Cranial nerves: Nuclei, Distribution & Lesions

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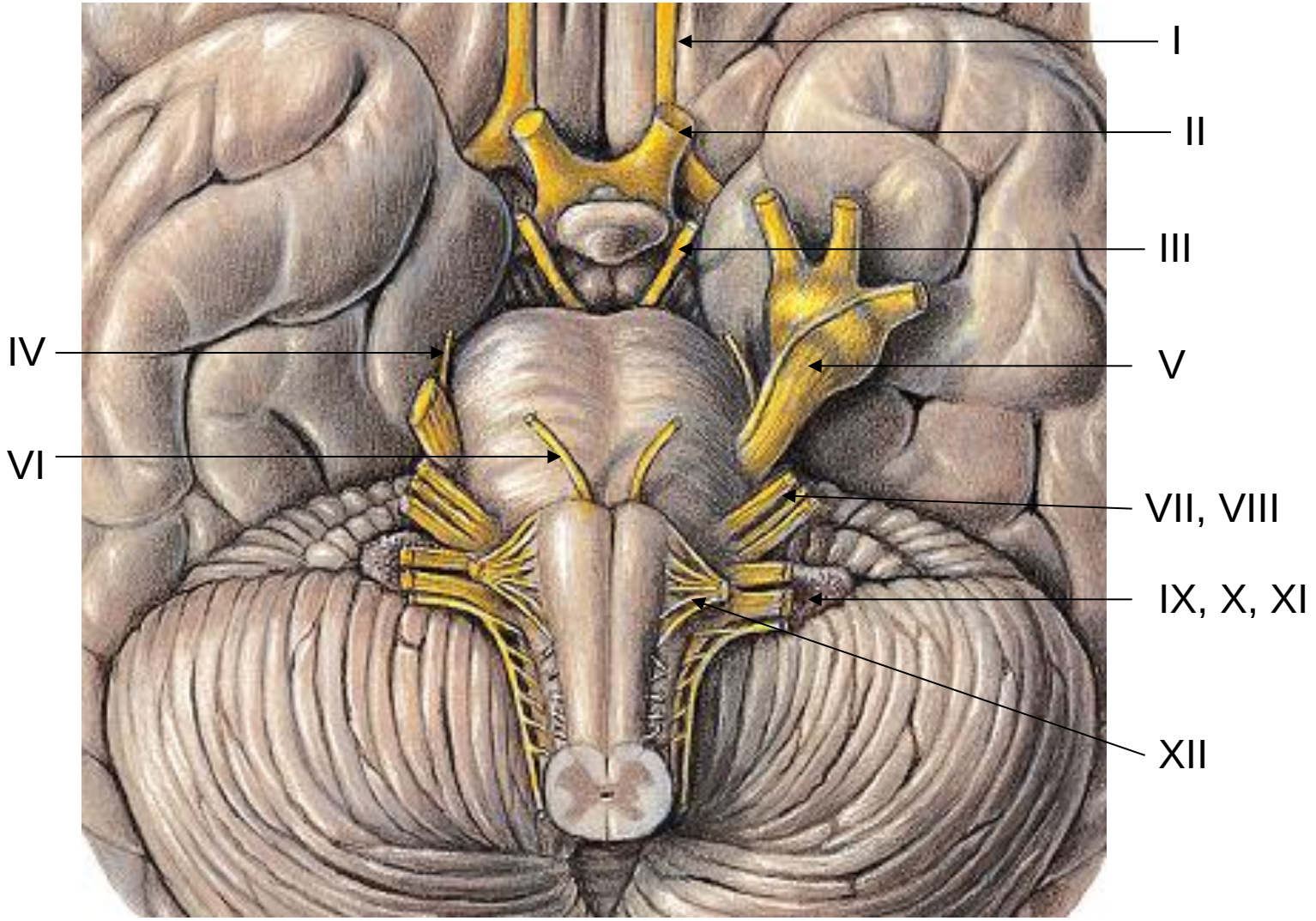
Outline for Each Cranial Nerve

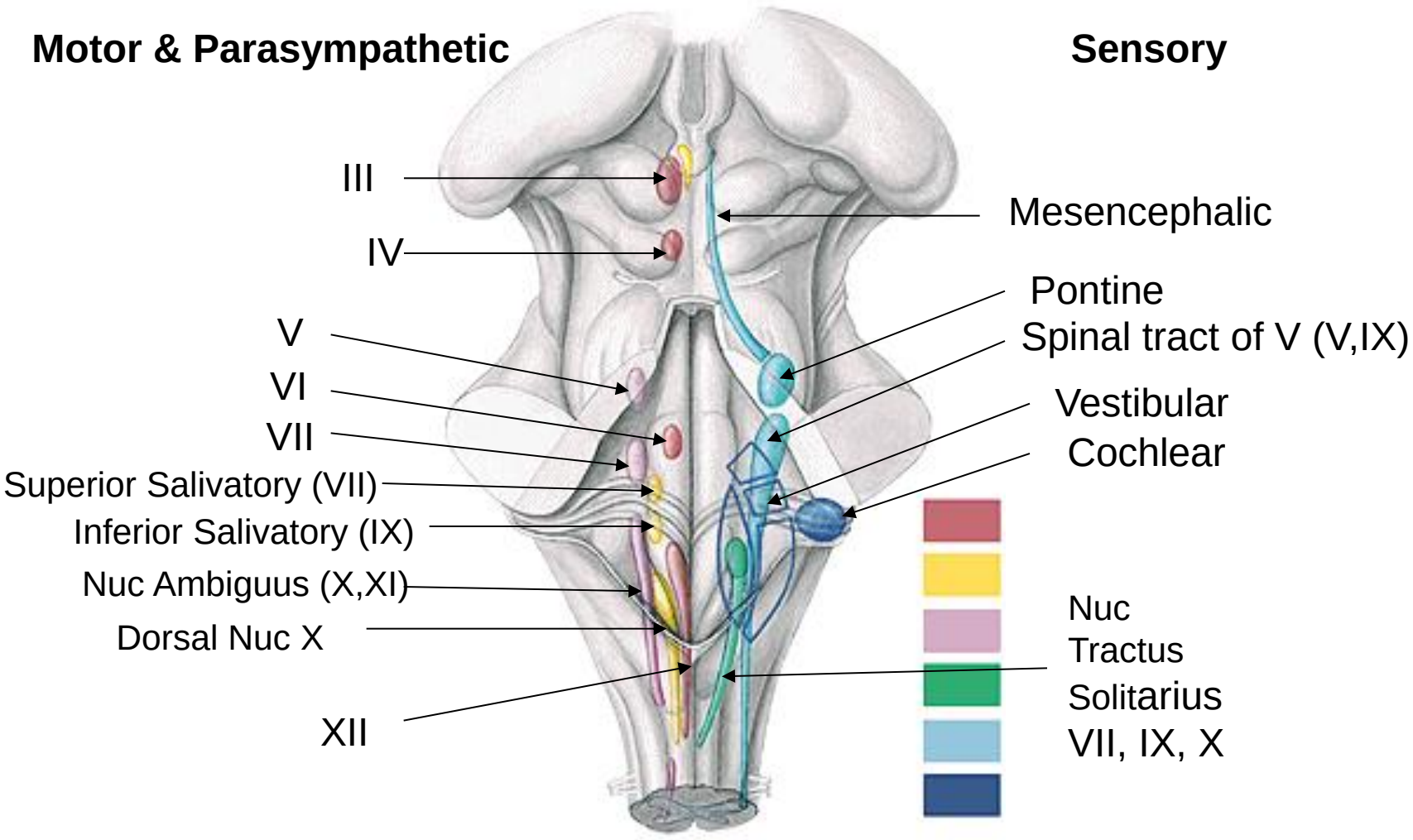
- Origin & point of attachment in brainstem
- Course – Any significance!!!
- Point of exit from or entry into skull (Foramen)
- Distribution/Function (Motor, parasympathetic, sensory, special sensation)
- Dysfunction in case of lesion

Cranial Nerves in Humans



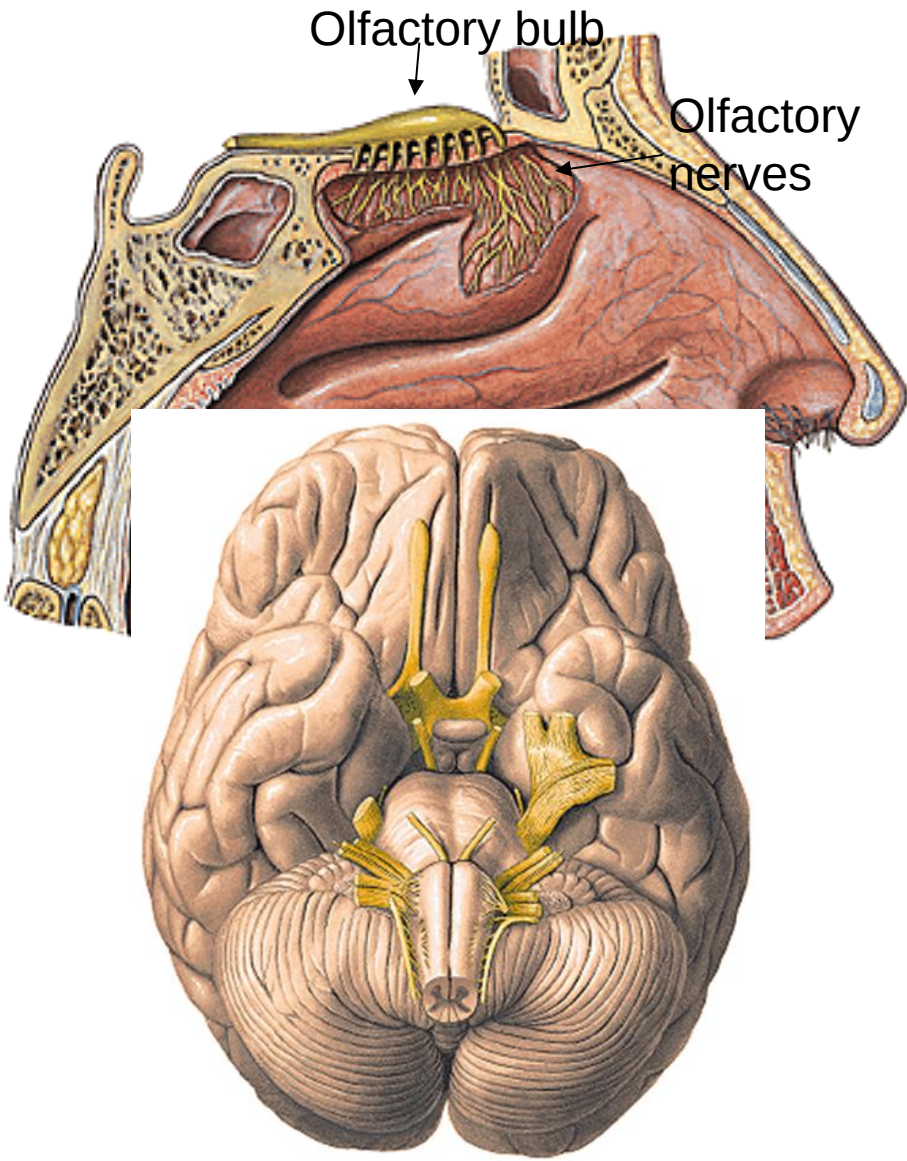
12 bilaterally paired nerves attached directly to a part of brain: cerebrum (I & II); midbrain (III, IV) pons (V, VI, VII, VIII) medulla (IX, X, XI, XII)

Topographic Position of Cranial nerve nuclei



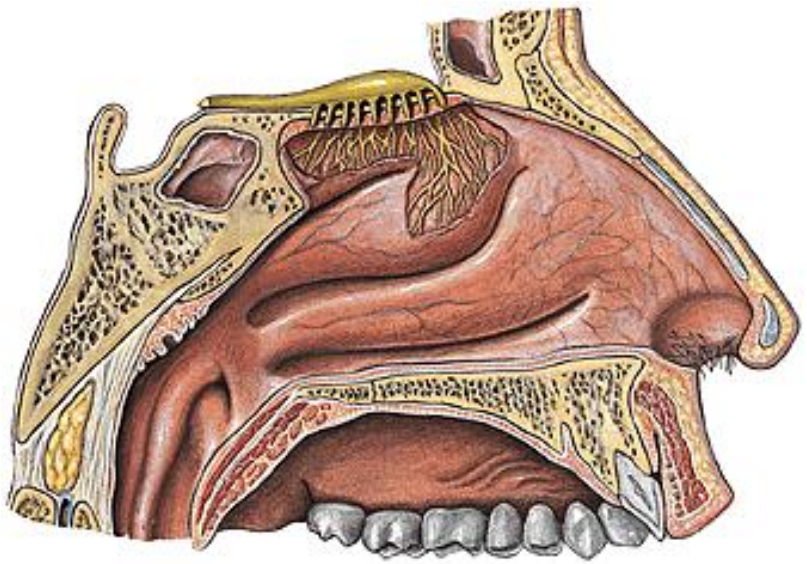
Olfactory Nerve (I)

- **Origin:** 20 neurons from mucosa of upper part of nasal cavity: Pass via **cribriform foramina**
- **End:** Olfactory bulb (largest neuron called mitral cell)
- Olfactory tracts from bulb divide into lateral & medial striae
- Lateral stria →lateral olfactory area of cerebral cortex
- Medial stria → opposite olfactory bulb via anterior commissure



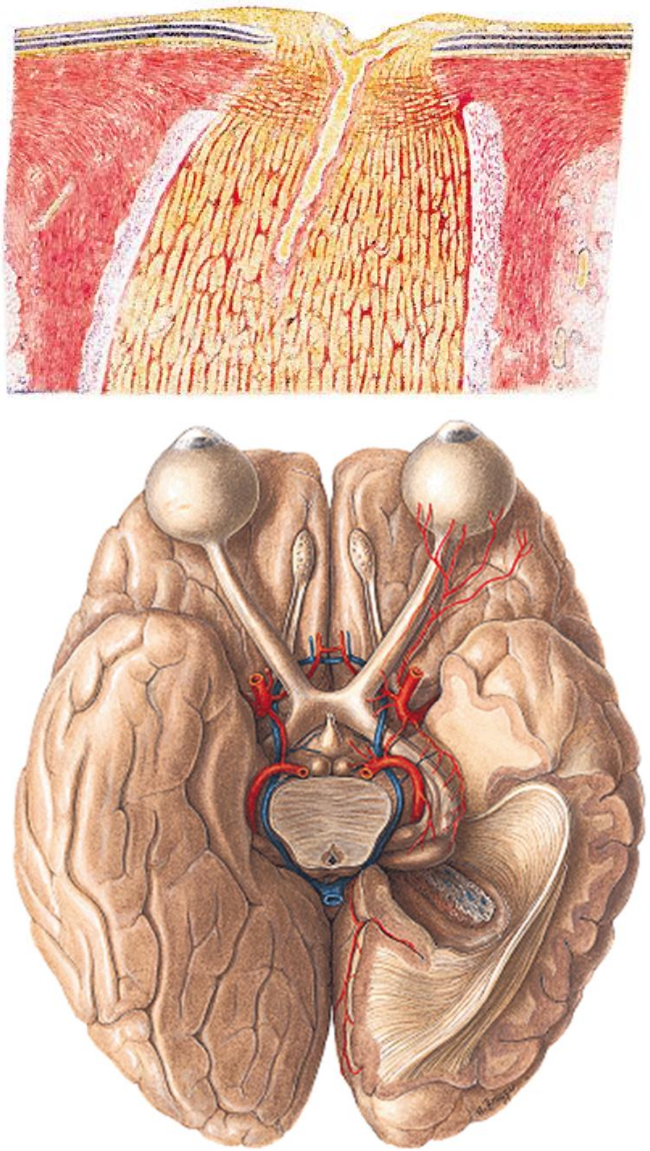
CN I Olfactory: Function & applied

- **Function:** smell
- **Dysfunction:** Anosmia – loss of olfaction
- **Applied**
  - Head injury may tear nerves filaments passing through cribriform plate especially in fractures involving anterior cranial fossa
  - Leakage of CSF through nose (CSF rhinorrhoea) from tearing of meningeal covering of nerve



Optic Nerve (II)

- **Origin:** Axons of ganglionic cells of retina
- **Course:**
  - Pass through **optic canal**. Unites with that of opposite side to form optic chiasma
  - Continues as optic tract & end in Lateral Geniculate Body (LGB)
  - Optic (geniculo-calcarine) radiations arise from LGB & end in visual cortex
- **Function**:
  - Vision & accommodation reflexes

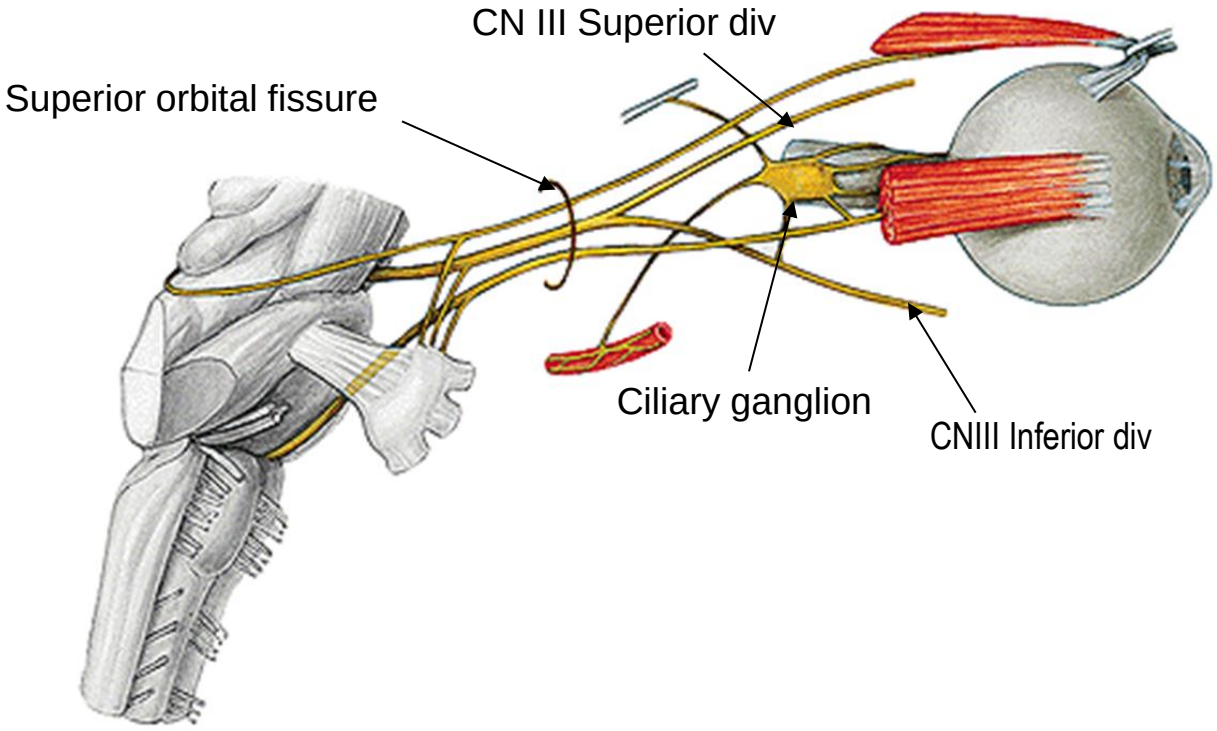


Oculomotor Nerve (III)

Origin: Oculomotor Nucleus (Motor) & Edinger-Westphal (Parasympathetic)

- **Course:** Lies on medial side of crus cerebri, along lateral wall of cavernous sinus; enter orbit through **superior orbital fissure**. Divides into <u>superior & inferior divisions</u>
- Parasympathetic fibres pass via inferior division

Cranial nerves III, IV, & VI



Oculomotor Nerve…

Distribution: Extraocular muscles

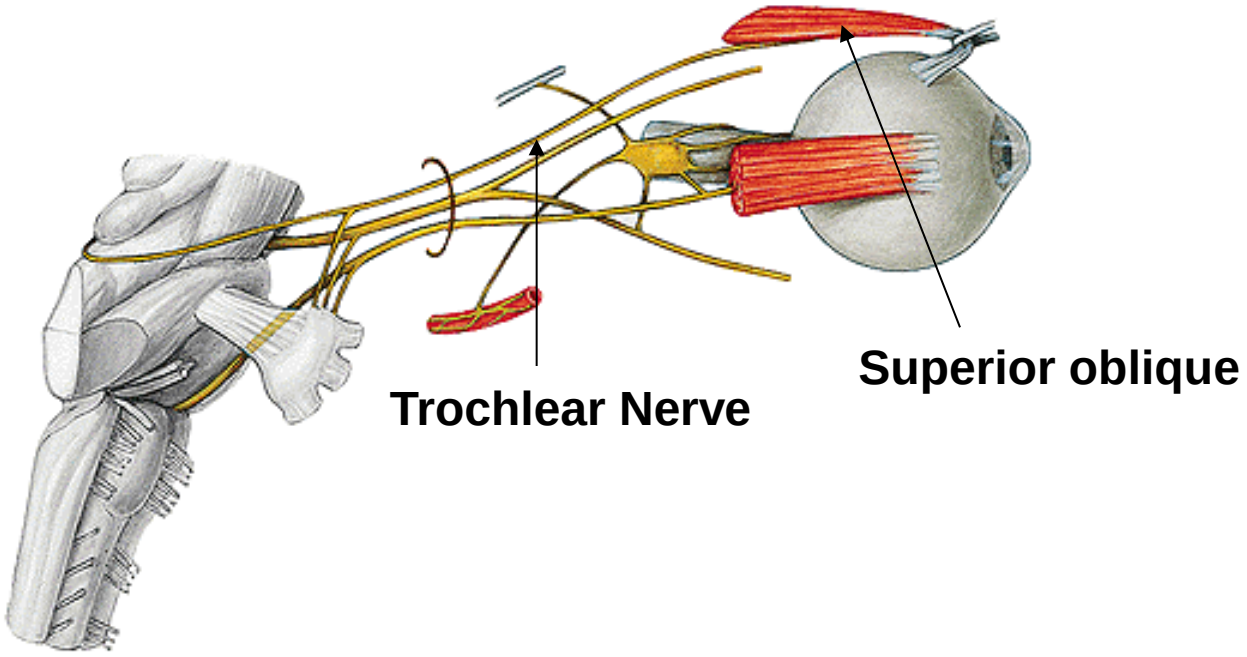
- Superior, inferior, medial recti, inferior oblique, levator palpebral superioris
- Sphincter pupillae muscle of iris & ciliary muscle constricts pupil & accommodates lens

Dysfunction

- Eye deviation - down & out (Lateral stabismus)
  - lateral rectus & superior oblique unopposed.
- Ptosis (drooping of eyelid)
- Mydriasis (fully dilated pupil)
- Loss of power of accommodation
- Diplopia

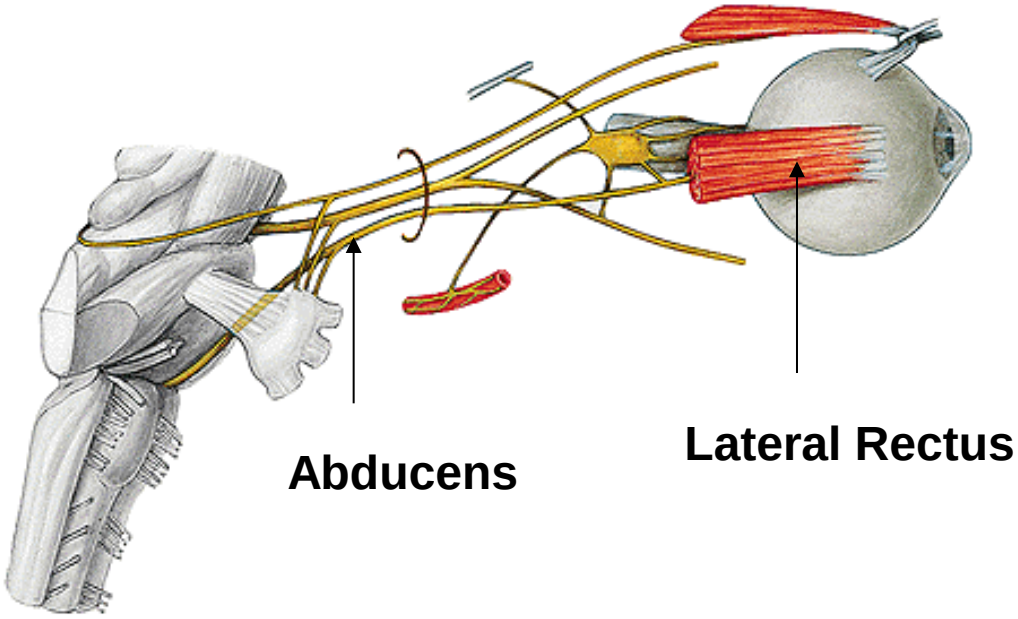
Trochlear Nerve (IV)

- Origin: Trochlear Nucleus. Most slender of cranial nerves
- Course: Only nerve to emerge from dorsal part of brainstem & its fibres cross. Passes onto lateral wall of cavernous sinus, then **superior orbital fissure**
- Distribution: Superior oblique
- Dysfunction: Rarely paralysed alone
  - Diplopia (double vision) on looking down & Extorsion



Abducens Nerve…

- Origin: Abducens nucleus
- Course: Longest course in subarachnoid space.
- Emerges between pons & medulla, passes through cavernous sinus
- Enters orbit through **superior orbital fissure**
- Distribution: Supplies Lateral rectus
- Dysfunction: Medial deviation & diplopia. Cannot look outwards



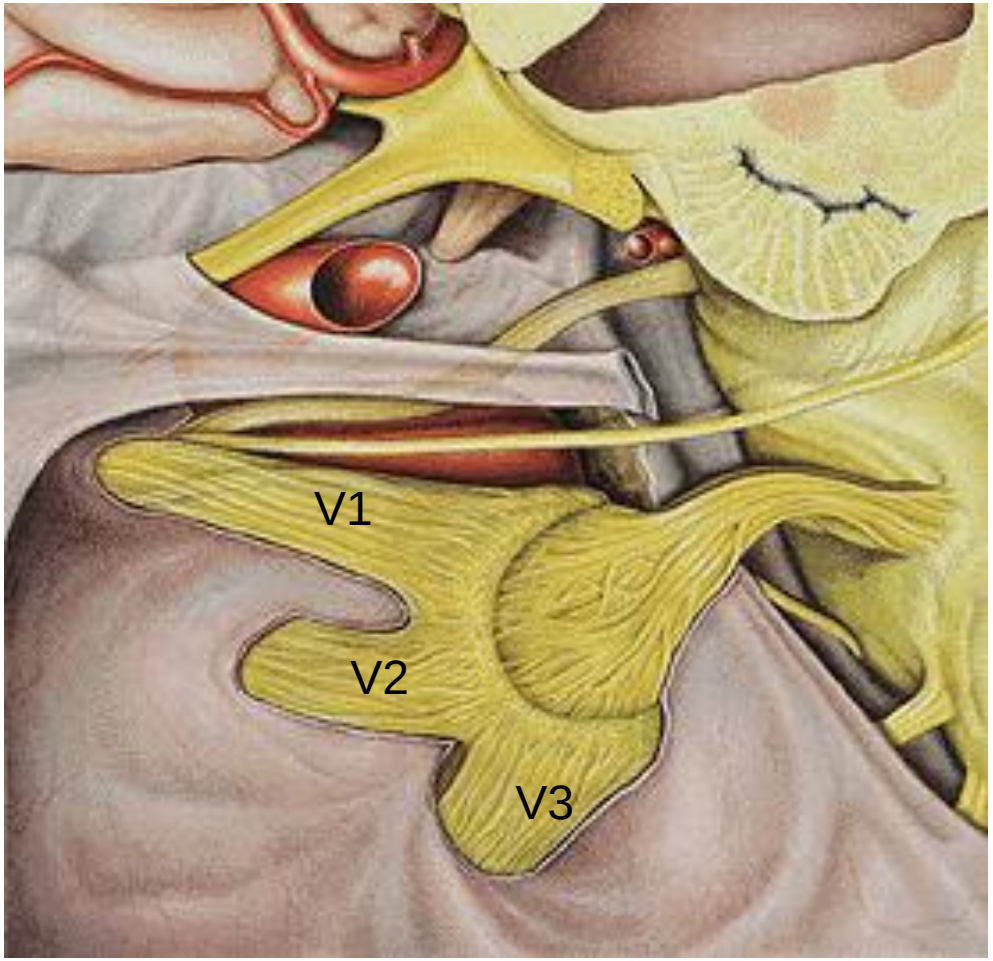
Trigeminal Nerve…

Largest CN

Origin: Motor Nucleus
Sensory Nucleus:
mesencephalic Nuc.
pontine (chief) &
spinal Nuc

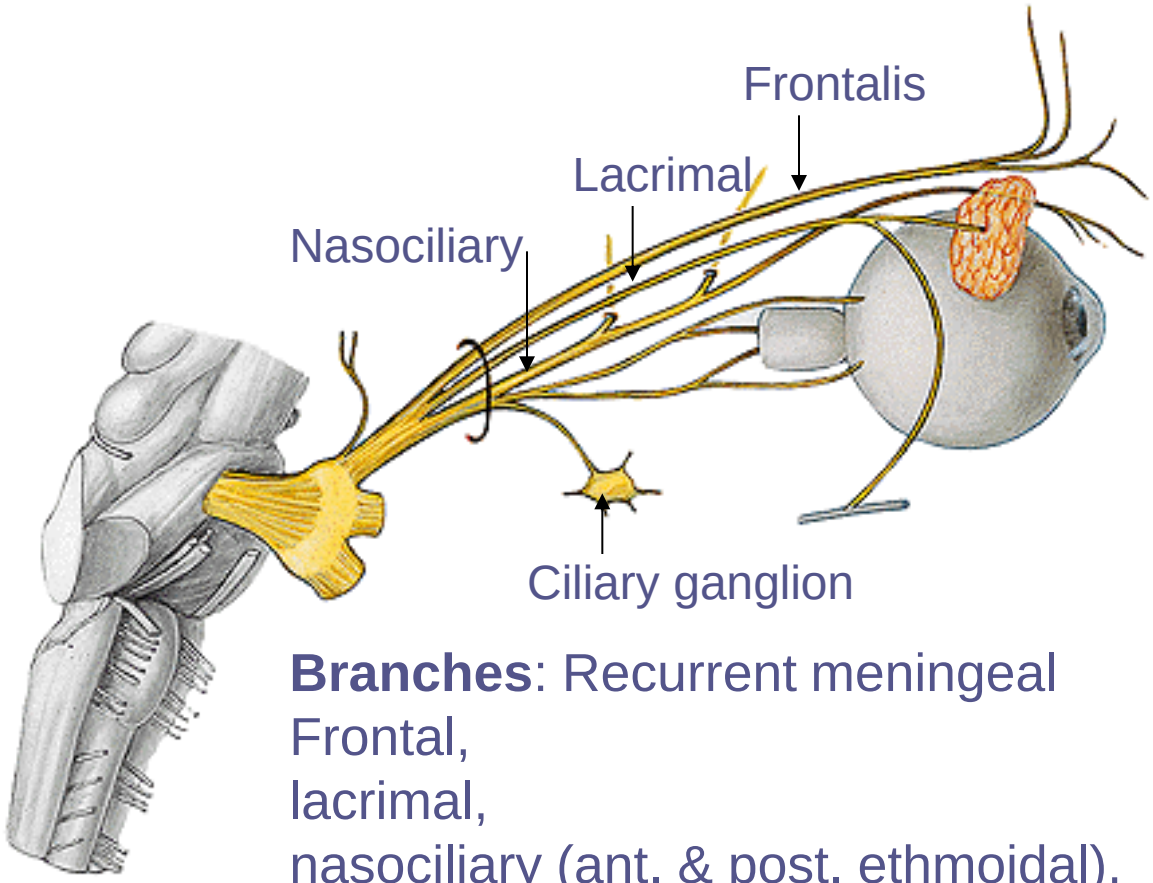
Has 3 divisions:

Ophthalmic
Maxillary
Mandibular



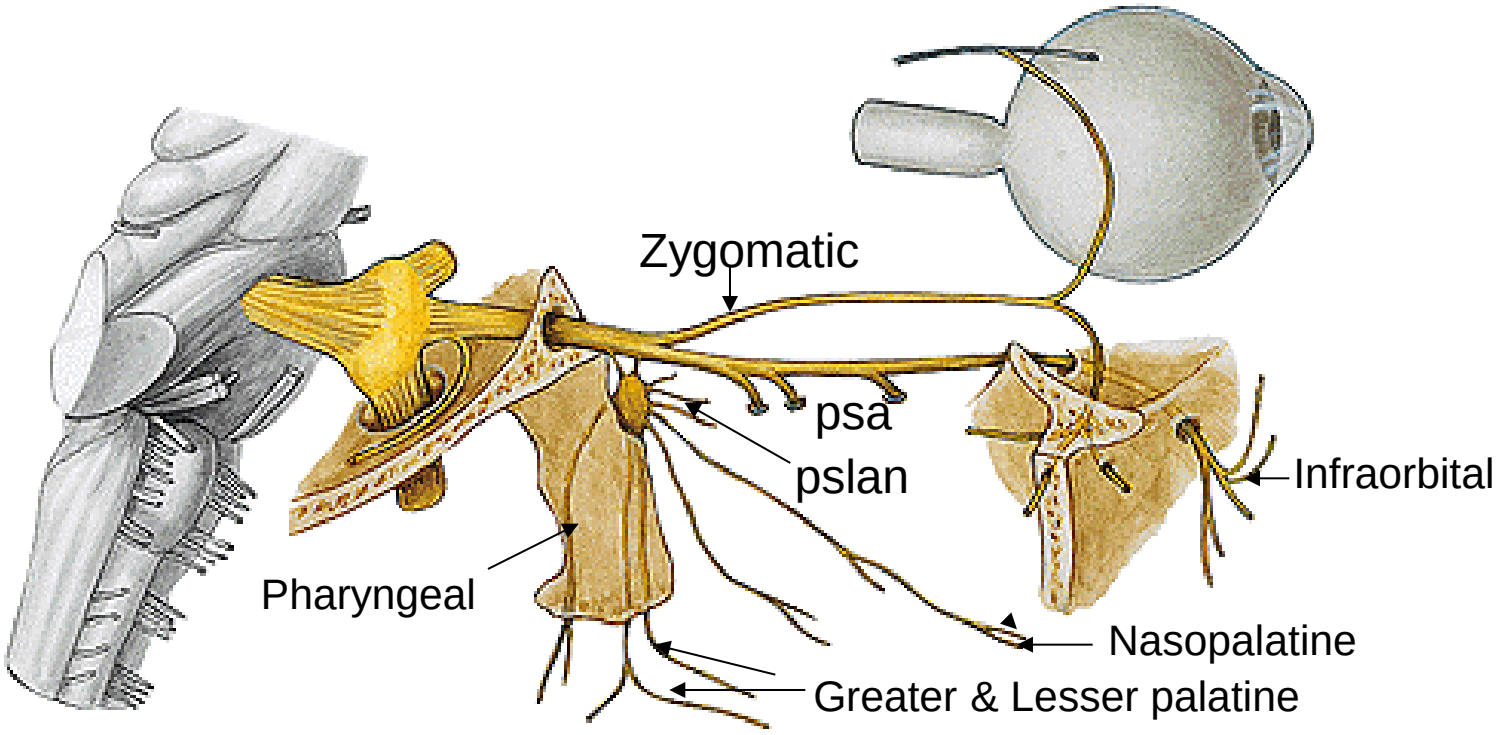
Ophthalmic Division (V1) - **superior orbital fissure**
Maxillary Division (V2) - **foramen rotundum**
Mandibular Division (V3) –
.foramen ovale

Ophthalmic Nerve [V1]



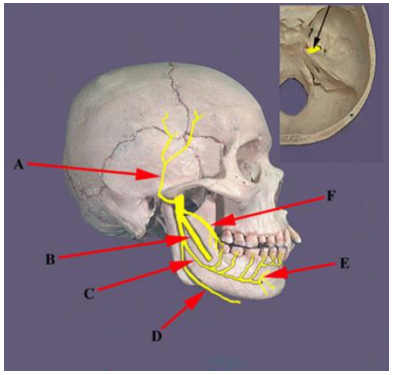
Branches: Recurrent meningeal
Frontal,
lacrimal,
nasociliary (ant. & post. ethmoidal),
(long & short ciliary, infratrochlear

Maxillary nerve [V2]



Branches: meningeal, Zygomatic (facial & temporal)
Post superior alveolar (psa), posterior superior lateral nasal (psln), Infraorbital, Greater & lesser palatine Nasopalatine, Pharyngeal

Mandibular nerve [V3]



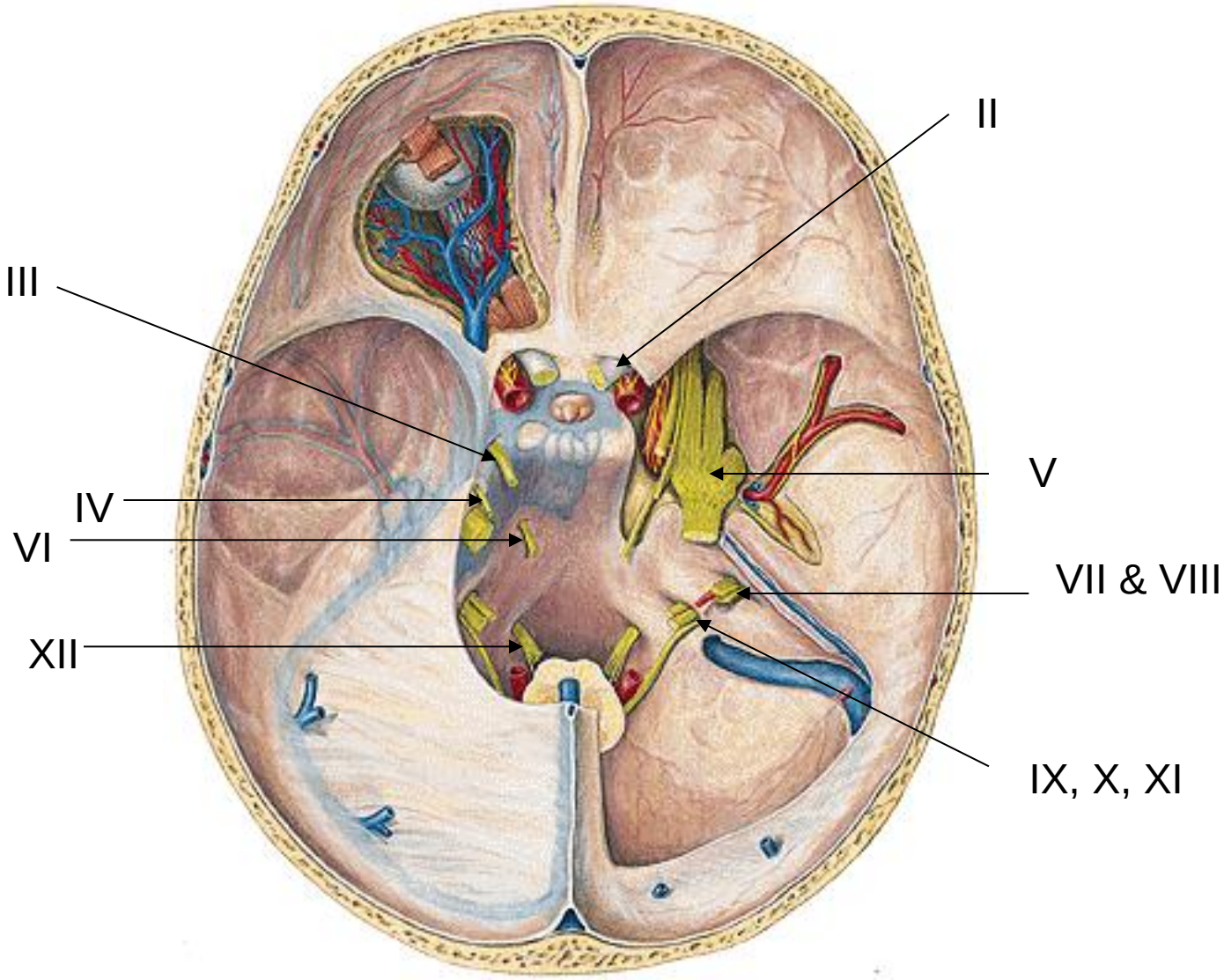
Branches:
Meningeal, Buccal, Auriculotemporal (AT)
Inferior alveolar, lingual (L), muscles of mastication (M, LP), Tensor veli palatini, Mylohyoid, anterior belly of digastric, tensor tympani

Summary Distribution/dysfunction of V

- Sensory
  - Periodontal ligaments of teeth
  - Reflex control of force of bite
  - Discriminative tactile: from skin of face, mucous membrane of middle ear, pharygotympanic tube, pharynx, larynx
- Motor
  - Muscles of mastication
  - Tensor tympani
  - Tensor veli palatine
  - Mylohyoid
  - Anterior belly of digastric

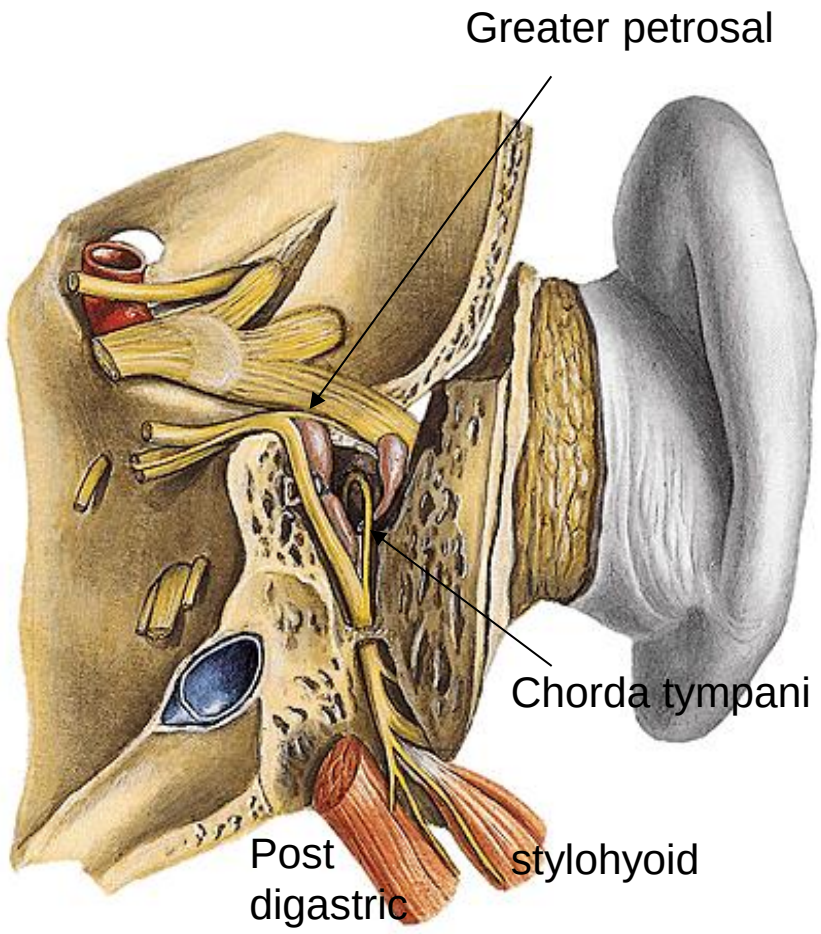
- **Trigeminal Nerve dysfunction**
- Trigeminal neuralgia – pain in distribution of maxillary and/or mandibular nerve.
- Decreased forehead pain and touch, corneal reflex (1st sign of lesion of ophthalmic nerve), cheek touch & pain, jaw touch & pain & jerk, and weakness of muscles of mastication

Cranial Nerves in Base of Skull



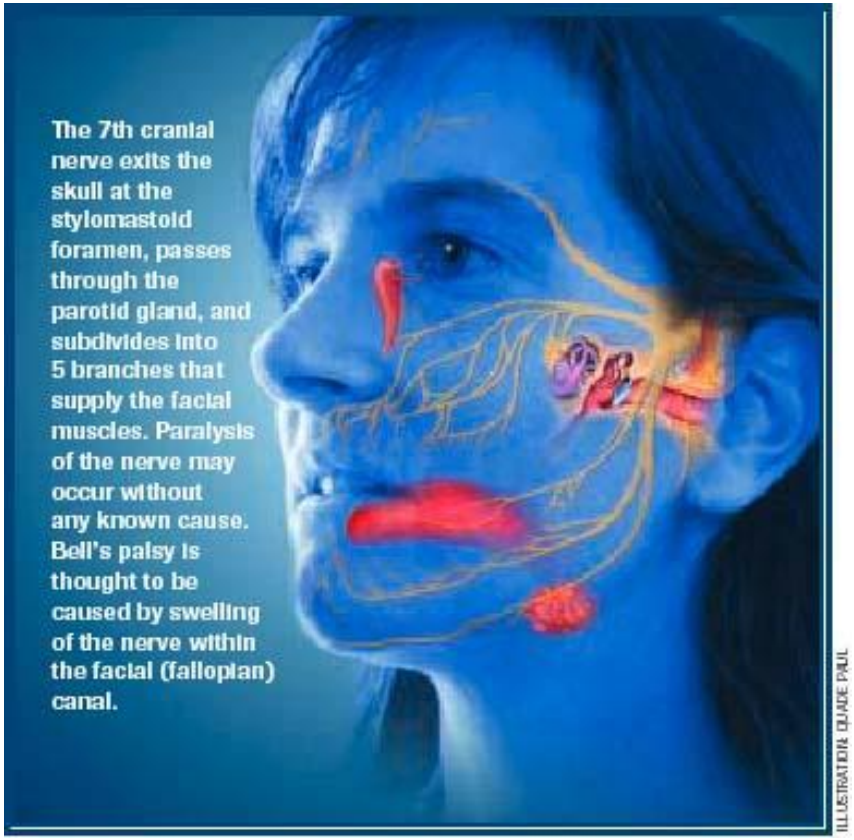
Facial Nerve: Origin and Course

- **Origin:**
  - Motor Nucleus: Fibres loop over CN VI nucleus creating facial colliculus in floor of 4th ventricle (internal genu)
  - Superior salivatory & Lacrimal Nucleus (parasympathetic)
  - Sensory Nucleus (Tractus solitarius/Gustatory Nucleus
- **Course:** Internal acoustic meatus to enter facial canal
- Forms geniculate ganglion (taste & salivation) and turns sharply inferiorly (*chorda tympani* leaves)
- Stylomastoid foramen to supply muscles including those of facial expression.



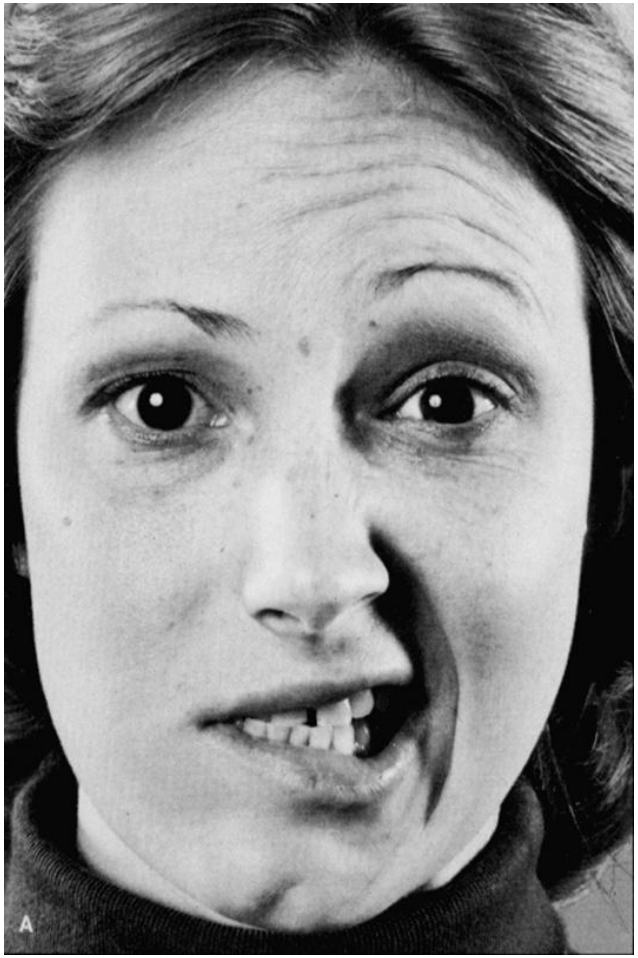
CN VII Distribution

- Motor to
  - muscles of facial expression (TZBMC), stapedius, stylohyoid, posterior belly of digastric
- Taste from anterior 2/3 of tongue
- Skin of external acoustic meatus
- Mucous membrane of nasopharynx & palate
- Lacrimal, nasal, palatine, submandibular & sublingual glands.



CN VII Dysfunction

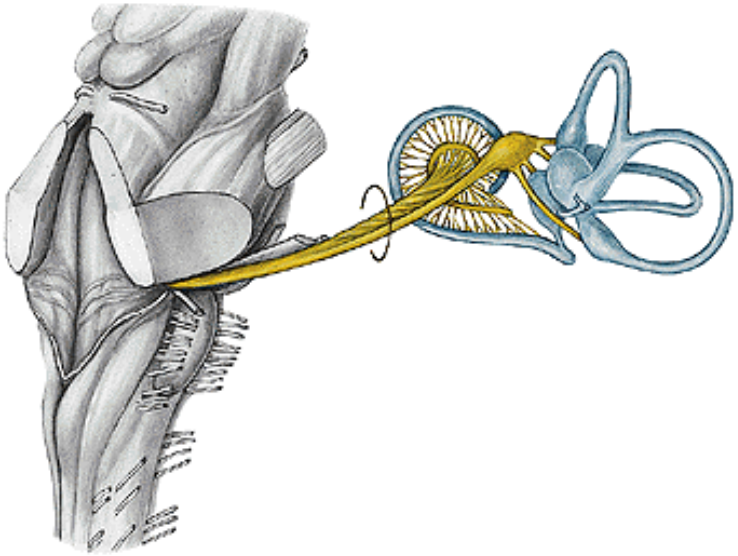
- Most frequently paralysed of all cranial nerves
- Infranuclear lesion (LMN) – Bell's palsy (most common):
  - facial muscles paralysis/weakness with asymmetry of corner of mouth
  - Inability to close eye or wrinkle forehead on affected side
  - excessive acuteness of hearing (hyperacusis)
- Decreased tearing, salivation & taste



medicine.tamu.edu/neuro/

Vestibulo-cochlear Nerve

- **Origin/termination:**
  - Vestibular ganglion (semicircular canal) & end in Vestibular Nucleus
  - Spiral ganglion (Organ of Corti) & end in Cochlear Nucleus
- Both pass with CN VII through **internal acoustic meatus**

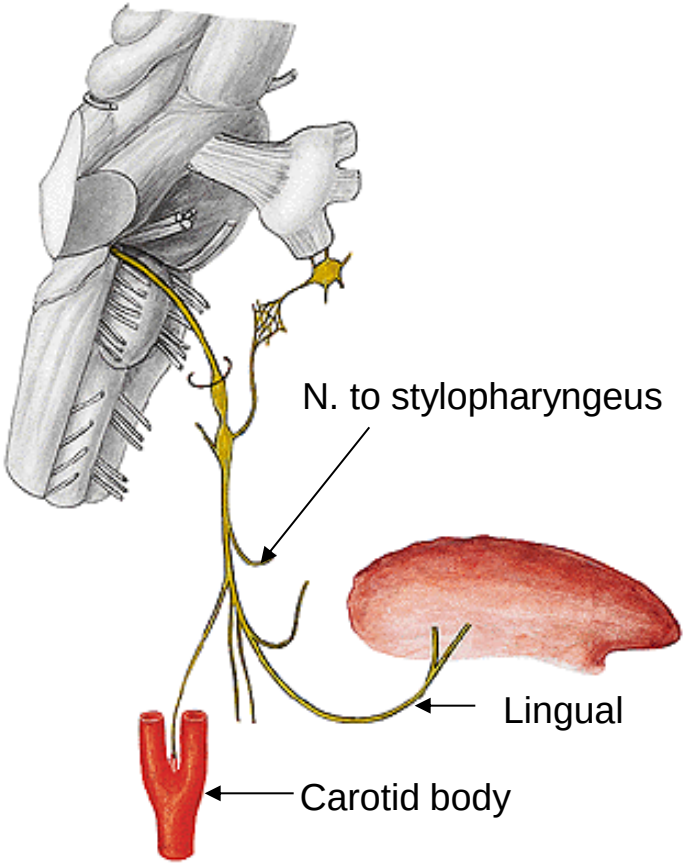


- **Functions:**
  - Semicircular canals, utricle & saccule (balance and posture).
  - Cochlea (hearing)
- **Dysfunction**
- Vestibular nerve: Dysequilibrium & vertigo
- Decreased hearing (nerve deafness) – cochlear lesion
- Conduction deafness – external or middle ear

Glossopharyngeal (IX)

- **Origin:** Nuc. ambiguus (Motor)
  - Inferior salivatory (Parasympathetic)
  - Tractus solitarius (Special sensory)
  - Spinal Nuc. of V (General sensory)
- **Course:** Passes through **jugular foramen**

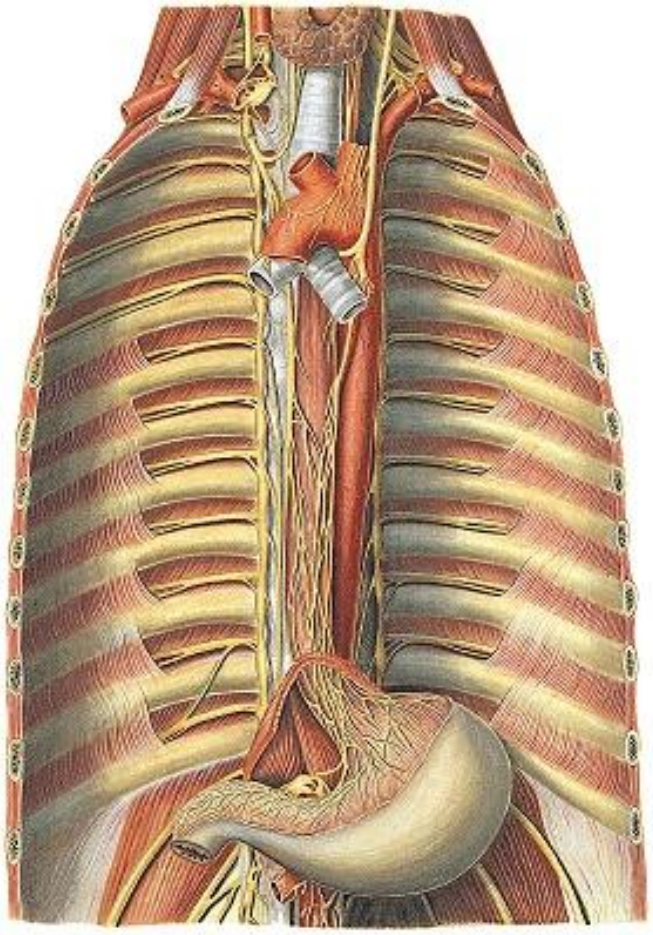
- **Distribution:** Stylopharyngeus, Parotid gland (parasympathetic & sensation), carotid body & sinus, pharynx & middle ear, Taste posterior 2/3 of tongue, Tonsil & palate, Sensation from external ear
- **Dysfunction:** Decreased Salivation, sensation to back of ear, gag reflex (closure of glottis), taste
- Paralysis of stylopharyngeus is insignificant



Vagus Nerve (X)

- *'Wanderer'*; longest course & largest distribution
- **Origin:** Nuc ambiguus (Motor); Dorsal Nucleus of X (Parasympathetic) & Tractus solitarius (Sensory)

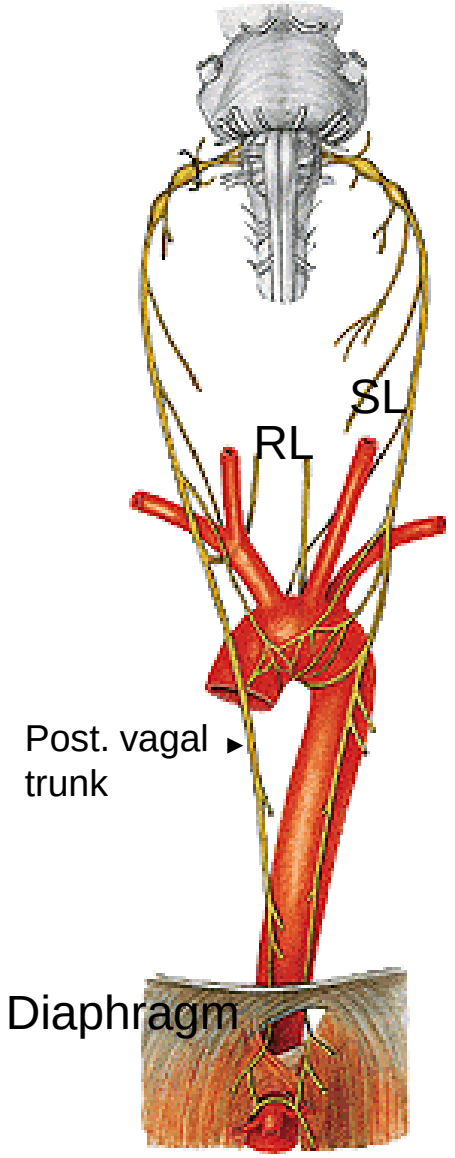
- **Course:** Leaves skull through **jugular foramen**, passes within carotid sheath in neck then Oesophageal opening to supply abdominopelvic organs via coeliac, hepatic, renal & hypogastric plexuses



Distribution/Dysfunction of Vagus Nerve

- **Motor:** Pharyngeal constrictor muscles, intrinsic muscles of larynx, muscles of palate.
- **Parasympathetic:** Smooth muscles of trachea, bronchi, GI tract, heart
- **Sensory**: Tongue, pharynx, larynx, thoraco-abdominal viscera, auricle, external auditory meatus, meninges of post cranial fossa.

- **<u>Dysfunction</u>:**
- Recurrent laryngeal nerve palsies are common from malignant diseases & surgical damage during surgery on thyroid gland, neck, oesophagus, heart & lung
- Hoarseness and Dysphagia
- Decreased gag reflex, sensation in external auditory meatus, pharynx, tachycardia



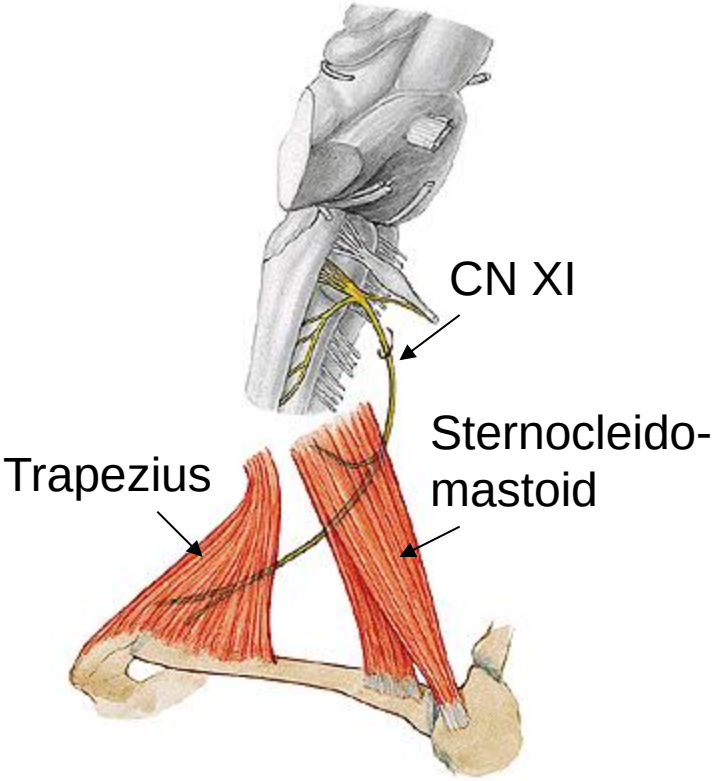
Accessory Nerve (XI)

Origin: Cranial root: Nucleus Ambiguus (Motor)

- Accessory nucleus from Spinal cord (C1-C5) .
  - Joins cranial root before passing through jugular foramen

- **Distribution**
- Sternocleidomastoid & Trapezius muscles
- via fibres that join CN X (pharyngeal plexus) to striated muscles of soft palate, pharynx & larynx

- **Dysfunction:**
- Wry neck
- Decreased ability to shrug shoulders or turn neck to opposite side



Hypoglossal Nerve (XII)

- **Origin:** Hypoglossal Nucleus (motor)
- **Course:** Leaves skull through **hypoglossal canal &** supplies motor fibres to the tongue & most infrahyoid muscles.
-
- **Distribution:** Intrinsic muscles of tongue
- Extrinsic muscles:
  - Genioglossus, Styloglossus, Hyoglossus, except???
- **Dysfunction**:
- Weakness of tongue movement
- On attempted protrusion, tongue deviates towards affected side

Summary of Cranial nerves:

Review
Clinical Anatomy

Summary of CN
5th ed. Pg 1126/7 Table 9.1
(Pg. 1058 Table 9.2 -**7th ed**)

5th ed. Pg 1130 Table 9.3
Summary of CN Lesions
(Table 9.6 Pg. 1079-**7th ed**)