Cranial Nerves
by Ali Lucman
Cranial nerve origin

The 10 cranial nerves originate in the brainstem, which includes the midbrain, the pons, and the medulla. Two emerge from the cerebrum: the olfactory and the optic cranial nerves. There are 12 paired cranial nerves that can be divided into sensory, motor, or mixed nerves (with both motor and sensory involvement).
Names

I  N. olfactorius
II  N. opticus
III  N. oculomotorius
IV  N. trochlearis
V  N. trigeminus
VI  N. abducens
VII  N. facialis
VIII  N. vestibulocochlearis
IX  N. glossopharyngeus
X  N. vagus
XI  N. accessorius
XII  N. hypoglossus
Cranial nerves

How many cranial nerves are there?

How many out of these originate from the brainstem?

Where do the others originate from and which cranial nerves are they?
Mnemonic Aid for Cranial Nerves

Oh, once one takes the anatomy final - very good vacations are heavenly!

Olfactory, Optic, Oculomotor, Trochlear, Trigeminal, Abducens, Facial, Vestibulocochlear, Glossopharyngeal, Vagus, Accessory, Hypoglossal

To remember at least part of the sequence of the first set of cranial nerves that begin with the letter O, try this – You have I nose. You have II eyes. I - Olfactory; II -- Optic
Mnemonic Aids for Sensory and /or Motor Functions of Cranial Nerves

Some Say Marry Money, But My Brother Says Big Business Matters More

The first letter of each word signifies whether the particular cranial nerve is sensory only (S); motor (M); or both sensory and motor (B)
<table>
<thead>
<tr>
<th>Activity/exercise</th>
<th>1) Olfactory</th>
<th>Oh,</th>
<th>1) Sensory</th>
<th>Some</th>
</tr>
</thead>
<tbody>
<tr>
<td>2) Optic</td>
<td>Once</td>
<td>2) Sensory</td>
<td>Say</td>
<td></td>
</tr>
<tr>
<td>3) Oculomotor</td>
<td>One</td>
<td>3) Motor</td>
<td>Marry</td>
<td></td>
</tr>
<tr>
<td>4) Trochlear</td>
<td>Takes</td>
<td>4) Motor</td>
<td>Money</td>
<td></td>
</tr>
<tr>
<td>5) Trigeminal</td>
<td>the</td>
<td>5) Both</td>
<td>But</td>
<td></td>
</tr>
<tr>
<td>6) Abducens</td>
<td>anatomy</td>
<td>6) Motor</td>
<td>My</td>
<td></td>
</tr>
<tr>
<td>7) Facial</td>
<td>final-</td>
<td>7) Both</td>
<td>Brother</td>
<td></td>
</tr>
<tr>
<td>8) Vestibulocochlear</td>
<td>Very</td>
<td>8) Sensory</td>
<td>Says</td>
<td></td>
</tr>
<tr>
<td>9) Glossopharyngeal</td>
<td>good</td>
<td>9) Both</td>
<td>Big</td>
<td></td>
</tr>
<tr>
<td>10) Vagus</td>
<td>vacations</td>
<td>10) Both</td>
<td>Business</td>
<td></td>
</tr>
<tr>
<td>11) Accessory</td>
<td>are</td>
<td>11) Motor</td>
<td>Matters</td>
<td></td>
</tr>
<tr>
<td>12) Hypoglossal</td>
<td>heavenly!</td>
<td>12) Motor</td>
<td>More</td>
<td></td>
</tr>
</tbody>
</table>
Nuclei, components, course
Cranial nerves

- **Somatic**
  - **Somatomotor**
  - **Somatosensory**
    - General somatosensory
    - Specific somatosensory

- **Autonomic**
  - **Visceromotor**
    - General visceromotor
    - Specific visceromotor
  - **Viscerosensory**
    - General viscerosensory
    - Specific viscerosensory
Components

- **General somatosensory fibers (GSS):** extero- and proprioceptive impulses from head and face
- **Specific somatosensory fibers (SSS):** specific impulses from eye and ear
- **General viscerosensory fibers (GVS):** from visceral organs to viscerosensory nuclei.
- **Specific viscerosensory fibers (SVS):** specific impulses for smell and taste
- **General somatomotor fibers (GSM):** for skeletal muscles of eye and tongue
- **Specific visceromotor fibers (SVM):** for skeletal muscles with branchiogenic origin. Mastication, expression, swallowing
- **General visceromotor fibers (GVM):** from visceromotor nuclei; relay in parasympathetic ganglia. Heart muscle, smooth muscles, glands.
Nuclei

Columns

- **Medial**
  
  **general Somatomotor.** In the central grey matter; derive from *basal plate* of neural tube; supply striated muscles (III, IV, VI, XII).

- **Ventrolateral.**
  
  **Specific visceromotor.** Migrate ventrolaterally forming *inner genu*; derive from *basal plate*; supply muscles with *branchiogenic origin*; (V, VII).
Visceromotor column.
Lateral to medial and dorsal to ventrolateral clmn; derive from basal plate next to sulcus limitans; origin to efferent preganglionic fibers; parasympathetic supply of smooth muscles; (III, VII, IX, X).

Sensory column.
Lateral to sulcus limitans; derive from alar plate; accept central processes of sensory ganlia cells;

- General viscerosensory – close to sulcus limitans (VII, IX, X).
- General somatosensory - intermediate, general sensation from head/face (V)
- Specific somatosensory - lateral, hearing and balance impulses (VIII)
Motor, sensory, mixed
Classification

- **Sensory**: only afferent (sensory) fibers
  - N. Olfactorius
  - N. Opticus
  - N. Vestibulocochlearis

- **Motor**: only efferent (motor) fibers
  - N. Oculomotorius
  - N. Trochlearis
  - N. Abducens
  - N. Accessorius
  - N. Hypoglossus

- **Mixed**: sensory and motor fibers
  - N. Trigeminalis
  - N. Facialis
  - N. Glossopharyngeus
  - N. Vagus
Sensory-N. olfactorius

Olfactory membrane receptor cell connected with axons which go through the Foramen. Cribriform they then reach olfactory bulb then reaches olfactory tract. Olfactory tract continues to anterior perforated substance and then to the medial and lateral striae. The lateral straie axons reach the primary olfactory cortex in the cerebral cortex.
sensory-N. opticus

Ganglion cell receive input from photoreceptors → fibres pass through optic canal → optic nerve chiasm and tract and then to lateral geniculate body. After which the continuation of fibres reaches the primary visual cortex in the occipital lobe.
sensory-N. vestibulocochlearis

Ganglion Vestibulare (SSA) - Meatus internus acusticus - Nuclei Vestibulares
Ganglion Cochleare (SSA) - Canalis spiralis - Nuclei Cochleares

Cochlear nerve transmits sensory information of sound back to the brain and vestibular nerve transmits about balance. Appearance in the pontomedullary junction and exits the skull via the internal acoustic meatus.
Motor-N. oculomotorius

- **components**
  - Somatomotor fibres
  - Viceromotor fibres

- **origin**
  - nucl. oculomotorius
  - nucl. accessorius

- **appearance**
  - sulcus cruris medialis

- **course**
  - Lateral wall of *sinus cavernosus*

- **Exits skull**
  - Fissura orbitalis superior

- **innervation**
  - M. rectus superior, inferior, medialis; m. obliquus inferior; m. levator palpebrae superioris
  - M. sphincter pupillae & m. ciliaris

- **Ganglion ciliare : between n. opticus & m. rectus lateralis**
Damage of n. oculomotorius

- Diverging strabismus (squinting)
- Double vision
- Dilated pupil (mydriasis)
- Impaired accommodation
Motor-N. trochlearis [IV]

**Nucleus**
- Nucl. n. trochlearis (OCM)

**Appearance**
- Below inferior colliculus

**Course**
- Lateral wall of sinus cavernosus

**Exit**
- Fissura orbitalis superior

**Supply**
- Somatomotor:
  - M. oblique superior
Motor- N. abducens [VI]

<table>
<thead>
<tr>
<th>Nucleus</th>
<th>Nucl. n. abducentis (OCM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Fissura pontomedullaris,</td>
</tr>
<tr>
<td>Course</td>
<td>Thru sinus cavernosus,</td>
</tr>
<tr>
<td></td>
<td>lateral to a. carotis int.</td>
</tr>
<tr>
<td>Exit</td>
<td>Fissura orbitalis superior</td>
</tr>
<tr>
<td>Supply</td>
<td></td>
</tr>
<tr>
<td>Somatomotor:</td>
<td>M. rectus lateralis</td>
</tr>
</tbody>
</table>

![Diagram of the abducens nerve](image)
Damage of n. abducens

- Converging strabismus (squinting)
- Double vision
Motor- N. accessorius

Nucleus

Nucl. ambiguus - caudal (SVM)
Nucl. spinalis n. accessorii (GSM)

Appearance

Sulcus retroolivaris – radix (roots) cranialis
Btw radices ventralis & dorsalis – radix spinalis

Course

Radix spinalis enters skull thru for. magnum, joins radix cranialis

Exit

For. Jugulare
- pars cranialis – r. externus in n. vagus
- pars spinalis – from spinal nerves c1 to c6

Supply

M. trapezius, m. sternocleidomastoideus
Motor- N. hypoglossus [XII]

<table>
<thead>
<tr>
<th>Nucleus</th>
<th>Nucl. n. hypoglossi (GSM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Sulcus anterolateralis</td>
</tr>
<tr>
<td></td>
<td>btw oliva &amp; pyramis</td>
</tr>
<tr>
<td>Course</td>
<td>Cisterna basalis</td>
</tr>
<tr>
<td>Exit</td>
<td>Canalis n. hypoglossi</td>
</tr>
<tr>
<td>Supply</td>
<td>Somatomotor: Mm. styloglossus, hyoglossus, genioglossus, muscles of tongue</td>
</tr>
</tbody>
</table>
Mixed nerves
Mixed- N. trigeminus [V]

Components

- **SVM**: from nucleus motorius n. trigemini, muscles of mastication.
- **GSS**: from head and face to sensory nuclei of n.trigeminus; neurons in ganglion trigeminale, lying on petrosal part on temporal bone.
Branches

- **N. ophthalmic** (V1, sensory) exits thru *fissura orbitalis superior*, enters orbit

- **Branches**
  - **N. frontalis:**
    - N. supratrochlearis
    - N. supraorbitalis
  - **N. lacrimalis**
  - **N. nasociliaris**
**Opthalmic nerve Supplys:**

**Sensory:**
- Dura mater cerebri
- Eye
- Nasal mucosa
- Skin epicranial & eye area, back of nose

*Sympathetic fibers* for m. dilator pupillae. From upper Th segments, thru superior cervical ganglion. Reach branches of a. carotis interna
**N. maxillaris**  
(V2, sensory)

- Exit thru foramen rotundum
- Branches
  - N. infraorbitalis
  - N. zygomaticus
  - N. alveolaris superior
  - N. pterygopalatinus
Maxillary nerve Supplies:
- Dura mater cerebri
- Teeth – upper jaw
- Nasal & oral mucosa
- Skin between eyes and mouth
**N. mandibularis**

(V3, mixed)

- Exit thru *foramen ovale* and enters fossa infratemporalis

- **Branches**
  - N. auriculotemporalis
  - N. buccalis
  - N. lingual
  - N. alveolaris inferior
  - Nn. for masticatory muscles
Mandibular nerve
Supplys:

Sensory:
- Dura mater cerebri
- Teeth and gums of lower jaw
- Mucosa and floor of mouth
- Anterior 2/3 of tongue
- Skin temporal area, ear, below mouth

Motor:
- Muscles of mastication,
  m. mylohyoideus,
  venter anterior m. digastricus
Mixed-Facial Nerve VII

- Somatic Motor - facial expressions
- Autonomic Motor - salivary and lacrimal glands, mucous membranes of nasal and palatine mucosa
- Special Sensory - taste on anterior 2/3’s of tongue
- Damage produces sagging of facial muscles and disturbed sense of taste (no sweet and salty)
Clinical test: Test anterior 2/3’s of tongue with substances such as sugar, salt, vinegar, and quinine; test response of tear glands to ammonia fumes; test motor functions by asking subject to close eyes, smile, whistle, frown, raise eyebrows, etc.
Mixed- N. facialis [VII]

Components

- **SVM** from *nucleus n. facialis* for muscles of expression
- **GVM (n. intermedius)** from *nucleus salivatorius superior*, joins *ganglion pterygopalatinum & ganglion submandibulare*. Postganglionic fibers reach *glandulae lacrimalis, submandibularis & sublingualis*
- **SVS (n. intermedius)** from taste buds in anterior 2/3 of tongue, neurons in *ganglion geniculi of n. facialis* reaching *nucleus tractus solitarii*
- **GSS** skin of external ear
Facial nerve Course
Thru *meatus acusticus internus*, canal *facialis for. stylomastoideum*, enters *gl. parotid*, forming *plexus intraparotid* and giving off five branches for muscles of expression.
- **N. petrosus major**: GVM fibers to ganglion pterygopalatinum, postganglionic fibers thru n. zygomaticus & n. lacrimalis reach gl. lacrimalis

- **N. stapedius**: for m. stapedius origin pyramidal emminence and controls amplitude of sound waves to the inner ear.
Branches of facial nerve outside the skull

- temporal
- zygomatic
- buccal
- marginalis mandibulae
- cervical
- **Ganglion pterygopalatinum**: in fossa pterygopalatine below n. maxillaris
- **Ganglion submandibulare**: btw n. lingualis & gl. submandibularis
Damage of n. facialis - one side of the face drops paralysis in muscles for one Side of the face called bell’s palsy.
Mixed-Glossopharyngeal Nerve IX

- **Somatic motor** – Swallowing and voice production via pharyngeal muscles
- **Autonomic motor** - salivation, gagging, control of BP and respiration
- **Sensations** from posterior 1/3 of tongue including taste
- **Sensations** from baroreceptors and chemoreceptors
- **Damage** results in loss of bitter and sour taste and impaired swallowing, blood pressure anomalies (with CN X).
Mixed- N. glossopharyngeus [IX]

Components

- **SVM**: from nucleus ambiguus to m. stylopharygeus
- **GVM**: preganglionic from nucleus salivatorius inferior to ganglion oticum, postganglionic to glandula parotidea
- **SVS**: from ganglion inferior, central processes to nucleus tractus solitarii, peripheral processes to posterior 1/3 of tongue
- **GVS**: from mucosa of posterior 1/3 of tongue, pharynx, palatine tonsils, tuba auditiva & cavitas tympanica, sinus & glomus caroticus, reach nucleus tractus solitarii
Glossopharyngeal nerve Course: exit thru foramen jugulare

Branches

- **Lingual branch**: taste buds and mucosa of posterior 1/3 of tongue
- **Pharyngeal branch**: plexus pharyngeus, sensory and parasympathetic fibers
- **N. tympanic**: GVM thru n. tympanicus & n. petrosus minor reach ganglion oticum, postganglionic thru n. auriculotemporais (V3) for glandula parotidea
- **Carotid sinus branch**: for sinus & glomus caroticus
- Rami tonsillares & ramus m. stylophayngei

**Ganglion oticum**: below foramen ovale
Mixed-Vagus Nerve X

- Sensations from skin at back of ear, external acoustic meatus, part of tympanic membrane, larynx, trachea, esophagus, thoracic and abdominal viscera
- Sensations from bararoceptors and chemoreceptors
- Special sensory – taste from epiglottis and pharynx
- Somatic motor – Swallowing and voice production via pharyngeal muscles
- Autonomic motor – smooth muscle of abdominal viscera, visceral glands secretions, relaxation of airways, and normal or decreased heart rate.
- Damage causes hoarseness or loss of voice, impaired swallowing, GI dysfunction, blood pressure anomalies (with CN IX), fatal if both are cut
N. vagus [X]

Components

- **GVM**: nucleus dorsalis n. vagi, interrupted in parasympathetic ganglion, short postganglionic fibers supply heart muscle, smooth muscles and glands
- **SVM**: nucleus ambiguus, for muscles of pharynx + larynx
- **GVS**: from organs in neck, thorax, abdomen to nucleus tractus solitarii
- **GSS**: auricle, meatus acousticus externus & dura mater cerebri
Course
- Exits thru foramen jugulare
- Descends in sheath carotid btw internal a. carotid interna (communis) & v. jugularis interna
- N. vagus dexter
- Enters thorax to the right of trachea
- Descends behind v. brachiocephalic dextra & vena. cava superior
- Passes behind the root of right lung
- Forms plexus esophagus posterior
- Forms truncus vagalis posterior in hiatus esophagus, enters abdomen and gives off branch gastric posterior celiac
**N. vagus sinister**

- Enters thorax btw a. carotis communis & a. subclavia sinistra, behind v. brachiocephalica sinistra
- Passes anterior to arch of aorta, giving off *n. laryngeus recurrens*
- Passes behind the root of left lung
- Forms *plexus esophageus anterior*
- Forms *truncus vagalis anterior* in hiatus esophageus, enters abdomen, gives off *rr. gastrici anteriores & rr. hepatici*
Branches in neck

- **N. laryngeus superior**: descends along pharynx and gives off
  - **Ramus internus**, pierces membrana thyrohyoidea and supplies mucosa of larynx to rima glottis
  - **Ramus externus**, supplies m. cricothyroideus

- **Rami cardiaci cervicales superiores**: descend to plexus cardiacus

- **Ramus meningeus, ramus auricularis, rami pharyngei** (plexus pharyngeus)
N. laryngeus superior
Ramus internus
Ramus externus
Thoracic branches

- **N. laryngeus recurrens**
  - Right around a. subclavia sin., left around arcus aortae
  - Ascend in tracheo-esophageal sulcus
  - Enter larynx behind art. cricothyroidea, and turn into n. laryngeus inferior
  - Supply: laryngeal mucosa below rima glottis, laryngeal muscles except m. cricothyroideus

  - **Rami cardiaci inferiores**
  - **Rami tracheales**
  - **Rami esophagei**

- **Rami bronchiales**
Abdominal branches

- **Rr. gastrici anteriores + posteriores:**
  - Along lesser curvature of stomach supply anterior and posterior walls
  - At antrum pyloricus branches for pars pylorica

- **Rr. hepatici:** enter plexus hepaticus supply liver and gall bladder

- **Rr. celiaci:** for plexus celiacus, reach liver, pancreas, spleen, kidneys and gut to flexura colica sinistra
Openings in the skull through which the cranial nerves pass:

I olfactory
II optic
III oculomotor
IV trochlear
V Trigeminal
VI Abducens
VII facial
VIII vestibulocochlear
IX glossopharyngeal
X Vagus
XI Accessory
XII hypoglossal
Review Questions

Which cranial nerve has three subdivisions which pass through the superior orbital fissure, the foramen rotundum and the foramen ovale.

> Accessory
> Glossopharyngeal
> Vagus
> Trigeminal
> Facial
Review Questions

Which foramen do cranial nerves IX, X and XI pass through.

> Foramen spinosum
> Foramen rotundum
> Foramen ovale
> Jugular foramen
Review questions

The cranial nerves VII and VIII pass through the.

> Optic canal
> Jugular foramen
> Internal acoustic meatus
> Foramen spinosum
Review questions

Cranial nerves III, IV and VI pass through which opening.

> Superior orbital fissure
> Foramen rotundum
> Foramen ovale
> Optic canal
Thanks for listening and Learn anatomy or Die trying !!!!!!