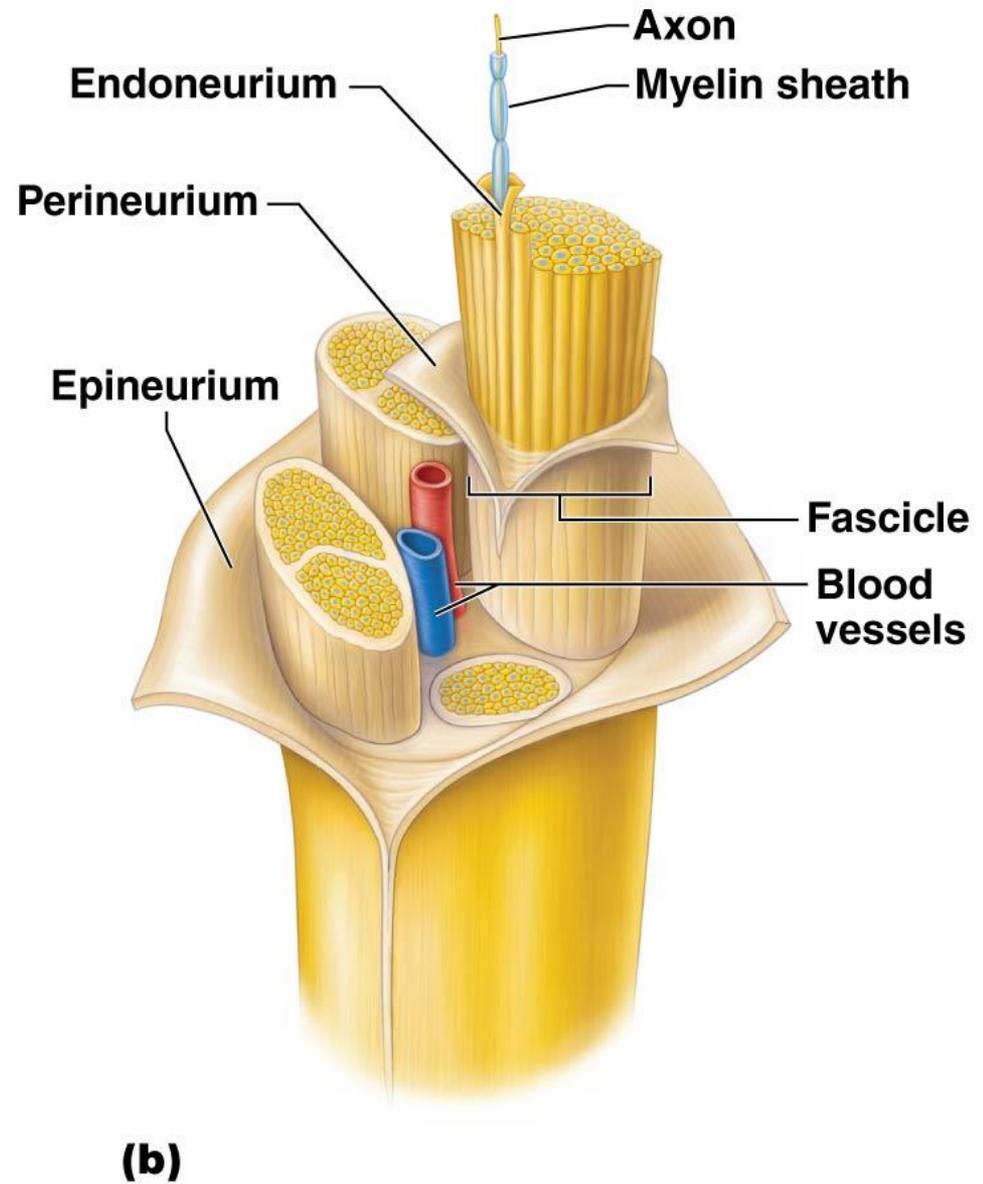
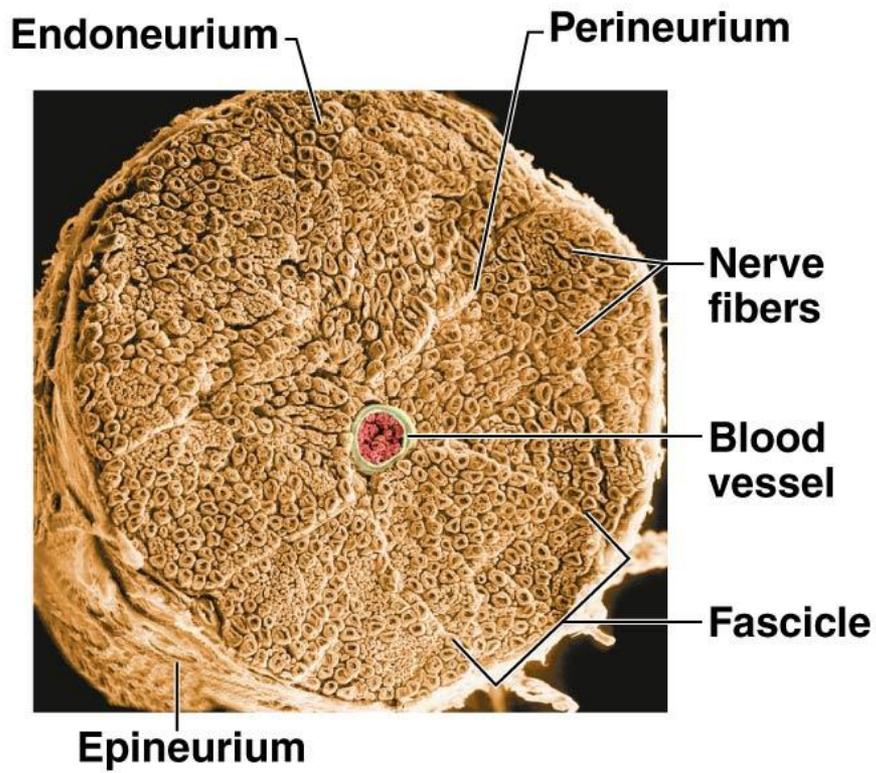


The Peripheral Nervous System

Dr. Ali Ebneshahidi

Peripheral Nervous System (PNS)

- Consists of **12** pairs of cranial nerves and **31** pairs of spinal nerves.
- Serves as a critical link between the body and the central nervous system.
- peripheral nerves contain an outermost layer of fibrous connective tissue called **epineurium** which surrounds a thinner layer of fibrous connective tissue called **perineurium** (surrounds the bundles of nerve or fascicles). Individual nerve fibers within the nerve are surrounded by loose connective tissue called **endoneurium**.



Cranial Nerves

Cranial nerves are direct extensions of the brain. Only nerve I (olfactory) originates from the cerebrum, the remaining 11 pairs originate from the brain stem.

Nerve I (**Olfactory**)- for the sense of smell (sensory).

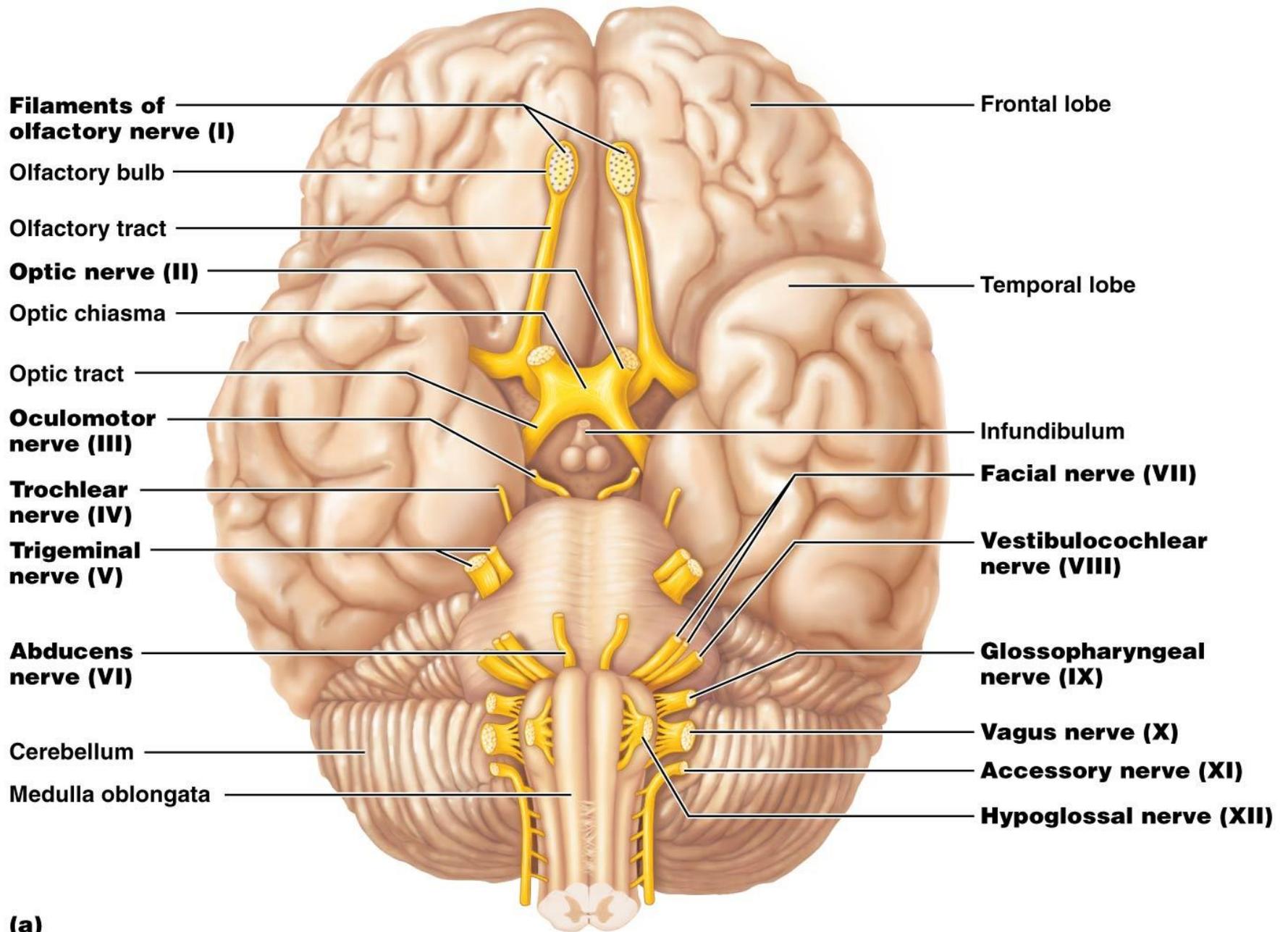
Nerve II (**Optic**)- for the sense of vision (sensory).

Nerve III (**Oculomotor**)- for controlling muscles and accessory structures of the eyes (primarily motor).

Nerve IV (**Trochlear**)- for controlling muscles of the eyes (primarily motor).

Nerve V (**Trigeminal**)- for controlling muscles of the eyes, upper, and lower jaws and tear glands (mixed).

Nerve VI (**Abducens**)- for controlling muscles that move the eye (primarily motor).



(a)

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Nerve VII (**Facial**) – for the sense of taste and controlling facial muscles, tear glands, and salivary glands (mixed).

Nerve VIII (**Vestibulocochlear**)- for the senses of hearing and equilibrium (sensory).

Nerve IX (**Glossopharyngeal**)- for controlling muscles in the pharynx and to control salivary glands (mixed).

Nerve X (**Vagus**)- for controlling muscles used in speech, swallowing, and the digestive tract, and controls cardiac and smooth muscles (mixed).

Nerve XI (**Accessory**)- for controlling muscles of soft palate, pharynx and larynx (primarily motor).

Nerve XII (**Hypoglossal**) for controlling muscles that move the tongue (primarily motor).

Cranial nerves I - VI	Sensory function	Motor function	PS* fibers
I Olfactory	Yes (smell)	No	No
II Optic	Yes (vision)	No	No
III Oculomotor	No	Yes	Yes
IV Trochlear	No	Yes	No
V Trigeminal	Yes (general sensation)	Yes	No
VI Abducens	No	Yes	No

Cranial nerves VII - XII	Sensory function	Motor function	PS* fibers
VII Facial	Yes (taste)	Yes	Yes
VIII Vestibulocochlear	Yes (hearing and balance)	Some	No
IX Glossopharyngeal	Yes (taste)	Yes	Yes
X Vagus	Yes (taste)	Yes	Yes
XI Accessory	No	Yes	No
XII Hypoglossal	No	Yes	No

(b)

*PS = parasympathetic

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Table 13.2 Cranial Nerves (continued)

III Oculomotor Nerves (ok''u-lo-mo'tor)

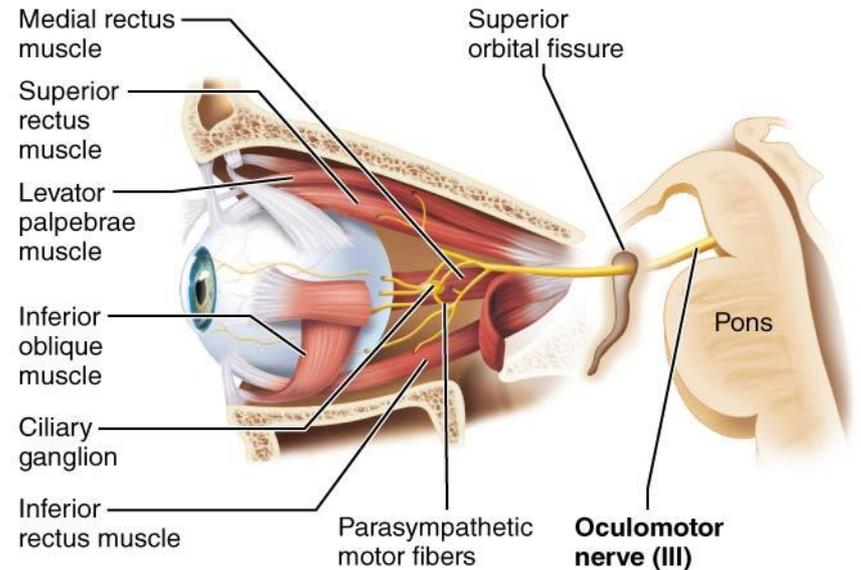
Origin and course: Fibers extend from ventral midbrain (near its junction with pons) and pass through bony orbit, via superior orbital fissure, to eye.

Function: Chiefly motor nerves (*oculomotor* = motor to the eye); contain a few proprioceptive afferents. Each nerve includes the following:

- Somatic motor fibers to four of the six extrinsic eye muscles (inferior oblique and superior, inferior, and medial rectus muscles) that help direct eyeball, and to levator palpebrae superioris muscle, which raises upper eyelid.
- Parasympathetic (autonomic) motor fibers to sphincter pupillae (circular muscles of iris), which cause pupil to constrict, and to ciliary muscle, controlling lens shape for visual focusing. Some parasympathetic cell bodies are in the ciliary ganglia.
- Sensory (proprioceptor) afferents, which run from same four extrinsic eye muscles to midbrain.

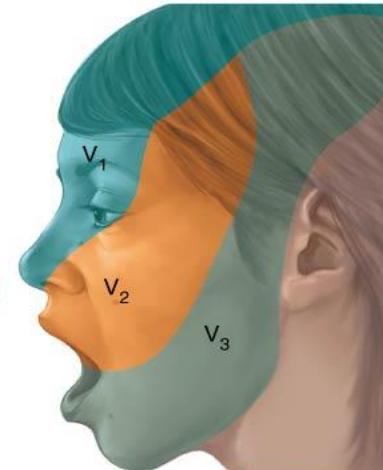
CLINICAL TESTING: Examine pupils for size, shape, and equality. Test pupillary reflex with penlight (pupils should constrict when illuminated). Test convergence for near vision and subject's ability to follow objects with the eyes.

 **HOMEOSTATIC IMBALANCE** In oculomotor nerve paralysis, eye cannot be moved up, down, or inward. At rest, eye rotates laterally [*external strabismus* (strah-biz'mus)] because the actions of the two extrinsic eye muscles not served by cranial nerves III are unopposed. Upper eyelid droops (*ptosis*), and the person has double vision and trouble focusing on close objects. + _____

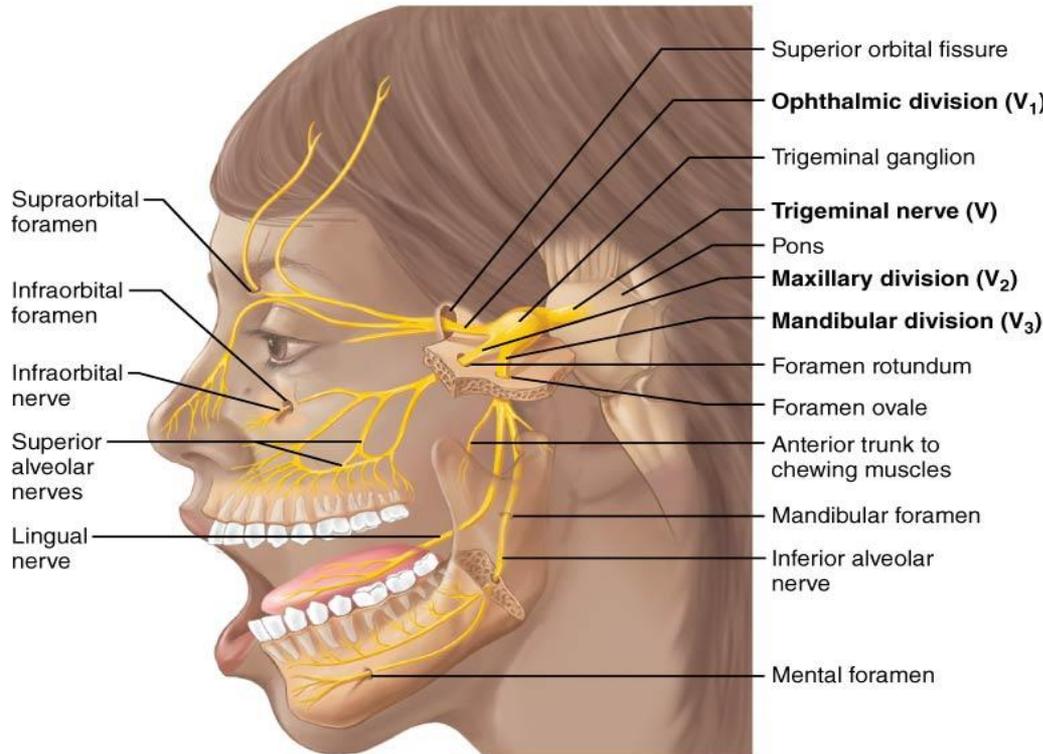


V Trigeminal Nerves

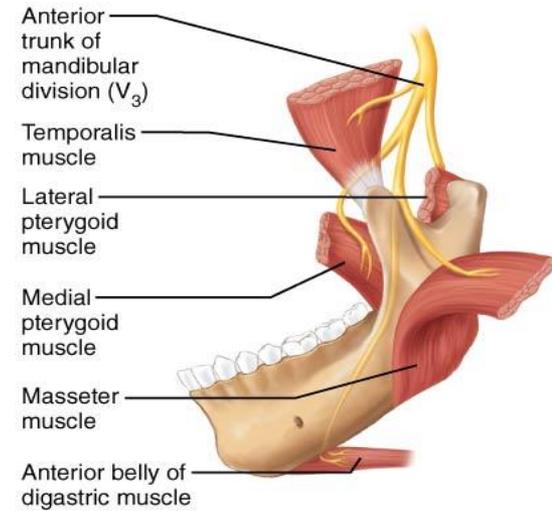
HOMEOSTATIC IMBALANCE *Trigeminal neuralgia* (nu-ral'je-ah), or *tic douloureux* (tik doo'loo-roo'; *tic* = twitch, *douloureux* = painful), caused by inflammation of trigeminal nerve, is widely considered to produce most excruciating pain known. The stabbing pain lasts for a few seconds to a minute, but it can be relentless, occurring a hundred times a day. Usually provoked by some sensory stimulus, such as brushing teeth or even a passing breeze hitting the face. Thought to be caused by a loop of artery or vein that compresses the trigeminal nerve near its exit from the brain stem. Analgesics and carbamazepine (an anticonvulsant) are only partially effective. In severe cases, surgery relieves the agony—either by moving the compressing vessel or by destroying the nerve. Nerve destruction results in loss of sensation on that side of face. +



(b) Distribution of sensory fibers of each division

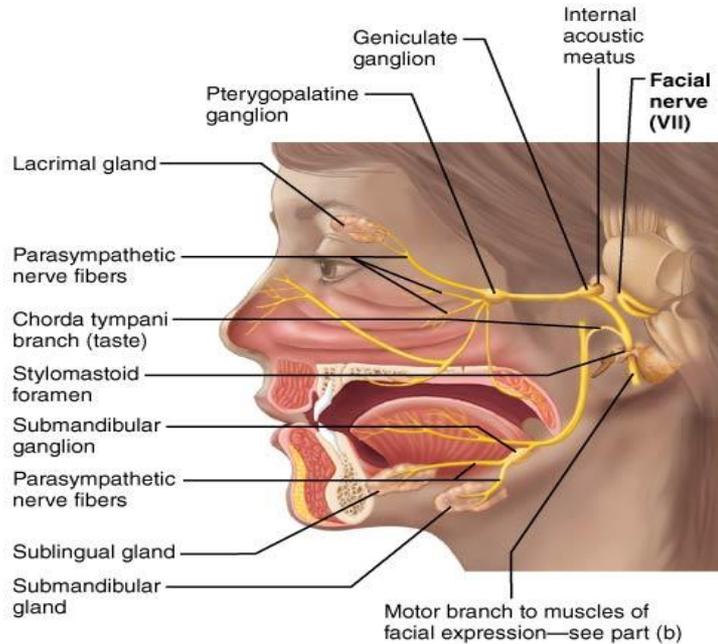


(a) Distribution of the trigeminal nerve

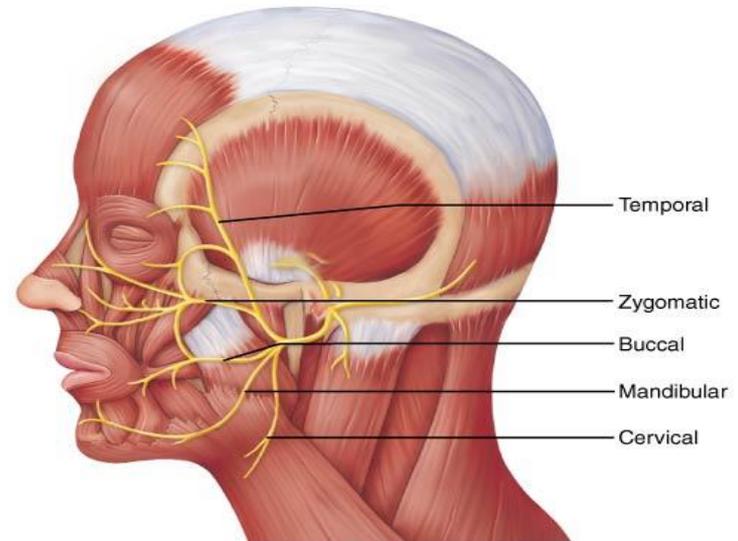


(c) Motor branches of the mandibular division (V₃)

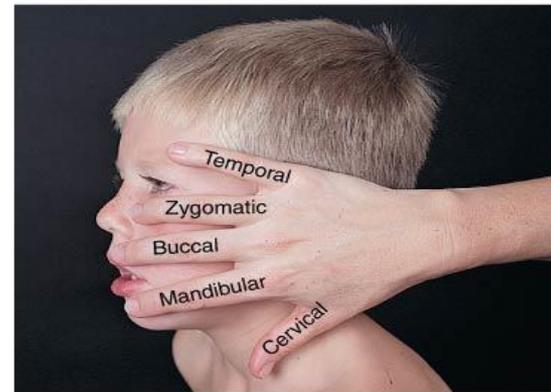
VII Facial Nerves



(a) Parasympathetic efferents and sensory afferents



(b) Motor branches to muscles of facial expression and scalp muscles



(c) A simple way to remember the courses of the five major branches of the facial nerve

Table 13.2 Cranial Nerves (continued)

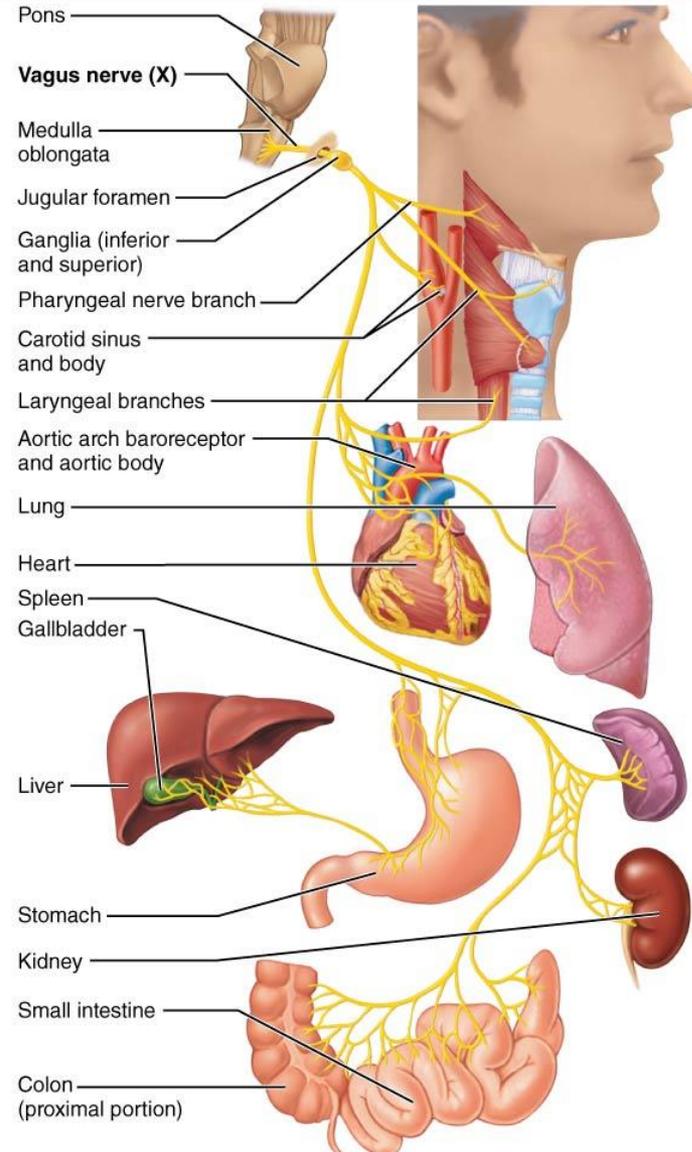
X Vagus Nerves (va'gus)

Origin and course: The only cranial nerves to extend beyond head and neck region. Fibers emerge from medulla, pass through skull via jugular foramen, and descend through neck region into thorax and abdomen. See also Figure 14.4.

Function: Mixed nerves. Nearly all motor fibers are parasympathetic efferents, except those serving skeletal muscles of pharynx and larynx (involved in swallowing). Parasympathetic motor fibers supply heart, lungs, and abdominal viscera and are involved in regulating heart rate, breathing, and digestive system activity. Transmit sensory impulses from thoracic and abdominal viscera, from the aortic arch baroreceptors (for blood pressure) and the carotid and aortic bodies (chemoreceptors for respiration), and taste buds on the epiglottis. Also carry general somatic sensory information from small area of skin on external ear. Carry proprioceptor fibers from muscles of larynx and pharynx.

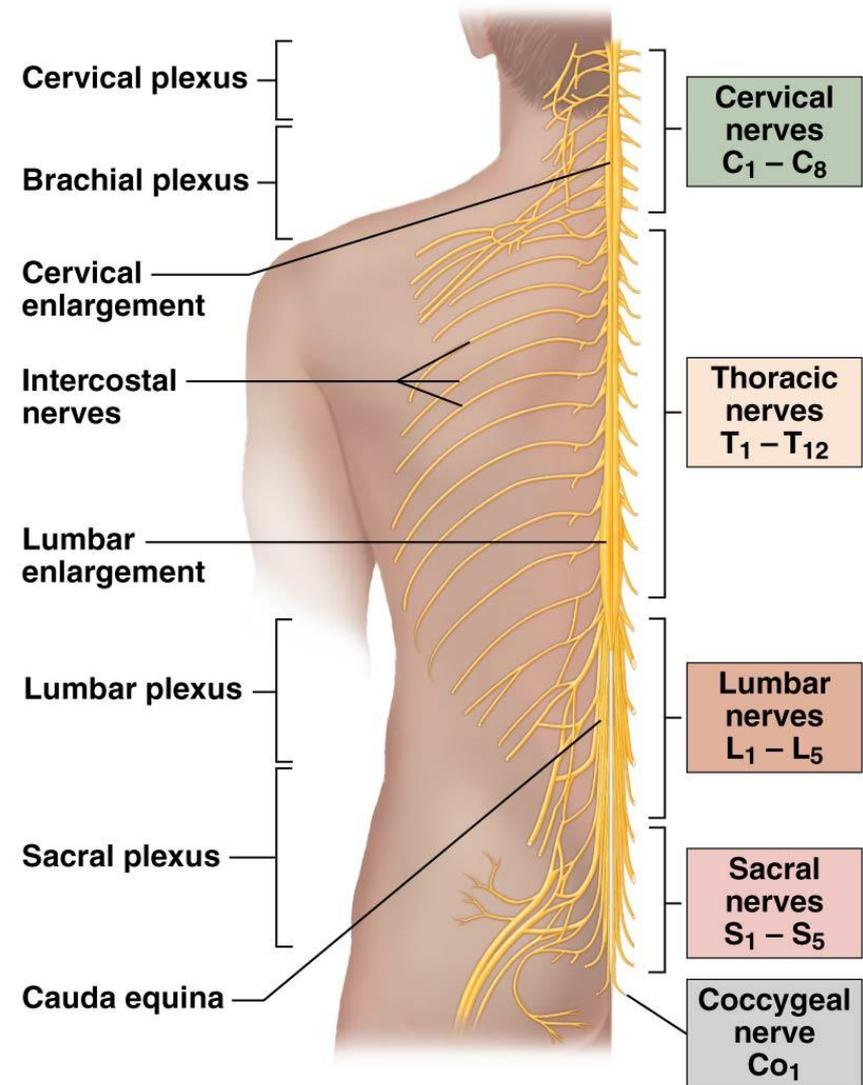
CLINICAL TESTING: As for cranial nerve IX (glossopharyngeal); IX and X are tested in common, since they both innervate muscles of throat and mouth.

 **HOMEOSTATIC IMBALANCE** Since laryngeal branches of the vagus innervate nearly all muscles of the larynx ("voice box"), vagal nerve paralysis can lead to hoarseness or loss of voice. Other symptoms are difficulty swallowing and impaired digestive system motility. These parasympathetic nerves are important for maintaining the normal state of visceral organ activity. Without their influence, the sympathetic nerves, which mobilize and accelerate vital body processes (and shut down digestion), would dominate. +



Spinal Nerves

- Spinal nerves are **mixed nerves** where both sensory and motor nerve fibers are found in each nerve, allowing these nerves to have two-way communication between the spinal cord and the arms, legs, neck, and body trunk.
- Except in the thoracic region, all spinal nerves form **plexuses**. In each plexus, nerve fibers of various spinal nerves are sorted and recombined, resulting in different nerve fibers from different spinal nerves reaching the same parts.

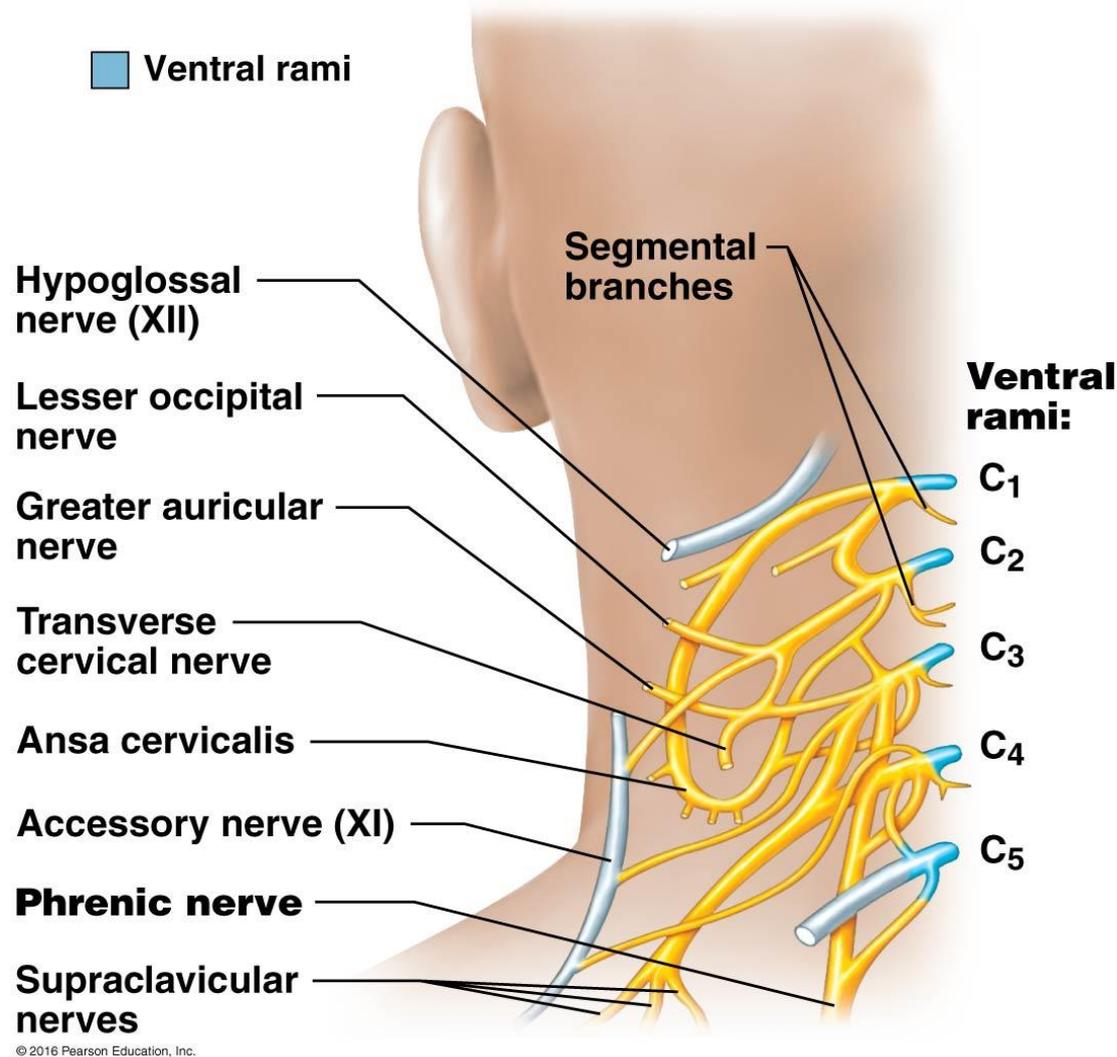


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Plexuses

Plexuses- are a network of spinal nerves.

1) **Cervical plexus (C₁-C₄)**: most branches are cutaneous and supply the skin of face and neck. Other branches supply muscles of the anterior neck. Fibers of C₃/ 4/5 Cervical nerves form the right and left phrenic nerve which supply the diaphragm.



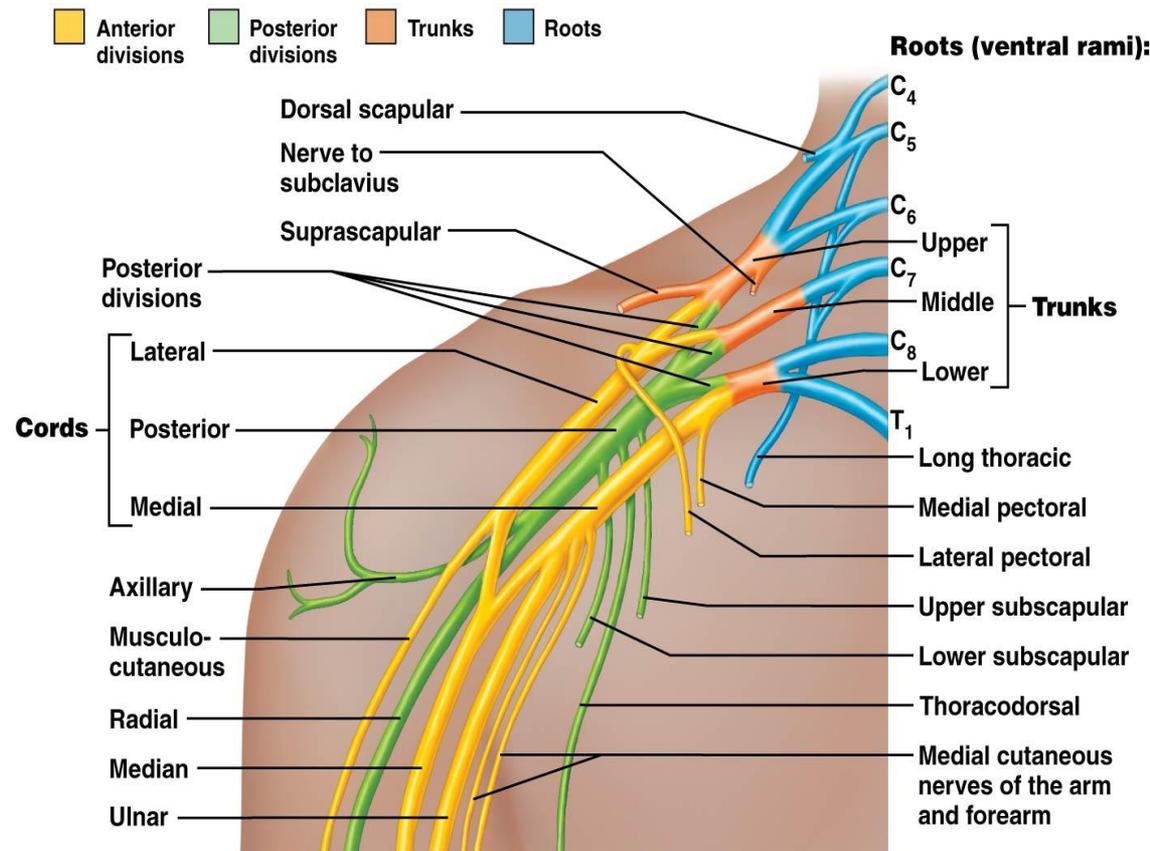
2) Brachial plexus (C5 – T1): form brachial plexus.

Major branches: main branches emerging from the brachial plexus include the following:

a) musculocutaneous nerve: supply muscle of the ant. arm and skin of forearm.

b) ulnar nerve: supply muscles of forearm, hands and skin of hands.

c) median nerve: supply muscles of the forearm and muscles of hands.



(a) Roots (rami C₅-T₁), trunks, divisions, and cords

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d) radial nerve: supply muscles of the post. arm and skin of forearm and hands. It is the largest brnch of C- plexus.

e) axillary nerve: supply muscles of the skin of the superior, lateral, and posterior regions of the arm.

other nerves associated with brachial plexus are:

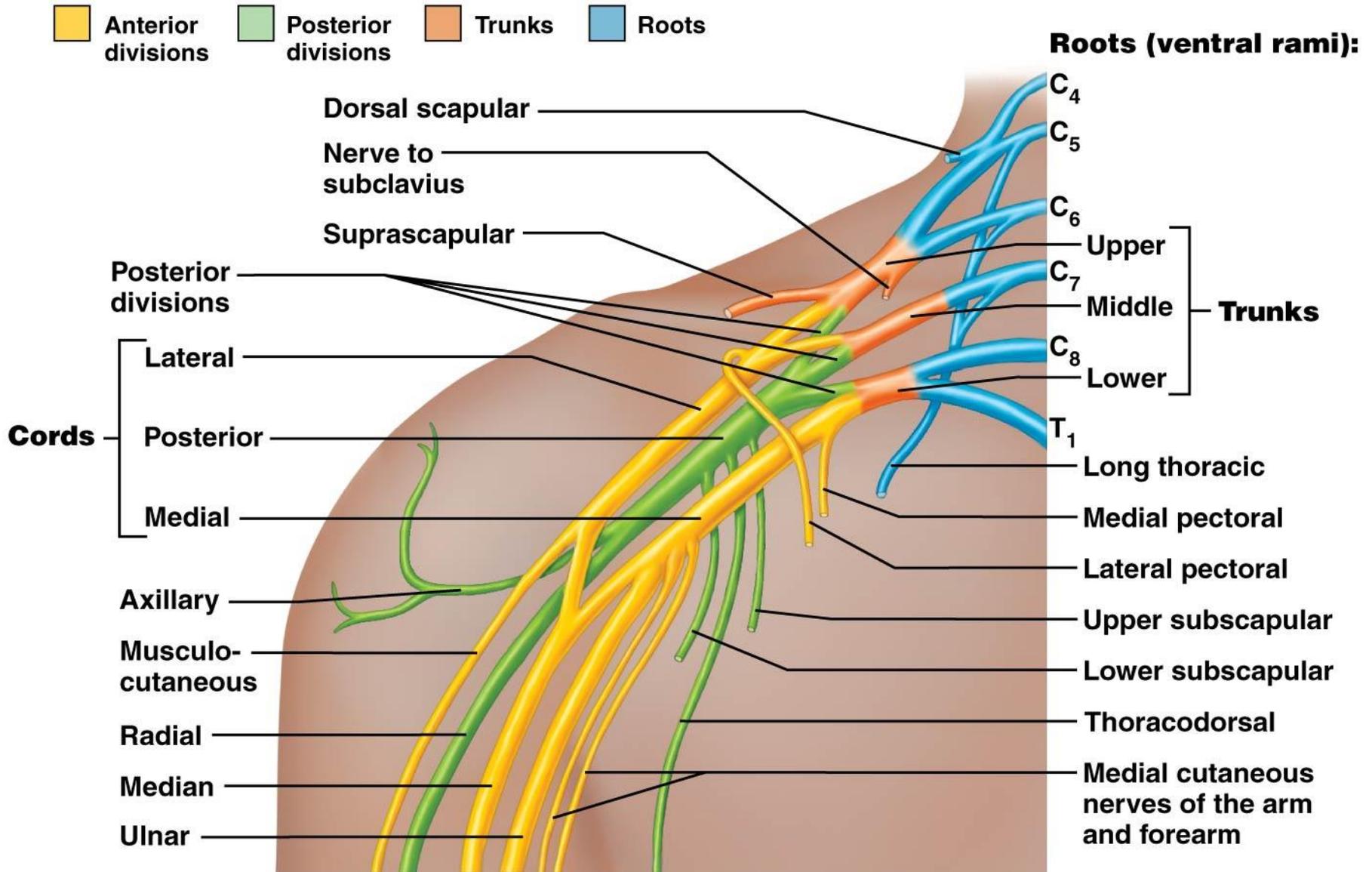
f) lateral & medial pectoral nerves: supply the pectoralis major and minor muscles.

g) dorsal scapular nerve: supply the rhomboideus major and levator scapulae.

h) lower subscapularis nerve: supply the subscapularis and teres major muscles.

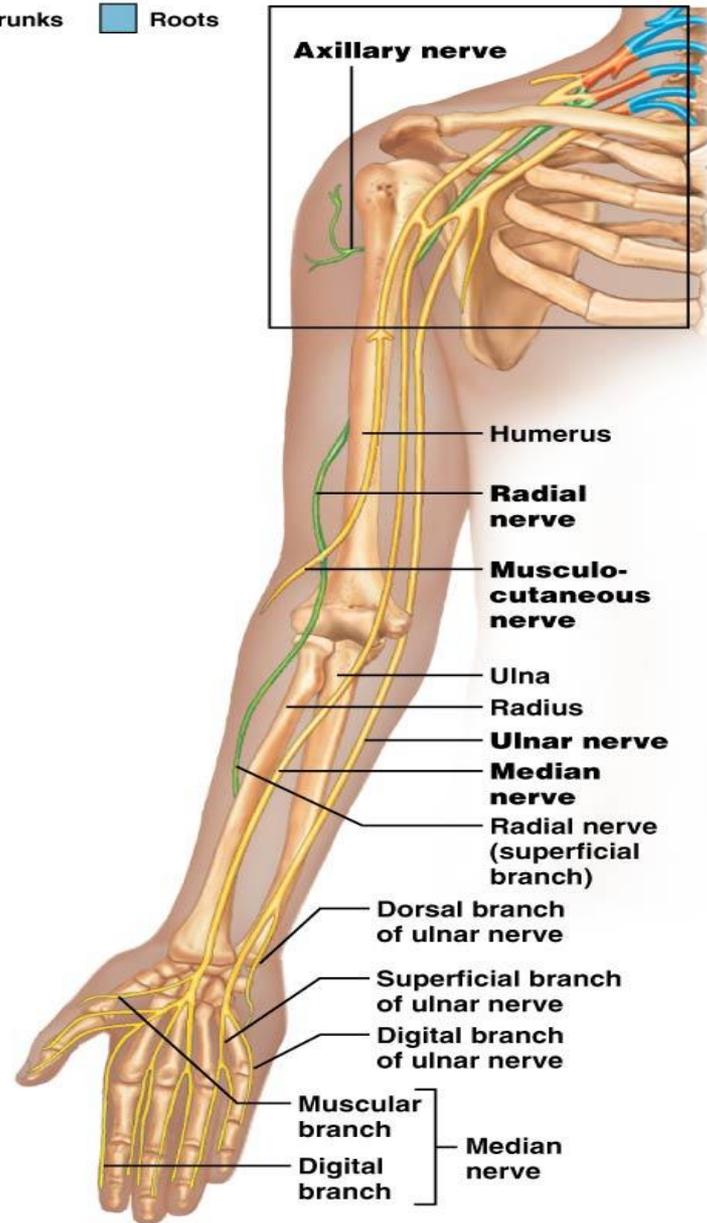
i) thoracic dorsal nerve: supply the latissimus dorsi muscle.

j) the suprascapular nerve: supply the supraspinatous and infra-spinatous muscles.

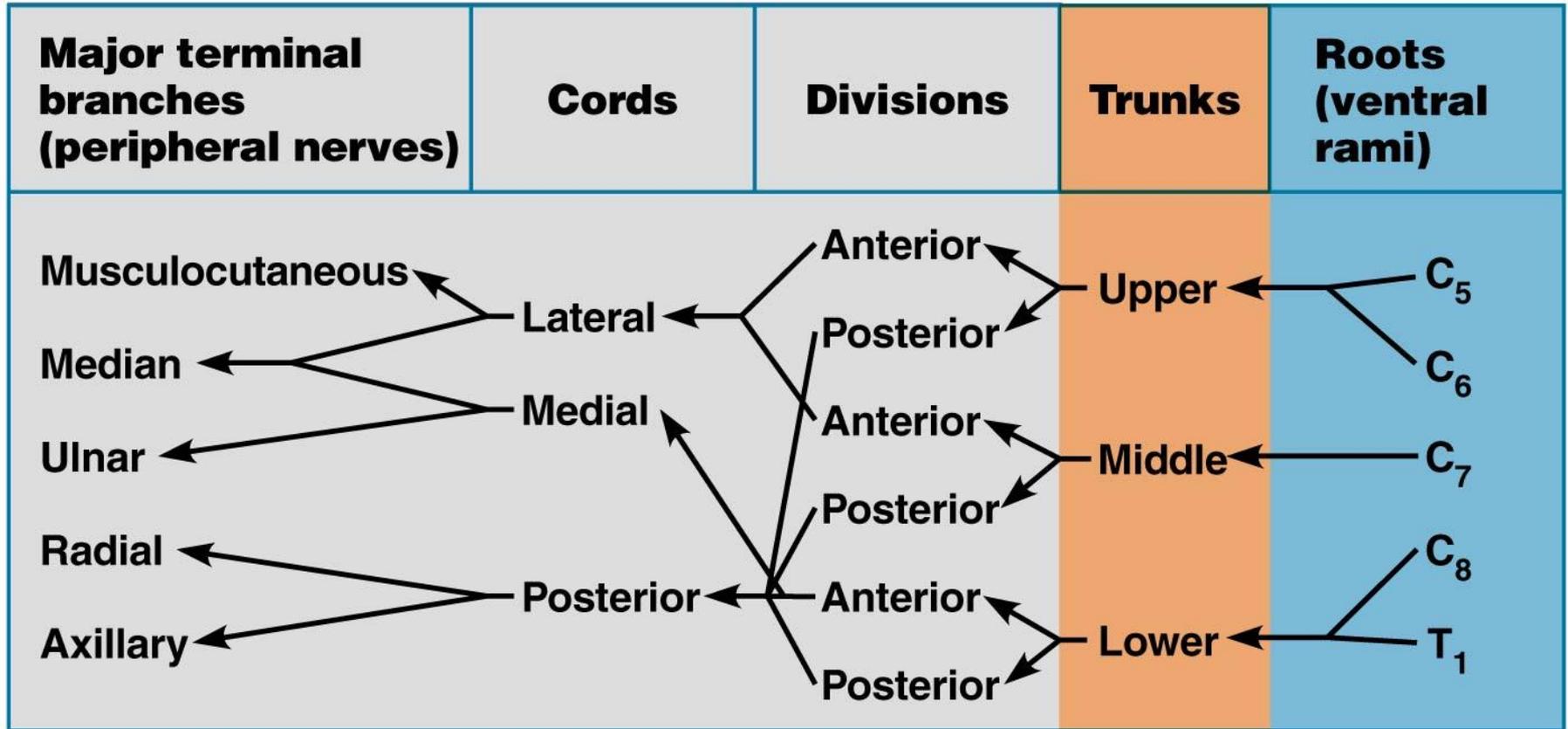


(a) Roots (rami C₅-T₁), trunks, divisions, and cords

Anterior divisions
 Posterior divisions
 Trunks
 Roots



(c) The major nerves of the upper limb



(b) Flowchart summarizing relationships within the brachial plexus

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3) lumbosacral plexus

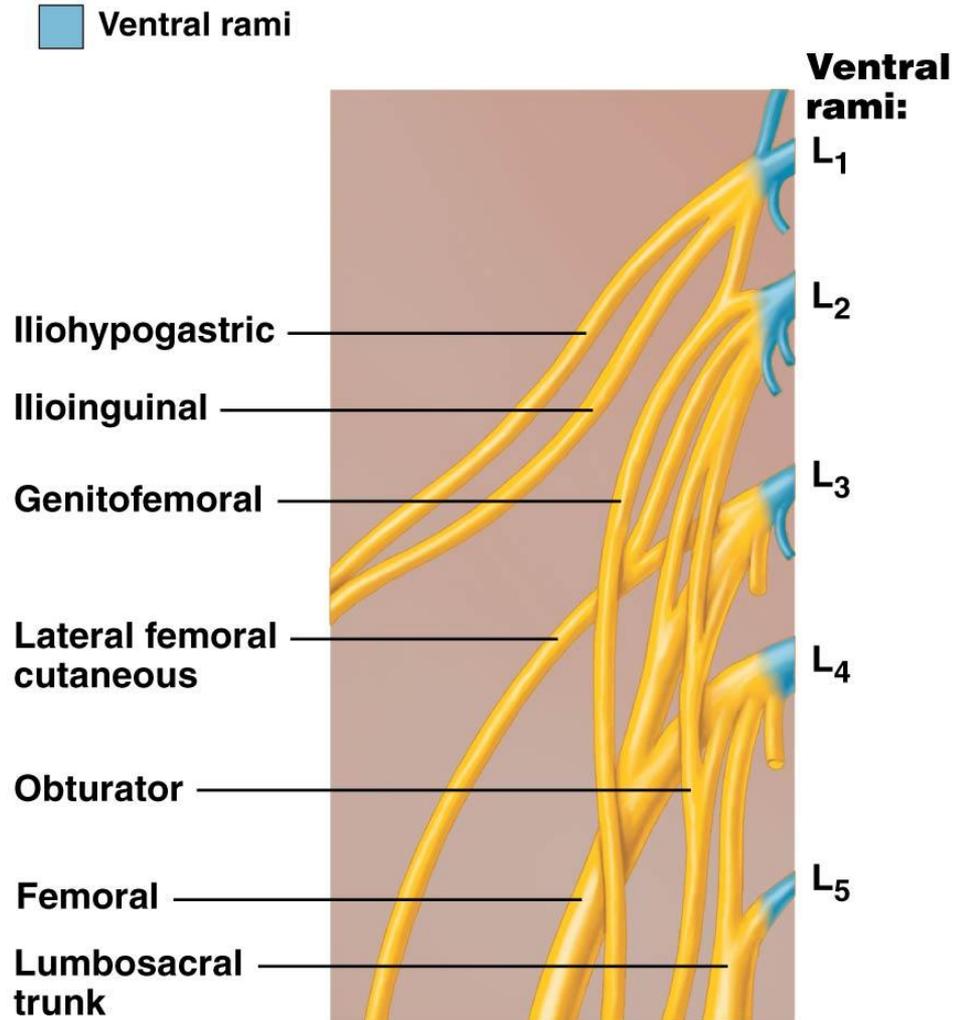
(T₁₂ - S₅):

Major branches :

a) **obturator nerve**: supply the adductor muscles of the thigh.

b) **femoral nerve**: supply quadriceps muscles. It is the longest nerve of the lumbar plexus.

c) **sciatic nerve**: divides into tibial and common peroneal nerve. It supply muscles and skin in the thighs, legs, and feet. It is the largest and longest nerve in the body.



(a) Ventral rami and major branches of the lumbar plexus

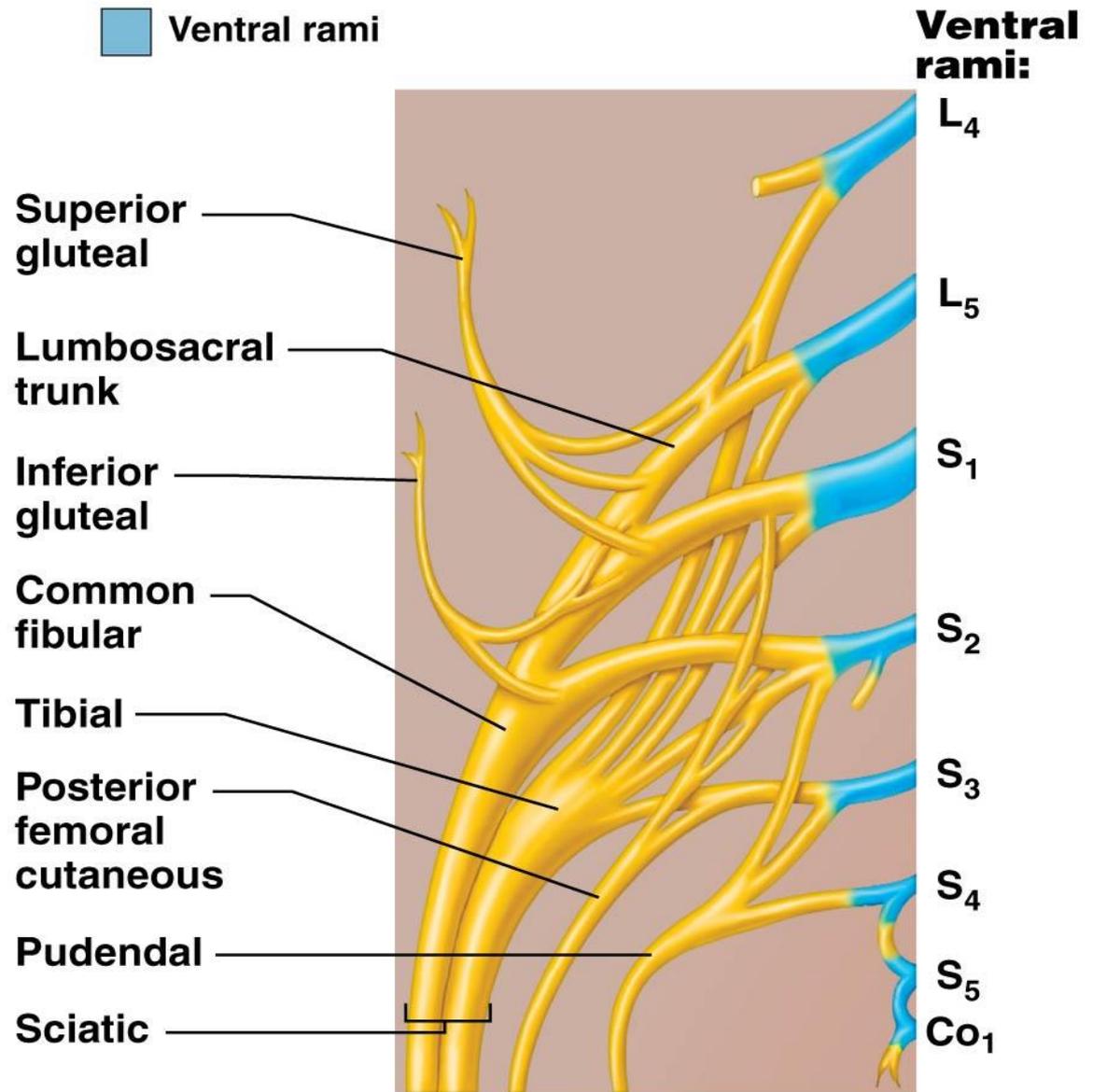
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other nerves

associated
with sacral
plexus are:

**d) pudendal
nerve:** supply
the muscles
of perineum.

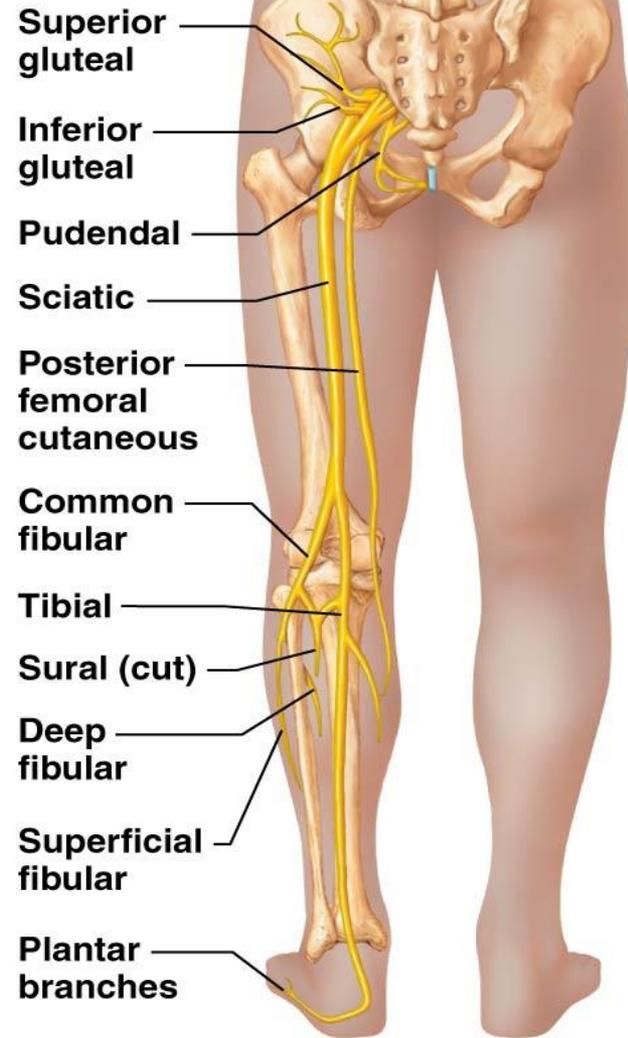
**e) inferior &
superior
gluteal nerve:**
supply the
gluteal
muscles and
the tensor
fascia lata
muscle.



**(a) Ventral rami and major branches
of the sacral plexus**

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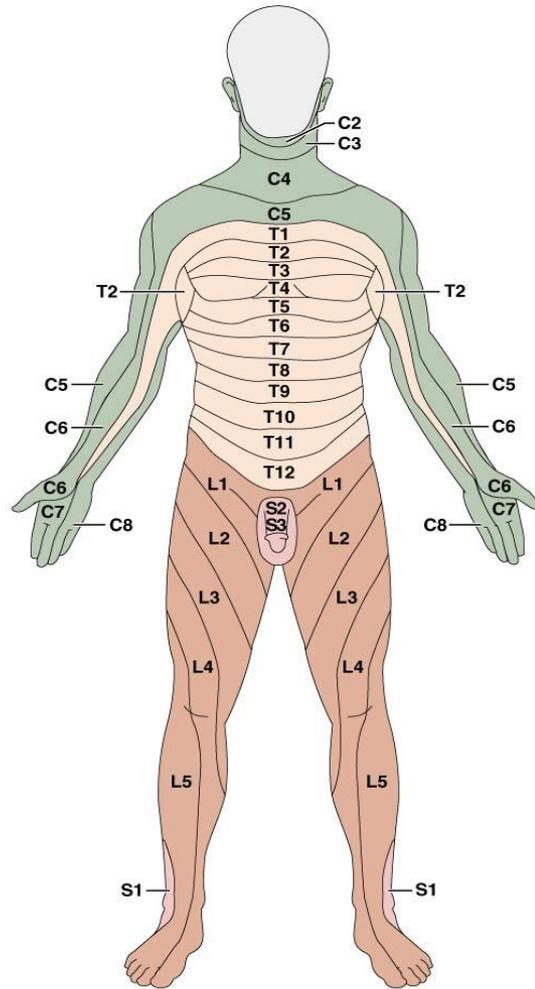
■ Ventral rami



(b) Distribution of the major nerves from the sacral plexus to the lower limb

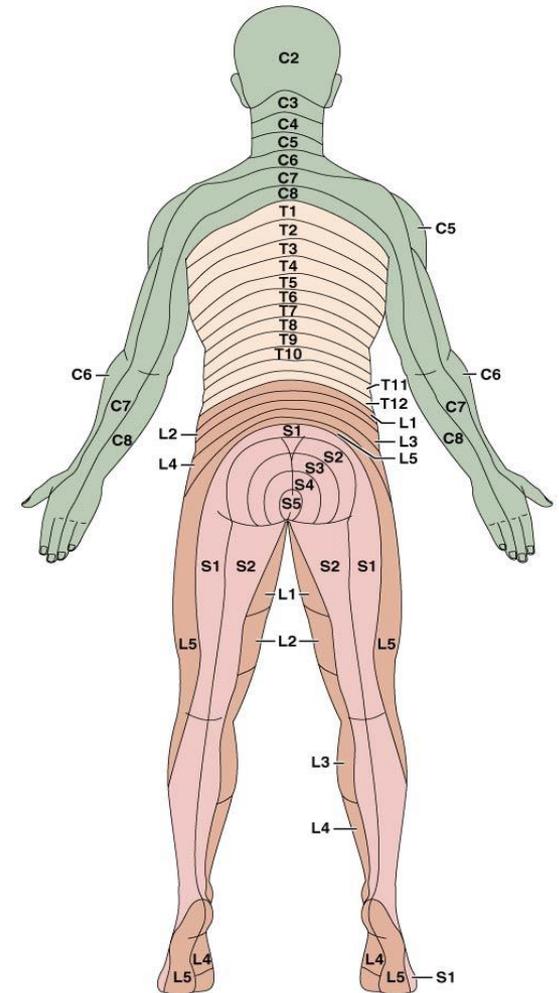
Dermatomes

Dermatome: is an area of skin that the sensory nerve fibers of a particular spinal nerve innervate. All spinal nerves except C_1 has dermatomes (example: the skin of upper limbs is supplied by ventral rami of C_5 - T_1).



(a) Anterior view

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(b) Posterior view