**Brainstem. CN Motor Nuclei**

**Video tutorial:** YouTube-The Noted Anatomist-Playlists-Brainstem-CN Motor Nuclei

**Learning objectives**

- **CN motor nuclei.** Identify and describe the topography, modality (somatic motor, branchial motor, visceral motor), associated cranial nerve and function for each of the following CN motor nuclei:
  - Somatic motor nuclei
  - Branchial motor nuclei
  - Visceral motor nuclei

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**Brainstem CN motor nuclei.** Organized medial to the sulcus limitans in the following fashion.

- **Somatic motor nuclei.** Homologous to ventral horn gray matter; located medial to sulcus limitans close to midline
  - Oculomotor nucleus. Rostral midbrain, associated with CN III; supplies all extraocular muscles not supplied by CN IV or IV; damage causes ptosis and eye deviating down and out
    - Superior rectus (SR). Tested by looking out and up
    - Medial rectus (MR). Tested by looking in
    - Inferior rectus (IR). Tested by looking out and down
    - Inferior oblique (IO). Tested by looking in and up
    - Levator palpebrae superioris (LPS). Elevates eyelid
  - Trochlear nucleus. Located in caudal midbrain at the level of the inferior colliculus; associated with CN IV. Axon from nucleus decussates to contralateral side of midbrain before exiting (only one); damage prevents looking in and down (damage of the nucleus produces a contralateral deficit; damage of the nerve produces an ipsilateral deficit)
    - Lesions of the nucleus produce deficit on the opposite side
    - Lesions of the nerve produce deficit on the same side
    - Superior oblique (SO). Tested by looking in and down
  - Abducens nucleus. Pons, associated with CN VI; damage to nerve results in double vision when looking laterally on side of lesion; damage to nucleus results in inability to look laterally on side of lesion (due to MLF damage)
    - Lateral rectus (LR). Tested by looking out
- Hypoglossal nucleus. Medulla; associated with CN XII. Extends the length of the medulla; damage causes tongue deviation to side of lesion when protruded (lick your wounds)
  - Tongue muscles (i.e., genioglossus). Tested by sticking tongue out of mouth (lick wounds)

- Branchial (pharyngeal/branchiomerical) motor nuclei. Located medial to sulcus limitans; more ventrally located compared to other motor brainstem nuclei. Branchial muscles are striated but they are not derived from somites. They instead develop from the mesenchyme of the branchial (pharyngeal) arches. As such, their motor neuronal cell bodies are in different nuclei.
  - Trigeminal motor nucleus. Mid-pons; associated with 1st branchial arch and CN V-3; damage causes weakness in jaw clenching and deviation to side of lesion while opening jaw
    - Muscles of mastication (temporalis and masseter mm. elevate the mandible). Tested by clenching jaw
  - Facial motor nucleus. Pons; associated with 2nd branchial arch and CN VII. Axons arises from the facial motor nucleus, course around the abducens nucleus before exiting laterally from the pons
    - Muscles of facial expression. Muscles located in the hypodermis of the face; nuclear damage causes ipsilateral facial palsy/supranuclear damage causes contralateral facial palsy with sparing of the forehead
      - Frontalis m. (wrinkles forehead). Tested by asking patient to raise eyebrows
      - Orbicularis oculi m. (closes eyes). Tested by closing eyes against resistance and corneal reflex
      - Zygomaticus major m. (elevates corner of mouth; smiling muscle). Tested by asking patient to smile or to show his/her teeth
      - Buccinator m. (flatten cheek area to keep food between teeth during chewing). Tested by having patient blow out cheeks.
      - Orbicularis oris m. (closes lips/mouth). Tested by having patient purse lips as in giving a kiss
      - Nasalis m. (elevates side of nose; flaring of nostrils).
  - Nucleus ambiguus. Medulla; associated with 3rd, 4th and 6th branchial arches and CN IX and CN X. Located deep in reticular formation
    - Levator veli palatini m. (elevates soft palate). Tested by saying “ahhhh”; damage causes soft palate to deviate away from side of lesion during gag reflex
- Pharyngeal muscles (constricts pharynx; swallowing). Tested by gag reflex and ability to swallow; damage results in swallowing difficulties

- Laryngeal muscles (changes vocal fold tension; abduction and adduction). Tested by making sounds with larynx; damage results in hoarse voice

- **Visceral (para) motor nuclei.** Homologous to lateral horn gray matter; located medial to and adjacent to the sulcus limitans
  - Edinger-Westphal nucleus. Midbrain; associated with CN III. Synapses in the ciliary ganglion and enters eye via the short ciliary nn.; damage causes mydriasis
    - Sphincter pupillae muscle (constricts pupil in bright light). Tested by pupillary light reflex
    - Ciliary muscles (lens accommodation).
  - Superior salivatory nucleus. Pons, associated with CN VII; damage causes dry eye, dry mucous membranes and dry mouth. Synapses in the following ganglia:
    - Pterygopalatine ganglion (lacrimal and nasopalatal glands)
    - Submandibular ganglion (submandibular and sublingual salivary glands)
  - Dorsal vagal nucleus. Medulla; associated with CN X. Synapses in the intramural ganglia of the heart, lung airways, esophagus, foregut (liver, gall bladder, pancreas) and midgut organs; damage may result in reduction in parasympathetic innervation
  - Inferior salivatory nucleus. Medulla; associated with CN IX. Synapses in otic ganglion (parotid gland); damage may result in dry mouth but likely no affect

4. **Clinical correlations.** Predict the clinical findings for brain stem injuries.

- Compare and contrast injuries to brain stem levels, individual CN's or individual nuclei

- Describe the pupillary light reflex corneal reflex, gag reflex, and baroreceptor reflex including associated brain stem levels, CN's and nuclei