

## Lecture Four

### THE SPINE

The bone of the spine may show manifestation of almost any disease that occurs elsewhere in the skeleton. Plain x-rays are the basic means of investigation but computed tomography is sometimes used for investigations requiring high resolution images.

The vertebrae (bones of the spine) are 33 articular bones. Because of their high number it is not easy to demonstrate all of them same time. So the bones are demonstrated in stages. These stages are usually according to their anatomical locations. They are:

- a. Cervical vertebrae – seven in number
- b. Thoracic (dorsal) vertebrae – twelve in number
- c. Lumbar vertebrae – five in number
- d. Sacral vertebrae – five in number
- e. Coccyx vertebrae – four in number

In total there are 33 vertebrae in normal subjects

The detailed structure of the vertebrae in the cervical, thoracic and lumbar regions differs but the general structure is similar. In the lateral view the vertebral bodies are approximately rectangular in shape. There may be shallow indentations on the upper and lower surface due to protrusion of disc material into the vertebral end plates. These indentations are known as **Schmorl's** nodes and are of no clinical significance.

#### Signs of abnormality of the spine:

1. The vertebral body may collapse: A collapsed vertebral body is one which has lost height. Collapse of vertebral body is best assessed on lateral radiograph and very difficult to assess at computed tomography. If there is collapse it is good to assess adjacent disc to see it is narrowed and to check if the pedicle has been destroyed.
2. Disc space narrowing: The intervertebral discs are radiolucent on plain films as they composed of fibrous tissue and cartilage. Normally the disc spaces are the same height at all levels in the cervical and thoracic spine. In the lumbar spine, the disc spaces increase slightly in height going down the spine except for the disc space at L5/S1 junction which is usually narrower than the one above it (between L4 and L5). Disc space narrowing is a feature of degenerative disease of the spine and disc space infection.
3. The pedicles: On plain films the pedicles are best assessed in the frontal view, except in the cervical spine where oblique views are necessary. The pedicles are also well demonstrated at computed tomography. Destruction of one or more pedicles is a sign of spinal metastases. Flattening and widening of the interpedicular distance occurs in tumours arising from the neural canal such as neurofibroma or meningioma.
4. The dense vertebra sign: Sclerosis may be part of a generalized process involving many bones. Common causes of sclerotic vertebra are:

- a. Metastases, especially from primary tumours of prostate or breast.
  - b. Malignant lymphoma.
  - c. Paget's disease.
  - d. Haemangioma.
5. The lytic vertebra sign: This may also be part of a widespread process or may be confined to one vertebra. Common causes of lytic vertebra are:
- a. Metastases, particularly from primary tumours of the lungs or kidneys.
  - b. Myeloma.
  - c. Malignant lymphoma.
  - d. Infection.
6. Paravertebral shadow: Paravertebral soft tissue shadow may first draw attention to an abnormality in the spine. Soft tissue swelling is easy to recognize on plain films in the thoracic region where the soft tissue adjacent to the spine is fusiform in shape. In the lumbar region the soft tissue shadow has to be large enough to displace the medial psoas outline before it can be recognized. In the cervical region anterior soft tissue swelling causes a forward displacement of the pharyngeal air shadow. At computed tomography paravertebral soft tissue shadow is recognized at all levels.

Causes of paravertebral soft tissue swelling include:

- a. Infection.
- b. Malignant neoplasms.
- c. Haematomas following trauma.

### **Radiological signs of some specific diseases of the spine:**

Some specific abnormal conditions of the spine and radiological signs that may be seen in them are as follows:

1. Degenerative disc disease (spondylosis):
  - a. There may be herniation of the degenerate disc.
  - b. Degenerate disc stimulate osteophytosis (the so called osteophytic lippings).
  - c. Soft tissue swelling.
  - d. Affects lower cervical and lower lumbar spines mostly.
  - e. Disc space narrowing.
2. Ankylosing spondylitis:
  - a. Fuzziness of sacroiliac joints.
  - b. Later, there is erosion of sacroiliac joints.
  - c. In late stages, fusion of the sacroiliac joint spaces and calcification of spinal ligaments and formation of vertically oriented bony bridges between vertebral bodies.
  - d. The whole spine may become fused into a solid bone. This appearance is called ***bamboo spine***.
3. Infection:
  - a. Destruction of the intervertebral discs and adjacent vertebral bodies.
  - b. Disc space narrowing with erosion of adjoining surfaces of vertebral bodies.
  - c. Collapse of vertebral bodies resulting in sharp angulation known as gibbus.

- d. Paravertebral abscess may result.
- e. If the infecting organism is *Staphylococcus aureus*, there are sclerotic bony changes.
- f. In tuberculous infection, there are lytic bony changes.
- g. Fusion of vertebral bodies when healing occurs.
- h. There may be calcification of the tuberculous paravertebral abscess.
- 4. Spondylolisthesis:
  - a. Forward slip of one vertebral body over the one below it.
  - b. It usually affects the lumbar spine most, especially at the L4/L5 and L5/S1 junctions.
  - c. This forward slip is best demonstrated in the lateral view of the involved segment of the spine.
- 5. Spondylolysis: Defect in the pars interarticularis, usually resulting from trauma but there is no forward slip of one vertebra over another.
- 6. Metastases and multiple myeloma:
  - a. Multiple myeloma gives rise to lytic lesions in the vertebral bodies.
  - b. There may be vertebral body collapse with metastases.
  - c. Metastases often involve both pedicles and vertebral bodies.

## **Possible Faults and Limitations in Spinal Radiographs**

### **Cervical spine:**

1. Closed mouth in the views of odontoid peg to be demonstrated. Open mouth projection is needed for demonstration of the odontoid peg but in case the patient is unconscious, a translucent block should be put in the patient's mouth to keep it open. This may limit the anatomical structures demonstrated. The limitation may also be seen in patients with added severe maxillofacial injury.
2. The tongue can cast soft tissue shadow on the bony structures and cause them to be obscured. This can be prevented by making the patient to continuously say aaaaaahhhhhh in a **drawl** during exposure.
3. Inadequate extension of the neck can cause the upper part of the cervical spine to be obscured. The base of the skull can likewise obscure C1 and C2 vertebral bodies.
4. In case of injury to C1, there is usually difficulty in maneuvering the neck and tomography should be used inevitably.

### **Thoracic spine:**

1. T1-T4 segment is usually superimposed on the trachea in anteroposterior view. This can be a source of confusion for a novice in plane x-ray interpretation.
2. T5-T8 segment is usually superimposed on the dense heart shadow in anteroposterior view. In the upper part of the abdomen, the IVC and aorta also superimpose on the vertebrae. To overcome this superimposition of structures, high KV should be used to burn off these soft tissue structures.
3. There may be motion blur if breath holding technique is used during exposure.
4. The shoulder is thick and usually obscures the upper thoracic spine segment in the lateral view.
5. There may be inappropriately ambitious coning which could lead to anatomical cut-off.

**Lumbar spine:**

1. If the shoulder is thrown forward the normal lumbar lordosis will be lost but flexing the knee preserves the curve but decreases its extent. A radiograph obtained with the shoulder thrown forward is inappropriate.
2. The L5/S1 junction (disc space) is usually foreshortened in anteroposterior view because it is projected by oblique rays coming to it. So coned down view is usually necessary to assess L5/S1 joint space.