

# Cervical spine radiology

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## Abstract

The lateral cervical spine radiograph is frequently utilized in the assessment of trauma patients and in perioperative care. Used in conjunction with a thorough clinical assessment it can demonstrate an unstable spine, be it due to trauma or rheumatological disease thus alerting the anaesthetist of the need for advanced precautions in airway management. In this article we review a systematic approach to the lateral cervical spine radiograph focussing on unstable cervical spines.

**Keywords** ankylosing spondylitis; cervical spine radiograph; rheumatoid arthritis; trauma

Readers will be aware of the potential for cervical cord injury during airway management in a patient with an unstable cervical spine be it due to traumatic or non-traumatic causes such as rheumatological disease. The lateral radiograph forms a frequently utilized and readily available initial imaging approach. This may be in the trauma series of radiographs that typically include the lateral cervical spine, chest and pelvis in the setting of acute injury or with flexion–extension views performed as part of planned pre-anaesthetic care.

## Trauma

The trauma series lateral spine radiograph is commonly used to assess alignment of the cervical vertebrae by tracing a series of three curved or arcuate lines<sup>1</sup> (Figure 1). A complete cervical spine trauma series includes a frontal view and a dedicated odontoid peg view. The lateral view must include the C7-T1 junction before the series is passed as normal. The arcs should be smooth with no steps. A step indicates loss of alignment and alerts the viewer to a potential injury and warrants a more focussed appraisal at that level. Even if a fracture is not detected, a step or loss of alignment raises a strong likelihood of underlying injury. This may include ligamentous injury not detectable on plain radiographs, an occult fracture detectable only on computed tomography (CT) or facet joint dislocation.

Facet joint dislocation may be unilateral or bilateral however both result in loss of alignment.

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## Learning objectives

After reading this article you should be able to:

- review trauma and preoperative lateral cervical spine radiographs methodically
- recognize radiographic signs of an unstable cervical spine
- recognize the plain radiograph signs that warrant further imaging

Each vertebrae needs to be traced in turn paying particular attention to the odontoid peg. Even small potentially innocuous fractures may be part of an unstable fracture-ligamentous injury complex and it is thus imperative that their significance is appreciated.

Once the vertebrae including their alignment have been assessed, the prevertebral soft tissues, which constitute the muscular layers of the pharynx becoming the oesophagus inferiorly, are assessed. At C1-4 they can measure up to 7 mm and from C5-7 22 mm (Figure 1).<sup>1</sup> Measurements above this range or focal protrusions raise the possibility of a haematoma with a high likelihood of underlying fracture.

## Rheumatoid disease

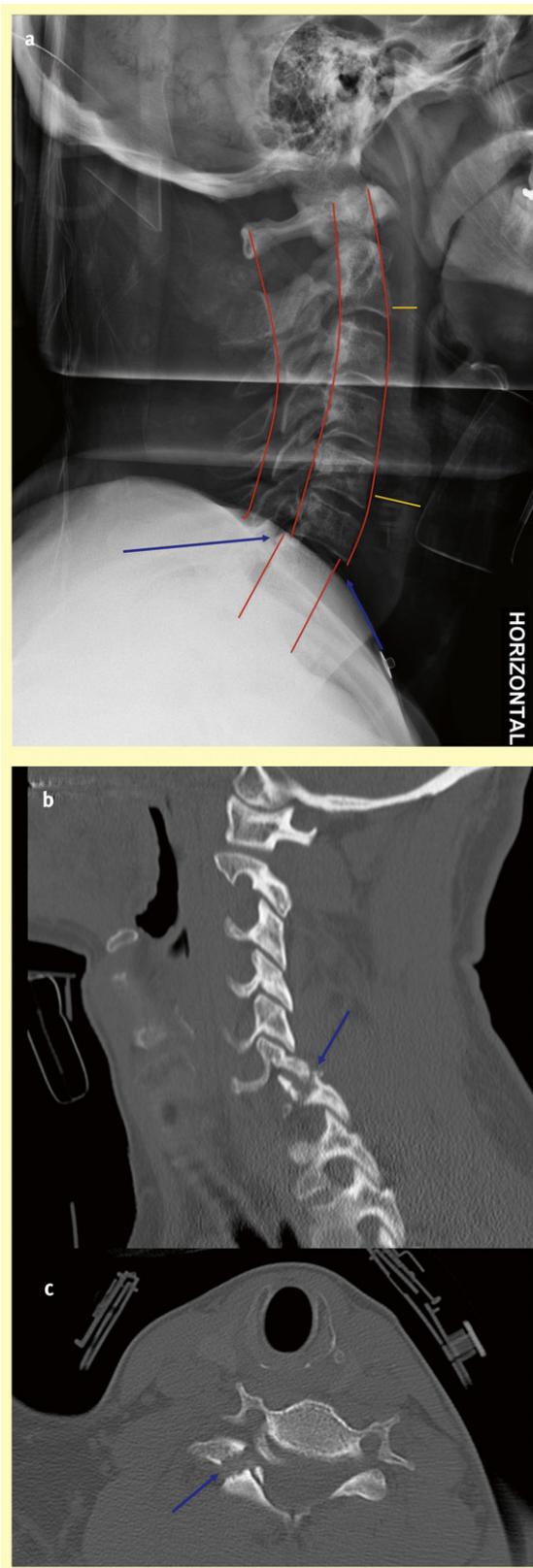
Rheumatoid arthritis shows a predilection for the ligamentous joints of the odontoid peg. The erosive nature of rheumatoid pannus can weaken and eventually destroy the ligaments that hold the ring of the C1 atlas in congruity with the C2 odontoid peg. The instability that can result may not be apparent on a standard lateral cervical spine radiograph. Paired flexion–extension radiographs are performed and the atlantoaxial distance measured in both positions to assess for instability (Figure 2). These radiographs are obtained with the patient performing the movements themselves and they are instructed not to perform movements which induce pain. The atlantoaxial distance should not measure more than 5 mm.

## Ankylosing spondylitis

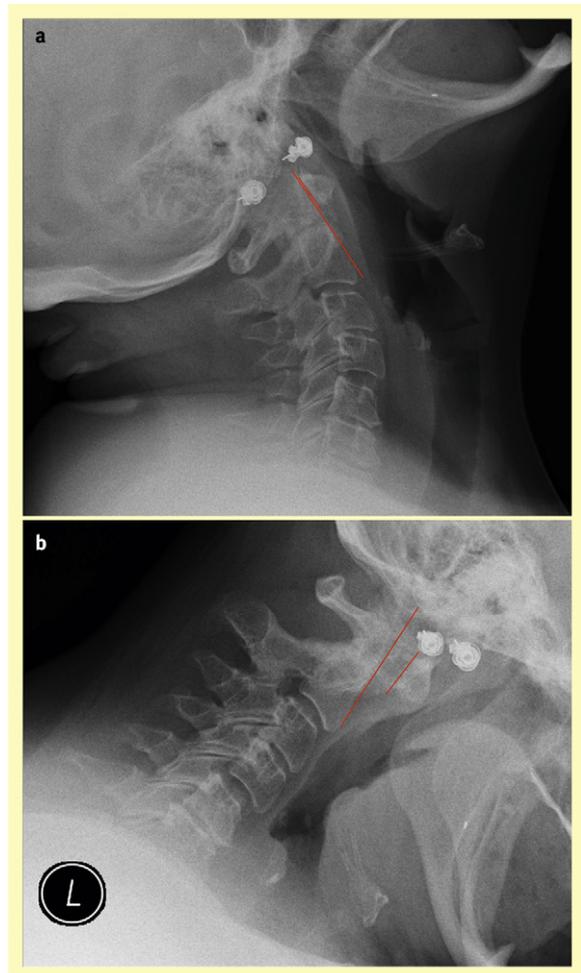
The ligaments of the spine including the cervical spine are progressively ossified and lose their flexibility in ankylosing spondylitis. Normal articulation and movements of the cervical spine are reduced. Essentially the spine ossifies into a non-articulating block. Fractures at any level may occur with quite trivial trauma or indeed manipulation. Fractures occur through the ossified ligaments and discs (Figure 3) and frequently not through the vertebrae themselves. The functional outcome is often an unstable cervical spine with the inherent threat to the cervical cord that entails.

## Further evaluation

Current National Institute for Health and Clinical Excellence (NICE) guidance 56 – *Head Injury*<sup>2</sup> states: *The current initial investigation of choice for the detection of injuries to the cervical*



**Figure 1** Lateral cervical spine radiograph (a) following trauma. Note there is artefact from the head blocks used for immobilization. The soft tissues of the shoulders are superimposed over C7 and T1 making assessment difficult however the vertebral body can be seen. The three lines used to assess alignment are marked in red. These lines should form smooth continuous curves with no steps or interruptions. There is a small anterior step of C6



**Figure 2** Preoperative cervical spine radiographs in extension (a) and flexion (b) in a patient with rheumatoid arthritis. The atlantoaxial distance is demonstrated between the two red lines. Note the significant difference between flexion and extension indicating an unstable atlantoaxial joint. The atlantoaxial distance is normally interpreted as normal up to 5 mm.

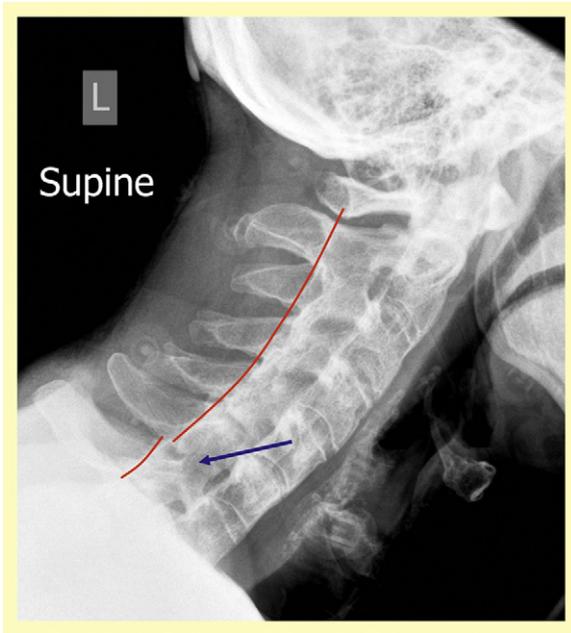
spine is the plain radiograph. Three views should be obtained and be of sufficient quality for reliable interpretation. For reasons of brevity this article has not covered the frontal and odontoid peg views, but we recommend Raby et al.<sup>1</sup> as an excellent and accessible review text of the subject.

In the setting of trauma, CT is the next investigation of choice to detect suspected but unproven fractures and delineate their extent (see Figure 1b and c). CT can demonstrate fracture fragments within the cervical canal and facet joint involvement. When neurological compromise has occurred or is suspected evaluation of the cervical spinal cord should be undertaken by magnetic resonance imaging.

If the cervical spine radiographs do not appear normal in the first instance the opinion of an experienced observer should be

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on C7 (blue arrows). Alignment is abnormal and an occult fracture was suspected. The patient was transferred for computed tomography (CT). Parasagittal (b) and axial (c) CT images of the same patient reveal a unilateral fracture dislocation through the C6/7 facet joint.



**Figure 3** There is ossification of the interspinous ligaments giving the 'bamboo spine' appearance in this patient with ankylosing spondylitis who had sustained minor trauma. Nonetheless on tracing the posterior of the three arcuate lines there is a step at C6/7. Further inspection at this level reveals the irregular radiolucent line (blue arrow) of a fracture.

### Criteria for the immediate request for CT imaging of the cervical spine (adults) from the NICE guidance 56 – *Head Injury*<sup>2</sup>

- Glasgow coma score below 13 on initial assessment
- Has been intubated
- Plain film series is technically inadequate (for example, desired view unavailable), suspicious or definitely abnormal
- Continued clinical suspicion of injury despite a normal X-ray
- The patient is being scanned for multi-region trauma

**Table 1**

sought. The NICE *Head Injury* guidance provides indications for the immediate CT imaging of the cervical spine in adults (Table 1). ◆

### REFERENCES

- 1 Raby N, Lerman L, de Lacey G. Accident and emergency radiology: a survival guide. 2nd edn. Elsevier Saunders, 2005.
- 2 <http://www.nice.org.uk/nicemedia/pdf/CG56NICEGuideline.pdf>; 2007.