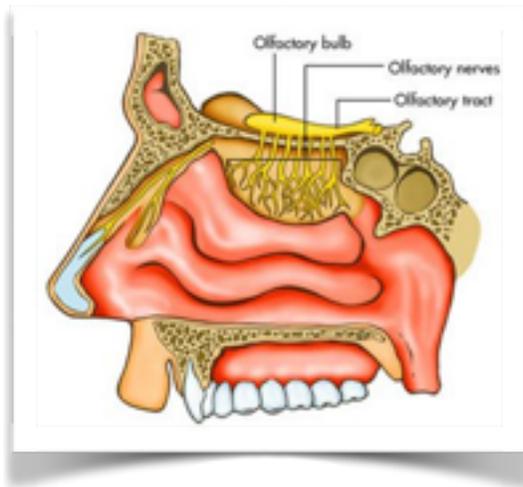Wendell Jones
Anatomy 2

CN I Olfactory

The olfactory nerve is actually a collection of sensory nerve rootlets that extend down from the olfactory bulb and pass through the many openings of the cribriform plate in the ethmoid bone.

      The olfactory nerve is a sensory nerve that helps transmit the sense of smell. Of the twelve cranial nerves, it is the shortest nerve and one of two cranial nerves that do not join with the brainstem. The olfactory nerve originates in the telencephalon of the cerebrum, and is located in the olfactory foramina in the cribriform plate of the ethmoid bone. At this location, the olfactory nerve innervates the olfactory epithelium. The nerves start out in the nasal mucosa of the nasal septum. After they are in this

cavity, the nerves end in the olfactory bulbs. The axons in the bulbs enter the brain at the olfactory tract and travel to the cerebral cortex just lateral to the optic chasm and the hippocampus.

Disorders associated with Cranial Nerve I:
- Hyposmia/Dysosmia – reduction of smell
- Anosmia – complete loss of smell
- Cacosmia – sensation of a foul stench or odor when none exists
- Parosmia – distorted smell
- Meningitis from cerebrospinal fluid leakage

CN II Optic

It enters the central nervous system at the optic chiasm (crossing) where the nerve fibers become the optic tract just prior to entering the brain.
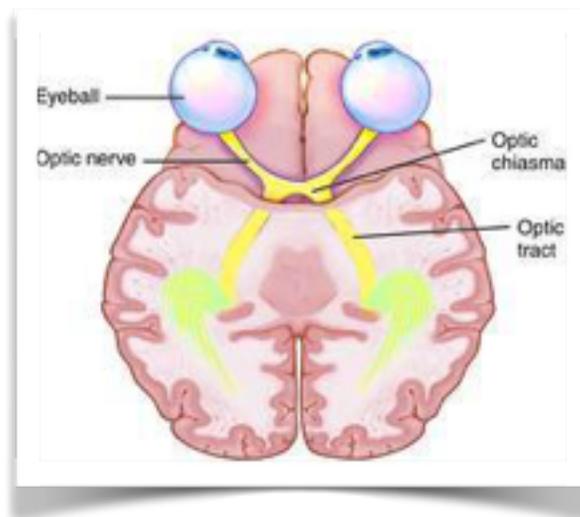
The optic nerve is a sensory nerve that transmits visual information to the brain via electrical impulses from the retina. Like the olfactory nerve, it

does not join with the brainstem. It is composed of retinal ganglion cells and is covered by all three layers of the three meninges, (dura, arachnoid, and pia mater). The optic nerve originates at the back of the retina, and partially decussates at the optic chiasm and terminates at the lateral geniculate nucleus. At the optic chiasm, the nerve fibers from the medial half of each retina decussate while the lateral fibers from each retina remain uncrossed or direct. The optic tract continues to the lateral geniculate body where synapses again take place and ends at the Calcarine fissure.

Disorders associated with Cranial Nerve II:
- Lesions in the optic tract can cause Homonymous Hemianopia, or partial blindness.
- Damage can also result in a monocular visual defect. This would be due to loss of input from the ipsilateral eye.

CN III Oculomotor

The nerve passes through the two layers of the dura mater including the lateral wall of the cavernous sinus and then enters the superior orbital fissure to access the orbit. The somatomotor component of the nerve divides into a superior and inferior division.
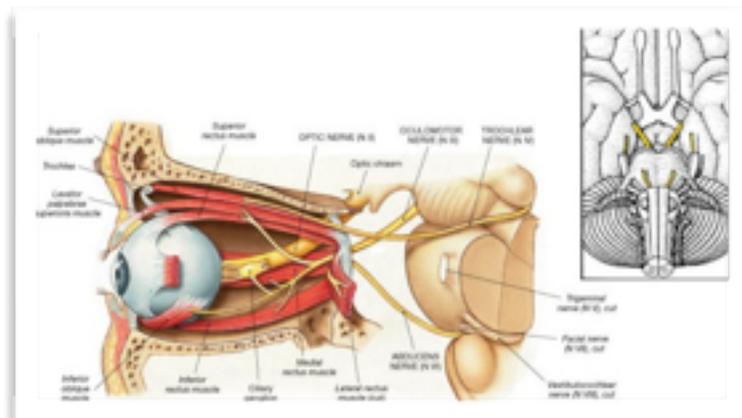
The oculomotor nerve has two main components: somatomotor and visceral. The somatomotor component innervates the extraocular muscles to move the eyeball. These signals allow the eyes to move upward, downward, inward, and medially. Second, the oculomotor nerve carries parasympathetic fibers to the iris, causing the iris to constrict when you're in bright light (visceral component). The oculomotor nerve is also responsible for holding the eyelids open.

Dysfunction of the third cranial nerve causes ptosis (drooping) of the eyelid. The eye may also be in abduction and turned down. If the visceral component is impaired, the papillary reflex is lost and the pupil is dilated. A lesion in the oculomotor nerve may also cause double vision (diplopia) or a "blown pupil"—a pupil that cannot constrict. If the medial rectus has become weakened, the eye will tend to drift laterally, sometimes termed a 'lazy eye'. Due to its location, the oculomotor nerve is susceptible to damage by elevated intracranial pressure, and a blown pupil can be a sign of serious neurological trouble.

CN IV Trochlear

The trochlear nerve is purely a motor nerve and is the only cranial nerve to exit the brain dorsally. The nerve travels in the lateral wall of the cavernous sinus and then enters the orbit via the superior orbital fissure. The nerve travels medially and diagonally across the levator palpebrae superioris and superior rectus muscle to innervate the superior oblique muscle.
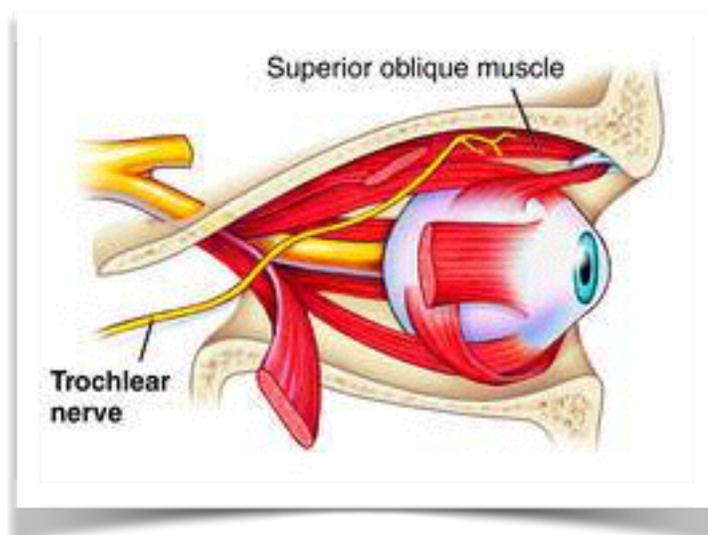
The trochlear nerve is a motor nerve that allows the eye to move in an upward and downward position. It originates in the trochlear nucleus which is located in the tegmentum of the midbrain. The trochlear nerve innervates the superior oblique muscles which moves the eyeball within the superior orbital fissure. Of the twelve cranial nerves, it has the smallest amount of axons.

Disorders associated with Cranial Nerve IV:

- Damage to the trochlear nerve can cause paralysis of eye movement.
- Vertical Dipolpia – weakness of the eye moving in a downward position. This improves with opposite (contralateral) side head tilt and worsens with same (ipsilateral) side head tilt. For example; this is usually a problem for someone when they are walking down stairs.
- Torsional Diplopia – a single object is seen as duplicates in someone's visual perception.
- Extorsion – outward rotation of the affected eye due to the unopposed action of the inferior oblique muscle.

CN V Trigeminal

The ophthalmic, maxillary and mandibular branches leave the skull through three separate foramina: the superior orbital fissure, the foramen rotundum and the foramen ovale. The ophthalmic nerve (V_1) carries sensory information from the scalp and forehead, the upper eyelid, the conjunctiva and cornea of the eye, the nose (including the tip of the nose, except alae nasi), the nasal mucosa, the frontal sinuses and parts of the meninges (the dura and blood vessels). The maxillary nerve (V_2) carries sensory

information from the lower eyelid and cheek, the nares and upper lip, the upper teeth and gums, the nasal mucosa, the palate and roof of the pharynx, the maxillary, ethmoid and sphenoid sinuses and parts of the meninges. The mandibular nerve (V_3) carries sensory information from the lower lip, the lower teeth and gums, the chin and jaw (except the angle of the jaw, which is supplied by C2-C3), parts of the external ear and parts of the meninges. The mandibular nerve carries touch-position and pain-temperature sensations from the mouth. Although it does not carry taste sensation (the chorda tympani is responsible for taste), one of its branches —the lingual nerve—carries sensation from the tongue.
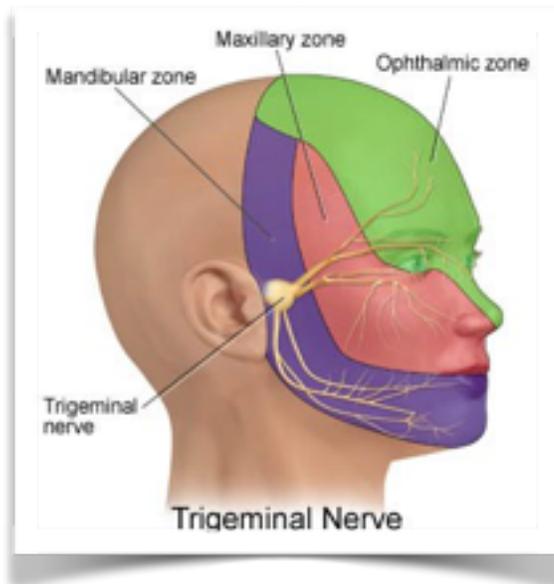
Trigeminal Nerve

The trigeminal nerve is primarily used for mastication and sensations of the face, these sensations include face, teeth, gums, and the anterior 2/3rds of the tongue. This nerve relays pain, temperature, and touch. Cranial nerve V is also responsible for flattening and tensing the soft palate, opening the

eustachian tube, and opening/closing the jaw. It also aids the movement of the larynx.

The trigeminal nerve is both motor and sensory. The motor portion of cranial nerve V is attached to the lateral edge of the pons. The motor portion stays within the area of the pons. The sensory portion, on the other hand, runs deeper to the mesencephalon and continuing down to the spinal cord.

CN VI Abducens

The abducens nerve leaves the brainstem at the junction of the pons and the medulla, medial to the facial nerve. In order to reach the eye, it runs upward (superiorly) and then bends forward (anteriorly).

The nerve enters the subarachnoid space when it emerges from the brainstem. It runs upward between the pons and the clivus, and then pierces the dura mater to run between the dura and the skull through Dorello's canal. At the tip of the petrous temporal bone it makes a sharp turn forward to enter the cavernous sinus. In the cavernous sinus it runs alongside the internal carotid artery. It then enters the orbit through the superior orbital fissure and innervates the lateral rectus muscle of the eye.
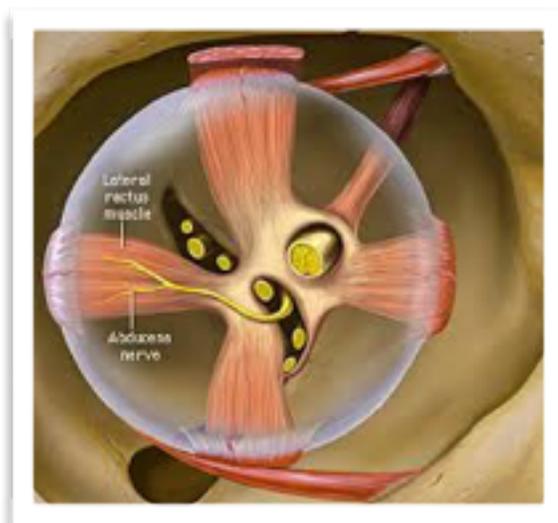
The abducens nerve is a motor nerve, responsible for controlling movement of a single muscle, the lateral rectus muscle in the eye, which turn the eyes laterally. It is located on the floor of the fourth ventricle. It has the greatest subarachnoid path of the 12 cranial nerves, traveling the greatest distance through the subarachnoid space around the brain. The long course of the abducens nerve between the brainstem and the eye makes it vulnerable to injury at many levels.

CN VII Facial

The path of the facial nerve can be divided into six segments.
1 intracranial (cisternal) segment
2 meatal segment (brainstem to internal auditory canal)
3 labyrinthine segment (internal auditory canal to geniculate ganglion)
4 tympanic segment (from geniculate ganglion to pyramidal eminence)
5 mastoid segment (from pyramidal eminence to stylomastoid foramen)
6 extratemporal segment (from stylomastoid foramen to post parotid branches)

Termination of supratochlear of infratochlear of maxillary
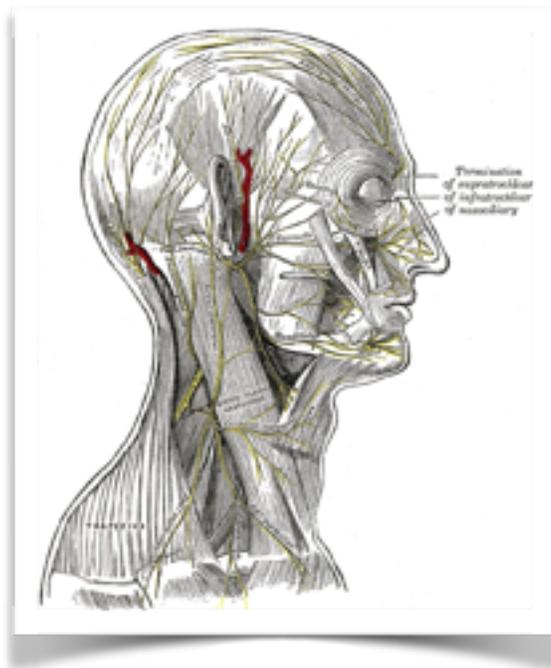
The facial nerve has both sensory and motor divisions. They originate in the pons near the reticular formation. The sensory portion of cranial nerve VII deals mostly with taste, checking the anterior 2/3rds of tongue. The motor portion directly correlates with facial expressions. These facial expressions include wrinkling the forehead, closing the eyes tightly, closing the mouth tightly, pulling back the corners of the mouth, tensing the cheeks, and pulling the larynx up and back. The facial nerve is also responsible for sublingual/submaxillary glands which are involved in salivation. There are several branches of the facial nerve. These include the cervical (platysma), mandibular (lower lip), zygomatic (muscles of eye and lower/upper lip), buccal (muscles of cheek/nose and lips), and temporal (muscles found around the eye).

 Damage to the facial nerve, often manifests in facial nerve paralysis, occurs randomly with no known cause. In most cases, it presents itself unilaterally. Signs of this occurring consist of drooling, droopy face, and weakness in facial muscles. Hyperacusis(heightened, consistent sound), occurs from damage to the facial nerve. Bell's Palsy also occurs when there is damage to the facial nerve. This manifests in twitching, weakness on one side of face, and impairment of taste. This is usually temporary paralysis and the cause is linked to a virus called herpes simplex.
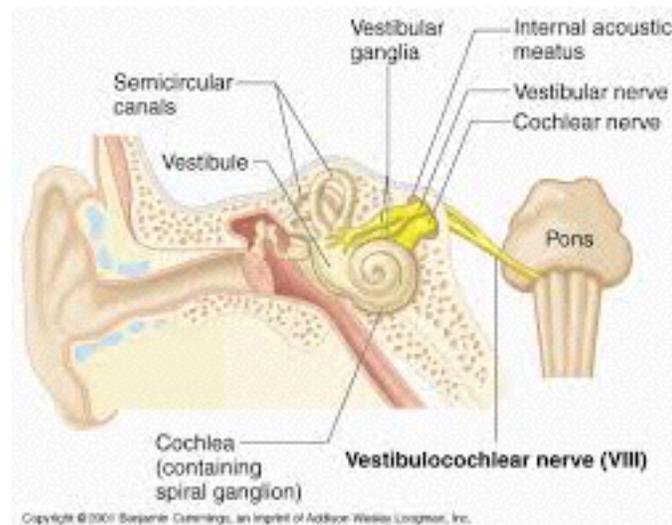
CN VIII Vestibulocochlear

The vestibulocochlear nerve consists mostly of bipolar neurons and splits into two large divisions: the cochlear nerve and the vestibular nerve. The cochlear nerve travels away from the cochlea of the inner ear where it starts as the spiral ganglia. Processes from the organ of Corti conduct afferent transmission to the spiral ganglia. It is the inner hair cells of the organ of Corti that are responsible for activation of afferent receptors in response to pressure waves reaching the basilar membrane through the transduction of sound. The exact mechanism by which sound is transmitted by the neurons of the cochlear nerve is uncertain; the two competing theories are place theory and temporal theory.
The vestibular nerve travels from the vestibular system of the inner ear. The vestibular ganglion houses the cell bodies of the bipolar neurons and extends processes to five sensory organs.

Vestibulocochlear nerve (VIII)

As the name implies, the vestibulocochlear nerve (or cranial nerve VIII), consists of two distinct parts: the vestibular nerve and the acoustic nerve. Although they both carry afferent information from the inner ear to the brain, the type of information they carry is different. The vestibular nerve carries information from your ear to your brain about balance and equilibrium and the acoustic nerve carries information to your brain about hearing. Cranial nerve VIII is responsible for sound sensitivity and controlling sensitivity to dynamic changes in equilibrium.

A lesion on the vestibular nerve would result in nystagmus (rhythmic oscillations of the pupil), unsteady gait, nausea and vertigo. A lesion on the auditory nerve would result in hearing loss and/or tinnitus. One of the most common brain tumors, a vestibular schwannoma or acoustic neuroma, occurs on the vestibular portion of cranial nerve VIII and is marked by the many of the above mentioned signs and symptoms. Many patients complain on tinnitus in one ear with fullness in that ear. Although acoustic neuromas are typically slow growing and benign, in rare cases they may grow large enough to compress the brainstem and threaten the patient's life.

CN IX Glossopharyngeal and CN X Vagus
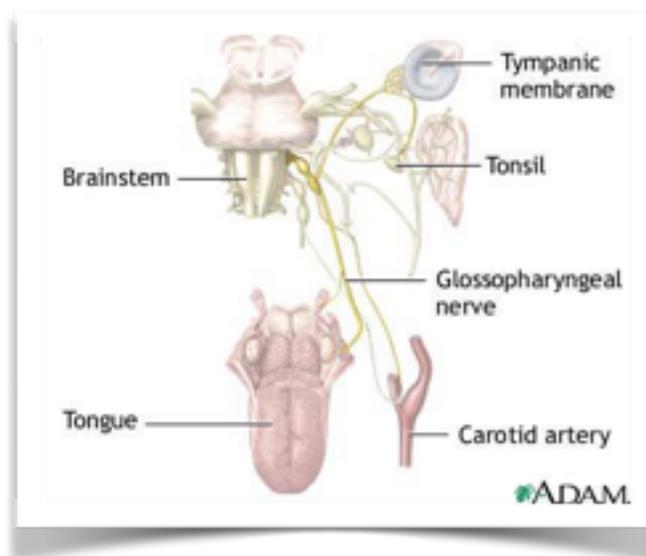
The *glossopharyngeal nerve* (cranial nerve IX) and *vagus nerve* (cranial nerve X) are often combined, because they exit from the brain stem side-by-side, and have similar and frequently overlapping functional and anatomical distributions in the periphery. These nerves both connect with many of the same brain stem nuclei, and are often damaged together.
In general, the glossopharyngeal nerve contains more sensory fibers, including from the posterior 1/3 of the tongue and pharynx, down to the level of the larynx, which is where the vagus nerve takes over. The vagus nerve is motor to the palate elevators and constrictors of the pharynx, which occurs in swallowing and gagging.

This nerve has motor, sensory, and autonomic nervous system nerve fibers.
Motor Components
It, along with the vagus nerve, provides some innervation to the upper pharyngeal constrictor muscles. It also innervates the stylophayngeus muscles, which elevates the larynx and pulls it forward during the pharyngeal stage of the swallow. This action also aids in relaxation and and opening of the cricopharyngeus muscle.
Sensory Components
This nerve mediates all sensation, including taste, from the posterior third of the tongue. It also carries sensation from the velum and superior portion of the pharynx.
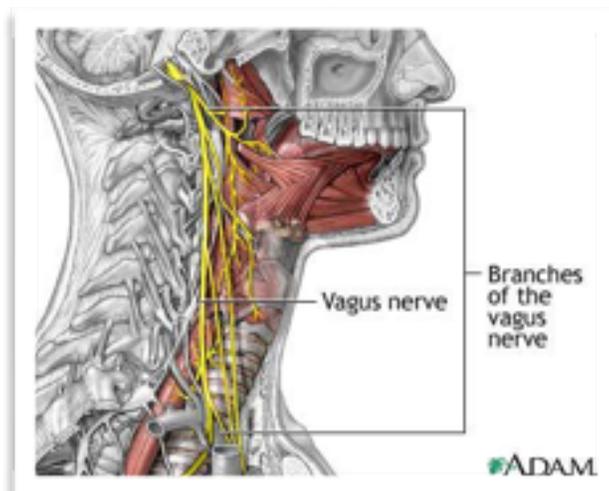
The vagus nerve is one of the main nerves for swallowing and can cause major problems, if injured. There are three main branches of the vagus: the pharyngeal, external superior laryngeal, and recurrent nerve branch.

Motor Components

This nerve is responsible for raising the velum as it innervates the glossopalatine and levator veli palatine muscles. As stated before, it works with the glossophayngeal nerve to innervate the pharyngeal constrictor muscles and intrinsic musculature of the larynx. The vagus is also responsible for vocal fold adduction (closing) during the swallow. It controls the muscles involved in swallowing, as well as those that control respiration.

Sensory Component

The vagus carries sensory information from the velum and posterior and inferior portions of the pharynx. It also mediates sensation in the larynx.

CN XI Spinal Accessory

Like other cranial nerves, the spinal accessory nerve exits the cranium through a specialized hole (or foramen). However, unlike all other cranial nerves, the spinal accessory nerve begins outside the skull rather than inside. In particular, in the majority of individuals, the fibers of the spinal accessory nerve originate solely in neurons situated in the upper spinal cord.[4] These fibers coalesce to form spinal rootlets, roots, and finally the spinal accessory nerve itself, which enters the skull through the foramen magnum, the large opening at the base of the skull. The nerve courses along the inner wall of the skull towards the jugular foramen, through which it exits the skull with the glossopharyngeal (CN IX) and vagus nerves (CN X). Owing to its peculiar course, the spinal accessory nerve is notable for being the only cranial nerve to both enter and exit the skull.
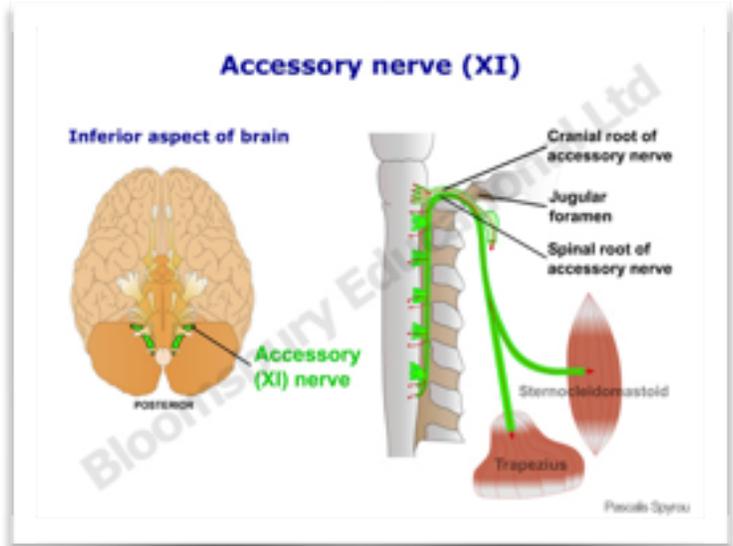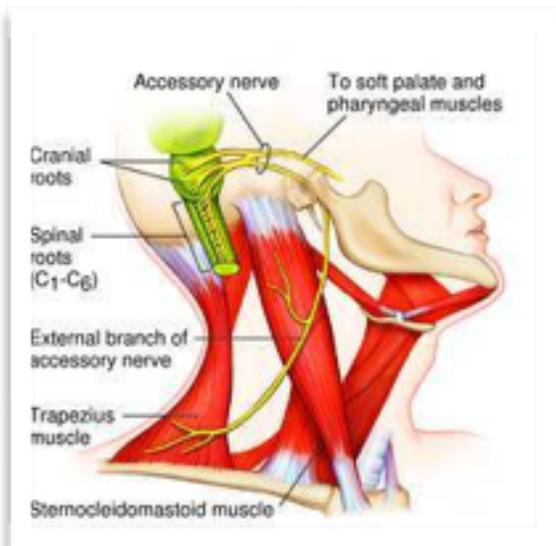
The spinal accessory nerve has one main function: to cause the contraction of the sternocleidomastoid muscle that helps turn, tilt, and thrust the head forward or raise the sternum and clavicle if the head is in a fixed position. It also innervates the trapezius muscle, which is responsible for shrugging the shoulders. The spinal accessory nerve sends motor signals to the uvula and the levator veli palatine.

Weakness in the sternocleidomastoid or trapezius muscles can be caused by lesions in the muscles, neuromuscular junction, or lower motor neurons of the accessory spinal nerve. Unilateral upper motor neuron lesions in the cortex or descending pathways cause contralateral weakness of the trapezius, with relative sparing of sternocleidomastoid strength. This may be explained by bilateral upper motor neuron projections controlling the sternocleidomastoid, in analogy to the bilateral projections controlling the upper face.

CN XII Hypoglossal

The hypoglossal nerve arises from the hypoglossal nucleus of the caudal brain stem emerging from the ventromedial medulla oblongata from a number of smaller rootlets[1][2] in the preolivary sulcus separating the *olive* and the *pyramid*. After passing through the subarachnoid space the nerve then exits the skull-base of the posterior fossa[3] through the hypoglossal canal. On emerging from the hypoglossal canal, it gives off a small meningeal branch and picks up a branch from the anterior ramus of C1. Following in near proximity to the vagus and spinal division of the accessory nerve,[2] it spirals behind the vagus nerve and passes between the internal carotid artery and internal jugular vein lying on the carotid sheath. After passing deep to the posterior belly of the digastric muscle, it passes to the submandibular region, passes lateral to the hyoglossus muscle, and inferior to the lingual nerve to reach and efferently innervate the tongue.[
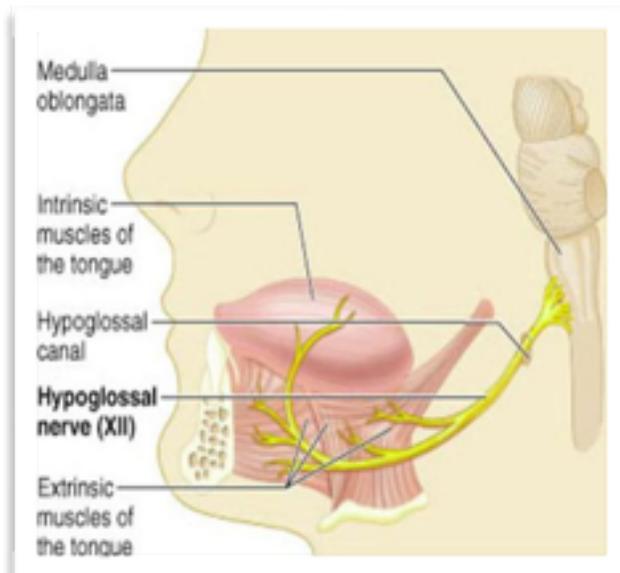
The hypoglossal nerve innervates the muscles responsible for tongue movement. The four intrinsic muscles of the tongue control tongue shortening, concaving narrowing, elongating, and flattening. The extrinsic muscles innervated account for tongue protrusion, drawing the tongue upward and backward and retraction and depression of the tongue. The

hypoglossus also acts with the chondroglossus to elevate the hyoid bone, thus participating in phonation.

Lower motor neuron damaged to the hypoglossal nerve may result in atrophy, fasciculations, weakness reduced range of movement, deviation of tongue to side of lesion, decreased tone, and consonant imprecision. Signs of upper motor neuron damage to the hypoglossal nerve include: weakness, reduced range of movement, deviation of tongue to contralateral side, increased tone, and consonant impression.

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