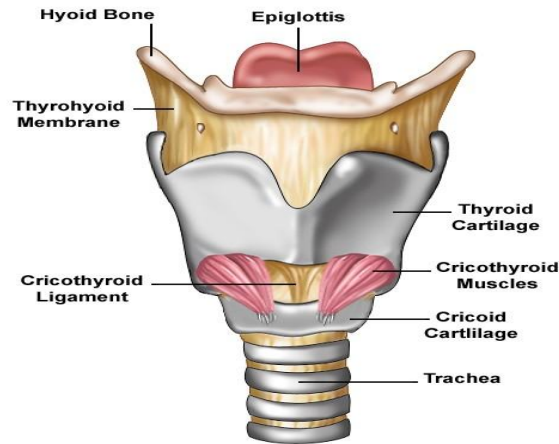


-The larynx-

-It is a box of cartilage and if we look to the following figure, we'll see: the hyoid bone, the epiglottis (the free edge of epiglottis which is connected to the tongue), thyrohyoid cartilage, cricoid cartilage and the rings of trachea.



-Most of the larynx is made of hyaline cartilage except the epiglottis which is made of elastic cartilage. Why it is made of cartilage?

-because the larynx and trachea have to be opened always for the passage of air. If they are without cartilage, they'll become like the esophagus which can collapse so there'll be no passage of air and this is impossible!.

-the hyoid bone is located on the upper border of the larynx (Not included in the larynx cartilage).

*The cartilage of the larynx is divided into:

1-Single cartilage: (The thyroid cartilage, The epiglottis and the cricoid cartilage).

2-paired cartilage: (The Arytenoid cartilage, The corniculate cartilage and the cuneiform cartilage).

-The larynx lies in the neck, extends from the middle of the 3rd cervical vertebrae (C3) till the lower border of the 6th cervical vertebrae (C6) [or the lower border of the cricoid cartilage], its opening is the laryngopharynx (inlet of larynx) behind the free edge of epiglottis, and it continues as trachea which contains C-shape hyaline cartilage to remain opened for the passage of the air.

-The cartilages of the larynx are connected together and to the hyoid bone by membranes and ligaments.

Ex:1- The thyrohyoid membrane and ligament: extends from the thyroid cartilage till the hyoid bone.

2-The cricothyroid membrane and ligament: extends from the cricoid cartilage till the thyroid cartilage.

3-The cricotracheal membrane and ligament: extends from the cricoid cartilage till the trachea.

-If there is a thickening in the membrane (which is made of C.T) laterally or in the midline, it'll become a ligament.

functions of the larynx

1- It acts as an open valve in the respiration: during respiration, the inlet of the larynx is open and the boundaries of this inlet are the free edge of the epiglottis and the aryepiglottic fold.

-The aryepiglottic fold is located in the both sides between the epiglottis and the arytenoid cartilage.

2-acts as a closed valve in deglutition: when we swallow the food, the bolus will push the epiglottis downward and the larynx is raised upward with the contraction of the aryepiglottic muscle so it'll lead to the closure of the inlet.

The larynx have to be closed during deglutition, sometimes when an absent-minded person is eating, instead of coordination, there'll be incoordination so a particle of food may enter the inlet and he/she will suffer from coughing until he release it out. So the coughing is protective to the larynx and only the air is allowed to enter it.

3-Acts as partially closed valve in the production of the voice:

-One of the important functions of the larynx is "vibration of the true vocal cords and production of the voice", so inside the larynx there are the true vocal cords, they'll have adduction (they'll close) ,abduction (they'll go away from each other),tension and relaxation.

-The respiration process consists of 2 processes:

*1-The inspiration *2-The expiration

*1-The inspiration is an active process, the diaphragm will contract and it'll move downwards so there'll be an decrease in the intrathoracic pressure (become less than the atmospheric).so there will be a gush of air through the nose→ Inflation of the lungs.what about the vocal cords?

-during inspiration the vocal cords will be abducted(away from each other) so the air will pass easily.

*2-The expiration is a passive process, the diaphragm will relaxe (raise up) causes a decrease in the volume of the thoracic cavity, which causes an increase in intrathoracic pressure, (the lungs will collapse/deflation of the lungs) thus air moves out of the lungs into the external atmosphere.

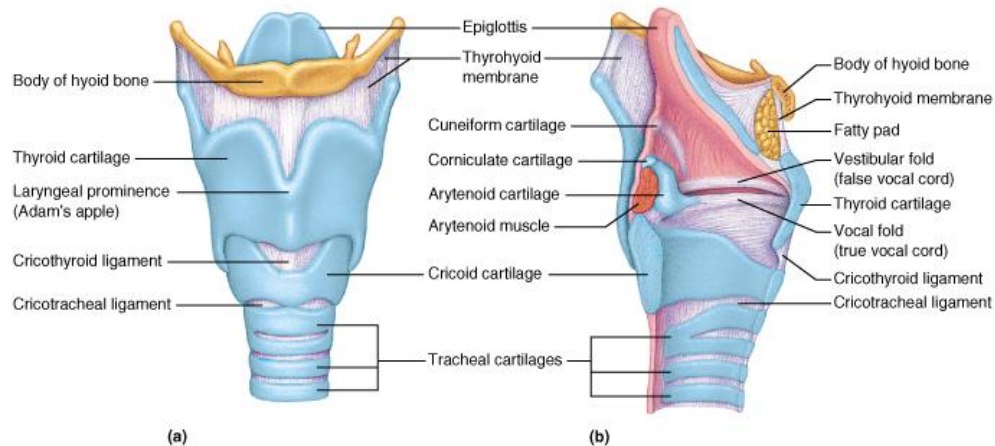
-What about the vocal cords?.During expiration they will be adducted, because when there is deflation of the lungs, the air will go upwards till it reaches the true vocal cords(the adducted vocal cords) and the air will be comprised below the vocal cords and this comprised air column is very important; the vibration causes partitioning of this air column releasing pulses of air, these air pulses will leave the larynx through the wall of the pharynx, nose and oral cavity → will produce the sound (production of the voice).

4-The coughing is a closure (adduction of the vocal cords) and a sudden opening of the vocal cords releasing all the comprised air and this is a protective reflection movement in order to release the foreign particles (food,water ..etc).

Parts of the larynx

1-Cartilage: single or paired, mostly hyaline cartilage.

2-Mucosa: makes the lining of the respiratory tract (including the larynx) which is –the lining mucosa-pseudostratified ciliated columnar epithelium EXCEPT the true vocal cords which are made of stratified squamous non-keratinized epithelium, because the true vocal cords (which are responsible of the production of the voice) may have an injury so the voice will disappear, mitosis and regeneration will occur few days after, and finally the mucosa will back to its normal state.



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-Here we have the arytenoid cartilage ,vocal process of the arytenoid cartilage , true vocal cords(which are attached to the angle of the thyroid cartilage) and tis attachment will be from inside.

-The true vocal cord has a ligament which is called “the vocal ligament” [it is covered by mucosa] and also it has a muscle which is called “vocalis muscle”.

3-ligaments:

Are located between the cartilages.[the midline of the membrane may be thickened to give a ligament as we said before].

Ex: 1- the thyrohyoid membrane and ligament 2-The cricotracheal membrane and ligament

4-Muscles:

-they are divided into: 1-extrinsic muscles (outside the larynx) 2-intrinsic muscles(inside larynx).

-We are concerned with the intrinsic muscles because they work on the vocal cords; some of them will cause adduction to the vocal cords others will cause abduction of them, shortening(tension) and relaxation.

-In the previous picture we can see the epiglottis (the free edge of the epiglottis) and the arytenoid cartilage and the connection between them which is the aryepiglottic fold, also we can see the lamina of the thyroid cartilage which posteriorly has superior and inferior horn and anteriorly has an angle and its upper part will give the laryngeal prominence (Adam's apple) which is more prominent in males rather than females.

-Also we can see the cricoid cartilage which has an arch anteriorly and a lamina (quadrangular part) posteriorly.

-Again the boundaries of the inlet of the larynx are:

-superiorly (above) :the free edge of the epiglottis.

-laterally (on the both sides): aryepiglottic fold.

-posteriorly: interarytenoid muscle.

*** We will start with cartilage***

1-The cricoid cartilage:

-single cartilage

-Its lower border is the lower border of the larynx.

-has a connection with the 1st tracheal ring by the *cricotracheal membrane* and ligament.

-has a connection with thyroid cartilage by cricothyroid membrane and ligament.

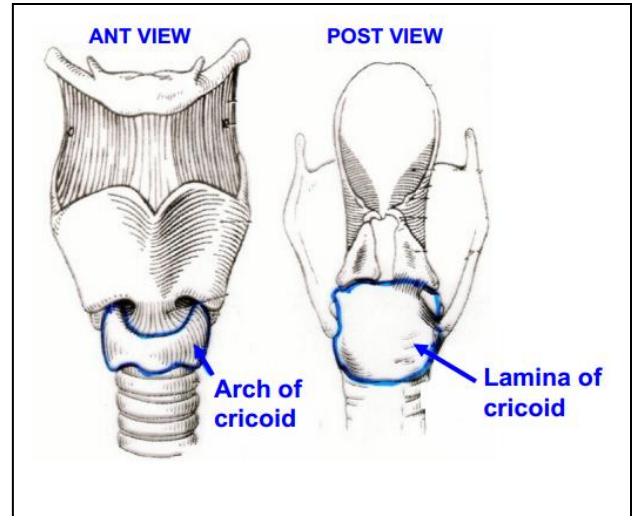
-Has an arch anteriorly and a lamina posteriorly. (like a signet ring)

-Has facet of articulation, so 2 facets are on the upper and lateral part of the cricoid and each of them will articulate with the arytenoid on the both sides.

-other articulations are laterally on the lamina of the cricoid, it'll articulate with the inferior horn of the thyroid cartilage.

-If we look at the lamina posteriorly, we will see a ridge and this ridge has 2 depressions on both sides (right and left) , these depressions are for attachment of **the posterior cricoarytenoid muscle** (its origin is the posterior part of the cricoid cartilage and the insertion in the muscular process of the arytenoid cartilage, its function is the abduction of the true vocal cords). So the arytenoid cartilage has 2 processes: vocal and muscular processes.

The function of the posterior cricoarytenoid muscle is abduction of the vocal cords when it contracts.



-The ridge gives an attachment to the esophagus because as we know :posterior to the larynx , we have the pharynx and the continuation of the pharynx is the esophagus (posteriorly to the larynx).

2-The thyroid cartilage:

-it consists of 2 laminae which are on the lateral side (there is a lamina in each lateral side).

-The 2 laminae are connected anteriorly to make an angle and the upper part of this angle will make the laryngeal prominence (Adam's apple, superior thyroid notch).

-Adam's Apple is more prominent in males because of the hormones; the secretion of testosterone at puberty in males will affect the bone, cartilage and the muscles and will make an acute angle which in turn will make the vocal cord long so the voice will become a low pitch voice.

-In females, there will be secretion of progesterone and estrogen which also will affect the cartilage (will become obtuse, nearly 120 degree), bone and muscles (become smooth),so the vocal cords will become short and this will lead to a high pitch voice.

*which muscle is responsible of the pitch of the voice?

-the cricothyroid muscle(extrinsic muscle, its function is to increase the pitch of the voice; tenses the vocal cords).

*The thyroid cartilage is opened posteriorly and has 2 horns:

1-superior horn which articulates with the greater horn of the hyoid bone.

2-inferior horn which articulates with the lateral part of cricoid cartilage.

-the thyroid cartilage has superior and inferior tubercles and between them there is an oblique line which in turn is an attachment for:

1-Sternothyroid muscle 2-Thyrohyoid muscle

-both of them are from the extrinsic muscles of the larynx.

-the cartilage also has superior and inferior thyroid notches.

-so again the angle of the thyroid:

* is acute or 90 degree in males and is obtuse (nearly 120 degree) in females.

*affects the length of the true vocal cords.

**gives attachment for:

1- The true vocal cords (extends from the vocal process of the arytenoid till the angle of the thyroid cartilage).

2- For the epiglottis.

3-The epiglottis:

-Has a leaf like appearance, has a free edge superiorly.

-has an attached apex (the apex makes an attachment and this attachment is on the angle of the thyroid cartilage).

-makes an attachment with the arytenoid cartilage which articulates with the lamina of cricoid cartilage to make the aryepiglottic fold which is the boundary of the inlet of the larynx on the lateral sides.

-Has 2 surfaces:

1- antero-superior surface 2- postero-inferior surface

-There is a difference in epithelium between the 2 surfaces; the posterior surface is lined with respiratory mucosa (pseudo stratified ciliated columnar epithelium), while the superoanterior surface which makes a connection with the tongue (oral cavity) is lined with stratified squamous non-keratinized.

-the respiratory surface (postero-inferior surface) has a ridge and an epiglottic tubercle.

- Remember its important function in the opening and closure of the inlet of larynx.

We are finished with the single cartilages in the larynx

***The paired cartilages*(refer to slides for the figures)**

The paired cartilages are:

1-the arytenoid cartilage(posteriorly)

2-the corniculate cartilage(articulates with the apex of the arytenoid)

3-the cuneiform cartilage (it is located in the aryepiglottic fold to strengthen the force of contraction of the **aryepiglottus**- which is a muscle that extends from the arytenoid cartilage to the epiglottis- and this is important in the closure of the inlet of the larynx).

1-The arytenoid cartilages:

-it is pyramidal in shape, has apex and base.

-The apex has a facet and this facet is for articulation with the corniculate cartilage.

*when we say facet and articulation it means that there is a movement that will affect the true vocal cords.

-one end of the true vocal cord is attached to the vocal process of the arytenoid cartilage anteriorly by the “vocal ligament” , the other end of the vocal cord is attached to the angle of the thyroid cartilage.

-The muscular process of the arytenoid cartilage is posterolateral and gives attachment to :

1-the posterior cricoarytenoid muscle (abduction of the vocal cords).

2-the lateral cricoarytenoid muscle (adduction of the vocal cords).

-so both of them are extended from the cricoid cartilage till the muscular process of the arytenoid cartilage).

-The cartilage also has a *smooth medial surface* and a *lateral surface* which has a ridge that makes 2 depressions:

1-the superior depression is for attachment of "vestibular ligament" which is a part of the false vocal cords.

2- the inferior depression is for the attachment of the "vocalis muscle" which is a part of the true vocal cords.

-so the true vocal cord consists of:

1-mucosa 2-ligaments 3-muscles (vocalis)

*there is no submucosa to prevent the accumulation of the fluids and edema.

-if there is accumulation of fluids → edema → suffocation and obstruction of the airways.

-the vocal cords are avascular (they are white in color), they receive the blood by diffusion.

2-The corniculate cartilage:

-conical in shape and makes an articulation with the apex of the arytenoid cartilage.

- It is important in the movement.

3-The cuneiform cartilage:

-small club-shape cartilage and they (from the both sides) are found suspended in the aryepiglottic fold.

-their function is to increase the strength of contraction of the muscles in the aryepiglottic fold (like the aryepiglottus),so they help in the closure of the inlet of larynx.

The ligaments

-maybe form from the thickening of the midline of the membrane.

-it divides into:

1-The extrinsic membrane and ligaments (make a connection with the cartilage from the outside)

2-The intrinsic membrane and ligaments (make a connection with the cartilage from the inside and below the mucosa).

-so the first layer is the mucosa then we have the intrinsic ligaments and membranes.

examples of the extrinsic membranes and ligaments

1-the thyrohyoid membrane and ligament (extends from the thyroid till the hyoid bone).

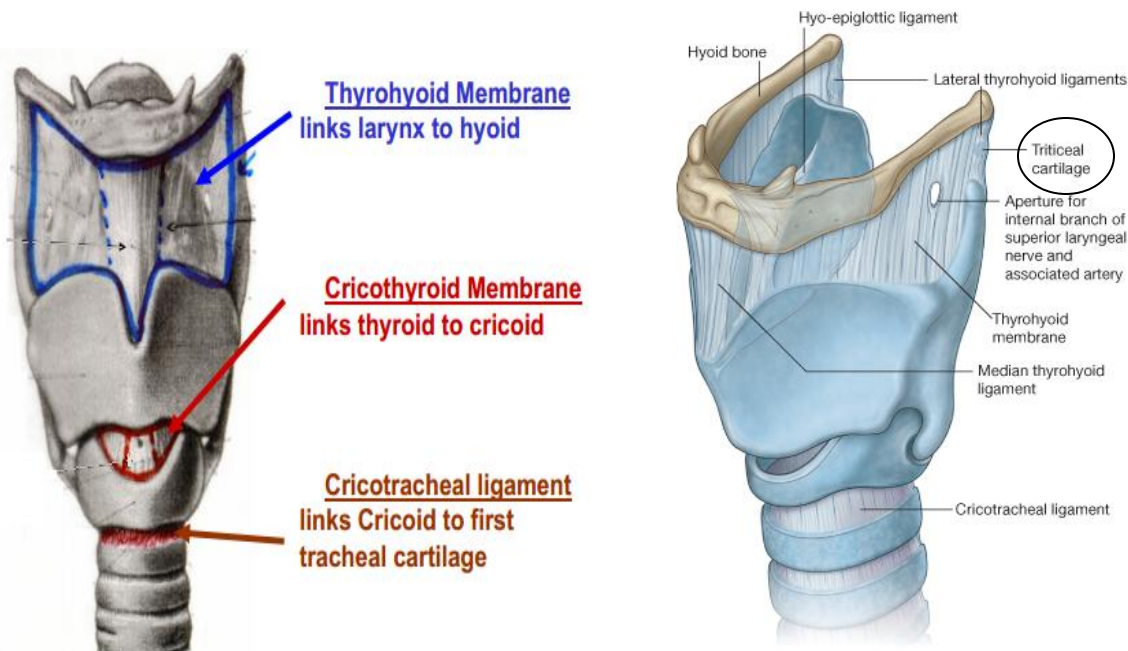
2-The hyoepiglottis membrane and ligament (extends from the hyoid bone till the epiglottis).

3-The cricotracheal membrane and ligament (extends from the cricoid till the trachea).

-we will start with the extrinsic membranes and ligaments.

1-The thyrohyoid membrane and ligament:

- extends from the upper border of the lamina of the thyroid cartilage upwards to reach the upper border of the hyoid bone internally NOT externally (we can see the hyoid without any coverage from the outside).
- laterally, there is a ligament which is called “the lateral ligament”, which forms the posterior border of the thyrohyoid membrane.
- there is an opening in this membrane for the nerve and blood supply of the larynx.
- Blood supply: the artery is the superior laryngeal artery which is branched from the superior thyroid artery which is a branch from the external carotid artery.
- The nerve supply: is from the internal laryngeal nerve which is a branch from the superior laryngeal nerve which in turn is a branch from the vagus nerve.
- the superior laryngeal nerve gives: 1- the internal laryngeal nerve. 2-the external laryngeal nerve (which will supply the cricothyroid muscle [responsible of the pitch of the voice]).
- so the internal laryngeal nerve pierces to reach the mucosa above the vocal cords (it is sensory to the mucosa above the true vocal cords).
- The blood supply of the larynx is from the superior and inferior laryngeal arteries.



-In the previous figure, you can see “the triticeal cartilage”, which is a small cartilage in the lateral ligament of the thyrohyoid membrane and it extends between the greater horn of the hyoid bone and the superior horn of the thyroid cartilage.

2-The cricotracheal membrane and ligament:

- extends from the lower border of the cricoid cartilage till the 1st ring of the trachea.
- it is important in the cases of airways obstruction in the larynx or above the vocal cords.

If there is an airway obstruction, a "tracheostomy" is had to be done.

-Tracheostomy: is a small opening in the cricotracheal membrane (it's usually done in operations) so the air will feed the lungs.

-The respiration is the first thing the doctor has to check when the patient comes to the emergency department.

-if there is an obstruction in the airways, we either do:

1-Tracheostomy 2-or use the endotracheal tube.

1-using of the endotracheal tube: it's a tube which enters from the oral cavity to the inlet of the larynx between the true vocal cords, by passing between the true vocal cords it prevents the adduction of them so there is no airways obstruction and the respiration is safe.

-in operations, when they do anesthesia, they use the endotracheal tube to make sure of the respiration.

2-tracheostomy: opening in the cricotracheal membrane (usually during operations in hospital), but outside the hospital we make the opening in the suprasternal notch (if you put your finger here, you'll feel the rings of the trachea).

-so if you open in any space between the rings of trachea, it'll cause the inflation of the lungs (inspiration).

-keep in mind that the brain tissue can survive 2-5 minutes without oxygen, if there is no oxygen for more than that, it will cause brain damage (degeneration).

3-the hyoepiglottic membrane and ligament:

-extends between the hyoid bone and the epiglottis.

finished with the extrinsic membranes and ligaments

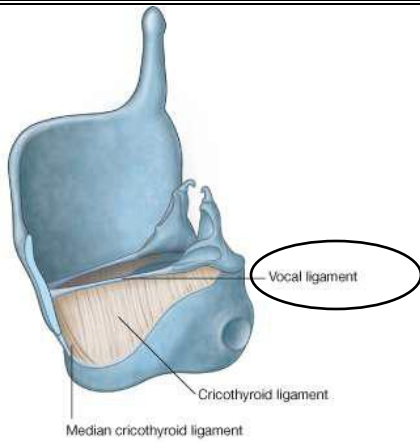
-the intrinsic membranes and ligaments are more important than the extrinsic, and they are fibroelastic membranes joining the cartilage together:

1-The cricothyroid membrane and ligament.

2-The quadrangular membrane and ligament.

-Both of them are located between the cartilages internally.

-the cricothyroid membrane and ligament is also called "*conus elasticus*" which extends from the cricoid cartilage (from the upper border and internal wall) and moves upwards then attaches in the vocal process of the arytenoid cartilage till the angle of the thyroid .(hence the name)



-we can see the “vocal ligament” which is the free edge of the conus elasticus(cricothyroid membrane) and it’s attached to the vocal process of the arytenoid cartilage and to the angle of the thyroid, covered with mucosa and gives an attachment to vocalis muscle or the thyroarytenoid muscle(the same).

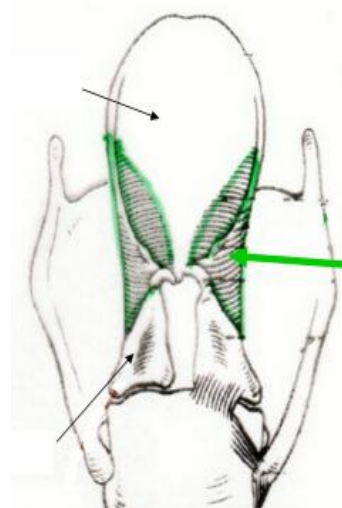
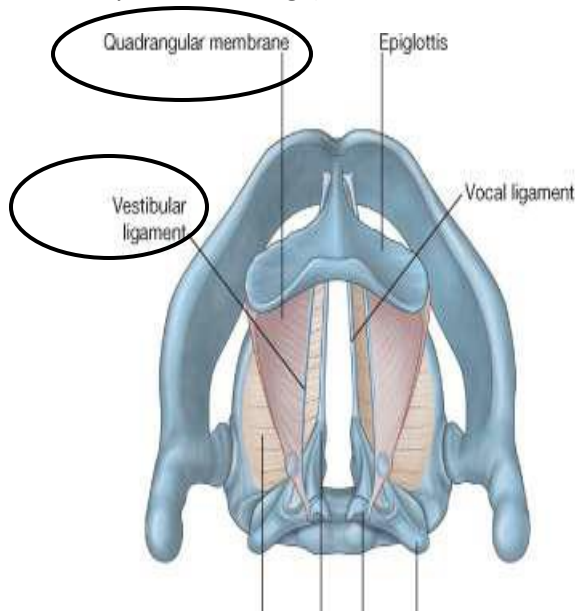
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-the quadrangular membrane runs between the lateral margin of the epiglottis and the anterolateral surface of the arytenoid cartilage.(from the epiglottis downward to the arytenoid)

-it’s quadrangular in shape hence the name. Has:

1-upper edge (which is the ridge of the epiglottis)

2-lower free edge (will make the vestibular ligament which is attached to the superior depression in the lateral wall of the arytenoid cartilage).



Quadrangular Membrane links Arytenoid To epiglottis

-the vestibular ligament is located in the vestibular fold because it is covered with mucosa, also it Participates in the formation of the false vocal cords and has nothing to do with the production of voice.

Sorry for any mistake

Good luck

