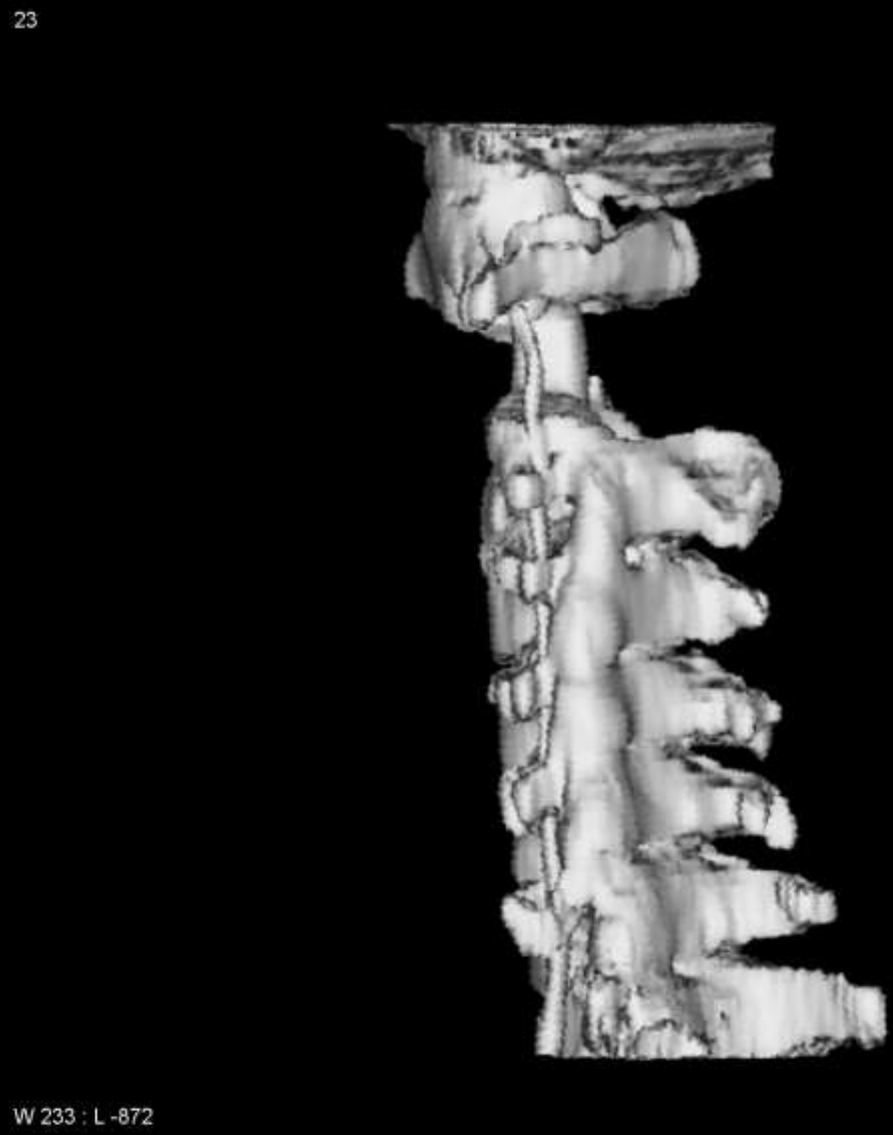
34M MVA

Atlantoaxial Dislocation



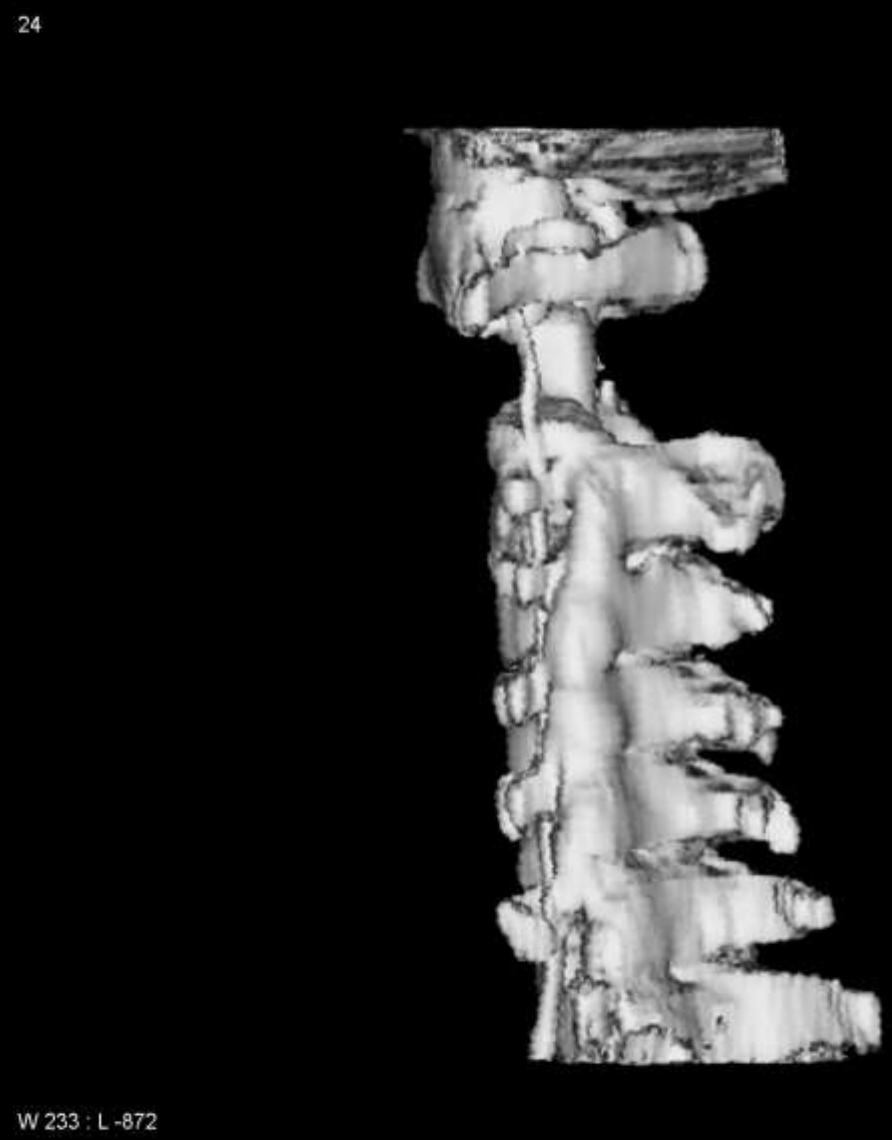
34M MVA

Atlantoaxial Dislocation



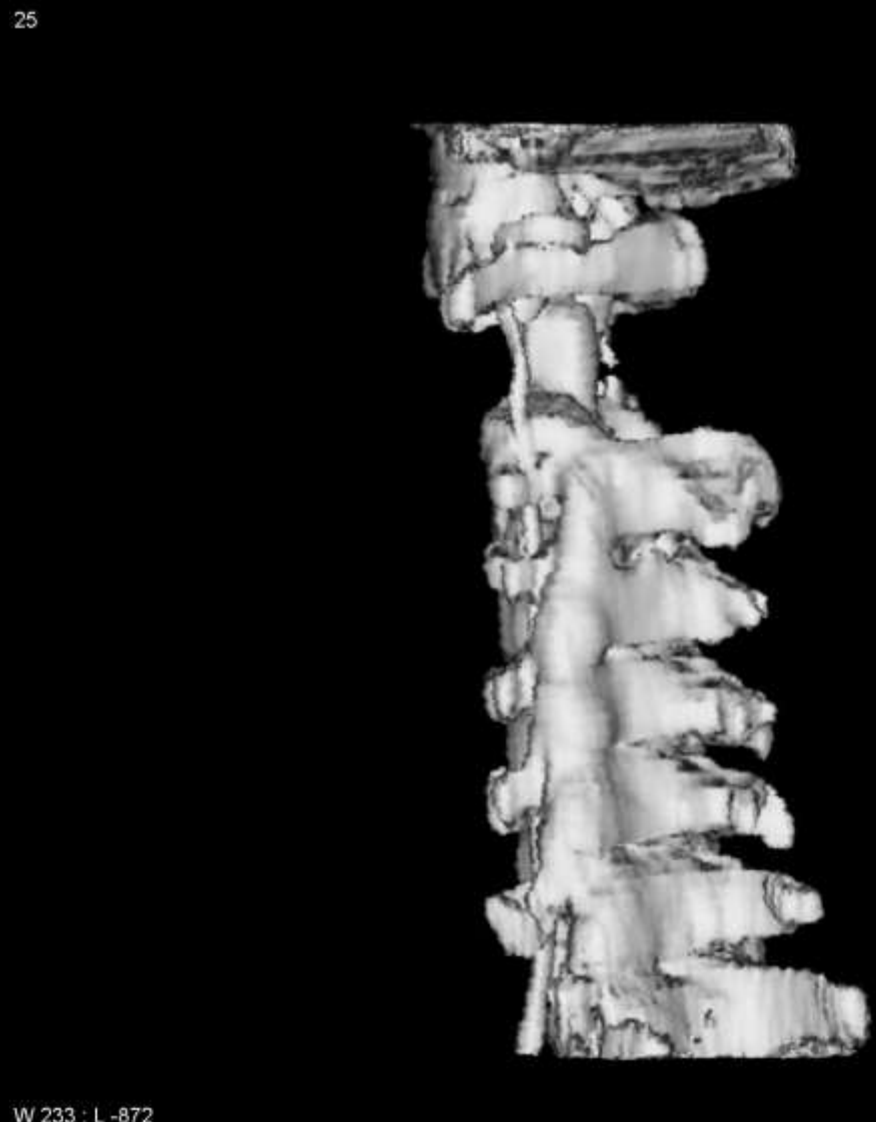
34M MVA

Atlantoaxial Dislocation



34M MVA

Atlantoaxial Dislocation

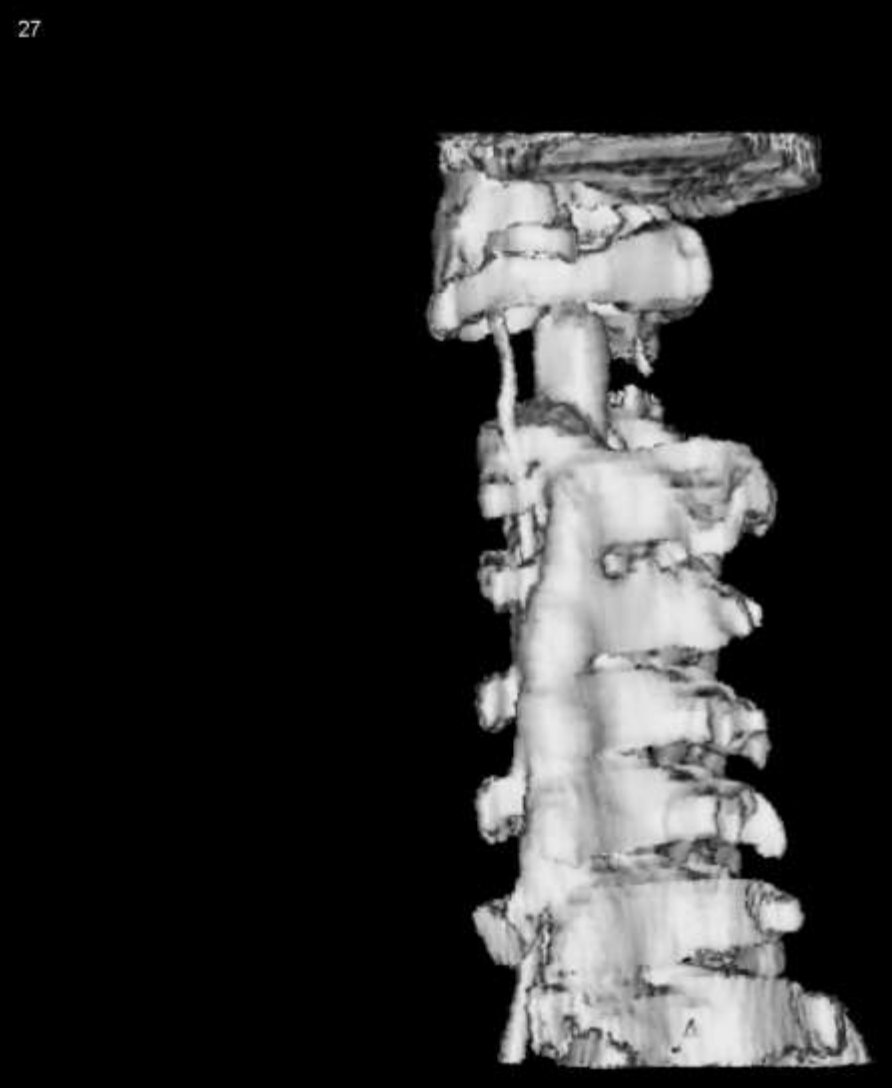


34M MVA

Atlantoaxial Dislocation

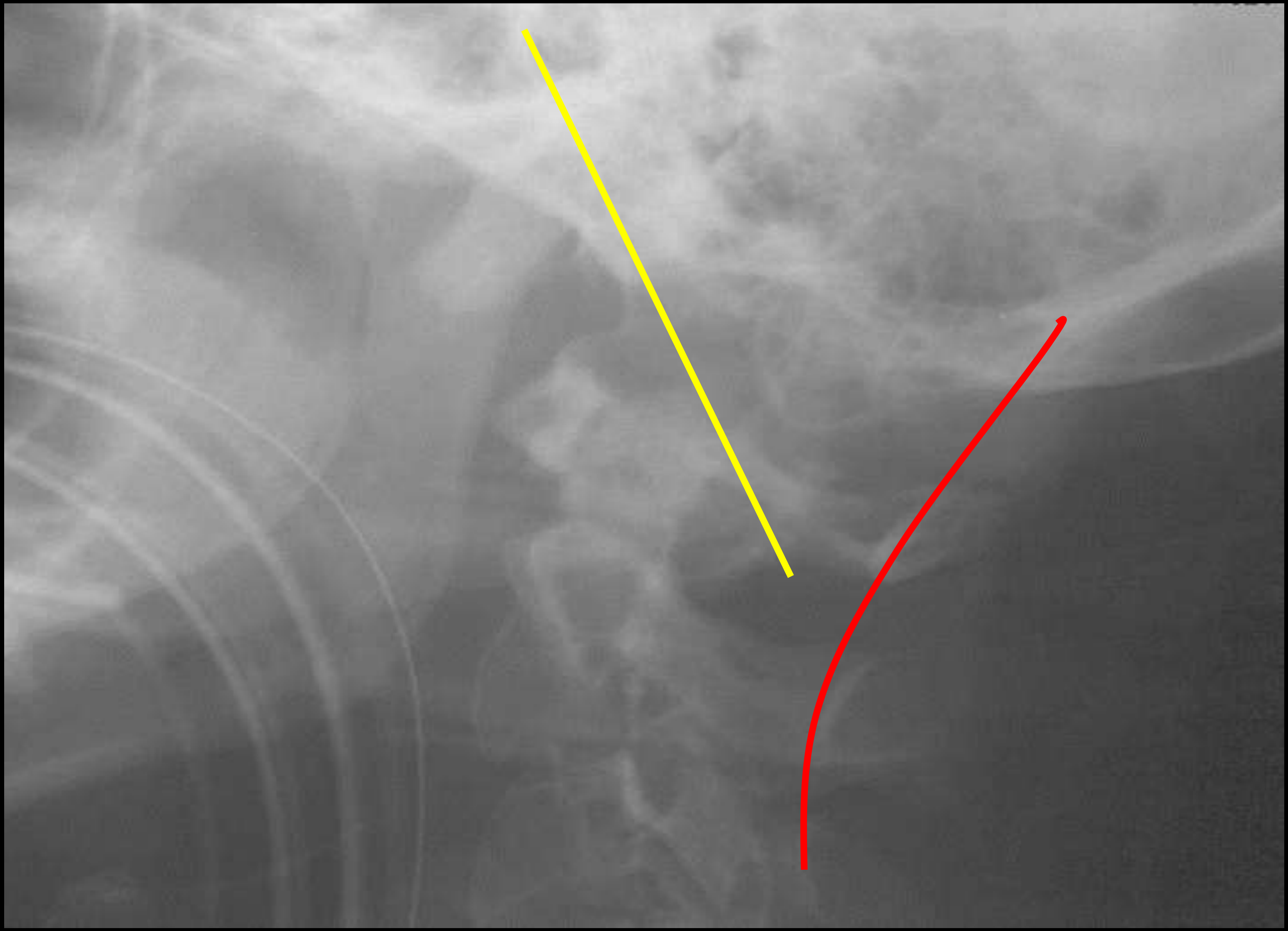
34M MVA

Atlantoaxial Dislocation

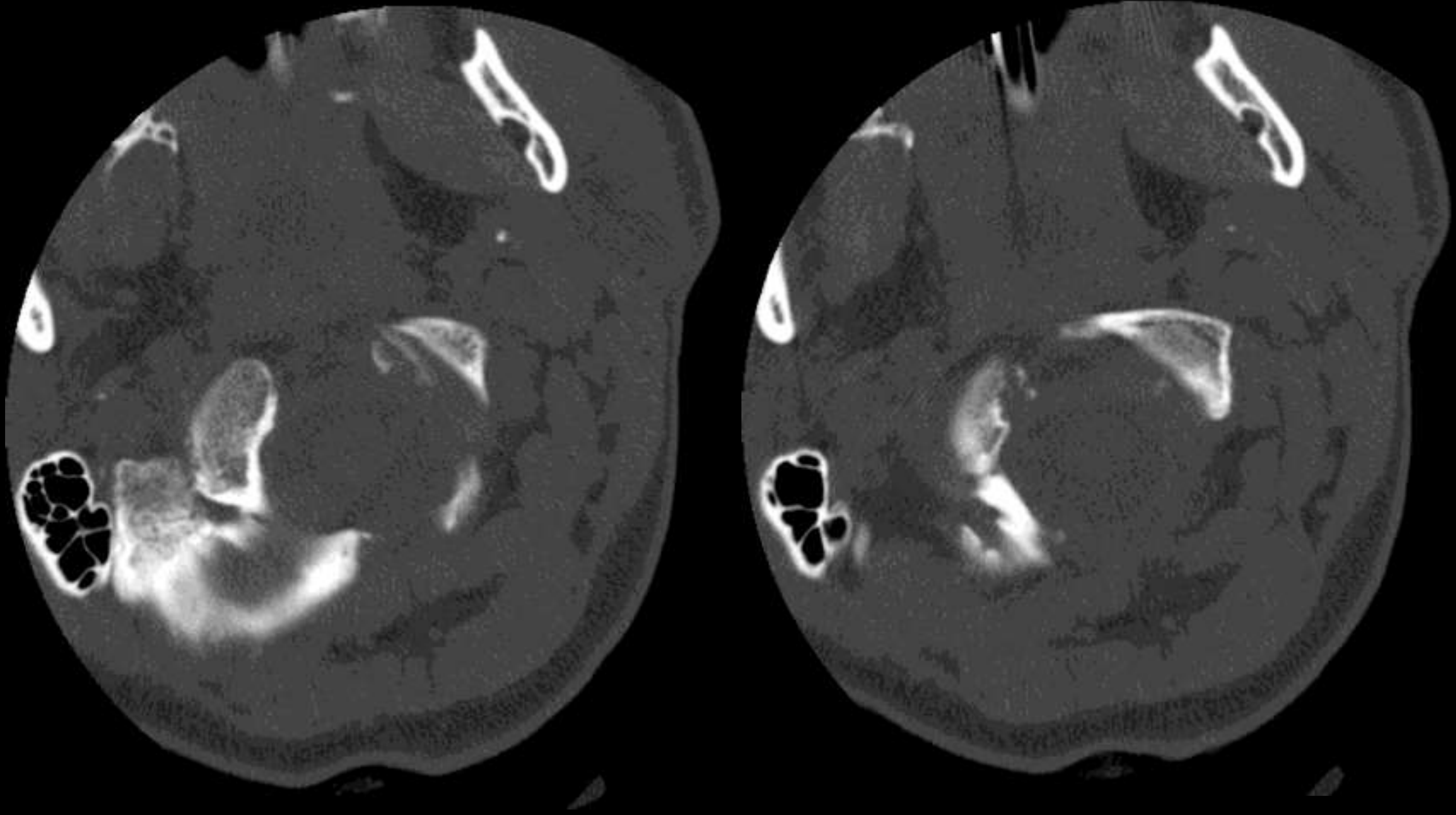


34M MVA

Atlantooccipital Subluxation

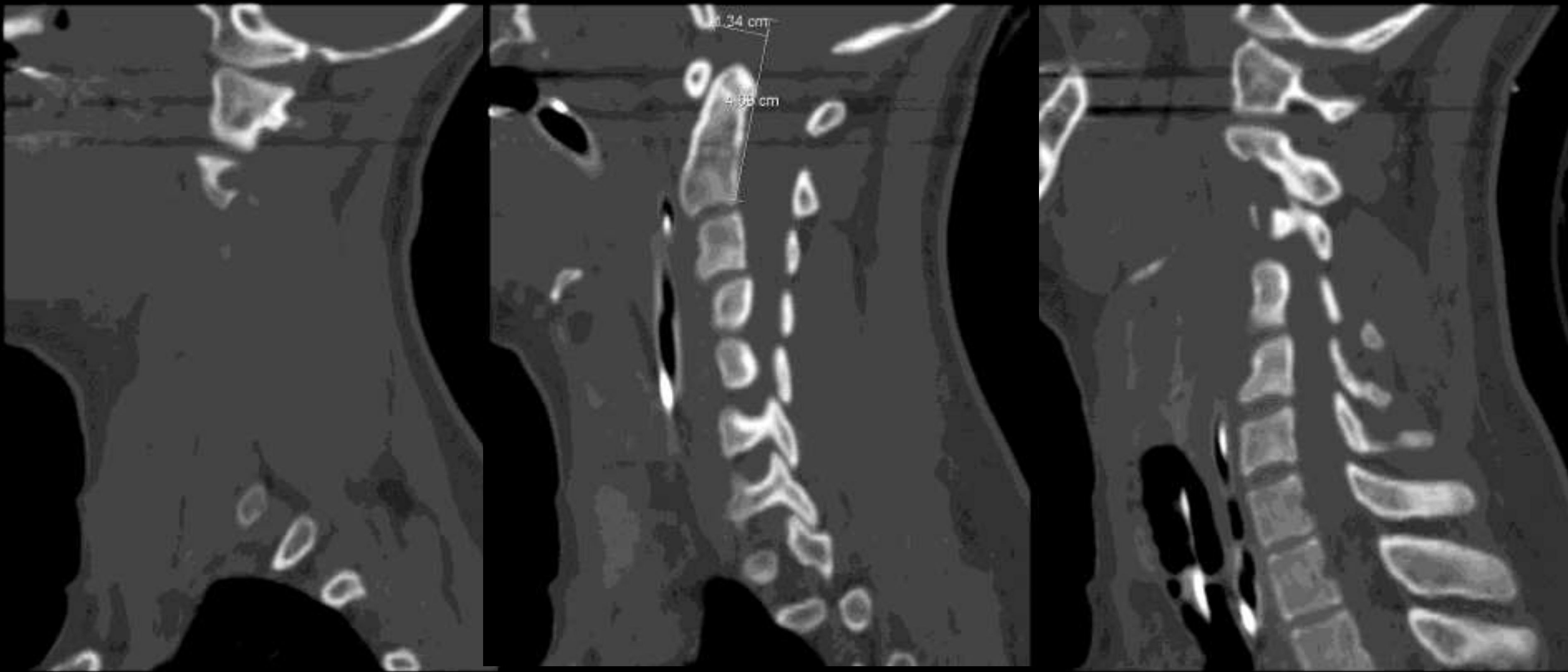


Atlantooccipital subluxation



23F Trauma

Atlantooccipital subluxation

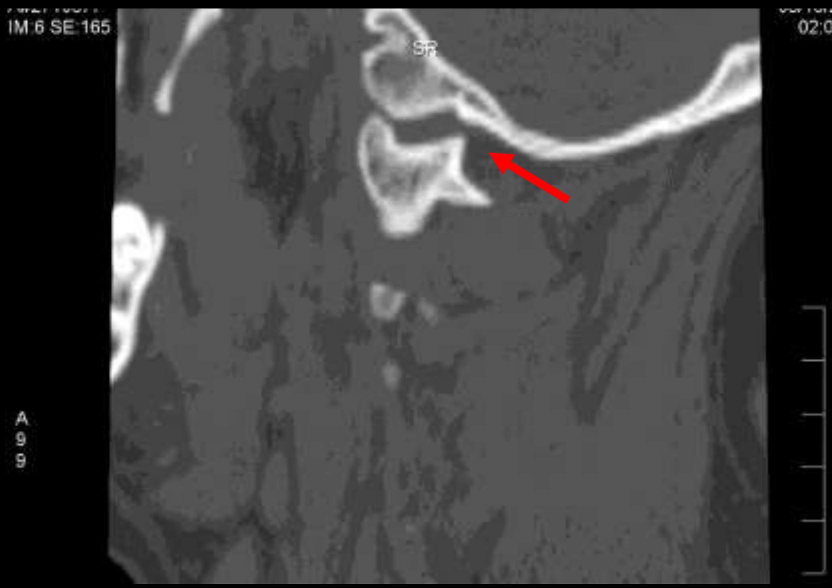


23F Trauma

Atlantooccipital subluxation

34M

Atlantooccipital subluxation



Right

27 Male in MVA

Atlantooccipital subluxation

16+1+10+1

Male in MVA

Atlantooccipital subluxation

15+1+10+1

Male in MVA

Atlantooccipital subluxation

14+1+10+1

Male in MVA

Atlantooccipital subluxation

13+1+10+1

Male in MVA

Atlantooccipital subluxation

12+1+10+1

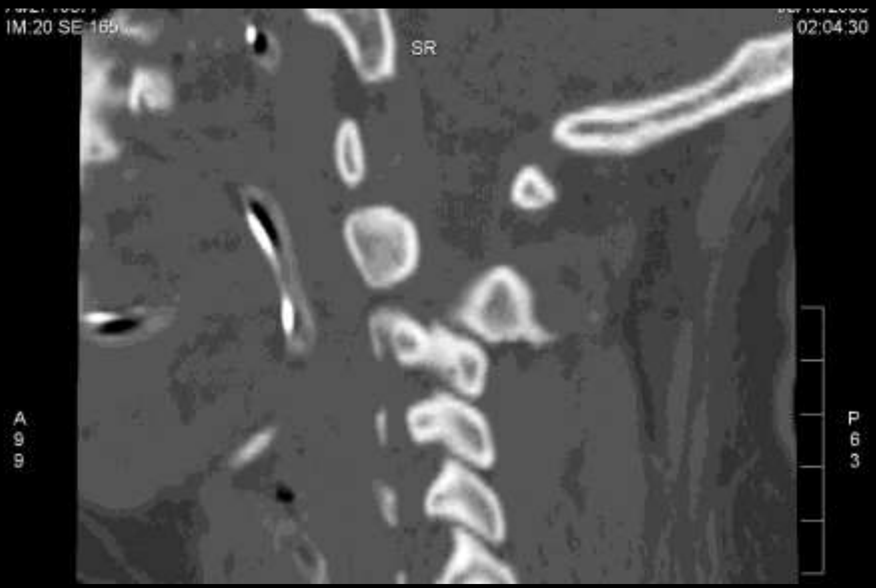
Male in MVA

Atlantooccipital subluxation

11+1+10+1

Male in MVA

Atlantooccipital subluxation



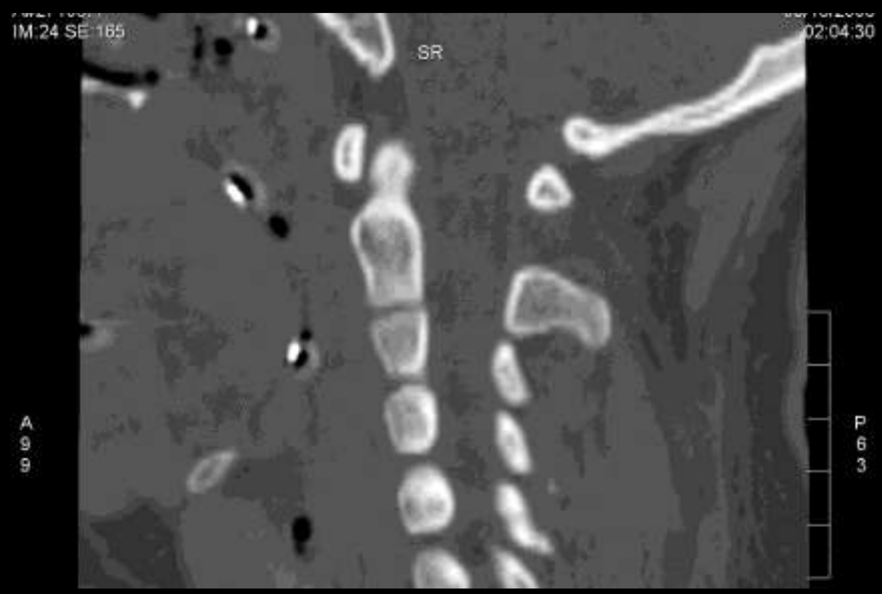
10+1+10+1

Male in MVA

Atlantooccipital subluxation

Male in MVA

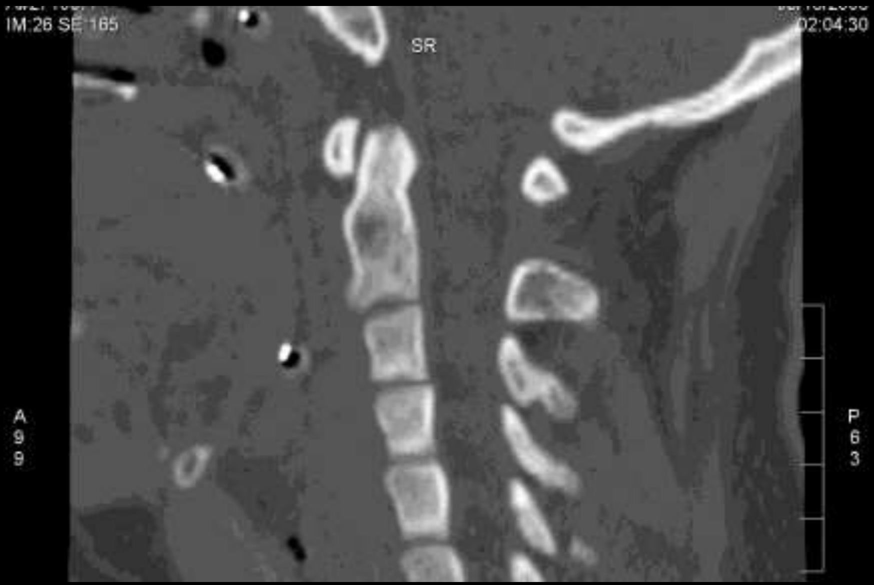
Atlantooccipital subluxation



8+1+10+1

Male in MVA

Atlantooccipital subluxation



Male in MVA

Atlantooccipital subluxation

6+1+10+1

Male in MVA

Atlantooccipital subluxation

5+1+10+1

Male in MVA

Atlantooccipital subluxation

4+1+10+1

Male in MVA

Atlantooccipital subluxation

Male in MVA

Atlantooccipital subluxation

2+1+10+1

Male in MVA

Atlantooccipital subluxation

Left

Male in MVA

Atlantooccipital subluxation

Male in MVA

Atlantooccipital subluxation

Male in MVA

Atlantooccipital subluxation

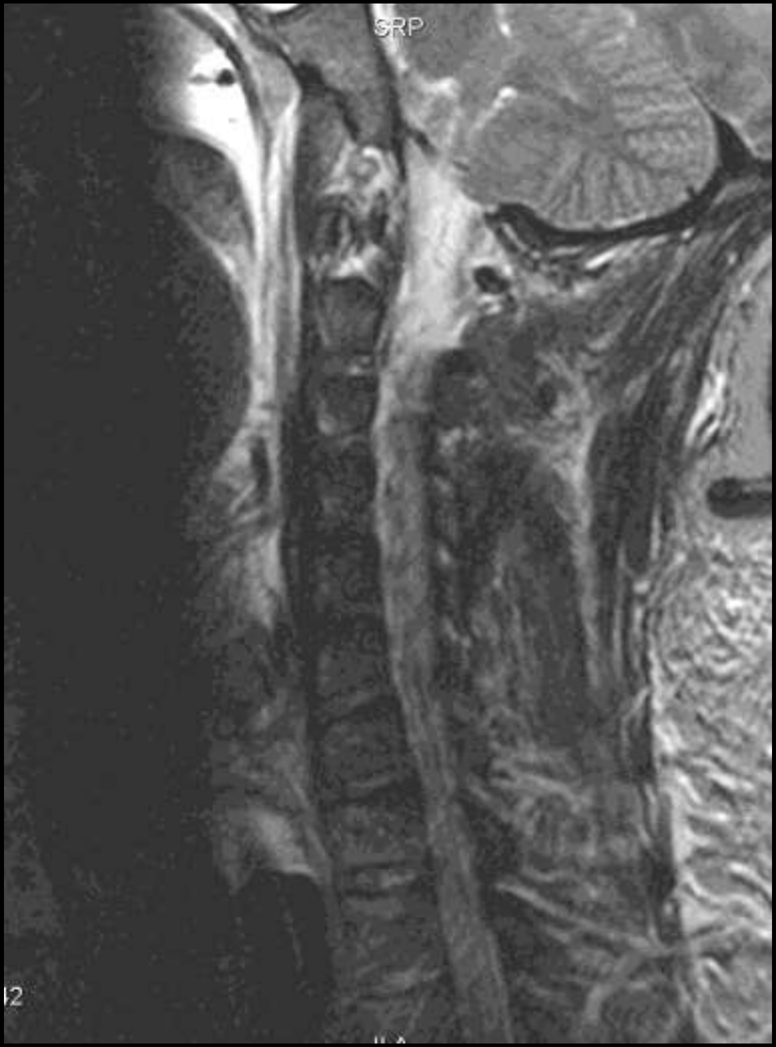
Male in MVA

Atlantooccipital subluxation

8+1

Male in MVA

Atlantooccipital subluxation



7+1

Male in MVA

Atlantooccipital subluxation

6+1

Male in MVA

Atlantooccipital subluxation

Male in MVA

Atlantooccipital subluxation

4+1

Male in MVA

Atlantooccipital subluxation

3+1

Male in MVA

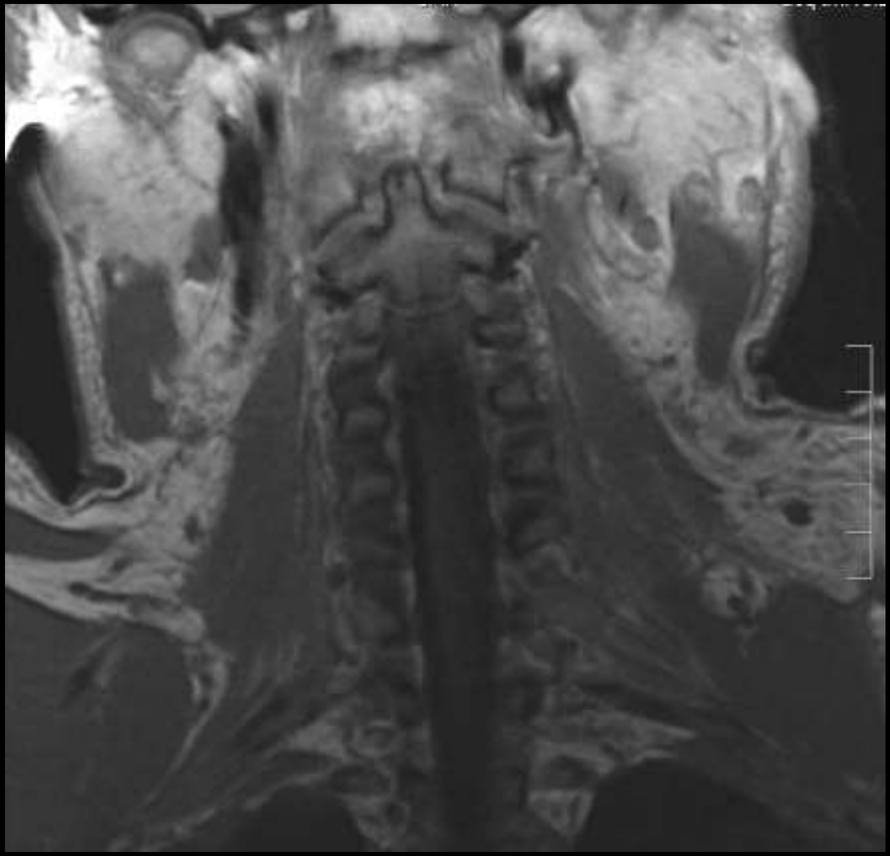
Atlantooccipital subluxation

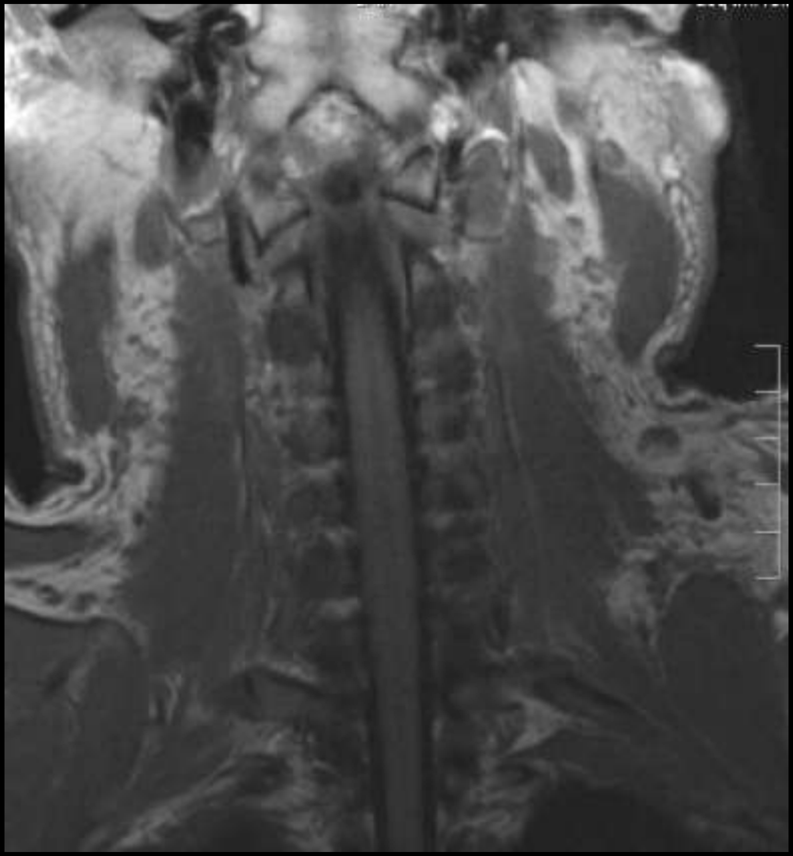
Male in MVA

Atlantooccipital subluxation

Male in MVA

Atlantooccipital subluxation





C1-2 Rotary fixation

Male in MVA

Occiptio Axial Dislocation

Occiptio axial dislocation 59F

Occiptio Axial Dislocation

Occiptio axial dislocation 59F

Occiptio Axial Dislocation

Occiptio axial dislocation 59F

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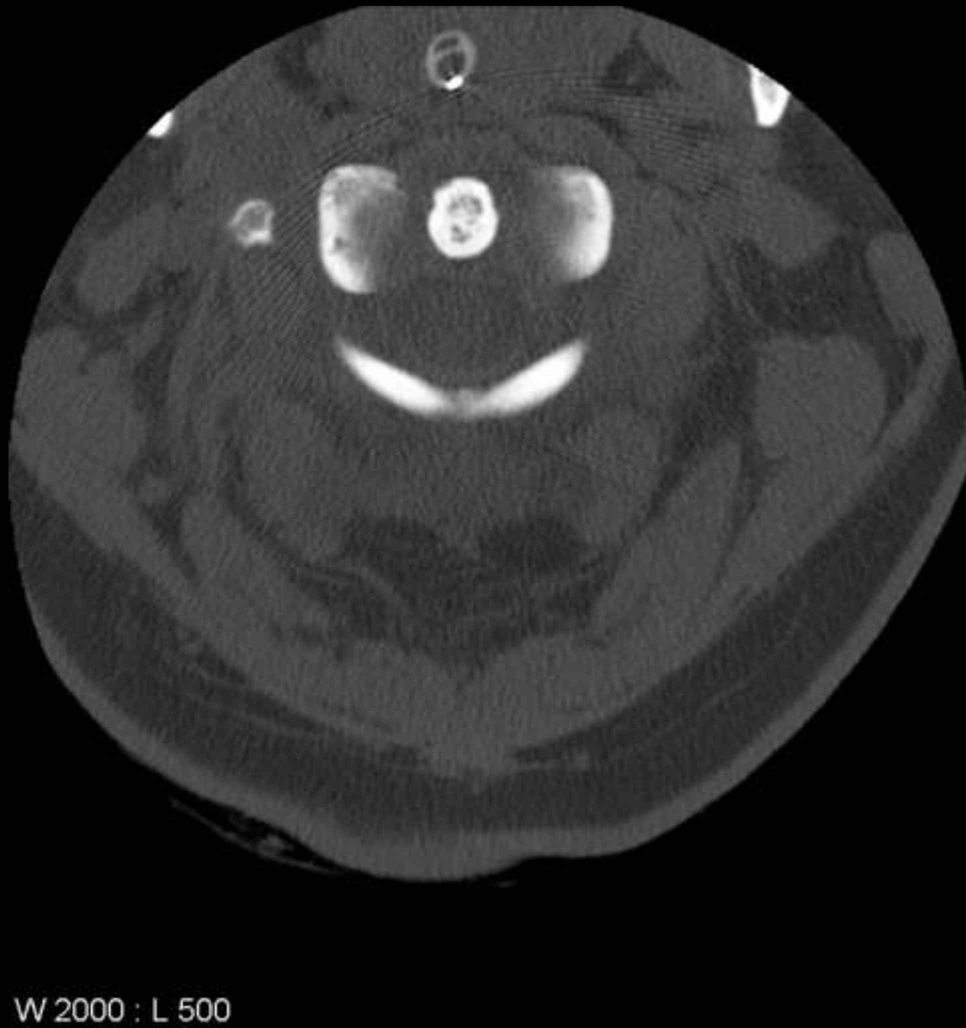
Occiptio Axial Dislocation



Occiptio axial dislocation 59F

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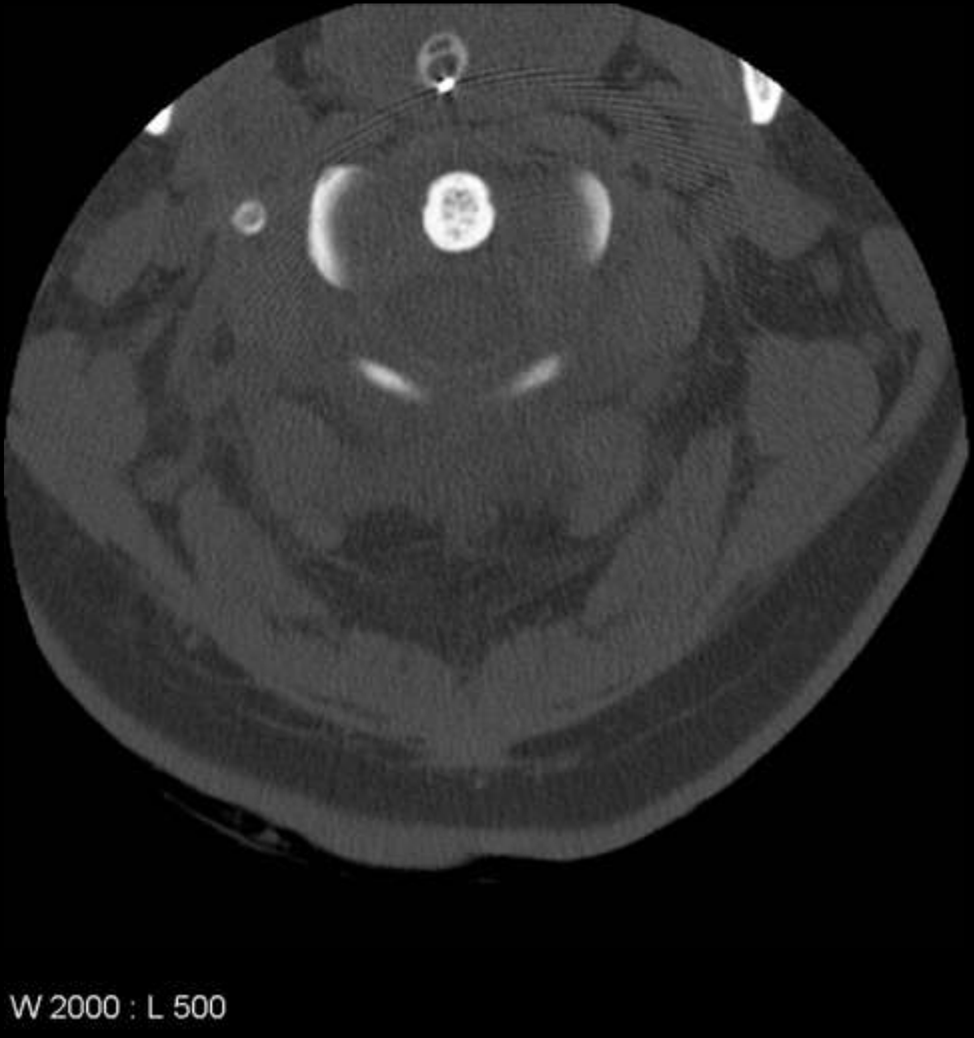

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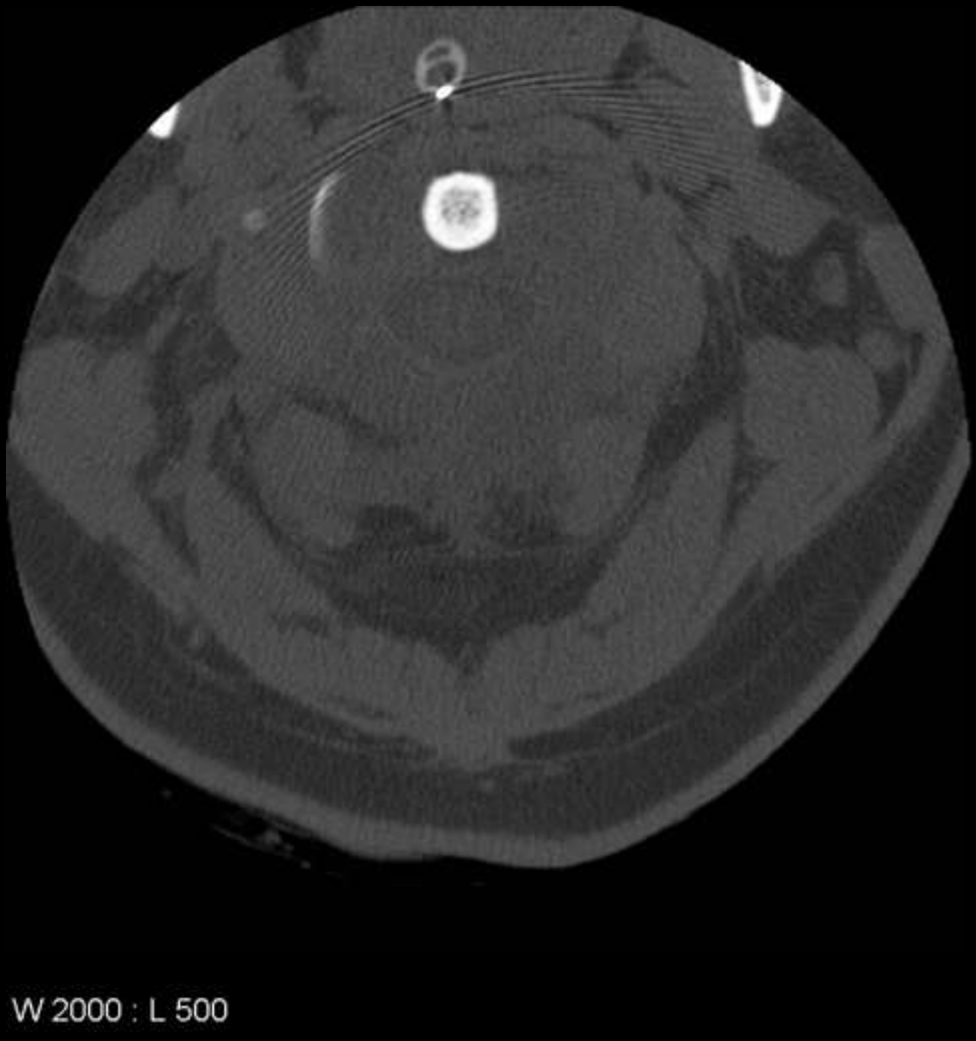

Occiptio axial dislocation 59F

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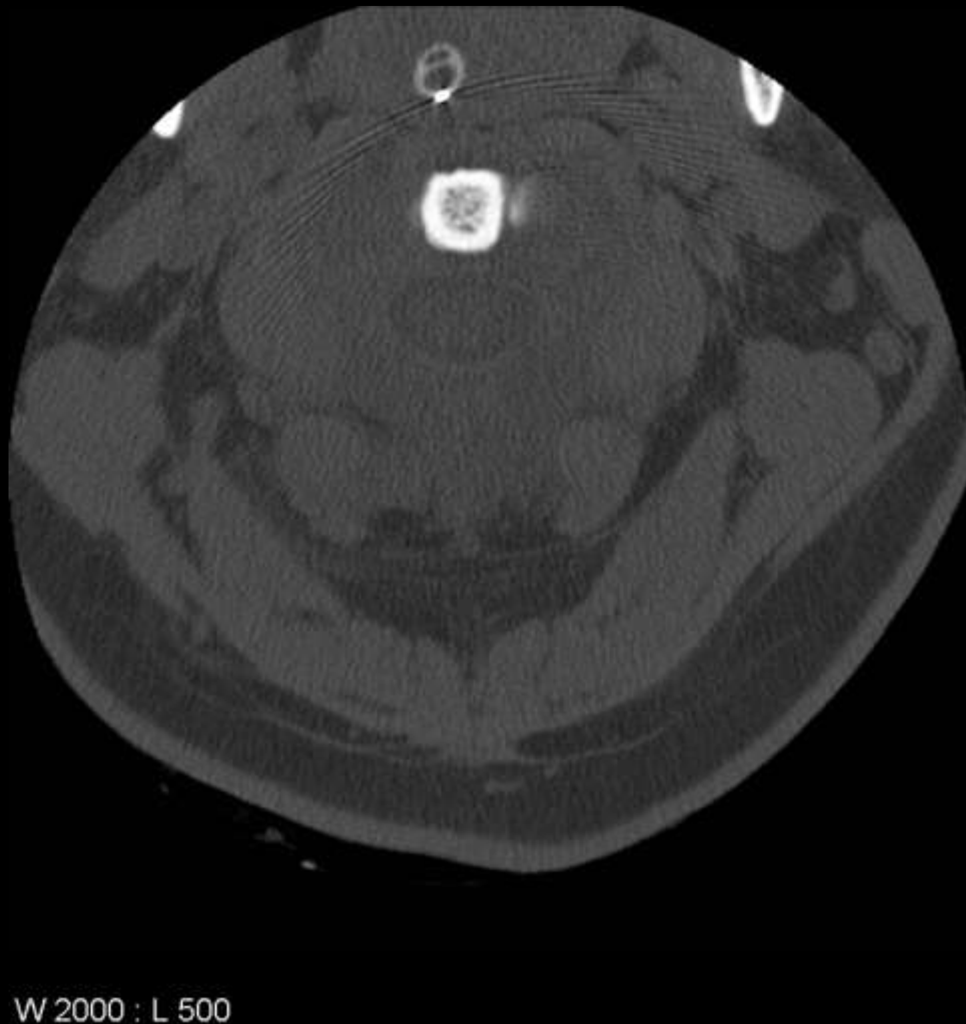

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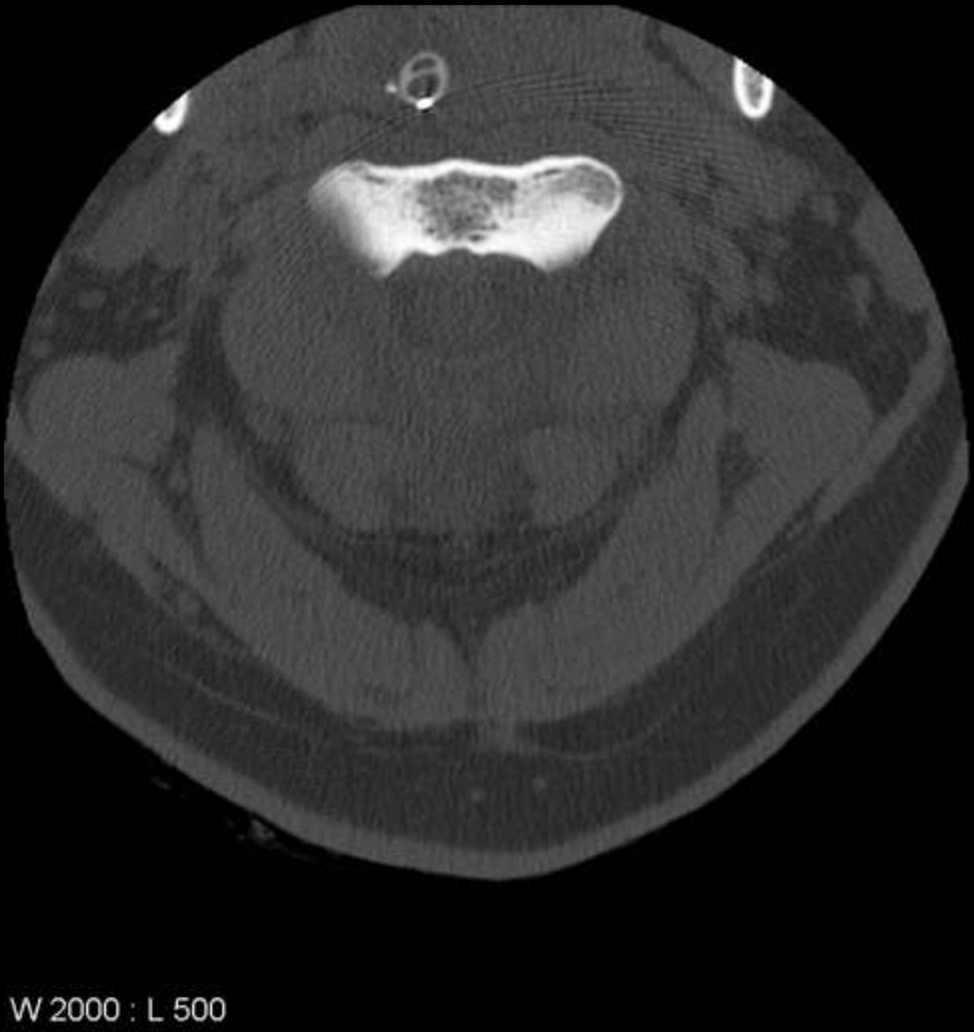

Occiptio axial dislocation 59F

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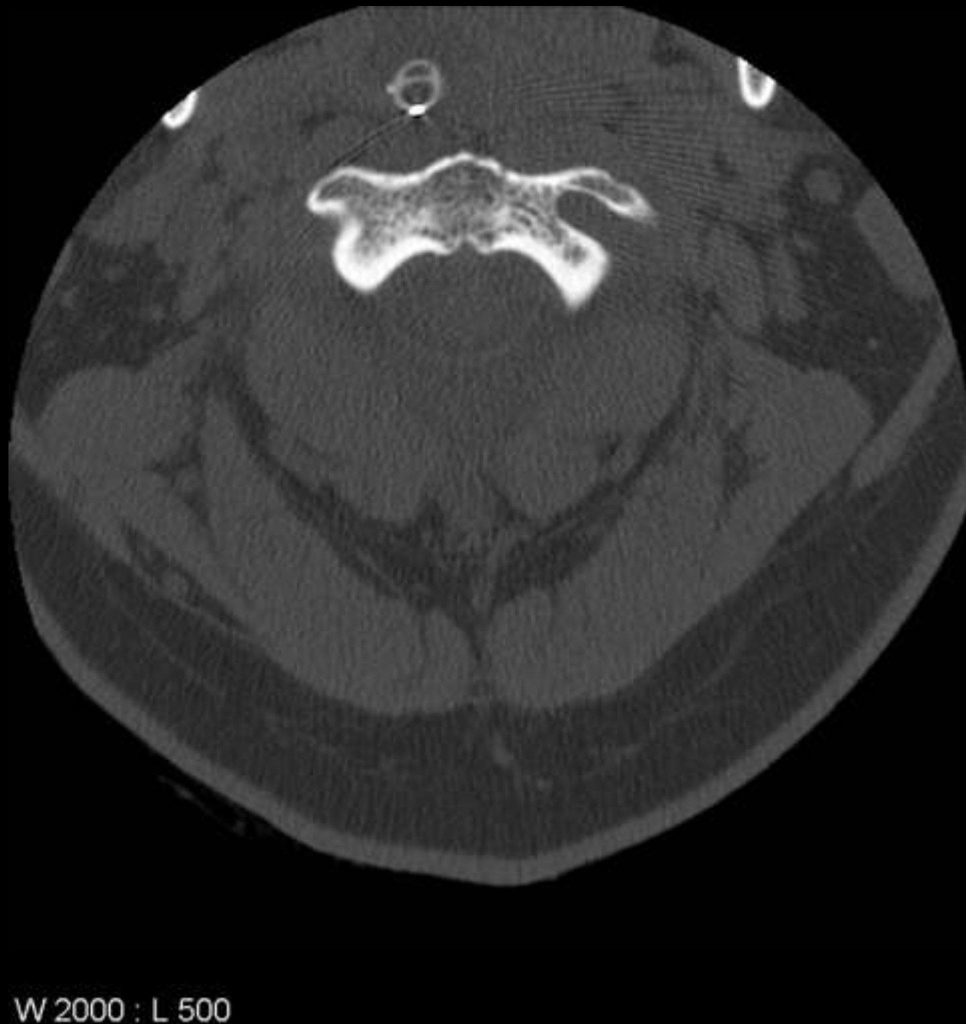

Occiptio Axial Dislocation

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Occiptio axial dislocation 59F

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Occiptio axial dislocation 59F

Occiptio Axial Dislocation

Occiptio axial dislocation 59F

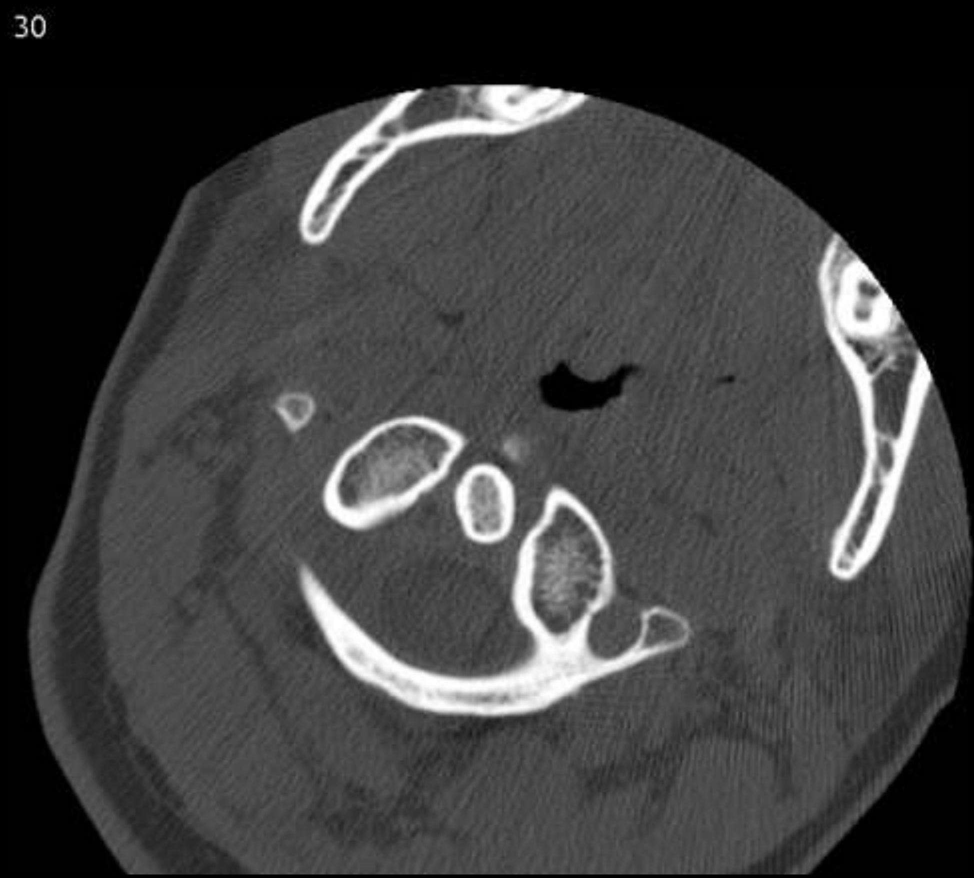
Rotary C1-2 Dislocation/Fixation

C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation

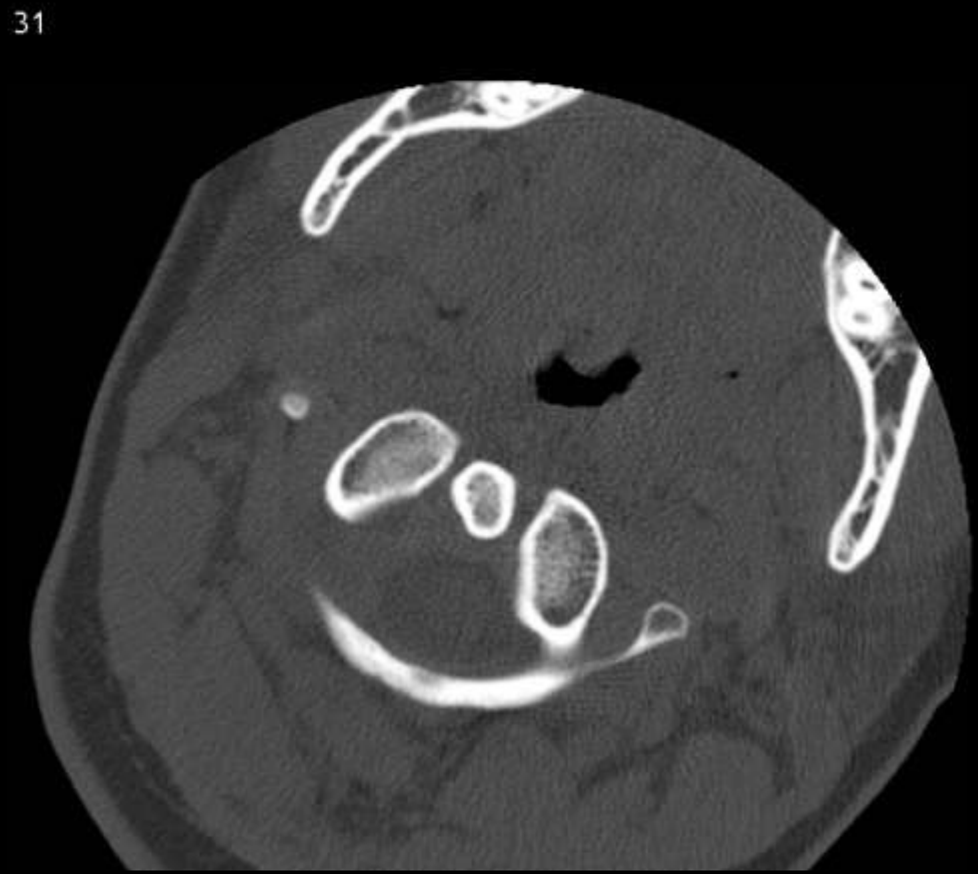
C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation



C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation



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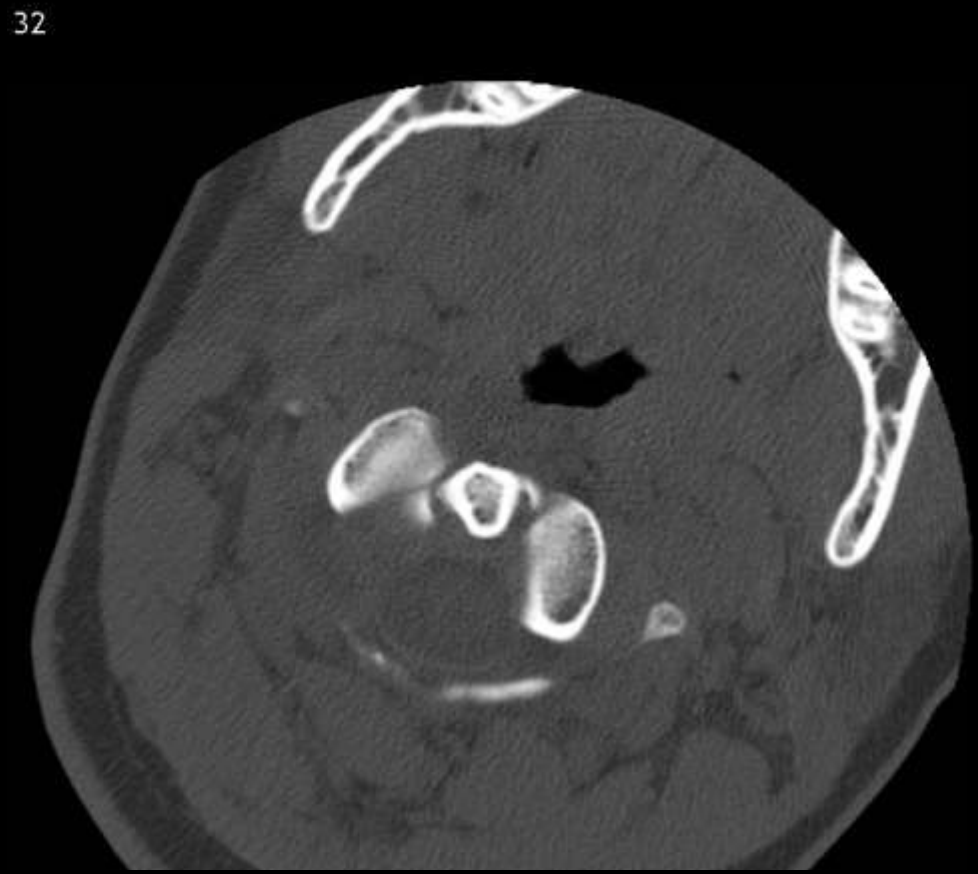
Rotary C1-2 Dislocation/Fixation



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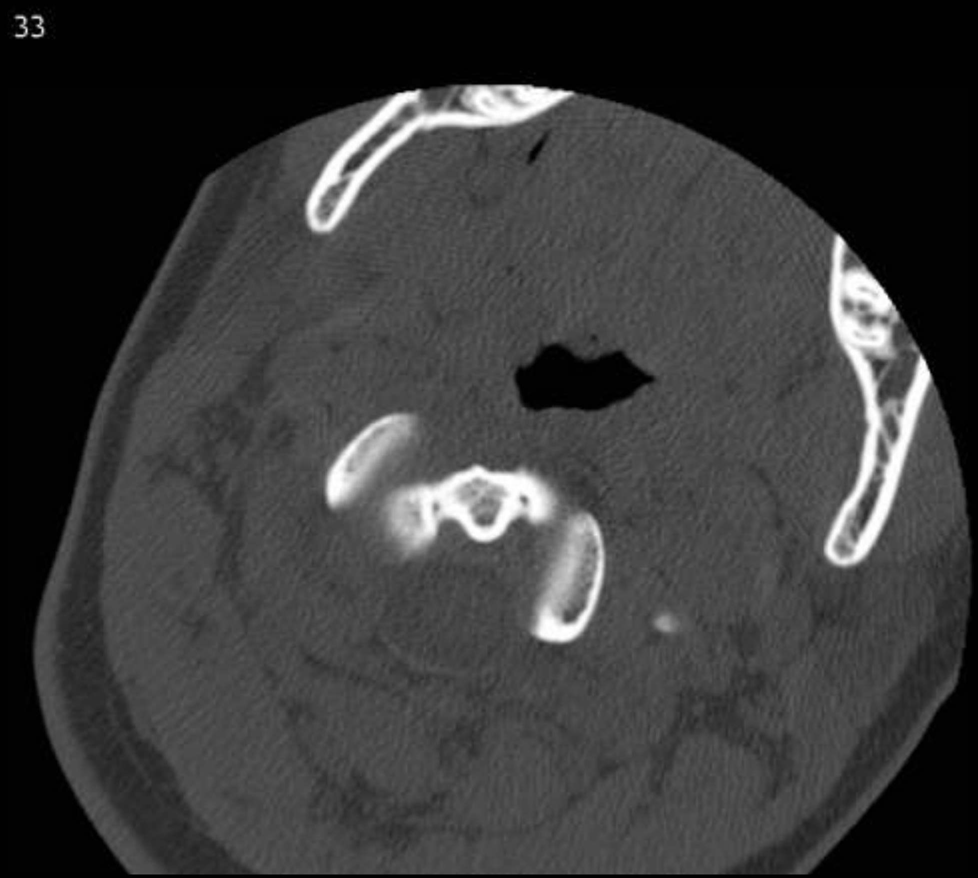

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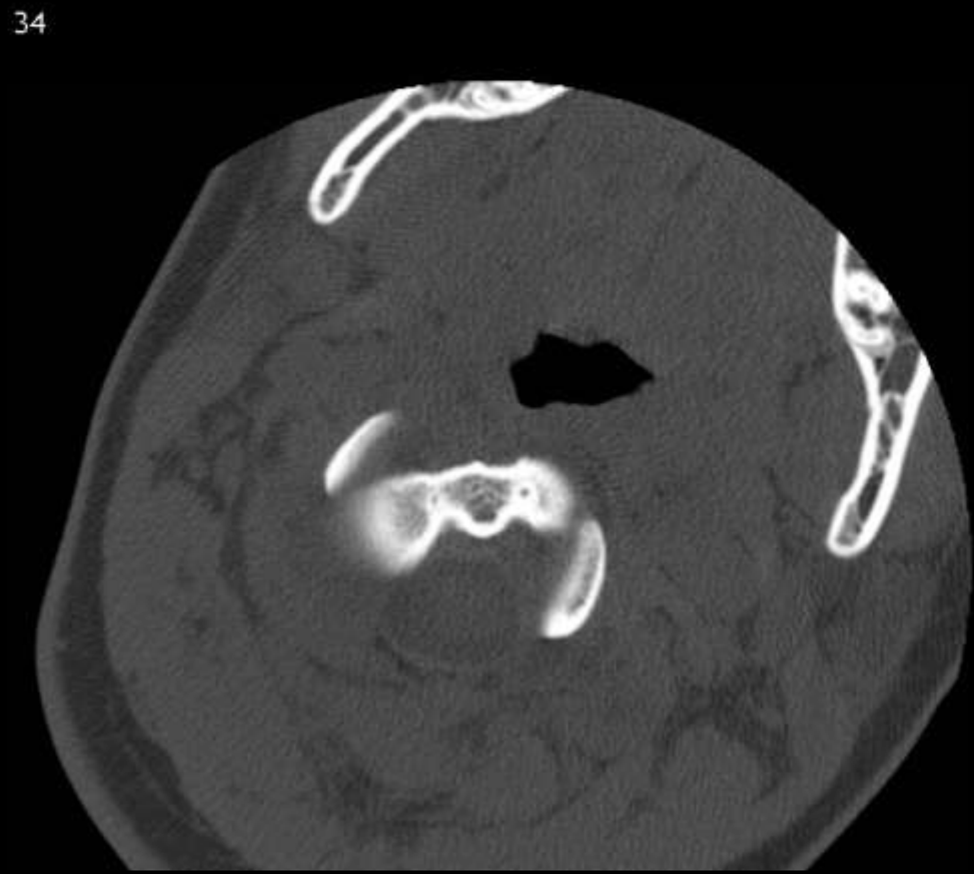
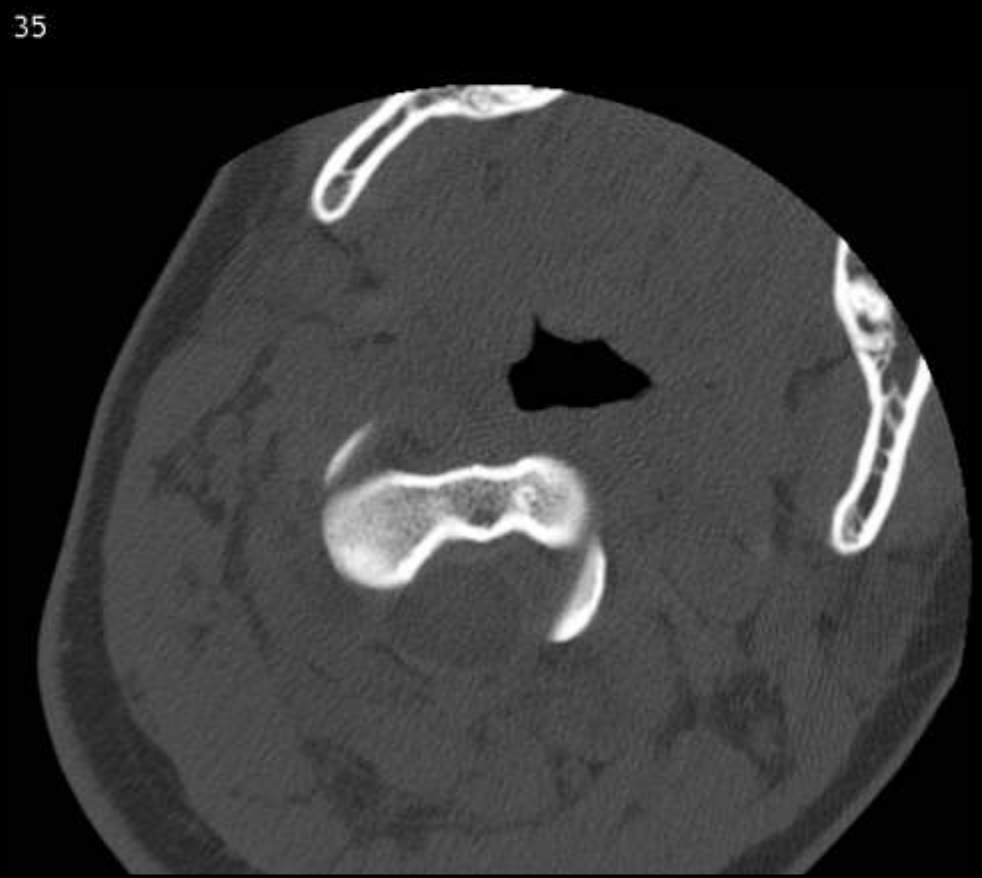
Rotary C1-2 Dislocation/Fixation



6+1+72

C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation



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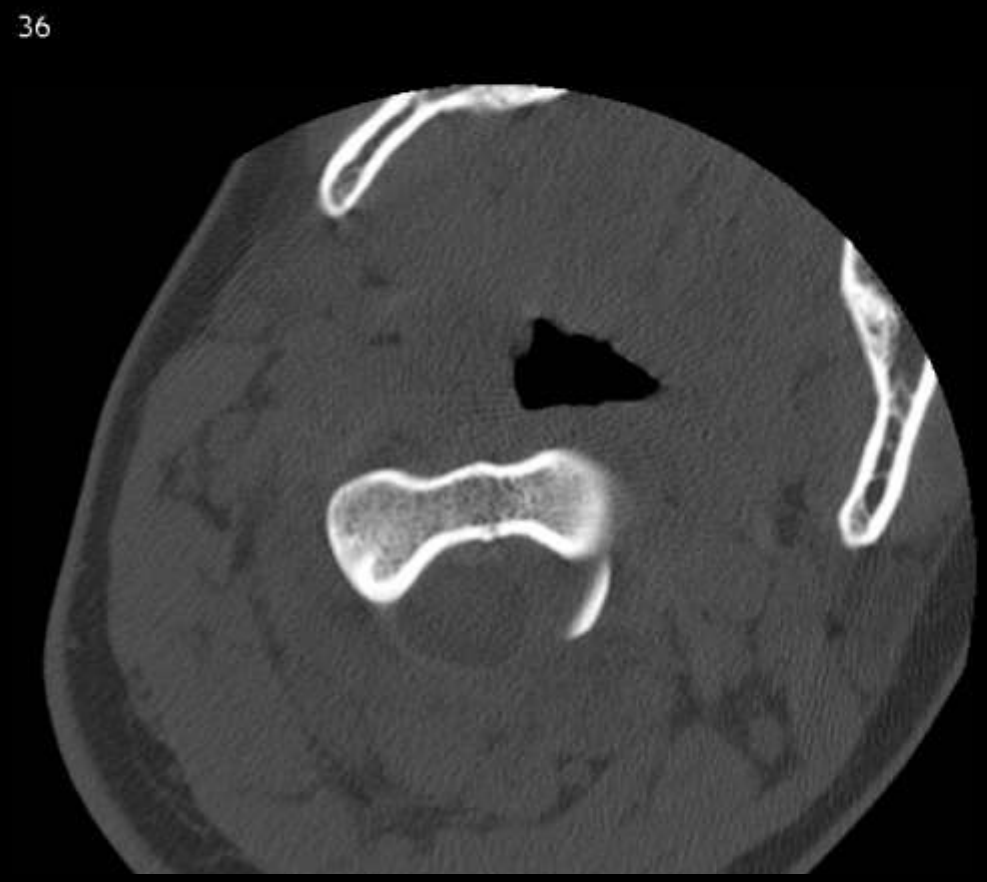
Rotary C1-2 Dislocation/Fixation



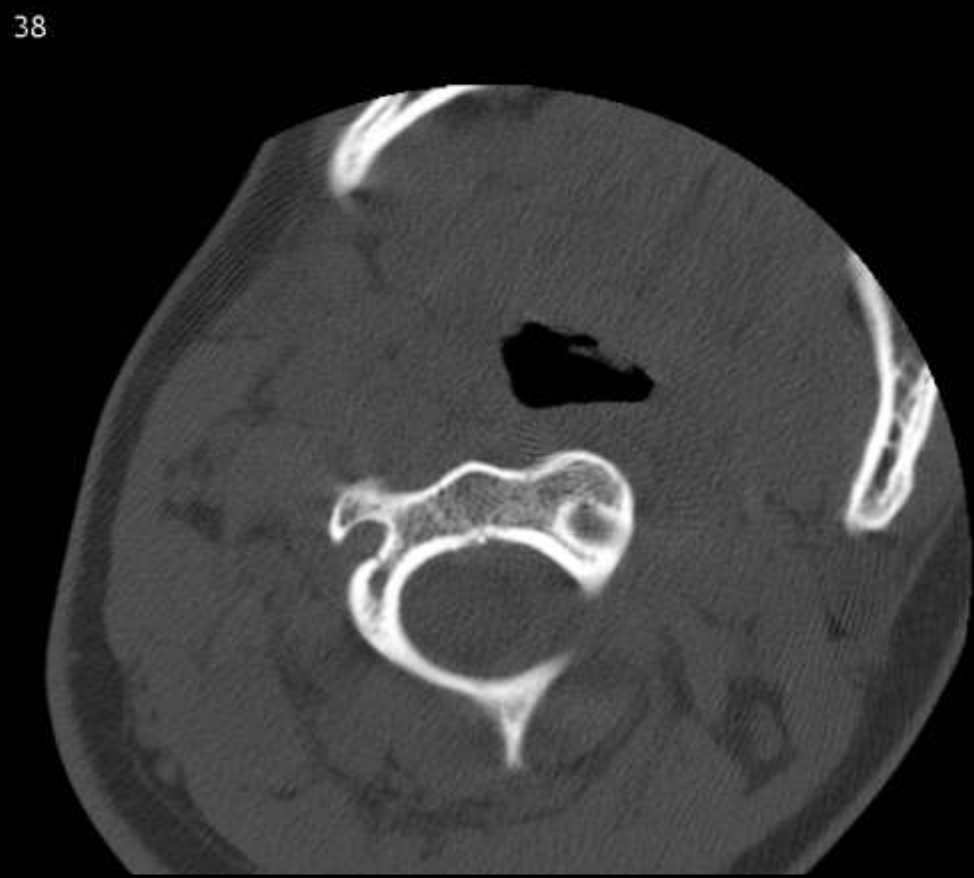
4+1+72

C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation

C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation



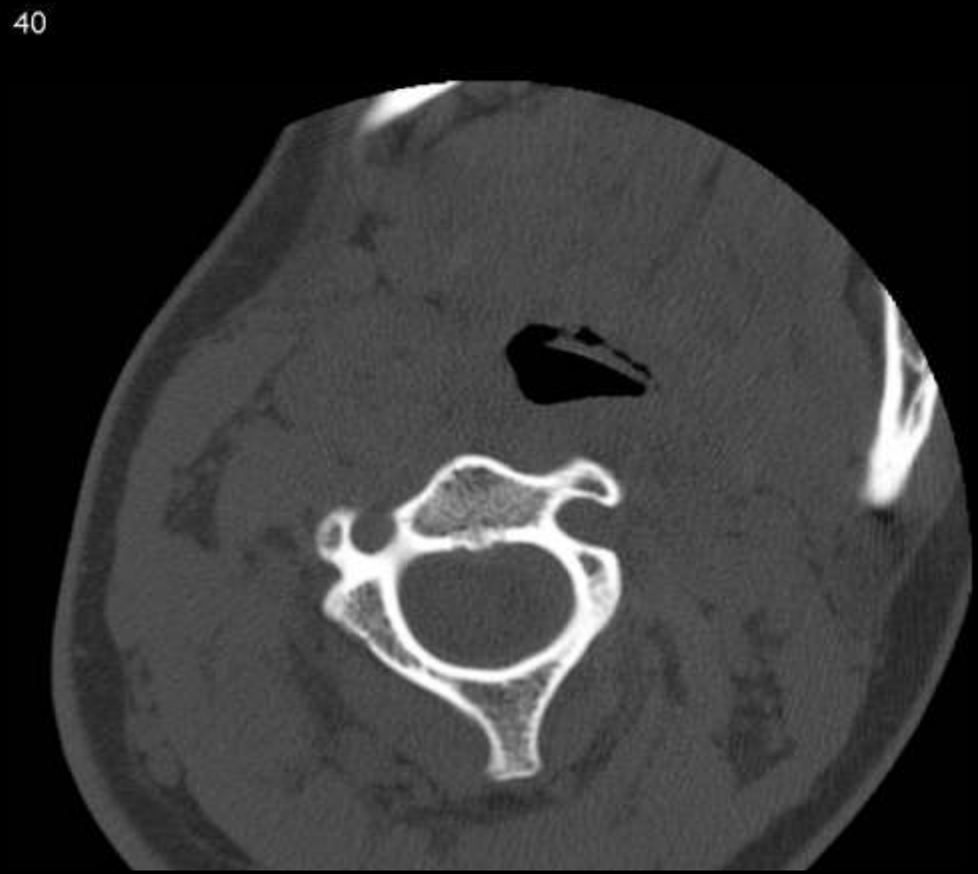
2+1+72

C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation

C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation



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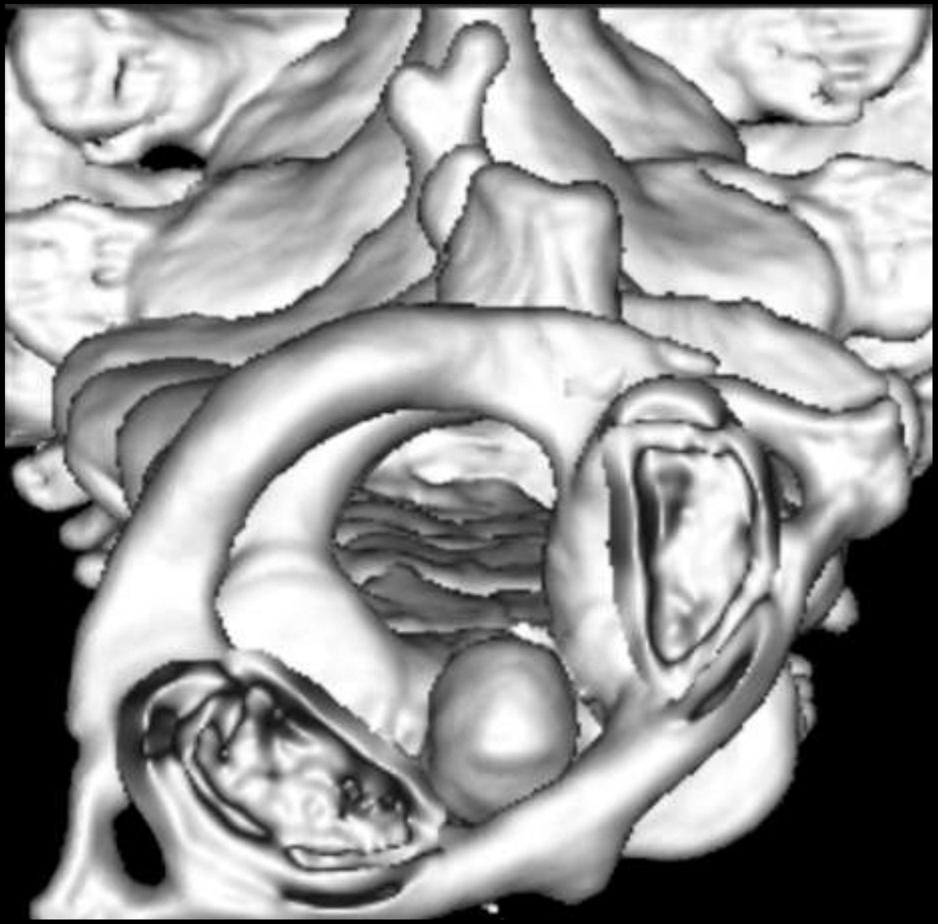
Rotary C1-2 Dislocation/Fixation



C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation

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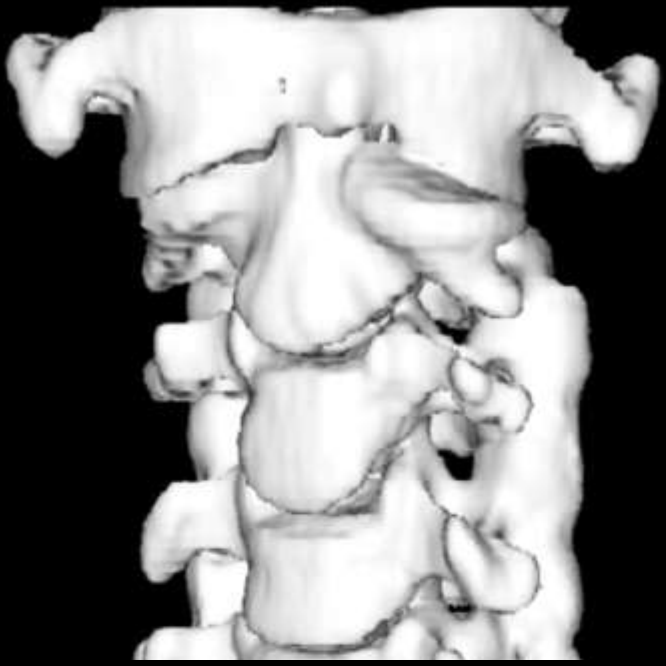
Rotary C1-2 Dislocation/Fixation



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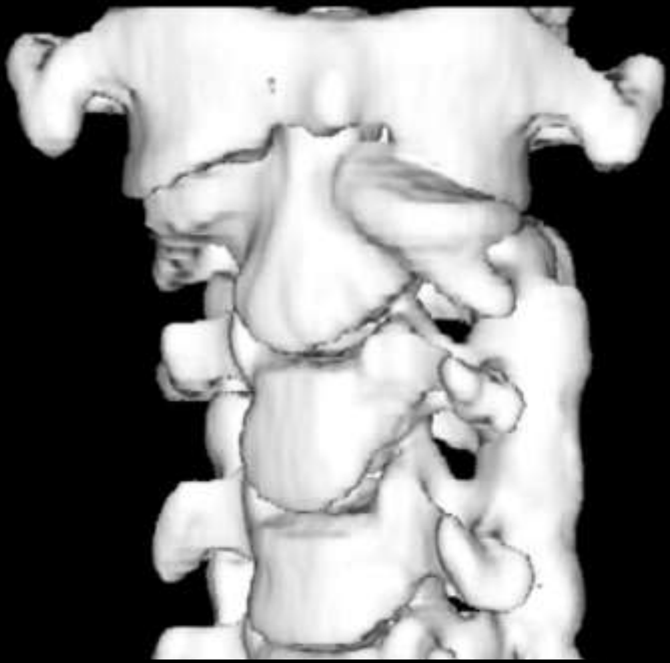
Rotary C1-2 Dislocation/Fixation



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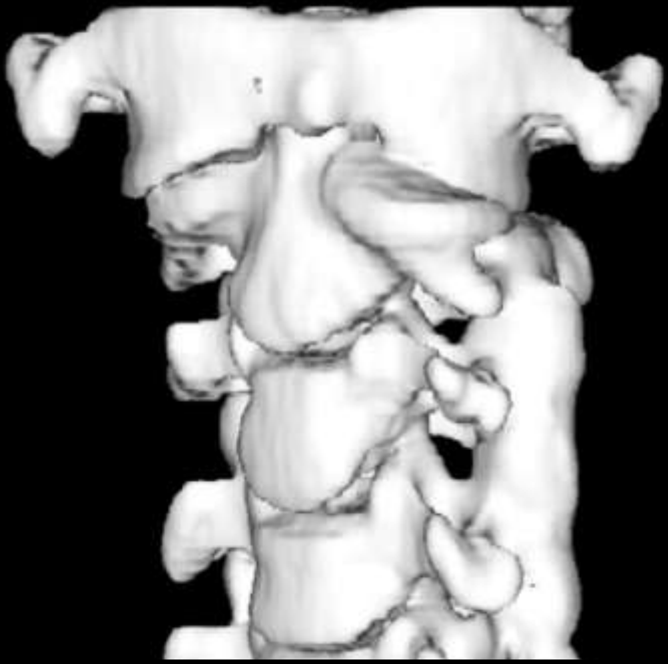
Rotary C1-2 Dislocation/Fixation



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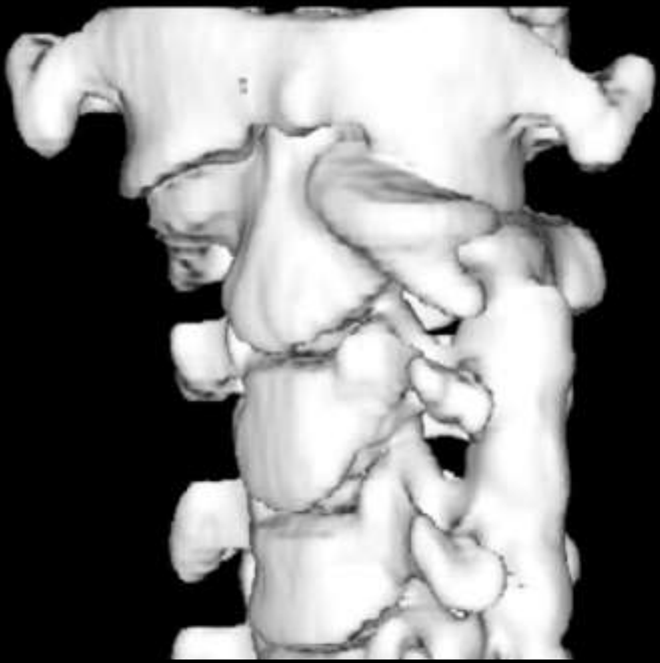
Rotary C1-2 Dislocation/Fixation



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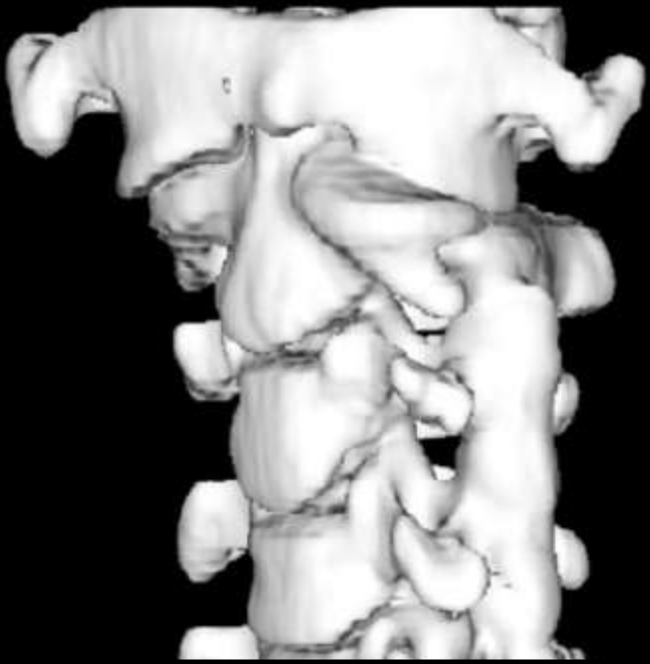
Rotary C1-2 Dislocation/Fixation



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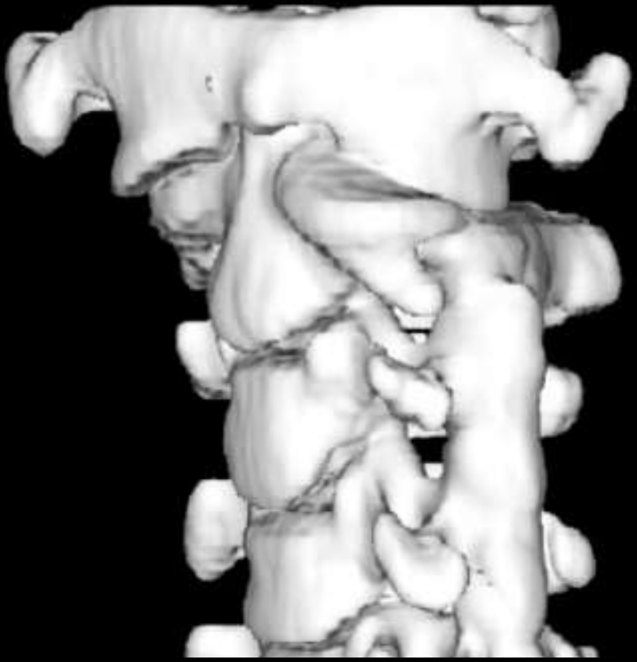
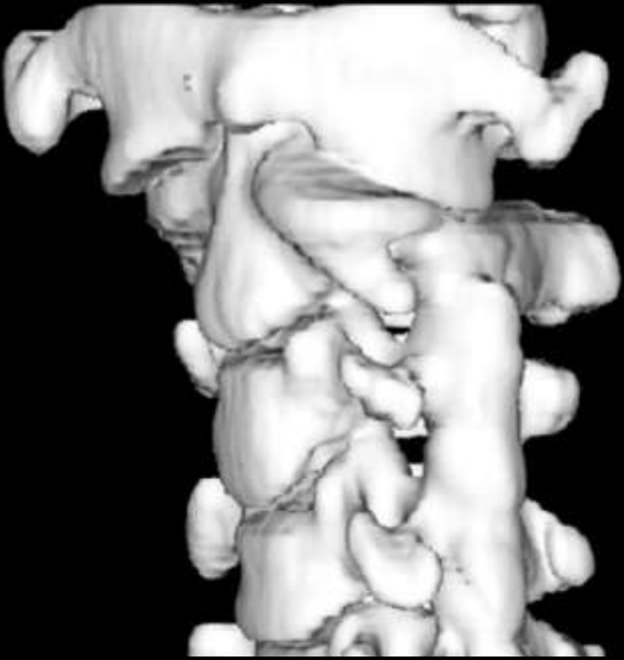
Rotary C1-2 Dislocation/Fixation



C1-2 locked 21F

Rotary C1-2 Dislocation/Fixation



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Rotary C1-2 Dislocation/Fixation

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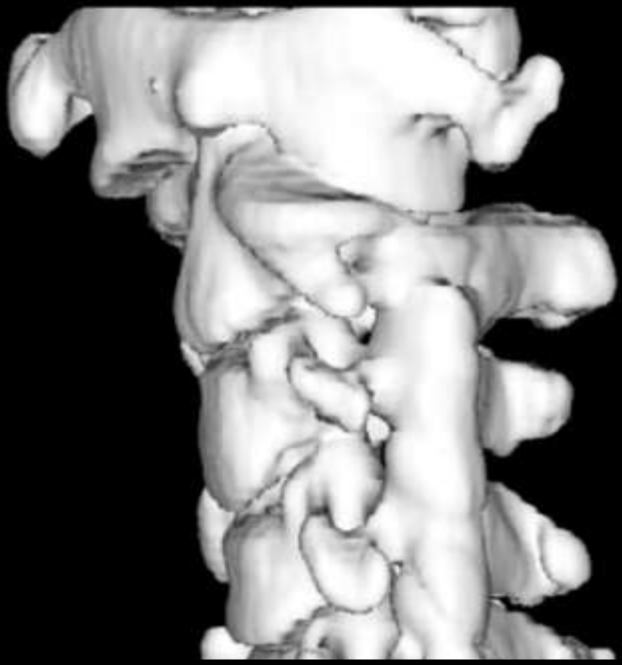
Rotary C1-2 Dislocation/Fixation



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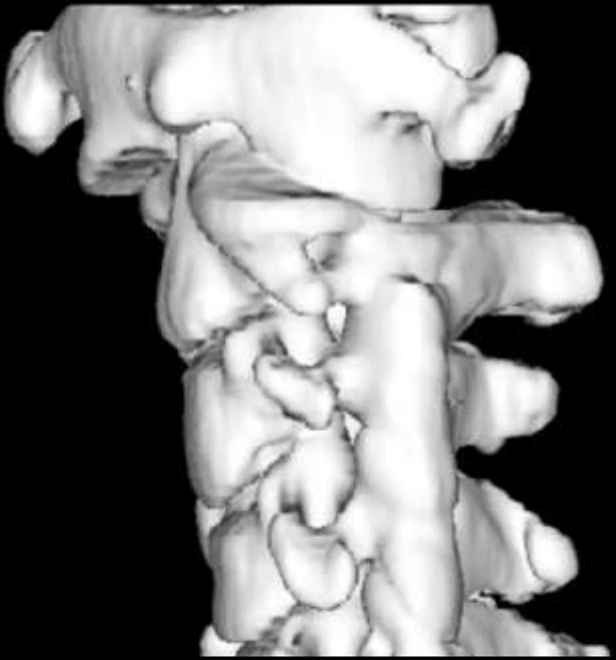
Rotary C1-2 Dislocation/Fixation



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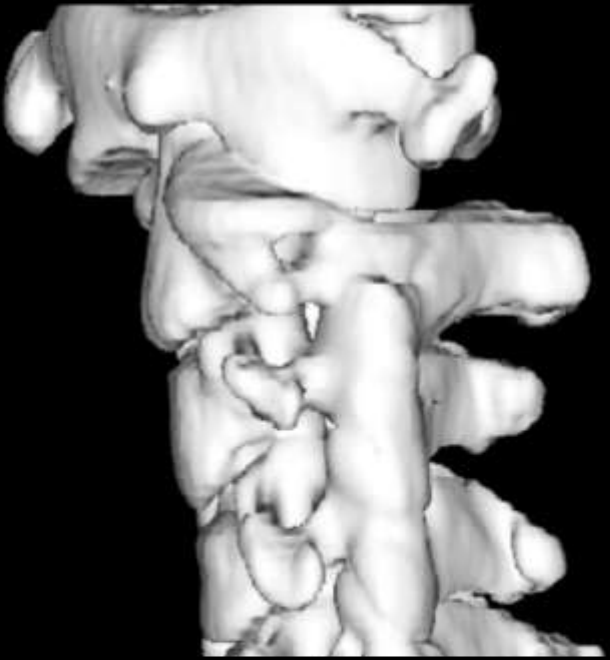
Rotary C1-2 Dislocation/Fixation



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Rotary C1-2 Dislocation/Fixation

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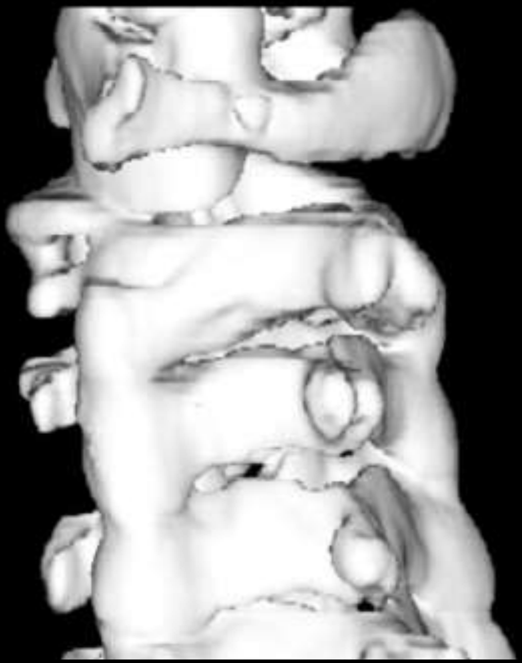

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Rotary C1-2 Dislocation/Fixation

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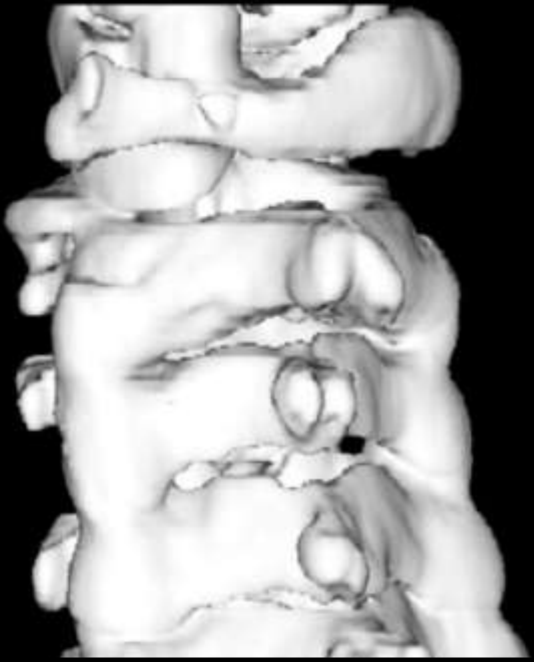
Rotary C1-2 Dislocation/Fixation



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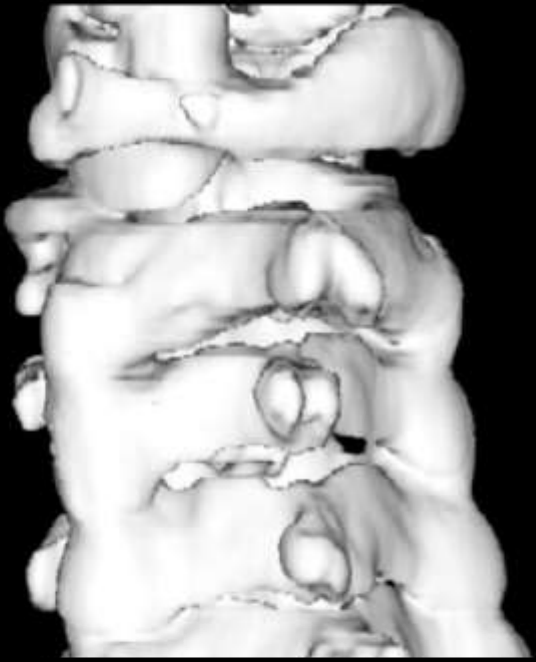

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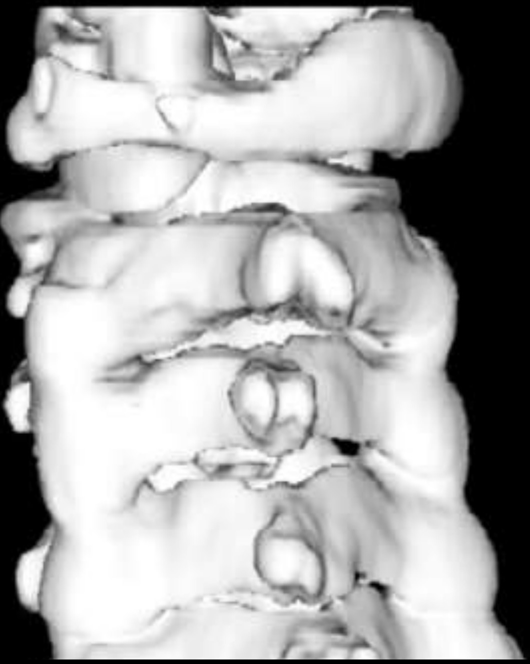

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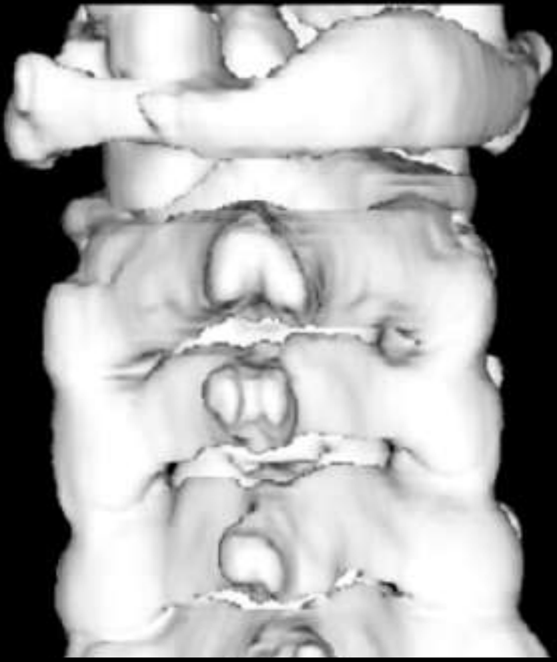
Rotary C1-2 Dislocation/Fixation



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Rotary C1-2 Dislocation/Fixation

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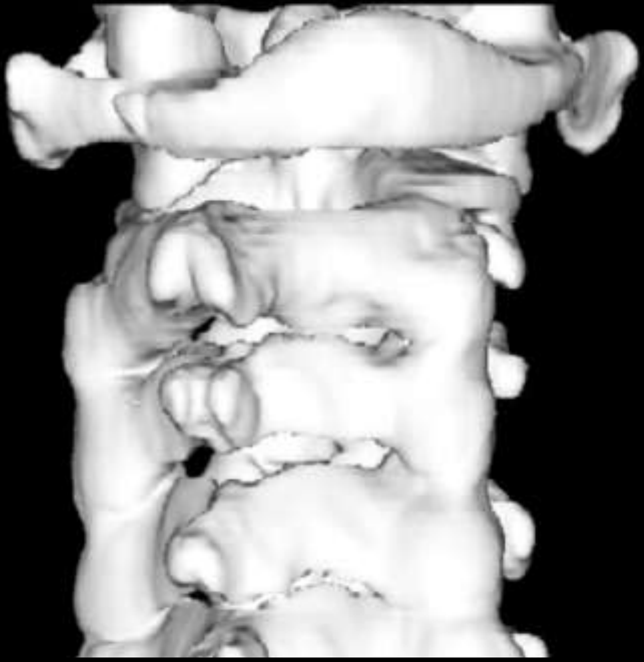

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Rotary C1-2 Dislocation/Fixation

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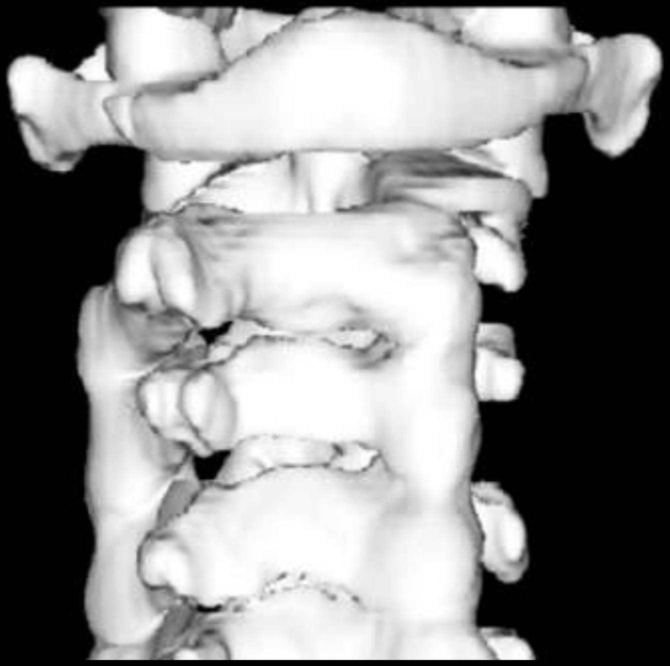

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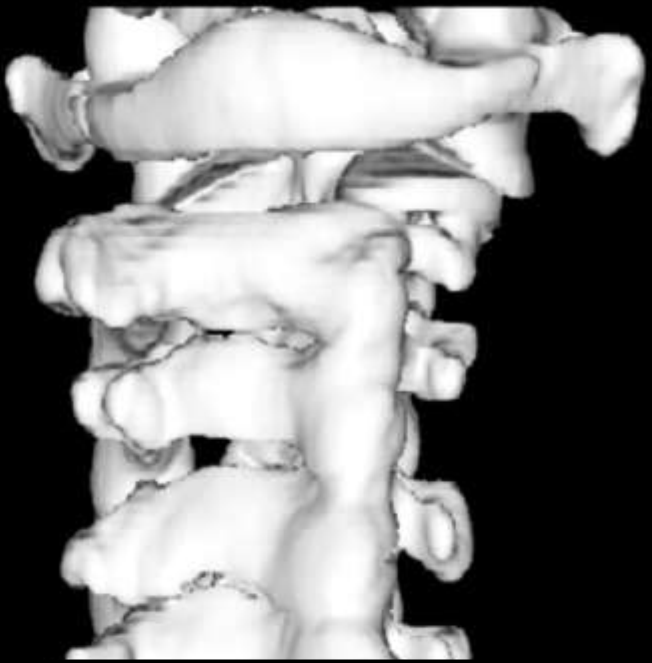
Rotary C1-2 Dislocation/Fixation



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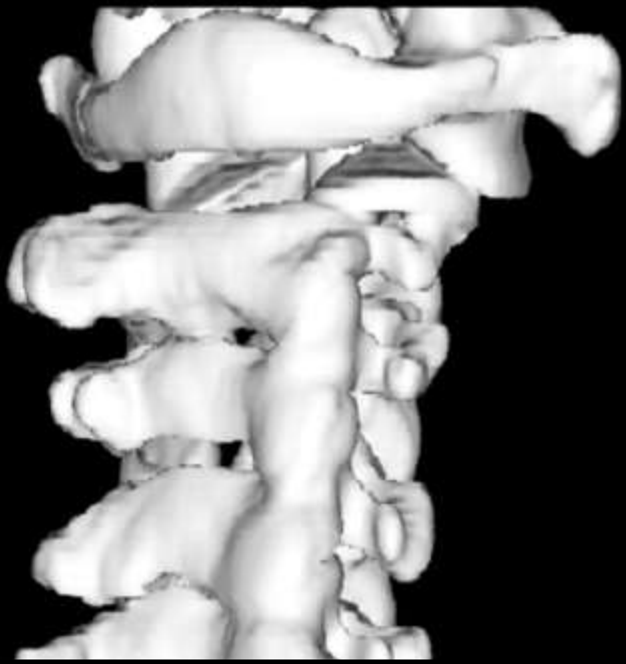

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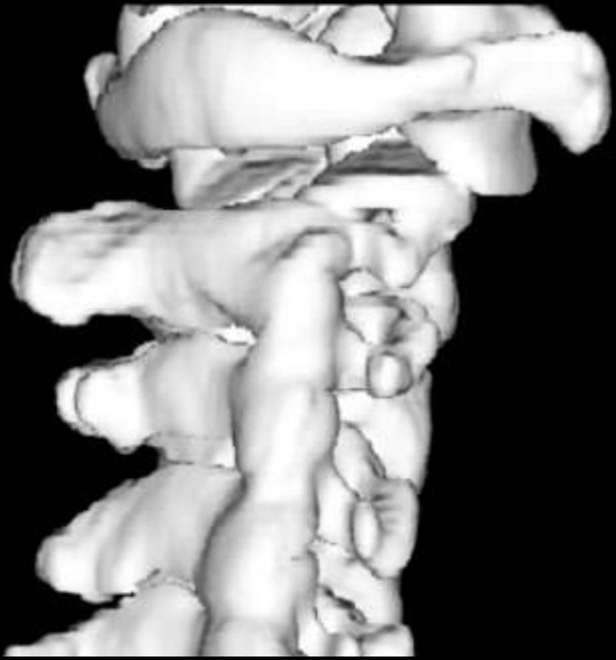

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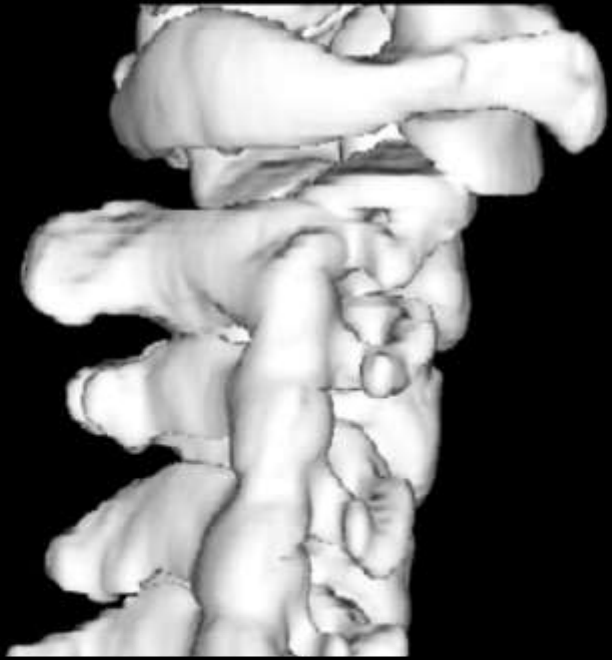

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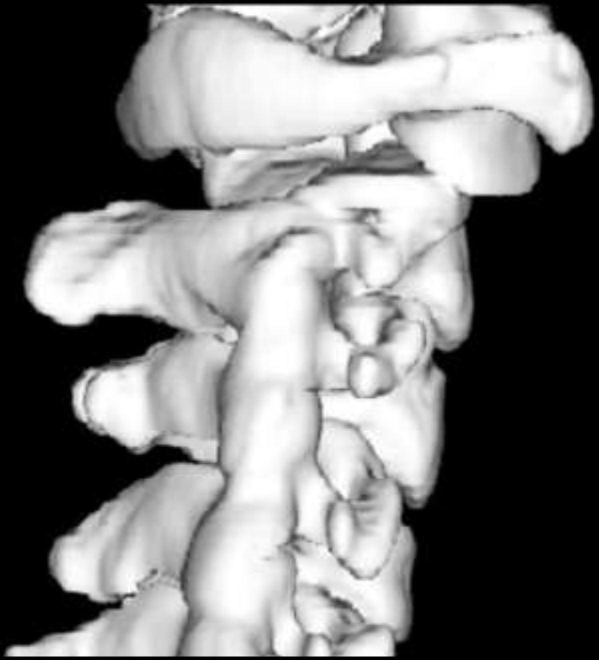

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