VOICE DISORDERS
PRAXIS CONTENT REVIEW

National Black Association for Speech-Language and Hearing

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Speaker Disclosure
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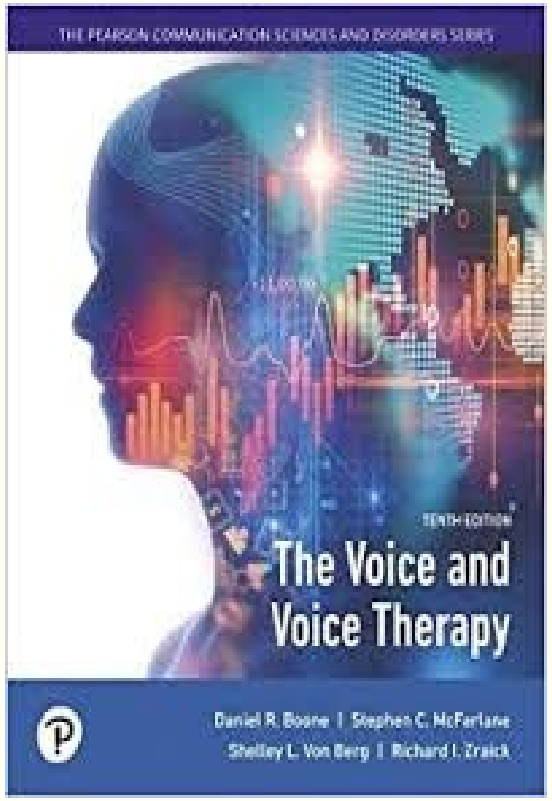
Relevant Financial Relationships:

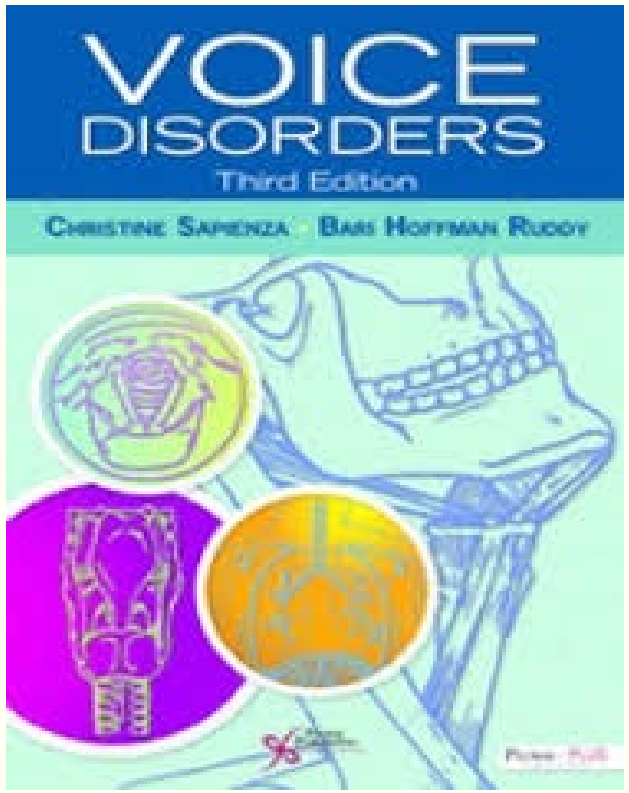
- Dr. Agyapong receives a fee for presenting at today's Praxis content review

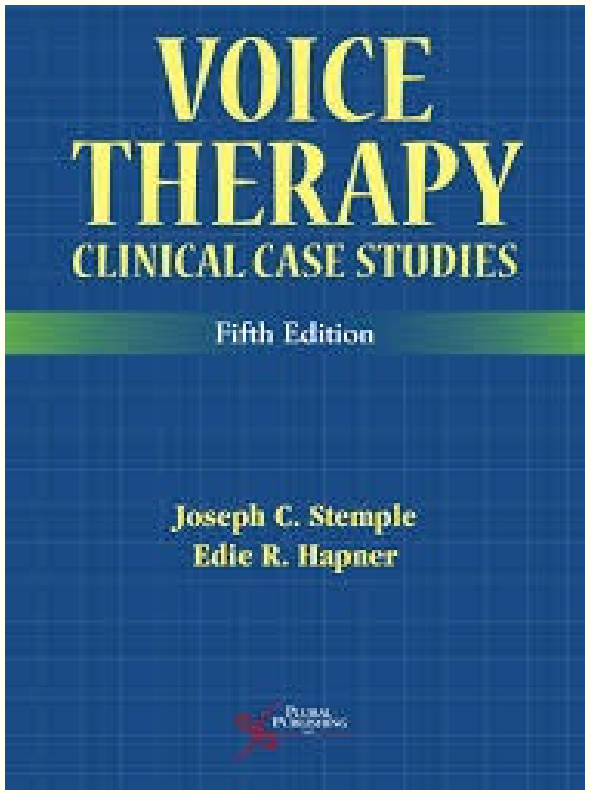
Relevant Nonfinancial Relationships:

- Dr. Agyapong has no relevant nonfinancial relationships to disclose

Resources-Textbooks







Objectives

Upon successful completion of this review course, participants will be able to:

1. Describe the anatomy and physiology of vocal mechanism.

2. Demonstrate techniques for the prevention of voice disorders through education and counseling of clients.

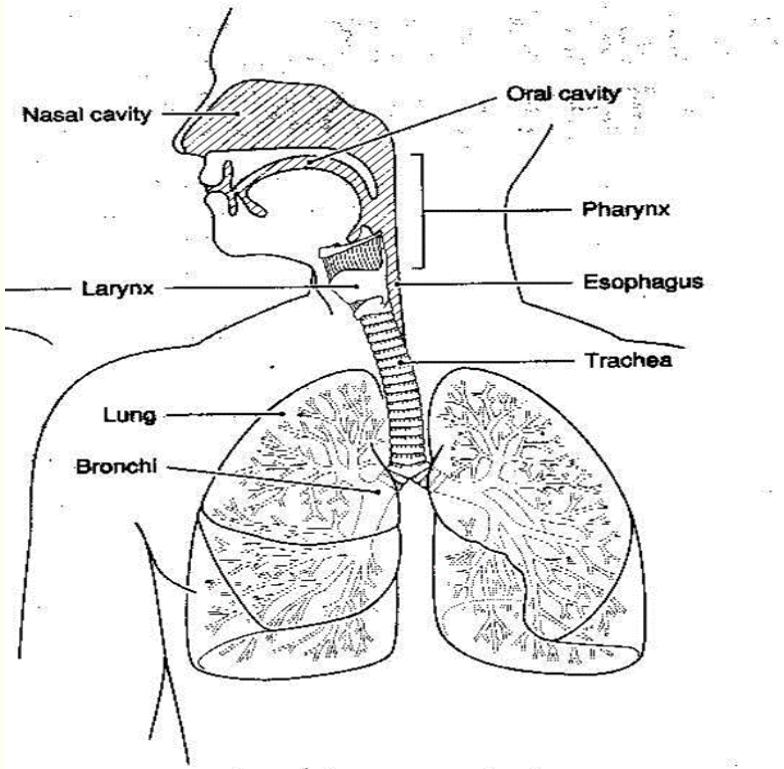
3. Identify three types of voice disorders and three types of resonance disorders.

4. Identify appropriate evidence-based intervention for pediatric and adult clients with voice and resonance disorders.

REVIEW OF ANATOMY

The Respiratory System

- Driving support of voice production
- Intricate balance between respiration (inhalation and exhalation) and phonation

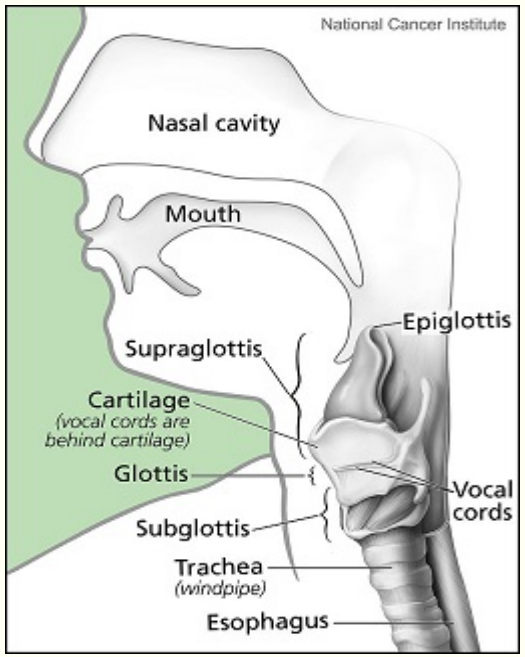


Respiratory Process

- Diaphragm lowers and rib cage expands
- Space in thoracic cavity increases
- Air pressure decreases in lungs
- Air flows down trachea into lungs
- Alveolar sacs and chest relax and air is forced from lungs

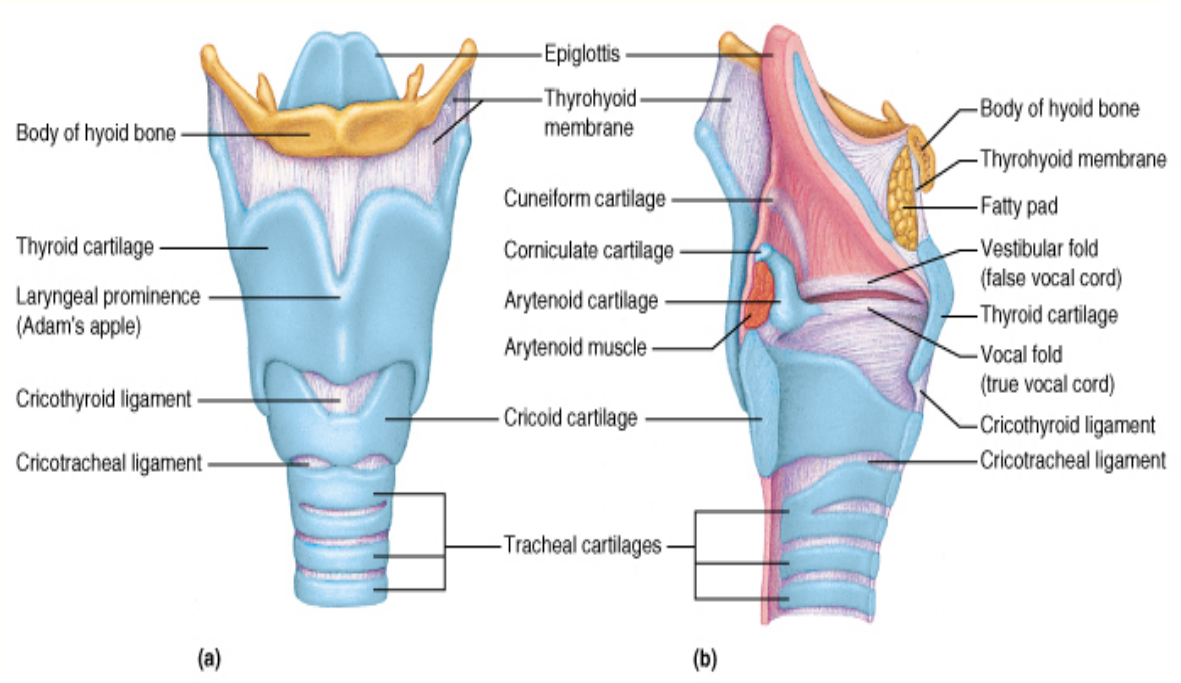
The Larynx

- The larynx acts as a sphincter
  - Closing off to protect the lower airways from foreign material
  - Opening to aid breathing
  - Serving as the sound source for voice production as pressure from the respiratory system is transferred from the subglottal space through the glottal space into the supraglottal cavity
- phonation
- Sits at top of trach[illegible]ongue



Framework of the larynx

- Cartilages
  - 3 paired
  - 3 unpaired
- Muscles
  - Intrinsic
  - Extrinsic



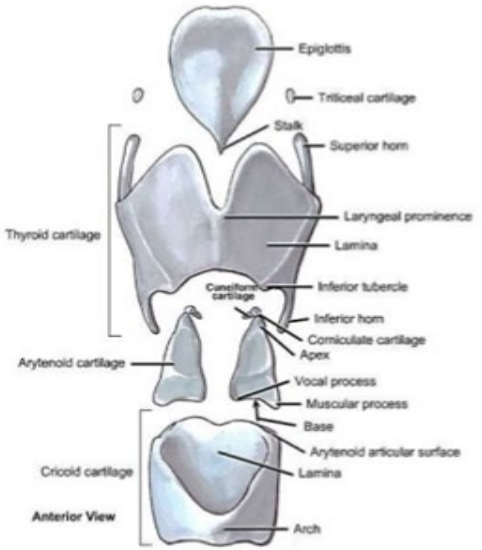
Cartilages

3 Unpaired

- Thyroid
- Cricoid
- Epiglottis

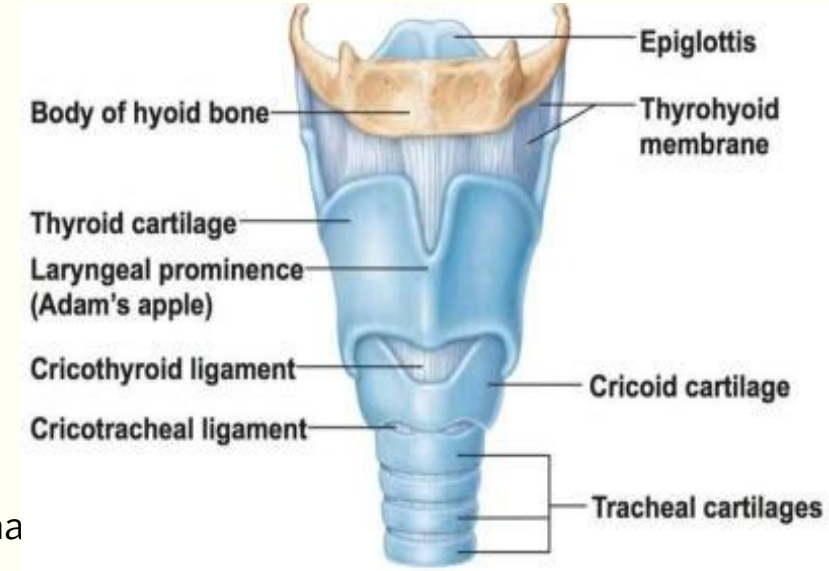
3 Paired

- Arytenoid
- Corniculate
- Cuneiform



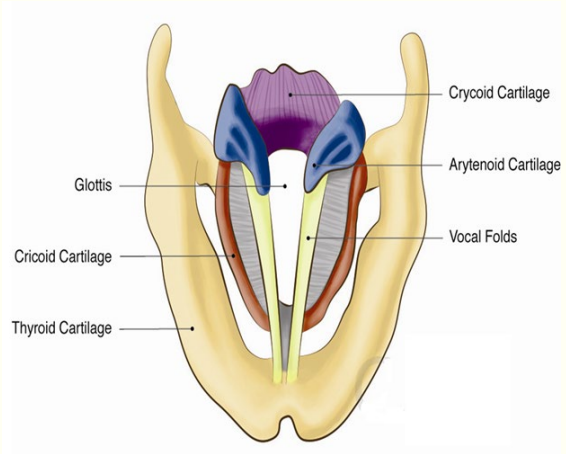
The Larynx

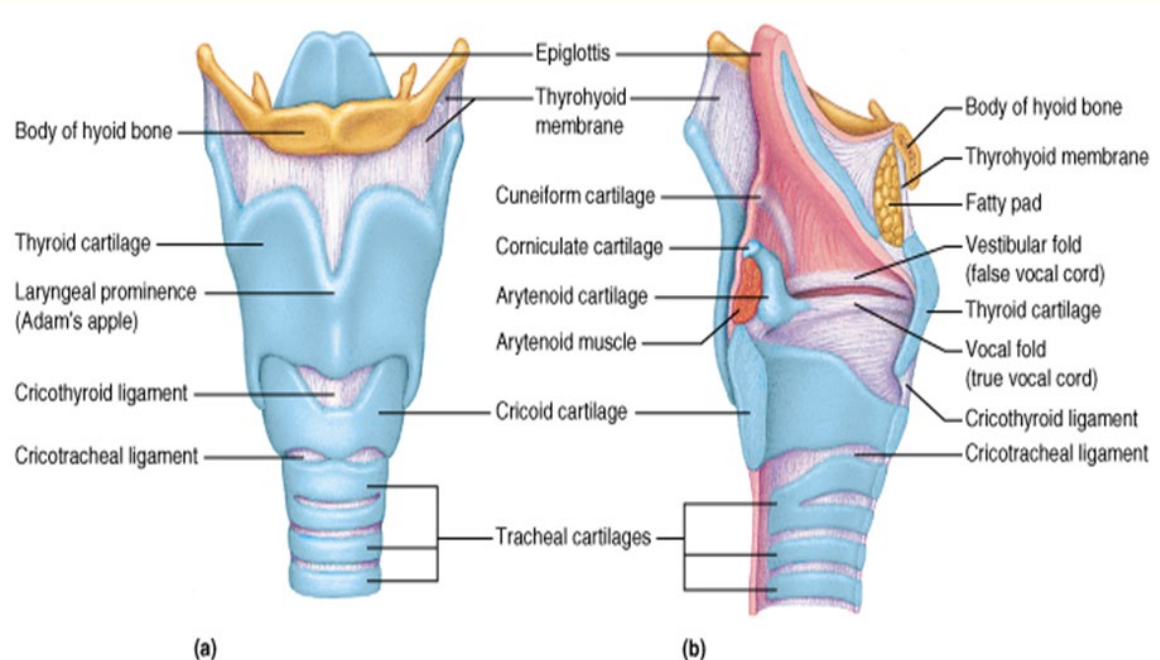
- Comprised of three unpaired cartilages
  - Cricoid cartilage
    - Complete ring atop the trachea
    - Side view looks like a signet ring, higher in the back
    - Articulates with thyroid via cricothyroid joint
  - Thyroid cartilage
    - Largest laryngeal cartilage
    - Articulates with cricoid cartilage via paired processes tha
  - Epiglottis cartilage
    - Leaflike cartilage
    - Protective structure during swallowing



The Larynx

- Composed of three paired cartilages
  - Arytenoid cartilage
    - Ride on high backed upper surface of cricoid cartilage
    - Articulation with cricoid cartilage allows a wide range of movement
    - Posterior attachment of vocal folds
    - Muscular and vocal processes provide point of attachment for thyromuscularis and thyrovocalis muscles
  - Corniculate cartilage
    - Ride on superior surface of each arytenoid
    - Landmark in the aryepiglottic folds
  - Cuneiform cartilage
    - Reside within the aryepiglottic folds
- Hyoid bone
  - Union between the tongue and laryngeal structures
  - Loosely articulates with the superior cornu of the thyro cartilage

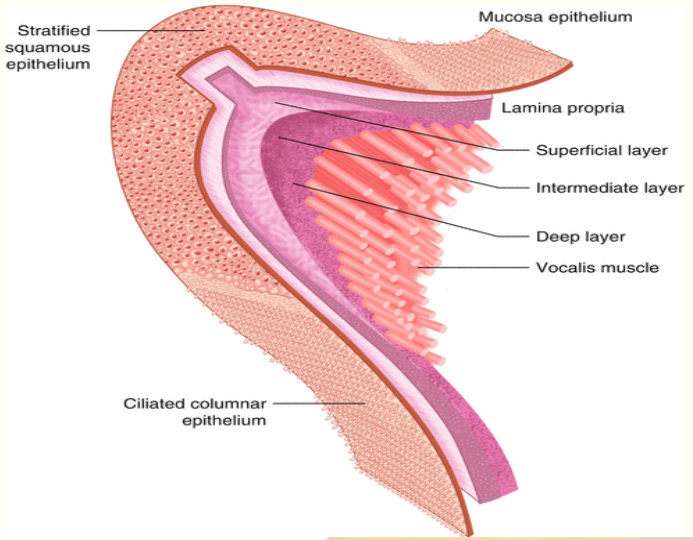


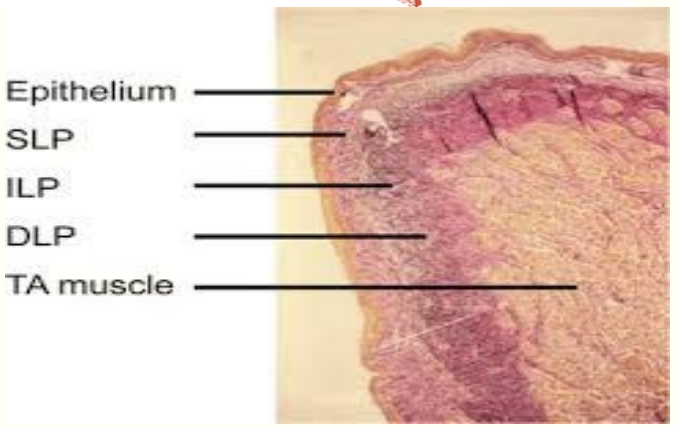


The Vocal Folds: Histology

The vocal folds have special vibrating qualities based on their unique multi-layered structure

- Five layers of tissue, deepest layer is muscle
- The 5 layers originally proposed by Hirano include:
  - Epithelium
  - Superficial Layer of the Lamina Propria, Reinke's space
  - Intermediate Layer of the Lamina Propria
  - Deep Layer of the Lamina Propria
  - Thyrovocalis muscle





Practice Question

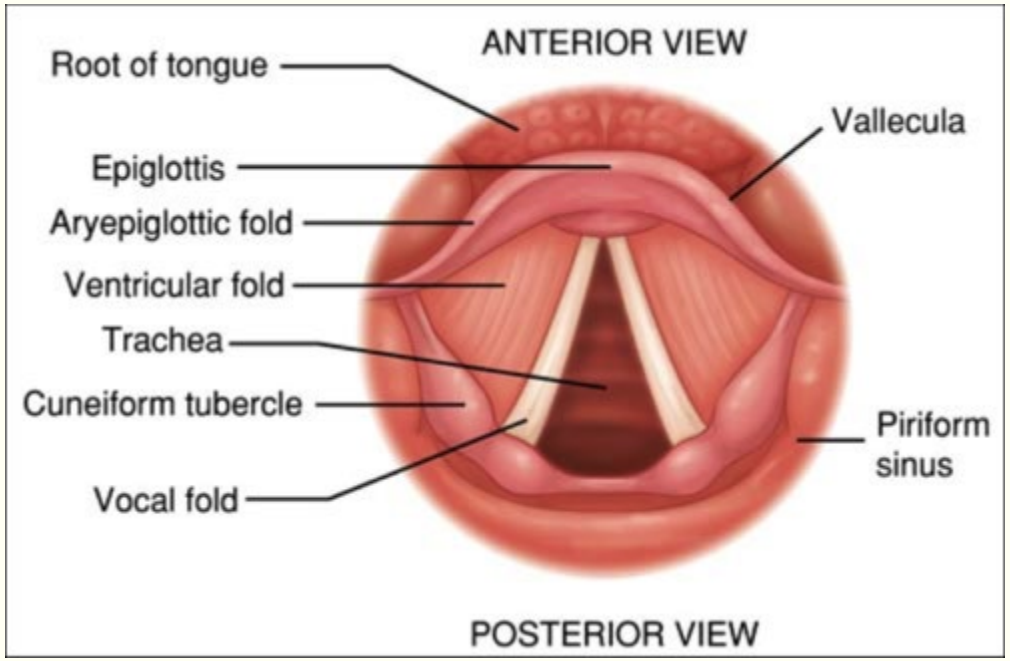
- Harriet is a 75-year-old woman with a history of smoking one pack of cigarettes per day for more than 50 years. Her chief voice complaint is rough voice quality, low speaking pitch, weak voice, and running out of air when she speaks. She saw an otolaryngologist (ENT), who diagnosed her with emphysema and Reinke's edema.

  The ENT report of his stroboscopic laryngeal exam noted "Reinke's edema bilaterally." Based on this information, which of the following laryngeal structures were affected?

  a) superficial layer of lamina propria
  b) Intermediate layer of lamina propria
  c) deep layer of lamina propria
  d) the vocalis muscle
  e) the vocal fold epithelium

The Ventricular Folds

- False Vocal Folds



Muscles of the Larynx

The muscles of the larynx are skeletal (i.e. under voluntary control for voice production, controlled by the central nervous system)

Intrinsic

Extrinsic

Muscles of the Larynx: Intrinsic

- The intrinsic laryngeal muscles
  - Found within the larynx
  - Functions:

1. Adduct
2. Abduct
3. Tense
4. Relax

Muscles of the Larynx: Intrinsic

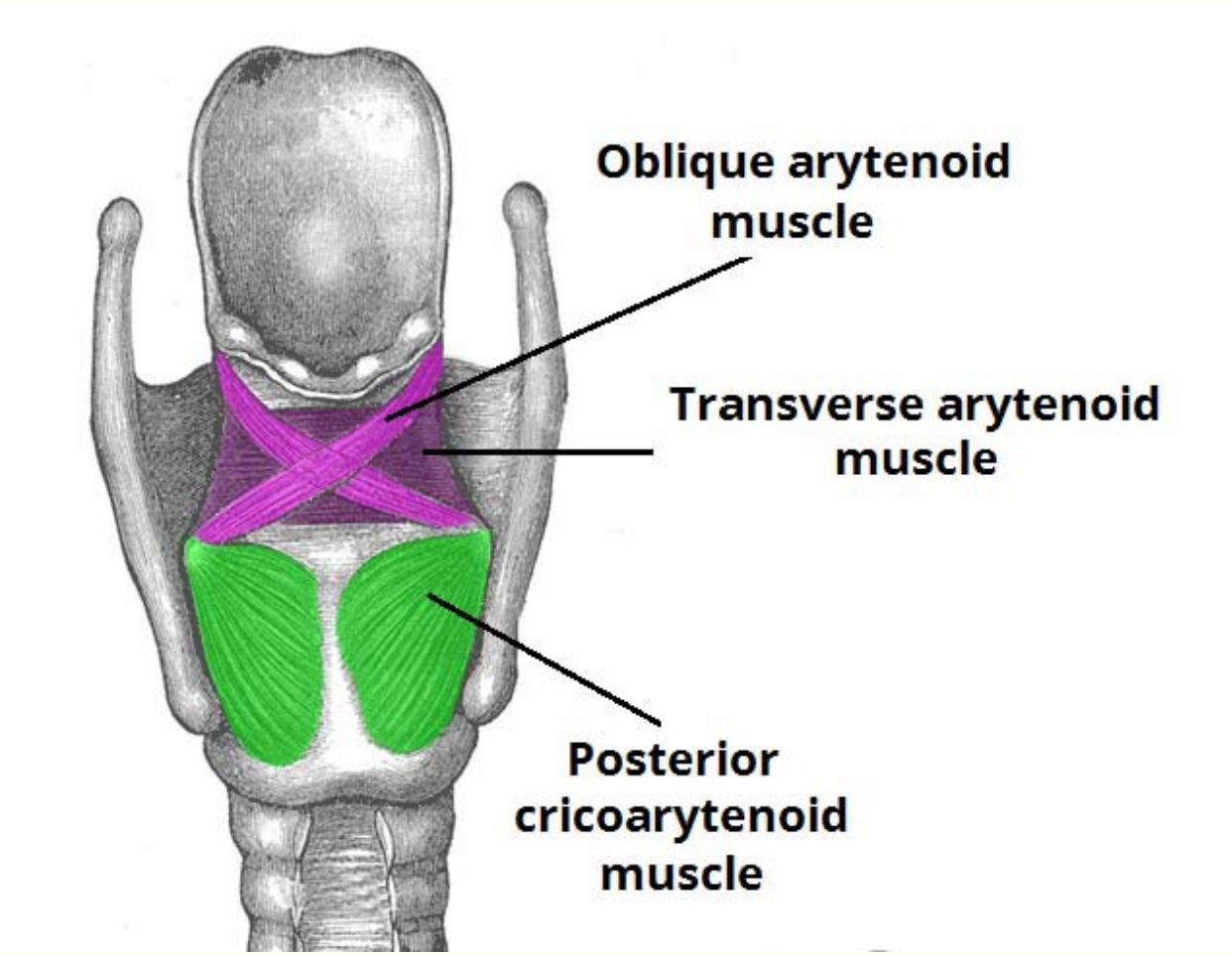
Thyroarytenoid (TA)

- Referred to as the deepest layer of the vocal fold structure
- 2 sections of the TA:
  - Thyrovocalis
    - The more medial section
    - Tenses the vocal fold when it contracts
  - Thyromuscularis
    - The more lateral section
    - Relaxes the vocal fold when it contracts

Muscles of the Larynx: Intrinsic

Posterior cricoarytenoid muscle (PCA)

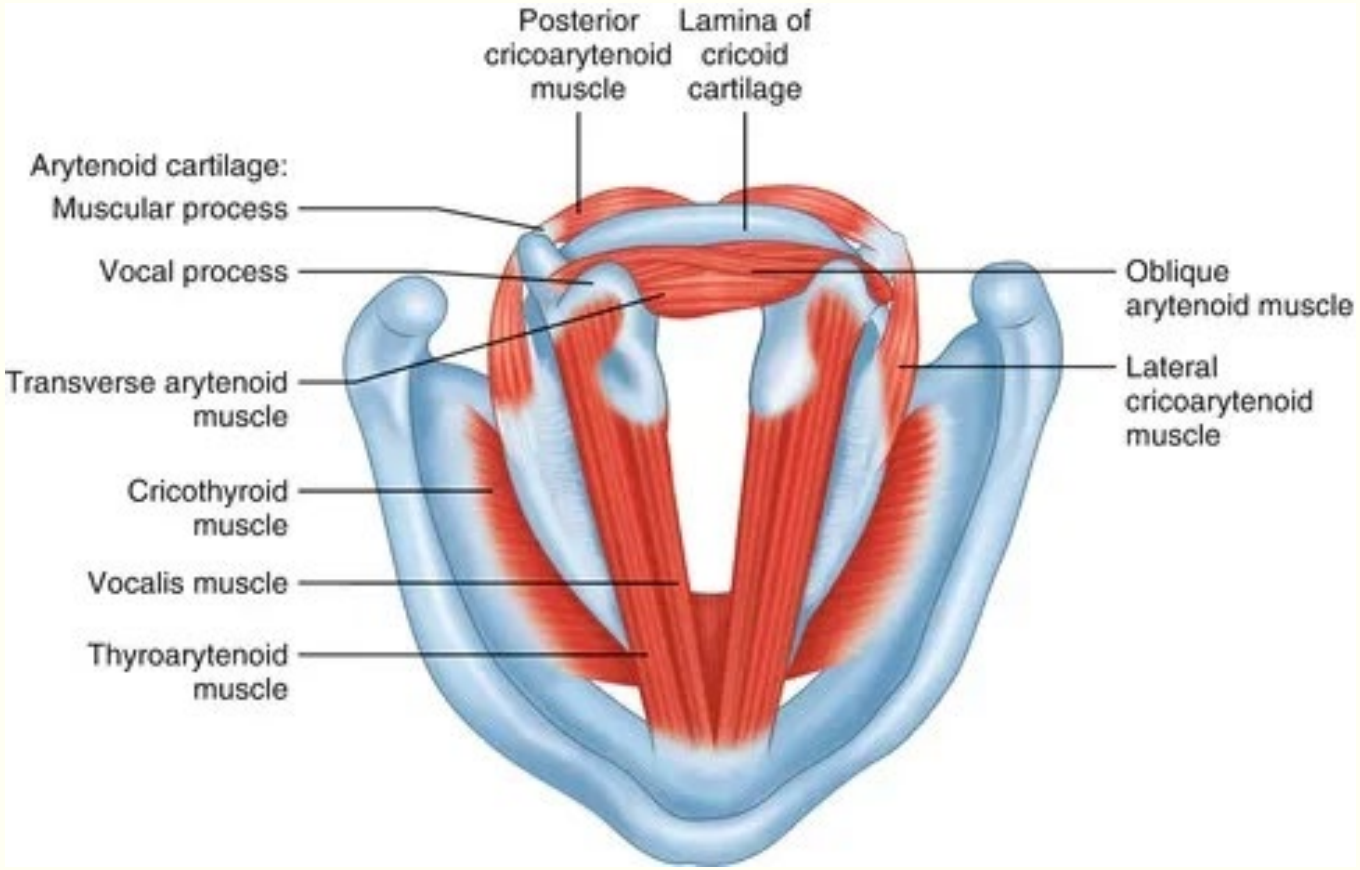
•Function: It abducts the vocal folds by moving the muscular process medially and rotating the vocal process laterally



Muscles of the Larynx: Intrinsic

The lateral cricoarytenoid (LCA)

Function: Upon contraction it adducts the vocal fold by moving the muscular process posterolaterally and the vocal process medially



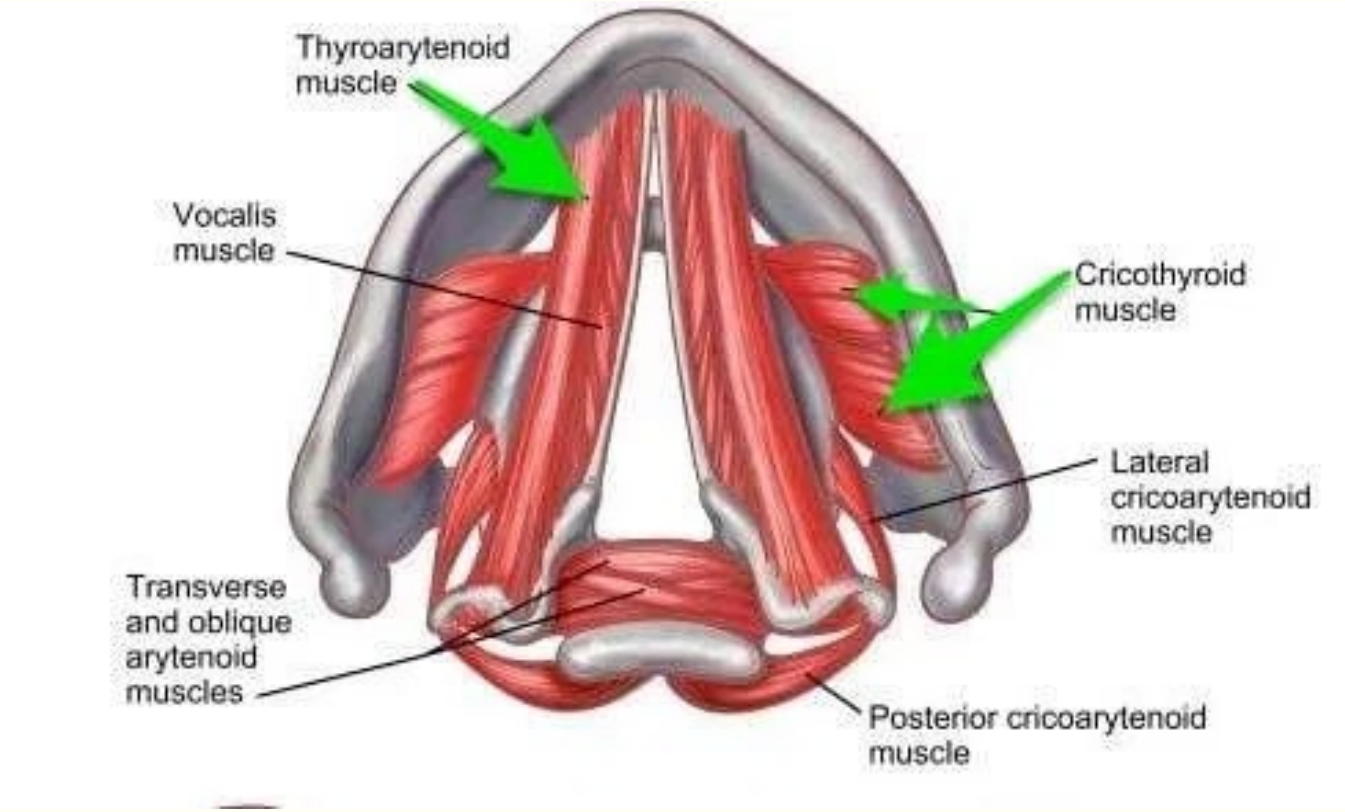
Muscles of the Larynx: Intrinsic

The cricothyroid muscle (CT)

Two sections of the CT belly:

- Pars recta
- Pars oblique

Function: Tenses the vocal folds



Summary of the Intrinsic Laryngeal Muscles' Function

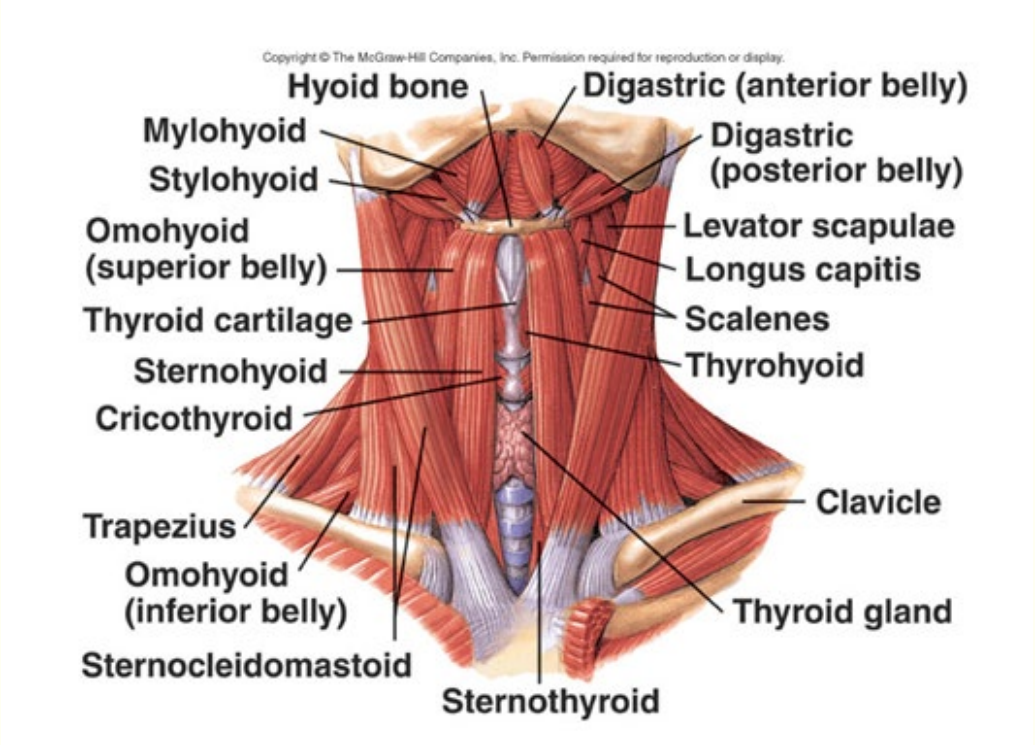
Muscle	Abduction	Adduction	Length	Tension	Relaxation
Thyrovocalis		X	Decrease	X	
Thyromuscularis					X
Posterior cricoarytenoid	X				
Lateral cricoarytenoid		X	Decrease		
Cricothyroid			Increase	X	
Transverse arytenoid		X			
Oblique arytenoid		X			

Muscles of the Larynx: Extrinsic

- Functions:

1. Elevate the larynx within the vocal tract
    - action of the suprahyoid extrinsic muscles

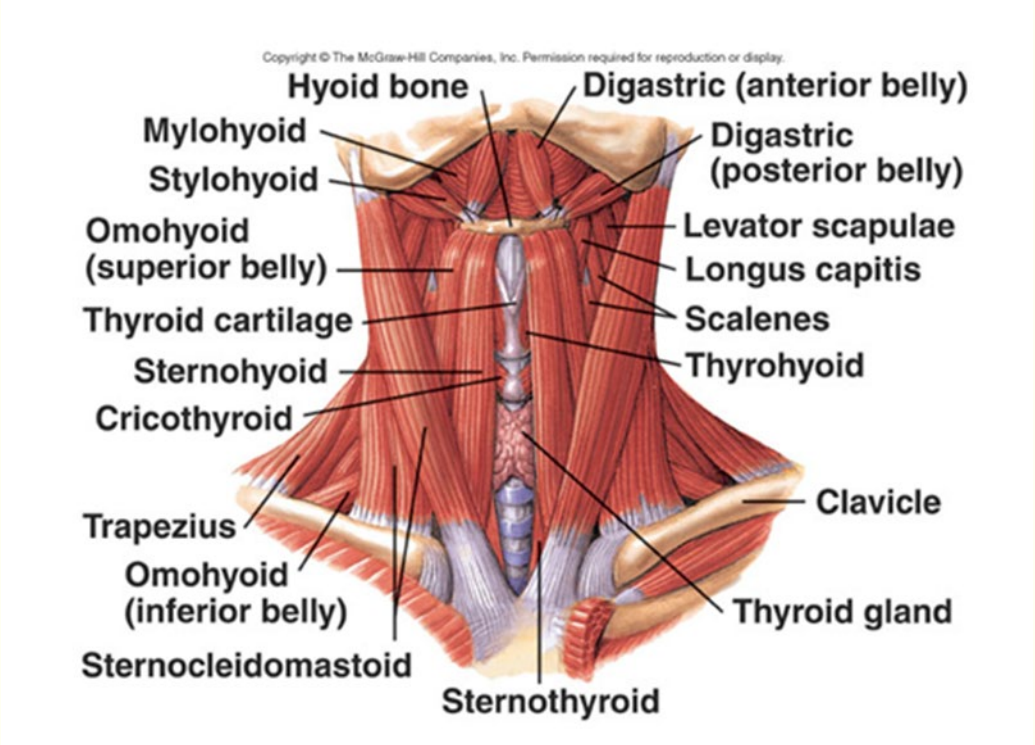
2. Depress the larynx
    - Action of the infrahyoid extrinsic muscles



Muscles of the Larynx: Extrinsic

Suprahyoid

- Elevate the hyoid bone and larynx primarily with their other functions serving jaw movement:
- These muscles include:
  - Digastric
  - Mylohyoid
  - Stylohyoid
  - Geniohyoid



Muscles of the Larynx: Extrinsic

Infrahyoid

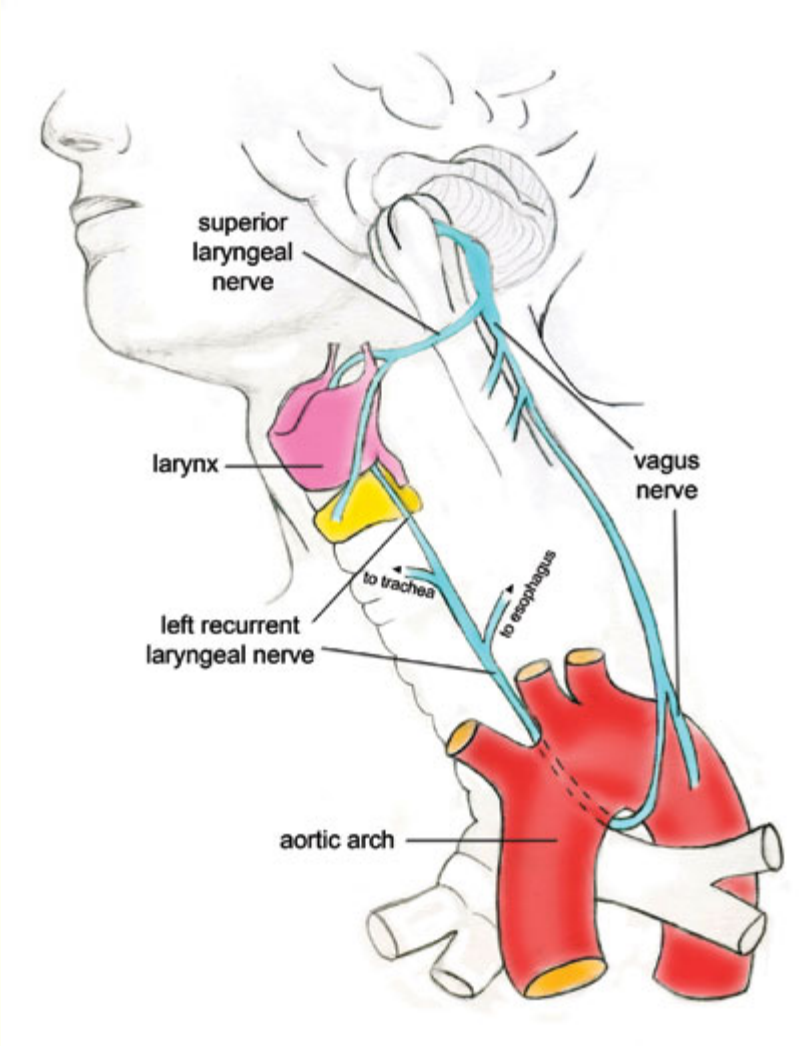
- Depress the hyoid and larynx
- These muscles include the:
  - Sternohyoid
  - Sternothyroid
  - Omohyoid
  - Thyrohyoid

Nerve Innervation

Vagus nerve

- Recurrent laryngeal nerve (RLN)
  - Supplies motor control or function to all of the intrinsic laryngeal muscles except the cricothyroid muscle

- Superior laryngeal nerve (SLN)
- Divides into the internal and external Branch.
- Internal is sensory
- External branch is motor and it travels and supplies the cricothyroid muscle



Practice Question

- John is a 60-year-old high school teacher who presented to our clinic with a 14-month history of progressive dysphonia following removal of his thyroid gland. A suspected VF paralysis had been ruled out by his ENT. We performed a follow-up rigid endoscopy at our clinic and observed normal VF mobility. Our endoscopic findings further revealed that the ventricular VFs tended to move toward the midline upon phonation, thus damping the vibration of the true VFs and interrupting the mucosal wave. Thick, sticky mucus was seen throughout the laryngeal vestibule, and pachydermia was observed at the posterior commissure. The patient presented with a strained voice that was occasionally choked off during the clinical interview. He reported that at times the voice improved, during singing or whistling, but otherwise, it was becoming harder and harder to force the voice out. The dysphonia was threatening his job as a teacher and coach, and he could no longer enjoy normal outings with his family. Voice facilitating approaches of focus and inhalation phonation resulted in easier vocal quality for a few phonatory attempts, but the strained quality and vocal arrests soon returned.

  A unilateral VF paralysis was originally suspected in this case because of surgical intervention in the vicinity of which cranial nerve?

- a) trigeminal
- b) Vagus
- c) olfactory
- d) optic

Practice Question

- A patient arrives at an acute care hospital in order to have open heart surgery. After the surgery, the patient verbalizes complaints about change in vocal quality, and the speech-language pathologist (SLP) is consulted. The SLP who performs the intake evaluation documents that the patient presents with an excessively high-pitched voice. Which of the following is a likely cause of the patient's change in vocal quality?

a) Development of vocal nodules from screaming at the nurse

b) A massive hemispheric stroke during surgery

c) Damage of the left recurrent laryngeal nerve during the surgery

d) Persistence of anesthesia effects, resulting in drug-induced change in vocal quality.

Voice Depends on Vocal Fold Vibration and Resonance

- Sound is produced when aerodynamic phenomena cause vocal folds to vibrate rapidly in a sequence of vibratory cycles with a speed of about:
  - 110 cycles per second or Hz (men) = lower pitch
  - 180 to 220 cycles per second (women) = medium pitch
  - 300 cycles per second (children) = higher pitch higher voice

Mechanisms for Changing Pitch

1. Lengthening the vocal folds the relative mass decreases, the cross-sectional area and decreasing thickness of the vocal folds create a faster vibratory rate.

2. Fundamental frequency can be increased by increases in subglottal pressure

Practice Question

- Harriet is a 75-year-old woman with a history of smoking one pack of cigarettes per day for more than 50 years. Her chief voice complaint is rough voice quality, low speaking pitch, weak voice, and running out of air when she speaks. She saw an otolaryngologist (ENT), who diagnosed her with emphysema and Reinke's edema.

  Which of the following mechanisms primarily accounts for the patient's low speaking pitch?
  a) Decreased mass of vocal folds
  b) Increased mass of vocal folds
  c) Incomplete glottic closure
  d) Decreased subglottic air pressure
  e) None of these

Mechanisms for Changing Loudness

- A doubling of lung pressure can increase the sound source output by 9.5 dB
  - The increased lung pressure causes an increase in peak flow rate and greater vibratory amplitude of the vocal folds

Vocal Register

Three registers that relate to the speaking voice:

Pulse/vocal fry register is a fundamental frequency range at the low end of the frequency scale (approximately 35-50 Hz)

Modal register is the range of fundamental frequency most commonly used by a speaker

Falsetto or loft register is a fundamental frequency range at the upper end of the vocal folds vibrating capacity

Vocal Health

- Contributing factors involved with the onset, maintenance and rehabilitation of a voice disorder include:
  - the patient's personality
  - their family dynamics
  - their medical history
  - the daily environmental influences to which they are exposed
  - their occupational demands
  - their expectations about the quality of their voice

Phonotrauma

- **Phonotrauma** is defined as the behavior(s) that contribute to laryngeal injury
  - inflammation or other forms of damage
- **Vocal Hygiene** refers to habits which support a healthy and strong voice throughout your life

Vocal Health

- Alcohol intake
- Cigarette Smoking
- Coughing and Throat clearing
- Caffeine Intake
- Sleep deprivation
- Talking too loudly
- Poor nutrition
- Dehydration

Laryngopharyngeal Reflux

- Acid Reflux is acid back-flow up from the stomach into the esophagus
- Acid that reaches the upper pharynx and upper airway is referred to as laryngopharyngeal reflux
- Lining of the larynx is less protective than the esophagus
- Common source of irritation in the larynx
- Contributes to the formation of granulomas

Practice Question

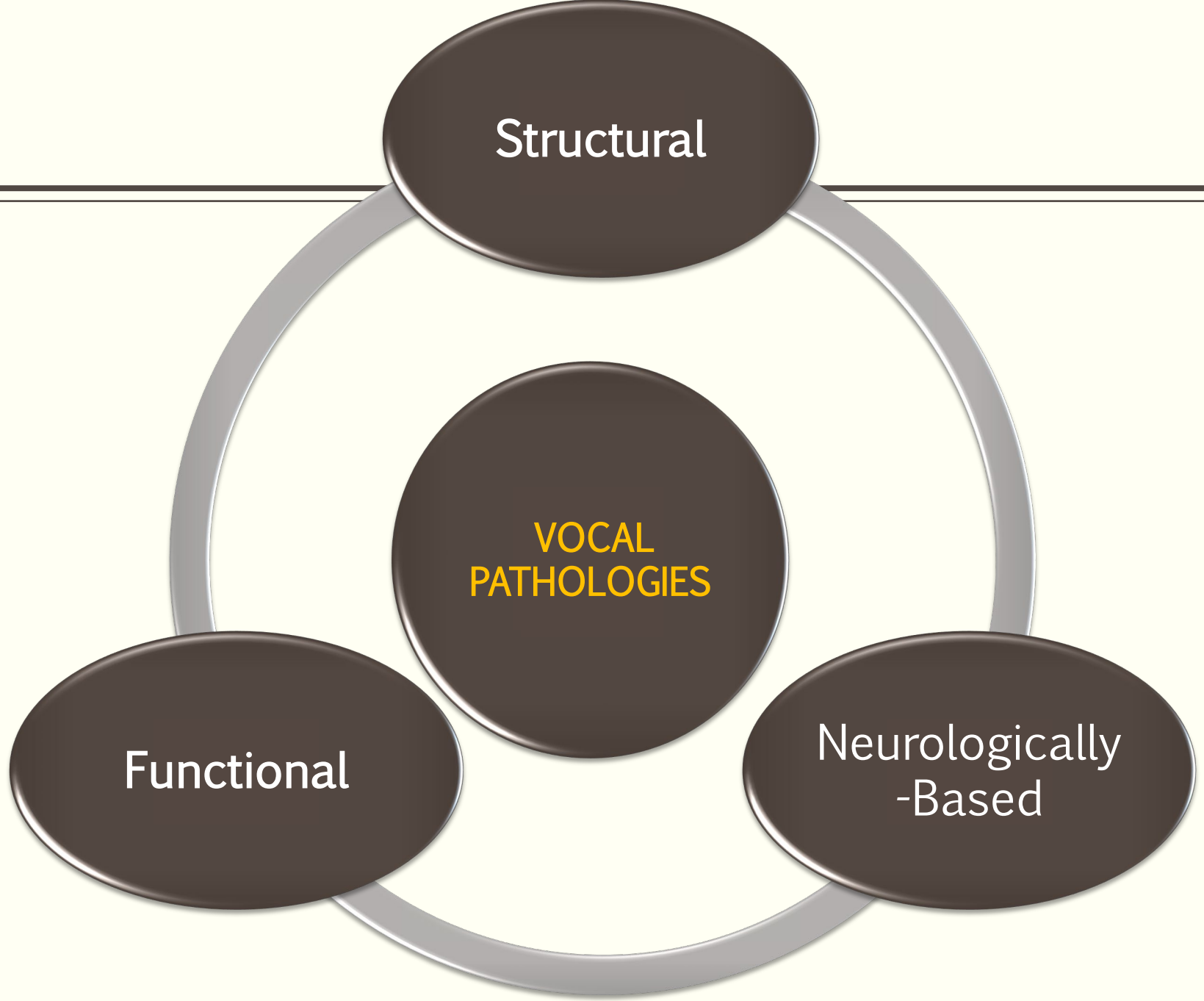
- The principal of a local elementary school has come to an outpatient voice center in order to ask the speech-language pathologists (SLPs) to give a presentation to the high school teachers regarding vocal health. According to the principal's reports, a large number of teachers complain of difficulty voicing and require frequent sick days to recover. Which of the following options is NOT appropriate to use as a method to prevent voice disorders for this population of teachers?

a) Using a nice strong voice to get students' attention

b) Taking voice breaks in between class

c) Using a sticker chart for behavioral management

d) Utilizing a seating chart for maximum vocal projection


Structural
VOCAL PATHOLOGIES
Functional
Neurologically -Based

STRUCTURAL PATHOLOGIES

Vocal Nodules

Description:

Common benign pathology; Caused from phonotraumatic behaviors; Inflammatory degeneration of the superficial layer of the lamina propria

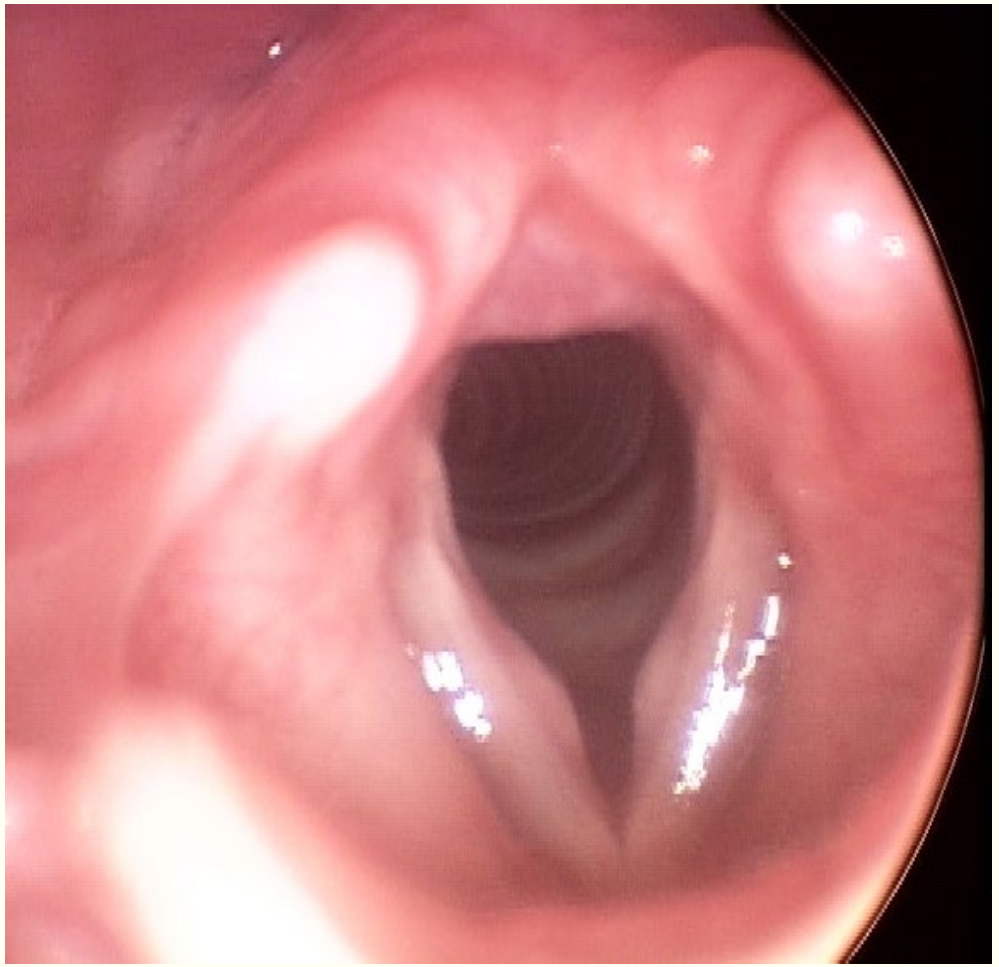
Typically form bilaterally

Voice Symptoms:

- Voice quality varies from early to mature formation
  - Raspy
  - Hoarse
  - Breathy
  - Easily fatigues
- Singers
  - Loss of vocal range
  - Loss of vocal endurance

Management:

- Behavioral voice therapy
- Vocal hygiene therapy
- Phonosurgery (Not often necessary)



Vocal Fold Polyps

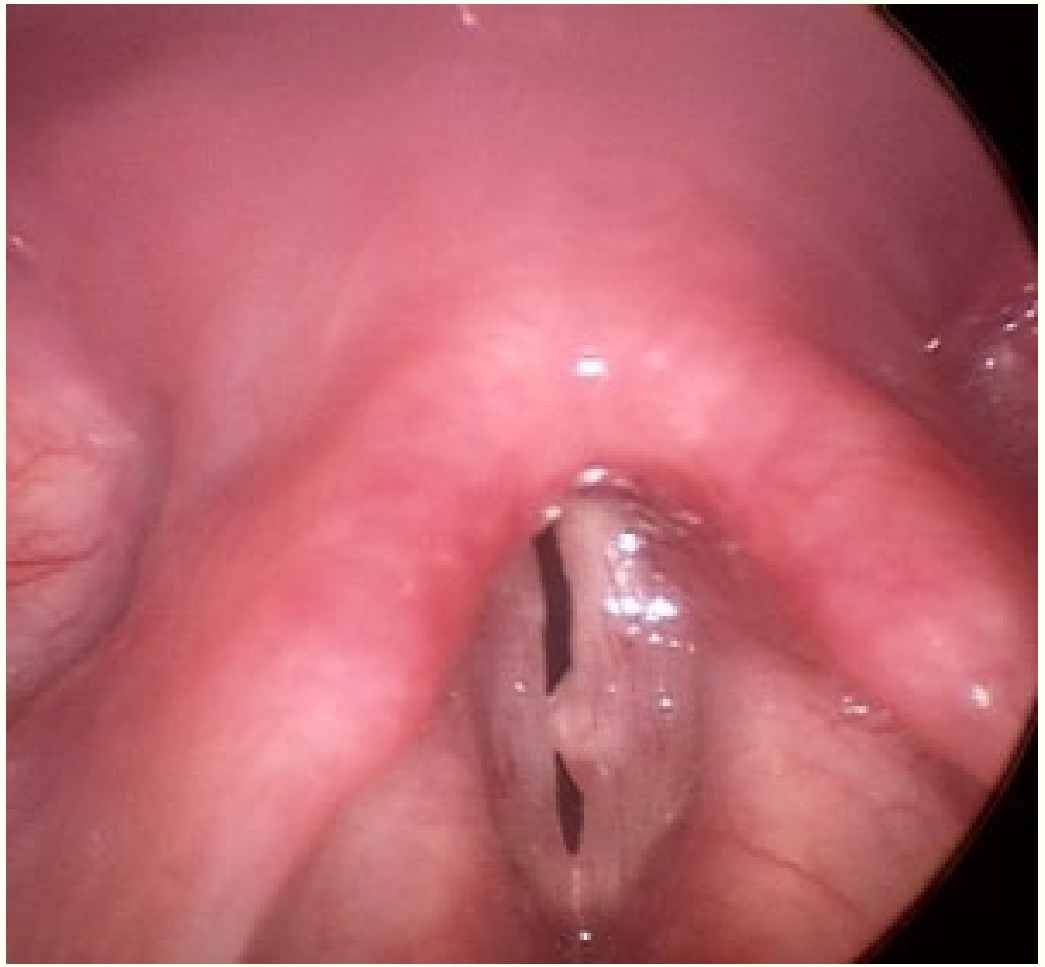
Description: Fluid-filled lesion; Develops in the superficial layer of the lamina propria; Has its own blood supply; Typically forms unilaterally; Usually results from phonotraumatic behaviors

Voice symptoms:

- Typical voice symptoms
  - Hoarseness
  - Roughness
  - Breathiness
  - Globus sensation
  - Effortful phonation
  - Loss of vocal endurance
- A pedunculated polyp that falls below the vocal fold edge may cause difficulty breathing

Management:

- Behavioral voice therapy
- Vocal hygiene
- Phonosurgery



Generalized Edema; Reinke's Edema/Polypoid degeneration

Description: Buildup of fluid in the superficial layer; Long-standing trauma or chronic exposure to irritants

- Cigarette smoke
- Laryngopharyngeal reflux

Voice symptoms:

- Voice symptoms
  - Lowered pitch and varying degrees of hoarseness
- Increased vocal fold mass
- Swelling can become large enough to cause symptoms of dyspnea
- Sleep apnea can occur

Management:

- Remove irritant (e.g., smoking)
- Vocal hygiene
- Phonosurgery

Practice Question

- A patient has undergone phonosurgery to remove lesions associated with polypoid degeneration. After a period of vocal rest, the patient returns to the hospital's voice center to begin treatment with the speech-language pathologist (SLP). Which of the following options is an appropriate first step in this patient's treatment?

a) Vocal hygiene information, in order to reduce high-fat foods

b) Use of hard glottal attack, in order to improve vocal closure

c) Vocal hygiene information, in order to reduce smoking

d) Recommendations for periodic, repeated phonosurgery as necessary

Laryngitis

Description:
- Inflammatory condition of the vocal fold mucosa
- Caused by:
  - Reaction to a viral and/or bacterial infection
  - Traumatic conditions
  - Autoimmune diseases

Voice symptoms:
- Generally produces hoarseness
  - Mild
    - Sore throat, cough and a fever
  - Severe
    - Caused by continued voice use during the bout of laryngitis

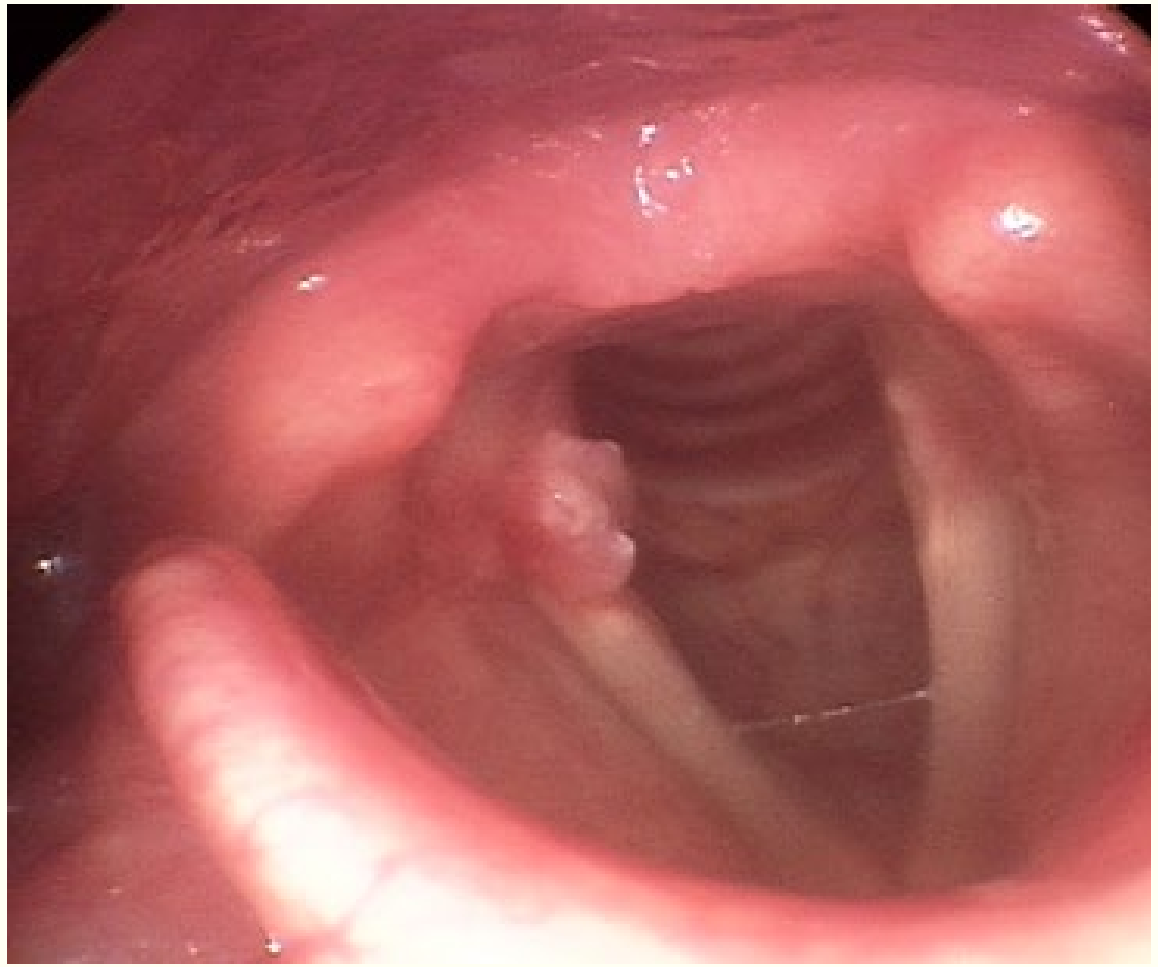
Management:
- Often resolves with rest and hydration
- Antibiotics
- Necessary to pinpoint the cause of the inflammation
  - Remove the causative irritant or pathogen
- Vocal hygiene

Contact Ulcers/Granulomas

Description: Found along the vocal processes
- Contact ulcers- raw sores on the mucus membrane of the arytenoid processes
- Granulomas tend to grow over contact ulcers until cause of irritation is addressed; Unilaterally or Bilaterally; Benign growths that can result from, LPR irritation, Intubation trauma, Phonotrauma

Voice symptoms:
- Hoarseness
- Breathiness
- Difficulty increasing vocal loudness
- Reduced pitch range
- Prolonged warm-up time
- If unilateral may have minimal to no change in voice quality

Management:
- Voice Therapy



Cysts

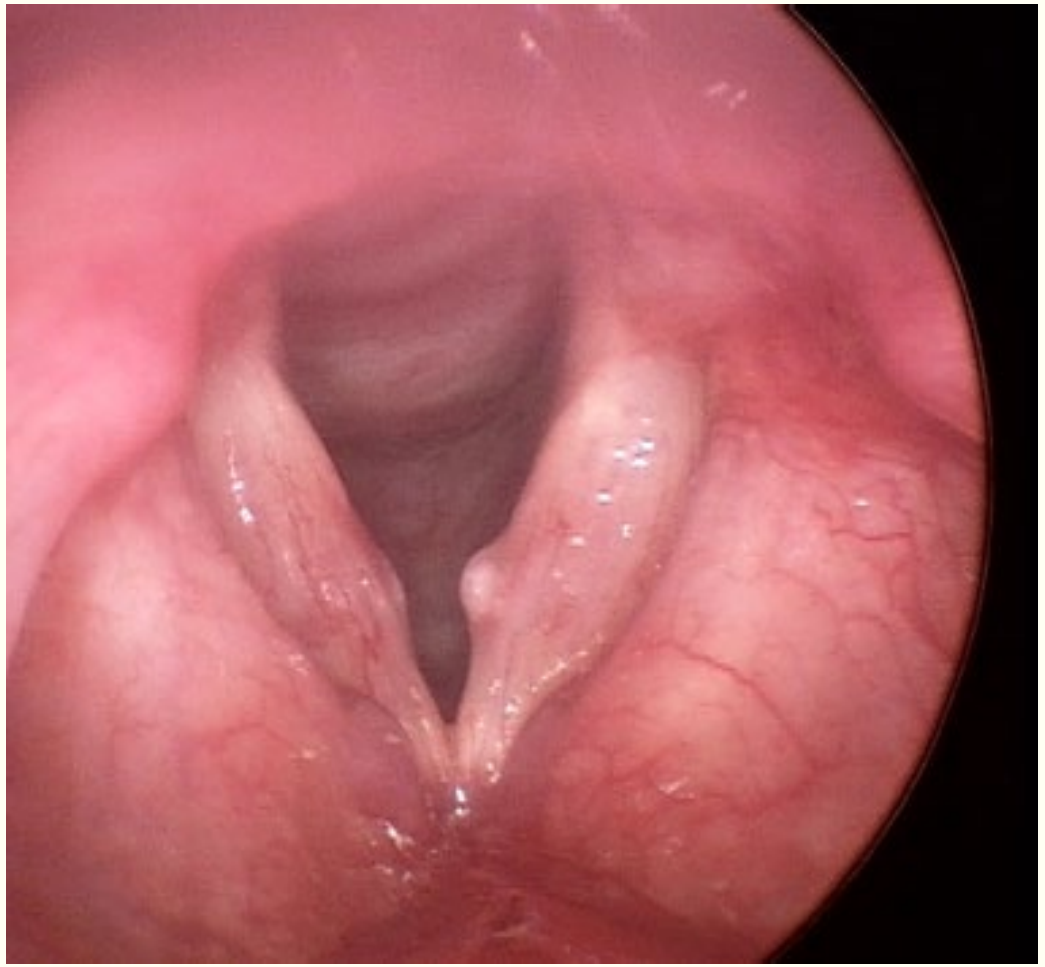
Description: Benign mucus-filled lesion surrounded by a membrane ;Located near the vocal fold surface; The causes (Phonotraumatic behaviors; Glandular blockage); Appear at the mid-membranous portion; Can present congenitally

Voice symptoms:

- Generally result in mild to severe hoarseness
- Voice quality is a function of the size, shape and firmness
- Globus sensation may be present
- Throat clearing and cough

Management:

- Vocal hygiene therapy
- Voice rest to help reduce edema surrounding the cyst
- Phonosurgical removal of the cyst is the most common treatment choice
  - Microsurgical excision
  - Avoid under and over-excision to minimize reoccurrence and inadvertent damage



Candida

Description: Candida is a yeast normally present in the body
- Candidiasis is a fungal infection that occurs as a consequence of weakness within the immune system

Voice symptoms:
- Voice quality
  - Pressed
  - Moderately hoarse
  - Breathy
  - Pain may be present

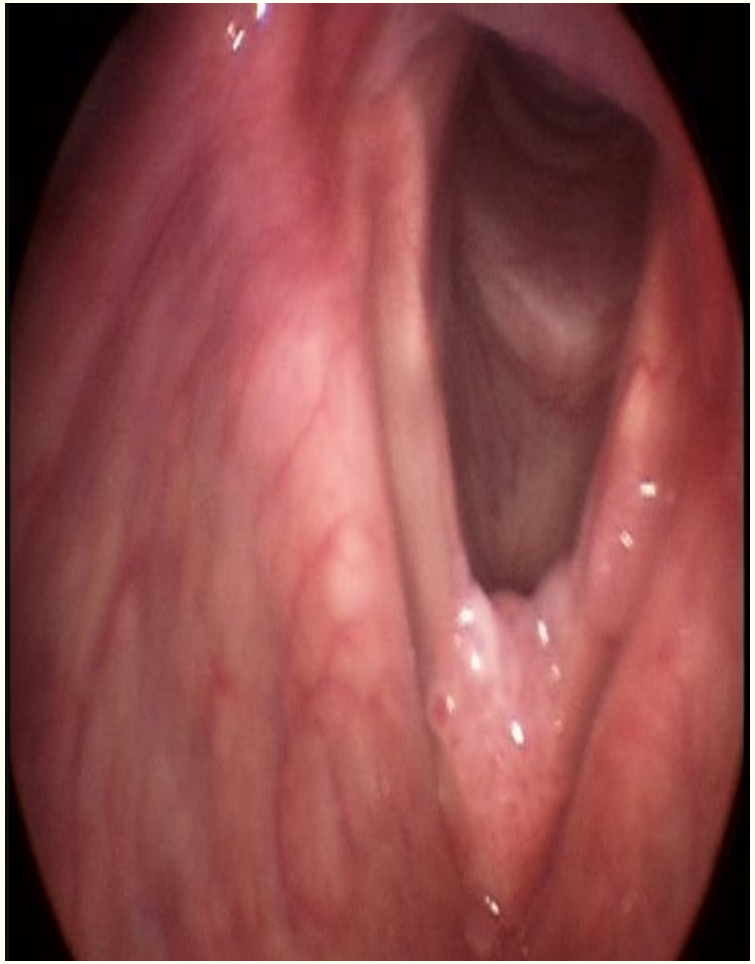
Management:
- Medication
- Removal of predisposing factors
- Implementation of good vocal hygiene
- Eliminate irritating factors. E.g. - Gastroesophageal reflu
- Increasing hydration
- Voice therapy is often not necessary

Laryngeal Papilloma

- **Description**: Caused by exposure to the human papilloma virus (HPV); Laryngeal papilloma can occur in both child and adult; Common sites for papillomatosis: True vocal folds, Trachea/bronchi; Palate; Nasopharynx; Rare instances, the lungs

Voice symptoms: Rough quality of voice
- Vibratory asymmetry
- Breathiness may occur if glottal closure effected
- Potential dyspnea and inspiratory stridor
- Chronic cough
- Weak cry
- Periods of aphonia

Management: Care for airway obstruction and ensure that ventilatory support is adequate
- The surgical procedures only offer symptomatic relief
- Microsurgical ablation
- Microdebrider resection
- Antiviral drugs
- Indole-3-carbinol
- Methotrexate
- Cidofovir
- Voice therapy during a state of non recurrence

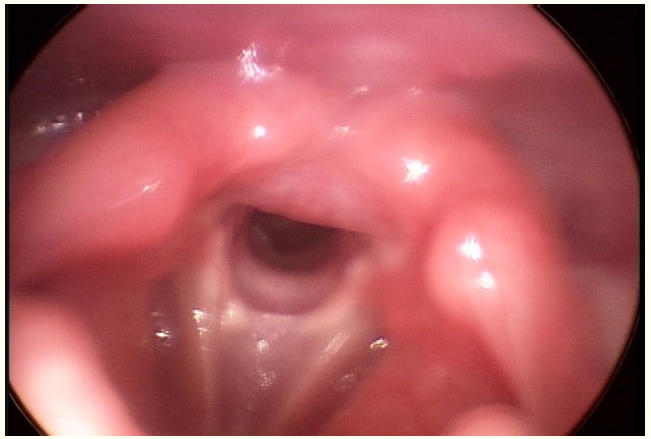


Laryngeal Web

Description: Could be congenital or acquired; Congenital laryngeal webs occur when there is a failure of recanalization during embryonic development; 75% occur at birth; Typically are located anteriorly; Can block up to 75% of the glottal airway

Voice symptoms:

- Voice symptoms
  - Hoarseness
  - Difficulty sustaining phonation

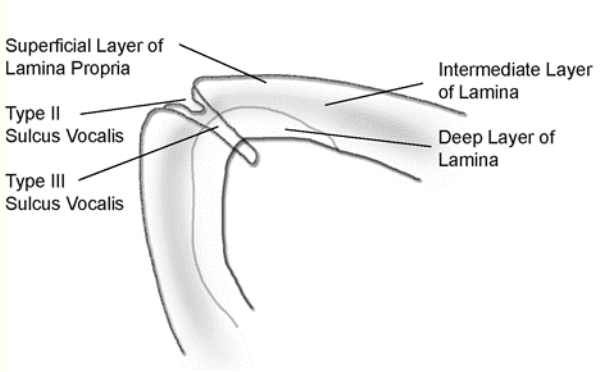


Management:

- Resection of the web
  - Either a knife or laser procedure
- A keel may be placed between the vocal fold edges to prevent re-scarring

Sulcus Vocalis

Description: Thinning or loss of the superficial layer of vocal fold tissue
Etiology undefined - linked to smoking



Voice symptoms: Perceived voice quality
- Hoarseness
- Weakness
- Increased effort
- Vocal fatigue

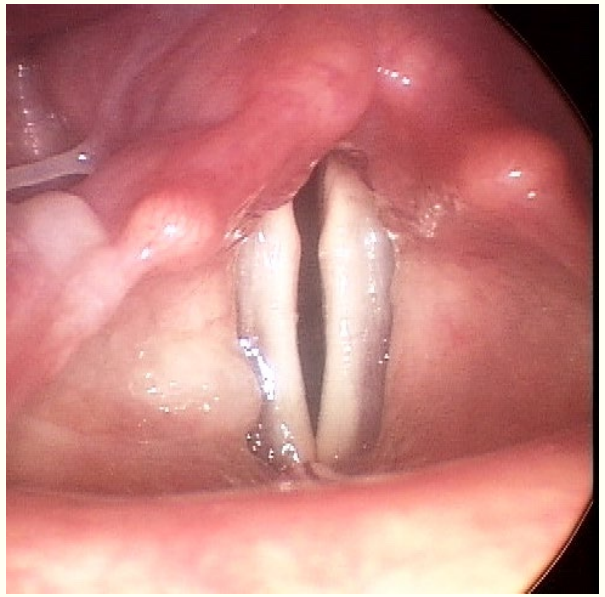
Management:
- Autogenous fat and fascia augmentation
- Improvements in vocal quality, glottal closure, mucosal wave excursion, acoustic, perceptual, and phonatory functions
- Other phonosurgical procedures
- Medialization or other injectables
- Materials used are fascia, fat and collagen

Presbylaryngis

Description: Sarcopenia; Wasting and thinning of muscle tissue
Effects on the thyroarytenoid muscle; Becomes thinner

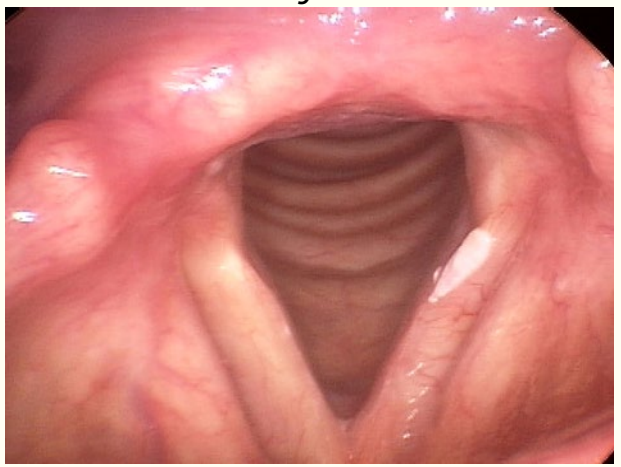
Voice symptoms:
- Softer, altered pitch with some accompanying roughness
- Tremor may be associated with aging
- Reduced vocal loudness
- Pitch differences are observed between the sexes
  - Male pitch tends to become higher with age
  - Female pitch tends to lower with age

Management:
- Voice therapy
- Emphasis on improving glottal closure
  - Medialization procedures
  - Use of injectables



Leukoplakia/Hyperkeratosis

Description: White plaque like formation occurring on the vocal fold surface
- Usually found at the anterior portion of the vocal fold but may extend into the interarytenoid area
- Considered a precancerous state and should be biopsied



Voice symptoms: Voice quality
- Rough
- Hoarse

Management:
- If biopsy is not found to be atypical then,
  - Vocal hygiene counseling
  - Counseling to indicate that unless the chronic irritation is minimized or removed the cell growth could reach a cancerous state
- Small leukoplakias:
  - Surgical excision usually suffices
- Patients should be followed for at least 3 to 6 months to monitor for recurrence

Dysplasia and Laryngeal Cancer

Description:
Pathologic tissue change in the mucosa; Identified with biopsy
Often indicative of early cancerous process
Appears whitish or reddish in color due to hypervascularization
Can form a mass, plaque, or irregularity on the vocal fold edge

Voice symptoms:
- Hoarseness
- Change in pitch (typically lower due to the mass effect)
- Vocal strain
- Sore throat or globus sensation
- Persistent cough
- Stridor

Management:
- A combined modality treatment
  - Surgery radiation and chemotherapy
- Prescribed and/or changed based on the stage of diagnosis
- Requires continued cancer surveillance through regular laryngeal examinations

Ankylosis of Cricoarytenoid Joint

Description: Resulting from injury after a traumatic dislocation; Potentially from intubation; Disease such as inflammation (Rheumatoid arthritis); Results in stiffness and/or fusion of the cricoarytenoid joint

Voice symptoms:
- Breathy or rough voice quality
- Difficulty prolonging a sustained vowel
- Pain during swallowing

Management:
- Medically by performing vocal fold mobilization under direct laryngoscopy

- Medialization of one or both vocal folds to increase glottic closure for tasks such as speech or cough

Laryngomalacia

Description: Most common cause of inspiratory stridor in infancy; Congenital condition of unknown etiology; Characterized by

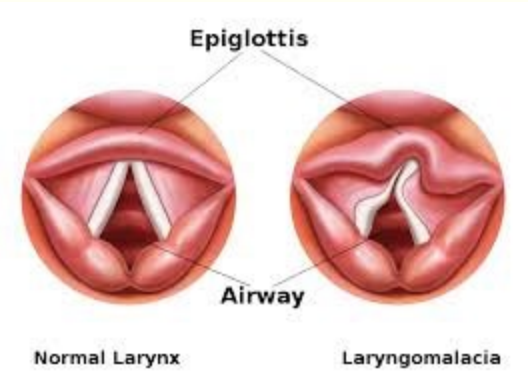
- Floppy epiglottis
- Large aryepiglottic folds
- Large arytenoids process

Voice symptoms:

- Intermittent inspiratory stridor
- Starts just after a few days or weeks following birth
- The degree of stridor increases as the depth and rate of breathing is increased

Management:

- Most infants do not require treatment as laryngomalacia resolves with maturation
- When surgery is needed:
  - Aryepiglottic fold incision
  - CO_2 laser supraglottoplasty
- Other possible complications to treat:
  - Esophageal reflux disease
  - Upper respiratory infections
  - Heart disease
  - Lung disease
  - Neurologic disease



Practice Question

- A 1-month-old infant is brought to a speech and language clinic, with parent complaints of an “unnatural cry and loud sounds when the child is breathing”. This problem has been present since birth and has remained stable since that time. Which of the following disorders is this child MOST LIKELY experiencing?

a) Subglottic stenosis

b) Laryngomalacia

c) Laryngeal web

d) Vocal fold nodules

Vascular Lesions: Varix and Ectasia

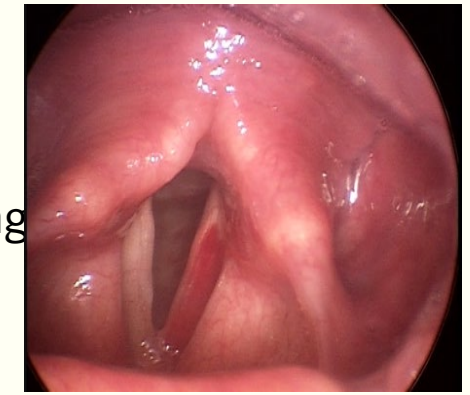
Description: Originating in the superficial layer of the lamina propria
- Direct result of phonotrauma
- Midmembranous portion of the vocal fold
- Related to high-pressure phonatory events
    - Shouting and oversinging
- More prevalent in women than men
    - Female hormonal cycle

Voice symptoms:
- Some present with a vocal fold varix or ecstasia
- Others present with a dysphonia
    - Loss of vocal range
        - Particularly in the higher frequencies
    - Hoarseness

Management:
- Voice rest until any blood is reabsorbed
- Vocal hygiene
- If surgery is necessary cold instrument dissection is ideal

Vascular Lesions: Vocal Fold Hemorrhage

Description: Damage to the tissues as a result of exposure to blood
- Extremely small delicate blood vessels which traverse the various tissue layers



Voice symptoms:
- When superficial layer of the lamina propria is affected the effects can be devastating
  - Dysphonia
  - Complete aphonia
  - Absence of voice

Management:
- Phonosurgical excision of microvascular lesions may prevent a vocal fold hemorrhage
- In the acute phase:
  - Complete and total voice rest in order allow the tissues time to heal
  - Once healed, residual dysphonia can be treated through a variety of augmentative procedures
    - Injection of fat or collagen to the vocal fold to restore vibratory capacities

FUNCTIONAL VOICE DISORDERS

Puberphonia

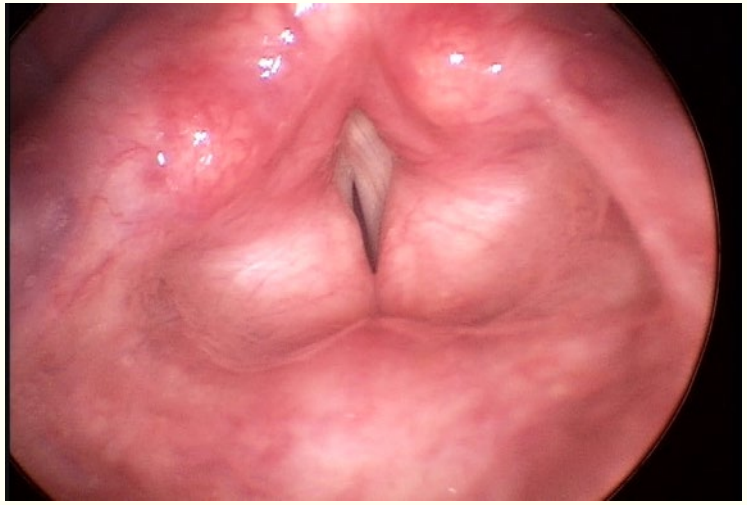
Description: Adolescent males who have seemingly maladjusted growth of the larynx
- Maintenance of a high-pitched voice
- Psychosocial repercussions for the male who is not past puberty

Voice symptoms:
- The pitch is higher than it should be
- Breathy
- Low vocal loudness

Management:
- Behavioral management
- Voice therapy techniques to reduce the higher pitch
  - Biofeedback computerized software
    - Kay Pentax Visipitch
  - Manual laryngeal massage therapy
  - Other relaxation techniques to help reduce muscle tension

Ventricular Phonation

Description: Use of the ventricular folds during voicing instead of, or along with, the true vocal folds
Common conditions with ventricular phonation: Accompanying severe muscle tension; Severe true vocal fold dysfunction; Compensatory technique



Voice symptoms:
- Low pitched
- Reduction in vocal range
- Reduction in loudness
- Pitch variability
- Roughness
- Hoarseness
- Vocal fatigue
- Globus sensation
- Pain in the ears

Management:
- If the true vocal folds are unable to produce voice:
  - Voice therapy
  - Psychotherapy
  - Pharmacological therapy
  - Surgical interventions (excision or laser surgery)

Practice Question

- John is a 60-year-old high school teacher who presented to our clinic with a 14-month history of progressive dysphonia following removal of his thyroid gland. A suspected VF paralysis had been ruled out by his ENT. We performed a follow-up rigid endoscopy at our clinic and observed normal VF mobility. Our endoscopic findings further revealed that the ventricular VFs tended to move toward the midline upon phonation, thus damping the vibration of the true VFs and interrupting the mucosal wave. Thick, sticky mucus was seen throughout the laryngeal vestibule, and pachydermia was observed at the posterior commissure. The patient presented with a strained voice that was occasionally choked off during the clinical interview. He reported that at times the voice improved, during singing or whistling, but otherwise, it was becoming harder and harder to force the voice out. The dysphonia was threatening his job as a teacher and coach, and he could no longer enjoy normal outings with his family. Voice facilitating approaches of focus and inhalation phonation resulted in easier vocal quality for a few phonatory attempts, but the strained quality and vocal arrests soon returned.

  The involvement of the ventricular VFs during voice attempts is most likely associated with:
  a) ataxic dysarthria
  b) result of LPRD
  c) maladaptive behavior adopted to try to compensate for irregular VF vibration
  d) precursor to hypokinetic dysarthria

Muscle Tension Dysphonia

Description: Increased muscle activity in the head and neck

- Responses on case history often include:
  - Stress, anxiety, depression, high vocal demand, issues with time management, and general complaints of being overloaded both physically and emotionally
- Other conditions associated with MTD include:
  - Laryngopharyngeal reflux

- Voice symptoms: Voice quality:
  - Strained
  - High pitch

When vocal fold tension appears high

- Folds may never adduct
  - Breathiness weakness to the sound quality

Management:

- Voice therapy:
  - Biofeedback
  - Laryngeal relaxation techniques
  - Resonant voice therapy
  - Circumlaryngeal massage
  - Accent method

Practice Questions

- Miranda is a 34-year-old woman with a 3-month history of dysphonia, which began after an upper respiratory infection. Her chief voice complaints are harsh and strained vocal quality, high speaking pitch, and vocal fatigue by the end of the day. She saw an ENT, who diagnosed her with muscle tension dysphonia and LPRD. Miranda also complains of being depressed because of the changes in her social life due to her dysphonia.

  Which of the following laryngeal findings would also likely be noted by the ENT?
  a) swelling and redness of the vocal folds and arytenoid mucosa
  b) vocal fold atrophy
  c) vocal fold nodules
  d) paresis

Transgender/Transsexual Voice Transition

Description: Individuals seeking to change the gender role assigned to them at birth
  - Masculinization transition from female to male
  - Feminization transition from male to female

- Persons seek voice treatment to assist in producing a voice pitch which is in agreement with their new gender identity

Voice symptoms:
- Pitch of the person transitioning from female to male will be too high
- Pitch of the person transitioning from male to female will be too low
- Other variables to work on:
  - Resonance
  - Intonation
  - Rate
  - Vocal intensity

Management:
- Reducing or increasing the fundamental frequency
  - Biofeedback
  - Use of a hierarchical approach
  - Homework exercises
    - Real-world tasks to help achieve generalization of the therapeutic target
- Modification of loudness
  - Biofeedback techniques
  - Vocal Function Exercises
- Resonance
  - Frontal focus therapy
  - Lessac Madsen Resonant Voice Therapy

Conversion Aphonia

Description: Related to a manifestation of stress, depression, or anxiety; Psychogenic voice disorder; Tends to emerge very quickly; Can be associated with a traumatic event and severe stress; No evidence of a physical or neurologic cause

- Significant functional and social impact

Voice symptoms: No voice on attempted phonation or
  - If voicing does emerge it is often high pitched and very strained
- Often pain in the neck area and extrinsic laryngeal muscle tightness when attempting to phonate

Management:

- Psychiatric treatment
- Voice therapy
- Cognitive behavioral therapy
- Antidepressants

NEUROLOGICALLY-BASED PATHOLOGIES

Unilateral True Vocal Fold Paralysis

Description: Complete immobility in one vocal fold; The Recurrent Laryngeal Nerve (RLN); Primarily responsible for vocal fold abduction and adduction; Branch of cranial nerve X, the vagus nerve

Voice symptoms:
- May exhibit
  - Aphonia
  - Completely normal voicing
- Highly variable
- When paralyzed in a highly abducted position:
  - Breathy
  - Weak
- Dysphagia is common
  - Due to difficulty closing the glottis

Management:
- Direct trauma
  - “Wait and see” approach is often preferred
  - 6 month time window
- Behavioral voice therapy to facilitate vocal fold closure
  - Pushing Techniques
  - Vocal Function Exercises
  - Resonant Voice Therapy
  - Lee Silverman Voice Therapy (LSVT)
- Surgical interventions consist of
  - Medialization (Ishhiki Type I thyroplasty)
  - Vocal fold augmentation
  - Reinnervation surgical procedures

Bilateral True Vocal Fold Paralysis

Description: Commonly results from
  - Surgical trauma, malignancies, endotracheal intubation neurologic disease, or idiopathic causes
- Life threatening when the folds are fixed in the paramedian position
- Can sometimes be confused with bilateral arytenoid cartilage fixation

Voice symptoms:

- Voice is highly variable:
  - Completely normal phonation
  - Complete aphonia
  - Inspiratory stridor
    - May signal airway obstruction

Management:
- If no emergent need
  - "Wait and see"approach
- Concern for airway patency:
  - Tracheotomy
  - Cordectomy
    - Widen the glottis
  - Pacing strategies implantable electrical stimulators
  - Secondary adductor muscle block
    - Botulinum toxin

Practice Question

- Which of the following would be the most appropriate treatment for a patient with bilateral vocal fold paralysis?

a) Lifestyle changes

b) Medications

c) Surgery

d) Speech therapy

Superior Laryngeal Paralysis

Description: The superior laryngeal nerve (SLN)

- Branch of the vagus nerve
- Bilaterally innervates the cricothyroid

- Occurs through:
  - Trauma
  - Neoplastic
  - Infectious conditions with viral infections

- Damaged during surgery of the thyroid gland

Voice symptoms:

Weak, breathy voice, hoarse and disruption in vocal frequency ranges

Management:
"Wait and see" approach
Surgical interventions:

- Fusion of the thyroid and cricoid cartilages
- Other procedures are being tested in the animal model

Spasmodic Dysphonia

Description: Unknown origin although thought to be related to basal ganglia dysfunction

- Affects the laryngeal adductory and abductory muscles during phonation
- Two Types:
  - Adductor SD
    - Irregular closure of the vocal folds
  - Abductor SD
  - Mixed SD

Voice symptoms: The voice quality:

- Abductory
  - Weak and breathy
- Adductory
  - Strained
- Abductory and adductory spasms
  - Perceived as stoppages in voice
    - Sustained vowel production
    - Delayed onset
- ADSD is often confused with muscle tension dysphonia (MTD)

Management:

- ADSD: Botox Injection into the TA muscle
- Behavioral therapies may play a role in the management of ADSD

Practice Question

- In this type of voice disorder, botox is injected either unilaterally or bilaterally.

a) Spasmodic dysphonia

b) Vocal fold paralysis

c) Psychogenic voice disorders

d) Polyps

Essential Voice Tremors

Description: Hyperkinetic movement disorder

Voice symptoms:
- Easy to identify perceptually during vowel prolongation
- Audible and rhythmic cycles of the tremor occurring every 4 to 6 Hz
- Also characterized by
- Pitch and voice breaks
- Difficulty differentiating essential voice tremor from adductor spasmodic dysphonia
- Laryngeal EMG can help differentiate between the two

Management:
- Pharmacologic management:
- Beta-blockers and propranolol and metoprolol
- Other drug treatments include:
- Use of anticonvulsants, benzodiazepines,
- calcium channel blockers, and Botox
- Deep brain stimulation

Myasthenia Gravis

Description: Due to reductions in the peripheral nervous system; Results in a severe decline in muscle's ability to contract; Muscle weakness

Voice symptoms:
Inspiratory stridor, reduced vocal loudness, monotone voice, hypernasality, hoarseness, and tremor

Management:
Pharmacologic treatments

- Anticholinesterase agents
- Immunosuppressive

A surgical option - Thymectomy

Hypophonia Associated With Parkinson's Disease

Description: Neurodegenerative disease of the extrapyramidal system

Voice symptoms:
- Decreased vocal pitch and loudness range
- Breathiness
- Roughness
- Hoarseness
- Vocal tremor

Management:
- Difficult to treat
- Heterogeneous symptoms
- Vary with time of day, medication state, mood, age, sex, disease severity, patient motivation
- Insufficient evidence to support speech therapy as a sole treatment in any indication of PD
- Expiratory muscle strength training (EMST)

Multiple Sclerosis

Description:
Autoimmune and inflammatory disease of neurogenic origin; Demyelination and axonal damage
- Progressive disability

Voice symptoms:
- Abnormally long pauses between words or syllables
- Words are slurred
- Hypernasal sound quality
- Difficulty raising the vocal loudness
- Weak phonation
- Disturbances of the respiratory cycle

Management:
- No management therapies modify the course of MS
- Symptomatic treatments
- Pharmacologic therapies
  - Immune modulating drugs
    - Interferon beta 1a and 1b, chemotherapeutic
  - Corticosteroids such as prednisone and pain medications
  - Antidepressants
- Diet and lifestyle
  - Modifications
  - Exercise therapies

ASSESSMENT

Assessment

- Case History
- Self-Assessment: VHI
- Oral-Peripheral Examination
- Assessment of Respiration:

- Auditory-Perceptual Assessment:
  - GRBAS: This includes 5 components: G(rade) --overall grade of hoarseness, R(oughness), B(reathiness), A(esthenia) --weakness, and S(train)
  - CAPE-V: The Consensus Auditory Perceptual Evaluation of Voice (CAPE-V)
- Instrumental Assessment:
  - Laryngeal Imaging: Videolaryngostroscopy
  - Acoustic Assessment: Loudness, pitch, jitter and shimmer

TREATMENT

Treatment Options

- **Vocal Hygiene**: eliminate any behaviors that cause trauma to the structural health and function of the vocal folds

Treatment Options

Physiologic Voice Therapy: Direct exercises are used to activate the laryngeal muscle and work other subsystems, such as respiratory and supraglottal systems

- Accent Method
- Conversation Training Therapy (CTT)
- Cup Bubble/Lax Vox
- Expiratory Muscle Strength Training (EMST)
- Lee Silverman Voice Treatment (LSVT®)
- Manual Circumlaryngeal Techniques
- Phonation Resistance Training Exercise (PhoRTE)
- Resonant Voice Therapy
- Stretch and Flow Phonation
- Vocal Function Exercises (VFEs)

Practice Question

- A patient presents to the local voice clinic with complaints of difficulty producing voice, which is made worse during prolonged periods of vocal use. After receiving an initial evaluation by both the otolaryngologist and the SLP, the patient is diagnosed with muscle tension dysphonia, specifically with excess tension in the vocal fold adductor muscles. Which of the following treatment approaches is appropriate to utilize with this patient in an effort to alleviate these vocal problems?

a) Lee Silverman Voice Treatment (LSVT)

b) Head Turn maneuvers

c) Straw phonation

d) Circumlaryngeal massage

Practice Question

- A speech-language pathologist at the local speech and language clinic has been assigned a patient presenting as completely aphonic. After comprehensive evaluation, the SLP finds nothing structurally or physiologically wrong with the patient's laryngeal mechanism; however, the patient continues to present with difficulties during speech-related activities. Which of the following is an appropriate approach for the SLP to take in treating the patient?

a) Refer the patient to a gastroenterologist, in order to establish a potential diagnosis of laryngopharyngeal reflux.

b) Refer the patient to a pulmonologist, to determine the state of the patient's respiratory mechanism

c) Refer the patient to a psychiatrist, in order to establish a potential diagnosis of the psychogenic

d) Send the patient home with referral for two weeks of complete voice rest, at which point all problems should resolve.

Treatment Options

Symptomatic Voice Therapy: Direct exercises are used to activate the laryngeal muscle and work other subsystems, such as respiratory and supraglottal systems

- Amplification
- Auditory Masking
- Biofeedback
- Chant Speech
- Confidential Voice
- Glottal Fry
- Inhalation Phonation
- Semi-Occluded Vocal Tract (SOVT) Exercises

Treatment Options

- **Eclectic Therapy**: Uses multiple behavioral therapy orientations to address patients' care

Resonance

- Fundamental frequency: The strongest and slowest vibration of the vocal folds is known as the fundamental frequency, which is the lowest frequency of a periodic waveform.
- The faster vibrations that occur simultaneously are called overtones or harmonics. These component frequencies are whole number multiples of the fundamental frequency.

- As the sound travels upward from the vocal folds, it is modified by the natural resonance of the cavities of the vocal tract.
- Resonance refers to the tendency of a system to vibrate (oscillate) with a large amplitude at certain frequencies than at others.
- As the complex phonated sound goes through a cavity, it is filtered by the cavity's natural resonance, resulting in selective enhancement of certain formant frequencies as opposed to others.

The Source-Filter Model

- The interaction between phonation and resonance, where the vocal folds are the source and the vocal tract the filter.
- The frequencies that are enhanced through resonance depend on the size and shape of the resonating cavity.
  - When a complex sound passes through a relatively short or small cavity, the higher frequencies in that sound will be enhanced. If that same complex sound passes through a longer or larger cavity, the lower frequencies in that sound will be enhanced.

  Resonance is a component of all voiced phonemes, but particularly important for vowels because they are produced by manipulating the resonance

Resonance Disorders

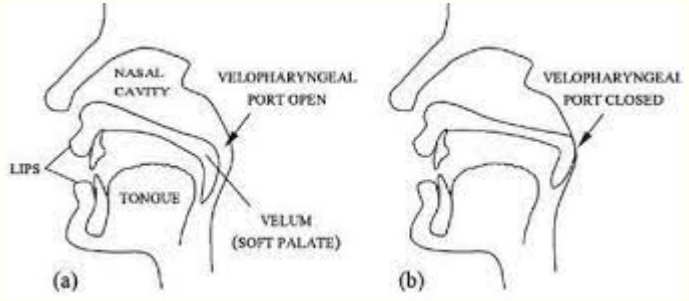
Characterized by abnormal transmission of sound energy through the oral, nasal, and/or pharyngeal cavities of the vocal tract during speech production.

They include

- Hypernasality
- Hyponasality
- Cul-de-sac resonance
- Mixed resonance

Causes of resonance disorder

- Dysfunction of the velopharyngeal valve
- An opening or fistula in the palate
- Obstruction in one or more of the vocal cavities
- Misarticulation



Hypernasality

- This is a resonance disorder that occurs when there is abnormal nasal resonance during the production of oral sounds.
- This is caused by abnormal coupling (sharing of acoustic energy) of the oral and nasal cavities during speech.
- Often described as “nasal” muffled, or characterized by mumbling.
- Associated with very low volume from the reduction of oral acoustic energy in combination with damping (absorption of sound energy) as the sound goes through the pharynx and turbinates.
- Because hypernasality is caused by abnormal resonance of sound (as opposed to airflow), it is always associated with voiced, rather than voiceless, speech sounds. Particularly perceptible on vowels.

Hypernasality

- The most common cause of hypernasality is a relatively large velopharyngeal opening secondary to velopharyngeal insufficiency
- Large oronasal fistula or very thin velum caused by submucous cleft

Hyponasality and Denasality

- Hyponasality occurs when there is a reduction in normal nasal resonance during speech caused by obstruction in the nasopharynx or nasal cavity.
- Denasality typically refers to abnormal resonance caused by total upper airway obstruction.
- Hyponasality affects production of nasal consonants
- It is almost always caused by obstruction somewhere in the nasopharynx or nasal cavity.
  - Allergic rhinitis
  - Common cold
  - Adenoid hypertrophy
  - Congenital structural abnormalities

Cul-de-sac

- Occurs when the acoustic energy enters a cavity of the vocal tract but is blocked from exiting at the cavity's normal outlet.
- The sound is therefore trapped in this blind pouch, and some of the sound is absorbed by the soft tissues.
- As a result, the speech is perceived as muffled and low in volume.
- Like hyponasality, it is caused by obstruction but in this case the place of the obstruction is at the cavity's exit point rather than at the entrance or within the nasal cavity.
- Cul-de-sac is always caused by a structural abnormality that blocks one of the resonating cavities. This type of disorder cannot be corrected with speech therapy. Correction requires medical or surgical intervention.
  - Oral cul-de-sac resonance: occurs when sound is partially blocked from exiting the oral cavity during speech.
  - This can occur as a result of microstomia (a small mouth opening)
  - Pharyngeal cul-de-sac: occurs when the sound is blocked from exiting the oropharynx during speech. This is typically caused by large tonsils that block the oropharyngeal opening.

Mixed Resonance

A combination of hypernasality, hyponasality, and cul-de-sac resonance. Although hypernasality and hyponasality cannot occur simultaneously, they can occur at different times in the connected speech of the same speaker. There can be hypernasality on oral sounds and hyponasality on nasal sounds.

Common in individuals with apraxia.

Can be caused by a combination of velopharyngeal incompetence and blockage in the pharynx.

Assessment of Hypernasality

- Using voiced (resonating) sounds, assess for the following:
  - **Hypernasality**—excessive nasal resonance on vowels and voiced oral consonants.
  - **Hyponasality**—too little or absent resonance on nasal consonants and adjacent vowels, especially /i/ and /u/.
  - **Mixed resonance**—elements of inconsistent hypernasality, hyponasality, and/or cul-de-sac resonance in connected speech.
  - **Cul-de-sac resonance**—sound is muffled and consonants are indistinct due to a blockage at the exit of the nasal, oral, or pharyngeal cavity.
- Use low-tech procedures during speech to confirm or verify what was heard:
  - Feel sides of nose for vibration that might accompany perceived hypernasality.
  - Alternately pinch and then release the nose (sometimes referred to as the *cul-de-sac test* or *nasal occlusion*) while individual produces a speech segment—a change in resonance indicates hypernasality.

Effect of Surgery on Resonance

- Adenoidectomy can improve hyponasality if there was obstruction.
- Tonsillectomy can eliminate cul-de-sac resonance by removing the blockage at the entrance of the oral cavity.
- Surgery to correct hypernasality (pharyngeal flap or sphincter pharyngoplasty) can be unsuccessful, resulting in residual hypernasality, or it can cause hyponasality from overcorrection.

Treatment of Resonance Disorders

- Resonance disorders are almost always caused by structural anomalies and, therefore, resonance disorders almost always require medical or surgical intervention.
- Hypernasality is usually caused by a structural or neurophysiological disorder that interferes with the function of the velopharyngeal valve. This can be corrected or improved only with surgery or a prosthetic device (if surgery is not an option).
- Hyponasality and cul-de-sac resonance are usually caused by a blockage in one or more of the cavities of the vocal tract.
  - Treated with medical or surgical intervention

Treatment of Resonance Disorders

- The only time speech therapy is indicated for resonance disorder is when the abnormal resonance is phoneme specific because of faulty articulation placement.
  - The use of a nasal sound consistently for an oral sound or an abnormally high tongue position during production of vowels.
  - This can even be noted after surgical intervention because of the preoperative development of compensatory productions.
  - Correction of the structure should be done first, and then speech therapy can be effective in correction of abnormal function that developed as a compensatory strategy.

References

Boone, D.R., McFarlane, S.C., Von Berg, S.L., & Zraick, R.I. (2020). *The voice and voice therapy* (10th ed.). Boston, MA: Pearson.

Kummer, A.W. (2021). Cleft Palate and Craniofacial Conditions. A Comprehensive Guide to Clinical Management (4th ed.). Burlington, MA: Jones & Bartlett Learning Publications.

Sapienza, C., & Ruddy, B.H. (2012). *Visual examination of voice disorders* (2nd ed.). San Diego, CA: Plural Publishing.

Stemple, J.C., Roy, N., & Klaben, B.K. (2014). *Clinical voice pathology: Theory & management* (5th ed.). San Diego, CA: Plural Publishing.

Questions

Please email me all your questions:
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References

Boone, D.R., McFarlane, S.C., Von Berg, S.L., & Zraick, R.I. (2020). *The voice and voice therapy* (10th ed.). Boston, MA: Pearson.

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