

# Anatomy of the vertebral column

Vishy Mahadevan

## Abstract

The vertebral column, synonymous with spinal column or spine, and known colloquially as the backbone, forms the central axis of the body's skeleton. Superiorly, it articulates with the skull, and inferiorly, it articulates with the two hip bones which in turn give attachment to the lower limbs. The vertebral column comprises the following five regions in cephalocaudal sequence: cervical, thoracic, lumbar, sacral and coccygeal. The vertebral column contains the spinal cord within the vertebral canal and thereby protects the spinal cord from external trauma. Degenerative diseases of the vertebral column account for the vast majority of spinal disorders in clinical practice. Trauma, neoplastic disease and developmental anomalies account for most of the remainder of spinal problems. Optimal medical and surgical management of spinal disease are crucially dependent on accurate clinical and radiological diagnosis and these, in turn, are reliant on a sound understanding of the structural and functional anatomy of the vertebral column. In this article a general description of the articulated vertebral column is followed by a description of the morphology of representative vertebrae from the vertebral regions.

**Keywords** Disc herniation; intervertebral disc; lamina; pedicle; spinal ligaments; spinal motion segment; vertebra; vertebral canal; zygapophyseal joint

The vertebral column forms the central axis of the body's skeleton. Along with the sternum and the twelve pairs of ribs it forms the skeleton of the trunk. The vertebral column is a very strong yet flexible midline strut. At its upper end the vertebral column articulates with the skull base and thereby supports the skull. The inferior part of the vertebral column articulates on each side, with the corresponding hip bone. The two hip bones are united anteriorly at the pubic symphysis to form the pelvic girdle.

Each hip bone, in turn, articulates with the head of the corresponding femur to form the hip joint. The vertebral column contains the spinal cord in the vertebral canal and thereby protects the spinal cord from external trauma.

Powerful muscles attached to the posterior part of the vertebral column provide support for the column, and are important in the maintenance of the posture of the individual.

For descriptive purposes the vertebral column is divided into five regions. From above downwards these are, in sequence, the cervical, thoracic, lumbar, sacral and coccygeal regions. The thoracic vertebral column articulates with the posterior ends of all the ribs, and thus forms the posterior wall of the thoracic skeleton (thoracic cage).

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## General description of the articulated vertebral column (Figure 1)

The adult vertebral column makes up about two-fifths of the total height of the body, and is formed of a vertical chain of bony elements termed vertebrae. From above downwards these comprise seven cervical vertebrae, twelve thoracic vertebrae, five lumbar vertebrae, the sacrum and coccyx. The cervical, thoracic and lumbar vertebrae are termed moveable vertebrae, on account of the fact that the individual vertebrae can move relative to their neighbouring vertebrae. The sacrum and coccyx, by contrast, are each formed by the fusion of vertebrae (five vertebrae fuse to form the sacrum while four fuse to form the coccyx). The sacrum and coccyx are therefore termed immovable.

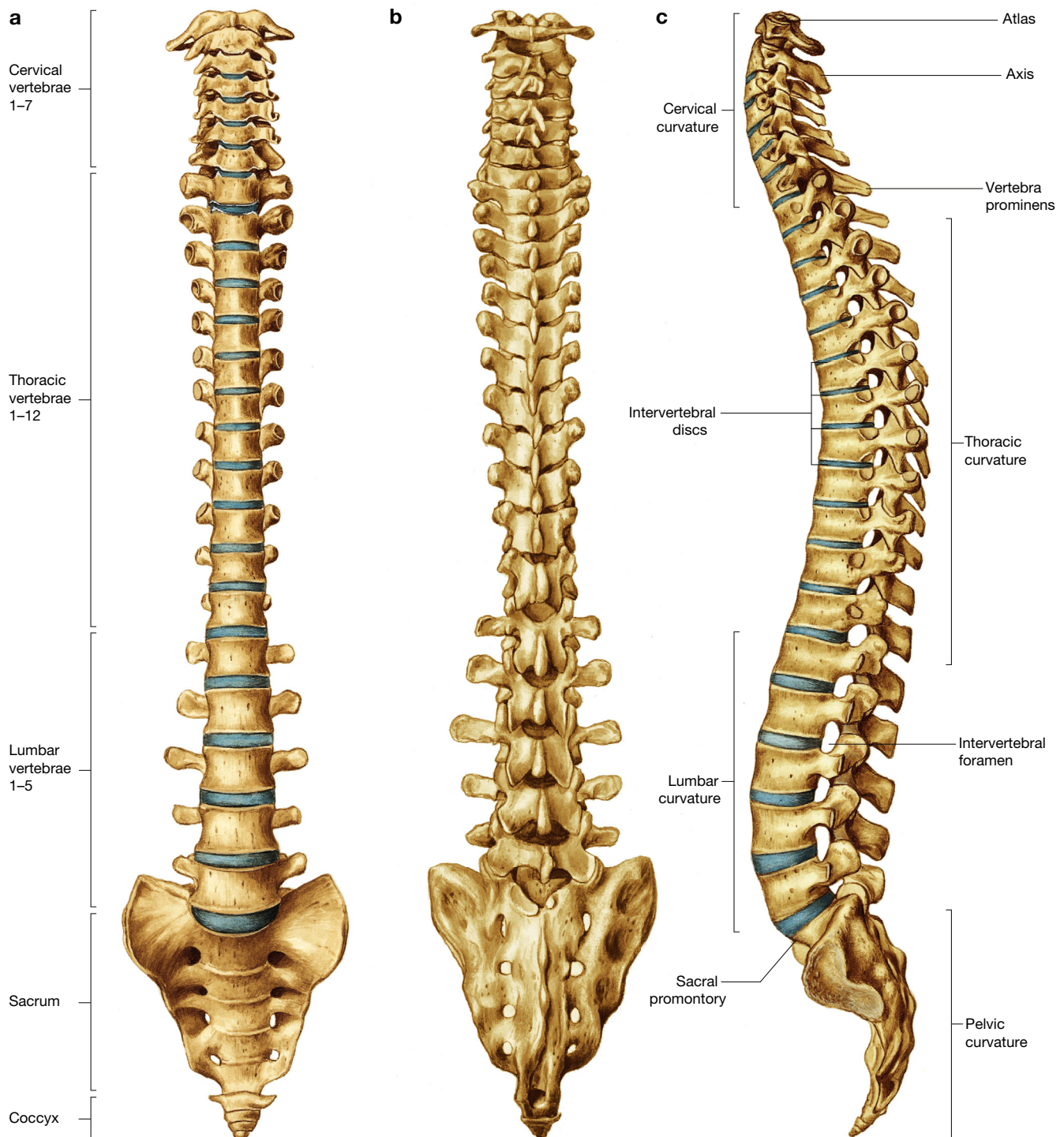
In the fetus the vertebral column is curved in the shape of the letter C (concave ventrally and reciprocally convex dorsally). This anterior concavity is termed the primary curvature of the vertebral column, and is retained throughout life in the thoracic, sacral and coccygeal regions of the column. However after birth, secondary curvatures with an anterior convexity (lordosis) appear gradually in the cervical and lumbar regions, resulting in the permanent sinuous curves of the fully developed spinal column that is evident when the column is viewed in profile (Figure 1). The cervical lordosis is the consequence of sustained extension of the head and neck produced by the postvertebral muscles when the child first holds up its head. The lumbar lordosis appears much later and is associated with the muscular support of the trunk provided by the powerful postvertebral muscles when the infant learns to sit, stand and walk.

## Morphology of a typical vertebra (Figures 2 and 3)

With the exception of the first two cervical vertebrae (atlas and axis respectively), all the moveable vertebrae, whether from the cervical, thoracic or lumbar regions, share a more-or-less common morphological design (Figure 2).

Thus each typical moveable vertebra features a cylindroid *vertebral body*, anteriorly. Attached to the back of the body is a bony arch, termed the vertebral arch (neural arch). Between the two is the vertebral foramen. In the articulated vertebral column, all the vertebral foramina 'stacked' one on top of another constitute, collectively, the vertebral canal (spinal canal). Occupying the upper two-thirds of the length of the vertebral canal is the spinal cord, which in the adult ends at the level of the first lumbar vertebra.

Projecting laterally from the vertebral arch on either side is the corresponding transverse process. Projecting backwards from the posterior midline of the vertebral arch is the spinous process. The part of the vertebral arch that lies between the roots of the transverse and spinous processes is termed the lamina, on account of its thick and plate-like shape (Figure 3). The right and left laminae meet in the posterior midline at the root of the spinous process (Figures 2 and 3). The most anterior part of the vertebral arch on each side, where the arch adjoins the back of the vertebral body, is termed the *pedicle* (Figure 3). The height of each pedicle is approximately half the height of the vertebral body (Figure 4). Thus there is a substantial gap between successive pedicles. This is called the intervertebral foramen



**Figure 1** The articulated vertebral column in an adult – anterior, posterior and lateral views

(Figures 4 and 5). Each intervertebral foramen transmits a spinal nerve with accompanying radicular arteries and veins.

Projecting upwards from the vertebral arch on either side of the midline, at approximately the junction of the lamina, pedicle and the root of the transverse process, is the superior articular

process, while projecting inferiorly from the vertebral arch in line with the superior articular process is the inferior articular process (Figures 3 and 4). Each articular process features a smooth articular facet that in life, is covered by a layer of articular hyaline cartilage.

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