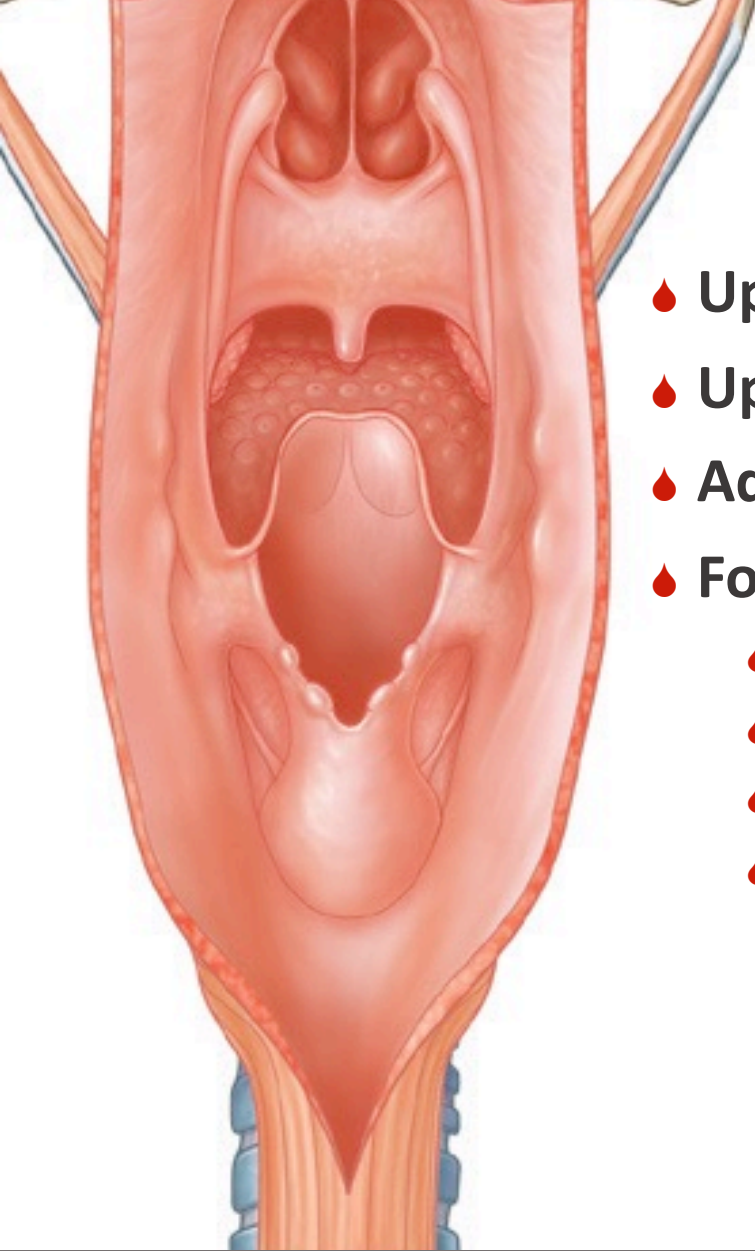
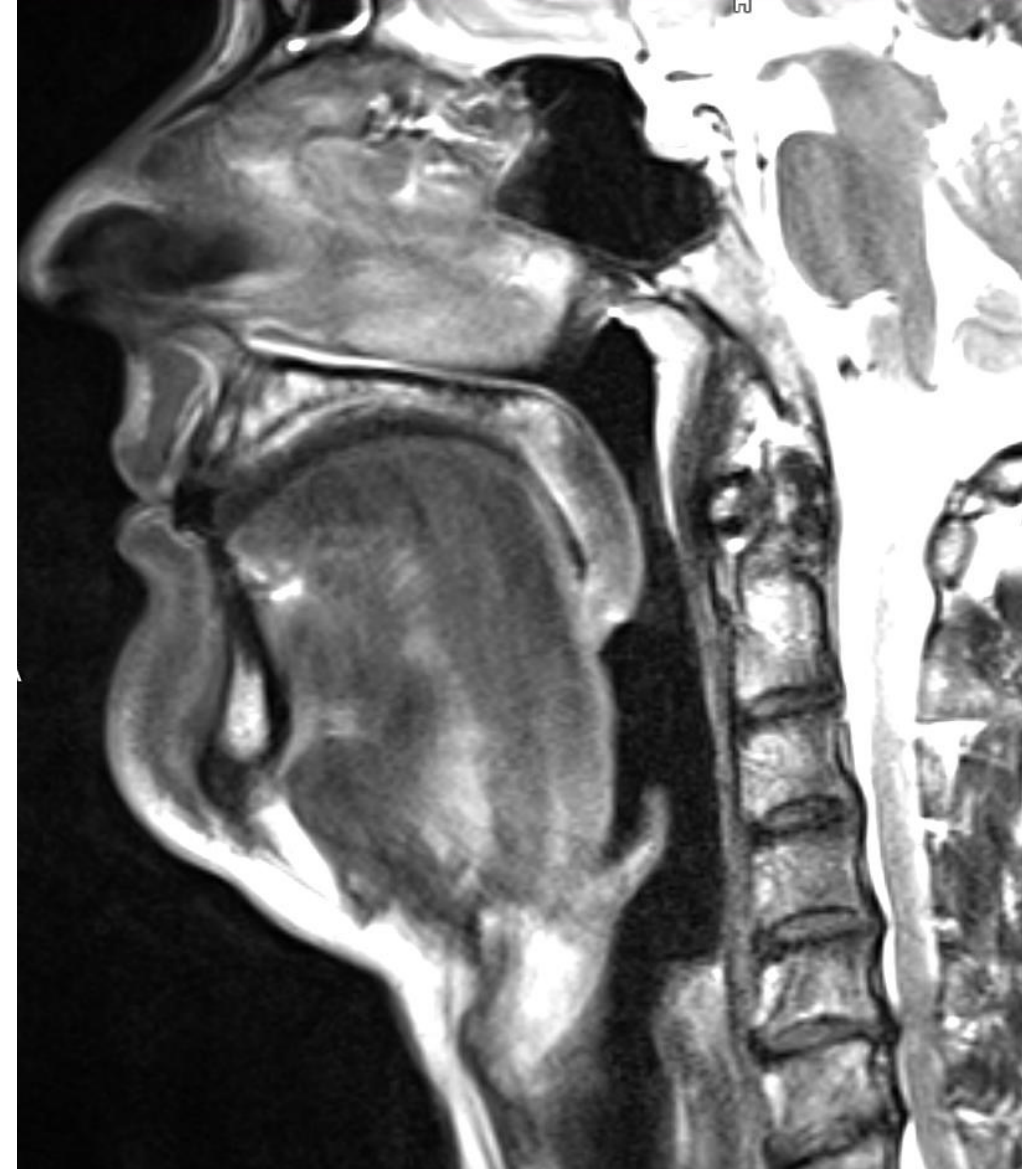


Larynx, trachea, bronchi, lungs

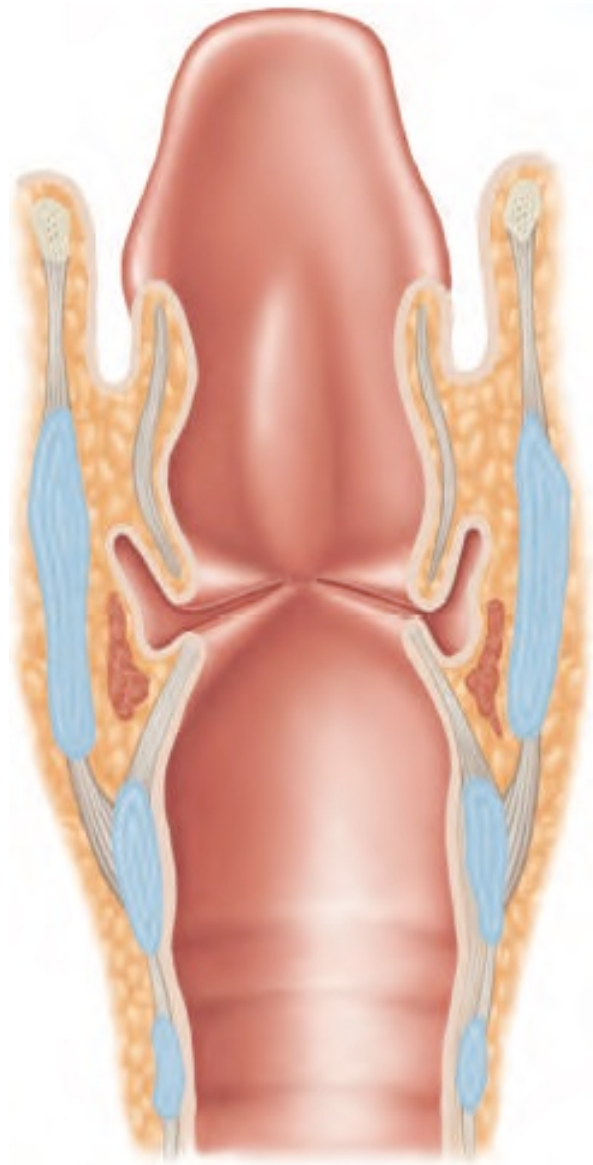
Prof. MUDr. Jiří Ferda, Ph.D.



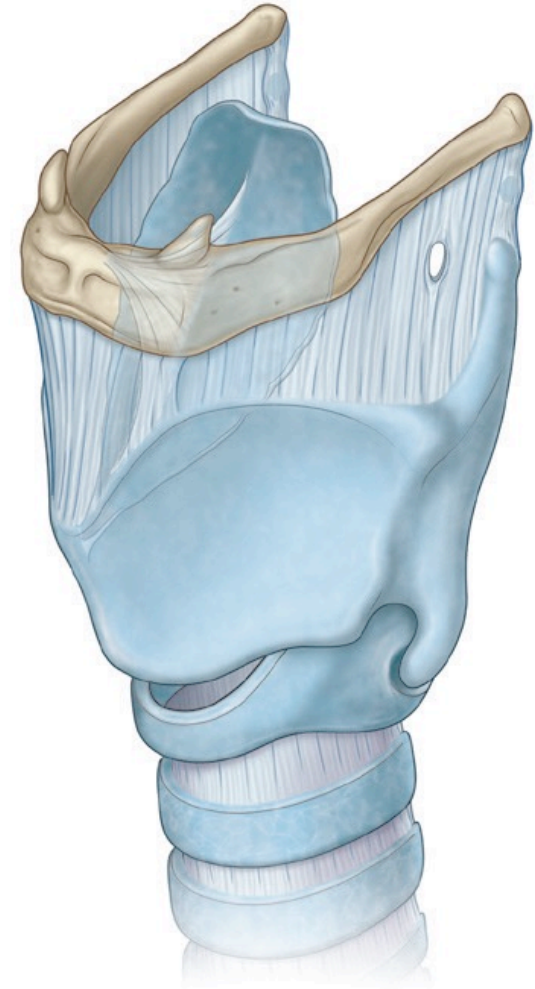
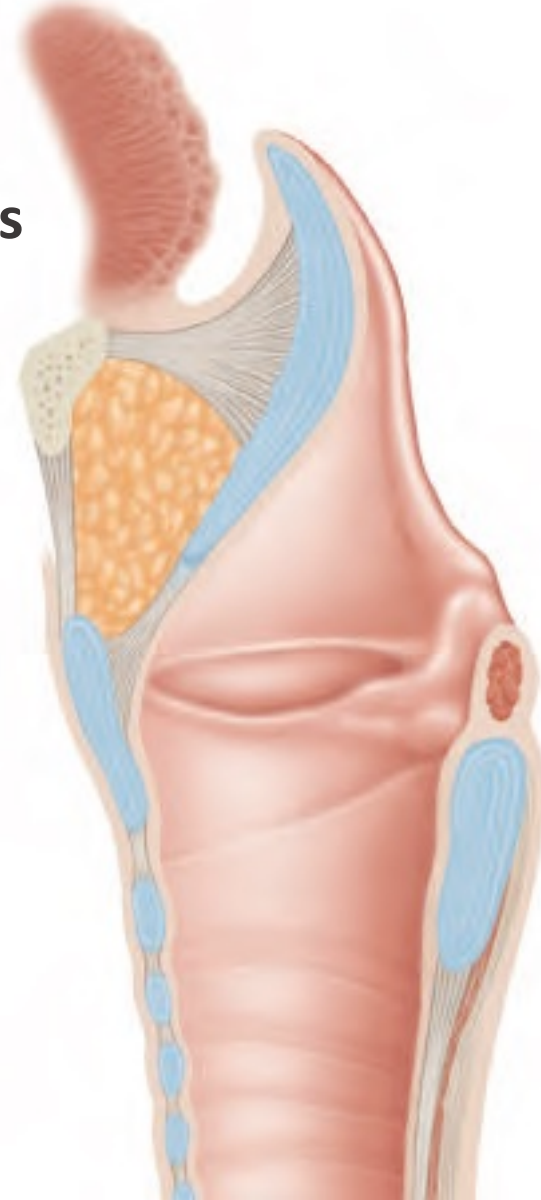
- ◆ Upper edge of epiglottis
- ◆ Upper margin of esophagus(C6)
- ◆ Aditus laryngis
- ◆ Fossae piriformes
 - ◆ Recessus piriformis
 - ◆ grooves
 - ◆ Leading solid and fluid meal
 - ◆ To esophagus



hypofarynx – laryngopharynx and larynx



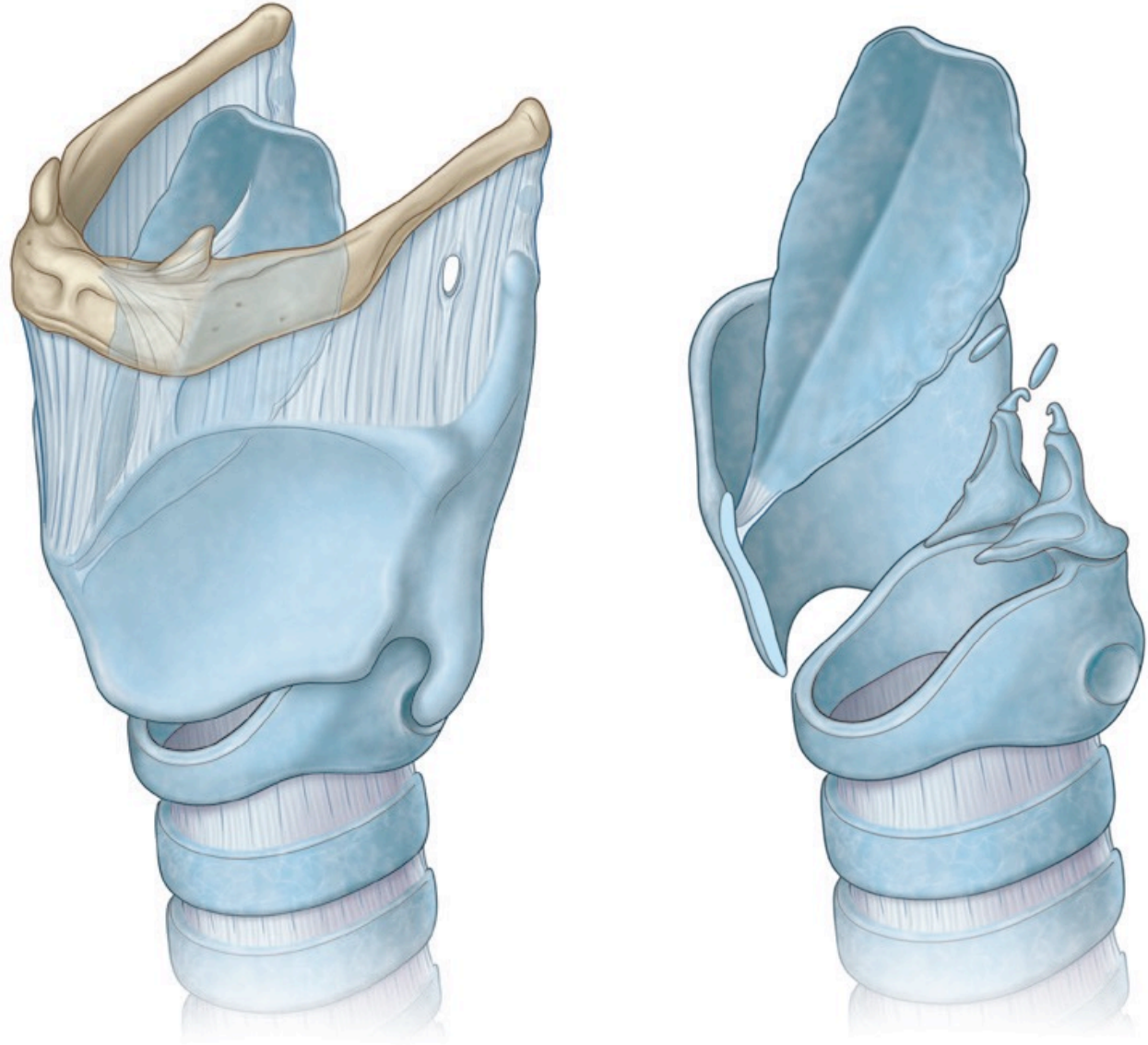
- ♦ **Aditus laryngis**
- ♦ Tuberculum epiglottidis
- ♦ Vestibulum
- ♦ Cavitas supraglottica
- ♦ Plica vestibularis
- ♦ Ventriculus
- ♦ Glottis
- ♦ Plica vocalis
 - ♦ lig. vocale, m. vocalis
- ♦ Cavitas infraglottica
- ♦ **Trachea**



larynx

cartilagines laryngis

- ♦ Cartilagines - skeleton laryngis
- ♦ **Paired**
- ♦ Cart. arytenoidea
- ♦ Cart. corniculata
- ♦ Cart. cuneiformis
- ♦ Cart. triticea
- ♦ **Unpaired**
- ♦ Cart. thyroidea
- ♦ Cart. cricoidea
- ♦ Cart. epiglottica



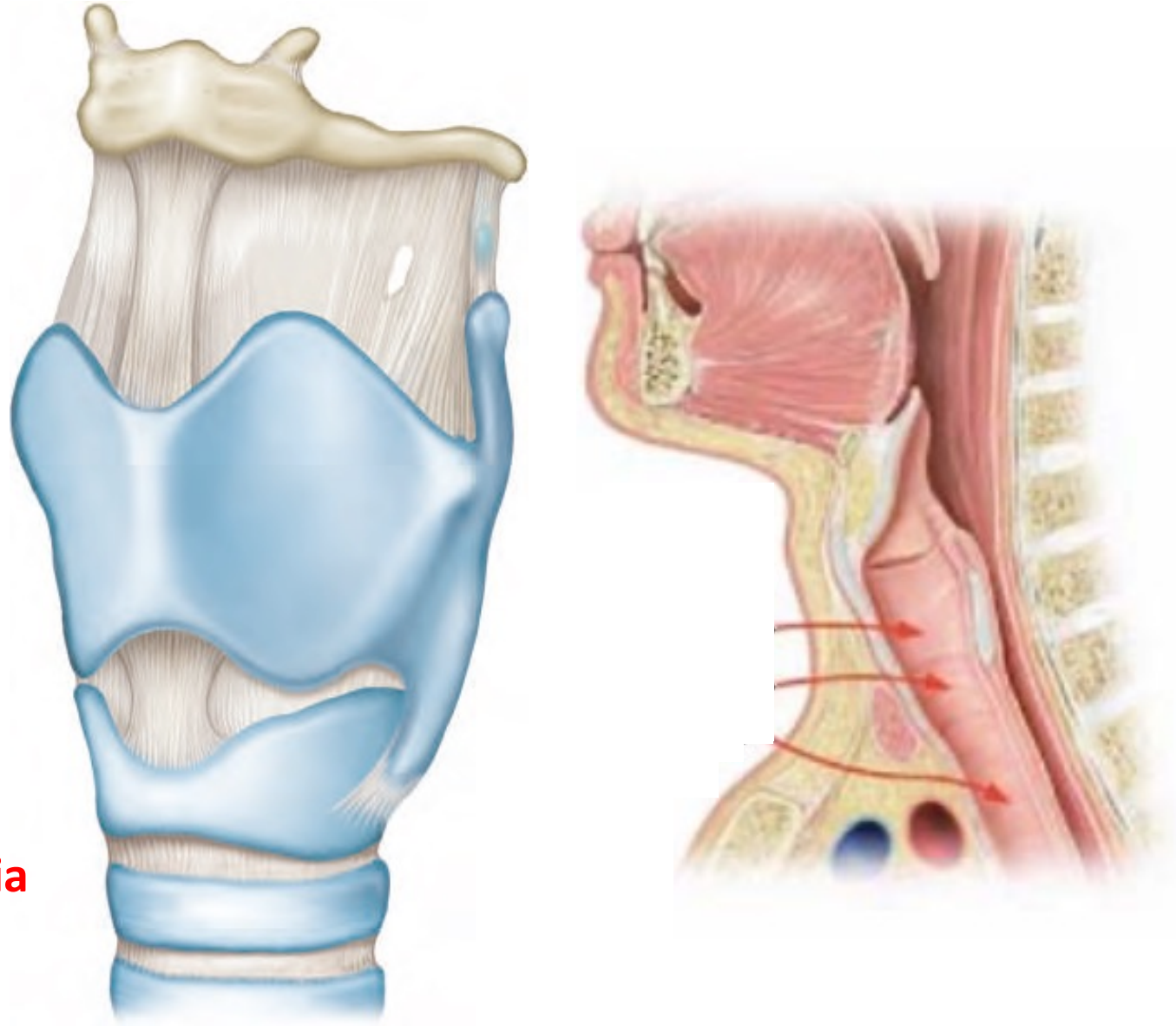
Larynx – anterior view

- ♦ **Cartilago triticea**
- ♦ **Cart. thyroidea**
- ♦ *Cornu superius*
- ♦ *Cornu inferius*
- ♦ *Lamina*
- ♦ *Incissura thyroidea*
- ♦ *Prominentia laryngis*
- ♦ *Linea obliqua*
- ♦ *Tuberculum superius*
- ♦ *Tuberculum inferius*
- ♦ **Cart. cricoidea**
- ♦ *Arcus anterior*



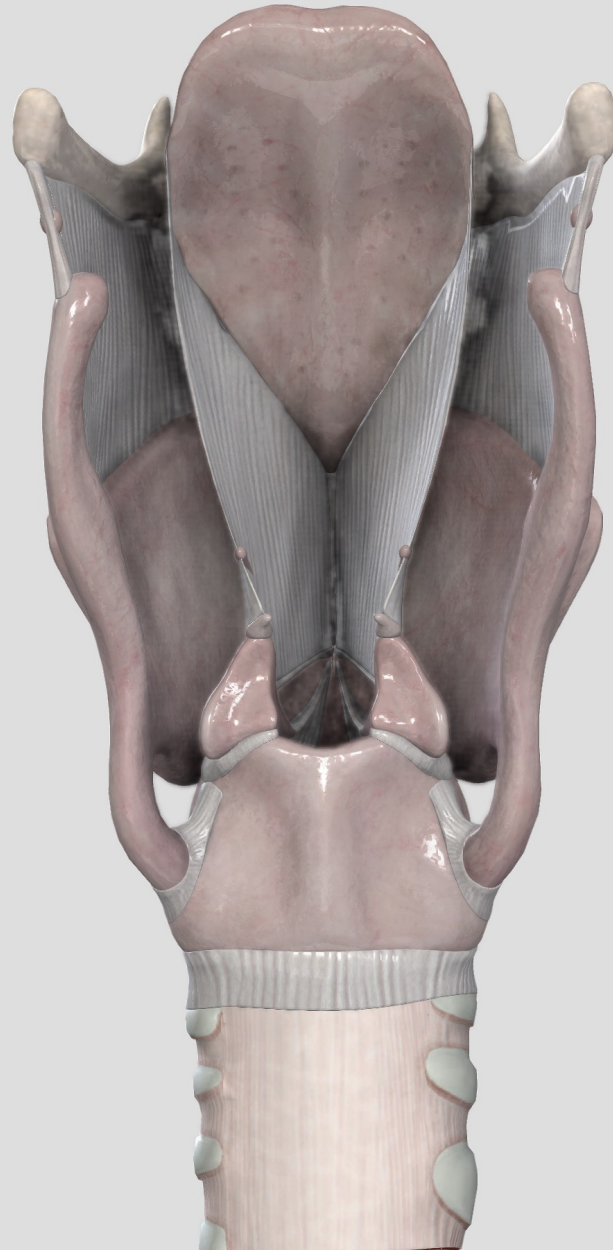
Assemblment of cartilages

- ♦ Os hyoideum
 - ♦ *Corpus, cornu minus, cornu majus*
- ♦ Lig. thyrohyoideum medianum
- ♦ Membrana thyrohyoidea
- ♦ Apertura membranae thyrohyoideae
 - ♦ (n. et. a. laryngea ant.)
- ♦ Conus elasticus - **coniotomia**
- ♦ Lig. cricothyroideum medianum
- ♦ Capsula articulationis cricothyroidea
- ♦ Ligamentum cricotracheale - **tracheostomia**
- ♦ Trachea



Cartilages – posterior view

- **Cartilago triticea**
- **Cart. thyroidea**
- *Cornu superius*
- *Cornu inferius*
- *Lamina*
- *Incissura thyroidea*
- **Cart. cuneiformis**
- **Cart. corniculatum**
- **Cart. arytenoidea**
- **Cart. cricoidea**
- *lamina*
- *crista*



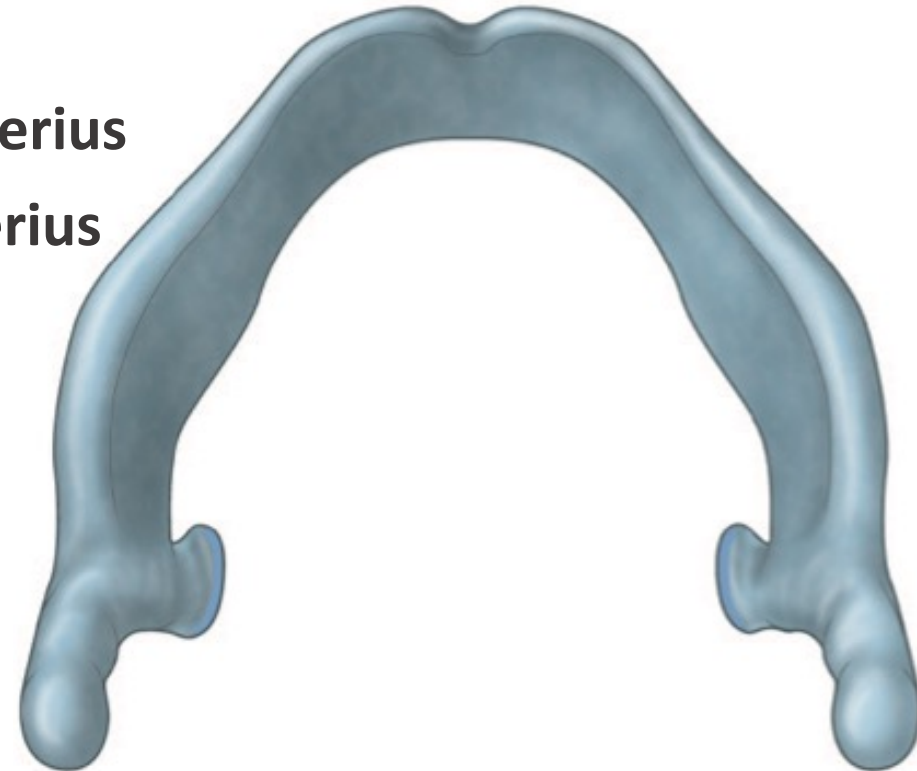
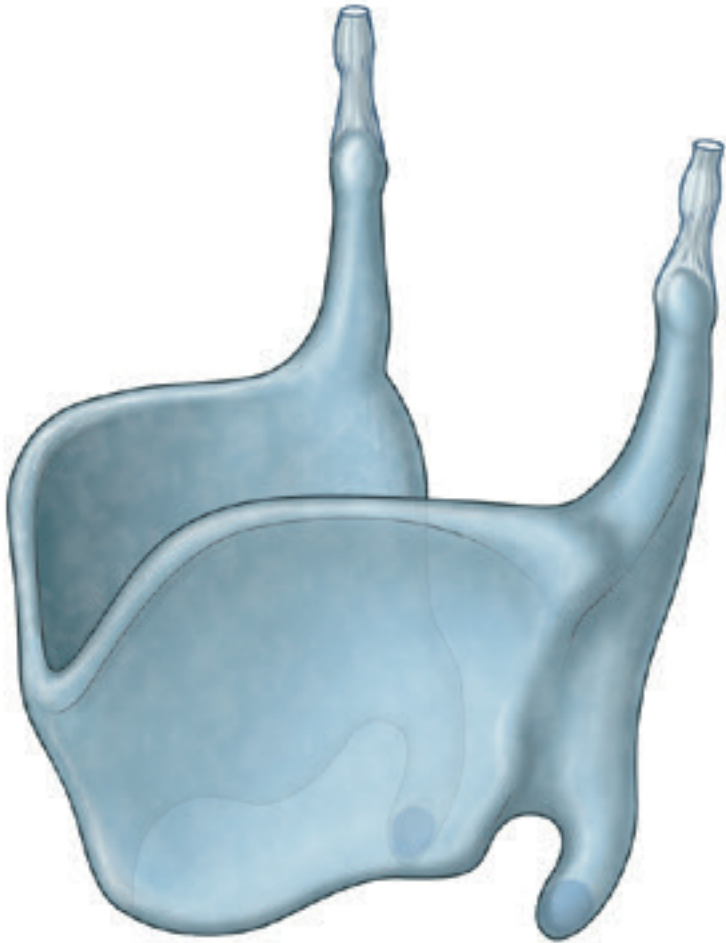
Epiglottis

- ♦ **Facies anterior**
- ♦ **Facies posterior**
- ♦ **Tuberculum epiglottidis**
- ♦ *Ligamentum hyoepiglotticum*
- ♦ *Ligamentum thyroepiglotticum*



Cartilago thyroidea

- ♦ Lamina
- ♦ Incissura superior
- ♦ Prominentia laryngis
- ♦ Incissura inferior
- ♦ Linea obliqua
- ♦ Tuberculum thyroideum superius
- ♦ Tuberculum thyroideum inferius
- ♦ Cornu superius
- ♦ Cornu inferius
- ♦ *Angulus laminarum*
 - ♦ 90-120 st.



Cartilago cricoidea

💧 **Cartilago cricoidea**

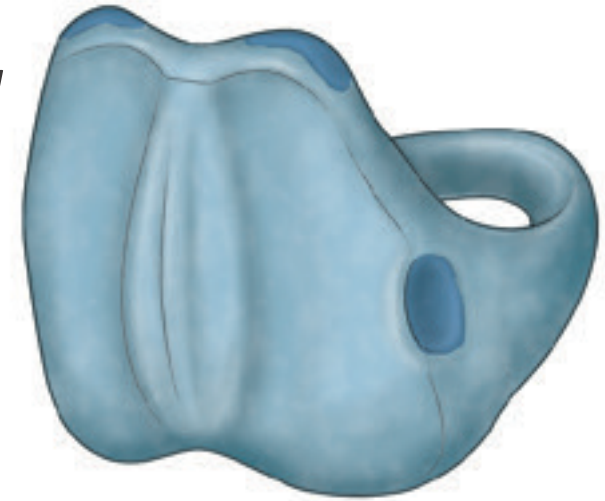
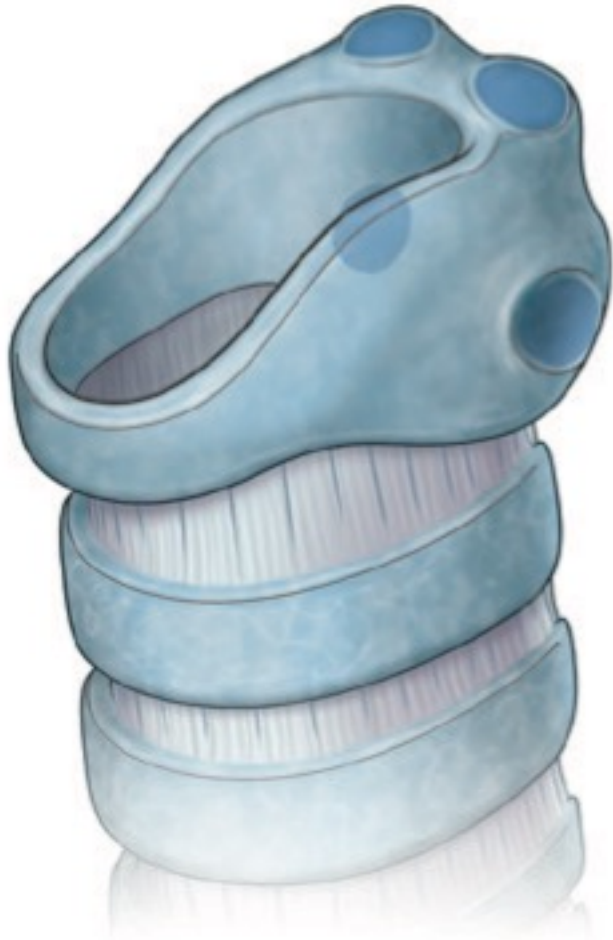
💧 *Anulus*

💧 *Lamina*

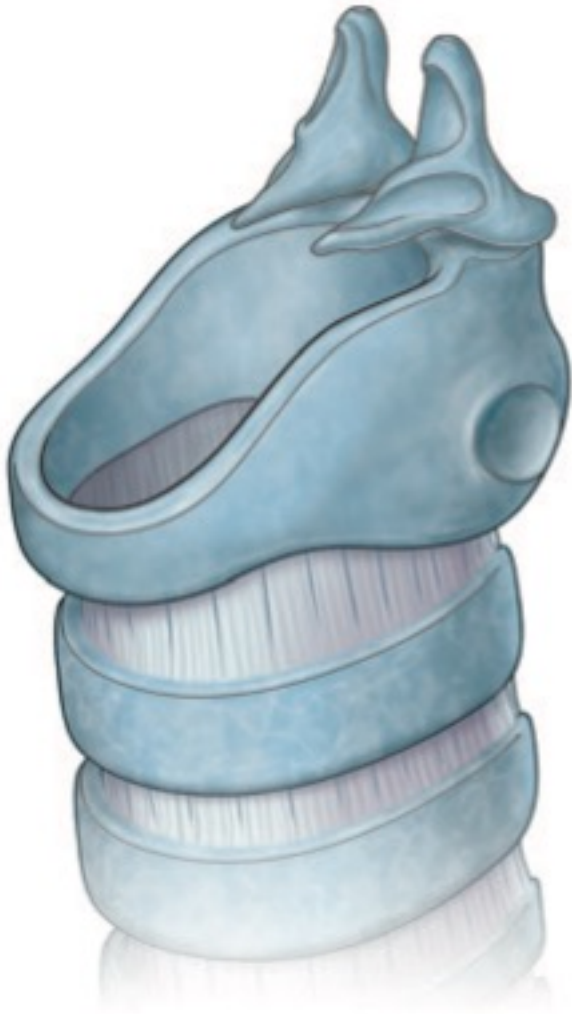
💧 *Crista*

💧 *Facies articularis thyroidea*

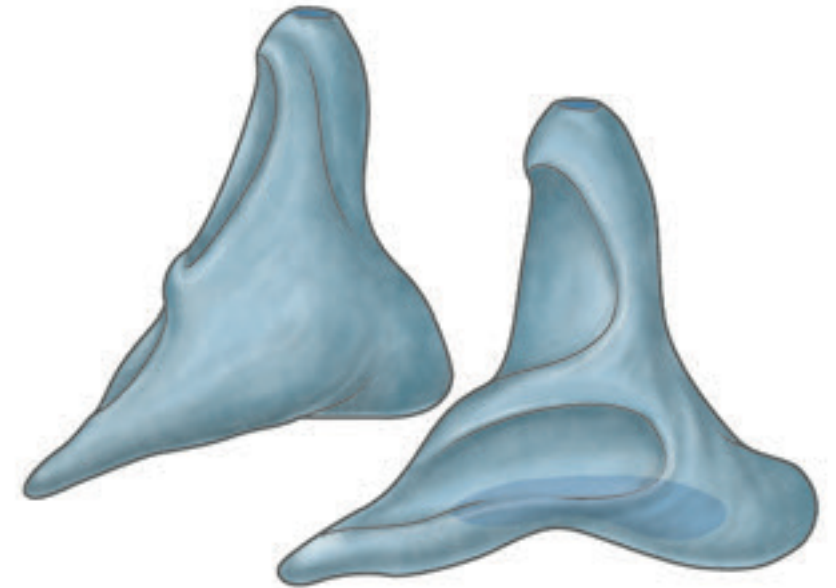
💧 *Facies articularis arytenoidea*



Cartilago arytenoidea

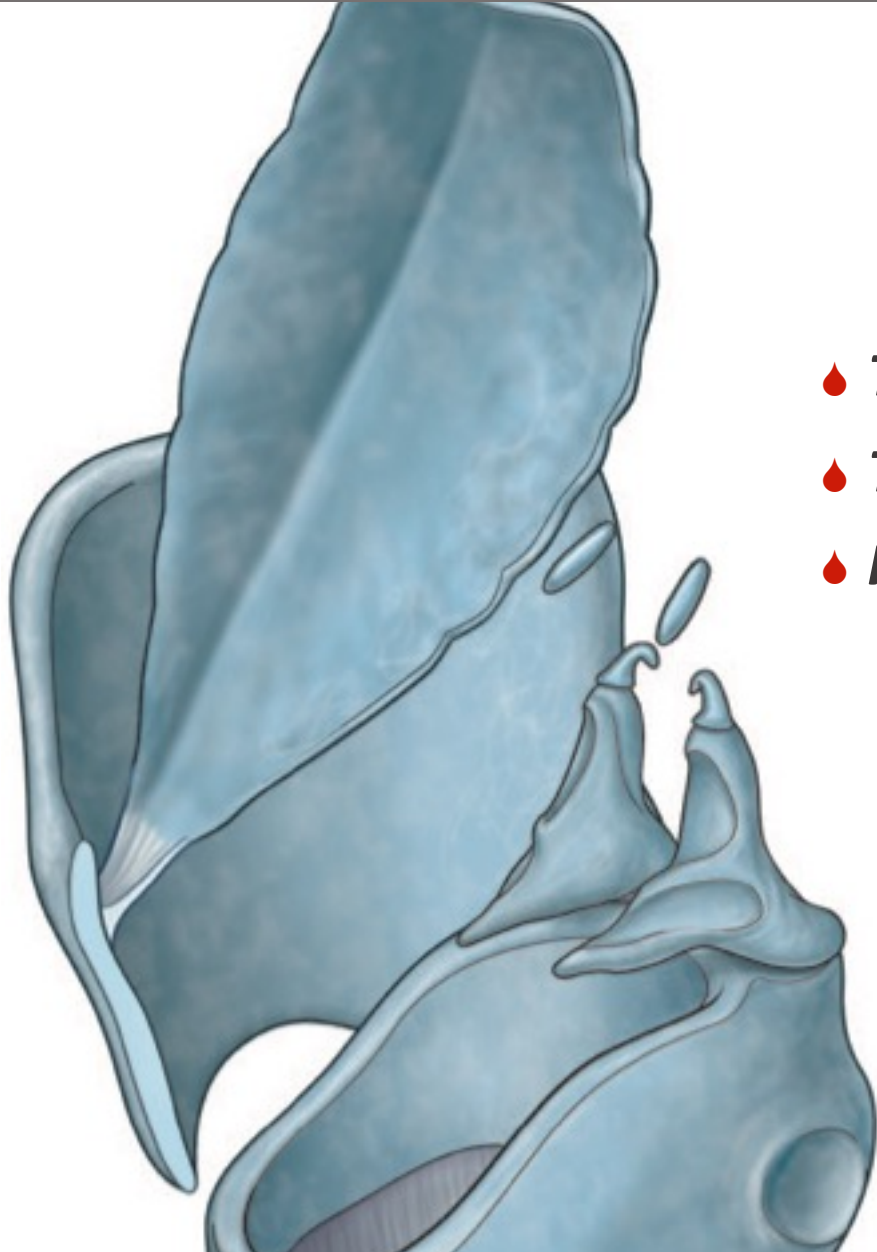


- ♦ **Processus vocalis**
- ♦ **Processus muscularis**

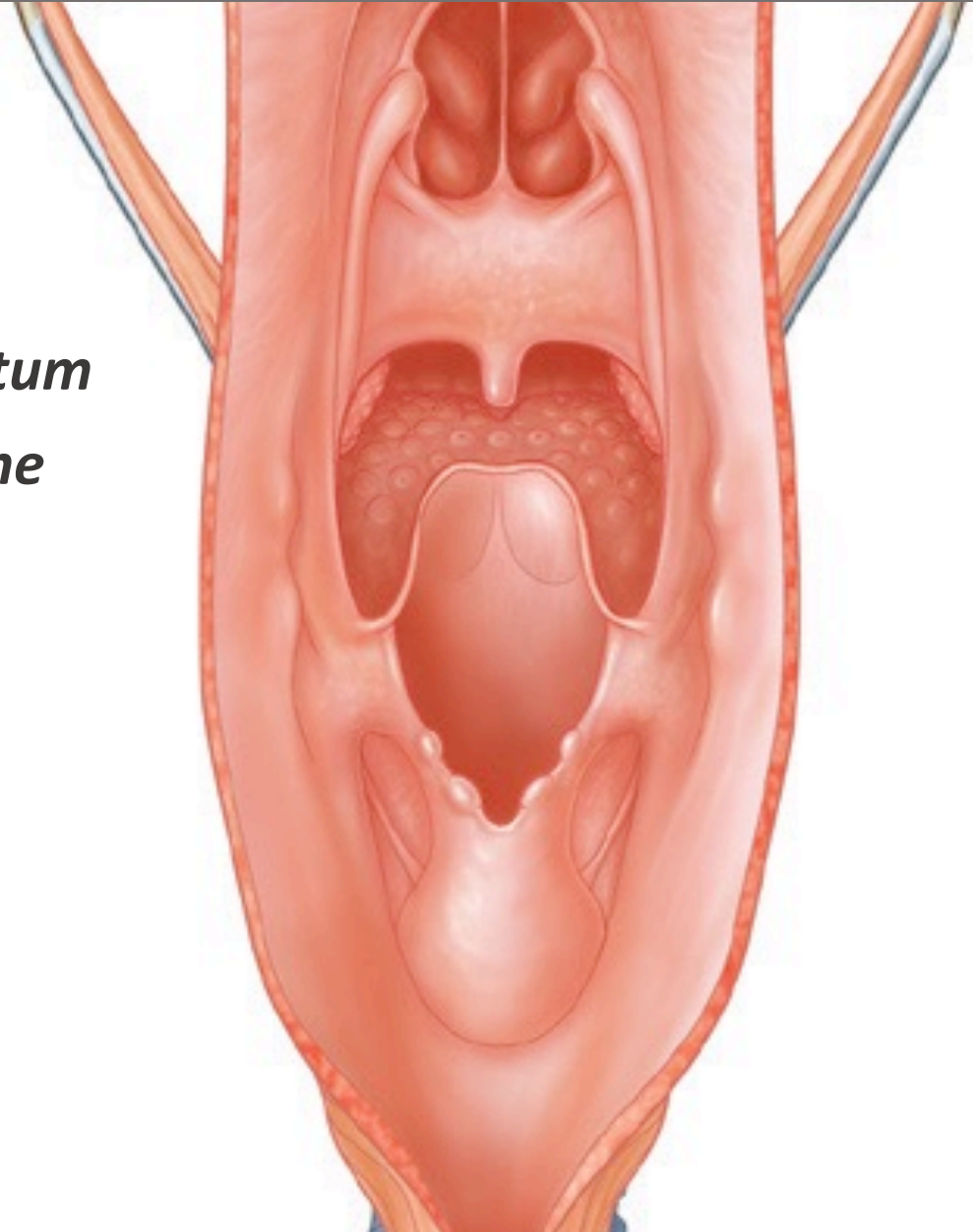


- ♦ *Insertio m. vocalis*
- ♦ *Insertio lig. vocale*
- ♦ *Insertio lig. vestibulare*

Cartilago corniculata et cuneiformis

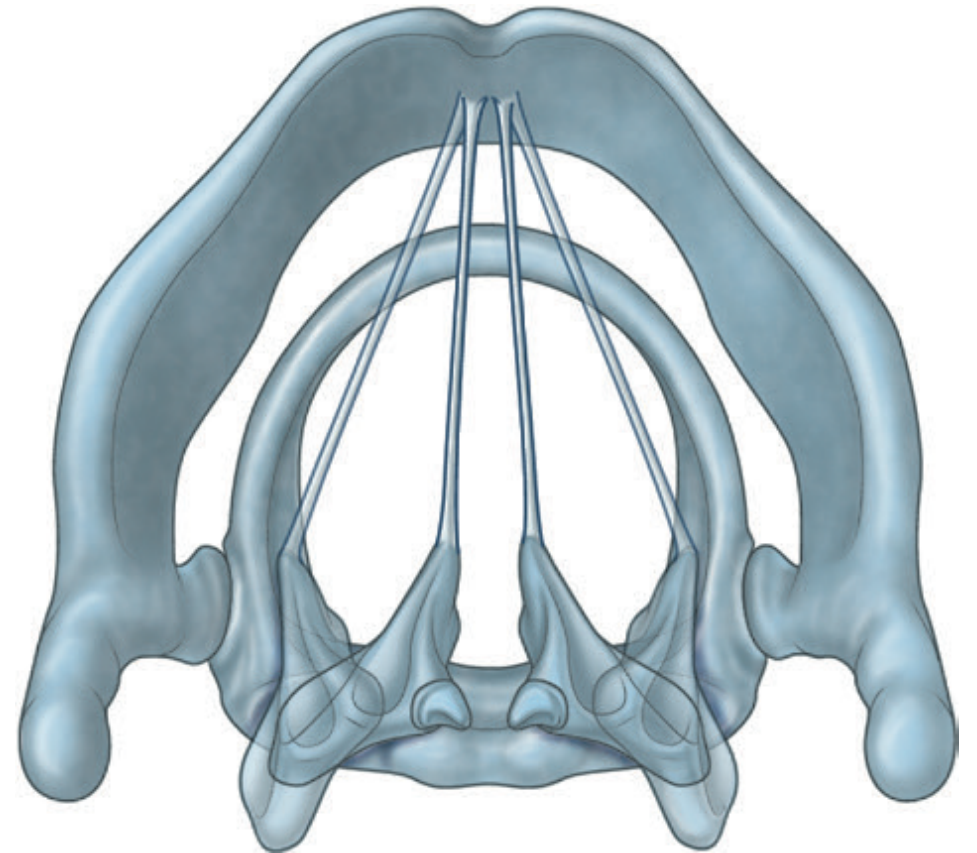
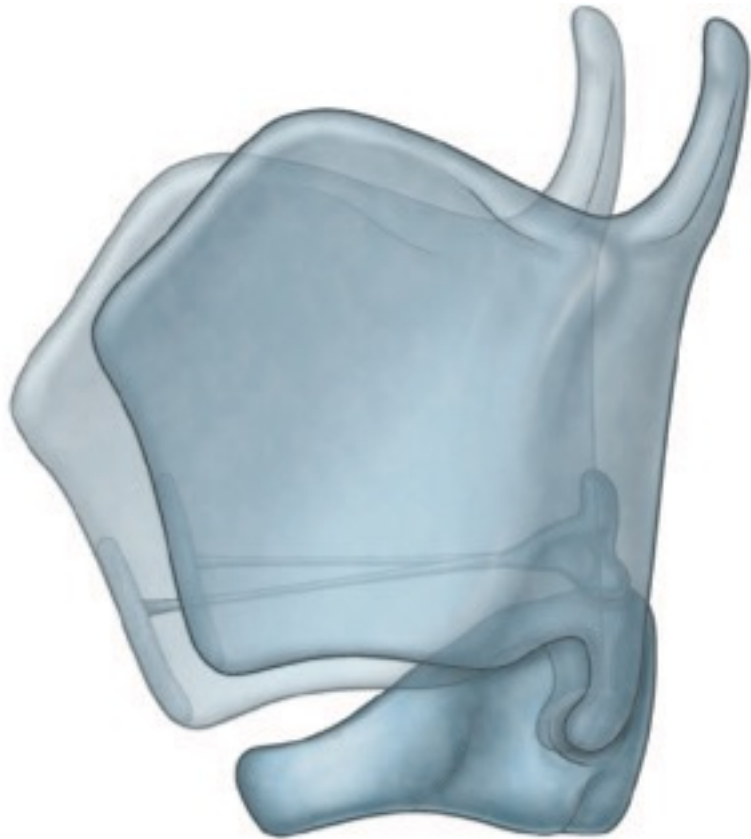


- ♦ *Tuberculum corniculatum*
- ♦ *Tuberculum cuneiforme*
- ♦ *Plica aryepiglottica*



Articulationes laryngis

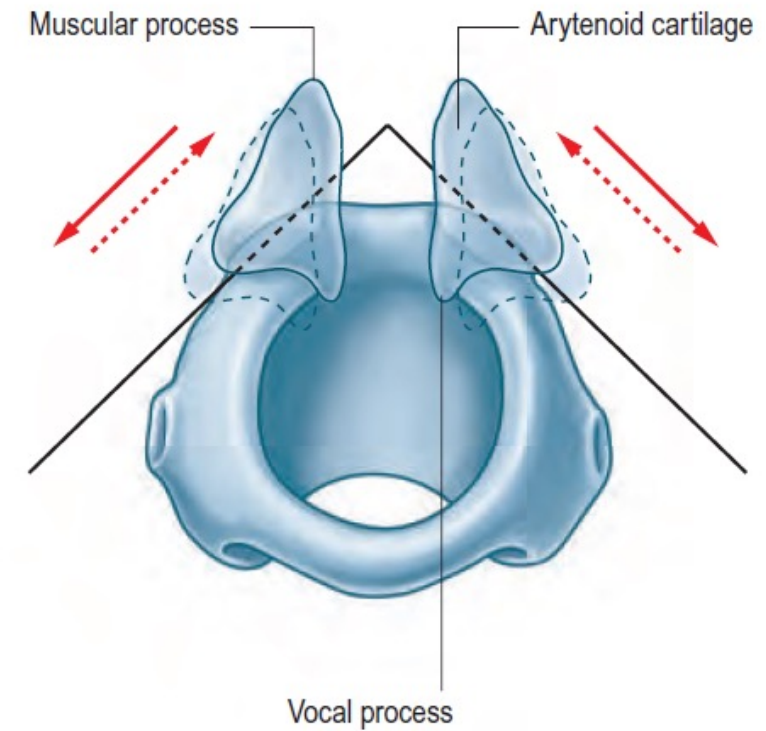
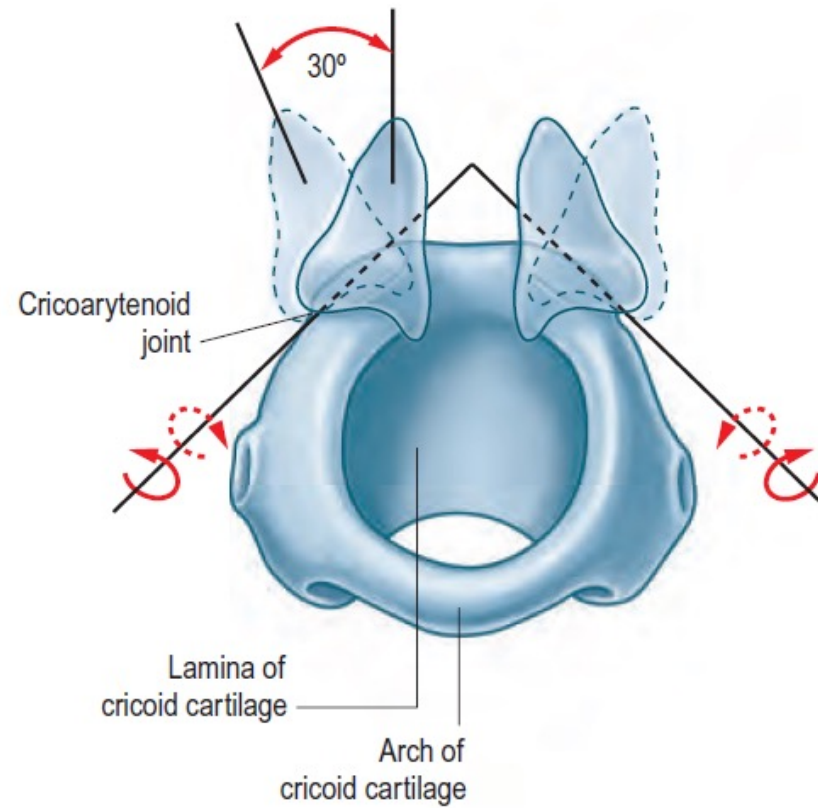
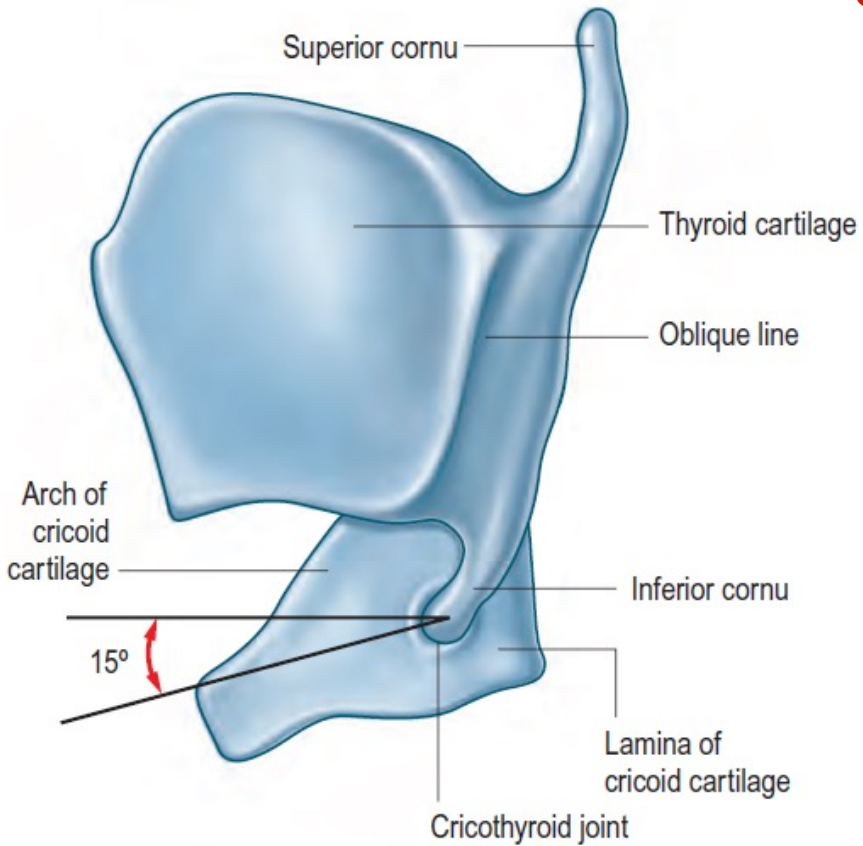
- ♦ **Articulatio cricothyroidea**
- ♦ ***Articulatio cricoarytenoidea***



Articulationes laryngis

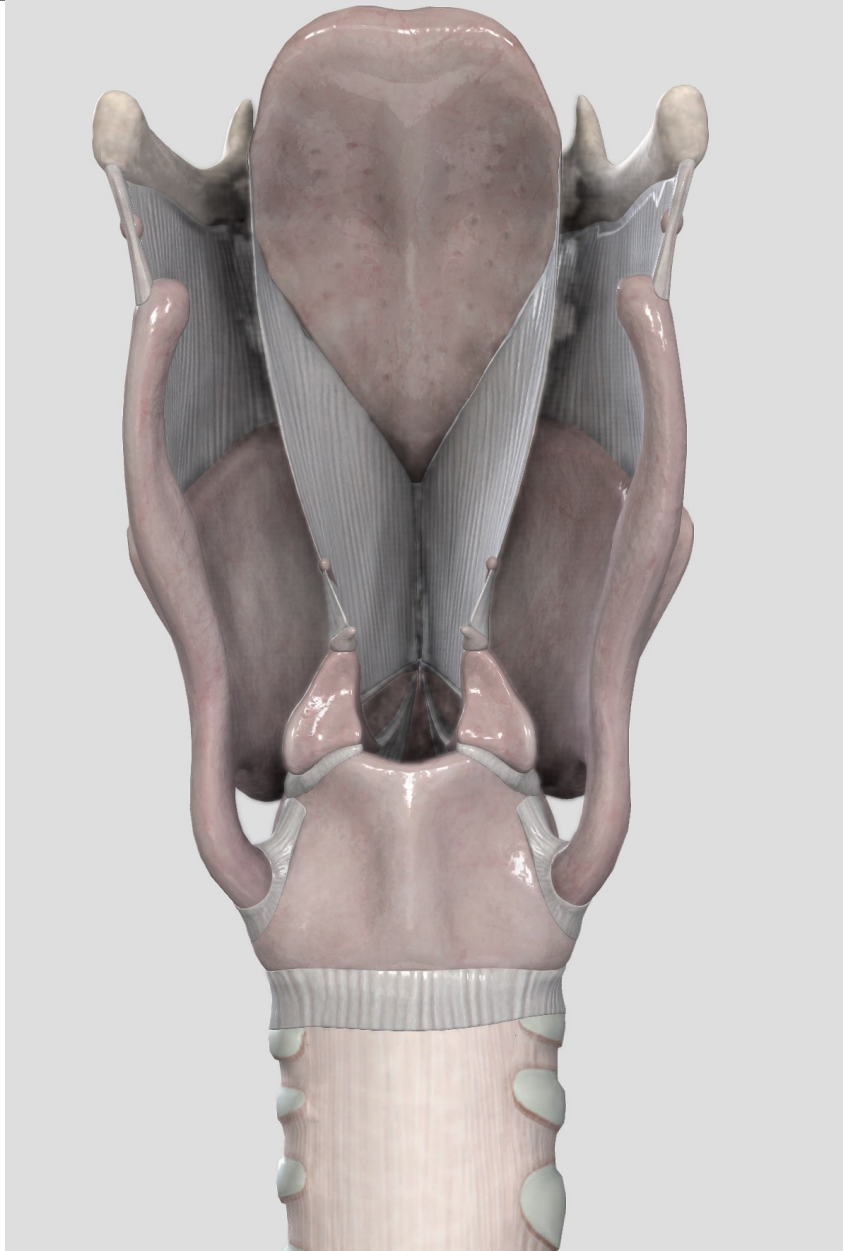
♦ **Articulatio cricothyroidea**

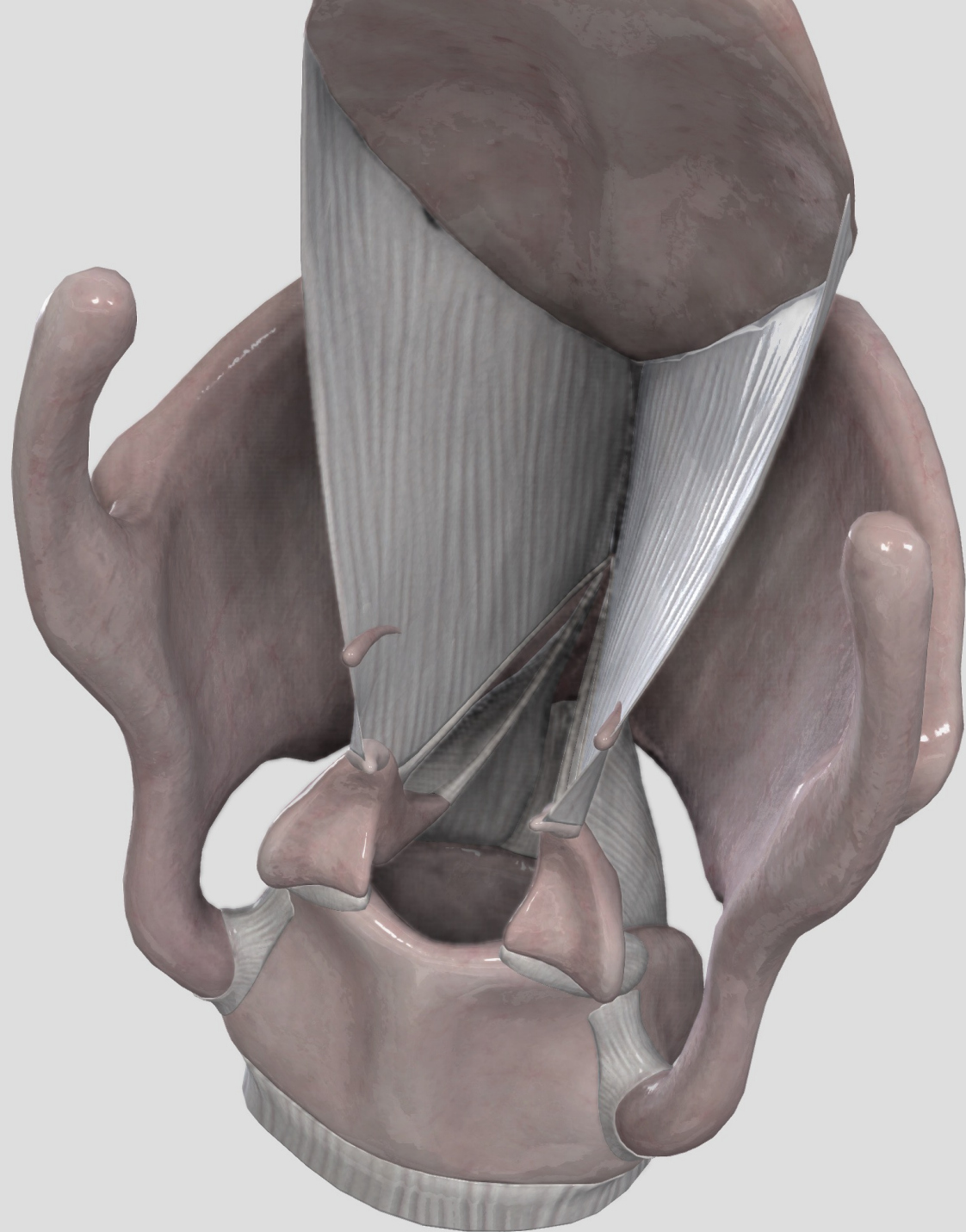
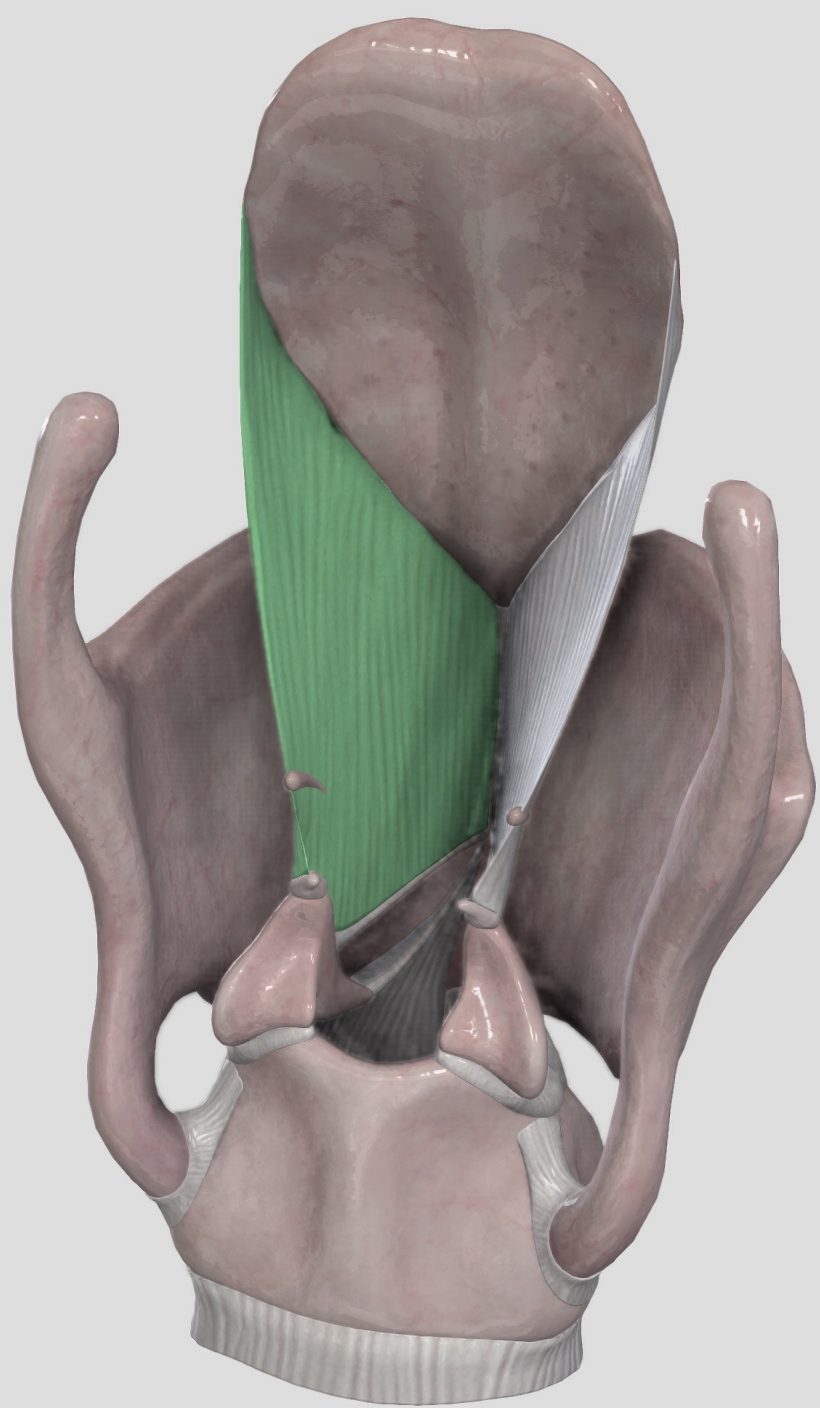
♦ ***Articulatio cricoarytenoidea***



Assemblage of cartilages

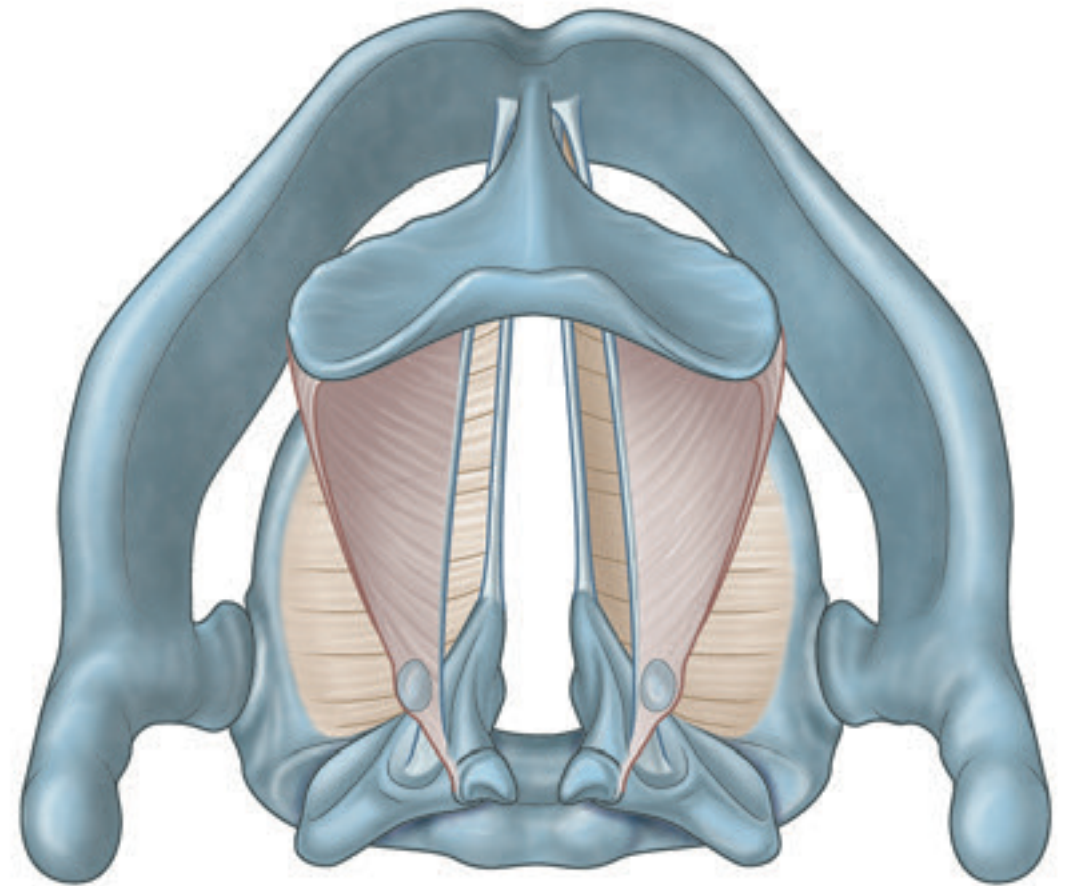
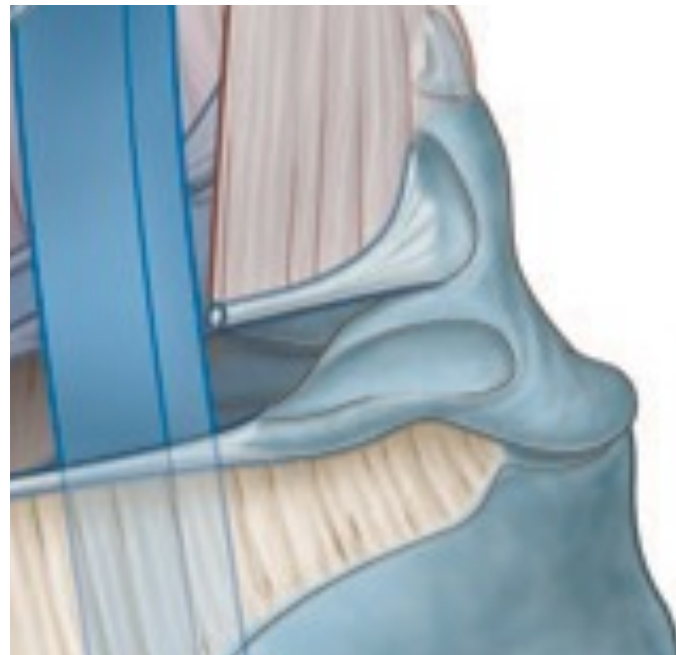
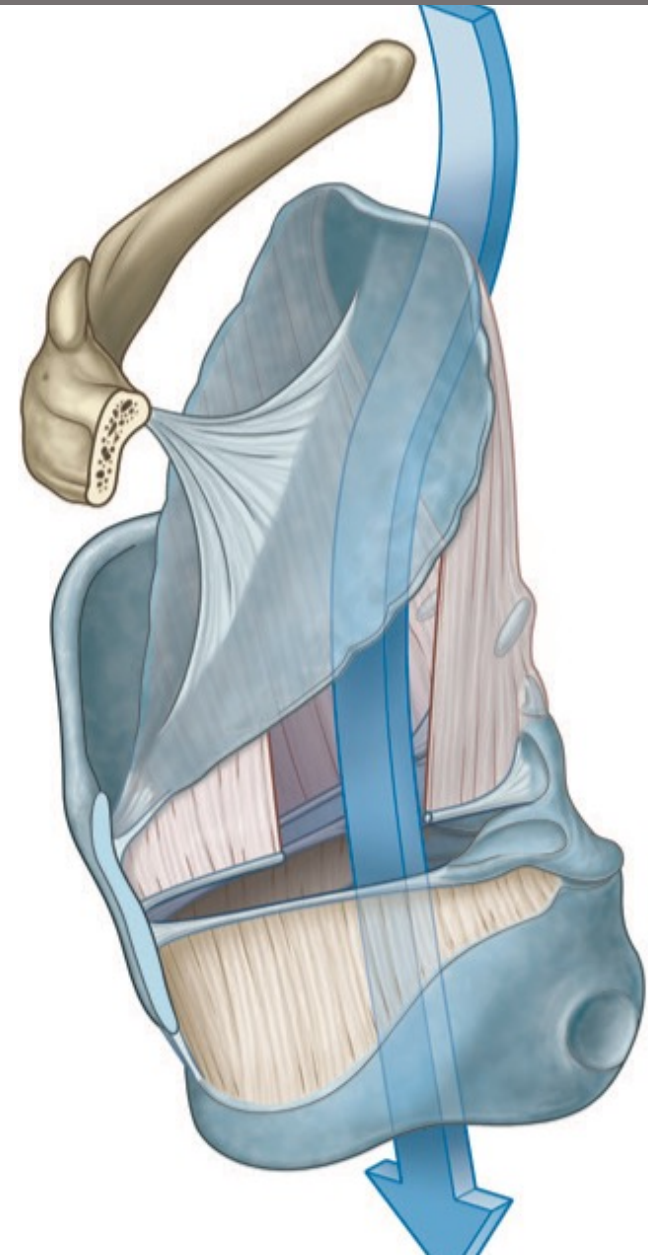
- ♦ *Lig. thyrohyoideum laterale*
- ♦ *Membrana thyrohyoidea*
- ♦ *Lig. thyroepiglotticum*
- ♦ *Lamina quadrangularis*
- ♦ *Capsula art. cricoarytenoidea*
- ♦ *Lig. cricoarytenoideum post.*
- ♦ *Lig. cricothyroideum medianum*
- ♦ *Capsula art. cricothyroidea*
- ♦ *Ligamentum cricotracheale*



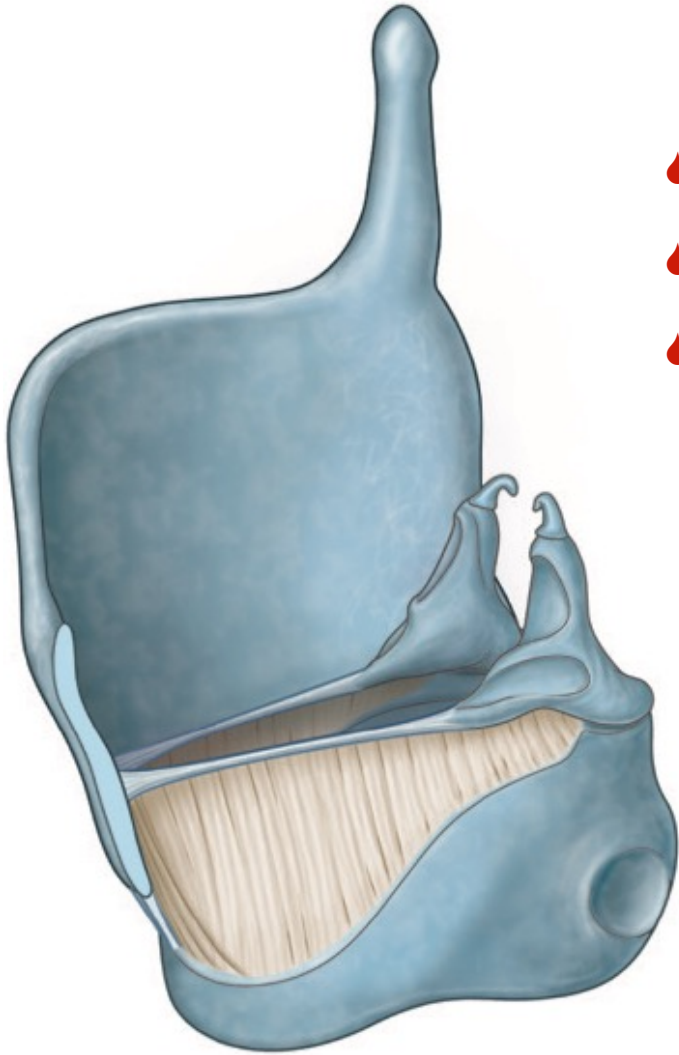


Internal ligamenta

- ♦ **Ligamentum hyoepiglotticum**
- ♦ **Lamina quadrangularis**
- ♦ *Plica aryepiglottica*
- ♦ **Ligamentum vestibulare**
 - ♦ False vocal ligament
- ♦ **Ligamentum vocale**
 - ♦ True vocal ligament



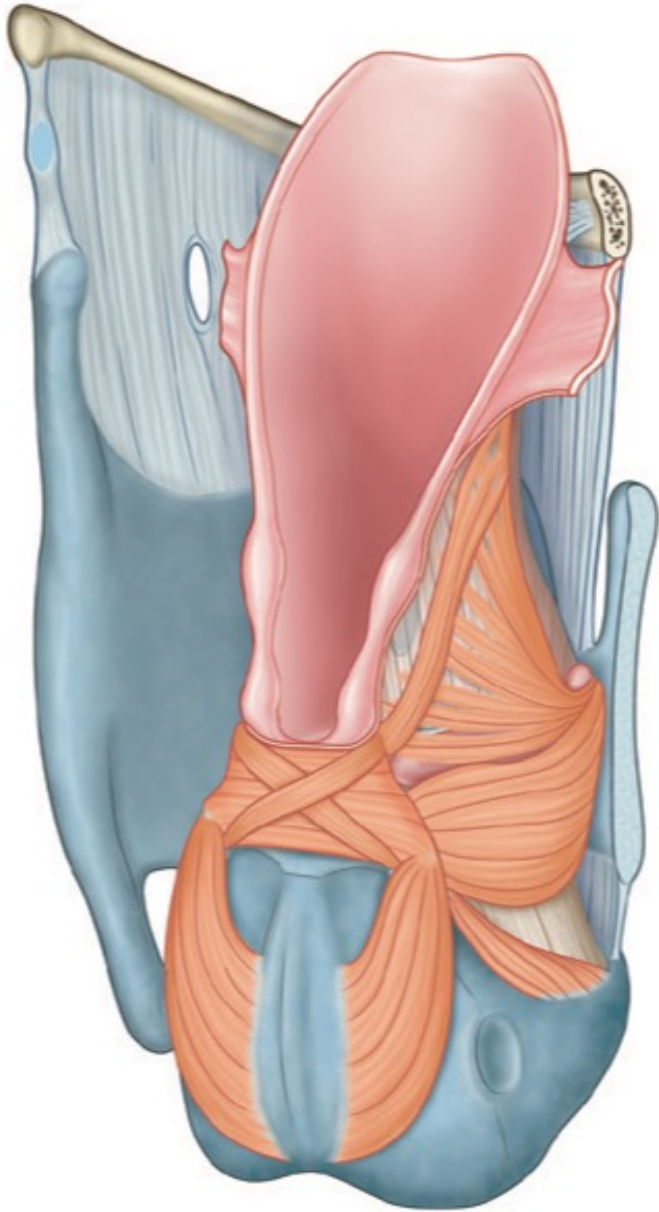
Conus elasticus



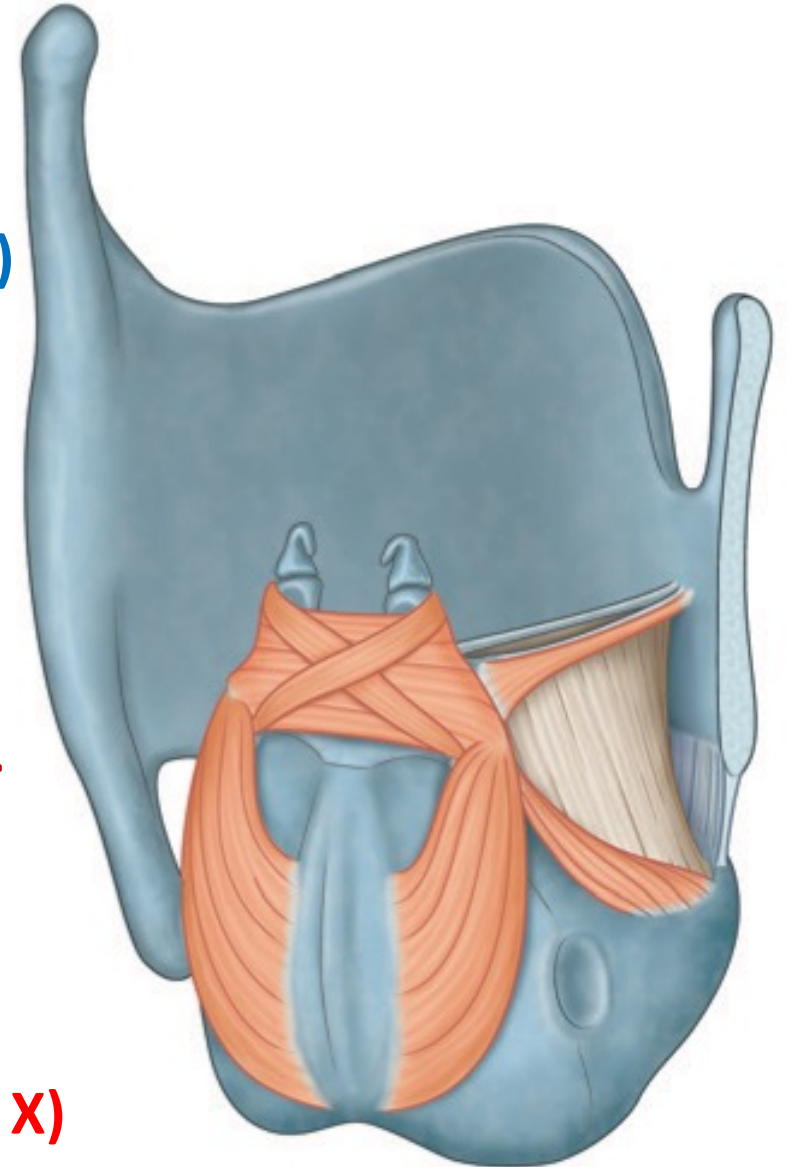
- ♦ Conus elasticus – **coniotomia**
- ♦ *Lig. cricothyroideum medianum*
- ♦ *Ligamentum vocale*



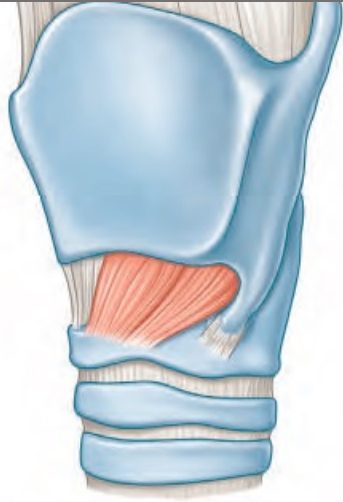
Musculi laryngis



- ♦ M. cricothyroideus
 - ♦ Pars recta
 - ♦ Pars obliqua
- ♦ ! N. laryngeus superior (N. X)
- ♦ M. arytenoideus transversus
- ♦ M. arytenoideus obliquus
 - ♦ Pars ary-epiglottica
- ♦ M. vocalis
- ♦ M. cricoarytenoideus posterior
- ♦ M. cricoarytenoideus lateralis
- ♦ M. thyroarytenoideus
 - ♦ Pars thyroepiglottica
- ♦ !! N. laryngeus recurrens (N. X)



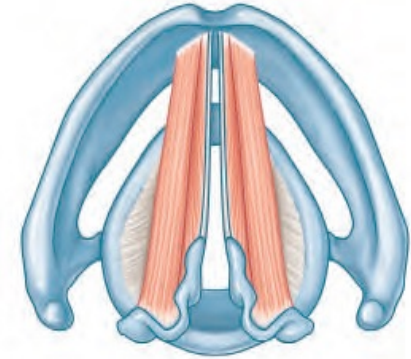
Musculi laryngis



- ♦ **M. cricothyroideus**

- ♦ Pars recta
- ♦ Pars obliqua

- ♦ **! N. laryngeus superior (N. X)**



- ♦ **M. arytenoideus transversus**

- ♦ **M. arytenoideus obliquus**

- ♦ Pars ary-epiglottica

- ♦ **M. vocalis**

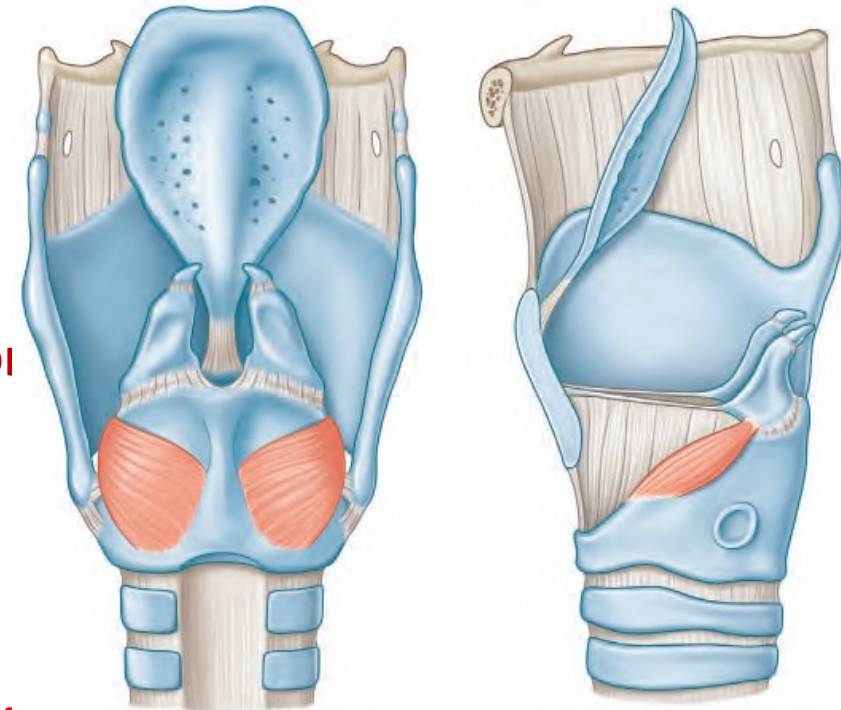
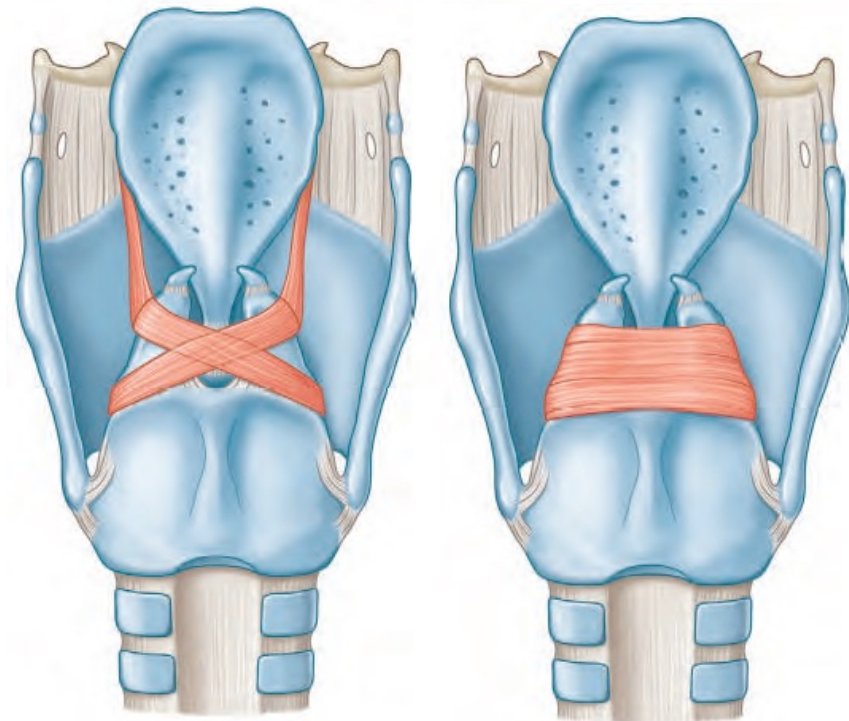
- ♦ **M. cricoarytenoideus posterior**

- ♦ **M. cricoarytenoideus lateralis**

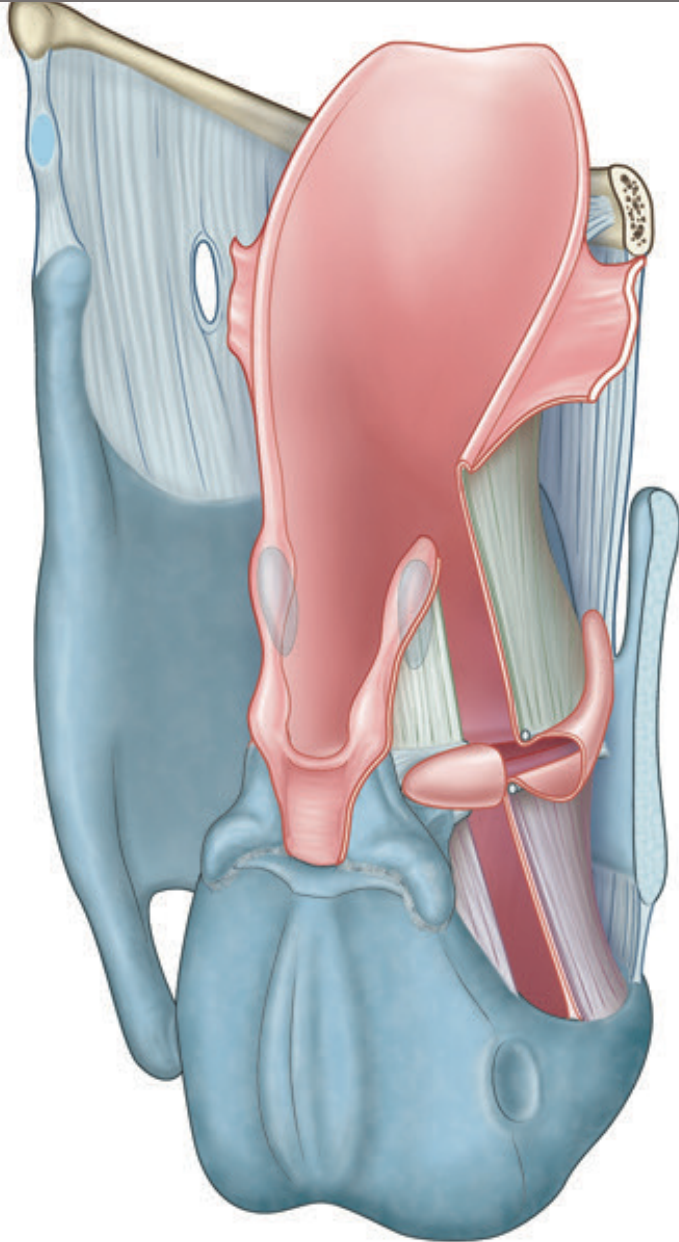
- ♦ **M. thyroarytenoideus**

- ♦ Pars thyroepiglottica

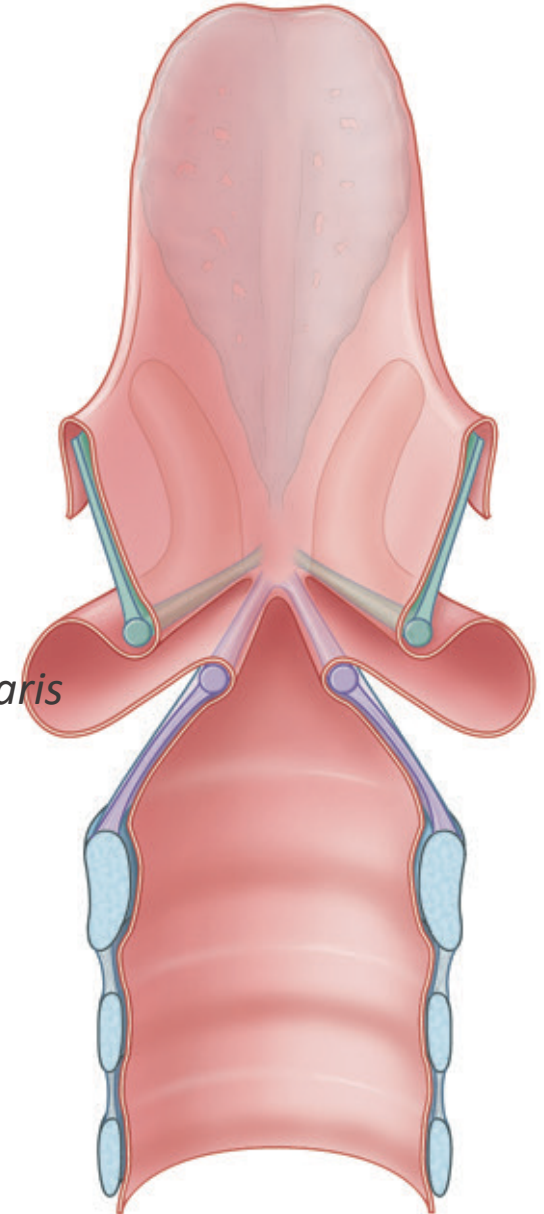
- ♦ **!! N. laryngeus recurrens (N. XII)**



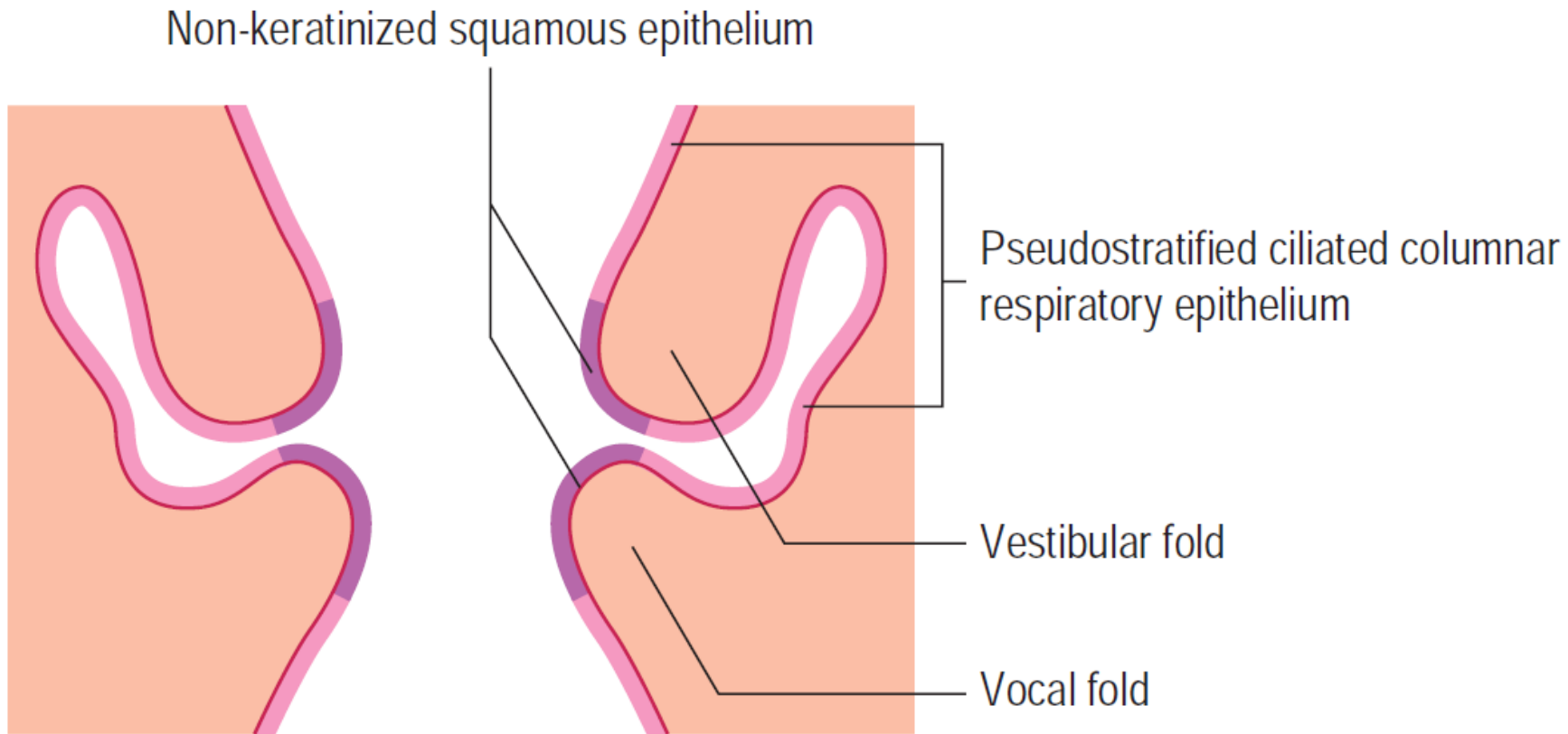
Cavitas laryngis



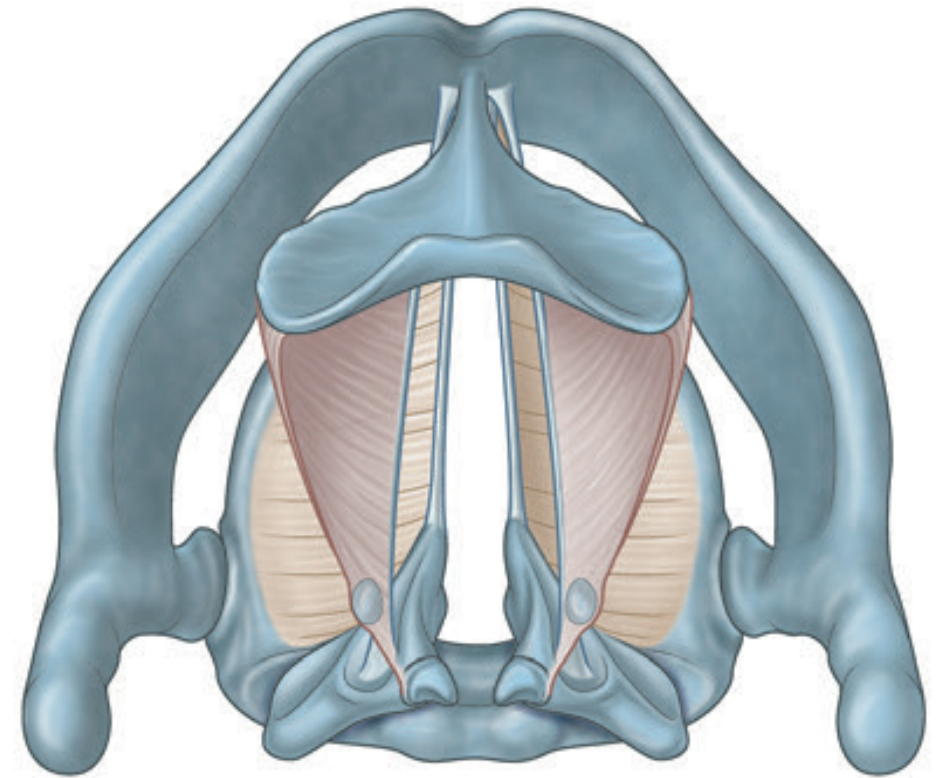
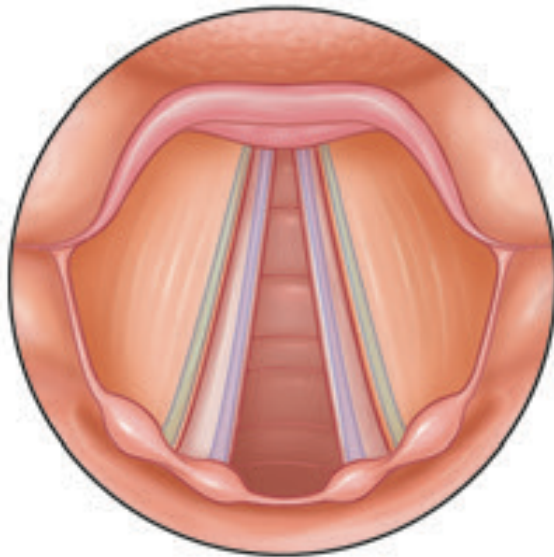
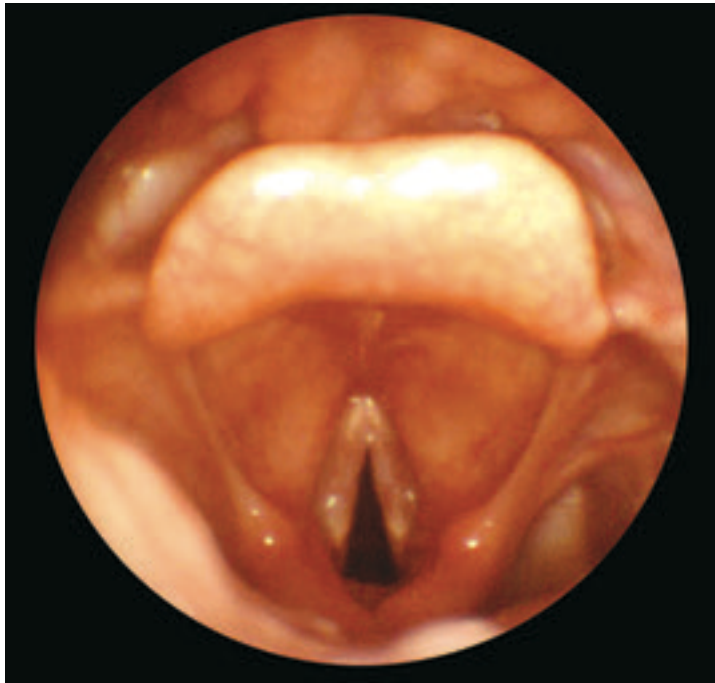
- ♦ **Plica aryepiglottica**
 - ♦ Fold between epiglottis and arytenoid cart.
- ♦ **Vestibulum**
- ♦ **Rima vestibuli**
- ♦ **Ventriculus**
 - ♦ Space between false and true vocal cord
- ♦ **Sacculus**
 - ♦ *space*
 - ♦ *between lamina thyrohyoidea and lamina quadrangularis*
- ♦ **Supraglottic space**
- ♦ **Rima glottidis**
 - ♦ **Anterior commissure**
 - ♦ *Incissura interarytenoidea*
 - ♦ *Plica interarytenoidea*
- ♦ **Infraglottic space**



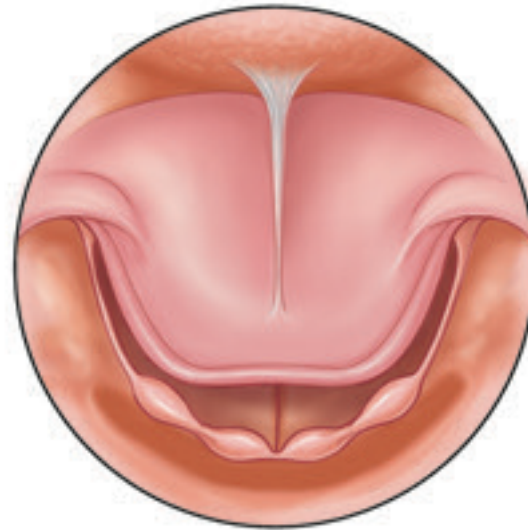
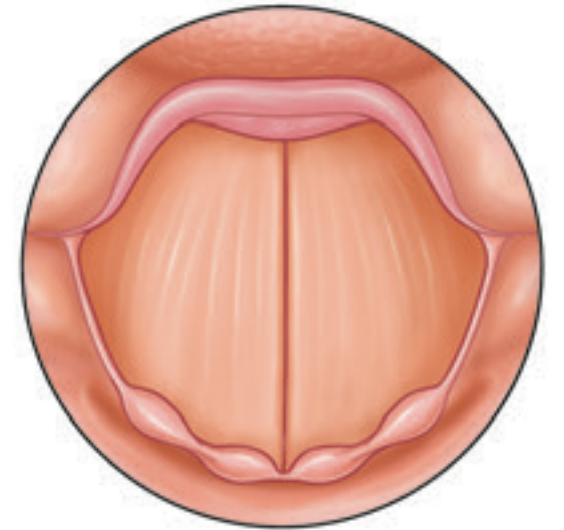
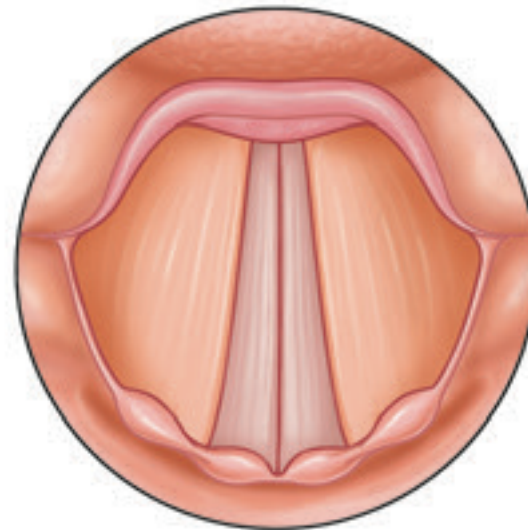
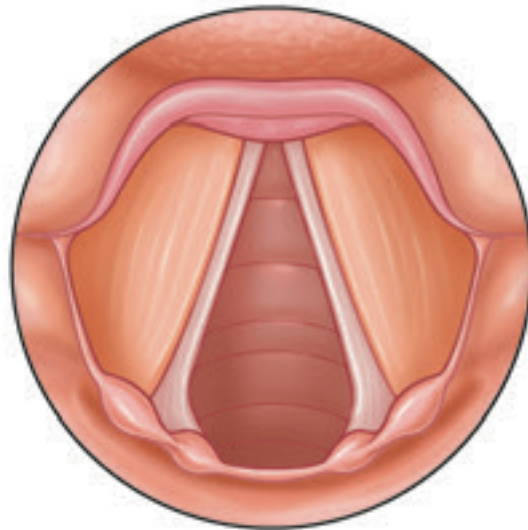
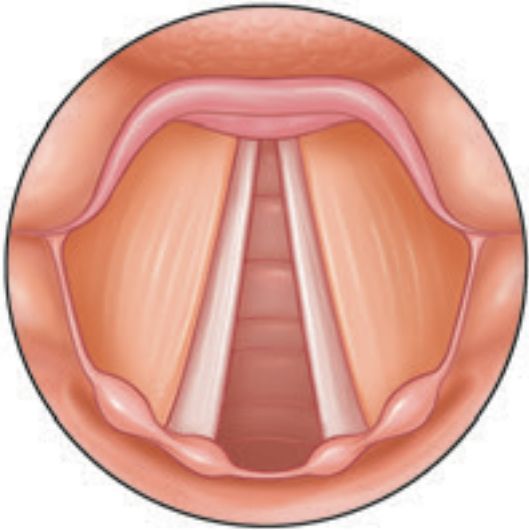
Rima glottidis



laryngoscopy

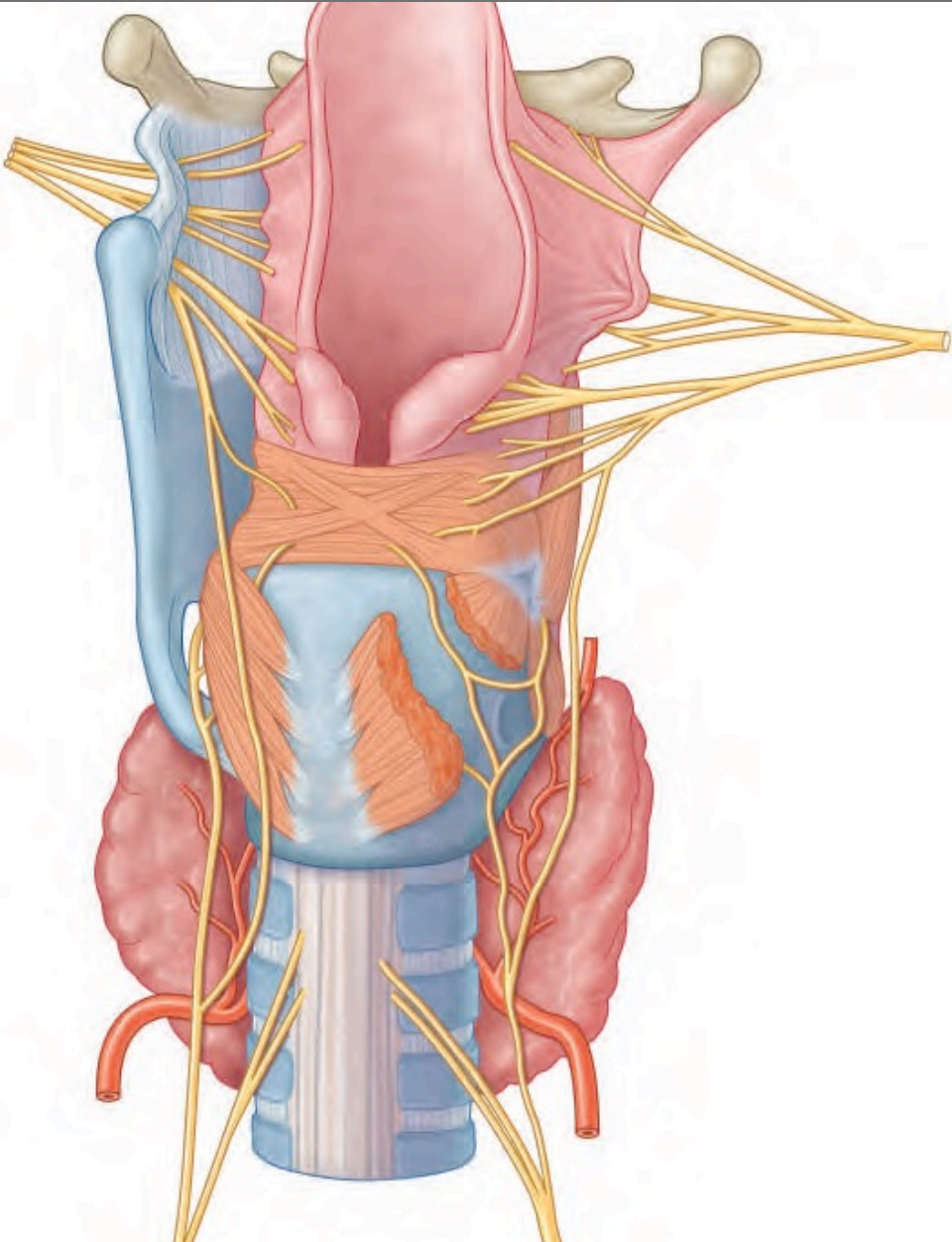


laryngoscopy



- ♦ Free breathing
- ♦ Deep inspiration
- ♦ Phonation
- ♦ Forced occlusion – Valsalva manoeuvre
- ♦ Swallowing

Laryngeal innervation

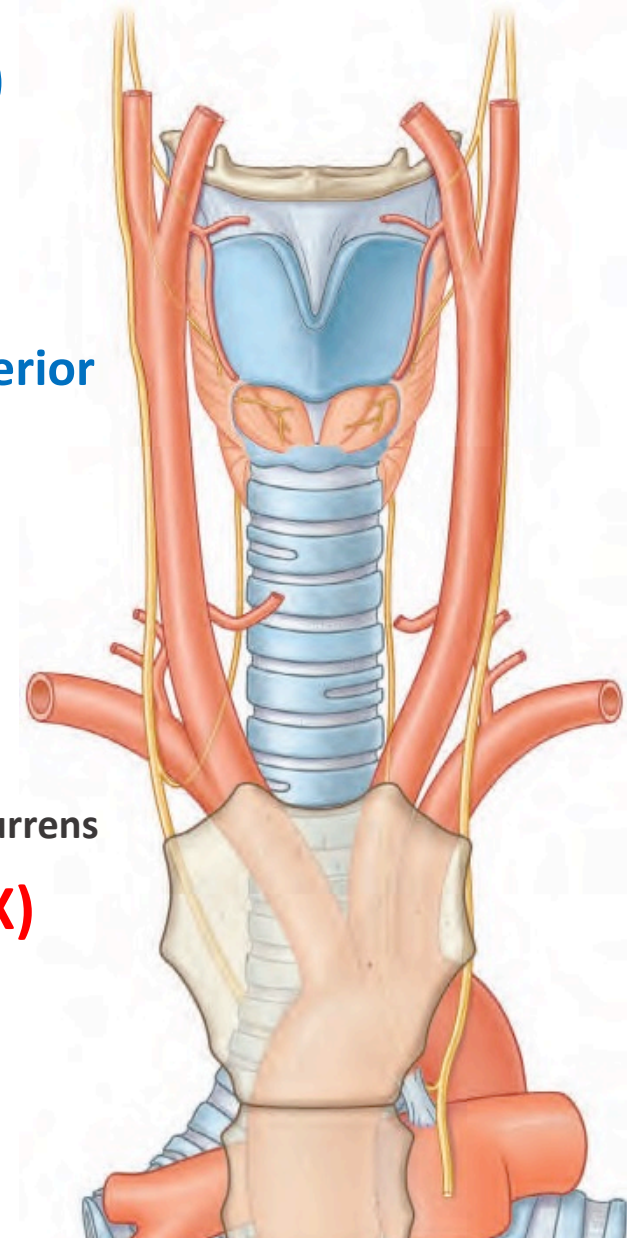


♦ N. laryngeus superior (n. X)

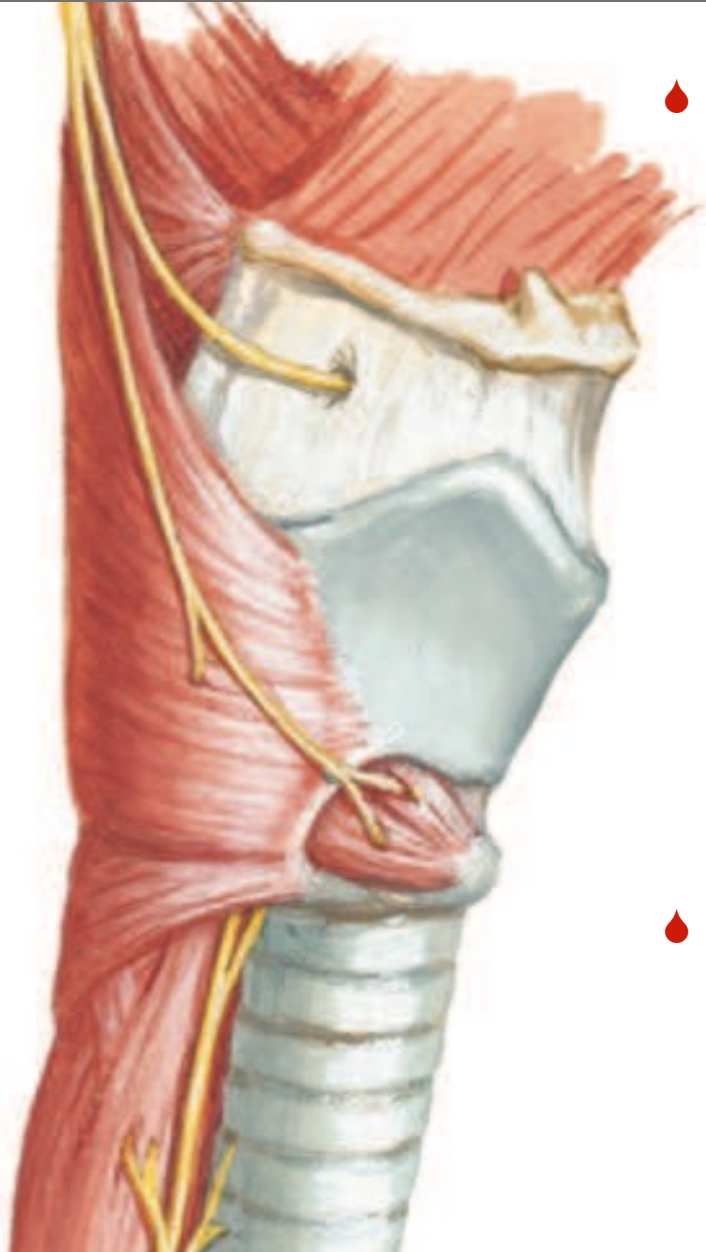
- ♦ N. l. s. externus
- ♦ M. cricothyroideus
- ♦ M. sternothyroideus
- ♦ M. constrictor pharyngis inferior
- ♦ Sympaticus
 - ♦ Ganglion cervicale superius
 - ♦ N. cardiacus superior
- ♦ N. l. s. internus
- ♦ sensoric
 - ♦ Above including plica vocalis
 - ♦ Communication with n. l. recurrens

♦ N. laryngeus recurrens (n. X)

- ♦ Other muscles
- ♦ sensoric
 - ♦ below plica vocalis including



Laryngeal innervation

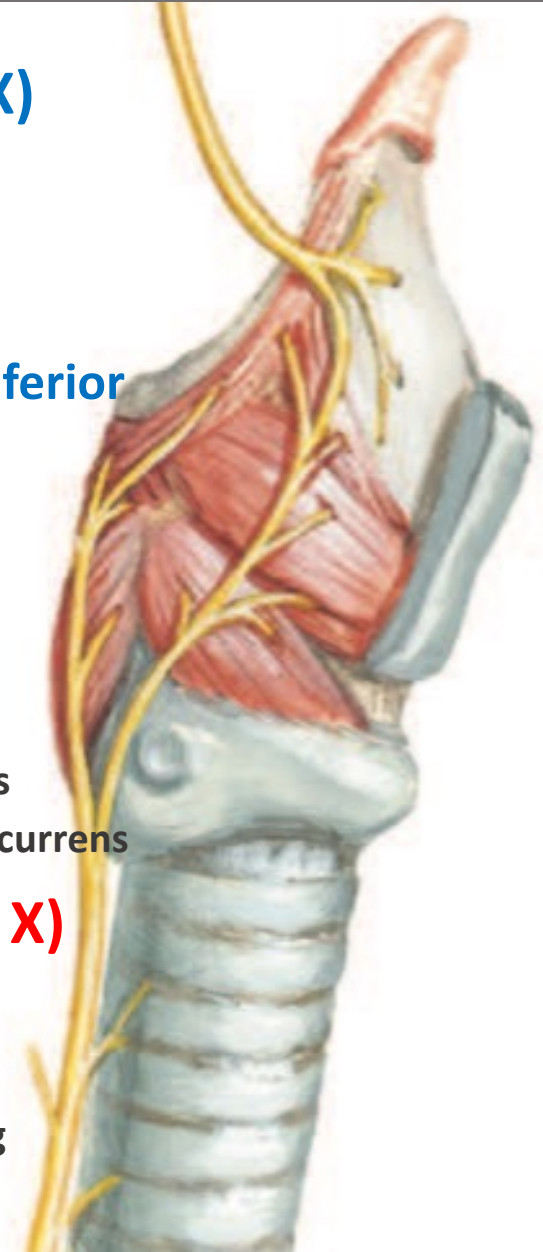


♦ N. laryngeus superior (n. X)

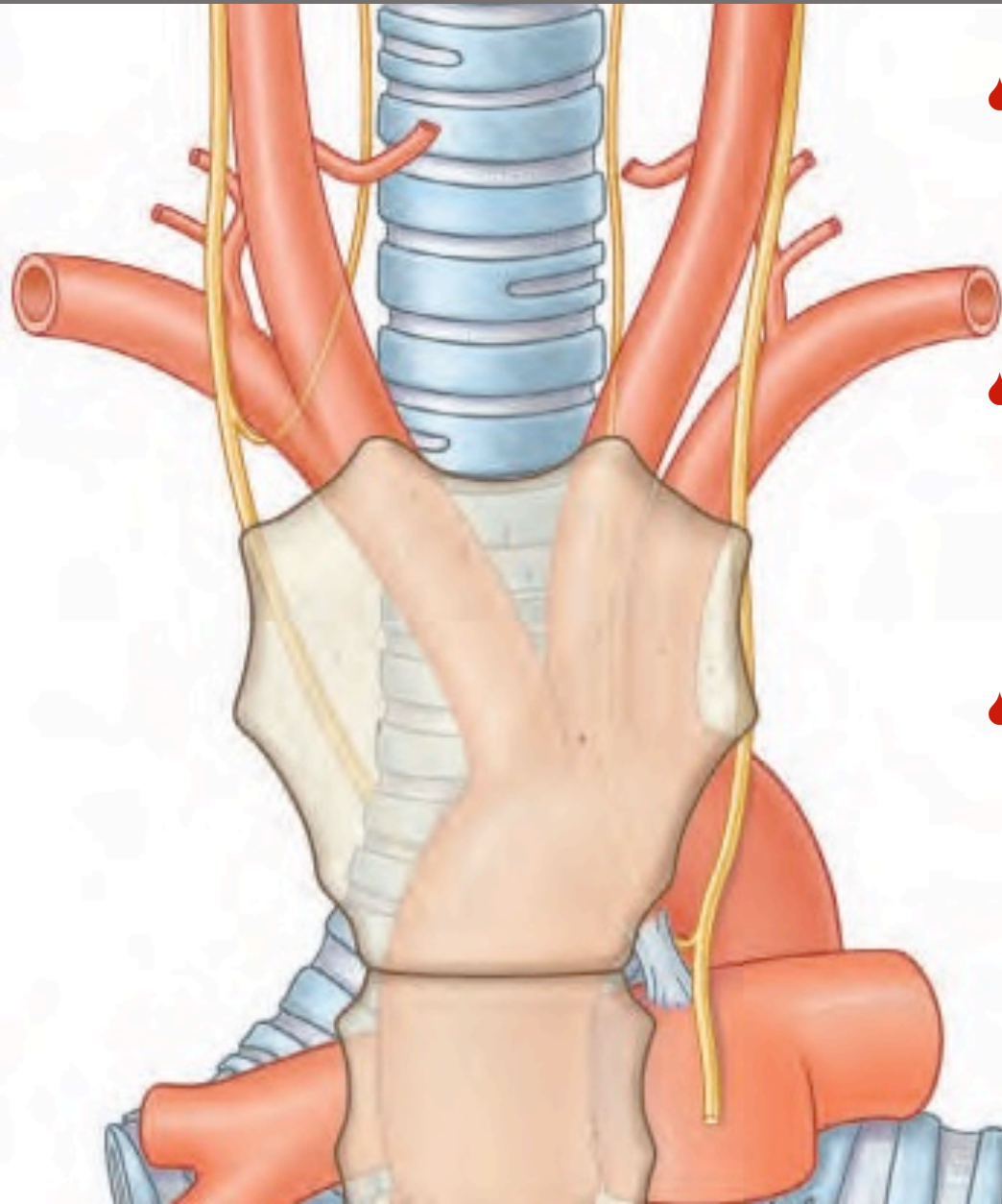
- ♦ N. l. s. externus
- ♦ M. cricothyroideus
- ♦ M. sternothyroideus
- ♦ M. constrictor pharyngis inferior
- ♦ Sympaticus
 - ♦ Ganglion cervicale superius
 - ♦ N. cardiacus superior
- ♦ N. l. s. internus
- ♦ sensoric
 - ♦ Above including plica vocalis
 - ♦ Communication with n. l. recurrens

♦ N. laryngeus recurrens (n. X)

- ♦ Other muscles
- ♦ sensoric
 - ♦ below plica vocalis including



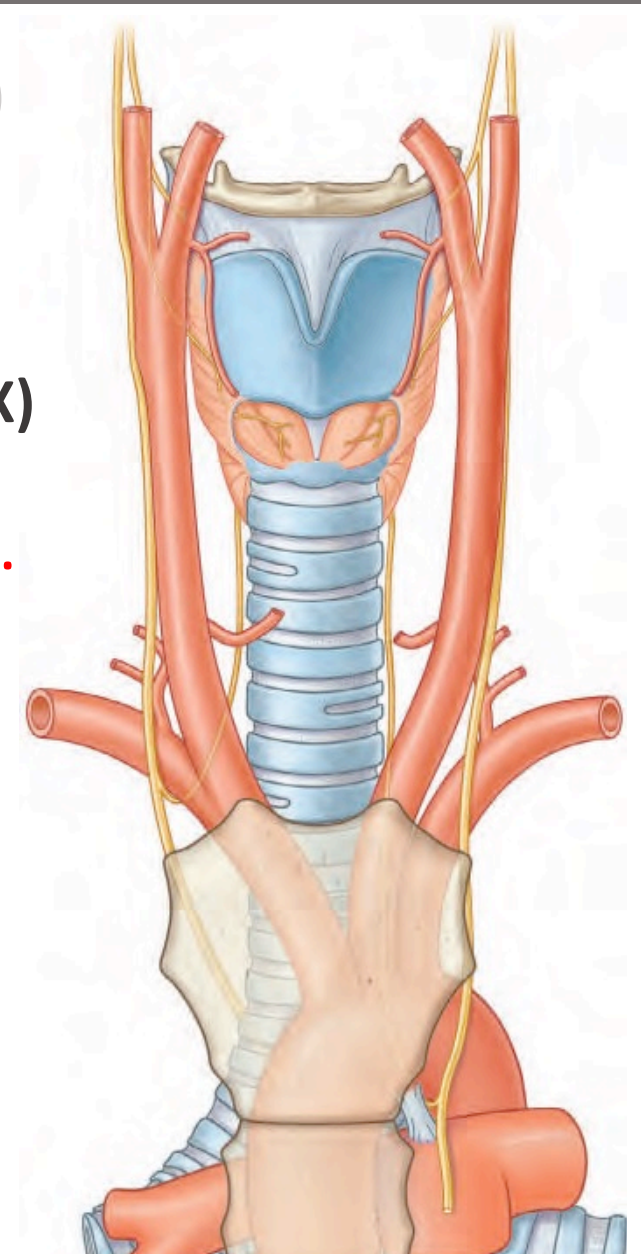
Nervus laryngeus recurrens



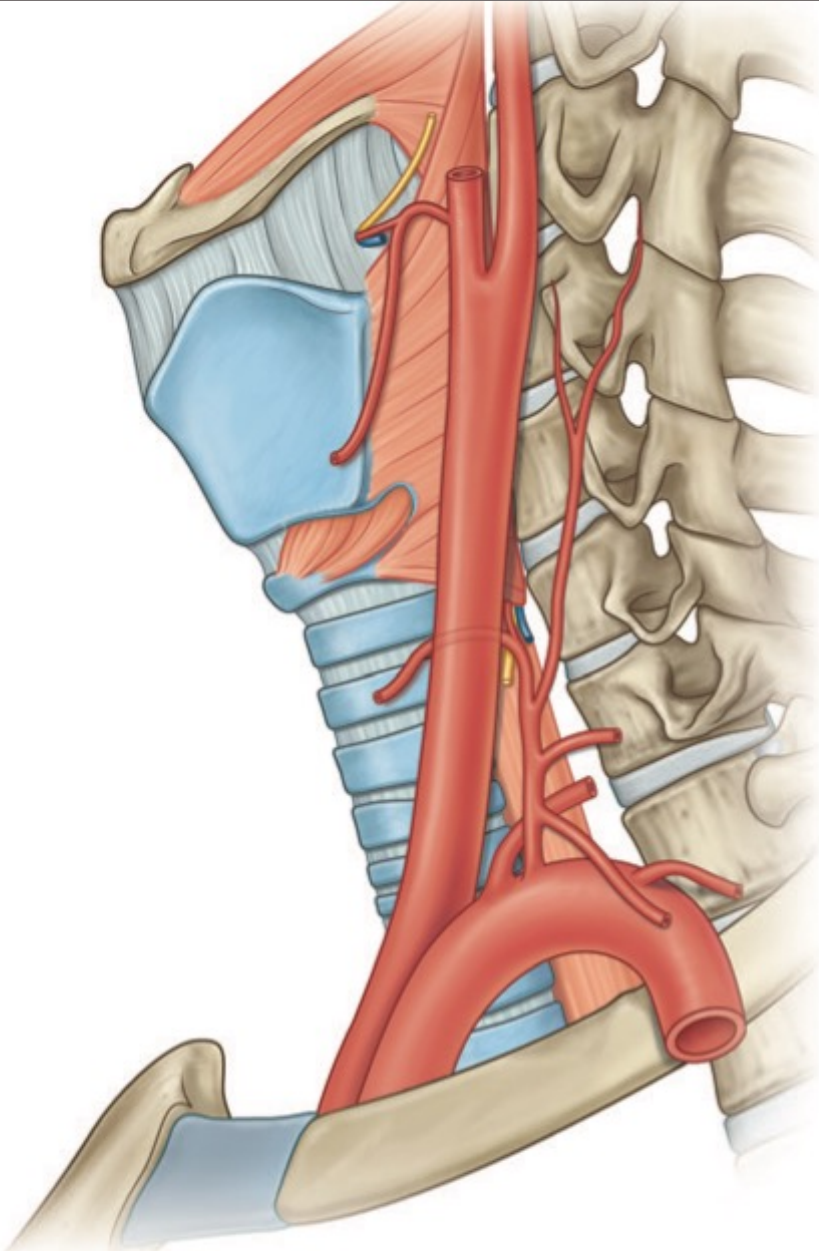
- ♦ N. laryngeus superior (n. X)
 - ♦ N.l.s. externus
 - ♦ N.l.s. internus
 - ♦ M. cricothyroideus
- ♦ N. laryngeus recurrens (n. X)
 - ♦ LEFT below aortic arch
 - ♦ RIGHT below a. subclavia dx.

♦ MOTOR FIBERS

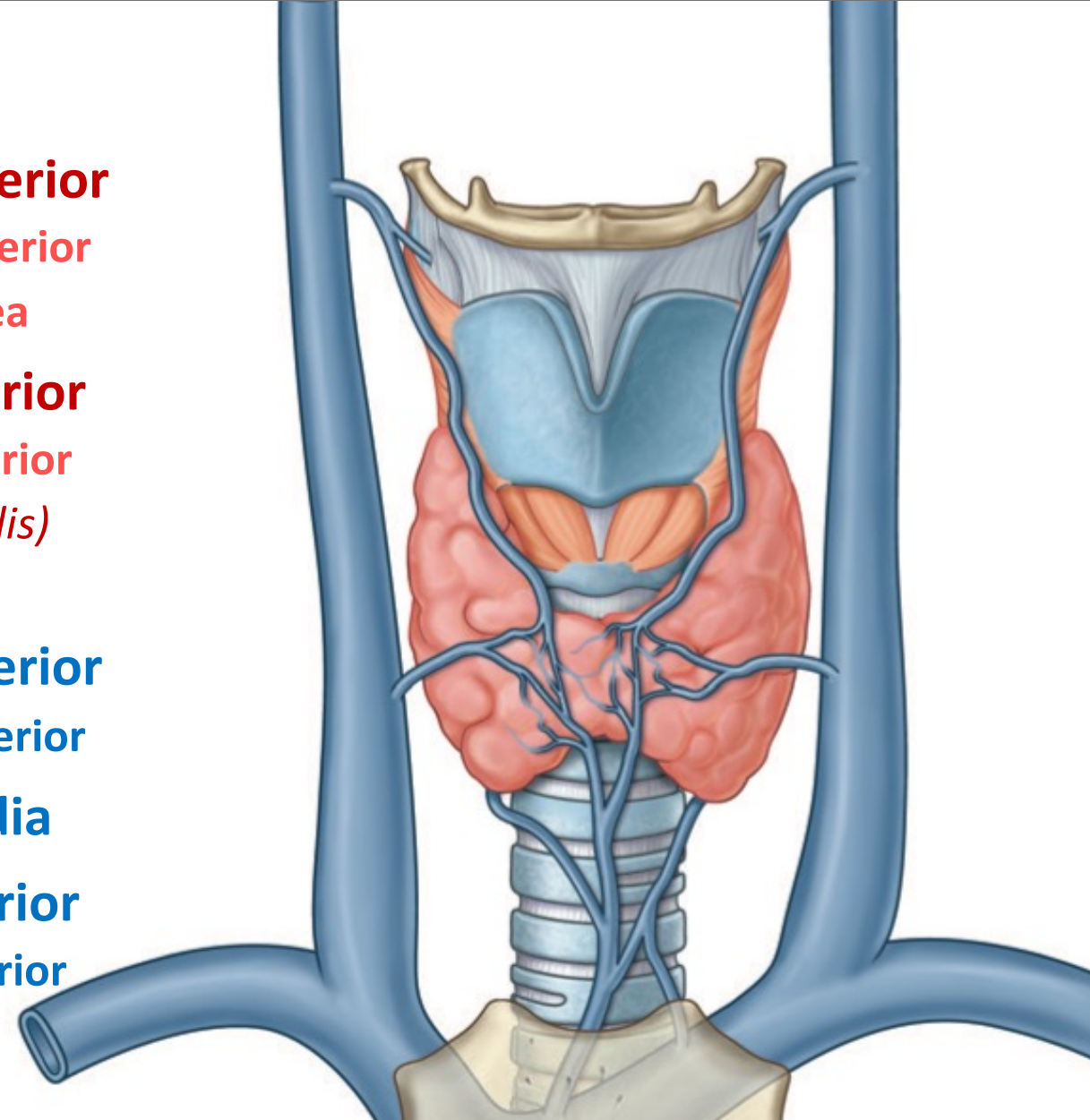
- ♦ origin
- ♦ N. XI. - PARS CRANIALIS
- ♦ Accompanied to N. VAGUS
- ♦ VI. branchial arch



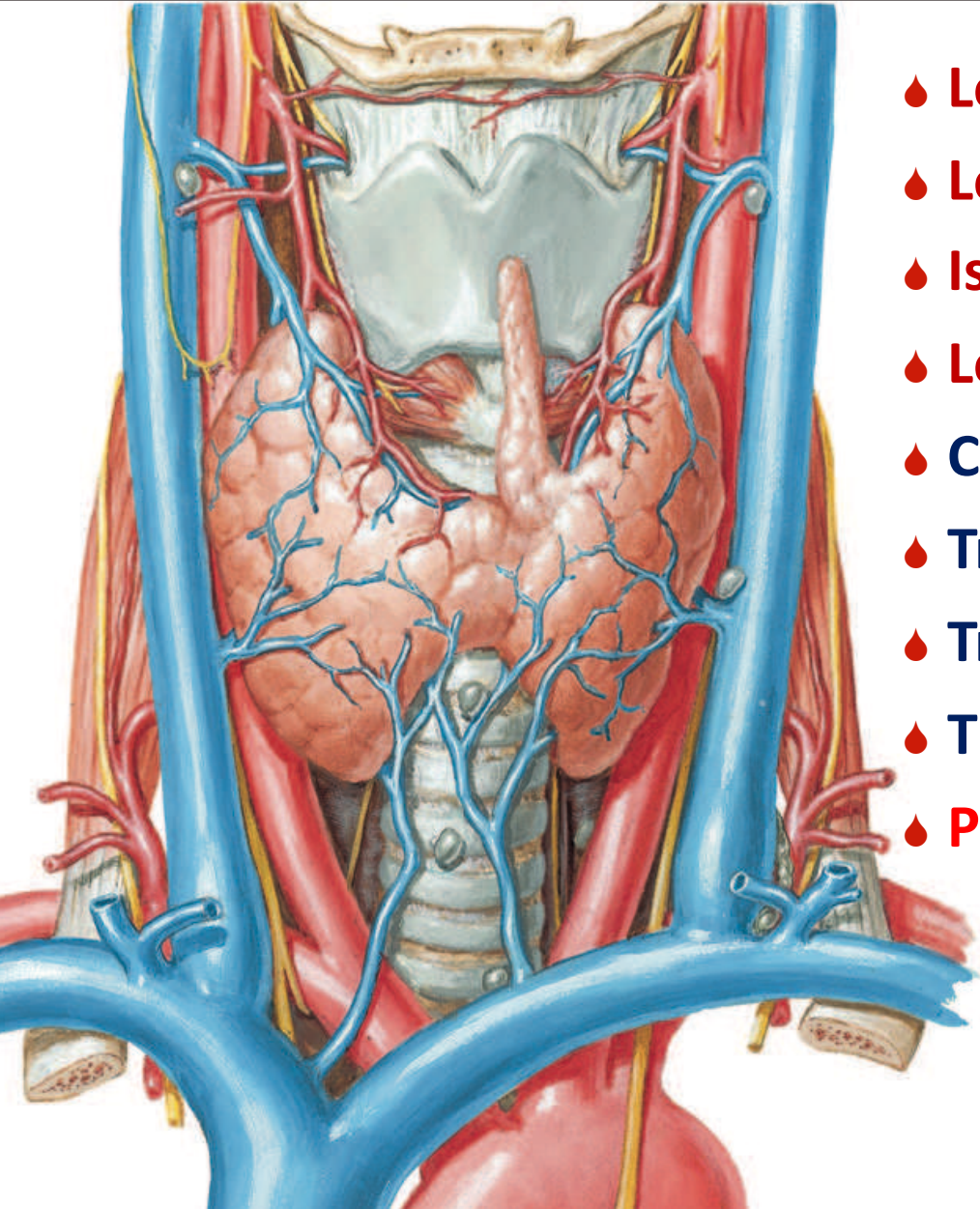
Vessels of larynx



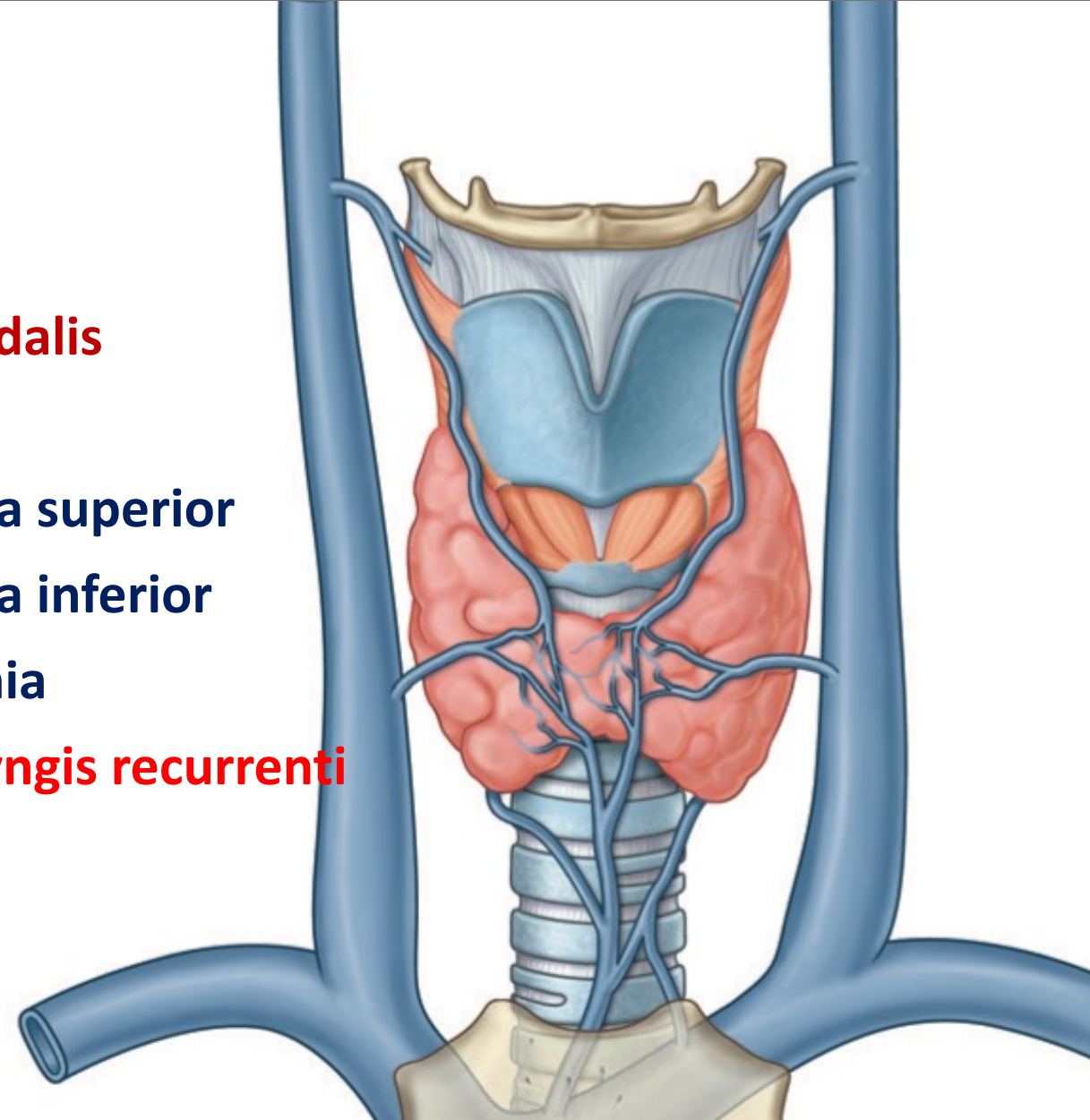
- ♦ **A. thyroidea superior**
 - ♦ A. laryngea superior
 - ♦ A. cricothyroidea
- ♦ **A. thyroidea inferior**
 - ♦ A. laryngea inferior
 - ♦ (*tr. thyrocervicalis*)
 - ♦ (*A. subclavia*)
- ♦ **V. thyroidea superior**
 - ♦ V. laryngea superior
- ♦ **V. thyroidea media**
- ♦ **V. thyroidea inferior**
 - ♦ V. laryngea inferior



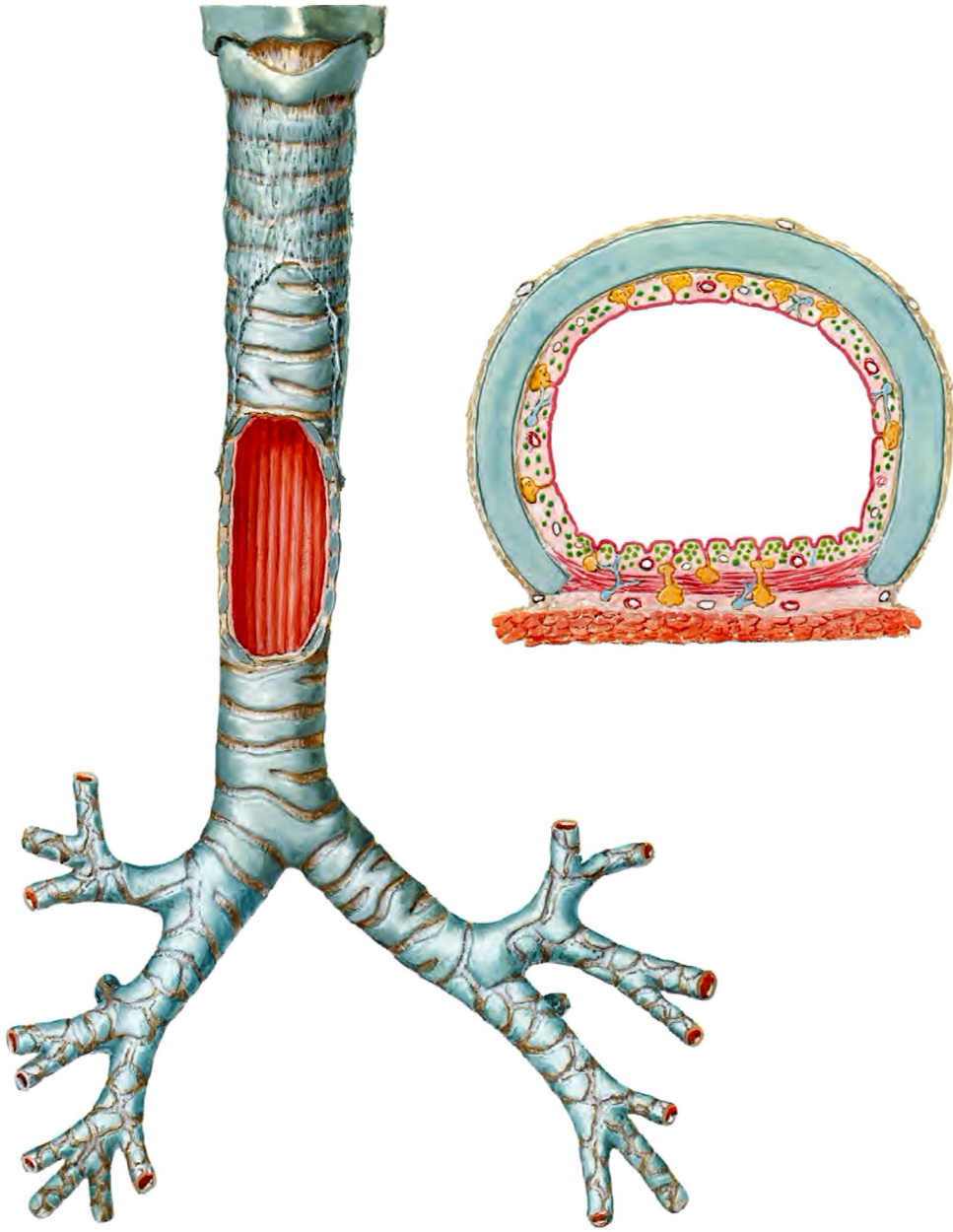
larynx – glandula thyroidea



- ♦ Lobus dexter
- ♦ Lobus sinister
- ♦ Isthmus
- ♦ Lobus pyramidalis
- ♦ Coniotomia
- ♦ Tracheostomia superior
- ♦ Tracheostomia inferior
- ♦ Thyroidectomy
- ♦ Paresis n. laryngis recurrenti

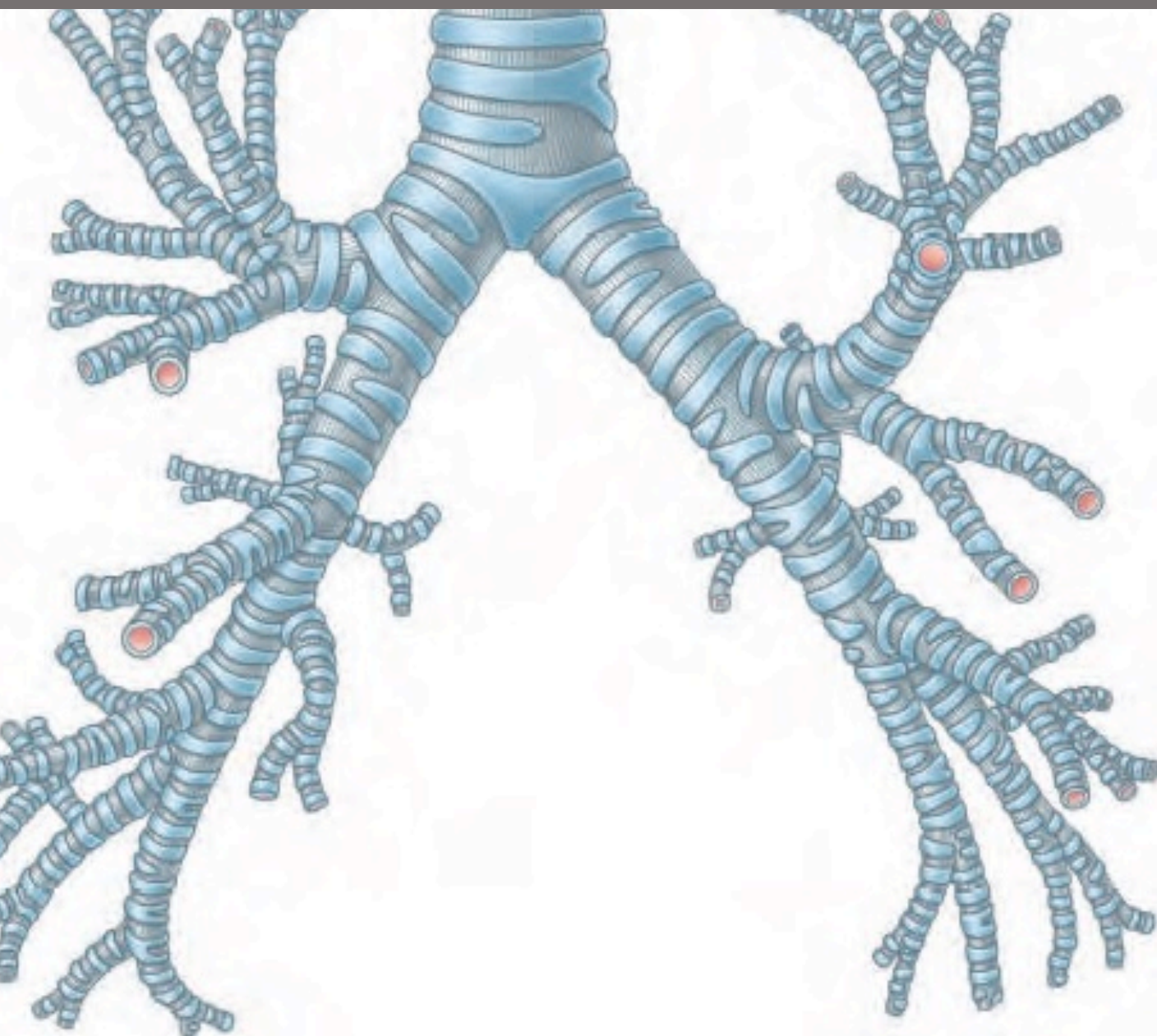


trachea



- ♦ extent C6 - Th4
 - ♦ Bifurcatio tracheae
 - ♦ Divided to bronchus dexter and sinister
 - ♦ Carina tracheae
- ♦ Lig. cricotracheale
- ♦ Paries membranaceus
- ♦ Musculus trachealis
- ♦ Cartilago tracheale
- ♦ Ligamentum anulare
- ♦ Fascia praetrachealis - adventicia
- ♦ Plicae verticales
- ♦ Fibrae elasticae
- ♦ Glandulae tracheales

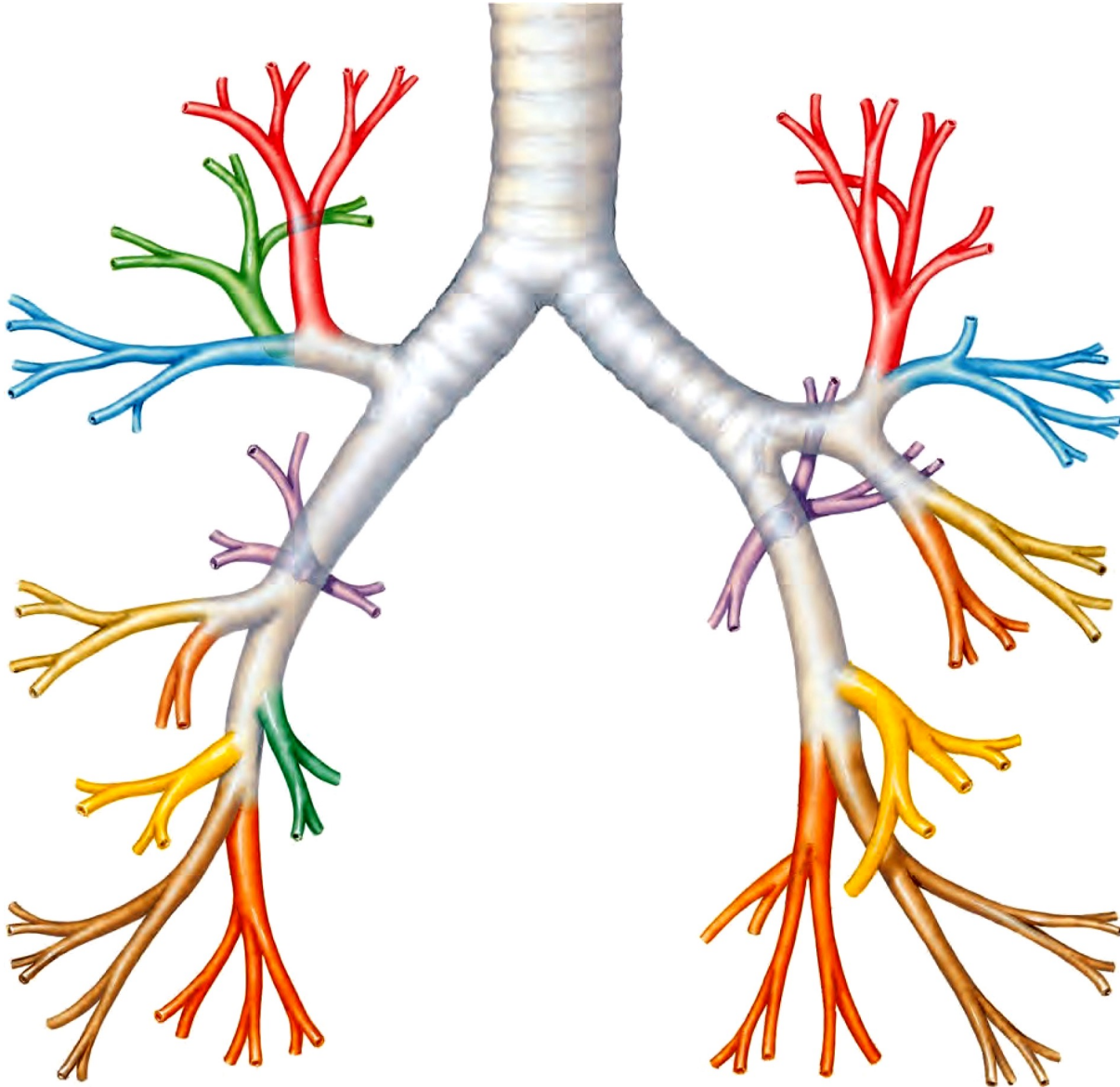
bronchi



- ♦ **Bronchus principalis**
 - ♦ Laterodorsocaudal course
- ♦ **Dexter**
- ♦ **A**horter, wider, straight
- ♦ **Sinister**
- ♦ **L**onger, thinner, S-shaped

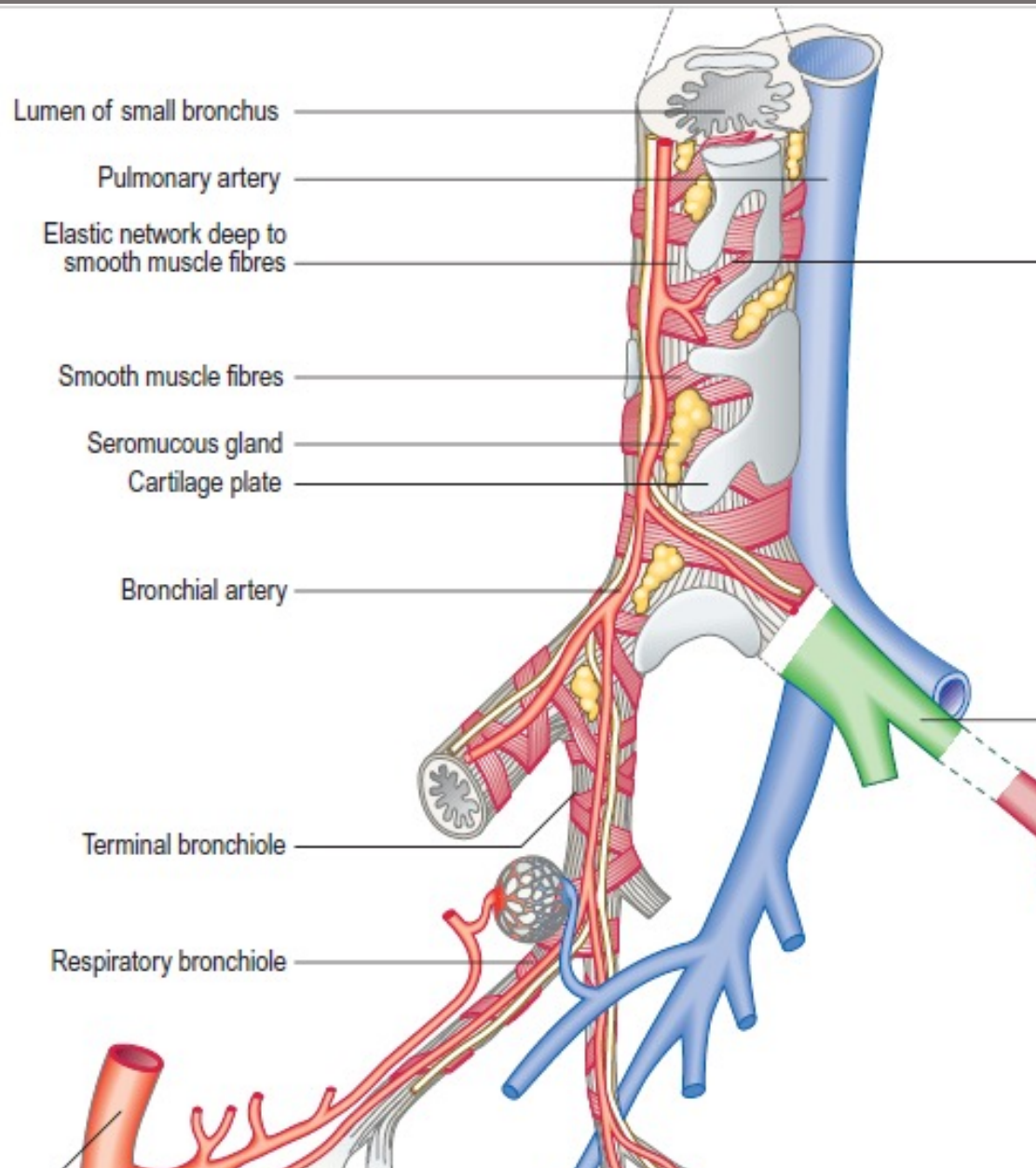
- ♦ Angle of bifurcation 70 - 90 degrees
- ♦ **R**ight bronchus 30 dg from vertical
- ♦ **L**eft bronchus 60 dg from vertical

bronchi



- ♦ Bronchi lobares
- ♦ Bronchus intermedius (dx)
- ♦ Bronchi segmentales
- ♦ Bronchi subsegmentales

Bronchial wall



♦ mucosa

- ♦ Ciliary cylindric epithelium
- ♦ Glands
- ♦ Lymphatic follicles

♦ Muscular layer

- ♦ Regulation of diameter
- ♦ Smooth muscle
- ♦ Parasympaticus - constriction
- ♦ Sympaticus - dilatation

♦ Fibrocartiliginous layer

- ♦ Larger bronchi – bowed cartilages
- ♦ Smaller than 1 mm – only plates in divisions
- ♦ Smaller than 1 mm – no cartilage

Terminla branching



- ♦ Bronchiolus terminalis
- ♦ Bronchiolus respiratorius
 - ♦ In the wall the first alveoli
- ♦ Ductus alveolaris
 - ♦ Last with muscles
- ♦ Atrium
- ♦ Sacculi alveolares
- ♦ Alveoli (10 pro sacculum)
- ♦ *Flat epithelium*
- ♦ *Rete capillare*
- ♦ *Sigle layered endothelium*
- ♦ *Porus Kohni*

Pulmones



Gray's Anatomy 41th ed.

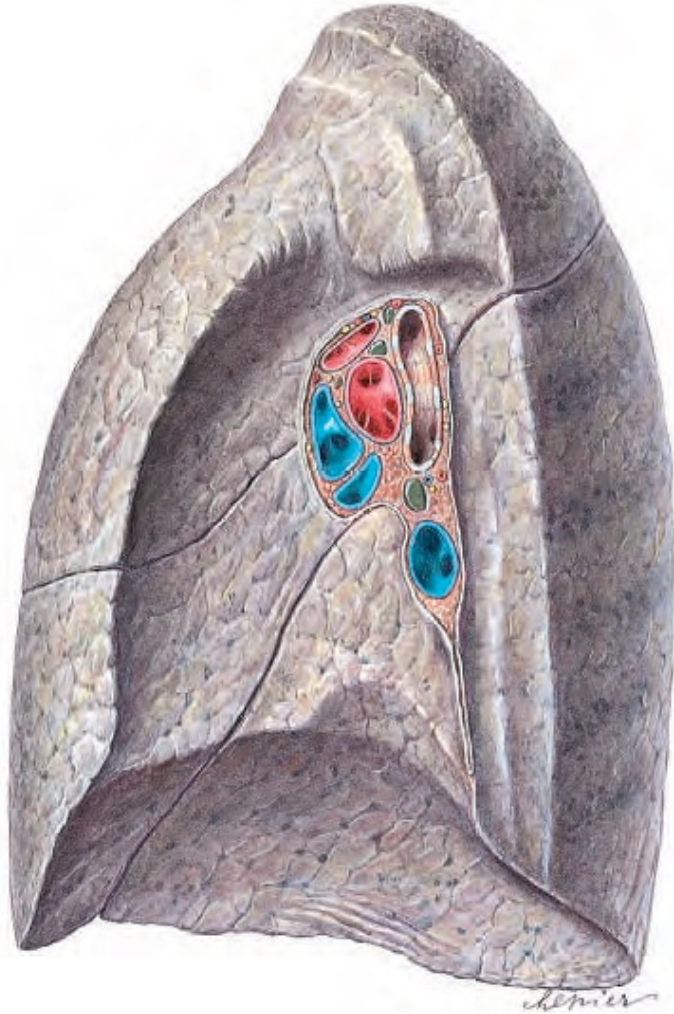
♦ Pulmo dexter

- ♦ Lobus superior
- ♦ Lobus medius
- ♦ Lobus inferior
- ♦ *Fissura horizontalis*
- ♦ *Fissura obliqua*

♦ Pulmo sinister

- ♦ Lobus superior
 - ♦ Lingula
- ♦ Lobus inferior
- ♦ *Fissura obliqua*

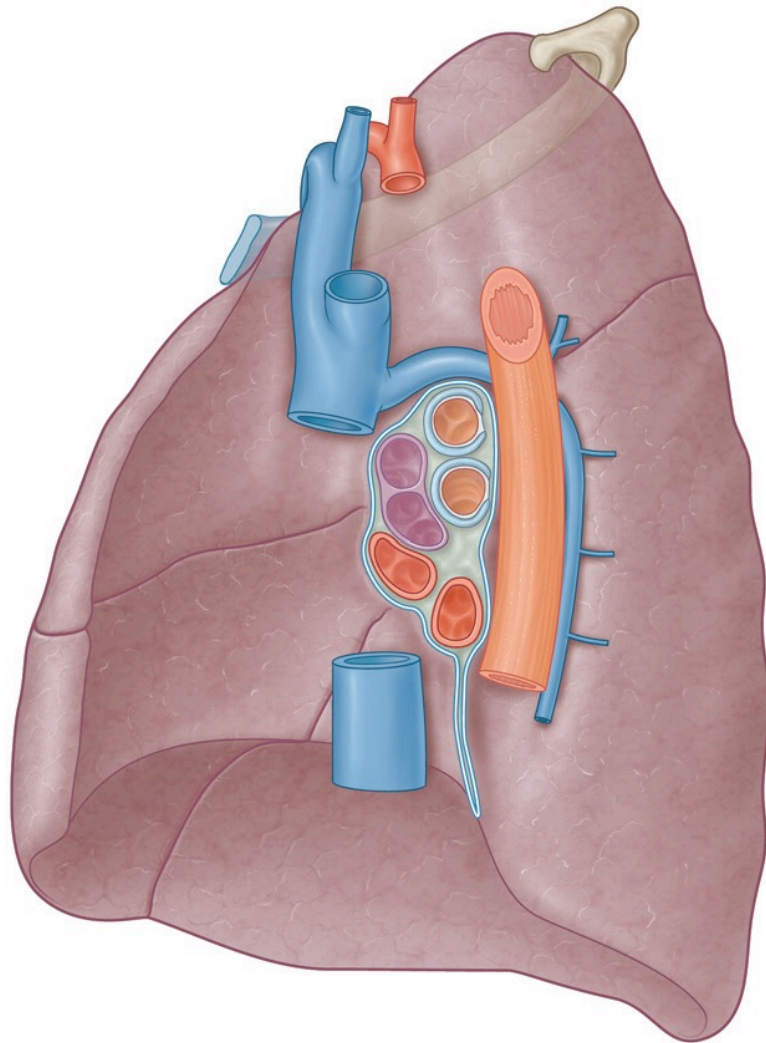
Pulmones



- ♦ Apex pulmonis
- ♦ Facies medialis
- ♦ Hilus pulmonis
- ♦ Facies costalis
- ♦ Facies diaphragmatica
- ♦ Basis pulmonis



Pulmo dexter



♦ Lobes and segments

♦ Lobus superior

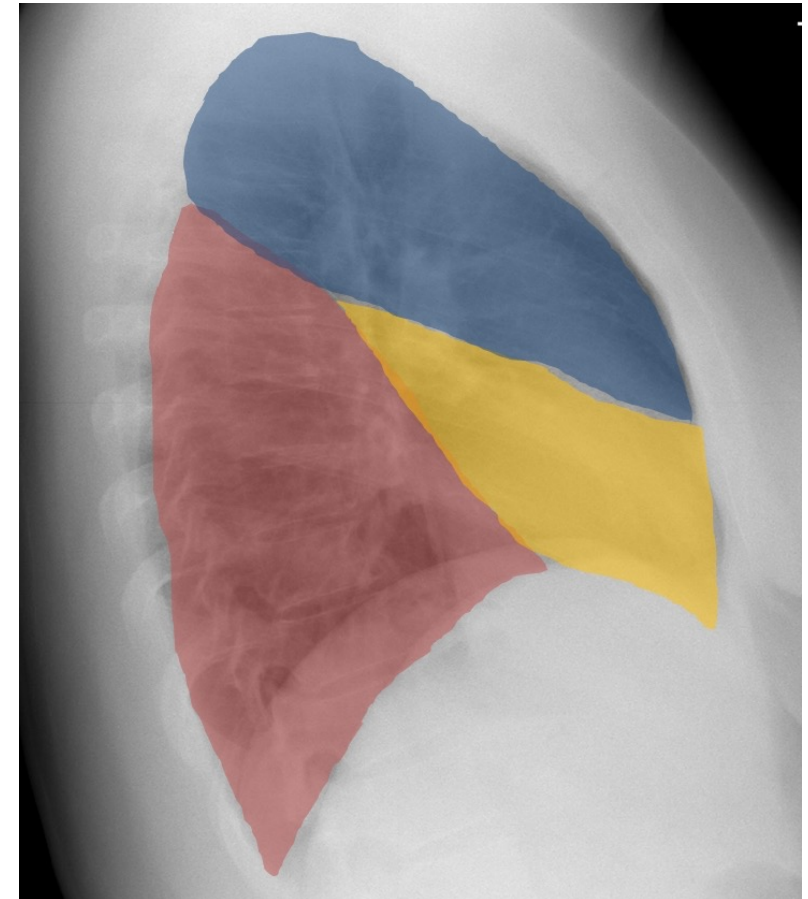
- ♦ Apicalis S1
- ♦ Posterior S2
- ♦ Anterior S3

♦ Lobus medius

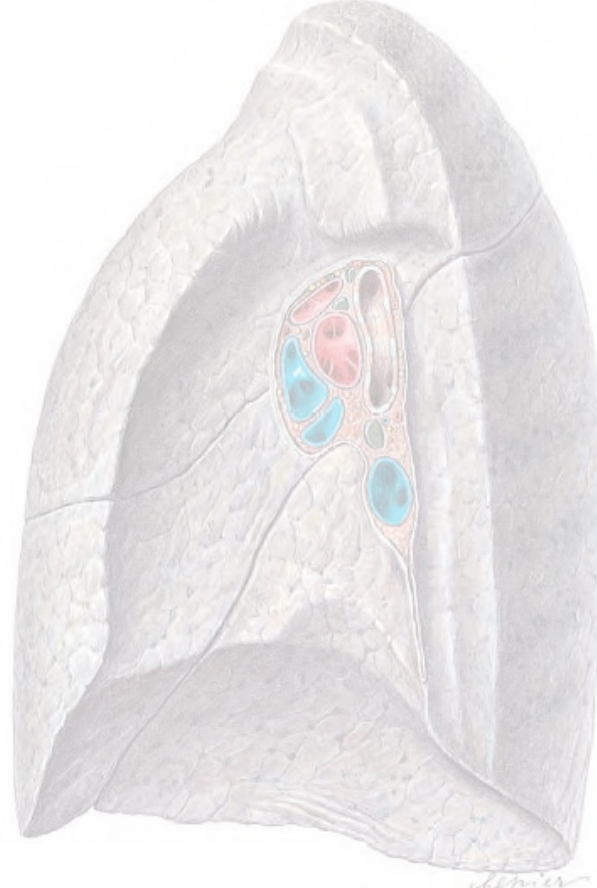
- ♦ Lateralis S4
- ♦ Medialis S5

♦ Lobus inferior

- ♦ Basalis apicalis S6
- ♦ Basalis medialis S7
- ♦ Basalis anterior S8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10



Pulmo dexter



♦ Lobes and segments

♦ Lobus superior

- ♦ Apicalis S1
- ♦ Posterior S2
- ♦ Anterior S3

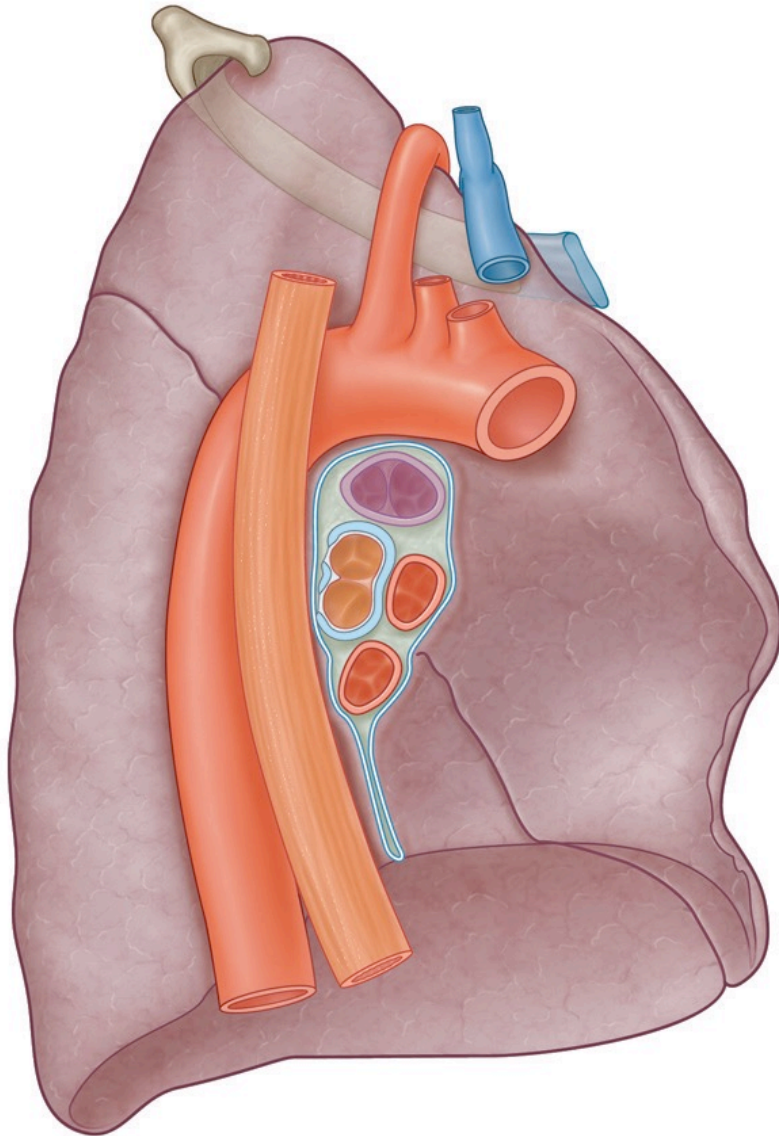
♦ Lobus medius

- ♦ Lateralis S4
- ♦ Medialis S5

♦ Lobus inferior

- ♦ Basalis apicalis S6
- ♦ Basalis medialis S7
- ♦ Basalis anterior S8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10

Pulmo sinister



♦ Lobes and segments

♦ Lobus superior

- ♦ Apicoposterior S1+2
- ♦ Anterior S3
- ♦ Lingularis superior S4
- ♦ Lingularis inferior S5

♦ Lobus inferior

- ♦ Basalis apicalis S6
- ♦ (*Basalis medialis* S7)
- ♦ Basalis anterior S7+8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10



Pulmo sinister



♦ lobes and segments

♦ Lobus superior

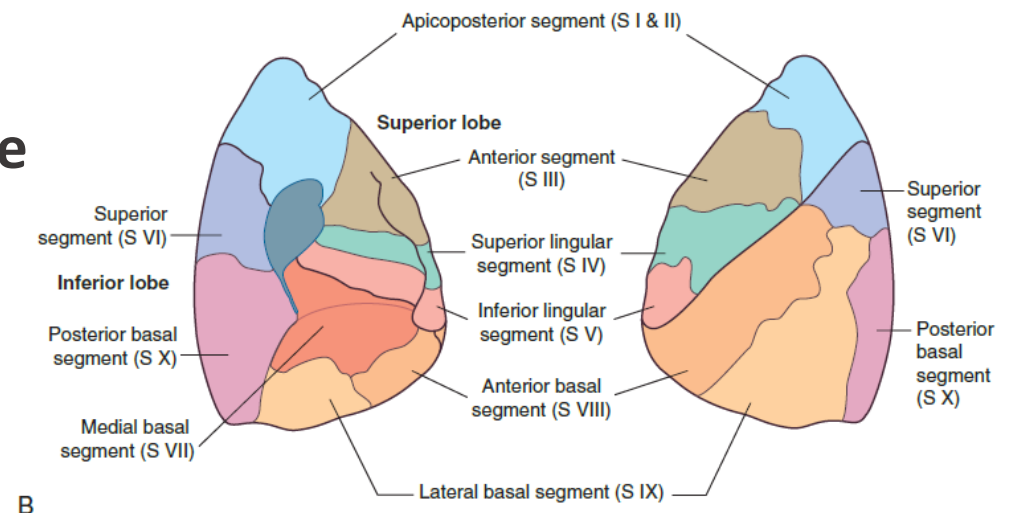
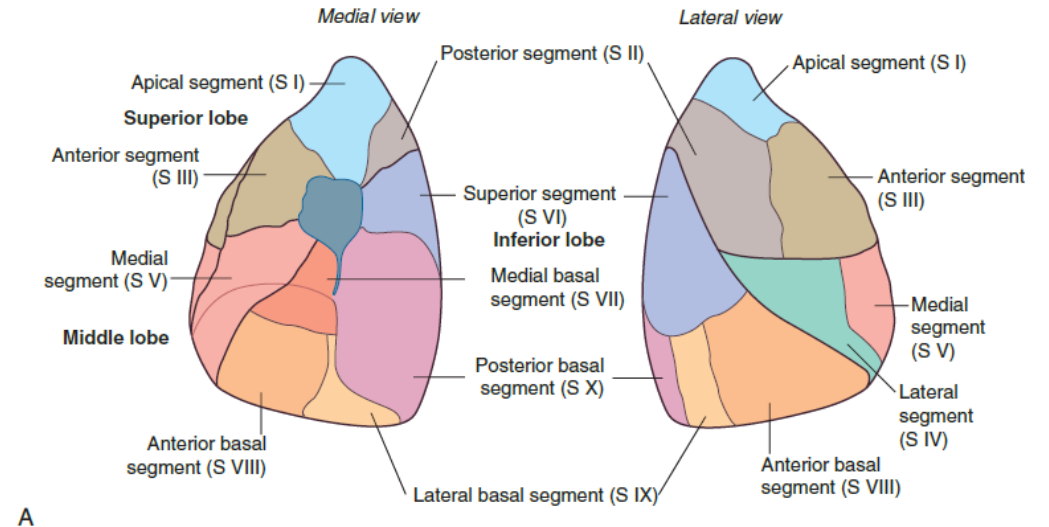
- ♦ Apicoposterior S1+2
- ♦ Anterior S3
- ♦ Lingularis superior S4
- ♦ Lingularis inferior S5

♦ Lobus inferior

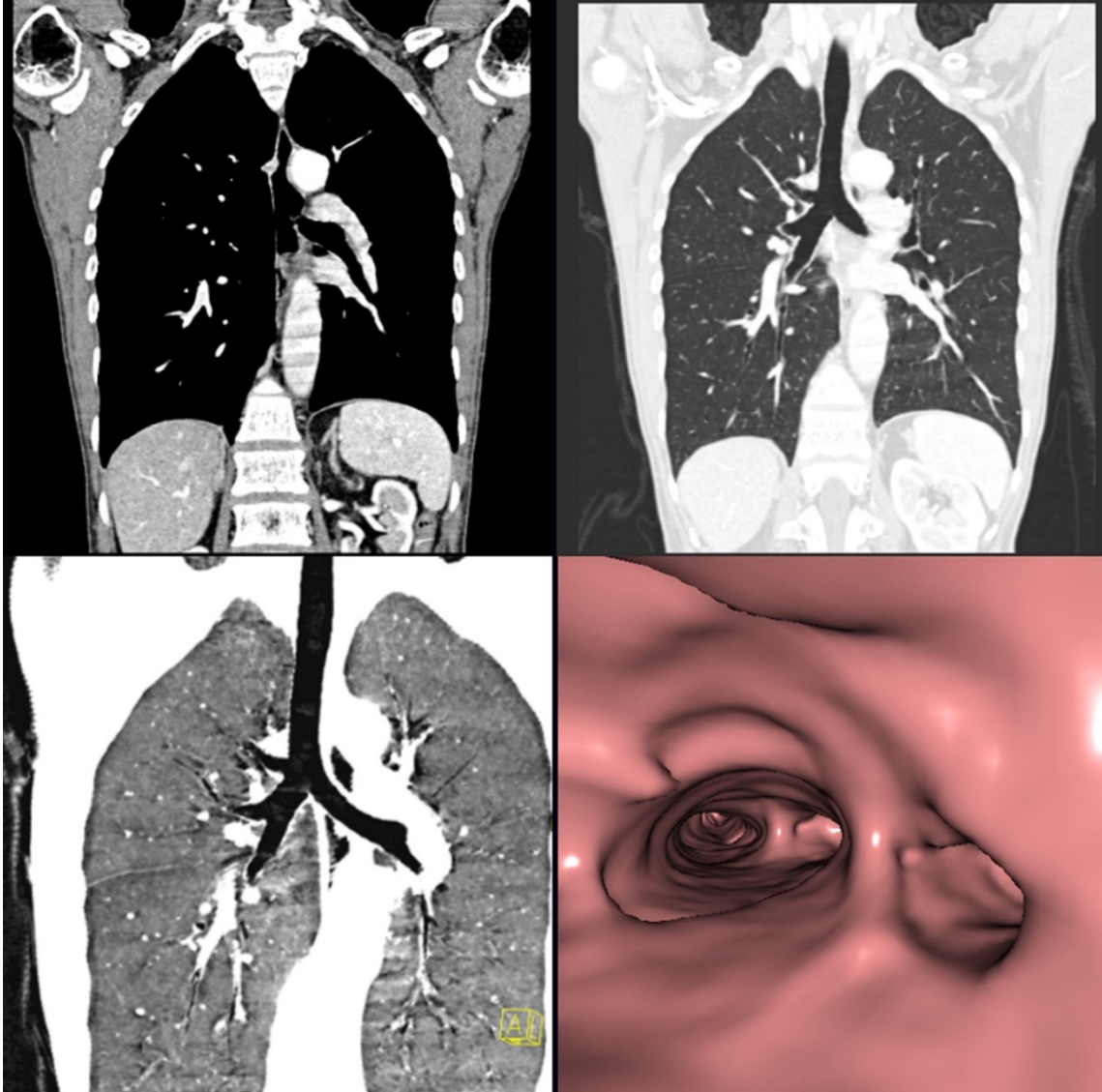
- ♦ Basalis apicalis S6
- ♦ (*Basalis medialis* S7)
- ♦ Basalis anterior S7+8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10

Segmentum pulmonis

- Conic shape
- centrally
 - Bronchus
 - Branch of a. pulmonalis
 - Branch of a. bronchialis
 - Central lymphatics
- Peripheral part
- septum from connective tissue
 - Rami venae pulmonalis
 - Peripheral lymphatics



Variability of lungs



- ♦ **Tracheal bronchus**

- ♦ *In some mammals (*Sus domestica*)*

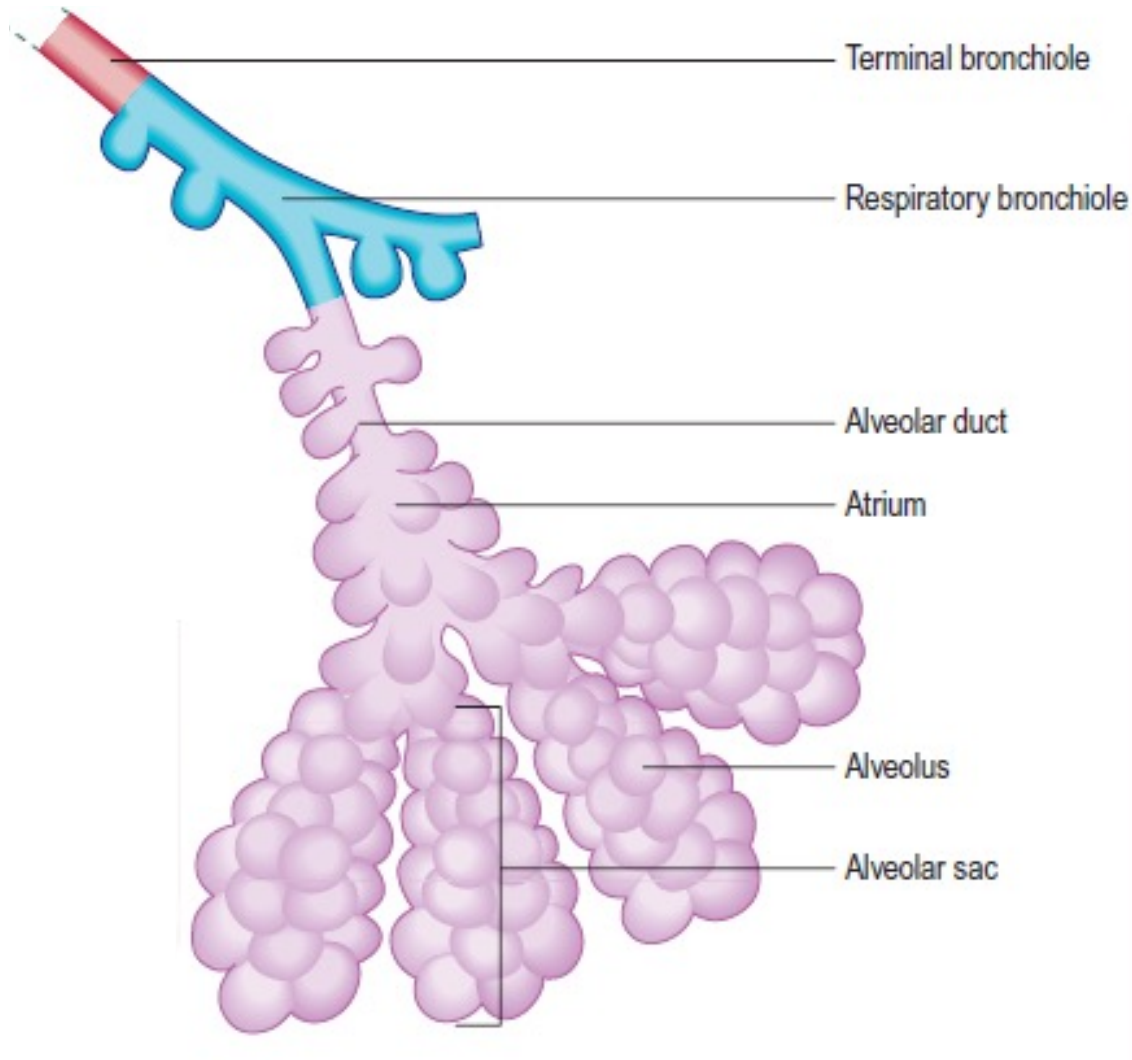
- ♦ **Accessory lobes**

- ♦ Lobus venae azygos
- ♦ Lobus apicalis (S6)
- ♦ Lobus cardiacus (S7)
- ♦ Lobus medius sinister (S4,5)

- ♦ **Lung sequestration**

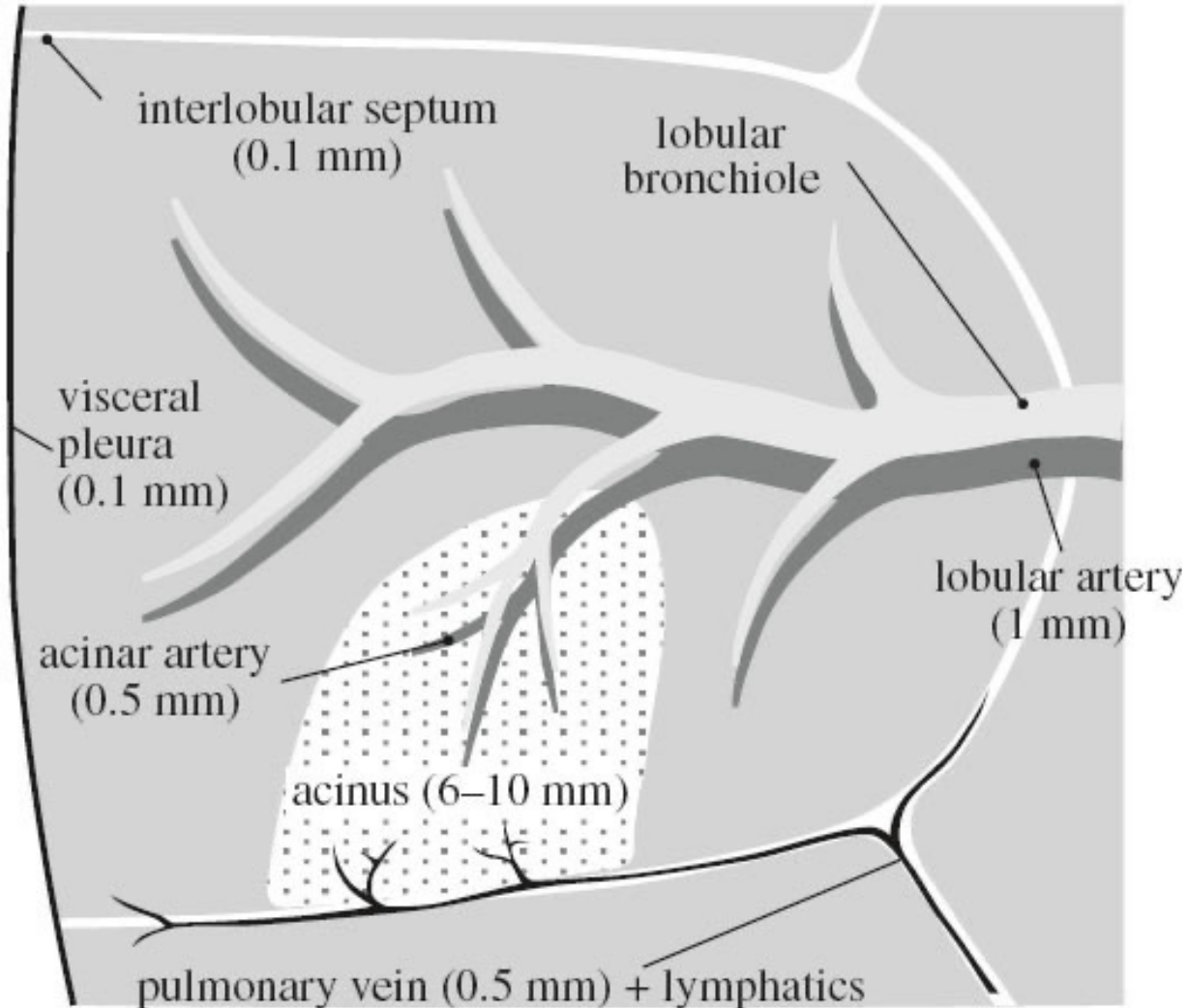
- ♦ Not connected to pulmonary functional circulation

Functional anatomy of lungs



- ♦ **Bronchi - branching 15 levels**
- ♦ **Bronchioles – branching in 5 levels**
- ♦ **„secondary lobulus“**
 - ♦ 3 - 5 terminal bronchioli
- ♦ **Lobulus „primary lobulus“**
 - ♦ One terminal bronchiolus
- ♦ **Acinus - 3 levels of respiratory bronchioli**
 - ♦ In walls alveoli
 - ♦ Ductuli alveolares
 - ♦ Last with muscles
 - ♦ Sacculi alveolares
 - ♦ Alveoli
 - ♦ Porus alveolares Kohnei
 - ♦ Openings between alveoli

Secondary lobulus



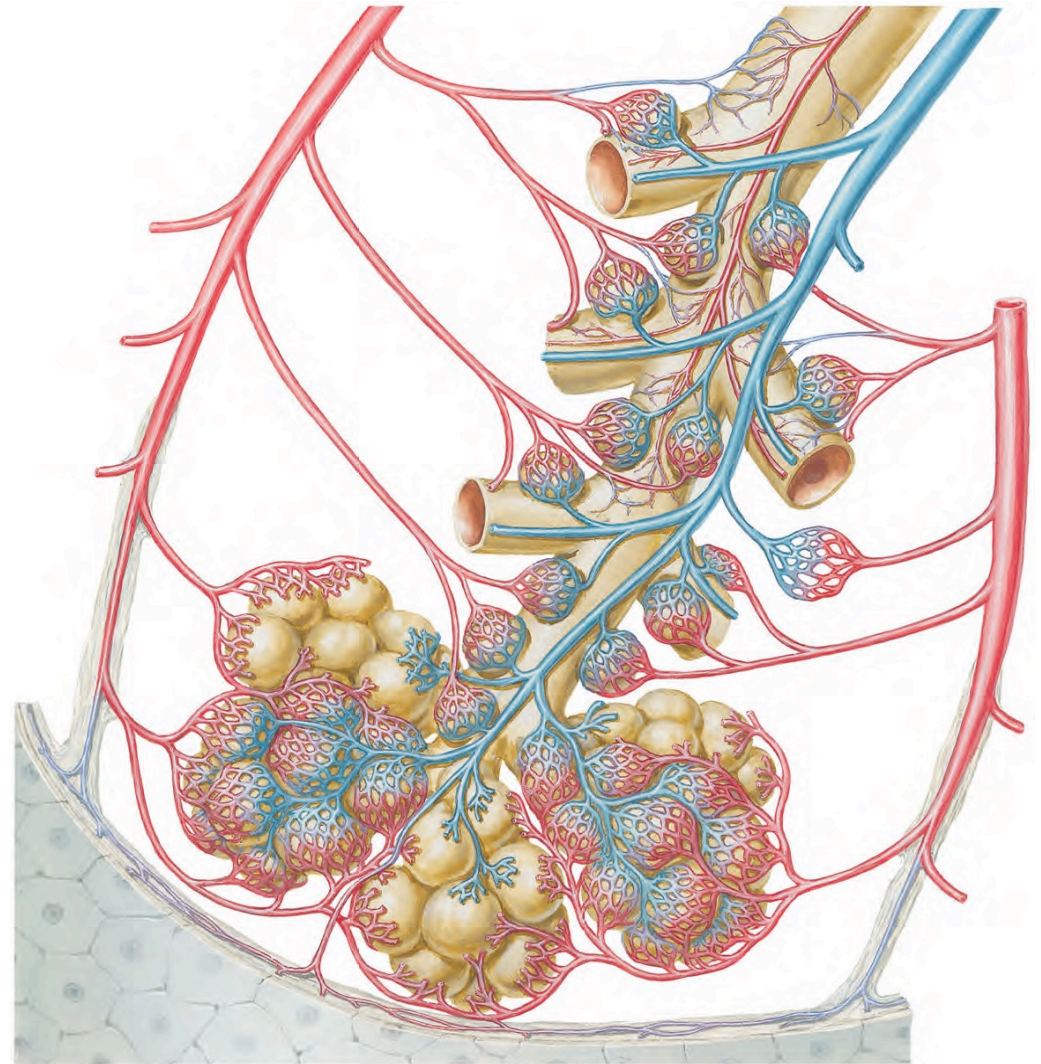
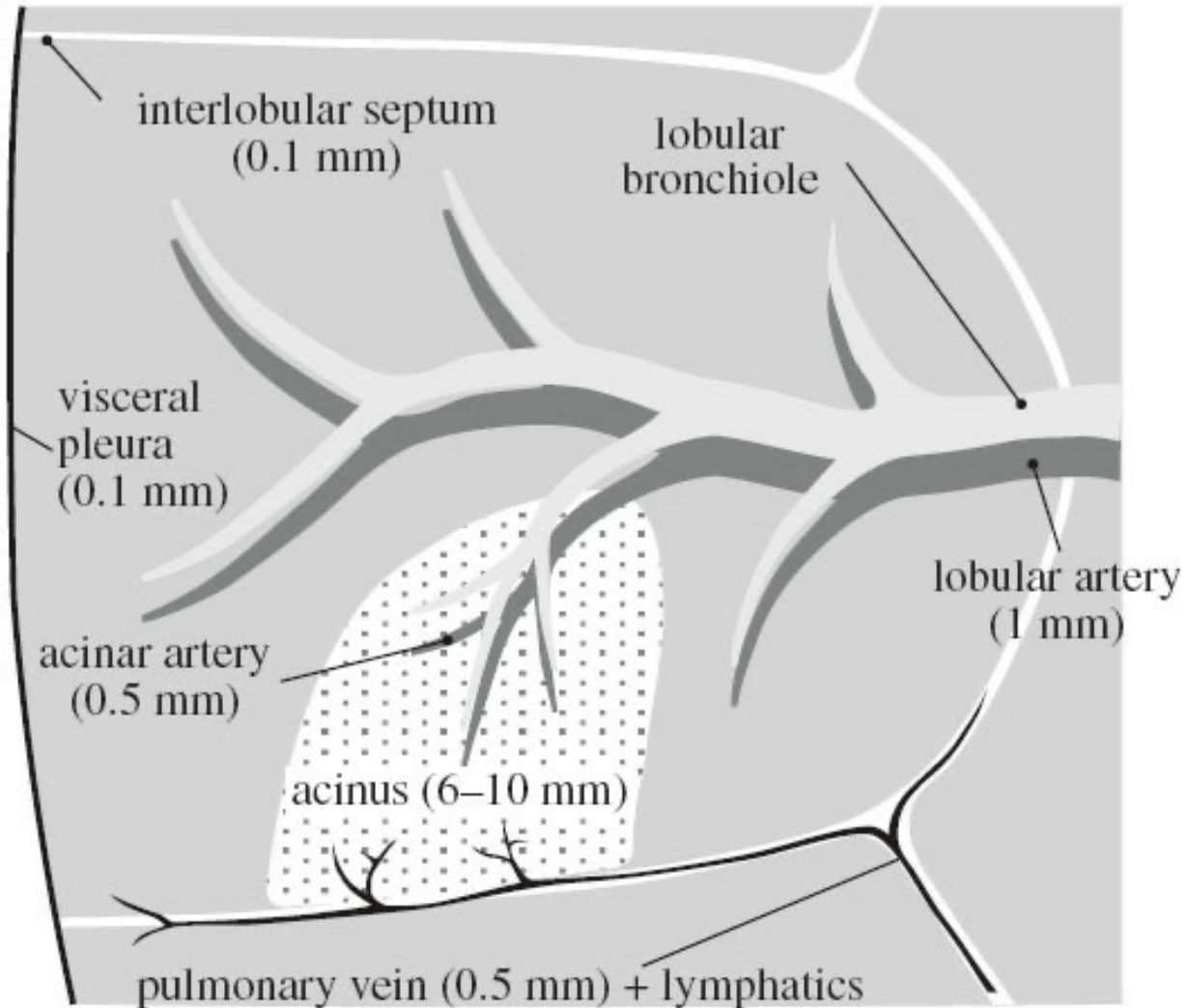
♦ „smallest visible unit in CT“

- ♦ Its own fibrous margins
- ♦ size 1 - 2 cm
- ♦ X-ray acinous shadows - 1 cm

♦ Interlobular septum

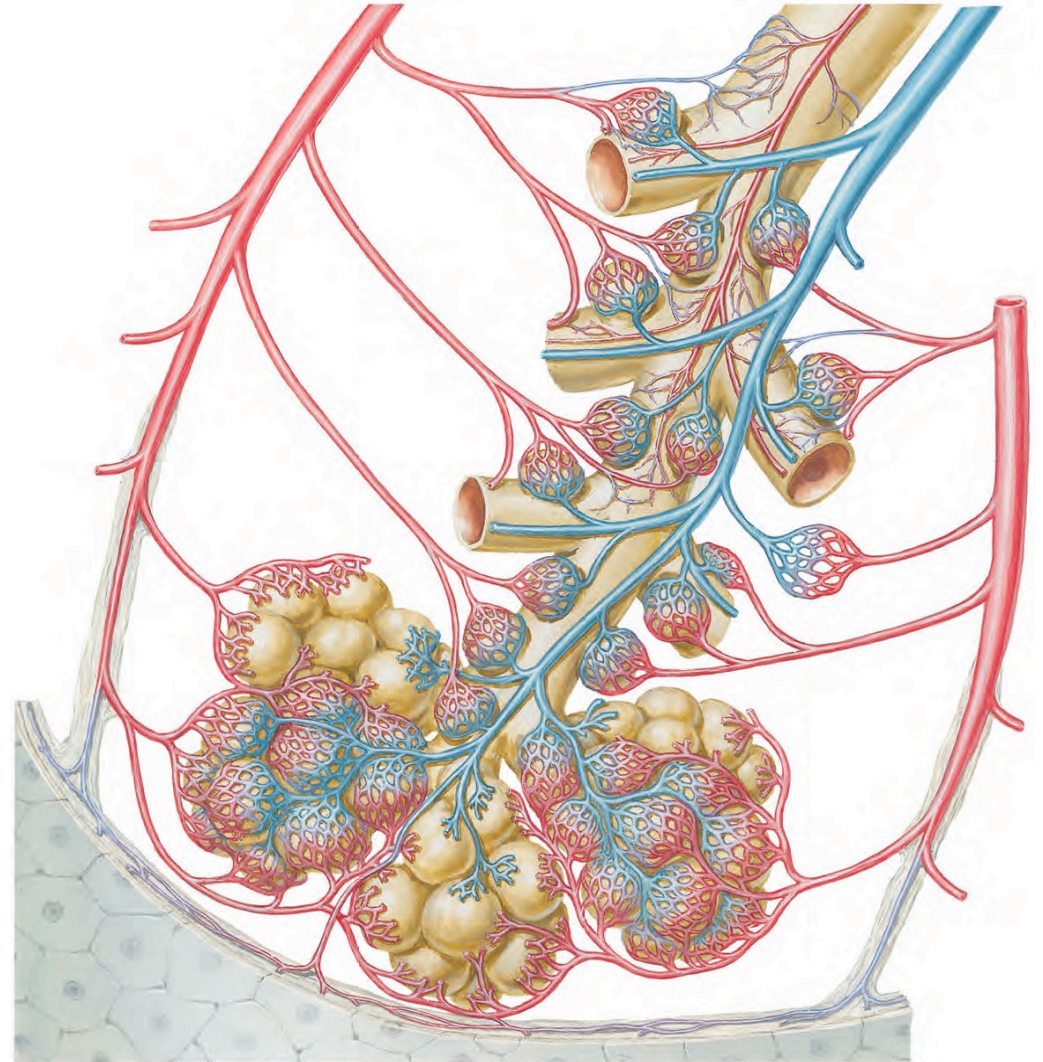
- ♦ V. pulmonalis + lymphatics
- ♦ Intralobular septa – between acini
- ♦ **Typical diseases patterns**
- ♦ *Interstitial edema*
- ♦ *Alveolar edema*
- ♦ *Interstitial fibrosis*
- ♦ *Lung inflammations*

Secondary lobulus



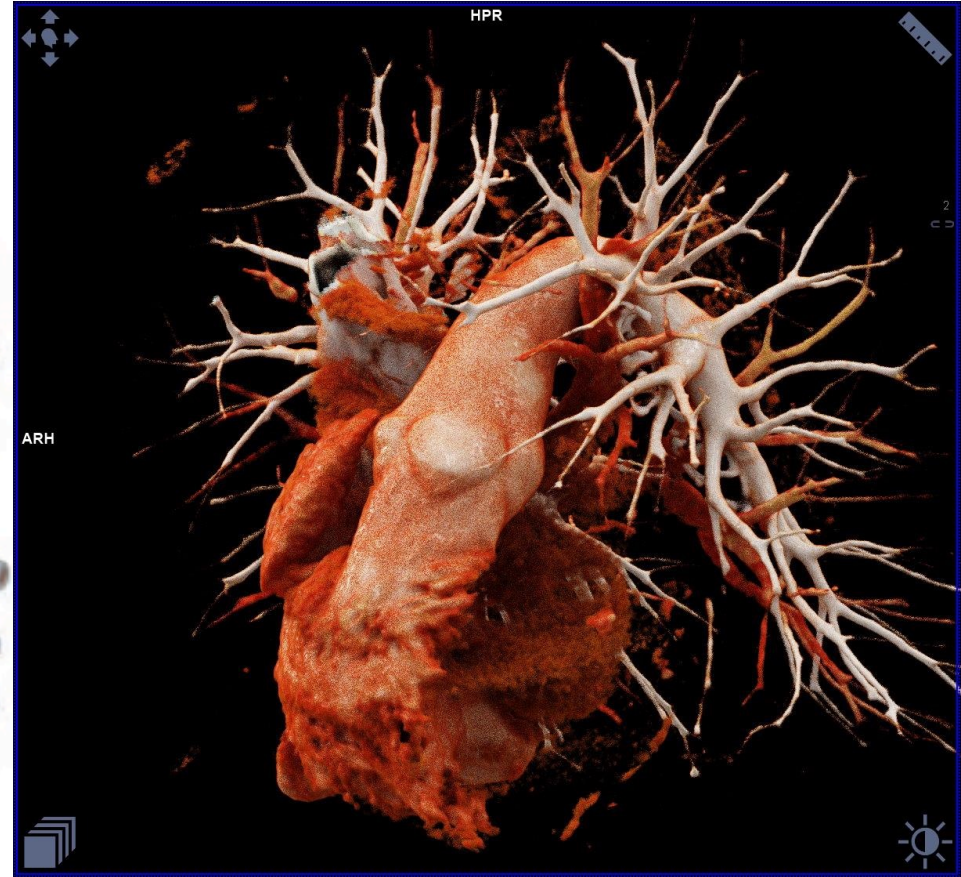
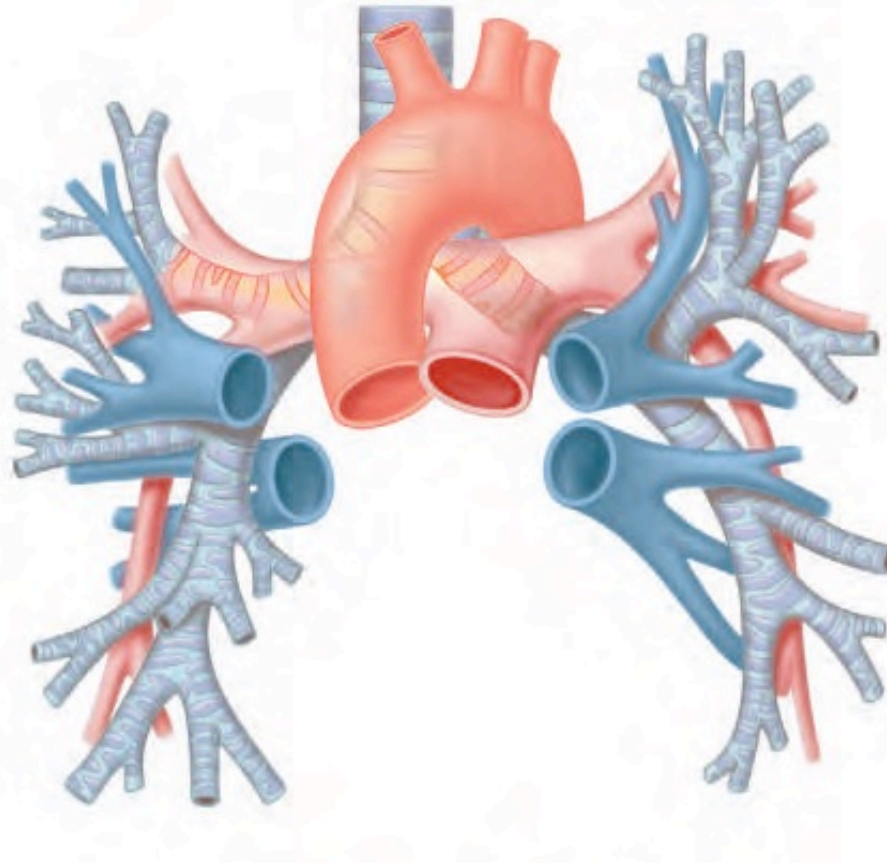
Functional blood circulation in lungs

- A. pulmonalis
- Ramus sinister
- Ramus dexter
- Rami lobares
- Rami segmentares
- Rami subsegmentales
- Rami lobulares
- Rete capillare
-
-
- V. pulmonalis



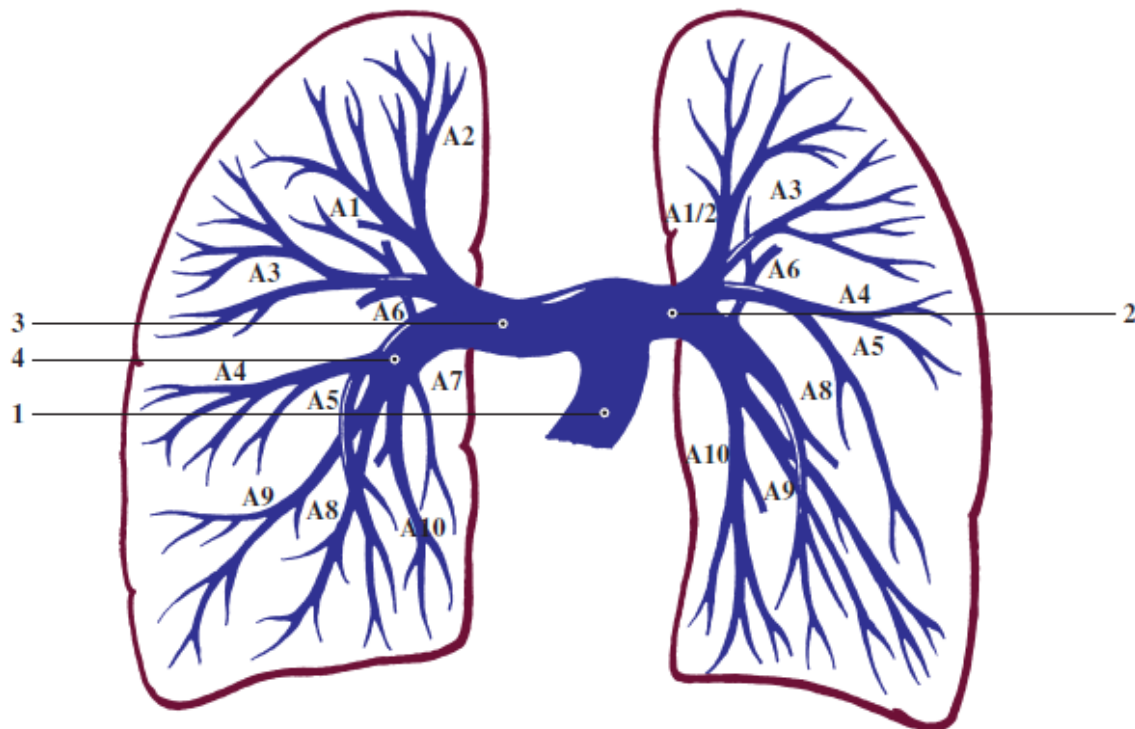
Vasa pulmonum

- ♦ **A. pulmonalis**
 - ♦ And its branches
 - ♦ Functional artery
 - ♦ De-oxygenated blood
- ♦ **Vv. pulmonales**
 - ♦ Oxygenated blood
- ♦ **Aa. bronchiales**
 - ♦ origines - aorta, intercostal arteries
 - ♦ Nutritive arteries
 - ♦ Hypertrophic in chronic lung diseases!

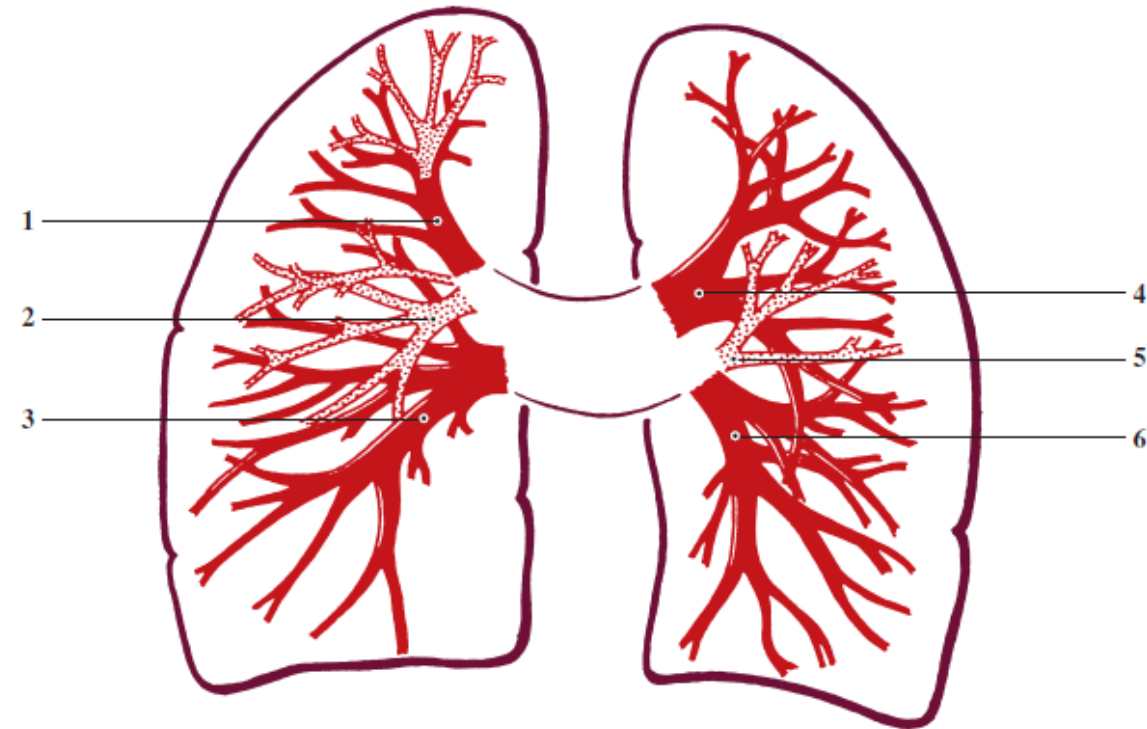


Vasa pulmonum

- 🔥 **Arteries follow the segmentary axes of lungs**
- 🔥 **Veins assembled in larger stems, with different course than arteries**
 - 🔥 **in wall of lung veins – myocytes of myocardial type**



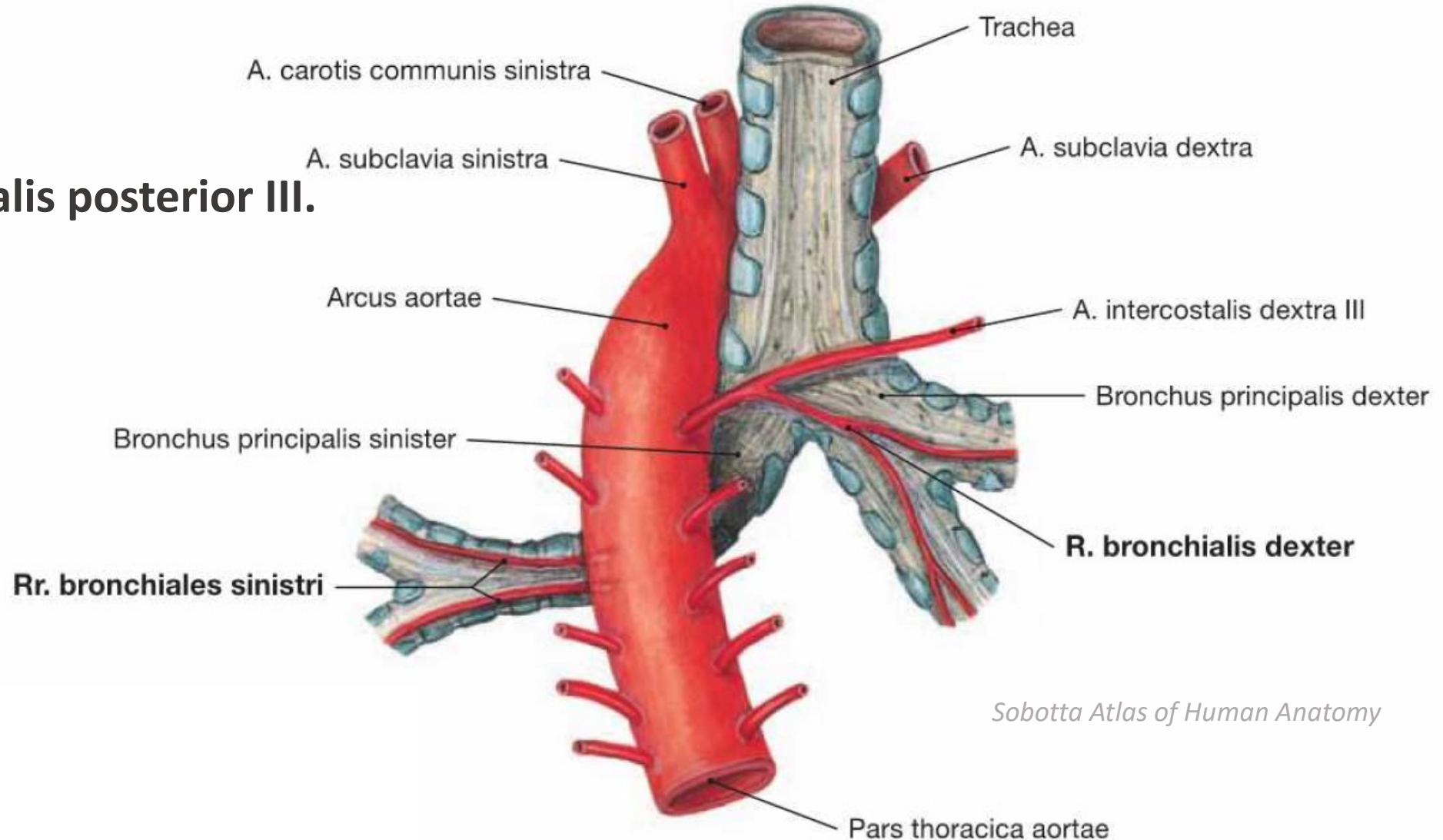
Obr. 4.1. Anatomie plicnice – schéma. 1 – a. pulmonalis – truncus; 2 – r. sinister; 3 – r. dexter; 4 – truncus intermedius; A1 až A10 – segmentární tepny



Obr. 4.2. Anatomie plicních žil – schéma. 1 – v. pulmonalis superior dextra; 2 – v. pulmonalis media dextra; 3 – v. pulmonalis inferior dextra; 4 – v. pulmonalis superior sinistra; 5 – v. pulmonalis media sinistra; 6 – v. pulmonalis inferior sinistra

Nutritive blood supply of lungs

- A. bronchialis
- Left from aorta
- Frequently two
- Right - a. intercostalis posterior III.
- bleeding
- Hemoptysis



Larynx, trachea, bronchi, lungs

Prof. MUDr. Jiří Ferda, Ph.D.