Thoracic Spine Technique

University of Salford
1st Year Students
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N.J. Oldnall

Region: Thoracic Spine

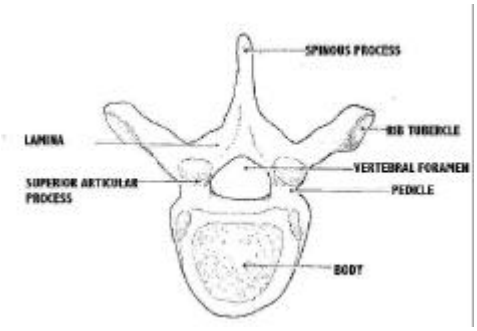
(The thoracic region of the columna vertebraliis; the vertebrae thoracicae as a whole; that part of the vertebral column, which enters into the formation of the thorax.)

1 Basic Anatomy

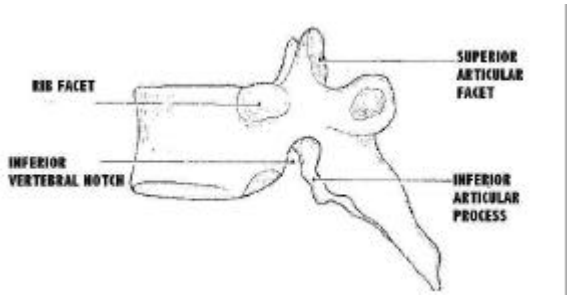
The thoracic vertebrae are larger than the cervical vertebrae and they form the posterior part of the bony thoracic cage. There are 12 thoracic vertebrae and they gradually increase in size from 1st to twelfth. They can easily be recognised as they have at least one rib facet on each side of the body for articulation with the head of a rib. The second to the eighth are typical the remainder differing in minor ways.

Fig 1 A typical thoracic vertebrae.

A) Superior Aspect



B) Lateral Aspect



The body is roughly heart shaped in plan view with roughly equal measurements laterally and antero-posteriorly. The anterior and lateral surfaces of the body are convex and the posterior aspect forming the vertebral foramina is concave. The posterior height of the body is greater than the anterior height producing the dorsal kyphosis. The upper vertebrae are more similar to the cervical ones and the lower more the lumbar vertebrae.

On the upper and lower margins of the lateral aspects of the body adjacent to the pedicles are the demi facets, which with the corresponding facets of the vertebrae above and below form the rib facets, which articulate with the head of the ribs.

The vertebral arch is formed by the pedicles and laminae; the pedicles arise from the upper part of the posterior surface of the body pointing directly back.

The lamina are wide flat bars which overlap the laminae below enclosing the vertebral canal, the vertebral foramen is smallest in the thoracic region and is flattened anteriorly and rounded posteriorly.

The transverse processes are directed posteriorly and laterally from the junction of the body and the pedicles, on the anteriorly projecting surface of each transverse process is a facet, which articulates with the facet on the tubercle of the associated rib. (T1,10,11,12 have whole facets T2-9 demi facets)

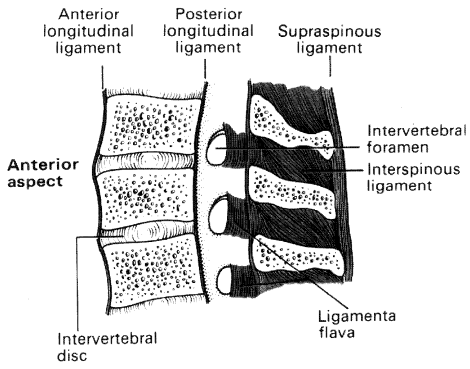
The spinous processes are long and point inferiorly and caudaly ending in a rough tubercle

The superior articular processes face postero-lateraly and articulate with the inferior articular facet of the above vertebra, which arise from the lateral part of the lamina facing antero-medially.

Joints

The bodies of the vertebrae are linked by cartilaginous slightly moveable joints between the pairs of superior and inferior surfaces of the bodies, and also between the facets of the matching superior and inferior articulations. The rib articulations the costovertebral joints are synovial joints.

Fig 2 Liagmentous anatomy of the thoracic vertebrae



Blood supply and Venous drainage.

The blood supply to the thoracic region is principally via branches of the descending thoracic aorta with pairs of intercostal arteries and branches to the vertebrae via the thoracic spinal arteries.

The principle venous drainage is via the intervetebral veins to anterior vertebral plexus and the internal vertebral plexus. These veins have poor valves and blood may flow from the pelvic plexus in a reverse direction in some circumstances, which it has been postulated is the reason for the spread of metastases from the pelvic region to the spine.

Movements

The multi-jointed structure of the spine allows some range of the following movements, flexion, extension and rotation.

Surface Markings

The spines of the vertebra slope down so that the palpable tips of the spines are lower than their corresponding bodies.

The spine of T1 is the lower of the two prominences that can be felt on the dorsal aspect of the patient at the base of the neck.

Body of T2/3 is at the level of the sternal notch

The spine of T3 is level with the palpable spine of the scapula.

The body of T4 lies level with the sternal angle

The junction bodies of T6/T7 lie midway between the sternal angle and the xiphisternum

The spine of T7 is level with the palpable inferior angle of the scapula.

The body of T9 lies at the level of the xiphisternum

The spine of T12 lies midway between the level of the iliac crest and inferior angle of the scapula.

2 Indications for imaging

Congenital abnormalities e.g. Scoliosis, kyphosis, hemivertebrae, butterfly vertebrae.
Trauma e.g., fractures,
Degenerative disease
Infection e.g.. Tuberculosis (Pott's disease), osteomyelitis
Pathologies, ankylosing spondlylitis, osteoporosis, osteochondritis (Schewermans disease), Paget's disease
Tumours, e.g. metastases, primary bone tumours, haemangioma,
Benign tumours e.g., neurofibroma, meningioma,

3 Contra Indications

Non specific other modalities may be more sensitive but in many cases unavailable i.e. MR
The 28-day rule in most hospitals is not applied for imaging of the thoracic spine but if there is known pregnancy care appropriate care should be exercised.

4 Patient Preparation

General psychology, remove any clothing bandages or splints where possible.
Starch free white gown and nickers or underpants.

5 Immobilisation

Non specific, a 'bucky band across the hips may help in unstable patients but usually flexion of the knees in the lateral position provides adequate stability, sandbags and pads may help in some cases.
In erect positions such as for scoliosis studies in young patients some form of support may be required. See notes on 'breathing laterals'.

6 Accessories

Sandbags, cassette holder, foam pads, beam limitation cones and lead rubber, grid cassettes for trauma work.

7 Radiation Protection

Direct lead rubber gonad protection.
Good technique with attention to collimation will reduce the radiation dose to the thyroid, breast tissue and the gonads.

8 Equipment Choice

Ceiling mounted tube assembly particularly for A/E trolley work.
Medium powered generator.
If breathing techniques are to be utilised a generator, which will permit a low mA to be used, hence a 'long' time exposure will be required.

9 Aftercare

Ensure any clothing and splints / bandages are replaced.
Ensure patient knows where to receive the results.

10 Basic Projections

- AP Thoracic spine
- Lateral thoracic spine

11 Additional projections

- Oblique thoracic spine
- Lateral cervico thoracic junction & Lateral thoraco lumbar junction, Scoliosis Erect thoracic spine

Projection 1: AP Thoracic spine

1 a Anatomy demonstrated

Vertebral bodies, intevertebral joint spaces posterior rib ends and costovertebral joints.

1. b Patient Position

The patient lies supine on the examination table knees and hips flexed to reduce thoracic kyphosis
(With the head at the anode end to utilise inherent anode heal effect, the midline in the centre of the table.)
Median sagittal plane at 90 degrees to the film plane, check ASIS and midpoint of clavicles equidistant from table.
Ensure the chin is clear of the upper dorsal vertebrae.

1. c Central Ray

The vertical central ray is centred in the midline to T7 which is midway between the sternal angle and the Xiphisternum,
Expose on suspended expiration

1. d Exposure Factors

KV		mAS		FFD	Focus	Grid?	Film/Screen combination
80-90		25		100	Fine	Yes	Regular

Film Evaluation

I Identification

Hospital Name, Patients name and examination number, date.

ii Limits of Examination

Superiorly the lower border of C6, Inferiorly the upper border of L2, Laterally the medial third of the ribs but collimation to minimise irradiation of breast tissue.

Iii Positioning and Projection.

Rotation, sterno clavicular joints should be evenly centred to the spine.
The spine should be centred to the film.
The intevertebral spaces should be visible

iv Exposure

The kV should be such that all the penetration of the denser lower regions should not be at the expense of over penetration of the upper regions, the anode heal effect should be utilised, the use of kV in the 80 -90 range will reduce contrast and ensure all regions are exposed optimally, an aluminium wedge filter may be utilised.
Ensure that the bony detail in all vertebras is visible and the mAS should be adjusted to ensure no region requires the use of a 'bright light'.

Note. The anode heal effect

The anode end of the film will produce slightly less exposure than the cathode due to absorption of the beam by the anode, to utilise this effect the AP may be performed with the anode at the head end, however the converse is required for the lateral.

Projection 2: Lateral Thoracic spine

1 a Anatomy demonstrated

Thoracic vertebral bodies, intervertebral spaces and intervertebral foramina, poor visualisation of upper 1, 2 and possibly 3 vertebrae.

1. b Patient Position

From the AP position the patient roles onto their left side, the head is supported on a pillow or pads and the waist supported to bring the median sagittal plane parallel to the film plane

1. c Central Ray

The vertical central ray is centred to the level of T7 and approximately 7cm from the dorsal skin surface, ensure the collimation will taker account of the thoracic curvature and include the bodies and spinous processes of all the thoracic vertebrae.

If it is not possible to bring the median saggital plane parallel to the film plane it may be necessary to angle the central ray a few degrees cranialy to maintain an angle of 90^0 between the central ray and the median sagittal plane.

Expose on suspended inspiration to depress the diaphragm or use the beathing technique.

*Breathing technique

Some schools of thought use a long time exposure to blur out the images of the ribs, however, with the ribs articulating with the vertebral bodies the movement of the bodies may occur and an impression of increased sharpness may be given due to the large differential sharpness between the ribs and the vertebral bodies.

1. d Exposure Factors

kV	mAS	mA	S	FFD	Focus	Grid?	Film/Screen
85	40	10*/400	4*/0.1	100	Fine	Yes	Regular

Film Evaluation

I Identification

Hospital Name, Patients name and examination number, date.

ii Limits of Examination

Superiorly the lower border of C6, Inferiorly the upper border of L2, Laterally the medial third of the ribs but collimation to minimise irradiation of breast tissue. The use of lead rubber shielding in line with the skin surface may reduce scatter and improve image quality in the region of the spinous processes and the medial ends of the ribs.

iii Positioning and Projection.

The vertebral bodies should be imaged in perfect lateral profile with superimposition of the medial end of the ribs, Ensure that the bony detail in all vertebra is visible and the mAS should be adjusted to ensure no region requires the use of a 'bright light' and the kV adjusted so that the contrast is controlled to ensure maximum visualisation of the complete thoracic spine. An additional project to demonstrate the cervico thoracic junction may be needed.

Breathing technique.

A long (2 second) is sometimes used to blur out the lung structures, however this may be a subjective result of the difference in movement between the vertebral bodies and the lung tissue, I think it is difficult to isolate the movement to the lungs without affecting the bony structures.

Additional Projection 1: Lateral Upper Thoracic Spine

1 a Anatomy demonstrated

Normally the upper three thoracic vertebras and the cervico-dorsal junction may be hard to visualise frequently being grossly under penetrated in the standard lateral projection. This projection may be needed to complete an examination particularly in cases of trauma of vertebral collapse.
This additional projection is to image C7 to T4.

2. b Patient Position

The patient can be examined erect or supine but this description is for the supine position.
The patient is positioned so that an imaginary line drawn at a tangent to the spinous process of T2 is along the long axis of the couch.
The patient lies on their side and may need to be padded under the waist to ensure that the median sagittal plane is parallel to the tabletop. This can be judged by palpating the spinous processes.
Flexion of the knees will aid stability; padding under the knee in contact with the table and or between the knees will prevent longitudinal twisting.
The arms are raised up over and above the head as far as possible.

2. c Central Ray

The vertical central ray is centred to the Axilla at the level of T3/4.
The required distance in from the skin surface depends upon the size and build of the patient.

2. d Exposure Factors

kV	mAS	mA	S	FFD	Focus	Grid?	Film/Screen
95	40	10*/400	4*/0.1	100	Fine	Yes	Regular

Film Evaluation

I Identification

Hospital Name, Patients name and examination number, date.

ii Limits of Examination

Superiorly C7, Inferiorly L1 Posteriorly skin surface, anteriorly the anterior margin of the most anterior vertebral body.

iii Positioning and Projection.

The vertebrae must be visualised in profile as a square, rotation about the MSP will produce double anterior and posterior borders, if the MSP is not parallel to the film plane will produce double inferior and superior borders.

Iv Exposure

The contrast must be low enough to visualise the dense upper region between the shoulders, but high enough to differentiate between the lung tissues and in particular osteoporotic vertebra.