The occasional c-spine x-ray

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This article has been peer reviewed.

Introduction

X-rays are used in conjunction with the clinical examination to "clear" the c-spine in patients who present with multiple trauma, head injuries with neck pain, and those who have altered levels of consciousness and unknown injuries. Recently, the "Canadian C-spine Rule" was published to help identify patients who may NOT require a c-spine x-ray.[1]

A lateral c-spine view can detect 60% to 80% of fractures.[2] Anterior–posterior (A–P) and open-mouth odontoid views improve the sensitivity to 80% to 95% or better.[3,4] For those of us who only occasionally interpret c-spine films, oblique views can make it much easier to detect certain injuries. Occasionally, fractures poorly seen on other views will be seen with flexion or extension. Adding a CT scan increases the sensitivity to 95% to 100%;[2,3] however, plain films are better than CT for detecting some injuries.[5]

Serious multiple injuries often require urgent treatment. Frequently, the c-spine is not cleared until after the patient is transferred to the referral centre.

Classification of c-spine fractures

For those who infrequently read these x-rays, there are 2 types of fractures: easy to find and hard to find.

1. Easy to find:
- C3–C6 flexion/extension injuries.

2. Hard to find:
- rotatory subluxations
- upper c-spine fractures – C1 & C2
- fractures in non-visualized C6 or C7

Most of these injuries can be detected or suspected in a lateral c-spine film and confirmed on other views.

Systematic interpretation

A systematic approach can help the physician to confidently determine whether a radiographic abnormality is visible.

Step A

Start with lateral c-spine (Fig. 1). Leave the patient on the stretcher or backboard with the hard collar on while this x-ray is being taken.

A1

Check for adequacy of the film. All of C7, and the top of T1 should be visible. The lower levels need to be visualized before the patient can be discharged with a cleared c-spine.[6] On the other hand, if a fracture is visible on an "inadequate" film there is no need to risk further injury by moving the patient to get more views.

A2

Check the alignment. Follow the 4 lines indicated on the diagram. Line 1 is formed from the anterior aspect of the vertebral bodies and continues to the top of the odontoid process. The anterior arch of C1 lies anterior to this line. Osteophytes often create irregularities in this line. Line 2 follows the posterior aspect of the vertebral bodies and meets Line 1 at the top of the odontoid. This line is not usually affected by osteophytes. Line 3 connects the laminae, and also marks the posterior border of the spinal canal. Line 4 connects the tips of the spinous processes. Note that C1 does not touch this line.

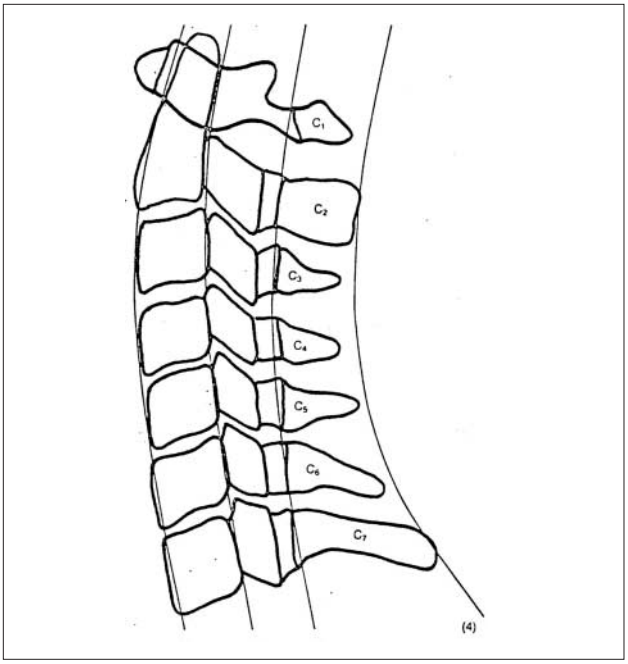

Fig. 1. Lateral c-spine view

A3

Look for soft tissue swelling (Fig. 2). In adults, the upper limit of normal is:

- 5 mm at C2
- 22 mm at C6

Next, check the space between the odontoid and C1 (atlas) anterior to it. This "atlanto-odontoid" space should be 3 mm or less.

A4

Look at the bones and disk-spaces. From C3–C7 each vertebral body should be about the same shape and size as its neighbour above and below. If the odontoid is intact on this film and the 4 lines demonstrate no abnormality, it is reasonable to proceed to more views. If normal but limited by not seeing C7, an attendant standing at the foot of the bed can pull on the patient's hands to bring the shoulders down.

If C7 cannot be seen despite arm traction, a

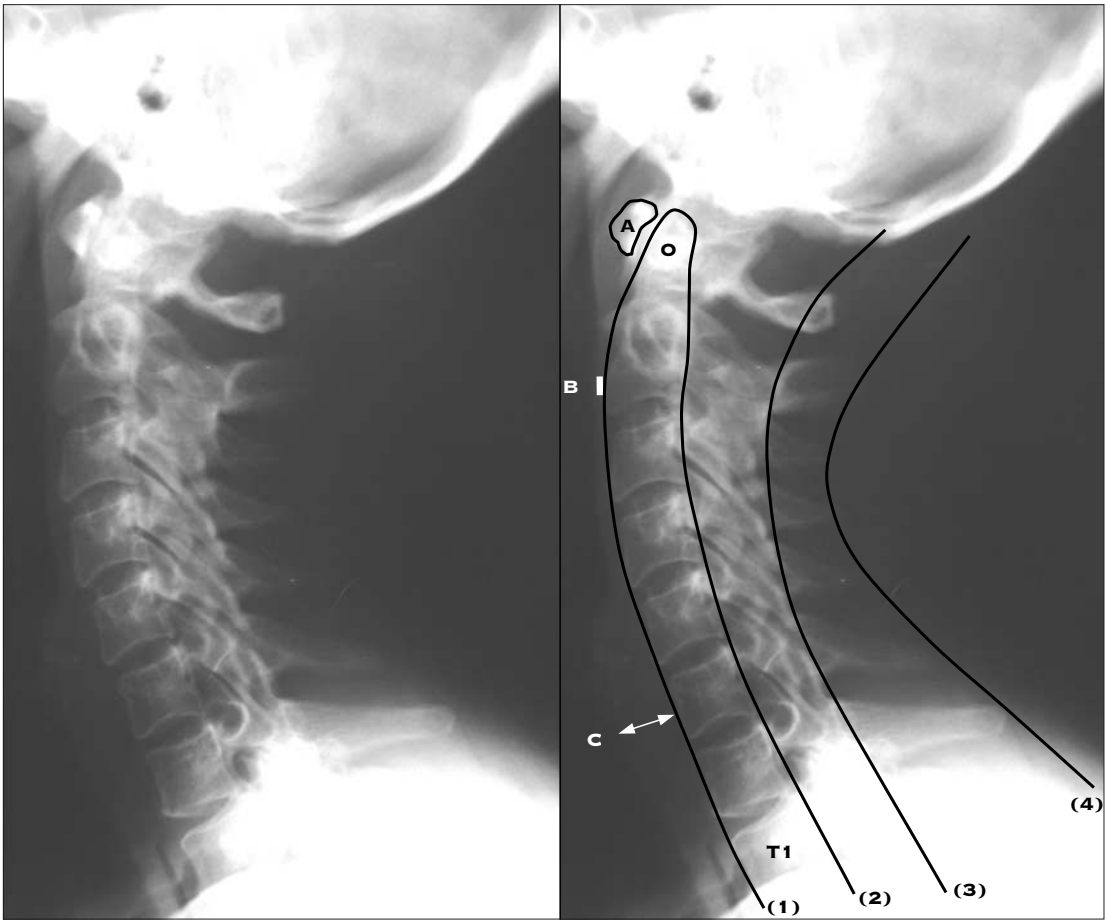

Fig. 2. Lateral c-spine:
- Adequate film: all of C7 is visible, as well as the top of T1
- All 4 lines form smooth arcs. Note that Lines 1 and 2 meet at the top of the odontoid (O). Note also that posteriorly C1 does not touch Line 4, and C1 (A) lies anterior to Line 1.
- Atlanto-odontoid space between C1 (A) and odontoid (O) is 3 mm or less.
- Soft tissue thickness anterior to C2 (B) is 5 mm or less.
- Soft tissue thickness anterior to C6 (C) is 22 mm or less.

Fig. 3. A–P view: Note the aligment of spinous processes.

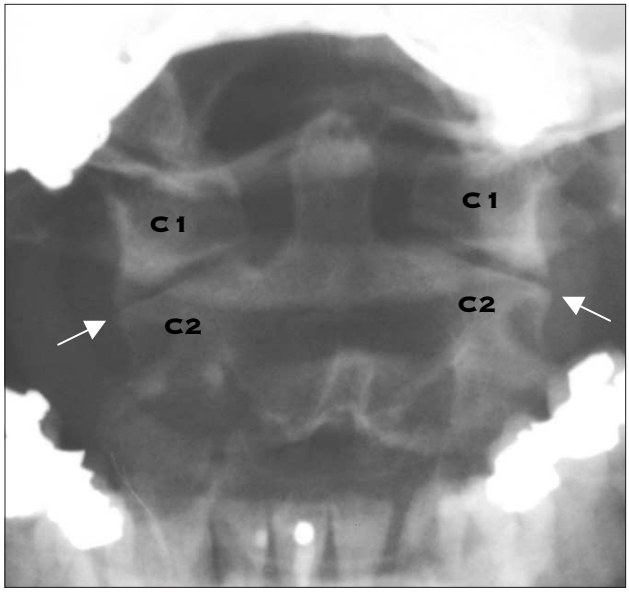

Fig. 4. Odontoid view: the lateral masses of C1 line up with the corresponding structure on C2 (indicated by arrows).

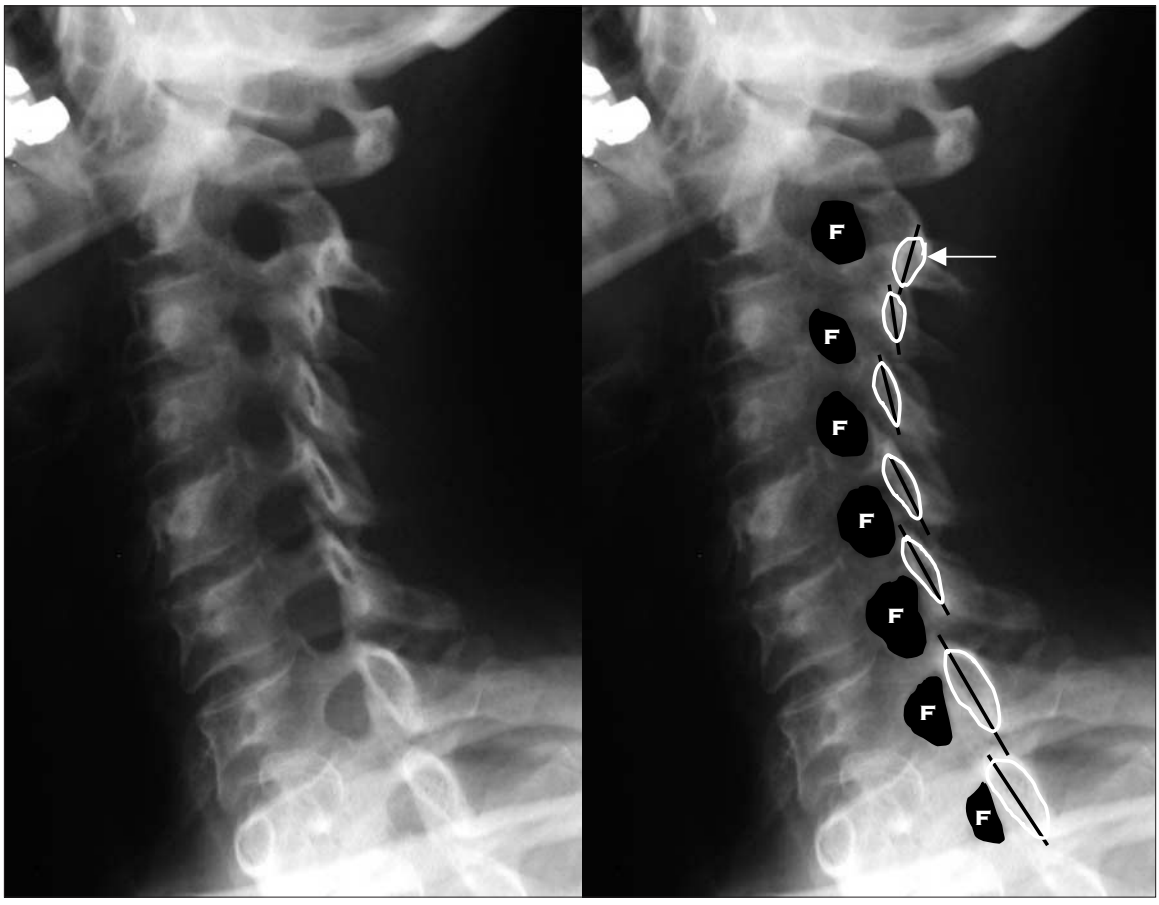

Fig. 5. Oblique view: Note the open neural foraminae (F), and the laminae (arrow) lining up like "shingles on a roof."

swimmer's view will be required. To find C6 and C7 on this view, look for vertebrae articulating with ribs, indicating thoracic levels. C6 and C7 can be identified by counting up from T1.

Step B

If the lateral is normal; remove immobilization and proceed with more views.

A–P (Fig. 3):

- look for **alignment** of the spinous processes

Odontoid view (Fig. 4):

- Check alignment of the lateral masses
- Look for odontoid fracture

Step C

Obliques (Fig. 5) are not routinely done in all hospitals. These can be useful to show unilateral facet dislocations. Look for:

- Intact foraminae. Facet dislocations often obliterate one foramen on this view.
- The laminae should line up like "shingles on a roof." This alignment is disrupted in a facet dislocation.

Flexion and extension views occasionally show injuries not otherwise seen.[7] Interpretation follows the same system as for the initial lateral c-spine view. These views can be falsely reassuring when the patient cannot adequately flex or extend the neck.[8]

Rural physicians are regularly faced with patients who have suffered trauma and have neck pain. Plain x-rays are usually the only diagnostic test available in the rural hospital. Plain films of the cervical spine have good sensitivity for fractures when compared with CT scanning. A systematic approach to interpretation can improve the confidence of rural physicians in interpreting these films. This systematic approach is summarized in Figure 6, the Checklist on page 42.

Competing interests: None declared.

References

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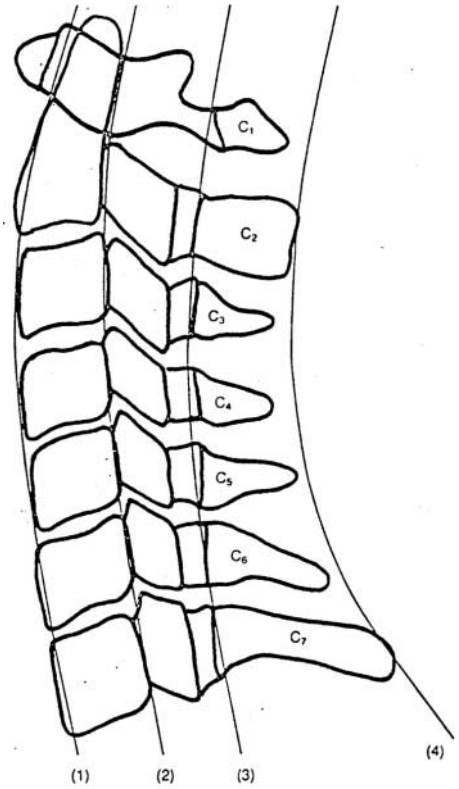
Please turn to page 42 for the C-spine X-ray Checklist.

C-spine x-ray checklist (adults)

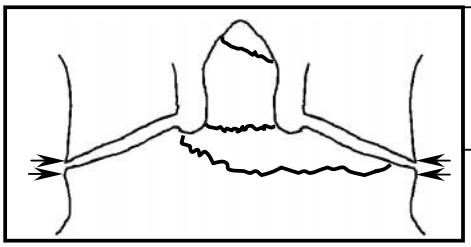


A. **Lateral c-spine** – keep hard collar on.
- ❑ adequacy of film – see all of C7, top of T1. If "No" – continue anyway. Repeat films if no fracture.
- ❑ Alignment – line 1 – continues along ant. odontoid
- ❑ Line 2 – continues along posterior odontoid
- ❑ Line 3
- ❑ Line 4 note C1 should *not* reach this line

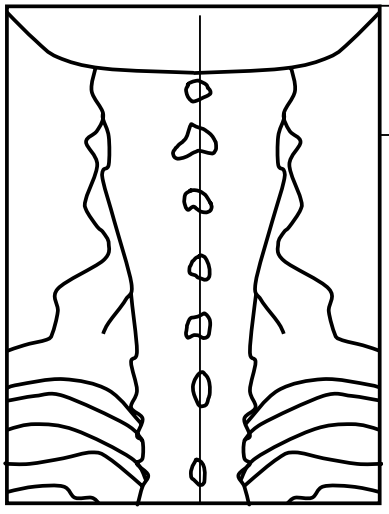
- ❑ Soft tissue thickness < 5 mm at C2
- ❑ < 22 mm at C6
- ❑ atlanto–odontoid space: 3 mm or less
- ❑ Bones – check for fractures. Shape of C3–C7 vertebral body should be approx. the same as the one above and below.

If a fracture is seen – do no further views – immobilize and transfer

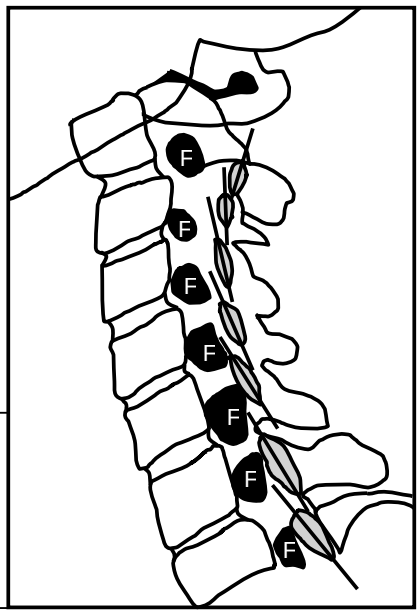
B. If lateral is normal, remove immobilization and proceed with more views



Odontoid view:
- ❑ Alignment of lateral masses (arrows)
- ❑ Odontoid fracture – 3 types shown



PA:
- ❑ Alignment of spinous processes only



C. **Obliques** –Useful for unilateral facet dislocations
- ❑ Foraminae all intact (F)
- ❑ Laminae line up like "shingles on a roof"

D. **Flexion–extension views** – for further reassurance if other views normal. Use lat c-spine checklist. Some injuries not obvious on initial lateral will be visible on a lateral view.

Fig. 6. C-spine x-ray checklist (adults)