
Review Ch 5 on the spinal cord organization, but not the tracts in the middle or lesions at the end of the chapter. Also review the basic concept of a reflex.

Review or skim Ch 12 on the vascular supply of the brain. Just look at pictures and legends for the clinical part at the end.

NEW: Chapter 7 Brainstem, but not the cerebellum part. BEWARE THE CRANIAL NERVES ARE KILLERS

NEW: Chapter 8 Cranial nerves, all of it including autonomic.

**ORIENTATION TO BRAIN STEM AND CRANIAL NERVE MOTOR NUCLEI**

Objectives:
1. Name all the cranial nerves and know their components and functions
2. Identify and locate the cranial nerves associated with the medulla, the pons and the midbrain.
3. Explain how cranial nerves differ from spinal nerves
4. List the cranial nerves that contain parasympathetic fibers and their function?
5. Recognize the major internal and external landmarks on the dorsal and ventral surface of the brain stem, so that you can determine if a gross or stained cross section is medulla, pons or midbrain.
6. Identify on cross sections the brain stem nuclei containing motor neurons, except for the salivatory nuclei.
7. Explain why cranial nerves are so important in localizing lesions.
8. Name reflexes that test these nerves. Describe the afferent and efferent limbs of these reflexes.
I. Medulla Oblongata - associated with CNs 9,10,11,12

A. External Anatomy.

1. Three prominent features on the ventral surface -- **pyramids, olives, pyramidal decussation.**

2. Associated cranial nerves (only motor components will be considered): CN’s 9, 10, 11, 12.

   a. **Hypoglossal nerve -- XII.**

      (1) Homologue of a ventral root; is somatic motor.

      (2) Innervates the somatic (striated) muscle of the tongue.

   b. **Vagus nerve -- X.** Two motor components.

      (1) Visceral motor component -- preganglionic parasympathetic axons.

      (2) Branchiomeric component -- innervates constrictor muscles of the pharynx and the intrinsic muscles of the larynx. These muscles are striated.

   NOTE: Although branchiomeric muscles are striated, they do not develop from somites. Hence, they are not considered to be somatic muscles. Instead, they develop from the mesenchyme of the pharyngeal (branchial, gill) arches.

   c. **Glossopharyngeal nerve -- IX.** Two motor components.

      (1) Visceral motor component -- preganglionic parasympathetic axons to the otic ganglion.

      (2) Branchiomeric component -- innervates the stylopharyngeus muscle.

   d. **Spinal accessory nerve -- XI.** It is considered to be branchiomeric in this course, where we try to simplify.

      The accessory nerve is divided into cranial and spinal portions. The cranial part, which innervates the intrinsic laryngeal muscles, quickly joins the vagus nerve and is considered part of the vagus nerve clinically and in this course.

      The **spinal** portion innervates the sternocleidomastoid muscle and part of the trapezius.

      ![Brainstem dental 2010.doc](https://example.com/photos)
Very important to learn the relationship of certain external landmarks and the cranial nerves.

B. Internal Anatomy.

1. The fate of the alar and basal laminae -- why brain stem sensory nuclei are lateral to motor nuclei. The basic plan.
2. The IV ventricle floor.
TYPICAL SECTION THROUGH ONE HALF OF THE MEDULLA

C. Cranial nerve motor nuclei.

   
   (a) Origin of N. XII.
   
   (b) Is comparable to the ventral horn.

   
   (a) Origin of the preganglionic parasympathetic axons of X.
   
   (b) Is comparable to the lateral horn.

   
   (a) Origin of the preganglionic parasympathetic axons of IX to the otic ganglion.
   
   (b) This tiny nucleus is rostral to the dorsal motor nucleus of X.
(c) Is comparable to the lateral horn

4. **Nucleus ambiguus.** Branchiomerie motor. Called branchial efferent or special visceral efferent in books.

(a) Origin of the branchiomeric axons of both IX and X.

(b) Axons of neurons in the rostral part of the nucleus join the IX nerve and those of neurons in the middle part, join X.

**NOTE:** Each of these nuclei can be divided into small clusters of neurons that innervate specific muscles. This is referred to as a somatotopic organization.

**D. Reticular formation.**

1. This forms the "central core" of the brain stem.
2. Its nuclear groups are not very obvious and the intermingling of nerve cell bodies and axons give the formation its name. Like olive loaf in the deli!
3. A "primitive" homoeostatically important part of the CNS; it contains cardiovascular and respiratory centers.

**E. Functional significance of the Medulla:** Vital Motor Regulatory Centers.

1. Reflex control of the cardiovascular system.
2. Reflex control of respiration.
3. Reflex control of swallowing and vomiting.
4. Important in phonation = control of tongue, pharynx, larynx
F. **Vascular supply** -- The *vertebral artery* and its branches.

1. **PICA** = Posterior Inferior Cerebellar Artery
2. **Anterior Spinal Artery**
II. Pons. - Associated with CN’s 5, 6, 7, 8

A. External Anatomy.


2. Associated cranial nerves
   a. Nerves at the level of caudal pons:
      (1) Vestibulocochlear nerve -- VIII. Ignore for now.

From Cranial Nerves, Stewart and Pauwels-Wilson
(2) **Facial nerve** -- VII. Two motor components:

(a) Visceral motor component -- preganglionic parasympathetic axons to the pterygopalatine and submandibular ganglia.

(b) Branchiomeric component -- innervates the facial muscles, the muscles of facial expression.

(3) **Abducens nerve** -- VI.

(a) Comparable to a ventral root; is somatic motor.

(b) Innervates the lateral rectus muscle of the eye.

(4) **Trigeminal nerve** -- V. The motor component is branchiomeric and it innervates the muscles of mastication.

B. **Internal anatomy** of pontine cranial nerve motor nuclei located within the tegmentum of pons.

1. Caudal Pons

   a. **Facial nucleus**.

      (a) Is a branchiomeric nucleus.

      (b) Axons innervate the muscles of facial expression.

   b. **Abducens nucleus**. Somatic motor nucleus.

      (a) Origin of N. VI.

      (b) Is a homologue of the ventral horn.

   c. **Superior salivatory nucleus**.

      (a) Visceral motor.

      (b) Its axons form the preganglionic parasympathetic component of VII.

2. **CN's of mid-pons, motor nucleus of V**.

   (a) Axons innervate the muscles of mastication.

   (b) Is a branchiomeric nucleus.

   **NOTE**: This nucleus is located in the dorsolateral tegmentum at the level of mid-pons thus we have to draw it on a section a bit more rostral.
C. Functional Significance of the Pons
1. Reflex control of the **micturition** and **respiratory** systems.
2. Important in **eye movements** and coordinated movement of the eyes and head.
3. **Corneal reflex** as an example

D. Vascular Supply – the **Basilar Artery** and its median and circumferential branches.
III. Mesencephalon (= Midbrain) associated with cranial nerves III and IV

A. **External** Anatomy.
   1. **Quadrigeminal plate = Tectum.** This is the dorsal aspect of the midbrain and it forms a roof over the aqueduct. It occurs as two sets of mounds.
      a. **Superior colliculus** associated with CN III
      b. **Inferior colliculus**, associated with CN IV
   2. **Cerebral peduncles** (crus cerebri) -- form the ventral aspect of the midbrain.
   3. Associated cranial nerves: 3, 4
      
      a. **Trochlear nerve -- IV.** Somatic motor.
         (1) The homologue of a ventral root (even though it has an aberrant course).
         (2) Innervates the superior oblique muscle of the eye. (Intorter, depressor, abductor when tested with the eye adducted.)
         (3) A small nucleus of motor neurons at level of inferior colliculus.
         (4) **Its axons cross the midline dorsal to aqueduct.** The only cranial nerve whose axons cross before emerging from the brain stem.
         (5) Emerges caudal to the inferior colliculus on opposite side.
         (6) Lesions of the nucleus produce deficit on the opposite
         (7) Lesion of the nerve produce deficit on the same side.
      
      b. **Oculomotor nerve -- III.** Two motor components:
         (1) Somatic motor component -- innervates all of the extraocular muscles not supplied by IV or VI and levator palpebrae superioris.
(2) Visceral motor component -- preganglionic parasympathetic axons to the ciliary ganglion.
   (a) Postganglionic axons to ciliary muscle and body.
   (b) Postganglionic axons to pupillary constrictors in iris. Constriction is called miosis. What is dilatation of the pupil called?

B. Internal Anatomy.

1. Tectum -- is dorsal to the aqueduct and includes the central gray and colliculi
2. Central gray matter -- surrounds the aqueduct (= periaqueductal gray)
3. Red nucleus.
4. Substantia nigra.
5. Cerebral peduncles -- the ventral surface.

6. Tegmentum
   a. Is located between the aqueduct and tectum dorsally and the cerebral peduncles substantia nigra ventrally.
   b. Contains cranial
   c. Other contents are the reticular formation and the red nucleus.
IV nerve motor nuclei: trochlear (IV) level of Inferior Colliculus

III, Oculomotor nerve and nucleus and Edinger Westphal nucleus at level of Superior Colliculus

Suzanne S. Stensaas ©
C. Functional Significance of the Midbrain.

1. The tectum is important in visual and auditory reflexes that orient the eyes, ears, head, and body toward visual and acoustic stimuli.

2. Coordinated eye movements.

3. Reflexes that control the diameter of the pupil and focusing the lens.

4. **Consciousness and arousal**: The mesencephalic ascending reticular activating system.

D. **Vascular** Supply – Branches of the basilar and posterior cerebral arteries
This is a Self-evaluation Test for after you have reviewed the material presented today.

1. What level of the brain stem is the
   a. Corneal reflex testing?
   b. Gag reflex testing?
   c. Pupillary light reflex testing?

2. Next state the location (nucleus) of the neuron cell body for the afferent and efferent limbs of each of these reflexes.
   Corneal Reflex
   a. Afferent
      a. Efferent
   Gag Reflex
   b. Afferent
      b. Efferent
   Pupillary Light Reflex
   c. Afferent
      c. Efferent

3. Now ask yourself what brain stem level each of the above reflexes testing?
   a. 
   b. 
   c. 

4. You have a patient who cannot look to the right with the right eye or smile or wrinkle the right side of their face. Characterize the lesion as to level, side, structure(s) involved.
Mid-sagittal MRI radiograph with nuclei superimposed.

Can you locate the following nuclei we have just studied? Remember, just the top 3 as we only discussed motor nuclei. (Special visceral refers to striated muscle derived from the branchial arches.)

- Ambiguus
- Facial
- Hypoglossal
- Trochlear
- Dorsal Vagal
- Abducens
- Oculomotor
- Motor nucleus of V
- Edinger-Westphal

Can you associate them with a particular level of the brain stem?
Can you name them?
Can you describe the motor function of each nerve?
Can you describe a sign of symptom of dysfunction due to damage to each of these nuclei?
Can you name a reflex you might test to check the integrity of these nuclei?
The next picture will help you if you get stuck

If you know this you will be in great shape for the exam!
Can you locate and name the **motor nuclei** associated with CNs 3,4,5,6,7,9,10,11, and 12? The preceding picture will help you. This is an MRI of the midsagittal plane.