Nervous System

Presented by: Amelia Granberry, DMD

Nervous System Overview

The nervous system has two main divisions: central and peripheral.

Figure 8-1

Nervous System Overview

- The neuron is the cellular component of the nervous system and is composed of a cell body and neural processes.
- A nerve is a bundle of neural processes outside the central nervous system and in the peripheral nervous system.

Figure 8-1

Nervous System Overview

- A synapse is the junction between two neurons or between a neuron and an effector organ, where neural impulses are transmitted.

Figure 8-1

Nervous System Overview

- In order to function, most tissue, structures, and organs have innervation, a supply of nerves to the body part.
- A nerve allows information to be carried to and from the brain, which is the central information center.
Nervous System Overview

• An accumulation of neuron cell bodies outside the central nervous system is a ganglion (plural, ganglia), such as the trigmeninal ganglion.

Figure 8-8

Nervous System Overview: Afferent and Efferent Nerves

• Nerves are of two types: afferent and efferent.

Figure 8-1

Nervous System Overview: Afferent and Efferent Nerves

• An afferent nerve or sensory nerve carries information from the periphery of the body to the brain (or spinal cord).
• Thus an afferent nerve carries sensory information such as taste, pain, and proprioception to the brain.

Nervous System Overview

• The plasma membrane of a neuron, like all other cells, has an unequal distribution of ions and electric charges between the two sides of the membrane.
• The fluid outside of the membrane has a positive charge; the fluid inside has a negative charge.
• This charge difference is a resting potential and is measured in millivolts.

Nervous System Overview

• The rapid depolarization of the cell membrane results in an action potential, which then causes propagation of the nerve impulse along the membrane.
• An action potential is a temporary reversal of the electric potential along the membrane for a brief period (less than a millisecond).

Figure 8-1
Nervous System Overview

• The action potential begins at one spot on the membrane but spreads to adjacent areas of the membrane, propagating the impulse along the length of the cell membrane.
• After passage of the action potential, there is a brief period—the refractory period—during which the membrane cannot be stimulated.

Clinical Note: Anesthesia

• Many local anesthetic agents such as lidocaine, as used in dentistry, mimic inhibitory neurotransmitters by decreasing sensory neurons’ ability to generate an action potential, thus producing localized anesthesia.
• Anesthesia is the loss of feeling or sensation resulting from the use of certain drugs or gases that serve as inhibitory neurotransmitters.

Central Nervous System

Central Nervous System

One of the major divisions of the nervous system, the central nervous system (CNS) includes both the brain and spinal cord.
Central Nervous System

• The system of membranes is the **meninges**, which has three layers: 
dura mater, arachnoid mater, and pia mater.

Central Nervous System

• The dura mater also surrounds and supports the large venous channels (dural sinuses) carrying blood from the brain toward the heart such as the cavernous sinus in the head.

Central Nervous System: Brain

• The major divisions of the **brain** include: the cerebrum, the cerebellum, the brainstem, and the diencephalon.

Central Nervous System: Brain

• The **cerebrum** is the largest division of the brain and consists of two cerebral hemispheres.

Central Nervous System: Brain

• The **cerebellum** is the second largest division of the brain, after the cerebrum.

Central Nervous System: Brain

• The **brainstem** has a number of divisions including the medulla, pons, and midbrain.

Central Nervous System: Brain

• The **medulla** is closest to the spinal cord.

• The **pons** connects the medulla with the cerebellum and with higher brain centers.

• The **midbrain** includes relay stations for hearing, vision, and motor pathways.
Central Nervous System: Brain

- Superior to the brainstem, the diencephalon primarily includes the thalamus and hypothalamus.
- The thalamus serves as a central relay point for incoming nerve impulses.
- The hypothalamus regulates homeostasis.

Central Nervous System: Spinal Cord

- The other component of the CNS, the spinal cord, runs along the dorsal side of the body and links the brain to the rest of the body.

Dissection Brain and Spinal Cord

Peripheral Nervous System

- The other major division of the nervous system, the peripheral nervous system (PNS), is composed of all the nerves stretching their pathways among the CNS and the receptors, muscles, and glands.
Peripheral Nervous System

- The PNS is further divided into the **afferent nervous system** or **sensory nervous system**, which carries information from receptors to the brain or spinal cord, and the **efferent nervous system** or **motor nervous system**, which carries information from the brain or spinal cord to muscles or glands.

Figure 8-1

Peripheral Nervous System: Somatic and Autonomic

- The **somatic nervous system (SNS)** is a subdivision of the efferent division of the peripheral nervous system and includes all nerves controlling the muscular system and external sensory receptors.
- The SNS involves both receptors and effectors.

Autonomic Nervous System: Sympathetic and Parasympathetic

- The **sympathetic nervous system** is involved in “fight-or-flight responses” such as the shutdown of salivary gland secretion with certain medications.
- The **parasympathetic nervous system** is involved in “rest-or-digest” responses such as the stimulation of salivary gland secretions.

Parasympathetic Nervous System

- Parasympathetic fibers associated with the glands of the head and neck region are carried within various cranial nerves and are briefly described here, as well as in greater detail later.
- Their ganglia are located in the head, and therefore parasympathetic neurons in this region may be either preganglionic neurons (before relaying in the ganglion) or postganglionic neurons (after relaying in the ganglion).
Nervous System

Cranial Nerves

The cranial nerves are an important part of the PNS. All 12 paired cranial nerves are connected to the brain at its base and pass through the skull by way of fissures or foramina.

**CRANIAL NERVE I**
- The first (I) cranial or *olfactory nerve* transmits smell from the nasal mucosa to the brain and thus functions as an afferent nerve.
- The nerve enters the skull through the perforations in the cribiform plate of the ethmoid bone to join the olfactory bulb in the brain.

**CRANIAL NERVE II**
- The second (II) cranial or *optic nerve* transmits sight from the retina of the eye to the brain and thus functions as an afferent nerve.

**CRANIAL NERVE III**
- The third (III) cranial or *oculomotor nerve* serves as an efferent nerve to some of the eye muscles that move the eyeball.
CRANIAL NERVE IV

- The small fourth (IV) cranial or trochlear nerve also serves as an efferent nerve for one eye muscle, as well as proprioception, similar to the oculomotor nerve but without any parasympathetic fibers.

CRANIAL NERVE V

- The fifth (V) cranial or trigeminal nerve has both an efferent component for the muscles of mastication, as well as some other cranial muscles, and an afferent component for the teeth, tongue, and oral cavity, as well as most of the skin of the face and head.

CRANIAL NERVE V

- The trigeminal nerve is the largest cranial nerve and has two roots: sensory and motor.

- The ophthalmic nerve (division) provides sensation to the upper face and scalp.
- The maxillary and mandibular nerves (divisions) provide sensation to the middle and lower face, respectively.

- The sensory root of the trigeminal nerve has three nerve divisions: ophthalmic, maxillary, and mandibular.

CRANIAL NERVE V

- The trigeminal nerve is the most important cranial nerve to the dental professional because it innervates relevant tissue, structures, and organs of the
CRANIAL NERVE VI
• The sixth (VI) cranial or abducens nerve or abducent nerve serves as an efferent nerve to one of the muscles that moves the eyeball, similar to the oculomotor and trochlear nerves.

CRANIAL NERVE VII
• The facial nerve is also important to dental professionals because it innervates relevant tissue of the head and neck and travels through the parotid gland.

CRANIAL NERVE VIII
• The eighth (VIII) cranial or vestibulocochlear nerve serves as an afferent nerve for hearing and balance.
• This nerve conveys signals from the inner ear to the brain.

CRANIAL NERVE IX
• The ninth (IX) cranial or glossopharyngeal nerve carries an efferent component for the pharyngeal muscle, the stylopharyngeus muscle, and the preganglionic gland parasympathetic innervation for the parotid salivary gland (relaying the otic ganglion).
• The nerve also carries an afferent component for the oropharynx and for taste and general sensation from the base of the tongue, and thus is the afferent limb of the gag reflex.

CRANIAL NERVE X
• The tenth (X) cranial or vagus nerve carries a large efferent component for the muscles of the soft palate, pharynx, and larynx and for parasympathetic fibers to many organs in the thorax and abdomen including the thymus gland, heart, and stomach.
• The nerve carries a smaller afferent component for a small amount of skin around the ear and for taste sensation for the epiglottis.

CRANIAL NERVE XI
• The eleventh (XI) cranial or accessory nerve functions as an efferent nerve for the trapezius and sternocleidomastoid muscles as well as for muscles of the soft palate and pharynx.
The twelfth (XII) cranial or hypoglossal nerve functions as an efferent nerve for both the intrinsic and extrinsic muscles of the tongue.

- The nerve exits the skull through the hypoglossal canal in the occipital bone.
- The hypoglossal nerve is important to dental professionals because it innervates the tongue.

Figure 3-19