

LARYNX

- * box of 9 cartilages (3 single & 3 pairs)
- * cervical vertebrae C3-C6 (at the level of Cricoid Cartilage)
- * begins with laryngopharynx opening & ends with trachea
- * suspended from hyoid bone above & attached to trachea below by ligaments & membranes

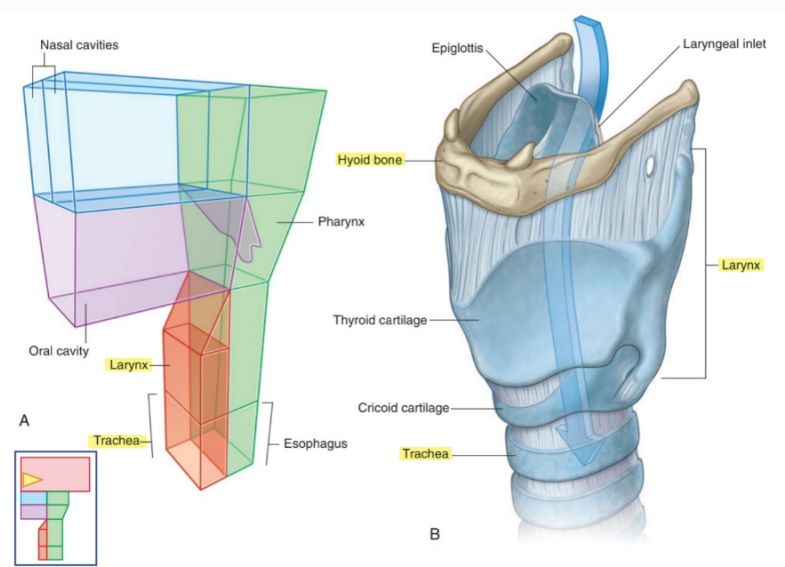


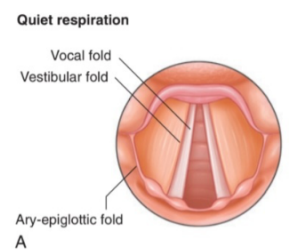
Fig. 8.209 Larynx. A. Relationship to other cavities. B. Lateral view.

* HISTOLOGY

- ① mucosa → respiratory = pseudostratified ciliated columnar epithelium except: vocal cords & ant. upper surface of epiglottis (like oral) (stratified squamous non keratinized)
- ② submucosa (CT)
- ③ membranes, ligaments, joints → connect cartilagenous parts
- ④ cartilage (skeleton)
- ⑤ muscles (intrincic laryngeal muscles + 1 extrensic)
- ⑥ adventitia

* FUNCTIONS

① open valve in respiration



Forced inspiration

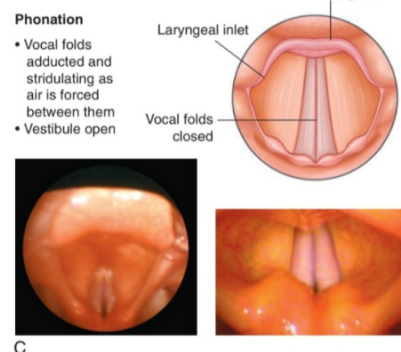
- Vocal folds abducted and rima glottidis wide open
- Vestibule open



④ closed true vocal cords suddenly open in coughing to release compressed air or foreign bodies & dust entering trachea

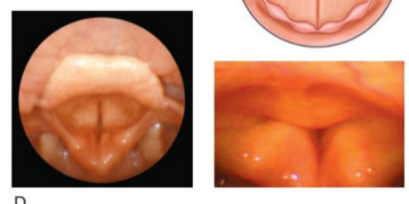
③ partially closed valve in speech (phonation)

vibration of true vocal cords in expiration (cords adduct medially forming a column of compressed air below it)



Effort closure

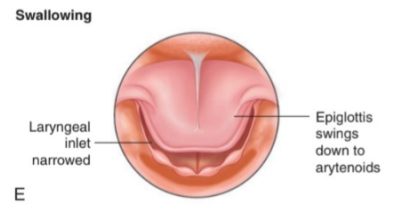
- Vocal folds and vestibular folds adducted
- Rima glottidis and vestibule closed



⑤ effort closure: during heavy lifting vocal cords are adducted completely (a column of air is formed below/ after releasing heavy object there is heavy expiration)

② close valve in deglutition

(epiglottis downwards & larynx upwards)



* CARTILAGE

3 single

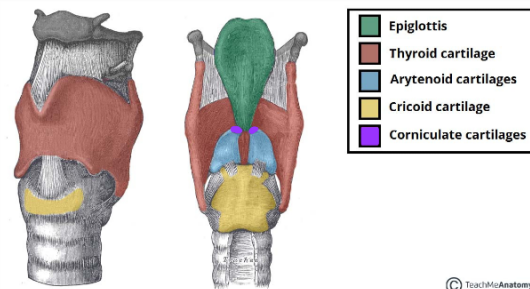
↳ thyroid / cricoid / epiglottis

3 paired

↳ arytenoid (most important / connect to upper border of lamina of cricoid)

↳ coniform

↳ corniculate (connect with apex of arytenoid forming a joint)



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1 CRICOID

• most inferior / signet ring shape

• important structures:

① lamina & arch

② 2 pairs of facets

③ 2 depressions

④ a ridge

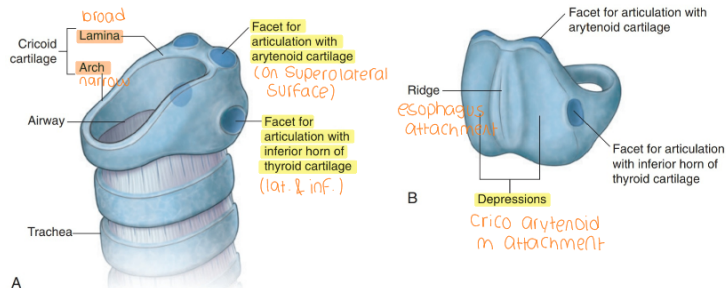


Fig. 8.210 Cricoid cartilage. A. Anterolateral view. B. Posterior view.

2 THYROID

• largest, has relations with lateral walls of thyroid

• important structures:

a) anteriorly

① laryngeal prominence

(connects rt & lt lamina)

↳ angle depends on hormones

• testosterone → heavier & bulkier bones, stronger muscles
(→ ↓\$ & ↓ pitch voice + longer true vocal cords)

• estrogen & progesterone → smooth light bones & muscles
(→ ↑\$ & ↑ pitch voice + shorter true vocal cords)

② superior thyroid notch

(separates rt & lt lamina)

③ inferior thyroid notch

b) posteriorly

① superior horn (connects with greater horn of hyoid bone by lateral thyroid ligament)

② inferior horn (its medial surface connects with cricoid)

c) laterally

① oblique line or ridge (curves anterior from base of superior horn to inferior margin of lamina / attaches neck strap muscles (sternothyroid, thyrohyoid, inferior constrictor))

② superior & inferior thyroid tubercles

(ends of oblique line)

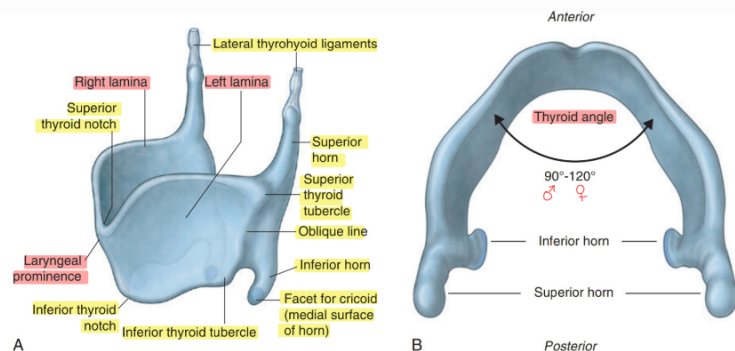
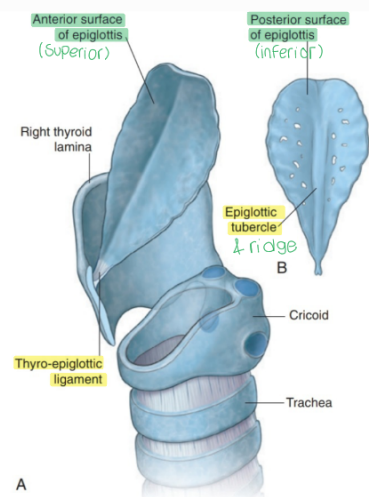


Fig. 8.211 Thyroid cartilage. A. Anterolateral view. B. Superior view.

3 EPIGLOTTIS

• leaf shaped / has:

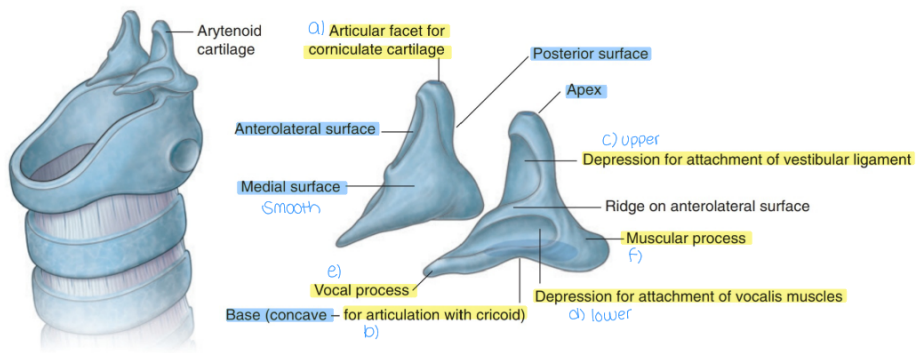
- ① Superior free edge
- ② apex (attaches between laryngeal prominence & inferior thyroid notch through thyroepiglottic ligament)
- ③ 2 Surfaces (superoanterior, posteroinferior)



4 ARYTENOID

• pyramid shaped
• structures:

- ① apex with facet (a)
- ② base with facet (b)
- ③ medial surface
- ④ anterolateral surface



with depressions (c,d) & a ridge to separate them

- c → attaches vestibular vocal cords (false vocal cords)
- d → attaches vocalis muscle (part of true vocal cords)

⑤ posterior surface that has (e,f)

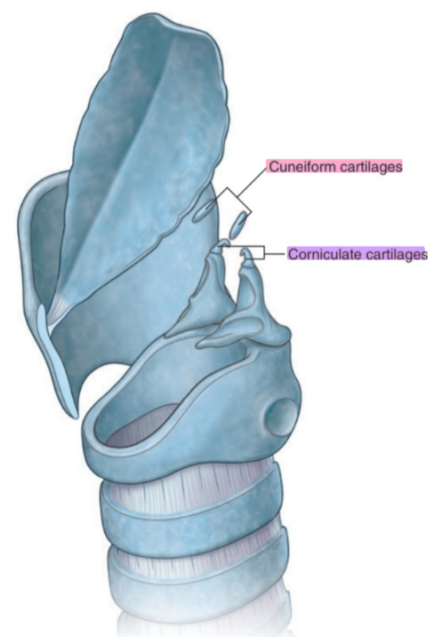
- e → vocal process anteriorly (attaches vocal ligament of true)
- f → muscular process posteriolaterally (attaches posterior & lateral cricoarytenoid muscles)

*** Aryepiglottic fold:** between arytenoid & epiglottis, contains:

- Aryepiglottic muscle (helps in closing inlet backwards & downwards)
- pair of cuneiform cartilage

5 CORNICULATE

articulate with apex of arytenoids & mark the end of aryepiglottic fold (membrane), their apices project posteromedially towards each other.



6 CUNEIFORM

ant. to corniculate, suspended with aryepiglottic fold to add a bony strength to help in closure of laryngeal inlet.

Fig. 8.214 Corniculate and cuneiform cartilages.

* MEMBRANES AND LIGAMENTS

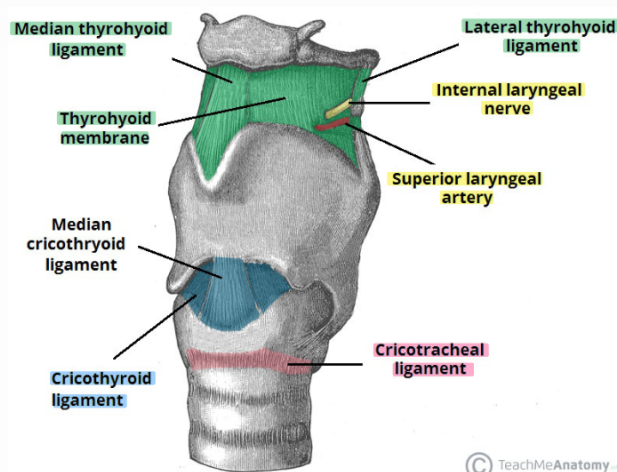
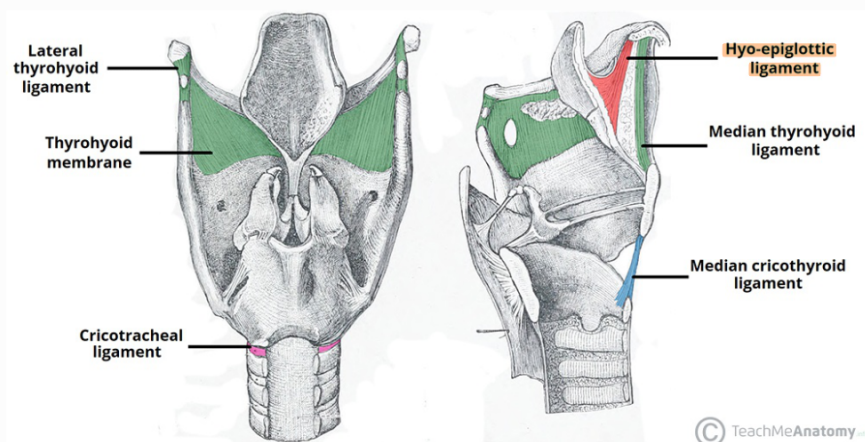
- Membrane: Sheet of fibrous tissue
- Ligament: folded memb. (double layer band of fibrous tissue)

extrinsic

- ↳ **thyrohyoid memb.**
- ↳ **hyoepiglottic lig.**
- ↳ **Cricotracheal lig.**

intrinsic

- ↳ **cricothyroid lig.**
- ↳ **quadrangular memb.**



□ THYROHYOID MEMBRANE

• relations:

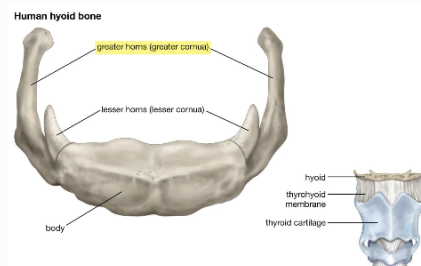
inferiorly → sup. margin of thyroid cartilage (to lamina & ant. margins of Sup. horns)

superiorly → hyoid bone (ascends medial to greater horns & post. to body of hyoid & attach to sup. margins of these structures)

posteriorly → thickened laterally

anteriorly → thickened at midline

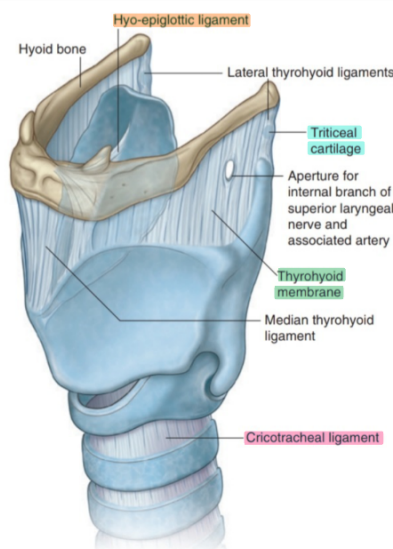
laterally → passage of: **Sup. laryngeal A / int. laryngeal N / lymph**
↳ Sometimes there is **triticeal cartilage** to strengthen.



□ CRICOTRACHEAL LIGAMENT

superiorly → lower border of the cricoid cartilage

inferiorly → upper border of the first tracheal cartilage



□ HYOEPIGLOTTIC LIGAMENT

anterosuperiorly → body of hyoid bone

posteriorly → midline of epiglottis

Fig. 8.215 Extrinsic ligaments of the larynx.

4 CRICOTHYROID LIGAMENT

- also called cricovocal memb or conus elasticus inferiorly → arch of Cricoid cartilage
- Superiorly → free upper margin enclosed by thyroid cartilage, thickens & attaches to vocal process post. & angle of thyroid cartilage ant. (forming vocal lig)
- anteromedially → thickened into med. lig. (perforated in emergencies for airway)

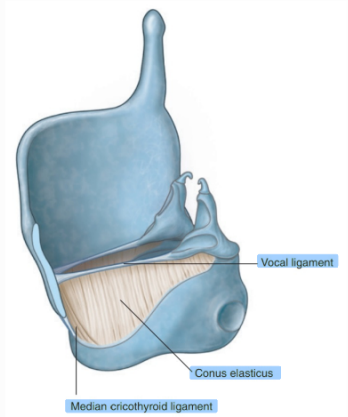


Fig. 8.216 Cricothyroid ligament.

5 QUADRANGULAR LIGAMENT

- anteriorly → lat. margin of epiglottis
- posteriorly → ant. lat. surface of arytenoid
- free upper margin → extends from aryepiglottic fold
- free lower margin → thickens & forms the vestibular lig. under vestibular fold (false vocal cord)
- attaches to corniculate cartilage
- vestibular ligament is separated from vocal ligament below by a gap
- vestibular ligament appears lateral to vocal ligament from superior view
- Rima Vestibuli → space between folds of false vocal ligaments
- Rima glottidis → space between true vocal ligaments

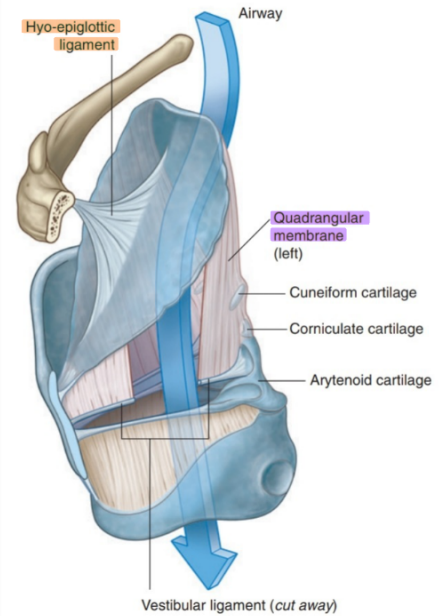


Fig. 8.217 Quadrangular membrane.

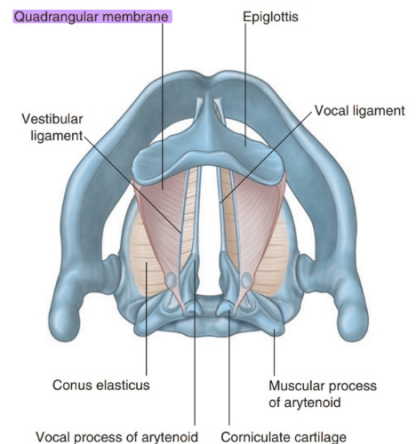


Fig. 8.218 Fibro-elastic membrane of the larynx (superior view).

* JOINTS (SYNOVIAL)

1) CRICOTHYROID JOINT

- between cricoid cartilage & inferior horn of thyroid cartilage
- surrounded by capsule & reinforced by ligaments
- movement: thyroid (forwards & tilting downwards on cricoid cartilage) → lengthens & adds tension on vocal ligament

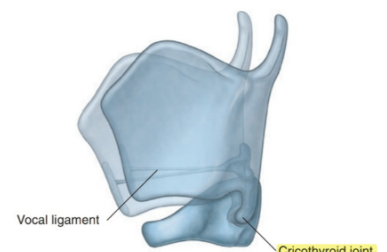


Fig. 8.219 Movements of the cricothyroid joints.

* this page may be more understandable when you finish the whole lecture

2 CRICOARYTENOID JOINT

- between articular facets on superolateral surfaces of Cricoid cartilage & bases of Arytenoid Cartilages
- movement: Synovial pivot (rotatory movement over cricoid cartilage):

a) internally (towards midline) → adduction of true vocal cords (by lateral cricoarytenoid muscle)

b) externally → abduction of true vocal cords (by posterior cricoarytenoid muscle)

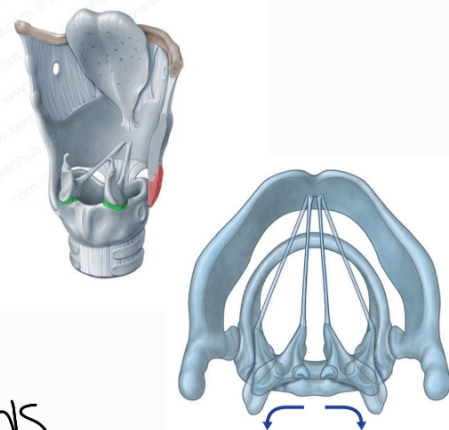


Fig. 8.220 Movements of the crico-arytenoid joints.

* LARYNGEAL CAVITY

- tubular in shape
- lined by mucosa
- supported by fibroelastic membrane of larynx & by cartilages.
- Superior aperture (inlet) opens into anterior aspect of pharynx just below & posterior to tongue
- closure of inlet is controlled by epiglottis moving down & back wards, larynx moving upwards (by aryepiglotticus & transverse muscles) → important for deglutition / prevents food entry to airways & coughing

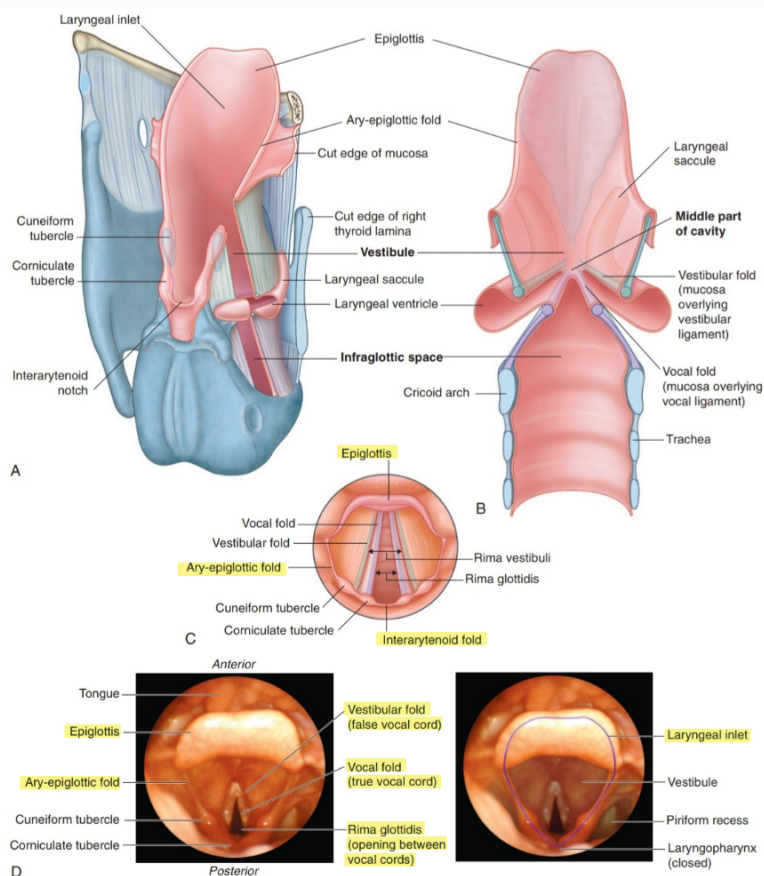


Fig. 8.221 Laryngeal cavity. A. Posterolateral view. B. Posterior view (cut away). C. Superior view through the laryngeal inlet. D. Labeled photograph of the larynx, superior view.

* Borders of inlet:

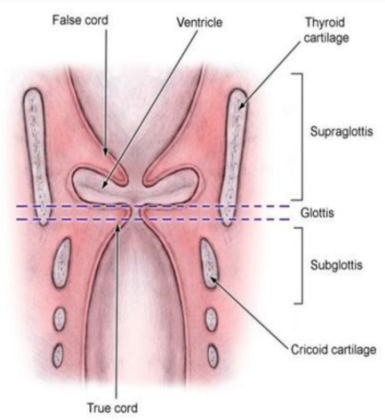
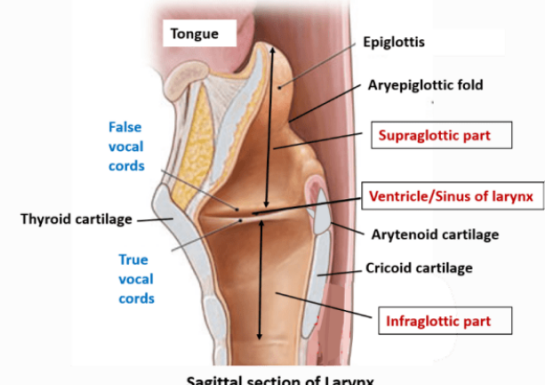
- anterior → mucosa of superior margin of epiglottis
- lateral → mucosal folds (aryepiglottic folds)
- posterior → mucosal fold that forms a depression medially between the 2 corniculate tubercles (interarytenoid notch)

* **intubation**: inserting a tube through mouth to trachea (passing larynx), we must insert it through rima glottidis to make sure airways stay open (eg.: during anesthesia in surgery)

* **aryepiglottic folds**: enclose superior margins of quadrangular membranes & adjacent soft tissues / 2 tubercles on the more posterolateral margin side mark positions of underlying cuneiform & corniculate cartilages

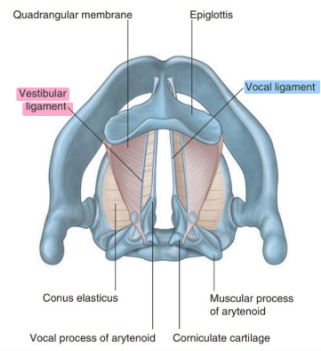
* Vestibular & vocal folds divide larynx into:

	from	to
① Vestibule (Supraglottic)	inlet of larynx	false Vocal Cords
② middle part (glottic)	false Vocal Cords	true Vocal Cords
③ infraglottic (subglottic)	true Vocal Cords	trachea



• on the lateral side of the glottic (middle) part there is a **ventricle**

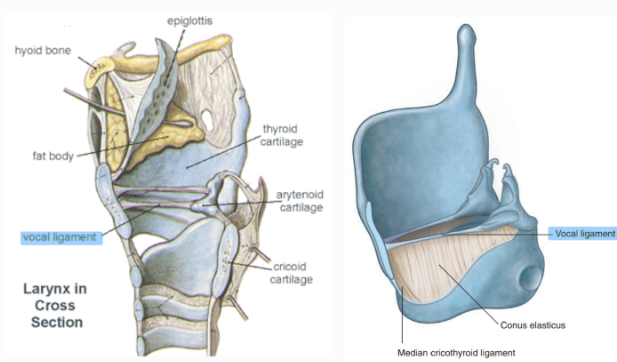
	TRUE VOCAL CORDS (Vocal Cords)	FALSE VOCAL CORDS (Vestibular Cords)
formed by	Vocal ligaments: thickened upper free edge of cricothyroid membrane (conus elasticus) / between vocal process of arytenoid & back of ant. lamina of thyroid cartilage	Vestibular ligaments: thickened lower free edge of quadrangular membrane.
mucosa	Stratified Squamous non keratinized (we need regenerable mitotic tissue because true vocal cords are prone to injury & loss of voice)	respiratory (pseudostratified columnar epithelium with goblet cells)
vasculature	absent (white)/supplied by diffusion	present (red)
movability	vocalis muscle (thyroarytenoid)	fixed (not movable)
Sup. View Side View (relationship)	medial inferior	lateral superior



Notes: • no submucosa → to prevent fluid accumulation, edema, adduction of vocal cords, suffocation

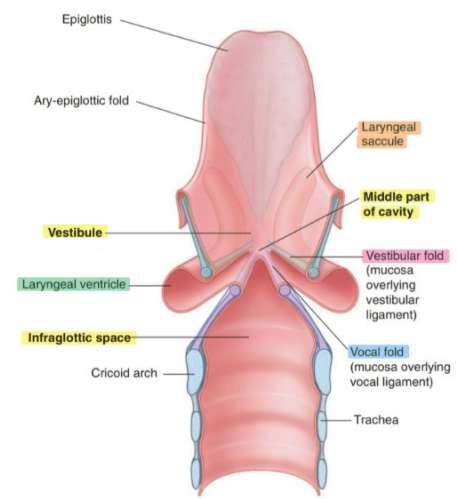
* true Vocal Cords

- ♀ → Shorter, more obtuse angle, higher pitch
- ♂ → longer, more acute angle, lower pitch

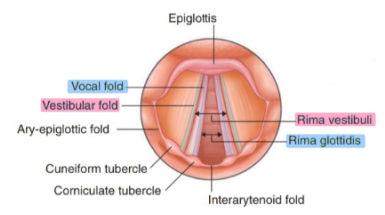


* laryngeal Ventricles & Saccules

- On each Side, mucosa of middle cavity bulges laterally through the gap between vocal & Vestibular ligament to form laryngeal ventricle
- Ventricle has a tubular extension (diverticulum) that forms laryngeal saccule → projects anterosuperiorly bet. Vestibular fold & thyroid cartilage
- Saccules has many seromucous glands that secrete lubricants for true vocal cords



- rima vestibuli : space between false vocal cords
- rima glottides : space between true vocal cords (narrowest point of laryngeal cavity)



* INTRINSIC MUSCLES OF LARYNX

	origin	insertion	action	nerve	
①	Cricothyroid (fan shaped, the only external muscle)	arch of cricoid	oblique part: posterior direction to inferior horn of thyroid. straight part: vertically and upward to the posteroinferior margin of the thyroid lamina	Tense true vocal cords Pulls the thyroid cartilage forward and rotate it down relative to the cricoid cartilage. (responsible for the high pitch)	External laryngeal nerve
②	Posterior cricoarytenoid	posterior surface of cricoid lamina	muscular process of arytenoid	pulling muscle externally, backwards and upwards abducts the vocal cords (open rima glottidis)	Recurrent laryngeal nerve
③	Lateral cricoarytenoid	lateral surface of cricoid lamina			
④	Transverse arytenoid	Back and medial surface of arytenoid cartilage	Back and medial surface of opposite arytenoid cartilage	Closes posterior part of rima glottidis by approximating arytenoid cartilages (interarytenoid area).	
⑤	Thyroarytenoid (vocalis)	Inner surface of thyroid cartilage	Arytenoid cartilage	Relaxes true vocal cords (responsible for low pitch)	
⑥	Oblique arytenoid	muscular process of one arytenoid	apex of the opposite arytenoid	narrow the inlet by adducting aryepiglottic folds	
⑦	aryepiglotticus	between arytenoid and epiglottis (within the aryepiglottic fold)		- widening of the laryngeal inlet by the abduction the aryepiglottic folds (acting alone) - its normal physiological action is aiding oblique arytenoid in closure of the inlet	

* the doctor considered thyroarytenoid & vocalis muscles as one muscle.

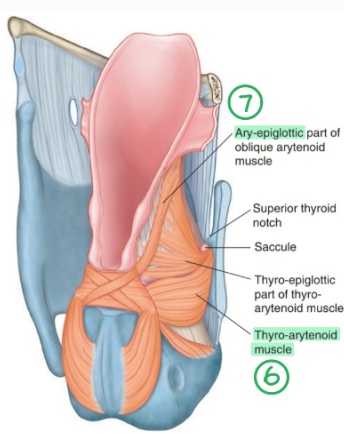


Fig. 8.224 Thyro-arytenoid muscle.

1

Cricothyroid muscle

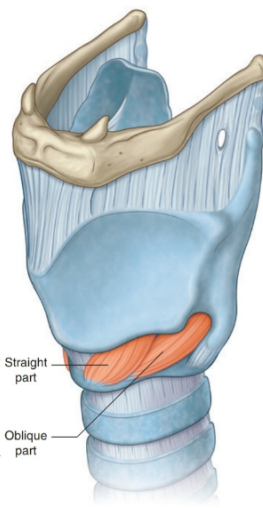


Fig. 8.222 Cricothyroid muscle.

4

Transverse arytenoid

5

Oblique arytenoid

2

Posterior crico-arytenoid

3

Lateral crico-arytenoid

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Vocalis muscle

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Fig. 8.223 Crico-arytenoid, oblique and transverse arytenoid, and vocalis muscles.

* actions result in closure of laryngeal inlet in deglutition:

1 food bolus pushes epiglottis back & down

2 larynx moves upwards

3 aryepiglottis muscle & oblique arytenoid muscle contraction

* EXTRINSIC MUSCLES OF LARYNX

• **Suprahyoid** → pull larynx upwards / closure of inlet

1 digastric 2 stylohyoid 3 myohyoid 4 geniohyoid

5 assisted by stylopharyngeus, salpingopharyngeus, palatopharyngeus

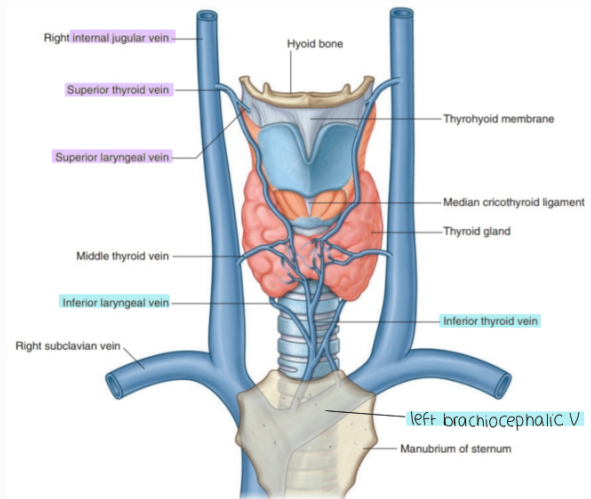
• **Infrahyoid** → pulls larynx downwards / open of inlet

1 sternohyoid 2 sternothyroid 3 omohyoid

VENOUS DRAINAGE

1 **Superior laryngeal** → Superior thyroid vein → internal jugular vein

2 **Inferior laryngeal** → inferior thyroid vein → left brachiocephalic vein (left brachiocephalic vein is more oblique & longer)



LYMPHATIC DRAINAGE

1 above true vocal cords

lymph nodes associated with superior laryngeal artery → **deep cervical lymph nodes**

2 below true vocal cords

lymph nodes associated with inferior thyroid artery → **paratracheal lymph nodes** (on cricothyroid ligament or upper trachea)

* BLOOD AND NERVE SUPPLY

• Artery & nerve that pierce thyrohyoid membrane

① Superior laryngeal artery
external carotid A → Superior thyroid A (runs with ext. laryngeal N) → Sup. laryngeal A

② internal laryngeal nerve
Sensory above true vocal cords

• Artery & nerve that ascend in the groove between trachea & esophagus entering larynx by passing deep to the margin of inferior constrictor muscle of pharynx

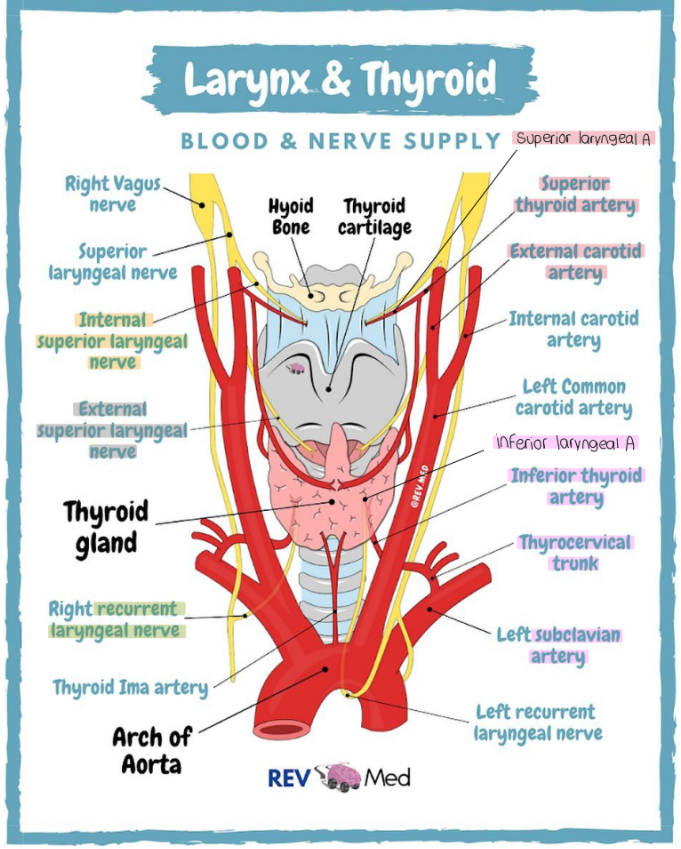
① inferior laryngeal artery

Subclavian A → thyrocervical trunk → inferior thyroid A → inferior laryngeal A

② recurrent laryngeal nerve

↳ sensory below true vocal cords

↳ motor for all intrinsic muscles except cricothyroid



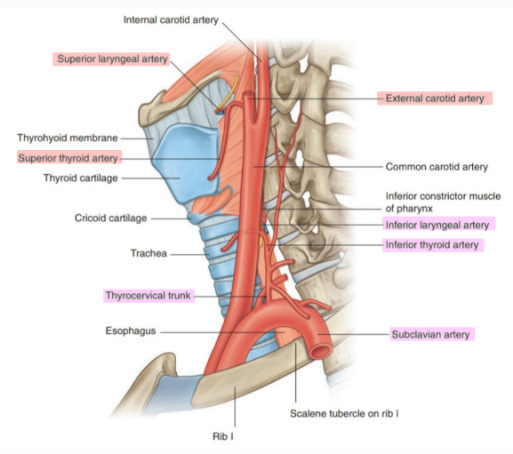
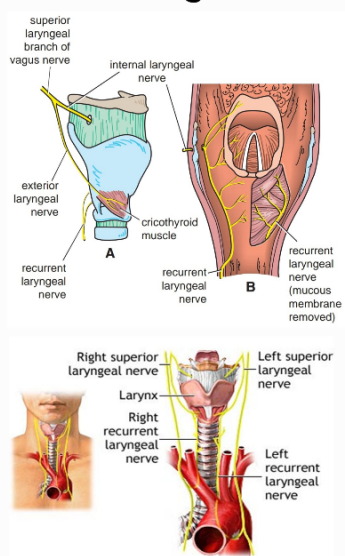
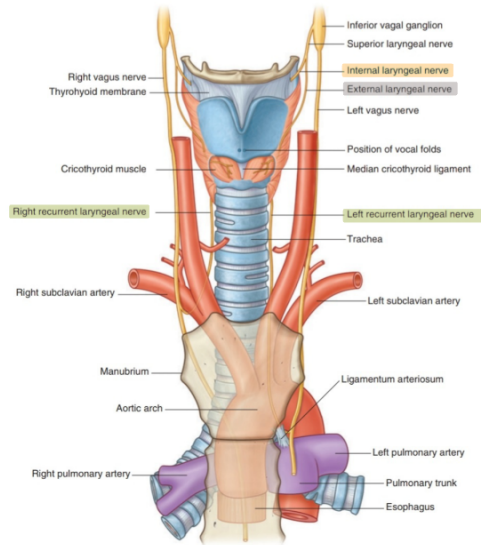
more about nerve supply:

• motor supply of Cricothyroid muscle: external laryngeal

• Vagus → Superior laryngeal → internal laryngeal
↳ external laryngeal

↳ recurrent laryngeal

• recurrent laryngeal: left is longer than right (left vagus is longer & gives left recurrent laryngeal below Arch of Aorta while right vagus gives right recurrent laryngeal at the root of neck below subclavian vessels → right is not found in chest)



* relations of larynx:

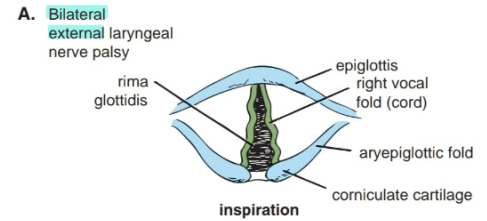
- laterally → carotid sheath & contents (CCA, IJV, vagus)
 - ↳ lateral lobes of thyroid
- posteriorly → pharynx & right recurrent laryngeal nerve
- anteriorly → skin, fascia & 4 infrahyoid muscles

* CLINICAL NOTES:

① injury of external laryngeal nerve

(during thyroidectomy & ligation of superior thyroid artery) → paralysis of cricothyroid muscle

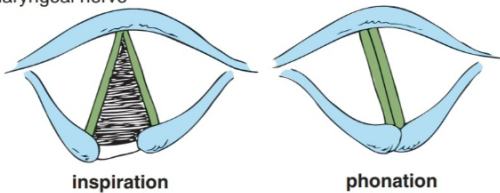
- bilateral injury → bilateral paralysis → hoarseness
- unilateral injury → unilateral paralysis → weakness of voice (loss of ability to tense vocal cords completely)



② injury of recurrent laryngeal nerve

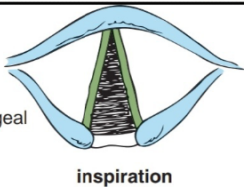
- partial section: superficial fiber injury (these supply abductor muscles) → adduction of vocal cords
- complete section: superficial & deep fiber injury → paralysis of abductors & adductors

B. Unilateral complete section of right recurrent laryngeal nerve



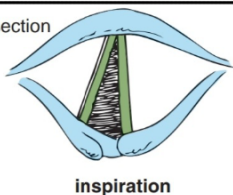
→ injured vocal cord is stuck between abduction & adduction states (doesn't affect breathing & respiration because the other vocal cord compensates)

C. Bilateral complete section of recurrent laryngeal nerves



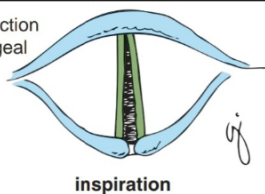
→ rima glottidis is partially closed / loss of speech / difficulty in breathing without suffocation

D. Unilateral partial section of right recurrent laryngeal nerve



→ hoarseness & difficulty of respiration

E. Bilateral partial section of recurrent laryngeal nerves



→ suffocation (most dangerous form)