Neuroanatomy

- **Lingual Muscles**
  - Your tongue is comprised of both intrinsic and extrinsic muscles.
- **Intrinsic Muscles**
  - Shapes the tongue
  - Tongue Base Retraction-propels bolus into pharynx
  - Reflexive lingual groove-maintains cohesive bolus for pharyngeal transfer.
  - Innervated by CN XII
  - Sensory is CN V, VII, IX
  - XII meets with above nerves at nucleus solitarius in the brainstem.
- *Transverse*
  - Origin: median fibrous septum
  - Insertion: mucosa at sides of tongue
  - Action: narrows and elongates the tongue.
  - Innervation CN XII
- *Vertical*
  - Origin: submucousal fibrous layer of dorsum of tongue.
  - Insertion: inferior surface of the tongue.
  - Action: flattens and broadens the tongue.
  - Innervation CN XII
- *Superior Longitudinal*
  - Origin: median fibrous septum, near epiglottis.
  - Insertion: sides of tongue
  - Action: retracts the tongue with the inferior longitudinal muscle, making the tongue short and thick.
  - Establishes lingual-dental connection.
  - A-P pattern.
  - Innervation CN XII
- *Inferior Longitudinal*
  - Origin: root of the tongue.
  - Insertion: apex of tongue.
  - Action: widens, shortens tongue; creates convex dorsum, depresses teeth.
  - A-P pattern-assists in propulsion of the bolus.
  - Innervation CN XII.
- **Extrinsic Muscles of the Tongue**
  - Give movement to the tongue.
  - Tongue retraction-primitive, protective reflex.

- Styloglossus with glossopalatine generate posterior lingual elevation.
- Tongue base retraction-propels bolus into pharynx.
- Reflexive lingual groove-maintain cohesive bolus for pharyngeal transfer.
- Reflexive protective retraction-prevents pharyngeal infiltrate, or premature lingual spillover during mastication.
- Innervation: CN XII

- *Styloglossus*
  - Origin: inferior portion of the styloid process of the temporal bone.
  - Insertion: lateral border of the tongue.
  - Action: elevates rear of tongue; retracts protruded tongue during mastication.
  - Innervation: CN XII.
- *Genioglossus*
  - Origin: upper mental spine on lingual surface of the mandible.
  - Insertion: Dorsum of tongue and body of hyoid bone.
  - Action: Inferior fibers help the tongue protrude, middle fibers depress the tongue, superior fibers draw the tongue tip back and down.
  - Innervation: CN XII.
- *Hyoglossus*
  - Origin: greater cornu of hyoid bone.
  - Insertion: posterior half of the side of the tongue.
  - Action: depress and retracts tongue.
  - Innervation: CN XII.
- **<u>Intrinsic Muscles of Mastication</u>**
  - Rotary-normal mastication pattern.
  - Vertical-no lateral jaw movement, jaw jerk reflex absent (trigeminal affected.)
  - Suck-swallow-primitive, motoric innervation, oral XII, pharyngeal X
  - Absent O-M pattern-bilateral destruction of CN motor lines V, X, XII.
  - Tonic bite: Contraction of temporal, masseter and internal pterygoid bilateral deficit muscles exterior pterygoid, platysmus, digastric, mylohyoid, geniohyoid.
- *Temporalis*
  - Origin: temporal fossa on the parietal bone and the whole of the covering fascia.
  - Insertion: anterior borders of mandibular ramus and coronoid process.
  - Action: raises and retracts the mandible.
  - Innervation CN V (mandibular division).
  - Antagonist: platysma.
- *Masseter*
  - Origin: lower edge of the zygomatic arch (superficial) medial edge of the zygomatic arch (deep).

- Insertion: coronoid process, ramus of mandible.
- Action: raises the mandible against the maxilla, protraction of mandible (closing the mouth).
- Innervation: CN V (mandibular division).
- Antagonist: Platysma

- *Internal Pterygoid (Medial pterygoid)*
  - Origin: lateral pterygoid plate; slips from the palatine bone; maxillary tuberosity.
  - Insertion: medial angle of the mandible.
  - Action: elevates mandible, closes jaw, helps lateral pterygoids in moving the jaw from side to side.
- *External Pterygoid*
  - Origin: great wing of sphenoid and pterygoid plate.
  - Insertion: mandibular condyle and the disc of the joint of the jaw.
  - Action: depresses mandible and draws mandible forward and sideways. (additional mandible depressors: platysma, digastric posterior, mylohyoid, geniohyoid.)
  - Innervation: CN V (mandibular division)
- **<u>Muscles of the Soft Palate</u>**
  - Velopharyngeal closure
  - Maximize nutritional intake
  - Provide passage of bolus
  - Cease nasal inhalation
  - Triggered by anterior faucial arches
  - The velum is activated by chewing.
- *Levator Veli Palatine*
  - Origin: apex of the petrous portion of the temporal bone; eustachian tube
  - Insertion: aponeurosis of soft palate
  - Actions: Raises soft palate to meet posterior pharyngeal wall
  - Innervation: CN X (Pharyngeal plexus)
- *Tensor Veli Palatine*
  - Origin: medial pterygoid plate of the sphenoid bone (scaphoid fossa)
  - Insertion: palatine aponeurosis; eustachian.
  - Action: Tenses the soft palate
  - Innervation: CN V (mandibular division)
- *Palatine Uvula*
  - Origin: posterior nasal spine; palatal aponeurosis (anterior)
  - Insertion: mucous membrane of uvula
  - Action: raises and shortens the uvula.

- Innervation: CN X (pharyngeal plexus)

- *Palatoglossus*
  - Origin: palatine aponeurosis
  - Insertion: tongue
  - Action: Raises posterior part of tongue
  - Innervation: CN X (pharyngeal plexus) (only muscle of the tongue not innervated by CN XII).
- *Palatopharyngeus*
  - Origin: palatine aponeurosis and hard palate
  - Insertion: upper border of thyroid cartilage
  - Action: pulls pharynx and larynx
  - Innervation: CN X (pharyngeal plexus) and XI
- **Muscles of the Pharynx**
  - Peristalsis reflex: propels the bolus to the esophagus
  - Sensory and motor innervation CN IX, X, XI
- *Superior Constrictor*
  - Origin: Lower posterior border of medial pterygoid plate; pterygomandibular raphe; alveolar process.
  - Insertion: pharyngeal raphe, pharyngeal tubercle.
  - Action: Contracts pharynx; aids movement of food bolus toward the esophagus.
  - CN X-Pharyngeal Plexus
- *Middle Constrictor*
  - Triggers Peristalsis
  - Origin: both cornua of hyoid bone; stylohyoid ligament.
  - Insertion: posterior median raphe of pharynx.
  - Action: contracts pharynx; aids movement of food bolus toward esophagus.
  - CN X (pharyngeal plexus)
- *Inferior Constrictor*
  - Triggers peristalsis
  - Origin: inferior side of cricoid cartilage; obliques line of thyroid cartilage.
  - Insertion: posterior median raphe of pharynx.
  - Action: Contracts pharynx; aids movement of food bolus.
  - CN X (pharyngeal plexus)
  - Helps to form the pharyngoesophageal segment (PES).
- *Cricopharyngeal*
  - Origin: cricoid and thyroid cartilage.
  - Insertion: posterior median raphe of pharynx.
  - Actions: contracts pharynx.

- CN X (pharyngeal plexus)
- PES between vertabrae 5 and 6

- *Stylopharyngeal*
  - Origin: base of styloid process of temporal bone.
  - Insertion: thyroid cartilage.
  - Action: elevates the larynx, elevates the pharynx.
  - CN IX (only group of muscles to be innervated by IX)
- *Salpingopharyngeal*
  - Origin: lower edge of eustachian cartilage.
  - Insertion: muscous membrane of pharynx.
  - Action: elevates pharynx.
  - CN X (pharyngeal plexus)
- **Intrinsic Muscles of the Larynx**
  - Lingual-laryngeal connection=CN XII
  - Reflexes:
  - Glottal Effort Closure Reflex which generates the airway.
  - Reflexive throat clearing/cough reflex.
- *Cricothyroid*
  - Origin: anterior and lateral surfaces of arch of cricoid cartilage.
  - Insertion: caudal border of the thyroid cartilage; anterior surface of lower cornu of thyroid cartilage.
  - Action: tension and elongation of the vocal folds.
  - CN X (superior laryngeal nerve)
- *Cricoarytenoids Lateral*
  - Origin: superior borders of cricoid cartilage.
  - Insertion: anterior surface of muscular process.
  - Action: draws arytenoids forward; aids in rotating arytenoids; tenses and adducts vocal folds.
  - CN X (recurrent laryngeal nerve)
  - Origin: posterior surface of cricoid cartilage.
  - Insertion: muscular process of arytenoid cartilage.
  - Action: rotates arytenoid, abducting vocal processess.
  - CN X (recurrent laryngeal nerve).
- *Interarytenoids Transverse*
  - Origin: posterior surface of arytenoid cartilage.
  - Insertion: posterior surface of opposite arytenoid.
  - Action: draws together arytenoid cartilages; adducts vocal folds.
  - CN X (recurrent laryngeal nerve).

- *Oblique*
  - Origin: base of one arytenoid cartilage at muscular juncture.
  - Insertion: apex of the opposite arytenoid.
  - Action: draws arytenoid cartilages together.
  - CN X (recurrent laryngeal nerve).
- *Thyroarytenoid*
  - Origin: internal and inferior surface of the angel of the thyroid cartilage.
  - Insertion: vocal process and anterior lateral surface of the base of the arytenoid cartilages.
  - Action: draws arytenoids forward; shortens and relaxes vocal folds.
  - CN X (recurrent laryngeal nerve).
- *Vocalis*
  - Origin: inferior surface of the angle of the thyroid cartilage.
  - Insertion: vocal process of the arytenoid cartilage and vocal ligament.
  - Action: differentially tenses vocal folds.
  - CN X (recurrent laryngeal nerve).
- **Extrinsic Muscles of the Larynx**
  - Laryngeal elevation reflex: epiglottal ROM
  - Laryngeal depression reflex: epiglottal recoil speed.
- **Suprahyoid**
- *Stylohyoid*
  - Origin: styloid process of the temporal bone.
  - Insertion: body of the hyoid bone.
  - Action: elevates and draws hyoid bone backward.
  - CN VII
- *Digastric*
  - Origin: anterior belly arises from internal aspect of mandible close to midline, posterior belly arises on medial side of mastoid process of temporal bone.
  - Insertion: intermediate tendon and the hyoid bone.
  - Action: elevates hyoid; depresses mandible.
  - CN V (anterior belly) CN VII (posterior belly).
- *Mylohyoid*
  - Origin: mylohyoid ridge of mandible.
  - Insertion: hyoid bone and median raphe.
  - Action: raises and projects hyoid bone and tongue.
  - CN V.
- *Geniohyoid*
  - Origin: internal surface of the mandible at the inferior mental spine.

- Insertion: anterior surface of the hyoid bone.
- Action: draws tongue and hyoid bone forward.
- CN XII.

- **Infrahyoid**
  - Unsupervised cup drinking and straw usage.
  - Goes with larynx muscles.
- *Sternohyoid* C1-C3
  - Origin: medial extremity of clavicle; superior and posterior portion of the sternum; sternoclavicular ligament.
  - Insertion: body of the hyoid bone, inferior surface.
  - Action: depresses hyoid bone.
  - CN XII.
- *Sternothyroid* C1-C3
  - Origin: superior and posterior portion of the sternum and first costal cartilage.
  - Insertion: oblique line of thyroid cartilage.
  - Action: depresses the thyroid cartilage.
  - CN XII
- *Thyrohyoid*
  - Origin: oblique line of the thyroid cartilage.
  - Insertion: body and greater cornu of hyoid bone.
  - Action: depresses hyoid bone or elevates larynx.
  - CN XII
- *Omohyoid* C1
  - Origin: superior margin of scapula.
  - Insertion: inferior border of the body of the hyoid bone.
  - Action: depress and retracts the hyoid bone.
  - CN XII.
- **Muscles of Facial Expression**
  - Cortical (conscious): middle brain
  - Brainstem (oral stage swallow)
- *Quadratus Labil Superior*
  - Origin: frontal process maxilla; lower margin of orbit; zygomatic bone.
  - Insertion: upper lip at midline.
  - Action: elevates upper lip
  - CN VII
- *Zygomatic Minor*
  - Origin: canine fossa of the maxilla.
  - Insertion: angle of mouth, upper lip.

- Action: elevates portion of upper lip.
- CN VII.

- *Zygomatic Major*
  - Origin: zygomatic bone.
  - Insertion: angle of mouth; upper lip.
  - Action: draws corner of mouth up and back.
  - CN VII.
- *Risorius*
  - Origin: fascia over masseter.
  - Insertion: skin at angle of mouth.
  - Action: retracts corner of mouth.
  - CN VII.
- *Depressor Anguli*
  - Origin: oblique line of mandible.
  - Insertion: angle of mouth, lower lip.
  - Action: depresses angle of mouth.
  - CN VII.
- *Quadratus Labii Inferior*
  - Origin: oblique line of mandible (anterior).
  - Insertion: lower lip at angle of mouth.
  - Action: depresses and retracts lower lip.
  - CN VII.
- *Mental*
  - Origin: incisive fossa of mandible.
  - Insertion: integument of chin.
  - Action: raises and protrudes lower lip.
  - CN VII.
- *Orbicularis Oris*
  - Origin: a sphincteric muscle, driving from others of the area, with no definite origins or insertions.
  - Action: closes mouth and puckers lip.
  - CN VII.
- *Buccinator*
  - Origin: alvoelar ridges of maxilla and mandible; pterygomandibular raphe.
  - Insertion: angle of the mouth mingling with fibers of mm forming upper and lower lips.
  - Actions: flattens cheek.
  - CN VII.

- *Platysma*
  - Origin: thoracic fascia over pectoralis major, deltoid and trapezious mm.
  - Insertion: mental protuberance of the mandible, skin of cheek and corner of mouth.
  - Action: depresses mandible; aids in pouting reaction; depresses corner of mouth, wrinkles skin of neck and chin.
  - CN VII.
- *Esophagus*
  - Swallowing starts primary peristaltic wave.
  - Something stuck in the esophagus starts a secondary wave.
  - Negative pressure
  - Peristalsis depends on size/temperature of bolus.
- *Hyoid*
  - Only bone in the swallowing mechanism.
  - Forms foundation of the tongue-embedded in the base of the tongue suspended by floor of mouth muscles and posterior belly of the digastric and sylohyoid.
- *Larynx*
  - Suspended from hyoid by thyrohyoid ligament and thyrohyoid muscle.
  - Movement of hyoid moves larynx unless stabilized by other muscles.
  - The opening is known as the laryngeal vestibule.
  - Contains false vocal folds, true vocal folds, ary-epiglottic folds, arytenoid cartilage.
- *Tongue*
  - Entirely made of muscle.
  - Consists of tip, blade, front, center, back
  - Pharyngeal tongue at circumvallate papillae to hyoid.
  - Contains taste buds allowing us to taste foods.
  - Moves the bolus within the oral cavity for proper mastication of bolus and propels the bolus posteriorly initiating the pharyngeal stage of the swallow.
- *Teeth*
  - Dentition is important for swallowing and it is important to assess dentition for appropriate diet recommendations.
  - Poor oral hygiene can contribute to aspiration pneumonia in patients with dysphagia.
- *Cheeks*
  - Buccal tension
  - Assists in creating appropriate pressures for initiating the pharyngeal swallow.
  - Assists in maintaining the bolus.

- Helps to prevent lateral pocketing of the bolus.

- *Roof of Mouth*
  - Maxilla (hard palate, velum, soft palate and uvula.
  - Soft palate is pulled down by palatoglossus, elevated/retracted by palatopharyngeus, levator palatal and superior pharyngeal constrictor.
- *Salivary Glands*
  - Parotid, submandibular, sublingual
  - Found on sides, tongue, lips, cheeks and roof of mouth.
  - 2 types of fluid: viscid (from parotid-thicker, mucous-like fluid) and serous (thinner, watery).
  - Maintains oral moisture, reduces tooth decay, assists in digestion, natural neutralizer of stomach acid.
- *Salivation*
  - Pair of nuclei-superior and inferior salivatory nuclei.
  - Send axons through VII and IX
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- *Cranial Nerves*
  - Originate in the brainstem (midbrain, pons, medulla), except I and II.
  - Sensory nerve nuclei tend to be lateral brainstem.
  - Motor nuclei tend to be medial.
  - Nerves with both have more than 1 nucleus of origin.
  - Sensory=afferent
  - Motor=efferent
  - Always located in the ganglion.

- Cranial Nerve V: Trigeminal

  - Mouth opening (ext. pterygoids).
  - Mandible movement (temporalis, masseter, lat/med pterygoids)-moves mandible from side to side, elevate and protrude the jaw.
  - Innervates muscles of mastication.
  - Innervates floor muscles with aid in elevation of larynx (mylohyoid, ant. Belly of digastric)-depresses mandible, raises hyoid bone, stabilizes hyoid bone.
  - Aids in velopharyngeal closure (tensor veli palatine)-tenses soft palate prior to elevation.
  - Everything powered to contraction by V is mandibular (mastication).
  - Also innervates tensor tympani.

- Mesencephalic Nucleus, Motor Nucleus, Main Sensory Nucleus, Spinal Nucleus of V.
- Motor
  - Mastication
  - Assists with Hyolaryngeal Excursion (HLE)
  - Tenses velum
- Sensory
  - Cheek (Pocketing)
  - Position of bolus in the mouth
- Impairment
  - Decreased awareness of pocketing
  - Possible nasal regurgitation
  - Pharyngeal symptoms

- Branches of Nerve V
  - Greater Palatine-Sensory: Mucosa of the hard palate.
  - Inferior Alveolar-Motor: mylohoid, anterior belly of digastric. Sensory: teeth of mandible, skin of chin.
  - Lingual-No Motor. Sensory: sense of anterior 2/3 tongue and floor of mouth.
  - Mylohyoid-Motor: mylohoid, anterior belly of digastric. No sensory.
  - Palatine Lesser-No motor. Sensory: Mucous membrane of soft palate and posterior hard palate.
  - Submandibular Ganglion-Secretomotor to the submandibular and sublingual glands and small glands of lingual muscosa.
  - Temporal Anterior Deep-Motor: temporalis, no sensory.
  - Temporal Posterior Deep-Motor: temporalis, no sensory.
  - Zygomatic- Motor: secretomotor fibers. Sensory: skin of the face lateral and superior to the orbit.
  - Zygomaticofacial- No motor. Sensory: skin of face lateral to the orbit.
  - Zygomaticotemporal- Motor: carries secretomotor fibers. Sensory: skin of face superolateral to the orbit.
  - Buccal- No motor. Sensory: skin of cheek, mucosal lining of cheek.
  - Ganglion, submandibular- Motor: secretomotor to the submandibular and sublingual glands and the glands of the lingual muscosa.
  - Alveolar, middle superior- No motor. Sensory: maxillary premolar teeth and gingiva.
  - Alveolar, posterior superior- No motor. Sensory: maxillary molar teeth and gingiva.

- Alveolar Inferior- Motor: mylohyoid, anterior belly of digastric. Sensory: teeth of mandible, skin of chin.
- Anterior Deep Temporal- Motor: temporalis. No sensory.
- Masseteric- Motor: masseter. No sensory.
- Maxillary Division- No motor. Sensory: skin of upper lip, cheek, lower eyelid, mucous membrane of palate, teeth and gingiva of maxillary alveolar arch.
- Mandibular Division- Motor: mylohyoid, anterior belly of digastric, tensor tympani, tensor veli palatini, temporalis, masseter, medial pterygoid and lateral pterygoid. Sensory: skin of lower lip and jaw, mucous membrane of tongue and floor of mouth, lower teeth and gingiva of the mandibular alveolar arch.

- Cranial Nerve VII: Facial
  - Muscles of facial expression.
  - Lip shape and movement (orbicularis oris).
  - Closure of lips, cheeks and tongue (buccinator- aids in mastication by pressing the bolus laterally into the molar teeth, platysma-depresses the mandible, stylohyoid-elevates the hyoid, retracts hyoid distally, stapedius)-
  - Lip closure and prep of bolus for transfer (orbicularis oris).
  - Assists in hyoid bone elevation by raising and stabilizing the hyoid bone (mylohyoid, post belly of digastric).
  - Raises larynx for airway protection (epiglottic ROM).
  - Motor
    - Lip closure
    - Buccal tone
    - Assists with HLE
  - Sensory
    - Sensation of tongue
  - Impairment
    - Anterior loss of bolus
    - Oral residue
    - Decreased taste
    - Residue in the lateral sulci
    - Pharyngeal symptoms

- Branches of VII
  - Mandibular Marginal- Motor: orbicularis oris, depressor anguli oris, depressor labii inferioris, mentalis. No sensory.

- Greater Petrosal- Motor: secretomotor (preganglionic, parasympathetic). No sensory.
- Termporofacial- Motor: muscles of facial expression of the upper part of face, frontalis and anterior and superior auricularis. No sensory.
- To digastric posterior belly- Motor: posterior belly of digastric. No sensory.
- Cervicofacial Division- Motor: muscles of facial expression of the lower part of the face, platysma. No sensory.
- Buccal branches of the facial- Motor: zygomaticus major and minor, buccinator, orbicularis oris, levator anguli oris, levator labii superioris and alaque nasi, risorius, procerus, nasalis. No sensory.
- Chorda Tympani- Motor: secretomotor to submandibular and sublingual glands. Sensory: taste to anterior 2/3 of the tongue.
- Nervus Intermedius- Motor: secretomotor to submandibular and sublingual glands. Sensory: taste from the anterior 2/3 of the tongue.
- Geniculate Ganglion- Motor: none. Sensory: taste from anterior 2/3 of the tongue.
- Ganglion Pterygopalatine- Motor: secretomotor to mucous glands of the palate. No sensory.
- Ganglion Geniculate- Motor: none. Sensory: taste from the anterior 2/3 of the tongue.
- Posterior belly of the digastric- Motor: posterior belly of the digastric. No sensory.

- Cranial Nerve IX: Glossopharyngeal
  - Autonomic secretory function of parotid salivary glands, parasympathetic.
  - Assists in velopharyngeal closure to prevent reflux to nose at start of pharyngeal and end of oral phase through elevation of larynx and pharynx (stylopharyngeal-only muscle).
  - Upper pharyngeal constrictor fibers.
  - Gag reflex.
  - Has no nucleus, shares with VII and X. (Sensory Solitary Nucleus, Motor Stylopharyngeus Nucleus Ambiguous.
  - Motor
    - Pharyngeal constriction
    - Pharyngeal shortening
  - Sensory
    - Senses arrival of bolus at the palate
    - Gag reflex

- Impairment
  - Difficulty initiating a swallow
  - Pharyngeal residue
  - Decreased taste

- Branches of IX
  - Ganglion, Otic- Motor: secretomotor to the parotid gland. No sensory.
  - Lesser Petrosal- Motor: Secretomotor for the parotid gland. No sensory.
  - Petrosal, Lesser- Secretomotor for the parotid gland. No sensory.
  - Tympanic- Motor: secretomotor to the parotid gland.
- Cranial Nerve IX: Spinal Accessory Nerve
  - Cervical spinal cord.
  - Trapezius and sternocleidomastoid.
  - No sensory.
  - No branches.

- Cranial Nerve XII: Hypoglossal
  - Only motor/no sensory pathways. Intrinsic and extrinsic muscles of tongue (except palatoglossus.)
  - Tongue movement to posterior oral cavity (A-P propulsion pattern and lingual-alvoelar seal).
  - Creating bolus of proper size (int/ext muscles).
  - Collection of food partilces from lateral/anterior sulci, palate and molars (int/ext muscles).
  - Mixing bolus with saliva.
  - Alvoelar-palatal contact before swallow (inf./sup. Longitudinals, transverse, vertical).
  - Transporting bolus from mid-palate to posterior 1/3 of tongue (same as above).
  - Bolus transport to pharynx.
  - Raises and lowers the hyoid bone to protect the airway (supra/infra muscles).
  - Tongue base retraction and lingual groove reflex and reflexive protective retraction.
  - Genioglossus-depresses tongue and allows protrusion, hypoglossus-depresses and retracts tongue.
  - styloglossus-retracts tongue and draws up lateral borders to generate a chute.
  - Tongue will deviate to the weak side (side of lesion).
  - Motor
    - Tongue motility

        - HLE (Hyoid-Thyroid approximation)
    - Impairment
        - Decreased bolus formation, propulsion and control
        - Pharyngeal residue
        - Possible decreased epiglottic inversion

- Cranial Nerve X: Vagus
    - Pharyngeal reflexes and pharyngeal constrictor muscles except stylopharyngeus. Superior, medial and inferior constrictors to constrict the walls of the pharynx.
    - Salpinopharyngeus-elevates pharynx and larynx.
    - Laryngeal reflexes-all laryngeal muscles (intrinsic laryngeal muscles-oppose vocal cords to protect the airway during the swallow, cricothyroid tips thyroid cartilage anteriorly to help protect the airway during the swallow).
    - General sensation of abdominal viscera.
    - Upper esophageal sphincter (UES) function-cricopharyngeus inhibits reflux.
    - Peristalsis/motility of esophagus.
    - Velopharyngeal closure-all muscles of soft palate except tensor veli palatine (levator veli palatini elevates the soft palate).
    - Palatoglossus-elevates posterior part of the tongue and draws the soft palate onto the tongue. Palatopharyngeus tenses the soft palate, draws pharynx superiorly, anteriorly and medially.
    - Motor
        - VP closure
        - TBR
        - UES closure/opening
        - Esophageal motility
        - Vocal Fold Approximation
        - Middle/inferior pharyngeal constriction

    - Sensory
        - Sensation of residue in the posterior/inferior portions of pharynx, larynx, esophagus

    - Impairment
        - Nasal regurgitation
        - Decreased airway protection (laryngeal vestibule closure decreased)
        - Pharyngeal residue (decreased sensation/constriction)

- pyriform sinus residue (decreased UES opening) and vallecular residue (decreased tongue base retraction)

- Branches of X
  - Inferior Laryngeal- Motor: thyroarytenoid, oblique, transverse, arytenoid, posterior and lateral cricoarytenoid, aryepiglottic, thyroeppiglotic, vocalis, secretomotor membrane of the larynx below V.C. Sensory: mucous membrane of the larynx below the V.C.

  - Laryngeal, Recurrent-Upper esophagus, lower pharynx, laryngeal (except cricothyroid), smooth muscles of trachea, secretomotor to mucosal glands in the upper esophagus, lower pharynx, larynx below the v.c., trachea. Sensory: upper esophagus, lower pharynx, larynx below v.c.
  - Laryngeal, Superior- Motor: cricothyroid, inferior pharyngeal constrictor, secretomotor to mucosal glands of larynx above the v.c. Sensory: mucous membrane of the larynx above the v.c.
  - Pharyngeal Plexus- Motor: vagus, all muscles of pharynx except stylopharyngeus, sympathetic, smooth muscle in pharyngeal vasculature. Sensory: glossopharyngeal, mucous membrane of lining in the pharynx.
  - Superior Laryngeal- Motor: Cricothyroid, inferior pharyngeal constrictor, secretomotor to 0mucosal glands of the larynx above the v.c. Sensory: mucous membrane of the larynx above the v.c.