

RESPIRATORY SYSTEM

جهاز التنفس
ANATOMY



Title: Sheet 3 – The larynx 1

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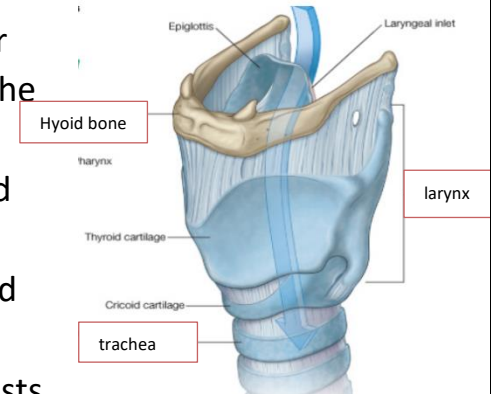
Helloooo, in this sheet we're gonna study about larynx. In this link, you'll find some extra pictures I collected from Kenhub to help you throughout this lecture.

<https://drive.google.com/file/d/1g8C6txbyvZw0o1CDf9sg-mDyf3y-F-gO/view?usp=sharing>

رح تحسوا حالكم ضايعين باول صفحتين لأنه المصطلحات جديدة، بس عادي كل ما مشيتوا بالشيت رح تفهموا أكثر و تصير الصورة أوضح، ف ما في داعي اول ما تقرؤوا مصطلح جديد تروحوا عجوجل 😊

Larynx

- Extends from the third cervical vertebra C3 to the lower border of the sixth cervical vertebra C6 (at the level of the lower border of the cricoid cartilage).
- The larynx begins with the **laryngopharynx opening** and ends with the **trachea**.
- It is suspended from the hyoid bone above and attached to the trachea below by membranes and ligaments.
- You can think of the larynx as a box of cartilage; it consists of layers that are arranged according to the following:



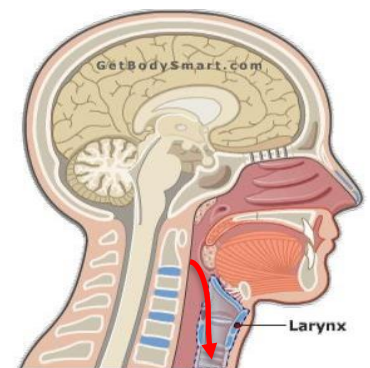
Histology corner:

1. **Mucosa:** The larynx is covered from the inside with respiratory mucosa (pseudostratified ciliated columnar epithelium) except for the true vocal cords and the anterior (upper) surface of the epiglottis, which are both lined with stratified squamous non-keratinized epithelium.
2. **Submucosa:** Connective tissue
3. **Membranes, ligaments and joints:** To connect the cartilaginous parts together.
4. **Cartilage:** The skeleton of the larynx.
5. **Muscles:** Intrinsic laryngeal muscles and one extrinsic.
6. **Adventitia**

Functions of the larynx: (recommended animation: <https://www.youtube.com/watch?v=IUvfAsBnn9g>)

1. **Acts as an open valve in respiration:** It needs to be open for the passage of air into and out of the lungs.

2. **Acts as a closed valve in deglutition:** When we swallow food, the bolus goes from the oral cavity through the oropharynx and to the esophagus. So, to prevent food from entering the inlet of the larynx, the epiglottis moves downward (contracts) and the larynx moves upward to completely close the inlet of the larynx.



3. **Acts as a partially closed valve in the production of voice (speech):** The production of voice happens during expiration due to vibration of the true vocal cord. So, during

expiration, the true vocal cord adducts (moves towards the midline), forming a column of compressed air below it. This compressed air vibrates the true vocal cord in order to produce voice (speech). <https://www.youtube.com/watch?v=b89RSYCaUBo>

4. **During cough, it is first closed and then opens suddenly to release compressed air.** Coughing happens to expel foreign bodies and dust entering the trachea. This process basically is the closure of the true vocal cord, forming below it a column of compressed air. When it opens suddenly, it causes the compressed air to exit suddenly.

– Cartilage of the larynx

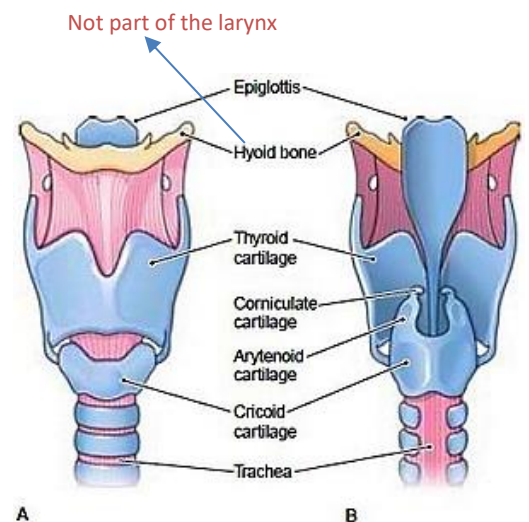
We said that the larynx is a box of cartilage. It contains single and paired cartilages:

a. **3 Single cartilage pieces:**

- Thyroid
- Cricoid
- Epiglottis

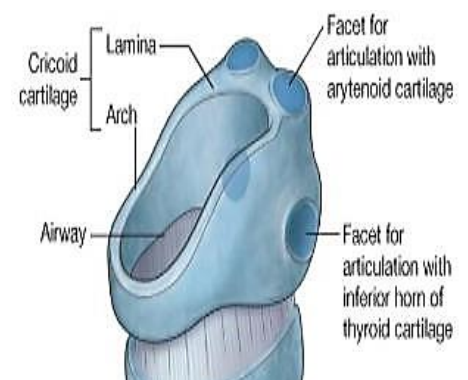
b. **3 Pairs:**

- **Arytenoid:** The most important, there is one on the right and one on the left. They connect to the upper border of the lamina of the cricoid cartilage.
- **Cuneiform**
- **Corniculate:** Connect with the apex of arytenoid. Together they form a joint.



1. Cricoid cartilage:

- The most inferior of the laryngeal cartilages.
 - Shaped like a 'signet ring.'
 - It has a narrow **arch anteriorly** and a broad **lamina posteriorly**. [completely encircles the airway].
 - **Facets: 2 facets on each side:**
- One on the lateral surface near the base and is for articulation with the inferior horn of thyroid cartilage.
 - One facet is on the sloping superolateral surface and articulates with the base of an arytenoid cartilage.

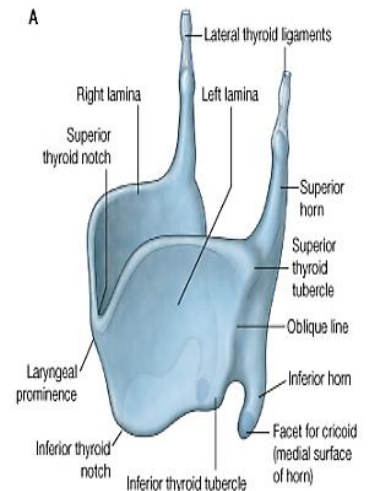
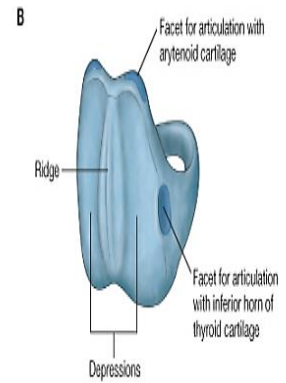


In other words, we have 4 facets. The upper two articulate with arytenoid cartilage, and the lower lateral two articulate with the inferior horn of thyroid cartilage.

- The posterior surface of the lamina has two oval depressions for attachment of the posterior crico-arytenoid muscle. They are separated by a ridge, which is for the attachment of the esophagus.

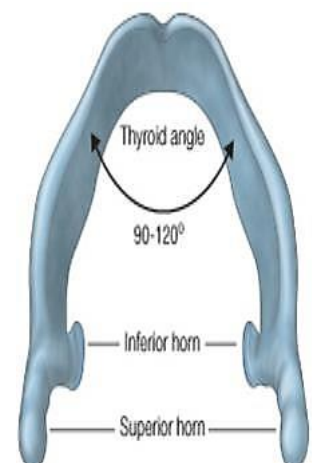
2. Thyroid cartilage

- The largest of the laryngeal cartilages. It has a relation with the lateral lobes of the thyroid gland.
- It is formed by a right and a left lamina:
 - ✓ **Anteriorly** they converge forming the laryngeal prominence.
 - ✓ **Posteriorly** they are widely separated.
- Superior to the laryngeal prominence, the **superior thyroid notch** separates the two laminae. The superior thyroid notch and the laryngeal prominence are palpable landmarks in the neck.
- The less distinct **inferior thyroid notch** is in the midline along the base of the thyroid cartilage.
- The posterior margin of each lamina is elongated to form a superior horn and an inferior horn:
 - ✓ **The inferior horn:** The medial surface articulates with the cricoid cartilage.
 - ✓ **The superior horn** connects with the greater horn of the hyoid bone by the thyrohyoid ligament.
- The lateral surface of lamina is marked by a ridge (**the oblique line**) which curves anteriorly from the base of the superior horn to the inferior margin of the lamina. The ends of the oblique line are expanded to form the **superior and inferior thyroid tubercles**.
- The oblique line is important for the attachment of the strap muscles of the neck (sternothyroid, thyrohyoid, and inferior constrictor).



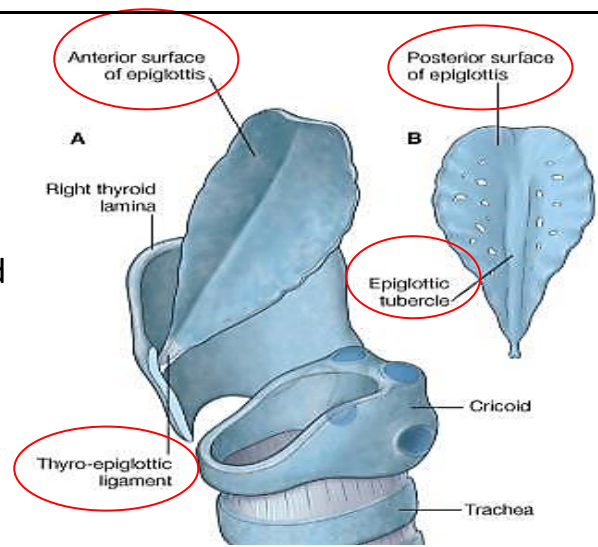
Laryngeal Prominence (Adam's apple): It is prominent in males and less prominent in females, as the angle between the two laminae is more acute in men (90°) than in women (120°). This difference is due to hormonal secretions; in males testosterone is secreted which causes the bones to be heavy and bulky and the muscles are large and strong so this leads to the formation of an acute angle that causes the voice to be low pitched (the true vocal cord is **longer** in males than in females).

In contrast, in females estrogen and progesterone are secreted, which cause the muscles and bones to be smooth and light, so the muscles do not affect the angle of the thyroid and it stays obtuse, and the voice in females becomes high pitched (the true vocal cord is shorter in females than in males).



3. Epiglottis

- It is a 'leaf-shaped' cartilage.
- It has a superior free edge and an apex that attaches in the midline between the laryngeal prominence and the inferior thyroid notch internally through the thyro-epiglottic ligament.
- It has two surfaces:
 - a. **Superoanterior** surface
 - b. **Posteroinferior** surface: Contains the epiglottic tubercle and ridge.

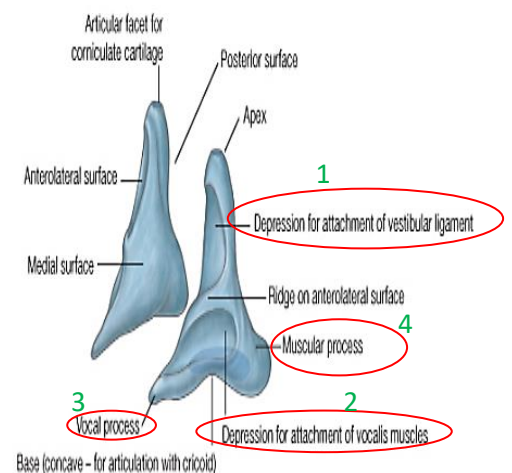
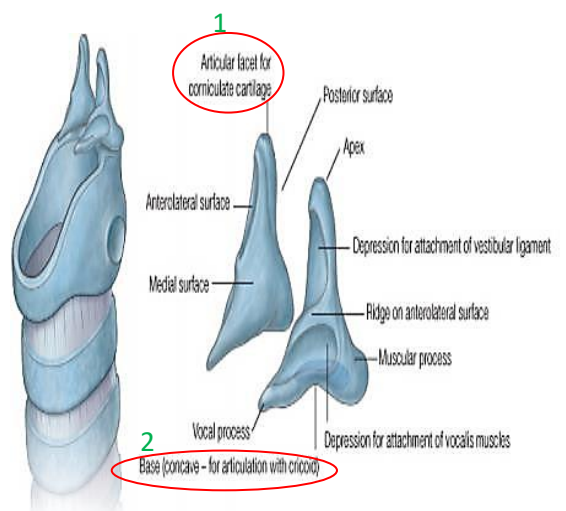


Histology corner:

The superoanterior surface has the same epithelium as the oral cavity: stratified squamous nonkeratinized epithelium (as it's located behind the pharyngeal part of the tongue). On the other hand, the posteroinferior surface has respiratory epithelium: pseudo...

4. Arytenoid cartilage:

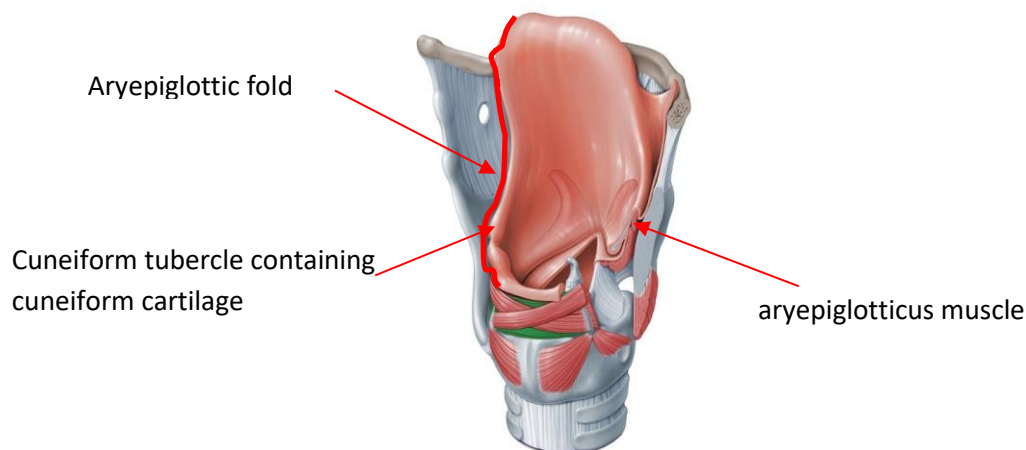
- The two arytenoid cartilages are pyramid-shaped, each one has an apex and a base:
 - a. The **apex** of arytenoid cartilage has a facet¹ that articulates with **corniculate cartilage**.
 - b. The **base** of arytenoid cartilage is concave (has a depression²) that articulates with the facet on the superolateral surface of the cricoid cartilage.
- Each arytenoid cartilage has two surfaces:
 - a. **Medial surface**: Smooth
 - b. **Lateral surface**: Has a ridge separating two depressions. The **upper depression**¹ is for the attachment of the vestibular vocal cord (false vocal cord) by the vestibular ligament (false vocal ligament) and the **lower depression**² is for the attachment of the vocalis muscle, which is a part of the true vocal cord.
- The base of arytenoid cartilage has:
 - a. **A vocal process anteriorly**³ to which the vocal ligament of true vocal cord is attached.



b. **A muscular process posterolaterally**⁴ for the attachment of the posterior and lateral cricoarytenoid muscles.

– Between the arytenoid and the epiglottis, there is a fold of fibroelastic membrane, called the **aryepiglottic fold** because it extends from the arytenoid to the epiglottis. This fold is very important because:

- ✓ It contains the aryepiglotticus muscle, which helps the inlet close backward and downward.
- ✓ It contains the pair of cuneiform cartilages.



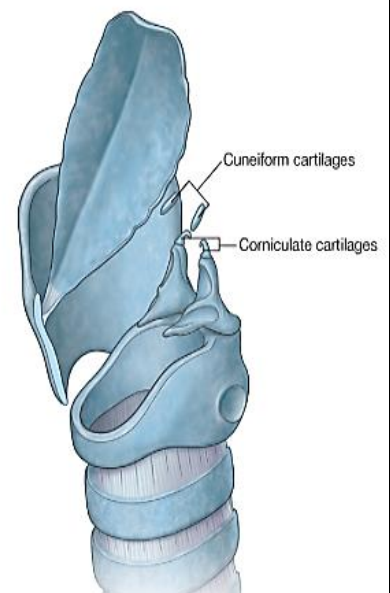
5. Corniculate and Cuneiform Cartilages:

a. Corniculate cartilages:

Two small conical cartilages that articulate with the apex of the arytenoids and mark the end of the aryepiglottic fold (membrane). Their apices project posteromedially towards each other.

b. Cuneiform cartilages:

Two small club-shaped cartilages that lie anterior to the corniculate cartilage. They are suspended in the aryepiglottic fold to add a bony strength to help in closure of the laryngeal inlet.



– Membranes and ligaments of the larynx

We can divide them into extrinsic and intrinsic membranes or ligaments. And from the name of the ligament we can know its attachments.

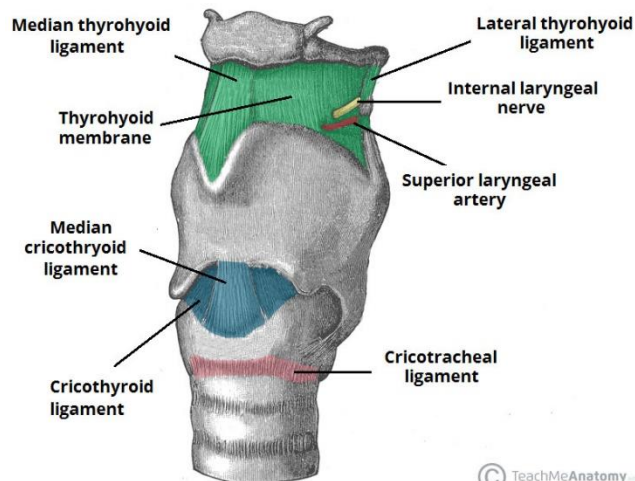
Extrinsic ligaments:

1. Thyrohyoid membrane
2. Hyo-epiglottic ligament
3. Cricotracheal ligament

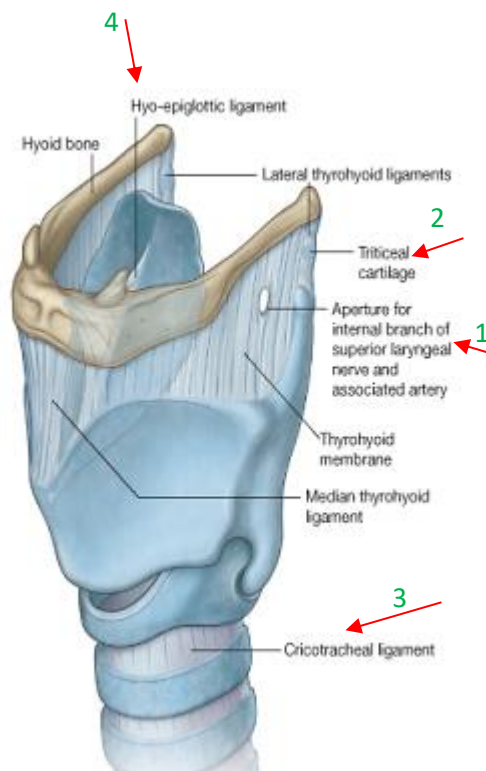
****A membrane is a sheet of fibrous tissue. A ligament is a folded membrane, making it a double-layer band of fibrous tissue.**

1. Thyrohyoid membrane:

- A tough fibroelastic ligament that spans between the superior margin of the thyroid cartilage below and the hyoid bone above. It is attached to the thyroid laminae and adjacent anterior margins of the superior horns of the hyoid bone. It ascends medial to the greater horns and posterior to the body of the hyoid bone to attach to the superior margins of these structures.



- The **posterior** borders of the thyrohyoid membrane are thickened to form the lateral thyrohyoid ligaments. They are also thickened **anteriorly** in the midline to form the median thyrohyoid ligament.
- There is an opening¹ in the lateral part of the thyrohyoid membrane on each side for the passage of:
 - a. Superior laryngeal artery
 - b. Internal laryngeal nerve
 - c. Lymphatic vessels.
- Occasionally, there is a small cartilage (triticeal cartilage²) in each lateral thyrohyoid ligament to give strength to the ligament.



2. Cricotracheal ligament³

Runs from the lower border of the cricoid cartilage to the adjacent upper border of the first tracheal cartilage.

3. The hyo-epiglottic ligament⁴

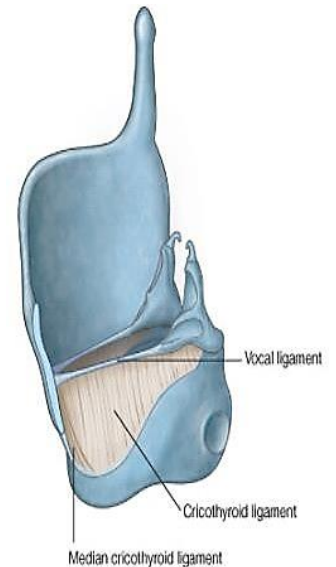
Extends from the midline of the epiglottis anterosuperiorly to the body of the hyoid bone.

Intrinsic ligaments

The fibro-elastic membrane of the larynx that links the cartilage together and completes the architectural framework of the laryngeal cavity. It is composed of two parts: a lower **cricothyroid ligament** and an upper **quadrangular membrane**.

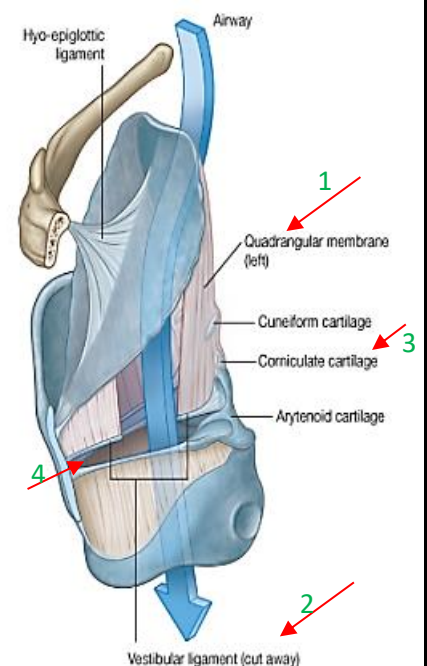
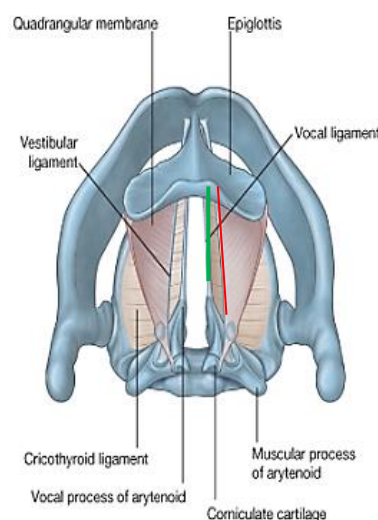
1. Cricothyroid ligament

- Also named the cricovocal membrane, cricothyroid membrane or **conus elasticus**.
- Originates from the arch of cricoid cartilage and extends superiorly to end in a free upper margin within the space enclosed by the thyroid cartilage.
- The upper free margin thickens and attaches to the vocal process of the arytenoid cartilage posteriorly, and the angle of thyroid cartilage anteriorly, forming the **vocal ligament**, which is under the vocal fold (true vocal cord) of the larynx.
- The cricothyroid ligament is also thickened anteriorly in the midline to form the **median cricothyroid ligament**.
- In emergency situations, the median cricothyroid ligament can be perforated to establish an airway.



2. Quadrangular ligament¹

- Originates from the lateral margin of the epiglottis and attaches to the anterolateral surface of arytenoid.
- The free upper margin extends from the aryepiglottic fold. The free lower margin thickens and forms the vestibular ligament² under the vestibular fold (false vocal cord).
- Attaches to the corniculate cartilage³.
- The vestibular ligament is separated from the vocal ligament below by a gap⁴.
- When viewed from above, the **vestibular ligament** is lateral to the **vocal ligament**.





Muscular Intruder:

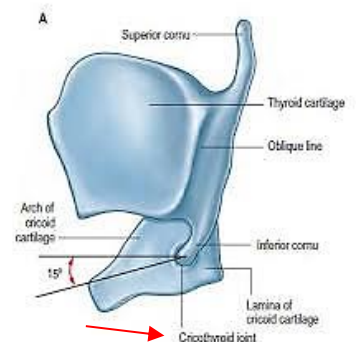
All muscles of the larynx are intrinsic and innervated by the recurrent laryngeal nerve, except for one lonely extrinsic muscle: the **cricothyroid muscle**. It is innervated by the external laryngeal nerve and is responsible for the high-pitched voice by tensing the true vocal cord.

* The doctor said that the cricothyroid muscle is important.

♥ Laryngeal joints (synovial joints)

1. Cricothyroid joints:

- Formed between the cricoid cartilage and the inferior horn of thyroid cartilage. It is surrounded by a capsule and is reinforced by associated ligaments.
- It enables the thyroid cartilage to move forward and tilt downwards on the cricoid cartilage. This movement effectively lengthens and puts tension on the vocal ligaments.



2. Cricoarytenoid joints:

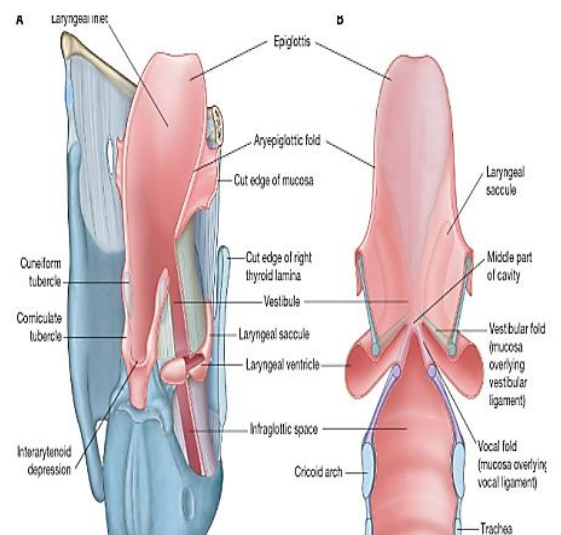
- Formed between articular facets on the superolateral surfaces of the cricoid cartilage and the bases of the arytenoid cartilages
- The crico-arytenoid joint is a synovial pivot joint and it has a rotatory movement for arytenoid over cricoid cartilage. So if the joint moves **internally** (toward the midline) the vocal cord (lateral cricoarytenoid muscle) adducts. If it moves **externally** the vocal cord (posterior cricoarytenoid muscle) abducts.



(This animation may be useful to imagine this joint movement: <https://www.youtube.com/watch?v=k9n9az3hfeY>)

♥ Laryngeal cavity

- The central cavity of the larynx is tubular in shape and is lined by mucosa.
- Support is provided by the fibro-elastic membrane of the larynx and by the cartilages to which it is attached.
- The superior aperture of the cavity (laryngeal inlet) opens into the anterior aspect of the pharynx just below and posterior to the tongue.



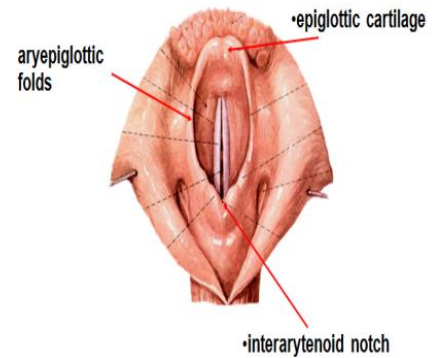
As we've said before, the closure of the inlet is controlled by the larynx moving upwards and the epiglottis moving backwards and downwards aided by the aryepiglotticus muscle and the transverse arytenoid muscle.

**The closure is important in deglutition, as we don't want any food particles to reach the airway, or else a coughing reflex will be initiated.

Borders of the inlet:

- ✓ **Anterior border:** Formed by mucosa covering the superior margin of the epiglottis.
- ✓ **Lateral borders:** Formed by mucosal folds (aryepiglottic folds).
- ✓ **Posterior border:** In the midline it is formed by a mucosal fold that forms a depression (inter-arytenoid notch) between the two corniculate tubercles.

Laryngeal cavity
inlet of larynx — bounded by upper border epiglottic cartilage, aryepiglottic folds and interarytenoid notch

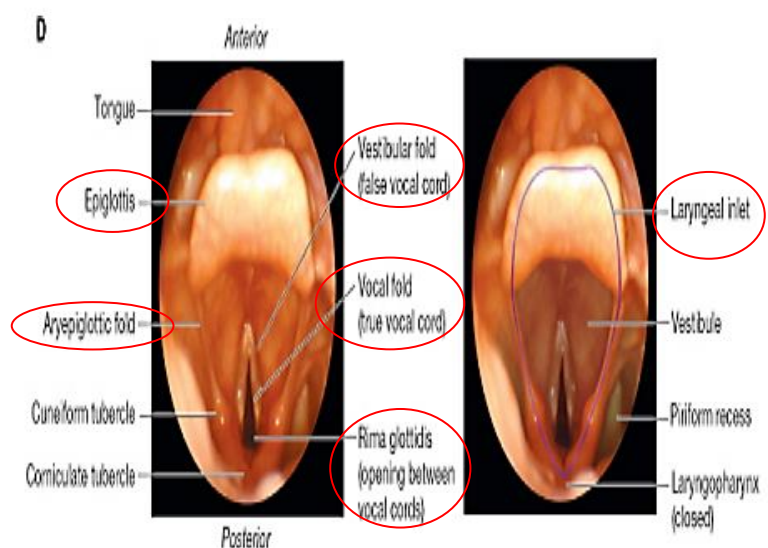


This view ↓ clearly shows the true vocal cords and the inlet between them would take you to the glottic part (rima glottidis) of the larynx (more about it in the next sheet).
Now, why is this important?

Sometimes, patients may go under anesthesia and will be unable to breath on their own during surgery, or they may be too sick or injured to provide enough oxygen to the body without assistance. So, **intubation** is done. In this procedure, a tube is inserted through the mouth right into the trachea through the larynx. Now, when you pass the tube through the larynx, you have to make sure you insert it through the rima glottidis to make sure that the airway stays open.

Aryepiglottic folds:

- Enclose the superior margins of the quadrangular membranes and adjacent soft tissues.
- Two tubercles on the more posterolateral margin side mark the positions of the underlying cuneiform and corniculate cartilages. (See page 5)



Good luck ♥