



Larynx I

Objectives:

- **Anatomy of the larynx.**
- **Physiology of the larynx**

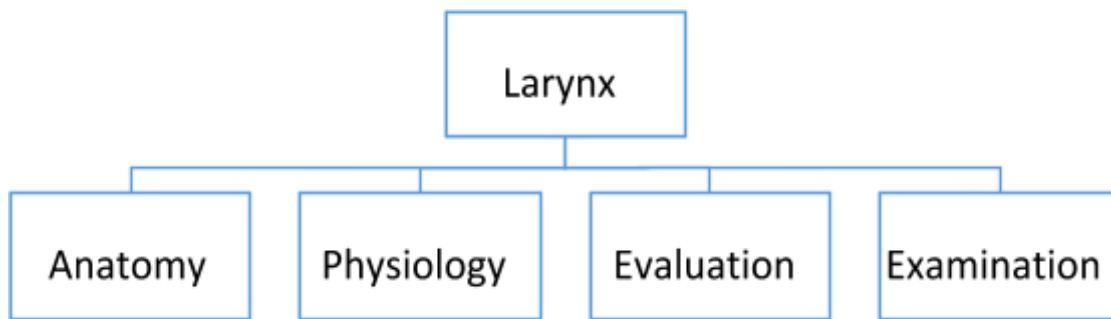
Resources: Slides+435team+Notes+Lecture notes of ENT

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Mind Map



Sample Case:

Doctor Didn't mention it, but it's useful.

❖ **Case: 35 years old female has dysphonia (hoarseness)?**

- **You should ask about:**
- **Duration, Onset (sudden, gradual), progression.**
- **Associated symptoms:**
 - **Difficulty in breathing** (In larynx we have two vocal cords which get abducted when talking –phonation-- by the help of four muscles and abducted when breathing by the help of one muscle). If pt vocal cord isn't opening while breathing she'll have stridor.
 - **Difficulty in swallowing:** posterior to the larynx is the esophagus if there's any problem there it might cause dysphagia.
 - **Neck swellings:** if pt has dysphonia and we examined the neck (neck mass: goiter) remember the course of the recurrent laryngeal nerve which passes through the neck suspecting a mass compressing the nerve.
 - **Aspiration and choking:** when talking or eating what normally happens cessation of breathing, vocal cords are attached adducted and epiglottis come anteriorly to close the airway (If pt has vocal cord paralysis, no sensation and choking might happen).
 - **Trauma:** ask about surgeries required intubation (the ETT is passing through the vocal cords posteriorly if the anesthetist was very aggressive he can dislocate arytenoid distorting the pt voice (it's not nerve problem but mechanical), blunt trauma, iatrogenic (most common cause for dysphonia here is thyroid surgery)
 - **Social life:** coffee and tea (foreign body sensation: throat clearance, feeling of something is stick to the throat)

- ❖ There are **two** types of reflux:
 - **GERD** (heartburn).
 - **LPR laryngopharyngeal reflux:**
 - Sometimes acidity go up to the larynx, in larynx it doesn't accept the acidity there so you start clearing your throat to wash it away. When examining the cords here they will be **edematous, red and congested**. Here you should ask about the **habits** which increase the reflux: coffee, tea, lying flat when sleeping, eat before going to bed.
 - Fever, weight loss, change in appetite (**Constitutional Sx**) to exclude cancer also URTI in winter causing laryngitis and that will cause some changes to the vocal cords (red, congested) leave it for few days it will resolve by it's on but in voice abusers like teachers, lawyers etc, you must give them ten days rest or else their vocal cords will be damaged.
 - **Examination:** If the patient has no history of any surgeries, trauma or anything just dysphonia and one of the vocal cord is immobile by examination (nose, throat and vocal cords) you must do CT scan chest and neck and follow the course of the recurrent laryngeal nerve passing from the chest up to the neck to exclude any masses compressing it causing his problem. if nothing was detected you label him as idiopathic.

Definitions:

- ❖ **Dysphonia:** a **descriptive** medical term meaning disorder of voice.
- ❖ **Hoarseness:** a **subjective** term, and usually refers to a weak or altered voice.
- ❖ **Voice changes:** **breathy** (vocal cords aren't closing well so the air is escaping this could be due to vocal cord paralysis) **harsh** (a mass compressing on vocal cord), tremulous, weak, reduced to a whisper, or vocal fatigue like in teachers where voice deteriorates with use.
- ❖ **Team 430:**
 - Normally person talks at end of respiration.
 - You breath then talk and never breath while talking without stopping, therefore while talking you are building up pressure causing the vocal cords to move and close during phonation.
 - in breathy voice 1 of the vocal cords is not moving, so instead of saying 10 words in 1 sentence someone with a breathy voice will say around 3 words and stop for a breath.

Anatomy :

- The larynx or voice-box is part of the upper respiratory tract.
- It is lined with **ciliated columnar epithelium** **except** over the vocal folds or 'cords' which are covered with **squamous epithelium**. so when you take a sample from the larynx and you see that it's lined with **squamous epithelium** then you have to rule out cancer (metaplasia), and **vica versa**.
- It is made of a series of cartilages, the main ones being the **epiglottis**, the **cricoid cartilage** (a complete ring just above the trachea) and the **thyroid cartilage**, which you can palpate as the 'Adam's Apple' externally in the neck. **between the thyroid cartilage and the cricoid cartilage is the cricothyroid membrane**.
- Various membranes, muscles and ligaments complete the structure of the larynx

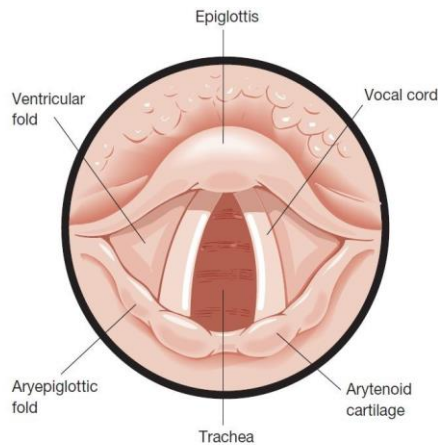


Figure 25.2 The structures seen on indirect laryngoscopy.

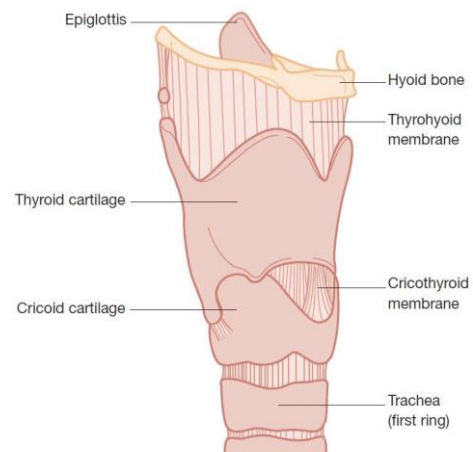
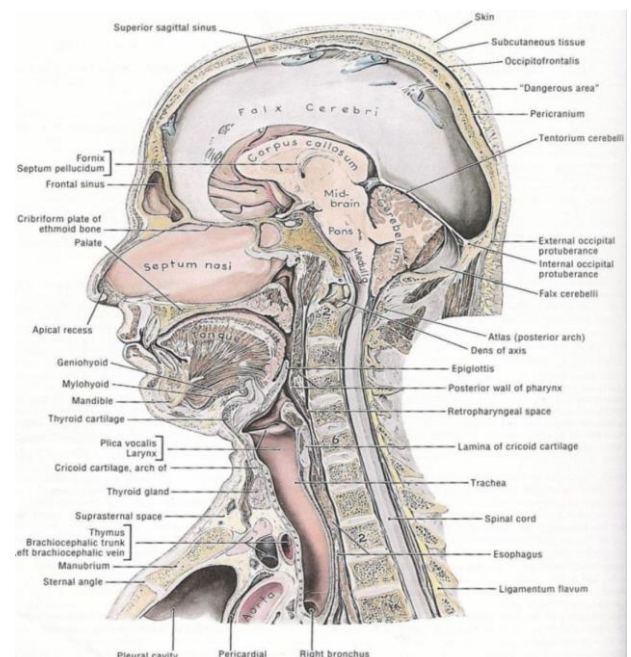


Figure 25.1 The main cartilages and membranes of the larynx.

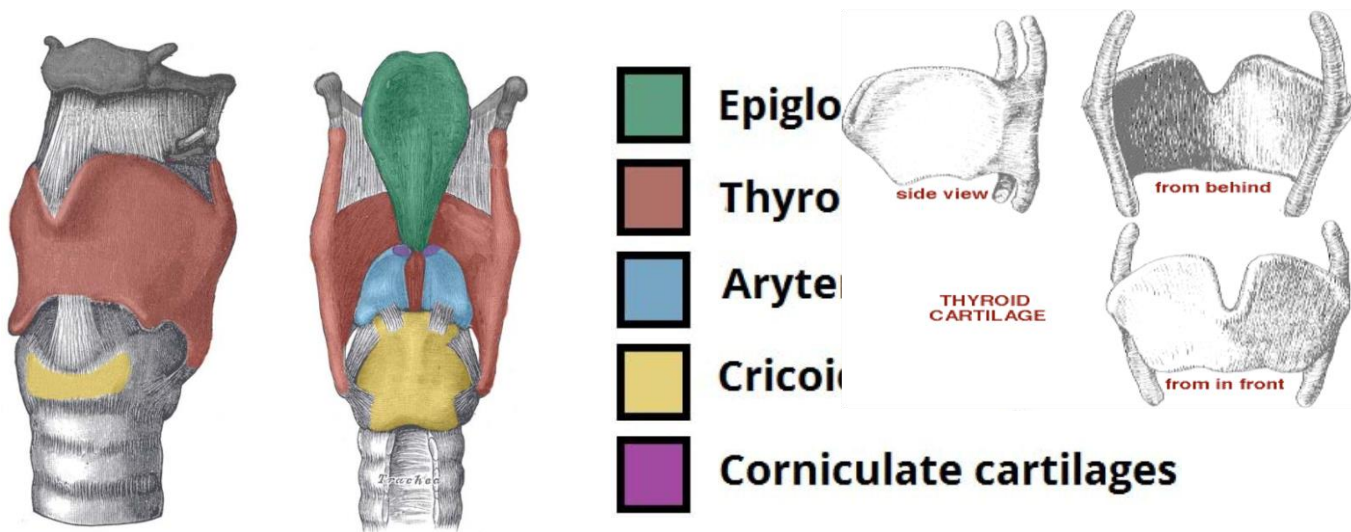
- The Larynx extends from the epiglottis to the cricoid cartilage.
- The epiglottis is on top behind the Arytenoid cartilages and the hyoid bone.

❖ Skeletomembranous Framework of the Larynx:

- **Thyroid cartilage.**
- **Cricoid cartilage.**
- paired **arytenoids** cartilage.
- **Corniculate** and **Cuneiform** Cartilage.
- **Epiglottis.**
- **Hyoid bone.** it's important for larynx stability.



- ❖ When you feel your neck there are two cartilages first is the thyroid (shield like) open posteriorly and below it the cricoid (complete ring) both are hyaline cartilages so it will be calcified with time in elderly people (if x-ray was done on a 45 years old patient and found opacity it is normal) and the joint between them is synovial joint allowing some movement between the cricoid and the thyroid cartilages



❖ Thyroid Cartilage: OSCE

- Shield like
- Thyroid cartilage is opened posteriorly.
- In men it is noted as Adam's apple. *it's more prominent in men*
- It is attached to the cricoid.

➤ Cricoid Cartilage:

- Signet ring shaped.
- the only **complete skeletal ring** for the air way. *it facilitates the opening and shunting of the airway*
- Both thyroid and cricoid cartilage are hyaline (calcification).
- Cricothyroid joint is a Synovial joint (hinge motion)¹.
- Cricoid Cartilage is the narrowest area where the airway obstruction usually happens because it is a complete ring.
- Thyroid and cricoid might be seen as bones (calcified) in an X--Ray of a 40--

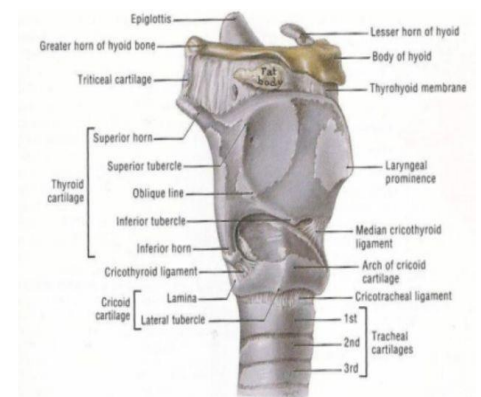
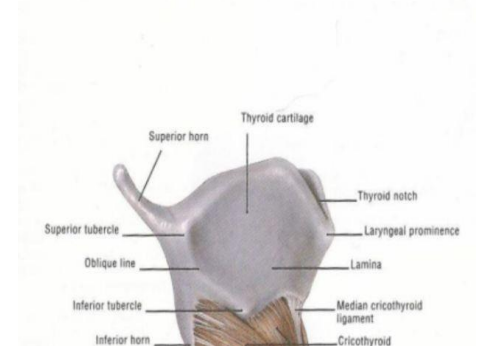


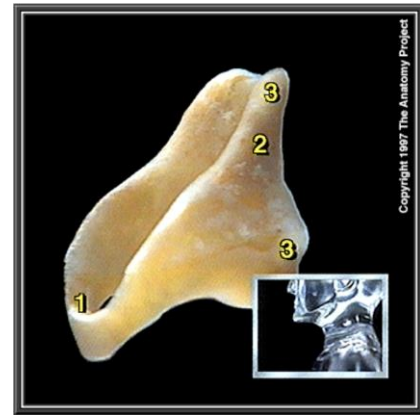
Figure 8-53. Lateral view of the skeleton of the larynx. The larynx extends vertically from the tip of the epiglottis to the inferior border of the cricoid cartilage. The hyoid bone is not part of the larynx.



¹ movement along one axis (forwards and backwards).

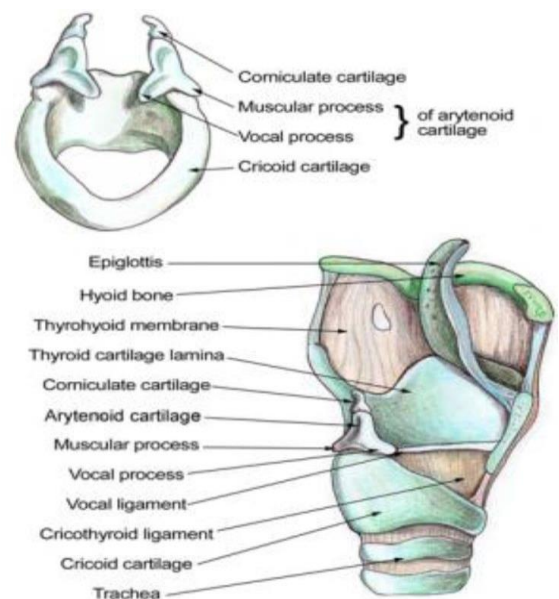
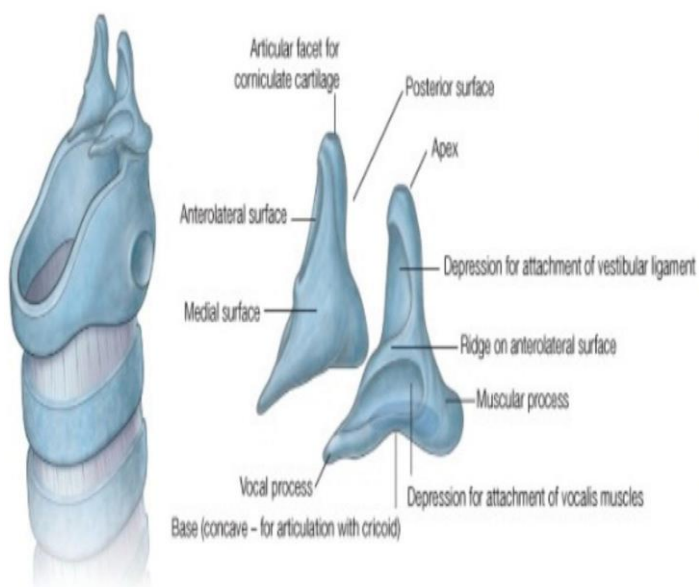
➤ Arytenoid Cartilage:

- Pyramidal shaped
- it has an anterior (vocal) process and posterior (muscular) process.
- Apex, vocal processes attached to the vocal cords & muscular processes attached to the muscles that moves the vocal cords.
- Cricothyroid joint: Synovial (Rocking motion).
- the only muscle that causes abduction to the vocal cords is posterior Cricothyroid muscle.



➤ Corniculate and Cuneiform Cartilage:²

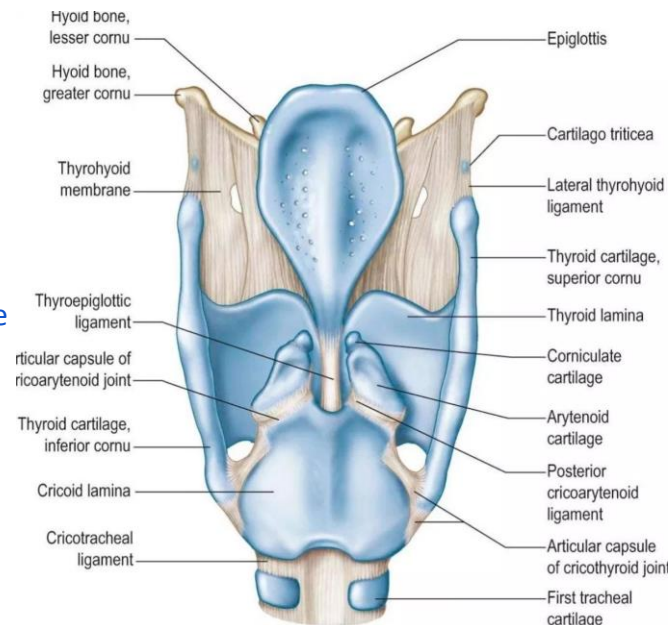
- above the arytenoid cartilage is another small cartilage called corniculate cartilage. it helps to prolong arytenoid cartilage posteriorly and medially



² no significance in humans

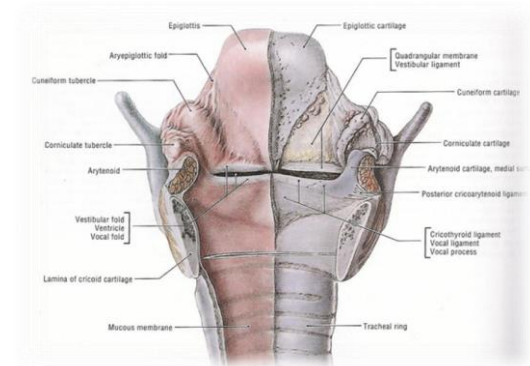
❖ Epiglottic Cartilage:

- Leaf like structure.
- Elastic cartilage.
- Its ligaments and fold:
 - Thyroepiglottic ligament (to thyroid). **anteriorly. it provides the stability to the epiglottis**
 - Hyoepiglottic ligament (to hyoid bone).
 - Glossoepiglottic fold → valleculae (Valleculae is the base of the tongue where the tongue is attached to the epiglottis). **the one we see it during intubation.**
- The epiglottis on top is attached to the thyroid cartilage midline, inner margin of thyroid, it's an elastic cartilage while swallowing it covers the airway and directs the food to cricopharynx.
- Thyroid, cricoid and epiglottis are all single cartilages unlike the others are paired.
- The pic in Posterior view.
 - when we swallow the larynx will ascend and that will help the epiglottis to close the airway.



❖ Laryngeal Membranes:

- **The cartilages are covered by membranes that form folds and ligaments.**
- Quadrangular membrane:
 - Upper and lower border → thickened
 - Aryepiglottic fold (it goes up covering the epiglottis)
 - Vestibular fold (or ventricular fold inferiorly also called **false vocal cord**) **ventricle is the area between the true and the false vocal cords**
- Triangular membrane (conus elasticus):
 - Medial and lateral border is free → thickened → vocal ligament
 - Covers the trachea going up and ends at the level of vocal ligaments or fold.
- Between the upper membrane (quadrangular m) and the lower membrane (triangular m) there is a very weak area (in the larynx) which is not covered by any membrane we call it the ventricle or vestibule or saccule.
 - the functional anatomy of the membranes is important(pic)**



❖ Laryngeal Mucosa:³

- All mucosa from trachea to aryepiglottic fold.
- ciliated columnar epithelium with goblet cells
- Common tumor is Adenocarcinoma
- Except vocal cord and aryepiglottic fold.
- squamous epithelium.
- Commonest tumor in larynx is Squamous Cell Epithelium
- Most common tumor of vocal cords is squamous cell carcinoma

❖ Cavity of Larynx:

- The area between the Vocal Cords is Glottis.
- The area above the Vocal Cords is Supraglottis or Epiglottis.
- The area below the vocal Cords is Subglottis.

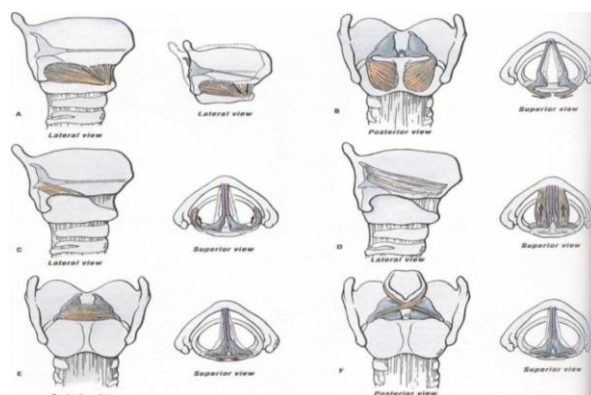
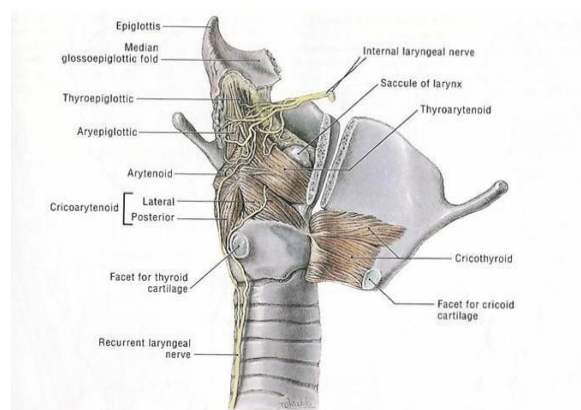
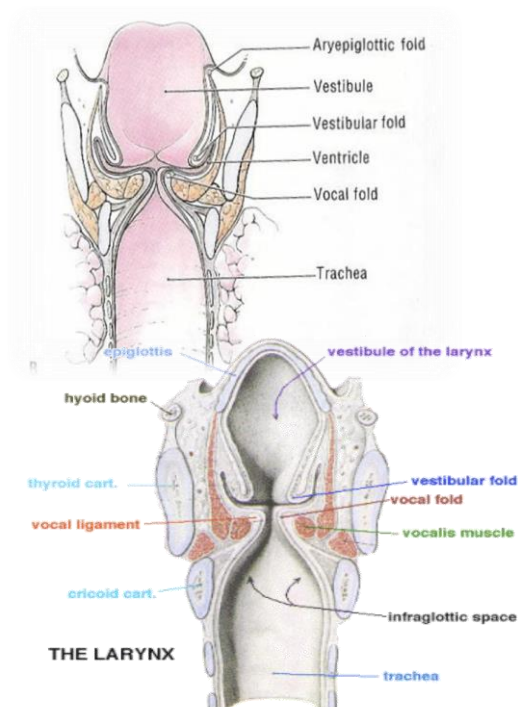
❖ Laryngeal Musculature:

➤ Extrinsic:

- Extrinsic **depressors**: (C1--C3)
 - Sternohyoid, sternothyroid, thyrohyoid, omhyoid.
- Extrinsic **elevators**: above the hyoid bone
 - Genohyoid (C1), diaphragm (CNV--CNVII) mylohyoid (v) stylohyoid (VII) **Used in swallowing. Contraction->Larynx up->swallowing.**
- All elevators attachments are above
- Depressors attachments are below to suit their function (Dr: the extrinsic muscles are not so important focus on the intrinsic ones)

➤ Intrinsic:

- **Abductors**: (breathing: open the airway)
 - posterior cricoarytenoid (PCA). when the two muscles move laterally the vocal cords open.
- **Adductors**: (talking: phonation)
 - thyroarytenoid (TA⁴), lateral cricoarytenoid (LCA), cricothyroid⁵, interarytenoid₂



³ so we must know from where we are taking the biopsy (different cancer)

⁴ most important in the bulk of vocal cords.

⁵ for stretching of the voice

A: Cricothyroid

B: Posterior Cricoarytenoid. C: Lateral Cricoarytenoid.

D: Thyroarytenoid.

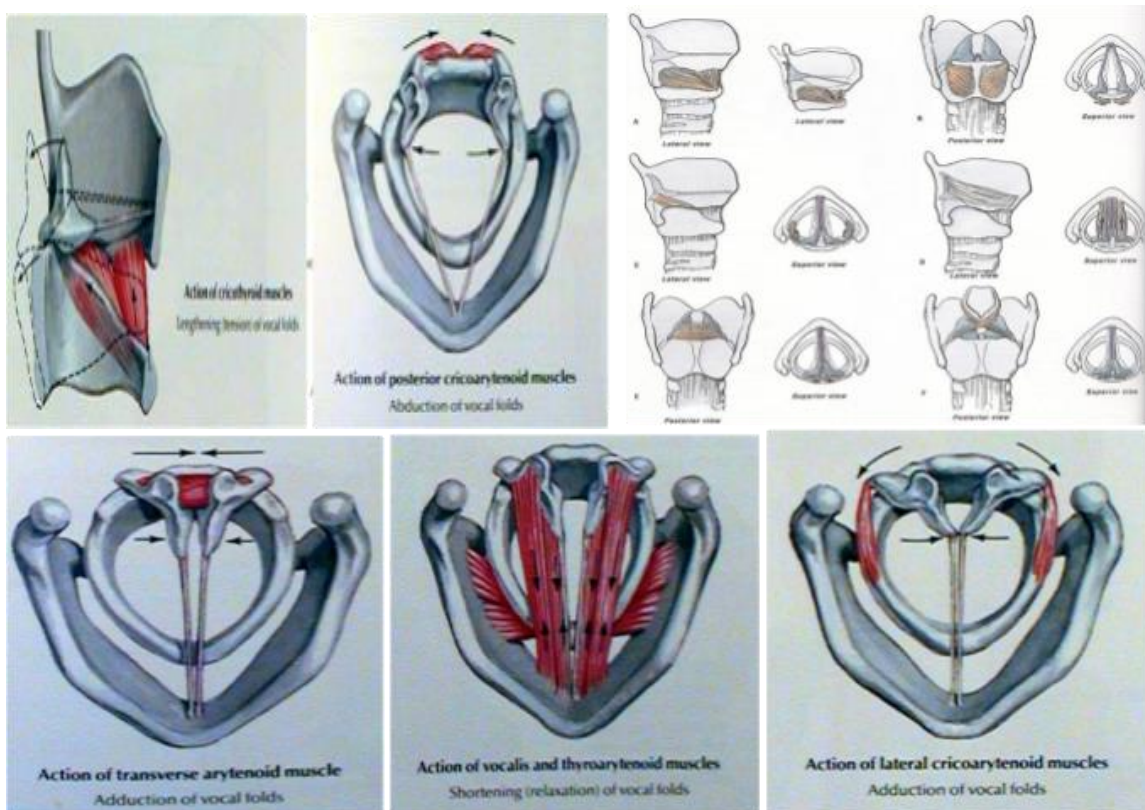
E?

F: Oblique Arytenoid.

*i'm not 100% sure of the muscles of (A, D) above.

❖ **Vocal cords have 2 movements:**

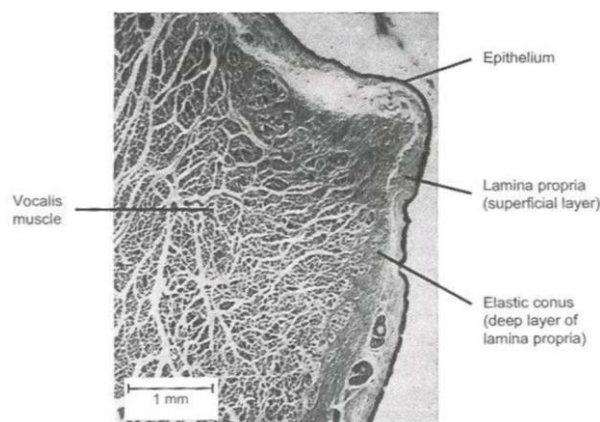
- Adductors (4 muscles) are used for speaking, Abductor (1 muscle) used for breathing and located Posteriorly. **(Important for MCQs)**
- Cricoidthyroid is an adductor muscle. But mainly it is responsible for the **Vocal Cord tension** of the vocal cords and supplied by the **Superior Laryngeal Nerve (SLN)**. **(Important for MCQs)**



Histology, Blood Supply, and Nerve supply

❖ Vocal cord layers:

- Squamous epithelium. **No lymphoid tissue**
- Lamina propria:
 - it helps to provide elasticity and protection to the vocal cords.
 - superficial layer Reinke's space. **Reinke's edema** is the collection of fluid within the Reinke's space that causes heavy voice in smoker.
 - Intermediate layer.
 - Deep layer
 - Intermediate + deep layers = vocal ligament (the two layers are attached to each other)
- **Vocalis (thyroarytenoid muscle)**



❖ Blood Supply:

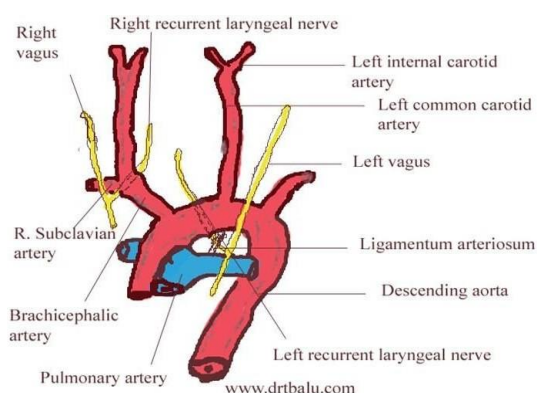
- Superior and inferior laryngeal artery and veins.

❖ Lymphatic Drainage:

-doctor: this is not your level.

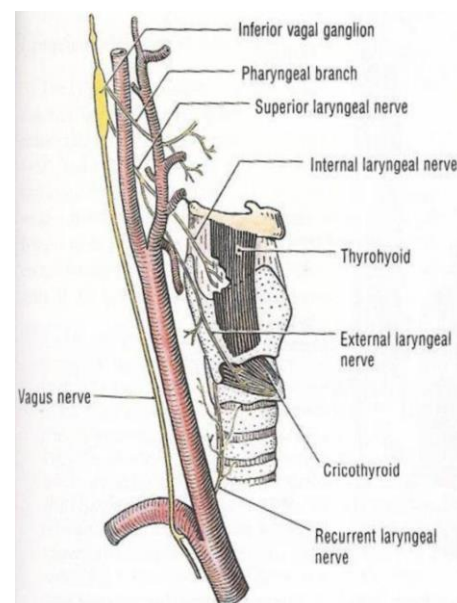
- Above vocal cord ▶ upper deep cervical lymph node.
- Below vocal cord ▶ lower deep cervical lymph node.

Vocal Cords have no lymphatic drainage, so when the patient has vocal cord carcinoma, he won't have metastasis unless it goes supraglottic or subglottic he can start to have metastasis from there.



❖ Nerve supply: important

- Vagus gives 2 branches: **from the right side**
- Superior laryngeal nerve (SLN)
 - Internal branch (sensory) + superior laryngeal artery.
 - External branch (motor) ▶ cricothyroid muscle only. **the one that gets contracted while shouting.**
- **Recurrent laryngeal nerve (RLN) very important**
 - RT side: crosses the subclavian artery
 - LT side: arises on the arch of the aorta deep to ligamentum arteriosum (left is longer)
 - It is divided behind the cricothyroid joint.
 - Motor ▶ all the intrinsic muscles except the cricothyroid.
 - Sensory.



- **How to manage vocal cord paralysis?** Wait for 6 months it might resolve by its own. If it didn't or the patient count on his voice for living, you interfere earlier. by injecting materials absorbable within six months to close the vocal cord temporary.

SLN: sensation above the vocal cords, choking means (they are working well, good sensation).

RLN: sensation of vocal cords and below. Left course is longer than the right course. However, vocal cord paralysis might be caused by:

thyroidectomy - most common), brain tumor, vocal cord tumor, esophageal, mediastinal. Tumors compressing the nerve, **iatrogenic causes: in cardiac thoracic surgery** or idiopathic: waking up in the morning sounding weird).

Most common is to have left vocal cord paralysis due to the long course of the left recurrent laryngeal nerve.

❖ **Pediatric Airway Anatomy:**

- The neonates **are obligate nasal breathers until 2 months**. They can't breathe from their mouth first when they are born. **they have high larynx and epiglottis so the soft palate will cover the central side (mouth airway) witch will guide the milk to move to the lateral sides. that's why they can eat and breath at the same time.**
- The epiglottis at birth is **omega Ω** shaped.
- The infants have **high larynx C1-C4**.

430 Team:

Any smoker should undergo vocal cord carcinoma screening.

Lymph nodes drain into cervical lymph nodes so any patient that comes with neck mass especially painless you should consider lymphoma.

Hx: Onset and duration, URTI.

PEx: Complete head & neck examination

Physiology

- **Protection** of the lower air passages.
 - Phonation.
 - **Respiration**.
- **Protection:** of the lower airway passage
- Closure of the laryngeal inlet.
 - Closure of the glottis.
 - Cessation of respiration.
 - Cough reflex (forced expiration is made against a closed larynx).
 - Closure of the airways during swallowing the bolus.
 - **Patient with CVA or neurological problem have loss of sensation so all the time they aspirate or choke.**

➤ Phonation:

- Voice is produced by vibration of the vocal cord.
- Source of energy is the airflow (good lung → good voice).
- Normal vocal fold vibration occurs vertically from inferior to superior.
- The mouth ,pharynx ,nose ,chest (are resonating chambers).
- We talk during expiration (we take deep breath feel pressure in subglottic area this pressure help in pushing the air between the vocal cords and start vibrating them).
- If I have bronchial asthma it means that the amount of air is little, I won't be able to talk for long time because the pressure was so little.
- COPD, Smoker → low air amount → low vocal vibration → dysphonia.

➤ Respiration:

- Vocal cord in abduction position
- ❖ 430 Team:
 - We speak at the end of expiration so that air comes out of the lung, through the trachea, and into the larynx.
 - The air makes the vocal folds vibrate. So, we need normal mobile vocal cords and mucosa not thick secretions or masses or infections or allergic rhinitis closing the resonating chambers.
 - When the vocal folds vibrate, they alternately trap air and release it. Each release sends a little puff of air into the pharynx each puff of air is the beginning of a sound wave.
 - The sound wave is enhanced as it travels through the pharynx, by the time it leaves the mouth, it sounds like a voice.
 - The mouth, pharynx, nose, and chest which all should also be normal.
 - tongue is important for articulation of the voice.

Voice Mechanism

doctor didn't mention it

- Speaking involves a voice mechanism that is composed of three subsystems:

- 1) Air **pressure** system.
- 2) **Vibratory** system.
- 3) **Resonating** system.

The "spoken word" result from three components of voice production:

- **Voiced sound:**

The basic sound produced by vocal fold vibration "buzzy sound"

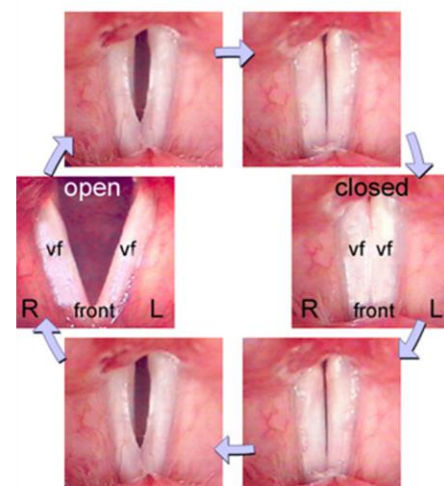
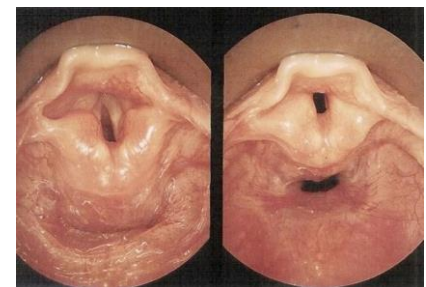
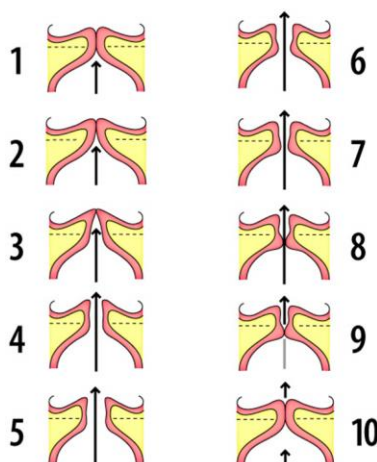
- **Resonance:**

- voiced sound is amplified and modified by the vocal tract resonators (throat, mouth cavity, and nasal passages)

- **Articulation:**

- the vocal tract articulators (the tongue, soft palate, and lip) modify the voiced sound.

- Vocal fold vibrates rapidly in sequence of vibratory cycles with a speed of:
 - 110 cycles per second (men)= lower pitch
 - 180 to 220 cycles per second (women)=medium pitch
 - 300 cycles per second (children)= higher pitch
 - Louder voice: increase in amplitude of vocal fold vibration



- Vocal cord vibration: **Bernoulli Effect**

- Air comes from the lung opens the lower lip then the middle then the upper lip. Cannot be seen by direct visualization (very fast (300 cycle)). Can be seen by stroboscope.

- **Laryngeal Sphincters:**

- True vocal cord.
- false vocal cord.
- Aryepiglottic sphincter.
- Aryepiglottic fold is between the epiglottis and arytenoid. If it is short, then the epiglottis will always be covering the airway (air obstruction)

Evaluation of dysphonic patients

- ❖ **History of Dysphonia (hoarseness):**

- Onset.
- duration.
- severity.
- URTI.
- fever.
- cough.
- voice abuse (job).
- tobacco or alcohol.
- dysphagia.
- aspiration.
- breathing difficulty (stridor).
- weight loss. **think about cancer**
- GERD.
- trauma.
- previous surgery.
- neck mass.
- Laryngopharyngeal reflux (throat clearance).
- **(Occupation and medication are important).**

❖ Examination

- Complete ENT examination
- Laryngeal examination and voice assessments:
 - Indirect laryngoscope (using mirror in old days) **they used to do it before.** Direct laryngoscope done in the OR
 - OR
 - Fibreoptic flexible** scope (MCQ: indications are examination of nose, nasopharynx). **small scope that goes inside the nose all the way to the larynx.**
- Stroboscopy for vocal cord vibration assessment. **to check if there is any scars or cysts. done for patients with voice problems.**
- Acoustic analysis
- Cranial nerves (tumors might be compressing the involved nerves) Neck examination
- You always have to examine the patient nose, throat and vocal cords

the difference between laryngoscopy and bronchoscopy is that bronchoscopy has an opening for breathing so you can ventilate at the same time.

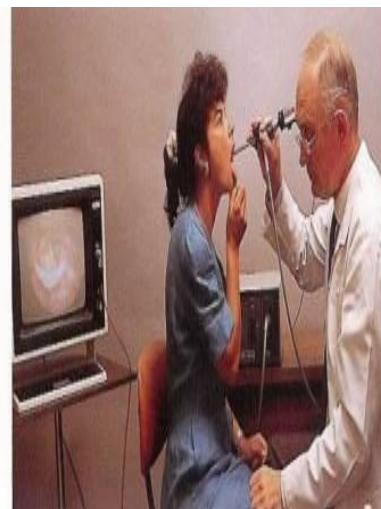
you always have to examine the patient nose, throat, and vocal cords and always mention in the OSCE you need to examine the cranial nerve



**Indirect
Laryngoscope**



**Direct
Laryngoscope**





Laryngoscopy

- we use it and we insert a camera with it to see. done in the OR

430 Team:

In Exam: Mention 2 indications of the flexible fibre optic?

Always: Children and Gag reflex (GERD)

Nasal polyp surgery >FESS

**Vocal Cord polyp nodule
>Microlaryngoscopy**

Deviated septum >Septoplasty

Rigid bronchoscopy

- Commonly used. Because you can't ventilate the patient with the flexible bronchoscopy

Long- horn is called bronchoscopy Indications: foreign body removal, biopsy, washing trachea and visualization.

In the rigid nasopharyngoscope: Nose use the angle of (0--30) degrees.

Looking down use (70--90) degrees for vocal cords

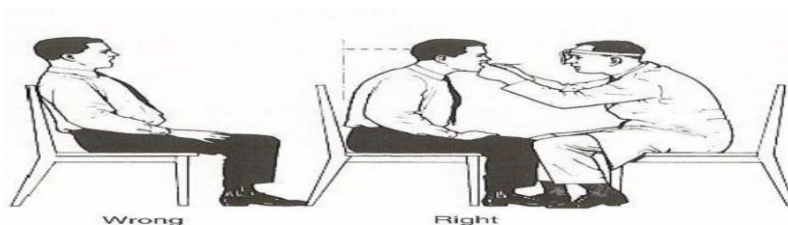


Figure 1.3
Position of the patient's head and neck for indirect laryngoscopy to create the best angle for a comprehensive view of the laryngeal structures.



