CRANIAL NERVES

✓**Nerves which originates from the brain is called cranial nerves.**

✓ **There are 12 pairs of cranial nerves.**

Name of the Cranial Nerves

- I. Olfactory n.
- II. Optic n.
- III. Occulomotor n.
- IV. Trochlear n.
- V. Trigeminal n.
- VI. Abducent n.
- VII. Facial n.
- VIII. Vestibulocochlear n.

IX.Glossopharayngeal n

X. Vagus n.

XI. Accessory n.

XII. Hypoglossal n.

CRANIAL NERVES

Functional group of cranial nerves:

I. Olfactory nerve: **Sensory**
II. Optic nerve: **Sensory**
III. Occulomotor nerve: **Motor**
IV. Trochlear nerve: **Motor**
V. Trigeminal nerve:**Mixed** (Sensory+Motor)
VI. Abducent nerve: **Motor**
VII. Facial nerve: **Mixed**
VIII. Vestibulocochlear nerve: **Sensory**
IX. Glossopharyngeal nerve: **Mixed**
X. Vagus nerve: **Mixed**
XI. Accessory nerve: **Motor**
XII. Hypoglossal nerve: **Motor**

Origin of the Cranial Nerves.

I. Olfactory nerve: Nasal mucosa
II. Optic nerve: Retina
III. Occulomotor nerve: From the cerebral peduncle
IV. Trochlear nerve: Dorsal part of mesencephalon
V. Trigeminal nerve: Lateral to the pons
VI. Abducent nerve: Trapezoid body
VII. Facial nerve: Lateral to the pons
VIII. Vestibulocochlear nerve: Lateral to the trapezoid body
IX. Glossopharyngeal nerve: Medulla oblongata
X. Vagus nerve: Medulla oblongata
XI. Accessory nerve: Medulla oblongata
XII. Hypoglossal nerve: Medulla oblongata

Major Supply of Cranial Nerve

I. Olfactory nerve: Nasal mucous membrane.

II. Optic nerve: Retina of the eye. Paralysis cause blindness.

III. Occulomotor nerve: **Medial rectus, Ventral rectus & Ventral oblique muscles of the eye ball**

IV. Trochlear:Muscles of the eye ball

V. Trigeminal:

(a) Opthalmic nerve: Lacrimal gland, conjunctiva of eye ball, eye lid, and face.

(b) Maxillary nerve: Upper teeth, skin of nose and muzzle and **horn of the ruminant as cornual n. In amputation of the horn in cattle this nerve should desensitized by local anesthesia.**

(c) Mandibular nerve: Lower teeth, muscle and skin of cheek, tongue etc. **Paralysis of the Tigeminal nerve in dog cause drop jaw.**

Major Supply of Cranial Nerve

VI. Abducent: Lateral rectus muscle of the eye ball.

VII. Facial: Muscles and skin of the face, ear, salivary gland, eye lid etc. Paralysis of this nerve cause dropping of the muzzle, inability to close the eye, reduction of the secretory activity of the lacrimal gland and salivary gland.

VIII. Vestibulocochlear nerve: Responsible for hearing. Paralysis of the nerve cause deafness.

Major Supply of Cranial Nerve

IX. Glossopharyngeal nerve: Supply to the tongue and pharynx. In the horse damage to this nerve characterized by difficulties in swallowing.

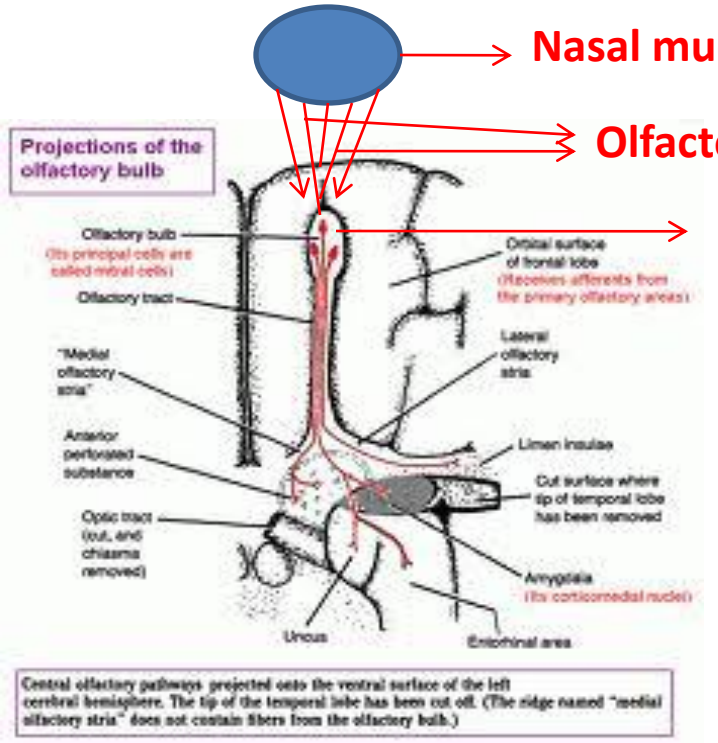
X. Vagus nerve: It is the longest nerve and supply to the pharynx, larynx, trachea, bronchi, lungs, stomach and other viscera. Paralysis of the left laryngeal nerve (a branch of vagus) cause roaring of horse due to difficulties in respiration.

Major Supply of Cranial Nerve

XI. Accessory nerve: Supply to few muscle of the neck.

XII. Hypoglossal nerve: This nerve supply to the tongue of animals.

Image for Olfactory Nerve



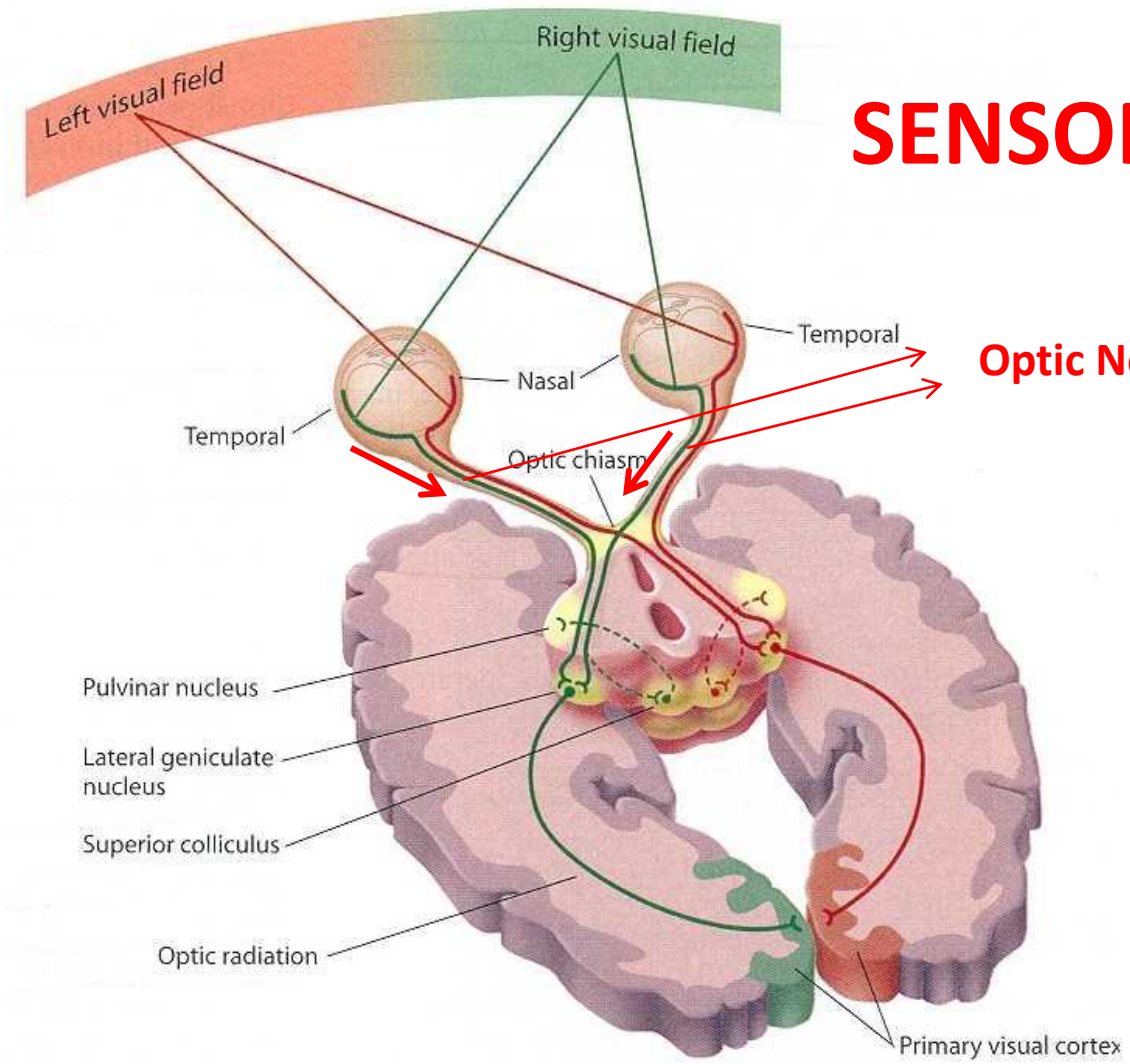
Nasal mucosa

Olfactory nerve

Olfactory Bulb

SENSORY NERVE

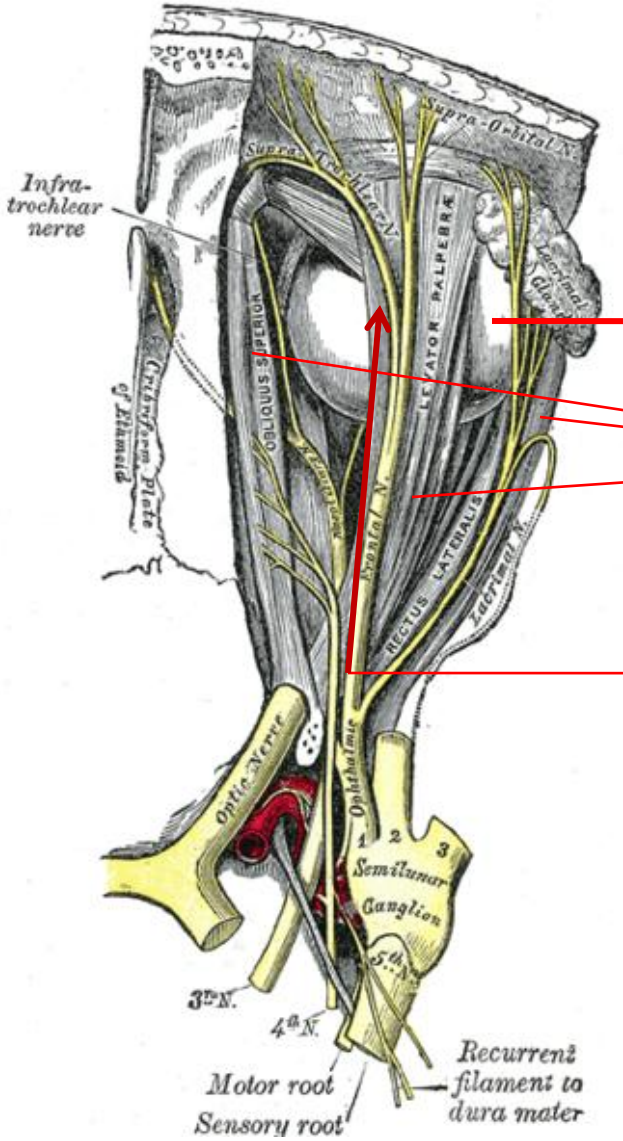
Image for Optic Nerve



SENSORY NERVE

Optic Nerve

Image for occulomotor Nerve



MOTOR NERVE

Eye Ball

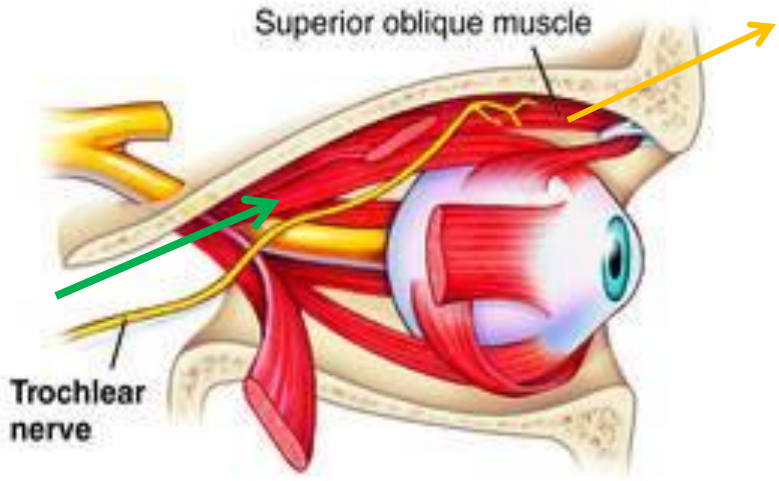
Eye Muscles

Occulomotor Nerve

Supply: Medial rectus, Ventral rectus & Ventral oblique muscles of the eye ball

Image for Trochlear Nerve

MOTOR NERVE



Dorsal Oblique Muscles

Supply: Dorsal Oblique Muscles

Image for Trigeminal Nerve- Opthalmic n.

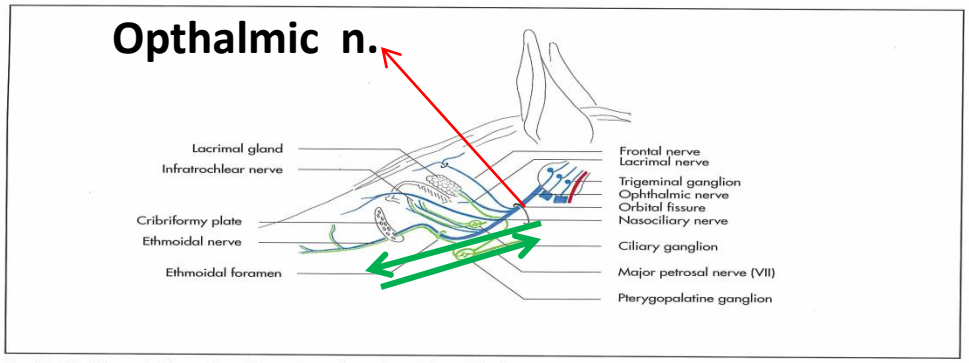


Fig. 14-54. Schematic illustration of the primary branches of the ophthalmic nerve in the horse (blue = sensory, red = motor, green = parasympathetic fibres).

with the zygomatic nerve) to the cornual branch. The **secretory fibres** for the innervation of the lacrimal gland come from the intermedial portion of the intermediofacial nerve and form synapses in the **pterygopalatine ganglion.** The postganglionic fibres run with the maxillary and zygomatic nerve before they join the lacrimal nerve.

The **frontal nerve** passes rostrally under the periorbita dorsal to the dorsal oblique and dorsal rectus muscles of the eyeball. Upon reaching the dorsal margin of the orbit, it penetrates the periorbita and winds around its dorsal margin. In the horse, it passes through the supraorbital foramen. It innervates the skin and conjunctiva of the upper lid, the nasal canthus and the forehead. One branch extends to the frontal sinus.

The **nasociliary nerve** is the largest branch of the ophthalmic nerve. It passes lateral to the optic nerve before crossing over it to reach the medial aspect of the orbit. The nasociliary nerve gives off the short and long ciliary nerves before it bifurcates into the ethmoidal and the infrachtrochlear nerves. The short ciliary nerves pass through the ciliary ganglion. The ciliary nerves run between the sclera and choroid to reach the iris. They extend branches into the bulbar conjunctiva, the ciliary muscle and the cornea.

The **ethmoidal nerve** passes through the ethmoidal foramen to re-enter the cranial cavity. Staying external to the dura mater, it runs to the cribriform plate through which it enters the nasal cavity. It innervates the olfactory mucosa with sensory fibres and sends branches to the frontal sinus and the roof of the nasal cavity to the nasal apex.

The **infratrochlear nerve** runs along the medial aspect of the orbit to the nasal canthus, where it innervates the conjunctiva, the third eyelid and the lacrimal caruncles.

Maxillary nerve (V_2)

The maxillary nerve is considerably stronger than the ophthalmic nerve. It is **sensory** to the lower eyelid, nasal mucosa, upper teeth, upper lip, and nose. Its distal branches comprise of **postganglionic fibres** that supply the lacrimal, nasal and palatine glands. Before leaving the cranial cavity through the **round foramen and orbital fissure** respectively, it detaches the **meningeal branch** (ramus meningeus) for the basal parts of the dura mater (Fig. 14-55 and 14-1). In the pterygopalatine fossa it divides into the:

- Zygomatic nerve (n. zygomaticus),
- Pterygopalatine nerve (n. pterygopalatinus),
- Infraorbital nerve (n. infraorbitalis).

Closely related to the maxillary nerve is the **parasympathetic pterygopalatine ganglion,** which is located medial to the nerve in its course through the pterygopalatine fossa. The **zygomatic nerve** runs on the lateral aspect of the orbit. It innervates the skin of the temporal and frontal region, together with the lacrimal, frontal and auriculopalpebral nerves. It contributes to the cornual nerve, which innervates the horn in ruminants. It provides the lacrimal nerve with parasympathetic fibres from the **pterygopalatine ganglion.** The zygomatic nerve is not present in the cat. The **pterygopalatine nerve** arises from the deep surface of the maxillary nerve from where it passes rostrally. It divides into the:

- Caudal nasal nerve (n. nasalis caudalis),
- Major palatine nerve (n. palatinus major),
- Minor palatine nerve (n. palatinus minor).

MIXED NERVE

Image for Trigeminal Nerve- Maxillary n.

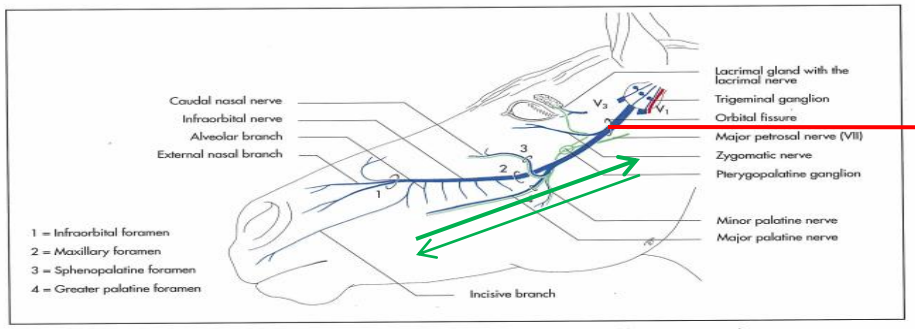


Fig. 14-55. Schematic illustration of the primary branches of the maxillary nerve in the horse (blue = sensory, red = motor, green = parasympathetic fibres).

The **caudal nasal nerve** leaves the pterygopalatine fossa through the sphenopalatine foramen to enter the nasal cavity. It divides into a medial and lateral branch that provides sensory innervation to the nasal septum and to the nasal mucosa of the ventral nasal conchae and the ventral and middle meatus.

The **major palatine nerve** enters the palatine canal through the major palatine foramen and innervates the mucosa of the hard palate. The thin, **minor palatine nerve** provides sensory innervation to the soft palate. The infraorbital nerve is the direct continuation of the maxillary nerve. It enters the infraorbital canal at the maxillary foramen and reappears rostrally on the face through the infraorbital foramen. It gives off **alveolar branches** (rami alveolares) to the maxillary cheek teeth and innervates the skin on the nose, the skin and mucosa of the muzzle and the upper lip. **Branches of the maxillary nerve** convey secretory-parasympathetic fibres from the pterygopalatine ganglion to the lacrimal gland and to various glands of the nose and palate.

Mandibular nerve (V_3)

The mandibular nerve is as strong as the maxillary nerve, but in contrast to the other branches of the trigeminal nerve it is both, **sensory** and **motor** (Fig. 14-56 and Table 14-1). It provides motor innervation to the muscles concerned with prehension and mastication. It provides sensory innervation to the buccal cavity, tongue, mandibular teeth, the lower lip and parts of the facial skin. After detaching a meningeal branch, the mandibular nerve leaves the cranial cavity via the oval foramen (oval incisura in the horse). It detaches the following primary branches:

- Masticator nerve (n. masticatorius)
- Buccal nerve (n. buccalis)
- Auriculotemporal nerve (n. auriculotemporalis) formerly termed superficial temporal nerve (n. temporalis superficialis),
- Lingual nerve (n. lingualis) and
- Inferior alveolar nerve (n. alveolaris inferior).

Just after its passage through the oval foramen, the mandibular nerve detaches the masticator nerve, that divides into the **masseteric nerve** (n. massetericus) and the **deep temporal nerves** (nn. temporales profundi). The masseteric nerve passes through the mandibular notch between the condylar and the coronoid process of the mandible to enter the masseter muscle on its lateral side. The deep temporal nerves are motor to the temporal muscle.

The **medial** and **lateral pterygoid nerve** arise from the mandibular nerve ventromedially and innervate the like-named masticatory nerve. Close to the origins of masticatory nerves lies the otic ganglion. Motor nerves for the tensor muscle of the soft plate and tensor tympani muscle leave the mandibular nerve at the level of the otic ganglion.

The **buccal nerve** passes rostrally between the lateral pterygoid muscle and the temporal muscle to reach the cheeks. It is sensory to the mucosa and the skin of the cheek and conveys secretory fibres from the otic ganglion to the buccal glands. (The term buccal branches (rami buccales) designate the motor branches of the intermediofacial nerves to the cheeks).

The **auriculotemporal nerve** arises from the caudal border of the mandibular nerve. It is covered by the parotid salivary gland and bends around the caudal border of the

Maxillary Nerve

MIXED NERVE

Image for Trigeminal Nerve- Mandibular n.

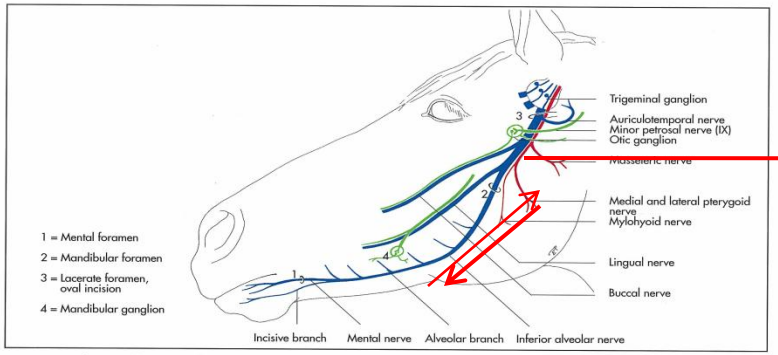


Fig. 14-56. Schematic illustration of the primary branches of the mandibular nerve in the horse without the deep temporal nerves (blue = sensory, red = motor, green = parasympathetic fibres).

mandible to reach the face just ventral to the temporomandibular joint. It divides into an auricular branch and a temporal branch. The auricular branch runs along the rostral margin of the external acoustic meatus to the base of the external ear, and innervates the skin in this area, together with the rostral auricular branch of the intermediofacial nerve. The temporal branch detaches smaller nerves, which innervate the external acoustic meatus, the parotid gland and the skin of the cheeks.

The **mandibular nerve** terminates by bifurcating into the lingual and the inferior alveolar nerves. The inferior alveolar nerve passes between the lateral and medial pterygoid muscles. Before entering the mandibular canal at the mandibular foramen, it detaches its last motor branch, the mylohyoid nerve, which innervates the mylohyoideus muscle and the rostral belly of the digastric muscle. It passes through the mandibular canal supplying alveolar sensory nerves to the teeth and reappears at the mental foramen as the mental nerve, which innervates the skin and mucosa of the lower lip and chin.

The **lingual nerve** passes lateral to the stylohyoid, then medial along the mylohyoideus to reach the tongue, where it divides into **deep and superficial branches.** It is sensory to the mucosa of the rostral two thirds of the tongue and the floor of the oral cavity. It is joined by the chorda tympani, a branch of the intermediofacial nerve, which introduces sensory and parasympathetic fibres from the mandibular ganglion. These supply secretory innervation to the sublingual and mandibular glands.

Damage to the trigeminal nerve causes paralysis of the masticatory muscles characterised by a dropped jaw. This condition is most common in the dogs, in which it may be an idiopathic condition. In many cases it occurs, concurrently with paralysis of the hypoglossal nerve, which causes the tongue to hang out of the mouth in affected animals. Most common aetiologies include brain abscesses, brain trauma and rabies.

Abducent nerve (VI)

The abducent nerve provides motor innervation to the lateral rectus bulbi muscle and the lateral quarter of the retractor bulbi muscle of the eyeball. Its fibres originate in the motor nucleus of this nerve in the dorsal part of the pons, where motor fibres of the intermedio nerve arch around it (Fig. 14-14, 16, 46 and Table 14-1).

The abducent nerve emerges on the rostral end of the lateral ventral groove of the medulla oblongata and leaves the cranial cavity together with the maxillary, oculomotor and trochlear nerves, through the round opening or the orbital fissure respectively.

Facial nerve (VII)

The axons of the facial nerve arise from two separate nuclei in the **medulla oblongata.** The motor nucleus is located in the ventral part of the rostral medulla oblongata close to the pons. The fibres from this nucleus run dorsally, around the abducent nucleus to curve ventrally again. The **preganglionic parasympathetic fibres** of the facial nerve originate in the parasympathetic nucleus, which is located caudal to the motor nucleus. The motor and parasympathetic fibres unite just distal to their emergence of the brainstem, lateral to the trapezoid body, to form the roots of the facial nerve. They are joined by sensory fibres from the **geniculate ganglion** (ganglion geniculi). An intermediate portion constitutes the sensory and parasympathetic portion of the facial nerve, while the facial

Mandibular Nerve

MIXED NERVE

Image for the Abducent Nerve

MOTOR NERVE

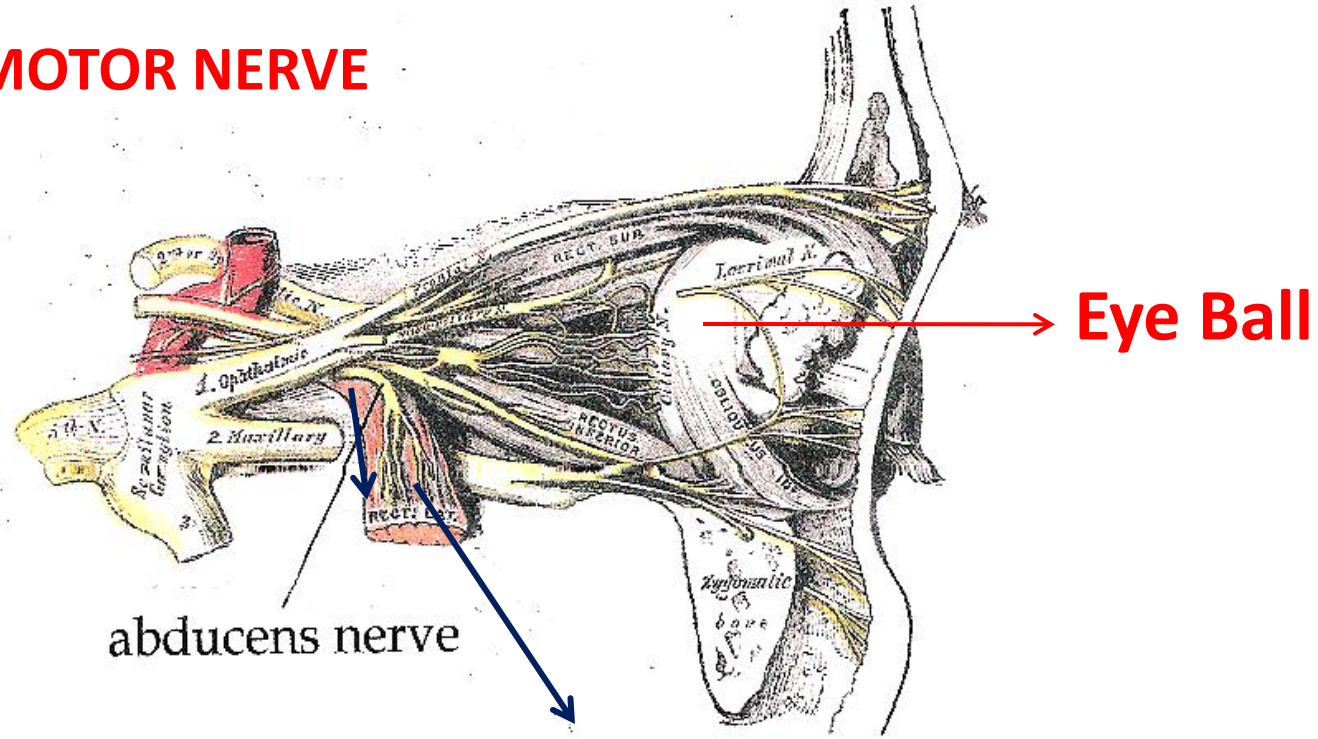


Image for the Facial Nerve

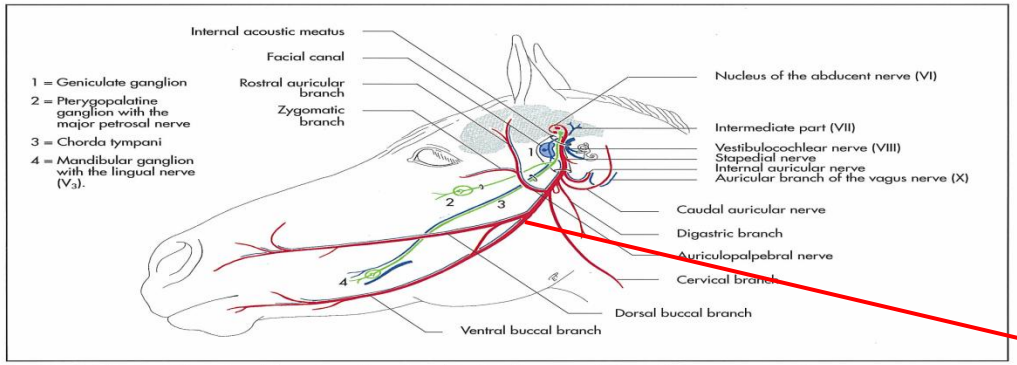


Fig. 14-58. Schematic illustration of the primary branches of the facial nerve in the horse (blue = sensory, red = motor, green = parasympathetic fibres).

innervates the muscles concerned with opening of the mouth. The **auriculopalpebral nerve** arises at the base of the ear. It crosses the zygomatic arch, covered by the parotid gland, and detaches branches to the rostral auricular muscles (rami auriculares rostrales) and a zygomatic branch. Its fibres unite with trigeminal fibres from the auriculotemporal, the lacrimal and the frontal nerves to form a rostral auricular plexus between the eye and the ear from where motor fibres innervate the muscles of the eyelids.

The facial nerve detaches branches to the parotid gland, the parotidoauricular muscle and the cutaneous colli muscle. The branch that innervates the cutaneous colli leaves the facial nerve on its ventral border and unites with fibres of the ventral branches of the first cervical nerve. It is not present in the ox and the sheep.

The **main trunk** reaches a subcutaneous position on the masseter muscle at the rostral border of the parotid gland. Here it terminates by dividing into **buccal branches.** These form a plexus (plexus buccalis), which vary not only among the different species, but also among individuals. From the buccal plexus arise motor branches to the muscles of the cheek, lips and the nares. These are joined by sensory fibres from the auriculotemporal and infraorbital branch of the trigeminal nerve.

The **clinical signs of facial nerve paralysis** clearly depend on the site of the lesion. Lesions, that involve central parts of the nerve, affect the whole facial field, including paralysis of the muscles of the ear, eyelids, nose and lips and lead to loss or reduction of the secretory activity of the lacrimal and salivary glands. More peripheral lesions, that occur in the middle ear or outside the skull lead to unilateral paralysis of the mimetic musculature. It is characterised by asymmetrical drooping of the muzzle and inability to close the eye. Humans show an increased sensitivity to noise (hyperakusis). In horses, the subcutaneous part of the nerve is sometimes damaged by pressure exerted from a tight halter and may paralyse the muscles of the lips and cheeks.

Vestibulocochlear nerve (VIII)

The vestibulocochlear nerve only provides sensory innervation and is composed of the vestibular nerve, that is concerned with balance and the cochlear nerve, that is concerned with hearing (Fig. 14-30, 46 and Table 14-1).

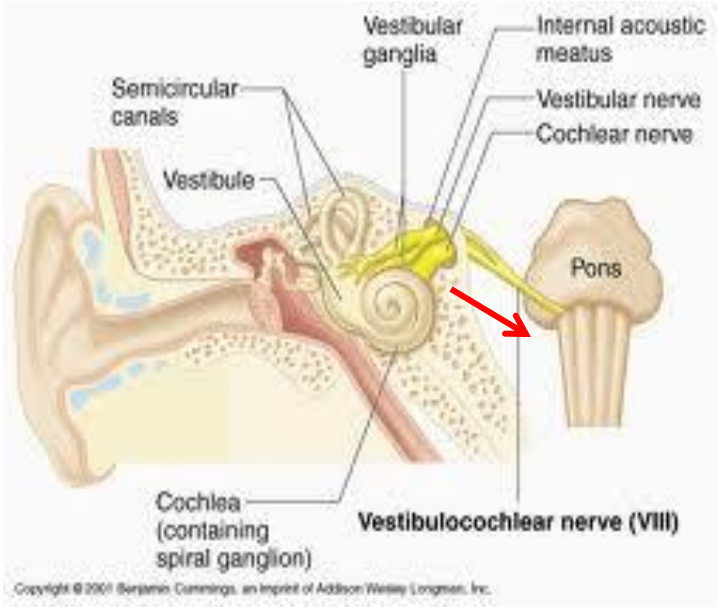
The **vestibular nerve** connects the vestibular apparatus of the inner ear with the brain. The cell bodies of its bipolar neurons are located in the vestibular ganglion and the peripheral fibres arise from the **cristae** (cristae ampullares) and **maculae** (maculae utriculi et sacculi) of the membranous labyrinth. The **vestibular ganglion** is located within the fundus of the internal acoustic meatus and consists of a superior and an inferior part. The afferent fibres of the vestibular component form the vestibular root, that enters the medulla at the trapezoid body, where it passes to the vestibular area with its terminating nuclei (nucleus vestibularis rostralis, spinalis, medialis, lateralis). Part of the fibres pass directly to the cerebellum.

The **cochlear nerve** transmits impulses from the ear to the brain perceived as hearing. It is composed of fibres whose cell bodies are located within the band-shaped **spiral ganglion** within the osseous modiolus of the cochlea. The peripheral processes of these cells end by synapsing with hair cells of

MIXED NERVE

Facial Nerve

Image for the Vestibulocochlear Nerve



Sensory Nerve

Image for IX, X, XI, XII Nerves

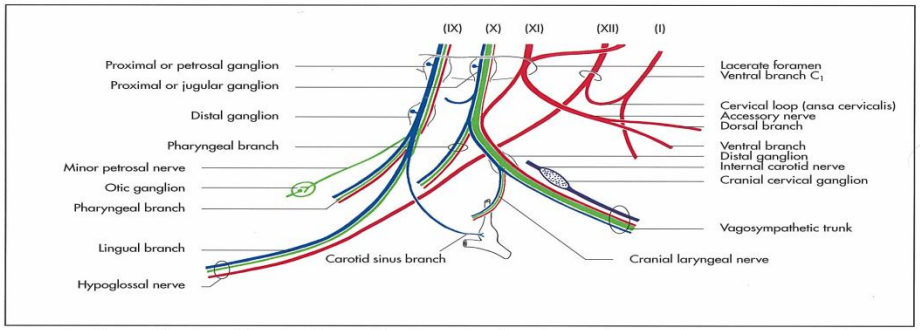


Fig. 14-60. Schematic illustration of the original parts of the vagus group (glossopharyngeal, vagus and accessory nerves) and the hypoglossal nerve, including major ganglia (Budras and Röck, 1997).

In the horse, the glossopharyngeal nerve passes through the medial compartment of the guttural pouch, in a common fold with the hypoglossal nerve. Inflammation of the guttural pouch may cause damage to these nerves, which is characterised by difficulties in swallowing.

Vagus nerve (X)

The vagus nerve is not restricted to the **head,** like the other cranial nerves, but has a widespread distribution to innervate the **viscera of the thoracic** and **abdominal cavities.** It is the largest parasympathetic nerve of the autonomous nervous system (Fig. 14-46, 60, 61 and Table 14-1).

The vagus is a **mixed nerve,** conveying motor, sensory and parasympathetic fibres. The motor fibres arise in the **caudal part of the nucleus ambiguus** of the medulla oblongata and are joined by additional motor fibres from the accessory nerve. The **cell bodies** of the **pseudounipolar sensory neurons** are located in the **proximal ganglion of the vagus nerve** (formerly called jugular ganglion). Their receptors are located in the viscera and their afferent fibres extend to sensory nuclei in the medulla oblongata.

The **parasympathetic preganglionic cell bodies** are located in the **parasympathetic nucleus of the vagus,** which lies immediately caudal to that of the glossopharyngeal nerve in the medulla oblongata. The long preganglionic parasympathetic fibres of this nucleus terminate in the intramural ganglia of the thoracic and abdominal viscera. The parasympathetic branches of the head synapse in the **distal ganglion** (formerly called ganglion nodosum), which is located at the detachment of the cranial laryngeal nerve.

The vagus nerve emerges on the ventrolateral aspect of the medulla oblongata between the glossopharyngeal and the accessory nerve with which it passes through the jugular foramen. The proximal ganglion of the vagus lies within the **jugular foramen.** The vagus nerve detaches a small **meningeal branch** (ramus meningeus) and the auricular branch close to the jugular foramen.

The **auricular branch** joins a branch of the facial nerve to innervate the skin on the inside of the external ear. It is the only branch of the vagus, which innervates the skin. It is hypothesised, that this branch plays a major role with regards to auricular acupuncture.

The next branch to arise is the strong **pharyngeal branch,** which joins the glossopharyngeal nerve in the formation of the **pharyngeal plexus.** This plexus forms a fine network with numerous dispersed groups of nervous cells on the surface of the muscles and in the tela submucosa of the pharynx. These vagus fibres provide sensory innervation to the mucosa of the epiglottis, trachea and esophagus. Branches for the constrictors of the pharynx and the root of the tongue arise from the pharyngeal plexus.

The **cranial laryngeal nerve** arises from the vagus at the **distal ganglion** and marks the end of the cranial portion of the vagus nerve. It passes to the larynx, where it divides into an **external** and an **internal ramus.** The external branch innervates the caudal pharyngeal constrictors, while the internal branch is sensory to the larynx. Before bifurcating the cranial laryngeal nerve detaches the depressor branch, that runs either alone or together with the **vagosympathetic trunk** to the **cardiac plexus,** where its action is to slow the heart rate.

The vagus nerve receives **sympathetic fibres** from the **cranial cervical ganglion.** The distal ganglion of the vagus nerve is visible macroscopically in the dog, cat and pig, while in the horse, ox and sheep is consists of several dispersed cell bodies and requires a microscopic identification. In the goat both discrete and diffuse ganglia occur in different individuals.