Surgical Management of Intradural Spinal Cord Tumors

A Protocol of a Thesis Submitted for Partial Fulfillment of M.D. Degree in Neurosurgery

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Anatomy

Osseous relationship

Cervical Spine

The cervical spine consists of two “special” vertebrae– the atlas and axis – connecting the spine with the cranium in a complex set of joints and ligaments, and five "ordinary” vertebrae in a slightly lordotic curve. The atlas is formed like a ring with small lateral masses, which articulate with the occipital condyles of the cranium above and the lateral masses of the axis underneath fig (1),(2). A fifth joint provides the rotation of the head and is formed between the atlas and the dens axis (i.e., the odontoid process). **(Anson JA, Spetzler RF., 1993)**

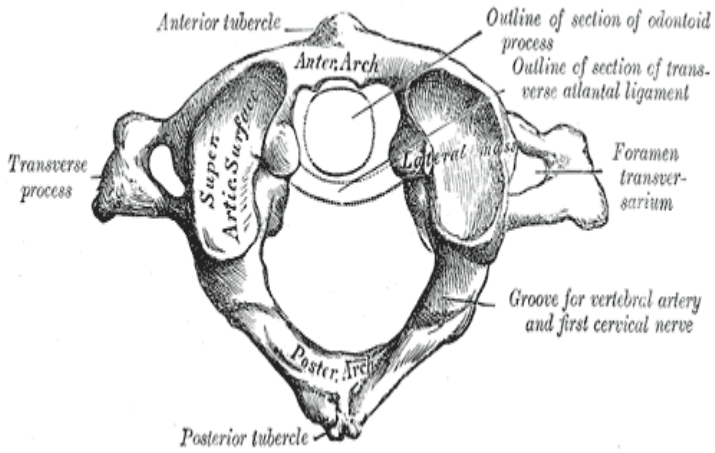

Fig (1) First cervical vertebra or atlas **(Anson JA, Spetzler RF., 1993)**

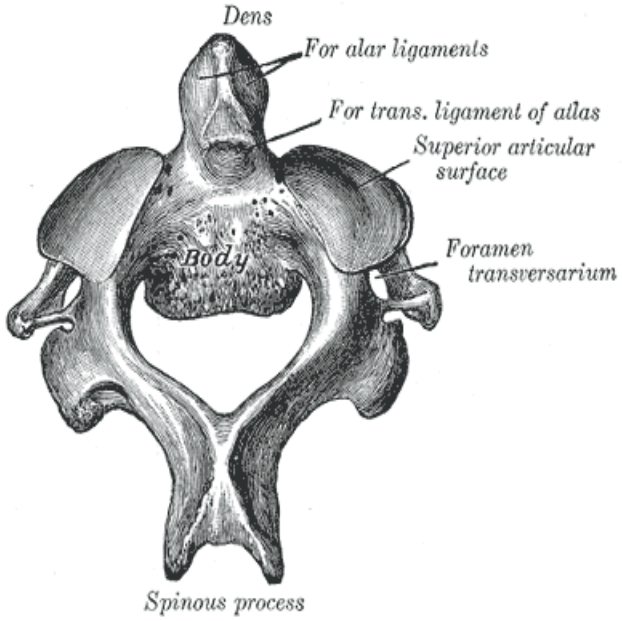

Fig (2) Second cervical vertebra, from above. (**Anson JA, Spetzler RF., 1993**)

The remaining vertebral bodies are rectangular in shape, with a slight depression of the superior surface, giving rise to bony edges on either side (i.e., the uncinate processes).

The posterior elements of the second to seventh vertebra form the neural arches consisting of pedicles, the lamina, and spinous processes. The short pedicles connect the vertebral body with the facet joints, which are formed by articular processes above and below. Fig 3, 4

A neuroforaminae is formed by pedicles above and below the vertebral body and uncinate process medially, the transverse process laterally, and the articular processes posteriorly. The

cervical foraminae are oriented about 30c anterolaterally. The spinous processes point downward in the midline.

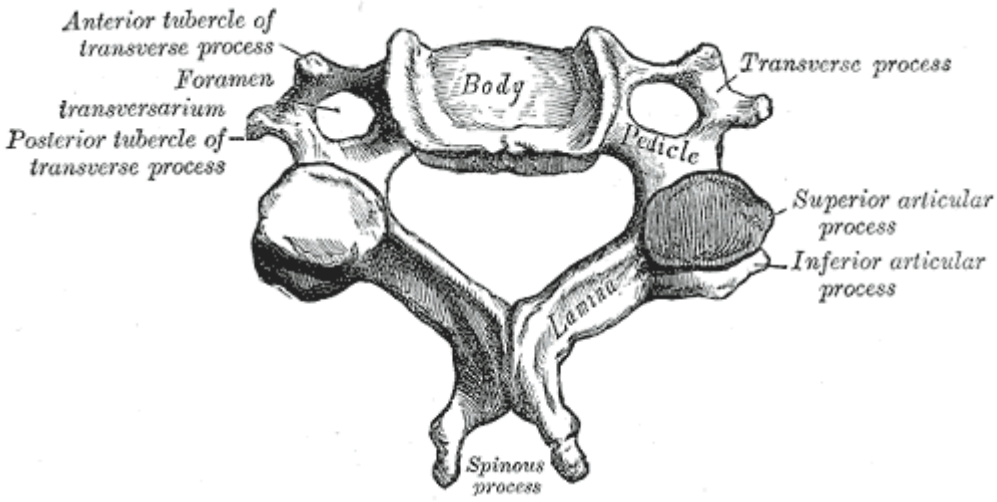

Fig (3) A cervical vertebra. **(Anson JA, Spetzler RF., 1993)**

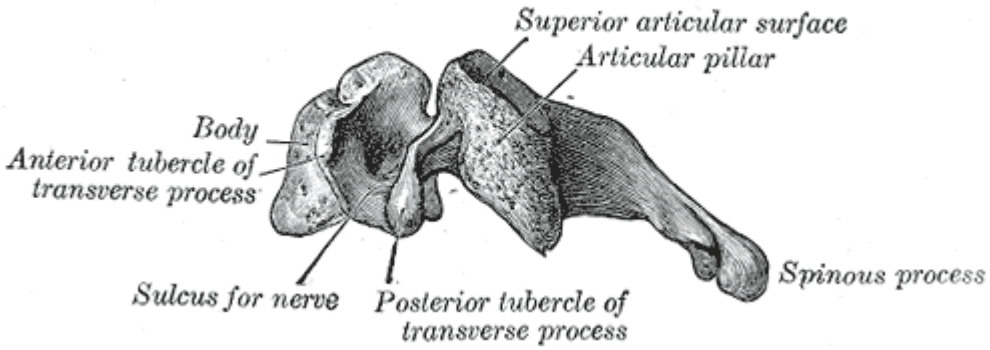

fig (4) Side view of a typical cervical vertebra**(Anson JA, Spetzler RF., 1993)**

The average anterior–posterior diameter of the bony spinal canal measures 18–20 mm at C1 and C2, and 15–17 mm between C3

and C7. The thecal sac measures 10–14 mm throughout the cervical spine, and the spinal cord 6–9 mm. **(Austin G.** 1997)

Thoracic Spine

The 12 thoracic vertebral bodies are rectangularly shaped with flat superior and inferior surfaces. The neural foraminae exit almost laterally. The intervertebral discs appear flatter than their cervical and lumbar counterparts. The neuroforaminae are directed laterally. The laminae form an almost circular spinal canal of constant width throughout the thoracic spine.fig (5)

The major difference in the bony anatomy of the thoracic spine is the articulation with the ribs. The heads of ribs 2–10 articulate with their posterior surfaces to the posterlaterally aspects of vertebral bodies. Half of the joint surface is on the superior and half on the inferior body. Ribs 1, 11, and 12 articulate only with the upper part of the corresponding vertebral body. Furthermore, the tubercles of ribs 1–10 articulate on their posterior surfaces with the transverse processes of the same-numbered vertebral body. **(Benzil DL., et al 1992)**

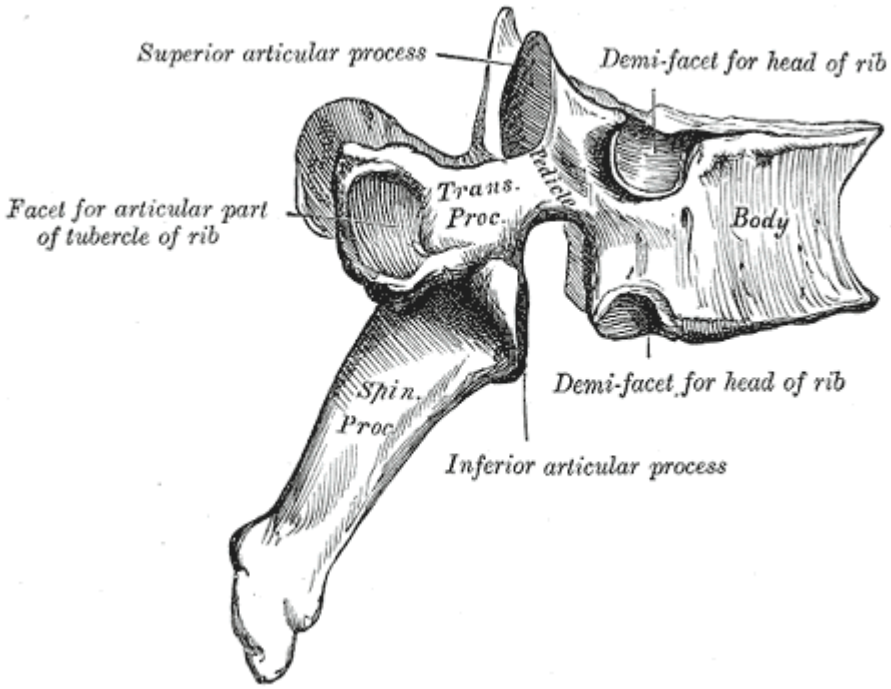

Fig (5) A thoracic vertebra (**Anson JA, Spetzler RF., 1993)**

Lumbar Spine and Sacrum

Similarly to the thoracic vertebrae, the five lumbar vertebral bodies are rectangular in shape, with flat superior and inferior surfaces. The pedicles project posterlaterally. The neural foraminae exit almost laterally. The posterior border of each foramen is formed by the articular processes. These processes are comparably long and form the facet joints. The lumbar laminae form an oval spinal canal in the upper lumbar spine. In the lower part, the shape becomes more triangular, with bony recesses anterolaterally; these are formed by indentations of the superior articular processes of the facet joints. The sacrum is composed of

four or five fused vertebrae that form a triangle. It articulates laterally with the iliac bones.fig (6)

Lumbar nerve root sleeves lie anterolaterally to the thecal sac at the level of the pedicle, and continue into the upper half of the neuroforaminae. **(Manzano G, et al 2008)**

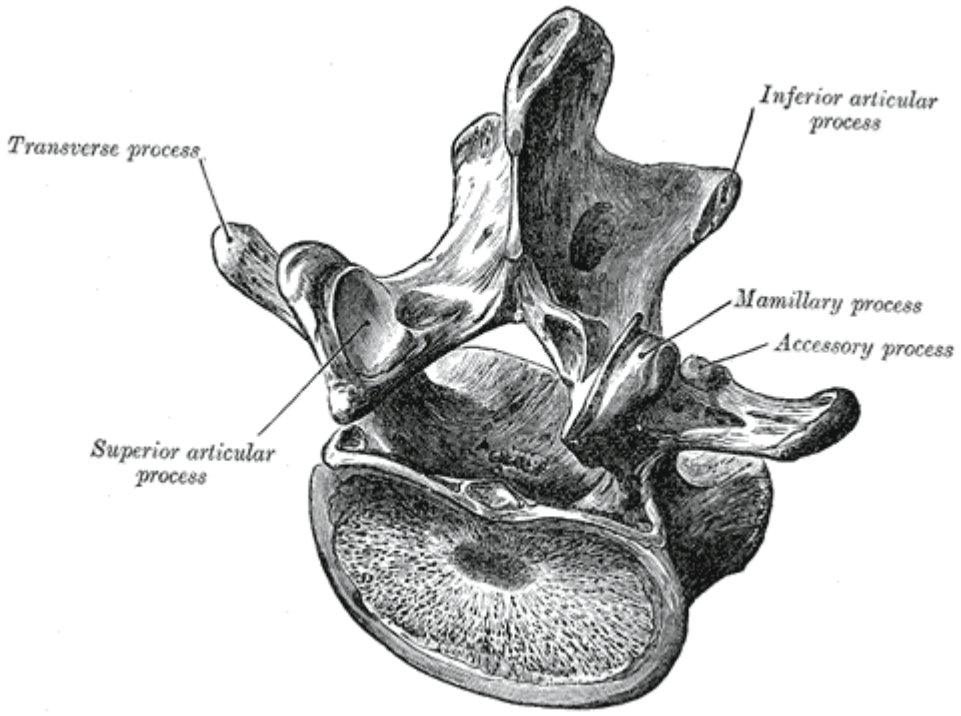

Fig (6) A lumbar vertebra from above and behind. **(Anson JA, Spetzler RF., 1993)**

Gross Anatomy of the Spinal Cord

The spinal cord is the elongated, cylindrical part of the central nervous system which occupies most of the vertebral canal. Its average length is 45.9cm in male and 41.5cm in female. It extends from the level of the cranial border of the atlas to the caudal

border of the first or the second lumbar vertebra. This level of termination is a subject to variation. The cord's termination may be as high as the lower third of the twelfth thoracic vertebra or as low as the disc between the second and the third lumbar vertebra. The spinal cord narrows caudally to a sharp tip, the conus modularise. **(Blight AR.et al 1993)**

The spinal cord coverings

The spinal cord is enclosed in three membranes or meninges. These are, from without inward, the dura, arachnoid, and the pia maters, which are separated from each other by subdural and subarachnoid spaces, the former being merely potential, the latter being occupied by the cerebrospinal fluid**. Fig (7)**

The cervical enlargement is the more pronounced and corresponds to the large spinal nerves supplying the upper limbs. Hence it extends from the third cervical to the second thoracic segment, its maximum circumference (about 38mm) being in the sixth cervical segment. The lumbar enlargement similarly corresponding in level to the segmental innervations of the lower limbs beginning at the first lumbar segment and extending to the third sacral the equivalent vertebral levels being ninth to twelfth thoracic. Its greatest circumference (about 35mm) **(Flanders 'AE,et al 1990)**

Fissures and sulci mark the external surface of the spinal cord through most of its length. An anterior median fissure and a posterior median sulcus and septum almost completely divide the cord into symmetrically right and left halves ,joined across the midline by a commissural band of nervous tissue , in which is situated the central canal.

The anterior median fissure, traversing the whole length of the ventral surface of the spinal cord, has an average depth of 3mm, being deeper than this at caudal levels. It contains a reticulum of pia mater, and immediately dorsal to it is a lamina of nerve fibres, the anterior white commissure.Perforating branches of the spinal vessels pass from the fissure into the commissure to supply the central region of the spinal cord.

The posterior median sulcus is much shallower, and from it a posterior median septum of neuralgia penetrates more than halfway into the substance of the cord, reaching almost to the central canal.

A posterolateral sulcus exists on either side of the posterior median sulcus, and along it the dorsal spinal roots enter the cord. The white matter of the cord between the posterior median and the posterolateral sulcus on each side is the posterior funiculus.Through the cervical and upper thoracic segments the surfaces of this funiculus present a further longitudinal furrow, the

postero-intermediate sulcus, which mark the position of a septum extending into the posterior funiculus and dividing it into two large tracts, the fasciclus gracilis, which is medial, and the fasiculus cuneatus which is lateral**. (Saraceni C et al 2009)**

The region of the spinal cord between the posterolateral sulcus and the anterior median fissure is the anterolateral funiculus, which is further subdivided into anterior and lateral funiculi by the issuing anterior root of the spinal nerve. The anterior funiculus lies medial to, and includes the zone of emergence of the ventral root, whilst the lateral funiculus lies between the roots and the posterolateral sulcus.

The filum terminale, a fine filament of connective tissue about 20cm long, descending from the apex of the conus medullaris. Its cranial 15cm, the filum terminale internum, is surrounded by tubular extensions of the dural and arachnoid meninges and reaches as far as the lower border of the second sacral vertebra. Its final 5cm, the filum terminale externum, is closely united with the investing sheath of the dura mater, descending to an attachment to the dorsum of the first coccygeal vertebral segment.

The paired dorsal and ventral roots of the spinal nerve are continuous with the cord at the intervals along it. These cross the subarachnoid space, traverse the dura mater separately, and then