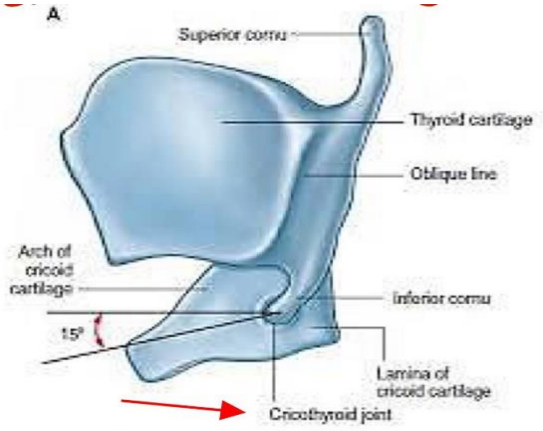
Laryngeal joints (synovial joints)

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.

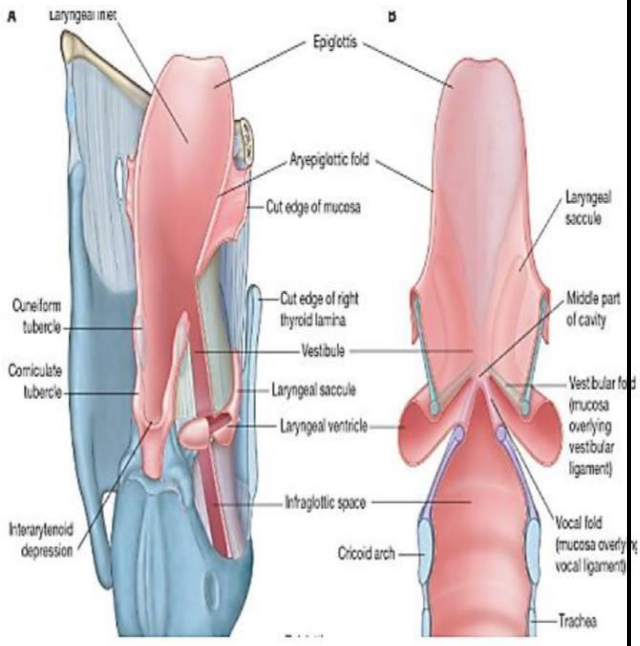
- the cricothyroid muscle is responsible for tens of true vocal cord and vocalis muscle for lengthening or relaxation.

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.

Laryngeal cavity



-start from the inlet toward trachea (c3-6)

-The vestibular and vocal folds divide the larynx into three major regions:

1. Vestibule: begins with the inlet of larynx to the false vocal cords.

2. Middle (glottic) part: continues from the false vocal cords to the true vocal cords. On its lateral side there is a ventricle.

The importance of this ventricle is that it has a tubular extension (like a diverticulum) that will form the

laryngeal saccule which projects antero-superiorly between the vestibular fold and thyroid cartilage

Within the walls of these laryngeal saccules are numerous seromucous glands from which secretions flow down to lubricate the true vocal folds (cords).

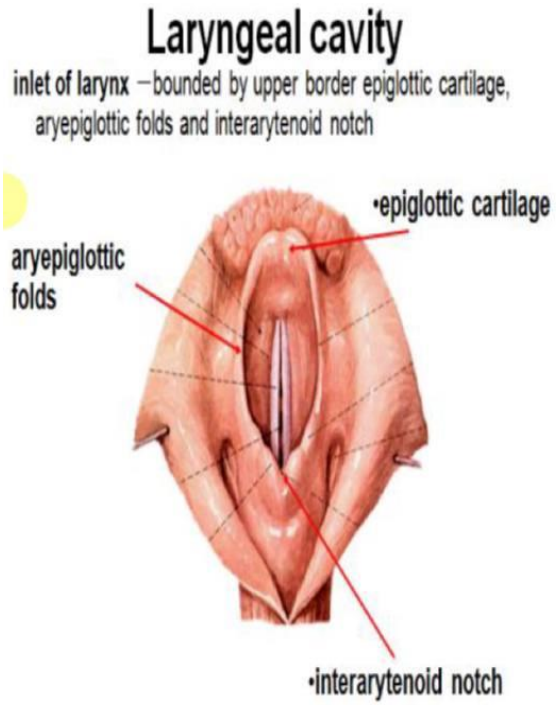
3. Infraglottic part: starts from the true vocal cords and leads to the trachea.

Clinical notes:

1-when true vocal cord closes the air will not flow towards the trachea , so in case of anesthesia of the patient we have to put endotracheal tube inside true vocal cord to prevent suffocation as a result of closure of true vocal cord during the operation.

2-when you do emergency tracheostomy make sure to open below the true vocal cord

Borders of the inlet:



✓ Anterior or superior 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.

Aryepiglottic folds:

-from epiglottis to arytenoid.

-have 1 muscle and 2 cartilages (aryepiglotticus muscle, cuneiform an corniculate cartilages).

-cuneiform located inside the fold but corniculate located at the end of the fold because it articulates with apex of arytenoid.

Note: in case of deglutition, 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.

Inferior opening

-It is the end of inferior compartment (3rd part) ,continuous with the lumen of trachea.

-below the true vocal cord there's the end of the larynx or the inlet of trachea.

FOLDS

True vocal cord:

-They consist of Vocal ligaments: It's the thickened, upper free edge of the cricothyroid membrane (conus elasticus)!!

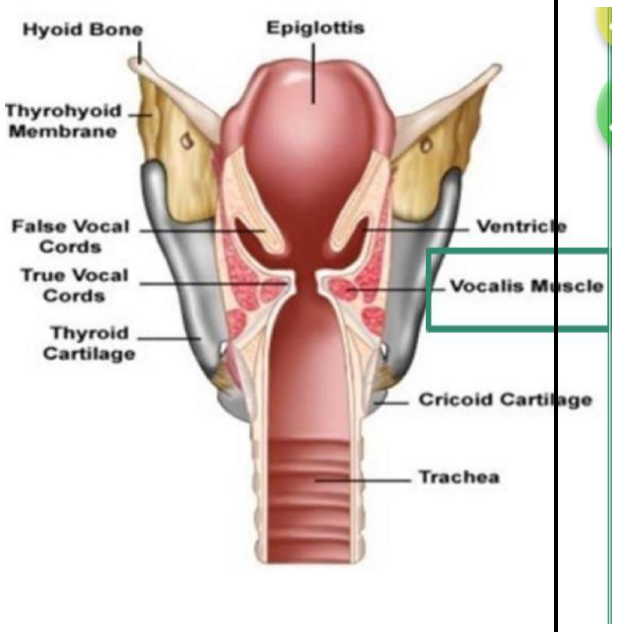
It extends on each side of the larynx, between the vocal process of the arytenoid and the back of the anterior lamina of thyroid cartilage.

- The lining epithelium of vocal cords' mucous membranes is stratified squamous non keratinized

-They have Vocalis muscles (thyroarytenoid muscle)

-They have no submucosa and no lymphatics; that's to prevent accumulation of fluid in them

which causes edema that could lead to adduction of vocal cords and suffocation.



Note: Difference of voice pitch between genders: females have shorter length of vocal cords, more obtuse angle and higher pitch of voice while males have longer length with an acute angle and lower pitch of voice.

False vocal cord (vestibular fold)

- They are formed by the lower free edge of quadrangular membrane.

- Unlike the true vocal cords, vestibular folds are:

› Vascularized (red in color)

› Fixed and not movable.

› Superior and more lateral to the vocal cords.

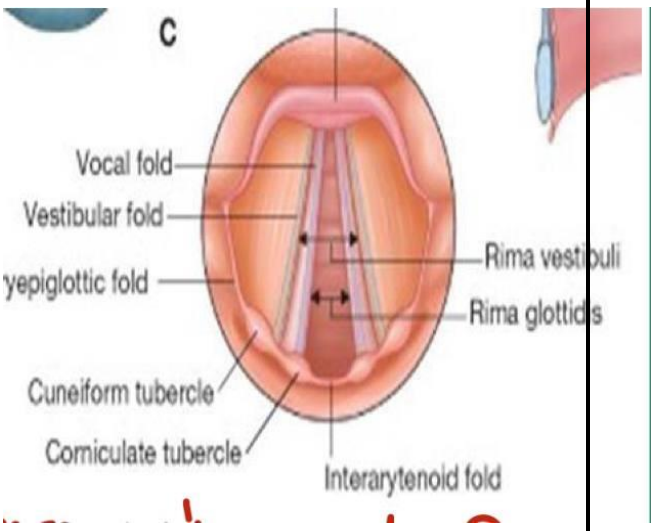
› Are covered by respiratory mucosa (pseudostratified columnar)

Rima vestibule and Rima glottis

The Rima vestibuli: is the space between the false vocal cords.

The Rima glottides: it is the space between the true vocal cords and the narrowest point in the laryngeal cavity.

-regarding the rima glottis it responds to abduction (narrowing by the action of P.cricoarytanoid) and adduction (widening by the action of L.cricoarytenoid) and has nothing to do with tensing and lengthening .



Intrinsic muscles of the larynx

Adjust tension in the vocal ligaments	Open and close the rima glottidis	Closure of the inlet of the larynx
Tensor- cricothyroid muscle	Adduction- lateral cricoaretenoid	Oblique arytenoid
Relaxation- Thyroareytenoid muscle(vocalis)	Abduction- posterior cricoarytenoid	Right and left aryepiglotticus muscles

1. Cricothyroid muscle: (usual EXAM QUESTION)

- It is the only EXTERNAL muscle.

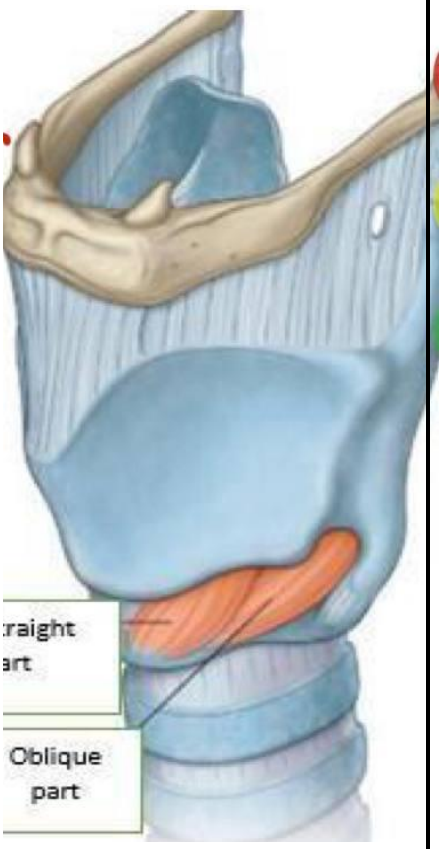
-Origin and insertion: In general, this muscle moves from the cricoid to the thyroid. It has two parts, oblique① and straight②.

-Nerve supply: THE ONLY MUSCLE SUPPLIED BY the EXTERNAL LARYNGEAL N branch of S. LARYNGEAL N.

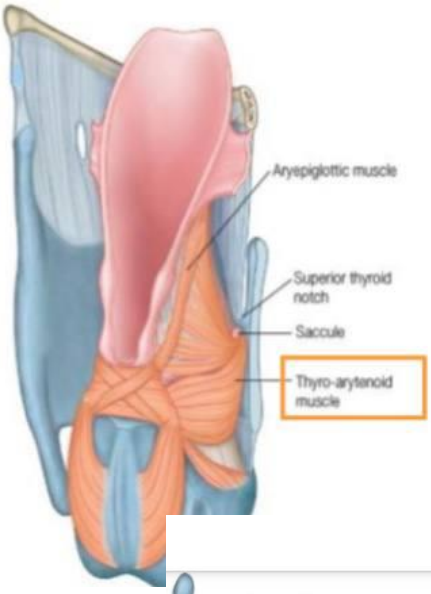
All other coming muscles are supplied by RECURRENT LARYNGEAL N.

-Action: tense vocal cords.

NOTE: During thyroidectomy and ligation of superior thyroid artery the external (superior) laryngeal nerve could be injured. Bilateral injury to the external laryngeal nerve results in bilateral paralysis of cricothyroid muscle and hoarseness and unilateral causes weakness of the voice (due to loss of the ability to tense vocal cords completely).



2. Thyroarytenoid (vocalis muscle)

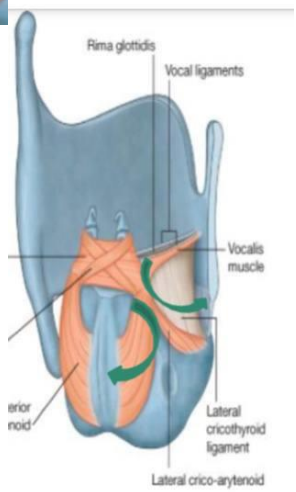


-It's a striated muscle and a part of true vocal cords, it relaxes the true vocal cords

-opposing cricothyroid muscle effect (cricothyroid is a TENSOR, vocalis is a RELAXATOR of the vocal cord)

-This muscle is responsible for low pitch of voice while cricothyroid is responsible for the high pitch.

3. Posterior and lateral cricoarytenoid muscles



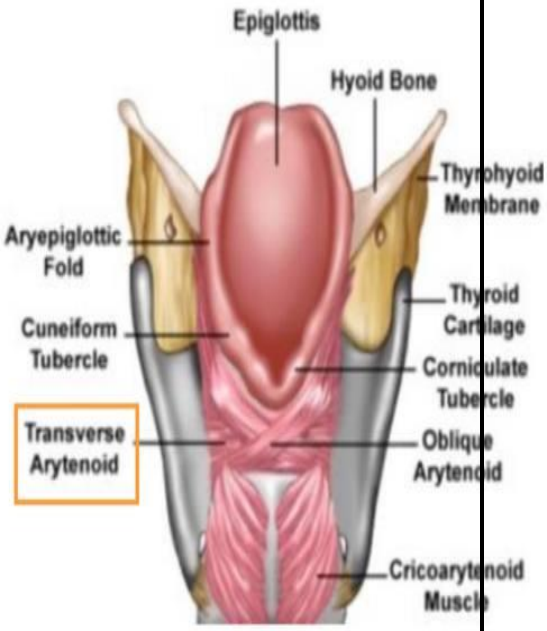
Origin: posterior cricoarytenoid originates from the posterior surface of cricoid lamina.

The lateral cricoarytenoid muscle originates from the lateral surface of cricoid lamina.

Insertion: both bind to the muscular process of arytenoid

Action: pulling the lateral cricoarytenoid muscles internally adducts the vocal cords, while pulling the Posterior cricoarytenoid externally backwards and upwards and by so abducts the vocal cords.

4. Transverse arytenoid



-Origin: runs transversely from one arytenoid to the other arytenoid.

Originates from Back and medial surface of arytenoid cartilage and insert in the Back and medial surface of opposite arytenoid cartilage.

-Action: Closes posterior part of rima glottidis by approximating arytenoid cartilages (interaretenoid area).

5. Oblique arytenoid

Origin: from the muscular process of one arytenoid to the apex of the opposite arytenoid.

Action: narrow the inlet by adducting aryepiglottic folds.

6. Aryepglotticus muscle

-Origin: between arytenoid and epiglottis, it lies within the aryepiglotticus fold

-Action: widening of the laryngeal inlet by the abduction the aryepiglottic folds when acting ALONE, but it narrows the inlet when acting with oblique arytenoid.

Extrinsic muscles of the larynx

-They are classified into suprahyoid and infrahyoid muscles → Suprahyoid muscles pull the larynx upward and aid in closure of inlet → Infrahyoid muscles depress the larynx downward.

Suprahyoid muscles:

› Digastric, stylohyoid, myelohyoid (diaphragma orsis) inserts in the midline, geniohyoid from inferior genio tubercle to hyoid.

Infrahyoid muscles:

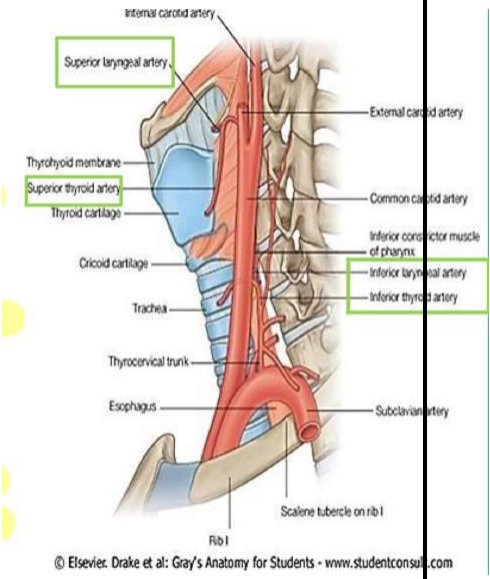
› sternothyroid, sternohyoid, omohyoid.

Blood supply of the larynx

1-Superior laryngeal artery: which pierces the thyrohyoid membrane with the internal laryngeal nerve chain: external carotid A. →superior thyroid A. (runs with ext. laryngeal N.)→ superior laryngeal A.

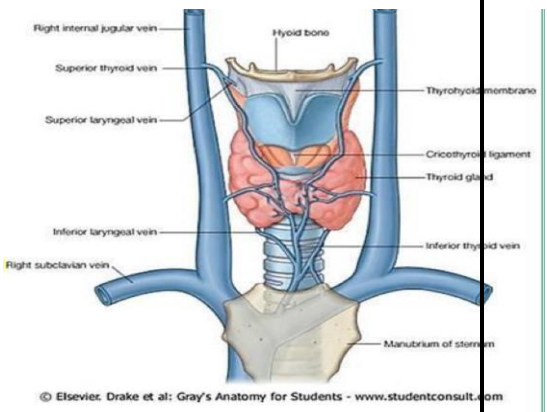
2. Inferior laryngeal artery:

chain: Subclavian artery→ thyrocervical trunk→ inferior thyroid→ inferior laryngeal



>>Recurrent laryngeal nerve passes between the branches of the inferior thyroid artery and then with the inferior laryngeal artery. Together, they ascend in the groove between the esophagus and trachea, entering the larynx by passing deep to the margin of the inferior constrictor muscle of the pharynx.

Venous drainage of the larynx



1-Superior laryngeal vein→ drains into superior thyroid vein→ internal jugular vein

2-Inferior laryngeal vein → inferior thyroid vein→ left brachiocephalic vein

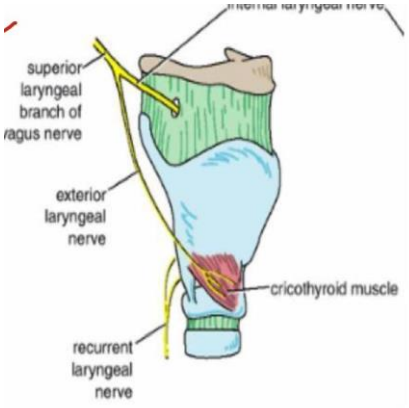
Lymphatic drainage

The lymphatic drainage is divided to above and below the true vocal cords:

1. Above the true vocal cords, lymphatics end in the deep cervical lymph nodes through the lymph nodes associated with superior laryngeal artery.

2. Below the true vocal cord, lymphatics drain into the lymph nodes associated with inferior thyroid artery and ends in paratracheal lymph nodes which drains into deep cervical.

Nerve supply



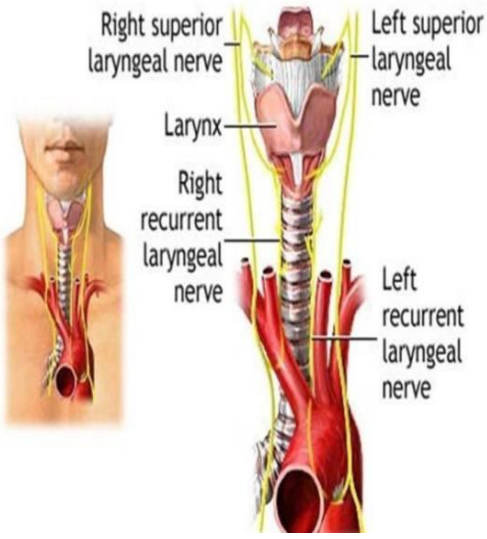
-generally speaking it's innervated by:

1-Superior laryngeal which divided to internal and external laryngeal.

2-Recurnt laryngeal.

>>Sensory innervation to the mucosa above the true vocal cords by internal laryngeal nerve.

>> Sensory innervation below the true vocal cords by the recurrent laryngeal nerve.



>>Motor innervation to all laryngeal muscles is by the RECURRENT LARYNGEAL NERVE [exception: cricothyroid which is supplied by the external laryngeal nerve a branch of the superior laryngeal of the vagus]

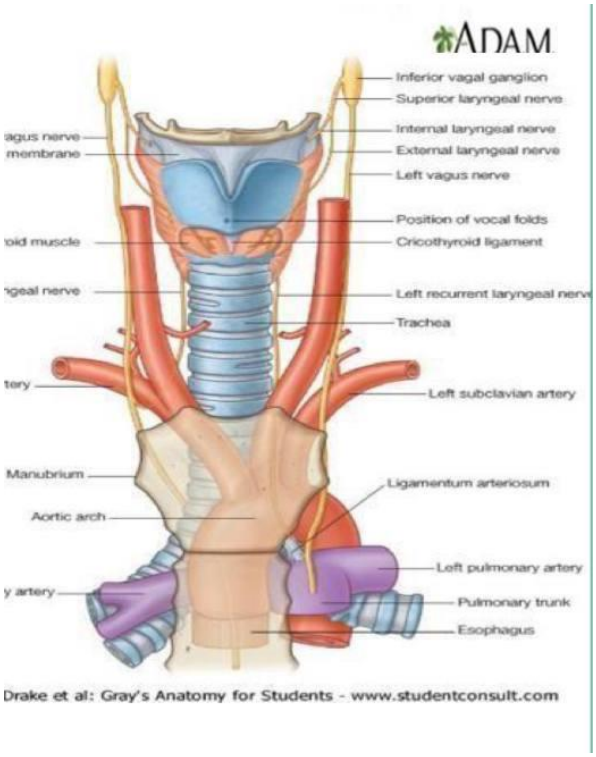
NOTE: left recurrent laryngeal is longer than right; The left vagus nerve (which is longer) descends to the thorax and gives the left recurrent laryngeal nerve below the arch of aorta which then ascends between trachea and esophagus to the larynx. The right vagus nerve gives the right recurrent nerve at the root of the neck, below the subclavian vessels.

Relations of the larynx:

→ Laterally: The carotid sheath and its contents which are: the common carotid artery, internal jugular vein and vagus nerve, sympathetic chain on the posterior wall .

→Posteriorly: pharynx and right recurrent laryngeal nerve.

→Anteriorly: Skin, fascia and 4 infrahyoid muscles.



Injury to recurrent laryngeal nerve

- Injury to the recurrent laryngeal nerve could be bilateral complete section, bilateral partial section, unilateral complete section or unilateral partial section (section as in cut).

General notes on recurrent laryngeal nerve injury:

→ Logically, there are two important things to look at after recurrent nerve injury: respiration and speech.

→ Partial injury: injury to superficial fibers (deep fibers are spared) that supply the abductor muscles due to manipulation or tension. Partial injury results in adduction of vocal folds and causes suffocation if it was bilateral. It is more dangerous than complete because in complete injury vocal cords are neither adducted nor abducted. SO, most dangerous form is partial bilateral due to suffocation, tracheostomy should be performed.

→Unilateral partial of recurrent causes hoarseness of voice, while unilateral complete injury of recurrent doesn't affect speech.

Forms of recurrent laryngeal nerve injury:

› Unilateral Complete section: One vocal fold (on the affected side) would be stuck in the position midway between abducted and adducted states Speech and respiration aren't much affected because the other side compensates.

› Bilateral complete section: difficulty in breathing without suffocation, rima glottidis is partially closed and the speech is lost as both cords are affected.

› Unilateral partial section: hoarseness in voice with difficulty in respiration.

› Bilateral partial section: dyspnea, stridor (snoring) and suffocation.Most serious, here the tracheostomy is a necessity.

Done by Hussam Daraghmeh