Terminal Nerves of the Brachial Plexus

Anatomy

RHS 241

Lecture 17

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Musculocutaneous nerve

- C5,6,7
- Arises from the **lateral cord**
- Enters the arm by piercing the coracobrachialis
- Courses deep to the **biceps brachii** muscle

Musculocutaneous nerve

- **Motor** distribution: innervates all muscles of the ***anterior compartment of arm*** (biceps brachii, coracobrachialis, brachialis)

- **Sensory** distribution: the ***lateral cutaneous nerve of the forearm***…….

Musculocutaneous nerve lesion sites / clinical conditions

- As the nerve courses within the axilla: uncommon
- **Motor** changes: weakened flexion & supination of the forearm
- **Cutaneous** changes: lateral forearm (part of the C6 dermatome)

Median nerve

- C5 – T1
- Arises as two roots from the **lateral & medial cords**
- Courses within the medial (protected) side of the arm

Median nerve

- Crosses the elbow joint just medial to the biceps tendon
- Courses within the **anterior compartment of the forearm** (deep to the flexor digitorum superficialis)
- Enters the hand by passing through the **carpal tunnel**

Median nerve

- **Motor** distribution:
  - Arm: none
  - Forearm: innervates all muscles of the anterior compartment except the flexor carpi ulnaris and ulnar half of the flexor digitorum profundus
  - Hand: thenar muscles and the lateral two lumbricals

Median nerve

- **Sensory** distribution:
  - Arm and forearm: none
  - Hand: lateral 2/3rds of the palm, plus the lateral 3 ½ fingers

Median nerve
Entrapment sites

- Elbow level: as the nerve enters the forearm by passing between the two heads of **pronator teres**

- Hand: as the nerve courses through the **carpal tunnel**

Median nerve clinical conditions

- **Ape hand:**
  - ➢ due to unopposed pull by the extensors & long abductor of the thumb (innervated by..??)
  - ➢ the thumb is pulled dorsally and laterally to lie near the plane of the palm
  - ➢ wasting of the thenar muscles gives the lateral half of the hand a flattened' ape-like appearance

Median nerve clinical conditions

- **Carpal tunnel syndrome:**
  - Painful hand condition caused by overuse (e.g., younger factory workers) or fluid/hormone changes (e.g., pregnancy)
  - Pain in the lateral side of the hand

Median nerve clinical conditions

- **Carpal tunnel syndrome:**

  - Muscle weakness (most noticeably of the thenar muscles and lateral two lumbricals)

  - Severe cases are treated surgically by releasing the flexor retinaculum

Ulnar nerve

- C7 – T1
- Arises from the **medial cord**
- Descends within the medial side of the arm
- Lies posterior to the medial epicondyle as it leaves the arm (compressing the nerve here is described as hitting one’s funny bone)

Ulnar nerve

- Enters the forearm by passing between the humeral and ulnar heads of the flexor carpi ulnaris
- Enters the hand by coursing superficial to the flexor retinaculum

Ulnar nerve

- **Motor** distribution:
  - Arm: none
  - Forearm: innervates the flexor carpi ulnaris and the ulnar ½ of flexor digitorum profundus
  - Hand: all muscles of the hypothenar eminence, all interossei, the 4th & 5th lumbricals, and the adductor pollicis

Ulnar nerve

- **Sensory** distribution:
  - Arm and forearm: none
  - Hand: skin of the medial 1/3rd of the palm, plus the 5th finger and ulnar half on dorsal and palmar aspects of the ring finger, plus all joints it crosses

Ulnar nerve
Entrapment sites

- Elbow level: as the nerve enters the forearm by passing between the two heads of the **flexor carpi ulnaris**

- Wrist: as a component of **Guyon's tunnel**

Ulnar nerve clinical conditions

- **Claw hand:**
  - Clawing of the ring and 5th fingers
  - Clawed finger = one in which the MPJ is hyper-extended and both the PIPJ & DIPJ are pulled into flexion
  - Most severe when entrapments of the ulnar nerve occur at the wrist level

    Explain Why…….?

Radial nerve

- C5 – T1
- Arises from the **posterior cord**

- Courses laterally & inferiorly to enter the posterior compartment of the arm

- In the arm, the nerve lies within the spiral groove of the humerus

Radial nerve

- Lies anterior to the lateral condyle of the humerus as it enters the forearm
- Divides here into the superficial branch (sensory/cutaneous) and deep branch (motor)
- The deep branch enters the forearm by passing between the heads of the **supinator** muscle

Radial nerve

- **Motor** distribution:
  - Innervates all muscles within the posterior compartments of the arm & forearm (e.g., extensors of the elbow and wrist)

Radial nerve

- **Sensory** distribution: cutaeous
  - Arm: lower half- lateral arm
  - Forearm: central posterior
  - Hand: lateral half of the dorsum
  - 3 ½ fingers dorsally

Radial nerve
Entrapment sites

- Arm: as the nerve lies in the **spiral groove of the humerus** (e.g., mid-humeral fractures)
- Proximal forearm: as its deep branch passes between the heads of the **supinator muscle**
- Axillary damage of the radial nerve can result from extended use of long crutches

Radial nerve clinical conditions

- **Wrist drop:**
  - ➢ Due to lost innervation to the extensors of the wrist
  - ➢ Sensation of the dorsal skin of the hand (lateral side) is unchanged with lesions of only the deep branch of the radial nerve

Axillary nerve

- C5 – C6
- Arises from the **posterior cord**

- Courses laterally to pass through the quadrangular space

- Closely related to the surgical neck of humerus

Axillary nerve

- **Motor** distribution:
  - Innervates the deltoid & teres minor muscles
- **Sensory** distribution:
  - Cutaneous to the skin over the lower half of the deltoid muscle (the vaccination area)

Axillary nerve
Entrapment sites

- As the nerve passes through the **quadrangular space** to innervate muscles of the posterior shouder
- Loss of function usually occurs with **anterior dislocation of the shoulder**
- The nerve is stretched by the downward and medial displacement of the proximal end of humerus

Axillary nerve clinical conditions

- Weakened / lost abduction of the arm (particularly beyond 30^{o}
- Sensory changes within the vaccination area

Secondary motor nerves arising from the brachial plexus

Long thoracic nerve:

- Arises from roots C5-C7
- Descends on the surface of the serratus anetrior muscle (near the mid-axillary line)
- Motor to the serratus anetrior

- Damage of this nerve: “winging of the scapula”

Secondary motor nerves arising from the brachial plexus

Suprascapular nerve:

- Arises from roots C5-C6 (superior trunk)
- Passes across the superior boarder of scapula
- Innervate the supraspinatus & infraspinatus

Secondary motor nerves arising from the brachial plexus

Thoracodorsal nerve:

- Arises from roots C6-C8 (posterior cord)
- Descends vertically to innervate the lattisimus dorsi

Secondary motor nerves arising from the brachial plexus

Lateral pectoral nerve:

- Arises from roots C5-C7 (lateral cord)

- Passes anetriorly to innervate pectoralis major (superior half) and medial fibers of pectoralis minor

Secondary motor nerves arising from the brachial plexus

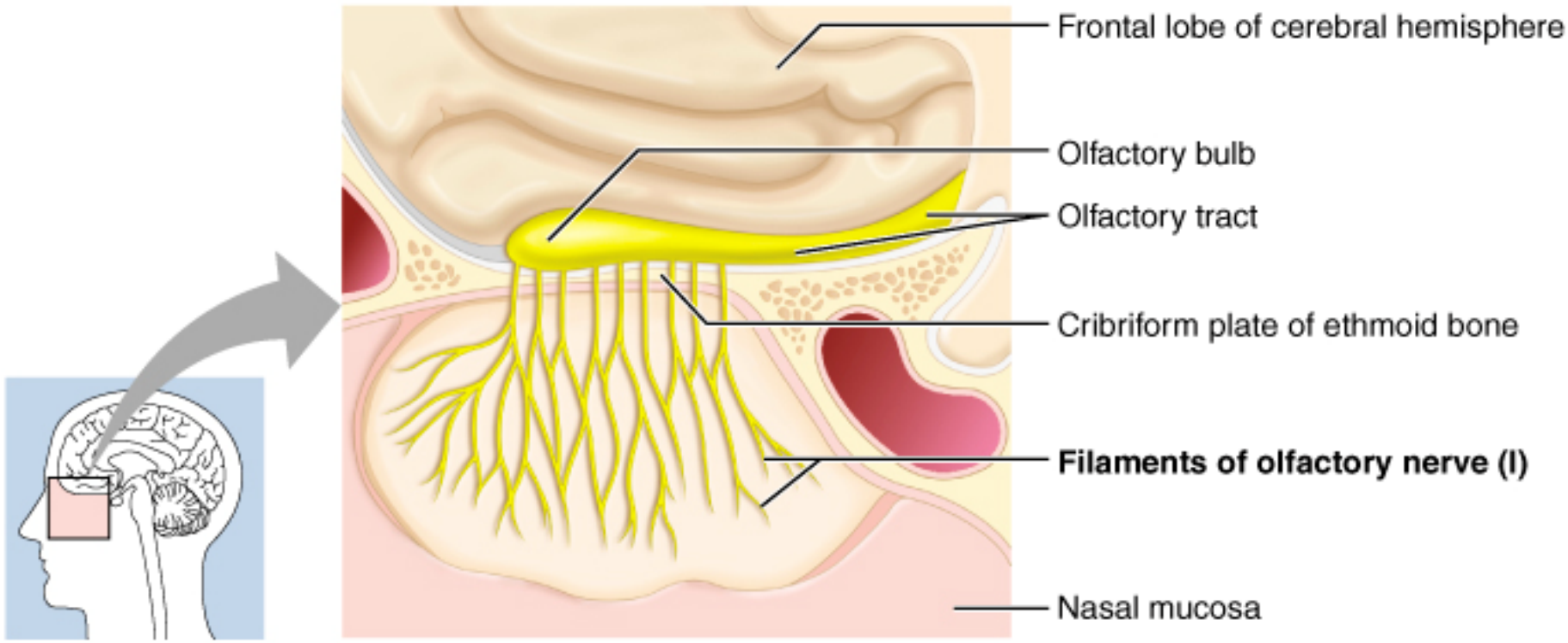
Medial pectoral nerve:

- Arises from roots C8-T1 (medial cord)
- Passes anetriorly to innervate pectoralis major (inferior half) and pectoralis minor

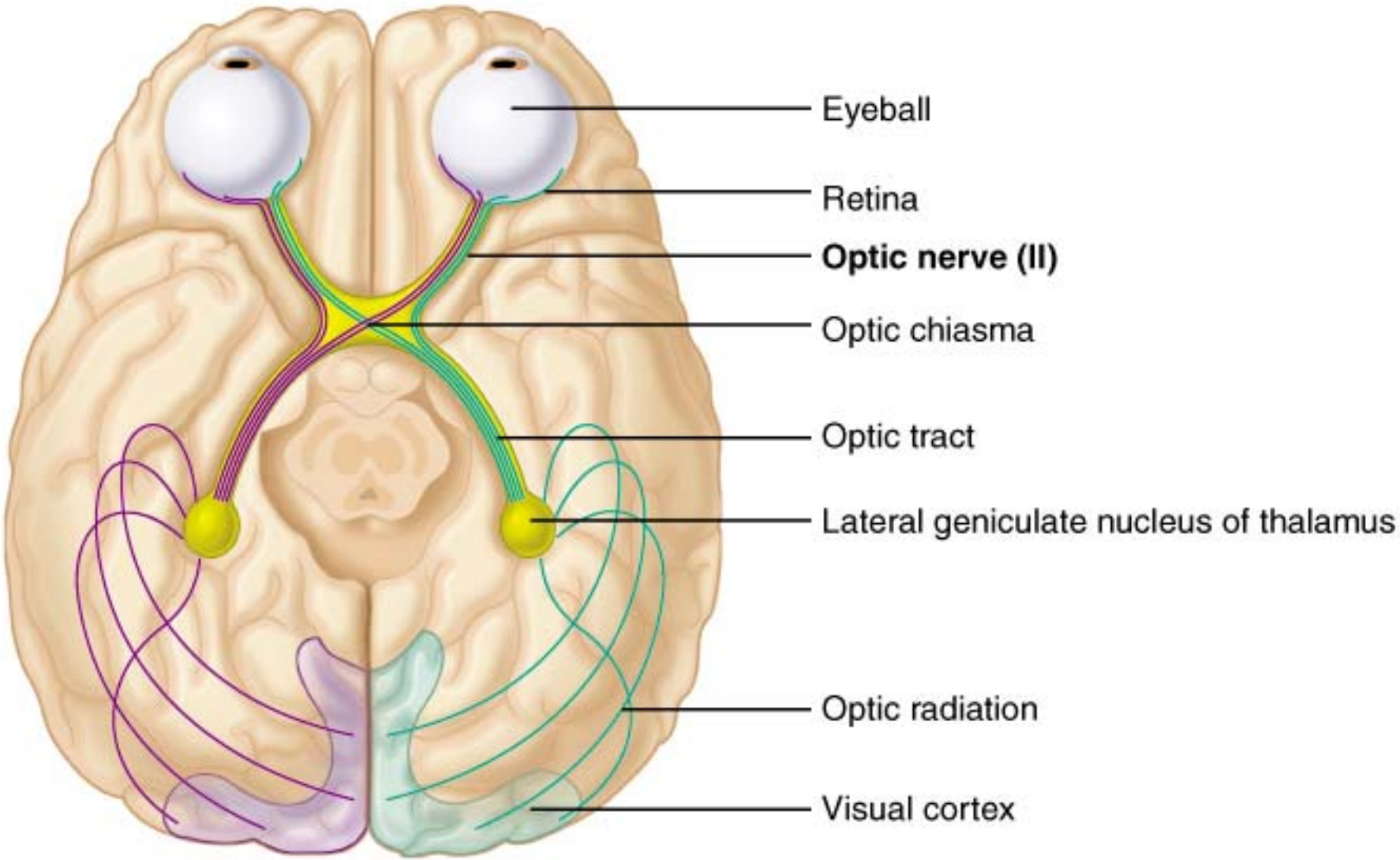
Cranial nerves

- Take their origin from the brain which is located in the cranium ⟷ “cranial nerves”
- Leave the CNS via foramina in the cranium
- Numbered in a way that indicates the order in which they leave the brain

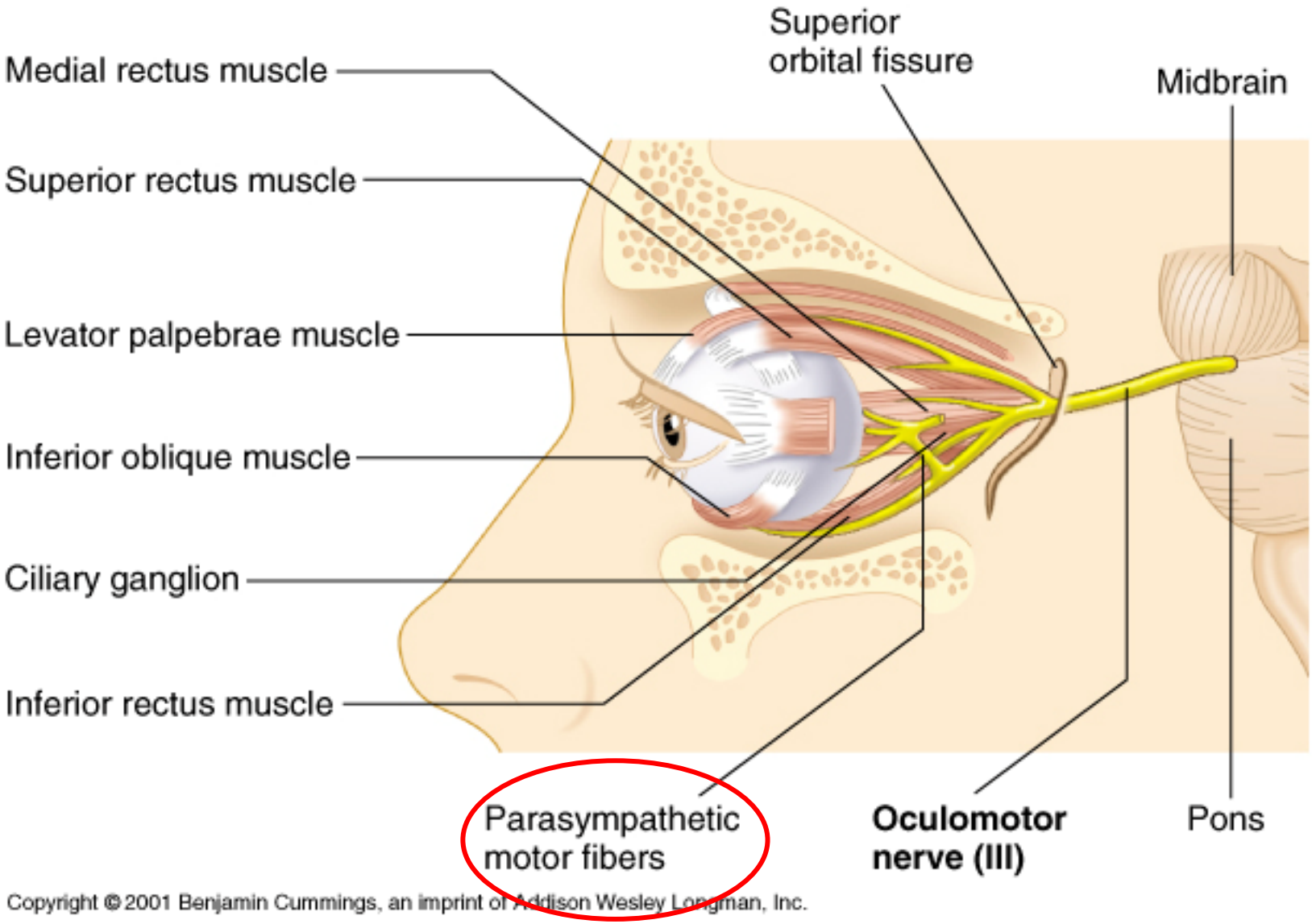
Olfactory – CNI- special sensory (smell)



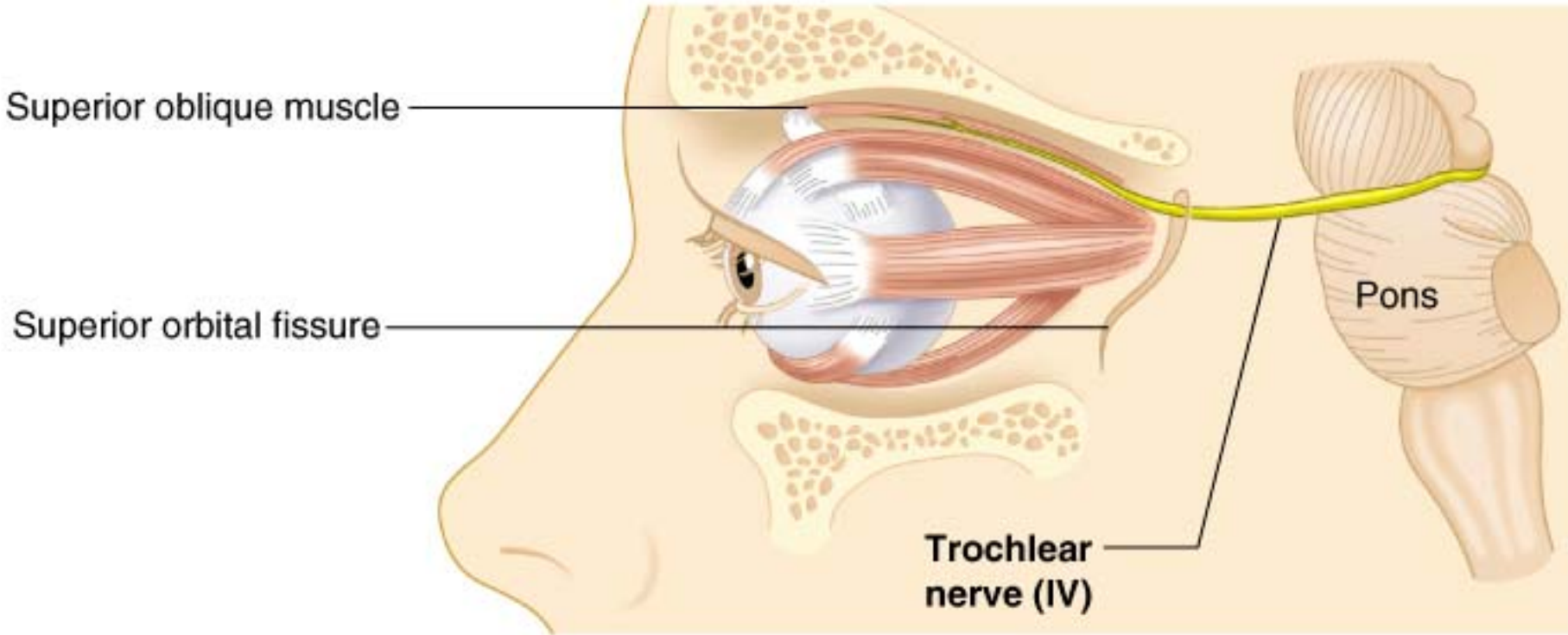
Optic – CNII- special sensory (sight)



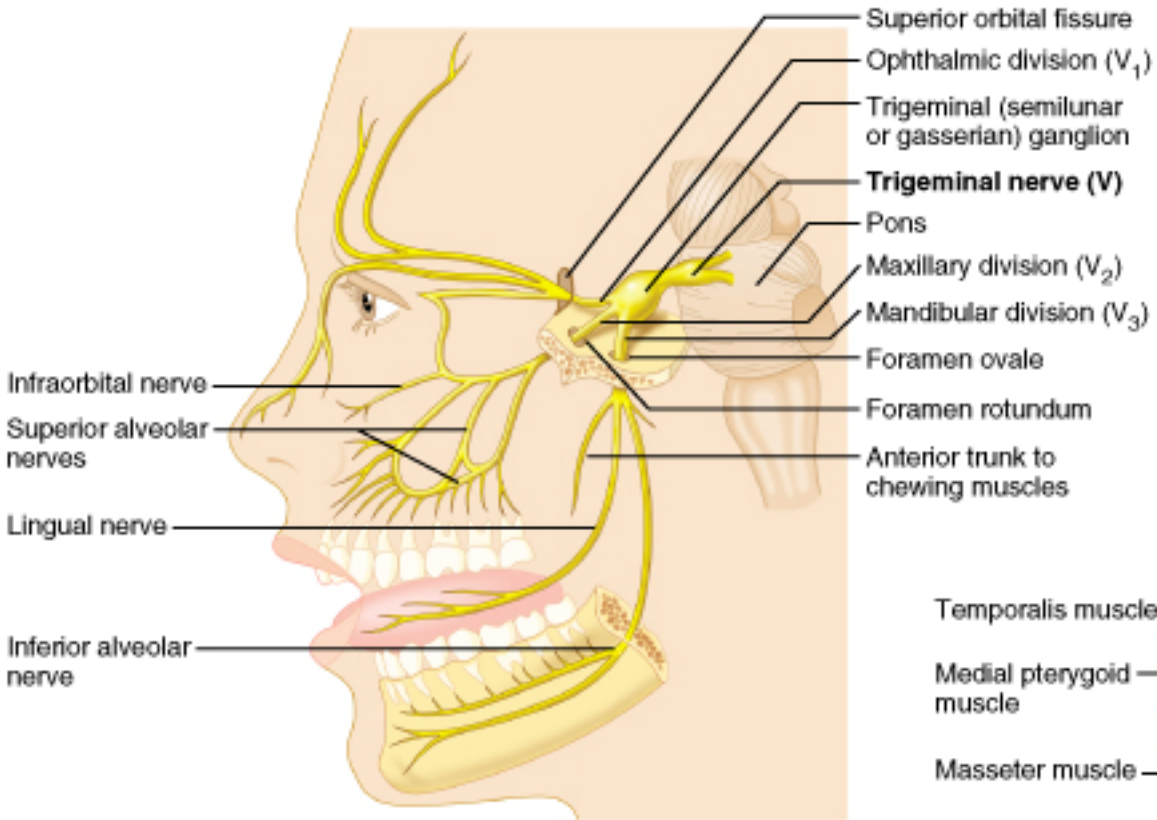
Oculomotor – CNIII- motor, PS (eyeball)

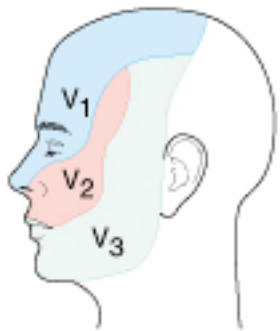


Trochlear – CNIV- motor (eyeball)

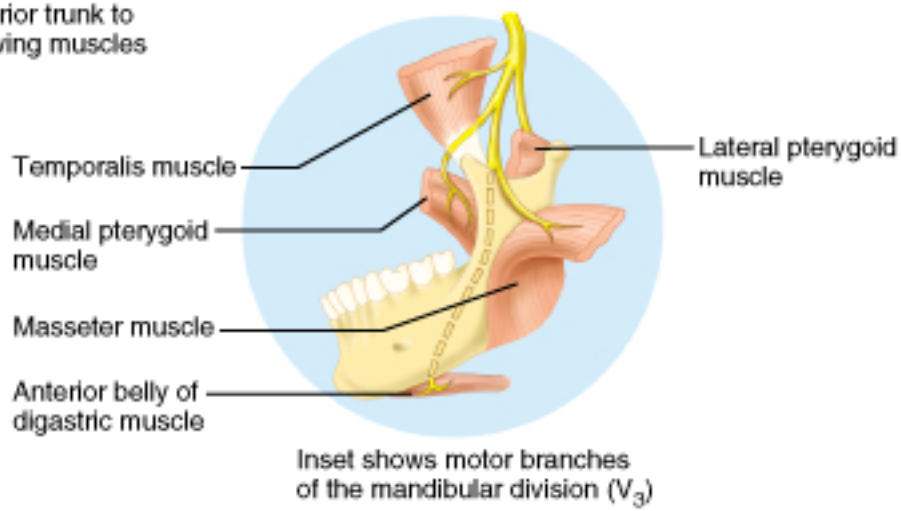


Trigeminal – CNV- sensory & motor



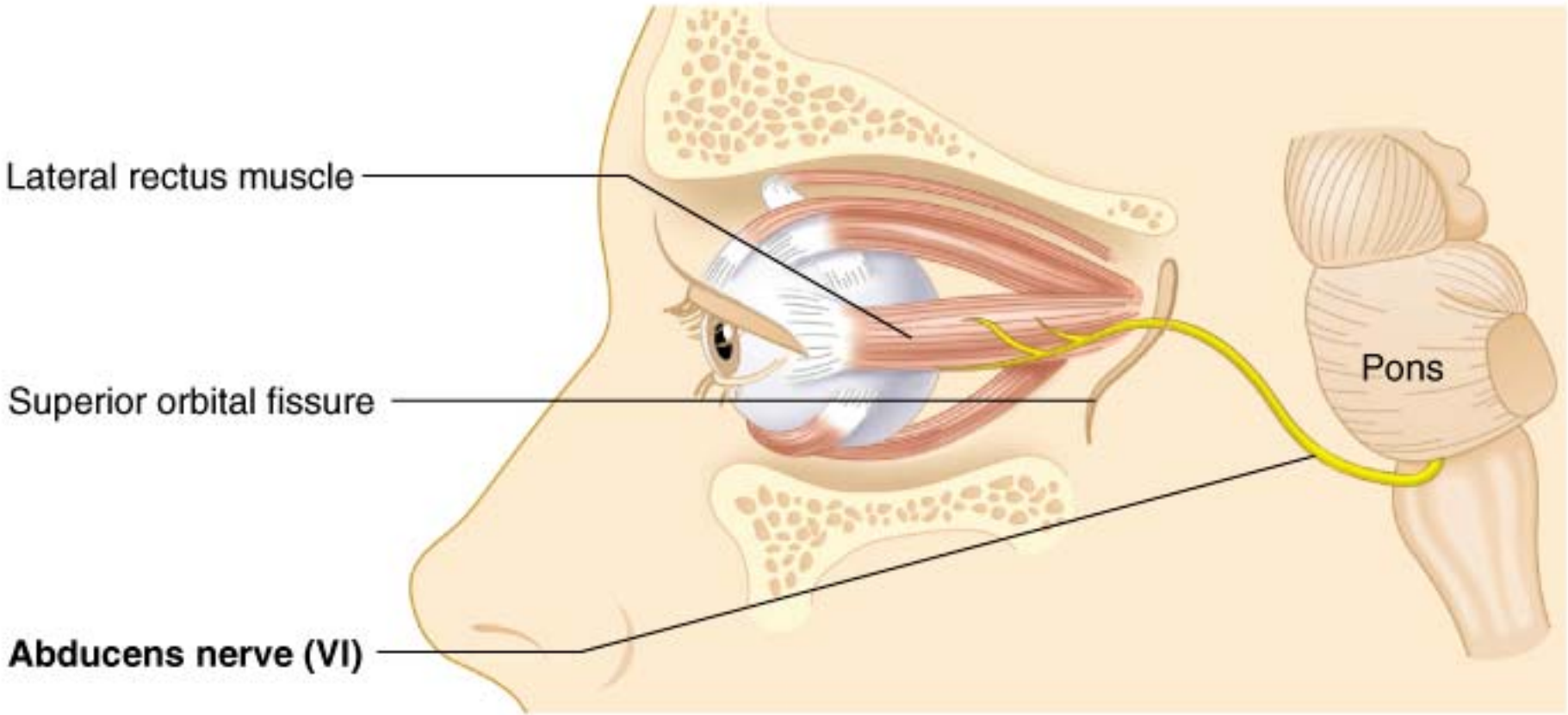


Distribution of sensory fibers of each division

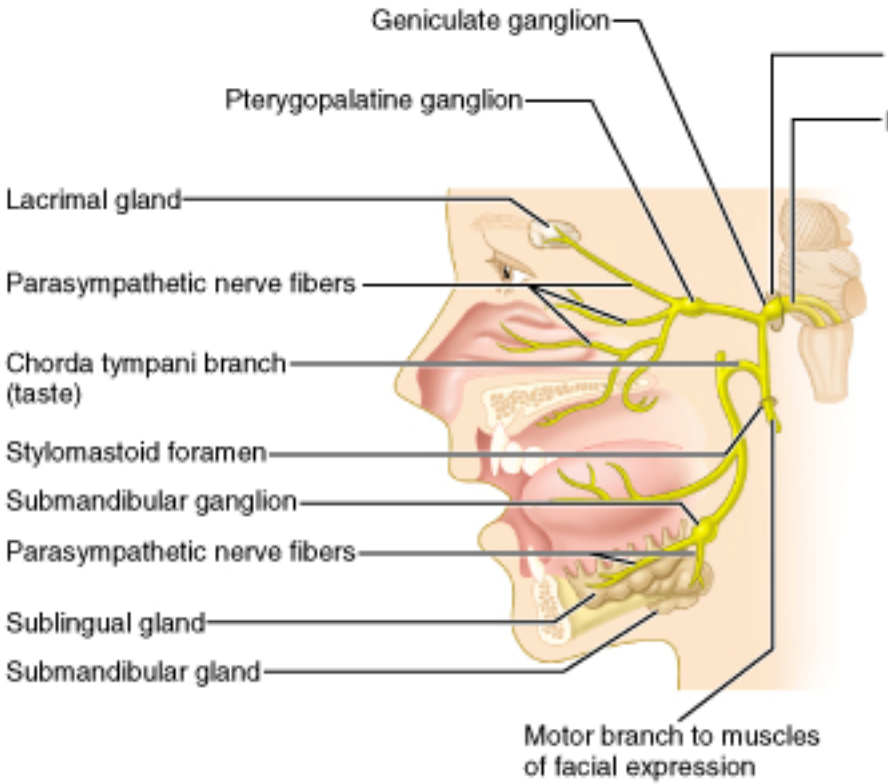


Inset shows motor branches of the mandibular division (V_3)

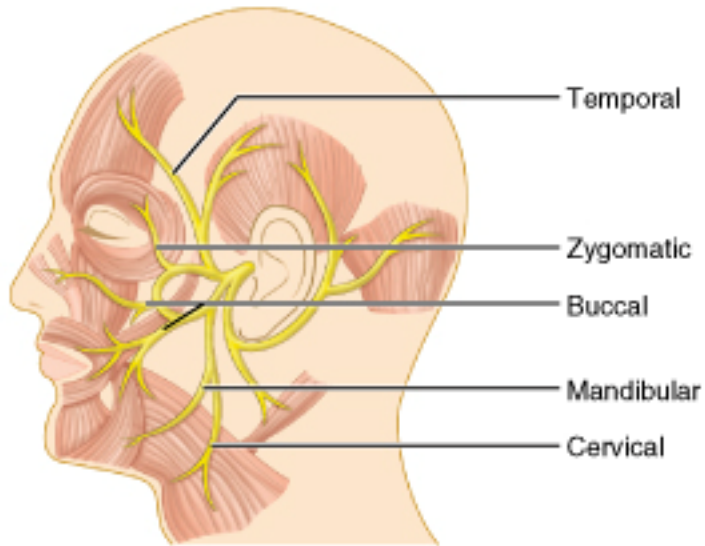
Abducent – CNVI- motor (eyeball)



Facial – CNVII- motor, sensory, PS

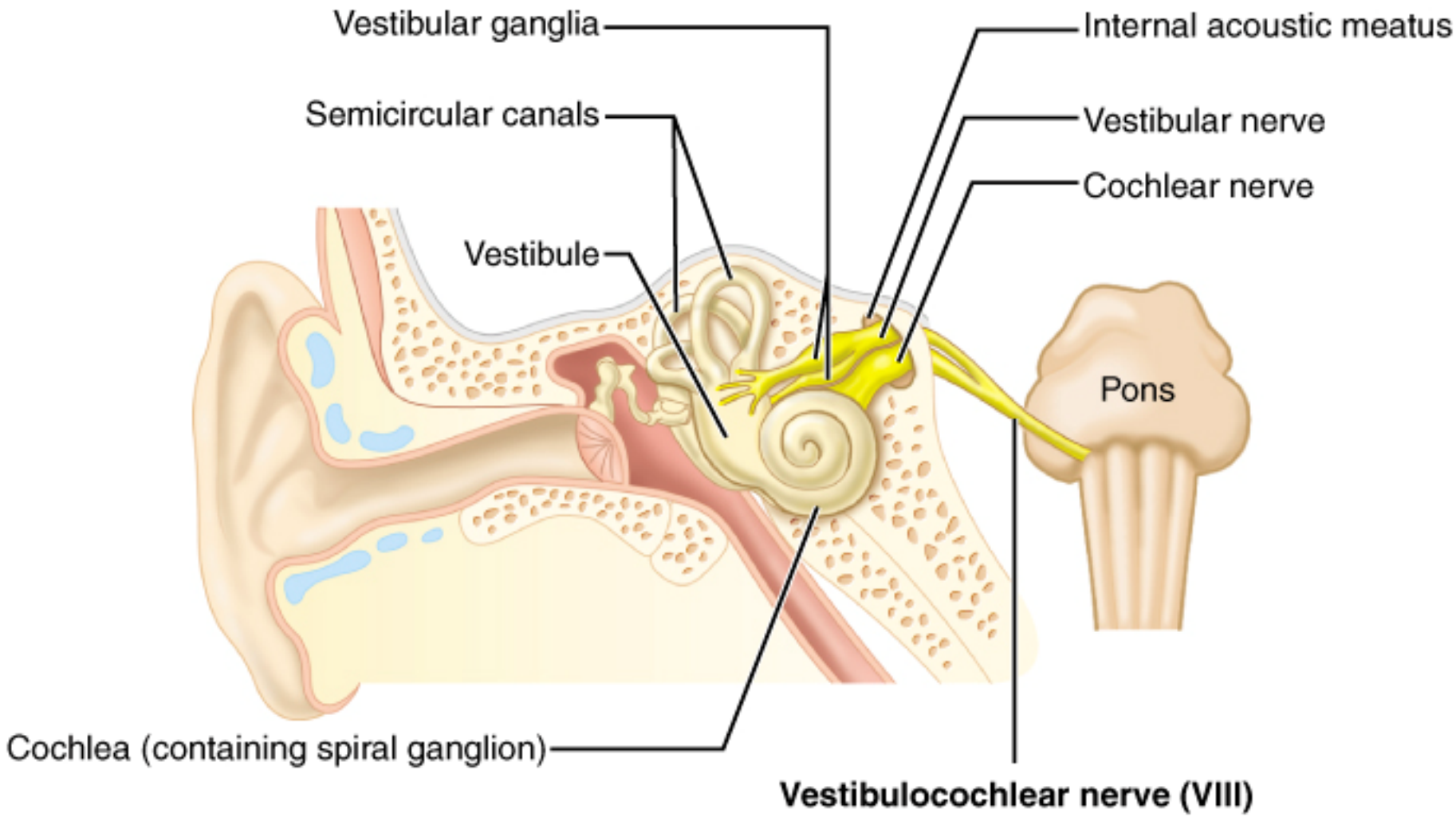


(a) Parasympathetic efferents and sensory afferents

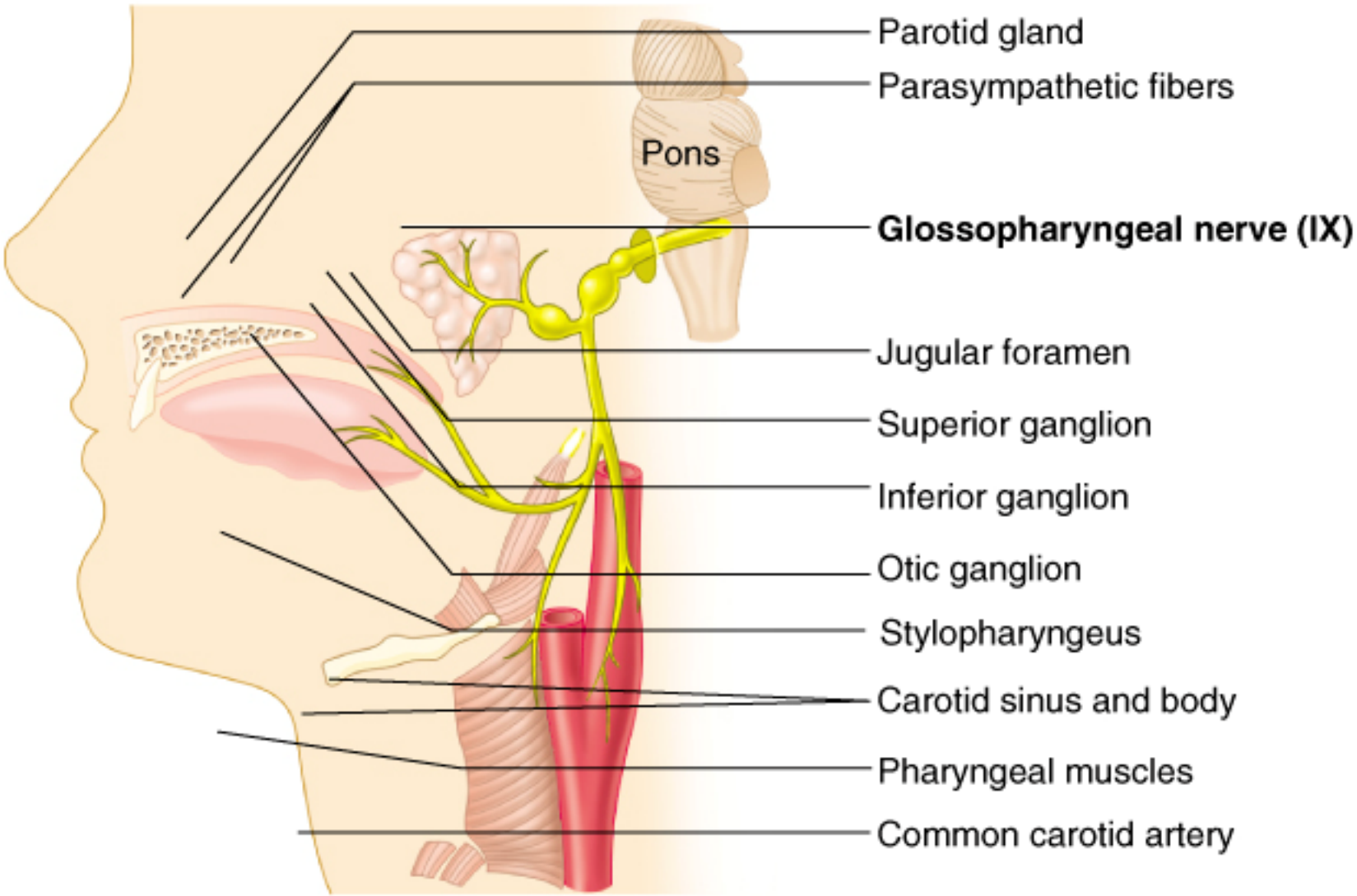


(b) Motor branches to muscles of facial expression and scalp muscles

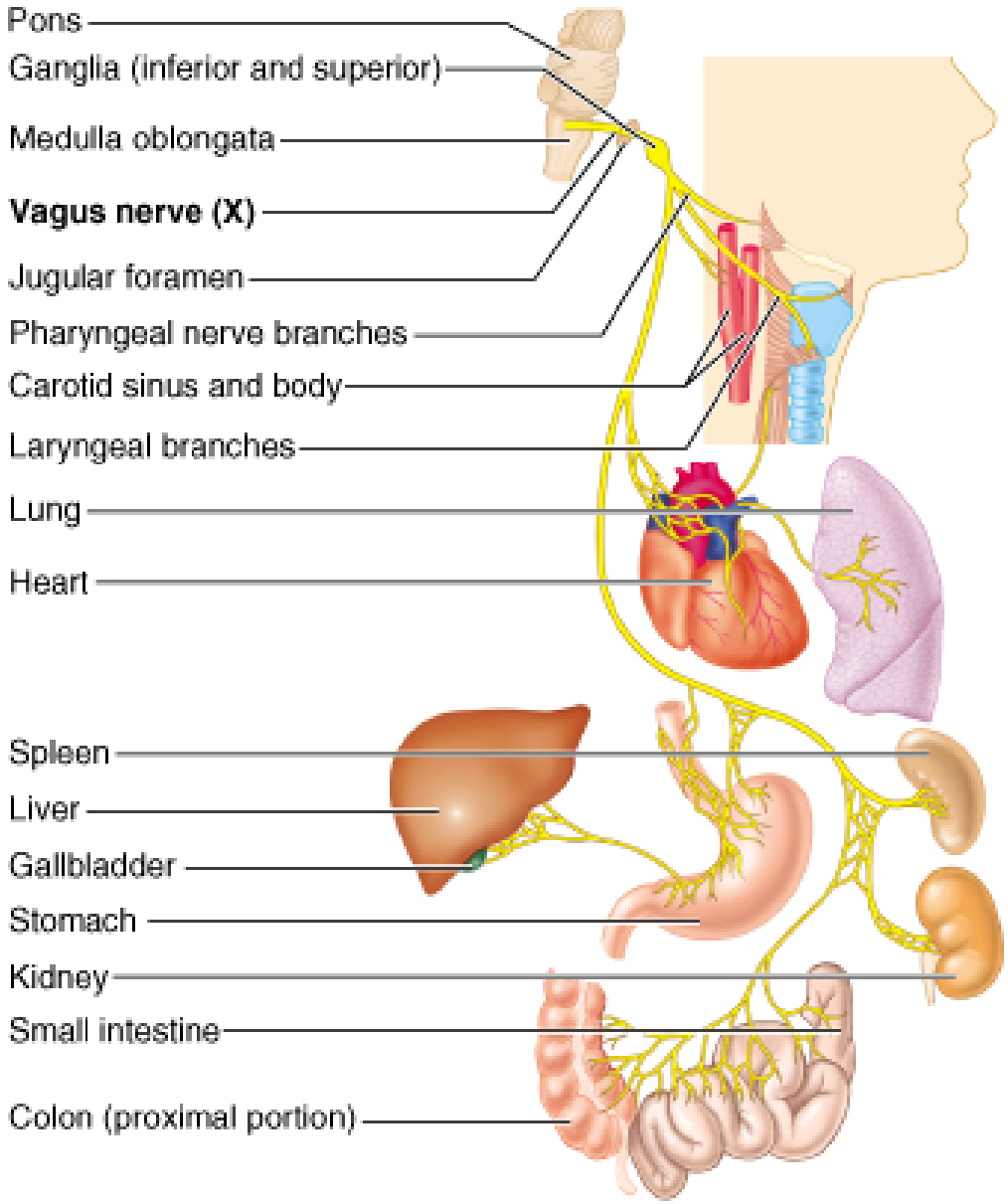
Vestribulocochlear – CNVIII-
special sensory (hearing/equilibrium)



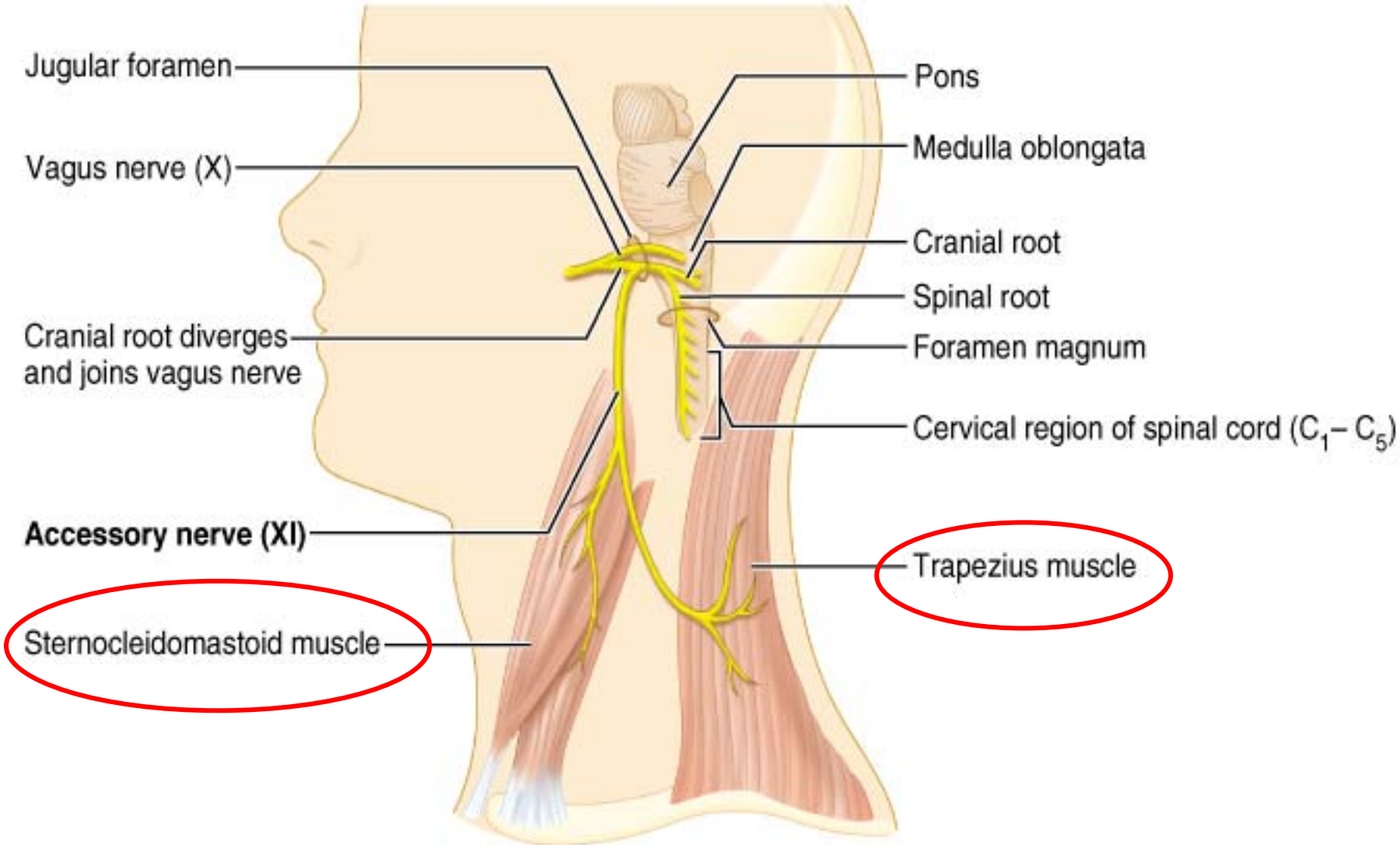
Glossopharangeal – CNIX-
motor, sensory, PS



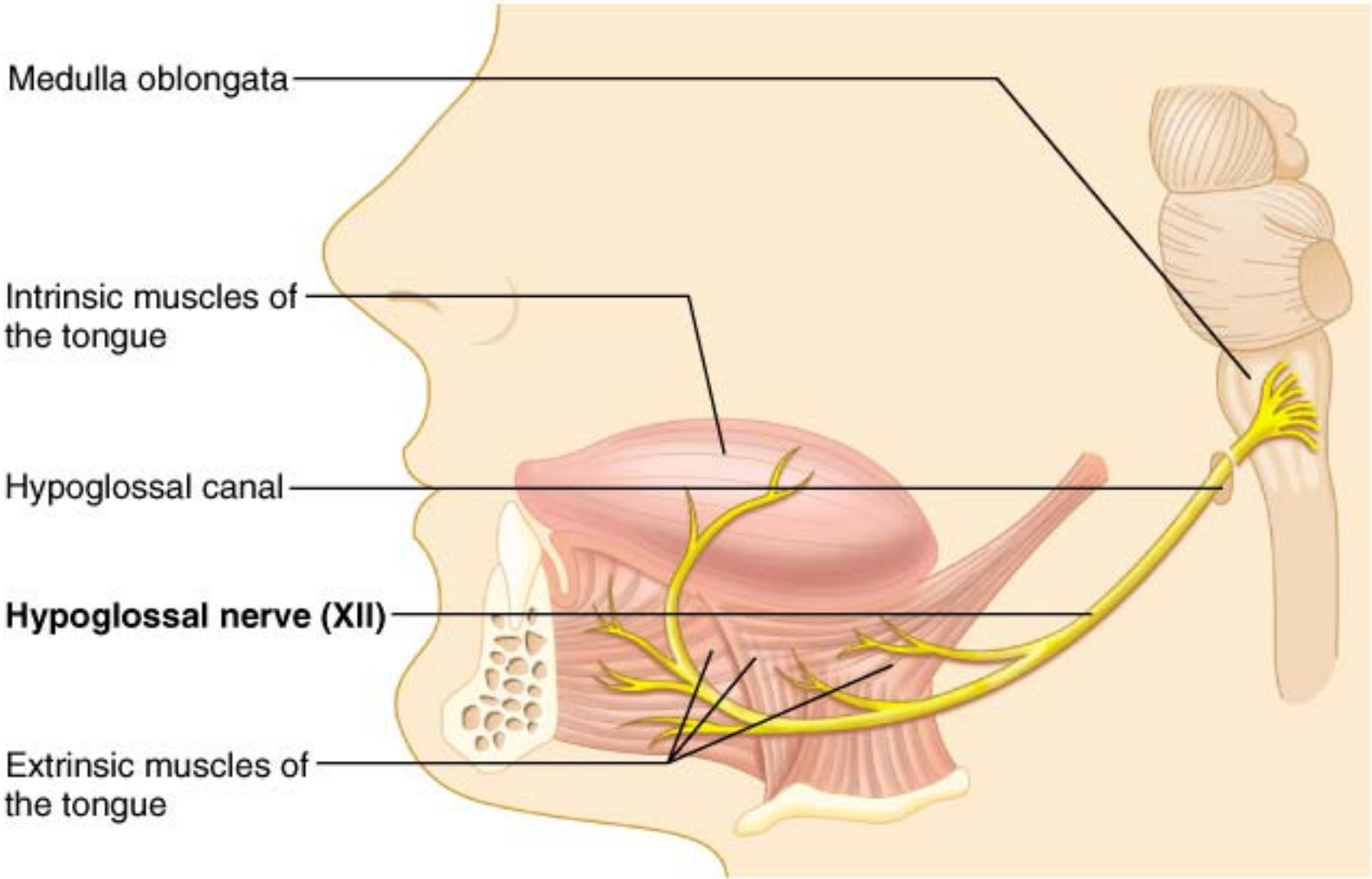
Vagus – CNX- PS, motor, sensory



Accessory – CNXI- motor



Hypoglossal – CNXII- motor (tongue)



Clinical questions on the UL

- Q: Where in the arm is the radial nerve at most risk of injury?

- A: risk of crushing injury where it lies next to the bone in the spiral groove at the back of the humeral shaft

Clinical questions on the UL

- Q: How does the motor nerve supply to the primary pronators & supinators of the forearm differ?

- A: the primary supinators (the supinator muscle) is innervated as an extensor via the radial nerve. The primary pronators (pronator quadratus & pronator teres) are innervated as flexors via the median nerve

Clinical questions on the UL

- Q: If the musculocutaneous nerve is severed, is elbow flexion still possible?

- A: yes, weak elbow flexion is still possible. The muscle responsible for this action is brachioradialis (since the biceps and brachialis would be paralyzed)

Clinical questions on the UL

- Q: what would be the motor deficit if the median nerve was cut at the elbow?

- A: loss of pronation, weakness in wrist flexion, loss of thumb mobility, and ulnar deviation of the hand

Clinical questions on the UL

- What is “student elbow”?
- Friction bursitis affecting the superficial olecranon bursa

Clinical questions on the UL

- What motions of the elbow would be hindered if the ulnar nerve were severed in the arm?

- None, because the ulnar nerve does not innervate any prime movers of the elbow

Clinical questions on the UL

- Where in the forearm and wrist are the ulnar nerve and median nerve most at risk of entrapment?

- A patient can pick up a suitcase but can’t pick up a dime. Speculate on the underlying mechanical problem.

Clinical questions on the UL

- Q: what are the palpable bony landmarks of the distal radius and ulna?
- Q: describe how the radial, ulnar, and median nerves enter the forearm
- Q: if the radial nerve is severed at the wrist, what would be the motor deficit?