Lecture 11

The skeletal system V - General Features of the Vertebral Column. General Structure of a Vertebra. Intervertebral Discs. Regional Characteristics of Vertebrae. Thoracic Cage.

Plan of the Lecture

1. General Features of the Vertebral Column
2. General Structure of a Vertebra
3. Intervertebral Discs
4. Regional Characteristics of Vertebrae
    a. The Cervical Vertebrae
    b. The Thoracic Vertebrae
    c. The Lumbar Vertebrae
    d. The Sacrum
    e. The Coccyx
5. The Thoracic Cage
    a. The Sternum
    b. The Ribs

LEARNING OUTCOMES

1. describe the general features of the vertebral column and those of a typical vertebra;
2. describe the structure of the intervertebral discs and their relationship to the vertebrae;
3. describe the special features of vertebrae in different regions of the vertebral column, and discuss the functional significance of the regional differences;
4. describe the anatomy of the sternum and ribs and how the ribs articulate with the thoracic vertebrae.

The vertebral column, or spine, physically supports the skull and trunk, allows for their movement, protects the spinal cord, and absorbs stresses produced by walking, running, and lifting. It also provides attachment for the limbs, thoracic cage, and postural muscles. Although commonly called the backbone, it consists of not a single bone but a flexible chain of 33 vertebrae with intervertebral discs of fibrocartilage between most of them. The adult vertebral column averages about 71 cm (28 in.) long, with the intervertebral discs accounting for about one-quarter of the length. Most people are about 1% shorter when they go to bed at night than when they first rise in the morning. This is because during the day, the weight of the body compresses the intervertebral discs and squeezes water out of them. When one is sleeping, with the weight off the spine, the discs reabsorb water and swell. Variations in this arrangement occur in about 1 person in 20. For example, the last lumbar

vertebra is sometimes incorporated into the sacrum, producing four lumbar and six sacral vertebrae. In other cases, the first sacral vertebra fails to fuse with the second, producing six lumbar and four sacral vertebrae. The coccyx usually has four but sometimes five vertebrae. The cervical and thoracic vertebrae are more constant in number. Beyond the age of 3 years, the vertebral column is slightly S-shaped, with four bends called the cervical, thoracic, lumbar, and pelvic curvatures. These are not present in the newborn, whose spine exhibits one continuous C-shaped curve, as it does in monkeys, apes, and most other four-legged animals. As an infant begins to crawl and lift its head, the cervical region becomes curved toward the posterior side, enabling an infant on its belly to look forward. As a toddler begins walking, another curve develops in the same direction in the lumbar region. The resulting S shape makes sustained bipedal walking possible. The thoracic and pelvic curvatures are called primary curvatures because they exist from birth. The cervical and lumbar curvatures are called secondary curvatures because they develop later, in the child's first few years of crawling and walking. Posterior to the body of each vertebra is a triangular space called the vertebral foramen. The vertebral foramina collectively form the vertebral canal, a passage for the spinal cord. Each foramen is bordered by a bony vertebral arch composed of two parts on each side: a pillarlike pedicle and platelike lamina. Extending from the apex of the arch, a projection called the spinous process is directed posteriorly and downward. You can see and feel the spinous processes on a living person as a row of bumps along the spine. A transverse process extends laterally from the point where the pedicle and lamina meet. The spinous and transverse processes provide points of attachment for ligaments, ribs, and spinal muscles. A pair of superior articular processes projects upward from one vertebra and meets a similar pair of inferior articular processes that projects downward from the vertebra above. Each process has a flat articular surface (facet) facing that of the adjacent vertebra. These processes restrict twisting of the vertebral column, which could otherwise severely damage the spinal cord. When two vertebrae are joined, they exhibit an opening between their pedicles called the intervertebral foramen. This allows passage for spinal nerves that connect with the spinal cord at regular intervals. Each foramen is formed by an inferior vertebral notch in the pedicle of the upper vertebra and a superior vertebral notch in the pedicle of the lower one. The thoracic cage consists of the thoracic vertebrae, sternum, and ribs. It forms a roughly conical enclosure for the lungs and heart and provides attachment for the pectoral girdle and upper limb. It has a broad base and a somewhat narrower superior apex. Its inferior border is the arc of the lower ribs, called the costal margin. The cage protects not only the thoracic organs but also the spleen, most of the liver, and to some extent the kidneys. Most important is its role in breathing; it is rhythmically expanded by the respiratory muscles to create a vacuum that draws air into the lungs, and then compressed to expel air.

Check yourself! The questions for self-control

1. Discuss the contribution of the intervertebral discs to the length and flexibility of the spine.
2. Construct a three-column table headed C4, T4, and L4. In each column, list all anatomical features that would distinguish that vertebra from the other two.
3. Name the three parts of the sternum. How many ribs attach (directly or indirectly) to each part?
4. Describe how rib 5 articulates with the spine. How do ribs 1 and 12 differ from this and from each other in their modes of articulation?
5. Distinguish between true, false, and floating ribs. Which ribs fall into each category?
6. Name the three divisions of the sternum and list the sternal features that can be palpated on a living person

Recommended readings:

1. Kenneth S Saladin - Anatomy & Physiology. The Unity of Form and Function (2016, McGraw-Hill Education)
2. Barbara Gylys - Medical Terminology Systems (2012, F.A. Davis Company)
3. Richard L. Drake A. Wayne Vogl, Adam W. M. Mitchell - Gray's Atlas of Anatomy, Second Edition (2015, Churchill Livingstone Elsevier)