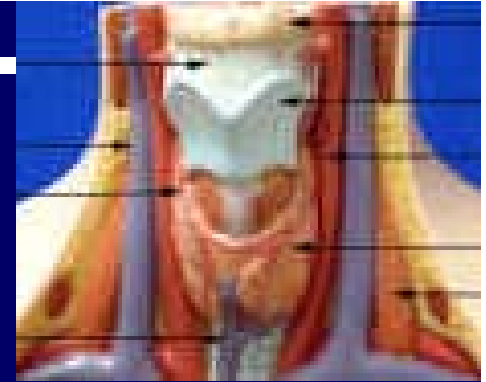


Anatomy of larynx & its  
relevance in pathways  
of spread of laryngeal  
cancer.

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## The Larynx

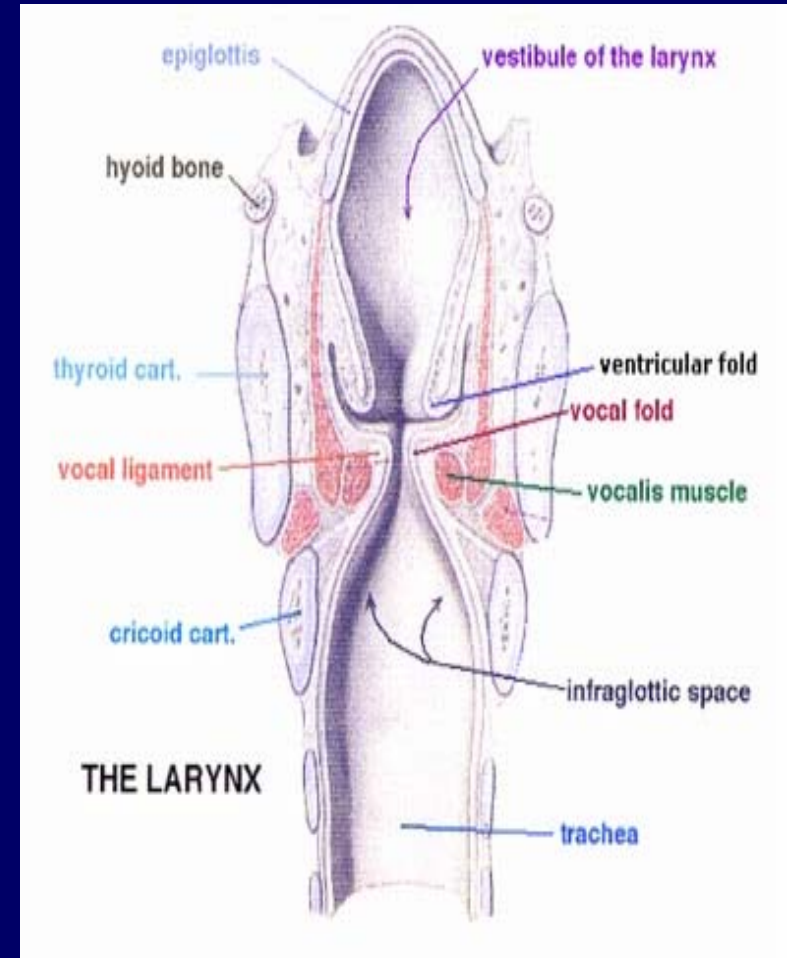


- Larynx is situated in the midline compartment of neck deep to strap muscles.
- Larynx protects lower respiratory tract, provides
  - controlled airway
  - Allows phonation
  - Generates high intrathoracic pressure for coughing / lifting weights.

# Surgical Anatomy

Larynx – 3 regions;

- Supra glottis
- Glottis
- Subglottis
  
- Embryologically &  
Anatomically distinct





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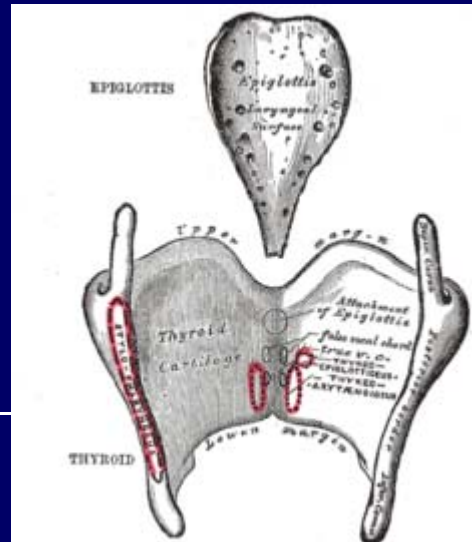
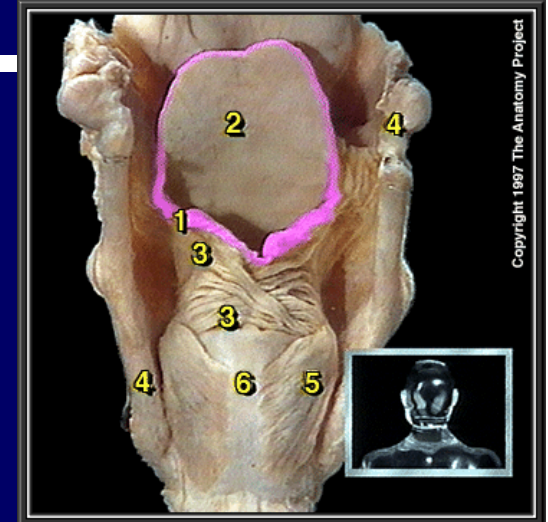
## Supraglottis

- Connects larynx to base of tongue
  - Extends upto ventricle
  - Subdivisions;
    - Epiglottis
    - AE fold
    - Arytenoid
    - False cord
    - Ventricle
  - Mucosal lining; stratified squamous epithelium
  - Rich in lymphatics
    - Exit through throhyoid membrane to jugulodigastric nodes
    - Cervical mets more common (b/l)
-

# Supra glottis

## Epiglottis;

- ❑ Leaf shaped fibrocartilage
- ❑ Narrow base- petiole attached to thyroid cartilage
- 2 surfaces;
- ❑ Laryngeal surface
- ❑ Lingual surface- connected to vallecula by glossoepiglottic ligament.
  
- ❑ Suprahyoid epiglottis- free end
- ❑ Infra hyoid epiglottis-
  - numerous pits
  - Related to preepiglottic space
  - Early Preepiglottic space invasion





---

## Supraglottis

### **AE Fold;**

- ❑ Extends from arytenoid to epiglottis
  - ❑ Contains corniculae & cuneiform cartilage.
  - ❑ Flabby – laryngomalacia
  - ❑ AEF,FC,TC forms 3 sphincters during pharyngeal phase of swallowing
-



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## Supraglottis

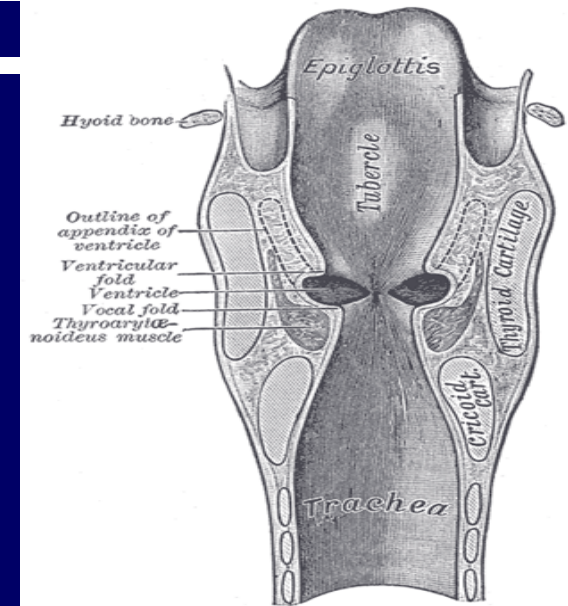
### **False cord;**

- Thin shelve like partition above ventricle
  - Ventricular ligament- infr end of quadrangular membrane.
    - Limits inferior spread of supraglottic ca
  - Compensates in phonation if true cord non functional
-

# Supraglottis

## Ventricle;

- ❑ Lower limit of SGL
- ❑ Rich in minor salivary glands
- ❑ Laterally – horizontal slit extends into ventricle
- ❑ Saccule of ventricle extends between vestibular ligament & thyroid cartilage
- ❑ Any tumor that crosses ventricle is transglottic ca
- ❑ Preepiglottic space tumors reaches paraglottic space by traversing ventricle







---

## Glottis

- ❑ It comprises; true cord anterior, posterior commissure
  - ❑ Rima glottis- triangular space between two vocal cords
  - ❑ Extends upto 1 cm below free margin of vocal cords
  - ❑ Narrowest portion in adult laryngx
-

# Glottis



## Vocal cord;

- Anterior 2/3; membranous
  - Vocal ligament & muscle
- Posterior 1/3; fibrous
  - Vocal process of arytenoid
  
- Vocal cord insert into midline of thyroid cartilage via Broyles ligament.
  - At the level of insertion inner perichondrium is absent.
  - Broyles ligament limits inferior spread of glottic ca
  - Once it is breached early cartilage invasion common (T1,4 Glottic ca)



---

## Glottis

Anterior commissure;

- ❑ Area between 2 vocal cords
  - ❑ Surface marking of AC;
  - ❑ Male; midline between thyroid notch and lower border
  - ❑ Female; junction of upper 1/3 and lower 2/3
  - ❑ Webbing more common
-



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## Glottis

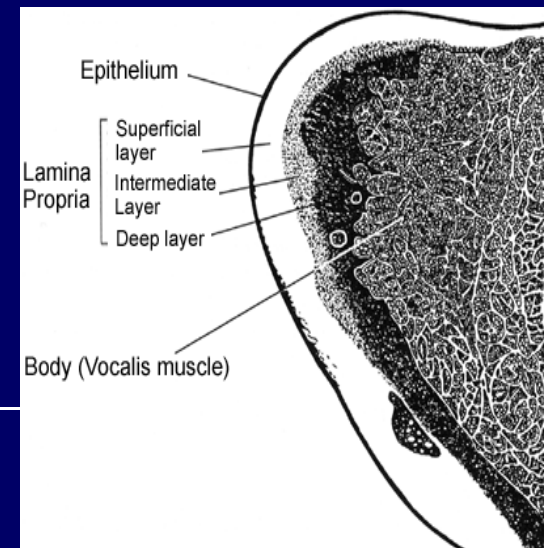
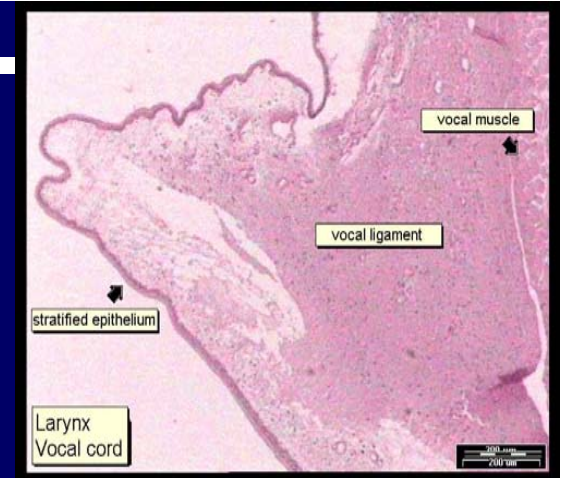
### **Posterior commissure;**

- Area between vocal processes
  - Respiratory portion
  - Post commissure scarring mimics b/l abductor cord palsy.
-

# Glottis

## Layered microstructure of vocal cord;

- Mucosa
- Lamina propria;
  - Superficial – Reinkes space
  - Intermediate
  - Deep layer | vocal ligament
- Muscular layer – thyroaytenoideus.



## Glottis



- ❑ Mucosal layer vibrates over reinkes space durinf phonation
- ❑ Any scarring affects phonation
- ❑ In invasive carcinoma, mucosal wave is absent-  
stroboscopy
- ❑ Sulcus vocalis- mucosa gets impregnated into deeper layers.



---

## Subglottis

- ❑ Narrowest portion of pediatric larynx
  - ❑ Extends upto lower border of cricoid cartilage
  - ❑ 2 parts;
  - ❑ Mobile upper part
    - Below the vocal process to upper border of cricoid cartilage
  - ❑ Fixed lower part;
    - Extends upto inferior part of cricoid cartilage
-



---

## Subglottis

### **In LTS,**

- ❑ Subglottic stenosis is more common in pediatric airway due to non expansile ring
  - ❑ Lower half – dealt by resection & anastomosis
  - ❑ Upper half – difficult to treat, arytenoid limits resection
-





## Laryngeal framework

- Cartilage
- Muscles
- Connective tissue compartments
- Potential spaces



# Laryngeal cartilages

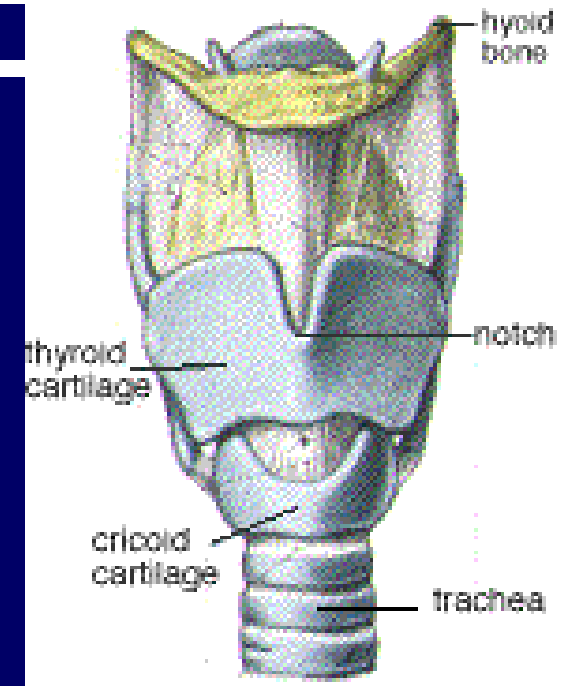
## Cartilages;

### □ Unpaired cartilages;

- Thyroid
- Cricoid
- Hyoid

### □ Paired cartilage;

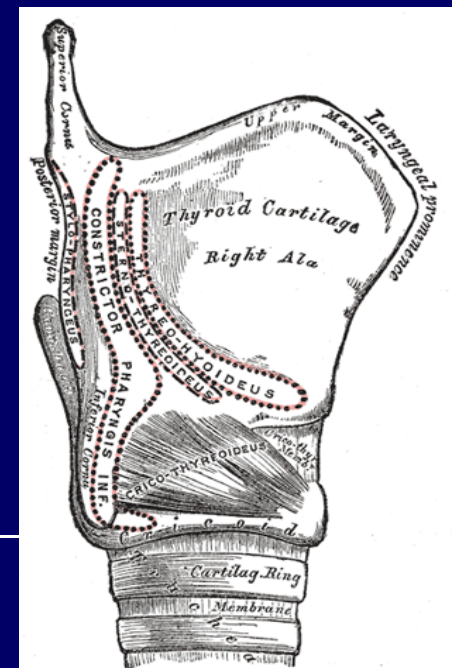
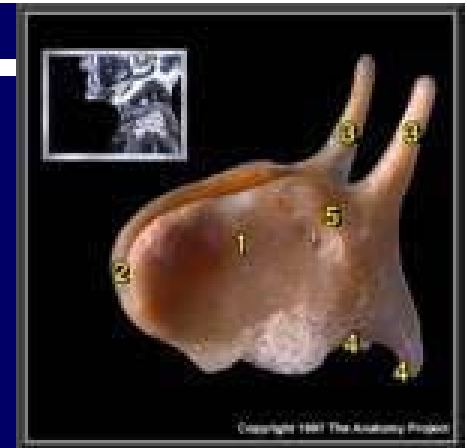
- Arytenoid
- Corniculate
- cuneiform



# Laryngeal cartilages

## Thyroid cartilage; (shield like)

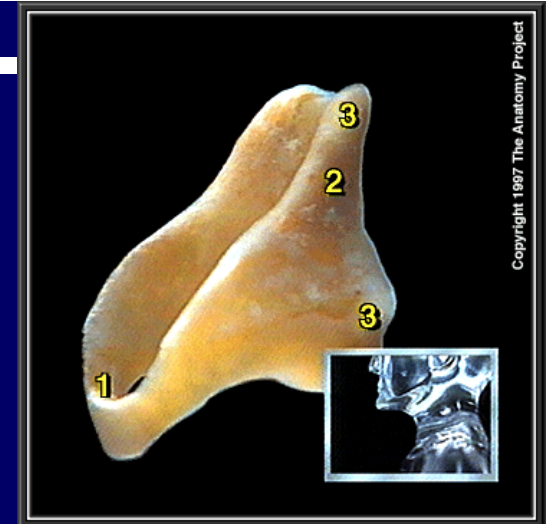
- 2 laminae fuse in midline to form thyroid prominence.
  - Male- acute(90°)
  - Female- obtuse (120°)
- Oblique line
  - Attachment to strap muscles, infr constrictor
  - Post part related to PFS.

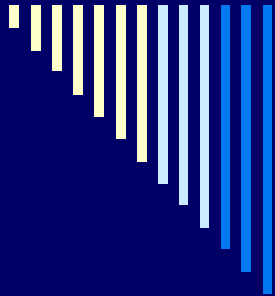


# Laryngeal cartilages

## Cricoid cartilage;

- ❑ Signet ring shaped
- ❑ Anterior arch-5-7mm
- ❑ Posterior lamina-2-3mm
- ❑ Cricothyroid jt related to RLN





## Hyoid bone;

- U shaped bone
- Suspends larynx in neck
- Body, greater & lesser cornua
- Gives attachment to supra/infra hyoid muscles (Extrinsic)
- Hyoid relations;
  - Post- pre epiglottic space
  - Hyoid need to be removed in preglottic spread.
  - Attached to epiglottis via hyoepiglottic ligament

# Laryngeal cartilages

## Arytenoid;

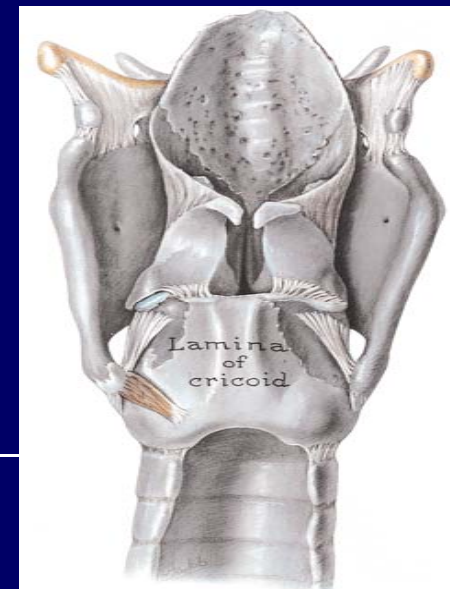
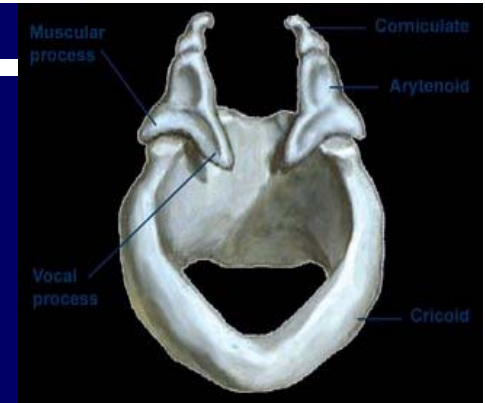
- ❑ Pyramidal shape
- ❑ Base- articulates with cricoid
- ❑ Apex- articulates with corniculate

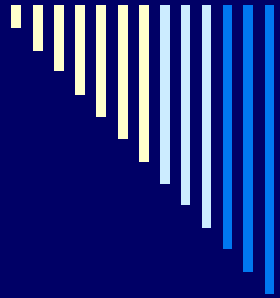
## 2 process;

- ❑ Muscular process- post, lat cricoarytenoid
- ❑ Vocal process- vocal ligament

## 2 surfaces;

- ❑ Medial – mucosa of post glottis
- ❑ Posterior- transverse arytenoideus.





## Laryngeal cartilages

### **Corniculate & cuneiform cartilage;**

- ❑ Vestigial structures within AE fold
- ❑ They tend to thicken AE fold, when used for resurfacing larynx after vertical hemilaryngectomy.(resp distress)



---

## Laryngeal connective tissues

- Ligaments;
  - Intrinsic
  - Extrinsic

### **Intrinsic ligaments;**

- Beneath the laryngeal mucosa the laryngeal cartilages are bound by intrinsic ligaments.
  - They are portions of broad sheath of fibrous tissue containing mainly elastic fibres.
  - They form barriers that divide larynx into compartments & serve to guide, limit the spread of laryngeal cancer
-



## Intrinsic ligaments

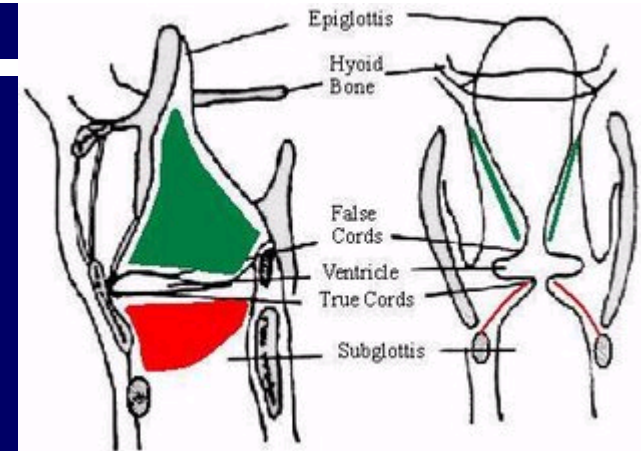
### Intrinsic ligaments

- Quadrangular membrane
- Conus elasticus

### Quadrangular membrane;

Attachments;

- Ant- lat border of epiglottis
- Post- medial surface of arytenoid
- Infr- thickened lower part forms vestibular ligament

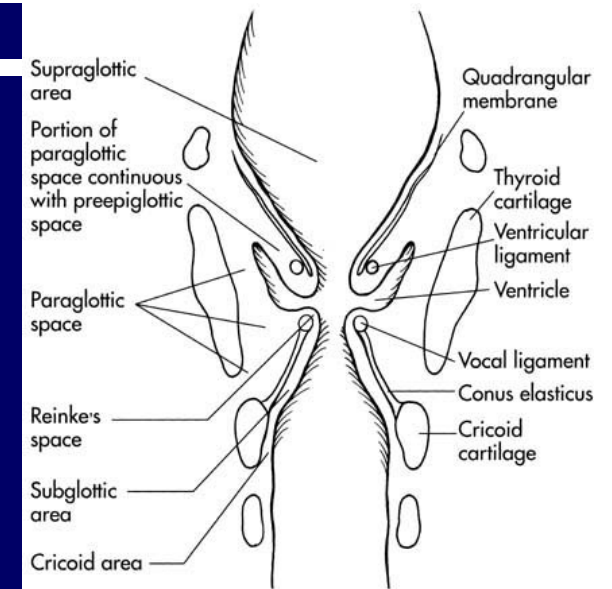


# Intrinsic ligaments

## Conus elasticus;

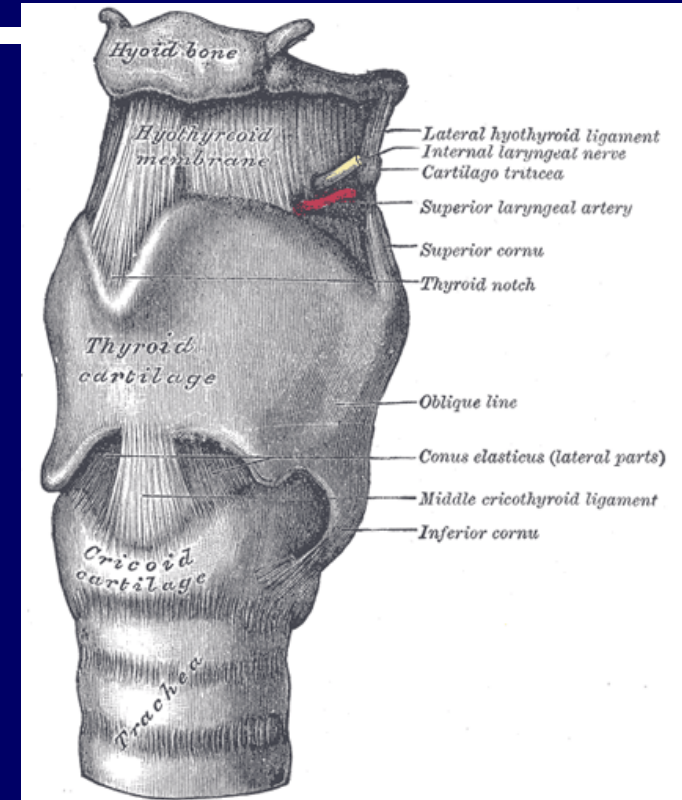
### Attachments;

- Ant - median cricothyroid ligament
- Post- vocal process
- Lat- thyroid cartilage
- Supr-thickened upper end forms vocal ligament
- Infr- lower border of cricoid cartilage



## Extrinsic ligaments

- Thyrohyoid membrane
- Cricothyroid membrane
  - Median
  - Lateral





## Laryngeal spaces



### **Reinkes space;**

- ❑ Submucosal space along most of the length of free edge of true cord
  - ❑ It allows mucosa to slide over underlying tissue
  - ❑ Very early glottic ca can be stripped off – with no obvious voice change
-

# Laryngeal spaces

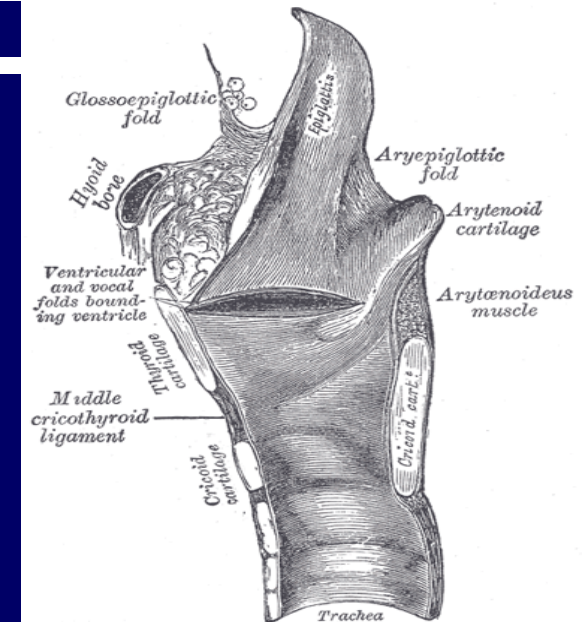
## Pre epiglottic space;(space of Boyer)

Extension;

- Supr -hyoepiglottic ligament
- Infr - thyroepiglottic ligament
- Post - epiglottis
- Ant - thyrohyoid membrane & thyroid cartilage

□ Content; fat, areolar tissue

□ Continues laterally with paraglottic space deep to quadrangular membrane



## Laryngeal spaces

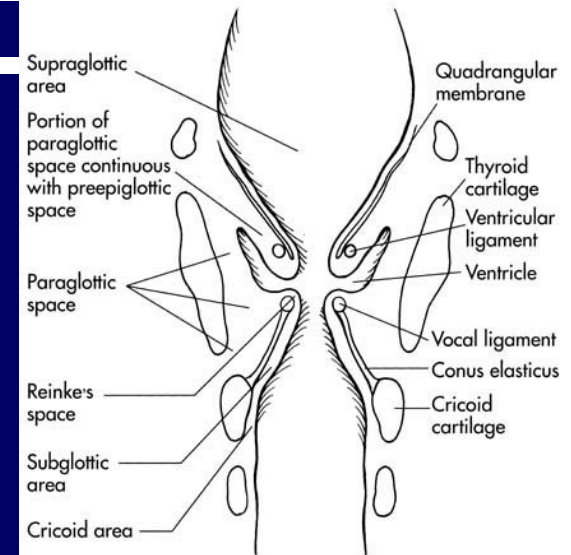
### Paraglottic space;

Lies at the level of glottis

Extensions;

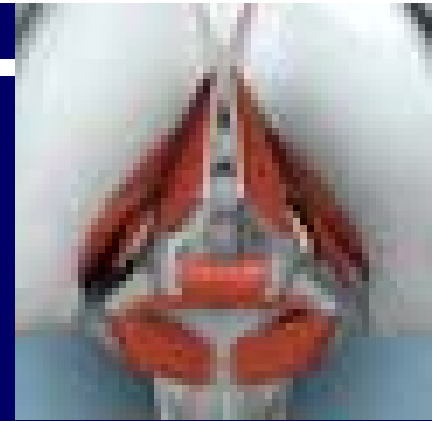
Supr	- separated from Supraglottis by quadrangular membrane
Infr	- conus elasticus
Lat	- thyroid cartilage
Post	- PFS

- Content; thyroarytenoideus muscle
- Inferolaterally it is continuous with cartilagenous defect between cricoid & thyroid cartilage
- Paraglottic involvement in glottic ca – fixity of cord





## Laryngeal muscles



### Laryngeal muscles;

- Intrinsic
- Extrinsic

### Intrinsic muscles;

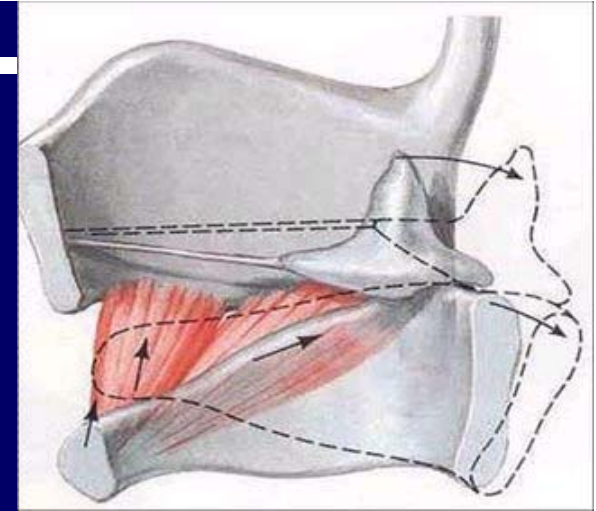
- Coordinates phonation, respiration, cough reflex, sphincter mechanism
  - Paired
  - Unpaired muscles (arytenoidues)
-



## Intrinsic muscles

### **Cricothyroid muscle;**

- ❑ Tensor of vocal cord
- ❑ Origin;            cricoid arch
- ❑ Insertion;        infr border thyroid cartilage
- ❑ Action;
  - Tilts thyroid forward & cricoid backward- stretching of vocal cord
  - Makes vocal cord thinner & longer - ↑ pitch
- ❑ Nerve; external branch of SLN



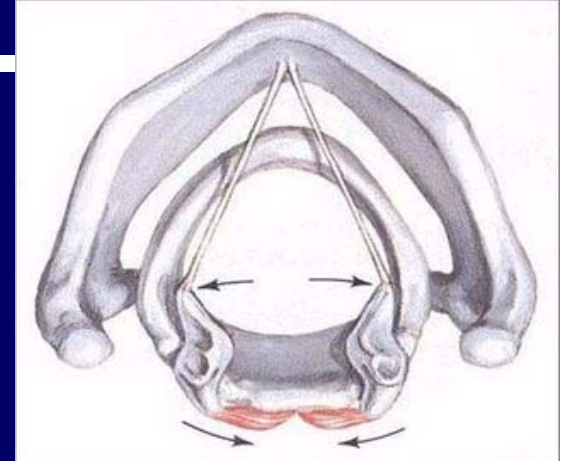




## Intrinsic muscles

### Posterior cricoarytenoid;

- ❑ Only abductor of vocal cord
- ❑ Origin- posterior surface of cricoid lamina
- ❑ Insertion- muscular process of arytenoid
- ❑ Action- vocal cord abduction
- ❑ Nerve - RLN

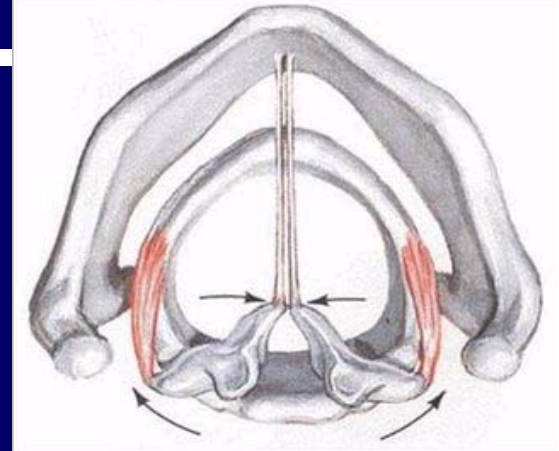




## Intrinsic muscles

### Lateral cricoarytenoid;

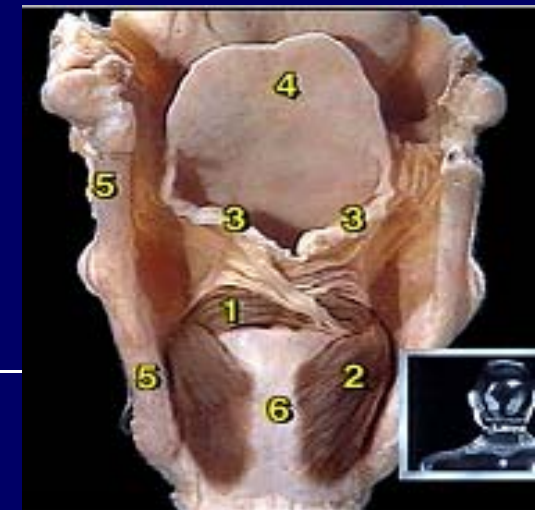
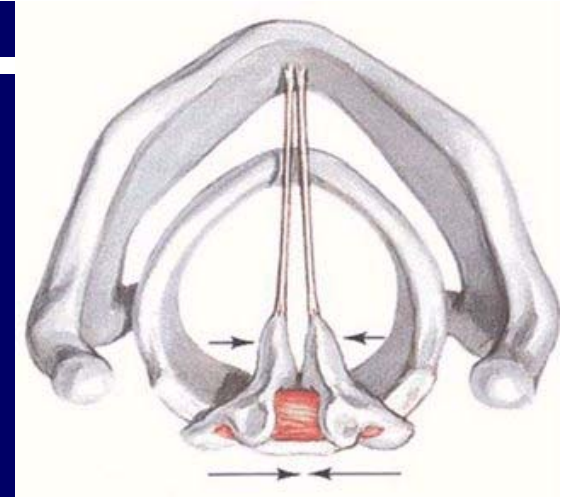
- ❑ Origin - cricoid ring
- ❑ Insertion - muscular process
- ❑ Action - adduction of vocal cord

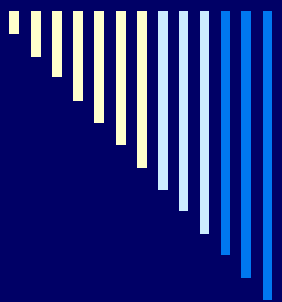


## Intrinsic muscles

### Artenoideus muscle;

- Oblique/ transverse part
- Oblique part continues as aryepiglotticus
- Adducts the vocal cord
- Aryepiglotticus- sphincter action AE fold during swallowing

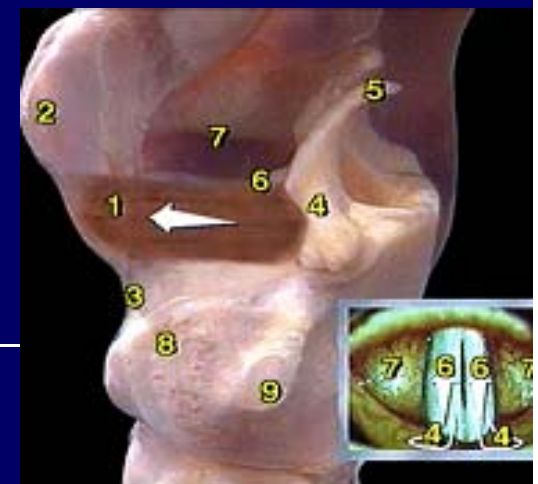
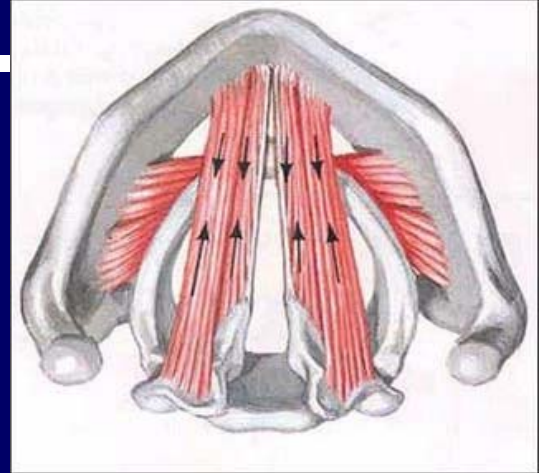




## Intrinsic muscles

### Thyroarytenoideus;

- ❑ origin- thyroid cartilage
- ❑ Insertion- vocal process
- ❑ Action- drags arytenoid forward
- ❑ Adduction of vocal cord





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## Laryngeal muscles

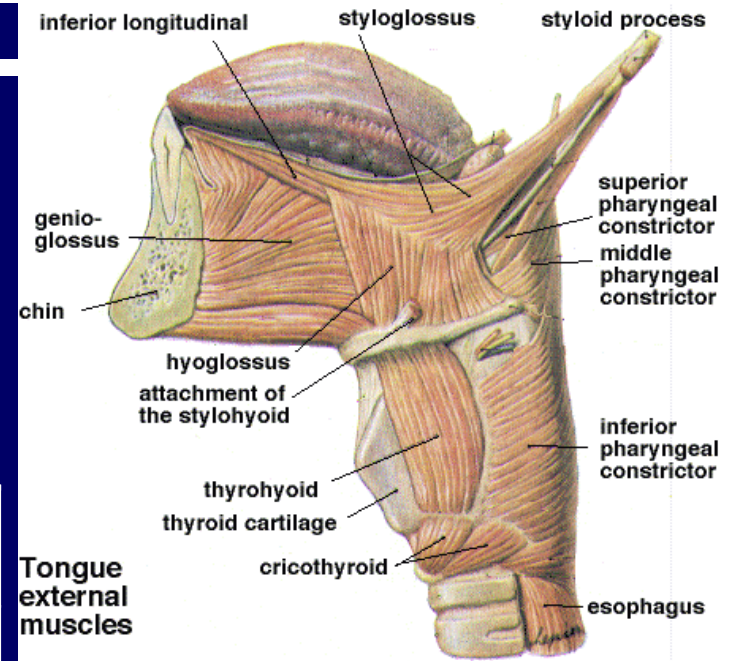
- ❑ Posterior cricoarytenoideus is the only abductor of larynx.
  - ❑ In RLN palsy, cord assumes median/paramedian position due to cricothyroid overactivity
  - ❑ Pitch is related to tension of vocal cord ( cricothyroid, throarytenoid muscle)
  - ❑ Intensity of voice – expiratory effort of subglottic pressure
-

# Extrinsic muscles

- Suprahyoid
- Infrahyoid

## Suprahyoid muscles;

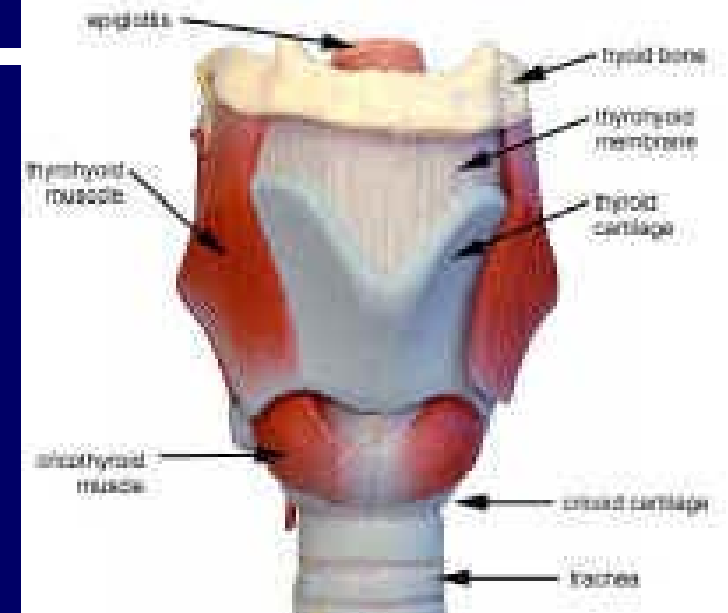
Muscle	Action
mylohyoid	Pulls hyoid forward
geniohyoid	Pulls hyoid forward
stylohyoid	Elevator/retractor of hyoid in swallowing
digastric	Pulls hyoid ant/post
stylopharyngeus	Elevates larynx
palatopharyngeus	Forward tilting of Lx
Salphingo pharyngeus	Elevates larynx



## Extrinsic muscles

□ Infra hyoid muscles;

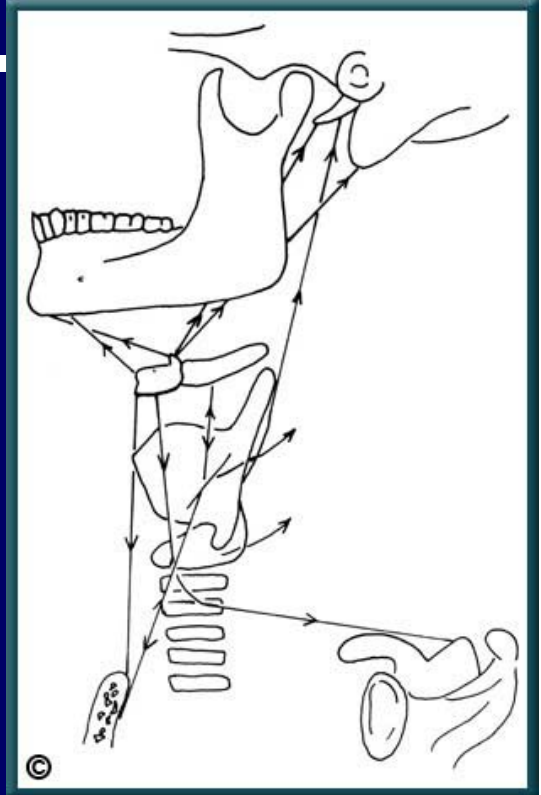
Muscle	Action
Thyrohyoid	Elevates larynx
Sternohyoid	Depress larynx
Sternothyroid	Depress larynx



## Extrinsic muscles

### Functions;

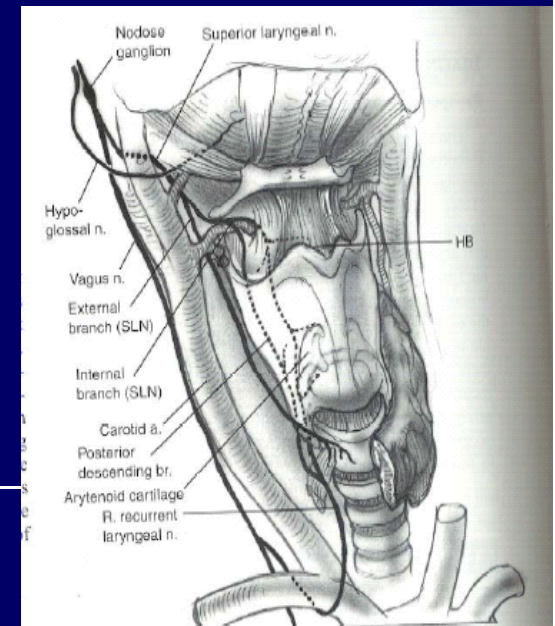
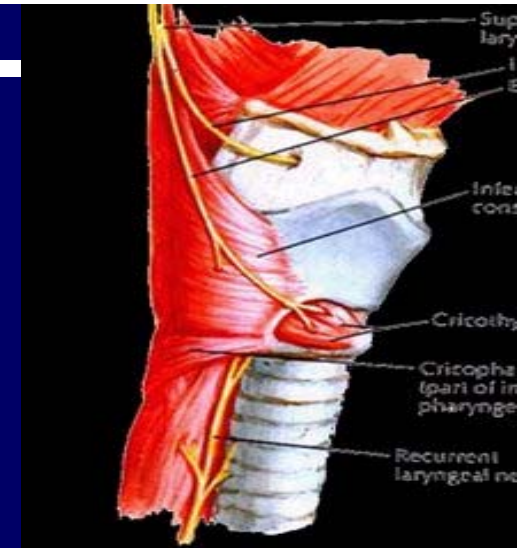
- Downward traction of the trachea with inspiration- vocal fold abduction
- Elevation & forward pull in larynx during deglutition- opens cricopharyngeal sphincter & prevents aspiration





## Nerve supply

- Superior & inferior neurovascular pedicle
- vagus-;**
- SLN;
  - External br
  - Internal br
- RLN (infr lx nerve)





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## Nerve supply

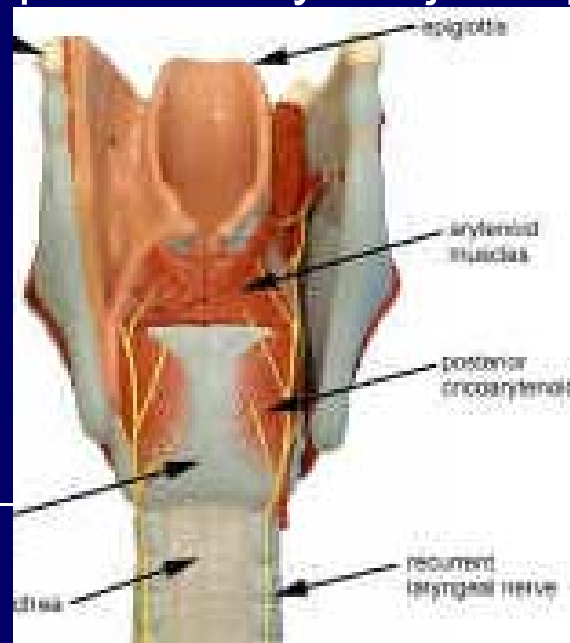
### Superior pedicle;

- SLN,
  - Supr Lx br of supt thyroid artery
  - Venae comitantes
  - Pierces thyrohyoid membrane – supplies supraglottic mucosa and runs ant to PFS mucosa
  - External branch descends over infr constrictor to supply cricothyroid
-

## Nerve supply

### RLN;

- Supplies all intrinsic muscles except, cricothyroid
- Ant & post branch
- Ascends along lat border of trachea post to thyroid gland, deep to cricothyroid jt deep to cricothyroid muscle.



# Vascular supply

## Arterial supply;

Superior thyroid artery ( laryngeal br)

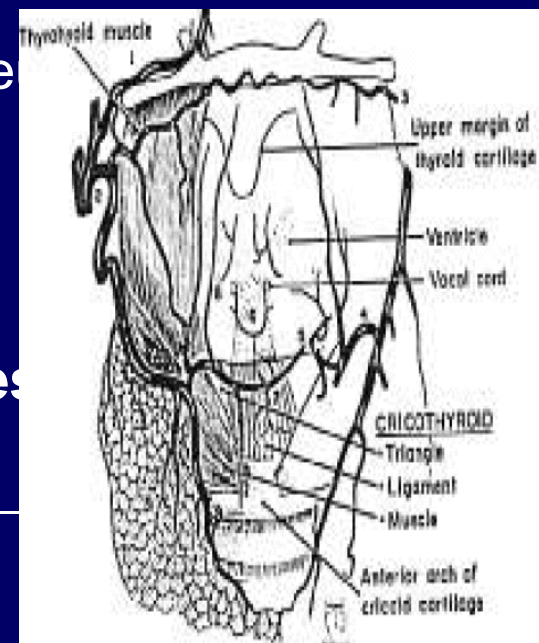
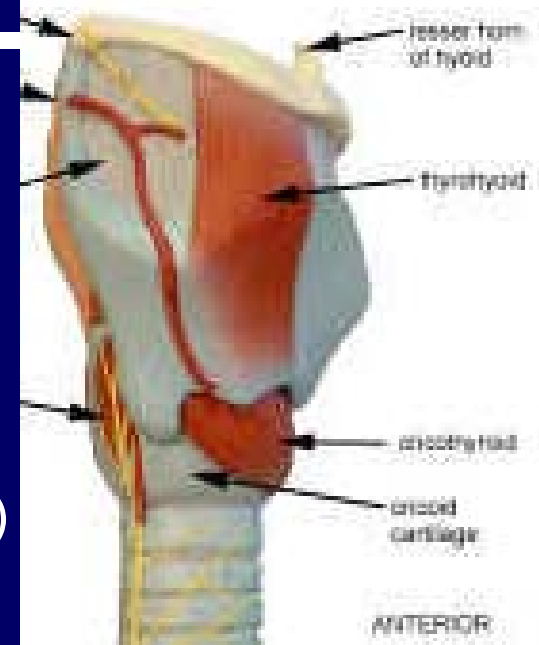
Inferior thyriod artery

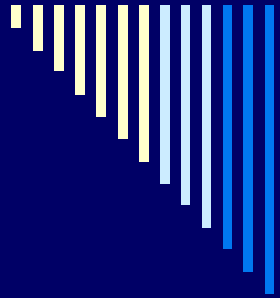
### 1. Supr laryngeal artery branches;

- ❑ Ascending br- PFS
- ❑ Descending br-thyroarytenoide
- ❑ Ventral – ventricle
- ❑ Median – false cord
- ❑ Dorsal- PFS, PCA

### 2. Inferior thyroid artery branches

- ❑ Medial
- ❑ Lateral





---

## Vascular supply

### **Venous drainage;**

- Supr Lx vein drains into IJV
  - Rest- mid thyroid vein
-



---

## Lymphatics

### **Above vocal cord;**

- Upper deep cervical node

### **Below vocal cord;**

- Lower deep cervical node through pre/para tracheal node & prelaryngeal node
  - Vocal fold- no lymphatics
-

---



## Patterns of spread of laryngeal cancer

- Tumor invasion is generally along lines of least resistance in potential spaces. The course being marked out by nerve, blood vessels and lymphatics passing away from the tumor in loose connective tissue.
-



## Glottic cancer

- Progress of glottic carcinoma is slow and predictable
- Common site – ant half, AC

### **Extension in 3 dimensions;**

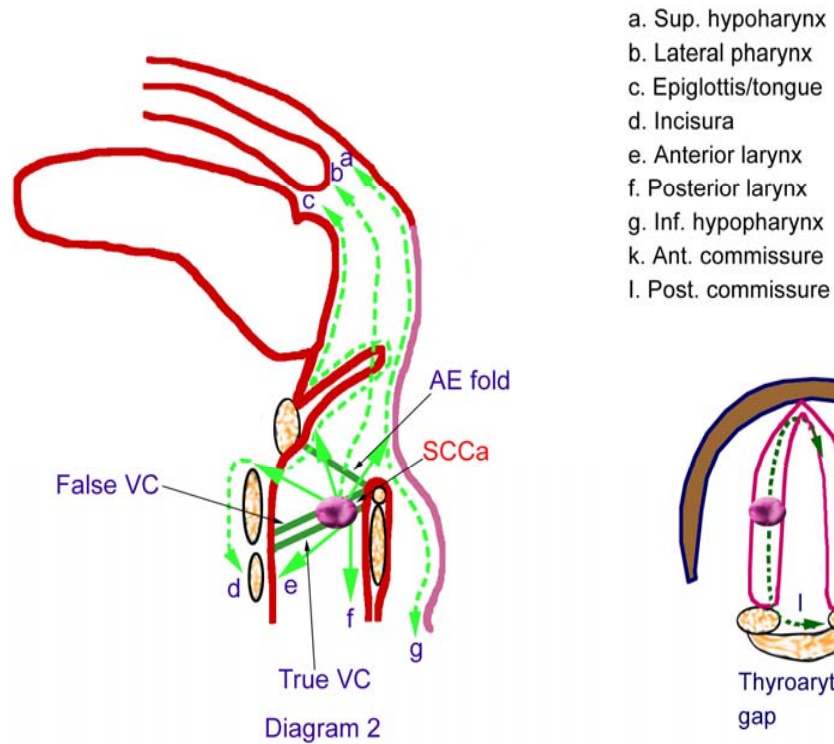
- Glottic plane- radially (ant- post)
- Vertical- AC to supra/subglottic spread
- Deep- through vocal lig, conus elasticus thyroartenoideus- paraglottic space.





# Glottic cancer

## SCCa Spread from TVC





---

## Glottic cancer

- Glottic lesion with mobile cord- supl to conus elasticus
  
  - Glottic ca with fixed cord;
    - Thyarytenoideus involvement (most common)
    - Vocal process of arytenoid
    - Subglottic extension
    - Perineural spread
  
  - Lymphatic spread less common.
  
  - Nodal metastasis seen in level 2,3,4 and delphian(pre tracheal node)
-



---

## Glottic cancer

- Thyroid cartilage invasion;
    - Common in ossified parts
  - Extralaryngeal spread;
  - Ant midline- thyroid cartilage/ cricothyroid membrane
  - Laterally – cricothyroid space
-



---

## Glottic cancer

### **Anterior commissure;**

- ❑ Invades thyroid cartilage through Broyles ligament
  - ❑ Supr- invades petiole of epiglottis
  - ❑ Infr- subglottis- cricothyroid membrane- extralaryngeal spread
  - ❑ T4 misdiagnosed as T1.
-

## Supraglottic cancer



- Usually remain localised
- Glottic spread relatively late
- Tumor behaviour influenced by
  - Exophytic/ulcerative growth
  - Primary epiglottic lesion/ more post,lat lesion
  - Pushing margins- better differentiated, exophytic, less invasive
- There is anatomical/embryological barrier to downward spread of these tumors below ventricles
- Thyroid cartilage involvement through pre epiglottic & paraglottic space— extralaryngeal spread



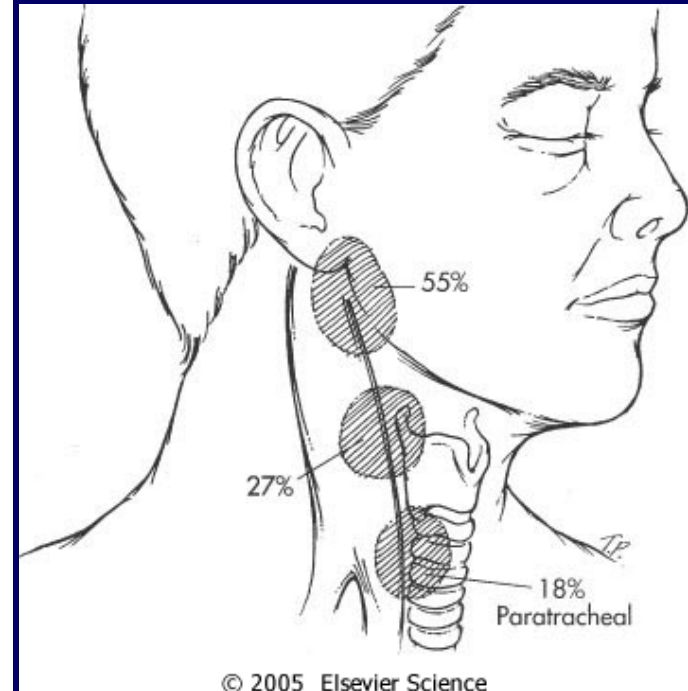
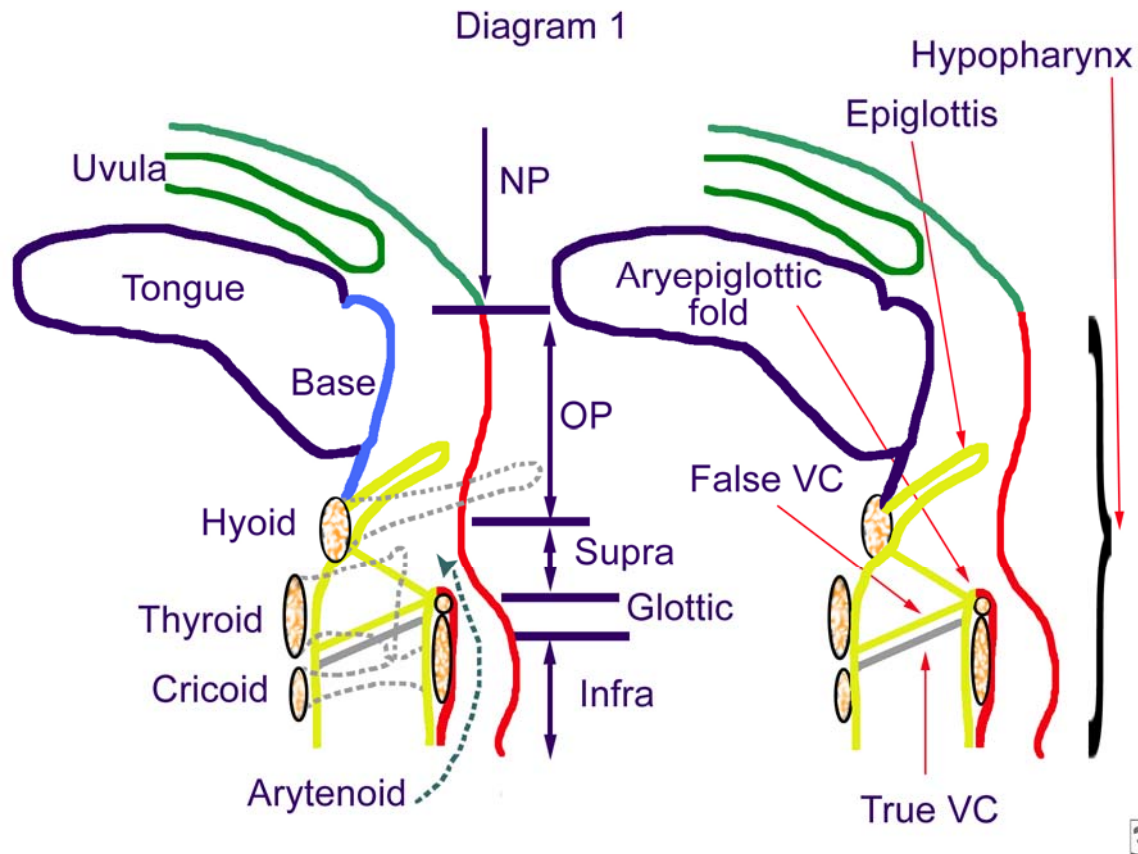
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## Supraglottic cancer

- ❑ Pushing margins- better differentiated, exophytic, less invasive
  - ❑ Exophytic tumors remain above ventricle, less submucosal spread.
  - ❑ Ulcerative tumor extend infrly to AC, ventricle, thyroid cartilage.
  - ❑ Thyroid cartilage involvement through pre epiglottic & paraglottic space– extralaryngeal spread
  - ❑ Frequent occult neck metastasis , high frequency of b/l node .
  - ❑ Metastasis occurs in level 2,3,4.
-

# Supraglottic cancer

Diagram 1





---

## Supraglottic cancer

### **Epiglottis;**

- ❑ Supr extn to vallecula, Base of tongue
- ❑ Suprahyoid epiglottic tumors spread to vallecula, BOT
- ❑ Infrahyoid epiglottic ca invades pre epiglottic space through lacunae-ant glottis

### **False cord;**

- ❑ Infr spread less common (quadrangular memb)
  - ❑ Usually spreads upwards to epiglottis, AE fold, arytenoid
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## Supraglottic cancer

### **Ventricle;**

- Usually transglottic at presentation
- Pre epiglottic space extn more common

### **Arytenoid, AE fold;**

- Usually extend to PFS, PCA
  - Rich lymphatics- ↑ nodal metastasis (b/l)
-

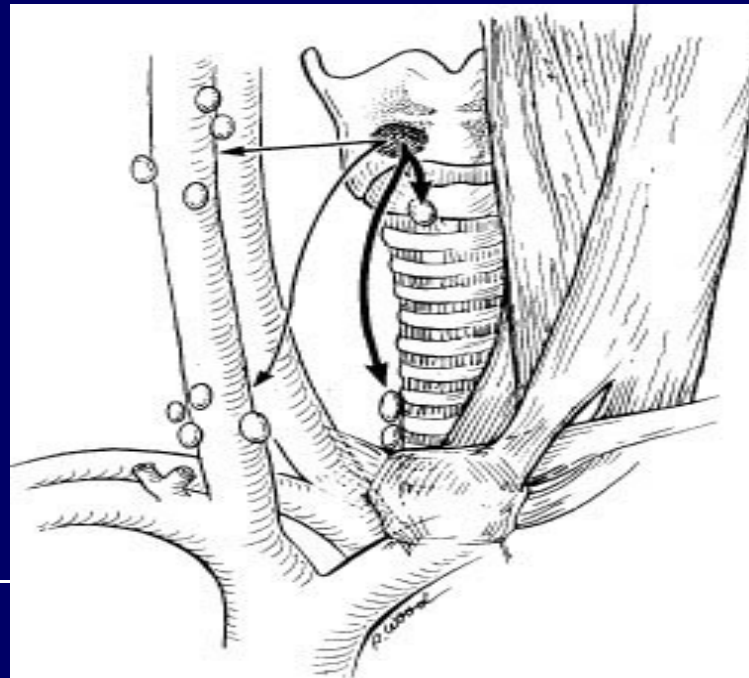
## Subglottic cancer



- ❑ Primary subglottic ca is rare.
- ❑ Primary tumor spread circumferentially
- ❑ Subglottic extn of glottic ca is more common
- ❑ Vocal cord lesion that extends 1cm or more below cord level have more tendency for cartilage invasion, extralaryngeal spread, invasive, poor prognosis
- ❑ Hence subglottic extn of more than 1cm antrly and 5mm posteriorly is contraindication for conservation laryngeal surgery

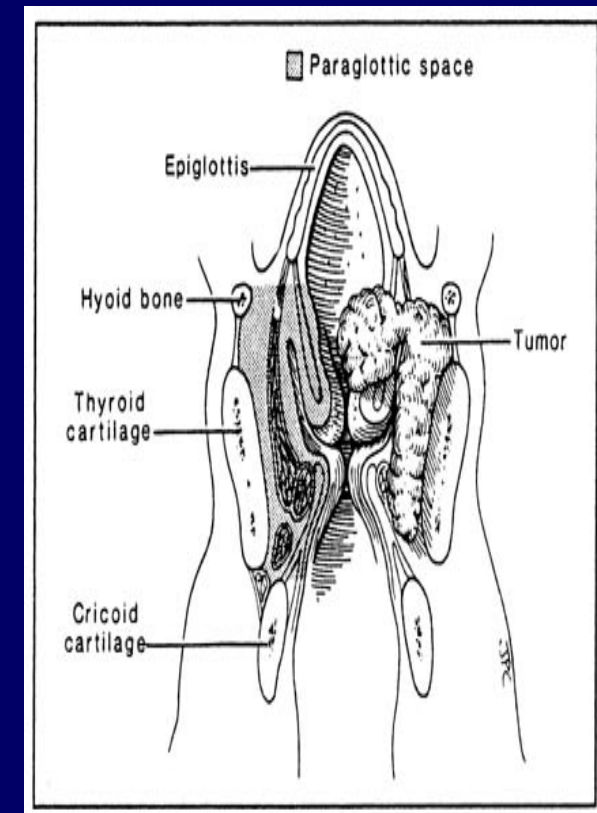
## Subglottic cancer

- Thyroid gland and pre paratracheal node involvement more common
- Thus subglottic tumors are usually advanced at presentation.



## Transglottic cancer

- ❑ Lesions that cross ventricle involving glottic and supraglottic region
- ❑ They are ventricular tumors that spread deeply upward and downward with relatively intact mucosa
- ❑ Invades paraglottic space lateral part of thyroid ala, cricothyroid membrane-extralaryngeal spread
- ❑ Often little mucosal involvement
- ❑ Biopsy difficult.
- ❑ Better done at ventricle





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## Summary

- Advancement in surgical refinements necessitates detailed knowledge of laryngeal anatomy.
  - Predetermined pathways helps us to predict disease spread , design surgical plan esp in management of early laryngeal cancer.
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