

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.

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

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.

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).

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.

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.

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 through 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.

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.

Cervical Spines Norms

Predental space	<ul style="list-style-type: none">• 3mm or less (4-5mm in children)
C2-C3 pseudosubluxation	<ul style="list-style-type: none">• 3mm or less (4-5mm in children)
Retropharyngeal space	<ul style="list-style-type: none">• < 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	<ul style="list-style-type: none">• < 11 degrees
Cord dimension	<ul style="list-style-type: none">• 10-13mm

Normal Cervical Spine

RP = retropharyngeal space

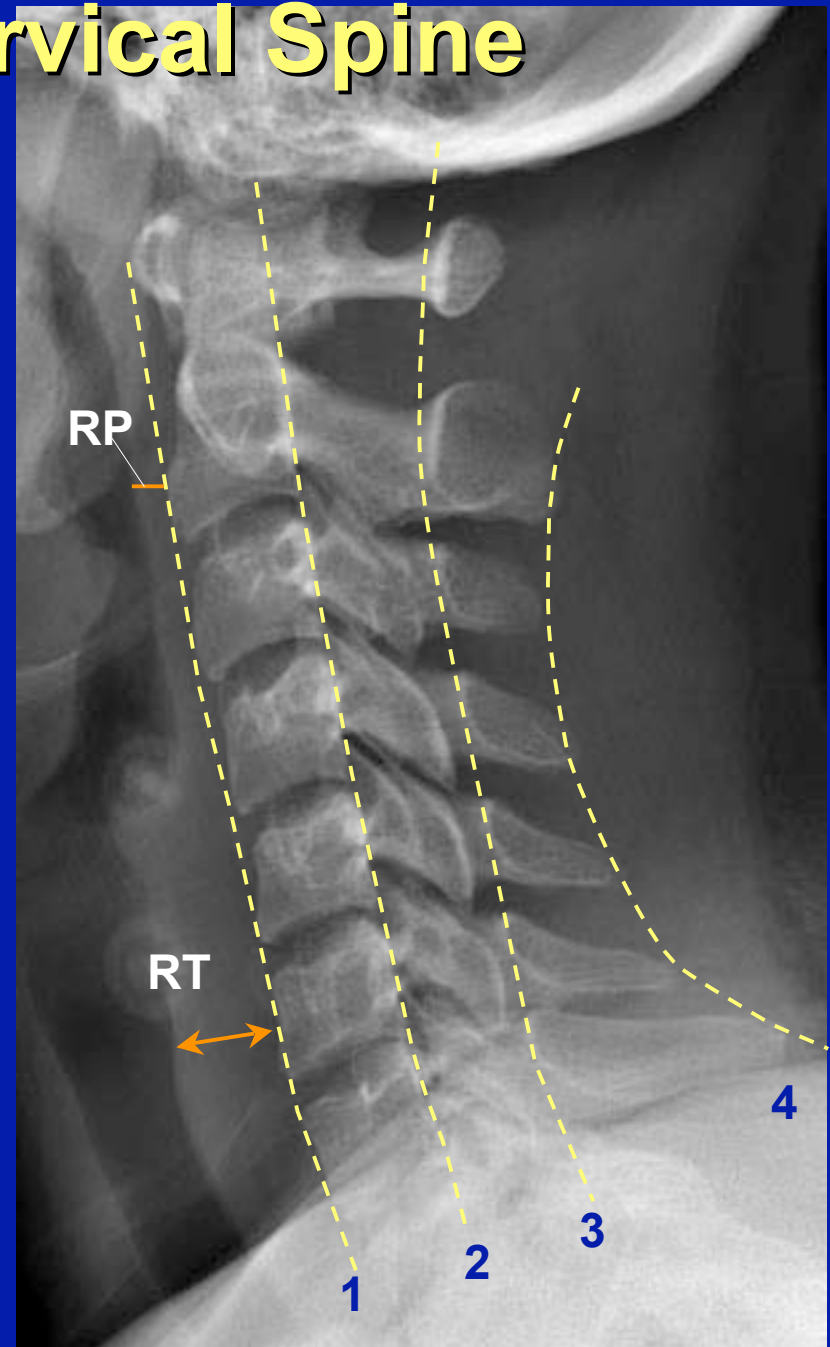
RT = retrotracheal space

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.

Case 1

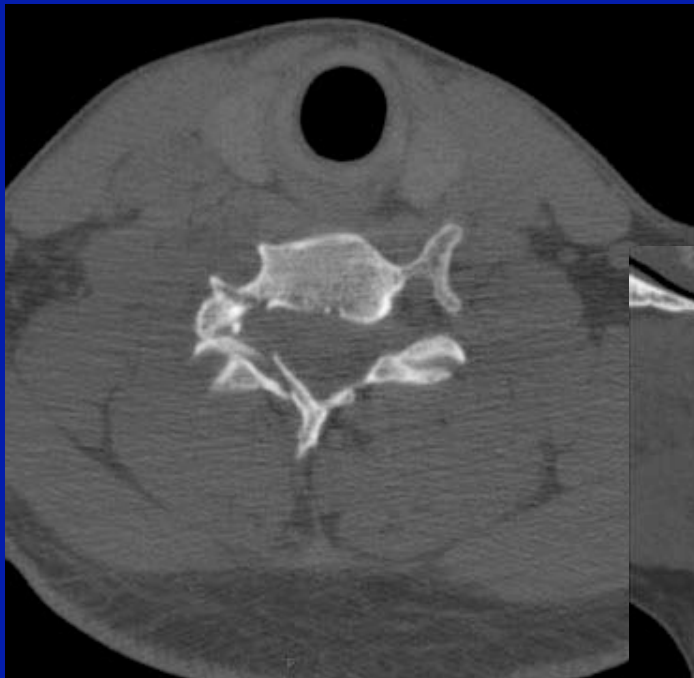


Lateral view does not show the cervico-thoracic junction



Swimmer's view shows anterolisthesis of C-6 on C-7 of $> 3\text{mm}$

Case 1



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

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

Teaching Points 1-1

- Must visualize through C7-T1.
- A translation of $>3.5\text{mm}$ 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.

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.

Teaching Points 1-3

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

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.



Case 2



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

Teaching Points - 2

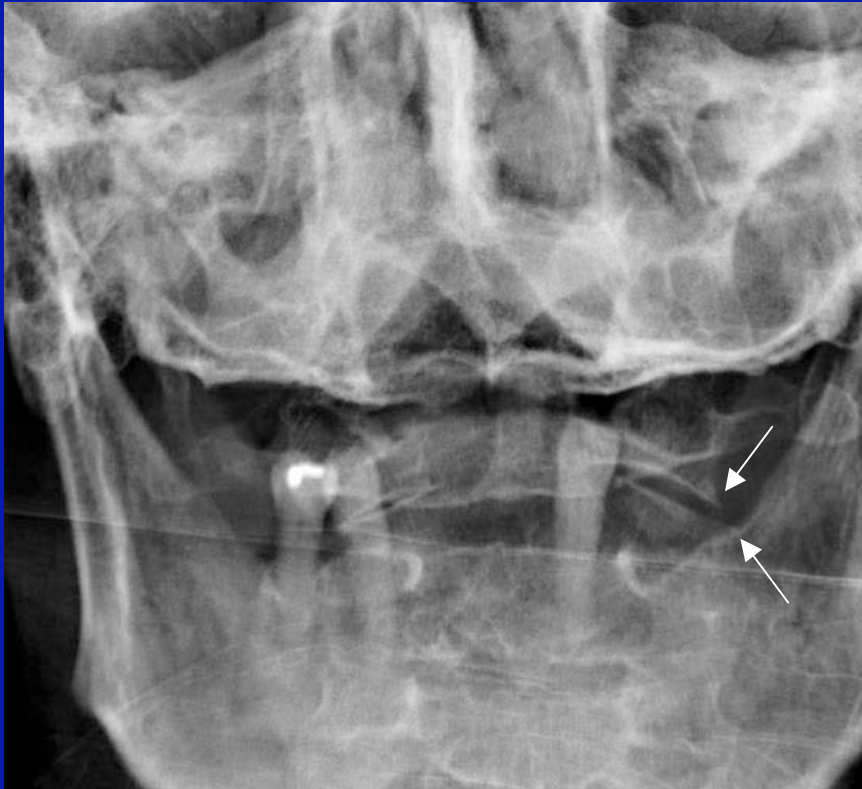
- The predens space should be less than 3mm for adults and less than 4mm in children.
- Increase in prevertebral soft tissue space at C2 and C6 is very specific, but not sensitive.
- Increased distance should trigger a CT exam to exclude occult pathology.

Case 3

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

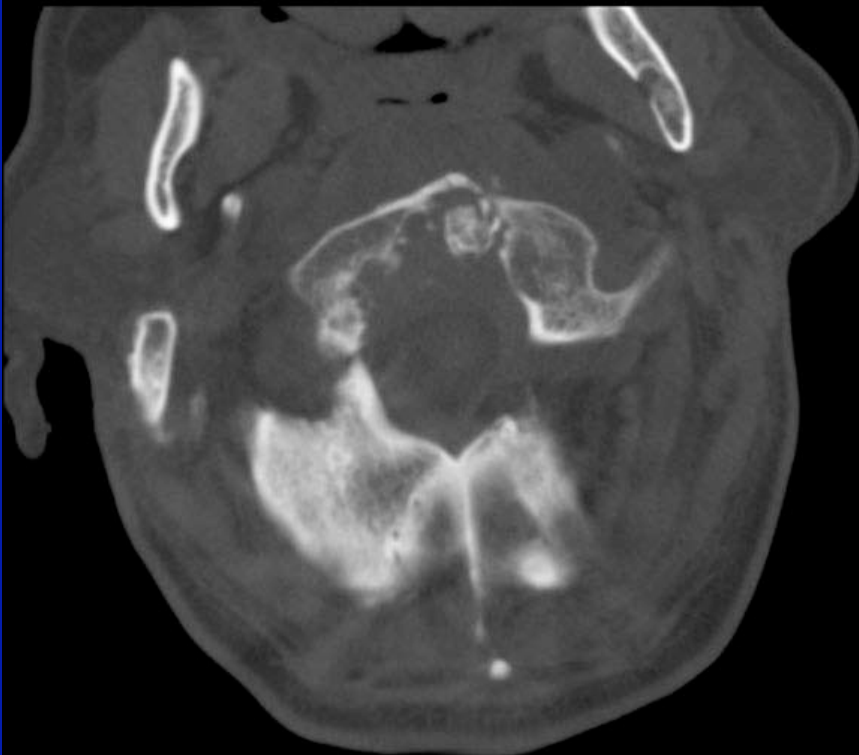


Case 3



Images show malalignment of lateral masses on the left.

Case 3



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

Teaching Points - 3

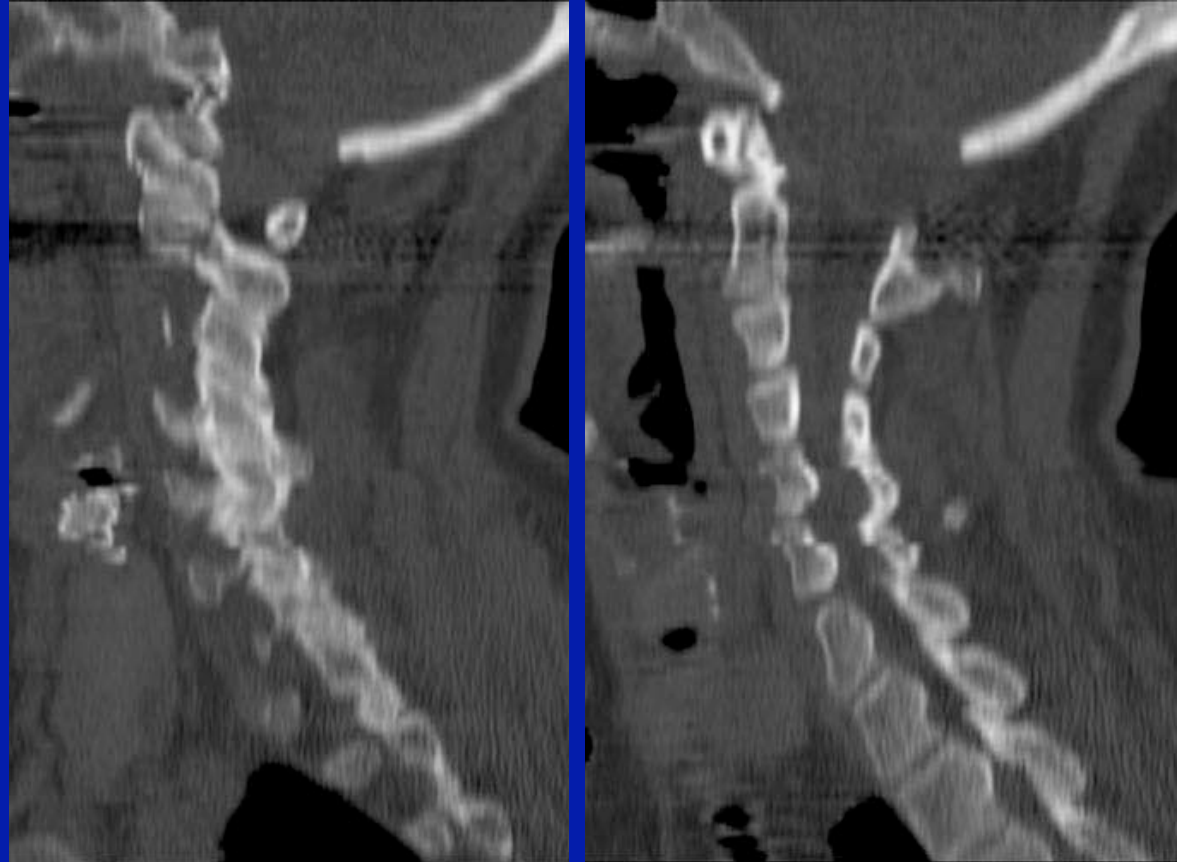
- Lateral masses of C1 should align with lateral masses of C2.
- The space on each side of dens should be symmetric.
- On an AP view cervical spines should align in midline.

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.

Case 4



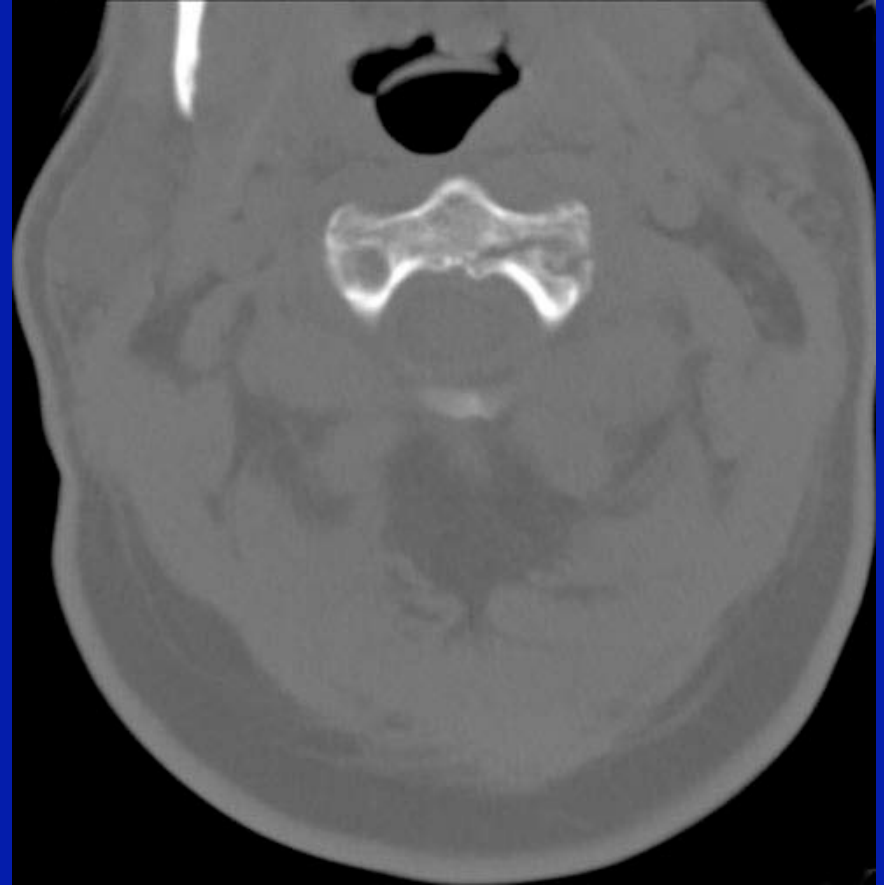
CT images show fracture through the pedicle of C2 with extension to the body.

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.



Case 5



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

Case 5

MRA showed no injury to left vertebral artery.



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.

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.

References

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