



# RS

## ANATOMY

### MODIFIED NO. 4



كتابة: صهيب زعيتر وعمر الصمادي

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# The Larynx

The topics of these lecture:

- Muscles of larynx (Intrensic and Extrensic muscles)
- Functions of larynx (4 main functions)
- Blood supply and nerve supply of larynx
- Some interesting clinical notes

Let's start

هانت! بسم الله

## Color code

Slides

Doctor

Additional info

Important

# Muscles of the larynx

# Intrinsic muscles

The muscles of the larynx either work on the true vocal cords or on the inlet of the larynx.

- Adjust tension in the vocal ligaments,  
They can cause tension or relaxation of the vocal ligament.
- Open and close the rima glottidis,  
Rima glottidis: It is the space between the true vocal cords. Narrowing (adduction) or widening (abduction) occurs in this space.
- Control the inner dimensions of the vestibule (the region between the laryngeal inlet and the vestibular folds)  
because the inlet is connected to vestibule.
- Close the rima vestibuli.  
Rima vestibuli: It is the space between the false vocal cords. As stated, it has no importance at all.

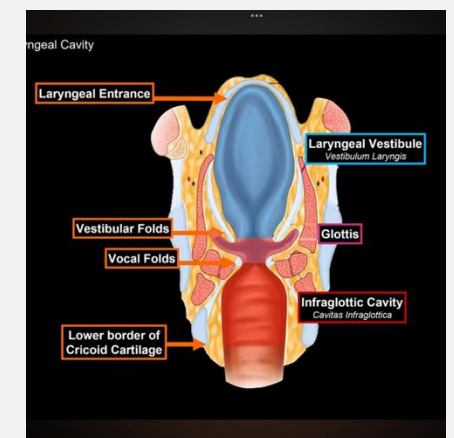
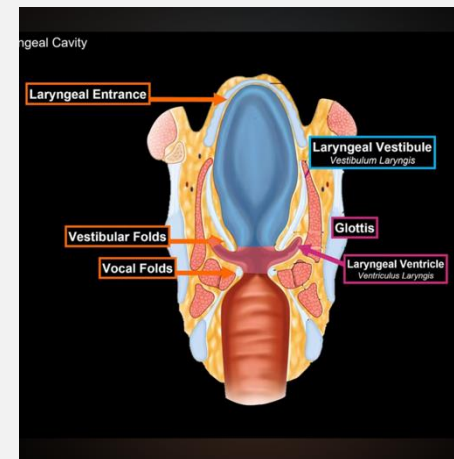
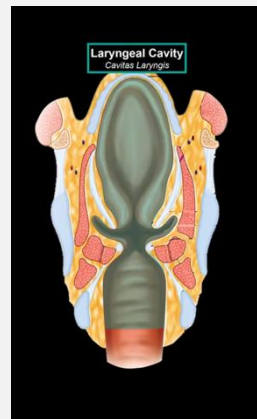
The **rima glottidis** and **rima vestibuli** are both anatomical spaces within the larynx, but they differ in location and function:

### Rima Glottidis:

- **Location:** It is the space between the vocal folds (true vocal cords) in the glottis region, which is the middle part of the larynx.

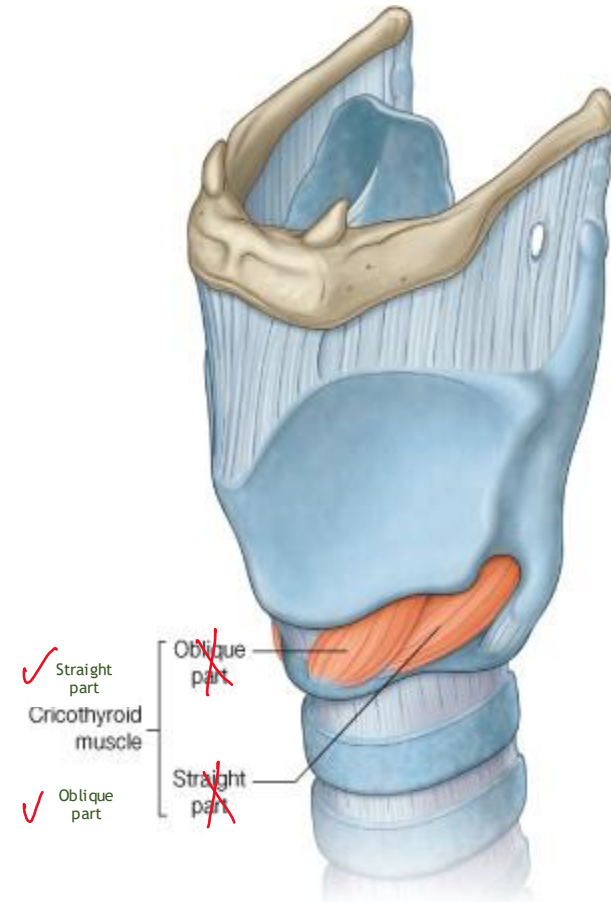
### Rima Vestibuli:

- **Location:** It is the space between the vestibular folds (false vocal cords) located above the rima glottidis in the vestibule of the larynx.



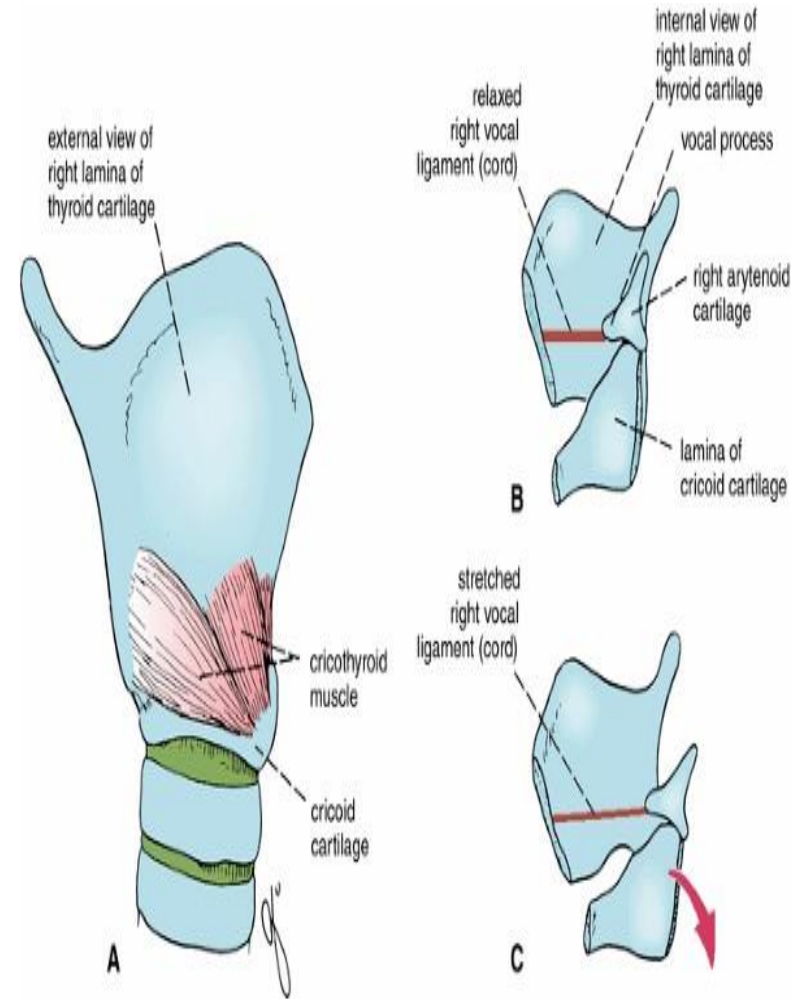
# Cricothyroid muscles

- Fan-shaped muscles
- Attached to the anterolateral surfaces of the cricoid cartilage and expand superiorly and posteriorly to attach to the thyroid cartilage
- Each muscle has an oblique part and a straight part:
- The **oblique part** runs in a posterior direction from the arch of the cricoid to the inferior horn of the thyroid cartilage
- The **straight part** runs more vertically from the arch of the cricoid to the posteroinferior margin of the thyroid lamina



# Cricothyroid muscles

- Pull the thyroid cartilage **forward** and **rotate** it down relative to the cricoid cartilage.  
in synovial joint between inferior horn of thyroid and cricoid
- These actions **Tenses of true vocal cords**
- Are the only intrinsic muscles innervated by the **superior laryngeal branches** of the vagus nerves  
it is supplied by **external laryngeal** nerve which is **branch of superior laryngeal** nerve which is branch of vagus nerve.
- All other intrinsic muscles are innervated by the **recurrent laryngeal branches** of the vagus nerves

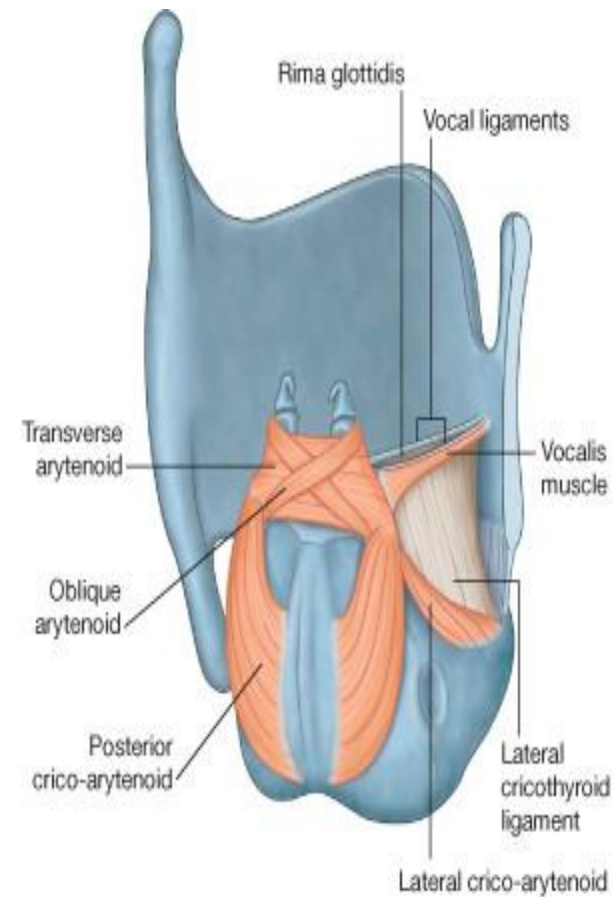


# Posterior crico-arytenoid muscles

- There is a right and a left **posterior crico-arytenoid**
- The fibers of each muscle originate from the Back of cricoid cartilage , and run superiorly and laterally to the muscular processes of the arytenoid cartilage
- **Abducts the vocal cords** by rotating arytenoid cartilage

when its contracts it pulls muscular process outward, causing abduction.

- Innervated by the **recurrent laryngeal branches** of the vagus nerves





# Lateral crico-arytenoid muscles

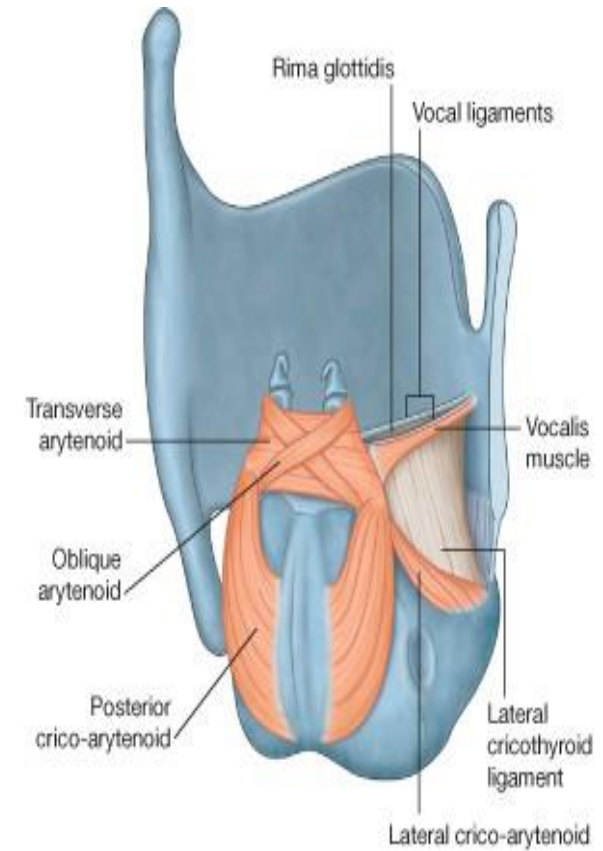
Opposite to Posterior crico-arytenoid muscles

- Muscle on each side originates from the Upper border of cricoid cartilage , and runs posteriorly and superiorly to insert on the muscular process of the arytenoid

- **Adducts the vocal cords** by internally rotating arytenoid cartilage

When its contracts it pulls muscular process inward, causing adduction

- Innervated by the **recurrent laryngeal**

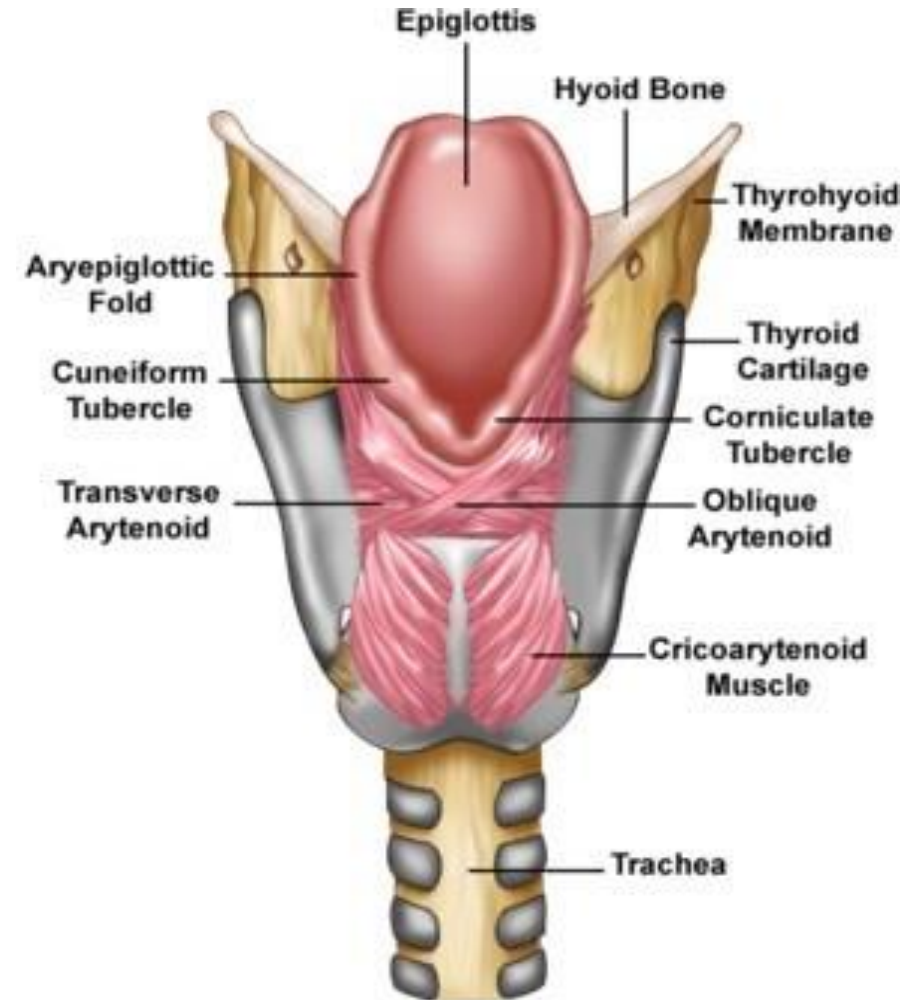


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The action of posterior and lateral crico arytenoid muscles  
[https://youtu.be/DXZZpMwPeJ4?si=n0HmSfVKb\\_A8vkV2](https://youtu.be/DXZZpMwPeJ4?si=n0HmSfVKb_A8vkV2)

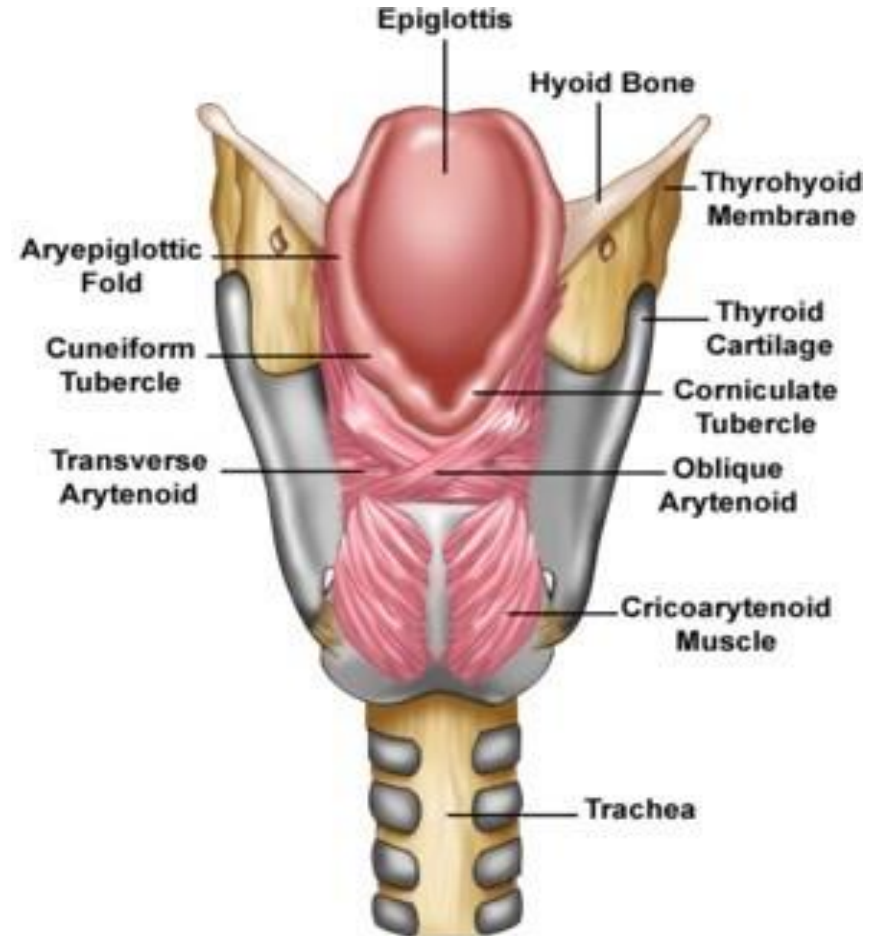
# Transverse arytenoid

- Originates from Back and medial surface of arytenoid cartilage and insert in the Back and medial surface of opposite arytenoid cartilage
- **Closes posterior part of rima glottidis** by approximating arytenoid cartilages  
When contraction occurs, it pulls the arytenoids towards each other, leading to the narrowing of the rima glottidis posteriorly.
- Recurrent laryngeal nerve



# Oblique arytenoid

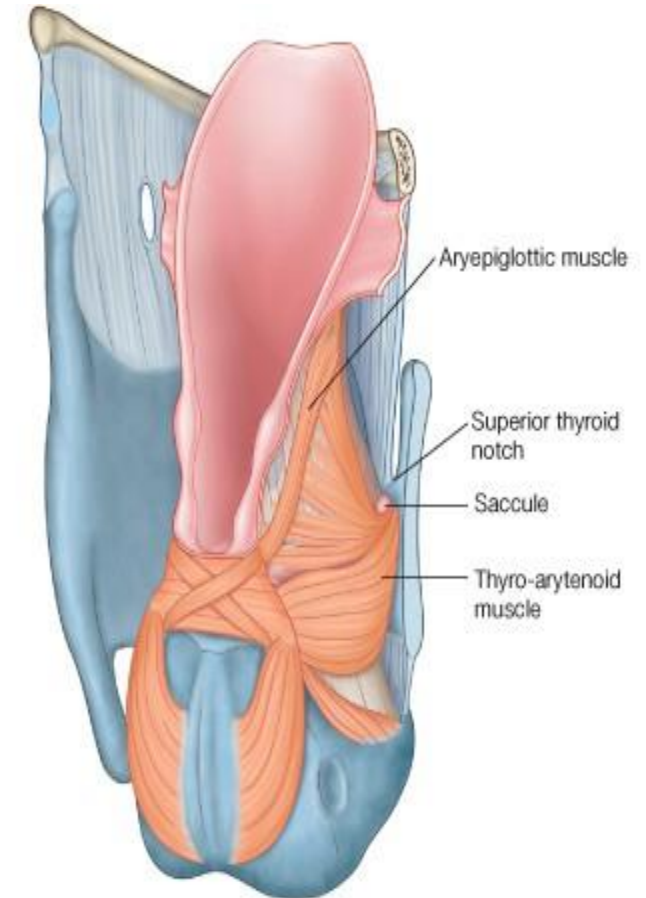
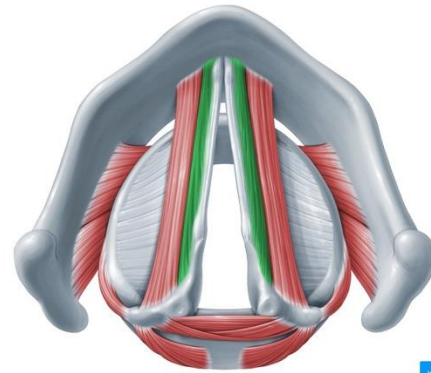
- From the Muscular process of arytenoid cartilage to the Apex of opposite arytenoid cartilage
- **Narrows the inlet of larynx** by bringing the aryepiglottic folds together
- **Recurrent laryngeal nerve**



# Thyroarytenoid (vocalis)

- From the Inner surface of thyroid cartilage to the Arytenoid cartilage

The vocalis muscle is a part of the thyroarytenoid muscle, specifically the part that is attached to the vocal cord.



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- **Relaxes vocal cords) or**  
laxation of vocal cords(
- **Recurrent laryngeal nerve**

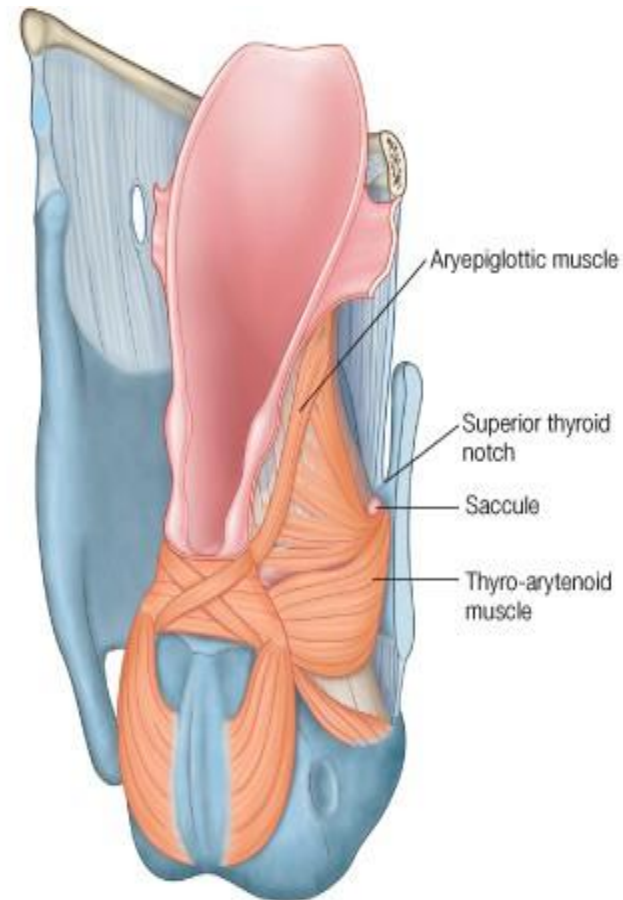
# Thyroepiglottic (aryepiglottic muscles)

- From the Medial surface of thyroid cartilage to the Lateral margin of epiglottis and aryepiglottic fold

At the edge of the epiglottis, its contraction leads to the widening of the inlet of the larynx that is opposite action to oblique arytenoid muscle action.

- **Widens the inlet** by pulling the aryepiglottic folds apart

- **Recurrent laryngeal nerve**



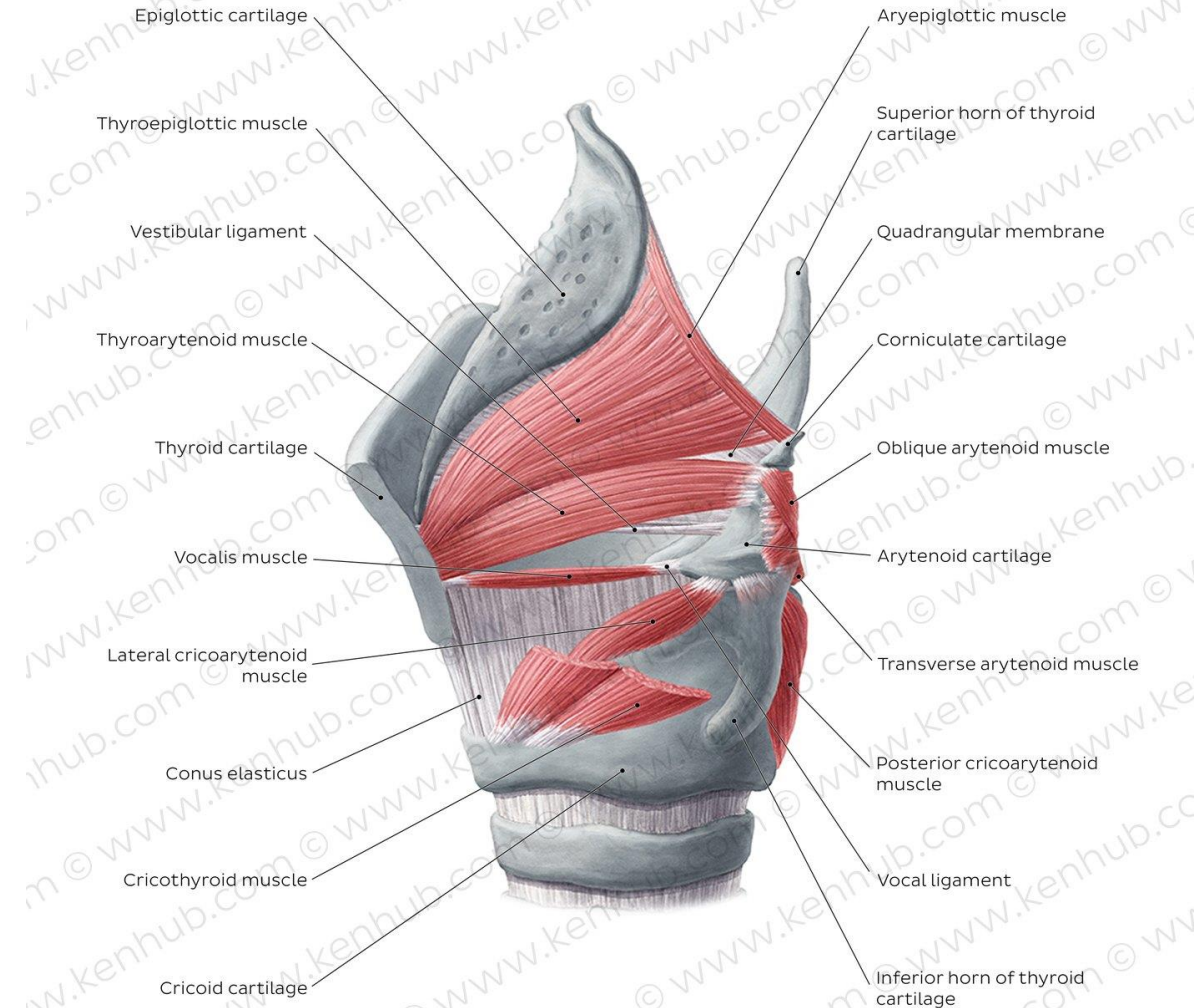
Extra table:

B-Intrinsic muscles: subdivided into two groups :		
Muscles controlling the laryngeal inlet	Oblique Arytenoid muscle	
	Aryepiglottic muscle	
Muscles controlling Movement of the vocal cord	Decrease Vocal cord length and tension	Thyroarytenoid muscle (Vocalis)
	Increase vocal cord length and tension	Cricothyroid muscle (Only one can found outside the larynx)
	Adductors	<u>Lateral</u> Cricoarytenoid
		Transverse Arytenoid
	Abductors	<u>Posterior</u> Cricoarytenoid

## Intrinsic muscles Extra picture

There are links in the last slide for certain muscles if you want to gain a better understanding.

Check them if you want 😊



# Extrinsic muscles

These muscles attached the larynx with other structures.

## suprahyoid muscles:

- Elevators of the larynx:
  - 1. Digastric muscle
  - 2. Stylohyoid
  - 3. Myelohyoid
  - 4. Geniohyoid
- The larynx moves up in swallowing by these muscles assisted by :
  - Stylopharyngeus, Salpingo-pharyngeus, And Palatopharyngeus.

## infrahyoid muscles

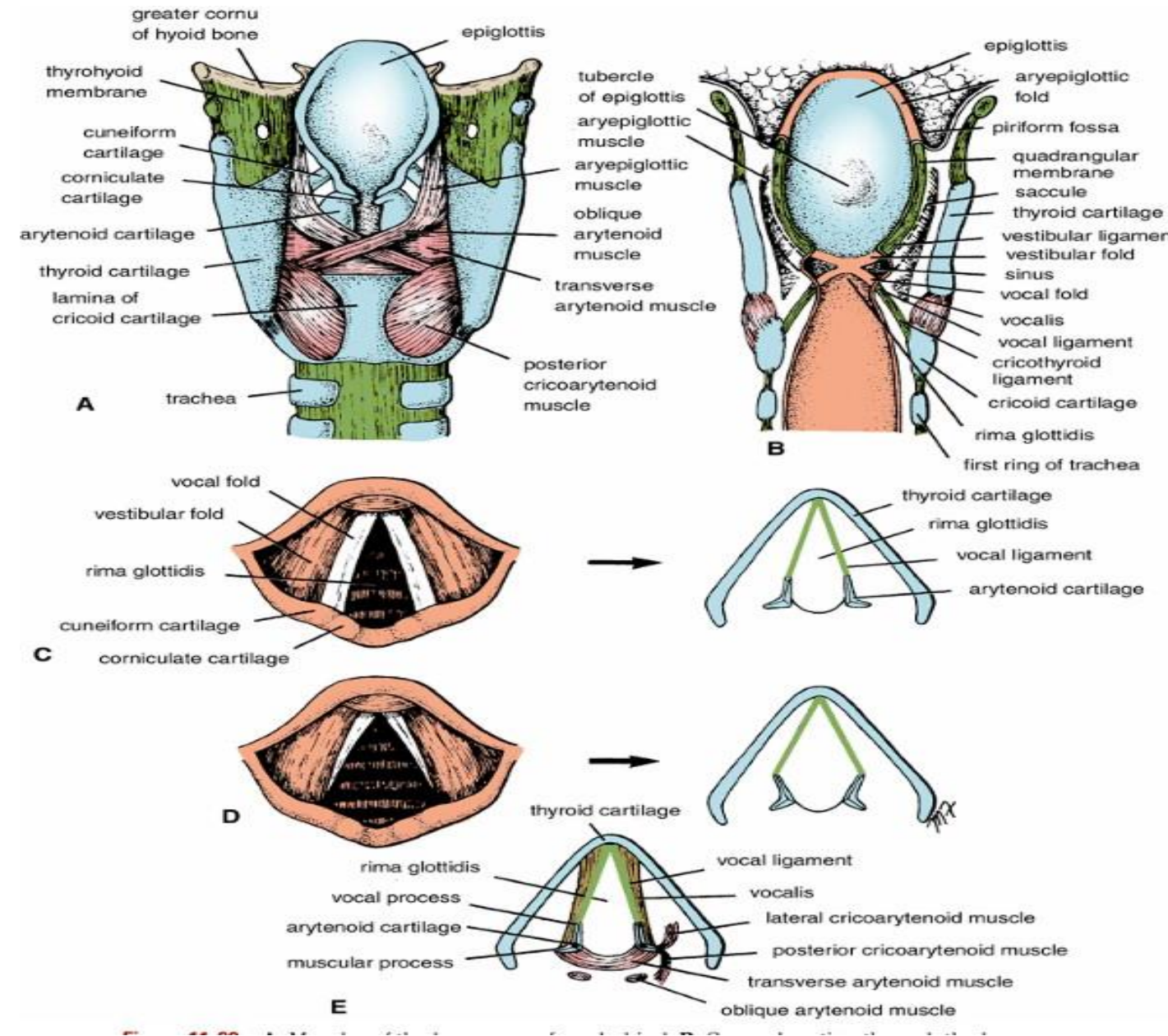
- Depressors of the larynx :
  - 1. Sternothyroid
  - 2. Sternohyoid
  - 3. Omohyoid



# Muscles and Cavity

Doctor here just mention names of some structures that we talked about before.

you can skip it xD

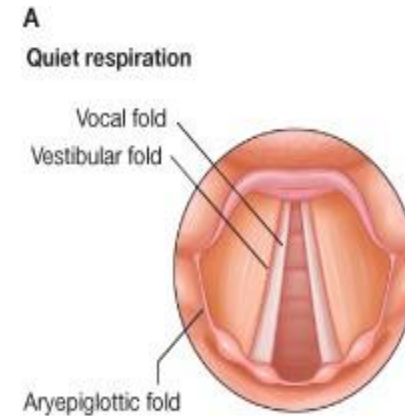


# Function of the larynx

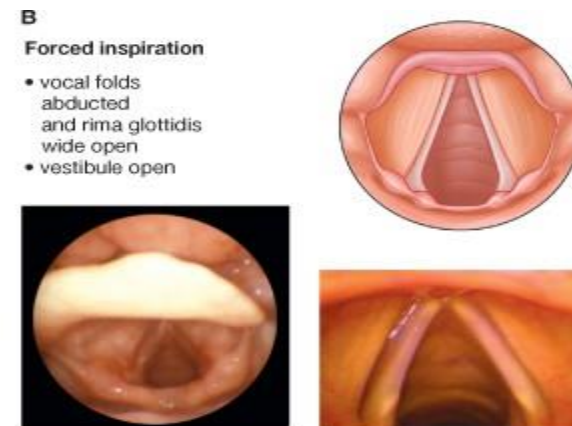
- We talked about all of them in the previous lecture

# Respiration

- During quiet respiration, the laryngeal inlet, vestibule, rima vestibuli, and rima glottidis are **open**
- During forced inspiration the arytenoid cartilages are **rotated laterally**, mainly by the action of the **posterior crico-arytenoid muscles**.
- As a result, the vocal folds are **abducted**, and the **rima glottidis widens** into a rhomboid shape, effectively **increases the diameter of the laryngeal airway**.

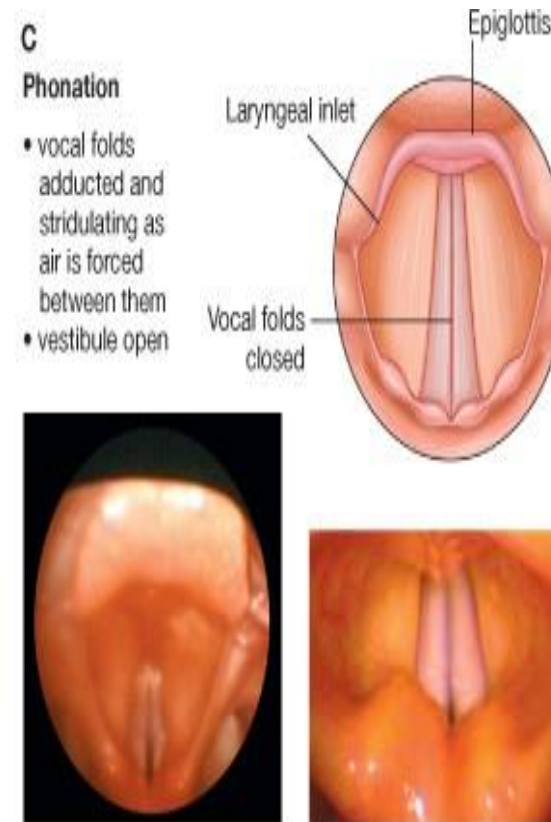


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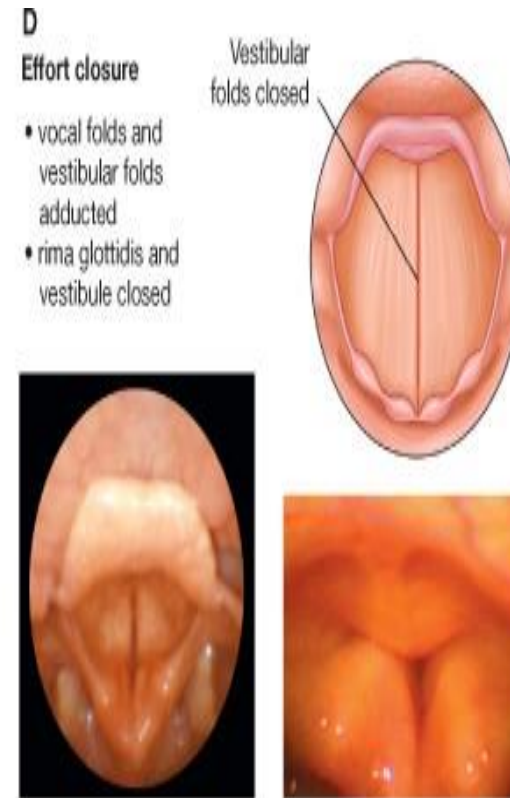
# Phonation

- When phonating, the arytenoid cartilages and vocal folds are **adducted** and air is forced through the **closed rima glottidis**
- This action causes the vocal folds to **vibrate** against each other and produce sounds
- Can then be modified by the upper parts of the airway and oral cavity
- **Tension** in the vocal folds can be adjusted by the **vocalis and cricothyroid muscles**.



# Effort closure

- Effort closure of the larynx occurs when air is retained in the thoracic cavity to **stabilize the trunk**
- For example during heavy lifting, or as part of the mechanism for increasing intra-abdominal pressure
- The rima glottidis is **completely closed**, as is the rima vestibuli and lower parts of the vestibule
- The result is to completely and **forcefully shut the airway**.



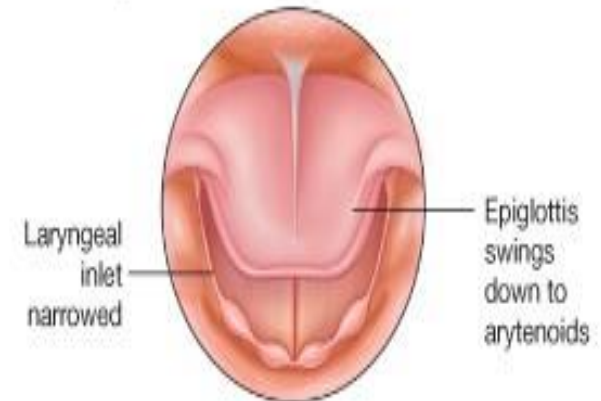
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When someone lifts or carries heavy objects, they take a deep inspiration without exhaling until the task is completed. During this time, the vocal cords remain in an **adducted** state. After finishing the task, a deep expiration follows to release the held breath.

# Swallowing

- During swallowing, the rima glottidis, the rima vestibuli, and vestibule are **closed** and the **laryngeal inlet is narrowed**
- The larynx moves **up and forward**
- This action causes the **epiglottis** to swing **downward** to effectively **narrow or close the laryngeal inlet**
- The up and forward movement of the larynx also **opens the esophagus**
- All these actions together **prevent solids and liquids from entry into the airway**

E  
Swallowing

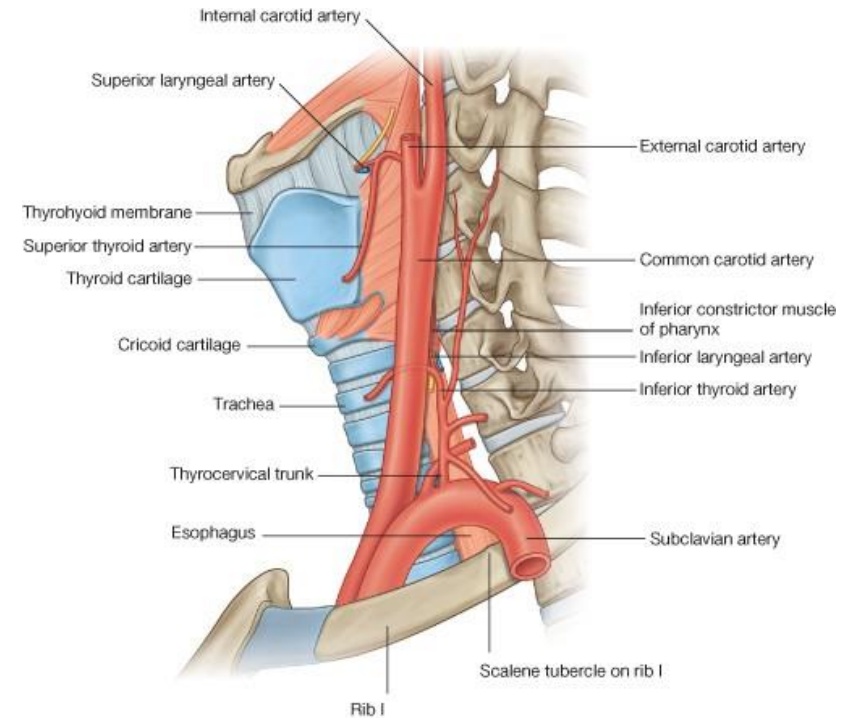


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# Blood Supply

# Arteries

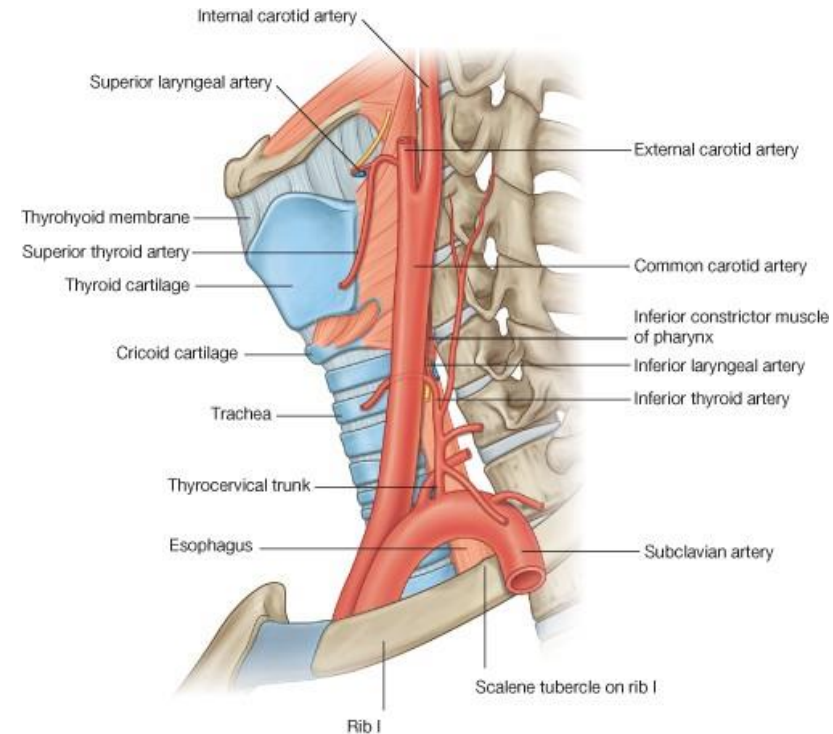
- The major blood supply to the larynx is by the superior and inferior laryngeal arteries
- The **superior laryngeal artery** originates from the superior thyroid branch of the external carotid artery,
- Accompanies the internal branch of the superior laryngeal nerve through the thyrohyoid membrane to reach the larynx.





# Arteries

- The **inferior laryngeal artery** originates from the inferior thyroid branch of the thyrocervical trunk of the subclavian artery
- Together with the recurrent laryngeal nerve, ascends in the groove between the esophagus and trachea
- It enters the larynx by passing deep to the margin of the inferior constrictor muscle of the pharynx;

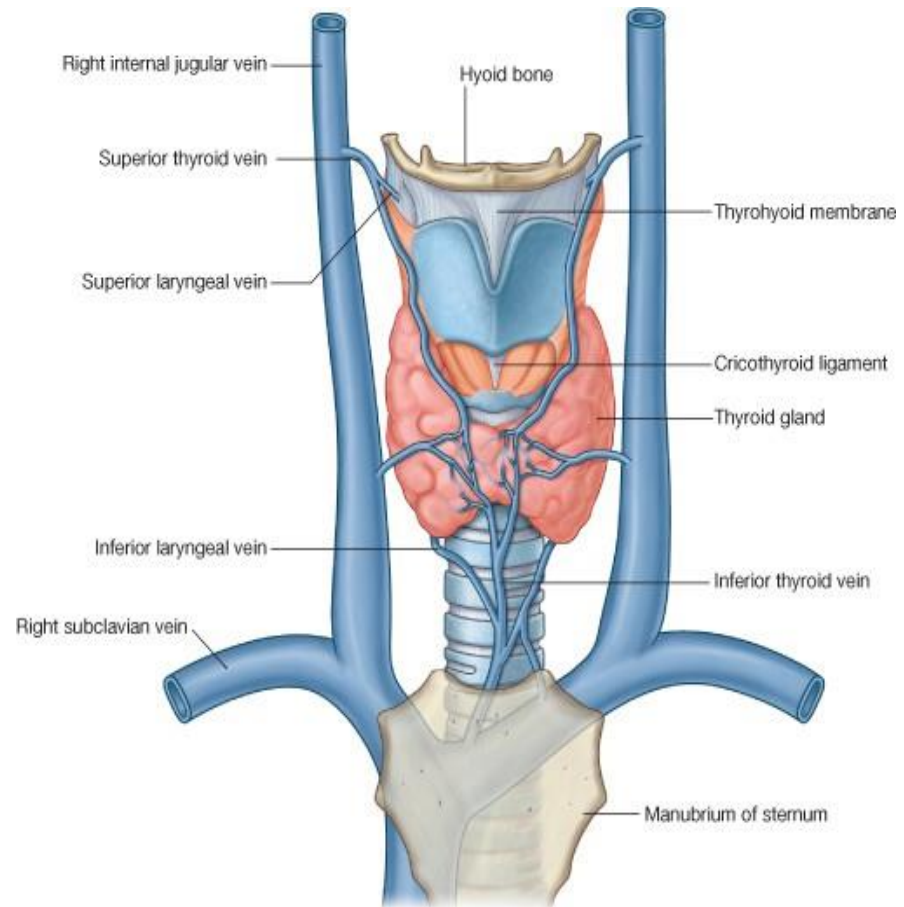


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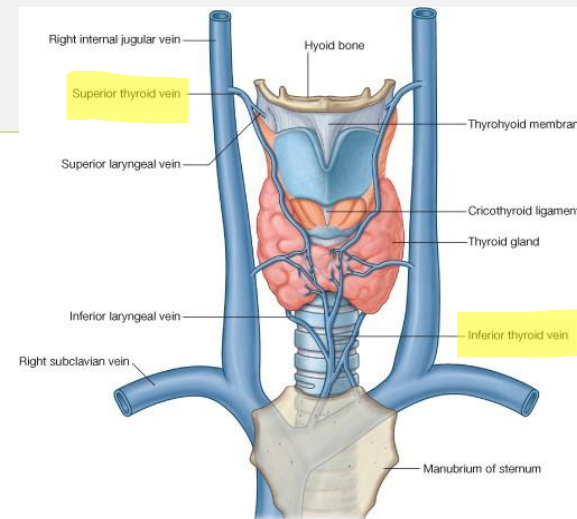
- The blood supply of the larynx comes mainly from the **superior laryngeal** artery and the **inferior laryngeal** artery.
- The superior laryngeal artery is a branch of the superior thyroid artery, a branch of external carotid, it is accompanied by the superior laryngeal nerve (a branch of vagus nerve), it enters the thyrohyoid membrane aperture alongside the **internal laryngeal nerve** (a branch of the superior laryngeal nerve we just mentioned).
- The superior thyroid artery (not laryngeal) supplies the cricothyroid muscle, it is accompanied by the **external laryngeal nerve** (the other branch of superior laryngeal nerve), so in cases of thyroidectomy, the nerve could be accidentally cut resulting in weakness of voice (will be explained later).
- The inferior laryngeal artery is a branch of the inferior thyroid artery -> a branch of thyrocervical trunk -> a branch of subclavian artery, it is accompanied by the recurrent laryngeal nerve, It enters the larynx by passing deep to the margin of the inferior constrictor muscle of the pharynx.

# Veins

- Veins draining the larynx accompany the arteries:
- **Superior laryngeal veins** drain into superior thyroid veins, which in turn drain into the internal jugular veins
- **Inferior laryngeal veins** drain into inferior thyroid veins, which drain into the left brachiocephalic veins.



- The veins have the same course as the arteries but in the opposite direction (of course).
- The superior laryngeal vein drains in the superior thyroid and the inferior laryngeal drains in the inferior thyroid vein.
- **The inferior thyroid vein is usually single and not a pair (right and left), draining in the left brachiocephalic vein.**



# Lymphatics

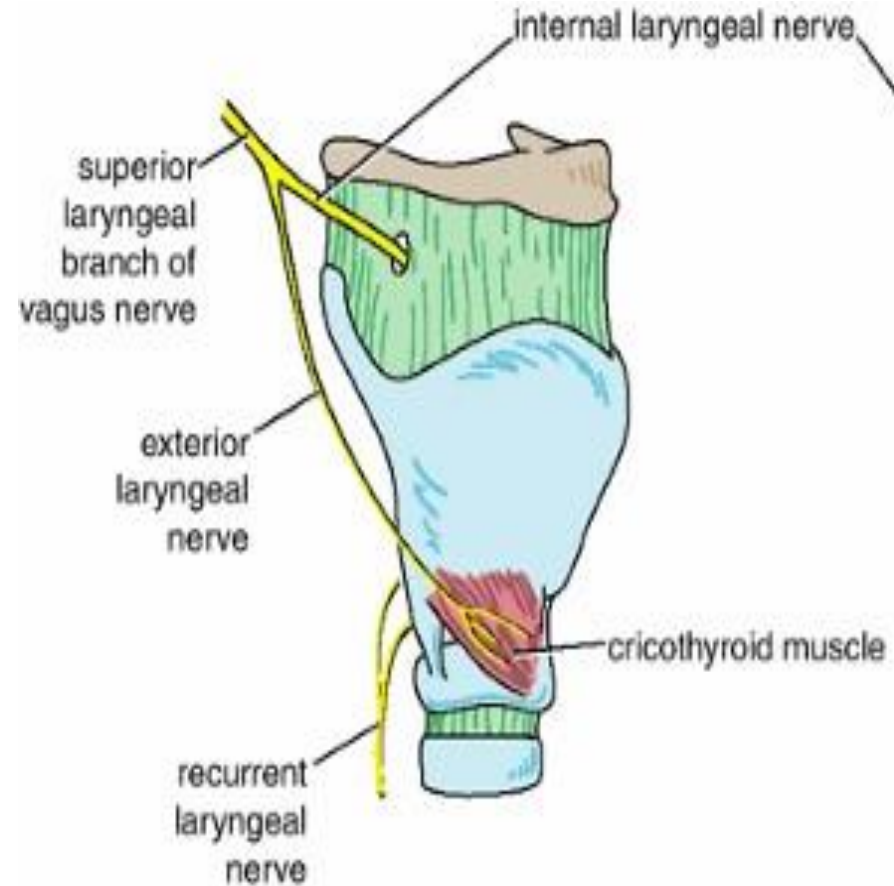
- Lymphatics drain regions above and below the vocal folds:
- Those above the vocal folds follow the superior laryngeal artery and terminate in deep cervical nodes
- Those below the vocal folds drain into deep nodes associated with the inferior thyroid artery
- Or with nodes associated with the front of the cricothyroid ligament or upper trachea.

Called : paratracheal lymph nodes

# Innervations

# Superior laryngeal nerves

- The **superior laryngeal nerves** originate from the inferior vagal ganglia high in the neck
- They descend medial to the internal carotid artery and divide into **internal** and **external branches** above the hyoid bone
- The external branch (**external laryngeal nerve**) descends along the lateral wall of the pharynx to supply the inferior constrictor of the pharynx and ends by supplying the **cricothyroid muscle**;



- Again, the superior laryngeal nerve is divided into internal and external
- As we said before, the external laryngeal nerve accompanies the superior thyroid artery, in case of thyroidectomy if the nerve is accidentally cut it will cause weakness of voice because we lost the function of tensing the vocal cord facilitated by the cricothyroid muscle which is innervated by the external laryngeal nerve.
- Unilateral cutting of external laryngeal nerve would cause weakness of voice without the total loss of it because the other vocal cord would compensate, but the bilateral cut would cause hoarseness of voice (بحّة) .

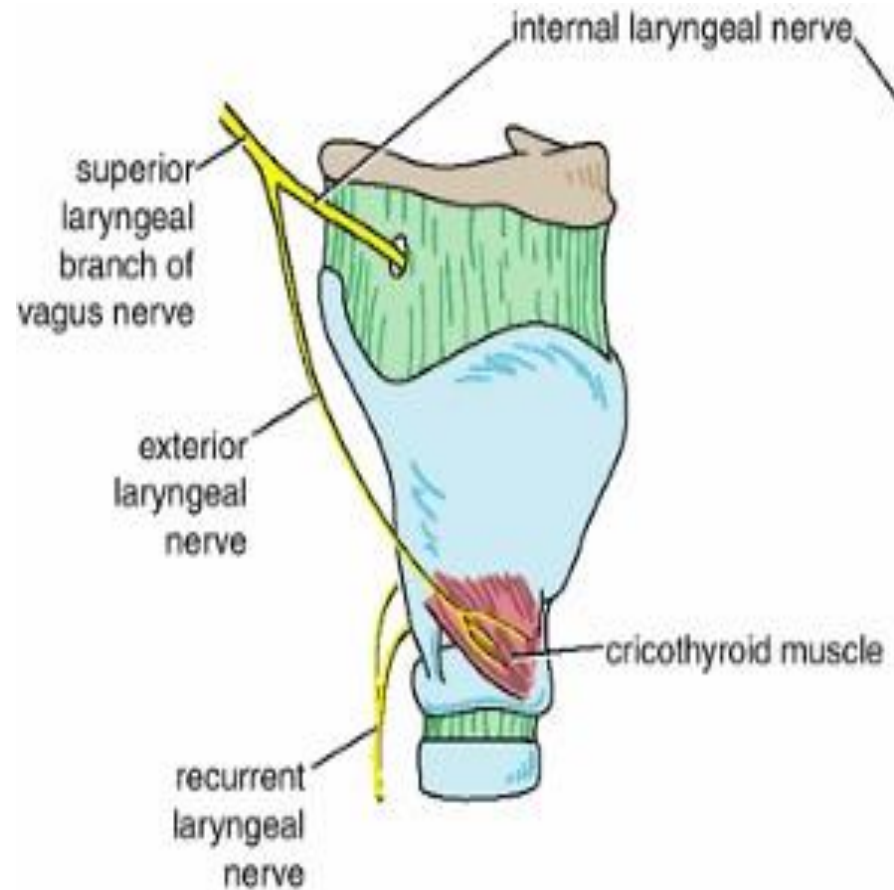




# Superior laryngeal nerves

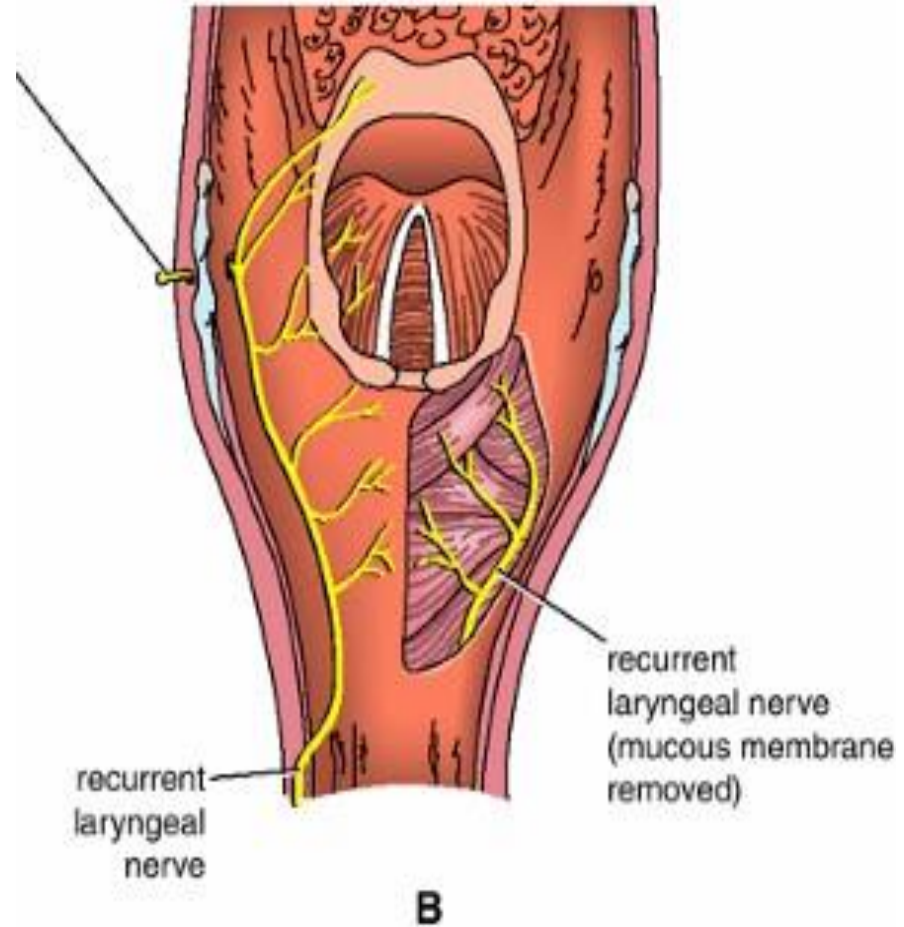
- The **internal laryngeal nerve** passes anteroinferiorly to penetrate the thyrohyoid membrane
- Internal nerve is mainly **sensory** and supplies the laryngeal cavity down to **the level of the vocal folds.**

- The internal laryngeal nerve is a sensory nerve for the mucosa above the true vocal cords



# Recurrent laryngeal nerves

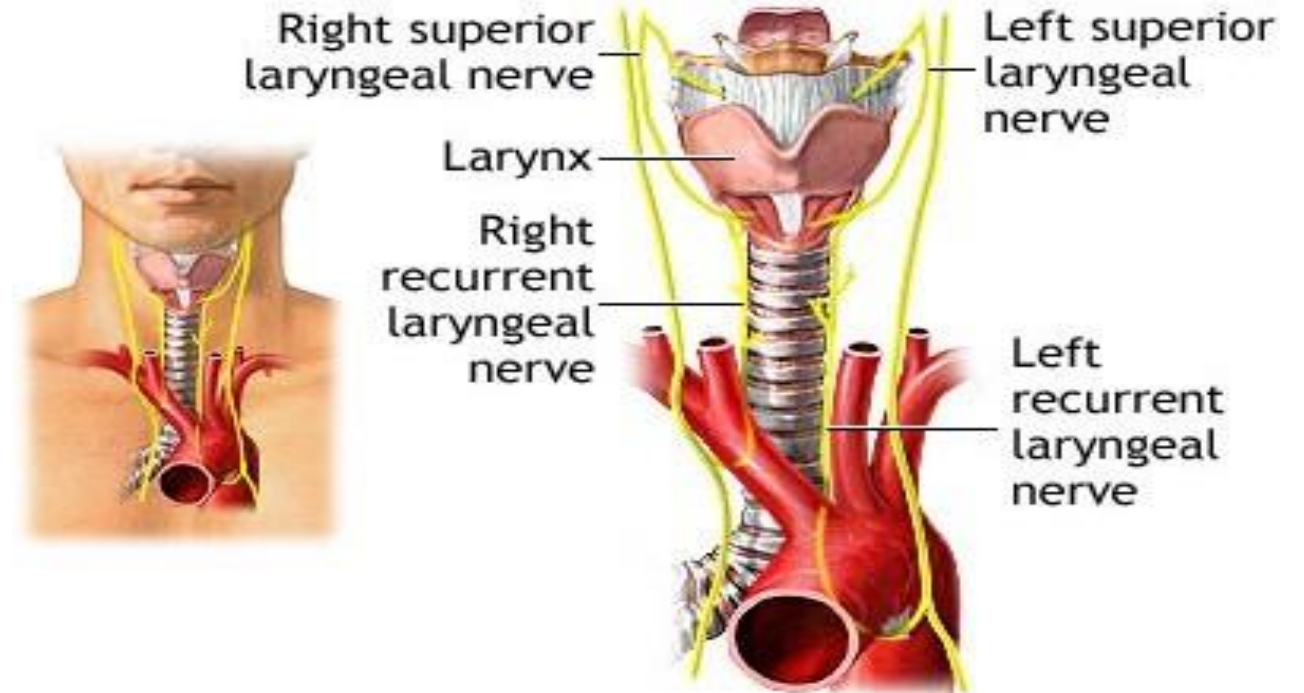
- The recurrent laryngeal nerves are:
- Sensory to the laryngeal cavity **below the level of the vocal folds;**
- Motor to all intrinsic muscles of the larynx **except for the cricothyroid.**



- The recurrent laryngeal nerve is a branch of the vagus nerv.
- It innervates all of the muscles of the larynx (motor) except the cricothyroid muscle that is inner stead by external laryngeal n.
- It is also sensory to the mucosa below the true vocal cords, while the internal laryngeal innervates the are above.

# Recurrent laryngeal nerves

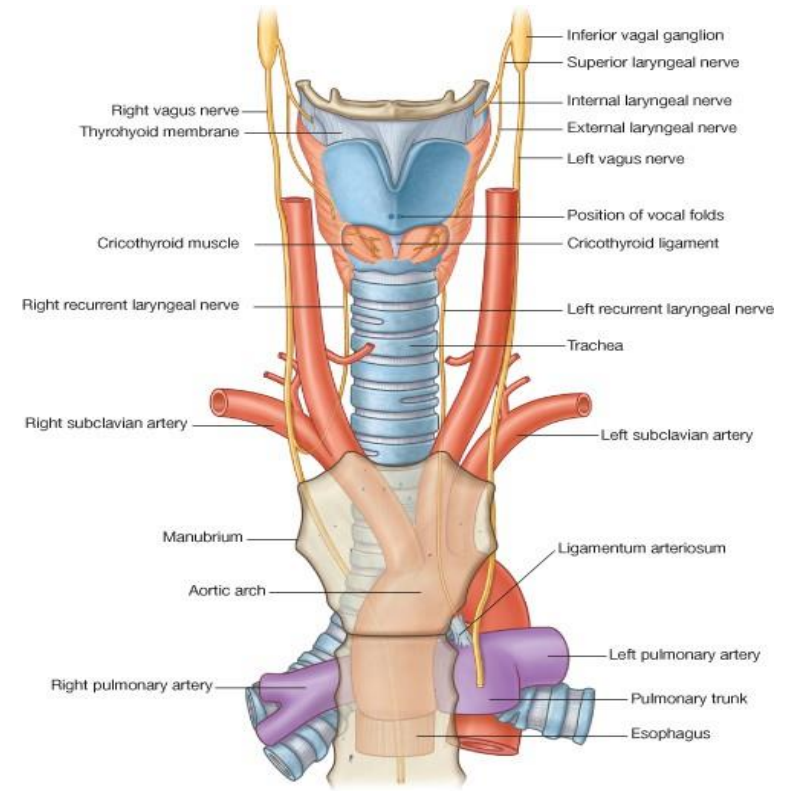
- The **left** recurrent laryngeal nerve originates in the **thorax** whereas the **right** recurrent laryngeal nerve originates in the **root of the neck**
- Both nerves generally ascend in the neck in the groove between the esophagus and trachea
- Enter the larynx deep to the margin of the inferior constrictor



- The course of the recurrent laryngeal is not the same on both sides (right and left).
- The right recurrent turns around the right subclavian artery at the level of the root of the neck, while the left recurrent turns around the arch of aorta at the level of the chest.
- So we conclude that the left recurrent is longer than the right recurrent.
- They both ascend between the trachea and the pharynx in a designated groove accompanying the inferior thyroid artery then the inferior laryngeal artery (upwards).

# Relations of the larynx

- On each side :
- **Carotid sheath (contents), and lateral lobe of the thyroid gland**
- Posterior:
- **Pharynx and the right recurrent laryngeal nerve**
- Inferior: Trachea
- Anterior:
- **Skin, fascia and its contents, 4 infra-hyoid muscles**



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- Laterally, the larynx is surrounded by the lobes of the thyroid gland, it is also related to the carotid sheath and its contents.
- Posteriorly there is the pharynx with the recurrent laryngeal nerve in between them.
- Anteriorly it's related to the skin, fascia and infrahyoid muscles (also called strap muscles).

# Clinical notes

# Thyroidectomy

- Sectioning of the **external laryngeal** nerve might happen in thyroidectomy
- Due to the close relationship between the external laryngeal nerve and the superior thyroid artery.
- Produces **weakness in voice** since the vocal cords cannot be tensed (cricothyroid M.).

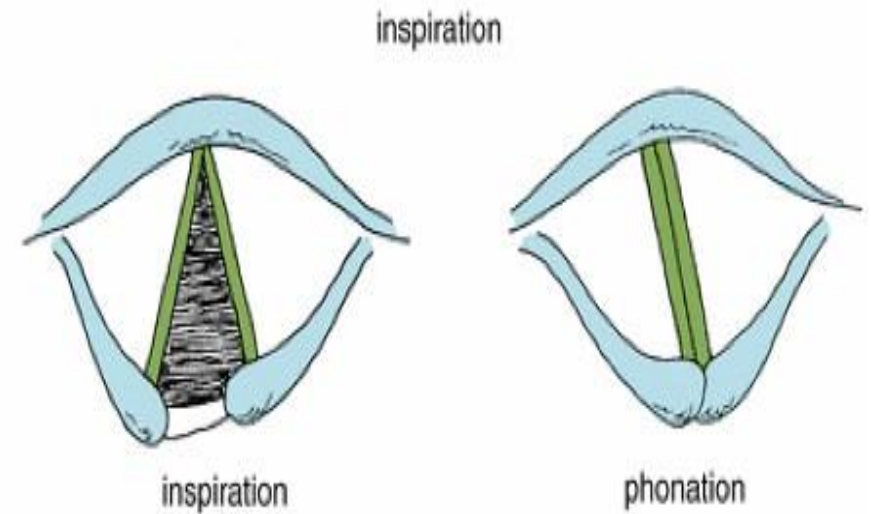


- Again, as we said before, the external laryngeal nerve accompanies the superior thyroid artery, in case of thyroidectomy we ligament the superior thyroid artery but we might accidentally cut the external laryngeal nerve.
- Knowing that the external laryngeal nerve gives motor innervation to cricothyroid muscle, we have two chances :
  1. Unilateral cut : only weakness of voice because the other vocal cord would compensate.
  2. Bilateral cut : hoarseness of voice (بحّة صوت).

# Section of the Recurrent laryngeal nerve

- **1. Unilateral complete section:**
- One vocal fold (on the affected side) in the position midway between abducted and adducted
- Speech not greatly affected as the other vocal cord compensate for the action.

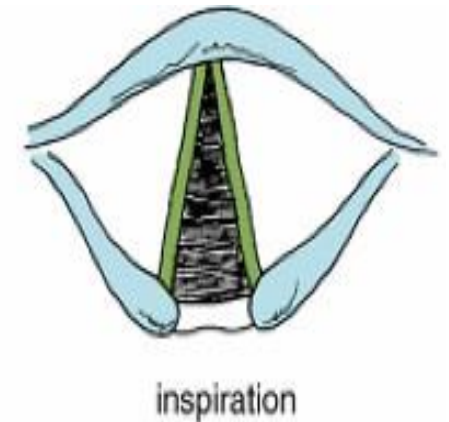
3. Unilateral complete section of right recurrent laryngeal nerve



# Section of the Recurrent laryngeal nerve

- **2. Bilateral complete section:**
- Both vocal folds in position midway between abducted and adducted
- Breathing is impaired since the rima glottis is partially close and speech is lost

2. Bilateral complete section of recurrent laryngeal nerves



# Section of the Recurrent laryngeal nerve

- **3. Unilateral partial section :**

- This results in a greater degree of paralysis of the abductor muscles than of the adductor .
- Therefore the affected cord is in the adducted midline position
- **weakness** of the voice (the other vocal fold compensates the action)

- The hoarseness of voice just in bilateral section.

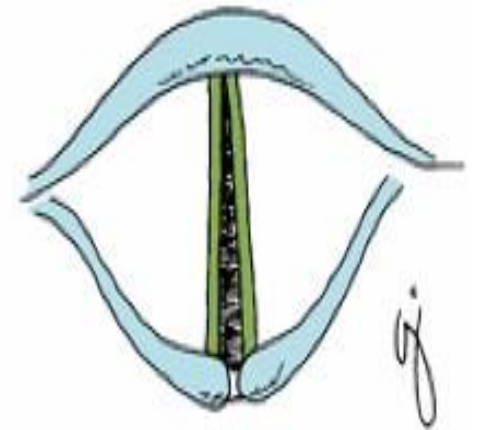
D. Unilateral partial section of right recurrent laryngeal nerve



# Section of the Recurrent laryngeal nerve

- **4. Bilateral partial section:**
  - The most dangerous situation.
- This results in bilateral paralysis of the abductor muscles
- Therefore the vocal folds are adducted together in the midline
- Acute breathlessness (Dyspnea) and stridor follow
- Lead to suffocation **اختناق** so tracheostomy is necessary

❖ Bilateral partial section of recurrent laryngeal nerves



inspiration

- The recurrent laryngeal nerve gives motor innervation to all muscles of the larynx (not cricothyroid) **especially those that abduct and adduct the vocal cords**. It is important to know that in the case of complete adduction of vocal cords; the airway is completely closed, so no air gets in or out of the lungs. Also, the abduction and adduction is important for phonation.
- We have 4 cases for the injury of the recurrent laryngeal nerve :
  1. Unilateral complete : loss of abduction and adduction in one vocal cord so it is midway between abduction and adduction but not totally adducted, results only in weakness of voice but the patient can breathe normally.
  2. Bilateral complete : loss of abduction and adduction in both vocal cords so they are midway between adduction and abduction (not completely closed), result in problems with speech (hoarseness of voice), and **difficulty with breathing** because airway is not completely open but breathing is still possible because it is not completely closed either.
  3. Unilateral partial : only the abduction part of the nerve is injured, and only on one side, results only in weakness of voice since the other vocal cord compensates.
  4. Bilateral partial : **THE MOST DANGEROUS**. Both nerves lost only their abduction part but the adducting is still functional causing the adduction to predominate, therefore completely closing the airway (suffocation), in this case we need to perform a tracheotomy to keep the patient alive.

In suffocation emergencies we usually perform suprasternal tracheotomy because it's easy to palpitate the trachea from this location, but in surgery we cut right under the cricoid cartilage because we can see exactly where we are cutting.

## Additional sources

- [Vocalis muscle](#)
- [Oblique arytenoid muscle](#)
- [Thyroarytenoid muscle](#)
- [Transverse arytenoid muscle](#)
- [Thyroepiglottic muscle](#)

الله أكبر  
لن تركع أمة قائدها النبي محمد  
صلى الله عليه وسلم

VERSIONS	SLIDE #	BEFORE CORRECTION	AFTER CORRECTION
V1→V2	21	abducted	Adducted
V2→V3			



امسح الرمز و شاركنا بأفكارك لتحسين أدائنا !!