Lectures of Human Anatomy

Vertebral Column-II

By

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Normal Curves of the Vertebral Column

1. **In the foetus:** The vertebral column shows one curve, with a concavity forwards.
2. **At the 3rd month of life (when the child begins to hold up his head upright):** another curve with convexity forwards appears in the neck region, called cervical curve.
3. **At the end of the 1st year of life (when the child begins to stand up):** another curve with convexity forwards appears in the lumbar region, called lumbar curve.
4. So, in the **adults,** the vertebral column shows 4 curves (2 primary and 2 secondary):
   a) **Primary curves** that are concave forwards:
      * Thoracic curve.
      * Pelvic (sacral) curve.
   b) **Secondary curves** that are convex forwards:
      * Cervical curve.
      * Lumbar curve.

Diagrams showing: Normal Curves of the Vertebral Column

5. **In the old age,** the inter-vertebral discs begin to atrophy, resulting in loss of the height gradually. This causes gradual return to the foetal anterior concavity.

**Abnormal spinal curvatures,** include the followings:

1. **Lordosis:** increased convexity forwards.
2. **Kyphosis:** increased convexity backwards. (Kyph/o means hill or mountain, indicating a hump on the back).
3. **Scoliosis:** increased convexity to one side. (Scoli/o means crooked, bent).

**Causes of Abnormal Curvatures:** include
   Congenital causes: appear at birth.
   Acquired causes: may result from diseases or prolonged wrong postures.
ARTICULATIONS OF VERTEBRAL COLUMN

Joints of Vertebral Bodies

- Bodies of each two adjacent vertebrae articulate together by intervertebral disc, except the first cervical vertebra (atlant) that is not has intervertebral discs. There are total 23 discs; 6 in cervical, 12 in thoracic and 5 in lumbar region.
- Disc is considered as a secondary cartilaginous joint, as it formed of fibro-cartilage.
- Bodies of vertebrae are connected together by 2 longitudinal ligaments; anterior longitudinal ligament in-front of bodies and posterior one behind the bodies within the vertebral canal.

Joints of Vertebral Arches

- The articular processes of the adjacent vertebrae articulate together by a pair of plane synovial joints.
- The arches are connected by the following ligaments:
  1. A pair of ligamenta flava, connecting the laminae of adjacent vertebral arches together.
  2. Supra-spinous ligament, connecting the tips of adjacent vertebral spines together.
  3. A pair of inter-spinous ligaments, connecting the adjacent vertebral spines together.
  4. A pair of inter-transverse ligaments, connecting the adjacent vertebral transverse processes together.

COSTO-VERTEBRAL JOINTS

A. Joints of Heads of Ribs

1. Articular parts: Head of rib articulates with the sides of bodies of adjacent vertebrae, as follows:
   - Upper small facet of the rib head articulates with the vertebra above.
   - Lower large facet of the rib head articulates with the corresponding vertebra.
2. Type: plane synovial joints.
3. Ligaments:
   i. Intra-articular ligament: It extends from the crest of head of rib to the intervertebral disc, dividing the joint cavity into 2 parts.
   ii. Radiate ligament: It is formed of 3 bands, radiating from the head of rib to the vertebra above, inter-vertebral disc and corresponding vertebra.
Ligaments at the head of rib

**B. **Costo-Transverse Joints

1. **Articular parts:** are the medial articular part of tubercle of the rib and the transverse process of the corresponding vertebra.

2. **Type:** plane synovial joints.

3. This type of joint is absent in the 11th and 12th ribs, as they have no tubercle. They are called free ribs.

N.B.: **Articulations of ribs:**
- Rib articulates with the vertebra posteriorly and with its costal cartilage anteriorly.
- The upper 7 pairs of costal cartilages reach the sternum.
- The next 3 pairs of costal cartilages; each one joins that of the rib above.
- The last pair of ribs are free, that not join other ribs.

**Atlanto-Occipital Joints**

There are a pair of joints, one on each side.

1. **Articular parts:** are
   - Occipital condyle of the skull (on the side of foramen magnum) and
   - The articular facet on the upper surface of the atlas.

2. **Type:** ellipsoid synovial joint.

3. **Movements:**
   - Nodding movements (expression of "yes") i.e. flexion and extension.
   - Lateral flexion.

N.B.: No rotation occurs at these joints.

4. **Ligaments:**
   - **Anterior atlanto-occipital membrane:** extends from the anterior arch of atlas to the anterior margin of foramen magnum. It represents a continuation for the anterior longitudinal ligament, connecting the vertebral bodies anteriorly.
   - **Posterior atlanto-occipital membrane:** extends from the posterior arch of atlas to the posterior margin of foramen magnum. It is similar to ligamenta flava, connecting vertebral laminae.
**Atlanto-Axial Joints**

They are three joints; one median and two lateral (one on each side).

**I. Median Atlanto-Axial Joint**

1. **Articular parts:** are
   - Dens of the axis
   - A ring, formed by anterior arch of atlas and transverse ligament.

2. **Type:** pivot synovial joint.

3. **Movements:**
   Rotatory movements (expression of "no") i.e. side to side movement.

**II. Lateral Atlanto-Axial Joints**

They are two joints, one on each side

1. **Articular parts:** are
   - Lower articular facet of atlas and
   - Upper articular facet of axis
   The articular surfaces are nearly circular and flat.

2. **Movements:**
   Gliding movements (expression of "no") i.e. side to side movement.

4. **Ligaments of atlantoaxial joints:**
   - **Apical ligament:** It is a median ligament, extending from the tip of dens of axis to the anterior margin of foramen magnum.
   - **Alar ligaments:** They are two ligaments; one on each side of apical ligament, extending from the dens of axis to the medial side of the occipital condyles.
     These ligaments limit the side to side movements. This aids in protection of the spinal cord.

   ![Diagram of Ligaments](image)

   **Ligaments attached to dens of the second vertebra "axis"**

   - **Membrana tectoria:** This is extension of the posterior longitudinal ligament to the occipital bone, just within the foramen magnum, covering the back of the dens.
   - **Cruciate ligament:** It is formed two bands; vertical and horizontal bands, forming together a cross-like ligament.
Vertical band extends from the posterior surface of body of axis to anterior margin of foramen magnum between the apical ligament and membrane tectoria. Horizontal band extends in-between the inner aspects of lateral masses of atlas, passing behind the dens, supporting it with the atlas.

![Schematic diagram showing sites of atlantoaxial joints](image)

**Functions of The Vertebral Column**

- a. It allows movements of the trunk.
- b. It protects the spinal cord.
- c. It represents the central support of the body, supporting the head and transmitting its weight to the hip bones and then to the lower limbs.

**Muscles of the Back of Vertebral Column**

These muscles extend vertically throughout the different regions of the vertebral column, occupying the groove on its lateral sides. They are collectively called *erector spinae (or sacrospinalis)*. Erector spinae is not a single muscle but a group of muscle bundles. Each muscle has 3 longitudinal bands from lateral to medial, as follows:

i. **Iliocostalis**
   - Iliocostalis lumborum.
   - Iliocostalis thoracis.
   - Iliocostalis cervicis.

ii. **Longissimus**
    - Longissimus thoracis.
    - Longissimus cervicis.
    - Longissimus capitis.

iii. **Spinalis**
    - Spinalis thoracis.
    - Spinalis cervicis.
    - Spinalis capitis.

**Movements of the Vertebral Column**

1. **Flexion:** Forward bending.
2. **Extension:** Backward bending.
3. **Lateral flexion:** - Flexion to one side (right or left).
4. **Rotation:** - Twisting of the trunk.
5. **Circumduction:** - Combination of all the above movements.

**Clinical Applications**

**Vertebral dislocation:**
Vertebral dislocation without fractures occurs only in the cervical region, due to the inclination of the articular facets of cervical vertebrae, i.e. the superior facet is directed posteriorly and superiorly while the inferior one is directed anteriorly and inferiorly. However, if it occurs in other regions of vertebral column, it usually follows fractures of the articular processes of that vertebrae. Cervical dislocation commonly occur at C4-5 or at C5-6, where movement is the greatest. Due to wide vertebral foramina at the cervical region, unilateral dislocation does not affect the spinal cord. It only causes severe pain due to nipping the spinal nerve at the same side. On the other hand, bilateral dislocation results in injury of spinal cord and may cause death.

**Herniated (slipped) intervertebral discs:**
It occurs mostly in the lumbar region. It sometimes occur in the lower cervical discs. It occurs as a result of trauma, degeneration as in old ages (weakness of ligaments), lifting heavy weights or exaggerated abnormal trunk movements. In this case, the nucleus pulposus herniates through the annulus fibrosus, posteriorly. This is because of the relative thin annulus fibrosus at its posterior part. The prolapsed disc presses on the spinal nerves emerging from the spinal cord. This results in numbness and pain in the limb, supplied by the affected nerves.