

ANATOMY OF LARYNX AND PHYSIOLOGY OF PHONATION.

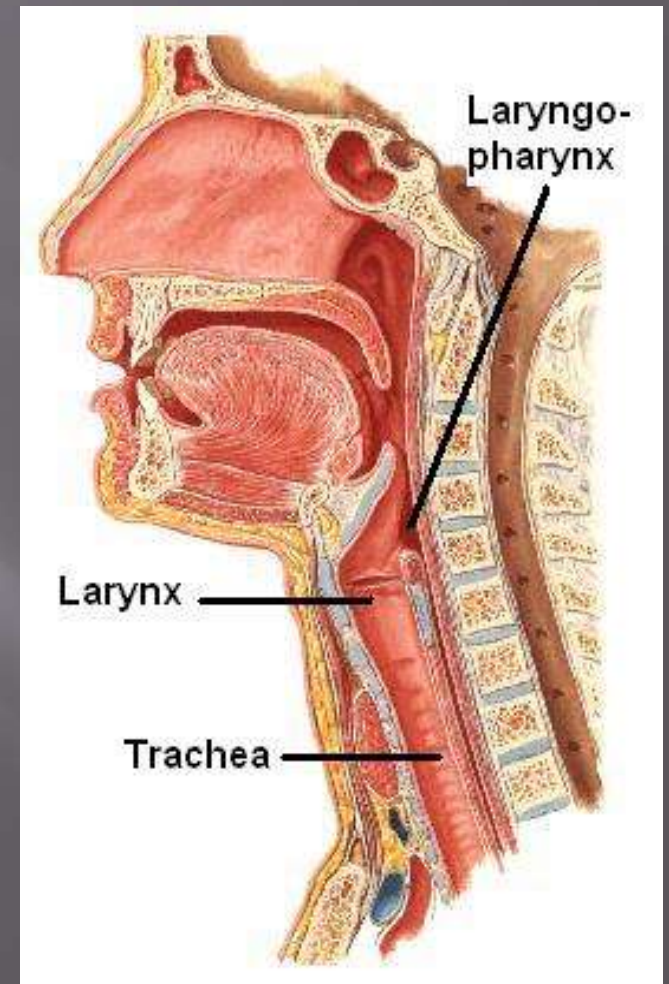
Dr.Santosh Mane
Associate Prof.
Dept of ENT

DEVELOPMENT OF LARYNX.

- ◎ Larynx develops from the tracheobronchial groove, which is a ventral midline respiratory diverticulum of the foregut.
- ◎ Arytenoid swellings appear on both sides of diverticulum & grow upwards & deepen to produce aryepiglottic folds.
- ◎ Hypobronchial eminence becomes epiglottis.
- ◎ The thyroid cartilage develops from the fourth bronchial arch.
- ◎ Cricoid cartilage & the cartilages of trachea develops from sixth arch.

THE LARYNX

- ◎ The larynx is cartilagenous framework that caps the lower respiratory tract.
- ◎ Opposite to C3 to C6.
- ◎ A 2-inch-long, tube-shaped organ, opens into the laryngeal part of the pharynx above and is continuous with the trachea below.
- ◎ Final AP diameter of larynx of about 36 mm in males & 26 mm in females.

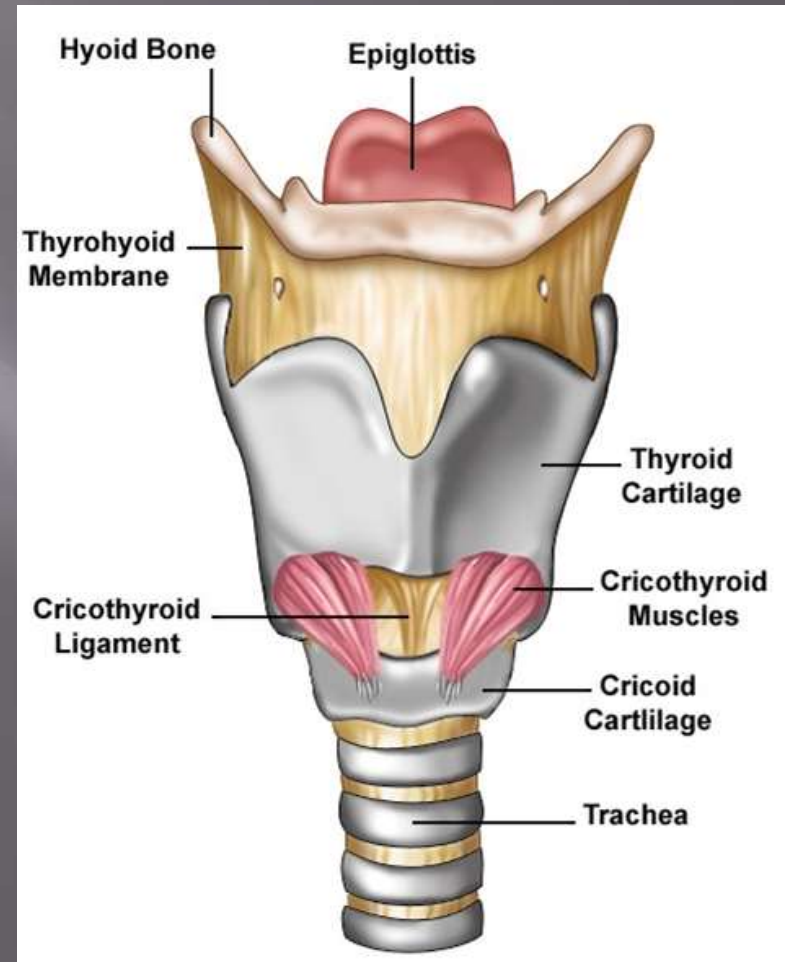


FUNCTIONS OF LARYNX

- ◎ To protect the lower respiratory tract- stop food/liquid from entering the lungs
- ◎ Respiration.
- ◎ Phonation.
- ◎ To increase intrathoracic pressure for fixation of chest by glottic closure.- essential for straining, climbing, coughing, childbirth.

STRUCTURE

- ◎ The larynx consists of four basic components:
 - A cartilaginous skeleton.
 - Membranes and ligaments.
 - Intrinsic and extrinsic muscles.
 - Mucosal lining.



THE CARTILAGES

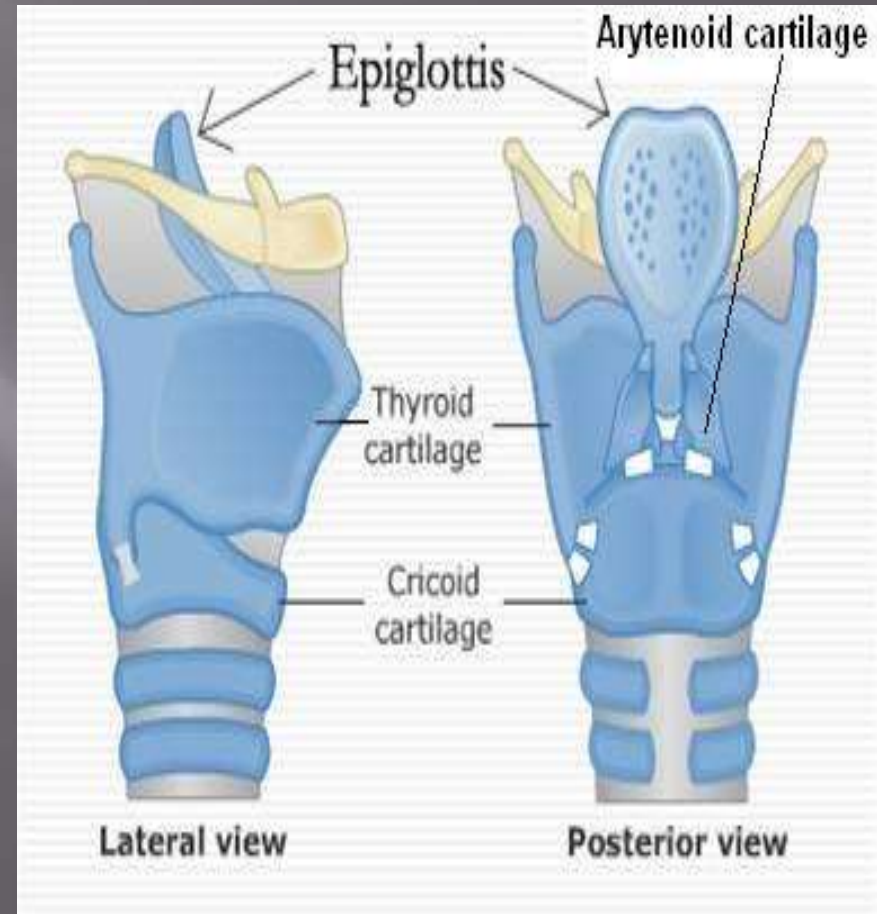
◎ The cartilaginous skeleton is comprised of :

- unpaired Cartilages:

- Thyroid
- Cricoid
- Epiglottis

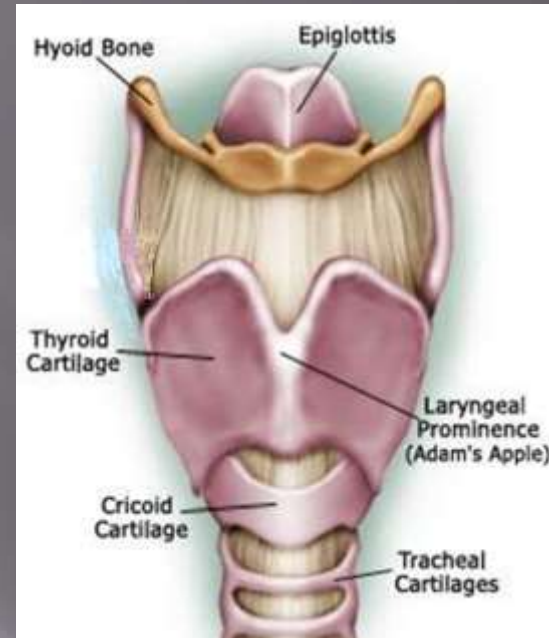
- Paired Cartilages:

- Arytenoid
- Corniculate (cartilage of santorini)
- Cuneiform (cartilage of wrisberg)

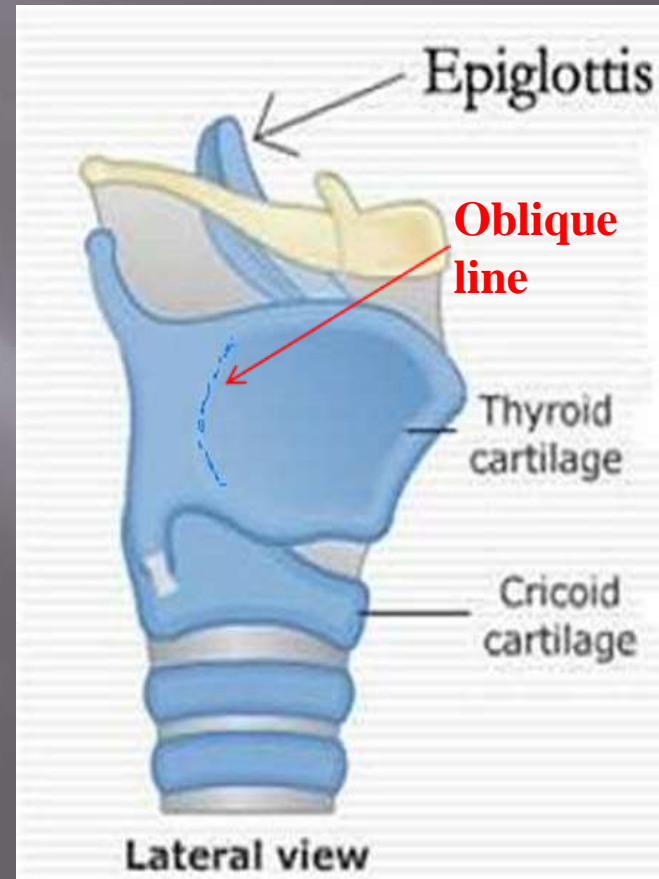


THYROID CARTILAGE

- It is the largest cartilage of all.
- Has **two laminae**, which meet in the midline and form a prominent angle, called laryngeal prominence (Adam's apple) and the superior thyroid notch at the rostral margin. Two laminae meet anteriorly forming an angle of 90 in males & 120 in females.

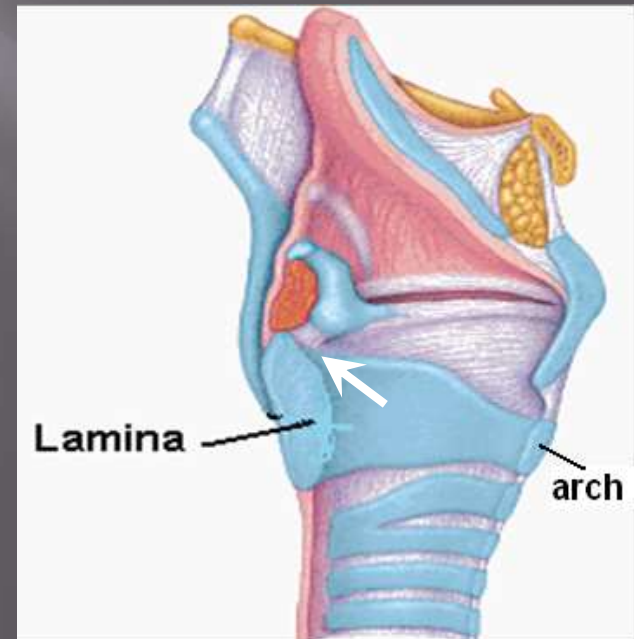
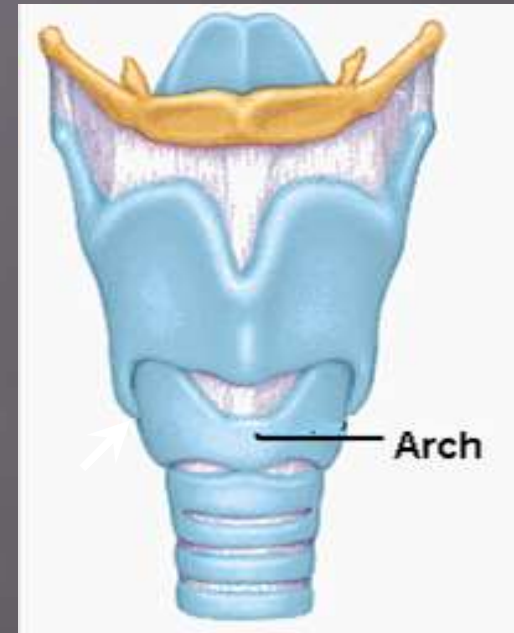


- The posterior border of each lamina forms superior & inferior cornu (horns).
- Outer surface of each lamina shows an **oblique line** which gives attachment to thyrohyoid, sternothyroid & inferior constrictor of the pharynx.
- The superior border gives attachment to the thyrohyoid membrane.



CRICOID CARTILAGE

- Lies below the thyroid cartilage.
- Forms a complete ring.
- Has a narrow anterior arch & a broad posterior lamina.
- Has an articular facet on its:
 - Lateral surface for articulation with inferior cornu of the thyroid cartilage (a synovial joint).
 - Upper border for articulation with base of arytenoid cartilage (a synovial joint).

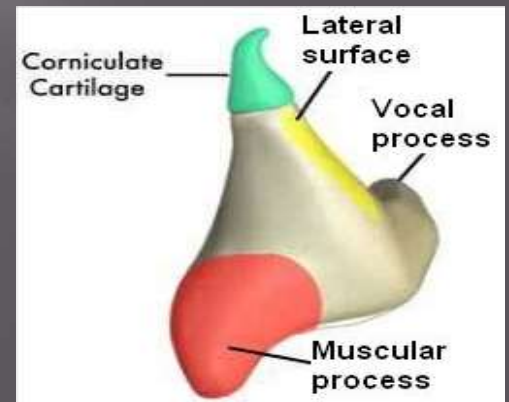


ARYTENOID CARTILAGES

- ⦿ Small, pyramidal in shape
- ⦿ Situated at the back of the larynx

Has:

- ⦿ A base articulating with the upper border of the cricoid cartilage
- ⦿ An apex supporting the corniculate cartilage
- ⦿ A vocal process projecting forward, gives attachment to the vocal ligament
- ⦿ A muscular process projecting laterally, gives attachment to intrinsic laryngeal muscles.



CORNICULATE & CUNEIFORM CARTILAGES

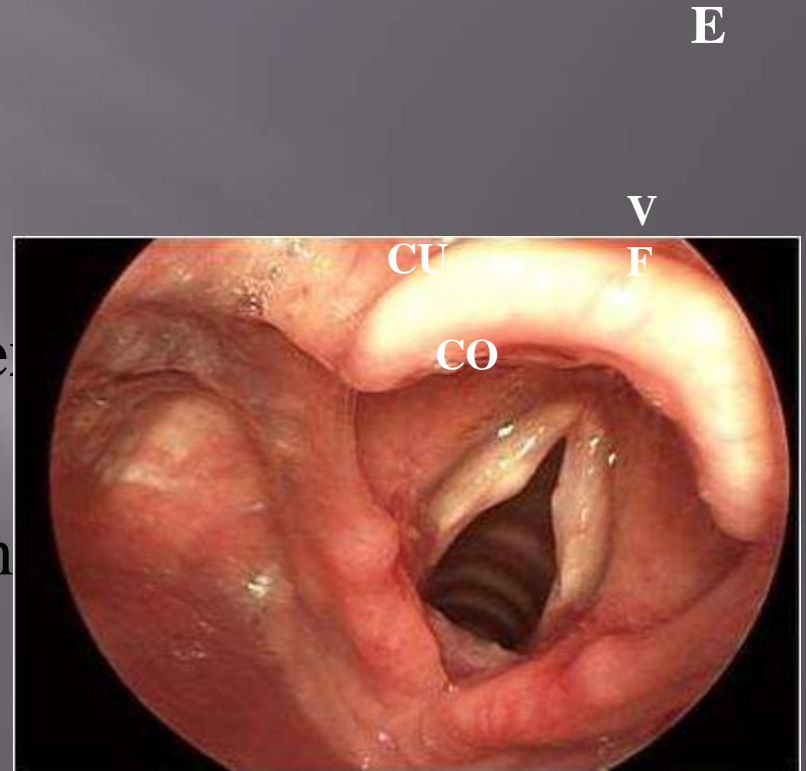
Corniculate Cartilages of Santorini

- ⊙ Small nodules.
- ⊙ Articulate with the apices of arytenoid cartilages.

Cuneiform Cartilages of Wrisberg

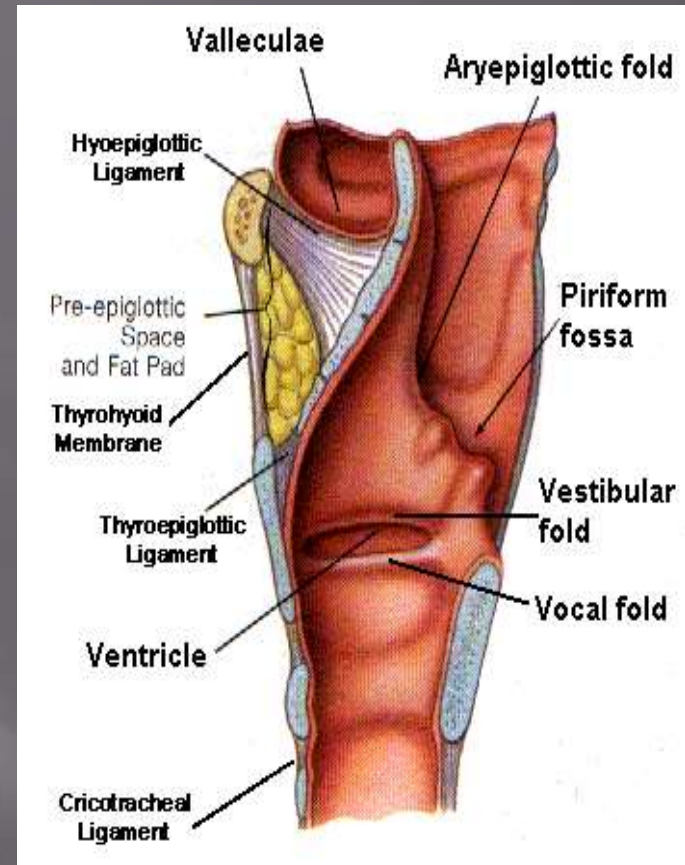
- ⊙ Small rod shaped, placed in each aryepiglottic fold, producing a small elevation.
- ⊙ Do not articulate with any other cartilage.

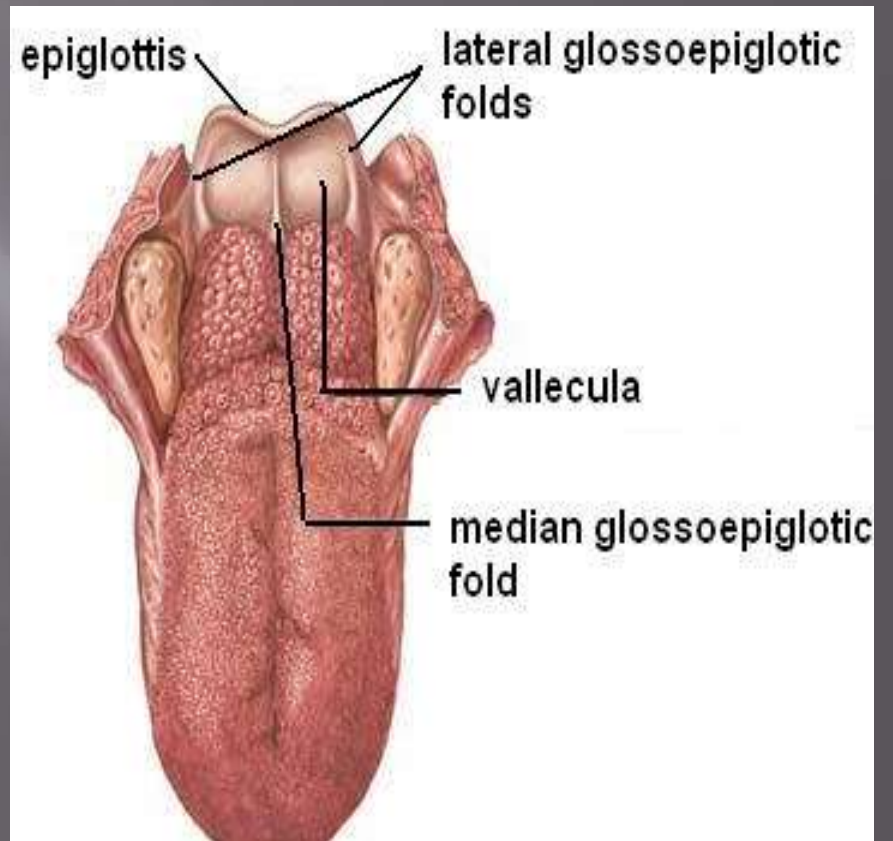
Serve as support for the ary-epiglottic fold.



EPIGLOTTIS

- Leaf shaped, situated behind the root of the tongue.
- Connected:
 - In front to the body of hyoid bone by the hyoepiglottic ligament which divides it into suprahyoid & infrahyoid epiglottis
 - By its stalk (petiole) to the back of thyroid cartilage by the **thyroepiglottic ligament**.
- Upper edge is free.
- Laterally gives attachment to **aryepiglottic fold**





MEMBRANES & LIGAMENTS

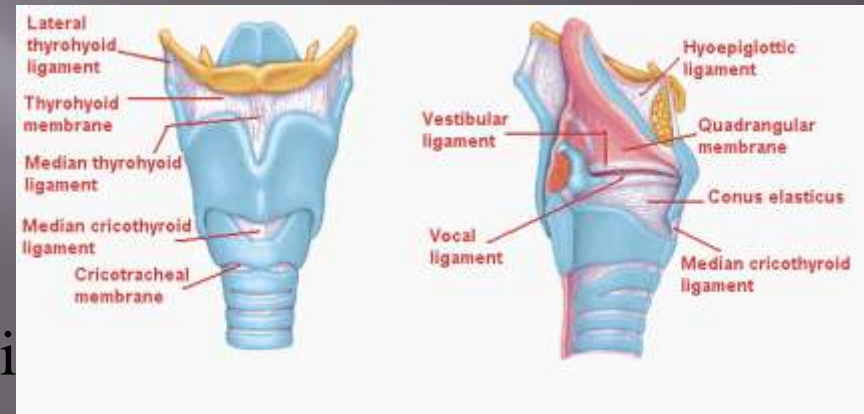
Laryngeal membranes-

Extrinsic –

- Thyrohyoid membrane & ligament (medial & lateral).
- cricotracheal membrane.

Intrinsic –

- Cricovocal membrane (conus elasticus / cricothyroid ligament / triangular membrane)
- Quadrangular membrane.



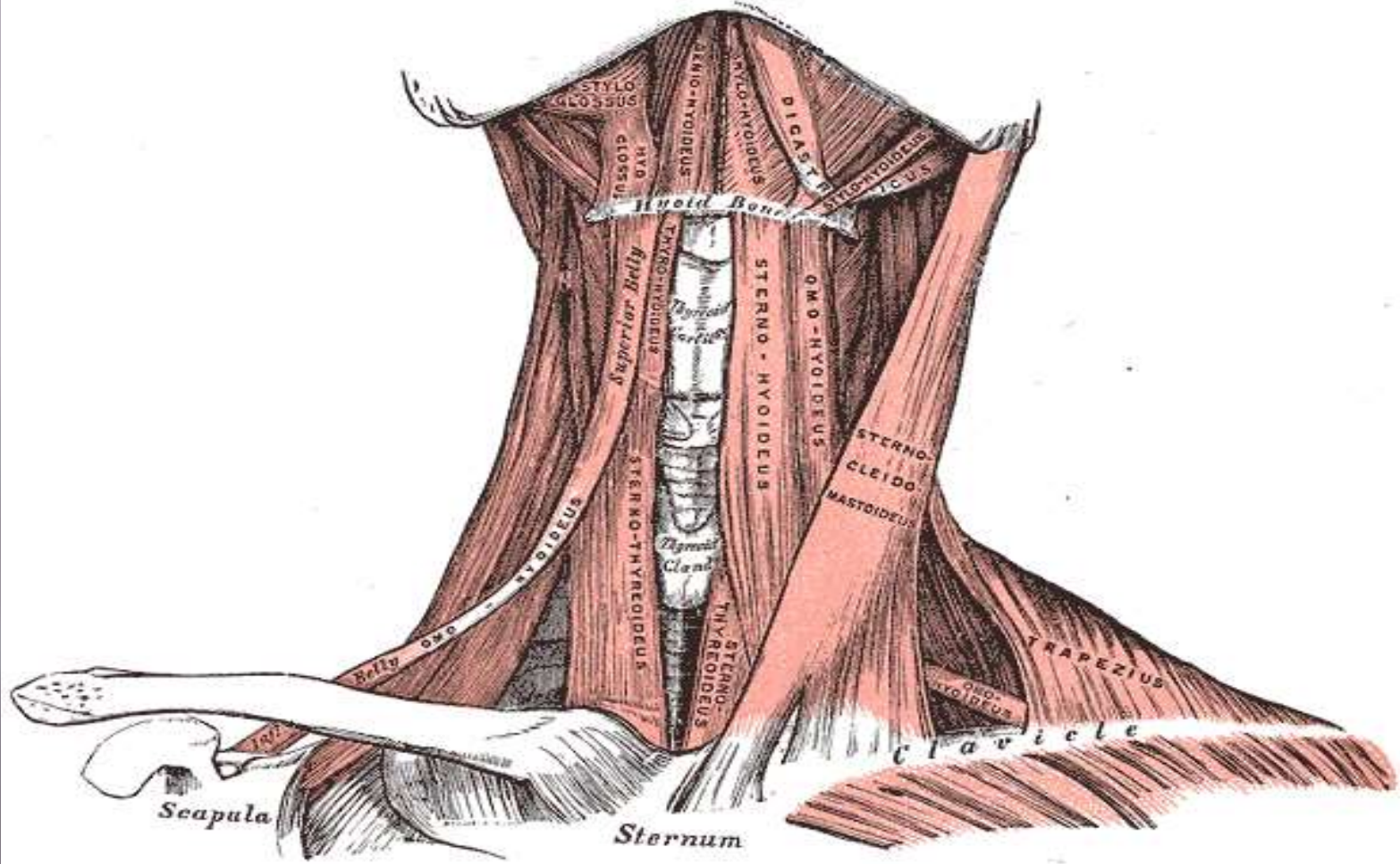
MUSCLES:

Divided into two groups:

- ⊙ Extrinsic muscles: divided into two groups.
 - Elevators of the larynx.
 - Depressors of the larynx.

- ⊙ Intrinsic muscles: divided into two groups
 - Muscles controlling the laryngeal inlet.
 - Muscles controlling the movements of the vocal cords.

Symphysis



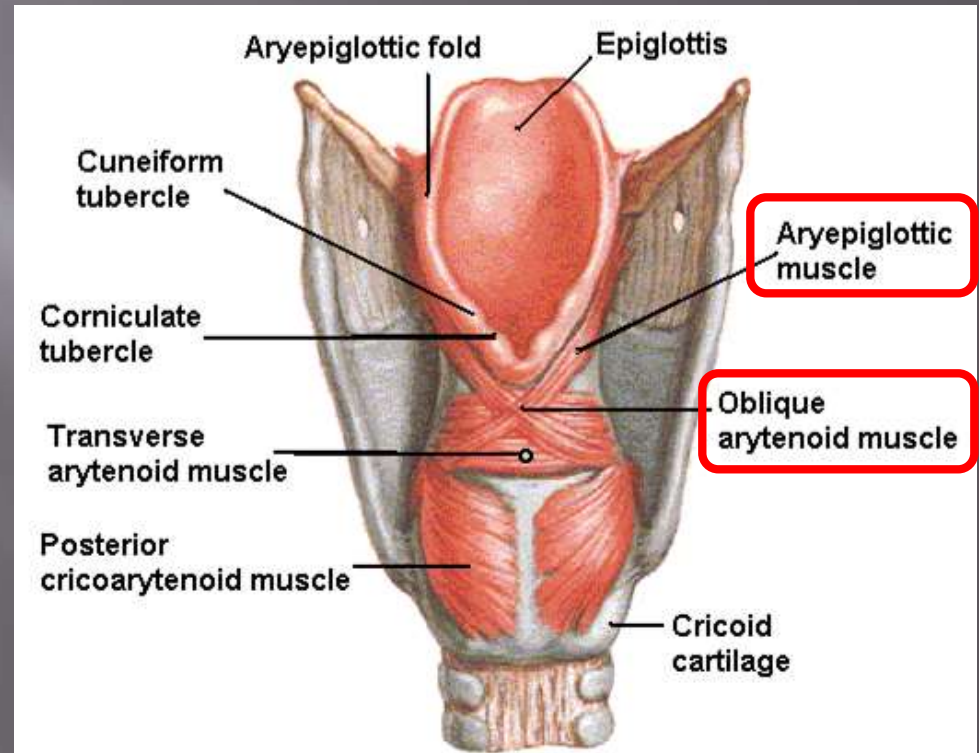
Scapula

Sternum

Clavicle

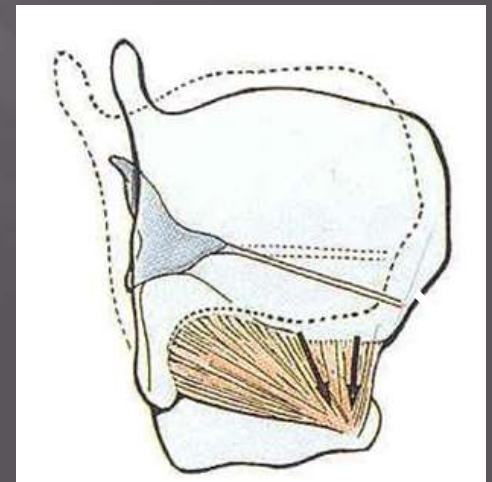
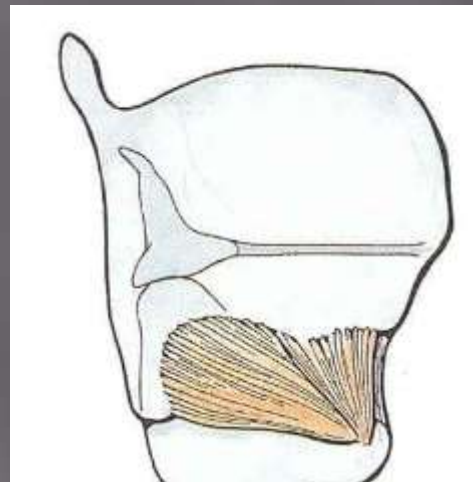
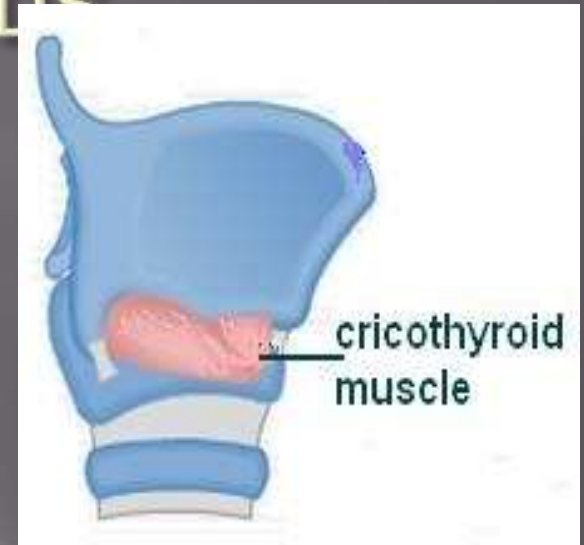
MUSCLES CONTROLLING THE LARYNGEAL INLET

- ◎ Oblique arytenoid
- ◎ Aryepiglottic muscle



MUSCLE INCREASING THE LENGTH & TENSION OF THE VOCAL CORDS

- Cricothyroid: increases the distance between the angle of the thyroid cartilage & the vocal processes of the arytenoid cartilages, and results in increase in the length & tension of the vocal cords.

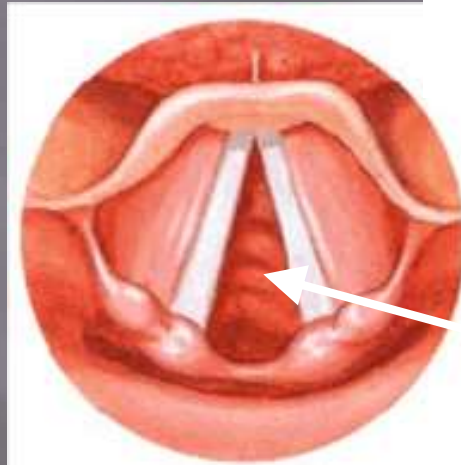
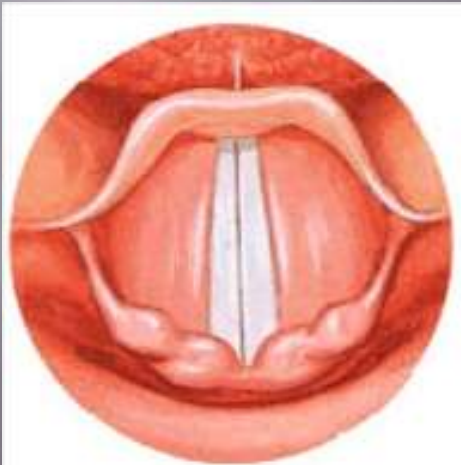
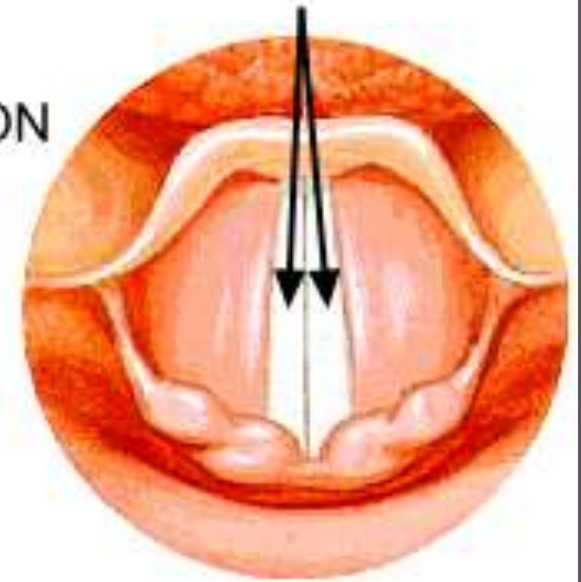


MOVEMENTS OF THE

- Adduction
- Abduction

PHONATION

Vocal Cords



Glottis (space between folds)

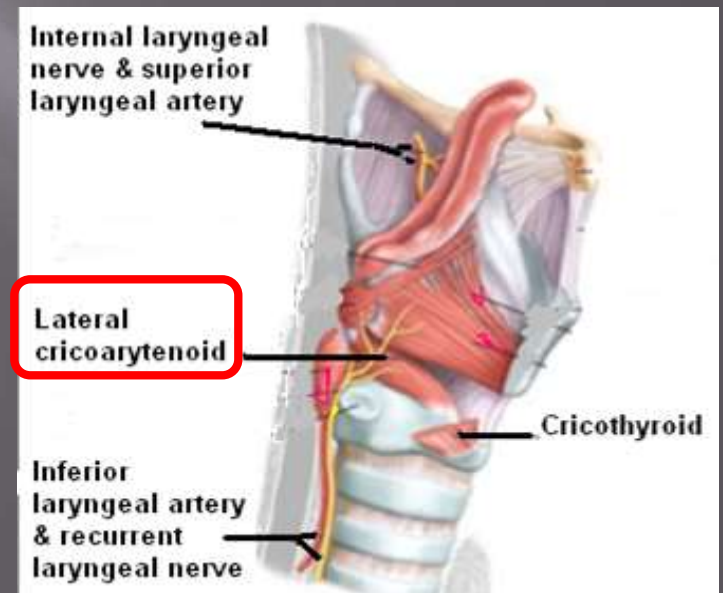
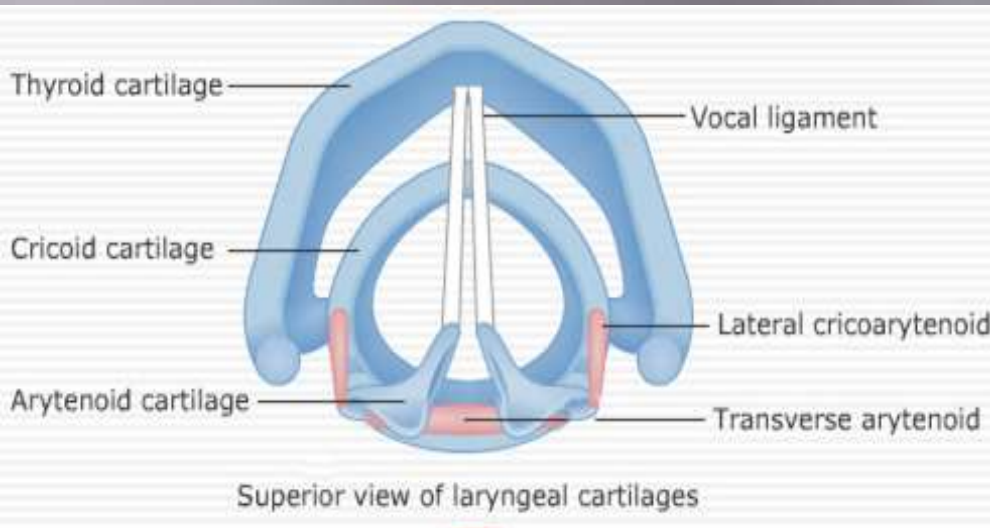
Folds closed (adducted)

Folds open (abducted)

(View from above)

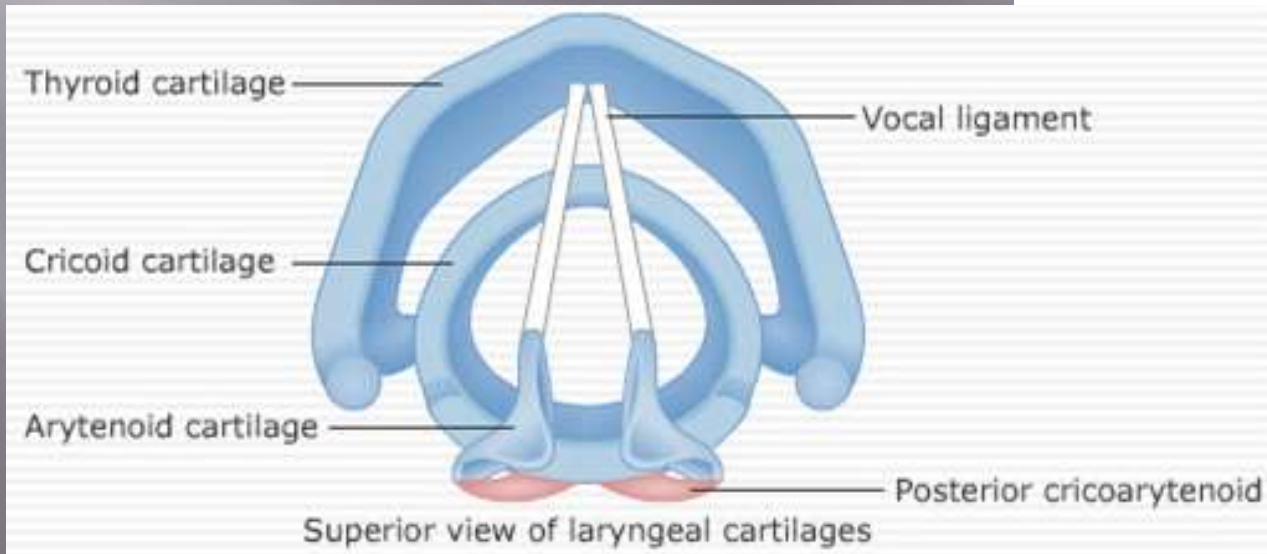
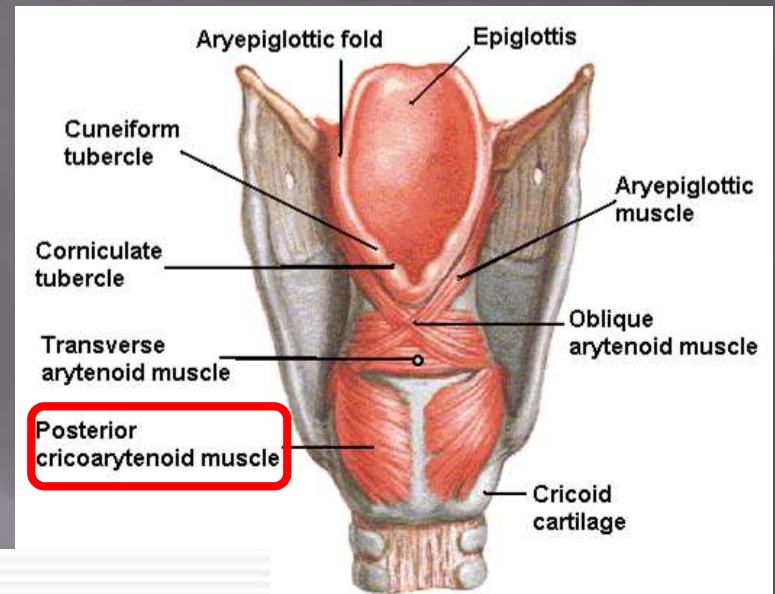
ADDUCTORS OF THE VOCAL CORDS

- ⦿ Lateral cricoarytenoid:
- ⦿ Adducts and lowers the vocal process
- ⦿ Vocal fold → thin, elongated, adducted
- ⦿ Free edge is sharp and passively stiffened



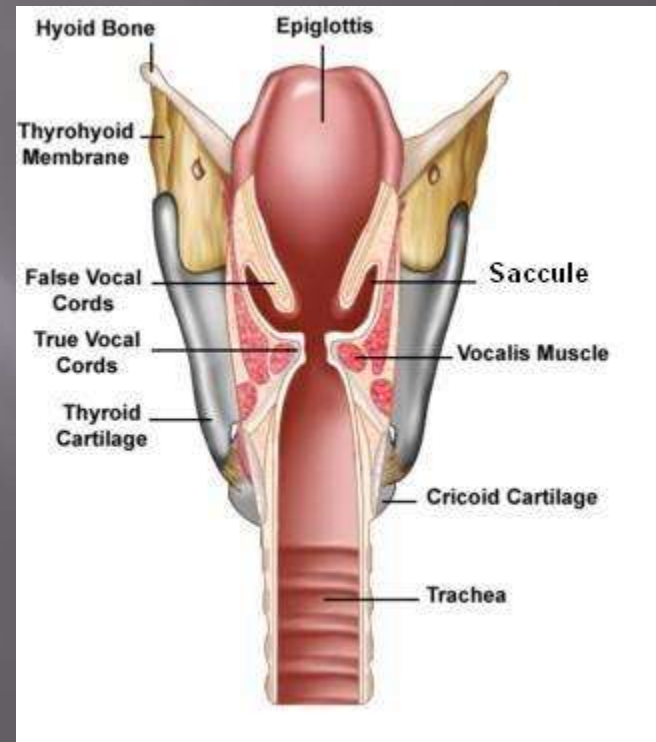
ABDUCTOR OF THE VOCAL CORDS

- Posterior cricoarytenoid
(safety muscle)
- Abducts and elevates the vocal process
- Vocal fold → thin elongated
- Free edge is rounded and passively stiffened.



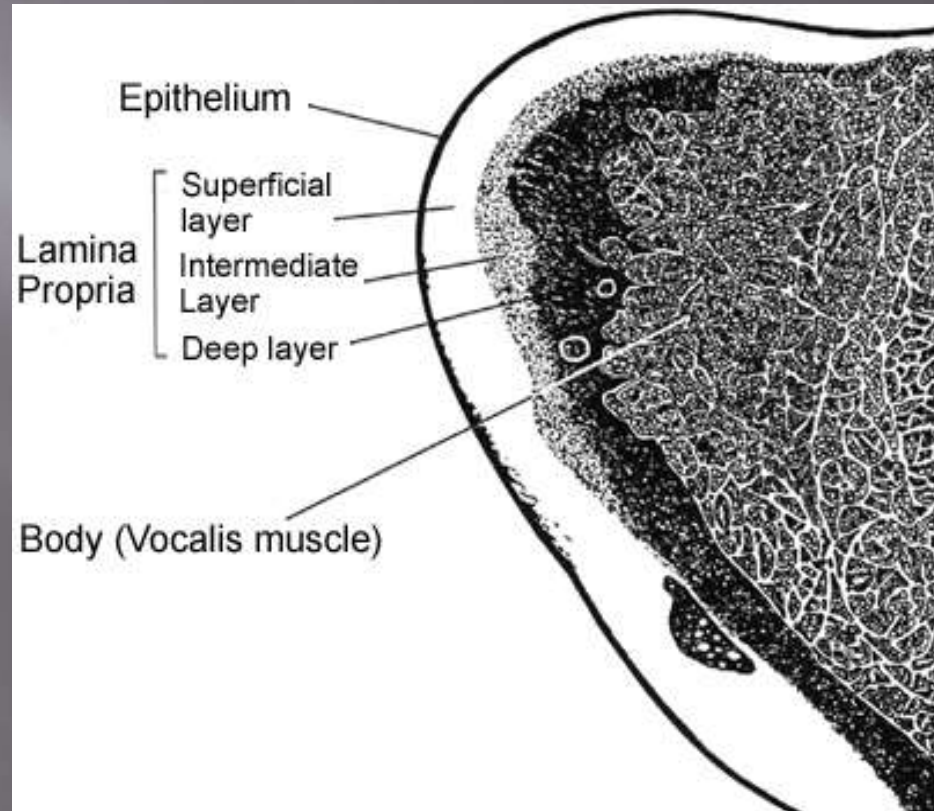
LARYNGEAL CAVITY

- Extends from laryngeal inlet to lower border of the cricoid cartilage where it becomes continuous with trachea.
- Inferior opening is continuously open while laryngeal inlet can be closed by downward movement of epiglottis.



VOCAL CORDS

- ◎ Vocal cord
 - Non keratinising stratified Sq. epithelium.
 - Lamina propria
 - Superficial loose fibrous
 - Intermediate elastic
 - Deep collagenous
- ◎ Vocalis muscle.



MUCOUS MEMBRANE

- ⊙ Most of the larynx is lined with pseudostratified ciliated columnar respiratory type epithelium.
- ⊙ The surface of vocal folds, upper half of posterior surface of epiglottis because of exposure to continuous trauma during phonation, is covered with nonkeratinising stratified squamous epithelium
- ⊙ Contains many mucous glands, more numerous in the saccule (for lubrication of vocal folds), on posterior surface of the epiglottis. There are no mucous glands in vocal folds.

BLOOD SUPPLY & LYMPH DRAINAGE

○ Arteries:

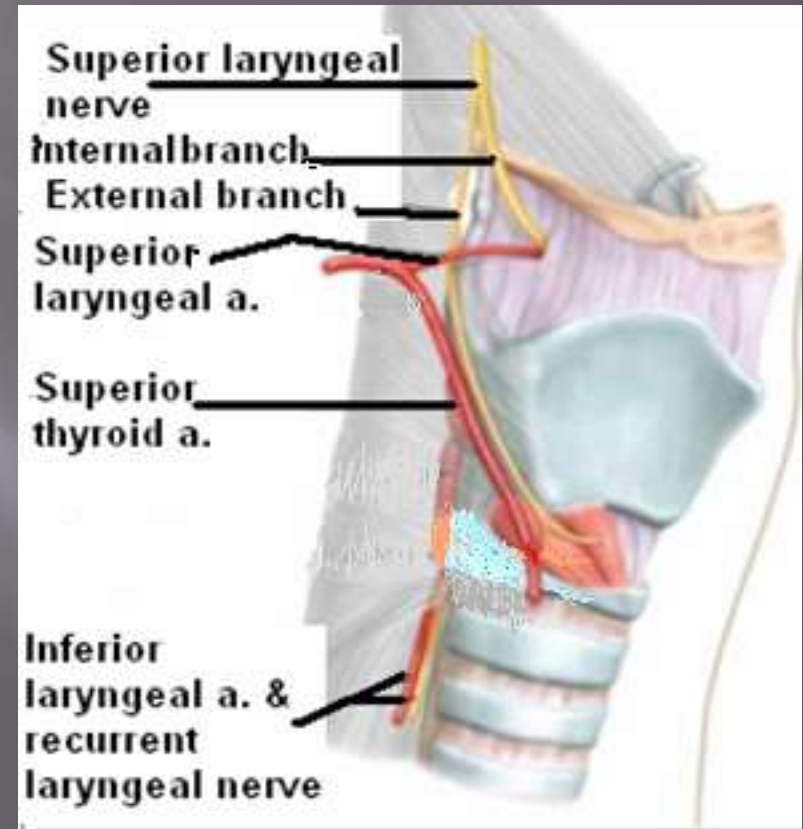
- Upper half: Superior laryngeal artery, branch of superior thyroid artery
- Lower half: Inferior laryngeal artery, branch of inferior thyroid artery

○ Veins:

- Accompany the corresponding arteries.

○ Lymphatics:

- Upper deep cervical lymph nodes.
- Lower deep cervical lymph nodes.



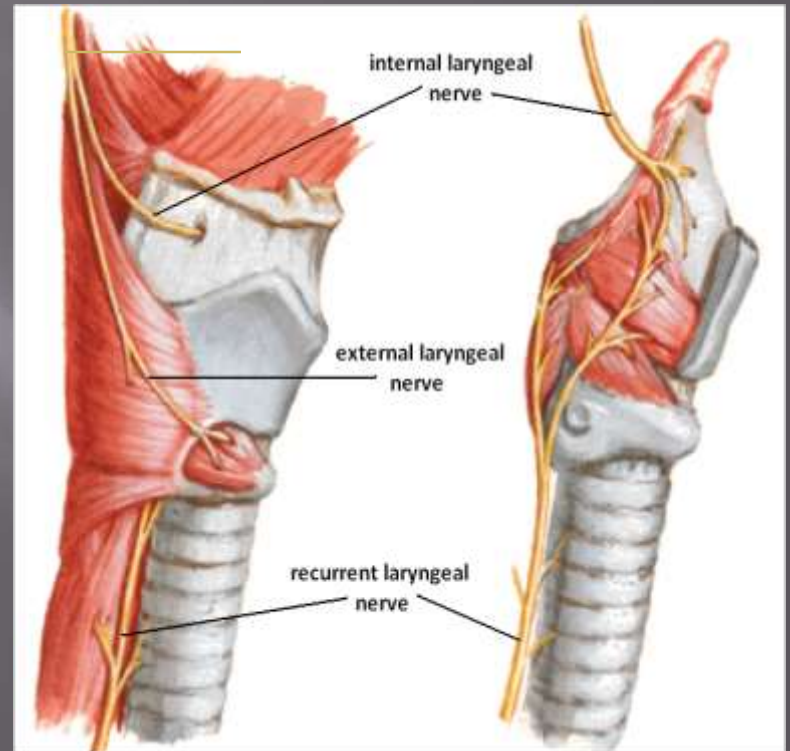
NERVE SUPPLY

○ Sensory

- Above the vocal cords: Internal laryngeal nerve, branch of the superior laryngeal branch of the vagus nerve.
- Below the vocal cords: Recurrent laryngeal nerve, branch of the vagus nerve.

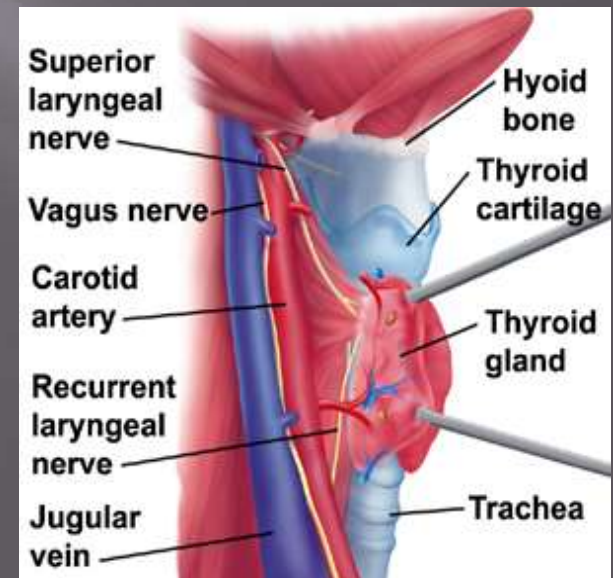
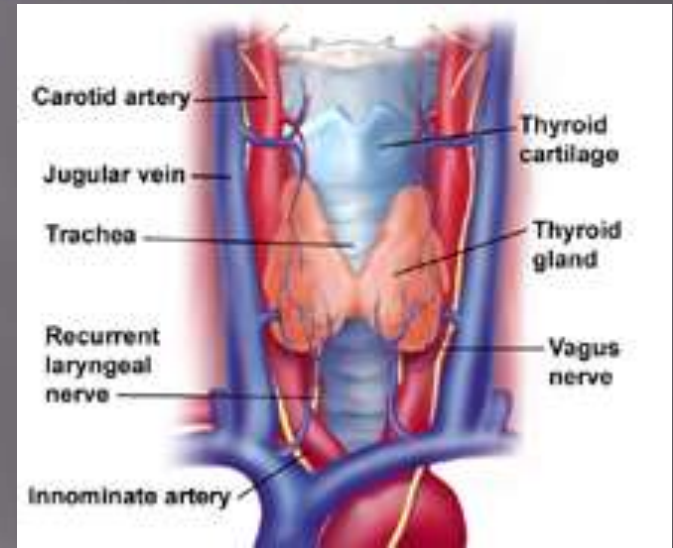
○ Motor

- All intrinsic muscles, except cricothyroid, supplied by the recurrent laryngeal nerve.
- The cricothyroid muscle is supplied by the external laryngeal nerve, a branch of the superior laryngeal branch of vagus nerve.

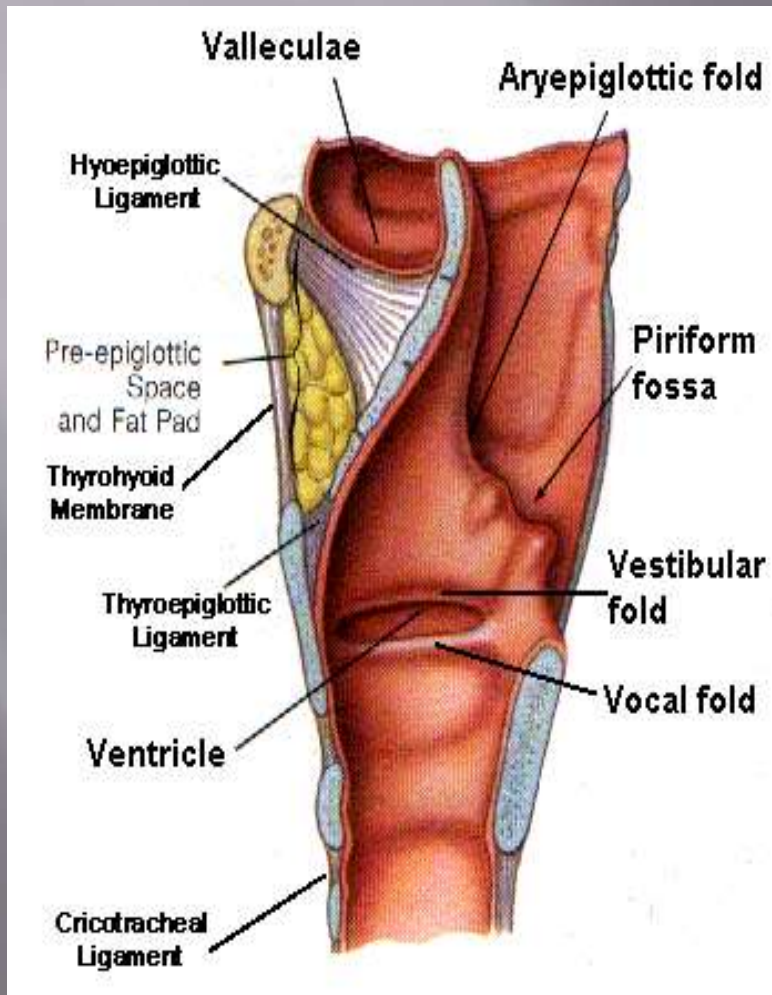


THE LARYNX: IMPORTANT RELATIONS

- The larynx related to major critical structures:
 - Carotid arteries , jugular veins, and vagus nerve.
 - Superior and inferior thyroid arteries.
 - Superior and recurrent laryngeal nerves.



SPACES OF LARYNX- PREEPIGLOTTIC SPACE OF BOYER



- Boundries-
- tumour spread-thr. Small perforation in epiglottis or thr hyoepiglottic ligament.
- Continuous laterally with paraglottic space.

PAEDIATRIC LARYNX

- ◎ The larynx of humans and great apes in infancy is higher in the neck so that they can breathe and suckle at the same time. In humans it descends gradually to adult position with growth of the neck.
- ◎ Cartilages are soft in infants & easily collapse on forced inspiration.
- ◎ Epiglottis is omega shaped, thyroid cartilage is flat.
- ◎ Infantile larynx is conical & small, adult larynx is cylindrical.

PHYSIOLOGY OF PHONATION

◎ NEURAL CONTROL OF PHONATION :-

- ◎ Phonation is an integrated function of CNS and PNS.
- ◎ Motor activity of phonation is integrated through a projection from PAG(Periaqueductal grey) to NRA(Nucleus Retroambiguus).
- ◎ NRA plays vital role in generating respiratory pressure and laryngeal adduction.

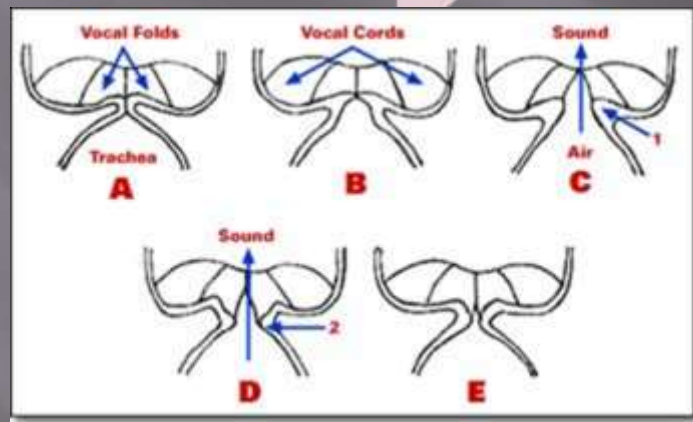
INITIATION OF VOICE

Prephonatory
inspiratory
phase
(abduction)

Adduction of
vocal cords

Pulmonary
air blast
separates the
cords

Exhaled air
produces the
**VOCAL
NOTE**

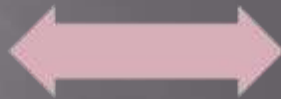


THE VIBRATORY CYCLE

Adduction



Recoil



Aerodynamic
circulation

PRODUCTION OF VOICE

◎ **The production of voice has three components:**

1. The generation of sound: Sound production originates from the larynx as a fundamental tone by the intermittent release of expired air between the adducted vocal cords resulting in their vibration.

2.The resonance of sound: This tone is modified by various resonating chambers (resonators) i.e. pharynx, mouth and paranasal sinuses.

3.The articulation of voice (speech production) : Finally converted to speech by the action of the mouth, nose, nasal cavity and throat, where the tongue, palate, cheek and lips are involved in articulation

PARAMETERS OF VOICE

- ◎ Quality, Loudness, and Pitch
- ◎ Quality :depends on symmetrical vibration at the midline of the glottis
- ◎ Loudness : is influenced by subglottic pressure, glottic resistance, transglottic air flow, and amplitude of vibration
- ◎ Pitch : depends on the alterations in length and tension of vocal folds

© *Thank you.....!!*
© Thank you.....!!