🧠 Trigeminal Nerve (CN V)

- 🔷 Type: Mixed (Motor + Sensory)
- 🔷 Nuclei (4)
  - Motor nucleus (mid-pons)
  - Mesencephalic nucleus (proprioception)
  - Principal sensory nucleus (touch, pressure)
  - Spinal nucleus (pain, temperature)
- 🔷 Trigeminal (Semilunar) Ganglion
  - Location: Meckel's cave
- 🔷 V1 – Ophthalmic Nerve (Sensory only)
  - Pathway: Cavernous sinus → Superior orbital fissure → Orbit
  - Branches:
    - Lacrimal nerve
      - Lacrimal gland, Conjunctiva, Lateral upper eyelid
      (communicates with Zygomaticotemporal from V2 carrying parasympathetic fibers)
    - Frontal nerve
      - Supraorbital → Forehead, Scalp, Frontal sinus
      - Supratrochlear → Medial forehead, Upper eyelid
    - Nasociliary nerve
      - Long ciliary nerves → Cornea (sensory), Dilator pupillae (sympathetic)
      - Sensory root to ciliary ganglion (passes through without synapse)
      - Posterior & Anterior ethmoidal → Nasal cavity, sinuses
      - External nasal
      - Infratrochlear → Medial eyelid, Side of nose
  - Clinical: Corneal reflex (afferent limb)
- 🔷 V2 – Maxillary Nerve (Sensory only)
  - Pathway: Foramen rotundum → Pterygopalatine fossa
    → Infraorbital groove & canal → Infraorbital foramen
  - Branches:
    - Meningeal branch → Middle cranial fossa
    - Zygomatic nerve
      - Zygomaticotemporal → Lacrimal nerve (V1)
      - Zygomaticofacial → Cheek
    - Superior alveolar nerves
      - Posterior → Molars, Maxillary sinus
      - Middle → Premolars
      - Anterior → Incisors, Canines
    - Infraorbital nerve → Lower eyelid, Cheek, Lateral nose, Upper lip
  - Ganglionic branches → Pterygopalatine ganglion
- 🔷 Pterygopalatine Ganglion (Parasympathetic relay center)
  - Inputs:
    - Greater petrosal nerve (from CN VII – parasympathetic)
    - Deep petrosal nerve (from internal carotid plexus – sympathetic)
  - Distribution via V2 branches to:
    - Lacrimal gland (via Zygomatic → Lacrimal)
    - Nasal mucosa
    - Palate (greater & lesser palatine nerves)
    - Pharyngeal mucosa
  - Clinical: Involved in lacrimation & nasal secretion reflexes

Lec2, Mandibular nerve

- Mandibular Nerve (V3) – Mixed (Motor + Sensory)
  - Origin:
    - Sensory Root: from Trigeminal Ganglion → Foramen Ovale
    - Motor Root: from Trigeminal Motor Nucleus (Pons) → joins sensory root in Foramen Ovale
  - Course:
    - Enters Infratemporal Fossa
      - Lateral to: Lateral pterygoid
      - Medial to: Otic ganglion, Medial pterygoid, Tensor palati
      - Posterior to: Middle meningeal artery
  - Branches from Main Trunk:
    - Nervus Spinosus (Sensory) → via Foramen Spinosum → Dura
    - Nerve to Medial Pterygoid (Motor)
      - Branches to:
        - Medial Pterygoid
        - Tensor Veli Palatini (via Otic ganglion, no relay)
        - Tensor Tympani (via Otic ganglion, no relay)
  - Anterior Division (Mainly Motor)
    - Masseteric Nerve → through mandibular notch → Masseter
    - Deep Temporal Nerves → Temporalis (anterior & posterior branches)
    - Nerve to Lateral Pterygoid
    - Buccal Nerve (Sensory only)
      - Between 2 heads of Lateral Pterygoid → Skin & mucosa of cheek and gums
    - 💥 Does NOT supply Buccinator (→ Facial Nerve does)
  - Posterior Division (Mainly Sensory)
    - Auriculotemporal Nerve
      - 2 Roots encircle Middle Meningeal Artery
      - Passes through Parotid Gland
      - Supplies:
        - Temple
        - External ear (upper auricle)
        - External auditory meatus & tympanic membrane
        - TMJ
        - Parotid gland (postganglionic parasymp from Otic Ganglion)
    - Lingual Nerve
      - Deep to Lateral Pterygoid → Joined by Chorda Tympani (CN VII)
      - Between Ramus of Mandible (lat) & Medial Pterygoid (med)
      - Close to inner surface of last molar (⚠️ extraction risk)
      - Crosses superficial to Hyoglossus, deep to Submandibular gland
      - Submandibular Ganglion hangs from it
      - Passes: Lateral → Inferior → Medial to Submandibular Duct
      - Carries:
        - General sensation (Ant. 2/3 of tongue + floor of mouth) → Trigeminal ganglion
        - Taste fibers (Ant. 2/3 tongue) → Chorda Tympani → Solitary nucleus
        - Parasymp fibers (CN VII → Submandibular ganglion → Submandibular & Sublingual glands)
    - Inferior Alveolar Nerve (Mixed)
      - Largest branch
      - Deep to Lateral Pterygoid → Enters Mandibular Foramen → Mandibular Canal
      - Branches:
        - Nerve to Mylohyoid (Motor) → Mylohyoid + Anterior belly of Digastric
        - Dental branches → Molars & Premolars
        - Incisive Nerve → Canine & Incisors
        - Mental Nerve → Exits Mental Foramen → Skin of chin
      - 🦷 Clinical: Inferior Alveolar Nerve Block
        - Injection near Mandibular Foramen → Anesthetizes mandibular teeth
  - Otic Ganglion (Parasympathetic)
    - Location: Infratemporal fossa, below Foramen Ovale
    - Relations:
      - Lateral: Mandibular nerve
      - Medial: Tensor Veli Palatini
      - Posterior: Middle Meningeal Artery
    - Roots:
      - Parasymp: CN IX → Tympanic Plexus → Lesser Petrosal → Synapse → Parotid via Auriculotemporal
      - Sympathetic: From Plexus around Middle Meningeal Artery
      - Sensory: From Mandibular Nerve (to Parotid)
      - Motor: From Nerve to Medial Pterygoid (no synapse) → Tensor muscles
    - Branches:
      - To Parotid Gland (via Auriculotemporal)
      - To Tensor Tympani & Tensor Veli Palatini
  - Testing CN V3 Function:
    - Sensory: Cotton wisp over mandibular skin
    - Motor: Clench teeth → Feel Masseter & Temporalis contract

- Facial Nerve (CN VII)
  - Functions
    - 👅 Special Sensory (Taste) – anterior 2/3 of tongue
    - 😶 General Sensory – external ear
    - 💪 Somatic Motor – facial expression muscles, stapedius, stylohyoid, digastric (posterior belly)
    - 💦 Visceral Motor (Parasympathetic) – salivary + lacrimal glands
  - Nuclei (in Pons)
    - 🧠 Motor Nucleus – muscles of facial expression
      - Upper face ↔️ bilateral cortical input
      - Lower face ↔️ contralateral cortical input
    - 🌀 Superior Salivatory Nucleus – submandibular & sublingual glands
    - 🌧️ Lacrimal Nucleus – lacrimation (emotional + reflex)
    - 👂 Nucleus of Solitary Tract – taste sensation
  - Course
    - Exits brainstem at: 👁️ Pontomedullary junction
    - Enters 🌀 Internal Acoustic Meatus (with CN VIII)
    - Inside Facial Canal (Petrous part of temporal bone):
      - → Geniculum (sharp bend) → Geniculate Ganglion
      - → Gives off:
        - 😢 Greater Petrosal Nerve
        - 🎧 Nerve to Stapedius
        - 👅 Chorda Tympani
      - Exits via 🕳️ Stylomastoid Foramen
  - Extracranial Course
    - Turns around Styloid process
    - Pierces Parotid Gland (superficial to 🩸 ECA & vein)
    - Forms Parotid Plexus → gives 5 terminal branches:
      - ⬆️ Temporal
      - 👁️ Zygomatic
      - 😃 Buccal
      - 😬 Marginal Mandibular
      - 👔 Cervical
  - Parasympathetic Pathways
    - 😢 Greater Petrosal Nerve → Pterygopalatine Ganglion → Lacrimal, nasal, palatal glands
    - 👅 Chorda Tympani → joins Lingual nerve (CN V3) → Submandibular Ganglion → Sublingual & Submandibular glands
  - Sensory Ganglion
    - 🎯 Geniculate Ganglion – for taste + general sensation
  - Injury Effects
    - LMN lesion: ❌ ipsilateral complete facial paralysis
    - UMN lesion: ❌ contralateral lower face only
    - Bell's Palsy: sudden, unilateral facial weakness
    - Other signs: 💧 dry eye, 👅 loss of taste, 📢 hyperacusis
  - Clinical Notes
    - CN VII = vulnerable in temporal bone fractures, infections, tumors
    - In Bell's Palsy → affects both motor & autonomic components
    - Chorda Tympani = mixed → taste + parasympathetic to glands

- Orbital Region
  - Area overlying the orbit & eyeball
  - Includes:
    - Upper & lower eyelids
    - Lacrimal apparatus

- 🌀 Orbits
  - Bilateral bony cavities (quadrangular pyramids)
  - Contain:
    - Eyeballs 👁️
    - Extraocular muscles
    - Nerves & vessels
    - Orbital fat
    - Most of the lacrimal apparatus
  - Walls:
    - Medial walls → parallel (separated by ethmoidal sinuses & nasal cavity)
    - Lateral walls → ~90° angle
  - Axes:
    - Orbital axes → diverge ~45°
    - Optical axes → parallel ("looking straight ahead")

- 🌀 Orbital Structures
  - Eyelids → control exposure of eyeball
  - Extraocular muscles → move eyeballs & raise upper eyelid
  - Orbital fascia → surrounds eyeball & muscles
  - Conjunctiva → mucous membrane lining eyelids
  - Orbital fat → fills empty spaces

- 🌀 Orbit Anatomy
  - Base:
    - Superiorly: Frontal bone
    - Laterally: Frontal & zygomatic processes
    - Inferiorly: Zygomatic + Maxilla
    - Medially: Maxilla + Frontal processes
  - Apex → Optic canal (lesser wing of sphenoid), medial to SOF

- 🌀 Orbital Walls
  - Superior (roof)
  - Medial wall
  - Inferior wall (floor)
  - Lateral wall

- 🌀 Openings into Orbit
  - Orbital opening → only 1/6 of eye exposed
  - Supraorbital notch → Supraorbital n. + vessels
  - Infraorbital groove & canal → Infraorbital n. + vessels
  - Nasolacrimal canal → Nasolacrimal duct → opens in inferior meatus
  - Inferior orbital fissure → communicates w/ pterygopalatine fossa
    - Transmits:
      - Maxillary n. + Zygomatic branch
      - Inferior ophthalmic vein
      - Sympathetic nerves
  - Optic canal → communicates w/ middle cranial fossa
    - Transmits Optic nerve (CN II) + Ophthalmic artery
  - Superior orbital fissure → communicates w/ middle cranial fossa
    - Transmits:
      - Lacrimal n.
      - Frontal n.
      - Trochlear n. (CN IV)
      - Oculomotor n. (CN III)
      - Abducent n. (CN VI)
      - Nasociliary n.

- 🌀 Nerves of the Orbit
  - Optic Nerve (CN II) → through optic canal w/ ophthalmic artery
  - Lacrimal Nerve → from CN V1 → via upper part of SOF
  - Frontal Nerve → from CN V1 → via upper part of SOF → divides into:
    - Supratrochlear
    - Supraorbital
  - Trochlear Nerve (CN IV) → via upper SOF → to superior oblique
  - Oculomotor Nerve (CN III) → via lower SOF
  - Nasociliary Nerve → from CN V1 → via lower SOF
  - Abducent Nerve (CN VI) → via lower SOF → to lateral rectus

- 🌀 Ciliary Ganglion
  - Location → near orbital apex, between optic nerve (medial) & lateral rectus (lateral)
  - Roots:
    - Sensory: from nasociliary n.
    - Sympathetic: from plexus around ophthalmic artery
    - Parasympathetic:
      - From Edinger-Westphal nucleus → CN III → n. to inf. oblique → synapse in ganglion
  - Branches: 8–10 short ciliary nerves → supply:
    - Parasympathetic → Sphincter pupillae + Ciliary muscle
    - Sympathetic → Dilator pupillae + Blood vessels
    - Sensory → Cornea, iris, choroid

- 🌀 Blood Vessels
  - Ophthalmic Artery:
    - From internal carotid after cavernous sinus
    - Through optic canal w/ CN II
    - Runs medial to orbit → gives off:
      - Central artery of retina
      - Muscular branches
      - Lacrimal artery
      - Ciliary arteries (ant & post)
      - Supratrochlear artery
      - Supraorbital artery
  - Ophthalmic Veins:
    - Superior → communicates w/ facial v.
    - Inferior → communicates w/ pterygoid venous plexus
    - Both drain to cavernous sinus via SOF

- 🌀 Lacrimal Apparatus
  - Lacrimal Gland:
    - Parts: Large orbital + Small palpebral
    - Location: Above eyeball, anterior & upper orbit, behind orbital septum
    - 12 ducts → open in lateral superior conjunctival fornix
  - Nerve Supply:
    - Sensory: Lacrimal branch of CN V1
    - Sympathetic: From superior cervical ganglion → deep petrosal n. → join parasymp. → via n. of pterygoid canal → pass through pterygopalatine ganglion
    - Parasympathetic:
      - Preganglionic: From CN VII → Greater petrosal n. → N. of pterygoid canal → Synapse in pterygopalatine ganglion
      - Postganglionic: Join zygomaticotemporal n. → join lacrimal n. → reach gland
  - Conjunctival Sac:
    - Conjunctiva: lines eyelids, reflected to eyeball (except cornea)
    - Superior & inferior fornices: reflection lines
  - Lacrimal Canaliculi:
    - Start at lacrimal puncta (in medial upper & lower lids)
    - Lead to lacrimal sac
  - Lacrimal Sac → in lacrimal groove
  - Nasolacrimal Duct → ~1.3 cm → opens in inferior meatus of nose

- 🔁 Circulation of Tear:
  Tears → Conjunctival sac → Puncta → Canaliculi → Lacrimal sac → Nasolacrimal duct → Inferior nasal meat

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