Cervical Surgery and Dysphagia

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Cervical Surgery and Dysphagia

- ACDF
- Disc arthroplasty
- Cervical corpectomy – more extensive dissection than ACDF
- Fixation with odontoid screw
- PCDF
- Occipitocervical fusion

ACDF: Anterior Cervical Discectomy & Fusion

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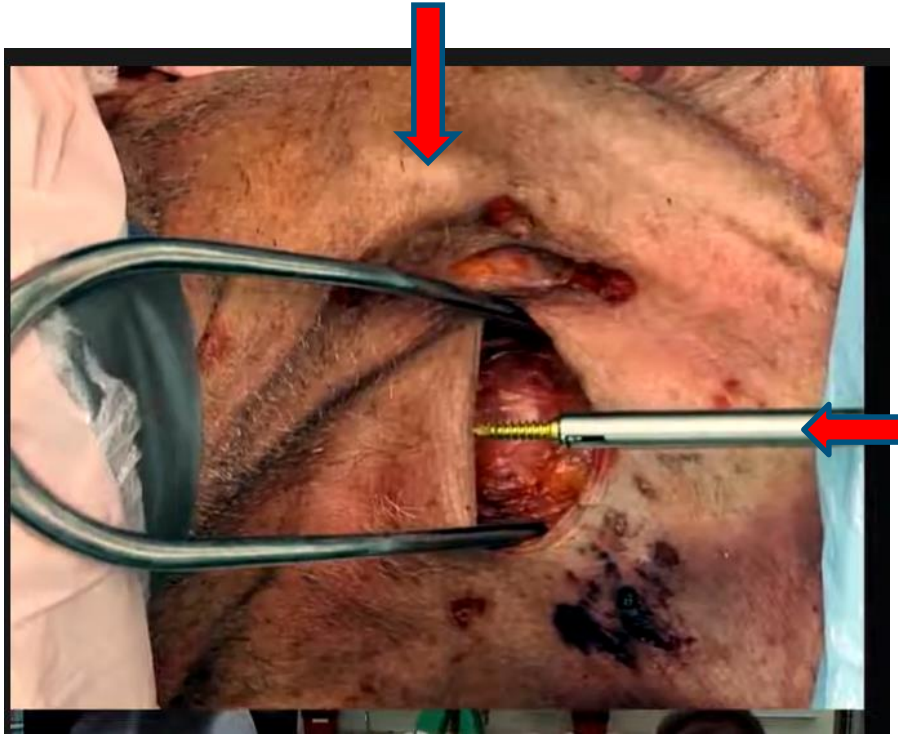
What is Anterior Cervical Diskectomy and Fusion (ACDF)?

- Damaged discs (cushion between the vertebrae) removed
  - Cervical Disc Herniation/prolapse
  - Cervical Stenosis
  - Cervical Myelopathy
  - Cervical Radiculopathy
  - Trauma
- Vertebrae fused to limit motion and provide stability to the spine
- Involves making transverse incision to the left or right of the midline
- Surgical retractors move soft tissue (including esophagus) out of way to get access to spine
- One of the most commonly performed spinal operations in the U.S

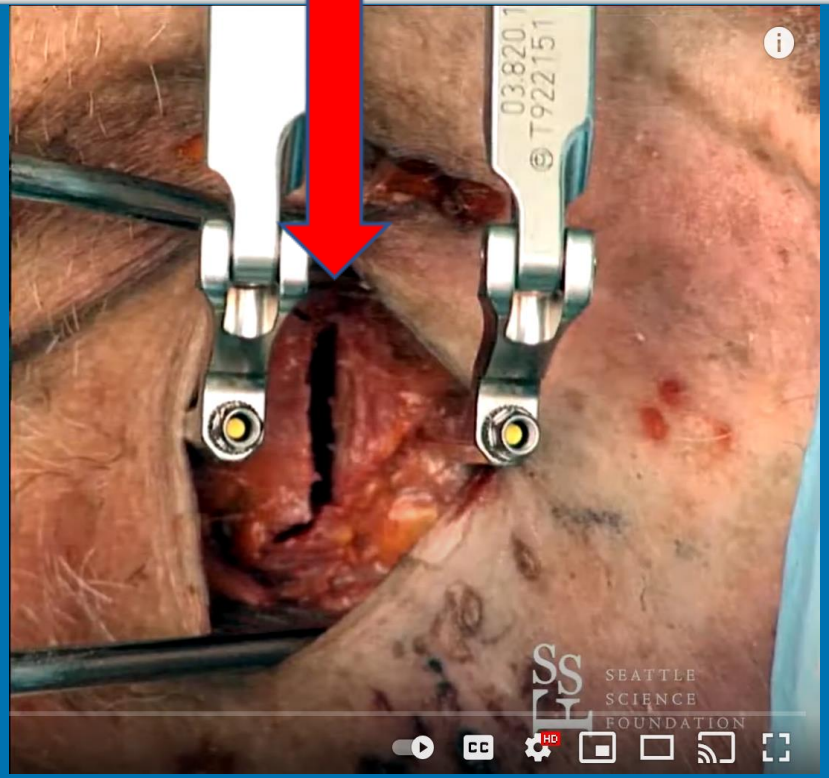
Thyroid notch



Midline

https://www.youtube.com/watch?v=JZy4M22MckU

Removed disc



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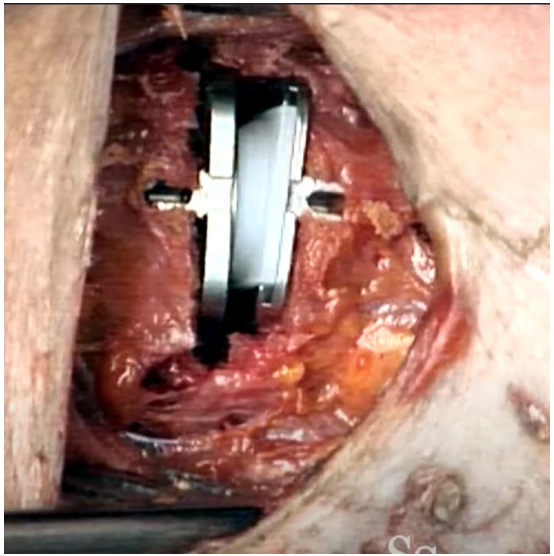
Anterior Cervical Disc Replacement

Artificial Disc



https://www.youtube.com/watch?v=JZy4M22MckU

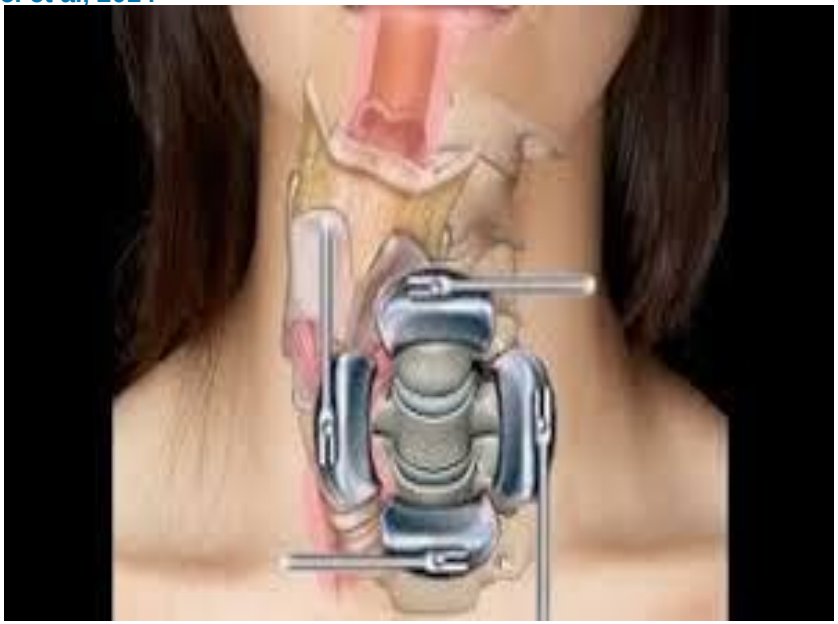
ACDF Video

Https://www.youtube.com/watch?v=gBcCUY_7ZVE

Dysphagia Incidence Post Anterior Cervical Spinal Surgery (ACSS)

Erwood et al., 2019; Miles et al., 2019; Liu et all, 2017; Lee et al., 2007; Carucci et al, 2014

- Common “complication”
- Incidence of ACSS early post-op varies from 1.7% - 79%
- Progressively declines over time:
  - At 1, 2, 6, 12, & 24 month follow-ups in Lee’s study: 54%, 34%, 19%, 15%, & 14%
  - Persistent dysphagia = 8-35%
  - Persistent severe dysphagia = 1.4%



Variable incidence

- Variations in type of surgery & surgical technique
- Extent of surgery
- Size of implants
- Relatively small sample sizes
- Exclusion criteria
- Timing of postoperative assessment
- Duration of follow up
- Definitions & measurements of dysphagia

Variable Incidence

Riley et al., 2010; Rihn et al., 2011; Anderson & Arnold, 2013

Definitions of dysphagia varied & most relied on subjective ratings of dysphagia

- Systematic review by Riley found instrumental assessment (“barium swallow”) in only 1/15 studies
- Dysphagia called “a kind of personal subjective experience”, a “subjective sensation”
- Patient-reported outcome measures deemed “preferred”, “more clinically relevant”, “more effective in identifying dysfunction” than “physiologic study”

Variable Incidence

Riley et al., 2010; Rihn et al., 2011; Anderson & Arnold, 2013

MBS too sensitive???

- Acknowledge that MBS is “gold standard” in eval of swallowing function, but contend that “such objective measures of dysphagia are extremely sensitive in patients undergoing ACSS”
- Admit that instrumentals valuable in determining extent of mechanical disability, but argue they don’t closely correlate with patient’s dysphagia symptoms

Dysphagia Outcomes Assessment Tools for ACSS Anderson & Arnold, 2013

Bazaz Scale – most widely used; not validated but "allows for the comparison of the results" to prior studies

	Episodes of swallowing difficulty (by patient report)	
Severity of dysphagia	Liquid	Solid
None	None	None
Mild	None	Rare
Moderate	None or rare	Occasional (only with specific foods like bread or meat)
Severe	Present	Frequent (and with a majority of solids)

Adapted from Bazaz et al, 2002.[35]

Dysphagia Outcomes Assessment Tools for ACSS[Mayo et al, 2019]

Abridged SWAL-QOL

- 50 ACDF patients completed full 44-question SWAL-QOL at 3 time points: preop, 6 weeks postop, 12 weeks postop
- Used only the 16 questions that exhibited both statistically & clinically significant differences at the postop time points when compared to preop
  - 5 questions relate to physical symptoms & 11 relate to QOL

Dysphagia Outcomes Assessment Tools for ACSS[Mayo et al, 2019]

Abridged SWAL-QOL sample questions

- It takes me longer to eat than other people.
- In the last month, how often have you experienced food sticking in your throat?
- Having to be so careful when I eat or drink annoys me.
- Social gatherings are not enjoyable because of my swallowing problem.

Dysphagia Outcomes Assessment Tools for ACSS Mayo et al, 2019

Abridged SWAL-QOL results

- Quicker (3.4 minutes for abridged vs. 9.37 minutes for full)
- More sensitive to detect dysphagia symptoms in ACSS than full version
  - 40% of pts experienced some degree of dysphagia @ 6 weeks, improving to 30% @ 12 weeks (compared to 32% & 18% with full SWAL-QOL)

Etiology of Dysphagia Post ACDF

Miles et al., 2019; Carucci et al., 2014; Erwood et al., 2019, Liu et al., 2018, Lawton, 2020

Not clearly understood, likely multifactorial

- Injury to nerves/tissues from stretching/retraction, compression, exposure, reduced perfusion, dissection
- Soft-tissue edema, hematoma or infection
- Scar formation
- Sensory impairment
- Alteration of C2-C7 angle, cervical immobilization & hyperextension
- Surgical plate thickness

Nerve injury Lawton, 2020

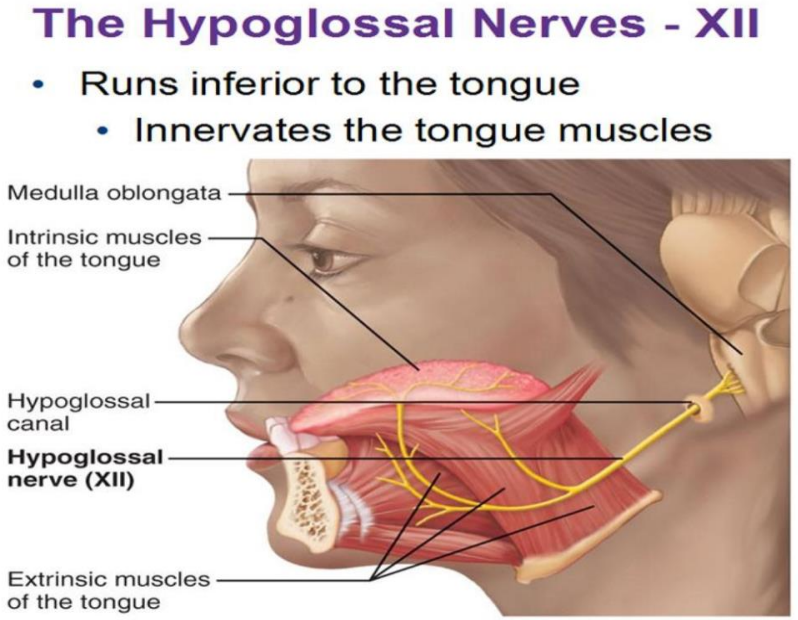
- Neuropraxis
  - Transient loss of neural conduction caused by a segmental demyelinization
  - Good prognosis for spontaneous recovery within days or week
- Axonotmesis \ak-sə-nət-ˈmē-səs\
  - Injury to both the axon and myelin sheath, disrupting axonal continuity
  - Spontaneous recovery possible; may take months

“At risk” structures

Lee et al., 2005; Humbert (2011); Martin-Harris (2015)

Hypoglossal (CN XII) nerves at level C3 or above

- Motor innervation to all intrinsic and extrinsic tongue muscles except palatoglossus
- Swallow functions: Oral bolus formation, oral bolus manipulation, lingual control, posterior oral containment, oral bolus transport

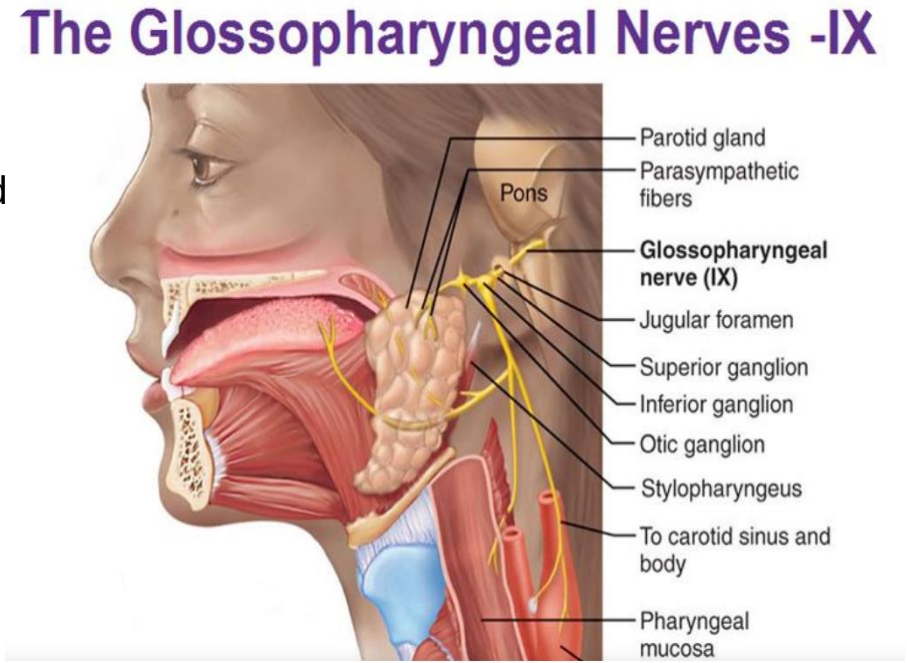


https://antranik.org/peripheral-nervous-system-cranial-nerves

“At risk” structures

Lee et al., 2005; Humbert, 2011; Martin-Harris, 2015

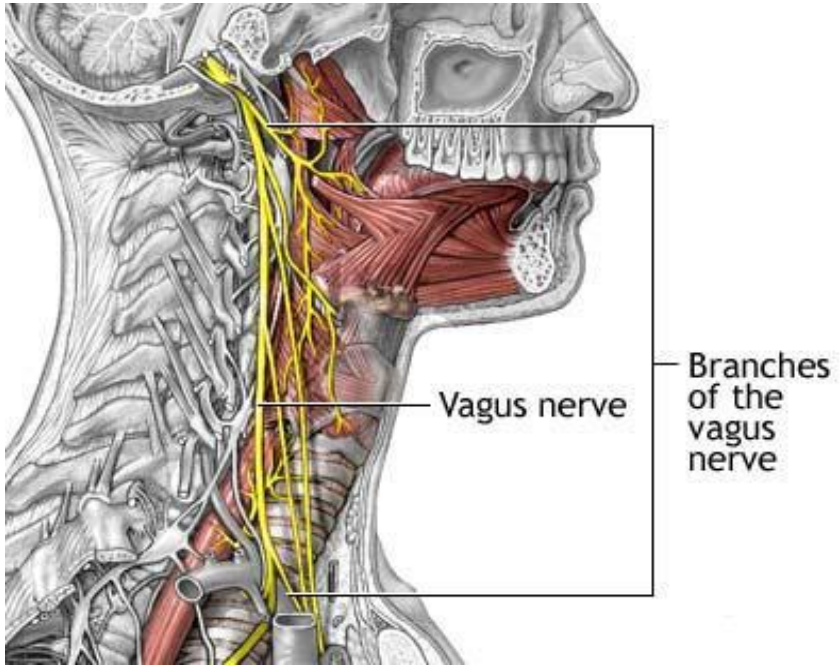
- **Glossopharyngeal (CN IX)** at level C3 or above
- General sensory for pharynx (faucial arches, back of tongue, parotid gland) and taste on posterior 1/3 tongue
  - Swallowing functions: initiation of pharyngeal swallow, posterior oral containment, salivary production
- Motor for stylopharyngeus and lateral part of superior pharyngeal constrictor
  - swallowing functions: pharyngeal bolus clearance
- Role in the pharyngeal plexus



https://antranik.org/peripheral-nervous-system-cranial-nerves

“At risk” structures Lee et al., 2005

- **Vagus (CN X)**
  - Pharyngeal branches
    - Role in the pharyngeal plexus
  - Superior laryngeal nerve
  - Recurrent laryngeal nerve
  - Cricopharyngeus at C5-C6
  - Vagus trunk

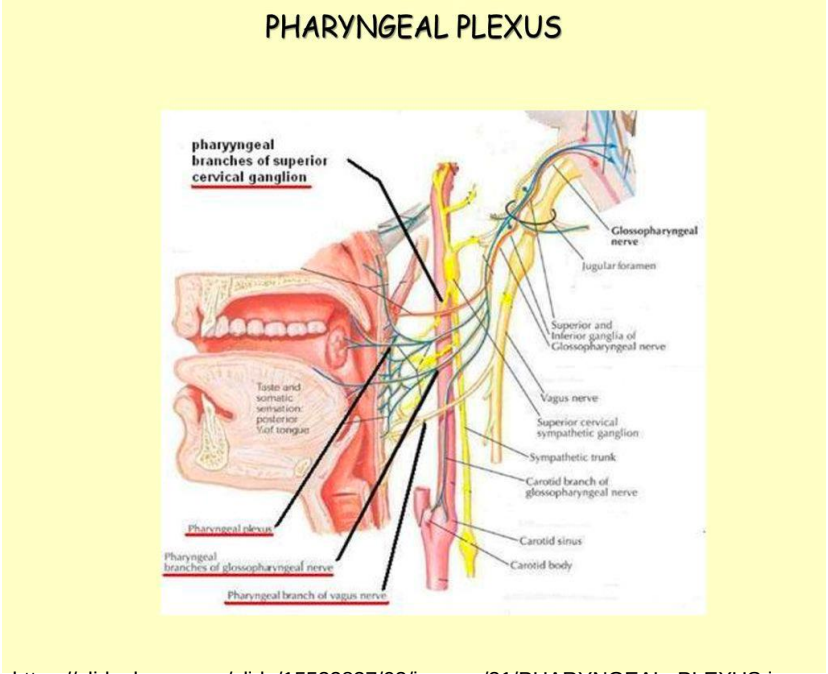


“At risk” structures

Gutierrez et al., 2019; Davidson & O’Rourke, 2018 Charleston Swallowing Conference

Pharyngeal plexus

- Pharyngeal branch of glossopharyngeal (CN IX), pharyngeal branch of vagus (CN X) & superior sympathetic ganglia contribute
- Both afferent & efferent fibers for swallowing are intertwined within it
- Located in the retropharyngeal space close to vertebral bodies of C2 and C3 vertebrae posteriorly, the PPW, and closer to the superior and middle constrictor anteriorly
- Swallowing deficits
  - Pharyngeal contractility deficits
  - Sensory impairment



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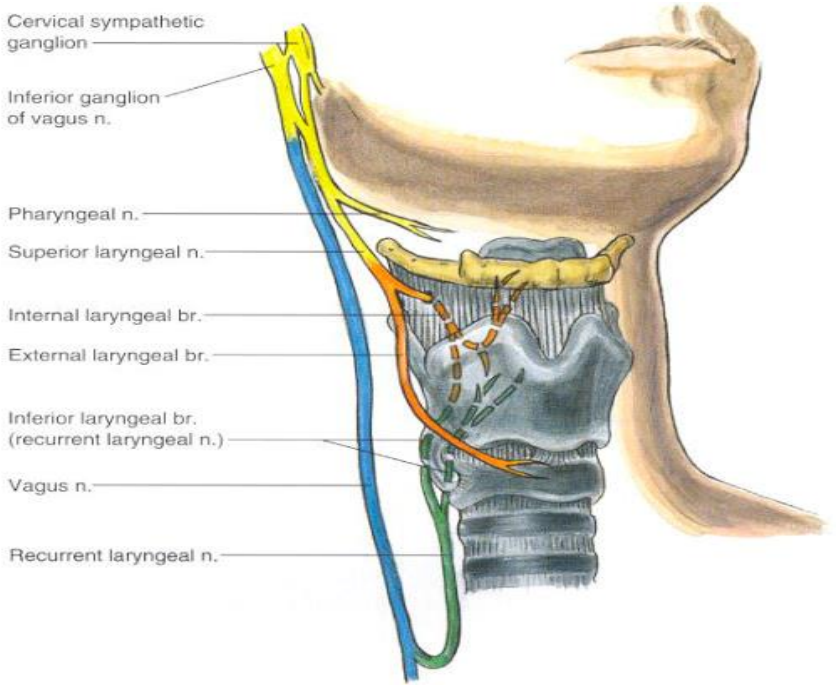
“At risk” structures

Lee et al., 2005; Davidson & O’Rourke, 2018 Charleston Swallowing Conference; Humbert, 2011; Marthin-Harris, 2015

Superior laryngeal nerve
branch of vagus at C3-C4

- Internal branch: Sensory deficits at larynx & pharynx - mucosa membrane at valleculae, epiglottis, aryepiglottic folds and most of larynx (true vf & above)
- External branch: Paresis & high pitch disturbance (motor to cricothyroid and inferior pharyngeal constrictor)



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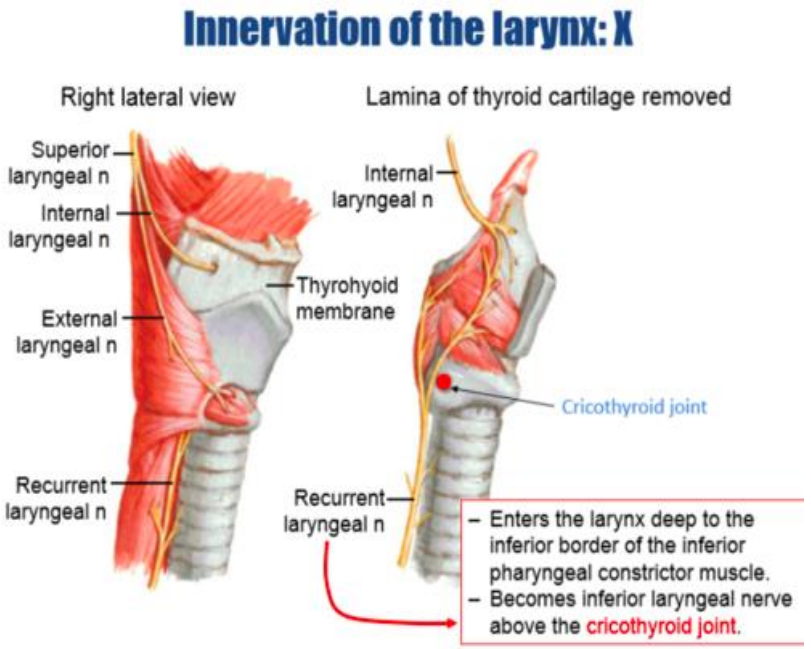
“At risk” structures

Lee et al., 2005; Davidson & O’Rourke, 2018 Charleston Swallowing Conference

Recurrent laryngeal nerve branch of vagus at C6 or lower

- Sensory loss to mucosa below vocal folds (shares sensory to vocal folds with iSLN)
- Motor to all intrinsic laryngeal muscles except cricothyroid
  - Vocal fold immobility
  - Glottal insufficiency
- Some motor to inferior constrictor/cricopharyngeus
- RLN injury incidence post ACDF
  - 11% after primary surgery
  - 14% if revision



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Nerve Supply of the Larynx

Sensory Nerves:

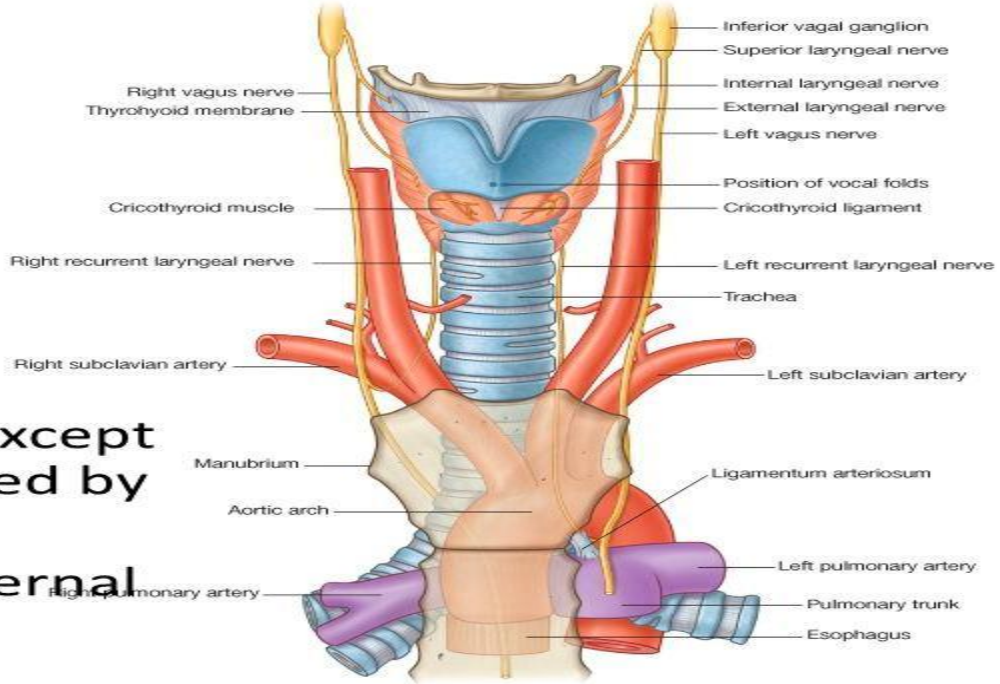
Above vocal cords: **Internal laryngeal branch** of superior laryngeal branch of vagus.

Below vocal cords: Recurrent laryngeal nerve.

Motor Nerves:

All intrinsic muscles of larynx except **cricothyroid muscle** are supplied by **recurrent laryngeal nerve**.

Cricothyroid is supplied by external laryngeal branch of superior laryngeal branch of vagus.



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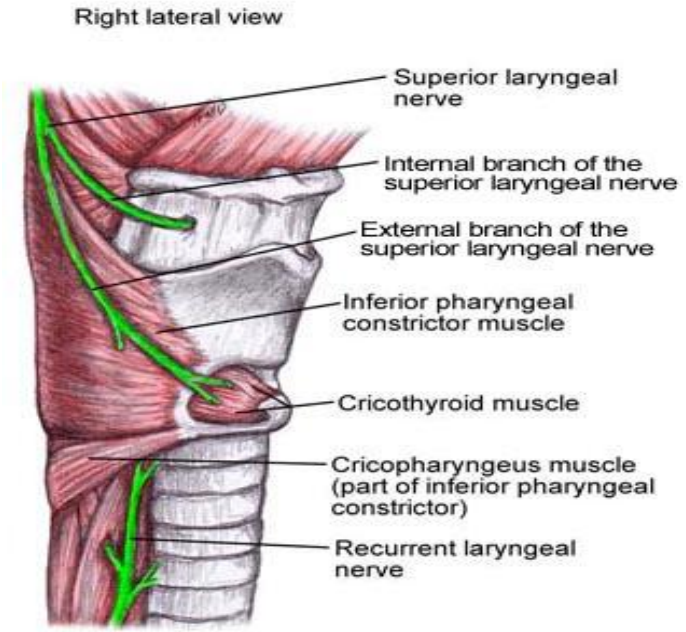
“At risk” structures Lee et al., 2005; O’Rourke

Cricopharyngeus at C5-C6

- A portion of the inferior pharyngeal constrictor
- The primary muscle of UES
- Innervation from pharyngeal plexus, and in majority, also the RLN &/or eSLN
- 3 physiologic events contribute to UES opening
  - Inhibition of CP
  - HLE
  - Generation of pharyngeal pressure resulting from valve closures & pharyngeal constriction



“At risk” structures Lee et al., 2005

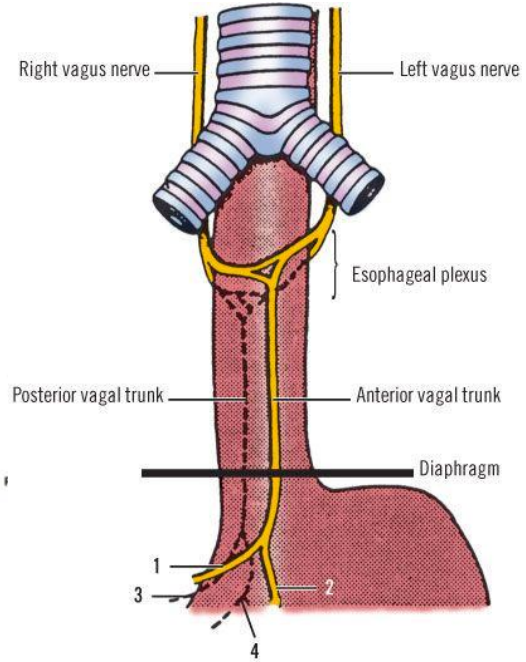
Vagus trunk - retraction at C3-C7

- Contributes to esophageal plexus
- Contributes parasympathetic fibers and afferent (mostly for autonomic reflexes) fibers

Esophageal plexus

1. the anterior vagal trunk on the anterior surface of the esophagus, mainly from fibers originally in the left vagus nerve;
2. the posterior vagal trunk on the posterior surface of the esophagus , mainly from fibers originally in the right vagus nerve.

- The vagal trunks continue on the surface of the esophagus as it passes through the diaphragm into the abdomen.



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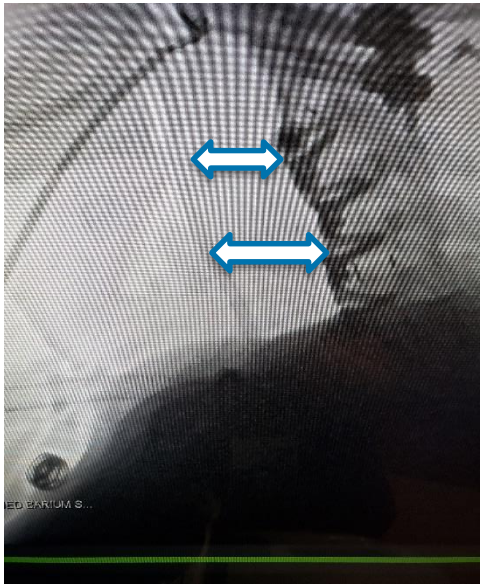
Pre-vertebral Edema

Lawton, 2020

- Obstructs epiglottic retroflexion
  - Vallecular stasis
  - Unprotected airway
- Impedes pharyngeal shortening & stripping wave
  - Pharyngeal stasis
  - Reduced HLE



Pre-vertebral Edema Lawton, 2020

- Edema resolution rate varied depending on site of edema:
  - Present @ 1 month for both C-3 & C-6 levels
  - C-3 resolved by 3 months while C-6 resolved by 6 months
- Degree of edema not significantly different when comparing ACDF pts with and without subjective dysphagia complaints
- Some ACSS pts show no physiologic impairment on MBS despite pharyngeal wall thickening

C2-C7 Angle Alteration

Tian & Yu, 2013

- Greater C2-C7 angle leads to cervical lordosis
  - PPW bulging
  - Pharyngeal stenosis
- All pts who developed long-term dysphagia (>2 yrs) had C2-C7 angle >5°
  - 5/172 in anterior group
  - 3/182 in posterior group

Risk Factors for Dysphagia Post ACDF

Miles et al., 2019; Liu et al., 2017

- Age > 65
- Female gender
- Revision surgery
- Multi-level surgery (3+ levels)
- Increased operative time
- Mid-cervical (vs. upper or lower cervical)
- C2-C7 angle > 9 degrees
- Use of bone morphogenetic proteins
- Use of instrumentation, especially high profile plate

Strategies for mitigating dysphagia

Li et al., 2018; Cui et al,, 2019

- Tracheal traction exercises preoperatively
- Reduce ETT cuff pressure after retractors placed
- Use of dynamic retractors
- Use lower profile instrumentation
- Alter surgical approach
- Avoid prolonged surgical time
- Administer steroids

Clinical Bedside Swallow Evaluation

- Vocal quality
- Pain level and complaint of odynophagia
- Secretion Management
- Oral motor exam
- PO trials – start with ice chips, then increasing quantities and viscosity
  - Patients may not feel ready for solid foods
- Look for multiple swallows or complaints of globus sensation
- Monitoring for s/s of aspiration

Functional Swallowing Abnormalities Post Spinal Surgery

Miles et al., 2019 –prospective study of 250 spinal surgery pts

- 79% traumatic cause
- 72% male
- Wide age range (age 14-87; mean 48 yrs)
- 49% cervical level, 6% cervical-thoracic

Functional Swallowing Abnormalities Post Spinal Surgery Miles et al., 2019

SLP consulted for BSE (75 pts), then FEES (62 pts) if indicated, then MBS (11 pts) if dysphagia persisted beyond acute phase (25-40 days post SCI)

- 85% of SLP referrals had cervical level SCI
- Most SLP referrals underwent anterior surgical approach
- Most pts significantly improved within 2 months
- At 6 months post, all but 3/75 returned to regular diet – 3 ACDF pts, NPO, severe dysphagia

Functional Swallowing Abnormalities Post Spinal Surgery Miles et al., 2019

Common FEES findings:

- Pharyngeal/laryngeal secretion accumulation
- Silent aspiration of secretions, food, drinks
- Pharyngeal residue build-up
- Aspiration often post-swallow d/t residue

Functional Swallowing Abnormalities Post ACDF Miles et al., 2019

Common MBS findings:

- Reduced hyoid displacement
- Reduced hyoid-larynx approximation
- Impaired pharyngeal constriction
- Impaired maximal PE segment opening
- 11/11 w/ pharyngeal wall thickness exceeding NL
- 11/11 MBS pts aspirated post swallow, with both thin and pudding, 7/11 silently

Structural Abnormalities Contributing to Dysphagia Post ACDF

Carucci et al, 2014 – 74 pts eval'd retrospectively,

(54 by MBS, 26 by esophagography) post ACF, with 93% found to have structural abnormalities

- Soft-tissue swelling = 91%
- Displacement of pharynx/esophagus d/t intact plate or bone graft = 32%
- Displacement d/t displaced plate or graft = 24%
- New retropharyngeal abscess = 4%
- Esophageal perforation = 4%

Functional Swallowing Abnormalities Post ACDF Carucci et al., 2014

Found functional abnormalities in 68% of 74 pt sample

- Aspiration = 49%
- Epiglottic dysfunction= 57%
- Diminished/absent pharyngeal stripping wave = 37%
- Residue pooling in valleculae or pyriforms = 46%
- Pooling of residue above the plate = 11%
- Cricopharyngeal dysfunction = 35%

SLP intervention Lawton, 2020

- Daily re-assessment
- Often clear for ice chips (after thorough oral care)
- Lack of studies addressing interventions specific to ACSS population
  - Select exercises that target specific physiologic impairments observed on instrumental swallow study
- Exercises and strategies requiring change of head position likely contraindicated for up to 6 weeks post surgery
- Compensatory strategy training
  - Multiple swallows
  - Volitional throat clear
  - Reduced bolus volume
  - Supraglottic swallow
- Education i.e. oral care, symptom monitoring

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