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## SOMATOSENSORY PATHWAYS

Sensations from the skin, muscles, and internal organs of the body are transmitted to the central nervous system via axons that enter via spinal nerves. Somatosensory information from the head and face is carried to the brain primarily via cranial nerve V, the trigeminal nerve. The cell bodies of these somatosensory receptors are located in clusters called dorsal root ganglia and cranial nerve ganglia. Two separate somatosensory pathways transmit information about sensations that are tightly localized (fine touch of the exteroceptive system & kinesthesia of the proprioceptive system) and poorly localized (temperature and pain of the exteroceptive system). Fine touch ascends via the segment of spinal cord white matter called the dorsal columns (the dorsal-column medial-lemniscal system), whereas diffuse somatosensory information ascends via the spinothalamic tract of the spinal cord (the anterolateral system). Each pathway projects to distinct areas of the thalamus and somatosensory cortex located in parietal lobe.

The dorsal-column medial-lemniscal system (denoted in the figure by the blue pathway) begins with somatosensory axons entering the spinal cord via the dorsal root and ascending in the dorsal columns ipsilaterally. The first synapse point for this pathway is in the dorsal column nuclei located in the medulla. The axons of neurons originating in the dorsal column nuclei decussate (cross over), ascending via the medial lemniscus to the contralateral ventral posterior thalamic nucleus (VPN). Somatosensory fibers of the trigeminal nerve (CN V), carrying information from the contralateral side of the face and head, also synapse in the VPN. The majority of VPN neurons project to the primary somatosensory cortex (SI), the remaining project to the secondary somatosensory cortex (SII) of the posterior parietal lobe.

The anterolateral system (denoted in the figure by the red pathway) begins with somatosensory axons entering the spinal cord via the dorsal root and synapsing upon entry. The majority of these second-order axons decussate, and ascend to the brain via

the anterolateral portion of the spinal cord white matter. This ascending system is composed of three separate tracts, the spinothalamic tract, the spinoreticular tract, and the spinotectal tract. The spinothalamic tract projects to the ventral posterior nucleus of the thalamus. This tract is involved in the perception of touch, temperature, and sharp pain. The spinoreticular tract projects to the brain stem reticular formation on its way to the parafascicular nucleus and intralaminar nucleus of the thalamus ). This pathway seems to be selectively involved in the perception of deep, chronic pain. The spinotectal tract projects to the tectum of midbrain. This tract is likely involved in some aspect of pain perception. The tracts of the anterolateral system project to both the primary and secondary somatosensory cortex, and to more posterior locations within the parietal lobe.

The selective area of skin innervated by the left and right dorsal roots of a particular spinal nerve is called a dermatome. The surface of the body has been mapped according to these dermatomes. It is important to note, however, that in reality the boundaries of these somatosensory regions overlap each other by approximately half of their width. Damage to a single dorsal root, therefore, produces slight loss of sensation. Both the sensation type and region of body represented are kept somewhat separate along all levels of the somatosensory pathway.