

"General Considerations"

» Cranial Nerves:

- 12 pairs supplying information to the brain from outlying receptor organs.
- Cause changes in peripheral effector organs via motor nerves.

» Arrangement of Nerve Cells:

- Unlike spinal cord, cranial nerve cells are grouped as nuclei located at various levels in the brainstem.

» Spinal nerves contain:

- Afferent somatic fibers
- Afferent visceral fibers
- Efferent somatic fibers
- Efferent visceral fibers

» Additional Cranial Nerve Fibers:

- Special somatic afferent fibers (e.g., visual, auditory)
- Special visceral afferent fibers (e.g., taste)

» Central Connections of Cranial Nerve Nuclei:

- Simplified version used in teaching due to unknown precise connections.

> Motor nuclei control delicate movements (eyes, larynx, face) requiring:

- Integrated muscle action
- Fine control of muscle tone

> Input sources for motor nuclei:

- Cerebellum
- Red nucleus
- Reticular formation
- Corpus striatum (similar to spinal cord lower motor neurons)

» Clinical Value Points:

1) Bilateral Corticonuclear Connections:

- > Present for all cranial motor nuclei, except:
 - Lower part of the facial nucleus (muscles of lower face)
 - Part of hypoglossal nucleus (genioglossus muscle)

2) Cranial Nerves with Afferent Sensory Fibers:

- Cell bodies located in ganglia along nerve course (equivalent to posterior root ganglia).
 - Olfactory nerves' cells are olfactory receptors.

3) Close Cranial Nerve Nuclei:

- Rare for disease to affect only one nucleus.
 - Example: Nucleus ambiguus serves glossopharyngeal, vagus, and cranial root of accessory nerve—commonly all three affected together.

"Clinical Examination of Cranial Nerves"

> Purpose:

- Reveals potential lesions in cranial nerve nuclei, central connections, or lower motor neurons.

"Olfactory Nerve Examination"

- Ensure nasal passages are clear.
- Apply aromatic substance (e.g., peppermint, clove oil, tobacco) to each nostril.
- Ask if the patient can smell and identify the substance.
- Note: Food flavors rely on smell, not taste.

» Anosmia (Loss of Smell):

- Bilateral: Caused by diseases of olfactory mucous membrane (e.g., common cold, allergic rhinitis).
- Unilateral: Due to disease affecting olfactory nerves, bulb, or tract.

> Lesion in Olfactory Cortex:

- Rarely causes complete anosmia due to bilateral fiber travel in cerebral hemispheres.

> Additional Causes:

- Fractures of the anterior cranial fossa involving cribriform plate of the ethmoid (tears olfactory nerves).
- Cerebral tumors (frontal lobes) or meningiomas of anterior cranial fossa (pressure on olfactory bulb or tract).

"Optic Nerve Examination"

» Patient Self-Report:

- Ask if the patient has noticed any change in eyesight.

» Visual Acuity Test:

- Near Vision: Patient reads a card with a standard type, each eye tested separately, with/without spectacles.

- Distant Vision: Patient reads Snellen chart from 20 ft.

» Visual Field Test:

- Examiner and patient sit 2 ft apart, covering opposite eyes (right eye of patient, left eye of examiner).
- Patient looks into examiner's pupil; a small object is moved in an arc around the periphery of the visual field.
- Patient reports visibility of the object, comparing their field with examiner's.
- Note: Check for central scotoma (loss in central vision area).

» Visual Pathway Lesions

> Common Causes:

- Expanding brain tumors, pituitary tumors, cerebrovascular accidents.
- Lesions often occur where nerve fibers are densely packed (optic nerve or optic tract).

> Types of Visual Loss:

- Circumferential Blindness: Caused by hysteria or optic neuritis (from infections in sphenoid/ethmoid sinuses affecting optic nerve).
- Total Blindness of One Eye: Due to complete section of one optic nerve.
- Nasal Hemianopia: Caused by partial lesion on lateral side of optic chiasma.
- Bitemporal Hemianopia: Follows sagittal section of optic chiasma (common in pituitary gland tumors pressing on chiasma).
- Contralateral Homonymous Hemianopia: Occurs with division of optic tract, optic radiation, or unilateral visual cortex destruction.
- Example: Right optic tract lesion leads to left temporal and right nasal hemianopia.

» Fundus Examination

> Procedure:

- Patient looks at a distant object.
- Use right eye/right hand to examine patient's right eye, and vice versa.

> Fundus Observations:

- Optic Disc: Creamy pink with clear lateral margin; center appears paler and hollowed.
- Retina: Pinkish red with no hemorrhages or exudates.
- Blood Vessels: Four main arteries and veins examined at arteriovenous crossings; veins should not be indented by arteries.
- Macula: Slightly darker than surrounding retina, patient looks directly at ophthalmoscope light for examination.

》 Extraocular Muscle Examination

> Eye Movement Test:

- Patient's head fixed; eyes move left, right, up, and down.
- Followed by eye movement upward-laterally, upward-medially, downward-medially, and downward-laterally.

> Pupillary Reactions:

- Test convergence with accommodation.
- Assess direct and consensual light reflexes.

"Oculomotor Nerve"

》 Functions:

- Supplies all extraocular muscles except the superior oblique and lateral rectus.
- Also supplies levator palpebrae superioris (muscle for eyelid elevation), sphincter pupillae (controls pupil constriction), and ciliary muscle (accommodation).

» Complete Lesion Effects:

- Eye Movement: Unable to move upward, downward, or inward.
- Resting Position: Eye looks outward (lateral) due to unopposed lateral rectus and downward due to unopposed superior oblique (external strabismus).

> Symptoms:

- Diplopia (double vision).
- Ptosis (drooping upper eyelid) from levator palpebrae superioris paralysis.
- Pupil dilation (nonreactive to light) due to sphincter pupillae paralysis and unopposed action of dilator muscle.
- Paralyzed accommodation of the eye.

» Incomplete Lesion Types:

- Internal Ophthalmoplegia: Loss of autonomic innervation to sphincter pupillae and ciliary muscle, sparing extraocular muscles.

- External Ophthalmoplegia: Extraocular muscle paralysis while sparing sphincter pupillae and ciliary muscle.

» Nerve Compression and Disease:

- Parasympathetic Autonomic Fibers:
Superficial in the oculomotor nerve, so they are often affected first in compressive lesions.
- Diabetic Neuropathy: Autonomic fibers unaffected; extraocular muscles may be paralyzed.
- Common Conditions: Diabetes, aneurysms, tumors, trauma, inflammation, and vascular diseases.

"Trochlear Nerve"

» Function:

- Supplies the superior oblique muscle, which moves the eye downward and laterally.

» Lesion Effects:

> Symptoms:

- Diplopia (double vision) when looking downward; the images are tilted due to superior oblique paralysis.
- Eye turns medially and downward, making it hard to look down and laterally.

» Common Conditions:

- Head injuries (nerve is prone to stretch and bruising), cavernous sinus thrombosis, aneurysms of the internal carotid artery, and vascular lesions in the dorsal midbrain.

"Abducens Nerve"

» Function:

- Controls the lateral rectus muscle, which moves the eye outward (laterally).

» Lesion Effects:

- Eye Movement: Unable to turn the eye laterally.
- Resting Position: Eye turns inward due to unopposed action of the medial rectus, causing internal strabismus.
- Symptoms: Diplopia (double vision) when looking straight ahead.

» Common Causes of Lesions:

- Head injuries, cavernous sinus thrombosis, aneurysms of the internal carotid artery, and vascular issues in the pons.

> Internuclear Ophthalmoplegia

- Mechanism: Lesion in the medial longitudinal fasciculus disconnects the oculomotor and abducens nuclei.

- Symptoms: When looking laterally, the affected eye moves outward, but the other eye remains straight, failing to follow.
- Causes: Multiple sclerosis, vascular diseases, trauma, brainstem tumors, or infarcts in branches of the basilar artery.

"Trigeminal Nerve"

» Divisions:

- Sensory root branches into ophthalmic (V1), maxillary (V2), and mandibular (V3) divisions.
- Motor root joins the mandibular division.

» Sensory Function Test:

- Lightly touch the face with cotton or a pin over each area of the three divisions.
- Corneal and conjunctival reflexes will be absent if the ophthalmic division is damaged.

» Motor Function Test:

- Ask the patient to clench their teeth to check the masseter and temporalis muscles.

» Trigeminal Neuralgia

- > Symptoms: Severe, stabbing facial pain, commonly in the skin areas supplied by mandibular and maxillary regions.
- Rarely affects the ophthalmic region.

"Facial Nerve"

» Functions:

- Controls muscles of facial expression.
- Provides taste sensation to the anterior two-thirds of the tongue.
- Secretomotor innervation to lacrimal, submandibular, and sublingual glands.

» Facial Expression Test:

- Ask the patient to show their teeth; normally, both sides of the mouth will reveal equal areas of the upper and lower teeth. In facial nerve lesions, the mouth distorts, with a greater area of teeth visible on the intact side.

» Eye Closure Test:

- Ask the patient to close their eyes firmly. If the orbicularis oculi muscle is weak on one side, the lid on that side can be raised more easily.

» Taste Sensation Test:

- Use small amounts of sugar, salt, vinegar, and quinine to test sweet, salty, sour, and bitter sensations on the anterior two-thirds of the tongue.

» Facial Nerve Lesions

> Lesion in pons:

- Both abducens nerve (lateral rectus muscle) and facial nerve dysfunction.

> Lesion in internal acoustic meatus:

- Both vestibulocochlear nerve (balance, hearing) and facial nerve dysfunction.

> Lesion involving nerve to stapedius muscle:

- Hyperacusis (excessive sensitivity to sound) in one ear.

> Loss of Taste

- Anterior two-thirds of tongue:

- Indicates damage to facial nerve proximal to the chorda tympani branch (in the facial canal).

> Parotid Gland Swelling

- Firm swelling in the parotid salivary gland with facial nerve impairment:
- Strong indication of parotid gland cancer involving the nerve within the gland.

» Facial Lacerations

- Deep facial cuts: May involve branches of the facial nerve.

» Upper vs. Lower Motor Neuron Lesions

> Upper motor neuron lesion:

- Muscles of lower face on the opposite side paralyzed; upper face muscles remain functional.
- Corticonuclear fibers supply upper face muscles from both cerebral hemispheres.

> Lower motor neuron lesion:

- All muscles on affected side paralyzed.

- Symptoms:

- Drooping of lower eyelid and mouth angle.
- Tears flow over the lower eyelid; saliva dribbles from mouth corner.
- Inability to close eye or expose teeth fully on the affected side.

» Emotional vs. Voluntary Movements in Hemiplegia

> Emotional facial movements preserved:

- Indicates separate upper motor neuron pathway for mimetic movements, independent from corticonuclear fibers.

> Pathway lesion:

- Loss of emotional movements while voluntary movements are preserved.

> Extensive lesion:

- Results in both mimetic and voluntary facial paralysis.

» Bell Palsy

> Definition:

- Unilateral dysfunction of the facial nerve within the facial canal.

> Mechanism:

- Swelling of the nerve in the bony canal applies pressure on nerve fibers.
- Causes temporary lower motor neuron facial paralysis.

> Cause:

- Unknown; may occur after exposure to a cold draft.

"Vestibulocochlear Nerve"

» Innervation:

- Utricle and saccule: Sensitive to static equilibrium changes.

- Semicircular canals: Sensitive to dynamic equilibrium changes.

- Cochlea: Sensitive to sound.

» Vestibular Nerve Function Disturbance

> Symptoms:

- Vertigo (dizziness) and nystagmus.
- Vestibular nystagmus: Rhythmic oscillation of eyes with the fast phase away from lesion side.

> Cause:

- Reflex control disturbance of extraocular muscles.

> Normal pathway involves:

Vestibular nerve → vestibular nuclei → medial longitudinal fasciculus → cranial nerve nuclei (III, IV, VI).

- Cerebellum: Assists in coordinating extraocular muscle movements.

> Tests:

- Caloric test:

- Temperature changes in external auditory meatus create endolymph convection currents (mainly in lateral semicircular canal), stimulating vestibular nerve.

> Causes of Vertigo:

i) Labyrinth diseases (e.g., Ménière disease).

ii) Lesions in:

- Vestibular nerve.
- Vestibular nuclei.
- Cerebellum.

iii) Multiple sclerosis, tumors, and vascular lesions in the brainstem.

» Cochlear Nerve Function Disturbance

> Symptoms:

- Deafness and tinnitus.

> Hearing tests:

- Whispered voice and vibrating tuning fork for each ear.

» Causes of Hearing Loss:

- Middle ear defects affecting auditory-conducting mechanism.
- Damage to receptor cells in spiral organ of Corti (cochlea).
 - Lesions in:
 - Cochlear nerve.
 - Central auditory pathways.
 - Temporal lobe cortex.

- Lesions in the Internal Ear:
 - Ménière disease.
 - Acute labyrinthitis.
 - Head trauma.
- Lesions in Cochlear Nerve:
 - Tumor (acoustic neuroma) or trauma.
- Lesions in CNS:
 - Tumors in midbrain.
 - Multiple sclerosis.
- Bilateral temporal lobe lesions cause deafness.

"Glossopharyngeal Nerve"

- Motor Supply:
 - Stylopharyngeus muscle.
- Secretomotor fibers to the parotid gland.

- Sensory Supply:

- > Posterior third of tongue:

- General sensation.

- Taste.

- » Testing Integrity:

- General sensation and taste on the posterior third of tongue.

- » Lesions:

- Isolated glossopharyngeal nerve lesions are rare.

- Commonly also involves the vagus nerve.

- "Vagus Nerve"

- » Innervation:

- Many important organs, with primary branches to the pharynx, soft palate, and larynx.

» Tests:

- Pharyngeal (gag) reflex: Touching the pharynx's lateral wall with a spatula should trigger a gag (pharyngeal contraction).
- Afferent pathway: Glossopharyngeal nerve.
- Efferent pathway: Glossopharyngeal (stylopharyngeus muscle) and vagus nerves (pharyngeal constrictor muscles).
- Unilateral vagus lesions: Reduced or absent gag reflex on the affected side.
- Soft palate test: Asking the patient to say "ah" should raise the soft palate and move the uvula backward in the midline.

» Laryngeal function:

- All larynx muscles are supplied by the recurrent laryngeal branch of the vagus, except the cricothyroid muscle (supplied by the external laryngeal branch).

- Vocal cords: Tested via laryngoscopy for hoarseness or voice loss (signs of vagal nerve palsy).

» Lesions affecting the vagus nerve in the posterior cranial fossa may also impact the glossopharyngeal, accessory, and hypoglossal nerves.

"Accessory Nerve"

» Innervation:

- Spinal root supplies sternocleidomastoid (SCM) and trapezius muscles.

» Tests:

- SCM function: Ask the patient to rotate the head against resistance, activating the opposite SCM.
- Trapezius function: Ask the patient to shrug the shoulders to engage the trapezius muscles.

» Lesion Effects:

- SCM paralysis: Head rotation weakness and atrophy on the opposite side.
- Trapezius paralysis: Shoulder drooping, difficulty raising the arm above horizontal, and atrophy.
- Causes of lesions: Tumors, trauma (e.g., stab or gunshot wounds) along the nerve's path.

"Hypoglossal Nerve"

» Innervation:

- Supplies intrinsic tongue muscles, styloglossus, hyoglossus, and genioglossus.

» Tests:

- Tongue protrusion: Observing tongue deviation.
- Lower motor neuron lesion: Tongue deviates toward the paralyzed side, accompanied by atrophy and possible fasciculations.

- Corticonuclear lesion: No atrophy or fasciculation, but tongue deviates opposite the lesion upon protrusion.

- Genioglossus (responsible for pulling the tongue forward) receives contralateral corticonuclear fibers.

» Lesion Causes:

- Tumors
- Demyelinating diseases
 - Syringomyelia,
 - Vascular accidents
- Trauma in the neck (e.g., stab or gunshot wounds).