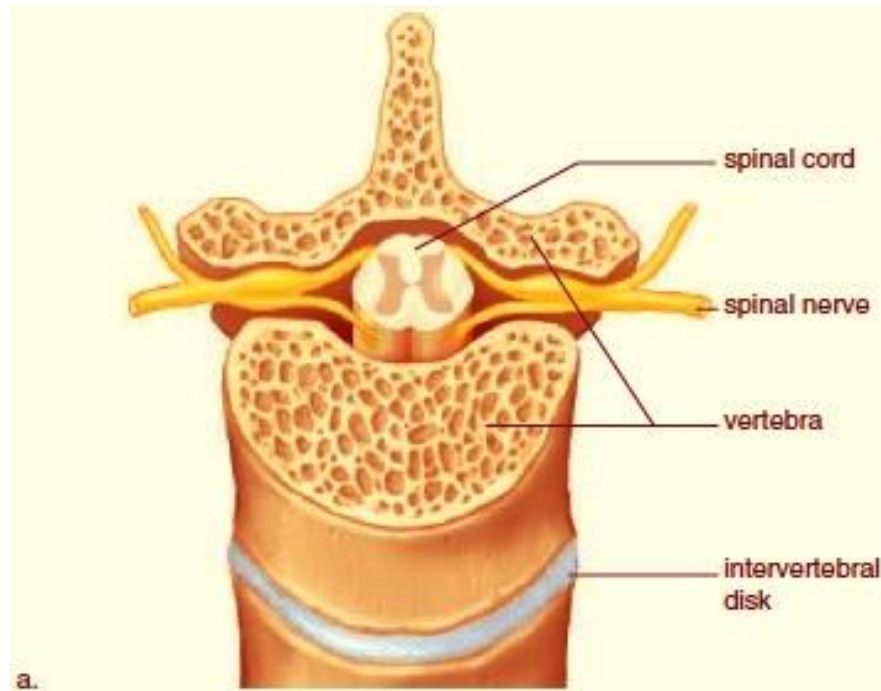


The Nervous System III

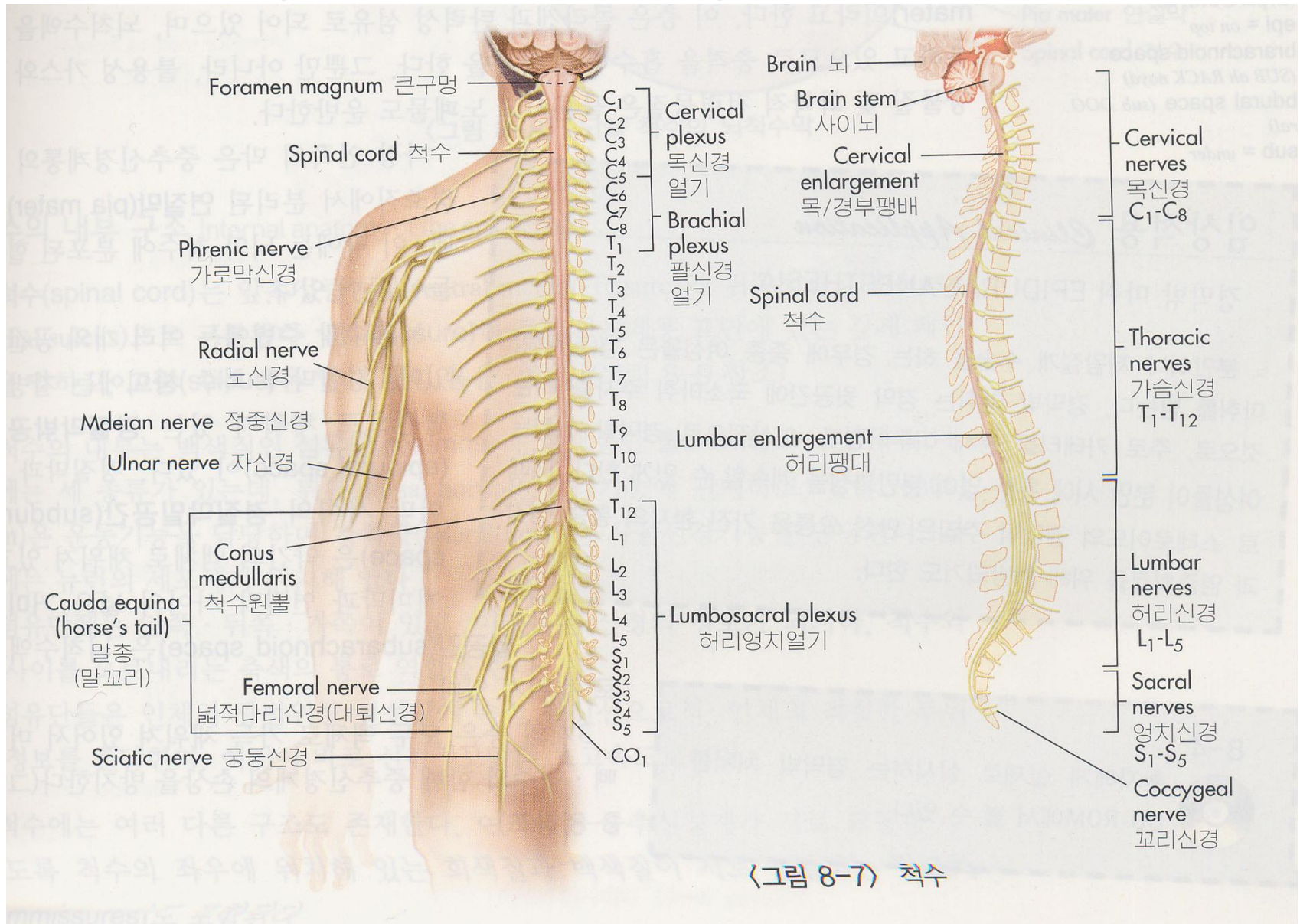
Spinal cord and spinal nerves



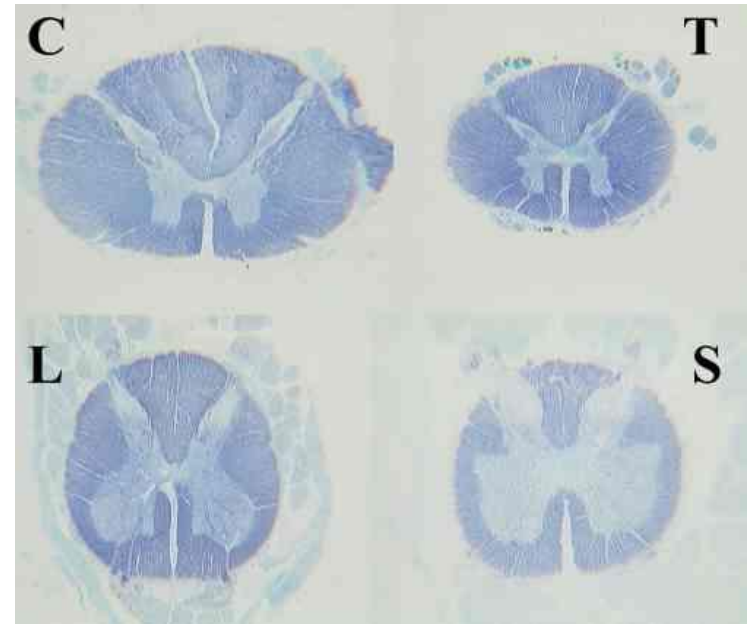
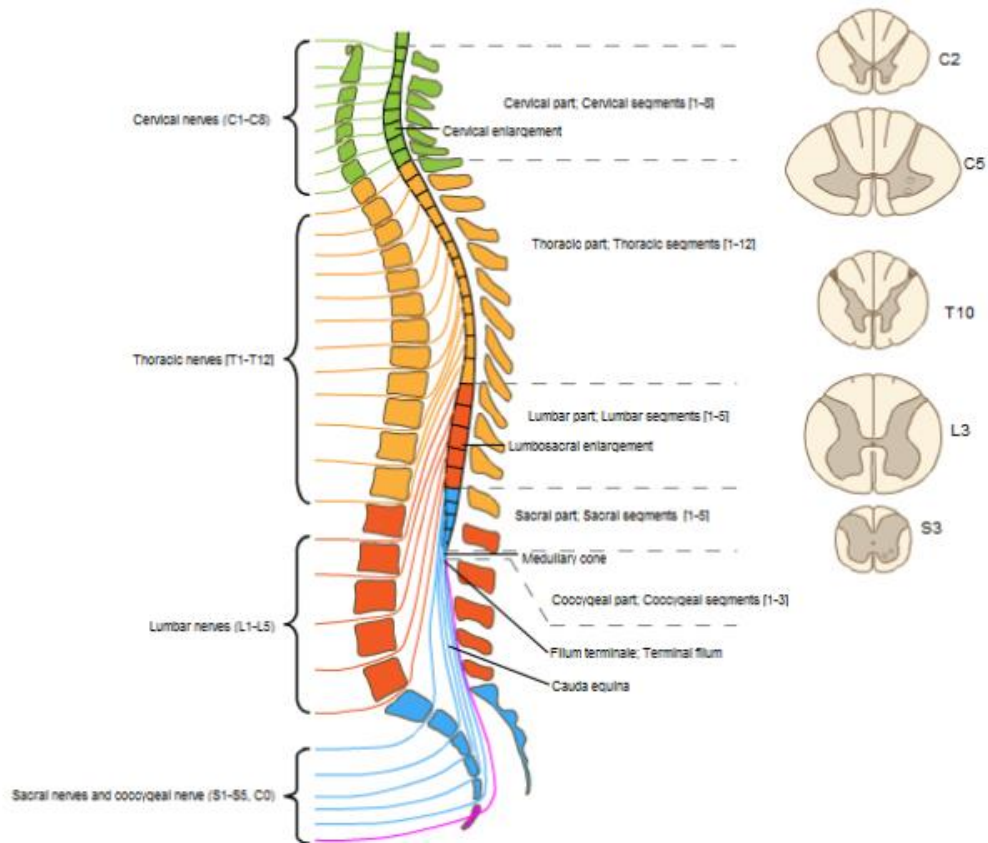
Spinal cord

- The **spinal cord** is a long, thin, tubular bundle of nervous tissue and support cells that extends from the brain (the medulla oblongata specifically).
- The brain and spinal cord together make up the central nervous system (CNS).
- The spinal cord begins at the occipital bone and extends down to the space between the first and second lumbar vertebrae; it does not extend the entire length of the vertebral column.
- It is around 45 cm (18 in) in men and around 43 cm (17 in) long in women. Also, the spinal cord has a varying width, ranging from 1/2 inch thick in the cervical and lumbar regions to 1/4 inch thick in the thoracic area.
- Diameter : 1~1.4 cm

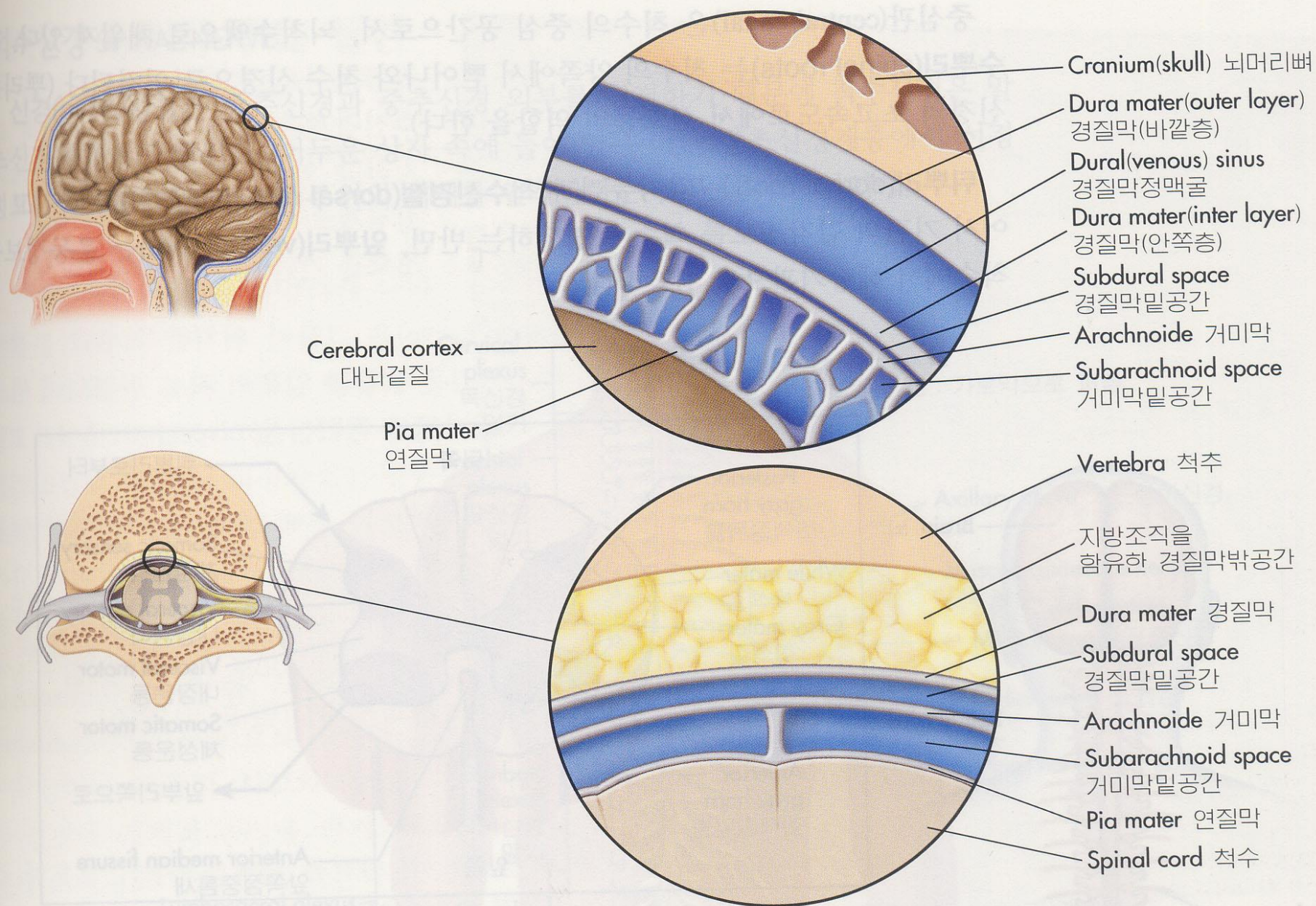
Spinal cord and spinal nerves



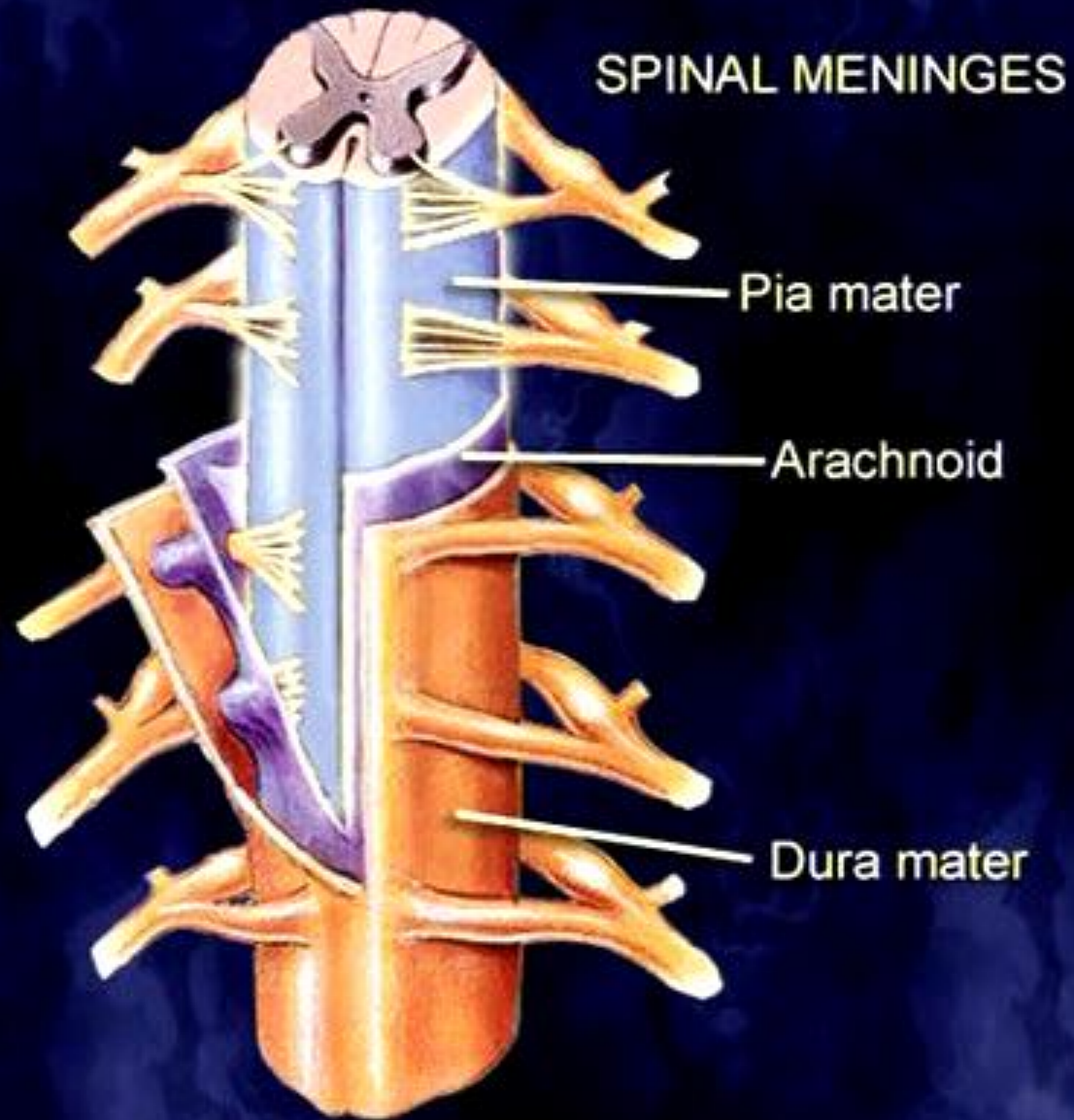
〈그림 8-7〉 척수

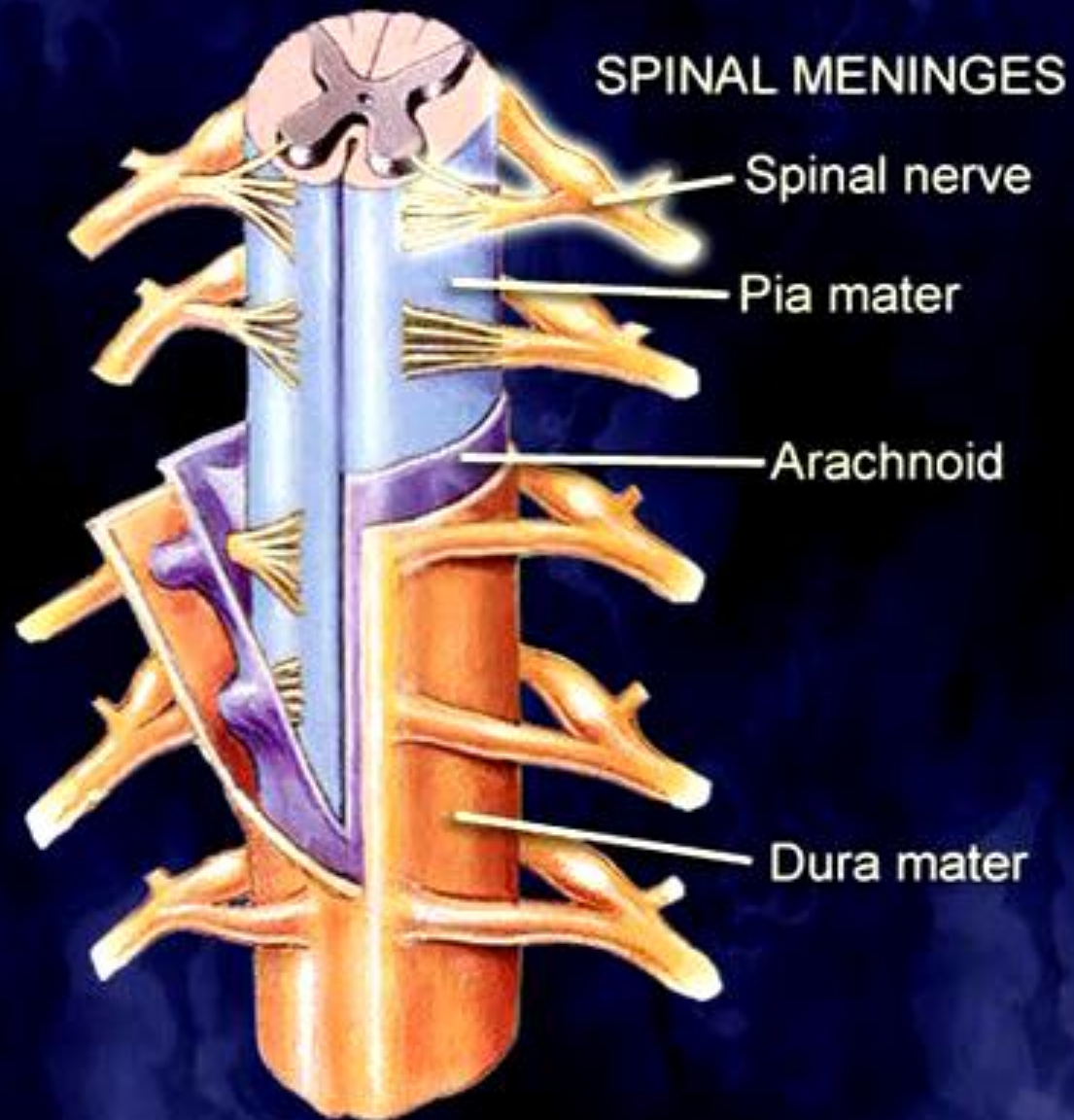


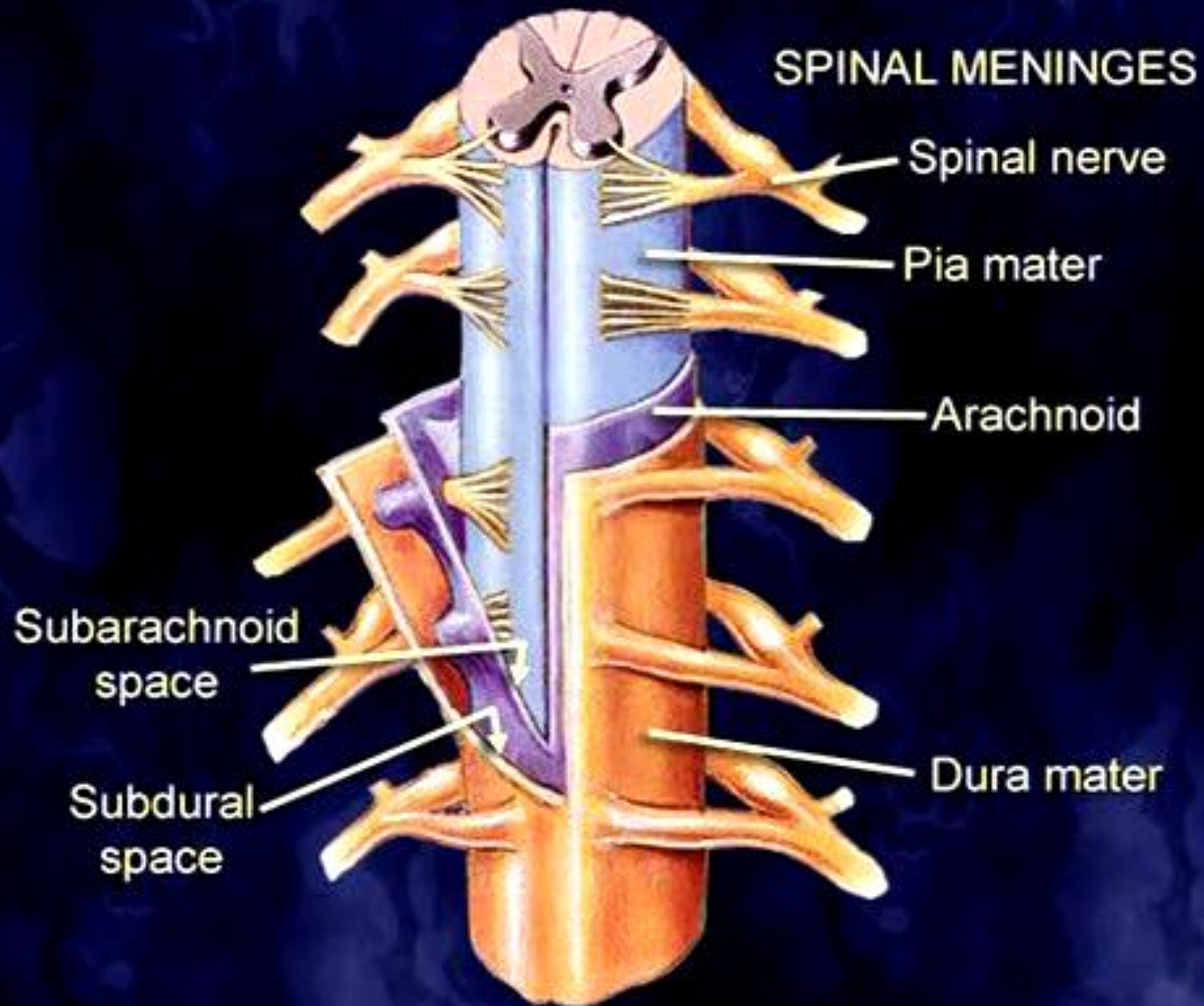
- The spinal cord is protected by three layers of tissue, called spinal meninges, that surround the canal.
- The dura mater is the outermost layer, and it forms a tough protective coating. Between the dura mater and the surrounding bone of the vertebrae is a space called the epidural space. The epidural space is filled with adipose tissue, and it contains a network of blood vessels.
- The arachnoid mater is the middle protective layer. Its name comes from the fact that the tissue has a spiderweb-like appearance.
- The space between the arachnoid and the underlying pia mater is called the subarachnoid space.
- The pia mater is the innermost protective layer. It is very delicate and it is tightly associated with the surface of the spinal cord.



〈그림 8-8〉 뇌와 척수의 뇌척수막







Cerebrospinal fluid
(CSF)

SPINAL MENINGES

Spinal nerve

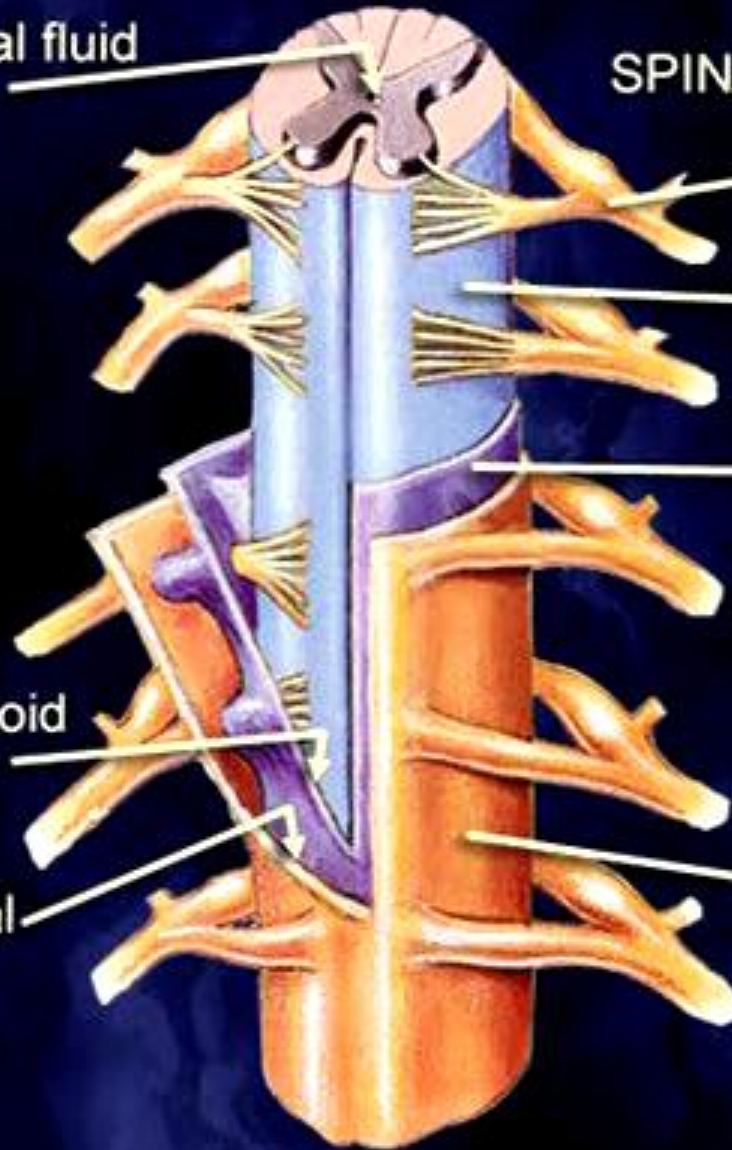
Pia mater

Arachnoid

Subarachnoid
space

Subdural
space

Dura mater



Cerebrospinal fluid
(CSF)

SPINAL MENINGES

Spinal nerve

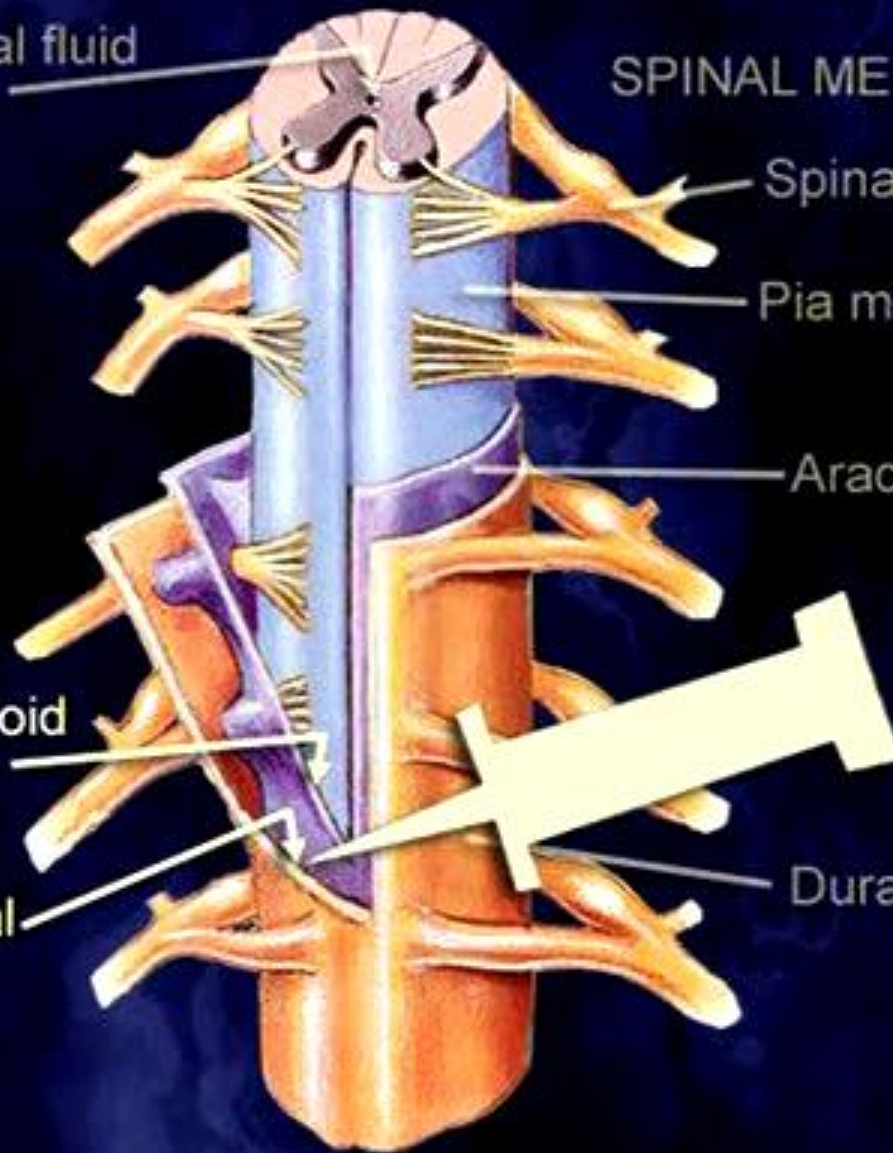
Pia mater

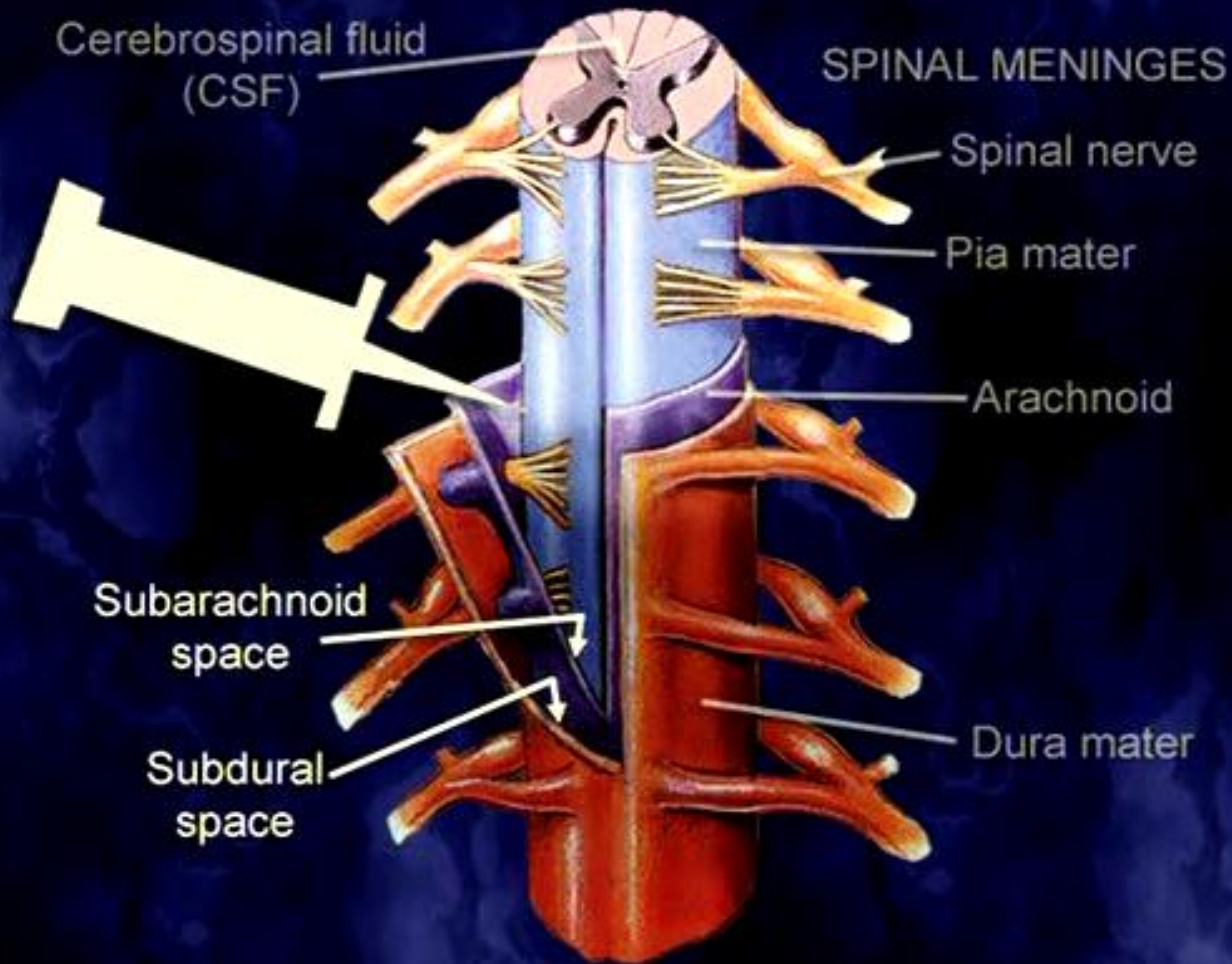
Arachnoid

Subarachnoid
space

Subdural
space

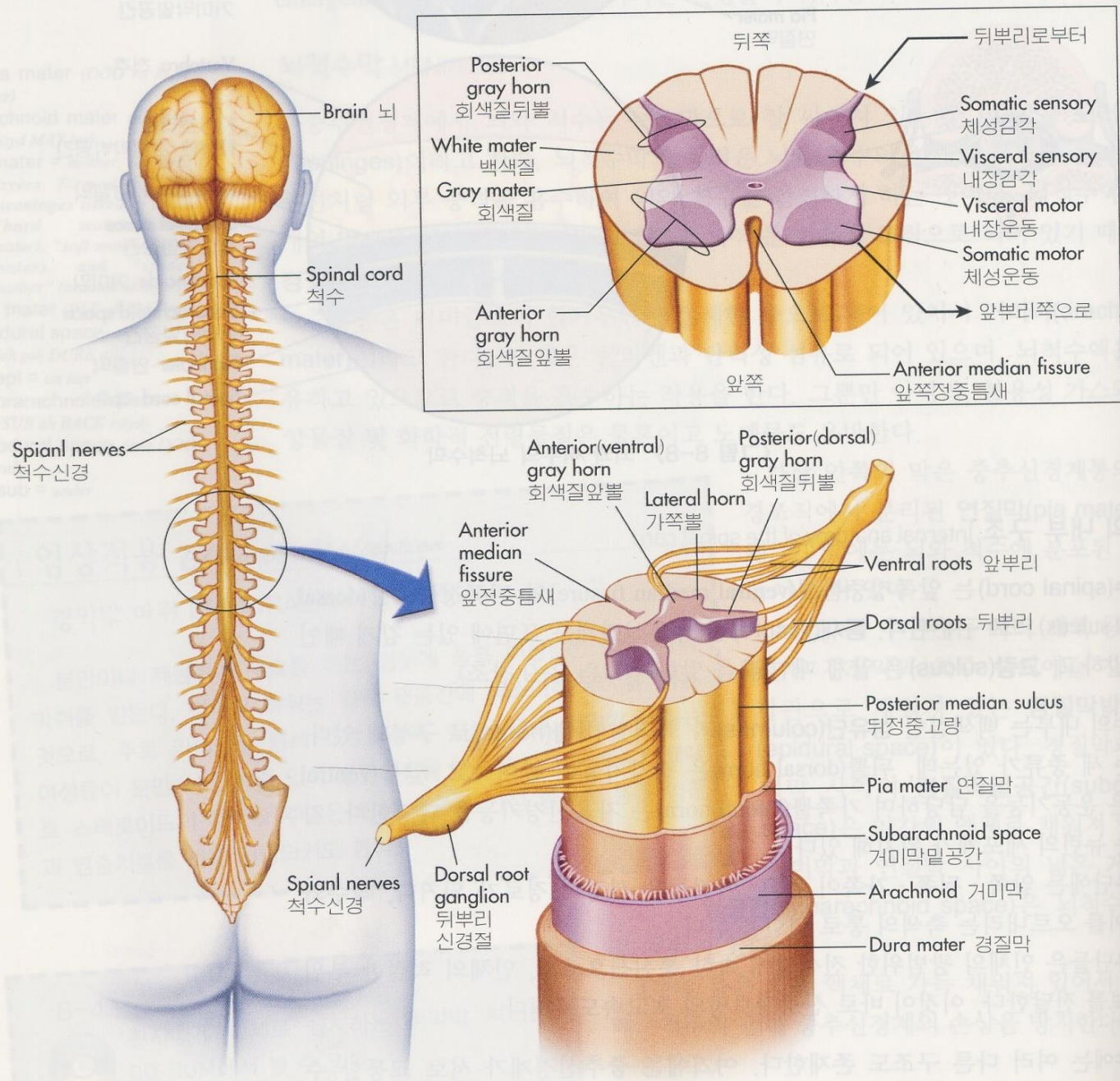
Dura mater





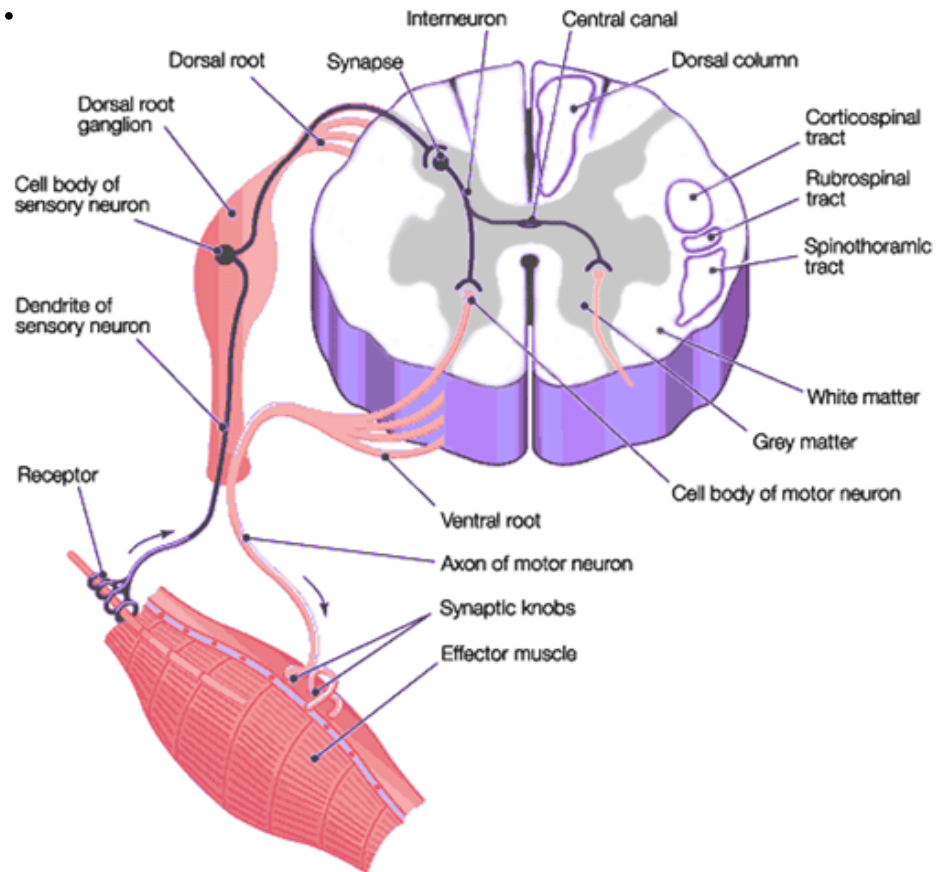
The white matter and the grey matter

- The white matter is located outside of the gray matter and consists almost totally of myelinated motor and sensory axons. “Columns” of white matter carry information either up or down the spinal cord.
- The gray matter, in the center of the cord, is shaped like a butterfly and consists of cell bodies of interneurons and motor neurons. It also consists of neuroglia cells and unmyelinated axons. Projections of the gray matter (the “wings”) are called horns.
- Ventral roots consist of axons from motor neurons, which bring information to the periphery from cell bodies within the CNS.
- Dorsal roots and ventral roots come together and exit the intervertebral foramina as they become spinal nerves.



〈그림 8-9〉 척수의 내부

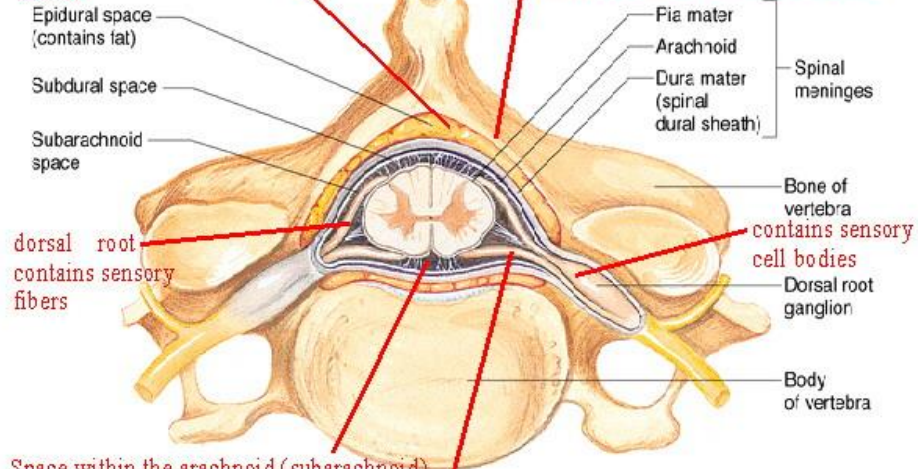
- Each segment of the spinal cord is associated with a pair of ganglia, called dorsal root ganglia, which are situated just outside of the spinal cord.
- These ganglia contain cell bodies of sensory neurons. Axons of these sensory neurons travel into the spinal cord via the dorsal roots.



The Spinal Cord

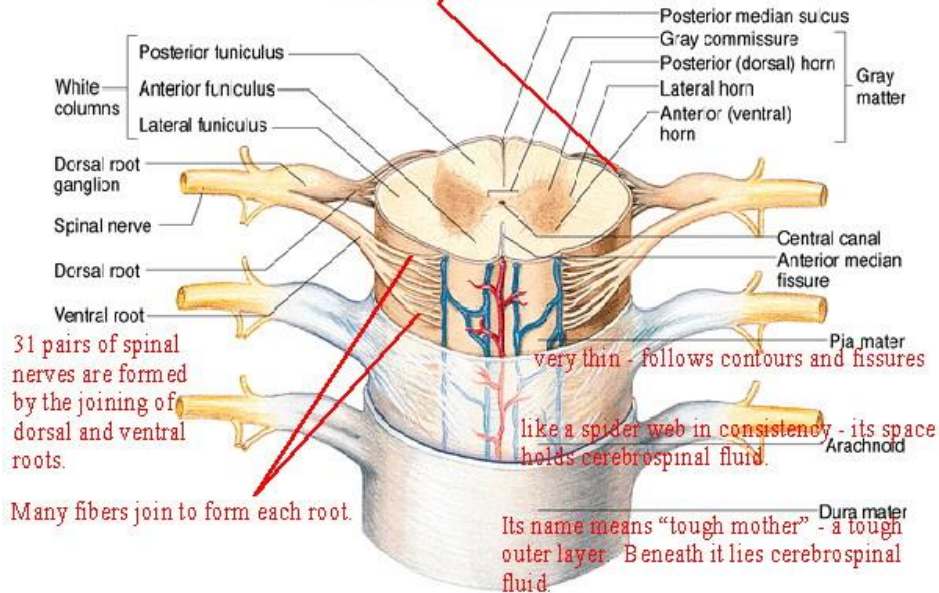
An "epidural" is given outside the dura mater to anesthetize spinal nerves

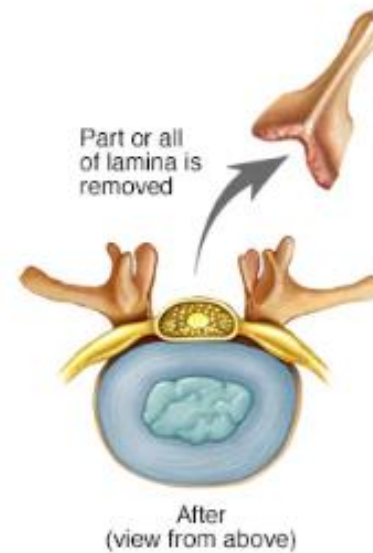
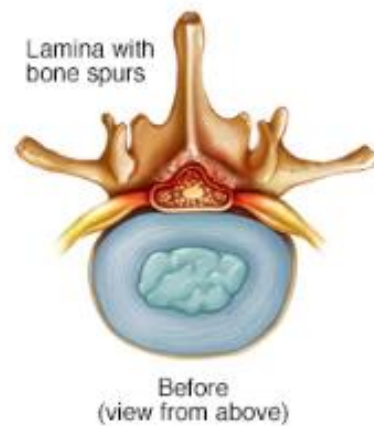
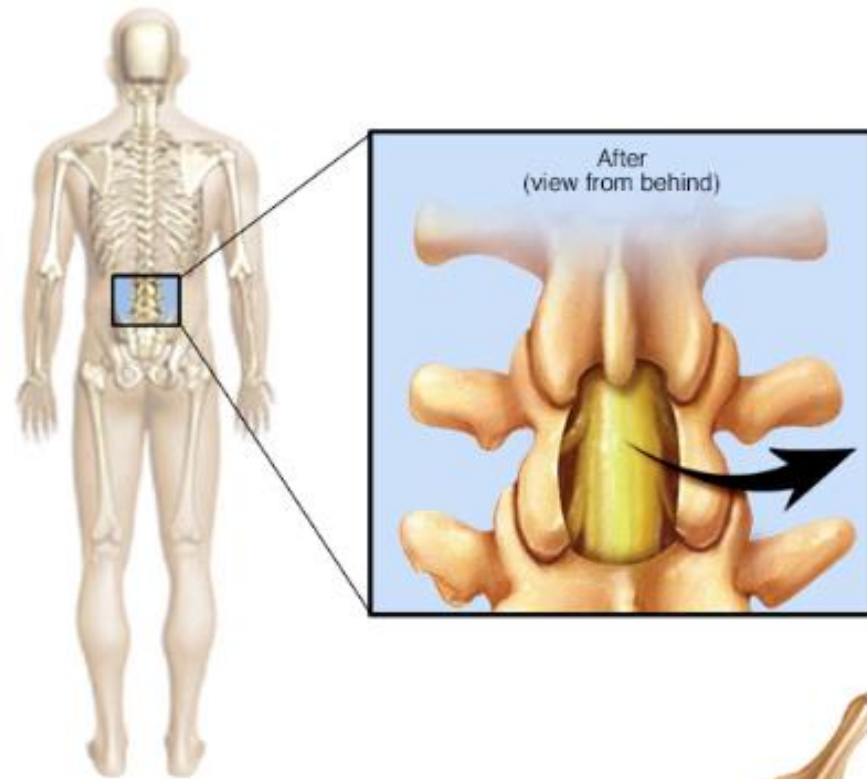
lamina - a laminectomy removes a section to relieve pressure and pain.

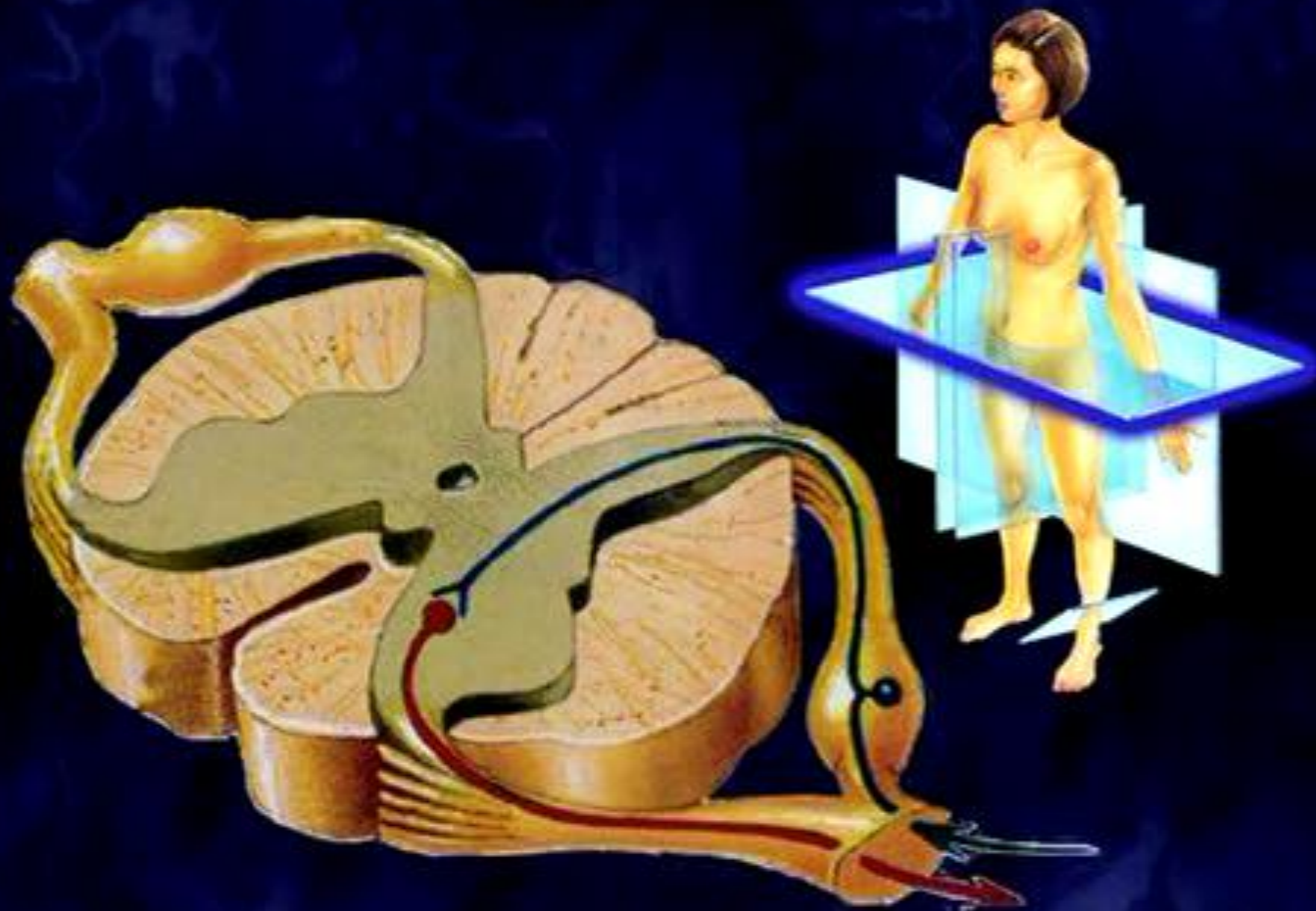


Space within the arachnoid (subarachnoid) and beneath the dura (subdural) holds cerebrospinal fluid.

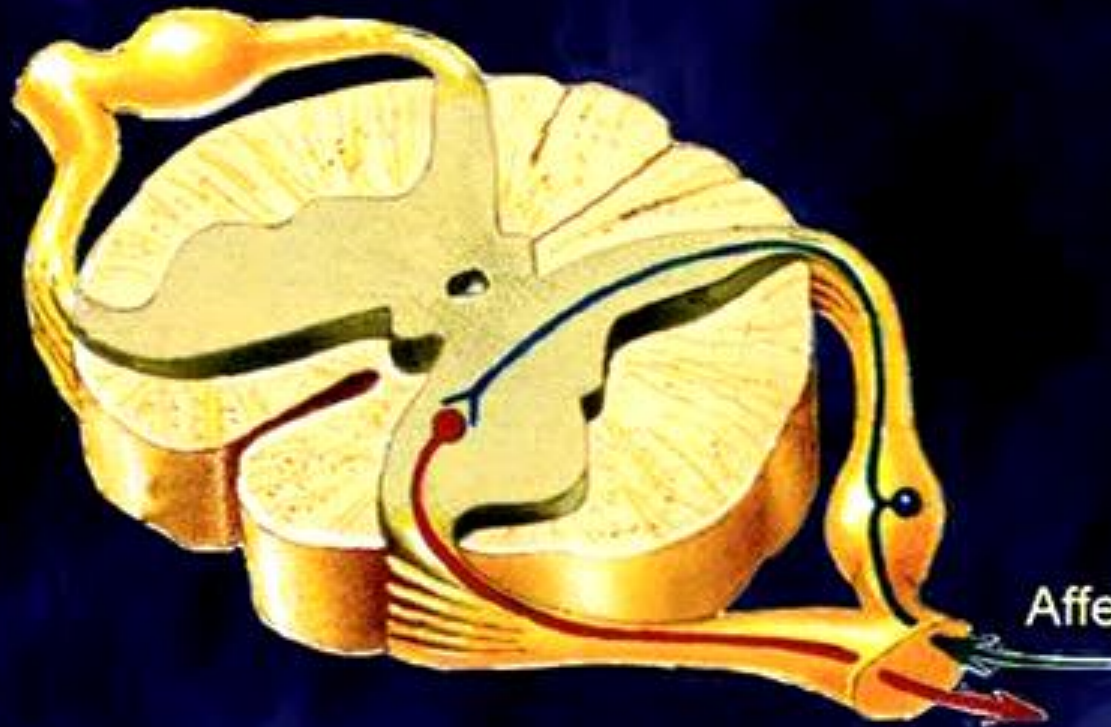
ventral root - contains motor fibers





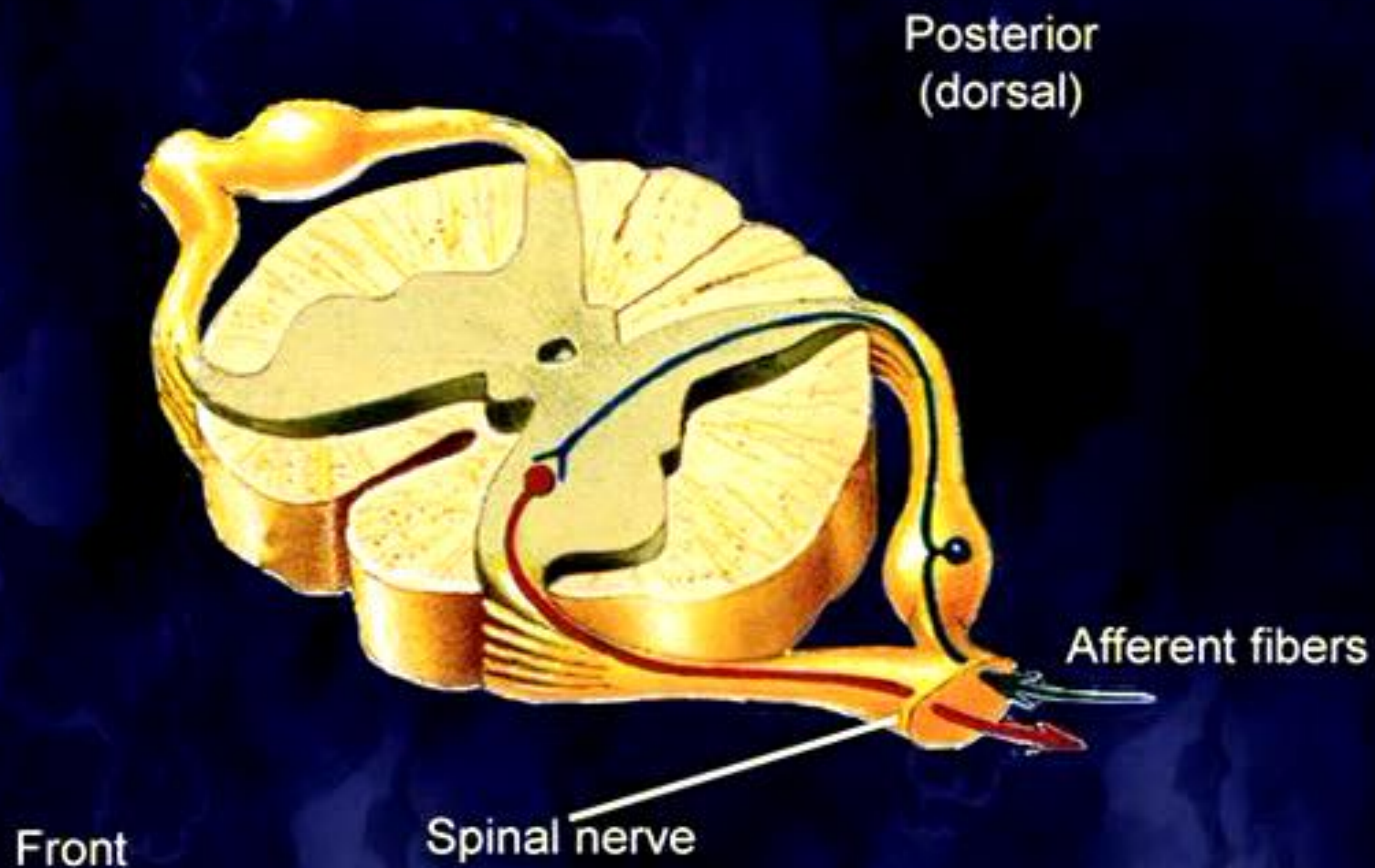


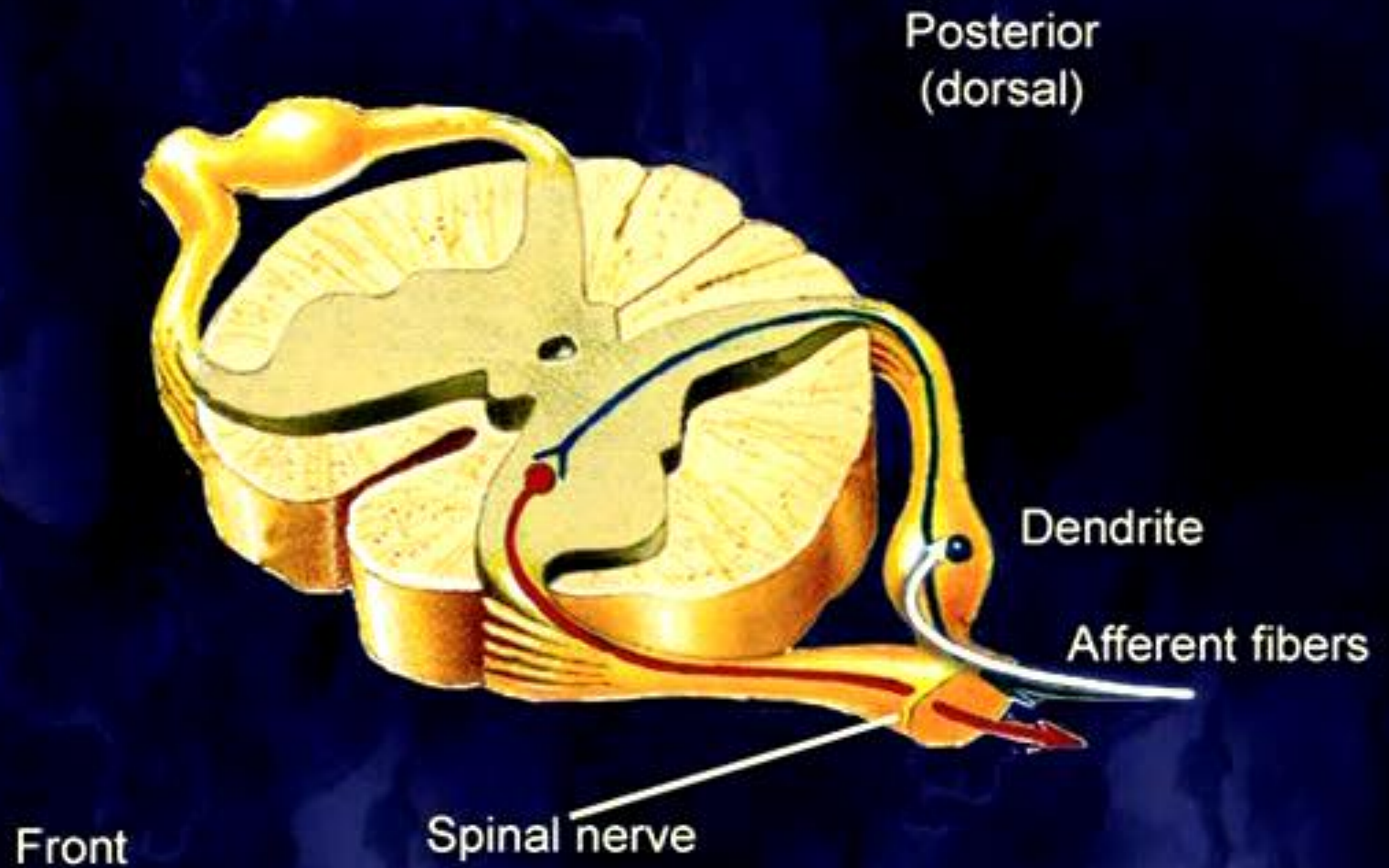
Back

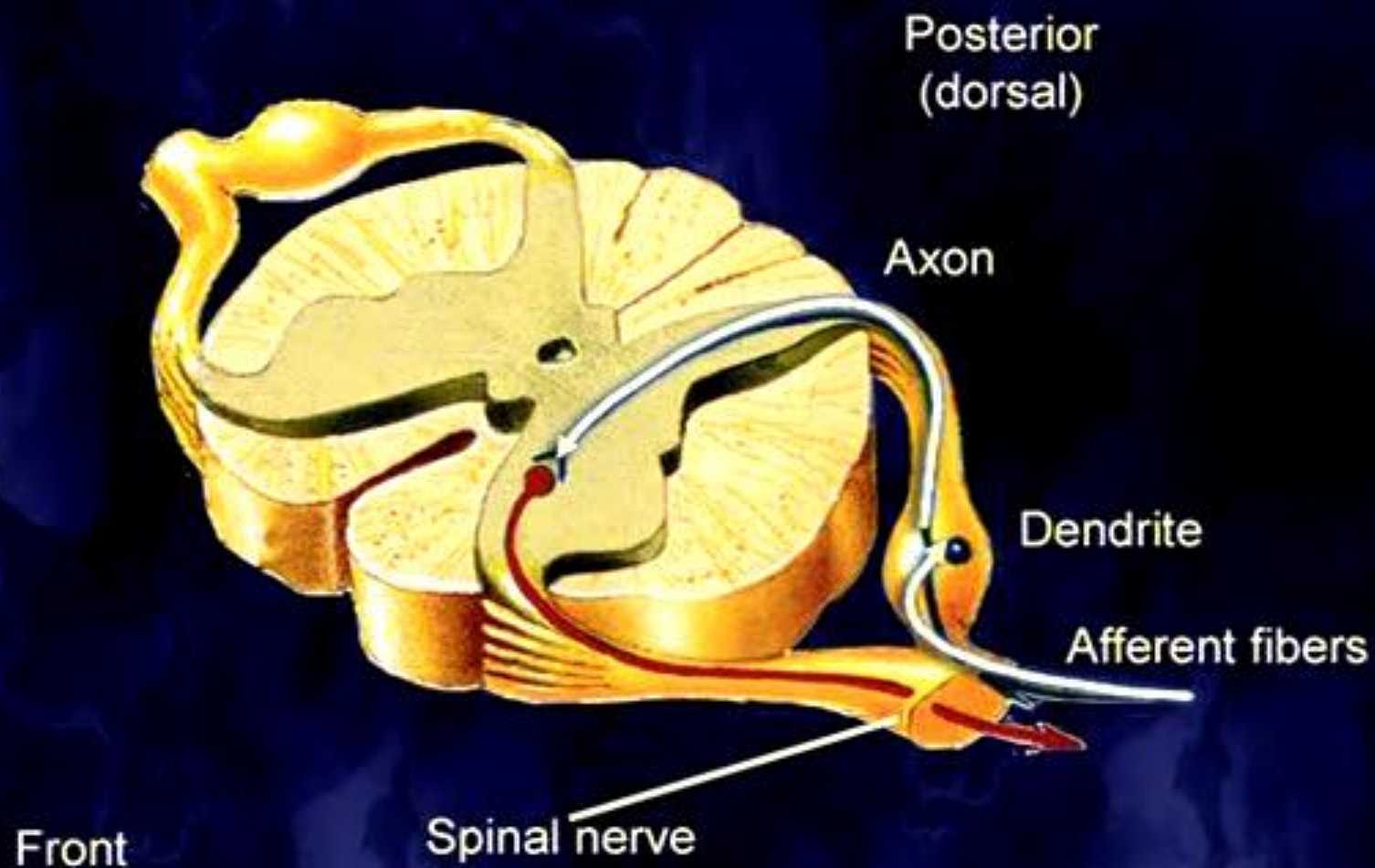


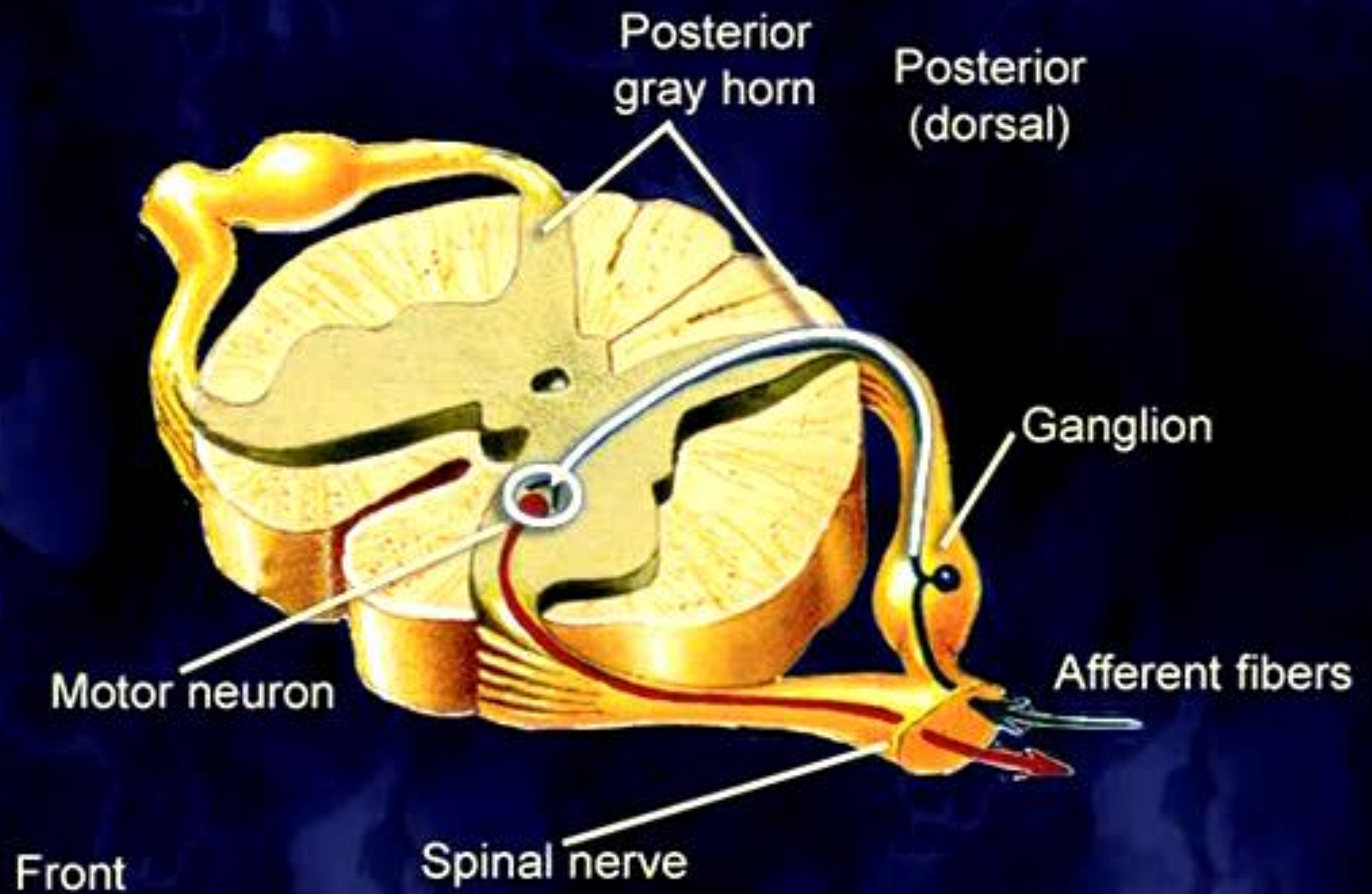
Afferent fibers

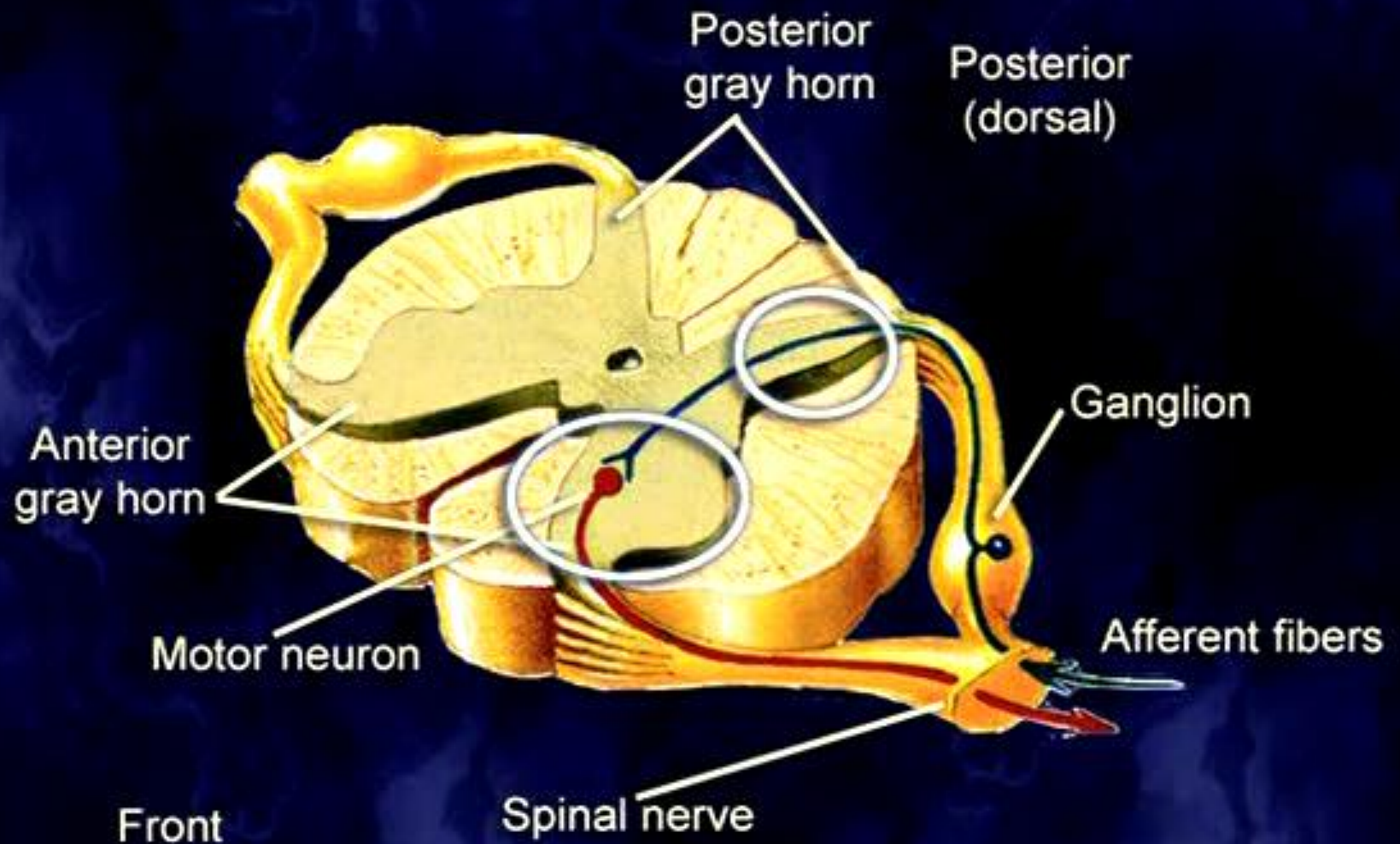
Front

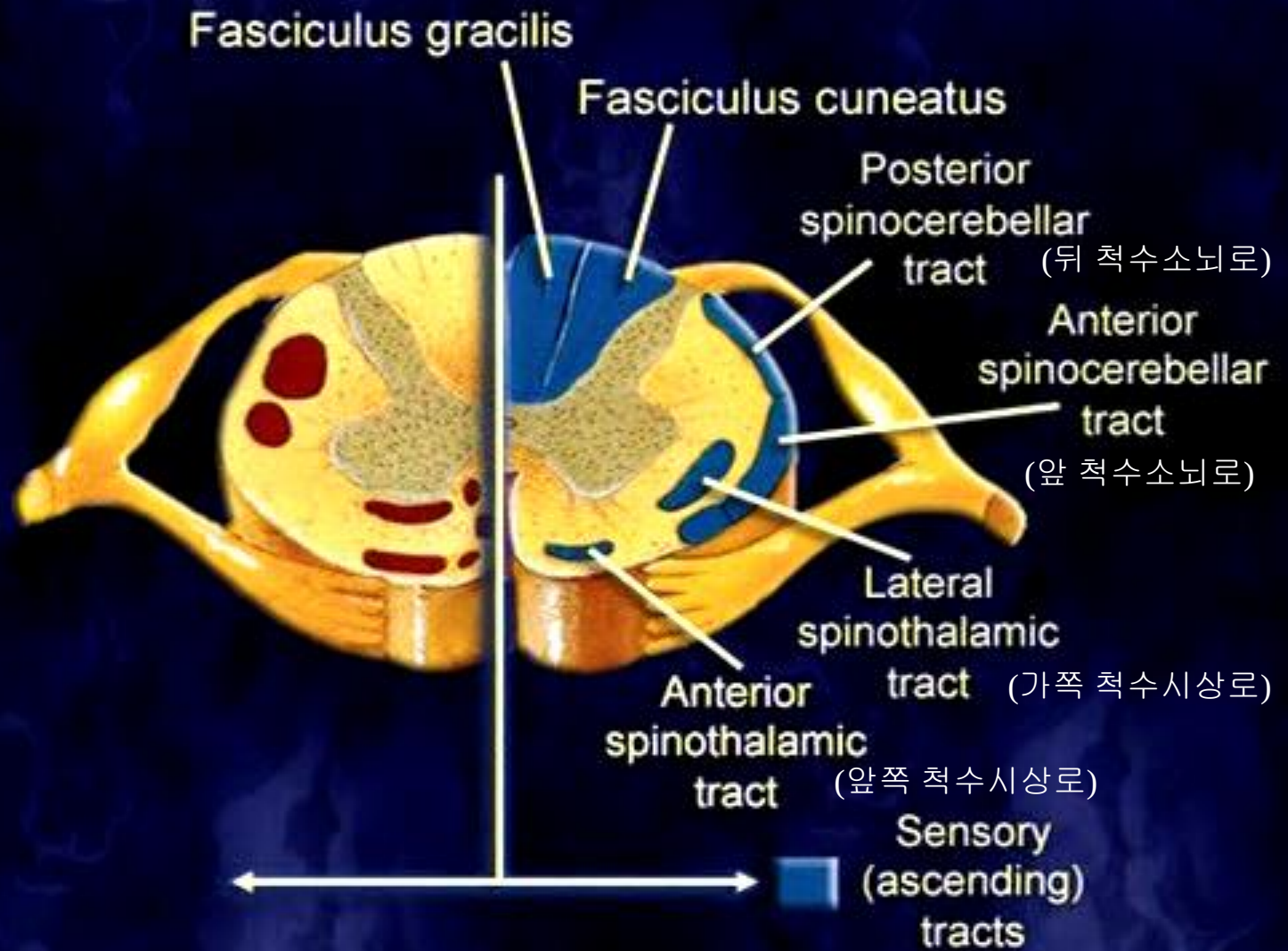


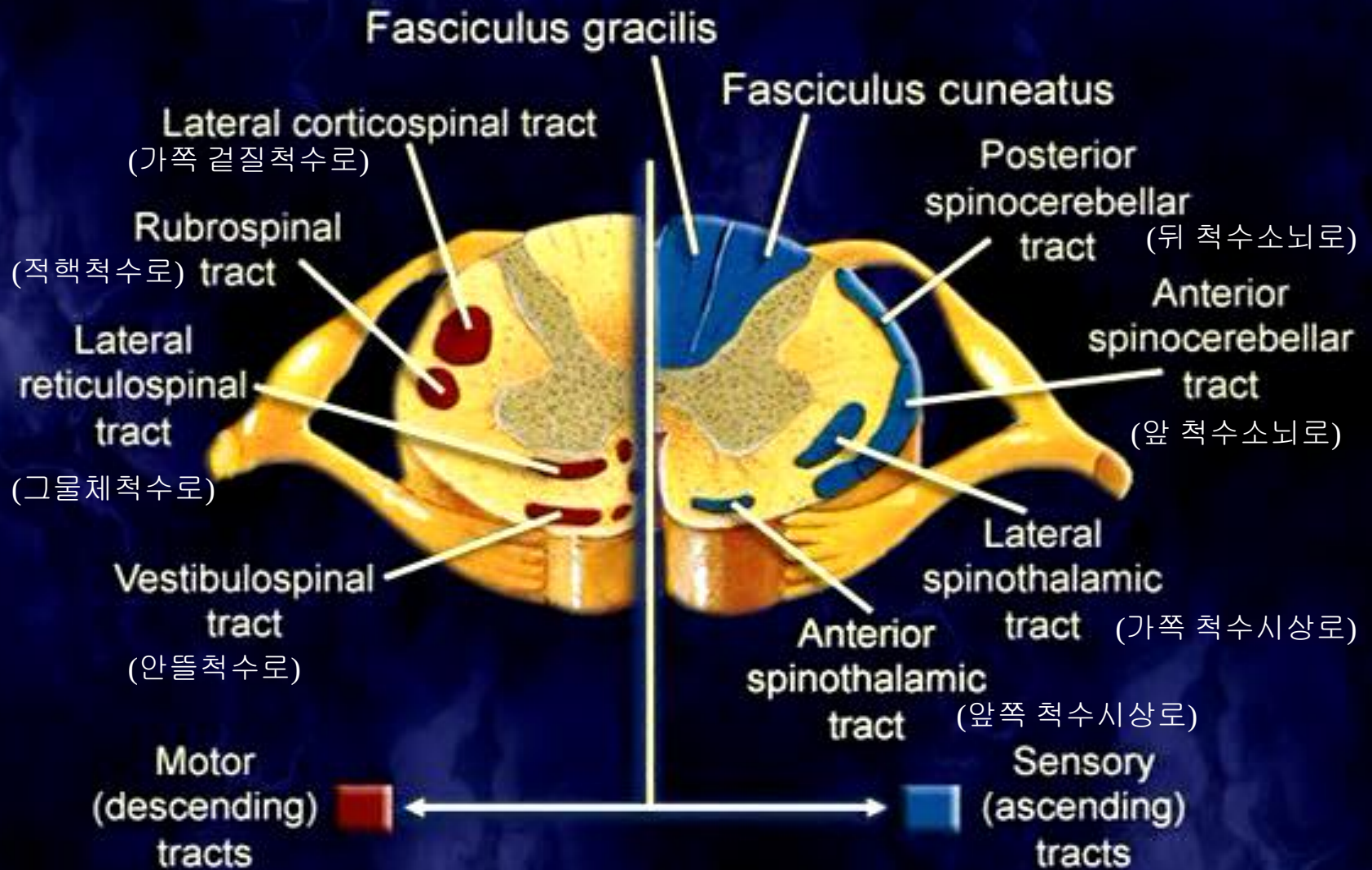


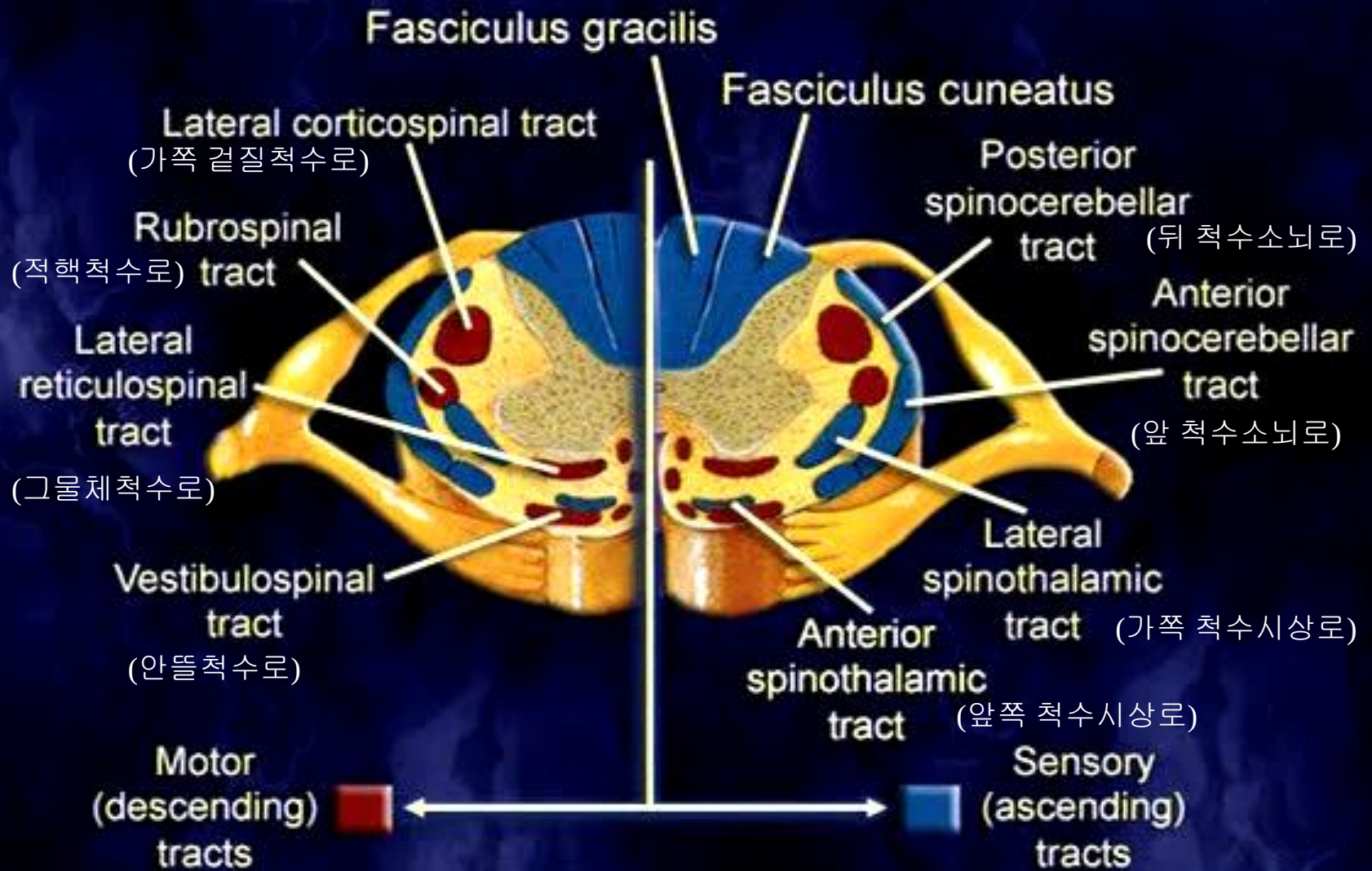












Motor and descending (efferent) pathways (red)

Pyramidal tracts

- Lateral corticospinal tract
- Anterior corticospinal tract

Extrapyramidal Tracts

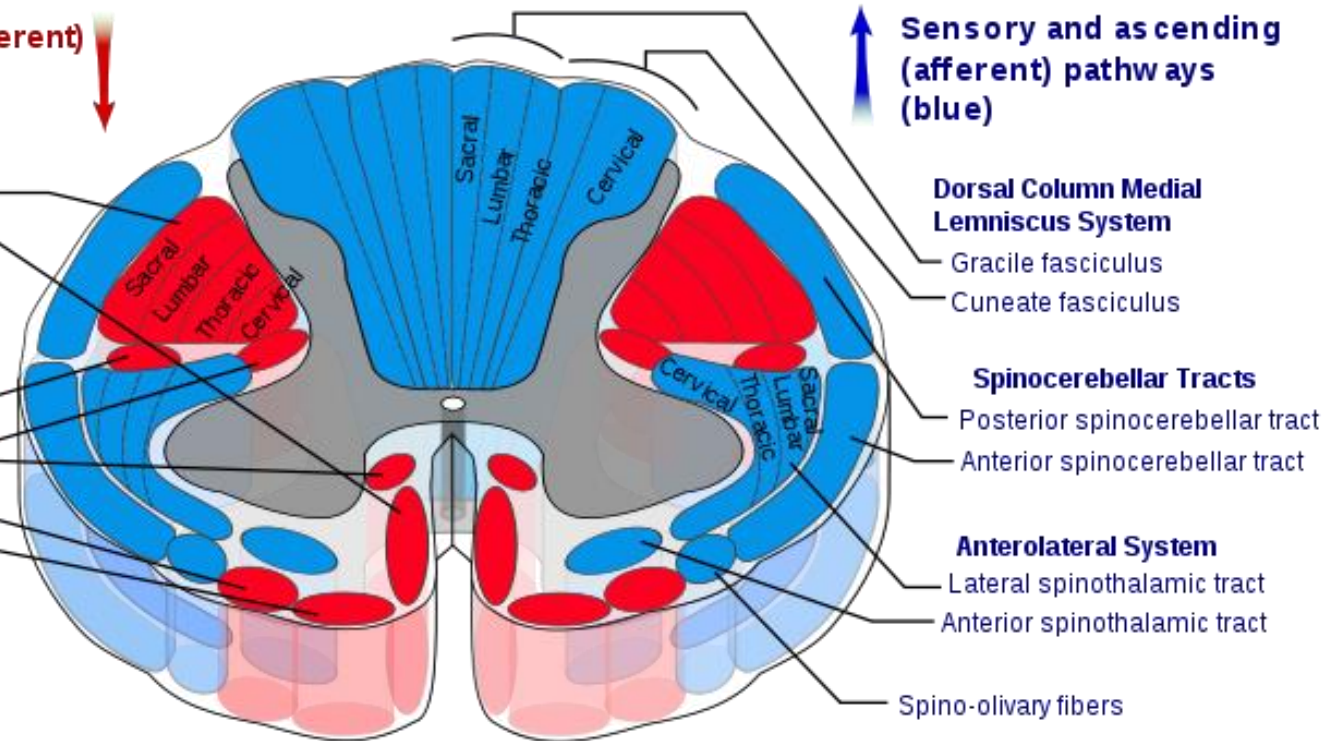
- Rubrospinal tract
- Reticulospinal tracts
- Olivospinal tract
- Vestibulospinal tract

적핵척수로

그물체척수로

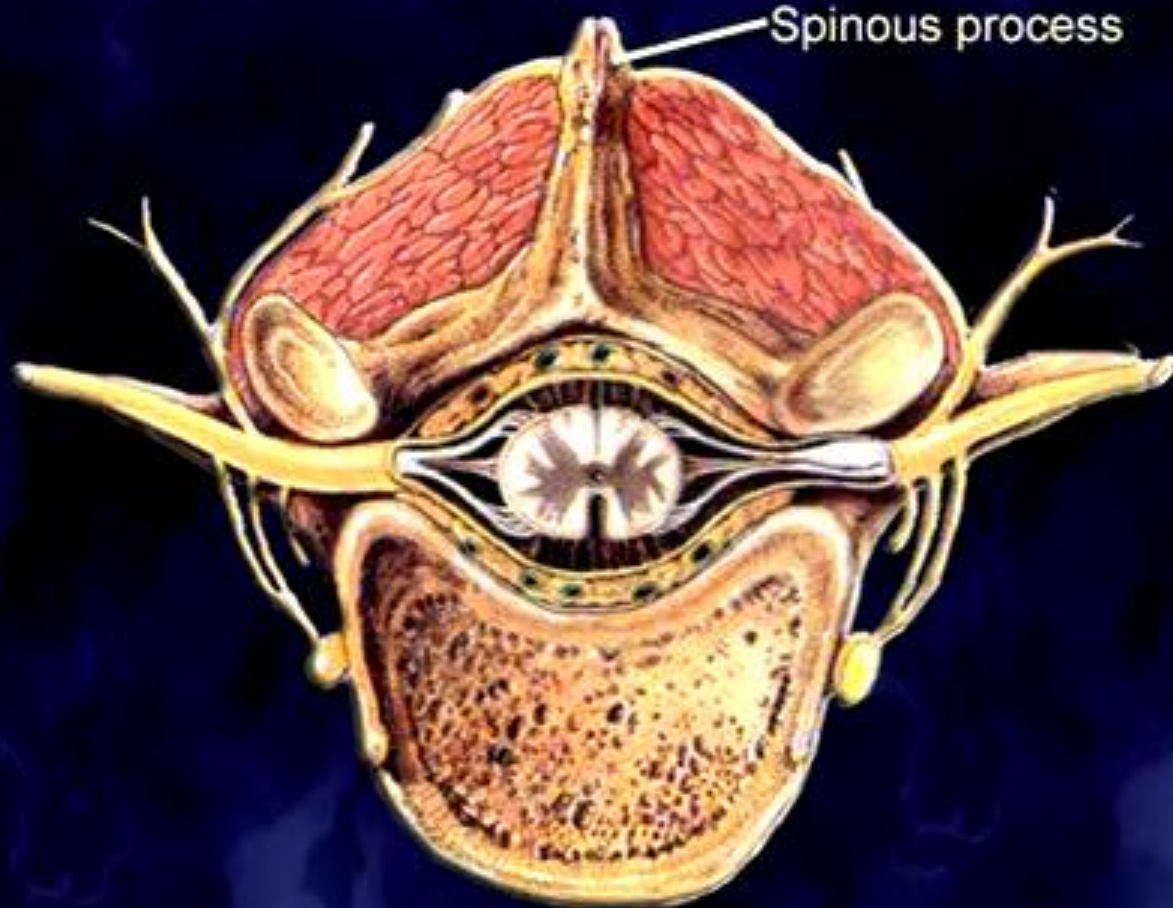
올리브 척수로

안뜰척수로

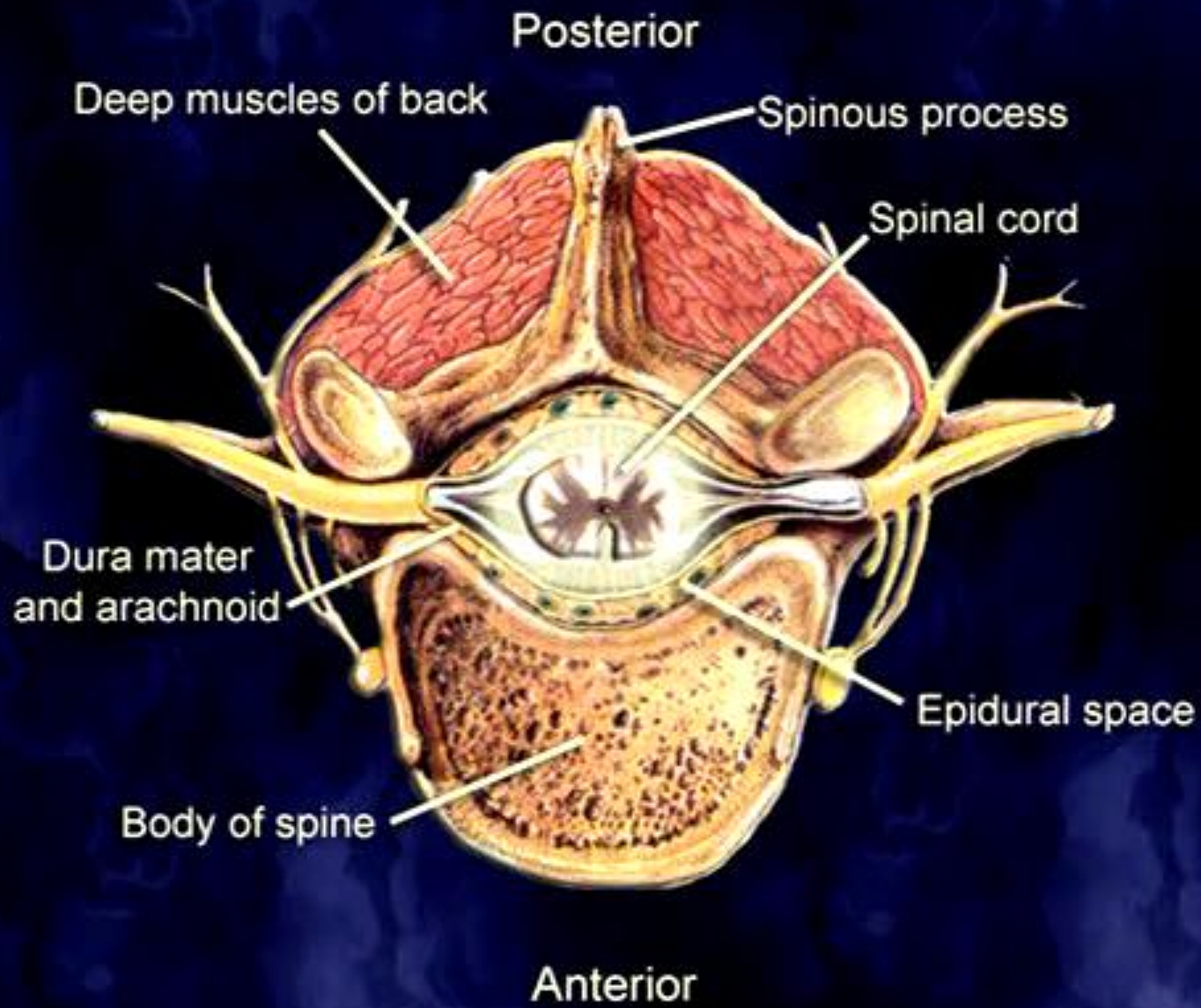


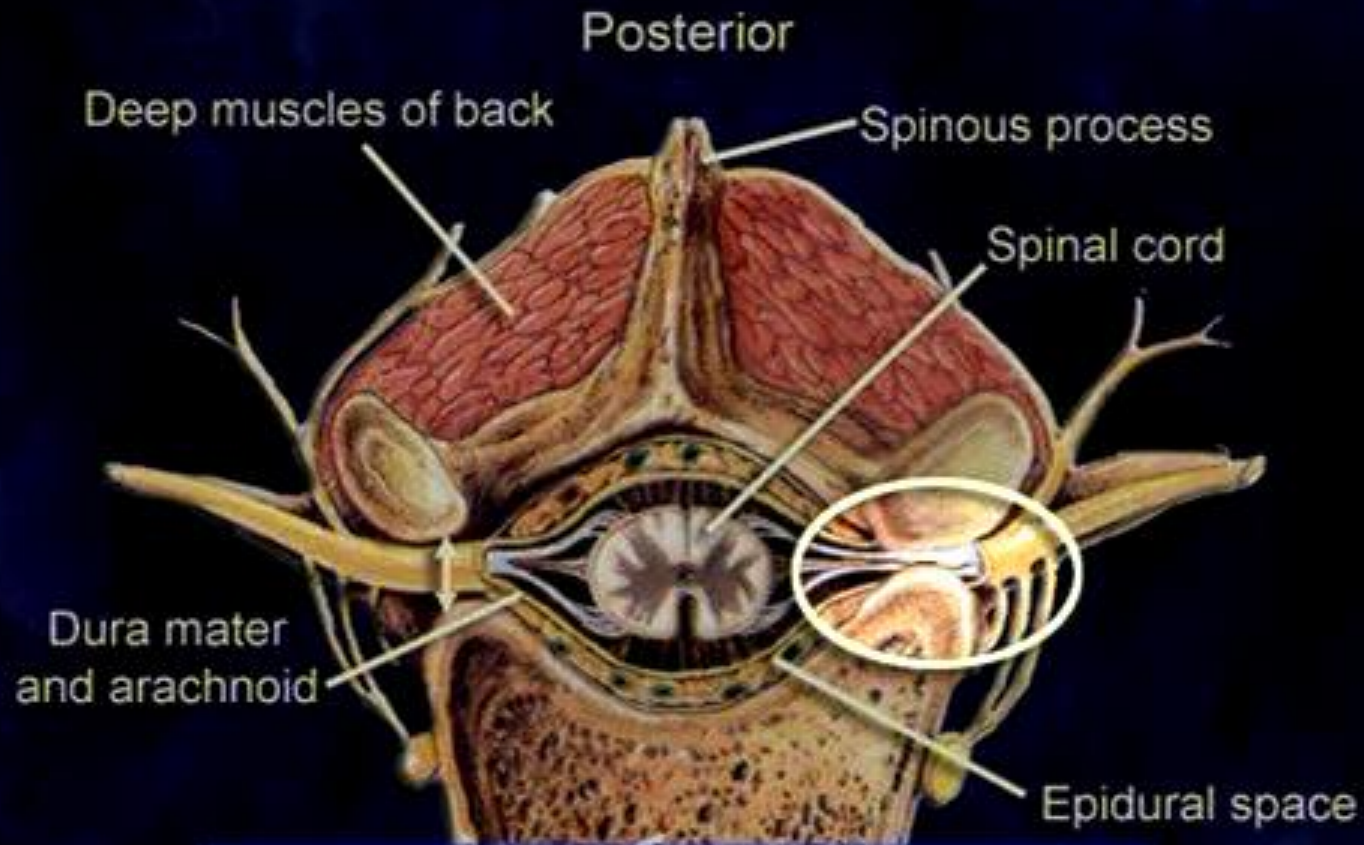
Posterior

Spinous process



Anterior

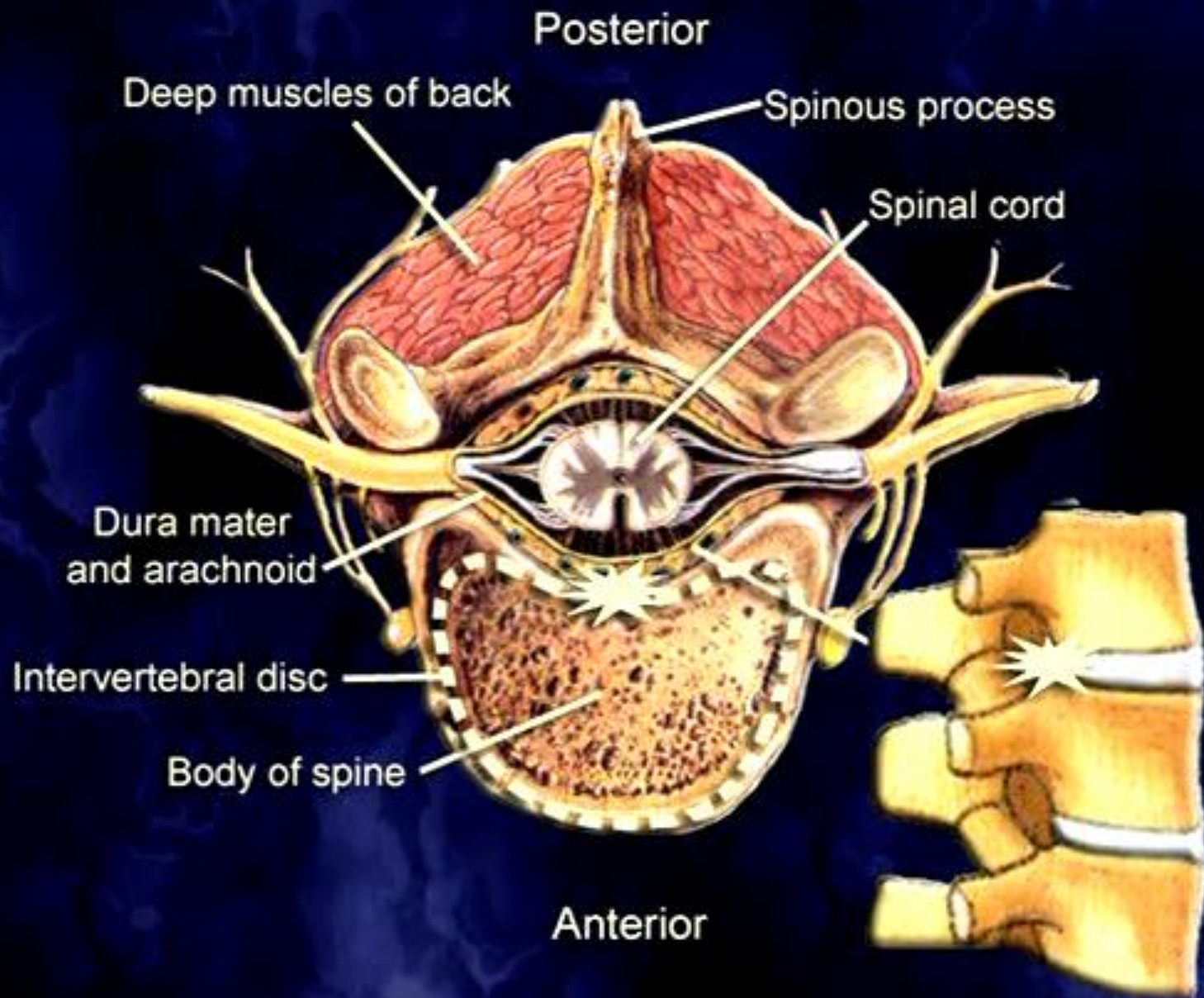


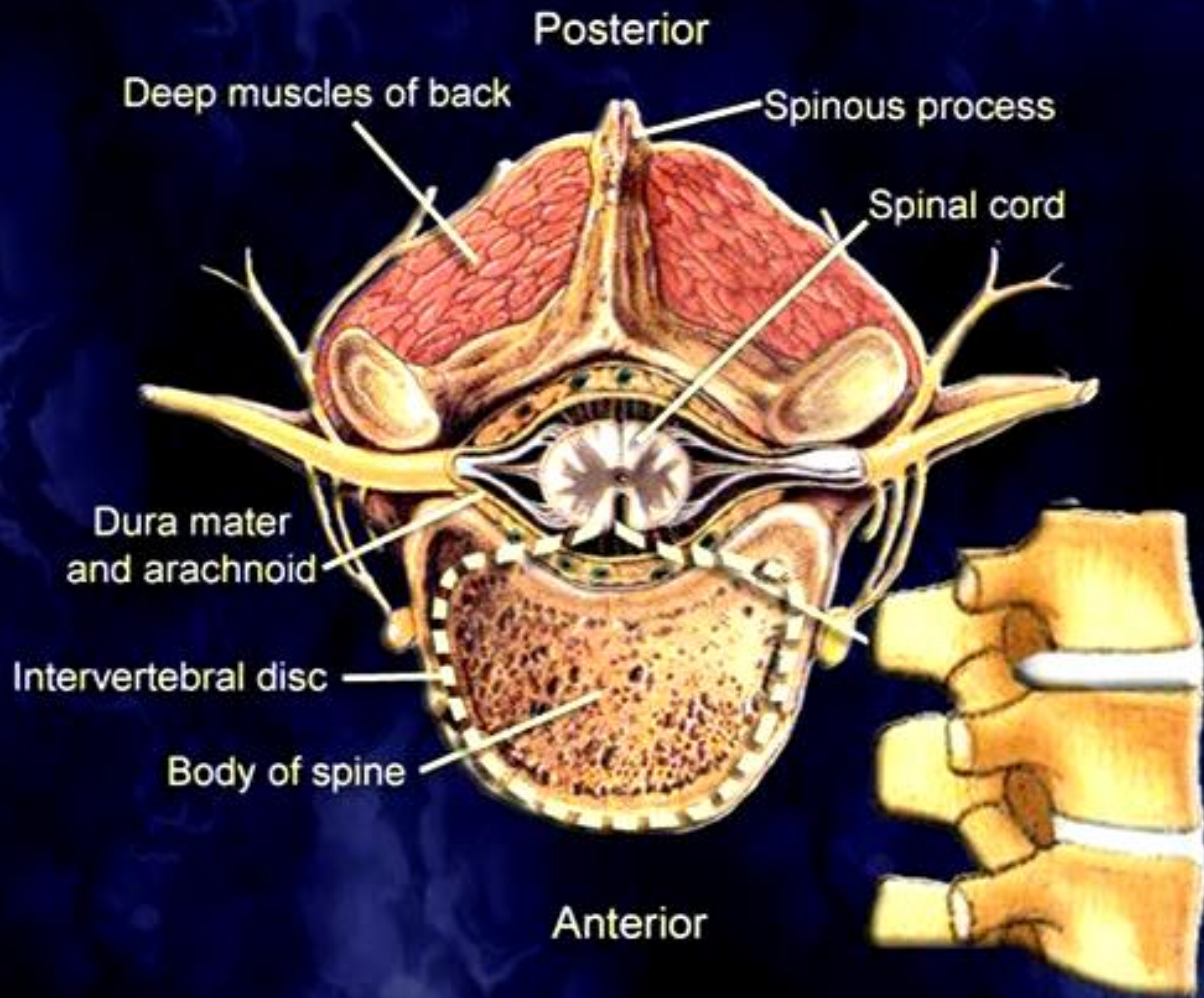


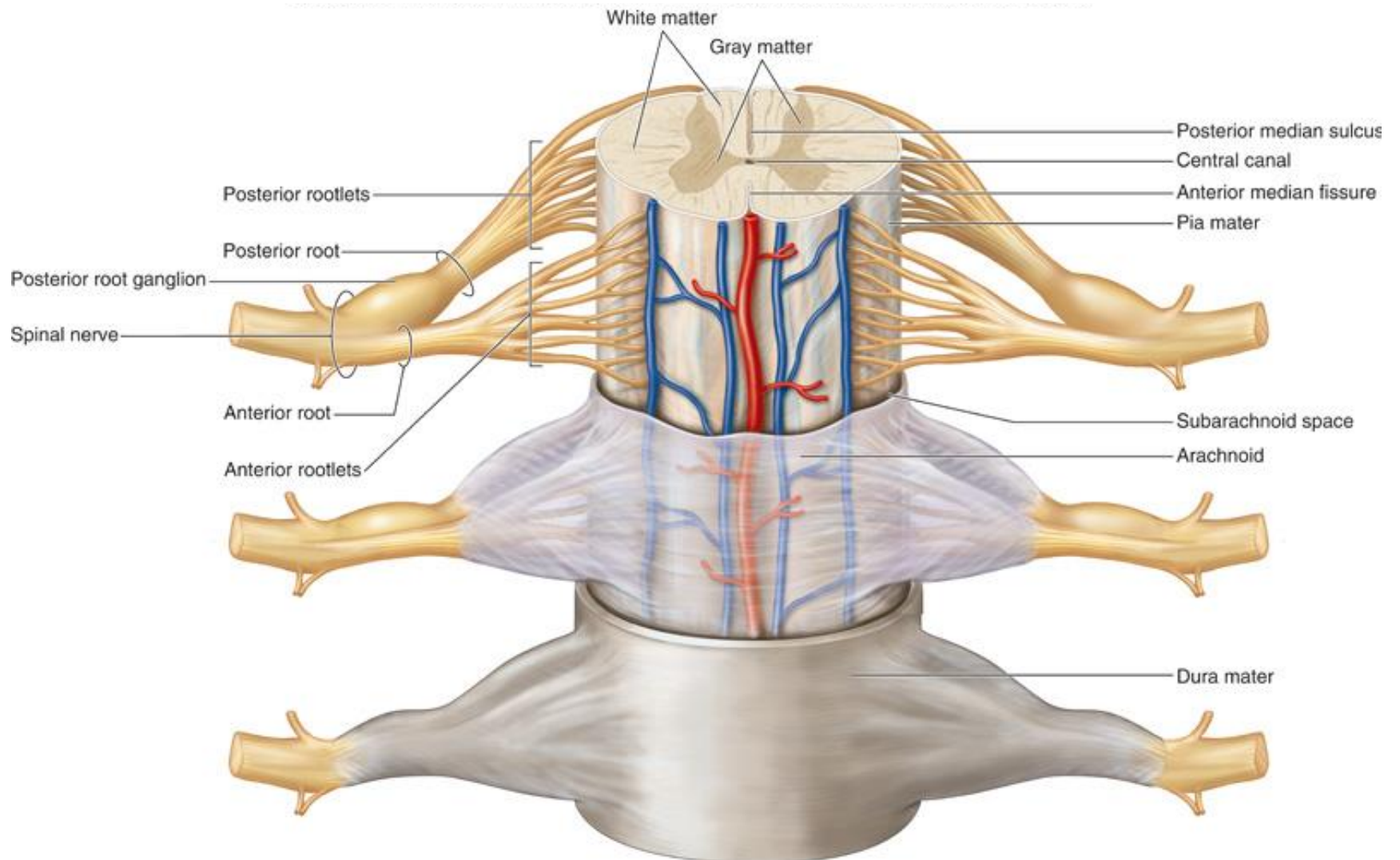
Bo

osteoarthritis

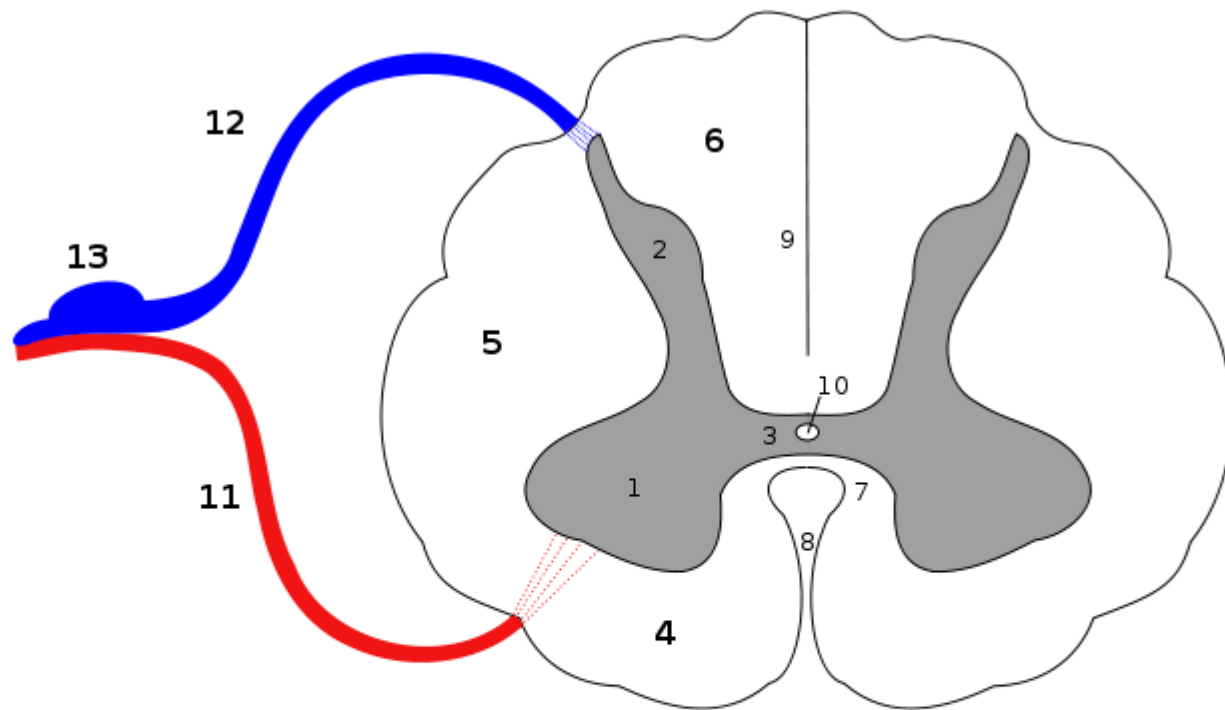
(degenerative arthritis)







(b) Anterior view



Gray matter

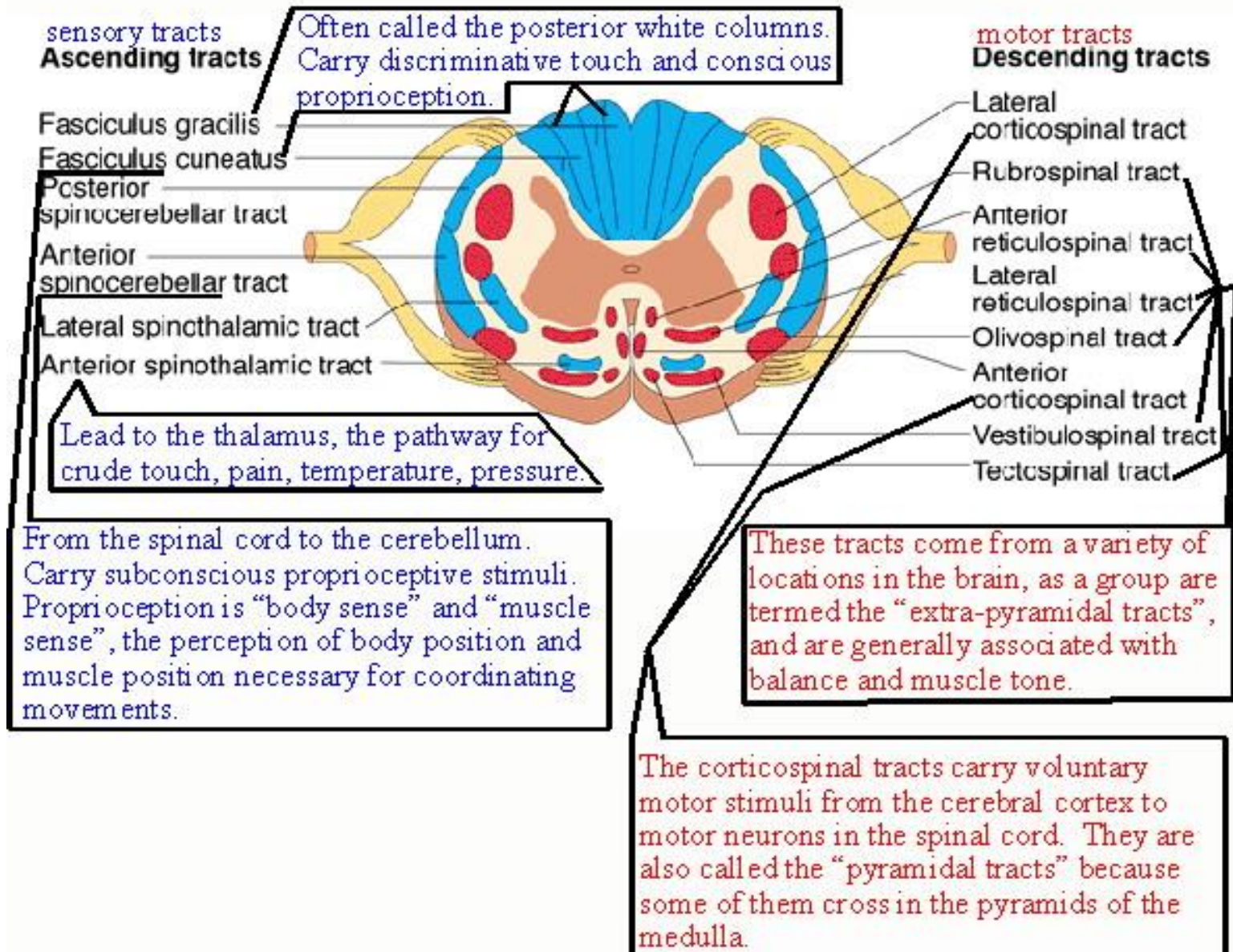
1. Anterior horn
2. Posterior horn
3. Gray commissure

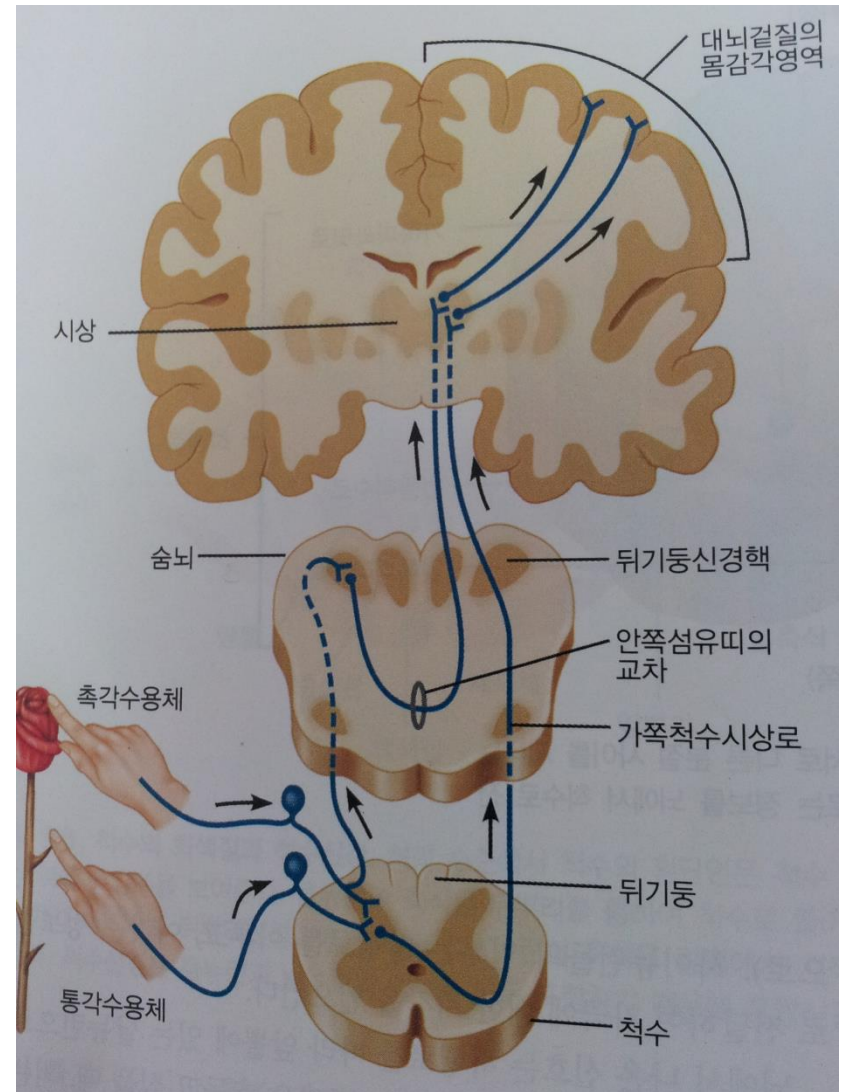
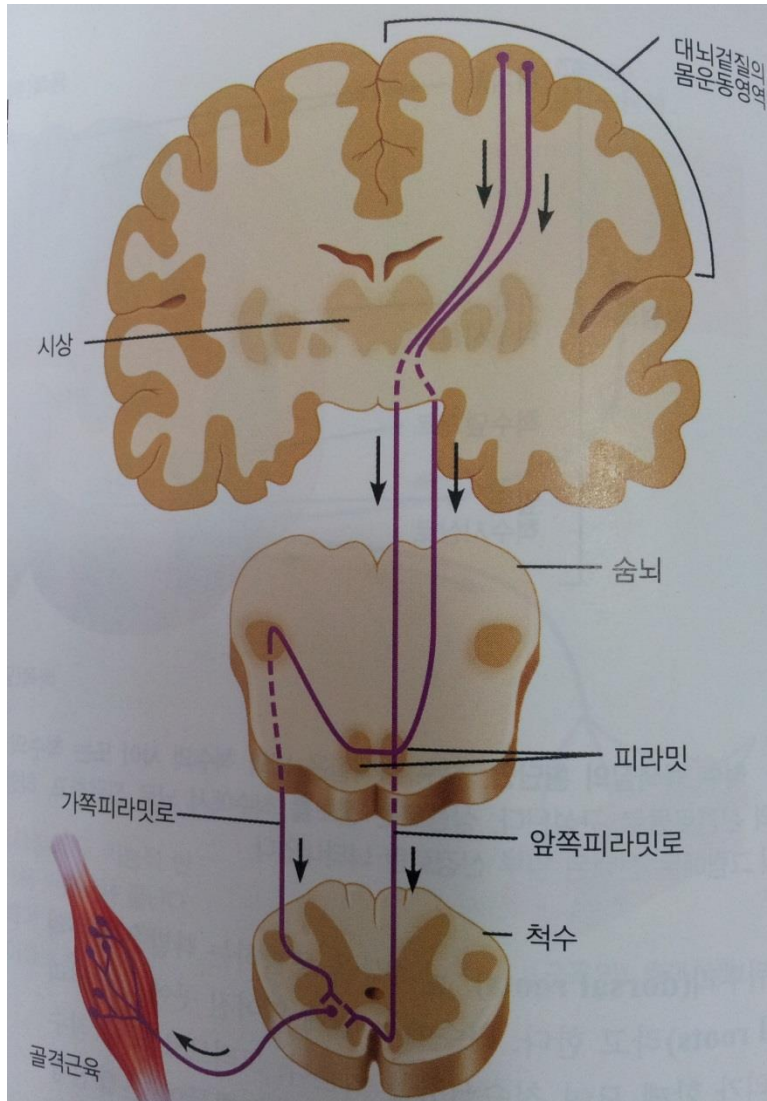
White matter

4. Anterior funiculus
5. Lateral funiculus
6. Posterior funiculus
7. Anterior commissure
8. Anterior median fissure
9. Posterior median sulcus

10. Central canal
11. Anterior root
12. Posterior root
13. Dorsal root ganglion

The Spinal Tracts





Motor and descending (efferent) pathways (red)

Pyramidal tracts

- Lateral corticospinal tract
- Anterior corticospinal tract

Extrapyramidal Tracts

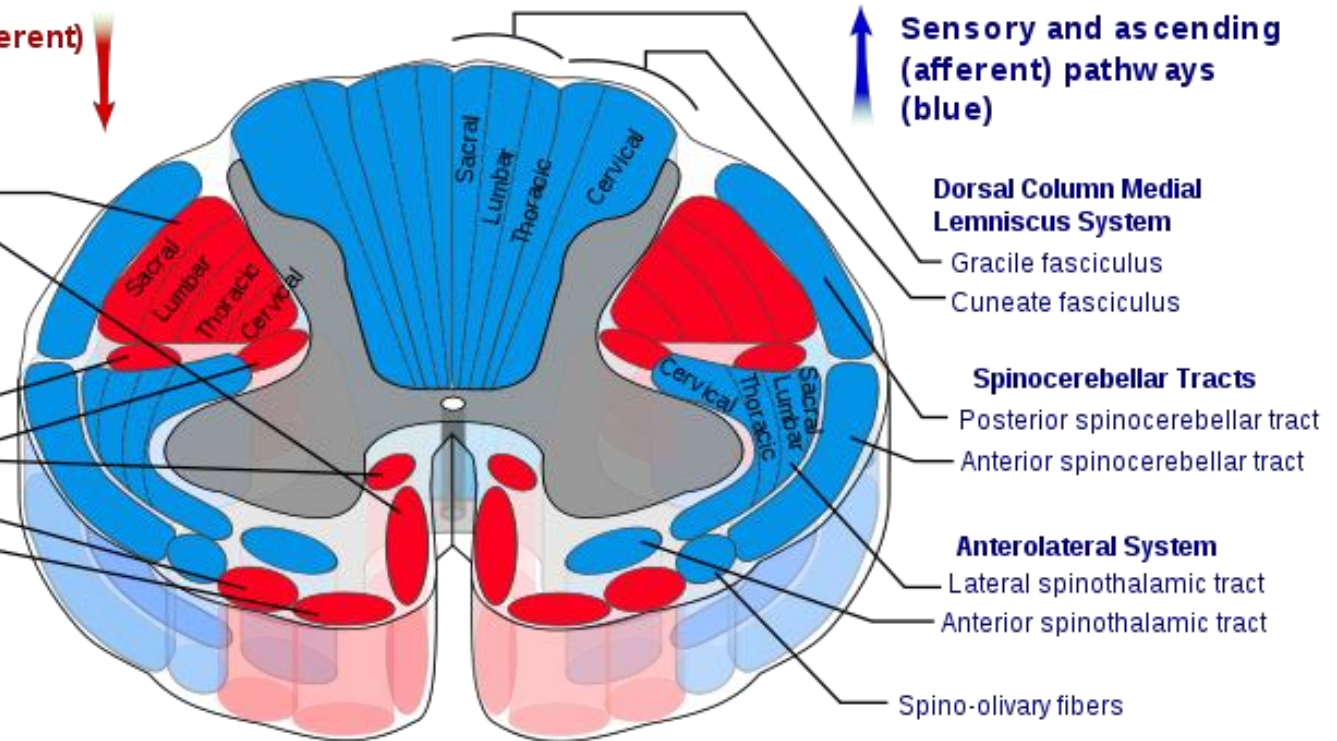
- Rubrospinal tract
- Reticulospinal tracts
- Olivospinal tract
- Vestibulospinal tract

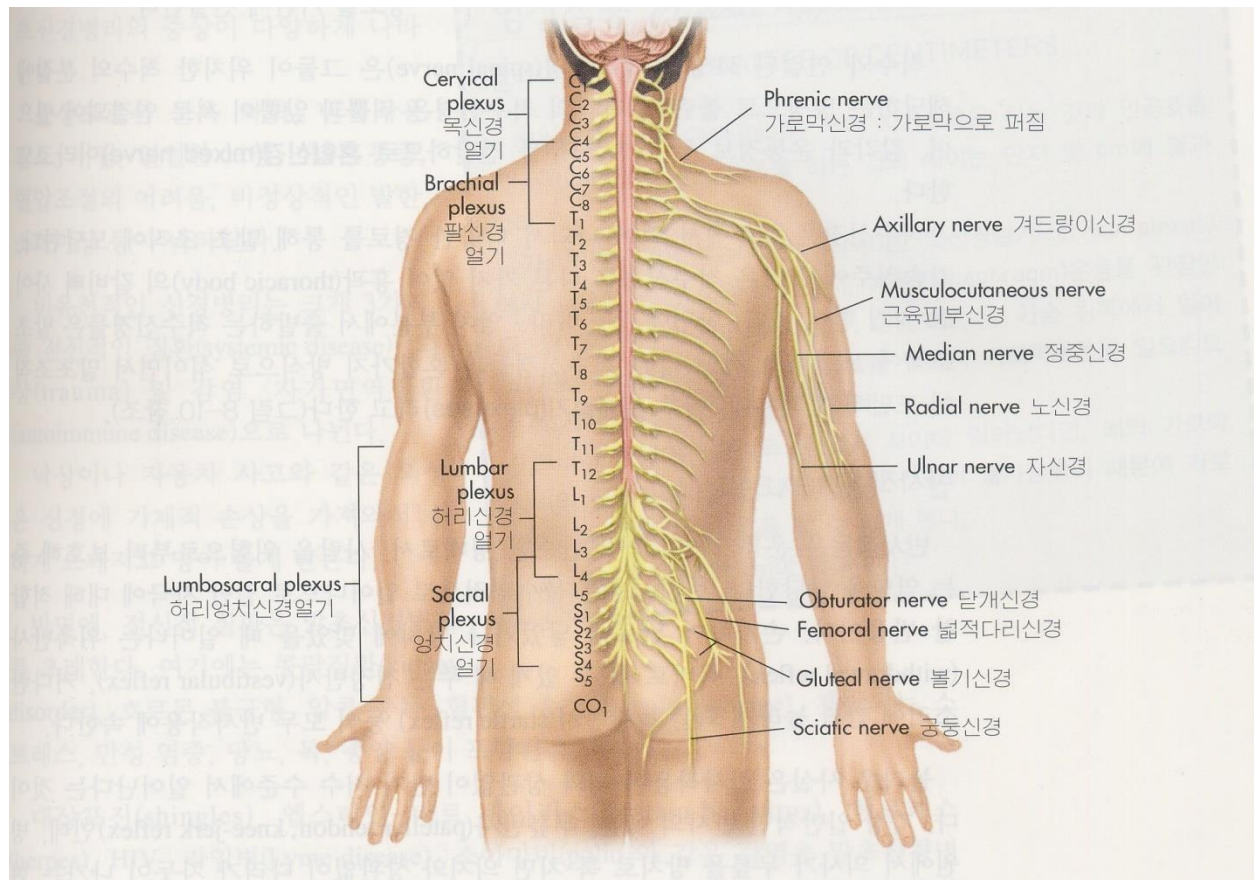
적핵척수로

그물체척수로

올리브 척수로

안뜰척수로





척수신경열기 SPINAL NERVE PLEXUSES

신경열기	위치	척수신경	관련부위	주요 신경
목 Cervical	목의 심층부, 목빗근 아래	C ₁ ~C ₄	목, 어깨의 피부와 근육	Phrenic(Diaphragm) 가로막
팔 Brachial	빗장뼈의 심층부, 목과 겨드랑이 사이	C ₅ ~C ₈ , T ₁	상지의 피부와 근육	Musculocutaneous 근육피부신경 Ulnar 자신경 Median 정중신경 Radial 노신경 Axillary 겨드랑이신경
허리엉치 Lumbosacral	등의 허리부위	T ₁₂ , L ₁ ~L ₅ , S ₁ ~S ₄	하복벽, 하지, 궁둥이, 외부생식기의 피부와 근육	Obturator 달개신경 Femoral 넓적다리신경 Sciatic 궁둥다리신경 Pudendal

〈그림 8-10〉 척수신경열기

Pathways (전도로)

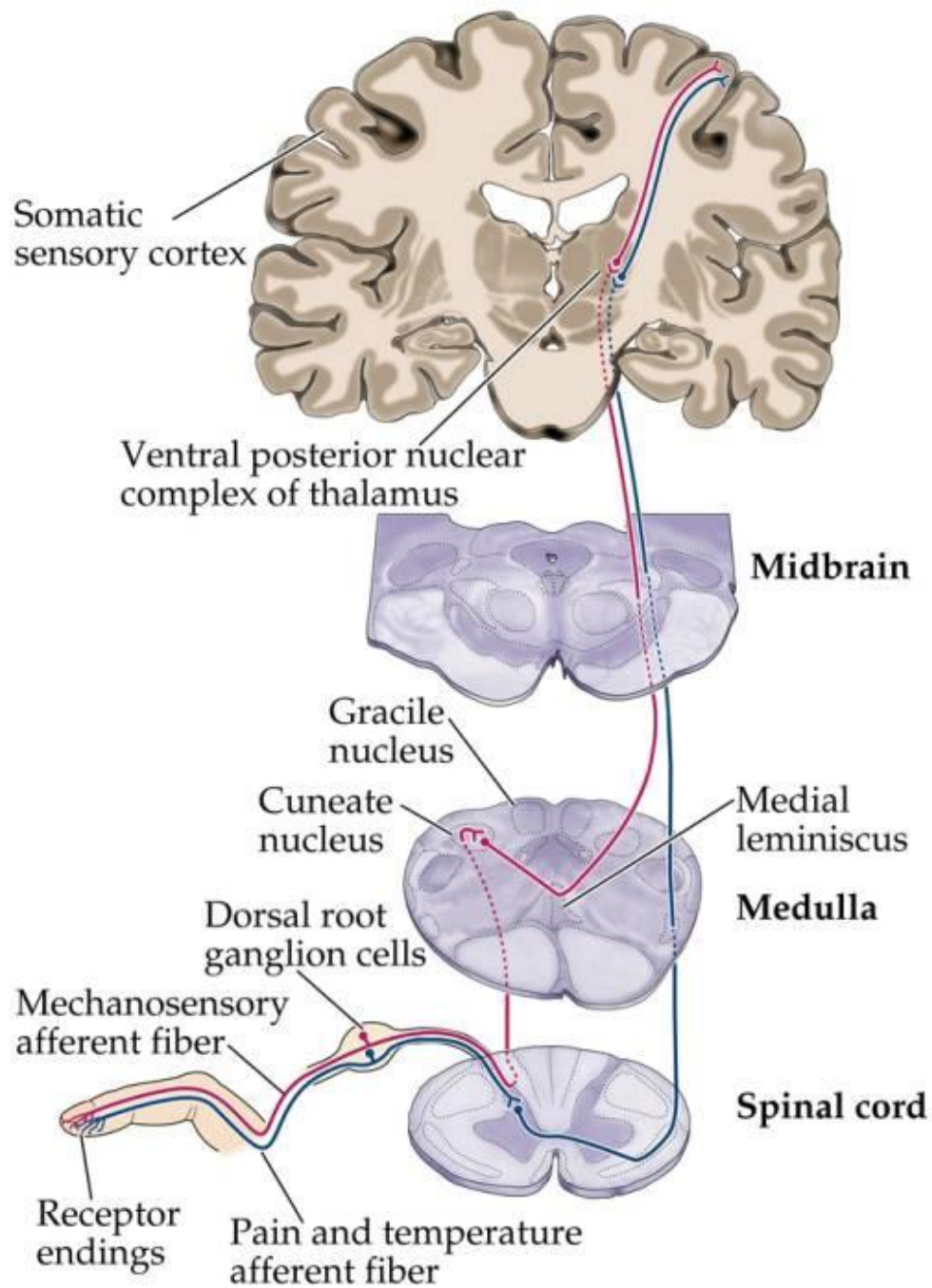
Ascending tracts (상행성 전도로)

- Ascending tracts generally are named "spino" and the portion of the brain that they terminate in (cerebellum or thalamus).
- The sensory cortex receives input from the ascending tracts after they pass through the thalamus.

1. 척수에서 뇌를 잇는 전도로 – 감각성 (구심성) 전도로
2. 후삭 – 내측모대로, 척수시상로 (spinothalamic tract),
척수소뇌로 등

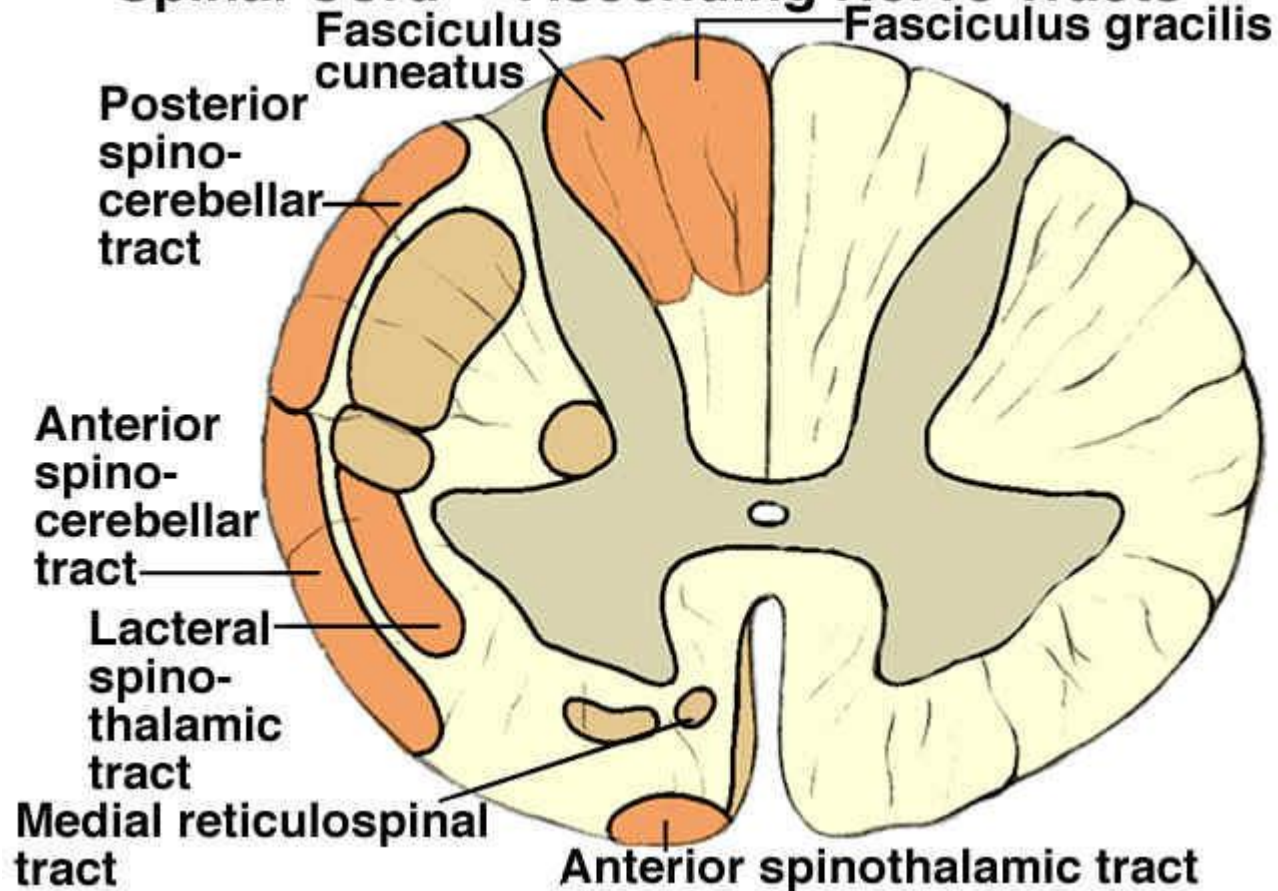
SOMATIC SENSORY PATHWAYS

- Dorsal Column- Medial lemniscal System
- Anterolateral System (spinothalamic tract)



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Spinal Cord — Ascending Nerve Tracts



Descending tracts (하행성 전도로)

Descending tracts name the region of the brain first, then add "spinal."

뇌에서 척수를 잇는 전도로 - 운동성 (원심성) 전도로

a. 추체로(pyramidal tract) :

- 골격근의 수의 경로로,
 - ✓ 대뇌피질 운동영역 → 내낭 → 대뇌각 → 추체교차 → 척수전각
- 외측 피질 척수로: 연수에서 교차
- 전피질척수로: 연수에서 비교차 - 해당 척수에서 교차함

b. 추체외로 (extrapyramidal tract)

골격근의 운동, 긴장 등을 반사 불수의적으로 지배하는
신경로의 총칭

- 주요 전도로

적핵척수로 (중뇌의 적핵 → 척수)

: 자세 및 근장력의 불수의적 조절

전정척수로 (교의 전정신경핵 → 척수)

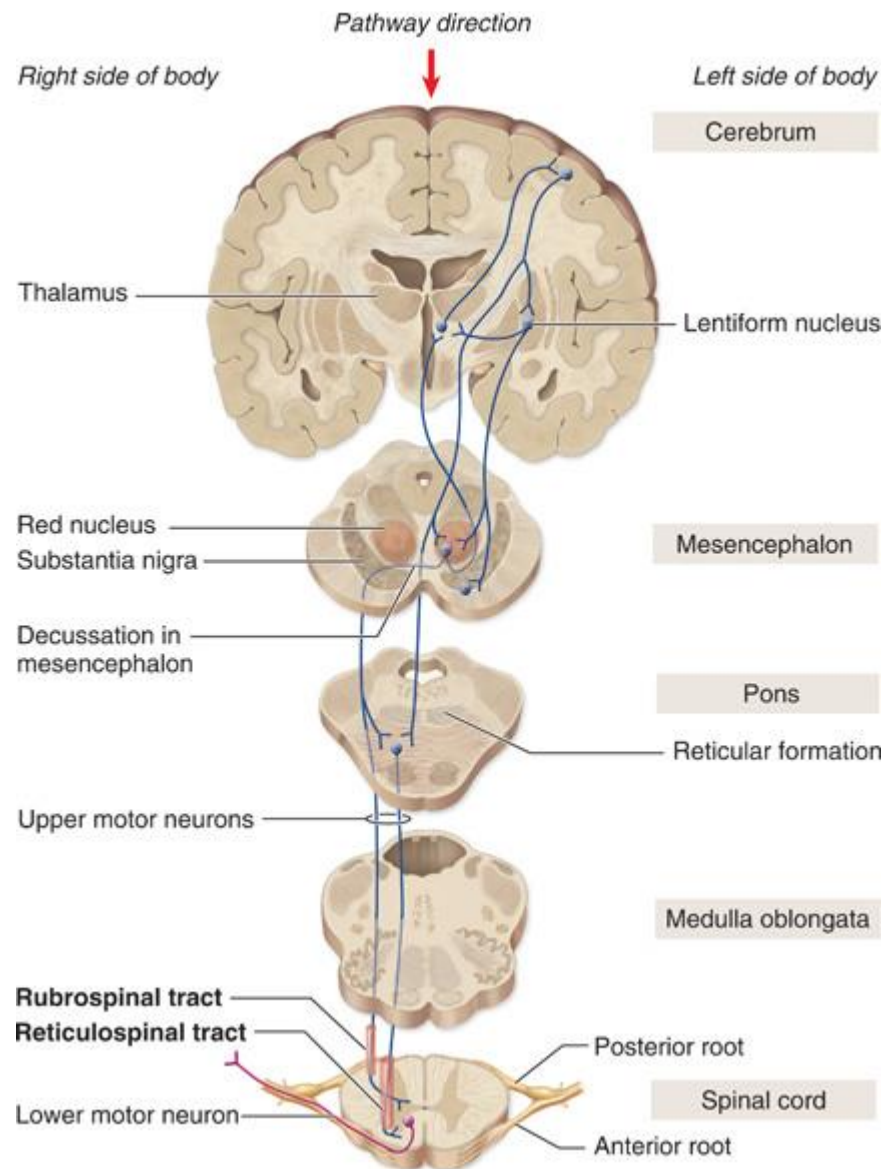
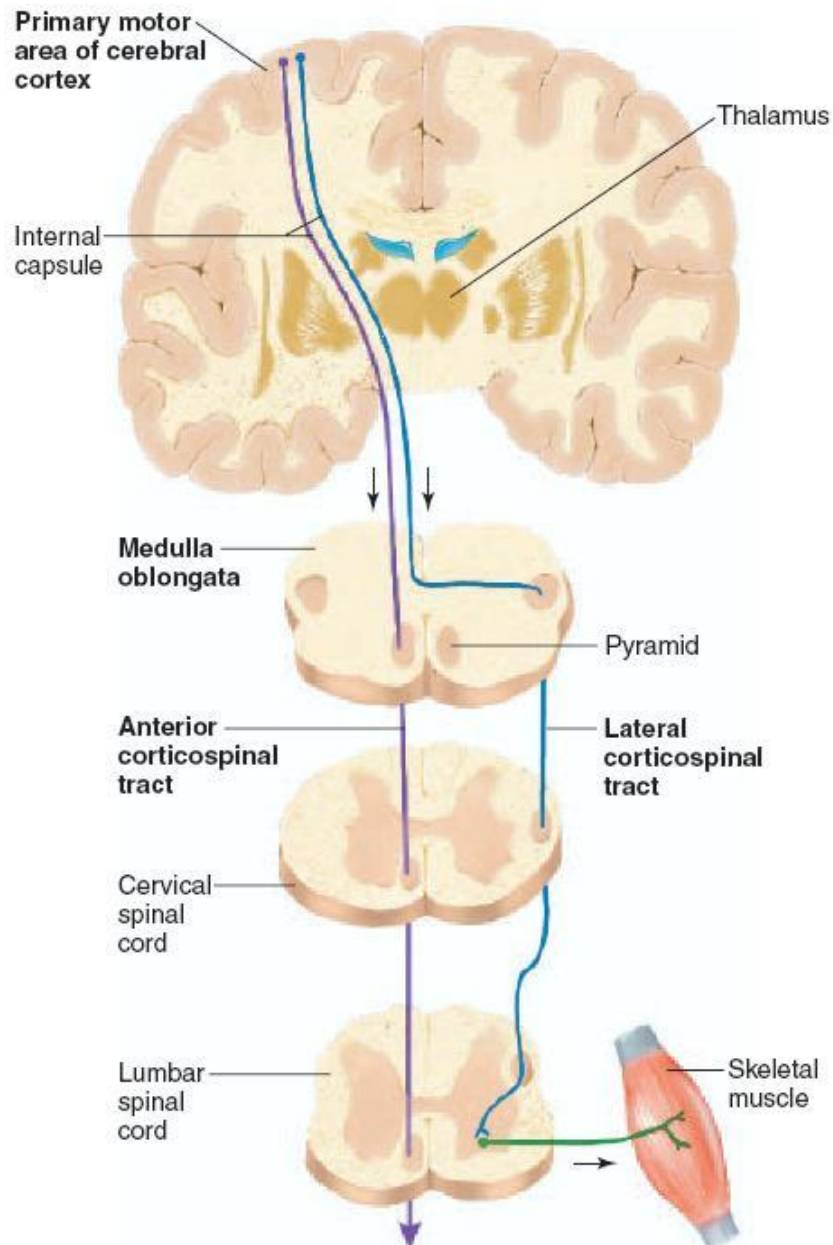
: 근장력 및 신체균형의 불수의적 조절

망상체척수로 (뇌간의 망상체 → 척수)

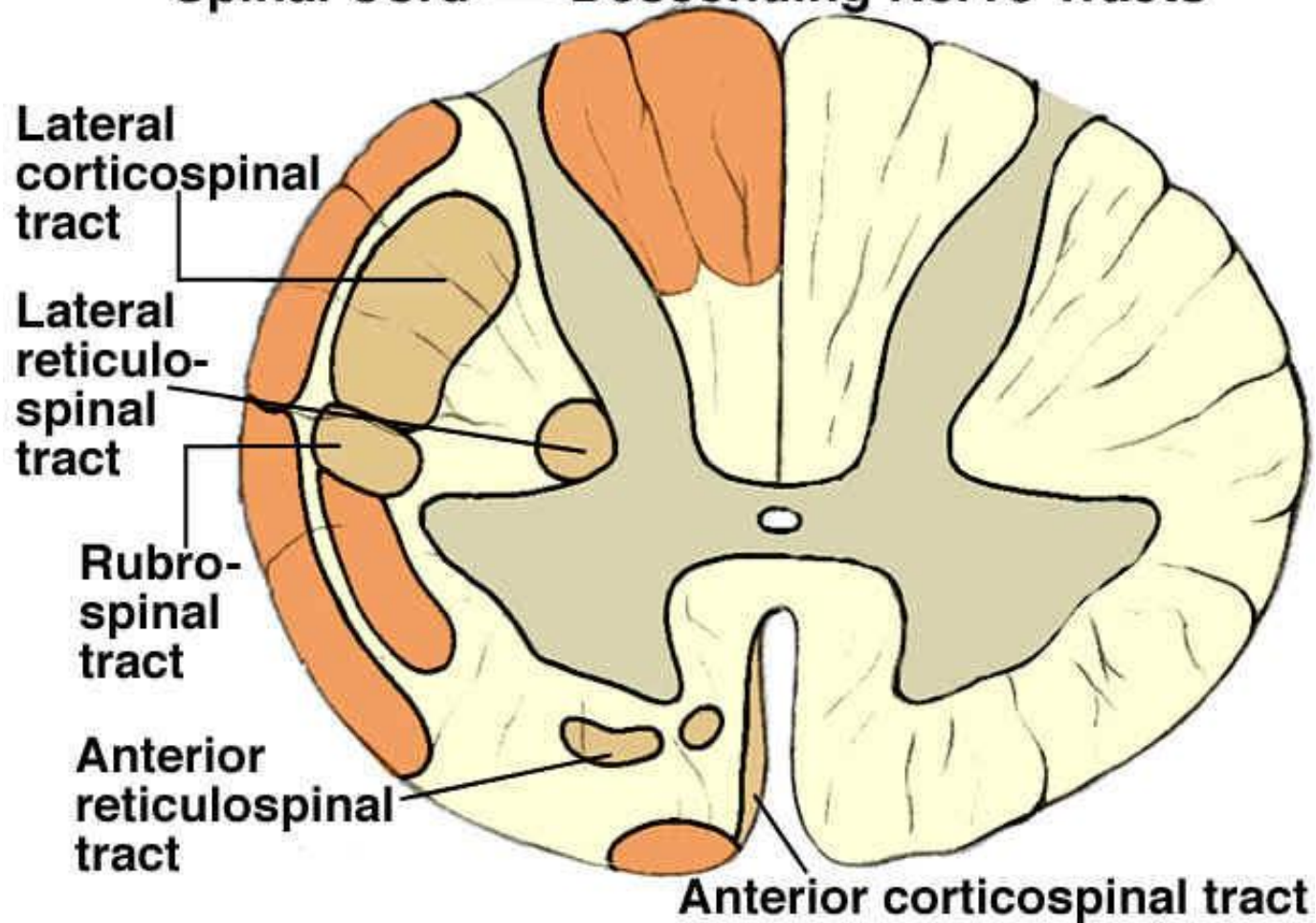
: 반사활동 및 자율기능의 불수의적 조절

시개척수로 (중뇌의 상구와 하구 → 척수)

: 시·청각에 대한 두경부 및 상지의 조절



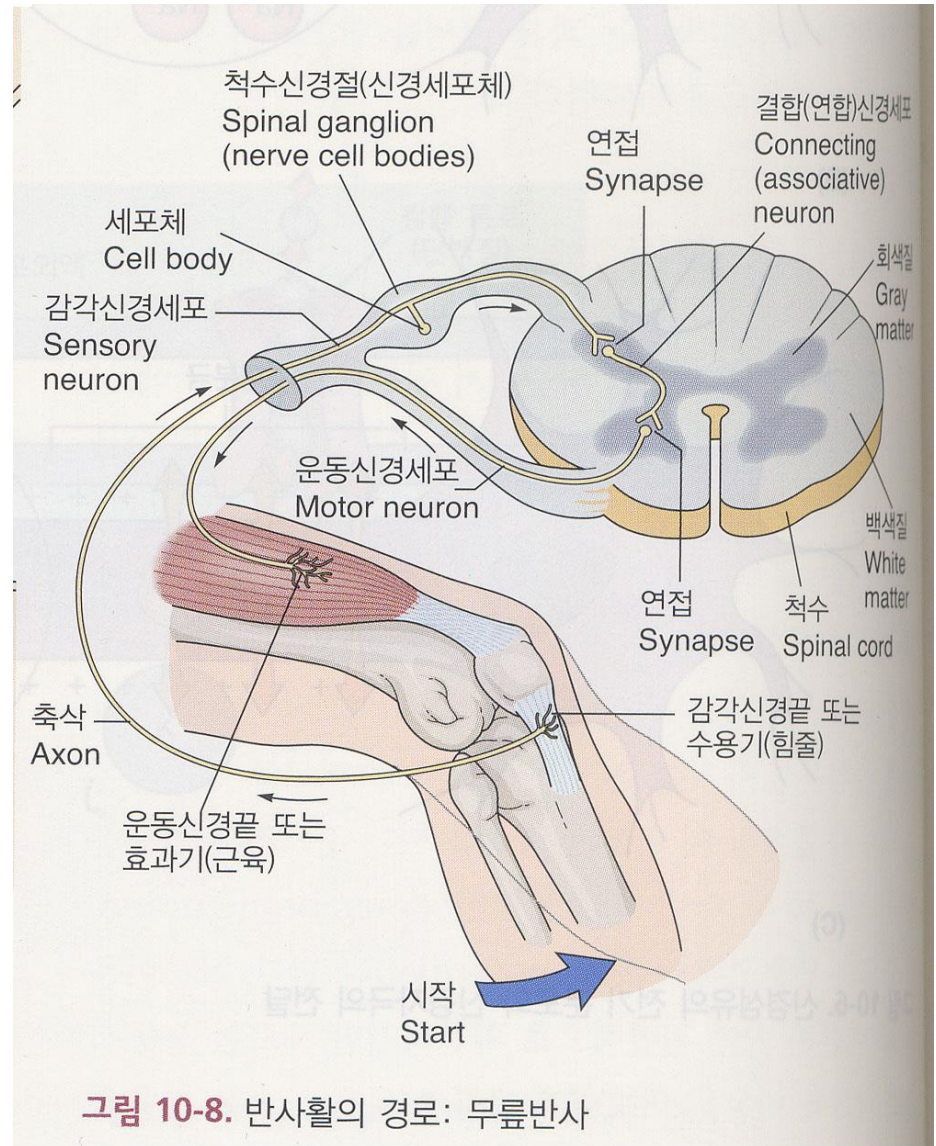
Spinal Cord — Descending Nerve Tracts



Reflex (반사)

1. 외부 자극에 대한 불수의적 반응
2. 반사활동에는 5개의 요소로 구성

- receptor
- afferent nerve
- reflex center
- efferent nerve
- effector



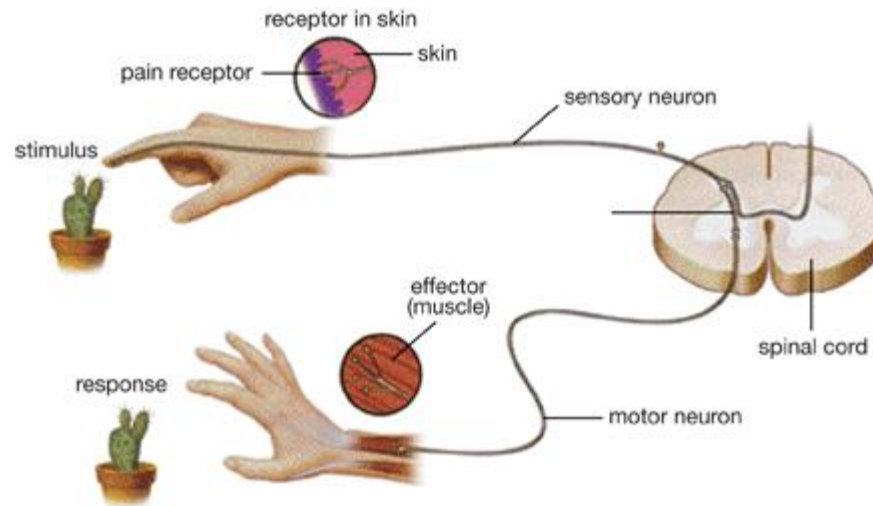
척수반사

신장반사

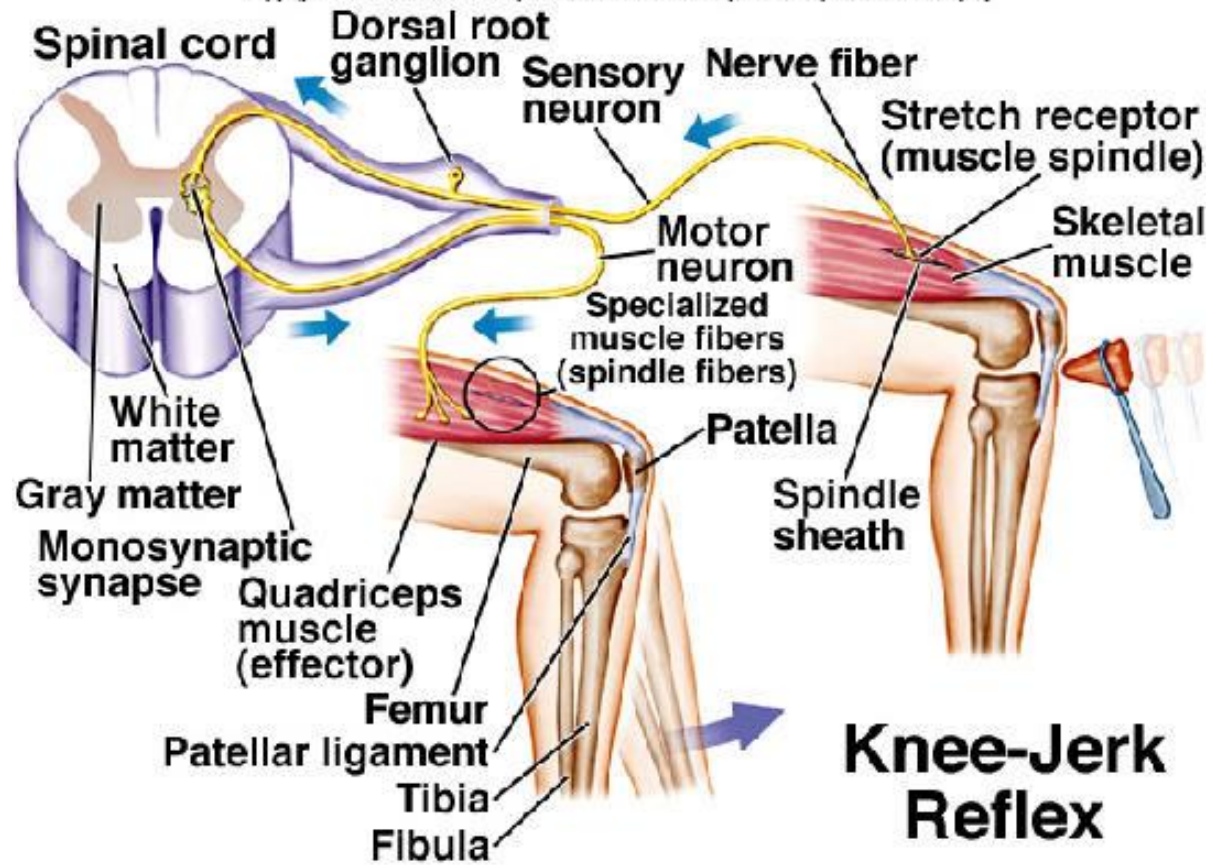
- 슬개건 반사 (근육방추 신장 반사; muscle spindle stretch reflex), 아킬레스건 반사

굴곡반사

- 도피 (withdrawal reflex), 유해자극 관절, 교차신전 (crossed-extensor reflex), 턱반사,

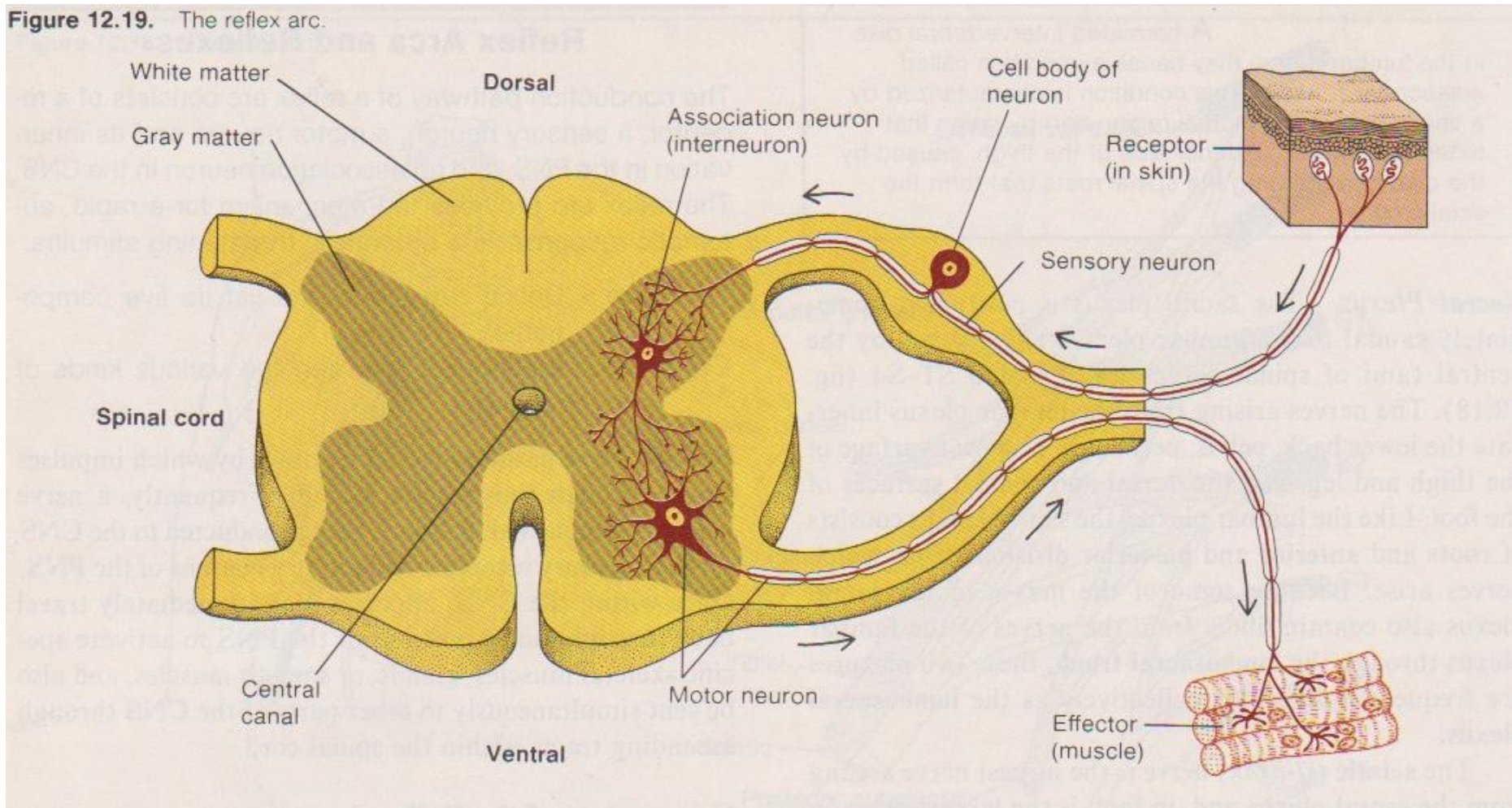


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The reflex arc

Figure 12.19. The reflex arc.



SOMATOSENSORY SYSTEM

I. General Features

A. Somatosensory means body sense

1. Receptors spread throughout body, rather than grouped in specialized receptor organs as in special senses
2. Convey information on tactile, thermal, pain, and sexual sensations

B. At least 3 serial neurons within the CNS

1. Primary afferent

- a. spinal afferents have cell bodies in dorsal root ganglia
- b. trigeminal afferents (supplying head) have cell bodies in cranial nuclei of brainstem

2. Secondary neuron in spinal cord of brainstem

- a. axon decussates (crosses over to other side of CNS)

3. Tertiary neuron in thalamus, which relays information to cerebral cortex

Figure 11.49. Ascending tracts composed of sensory fibers that cross over within the medulla.

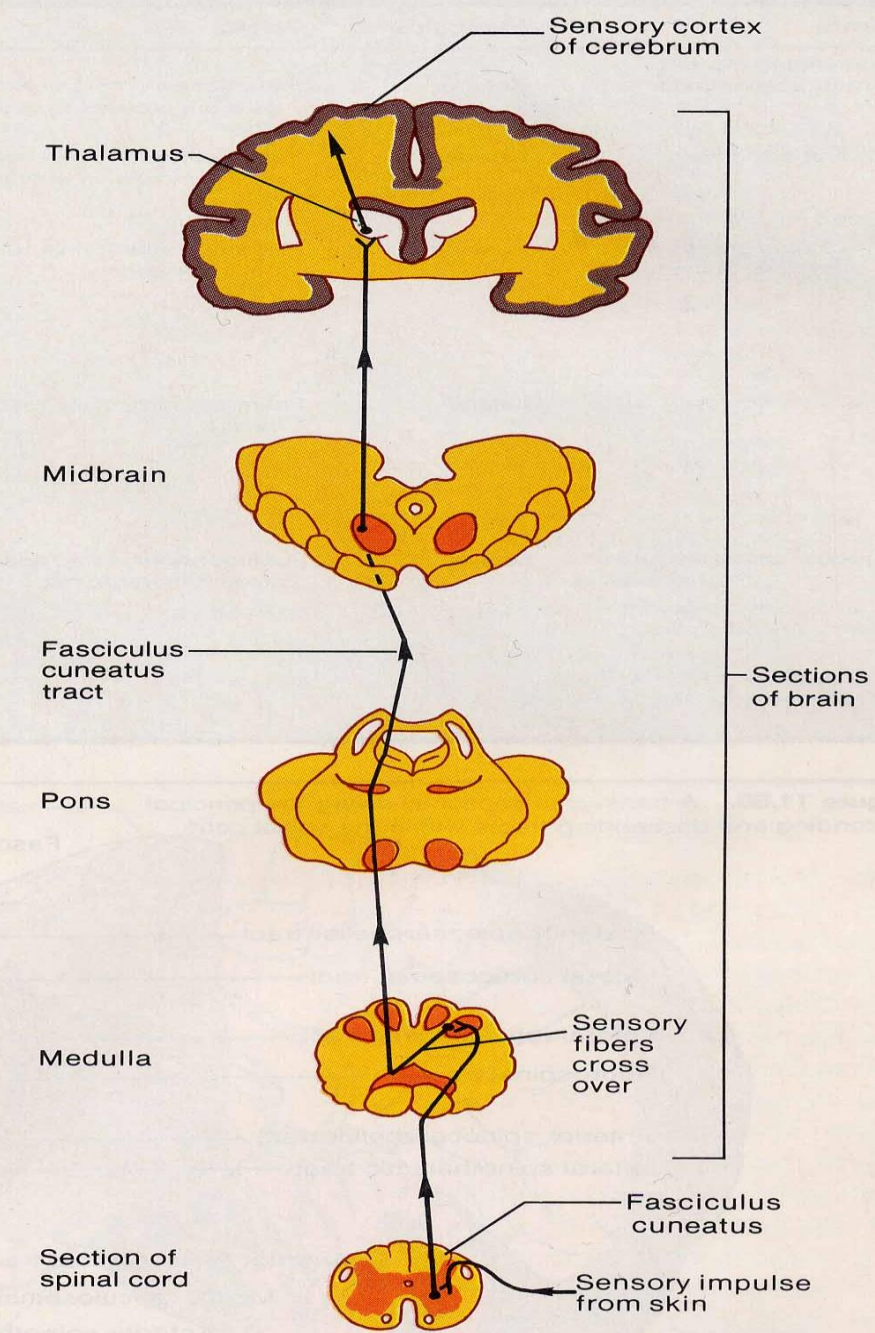


Figure 11.48. Descending tracts composed of motor fibers that cross over within the medulla oblongata.

