

OLFACTORY AND LIMBIC SYSTEMS

These two systems are reviewed together as they are closely related to each other, and a number of structures are common to both systems. Olfactory sensation serves an obvious function in providing us with information regarding this aspect of the surroundings. However, the sense of olfaction may arouse a wide variety of emotional responses which are largely governed by limbic system activity. Thus the limbic system receives a considerable input from olfactory sources in addition to input derived from many other areas.

OLFACTORY SYSTEM

Receptors are found in the upper portion of the nasal cavity, and comprise specialized bipolar neurons embedded in the olfactory mucosa. Hair-like processes extend out from the mucosal surface and these respond to odor. Central processes form the olfactory fila and enter the cranial cavity by passing through foramina in the cribriform plate of the ethmoid bone. These primary fibers end here, by synapsing on dendrites of multipolar mitral neurons in the olfactory bulb, which lies in the olfactory groove on the under surface of the frontal lobe.



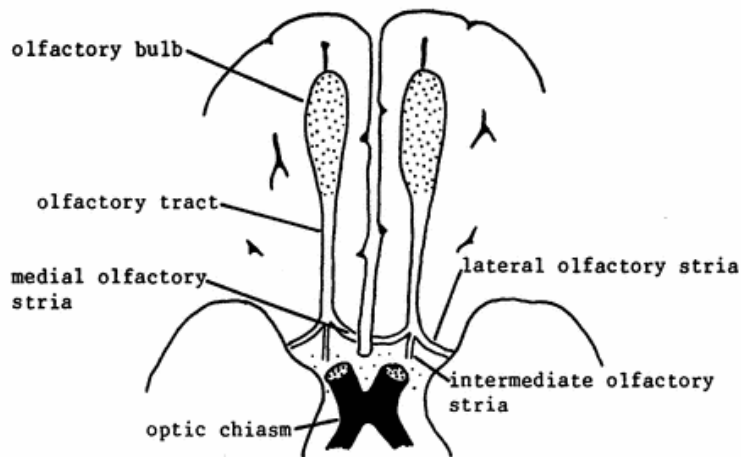
Olfactory Bulb and Nerves.

Axons of the mitral cells form the substance of the olfactory tract which passes caudally to attach to the brain.

Along the course of the olfactory tract are neurons which constitute the anterior olfactory nucleus. Some of the mitral cell axons synapse upon the cells of the anterior olfactory nucleus. Axons of the neurons of this nucleus may pass into the contralateral olfactory tract via the anterior commissure, to synapse on small granule cells in the olfactory bulb, helping to reinforce and enhance olfactory input.

Most axons of the olfactory tract attach to the base of the brain in the region of the anterior perforated substance close to the optic chiasm and the lamina terminalis.

The tract divides at its point of attachment into two well defined olfactory stria designated medial and lateral. A less well defined intermediate stria may be seen entering the anterior perforated substance.



Under Surface of the Brain Showing Olfactory Connections

The lateral olfactory stria terminates in the prepyriform cortex which lies immediately in front of the uncus on the parahippocampal gyrus of the temporal lobe. This region constitutes the primary olfactory cortex.

The medial olfactory stria terminates upon cortex of the medial side of the frontal lobe in the subcallosal gyrus (in the septal area).

NOTE: Olfaction is the only sensory modality which reaches the cerebral cortex without first being relayed via a thalamic nucleus.

Much of the activity generated by olfactory sensation is directed into paths which are concerned with providing reflex responses to this input.

Reflex Pathways Used by Olfactory Input.

1. Medial Forebrain Bundle - from the medial olfactory cortex in the septal area, caudally to the hypothalamus and midbrain tegmentum.
2. Stria Medullaris Thalami - from the septal region to the habenular nucleus in the epithalamus. The habenulo interpeduncular tract arising from the habenular nucleus makes connection with the interpeduncular region of the midbrain tegmentum.
3. Stria Terminalis - from the amygdaloid nucleus (activated by neurons in the lateral olfactory cortex) to the septal region, preoptic area and anterior hypothalamus. This fiber tract courses along the border of the lateral ventricle, adjacent to the caudate nucleus.