

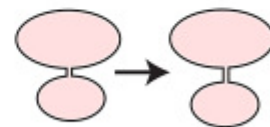
LARYNX - FUNCTION AND DEVELOPMENT

DURING SWALLOWING

- Closure of aditus by aryepiglotticus acting like a purse-string on the aryepiglottic folds
- Closure of rima glottidis/cords (lateral crico-arytenoids & transverse arytenoids)
- Epiglottis flips backwards/downwards with solid food
- Larynx/pharynx hauled up under the tongue (suprahyoid muscles)

DURING PHONATION

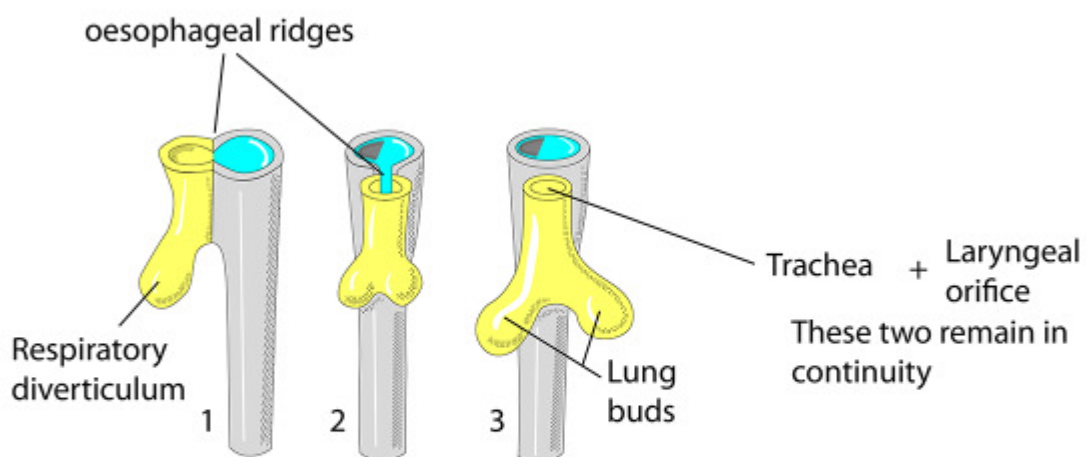
- Cords held together for up to 3mm
- Vocalis helps to change the amount of cord that approximates
- Series of jets of air
- Resonance produced by structures above larynx (pharynx/sinuses)
- Whispering is very wasteful of air as it is a constant stream



DURING COUGHING AND STRAINING

- Explosion of compressed air via closed cords

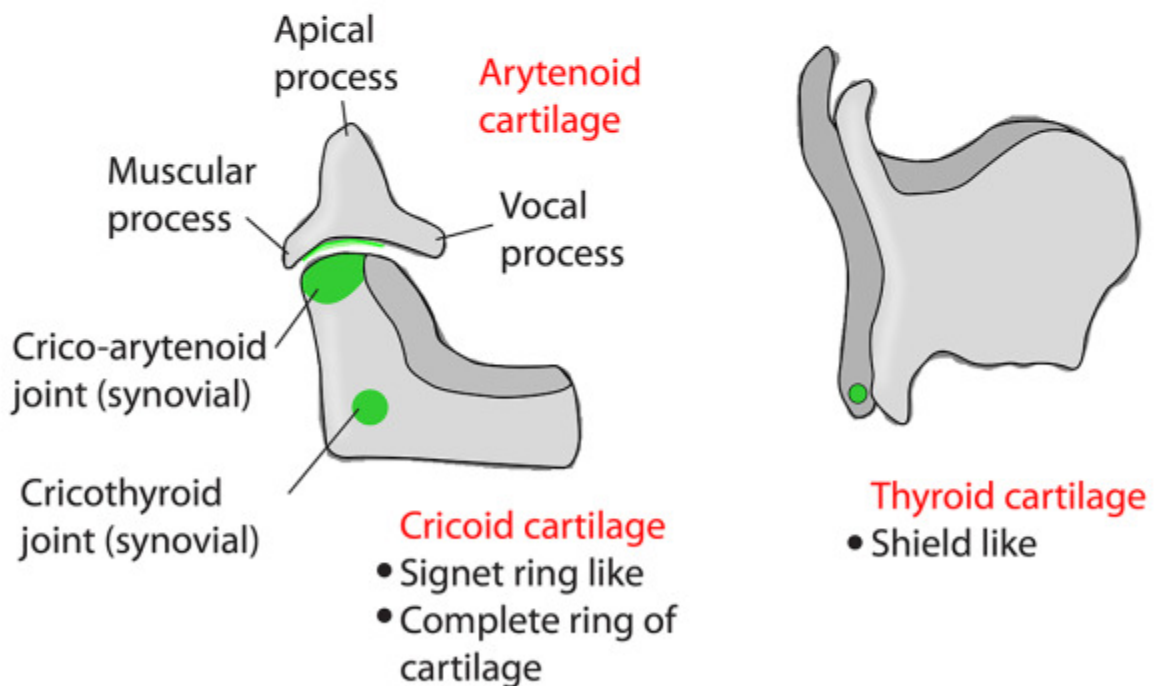
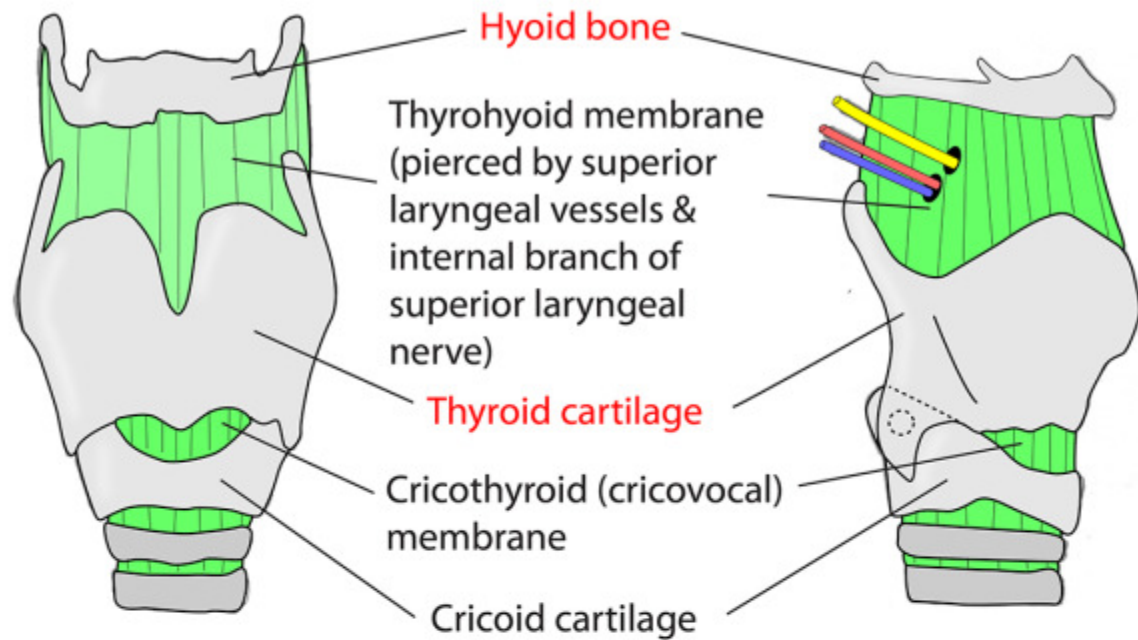
DEVELOPMENT



Redrawn, with permission, from Sadler TW. Langman's Medical Embryology. 11th ed. Baltimore: Lippincott Williams & Wilkins; 2010

At 4 weeks, there is an endodermally lined outgrowth from the ventral wall of the foregut - the respiratory diverticulum. Initially it is wide open into the oesophagus then the oesophageal ridges fuse to give an oesophago-tracheal septum. Cartilage and muscle of the respiratory tract form from the splanchnic mesoderm.

LARYNX - BONES/CARTILAGES

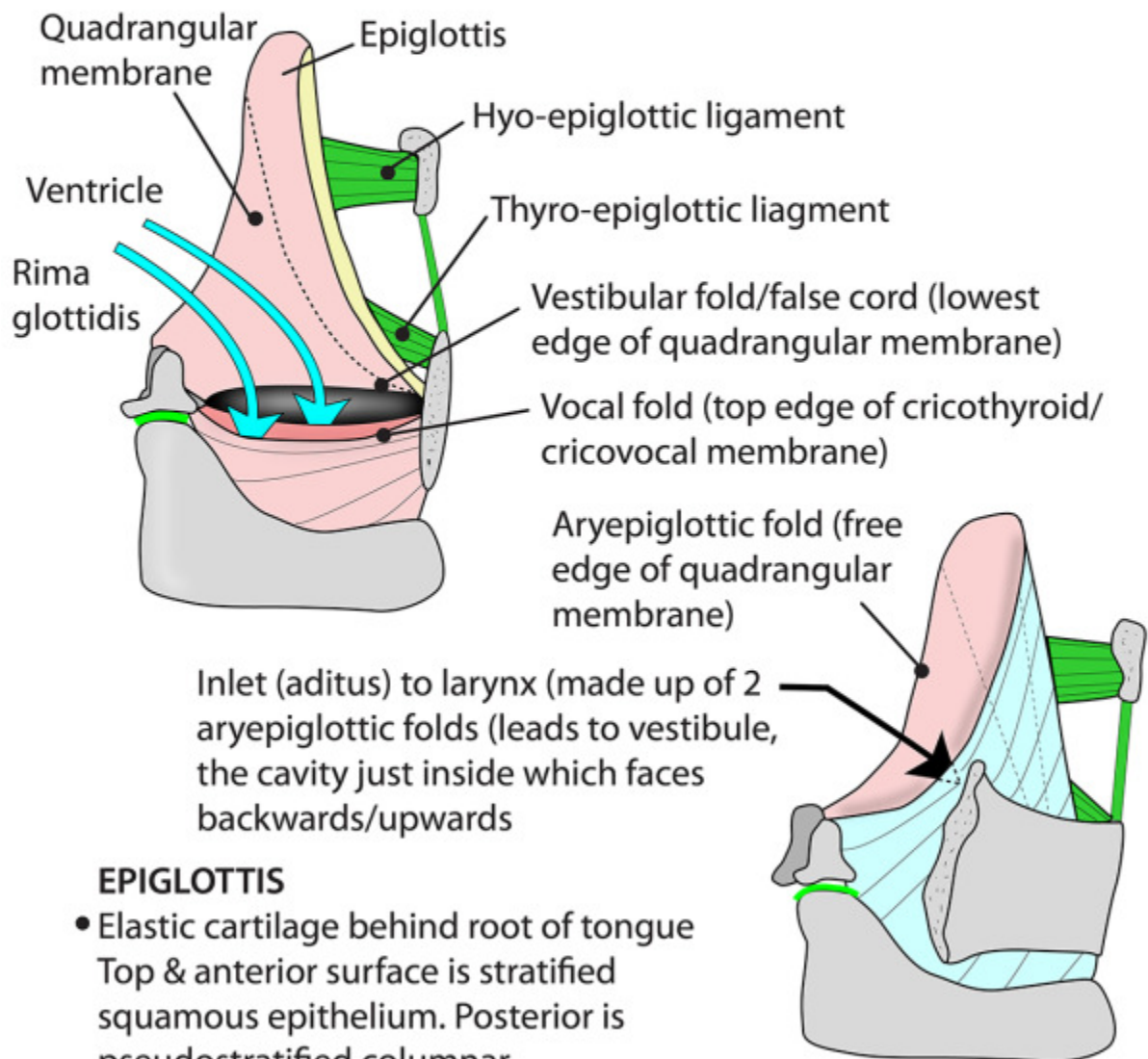


Larynx elevated by: Mylohyoid, digastric, stylohyoid, geniohyoid, thyrohyoid, stylopharyngeus, palatopharyngeus, salpingopharyngeus, inferior constrictor

LARYNX - INLET & EPIGLOTTIS

Inlet:

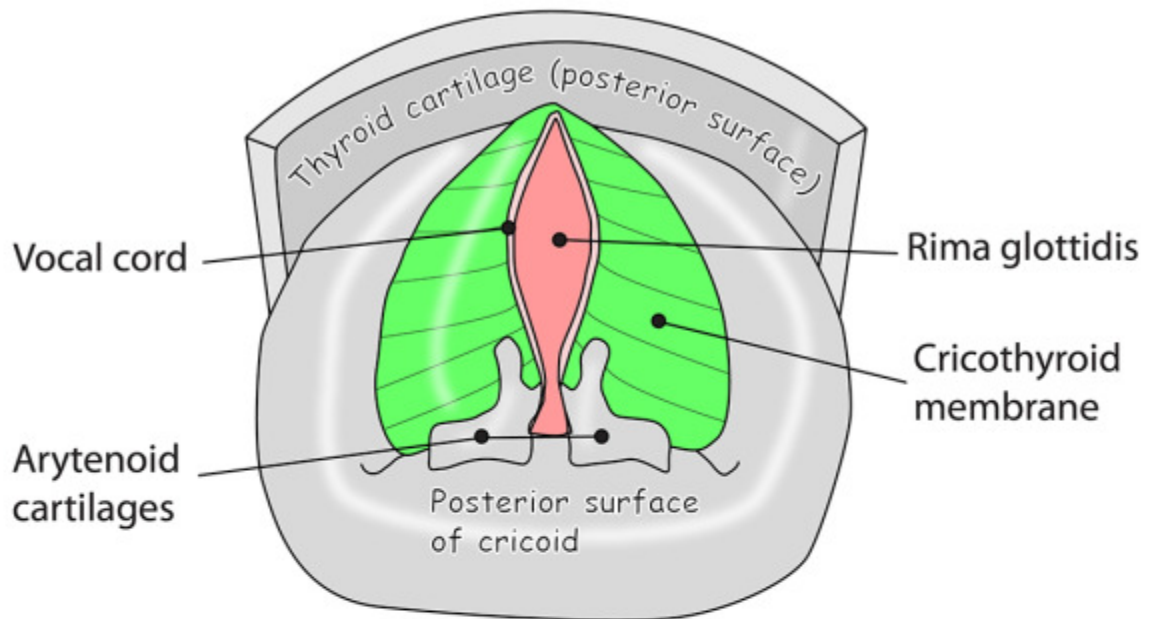
- Extends from tip of epiglottis to C6
- Open for respiration, partially closed for speaking, closed for coughing, straining and swallowing
- Hangs from hyoid bone via tongue/mandible (hyoglossus, mylohyoid, geniohyoid, digastrics, middle constrictor). Some effect on it by 3 of 4 strap muscles (omohyoid, sternohyoid & thyrohyoid)



EPIGLOTTIS

- Elastic cartilage behind root of tongue
Top & anterior surface is stratified squamous epithelium. Posterior is pseudostratified columnar
- Held by: hyo-epiglottic, thyro-epiglottic & aryepiglottic ligaments & median & lateral glosso-epiglottic folds

VOCAL CORDS/CRICOTHYROID MEMBRANE

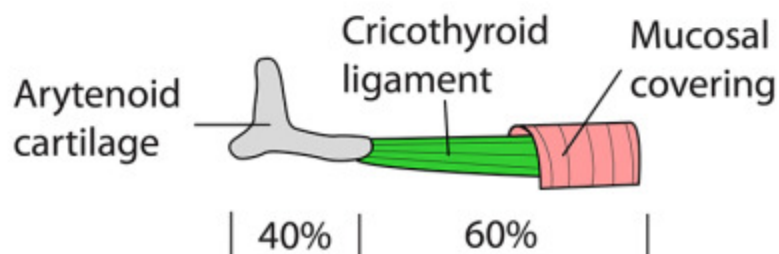


TRUE VOCAL CORDS are the free upper edges of the cricothyroid membrane (conus elasticus) where it is thickened to become the cricovocal ligament and covered with mucosa. The mucosa is pearly white and has no submucosa and thus cannot become oedematous

40% of the vocal cord is arytenoid cartilage

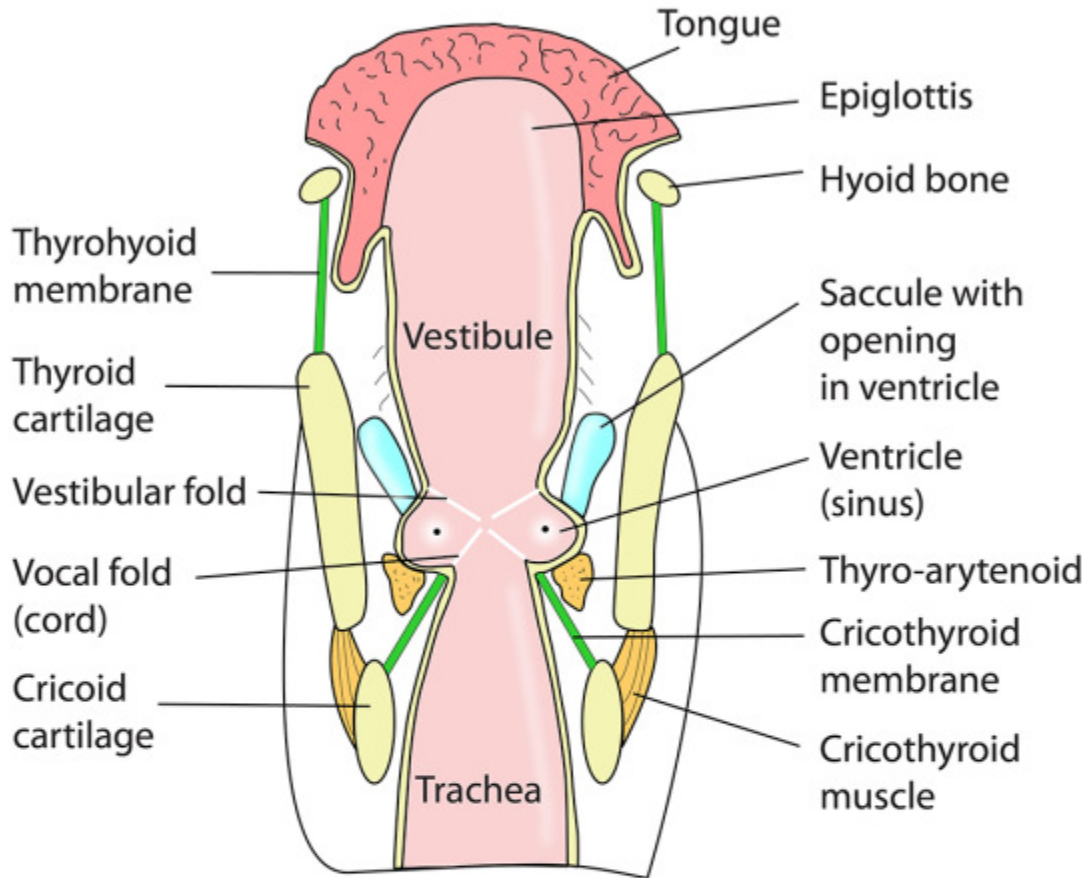
60% is membrane

The cricothyroid membrane is attached around the inside of the ring of cricoid cartilage and has a free upper margin that is attached to the arytenoid cartilages posteriorly and to the back of the thyroid cartilage anteriorly



LARYNX - CORONAL SECTION

Viewed from behind so looking anteriorly



Blood supply: Superior & inferior laryngeal arteries

Mucosa: Pseudostratified ciliated columnar. Mucous glands in sinus (cords & top of epiglottis - stratified squamous)

Nerve supply:

- Sensory above cords - Internal branch of superior laryngeal n
- Sensory below cords - Recurrent laryngeal n
- Motor to muscles - From nucleus ambiguus via cranial accessory
 - to: Cricothyroid - External branch of superior laryngeal n
 - to: All other laryngeal muscles, including upper oesophagus & cricopharyngeus - recurrent laryngeal nerve

Lymphatic drainage:

Above cords - upper deep cervical nodes

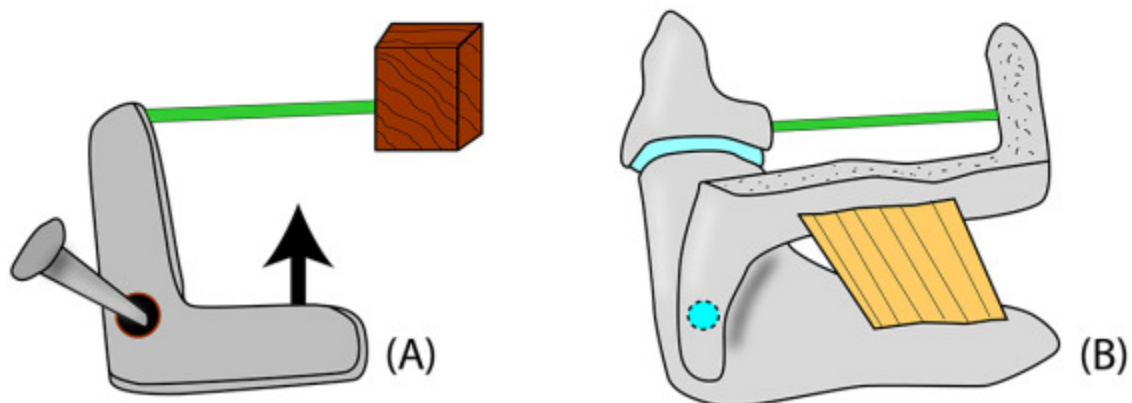
Below cords - lower deep cervical nodes

LARYNX - CRICOTHYROID MUSCLE

CRICOTHYROID has 3 special features that makes it different from other laryngeal muscles. These are:

- It is the only muscle that tightens the cords
- It is supplied the external branch of the superior laryngeal nerve and not the recurrent laryngeal
- It is the only intrinsic muscle of the larynx which on the outside of larynx

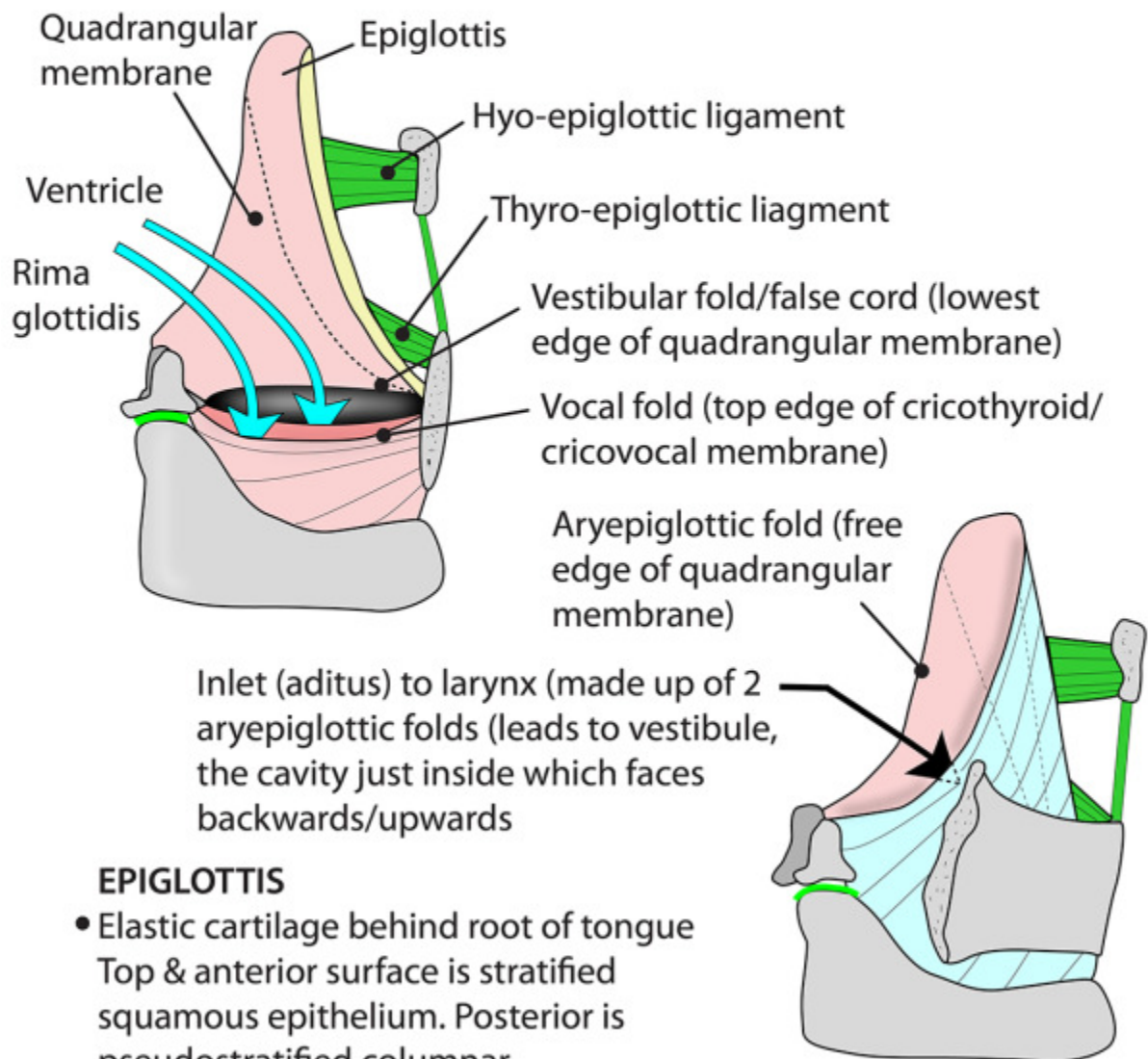
It is not initially obvious how this muscle tightens the cords but the illustration below helps with the understanding. If you can imagine a block of wood attached to the wall (A) with a strong piece of very slightly elastic string joining the block to the top of an angle-iron. The angle-iron can rotate on a nail in such a way that lifting the other end of it will tighten the string. The equivalent situation in the larynx (B) is that the cricothyroid muscle does the lifting of the angle-iron (cricoid) to tighten the cords. The thyroid cartilage is not fixed as is the block of wood in (A) so that both cartilages are tilted when the cords are tightened. Note that the cords are attached to the back of the thyroid cartilage and the vocal processes of the arytenoids



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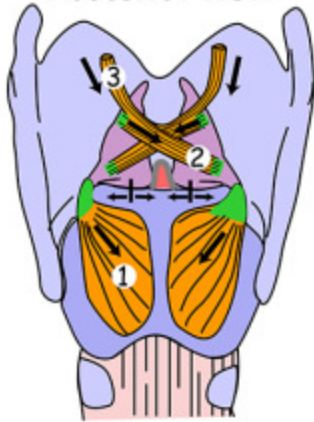


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LARYNX - INTRINSIC MUSCLES

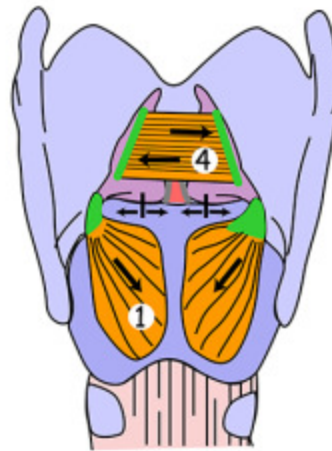
Posterior view



Posterior crico-arytenoid (1) abducts & opens cords

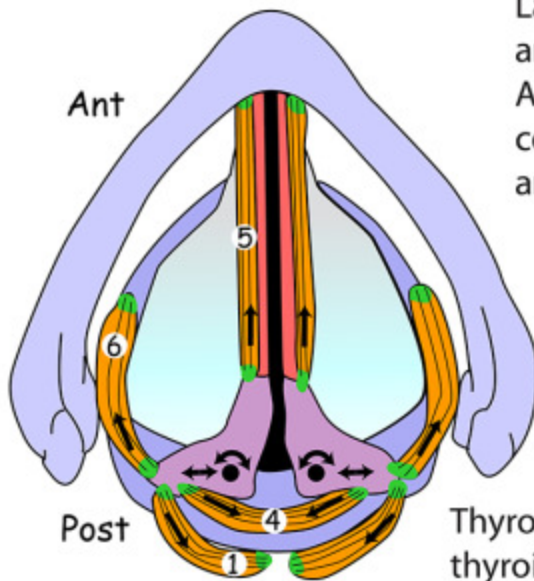
Oblique arytenoids (2) close cords by drawing together arytenoids. They extend into aryepiglottic fold as aryepiglotticus (3) to close the aditus

Posterior view



Transverse arytenoid (4) closes cords by drawing together arytenoids

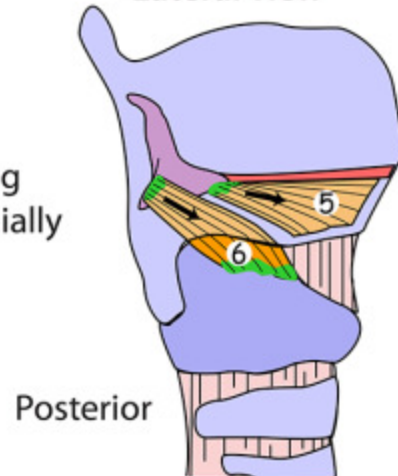
Looking down at cords



Lateral crico-arytenoids (6) Adduct/close cords by rotating arytenoids medially

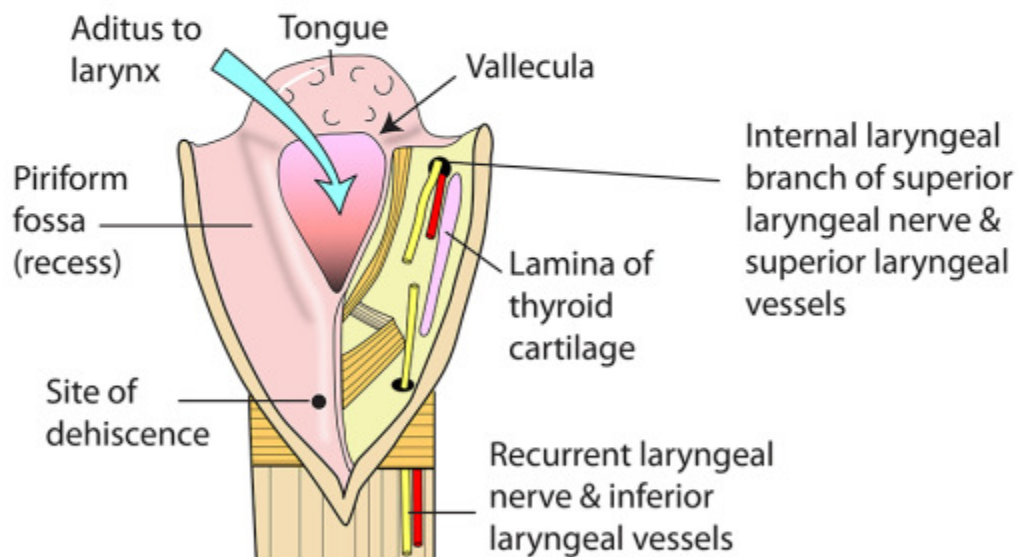
Thyro-arytenoids (5) loosen cords by pulling the thyroid cartilage towards the arytenoids. Vocalis is part of this muscle and changes the shape of the cords

Lateral view



LARYNGOPHARYNX

- **Extends from:** tip of epiglottis - C3
- **To:** start of oesophagus - C6
- **Anterior:** larynx, aditus, epiglottis
- **Posterior:** 3 overlapping constrictors, dehiscence of Killian, cricopharyngeus, vertebrae C4,5,6
- **Nerve supply:** internal laryngeal branch of superior laryngeal nerve (X) & recurrent laryngeal nerve (X).
Note that there is some overlapping of supply in the laryngopharynx unlike in the larynx
- **Lining:** squamous non-keratinising epithelium
- **Features:** aditus to larynx & piriform fossa



Piriform fossa

Medial: quadrangular membrane

Lateral: thyrohyoid membrane & lamina of thyroid cartilage

Hypopharynx

A clinical term for that part of the laryngopharynx below the aditus

Anterior: arytenoid cartilages

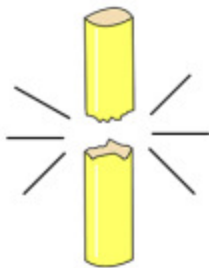
Posterior: dehiscence of Killian

SEMON'S LAW FOR DAMAGE OF NERVES TO LARYNX

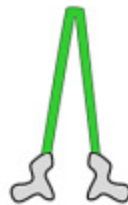
Semon's Law indicates the different effect between damage & transection of the recurrent laryngeal nerve as applicable to surgery in the region of this nerve (eg thyroidectomy or parathyroidectomy). It is probably more of a guide than a rule

Transection of recurrent laryngeal nerve

RLN



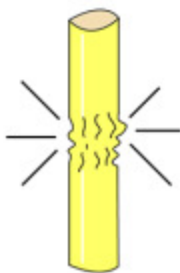
CORDS



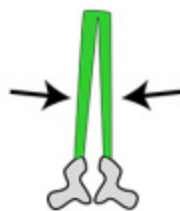
- Complete paralysis
- 1/2 ab(ad)ducted
- Cannot cough or speak

Trauma but no transection

RLN



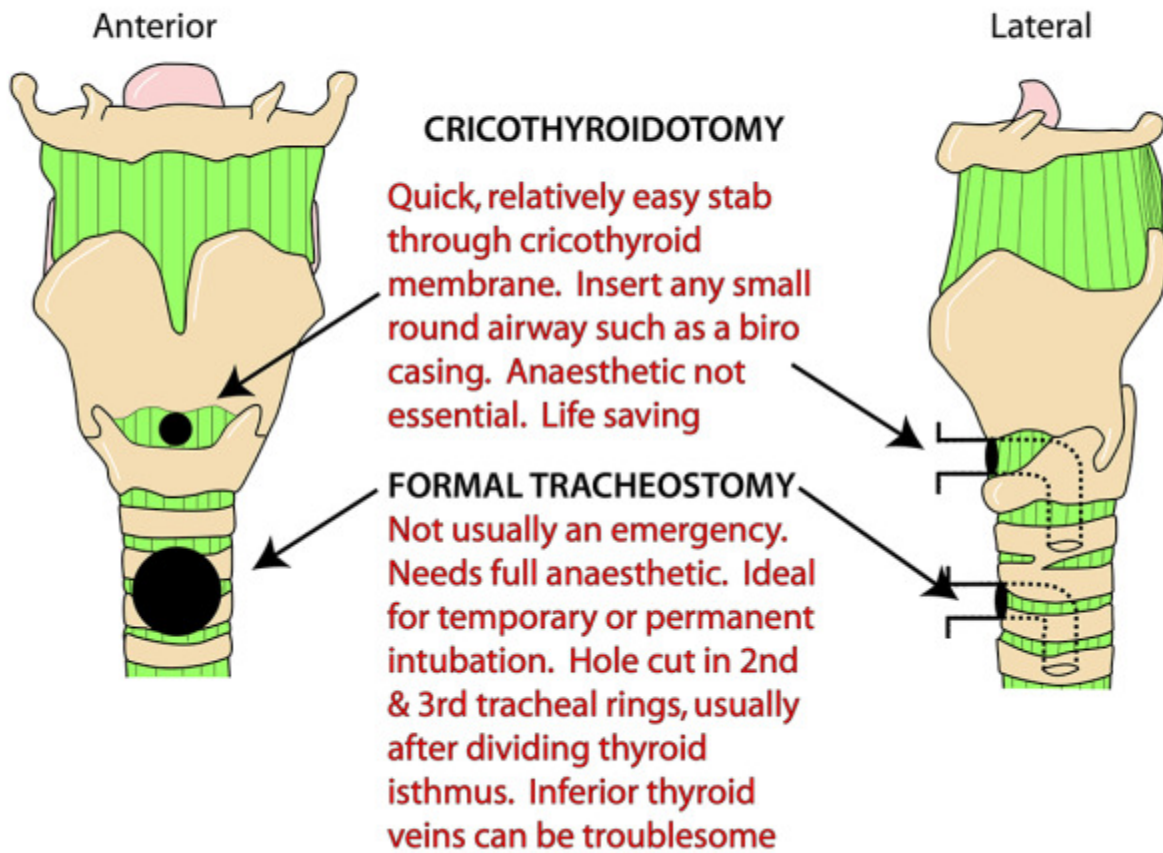
CORDS



- Partial paralysis
- Adducted cords
- Posterior crico-arytenoids most vulnerable
- Cannot breath

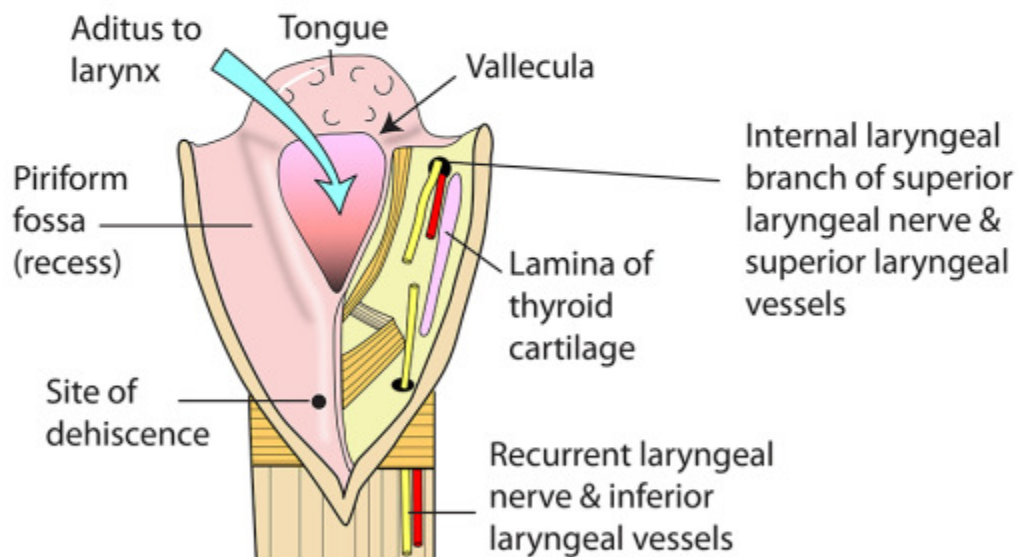
BILATERAL → DISASTER
UNILATERAL → CAN COMPENSATE

EMERGENCY ACCESS TO TRACHEA



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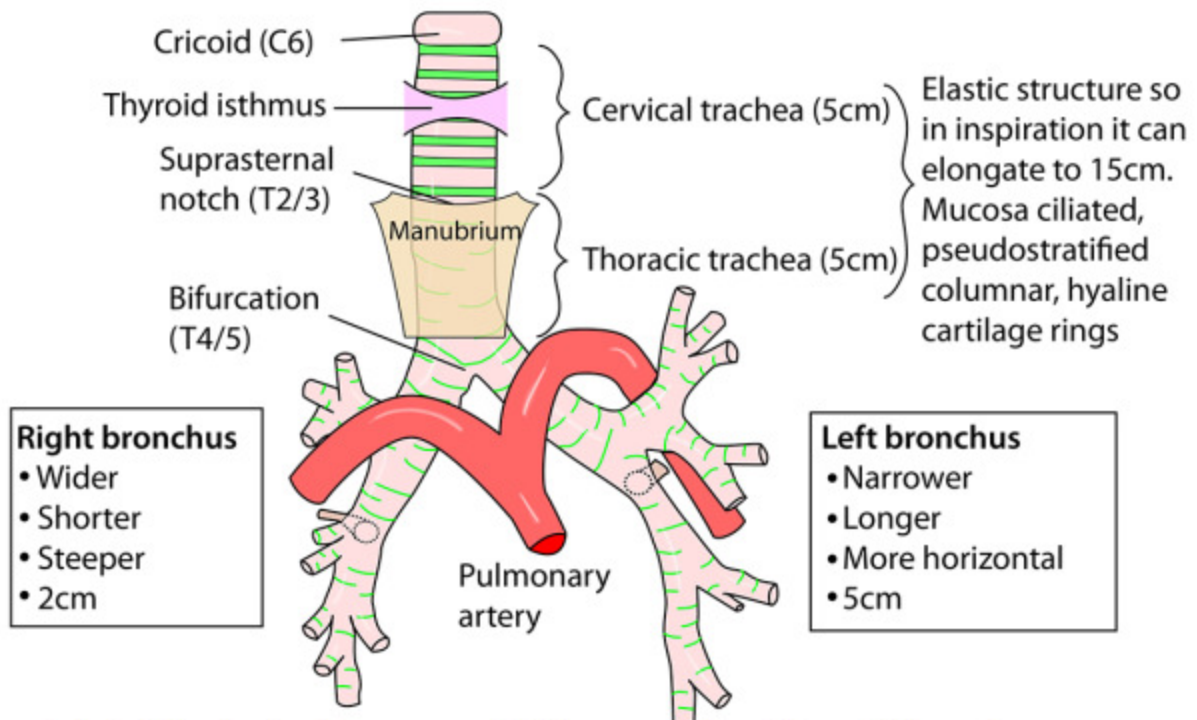
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Anterior: arytenoid cartilages

Posterior: dehiscence of Killian

RELATIONS OF TRACHEA & BRONCHI



Inhaled foreign bodies are more likely to enter the right main bronchus and then pass into the apical bronchus of the right lower lobe - the first one that points posteriorly

- Elastic structure
- 10cm long but extends to 15cm on inspiration
- C shaped cartilages - trachealis muscle closes C
- Mucosa ciliated pseudostratified columnar
- **Blood:** Inferior thyroid artery & veins & bronchial arteries
- **Lymph:** Posterior/inferior deep cervical
- **Nerves:** Vagus & recurrent laryngeal for pain and secretomotor
Sympathetic to blood vessels and smooth muscle (T1-4)
- **Relations:** (see cross section at C7)
 - Posterior - oesophagus, recurrent laryngeal nerves
 - Sides - carotid sheath, lateral lobes of thyroid to 6th ring
 - Anterior - Inferior thyroid veins, anterior jugular arch, thyroidea ima artery, levator glandulae thyroidea, thymus if large, manubrium, sternohyoid, sternothyroid, left brachiocephalic vein