Session Objectives

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- Compare and contrast sympathetic and parasympathetic innervation to the head and neck
- List the four parasympathetic ganglia of the head, their preganglionic input and postganglionic output
- Understand the innervation and function of the glands of the head (e.g., lacrimal gland, salivary glands, mucosal glands, sweat glands)
- Explain Horner's syndrome
- Explain Accommodation/Convergence reflex

Source: Course Syllabus

Sympathetic Innervation

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Preganglionic cell bodies

- T1-T2 lateral horn

Preganglionic axons

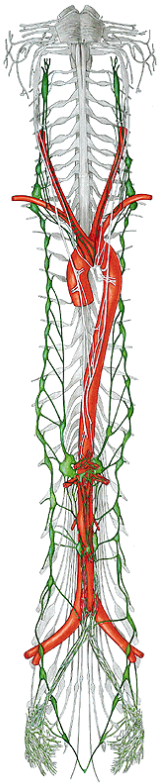
- Ventral roots T1-T2 > spinal nn. T1-T2 > ventral rami T1-T2 > white rami communicantes T1-T2 > paravertebral ganglia T1-T2 > ascend in sympathetic chain

Postganglionic cell bodies

- Superior cervical ganglion

Postganglionic axons

- Internal carotid plexus
- External carotid plexus



Sympathetic Innervation

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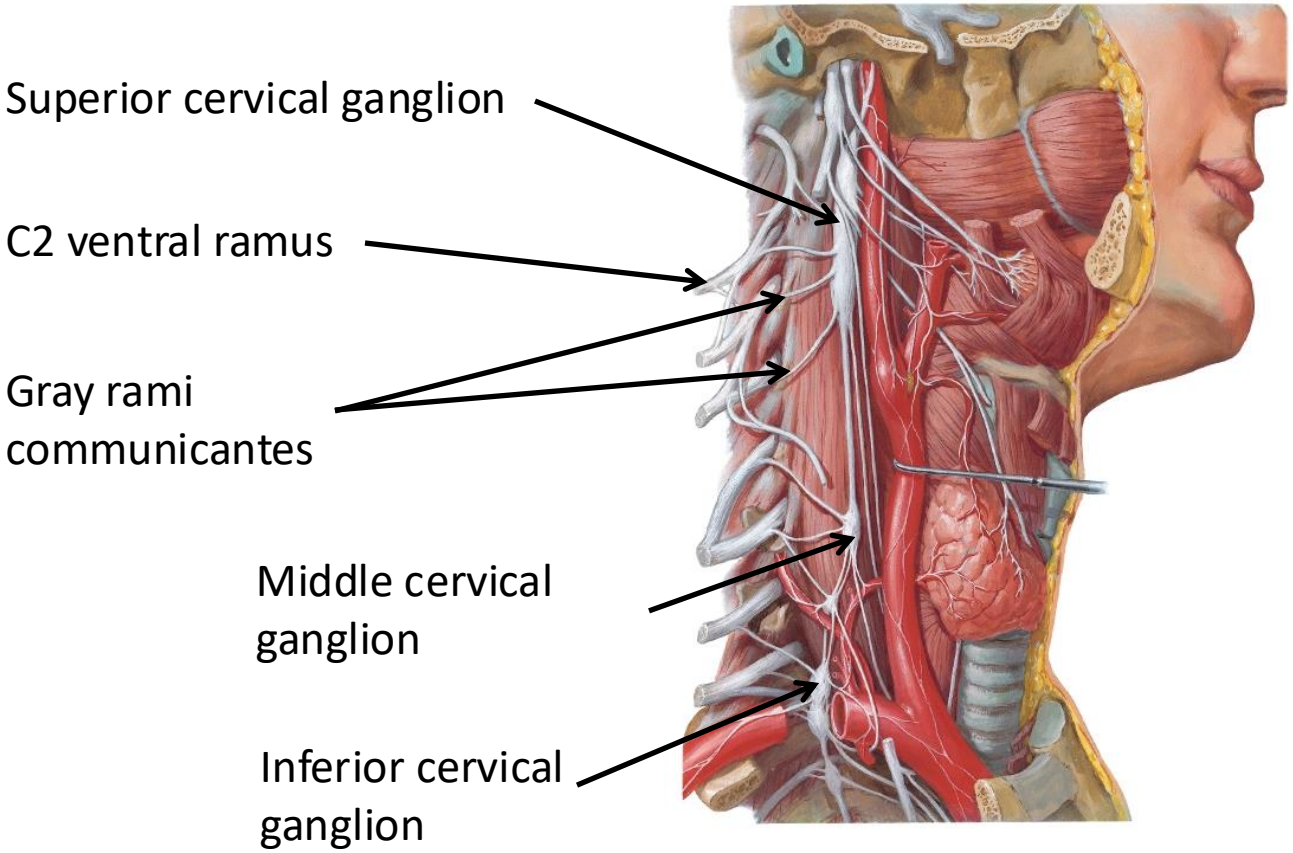

Source: Netter, Atlas of Anatomy

Sympathetic Innervation

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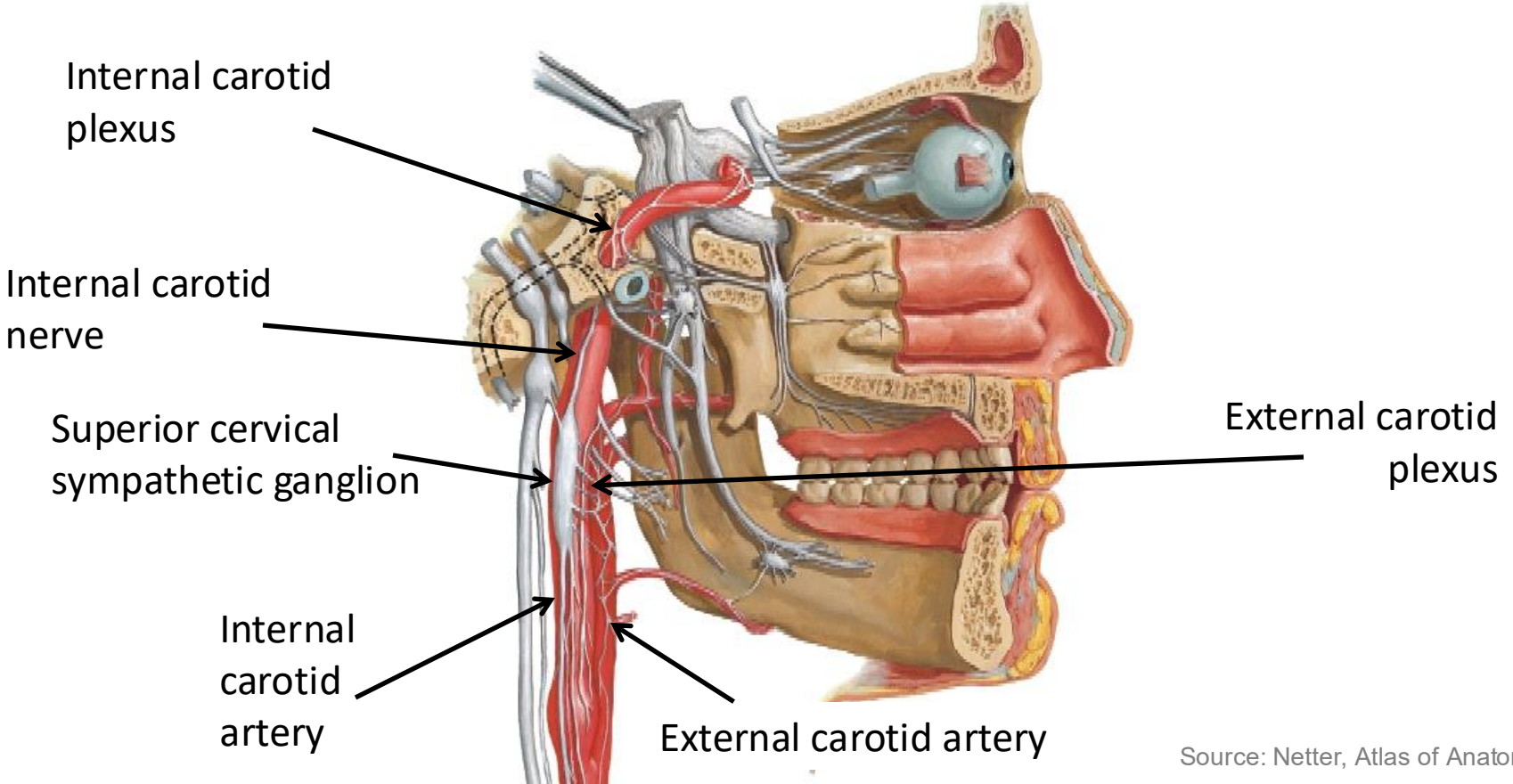

Source: Netter, Atlas of Anatomy

Internal Carotid Plexus

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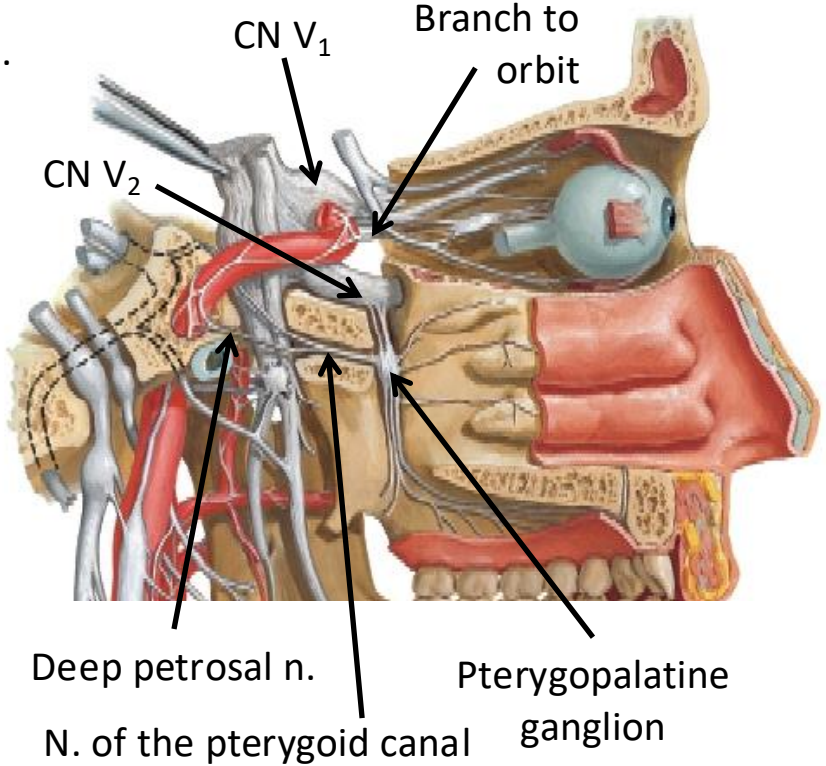
Orbital branch (through cavernous sinus and superior orbital fissure)

- Vasoconstriction of ocular arterioles via ophthalmic a.
- Contraction of dilator pupillae and superior tarsal muscles via V_1
- Vasodilation of facial arterioles via V_1
- sweat glands of forehead via V_1
- Contraction of arrector pili of forehead via V_1
- Ethmoid air cells via V_1 (effect?)
- (Lacrimal gland)

Deep petrosal (through pterygoid canal)

- Lacrimal gland
- Vasoconstriction of blood vessels in nasal cavity, palate, pharynx via V_2
- No effect on mucous glands



Source: Netter, Atlas of Anatomy

External Carotid Plexus

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Branches with maxillary a.

- Parotid gland

Branches with lingual a.

- Sublingual gland
- Submandibular gland

Branches with facial a.

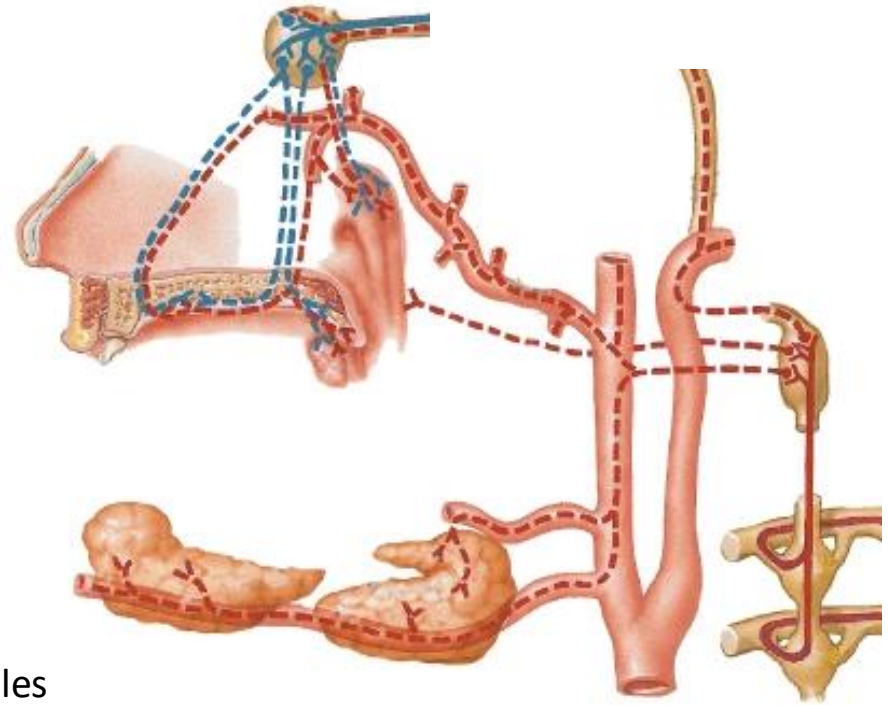
- Submandibular gland

Branches with superior thyroid a.

- Thyroid gland

With all branches

- Vasoconstriction of arterioles
- Facial sweat glands



Source: Netter, Atlas of Anatomy

Horner's Syndrome

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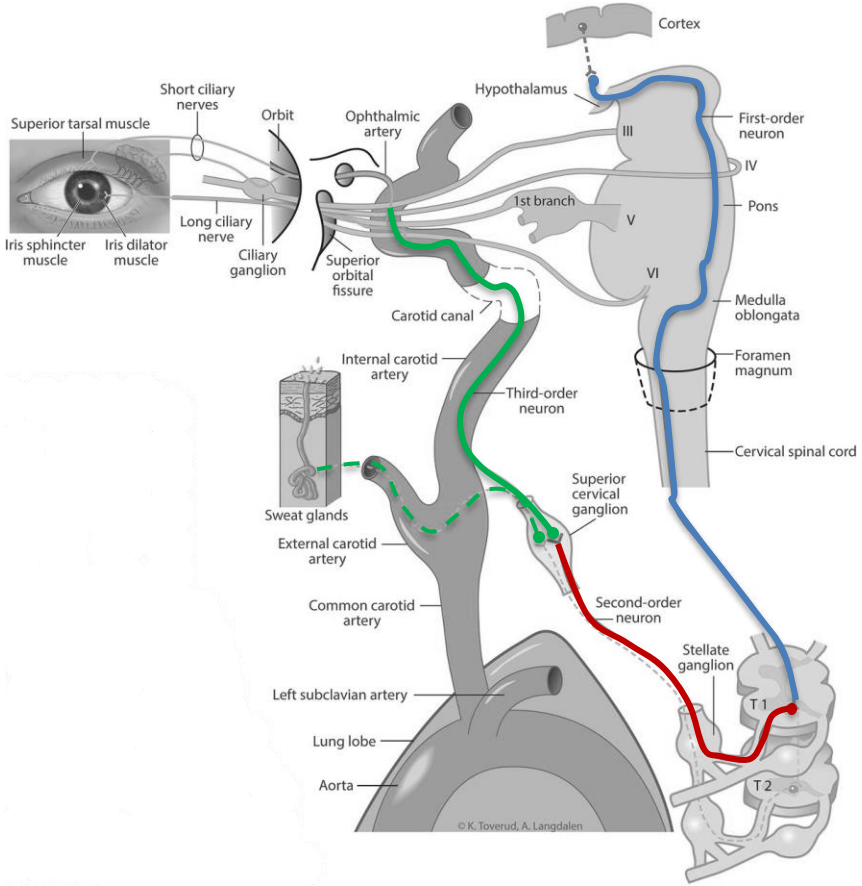

First-order neuron (Central)

Second-order neuron (Preganglionic)

Third-order neuron (Postganglionic)

Source: Alstadhaug, 2011

Horner's Syndrome

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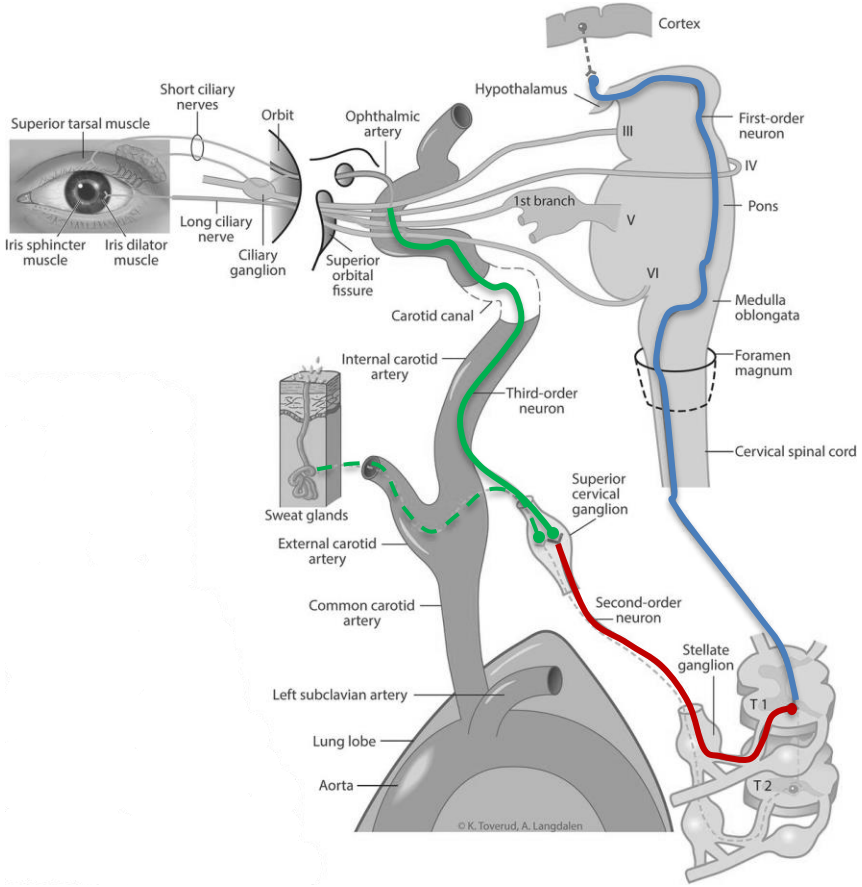

First-order neuron disorder (Central):
stroke, tumor, spinal cord trauma, cyst or cavity in the spinal cord

Second-order neuron (Preganglionic)
Pancoast tumor, trauma to neck or chest cavity during surgery or accident

Third-order neuron (Postganglionic)
Lesion of carotid artery, injury to skull base

Source: Alstadhaug, 2011

Parasympathetic Innervation

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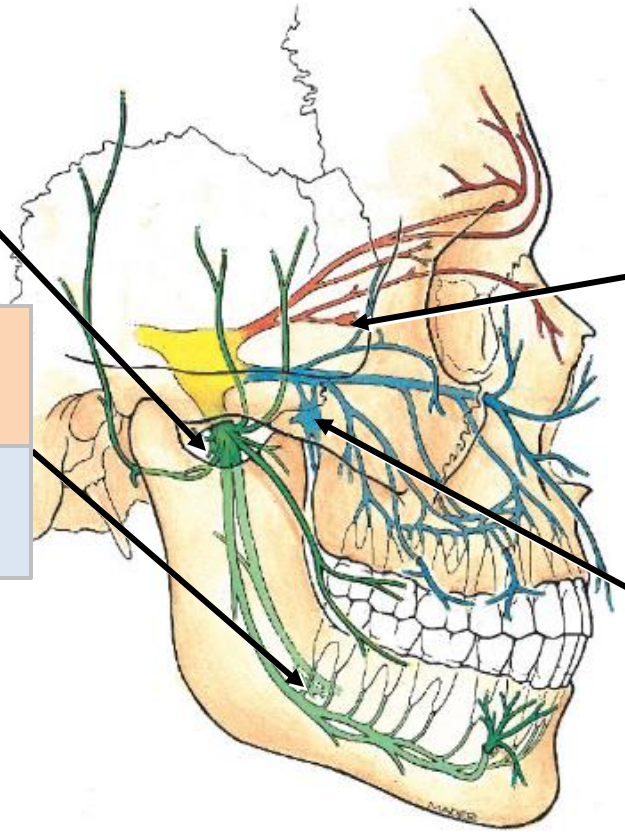
Otic ganglion
- connected to V_3
- preganglionics from CN IX

Submandibular ganglion
- connected to V_3
- preganglionics from CN VII



Ciliary ganglion
- connected to V_1
- preganglionics from CN III

Pterygopalatine ganglion
- connected to V_2
- preganglionics from CN VII

Parasympathetic Innervation

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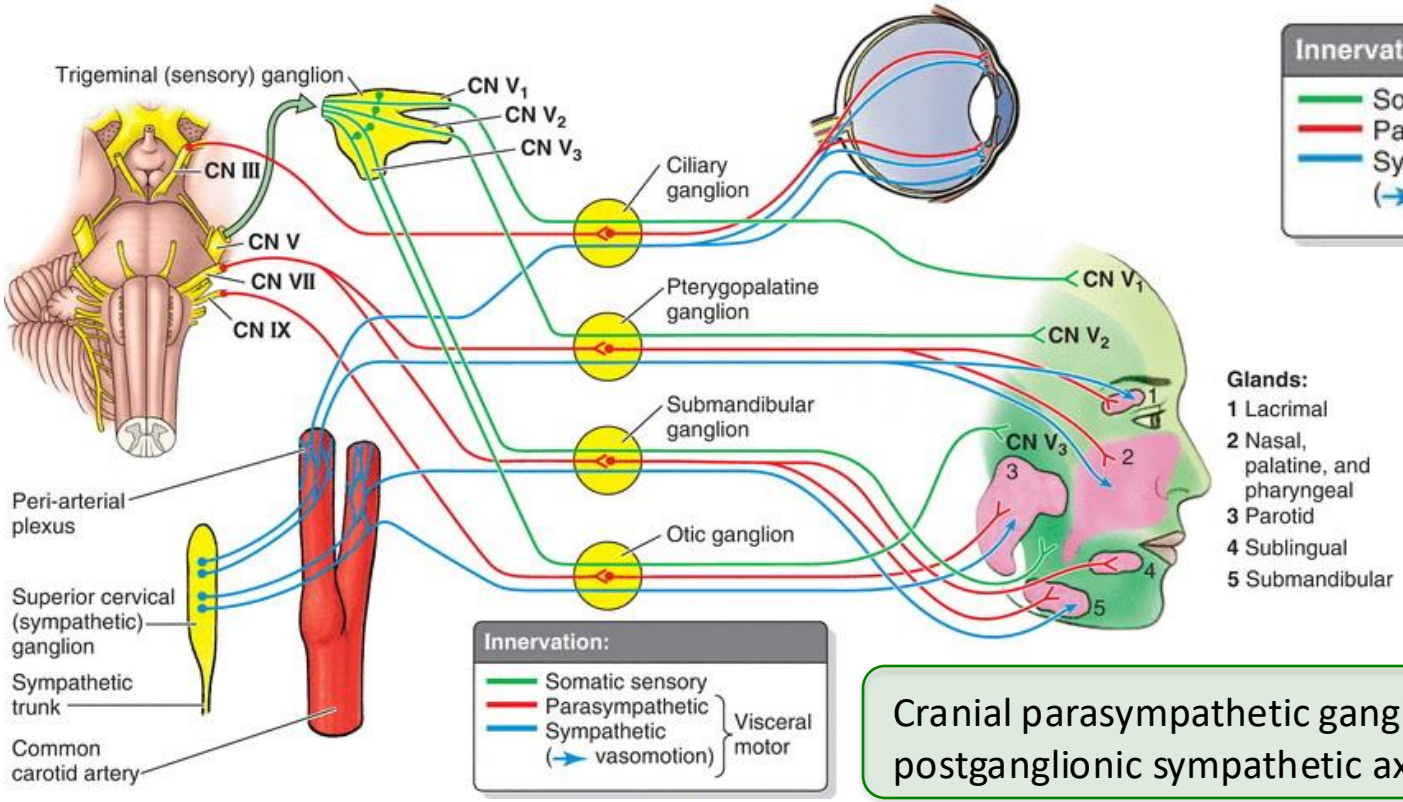

Cranial parasympathetic ganglia have sensory and postganglionic sympathetic axons passing through

Source: Moore et al., Clinically Oriented Anatomy 8e

Ciliary Ganglion

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Preganglionic cell bodies

- Brain (visceral efferent oculomotor nucleus)

Preganglionic axons

- Oculomotor Nerve (CN III)

Postganglionic cell bodies

- Ciliary ganglion

Postganglionic axons

- Short ciliary to: ciliary muscle (muscle of accommodation) and constrictor (= sphincter) pupillae

Ciliary Ganglion

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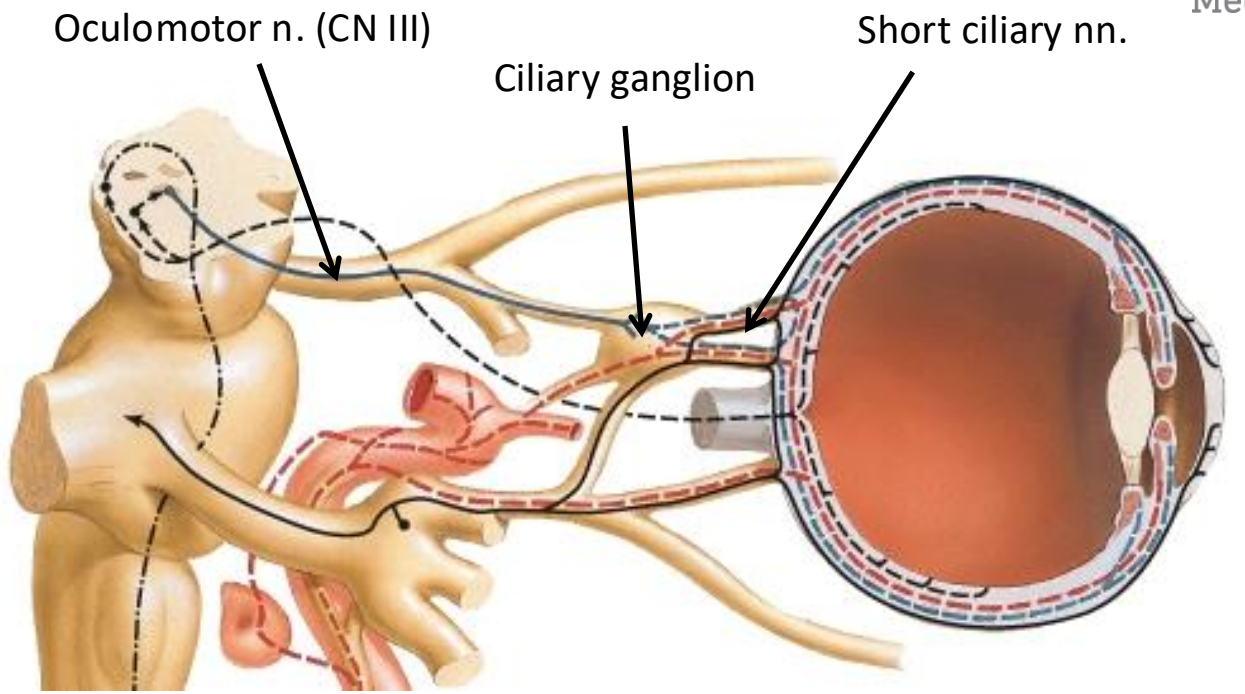

Sympathetic preganglionic

Sympathetic postganglionic

Parasympathetics preganglionic

Parasympathetics postganglionic

General sensory

Source: Netter, Atlas of Anatomy

Pterygopalatine Ganglion

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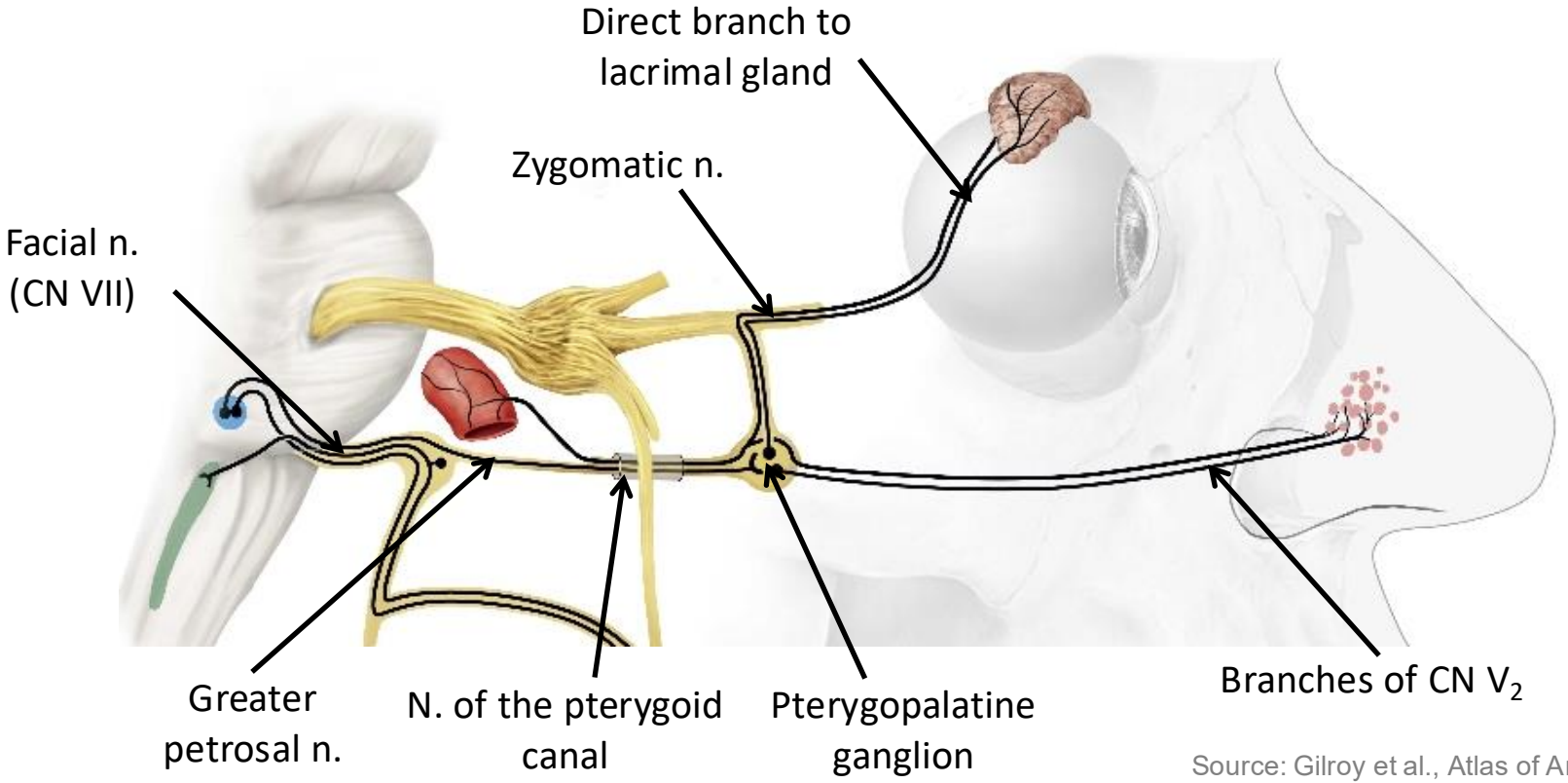

Source: Gilroy et al., Atlas of Anatomy

Pterygopalatine Ganglion

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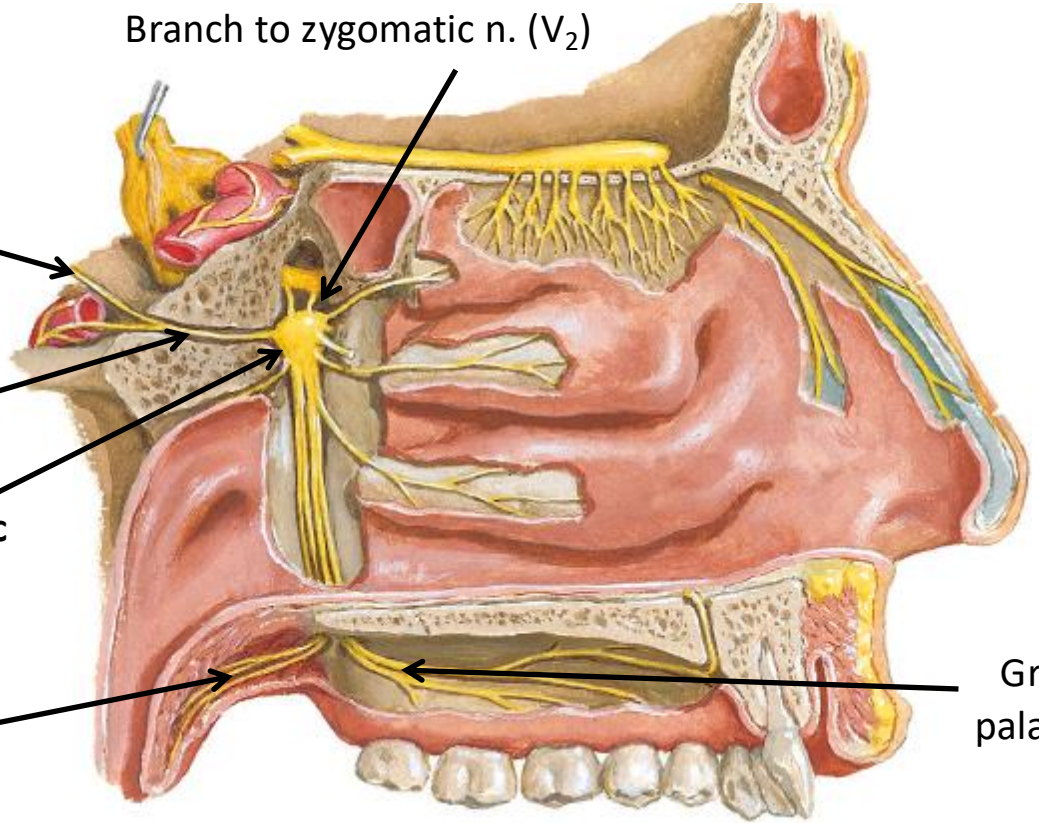

Source: Netter, Atlas of Anatomy

Submandibular Ganglion

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Preganglionic cell bodies

- Brain (superior salivary nucleus)

Preganglionic axons

- Facial Nerve (CN VII) > chorda tympani > lingual n (V_3)

Postganglionic cell bodies

- Submandibular ganglion

Postganglionic axons

- Submandibular gland: direct branches
- Sublingual gland: Lingual n.

Submandibular Ganglion

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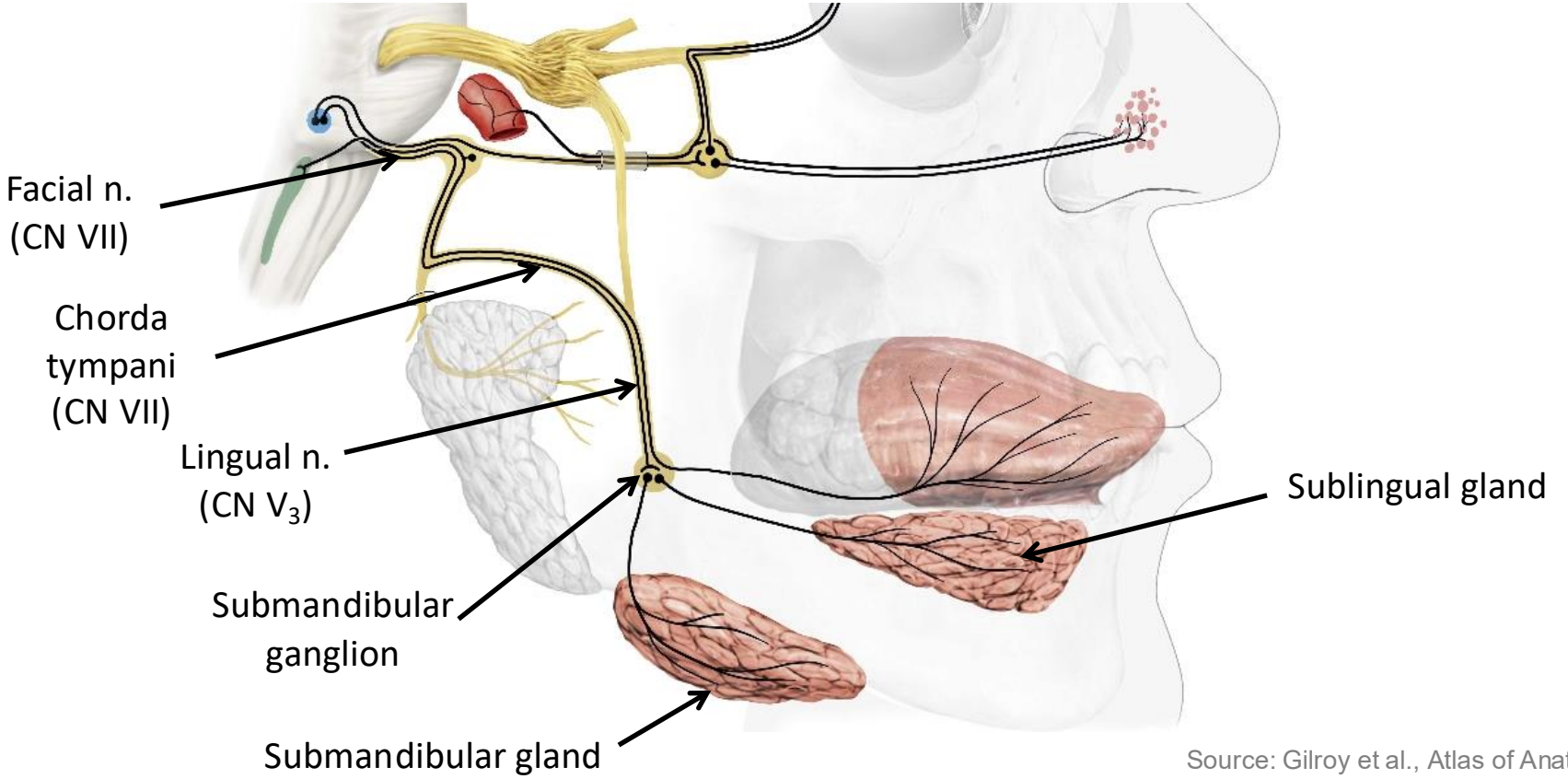

Source: Gilroy et al., Atlas of Anatomy

Submandibular Ganglion

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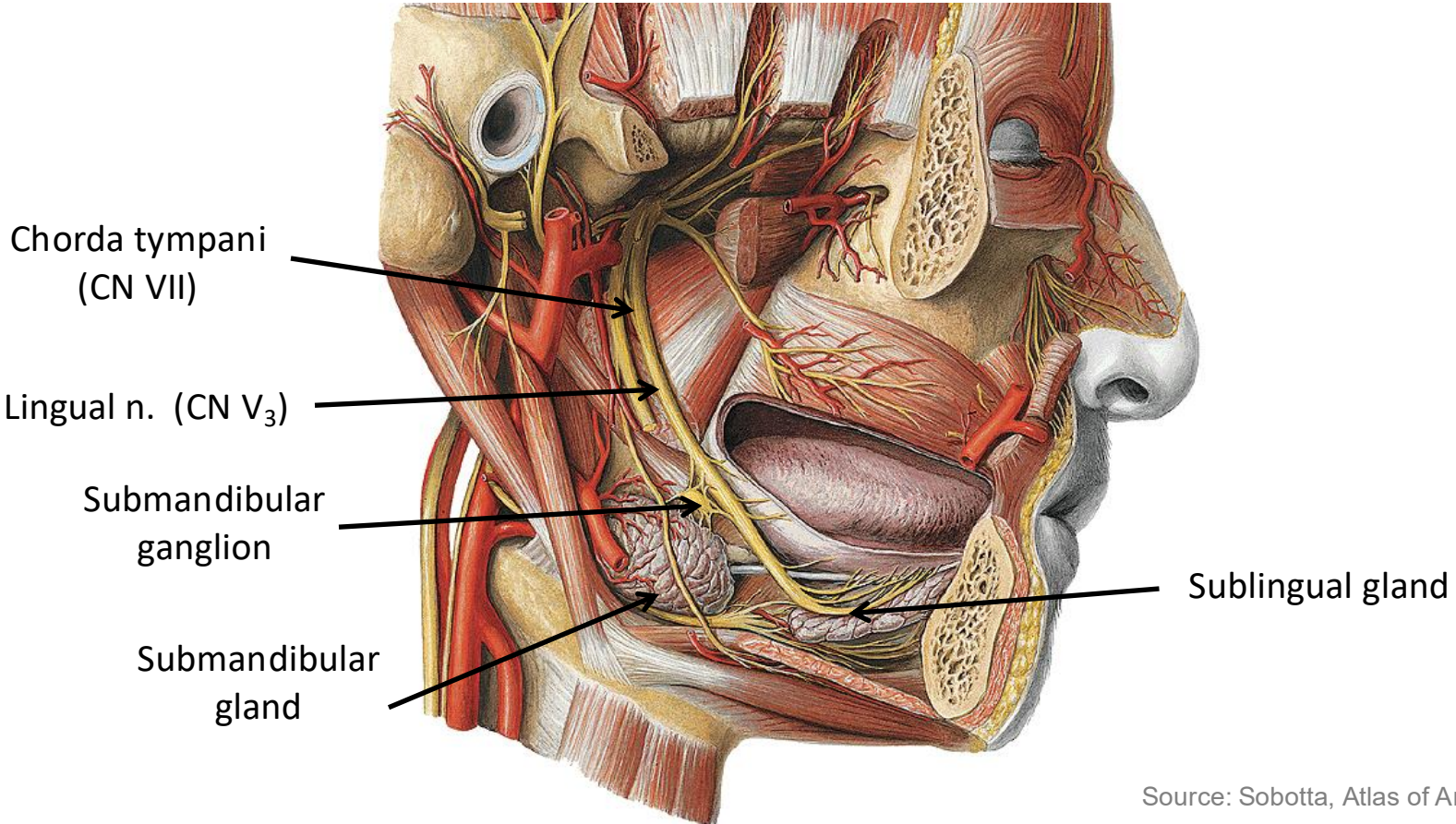

Source: Sobotta, Atlas of Anatomy

Otic Ganglion

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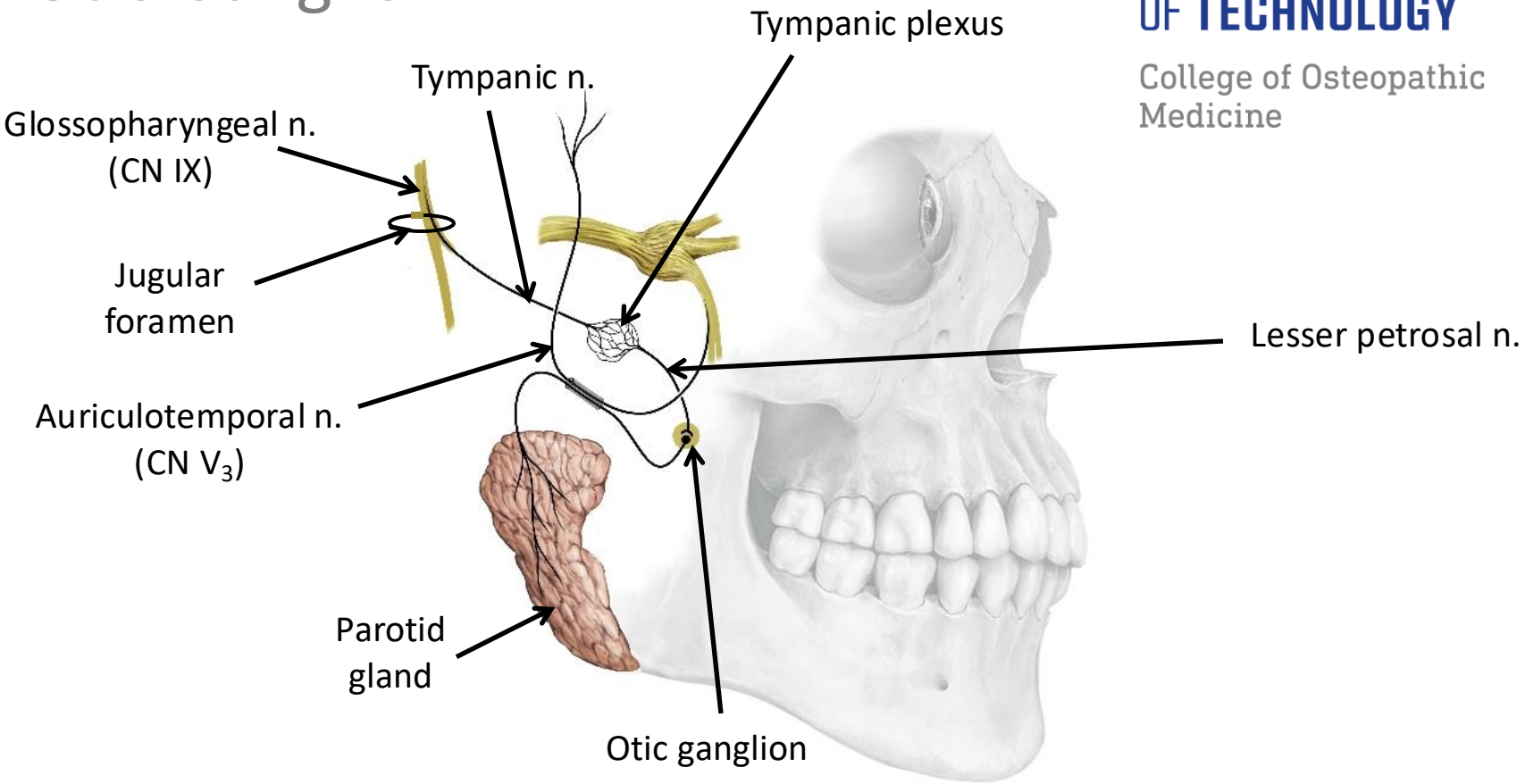

Source: Gilroy et al., Atlas of Anatomy

Otic Ganglion

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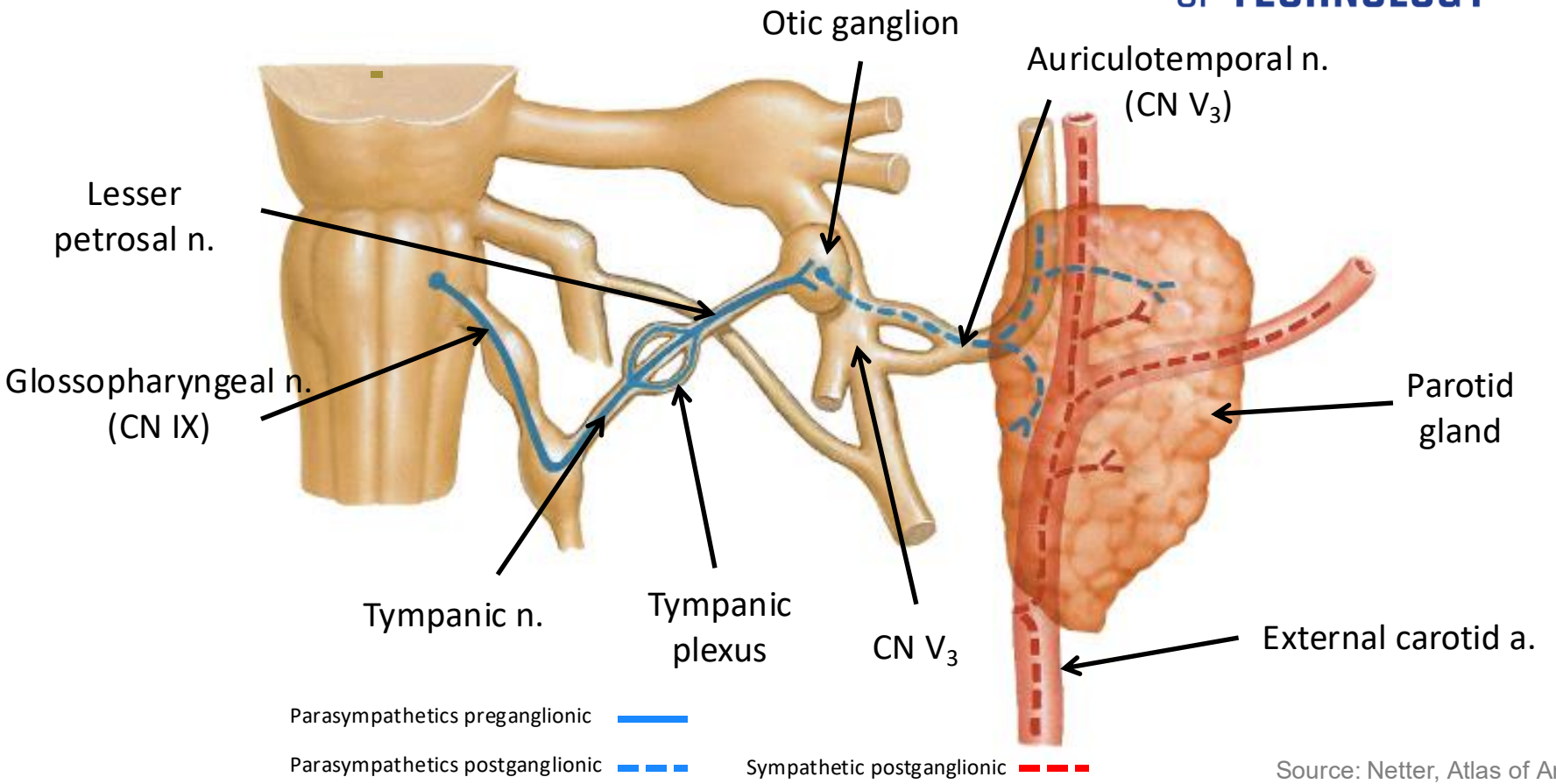

Source: Netter, Atlas of Anatomy

Vagus n.

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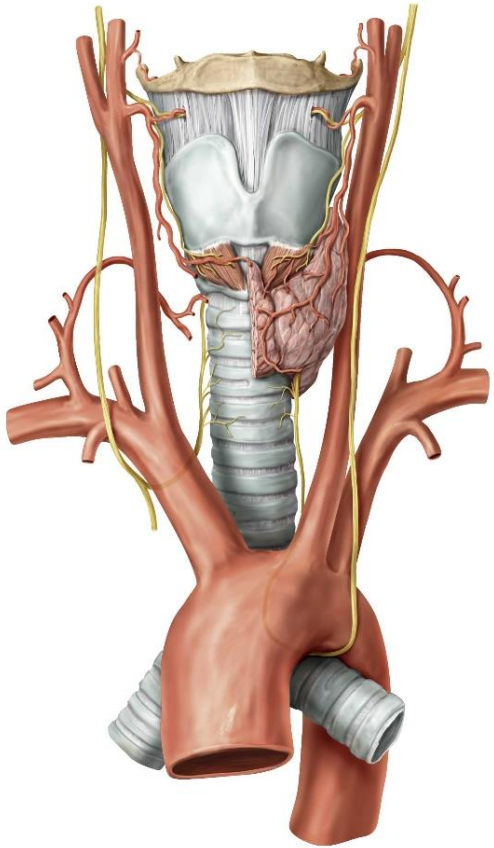

Pharyngeal branches

- Pharyngeal glands

Superior laryngeal n.

- Larynx above vocal fold

Recurrent laryngeal n.

- To thyroid and parathyroid glands
- Larynx below vocal folds

Source: Gilroy et al., Atlas of Anatomy

Vagus n.

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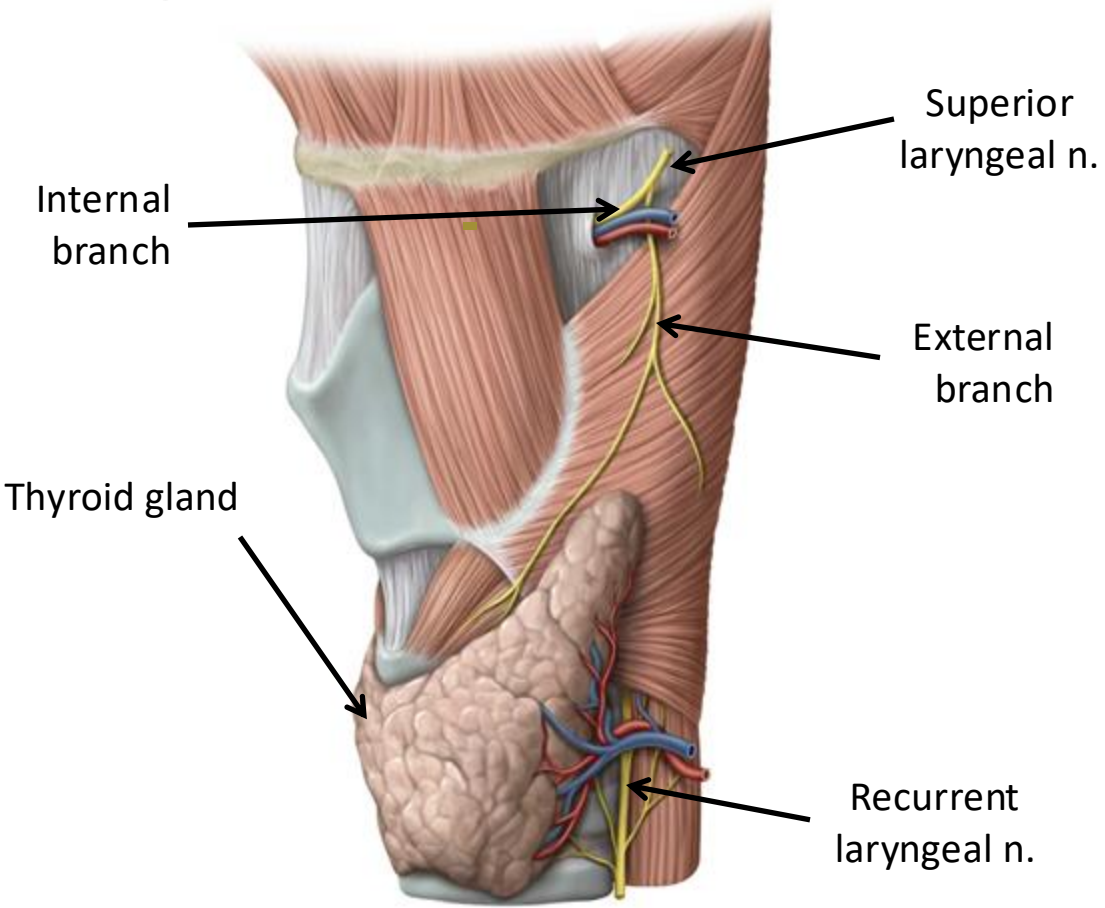

Superior laryngeal n.

- Larynx above vocal fold

Recurrent laryngeal n.

- To thyroid and parathyroid glands
- Larynx below vocal folds

Source: Gilroy et al., Atlas of Anatomy

Vagus n.

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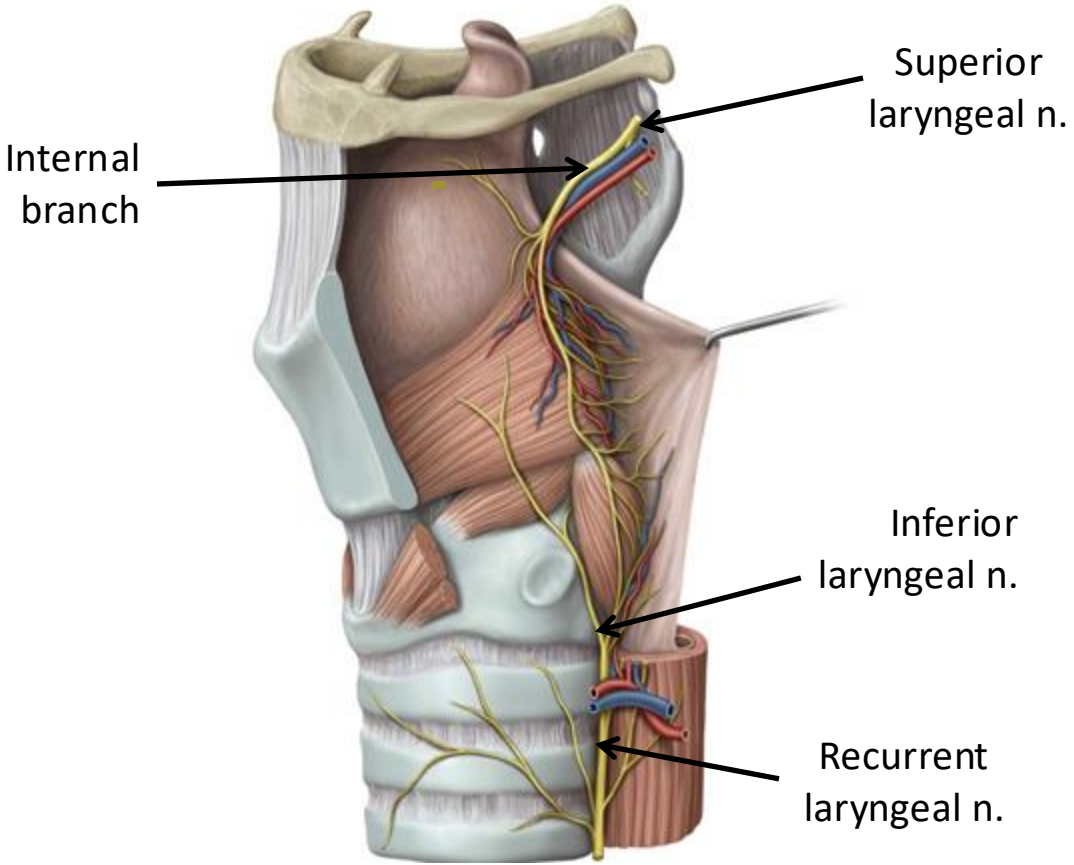

Superior laryngeal n.

- Larynx above vocal fold

Recurrent laryngeal n.

- To thyroid and parathyroid glands
- Larynx below vocal folds

Source: Gilroy et al., Atlas of Anatomy

Summary Parasympathetics

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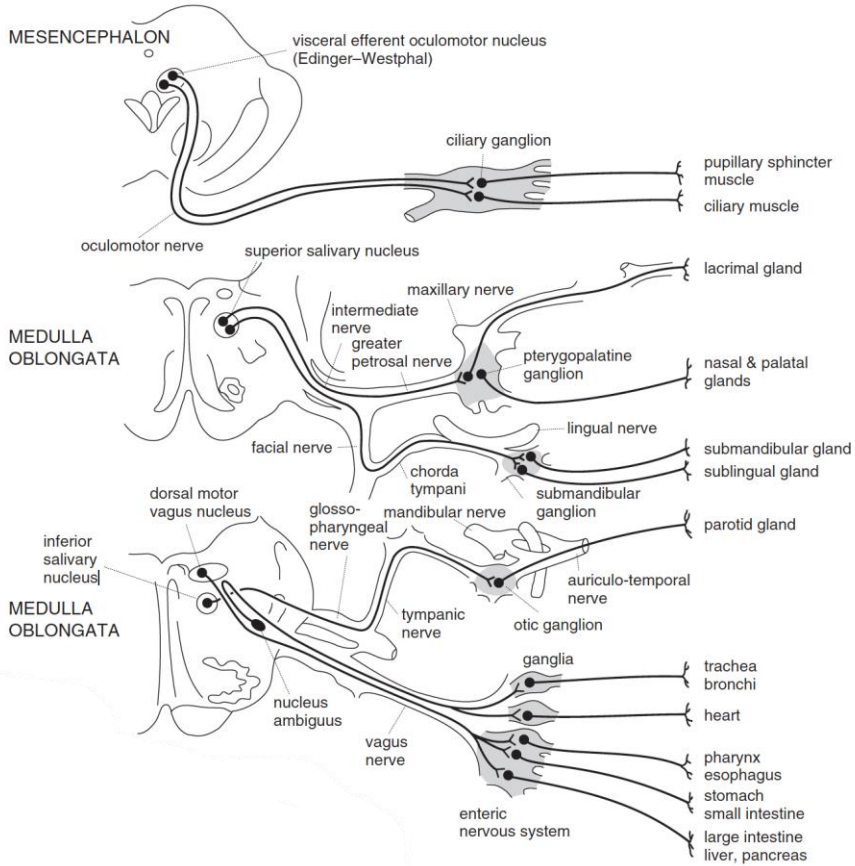

Source: Jänig, 2006

Summary

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- **Sympathetics**: preganglionic axons from T1-T2 lateral horn, synapse in superior cervical ganglion, postganglionic axons with internal and external carotid plexus

- **Parasympathetics**: preganglionic axons from CN III, VII, IX, X, synapse in four ganglia, postganglionc axons travel with CN V

- Best References: Jack Stern, 'Core Concepts' or 'Essentials of Gross Anatomy' (https://jackstern.org/EGA/EGA2003.html); Moore et al. Clinically Oriented Anatomy; Jänig. 2006. The Integrative Action of the Autonomic Nervous System

Lecture Feedback Form

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https://comresearchdata.nyit.edu/redcap/surveys/?s=HRCY448FWYXREL4R

Synonyms

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Sensory = part of afferents
Motor = part of efferents
Visceral Motor = Autonomics (note there are other definitions e.g. Autonomics = Visceral motor and sensory)
Ventral horn/root/ramus = Anterior horn/root/ramus
Dorsal horn/root/ramus = Posterior horn/root/ramus
Dorsal root ganglion = Spinal ganglion
Lateral horn = Intermediolateral column
Preganglionic = Presynaptic
Postganglionic = Postsynaptic
Sympathetic organ nerve = cardiopulmonary splanchnics
Sympathetic chain = sympathetic trunk = paravertebral chain
Paravertebral ganglia = sympathetic chain ganglia = sympathetic trunk ganglia
Prevertebral ganglia = sympathetic ganglia for pelvic and hindgut organs below the aorta
Preaortic ganglia = sympathetic ganglia for abdominal and pelvic organs on the aorta
Subdiaphragmatic ganglia = prevertebral and preaortic ganglia