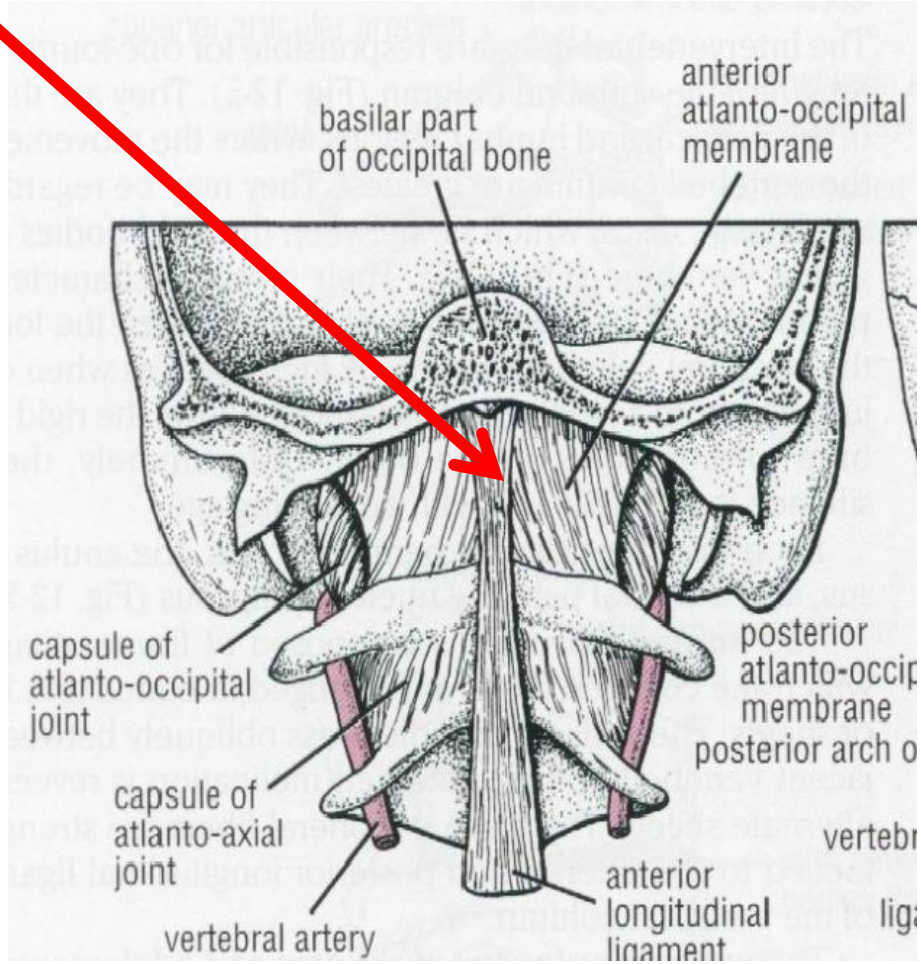
JOINTS OF THE VERTEBRAL COLUMN

Atlanto-Occipital Joints

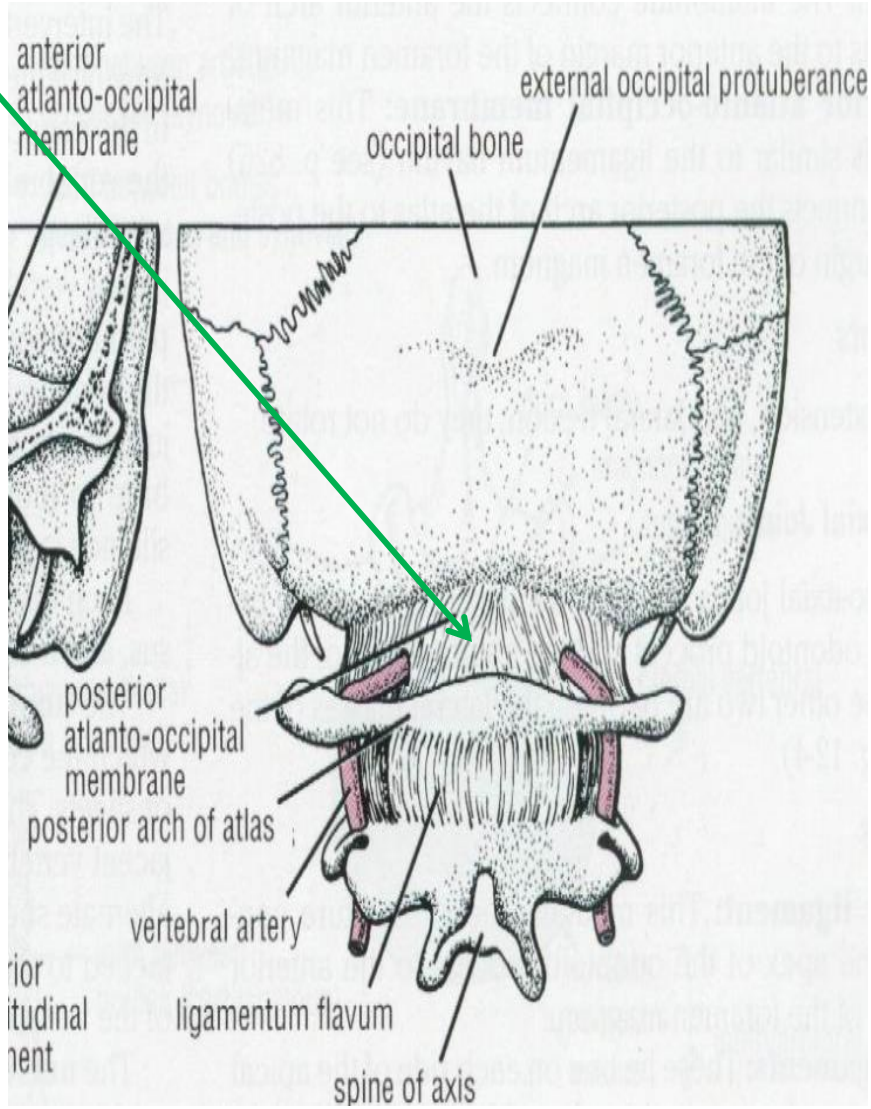
The atlanto-occipital joints are synovial joints that are formed between the occipital condyles, which are found on either side of the foramen magnum above and the facets on the superior surfaces of the lateral masses of the atlas below

Ligaments

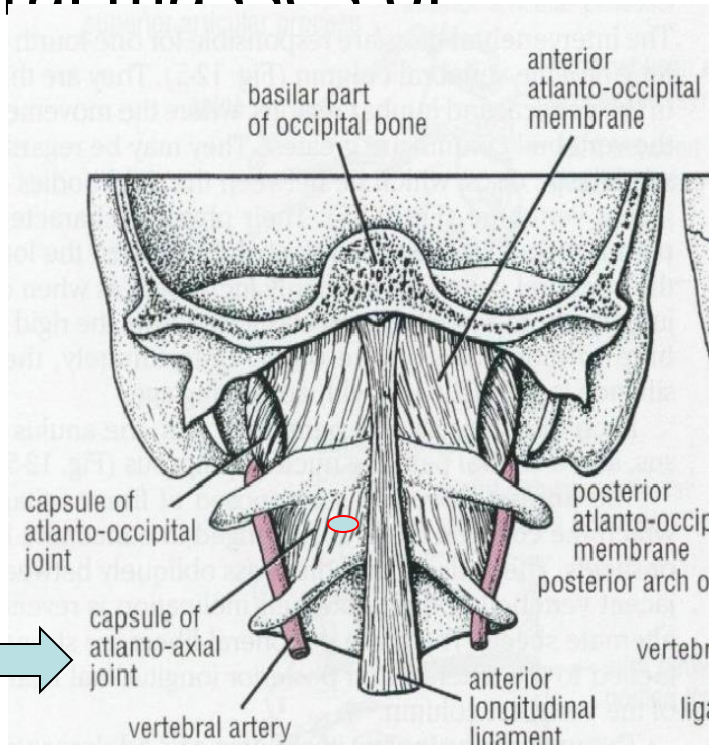
- **1. Anterior atlanto-occipital membrane:** This is a continuation of the anterior longitudinal ligament, which runs as a band down the anterior surface of the vertebral column. The membrane connects the anterior arch of the atlas to the anterior margin of the foramen magnum.



- **2. Posterior atlanto-occipital membrane: This membrane is similar to the ligamentum flavum and connects the posterior arch of the atlas to the posterior margin of the foramen magnum.**
- *Movements*
- Flexion, extension, and lateral flexion; they do not rotate.



- Atlanto-Axial **Joints**
- The atlanto-axial joints are three synovial joints; one is between the odontoid process and the anterior arch of the atlas, and the other two are between the lateral masses of the bones



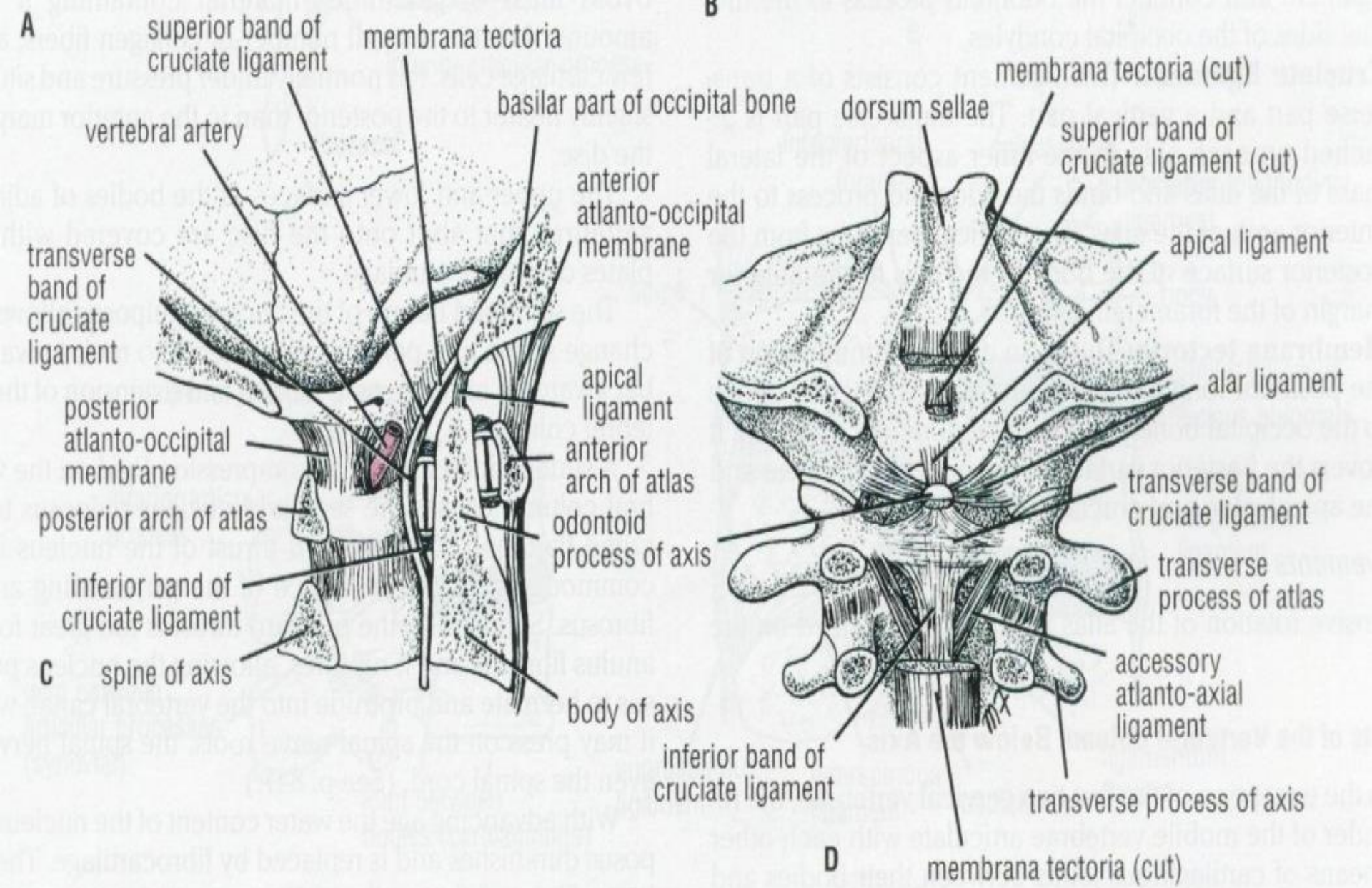


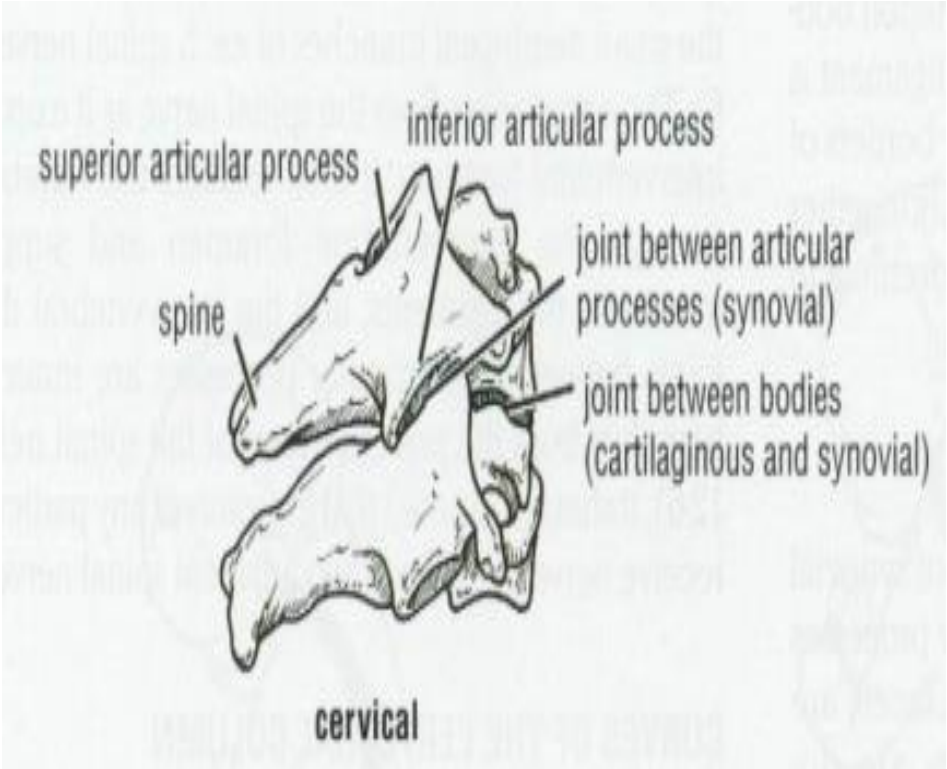
Figure 12-4 Atlanto-occipital joints: **A.** Anterior view. **B.** Posterior view. Atlanto-axial joints: **C.** Sagittal section. **D.** Posterior view; note that the posterior arch of the atlas and the laminae and spine of the axis have been removed.

- ***Ligaments***
- ***1.* Apical ligament:** This median-placed structure connects the apex of the odontoid process to the anterior margin of the foramen magnum.
- **2. Alar ligaments:** These lie one on each side of the apical ligament and connect the odontoid process to the medial sides of the occipital condyles

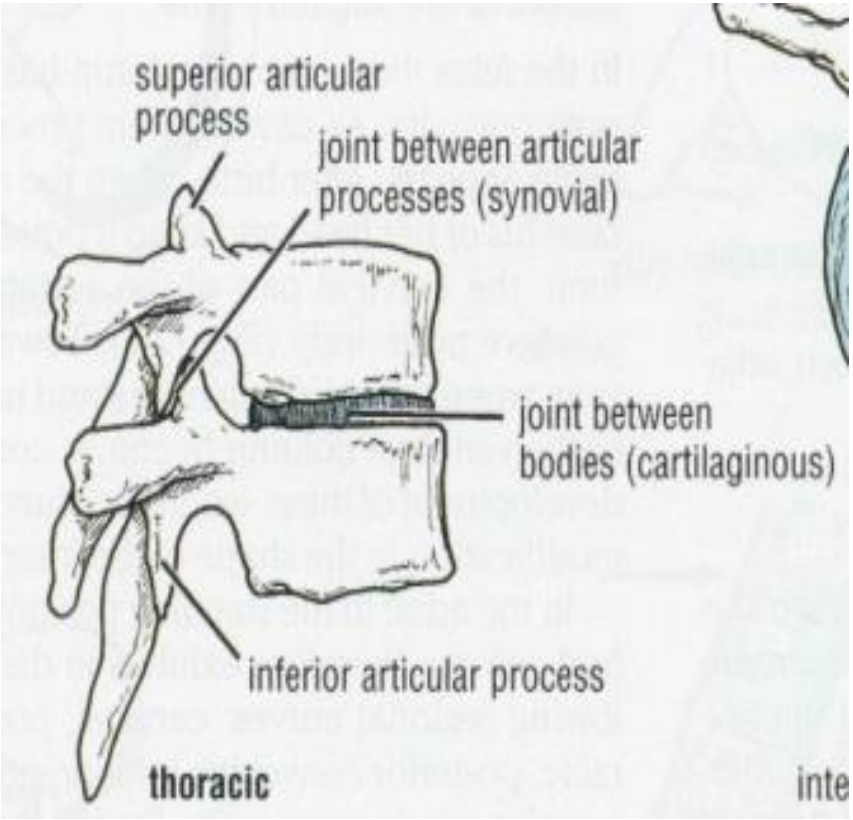
- **3. Cruciate ligament:** This ligament consists of a transverse part and a vertical part. The *transverse part* is attached on each side to the inner aspect of the lateral mass of the atlas **and binds the odontoid process to the anterior arch of the atlas**. The *vertical part* runs from the posterior surface of the body of the axis to the anterior margin of the foramen magnum.

- **4. Membrana tectoria:** This is an upward continuation of the posterior longitudinal ligament. It is attached above to the occipital bone just within the foramen magnum. It covers the posterior surface of the odontoid process and the apical, alar, and cruciate ligaments.
- *Movements*
- Extensive rotation of the atlas and thus of the head on the axis.

- **Joints of the Vertebral Column Below the Axis**
- With the exception of the first two cervical vertebrae, the remainder of the mobile vertebrae articulate with each other by means of **cartilaginous** joints between their bodies and by **synovial joints** between their articular processes

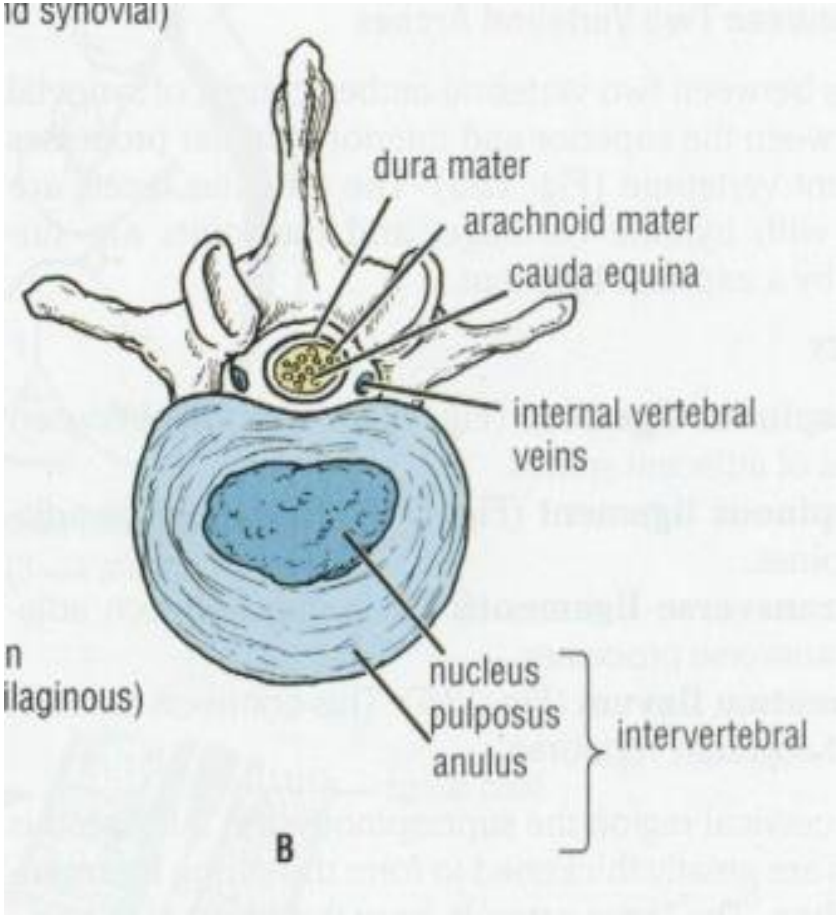


- **Joints Between Two Vertebral Bodies**
- The upper and lower surfaces of the bodies of adjacent vertebrae are covered by thin plates of **hyaline cartilage**. Sandwiched between the plates of hyaline cartilage is an **intervertebral disc** of **fibrocartilage**..

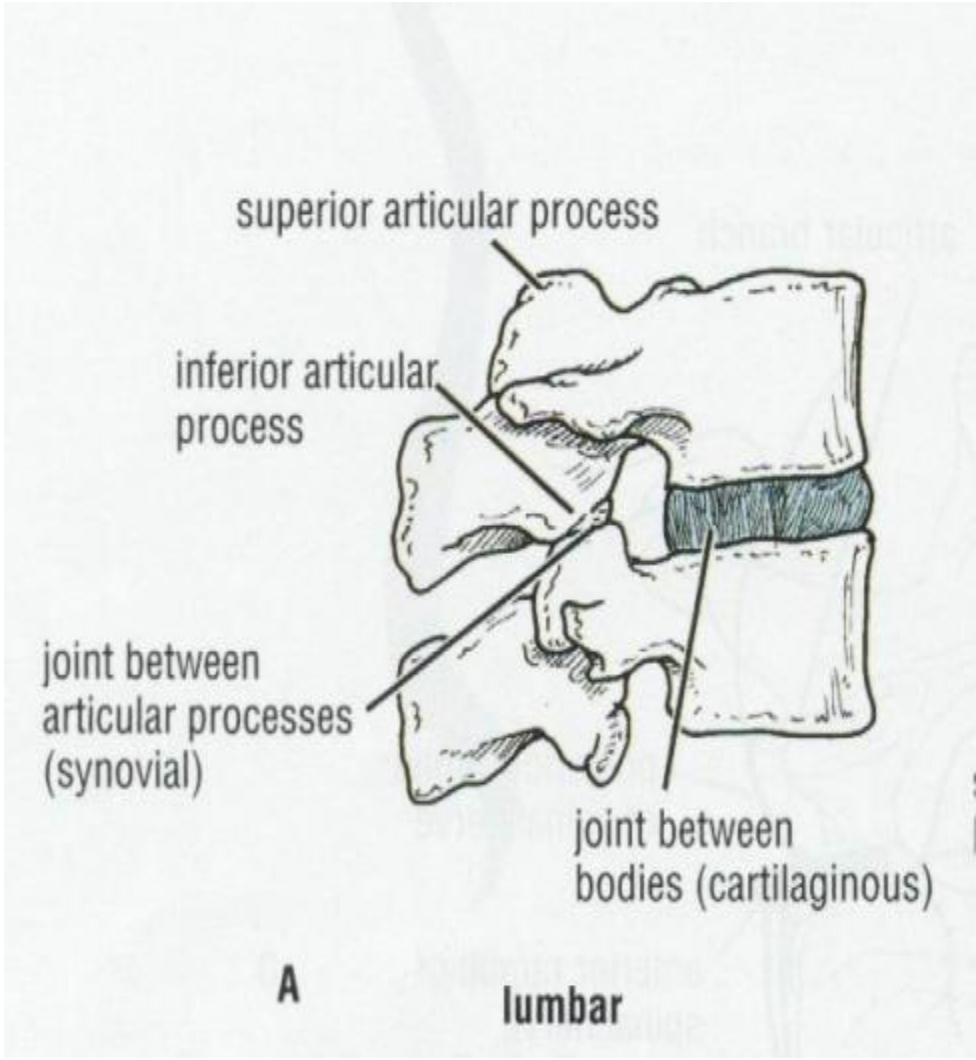


- The collagen fibers of the disc strongly unite the bodies of the two vertebrae
- In the lower cervical region, small synovial joints are present at the sides of the intervertebral disc between the upper and lower surfaces of the bodies of the vertebrae

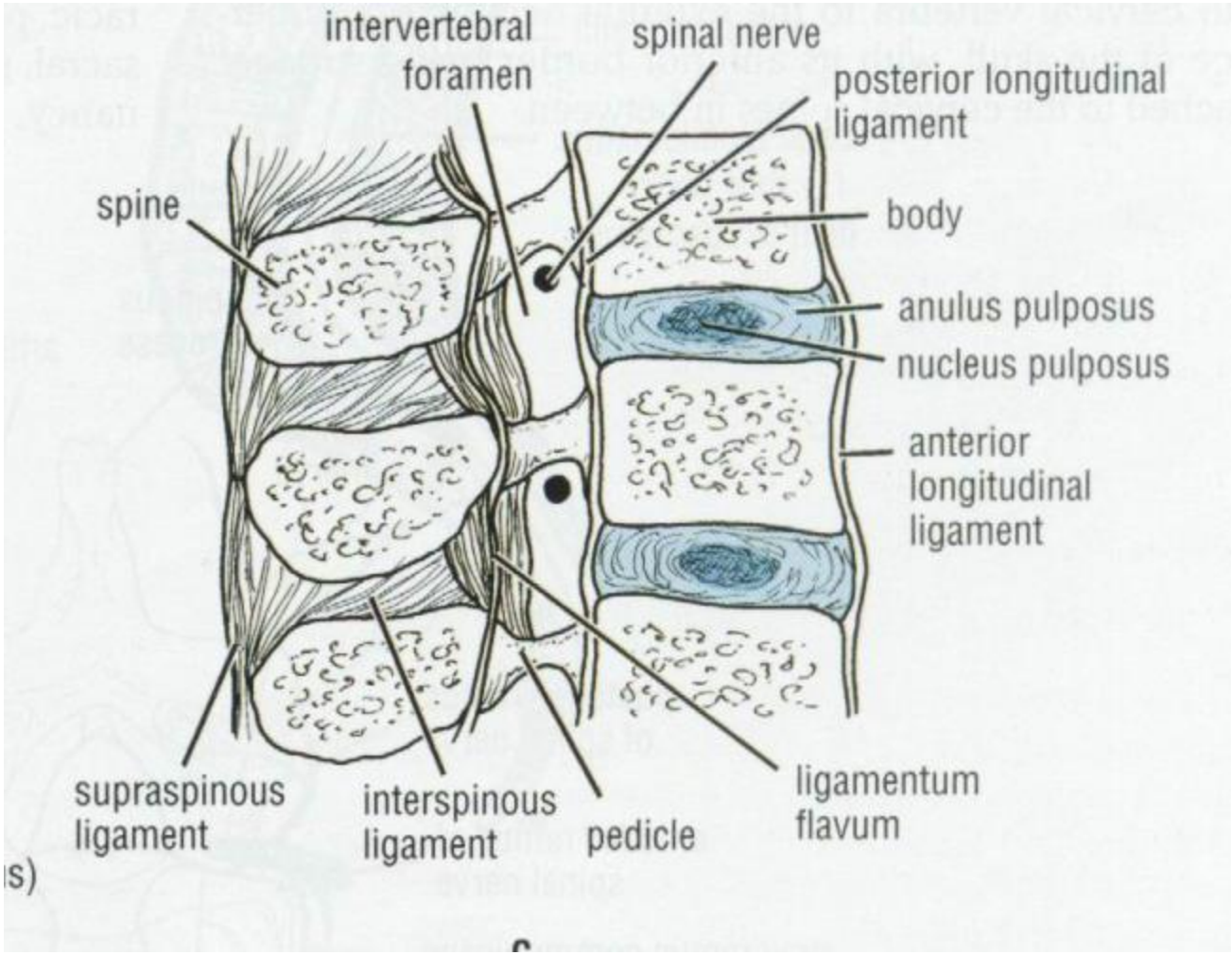
- ***Intervertebral Discs***
- **The intervertebral discs are responsible for one-fourth of the length of the vertebral column. They are thickest in the cervical and lumbar regions, where the movements of the vertebral column are greatest**



- They may be regarded as sernielastic discs, which lie between the rigid bodies of adjacent vertebrae. Their physical characteristics permit them to serve as shock absorbers when the load on the vertebral column is suddenly increased, as when one is jumping from a height. Their elasticity allows the rigid vertebrae to move one on the other. Unfortunately, their resilience is gradually lost with advancing age.



Each disc consists of a peripheral part, the anulus fibrosus, and a central part, the nucleus pulposus



- The **anulus fibrosus** is composed of fibrocartilage, in which the collagen fibers are arranged in concentric layers or sheets. The collagen bundles pass obliquely between adjacent vertebral bodies, and their inclination is reversed in alternate sheets. **The more peripheral fibers are strongly attached to the anterior and posterior longitudinal ligaments of the vertebral column.**

- The **nucleus pulposus** in children and adolescents is an ovoid mass of gelatinous material containing a large amount of **water, a small number of collagen fibers,** and a few **cartilage cells**. It is normally under pressure and situated slightly nearer to the posterior than to the anterior margin of the disc.
- The upper and lower surfaces of the bodies of adjacent vertebrae that abut onto the disc are covered with thin plates of hyaline cartilage.

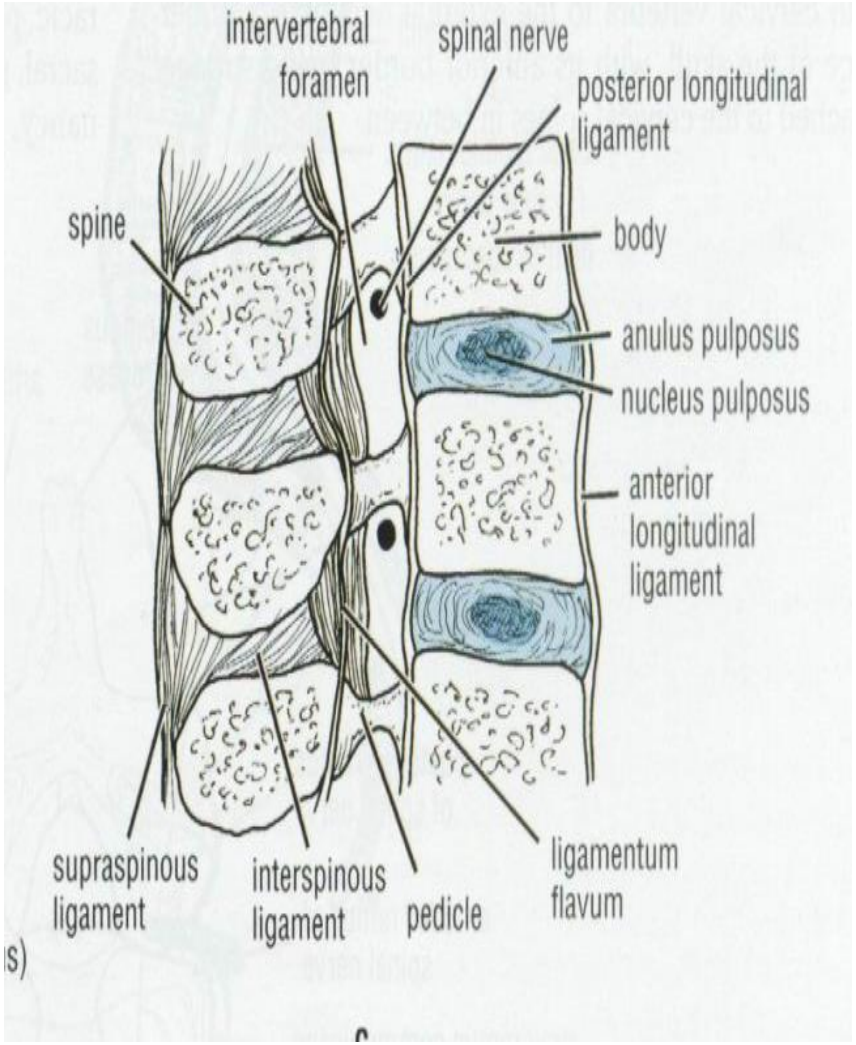
- Function of intervertebral discs:
- The semi fluid nature of the nucleus pulposus allows it to change shape and permits one vertebra to rock forward or backward on another, as in flexion and extension of the vertebral column.

Ligaments

- The **anterior and posterior longitudinal ligaments** run as continuous bands down the anterior and posterior surfaces of the vertebral column from the skull to the sacrum. The anterior ligament is wide and is strongly attached to the front and sides of the vertebral bodies and to the intervertebral discs.
- The posterior ligament is weak and narrow and is attached to the posterior borders of the discs.
- These ligaments hold the vertebrae firmly together but at the same time permit a small amount of movement to take place between them.

- **Joints Between Two Vertebral Arches**
- The joints between two vertebral arches consist of synovial joints between the superior and inferior articular processes of adjacent vertebrae . The articular facets arc covered with hyaline cartilage, and the joints are surrounded by a capsular ligament.

- *Ligaments*
- ***1.*** **Supraspinous ligament** : This runs between the tips of adjacent spines.
- **2. Interspinous ligament** : This connects adjacent spines.
- **3. Intertransverse ligaments:** These run between adjacent transverse processes.
- **4. Ligamentum flavum** : This connects the laminae of adjacent vertebrae.



- In the cervical region the supraspinous and interspinous ligaments are greatly thickened to form the strong **ligamentum nuchae.**
- The latter extends from the spine of the seventh cervical vertebra to the external occipital protuberance of the skull, with its anterior border being strongly attached to the cervical spines in between.

- NERVE SUPPLY OF VERTEBRAL JOINTS
- The joints between the vertebral bodies are innervated by the small meningeal branches of each spinal nerve .
- The nerve arises from the spinal nerve as it exits from the intervertebral foramen. It then reenters the vertebral canal through the intervertebral foramen and supplies the meninges, the ligaments, and the intervertebral discs.
- ***The joints between the articular processes are innervated by branches from the posterior rami of the spinal nerves .***
- It should be noted that the joints of any particular level receive nerve fibers from two adjacent spinal nerves.

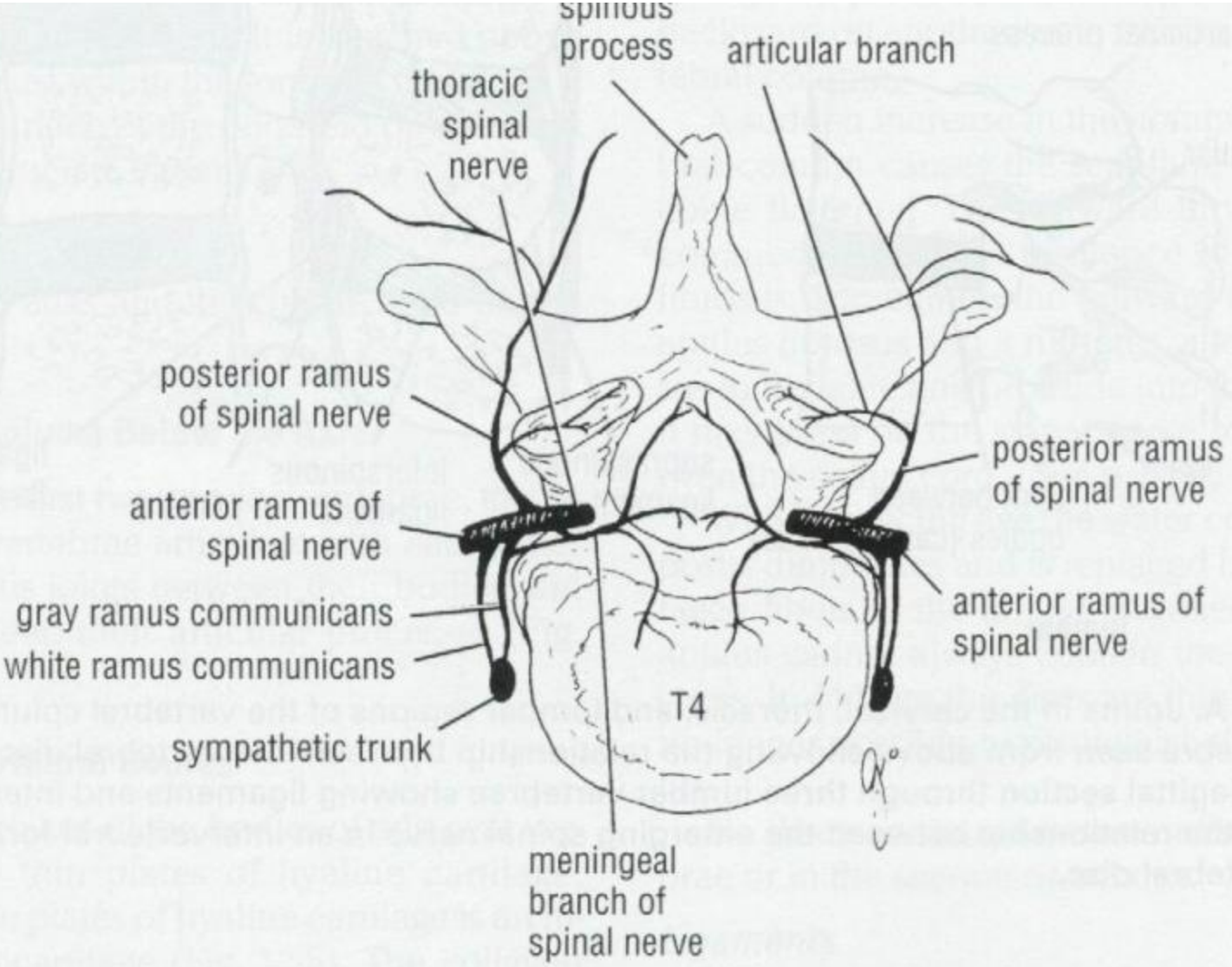


Figure 12-6 Diagram showing the innervation of vertebral joints. At any particular vertebral level, the joints receive nerve fibers from two adjacent spinal nerves.

- **Blood Supply of the Back**
- **ARTERIES**
- The following arteries supply the structures of the back.
- **In the cervical region,** branches arise from the occipital artery, a branch of the external carotid; from the vertebral artery, a branch of the subclavian; from the deep cervical artery, a branch of the costocervical trunk, a branch of the subclavian artery; and from the ascending cervical artery, a branch of the inferior thyroid artery.

- **In the thoracic region** branches arise from the posterior intercostal arteries, and **in the lumbar region** branches arise from the subcostal and lumbar arteries. **In the sacral region** branches arise from the iliolumbar and lateral sacral arteries, branches of the internal iliac artery.

- ## VEINS
- The veins draining the structures of the back form complicated plexuses extending along the vertebral column from the skull to the coccyx. The veins can be divided into *(a)* those that lie external to the vertebral column and surrounded it and form the **external vertebral venous plexus** and-(b) those that lie within the vertebral canal and form the **internal vertebral venous plexus .**These plexuses freely communicate with the veins in the neck, thorax, abdomen, and pelvis. Above they communicate through the foramen magnum with the occipital and basilar venous sinuses within the cranial cavity.

- The internal vertebral plexus lies within the vertebral canal but outside the dura mater of the spinal cord. It is embedded in areolar tissue and receives tributaries from the vertebrae by way of the **basivertebral veins** and from the meninges and spinal cord. The internal plexus is drained by the **intervertebral veins,** which pass outward with the spinal nerves through the intervertebral foramina. Here, they are joined by tributaries from the external vertebral plexus and in turn drain into the vertebral, intercostal, lumbar, and lateral sacral veins.

- The external and internal vertebral plexuses form a capacious venous network whose walls are thin and whose channels have incompetent valves or are valve-less. Free venous blood flow may therefore take place between the skull, the neck, the thorax, the abdomen, the pelvis, and the vertebral plexuses, with the direction of flow depending on the pressure differences that exist at any given time between the regions. This fact is of considerable clinical significance.

- **Lymph Drainage of the Back**
- The deep lymph vessels follow the veins and drain into the deep cervical, posterior mediastinal, lateral aortic, and sacral nodes. The lymph vessels from the skin of the neck drain into the cervical nodes; those from the trunk above the iliac crests drain into the axillary nodes; and those from below the level of the iliac crests drain into the superficial inguinal nodes. (See p. 168.)

- **Nerve Supply of the Back**
- The skin and muscles of the back are supplied in a segmental manner by the posterior rami of the HI pairs of spinal nerves. The posterior rami of the first, sixth, seventh, and eighth cervical nerves and the fourth and fifth lumbar nerves supply the deep muscles of the back and do not supply the skin. The posterior ramus of the second cervical nerve (the **greater occipital nerve)** ascends over the back of the head and supplies the skin of the scalp.
- The posterior rami run downward and laterally and supply a band of skin at a lower level than the intervertebral foramen from which they emerge. Considerable overlap of skin areas supplied occurs so that section of a single nerve