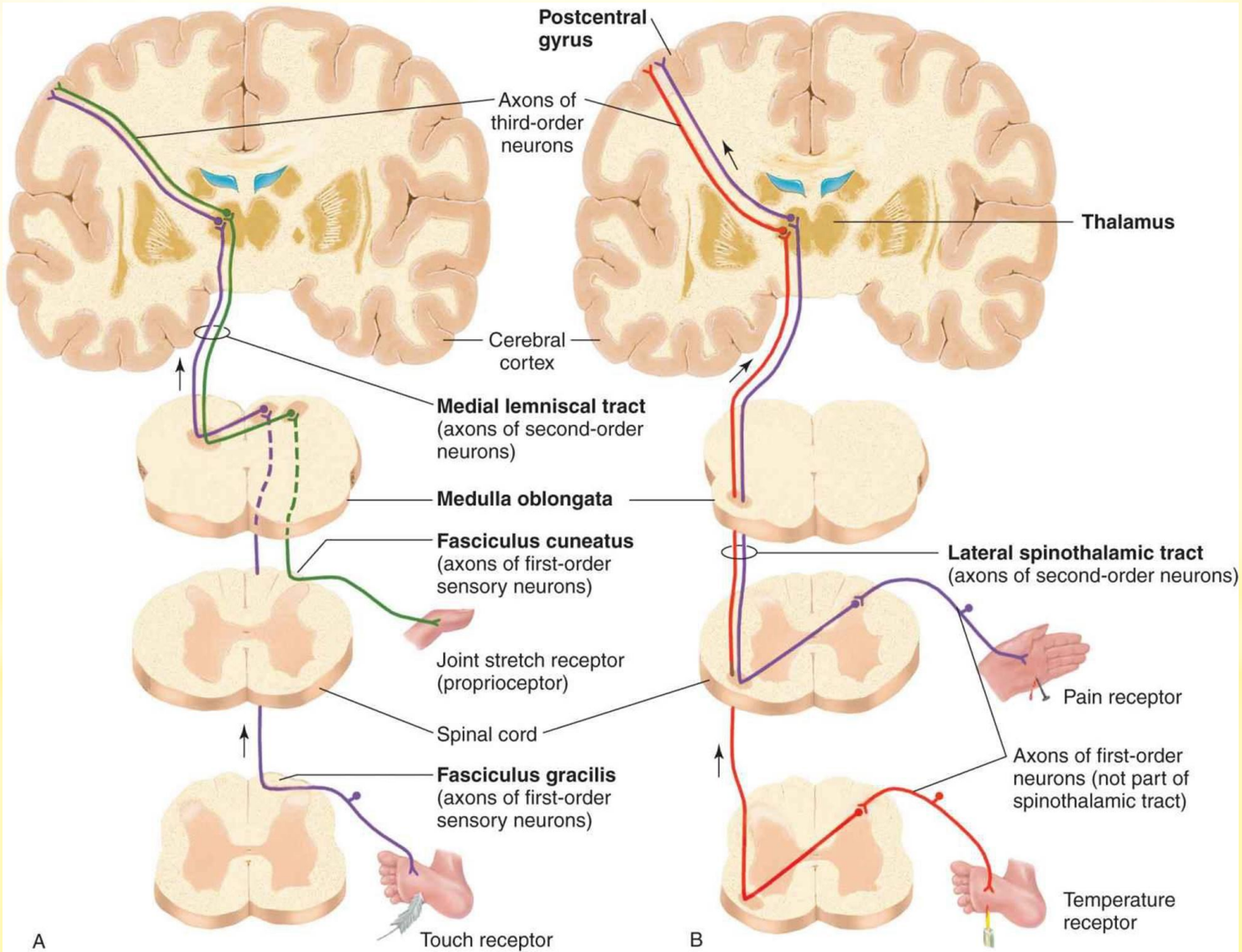
SOMATOSENSORY AND VISCEROSENSORY PATHWAYS

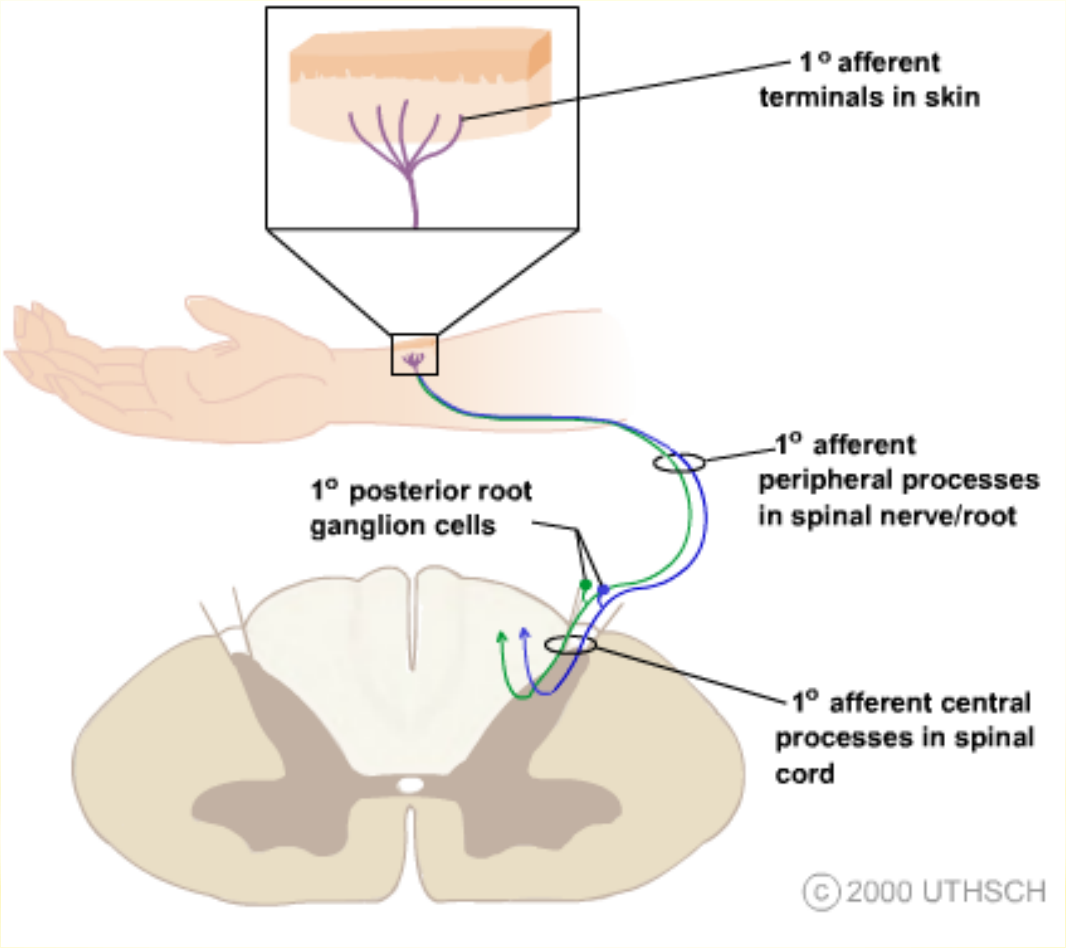
SOMATOSENSORY SYSTEMS

- inform about objects around us through touch
- inform about position and movements of our body parts (proprioception)
- monitor the temperature
- inform about painful, itchy and tickling stimuli

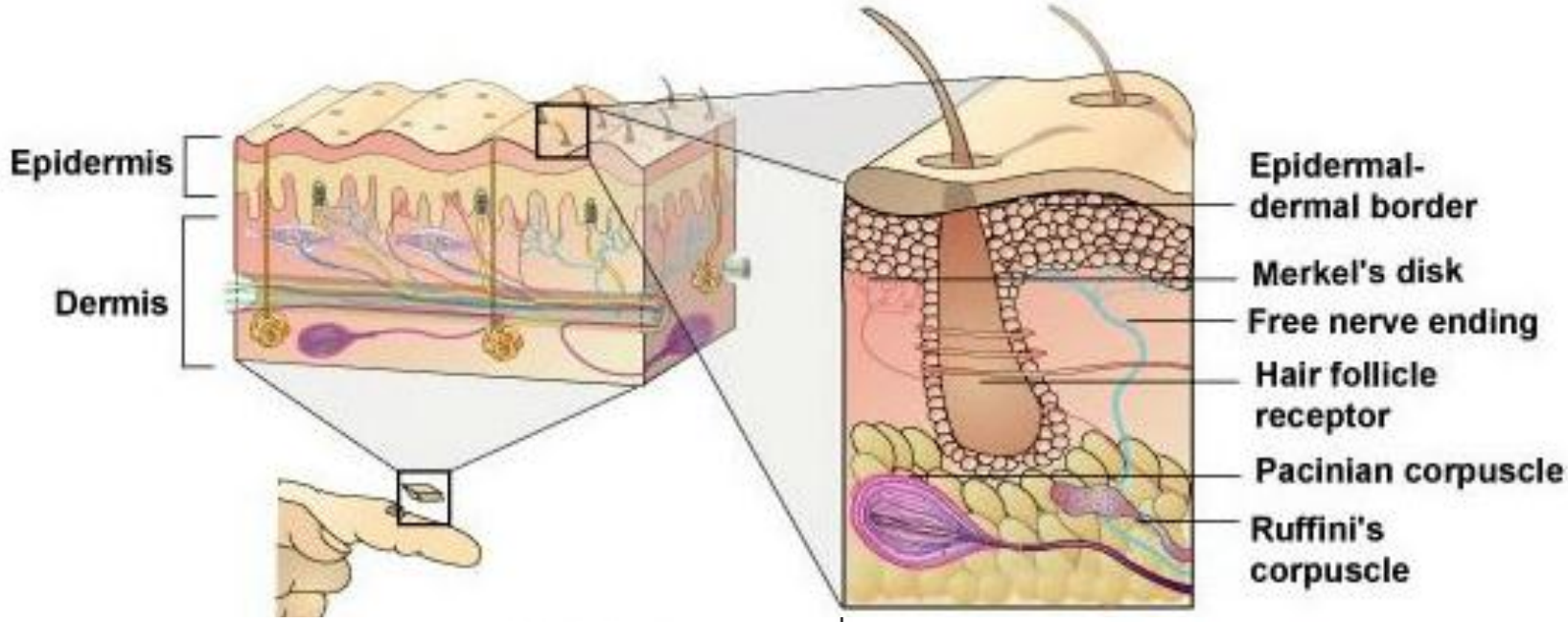
The somatosensory receptor and its central connections determine the modality specificity of the neurons forming a somatosensory pathway.

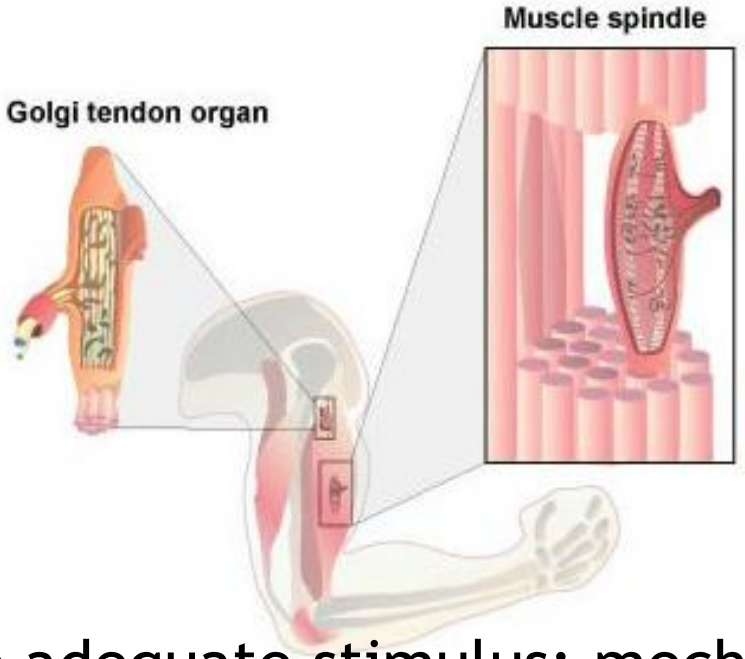


The cell bodies of the first-order somatosensory afferent neurons are located in dorsal root or cranial root ganglia

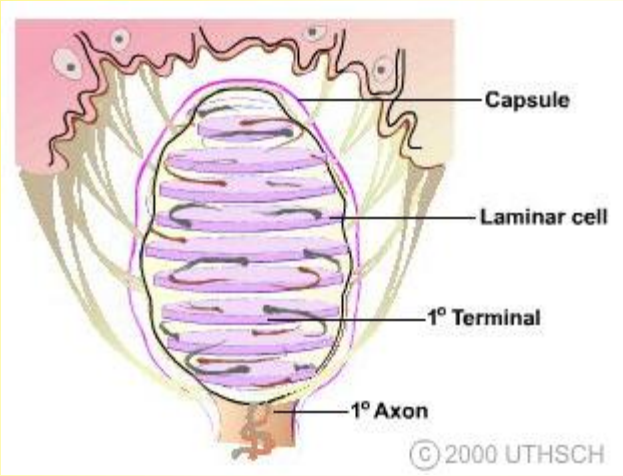


All the peripheral terminal branches of a 1° axon form only one type of somatosensory receptor.

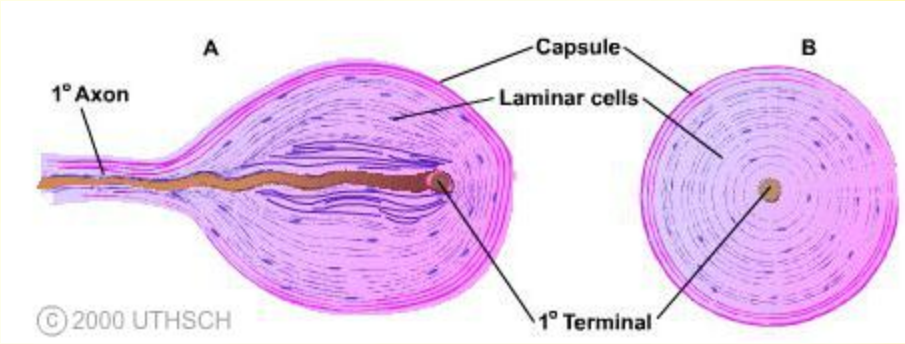




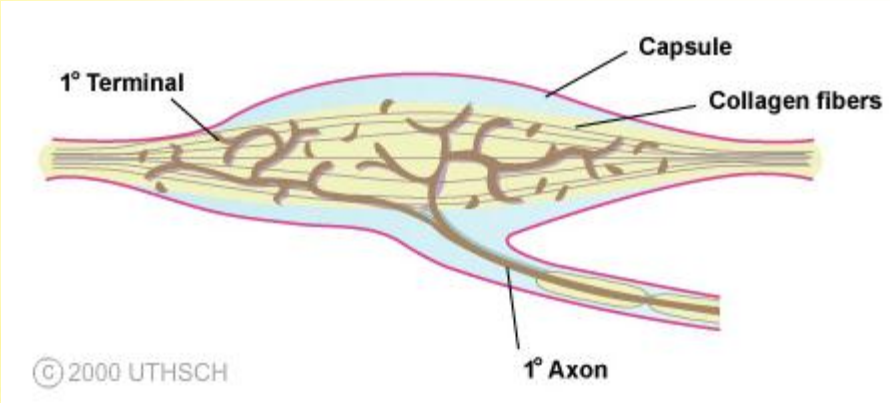
The adequate stimulus: mechanical force, temperature change, tissue damage, chemical action.



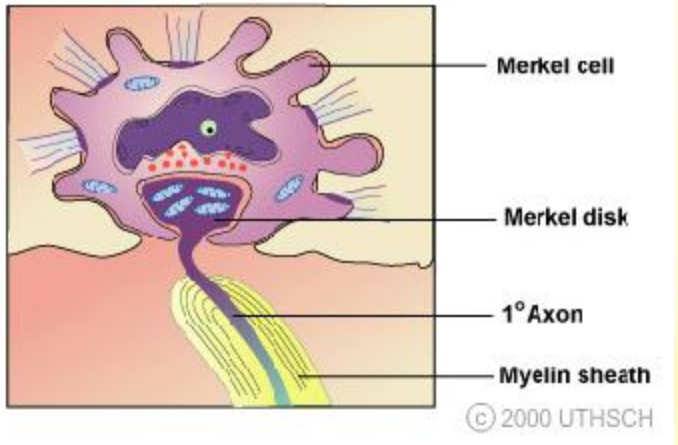
Meissner corpuscle



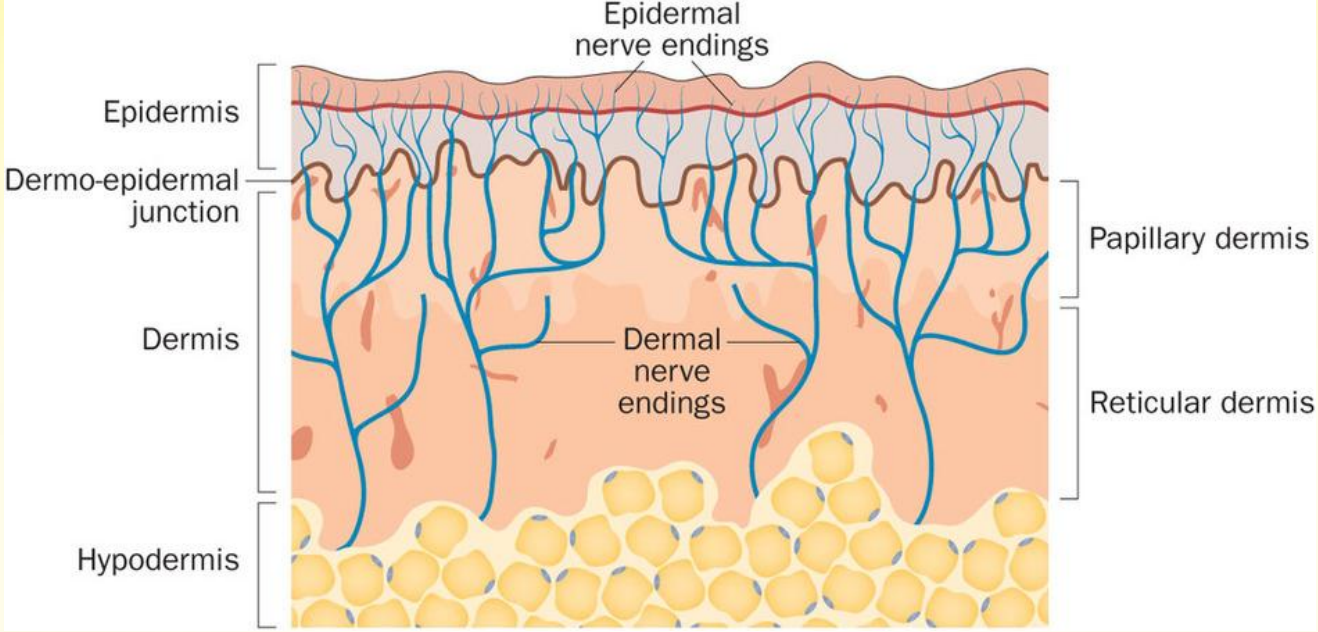
Pacinian corpuscle



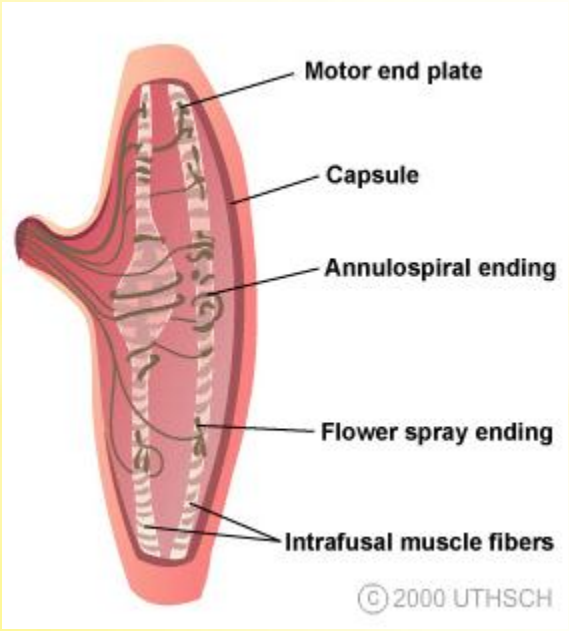
Ruffini corpuscle



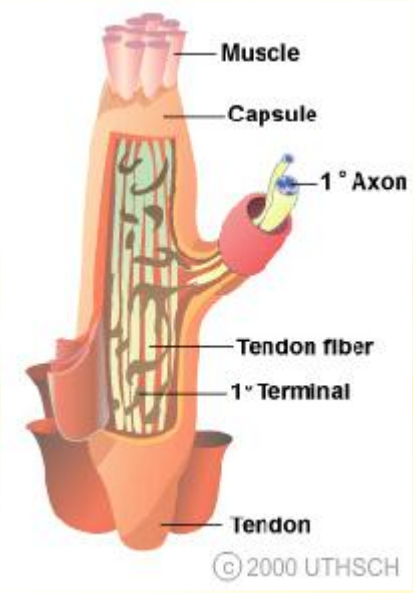
Merkel complex



Free nerve endings

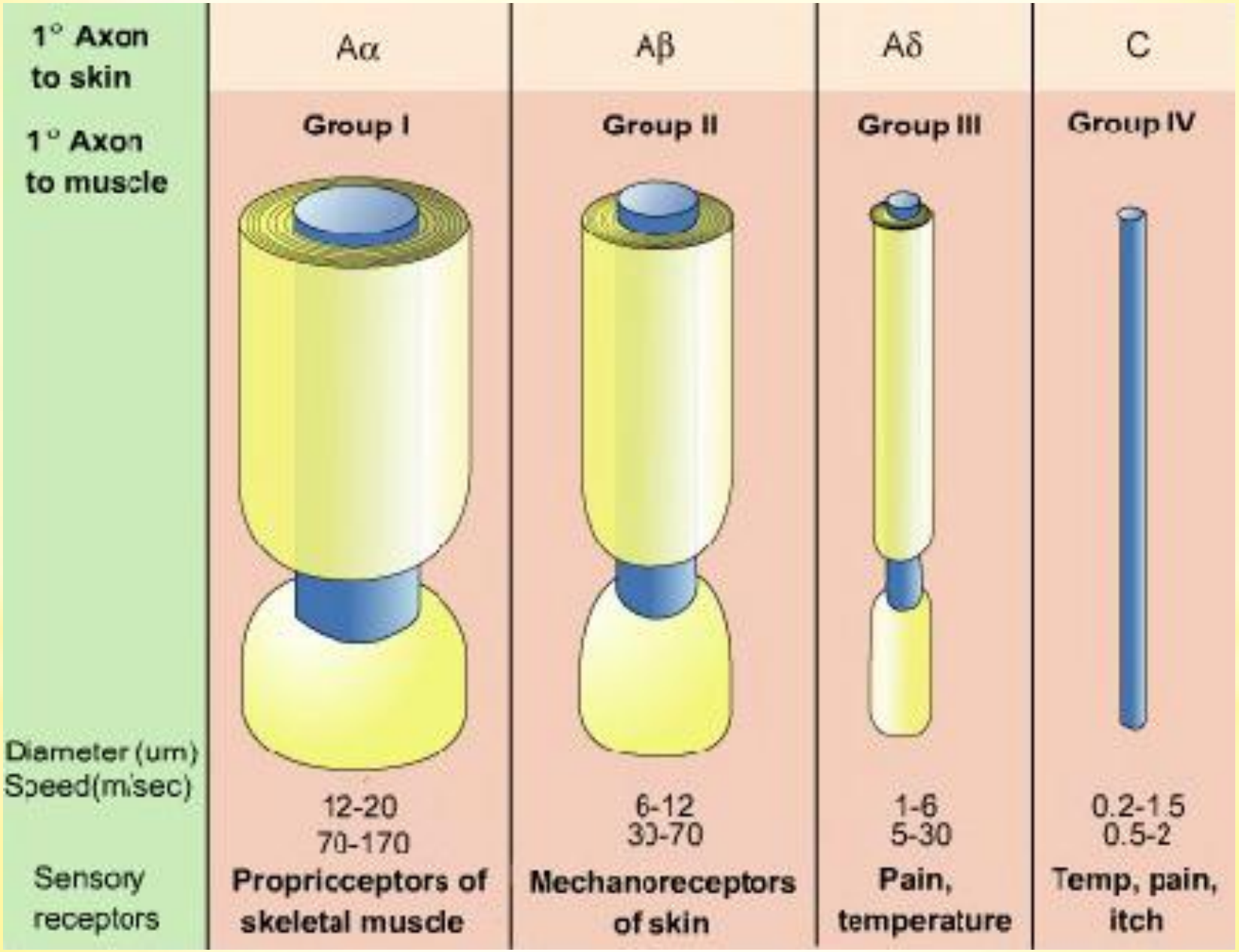


Muscle spindle

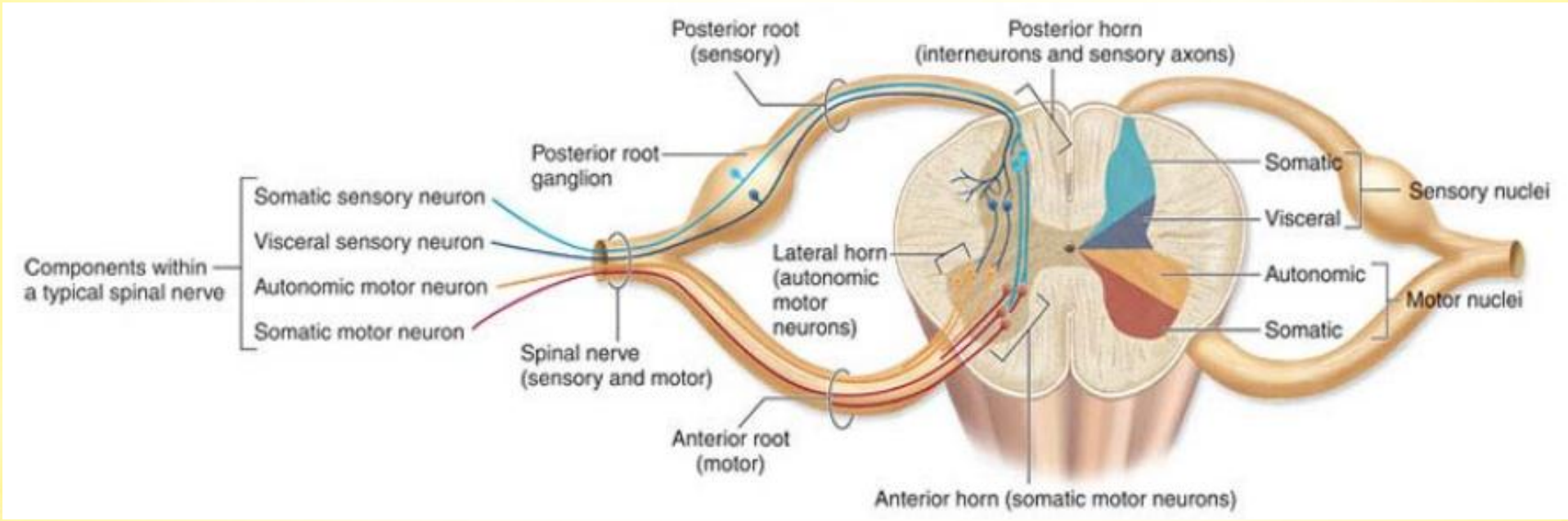


Golgi tendon organ

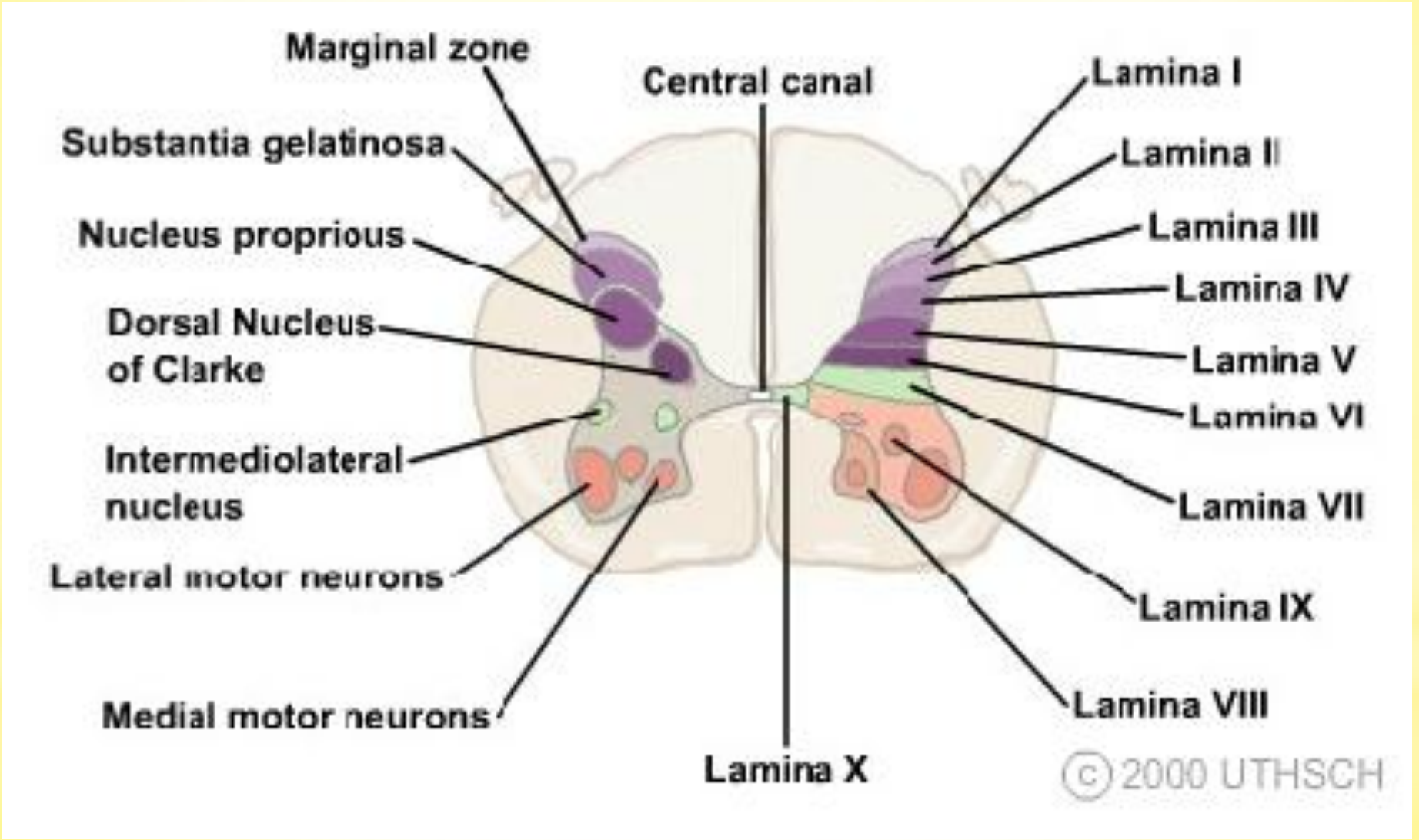
Peripheral Somatosensory Axons



The 1° afferent is a pseudounipolar neuron that has its cell body located in a peripheral (spinal or cranial) ganglion.

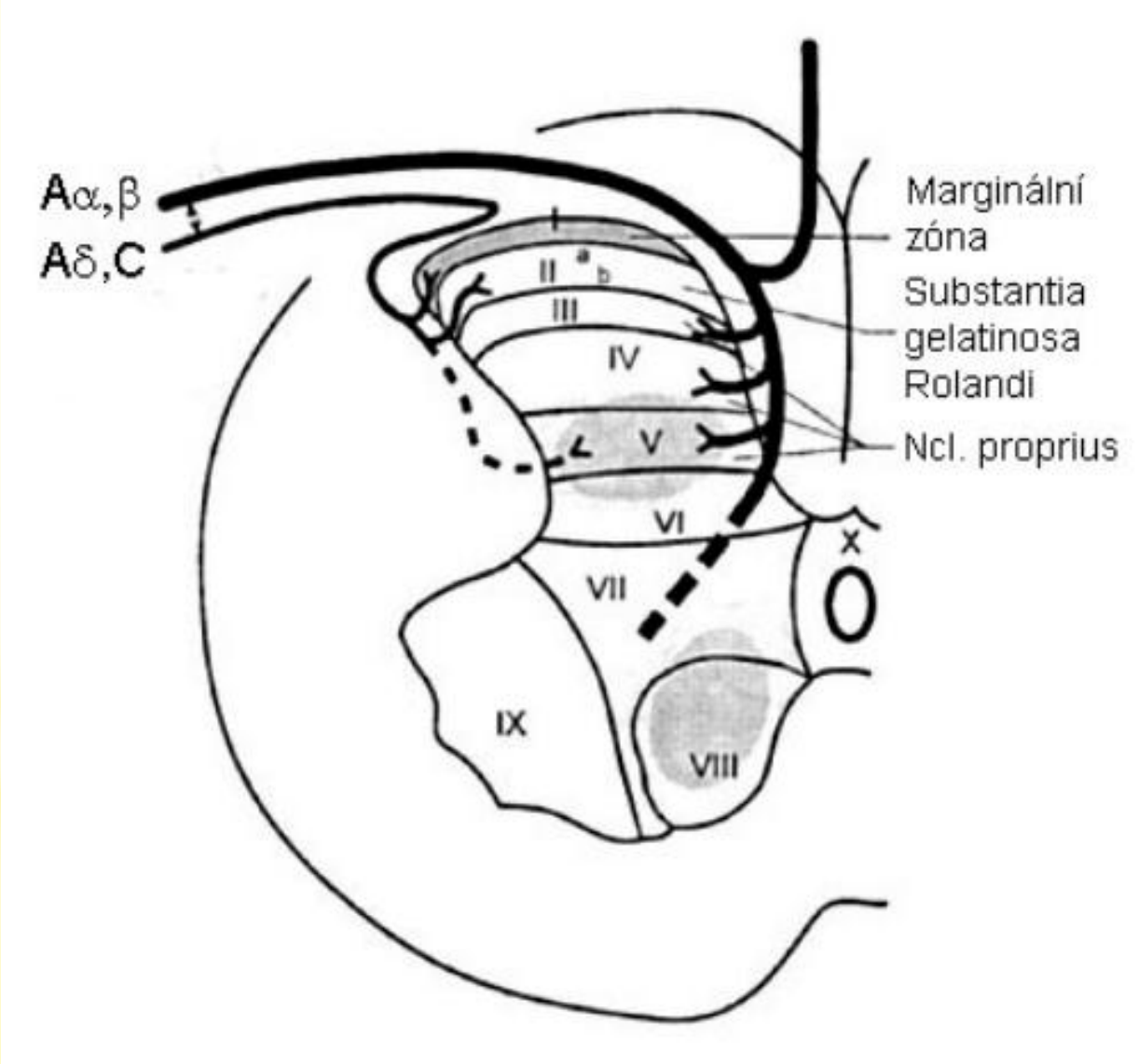


Spinal cord gray matter

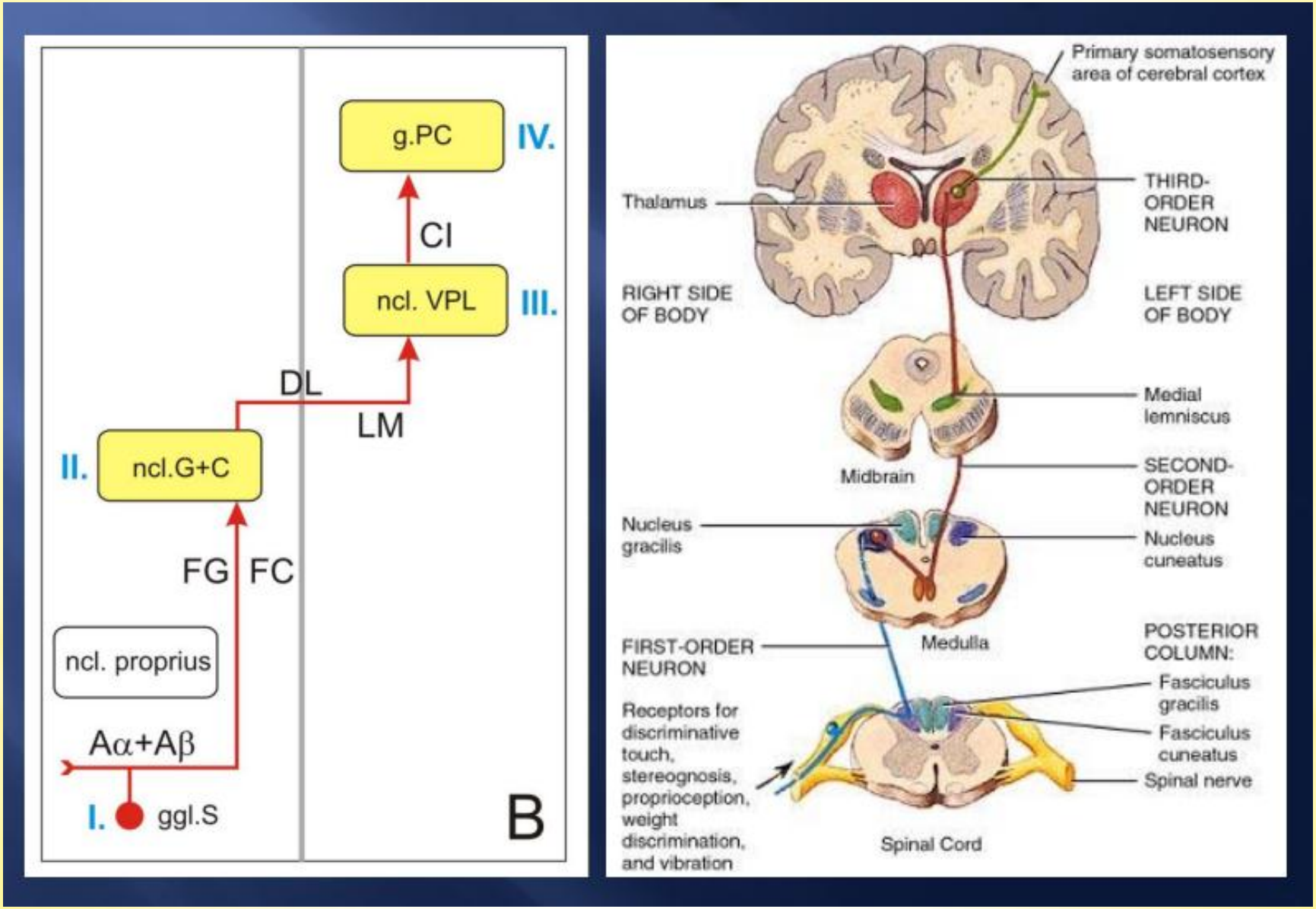


lamina (Rexed 1952)	nuclei
I	ncl. apicalis (ncl. posteromarginalis)
II + III	substantia gelatinosa Rollandi
IV + V	ncl. proprius
VI	ncl. thoracicus (Stilling – Clark‘s ncl.) C8-L3
VII	substantia intermedia
VIII	medial group of motoneurons
IX	lateral group of motoneurons
X	zona centralis, the grey substance around the central canal

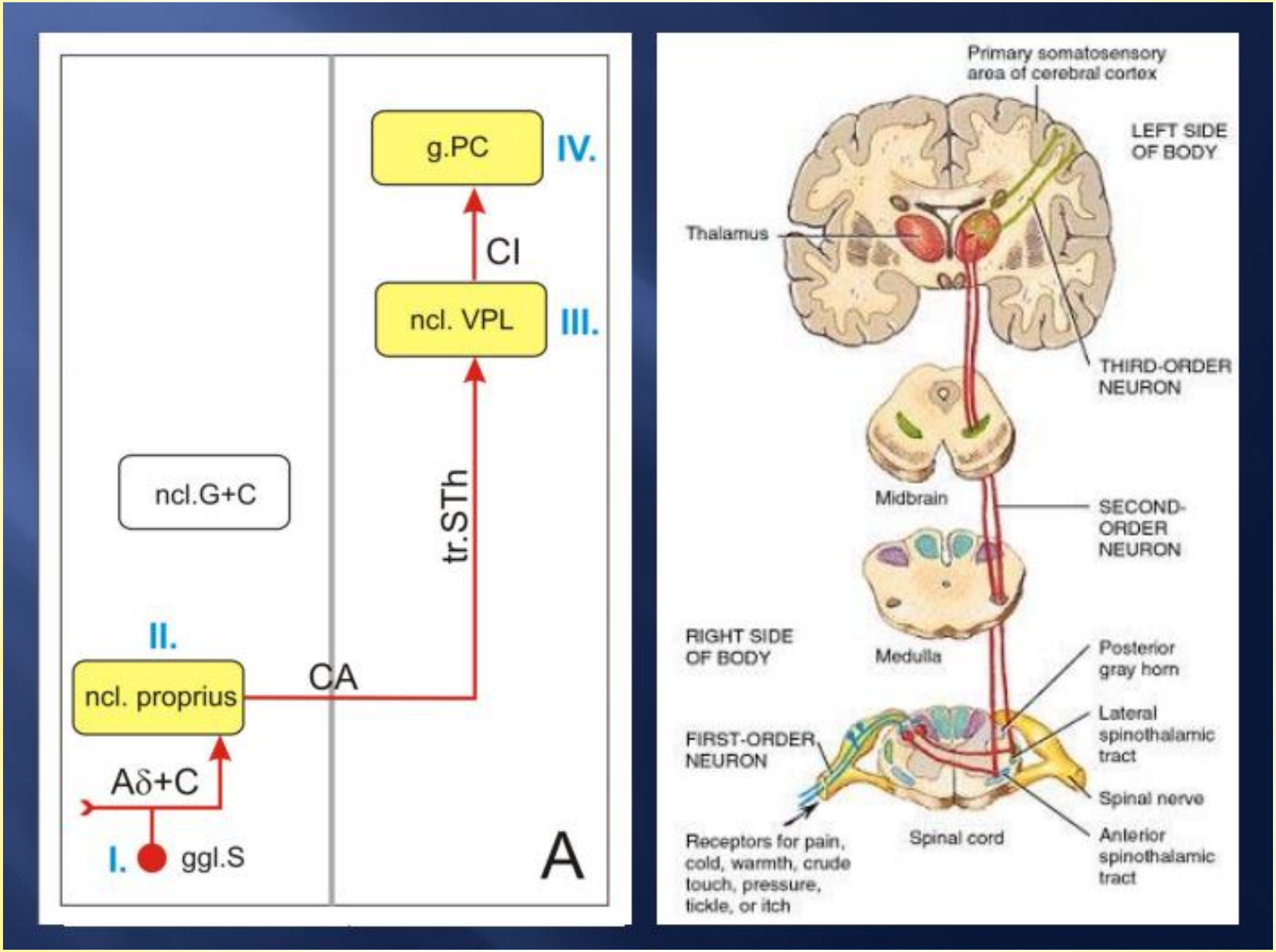
Spinal cord grey matter



Lemniscal system

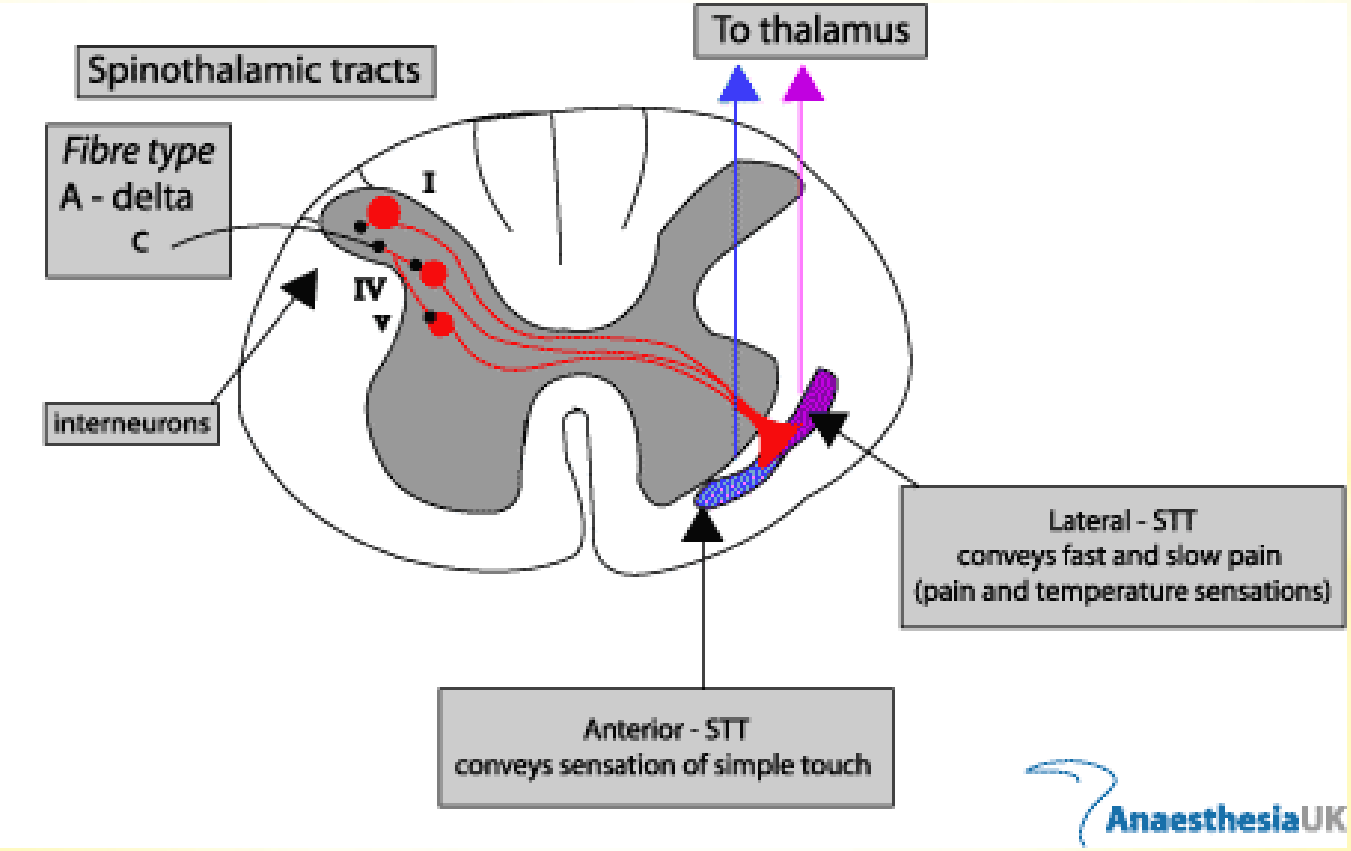


Anterolateral system



Anterolateral system

- Anterior spinothalamic tract
- Lateral spinothalamic tract



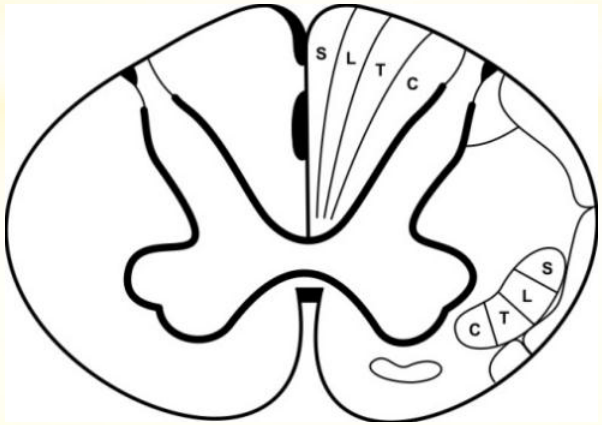
Somatosensory pathways

Lemniscal system

- younger
- perception with high discrimination ability
- discriminative touch, proprioception

Anterolateral system
(neospinothalamic pathway)

- older
- perception with low discrimination ability
- crude touch, pain and temperature



Spinoreticular tract
(paleospinothalamic pathway)

- the oldest
- **not** somatotopically arranged
- arouses the cerebral cortex (ARAS)
- report to the limbic cortex about the nature of a stimulus

Proprioception

- static component of proprioception
  - information from UL and LL mediated by one pathway

- dynamic (kinesthetic) component of proprioception
  - information from UL and LL mediated by separate pathways

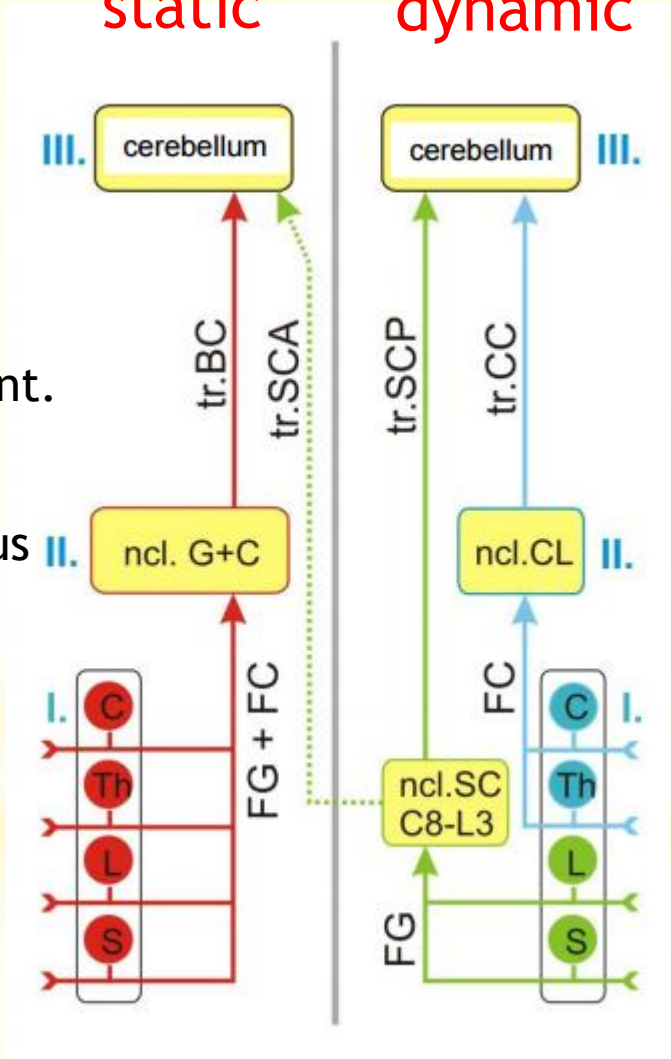
Spinal cord – reflexes

Cerebellum – coordination of movements

Cerebral cortex – consious proprioception

Non-conscious proprioception

static dynamic



tr. bulbocerebellaris

tr. spinocerebellaris ant.

ncl. gracilis et cuneatus

fasciculus gracilis et cuneatus

tr. cuneocerebellaris

tr. spinocerebellaris post.

ncl. cuneatus lateralis

fasciculus cuneatus

ncl. Stilling-Clark

fasciculus gracilis

Conscious proprioception

- static proprioception
  - DRG – fasciculus gracilis et cuneatus – gracile and cuneate (bulbar) nuclei – tr. bulbo-thalamo-corticalis – SI

- dynamic proprioception
  - LL + caudal part of trunk
    tr. spinocerebellaris post – ncl. Z (rostral to gracile ncl.) – medial lemniscus – ncl. VPL thalami – SI

  - UL + cranial part of trunk
    lateral cuneate ncl. – contralateral medial lemniscus – ncl. VPL thalami – SI

static dynamic

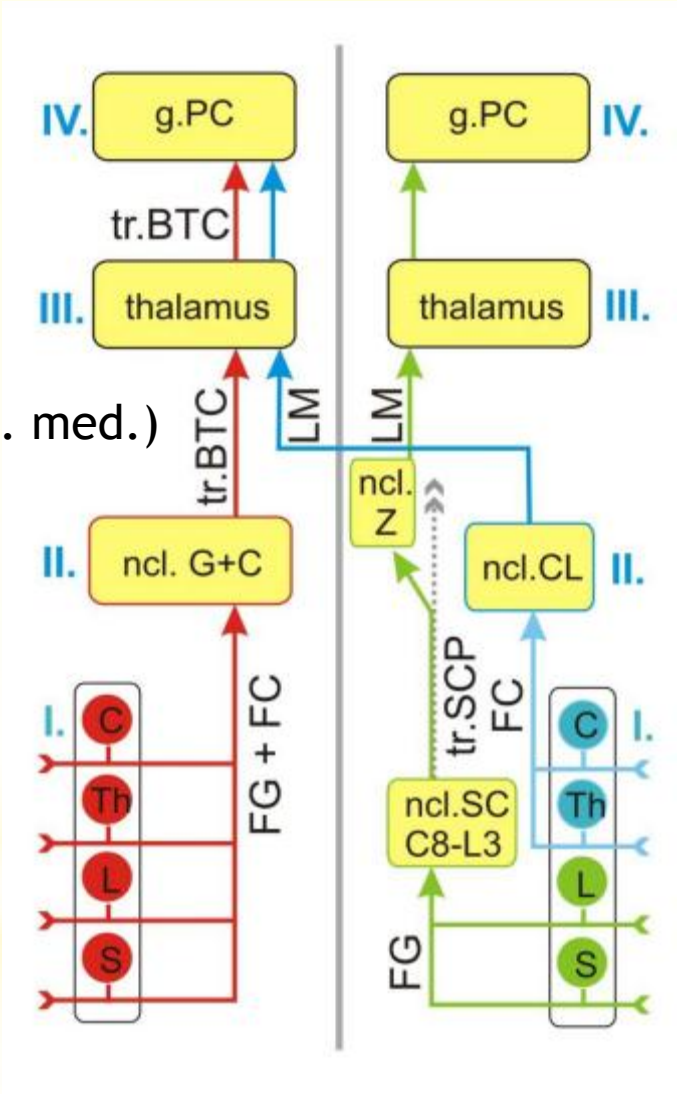
gyrus postcentralis (SI)

tr. thalamocorticalis

tr. bulbothalamicus (lemn. med.)

ncl. gracilis et cuneatus

fasciculus gracilis et cuneatus



gyrus postcentralis (SI)

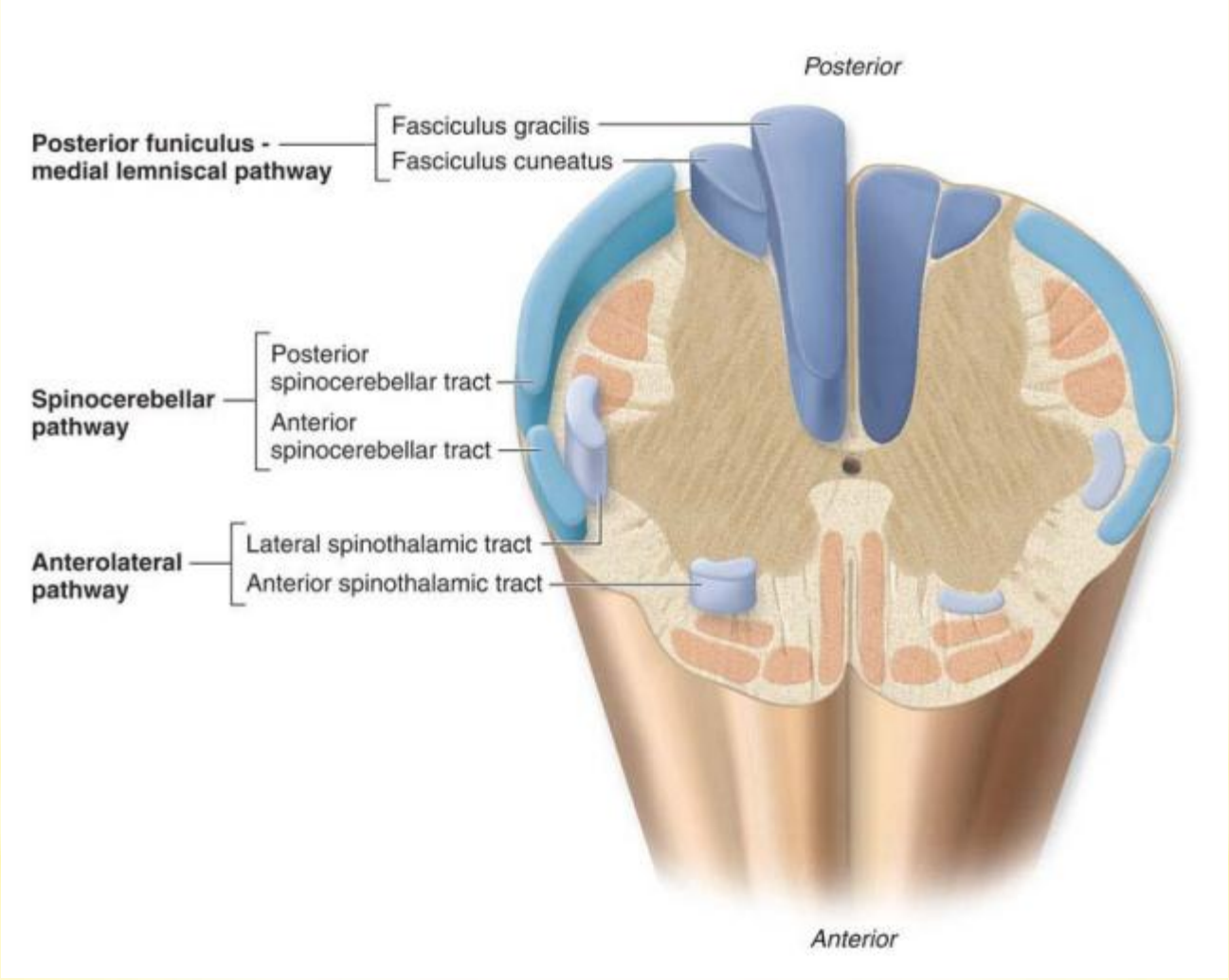
lemniscus medialis

ncl. cuneatus lateralis

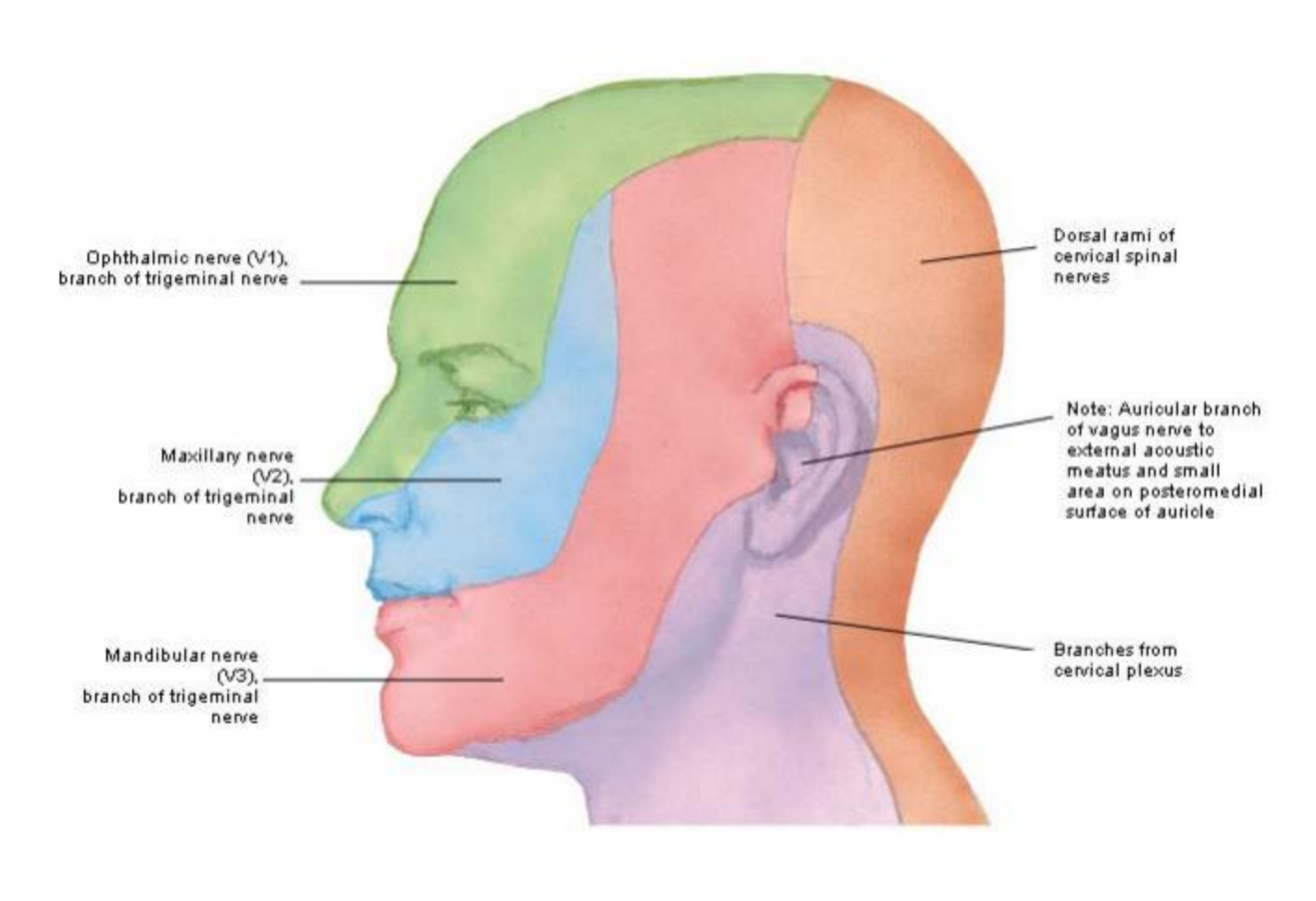
fasciculus cuneatus
tr. spinocerebell. post.

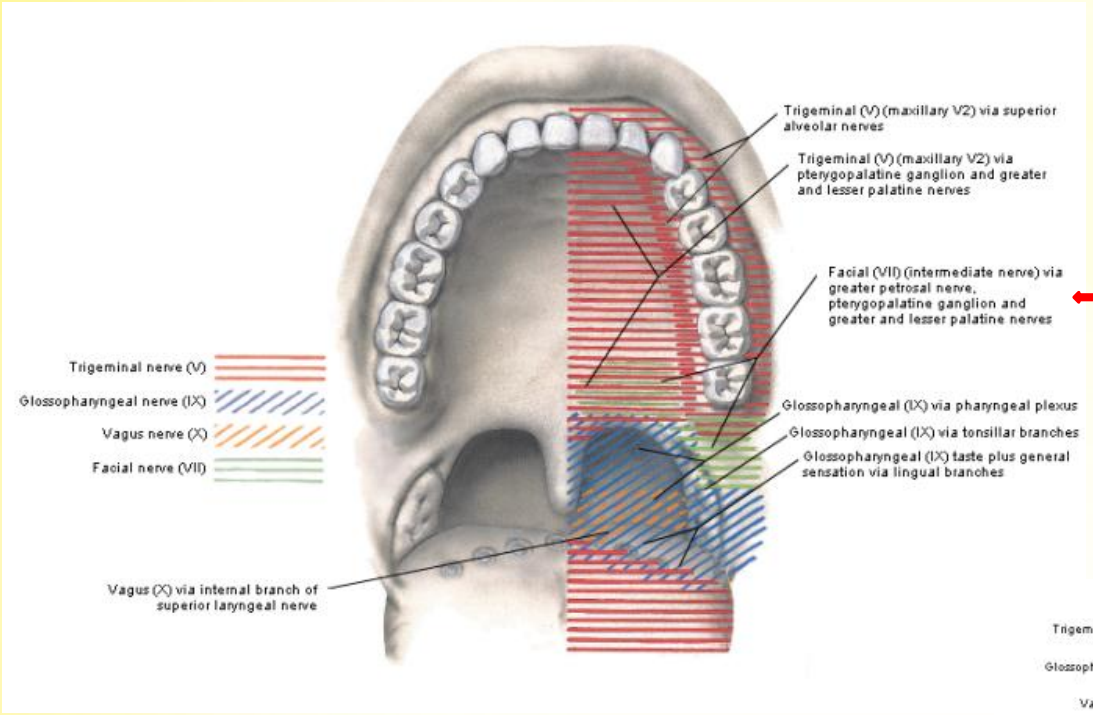
ncl. Stilling-Clark

fasciculus gracilis


Posterior
Posterior funiculus - medial lemniscal pathway
Fasciculus gracilis
Fasciculus cuneatus
Spinocerebellar pathway
Posterior spinocerebellar tract
Anterior spinocerebellar tract
Anterolateral pathway
Lateral spinothalamic tract
Anterior spinothalamic tract
Anterior

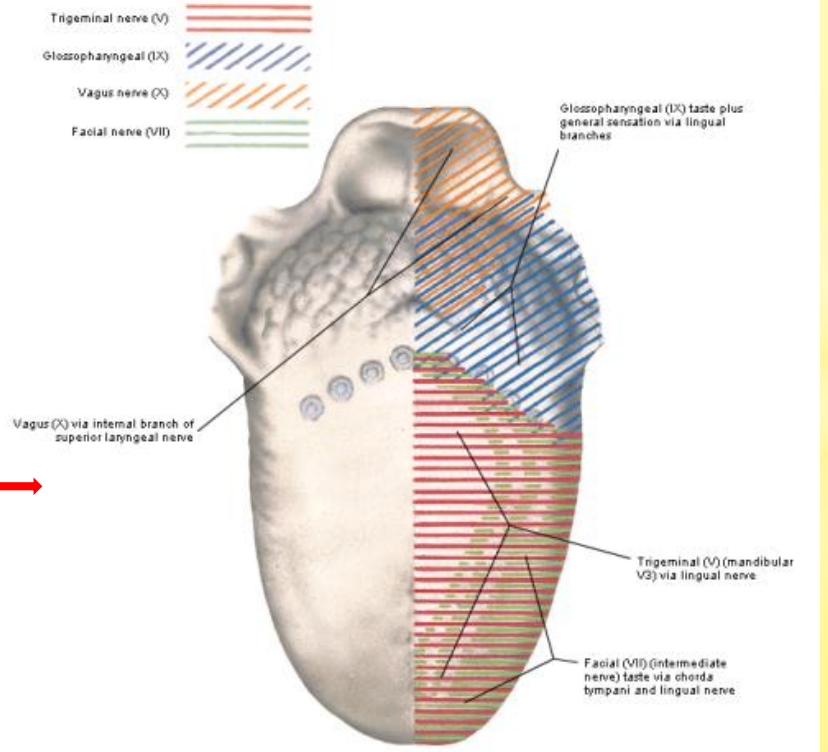
CN V


Ophthalmic nerve (V1), branch of trigeminal nerve
Maxillary nerve (V2), branch of trigeminal nerve
Mandibular nerve (V3), branch of trigeminal nerve
Dorsal rami of cervical spinal nerves
Note: Auricular branch of vagus nerve to external acoustic meatus and small area on posteromedial surface of auricle
Branches from cervical plexus



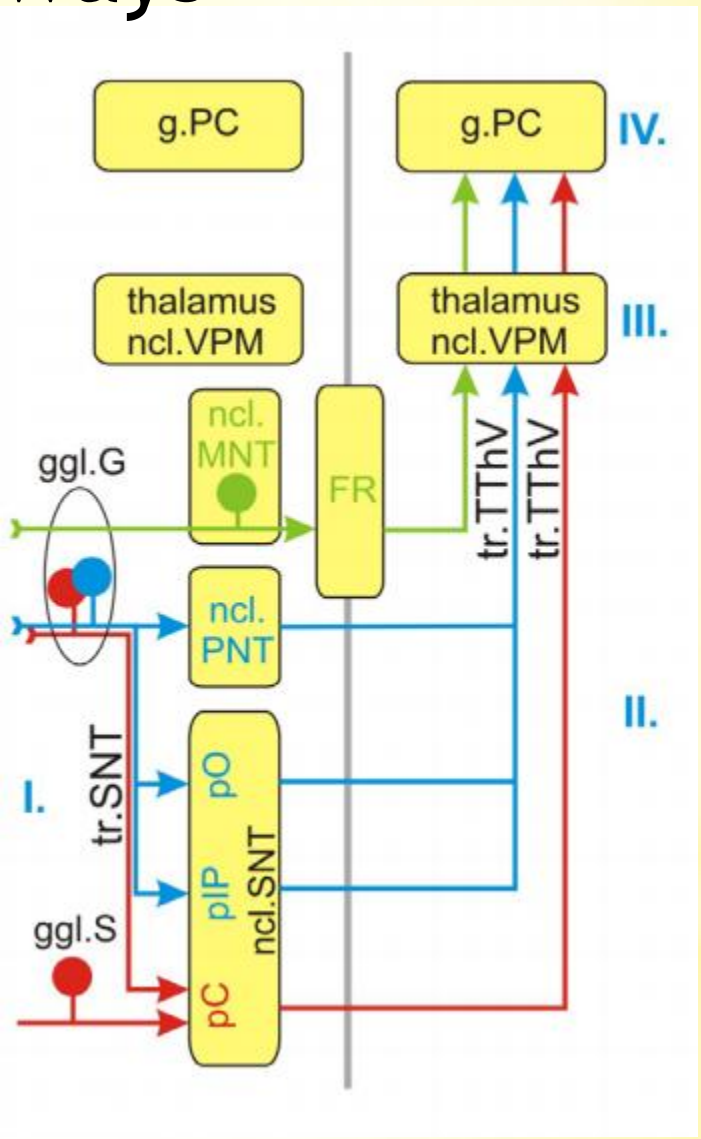
Maxillary nerve

Mandibular nerve

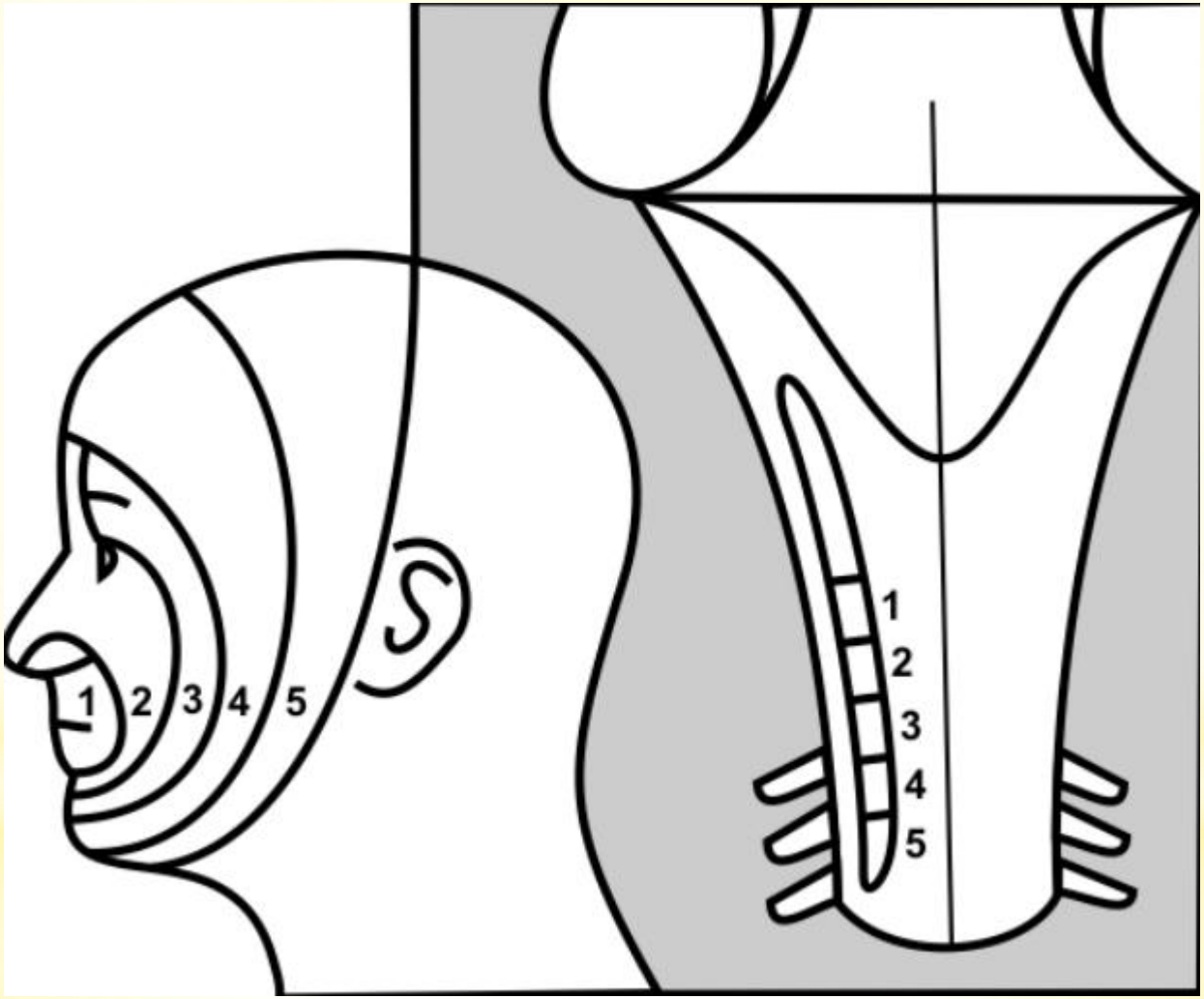


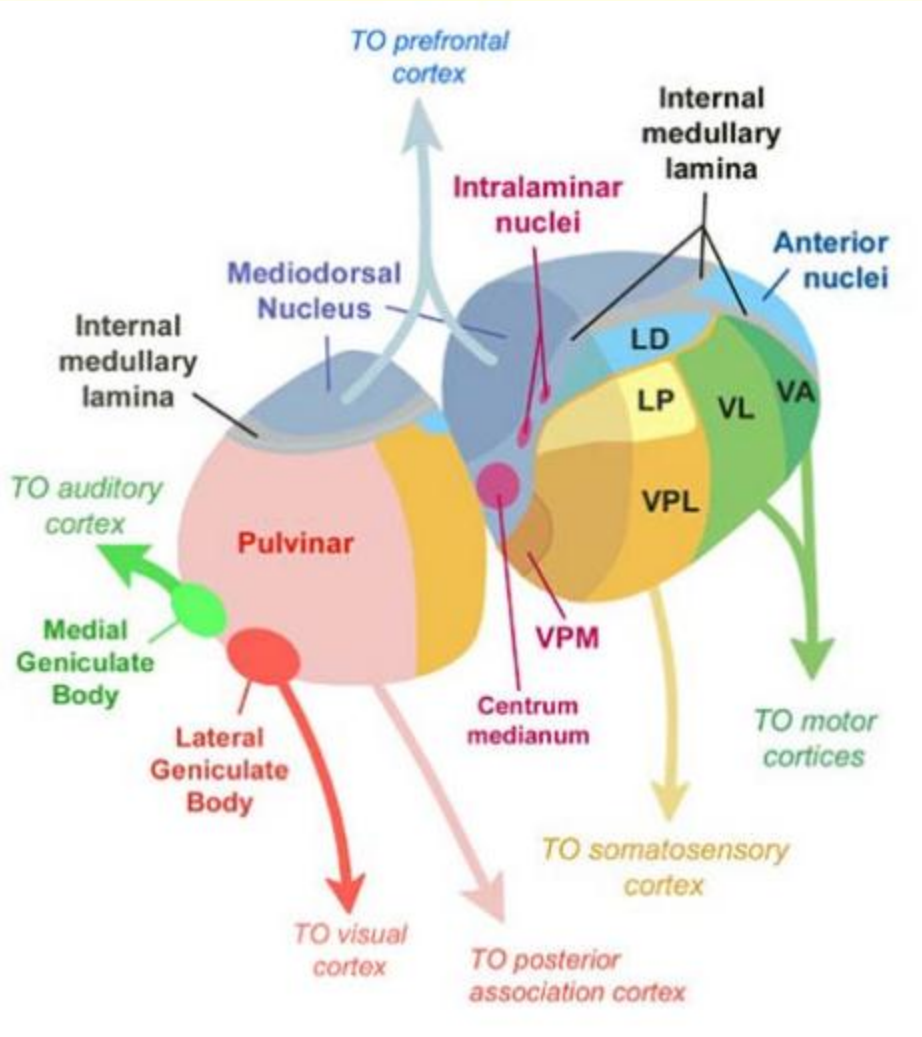
CN V - pathways

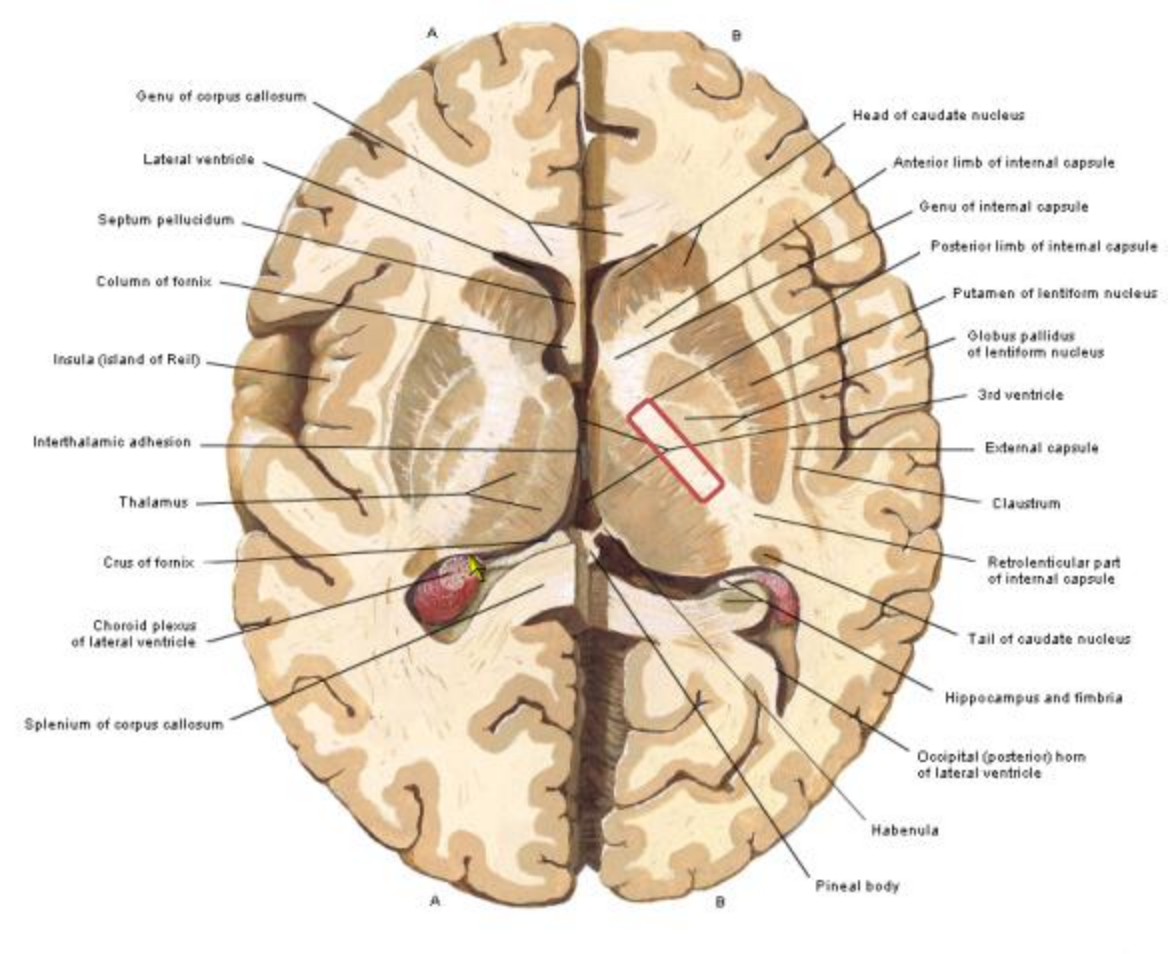
- touch, pain and temperature
- touch (discriminative touch)
- proprioception (muscles, temporomandibular joint, teeth)



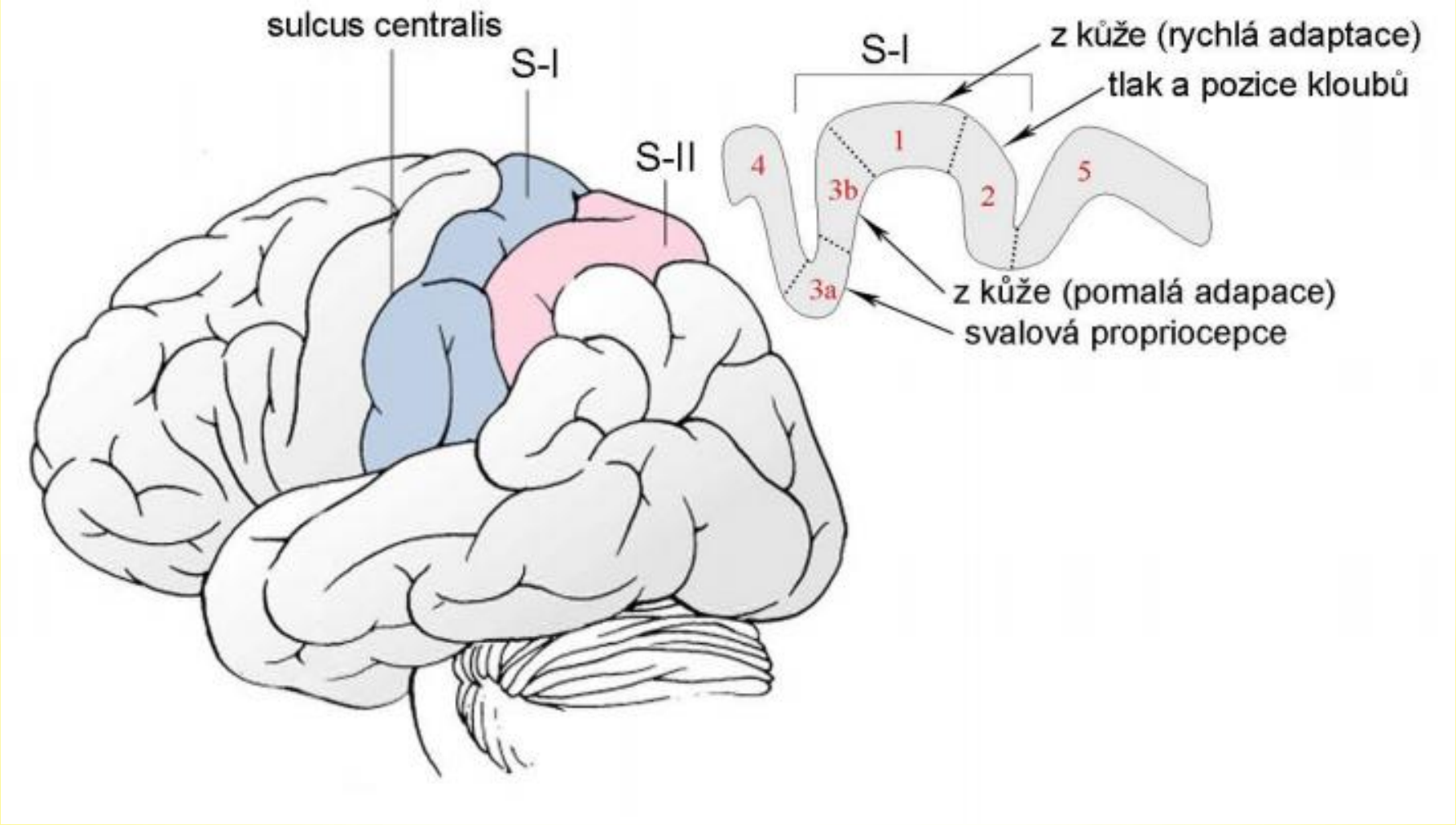
CN V - spinal nucleus

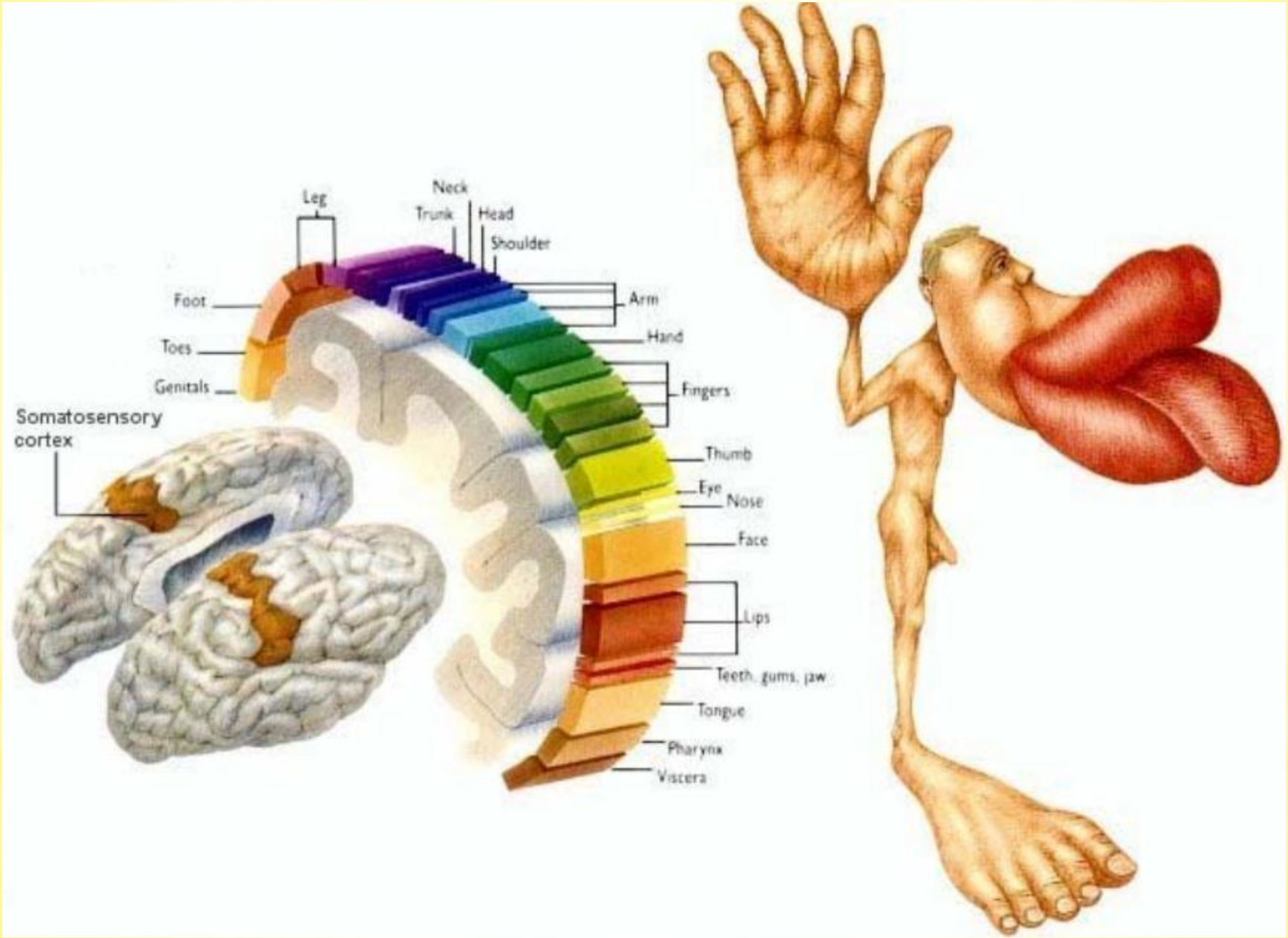



TO prefrontal cortex
Internal medullary lamina
Intralaminar nuclei
Anterior nuclei
Mediodorsal Nucleus
Internal medullary lamina
LD
LP
VL
VA
VPL
TO auditory cortex
Pulvinar
Medial Geniculate Body
VPM
Centrum medianum
TO motor cortices
Lateral Geniculate Body
TO somatosensory cortex
TO visual cortex
TO posterior association cortex

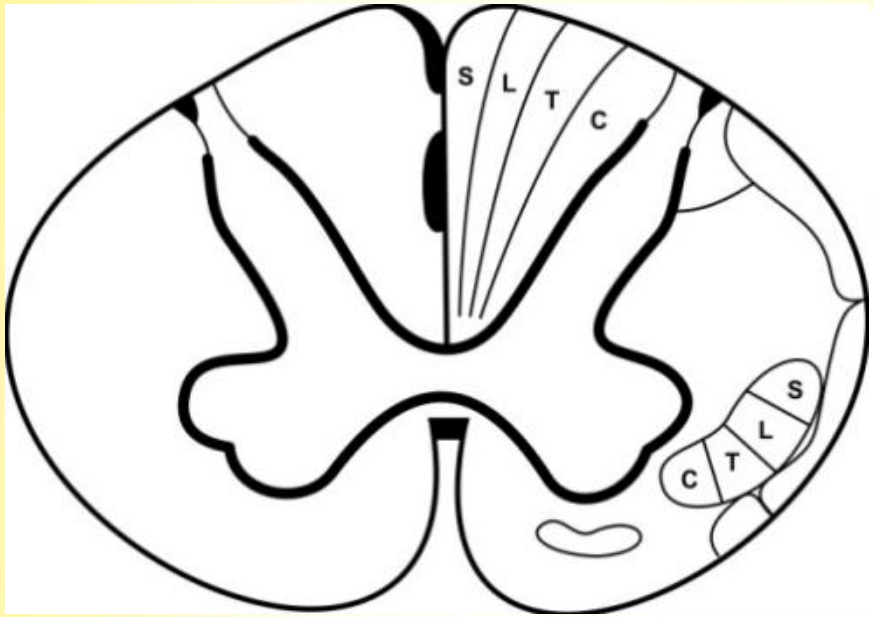

A
B
Genu of corpus callosum
Lateral ventricle
Septum pellucidum
Column of fornix
Insula (island of Reil)
Interthalamic adhesion
Thalamus
Crus of fornix
Choroid plexus of lateral ventricle
Splenium of corpus callosum
Head of caudate nucleus
Anterior limb of internal capsule
Genu of internal capsule
Posterior limb of internal capsule
Putamen of lentiform nucleus
Globus pallidus of lentiform nucleus
3rd ventricle
External capsule
Claustrum
Retrolenticular part of internal capsule
Tail of caudate nucleus
Hippocampus and fimbria
Occipital (posterior) horn of lateral ventricle
Habenula
Pineal body
A
B

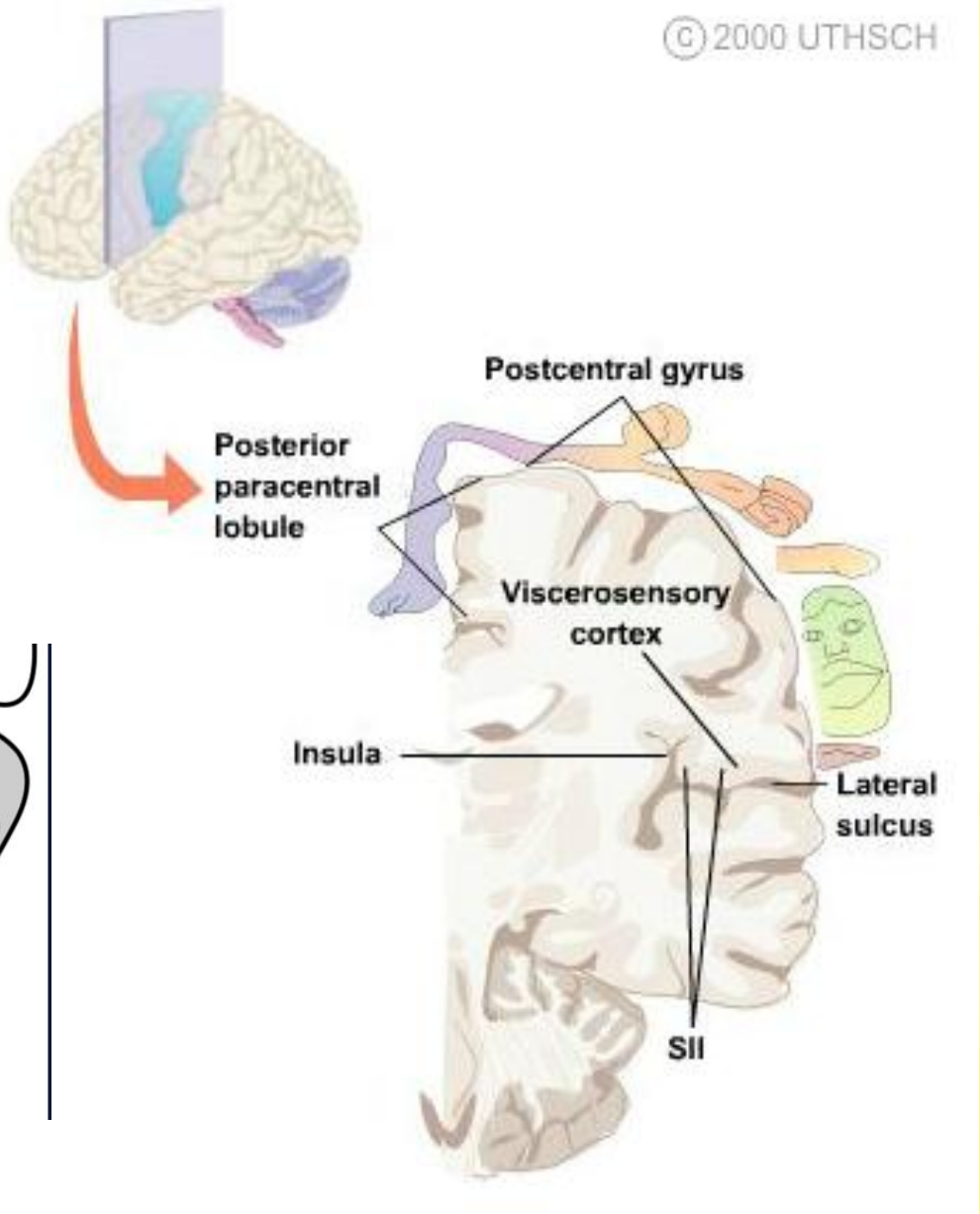
Somatosensory cortex – a. 3,1,2

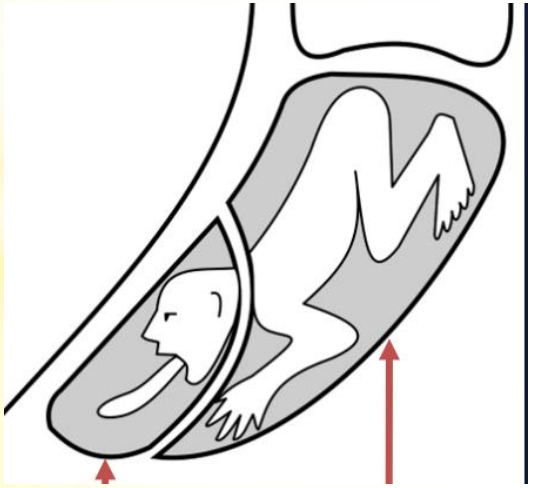



Leg
Neck
Trunk
Head
Shoulder
Foot
Arm
Toes
Hand
Genitals
Fingers
Somatosensory cortex
Thumb
Eye
Nose
Face
Lips
Teeth, gums, jaw
Tongue
Pharynx
Viscera

Somatotopic organization







VISCEROSENSORY PATHWAYS

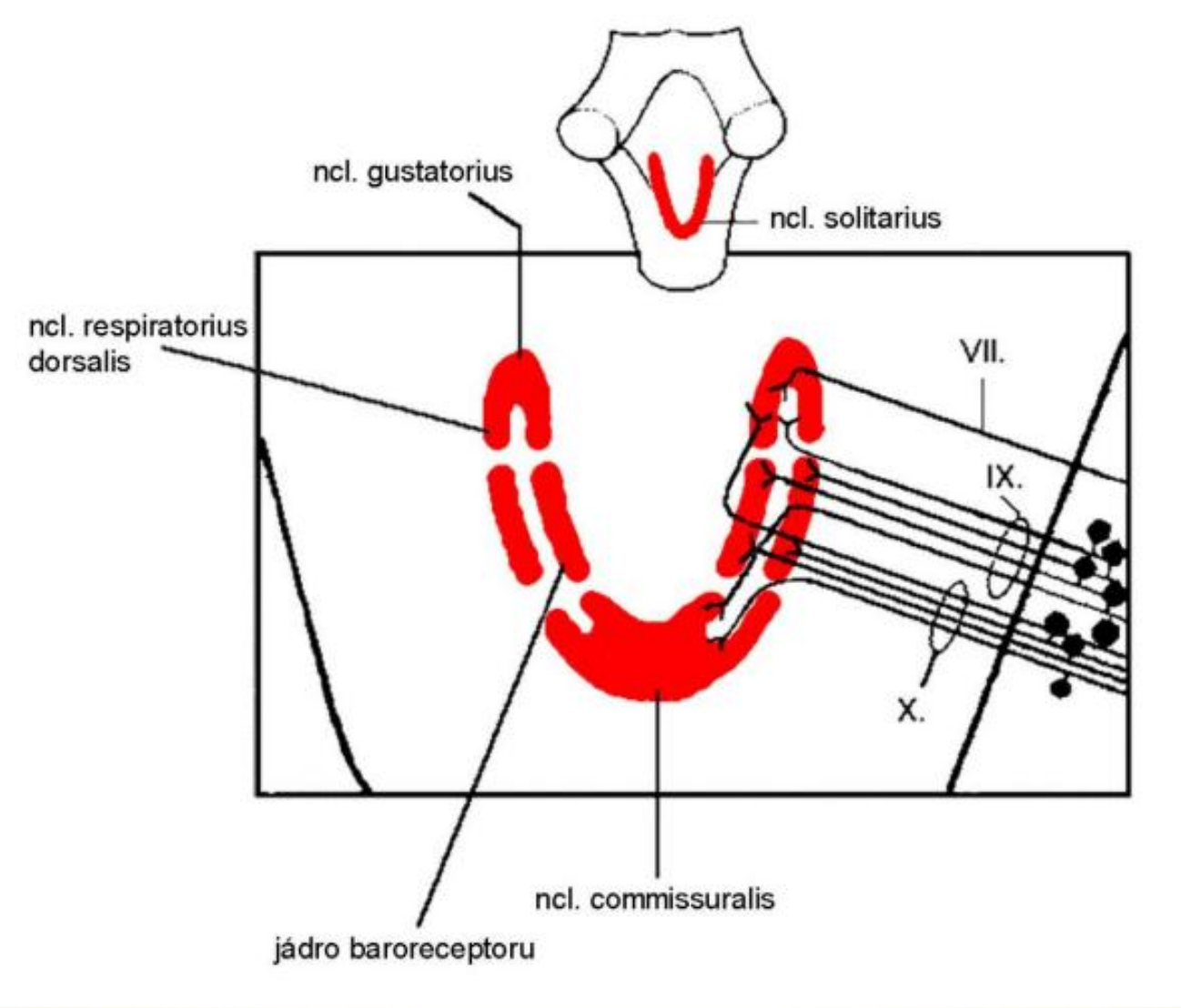
- carry information from the thoracic, abdominal and pelvic cavities, and from the cardiovascular system
- utilize autonomic pathways to reach the CNS
- participate in important reflexes
- most of them end in the hypothalamus

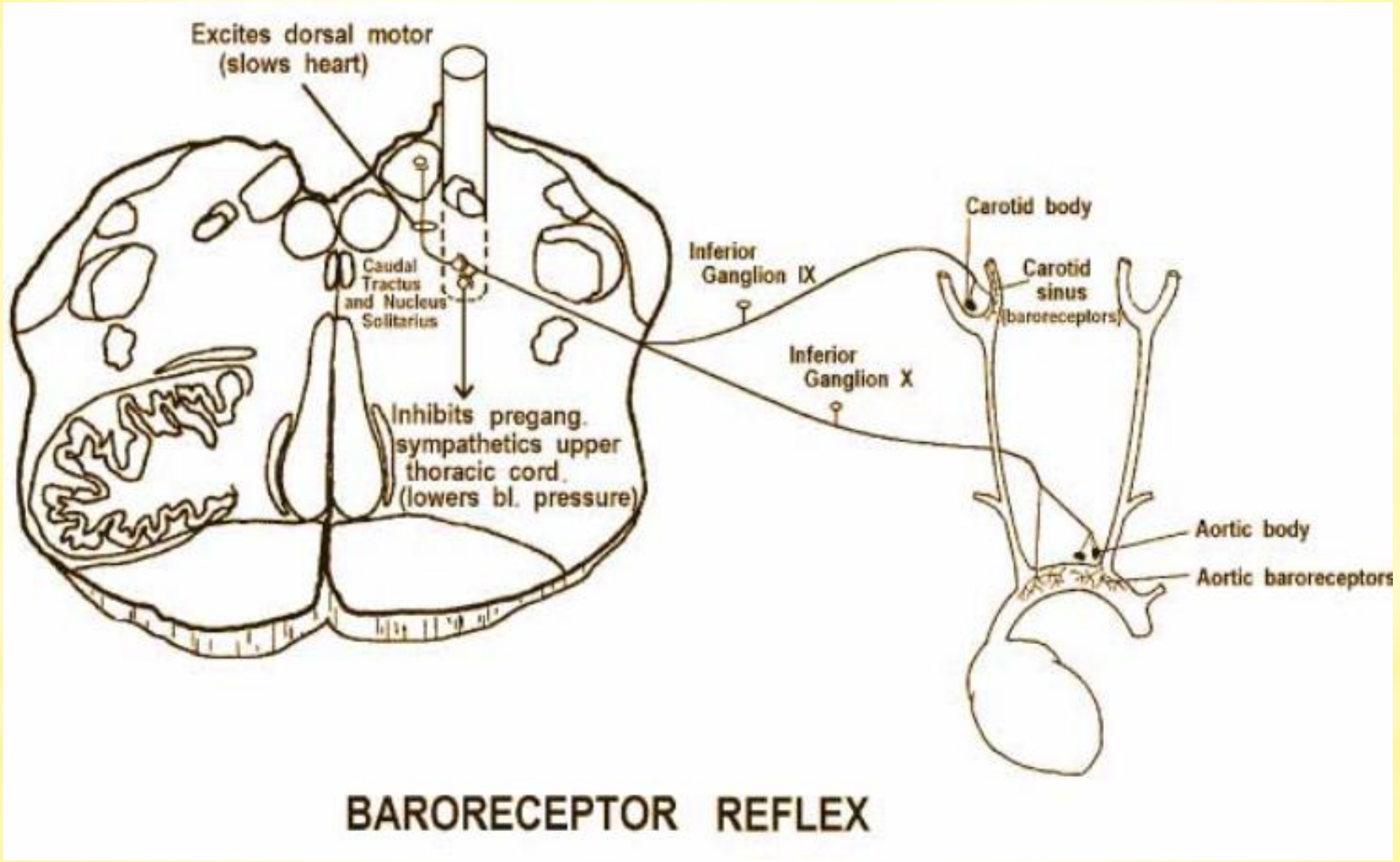
VS fibres in the parasympathetic nerves

- pseudounipolar neurons in the inferior ganglion of CN IX
  - mucosa of oropharynx → ncl. commissuralis (reflex contractions of pharyngeal muscles during swallowing)
  - carotid sinus (baroreceptor)
  - carotid body (chemoreceptor) → dorsal respiratory ncl.

- pseudounipolar neurons in the inferior ganglion of CN X
  - heart, respiratory organs and GIT → ncl. commissuralis
  - information about acidity of gastric juice → lateral hypothalamus (apestat)
  - aortic arch (baroreceptor)

Solitary nucleus (ncl. of solitary tract)

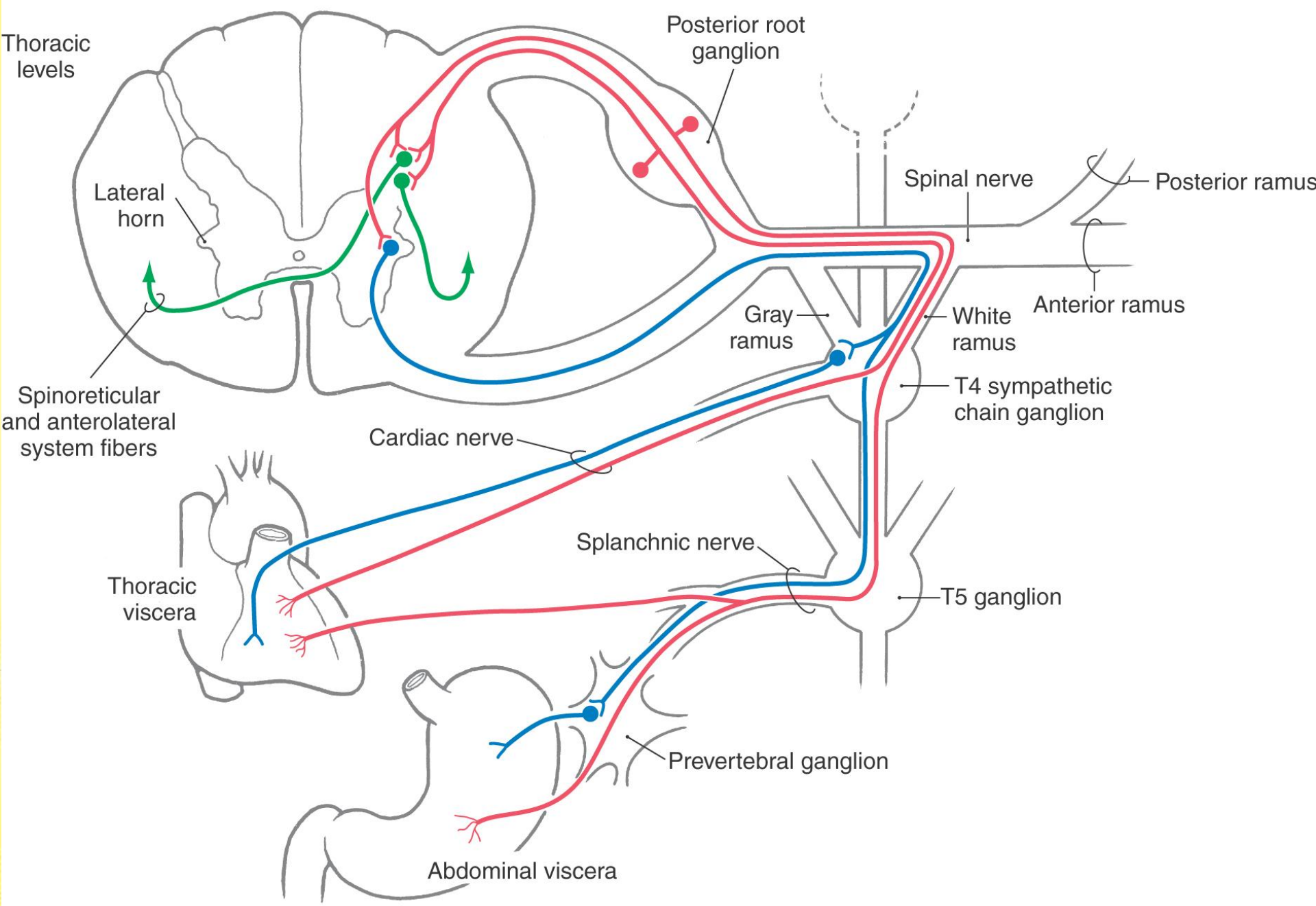




BARORECEPTOR REFLEX

VS fibres in the sympathetic system

- information about pressure, vibrations, temperature and pain from visceral organs
- dorsal root ganglion
- ncl. proprius
- tr. spinothalamicus → ncl. ventralis posterolateralis thalami → somesthetic cortex
- tr. spinoreticularis


Thoracic levels
Posterior root ganglion
Lateral horn
Spinal nerve
Posterior ramus
Anterior ramus
Gray ramus
White ramus
T4 sympathetic chain ganglion
Spinoreticular and anterolateral system fibers
Cardiac nerve
Splanchnic nerve
Thoracic viscera
T5 ganglion
Prevertebral ganglion
Abdominal viscera

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