

Clinical Anatomy of Trigeminal Nerve

The trigeminal nerve is the fifth of the twelve cranial nerves. Often referred to as "the great sensory nerve of the head and neck", it is named for its three major sensory branches. The ophthalmic nerve (V1), maxillary nerve (V2), and mandibular nerve (V3) are literally "three twins" carrying information about light touch, temperature, pain, and proprioception from the face and scalp to the brainstem.

- The three branches converge on the trigeminal ganglion (also called the semilunar ganglion or gasserian ganglion), which contains the cell bodies of incoming sensory nerve fibers. The trigeminal ganglion is analogous to the dorsal root ganglia of the spinal cord, which contain the cell bodies of incoming sensory fibers from the rest of the body.
- From the trigeminal ganglion, a single large sensory root enters the brainstem at the level of the pons. Immediately adjacent to the sensory root, a smaller motor root emerges from the pons at the same level.
- Motor fibers pass through the trigeminal ganglion on their way to peripheral muscles, but their cell bodies are located in the motor nucleus of the fifth nerve, deep within the pons. Motor fibers are distributed (together with sensory fibers) in branches of the mandibular nerve.

Branches of Trigeminal Nerve

- **The ophthalmic nerve (V1)** enters the middle cranial fossa

through the superior orbital fissure and courses within the lateral wall of the cavernous sinus on its way to the trigeminal ganglion. Ophthalmic Nerve is formed by the union of the frontal nerve, nasociliary nerve, and lacrimal nerve. Branches of the ophthalmic nerve convey sensory information from the skin of the forehead, upper eyelids, and lateral aspects of the nose.

- **The maxillary nerve (V2)** enters the middle cranial fossa through foramen rotundum and may or may not pass through the cavernous sinus en route to the trigeminal ganglion. Branches of the maxillary nerve convey sensory information from the lower eyelids, zygoma, and upper lip. It is formed by the union of the zygomatic nerve and infraorbital nerve.
- **The mandibular nerve (V3)** enters the middle cranial fossa through foramen ovale, coursing directly into the trigeminal ganglion. Branches of the mandibular nerve convey sensory information from the lateral scalp, skin anterior to the ears, lower cheeks, lower lips, and anterior aspect of the mandible. It is formed by the union of the buccal nerve, lingual nerve, inferior alveolar nerve, and auriculotemporal nerve.

- **The trigeminal ganglion** lies in a depression known as the trigeminal cave (or Meckel's cave). The trigeminal nerve exits the trigeminal ganglion and courses "backward" to enter the mid-lateral aspect of the pons.

- **Branchial motor nerves** exit the mid-lateral aspect of the pons,

course within the trigeminal nerve, pass through the trigeminal ganglion, and exit the middle cranial fossa within the mandibular nerve through foramen ovale. The branchial motor component of the trigeminal nerve consists of lower motor neurons whose cell bodies are located in the motor nucleus of the trigeminal nerve in the brainstem. (The term "branchial" refers to structures embryologically derived from the branchial arches) These nerves exit the mid-lateral aspect of the pons, course within the trigeminal nerve, pass through the trigeminal ganglion, and within the mandibular nerve before branching. The muscles innervated by the branchial motor component can be remembered as "the muscles of mastication (chewing) plus two tensors." That is, the temporalis, masseter, medial and lateral pterygoids, tensor veli palatini, and tensor tympani.

Trigeminal Hitchhikers:

Visceral motor nerves are not a true component of the trigeminal nerve, but "hitchhike" along its branches. (The term "visceral" refers to viscera, including smooth muscle and glands). They originate centrally from other cranial nerves and travel along sensory branches of the trigeminal nerve en route to glands. Visceral motor nerves can be subdivided into pre-ganglionic and post-ganglionic fibers. Pre-ganglionic fibers travel from cranial nerve nuclei in the brainstem (where their cell bodies are located) to peripheral ganglia in the head and neck. These include the pterygopalatine ganglion, otic

ganglion, and submandibular ganglion. Within these ganglia, pre-ganglionic fibers synapse with post-ganglionic fibers (whose cell bodies make up the bulk of the ganglia), which in turn travel to innervate glands.

The facial nerve gives rise to two important trigeminal hitchhikers - the Vidian nerve and the chorda tympani nerve.

The Vidian nerve (nerve of the pterygoid canal) emerges from the pterygoid canal carrying pre-ganglionic fibers to the pterygopalatine ganglion. After synapse, post-ganglionic fibers exit the ganglion and hitchhike along trigeminal nerve branches en route to the lacrimal gland and minor salivary glands of the palate and mouth.

- **The chorda tympani** exits the skull through the petrotympanic fissure and courses extracranially to join the lingual nerve. It carries pre-ganglionic fibers to the submandibular ganglion which "hangs" from the lingual nerve. After synapse, post-ganglionic fibers exit the ganglion to innervate the submandibular gland and sublingual gland.

The glossopharyngeal nerve also contributes an important trigeminal hitchhiker - the lesser petrosal nerve. It carries pre-ganglionic fibers to the otic ganglion. After synapse, post-ganglionic fibers exit the ganglion, hitchhiking along the auriculotemporal nerve to innervate the parotid gland.