52 The Cervical Spine

Objectives:
1. Be able to list the various imaging modalities in evaluation of the cervical spine.
2. Describe a systematic approach to evaluating the cervical spine.

Plain radiographs of the cervical spine are the initial imaging modality, where the frontal, lateral, and AP views may be supplemented by additional views (like the "open-mouthed" and extension/flexion views). Screening in spine trauma may begin with plain radiographs as traumatic injuries must be ruled out prior to moving the patient for other views and further treatment. Bony evaluation is now more commonly performed with CT which has much higher resolution and can provide multiplanar reformations. MRI is the modality of choice when spinal cord injury or ligamentous or soft tissue injury is suspected. A systematic and thorough review as outlined in the following steps is mandatory.

Systematic Approach to Evaluating the Cervical Spine with CT or Plain Film

(Figs. 52.1 and 52.2)

- Step 1: Count the visualized cervical vertebral bodies. It is mandatory that all seven cervical vertebrae (both the body and posterior elements) as well as the relationship of the inferior aspect of C7 with T1 are visualized.
- Step 2: Check the alignment of the anterior aspects of the vertebral bodies: the anterior vertebral line. There should be a smooth curve that is convex anteriorly as one progresses from superior to inferior in the cervical spine. Loss of this

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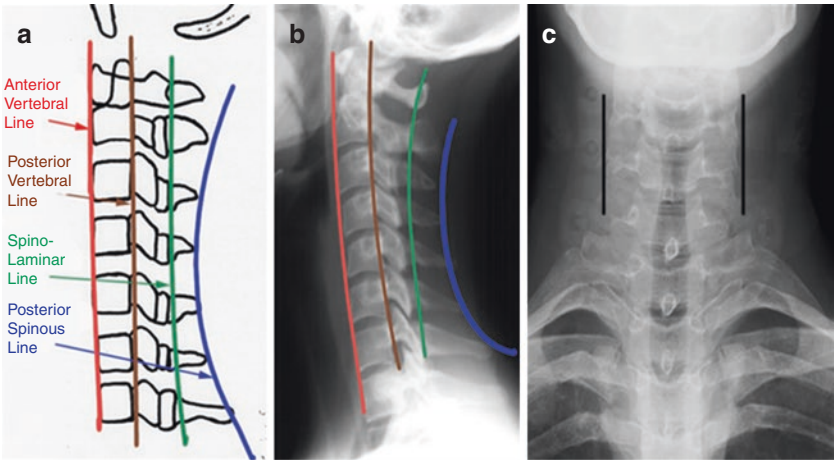

FIGURE 52.1 - CERVICAL SPINE LATERAL AND AP VIEWS
The anatomical landmarks are labeled on the diagram (**a**) and subsequently shown on the lateral radiograph (**b**). Note the undulating, rhythmic appearance of the lateral aspects of the cervical spine, bilaterally (**c**)

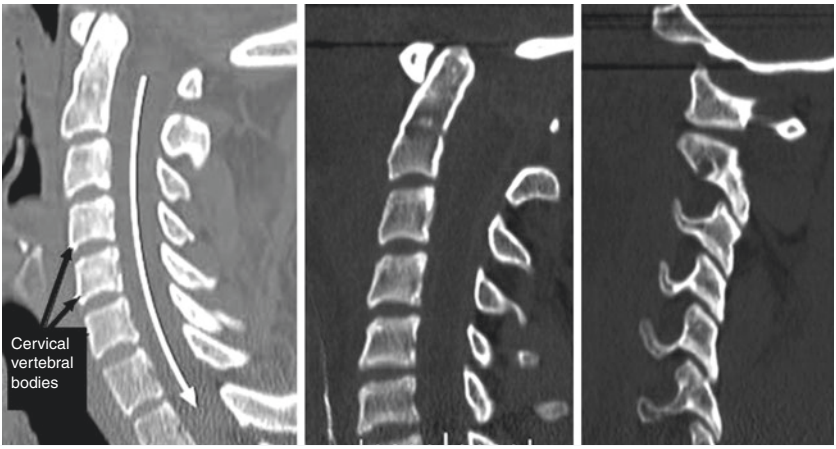

FIGURE 52.2 - CERVICAL SPINE CT SAGITTAL VIEWS
Normal alignment of the vertebrae with maintained body heights and normal facet articulations

curvature may indicate muscle spasm or soft tissue injury if the curvature is straightened or reversed. If the curvature changes abruptly, a fracture is likely.

- Step 3: Check the alignment of the posterior aspects of the vertebral bodies (posterior vertebral line, which represents the anterior aspect of the bony spinal

canal). For obvious reasons, this curvature should parallel the curvature of the anterior aspect of the vertebral bodies. Abnormalities of this curvature have the same significance as those of the anterior vertebral body curvature.

- Step 4: Check the alignment of the spino-laminar line. This is a smooth line drawn along the anterior aspect of the spinous processes (which represents the posterior aspect of the bony spinal canal). Again, any disruption of this smooth curvature should be viewed with suspicion.
- Step 5: Check the distance between the posterior aspect of the anterior arch of C1 and the anterior aspect of the odontoid process. This is the atlantoaxial space (sometimes called the predental space). Any increase in this distance may represent disruption of the transverse ligament that secures the posterior aspect of the dens to the atlas. The upper limit of normal for adults is 2.5 mm. Check the prevertebral soft tissues. As a general rule, think 6 and 2: at C2 they should be maximally 6 mm wide, and at C6 they should be maximally 22 mm wide. An openmouthed odontoid view is helpful to look for fractures of the odontoid process of C1 and the status of the lateral masses of C2 (Fig. 52.3).

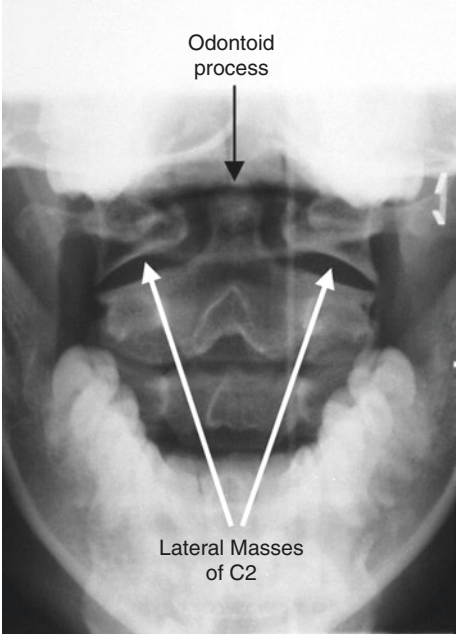

FIGURE 52.3 - OPEN-MOUTHED ODONTOID VIEW
The AP open-mouthed odontoid view provides an unobstructed view of both the odontoid process of C2 and the lateral masses of C1

The approach in evaluating a cervical spine CT is similar to that of a radiograph. However, with multiplanar reformats and better resolution, CT is much more sensitive than plain radiography. With the advent of multidetector CT, bony evaluation of the cervical spine is now done with CT, but the principles outlined above can be applied to any imaging modality.

MRI in the Cervical Spine Evaluation

MRI is very useful for evaluating spinal injuries. It is especially helpful for diagnosing or ruling out spinal cord injuries and acute compression of the spinal cord when clinical examination shows muscle weakness or paralysis. MRI is able to detect subtle changes in the vertebral column that may be an early stage of fracture, infection, or tumor. MRI may be better than CT scanning for evaluating tumors, abscesses, and other masses near the spinal cord (Fig. 52.4).

Evaluation of cervical spine MRI begins with the assessment of alignment, vertebral body heights, and presence abnormal marrow signal. Disc and ligaments are much better seen on MRI as compared to CT. Next, evaluation should include assessment of the cord for compression, canal stenosis, or abnormal signal within the cord. Finally, the pre-/paravertebral soft tissues and muscles are evaluated for hematoma or pathologic masses.

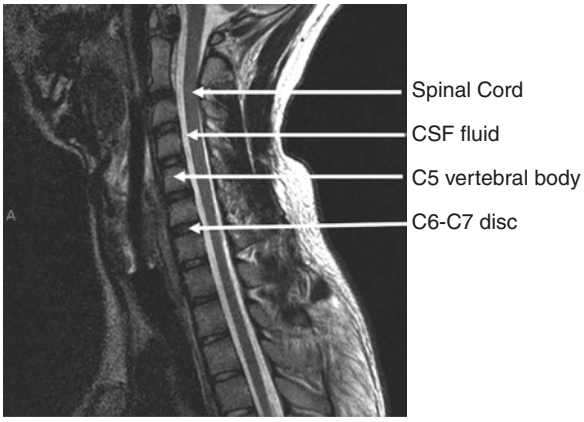

FIGURE 52.4 - SAGITTAL CERVICAL SPINE MRI
T2-weighted MRI of the cervical spine shows normal alignment of the vertebrae with normal bone marrow and spinal cord signal

S: Missing unstable cervical spine fractures or ligamentous injuries may lead to serious injury to a patient like quadriplegia and disastrous medico legal consequences for physicians.

A: Radiographs are very insensitive to acute neck trauma and hence CT cervical scan without contrast is the modality of choice. In significant fractures with or without dislocations of the cervical spine, fractures involving transverse foramina, and skull base fractures, CT angiogram of the neck is strongly recommended to look for arterial dissections. MRI is appropriate after CT if there is suspicion of myelopathy, intervertebral disc injury, or other ligamentous disruption.

F: For avulsion fractures, look for a corresponding donor site on the larger bone. Beware of isolated intervertebral disc, atlanto-axial, and atlanto-occipital widening type distraction injuries where the extent of soft tissue injuries are quite severe, despite an apparently normal radiograph. In patients with extensive spine ossification like ankylosing spondylitis or diffuse idiopathic skeletal hyperostosis (DISH), spine injuries can be disproportionately severe with respect to the degree of trauma.

E: In suspected acute cervical spine injury, the trauma team will often call the radiologist to clear the spine before removing the collar. Any fractures involving the bony spinal canal such as the pedicle, lamina, or articular pillars are highly unstable whereas isolated spinous process fractures are stable configuration fractures and will not result in cord injury.