Upper Cervical Spine - Occult Injury and Trigger for CT Exam

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Introduction

- Failure to recognize and diagnose injury to the upper cervical spine on plain radiographs can lead to dramatic and devastating consequences to the patient especially and to the radiologist.

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Introduction

- CT examination of the cervical spine aids and significantly improves diagnoses in many instances. Unfortunately it is neither economically feasible nor desirable to obtain CT on all patients

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Introduction

- Meticulous attention to detail and zero tolerance for deviations from the usual radiographic landmarks will help select cases that should obtain additional imaging in form of CT or MRI scans.

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Initial Factors in Spinal Trauma Evaluation

- Can a patient be cleared based on clinical examination.
- What plain radiographs should be taken.
- When to utilize additional modalities such as CT or MRI.

Clinical Clearance of Cervical Spine Injury Criteria

- Fully alert and oriented without mental status changes secondary to trauma, drugs or alcohol.
- No neck pain.
- No neurologic symptoms attributable to spine injury (paralysis, paresis, paresthesis).
- No history of head injury or loss of consciousness.
- No distracting injury (e.g. fractured arm).

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Clinical Clearance of Cervical Spine Injury Criteria cont'd

- If the conditions described on preceding slide are met, cervical spine can be cleared clinically.
- However, it is not always possible to determine if there was indeed head injury or loss of consciousness at time of accident due to lack of witnesses.
- Therefore radiographic evaluation is employed.

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Plain radiographs

- Overall up to 20% percent of cervical spine fractures are missed.
- Open mouth views are inadequate in unconscious patients.
- Lower C-spine frequently requires multiple repeats to visualize the C7-T1 junction.
- Current guidelines for clearing the C-spine can assist the inexperienced radiologist.

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Radiographic Evaluation

- An initial cross-table lateral film of the cervical spine is obtained as part of the trauma workup in many institutions.

  This is often inadequate as cranio-cervical and cervico-thoracic junction is poorly visualized and additional views are necessary.

Standard C-Spine Series

- An evaluation of cervical spine must include the following 3 views:
  1. lateral view
  2. anteroposterior view
  3. odontoid view

Lateral View

- Base of the occiput should be visualized
- Junction of C7-T1 must be visualized
- A swimmer's view taken with one arm extended over the head can be helpful

Anteroposterior View

- Must include the spinous processes of all the cervical vertebrae from C2 trough T1.

Odontoid View

- Must show relationship of the lateral masses of C1 and the odontoid process.
- If the patient is unconscious, an adequate odontoid view is not possible and a CT scan should be obtained.

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Cervical Spine Series

- A cervical spine series that lacks any one of the mentioned views or that does not cover the cervico-thoracic junction is inadequate and patient must remain immobilized until clearance can be obtained by other means such as CT.

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Cervical Spines Norms

Predental space	■3mm or less (4-5mm in children)
C2-C3 pseudosubluxation	■3mm or less (4-5mm in children)
Retropharyngeal space	■< 6mm at C2 ■< 22mm at C6 ■For children 1/2 to 2/3 vertebral body distance anteroposteriorly
Angulation of spinal column at any single interspace level	■< 11 degrees
Cord dimension	■10-13mm

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Normal Cervical Spine

RP = retropharyngeal space

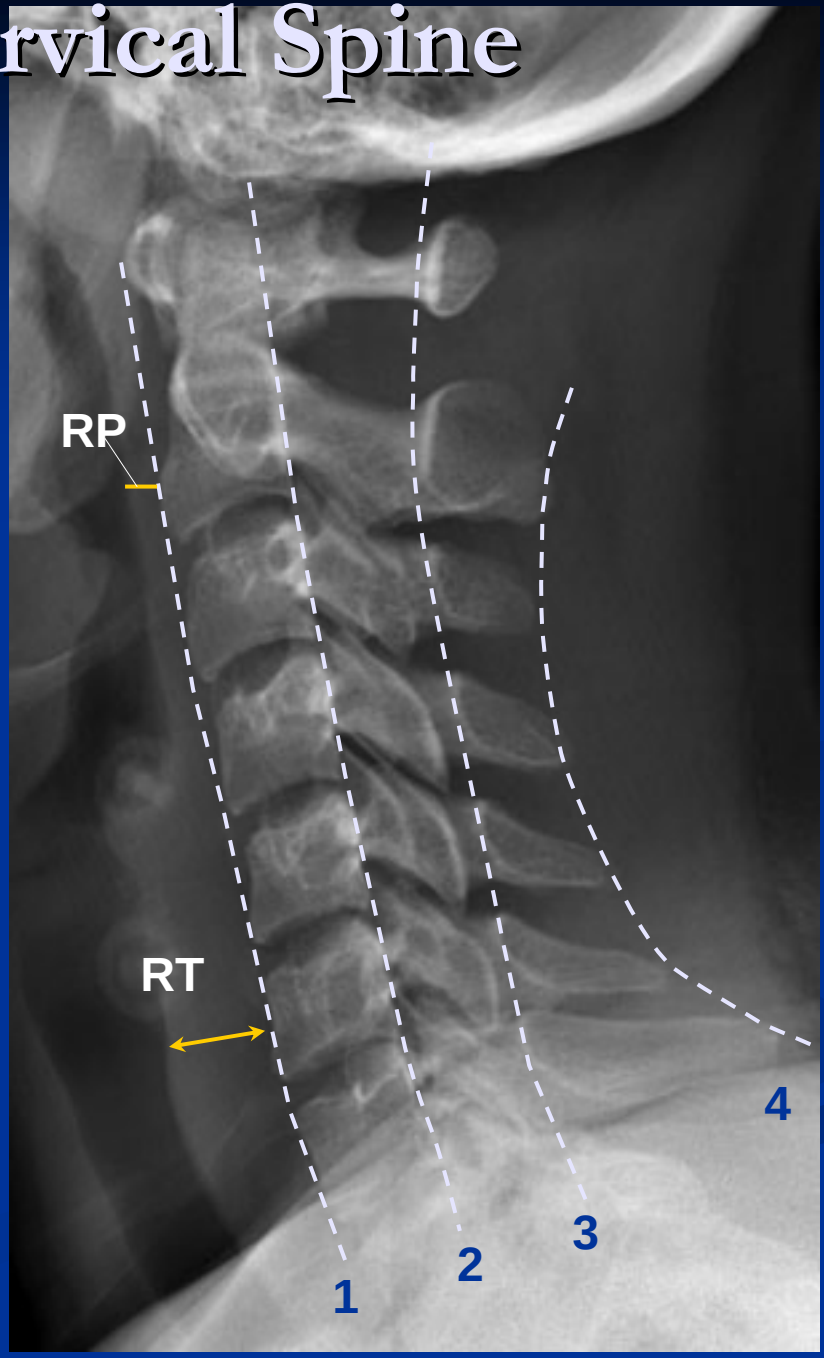
RT = retrotracheal space

1 = anterior vertebral line

2 = posterior vertebral line

3 = spinolaminar line

4 = posterior spinous line



Lateral View

- Four lines should be examined:
  - Anterior spinal line (1)
  - Posterior spinal line (2)
  - Spinolaminar line (3)
  - Posterior spinous process line (4)
- Any malalignment indicates an occult fracture or ligamentous injury and should trigger a CT scan.

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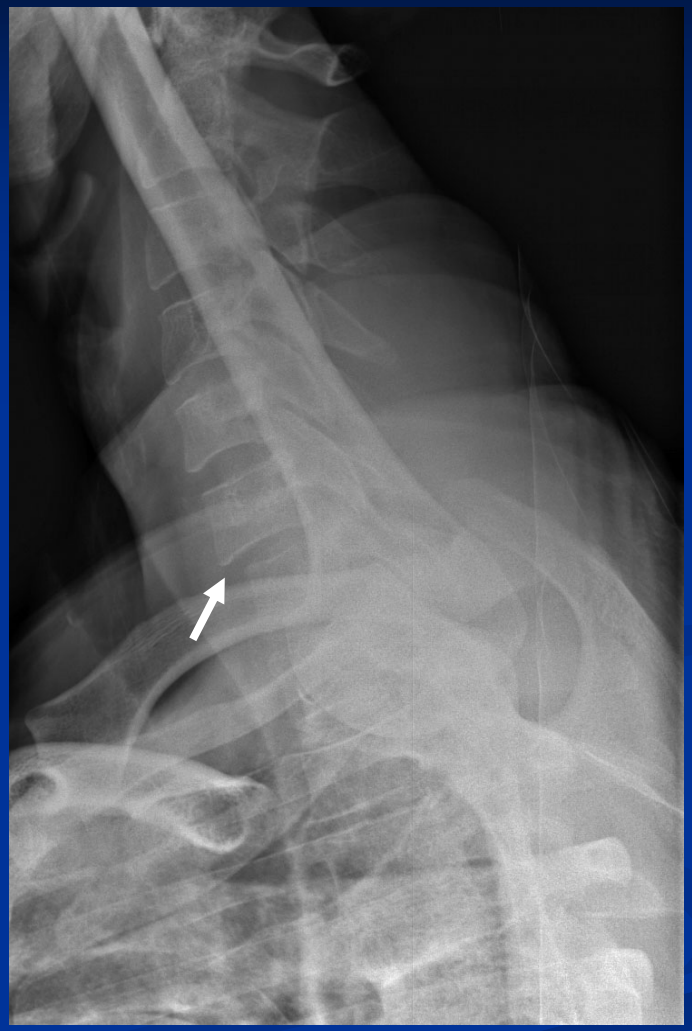
Case 1

Lateral view does not show the cervico-thoracic junction



Swimmer's view shows antero-listhesis of C-6 on C-7 of > 3mm

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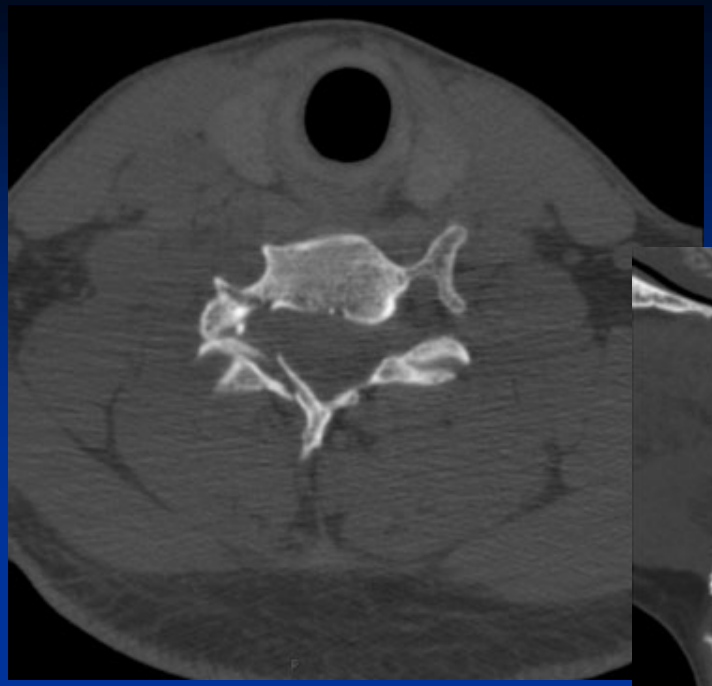
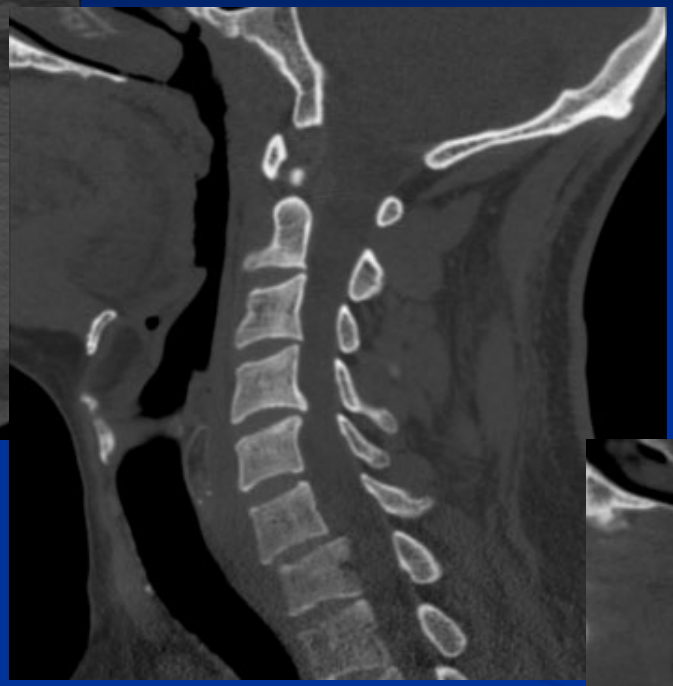
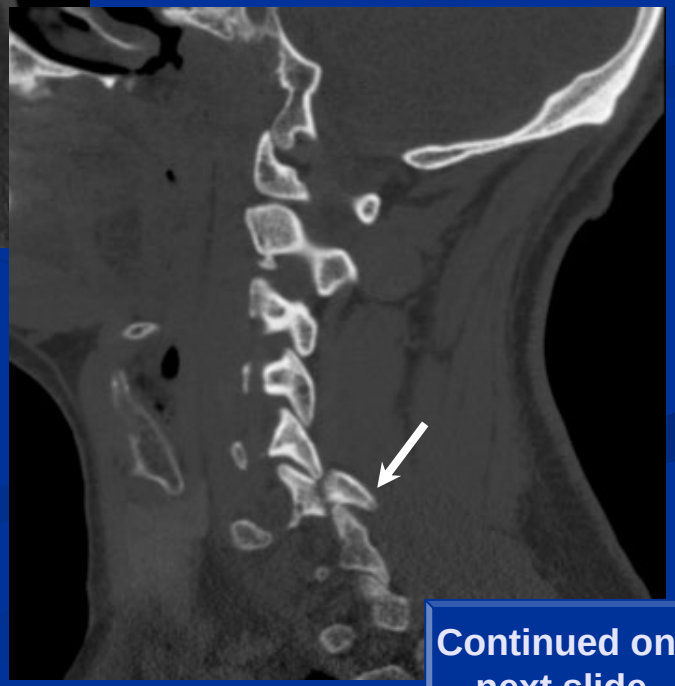
Case 1







Images show right-sided pedicle and lamina fracture, facet joint separation and leftward rotation in a jumped facet.

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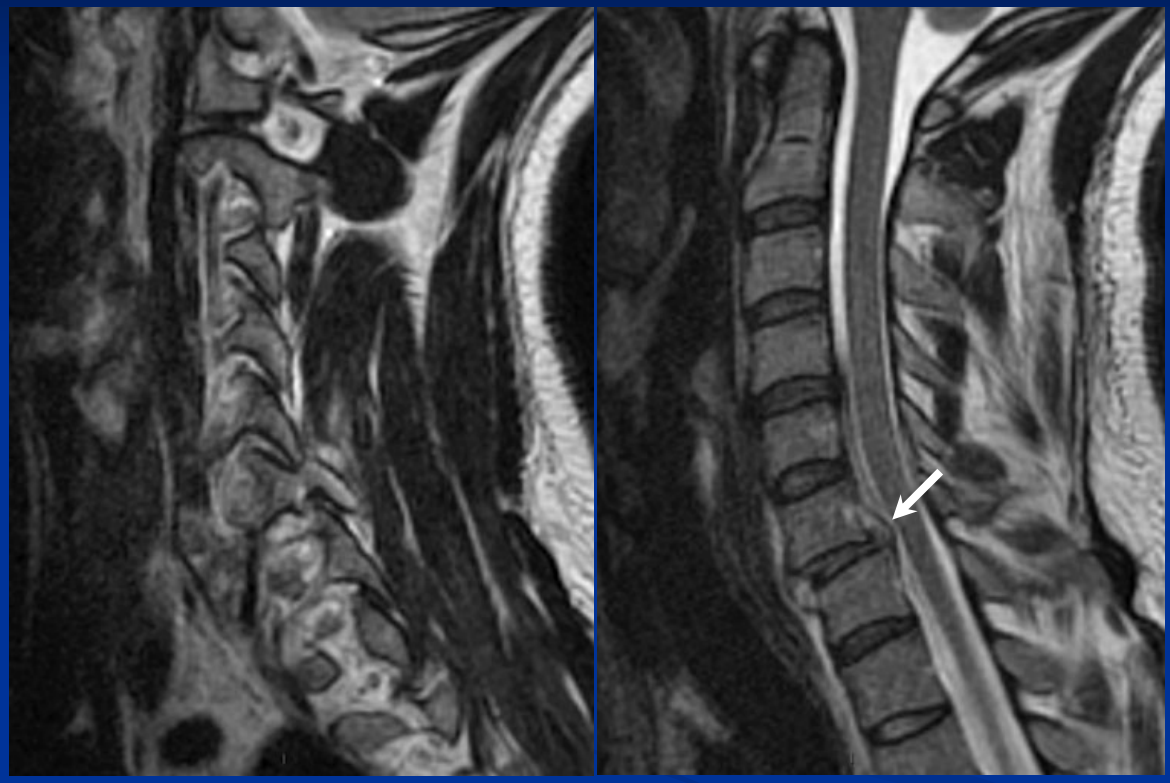
Case 1

CT of thoracic spine
T4 compression fracture and spinous process fracture



MRI evaluation shows no cord injury, but tear of the anterior and posterior longitudinal ligaments

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Teaching Points 1-1

- Must visualize through C7-T1.
- A translation of >3.5mm is significant anywhere.
- Anterior subluxation of one vertebra on another indicates facet disruption. Less than 50% of the width equals unifacet and more than 50% bilateral facet disruption.

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Teaching Points 1-2

- This case also demonstrates another crucial point.
- If a fracture of cervical spine is seen, complete CT evaluation of C, T, and L-spine is required to rule out additional fractures.
- 5% of spinal injuries have a second fracture elsewhere in the spine.

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Teaching Points 1-3

- The spinous processes are examined for evidence of interspinous space widening – “fanning”.
- Fanning indicates ligamental injury or an occult fracture and should trigger a CT exam.

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Case 2

Open mouth and lateral views show less than 3mm anterolisthesis of C4 on C5, likely degenerative. However prevertebral soft tissue space is
> 6mm which should trigger a recommendation for a CT exam.

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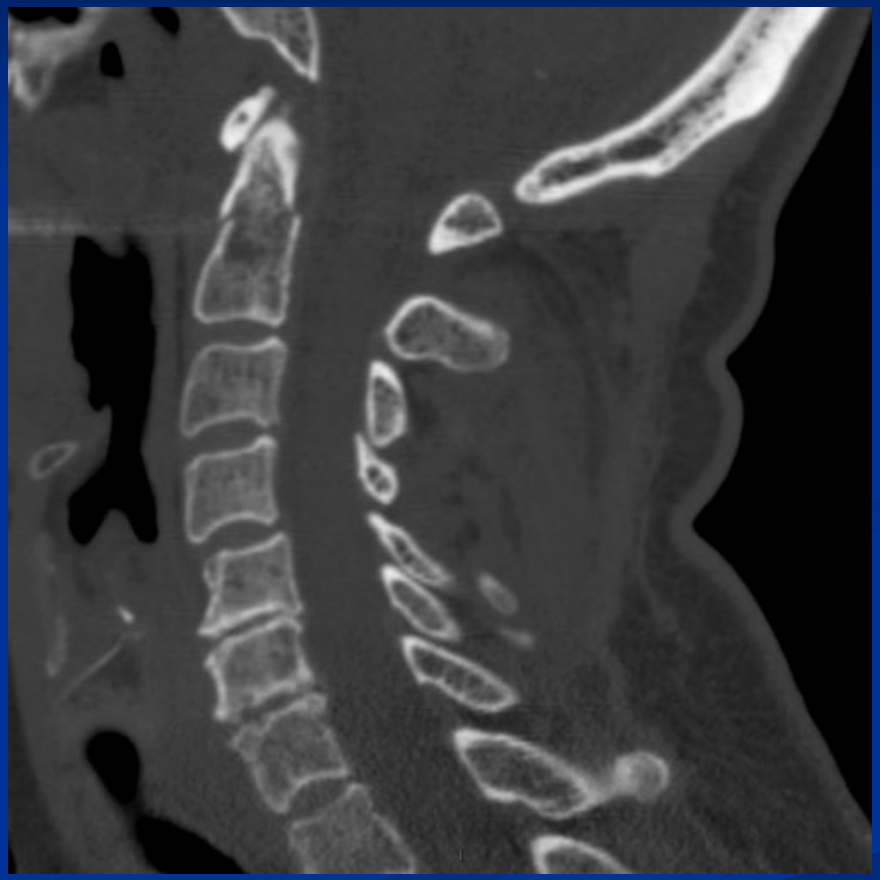
Case 2



CT images show fracture extends into body of dens (type III)

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Teaching Points - 2

- The predens space should be less than 3mm for adults and less than 4mm in children.
- Increase in prevertebral soft tissue space at C2 and C6 is very specific, but not sensitive.
- Increased distance should trigger a CT exam to exclude occult pathology.

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Case 3

Plain film radiograph shows prevertebral soft tissue swelling at C2 and C6 level and fracture of the dens.

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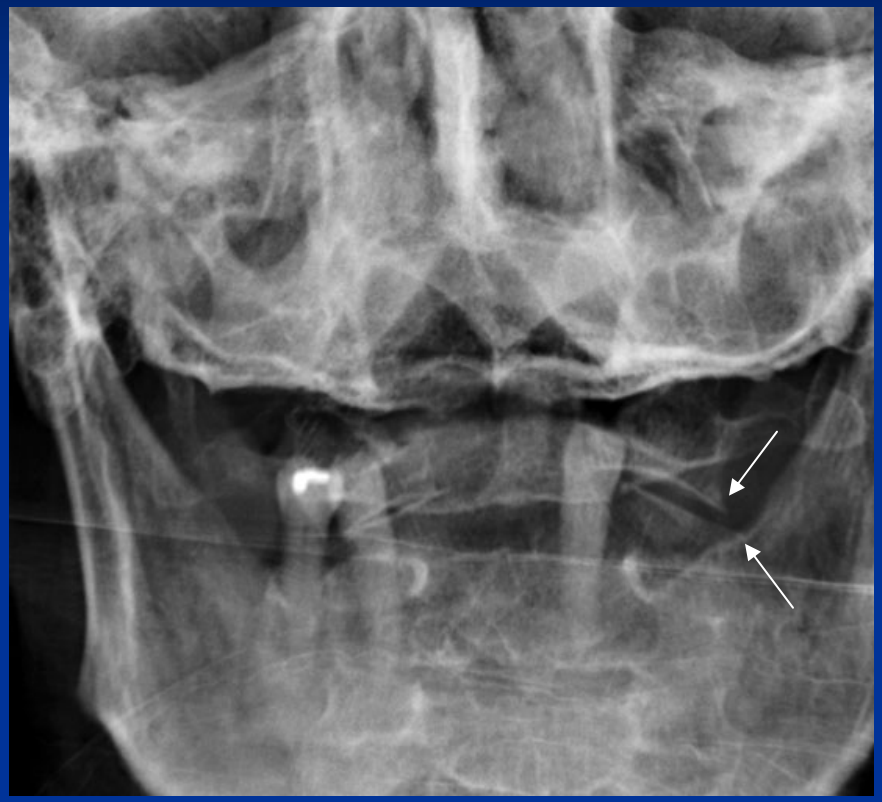
Case 3



Images show malalignment of lateral masses on the left.

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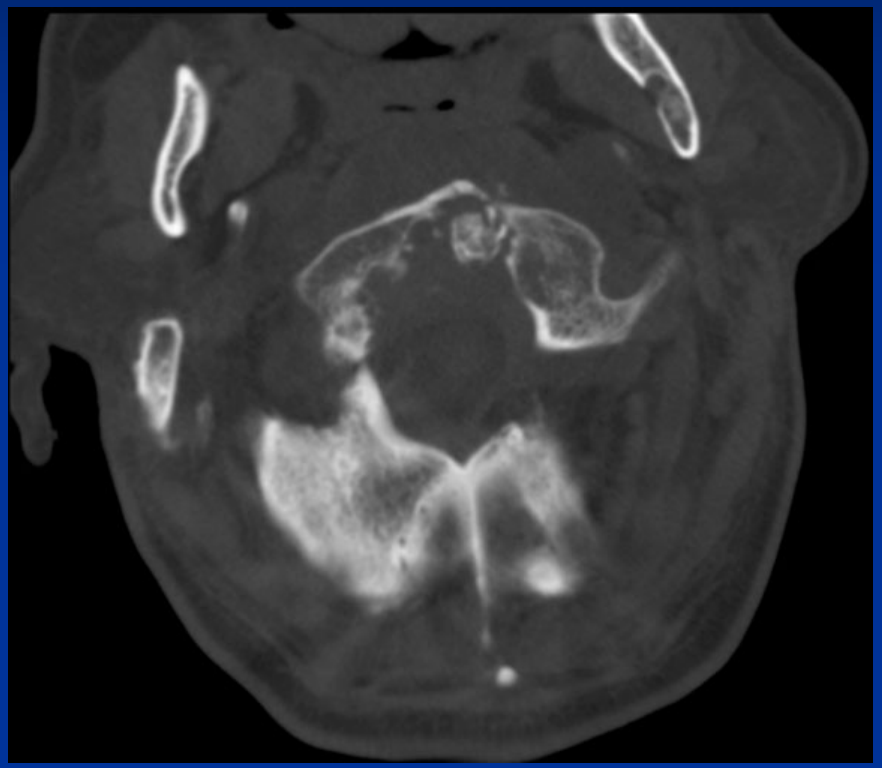
Case 3



CT images show fractures of the dens and anterior arch of C1 with soft tissue swelling.

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Teaching Points - 3

- Lateral masses of C1 should align with lateral masses of C2.
- The space on each side of dens should be symmetric.
- On an AP view cervical spines should align in midline.

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Case 4

Plain films which show lucent line running through body of C2 and a very subtle lucency through the pedicles/posterior elements of C2.

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Case 4

CT images show fracture through the pedicle of C2 with extension to the body.

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Case 5

Lateral view of the C-spine shows lucency at the posterior aspect of the body of C2 and indistinct posterior margin of dens. Fracture of C2 was suspected.

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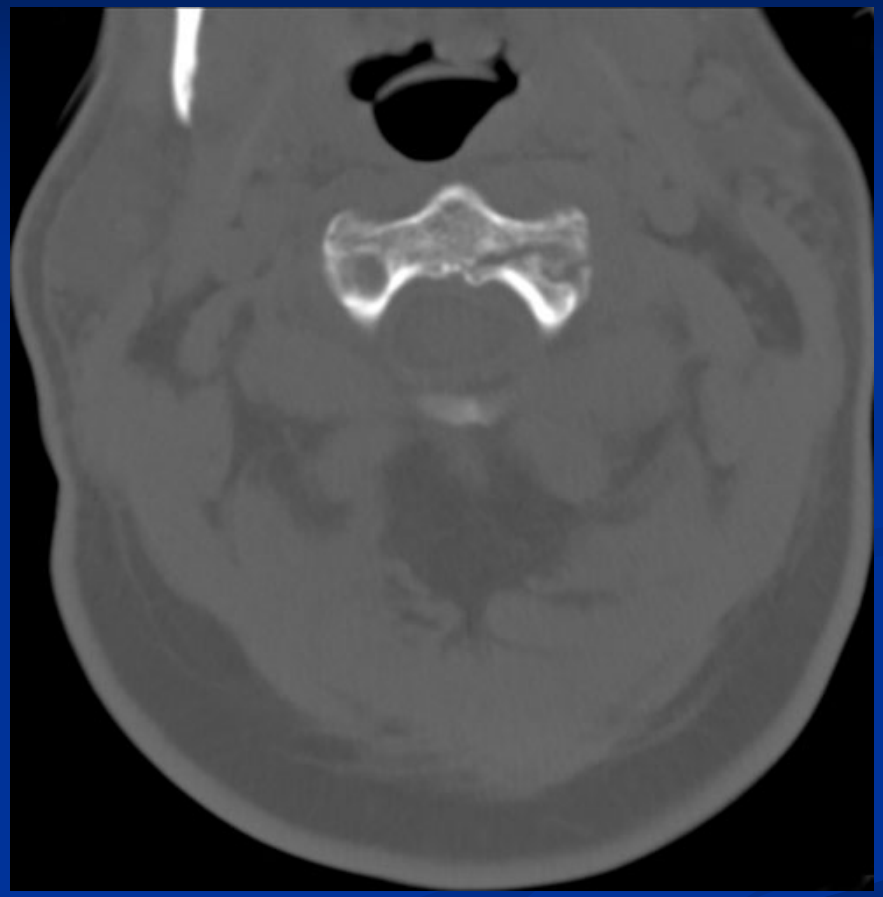
Case 5



Images show fracture of left lateral mass of C2 with extension to foramen transversarium.

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Case 5

MRA showed no injury to left vertebral artery.

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Teaching Point - 4

- Posterior elements of C2 and body of C2 can harbor tell tale signs of fractures, but can be extremely difficult to recognize. If suspected, a CT scan should be obtained.

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Conclusion

- Faced with a task of clearing a cervical spine, a number of options are available.
  - The first discriminator is whether or not the patient can be cleared clinically.
  - If that is not possible, radiographic evaluation is needed.
  - Strict adherence to a minimum three view plain radiograph C-spine series must be maintained.
  - Deviation from established parameters for cervical spine radiographs should trigger a CT for additional evaluation.

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References

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