Black = slides

Red = Doctor notes

Blue = Extra information for better understanding

Visceral pain

- Essentially all visceral pain that originates in the thoracic and abdominal cavities is transmitted through small type C pain fibers and, therefore, can transmit only the chronic, aching, suffering type of pain.

Visceral pain almost always slow and transmitted by small type c pain fibers which cause doll, aching pain

- One of the most important differences between surface pain and visceral pain is that highly localized types of damage to the viscera seldom cause severe pain.

and visceral pain is difficult to localise according to the less dense nociceptors if compared to the cutaneous one

- Conversely, any stimulus that causes diffuse stimulation of pain nerve endings throughout a viscus causes pain that can be severe.

- Any stimulus that excites pain nerve endings in diffuse areas of the viscera can cause visceral pain.

One characteristic of the visceral pain is that we must have diffuse stimulation of the nociceptors to have stimulus with good intensity , for example if we have perforation of the wall of the stomach, or if we have cut parts of the intestine the pain isn't painful as the pain that is acquired through the ischemia of a large portion of the large intestine , so the more diffuse the stimulus the more intense is the visceral pain

Visceral pain

- Such stimuli include ischemia of visceral tissue, chemical damage to the surfaces of the viscera, spasm of the smooth muscle of a hollow viscus, excess distention of a hollow viscus, and stretching of the connective tissue surrounding or within the viscus.

Visceral pain generally caused by chemical stimulus , such as ischemia: active nociceptors by decreasing blood supply so the tissue starts to die and many chemicals released such as potassium and proteolytic enzymes, and whatever the chemical that will stimulate the nociceptors , chemical damage to surface of the viscera such as perforation of the stomach will cause the release of gastric acids to the peritoneum and surfaces of the viscera in the abdomen and that will cause activation and stimulation of the nociceptors , also spasm in hollow structures (such as ureter) maybe

it can cause increasing in the metabolic rate because of contraction and activation of mechano-sensetive nociceptors and may press the blood vessel supply the structure and affect the blood supply so then we will have release of the chemicals, also distension of the hollow structures (such as bowel) will cause distension in the proximal part and activate the nociceptors so many stimuli can induce visceral pain.

Visceral pain

- A few visceral areas are almost completely insensitive to pain of any type.
- These areas include the parenchyma of the liver and the alveoli of the lungs
- Yet, the liver capsule is extremely sensitive to both direct trauma and stretch, and the bile ducts are also sensitive to pain. In the lungs, even though the alveoli are insensitive, both the bronchi and the parietal pleura are very sensitive to pain

Connective tissue membranes like the perosteum , parietal peritoneum , parietal pericardium , parietal pleura and liver capsule are all extensively innervated with nociceptors (the pain we feel because of bone fractures are caused by the periosteum not the bone it self)

Visceral Pain

- True visceral pain is transmitted via pain sensory fibers in the autonomic nerve bundles, and the sensations are referred to surface areas of the body that are often far from the painful organ.

- Pain from the viscera is frequently localized to two surface areas of the body at the same time because of the dual transmission of pain through the referred visceral pathway and the direct parietal pathway.

Extra slide for better explanation

According to the embryogenesis , visceral organs and dermatomes share the same 2nd order neurons (same spinal segment) in which they synapse , according to that this 2nd order neuron can receive signals from two different sources : autonomic nerves from the visceral organ , somatic nerves from dermatomes (skin) , then neural pathway continues to reach the brain cortex so the brain can determine the area in which signals came from , according to that if the brain refer the signal to the visceral organ itself we name this as true visceral pain this pain can be described as deep pain in a diffuse (non localized) area related to this viscera , on the other hand if the brain determine the source of the signal from dermatomes then this pain called referred pain , next figure will show dermatomes of the body

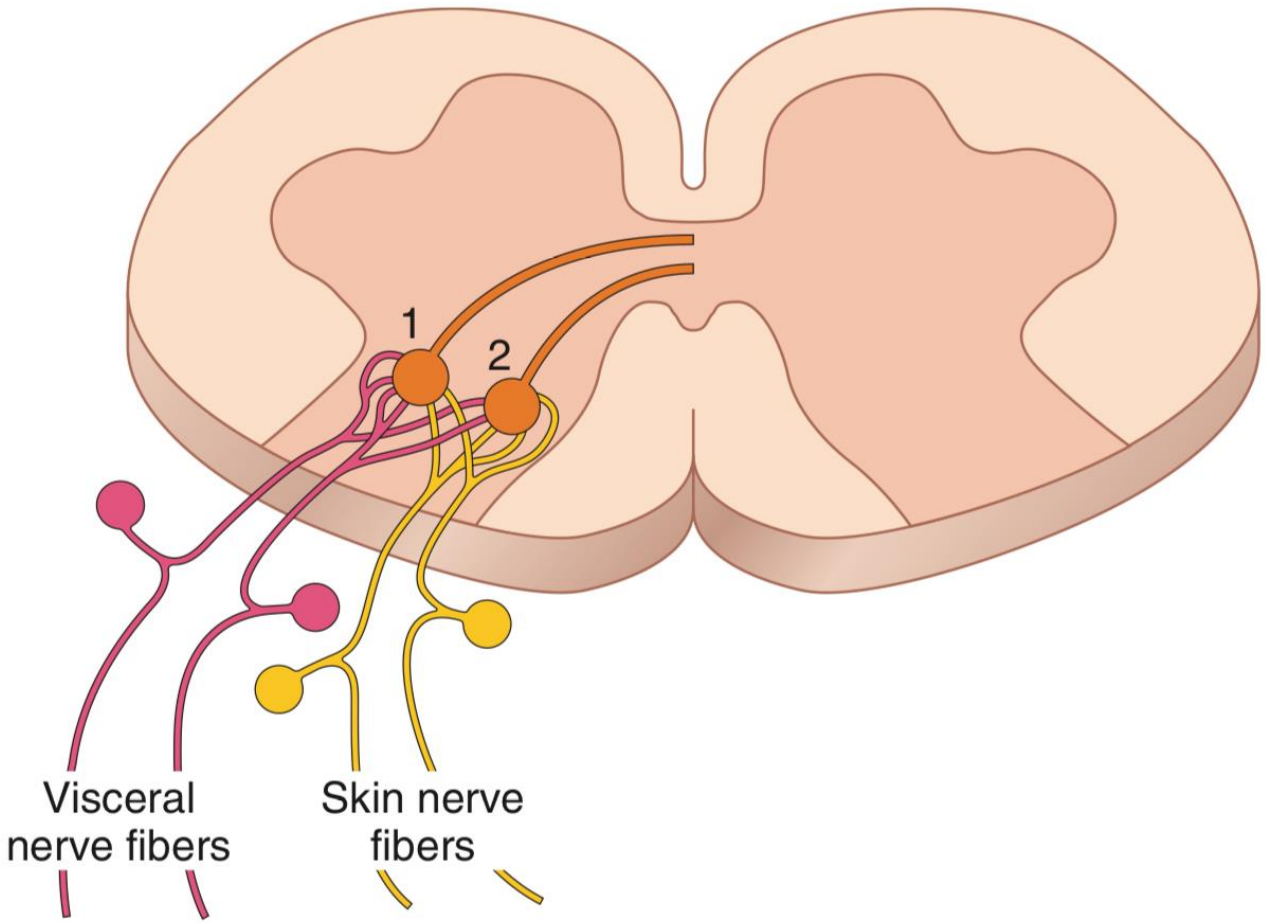


Figure 49-5. Mechanism of referred pain and referred hyperalgesia. Neurons 1 and 2 receive pain signals from the skin as well as from the viscera.

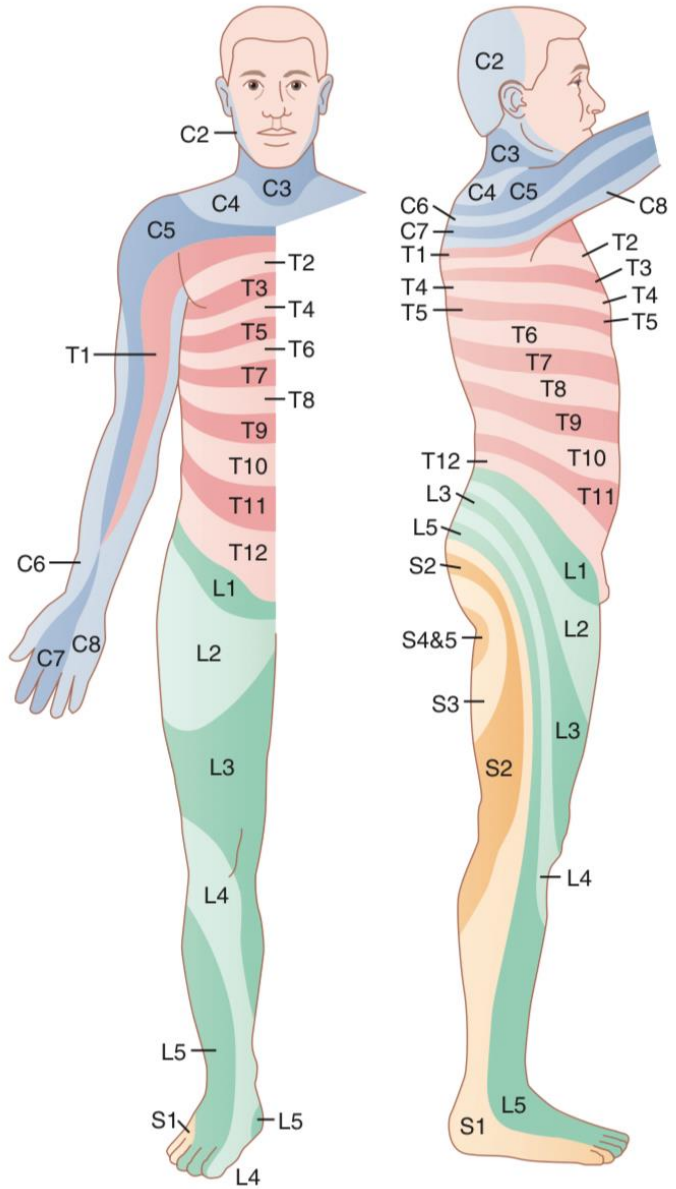


Figure 48-14. Dermatomes. *(Modified from Grinker RR, Sahs AL: Neurology, 6th ed. Springfield, Ill: Charles C. Thomas, 1966.)*

Parietal pain

- When a disease affects a viscus, the disease process often spreads to the parietal peritoneum, pleura, or pericardium.

- These parietal surfaces, like the skin, are supplied with extensive pain innervation from the peripheral spinal nerves.

- parietal sensations are conducted directly into local spinal nerves from the parietal peritoneum, pleura, or pericardium, and these sensations are usually localized directly over the painful area and sharp.

Localization of visceral and parietal pain

- Sensations from the abdomen and thorax are transmitted through two pathways to the central nervous system, the true visceral pathway and the parietal pathway.

- True visceral pain is transmitted via pain sensory fibers in the autonomic nerve bundles, and the sensations are referred to surface areas of the body that are often far from the painful organ.

- Conversely, parietal sensations are usually localized directly over the painful area.

According to the previous information..

Appendix is located in the right lower quadrant, appendix pain can be transmitted by two pathways, visceral and parietal.. , in case of appendicitis early stage the pain is transmitted mainly by visceral pathway which can cause true visceral pain or referred pain , after the progression of the disease pain can be transmitted through precisely-localized parietal pathway of parietal peritoneum

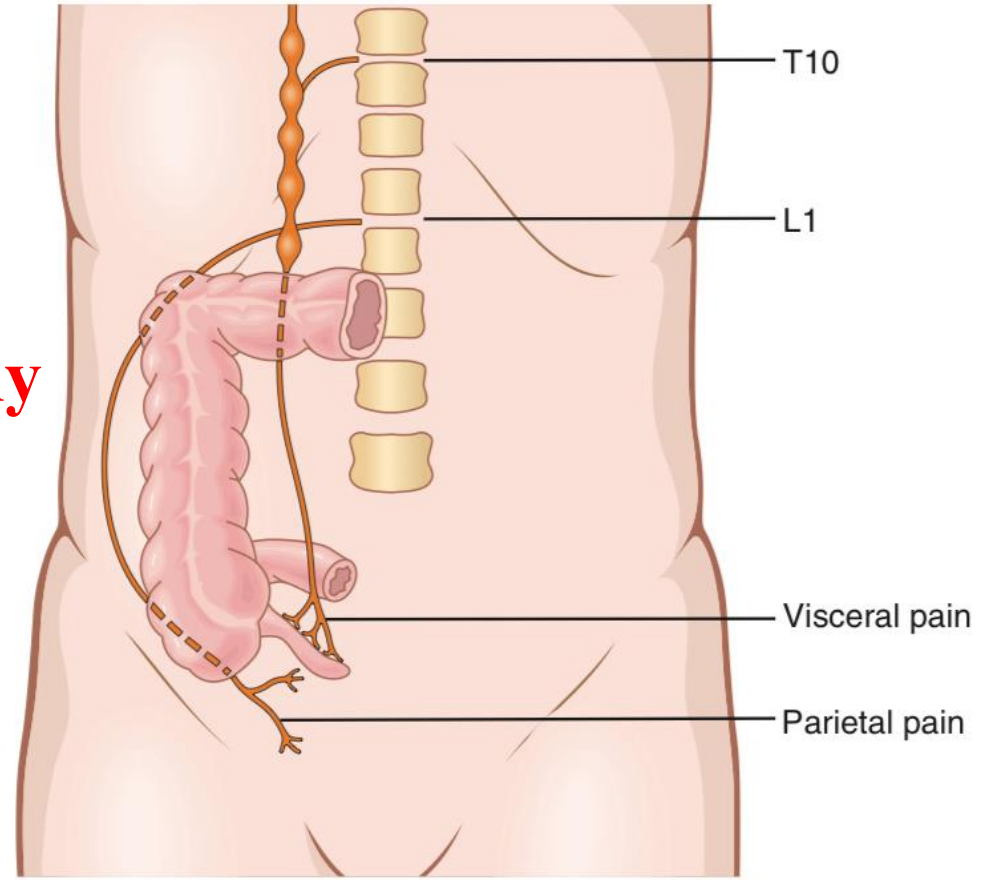


Figure 49-7. Visceral and parietal transmission of pain signals from the appendix.

Referred pain

- When visceral pain is referred to the surface of the body, the person generally localizes it in the **dermatomal** segment from which the visceral organ originated in the embryo, not necessarily where the visceral organ now lies.

- For example, the heart originated in the neck and upper thorax, so the heart's visceral pain fibers pass upward along the sympathetic sensory

Mechanism of referred pain

- branches of visceral pain fibers are shown to synapse in the spinal cord on the same second-order neurons that receive pain signals from the skin.

- When the visceral pain fibers are stimulated, pain signals from the viscera are conducted through at least some of the same neurons that conduct pain signals from the skin, and the person has the feeling that the sensations originate in the skin.

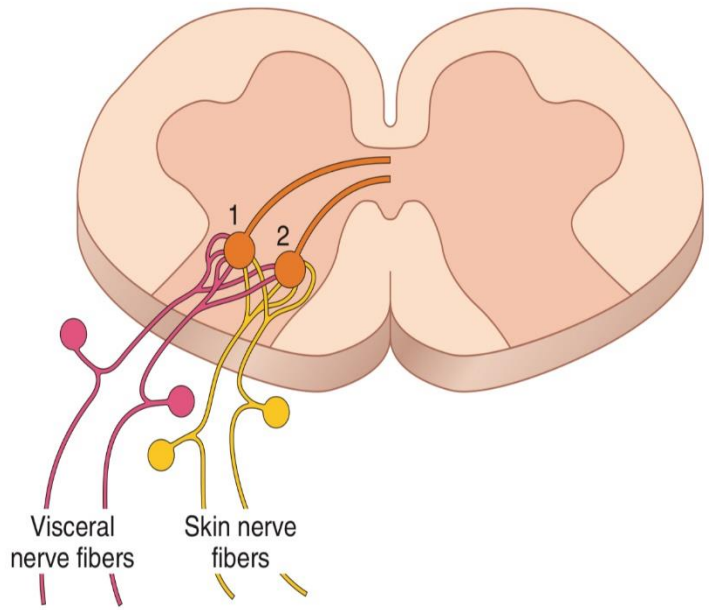


Figure 49-5. Mechanism of referred pain and referred hyperalgesia. Neurons 1 and 2 receive pain signals from the skin as well as from the viscera.

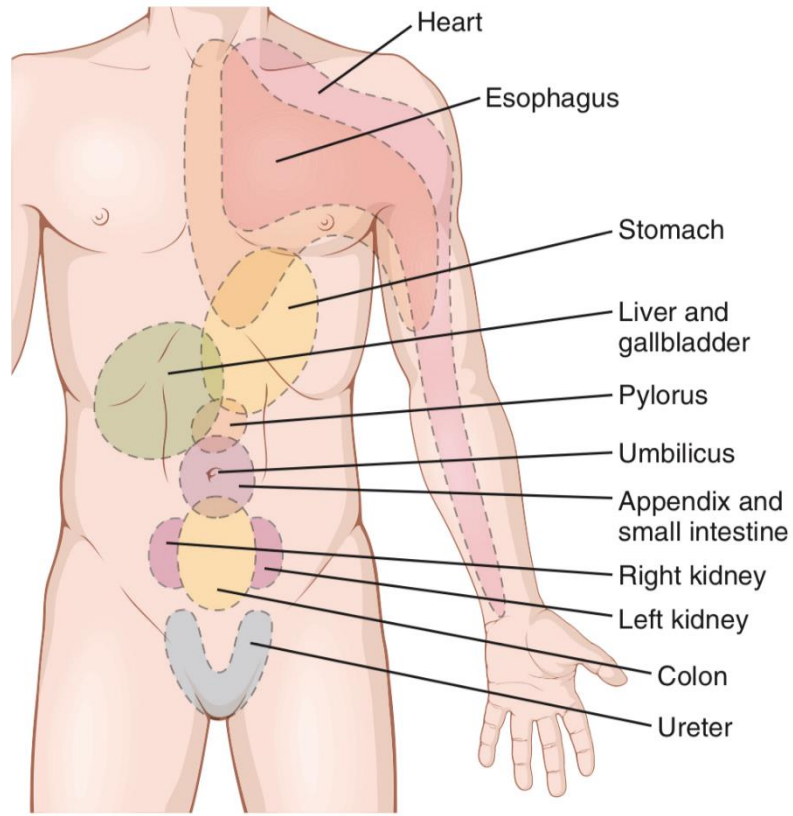
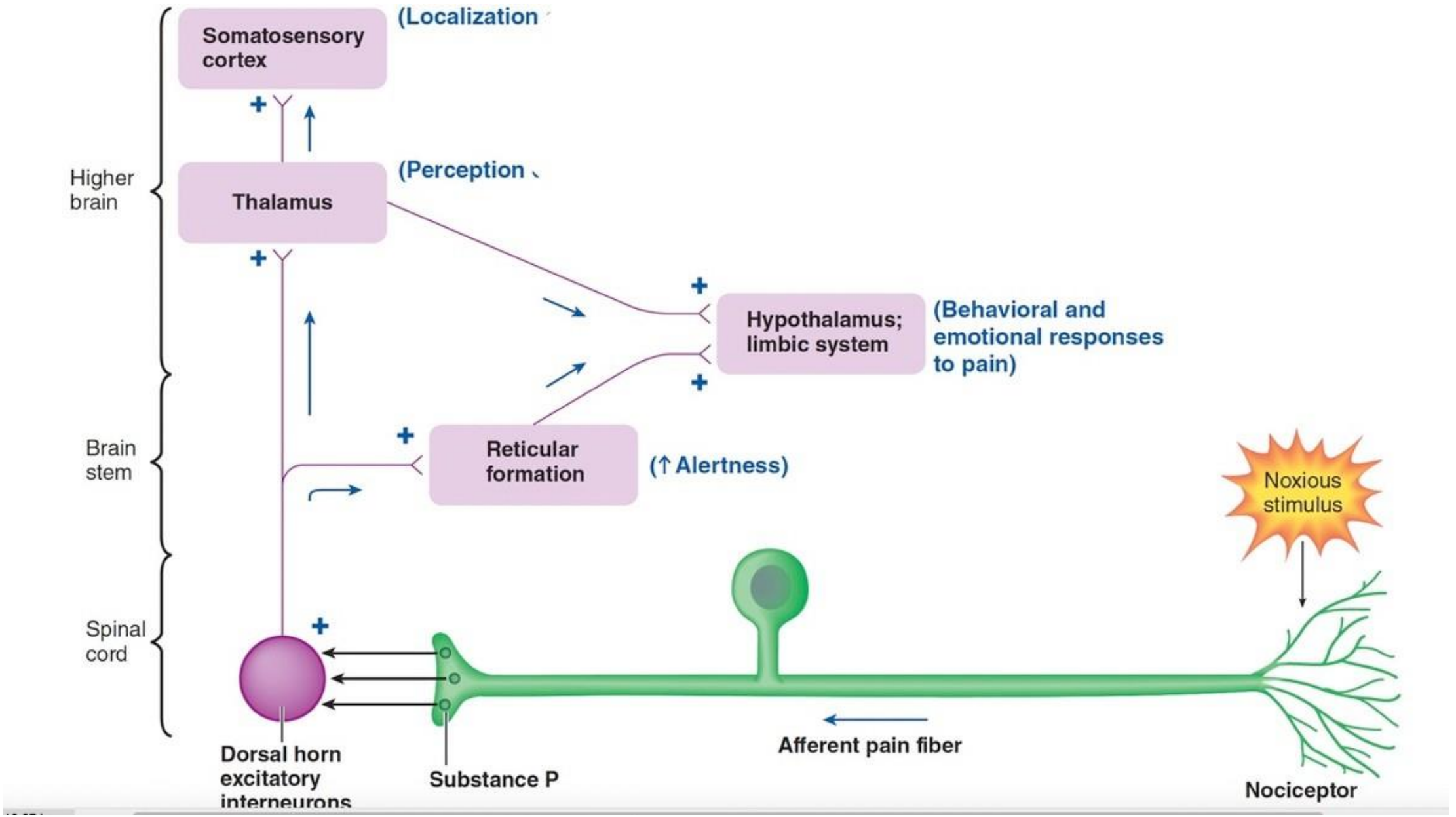
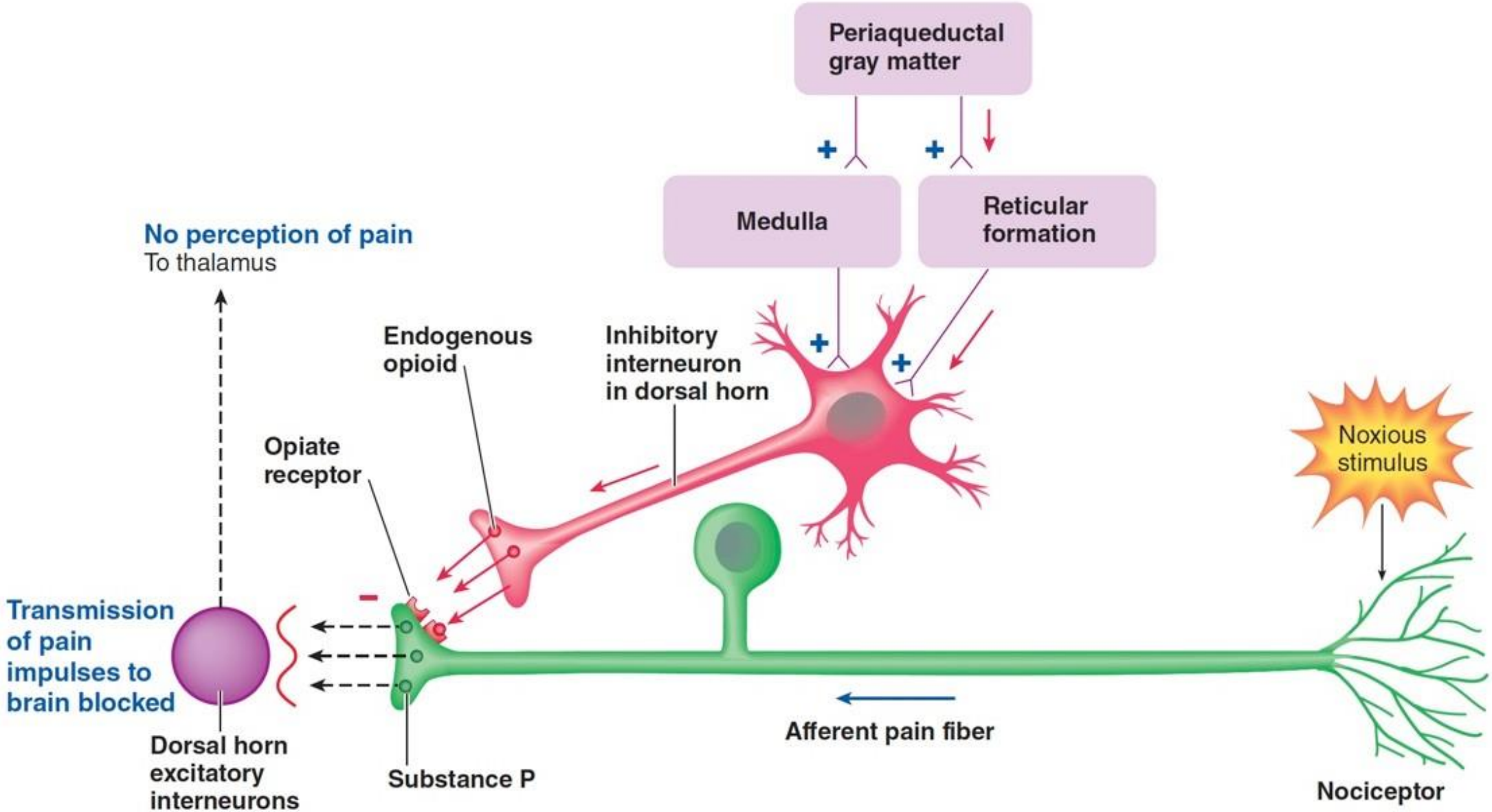
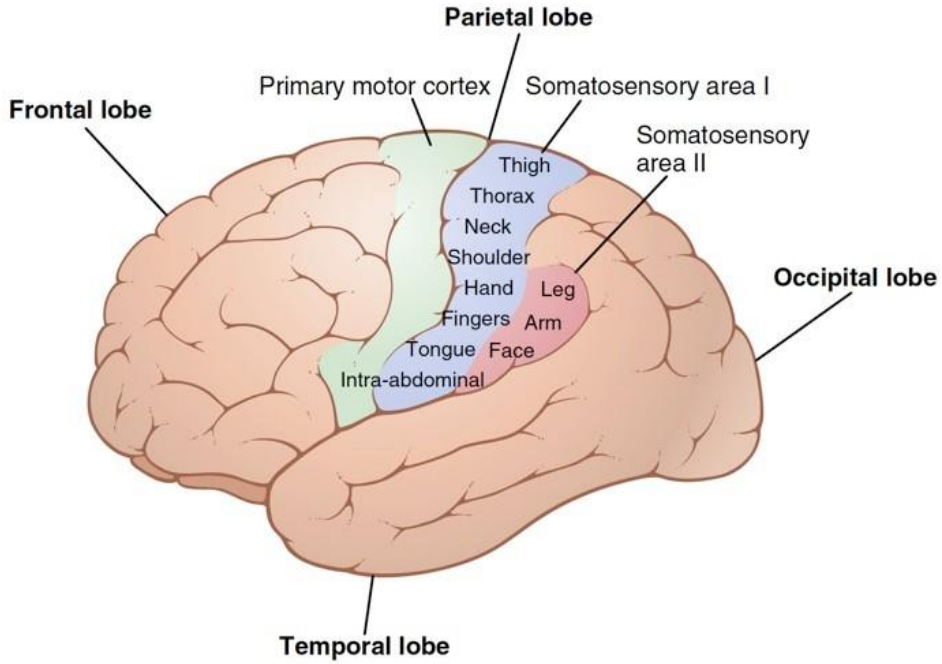


Figure 49-6. Surface areas of referred pain from different visceral organs.


Somatosensory cortex
(Localization
Higher brain
Thalamus
(Perception
Hypothalamus; limbic system
(Behavioral and emotional responses to pain)
Brain stem
Reticular formation
(↑ Alertness)
Noxious stimulus
Spinal cord
Dorsal horn excitatory interneurons
Substance P
Afferent pain fiber
Nociceptor


Periaqueductal gray matter
Medulla
Reticular formation
No perception of pain
To thalamus
Endogenous opioid
Inhibitory interneuron in dorsal horn
Opiate receptor
Noxious stimulus
Transmission of pain impulses to brain blocked
Dorsal horn excitatory interneurons
Substance P
Afferent pain fiber
Nociceptor

Somatosensory sensations will be integrated mainly in the primary somato sensory area which exist in the post central gyrus in the parietal lobe .



In general, physiologists divide cerebral cortex into primary area and association areas,and primary areas can be divided into sensory or motor

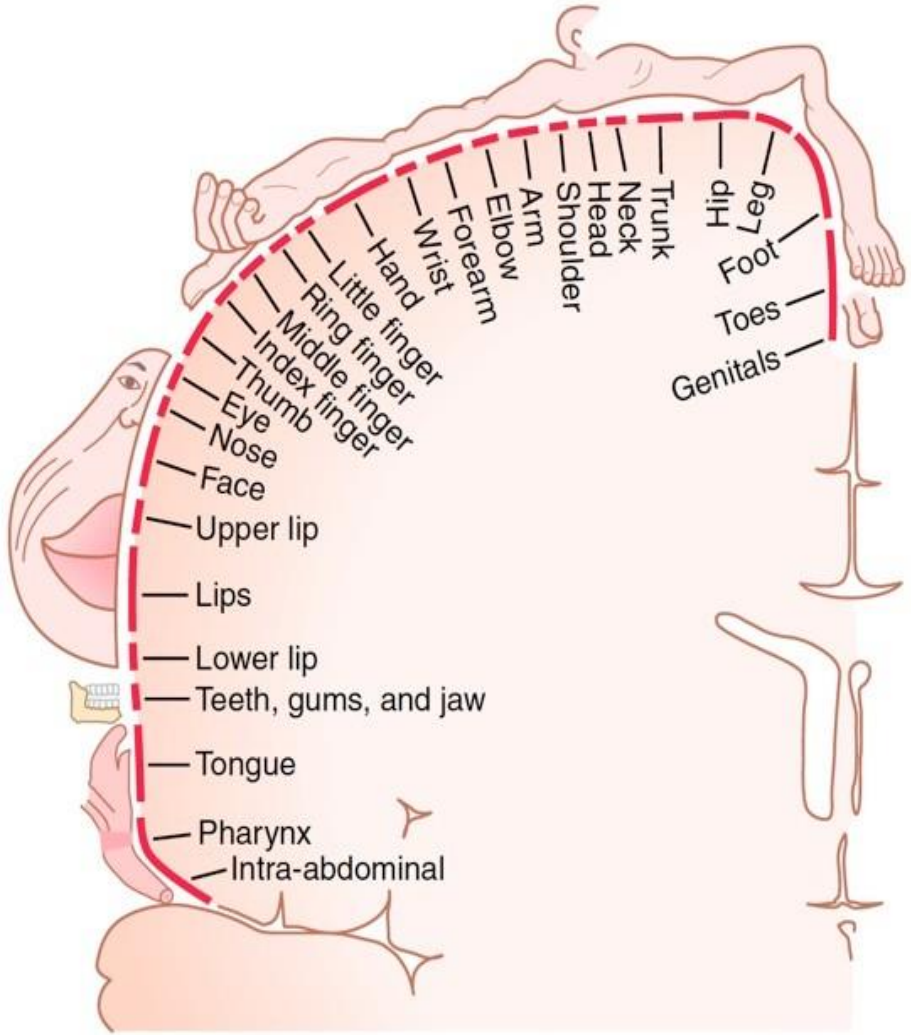
So the sensory signals will reach the primary sensory area directly (somatosensory area 1) and the motor signals will descend to the muscles from primary motor area so its direct contact with the PNS is consider

primary contact.

Main function of cerebral cortex is integrating different types of information together.
Primary somatic areas deliever the brain with the stimulus location,type and intensity
but things like integration and the nature of what is sensed are being processed in the
association areas.

Somatosensory area 2:We don’t know as much about it..

This figure shows a cross section through the brain at the level of post-central area gyrus demonstrating representations of the different parts of the body is separate regions of somatosensory 1. Note,however,that each lateral side of the cortex receives sensory sensory information almost exclusively from the opposite side of the body.
The sizes of these areas are directly proportional to the number of specialized sensory receptors in each receptive peripheral area of the body.



Somatosensory cortex

- The cerebral cortex is organized into six well-defined layers based on varying distributions of several distinctive cell types.

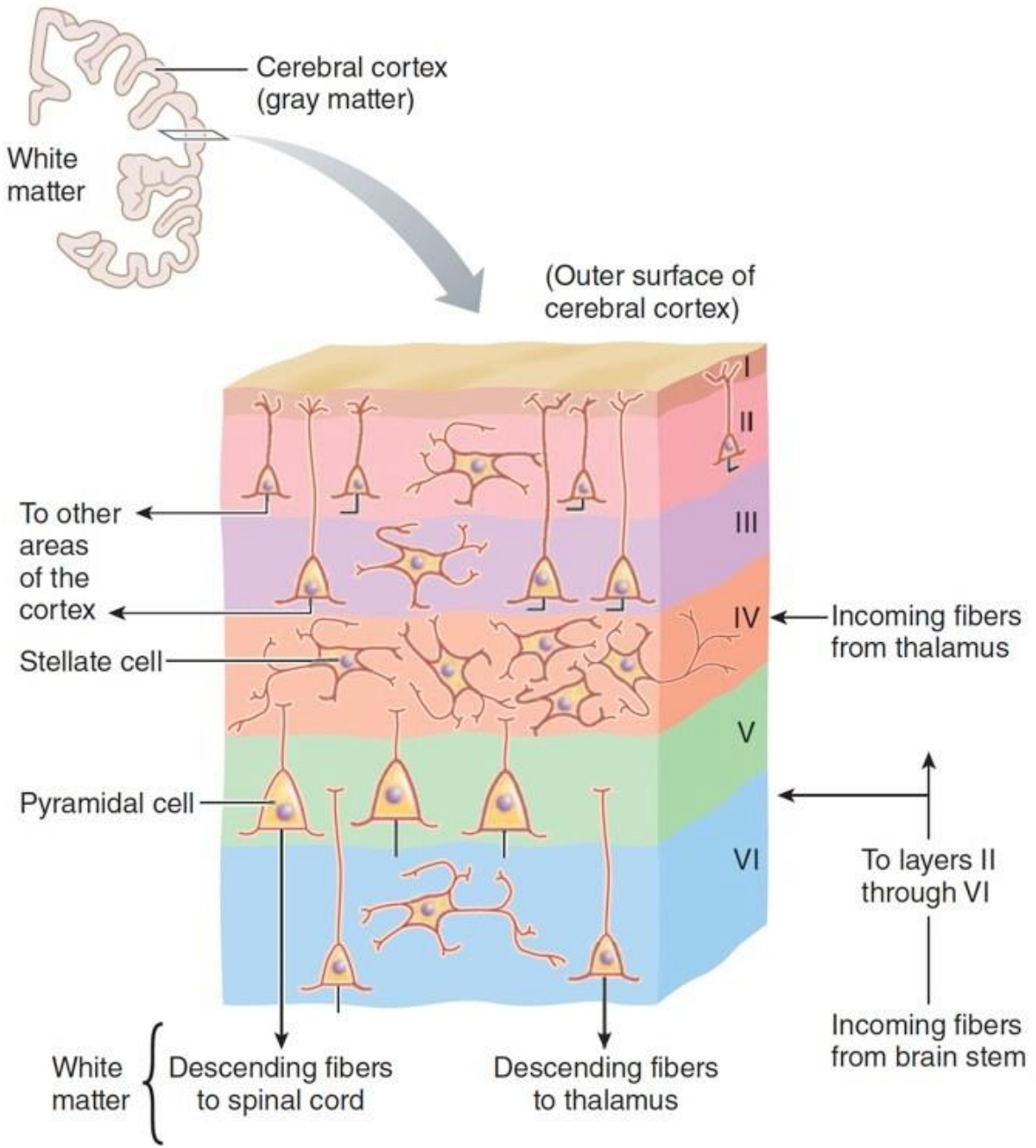
- These layers are organized into functional vertical columns that extend perpendicularly about 2 mm from the cortical surface down through the thickness of the cortex to the underlying white matter.

cerebral cortex is organized into 6 layers

each layer is divided according to the cell types which do different functions

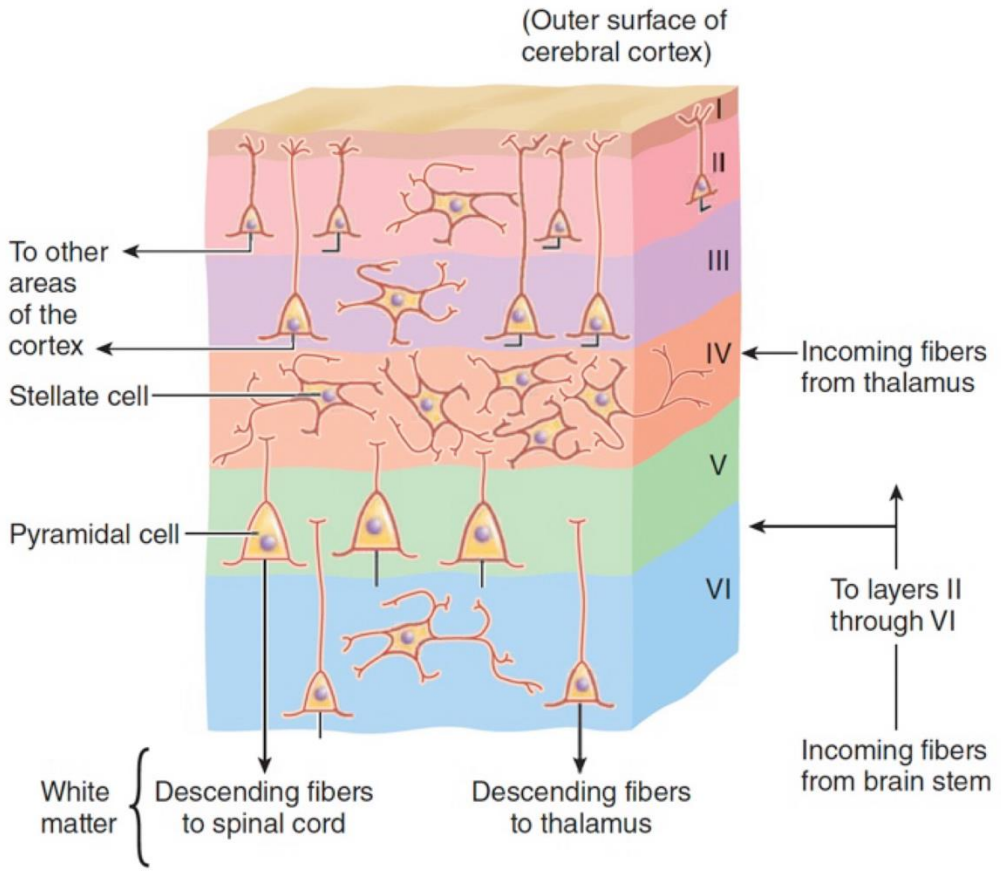
Difference between cortex regions is seen by differences in thickness of the layers according to the function of the area , for example sensory areas largest layer is layer 4 motor areas largest layers are 5&6

We can divide this layers into columns
Each column process specific modalities
Such as fine touch ….



Columns that are proximal (near) motor parts have thickness in the layer 5&6 and process modalities such as proprioception (Muscles tension & stretch) and so on

Layer 2&3 is specified for transmission Of signals to the other side through corpus Callosum



Somatosensory cortex

- The functional differences between various areas of the cortex result from different layering patterns within the columns and from different input–output connections

- In somatosensory cortex, each of these columns serves a single specific sensory modality.

Somatosensory cortex

- The incoming sensory signal excites neuronal layer IV first; the signal then spreads toward the surface of the cortex and also toward deeper layers.
- Layers I and II receive diffuse, nonspecific input signals from lower brain centers that facilitate specific regions of the cortex.
- The neurons in layers II and III send axons to related portions of the cerebral cortex on the opposite side of the brain through the corpus callosum.
- The neurons in layers V and VI send axons to the deeper parts of the nervous system. Those in layer V are generally larger and project to more distant areas, such as to the basal ganglia, brain stem, and spinal cord, where they control signal transmission.

* From layer IV, especially large numbers of axons extend to the thalamus, providing signals from the cerebral cortex that interact with and help to control the excitatory levels of incoming sensory signals entering the thalamus.

Somatosensory cortex

- In the most anterior part of the postcentral gyrus, located deep in the central fissure in Brodmann's area 3A, an especially large share of the vertical columns responds to muscle, tendon, and joint stretch receptors.
- Many of the signals from these sensory columns then spread anteriorly, directly to the motor cortex located immediately forward of the central fissure.
- These signals play a major role in controlling the effluent motor signals that activate sequences of muscle contracio

Somatosensory cortex function

- Widespread bilateral excision of somatosensory area I causes loss of the following types of sensory judgment:
- 1. The person is unable to localize discretely the different sensations in the different parts of the body. However, he or she can localize these sensations crudely.
- 2. The person is unable to judge critical degrees of pressure against the body.
- 3. The person is unable to judge the weights of objects.
- 4. The person is unable to judge shapes or forms of objects. This condition is called astereognosis.
- 5. The person is unable to judge texture of materials.

Somatosensory cortex function

(somatosensory area 1)
Localization of sensation

- In the specific absence of only somatosensory area I, appreciation of pain and temperature sensory modalities is still preserved both in quality and intensity.

- However, the sensations are poorly localized, indicating that pain and temperature localization depend greatly on the topographic map of the body in somatosensory area I to localize the source.

By time , lower CNS can take over but not to the precise degree of cerebral cortex (crude localization not fine localization) for tactile sensation, but for pain and temperature they aren't greatly affected and still intact in the absence of somatosensory area

Thalamus

- When the somatosensory cortex of a human being is destroyed, that person loses most critical tactile sensibilities, but a slight degree of crude tactile sensibility does return.

- Therefore, it must be assumed that the thalamus (and other lower centers) has a slight ability to discriminate tactile sensation, even though the thalamus normally functions mainly to relay this type of information to the cortex.

Thalamus : major relay station for sensory information
Damage of the thalamus can cause time loss of sensation and terrible pain

Somatosensory association area

- When the somatosensory association area is removed on one side of the brain, the person loses the ability to recognize complex objects and complex forms felt on the opposite side of the body.

Posterior to the primary somatosensory area , Integrate different sensory information

- In addition, the person loses most of the sense of form of his or her own body or body parts on the opposite side.

- When feeling objects, the person tends to recognize only one side of the object and forgets that the other side even exists. This complex sensory deficit is called amorphosynthesis.

Physical examination of sensory function

- Introduce yourself.
- Take permission.
- Privacy and chaperon.
- Wash your hands before and after.
- Explain the procedure.
- Sternum as a reference.
- Close eyes.
- Distal to proximal.
- Compare both sides.

Physical examination of sensory function

- Light touch.
- Pain.
- Vibration (on bony prominences).
- Position sense.
- Two point discrimination.
- Stereognosis and graphaesthesia.
- Sensory inattention.

V2

The highlighted note was added

(slide no. 27)