

# THYROID

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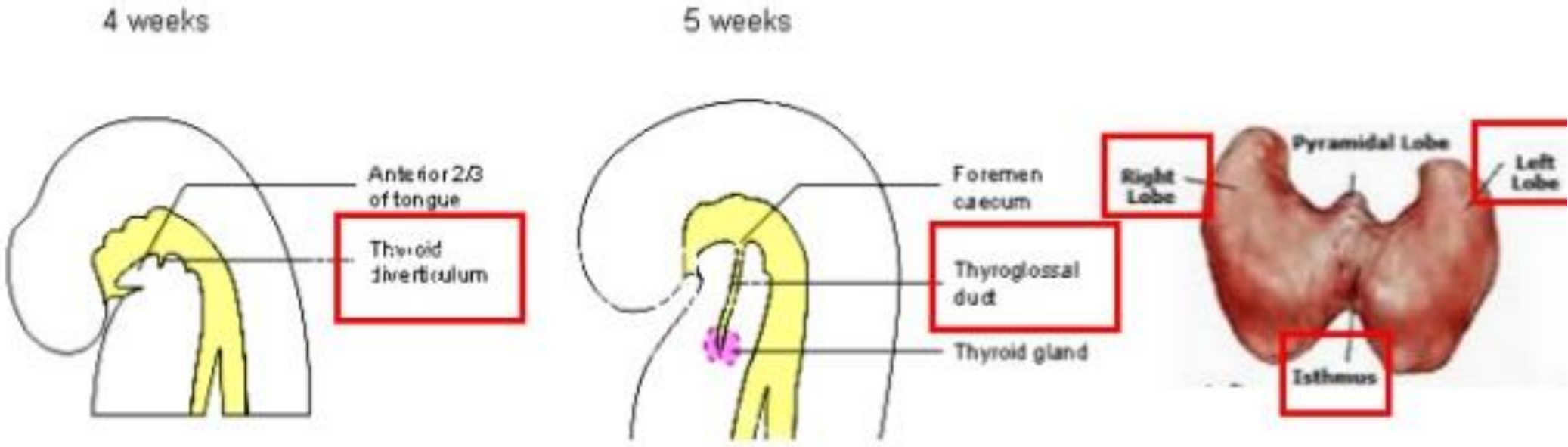
DR SUDHIR KUMAR SINGH

# Today's learning.....

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- Embryology
- Anatomy
- Physiology
- Thyroid function test
- Imaging
- Cytology

# Embryology of thyroid



# Embryology of thyroid.....

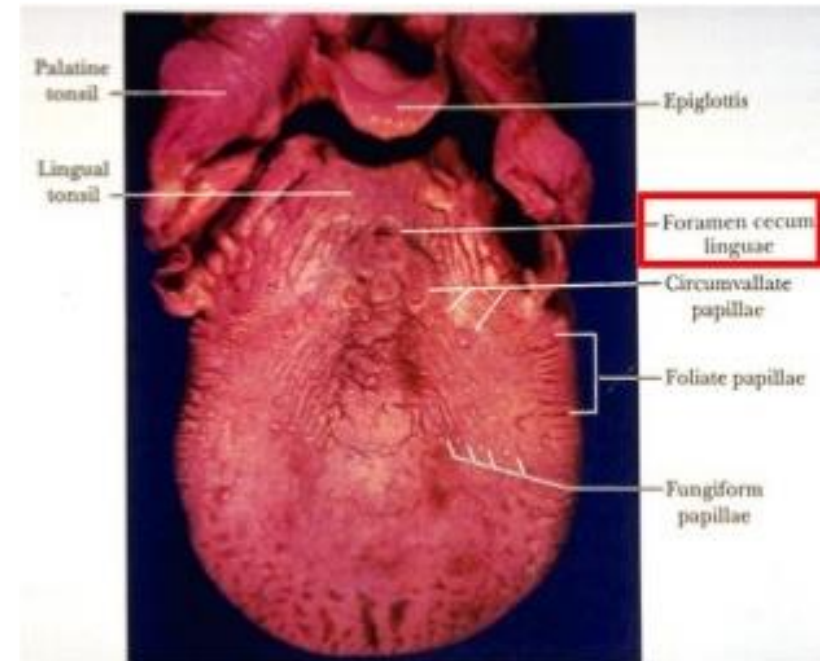
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- Arises as an endodermal diverticulum from the floor of the pharynx.
- **Week 3:** Thickening in the floor between the 1<sup>st</sup> and 2<sup>nd</sup> pharyngeal pouches.
- Week 4: Endoderm evaginates ventrally (into the mesoderm) to form the thyroid diverticulum.
- **Week 5:**
  - Formation of thyroglossal duct.
  - Bifurcation on the tip of Thyroglossal duct forms isthmus and the lateral lobes of the gland.
- Weeks 5-6: Growth of duct down to the neck, migration down to the neck.
- **Week 7:** Final position in relation to the larynx and the trachea.

# Important facts related to thyroid

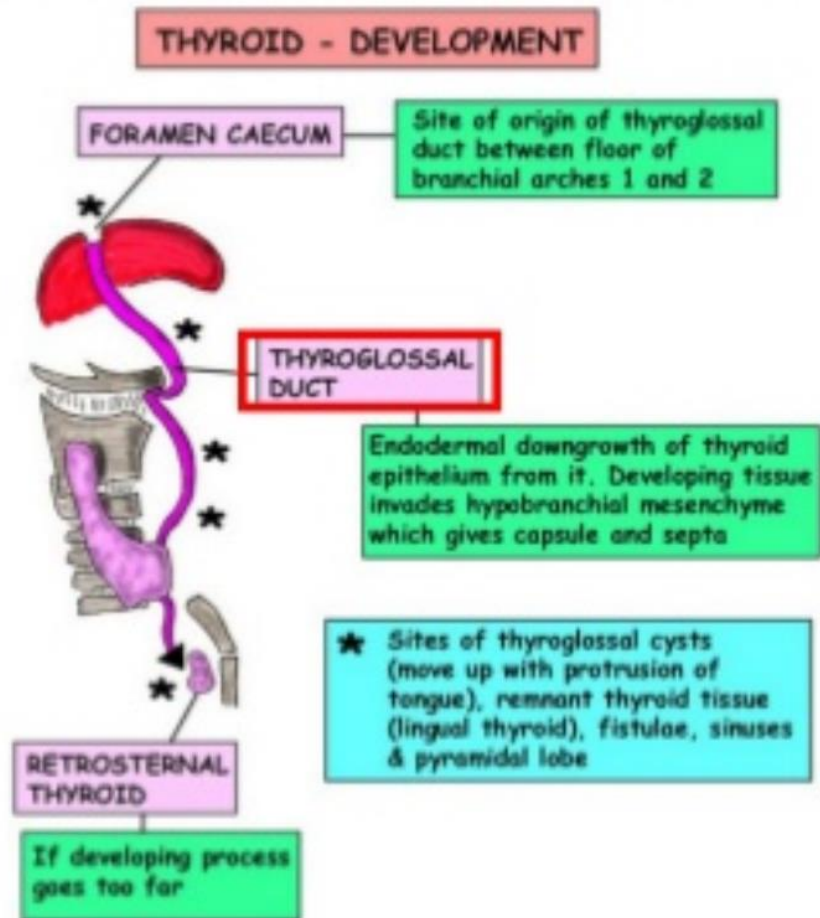
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- Thyroid tissue migrates inferiorly
- The duct portion begins to involute
- Site of connection thyroglossal duct with pharynx-  
“*Foramen Caecum*”



# Important facts related to thyroid.....

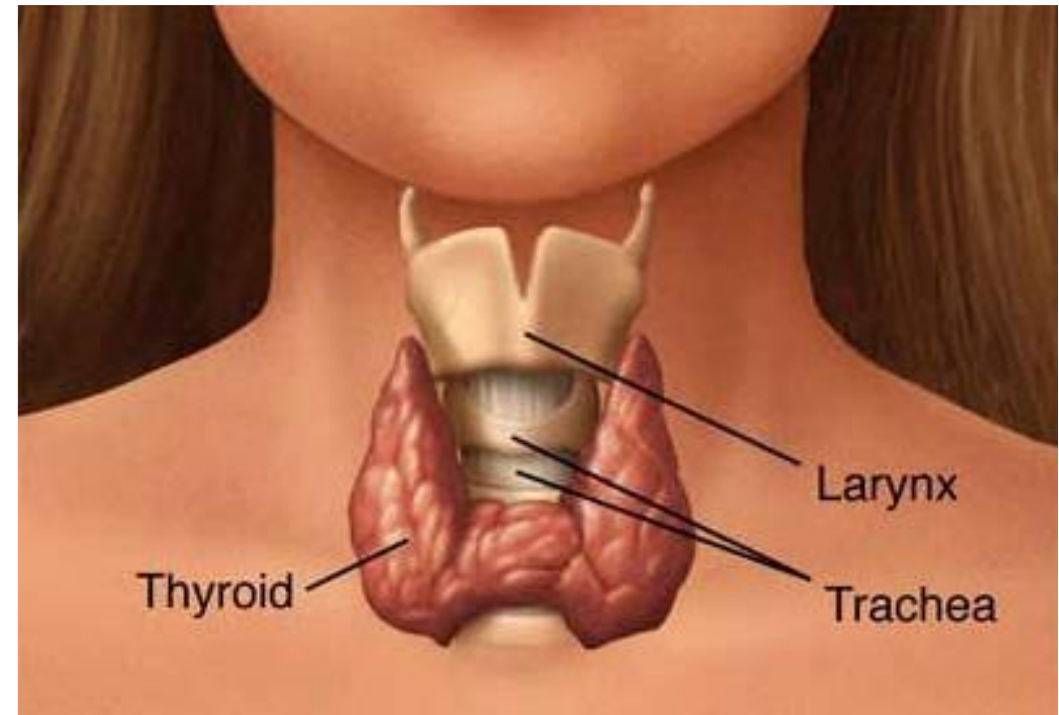
- Distal part of the thyroglossal duct may develop “Pyramidal Lobe”.
- Thyroid gland may develop in any part at the midline of the thyroglossal duct.
  - lingual, suprahyoid, retrohyoid or infrahyoid positions.
- Thyroid gland is relatively large in newborn babies.



# Anatomy of thyroid

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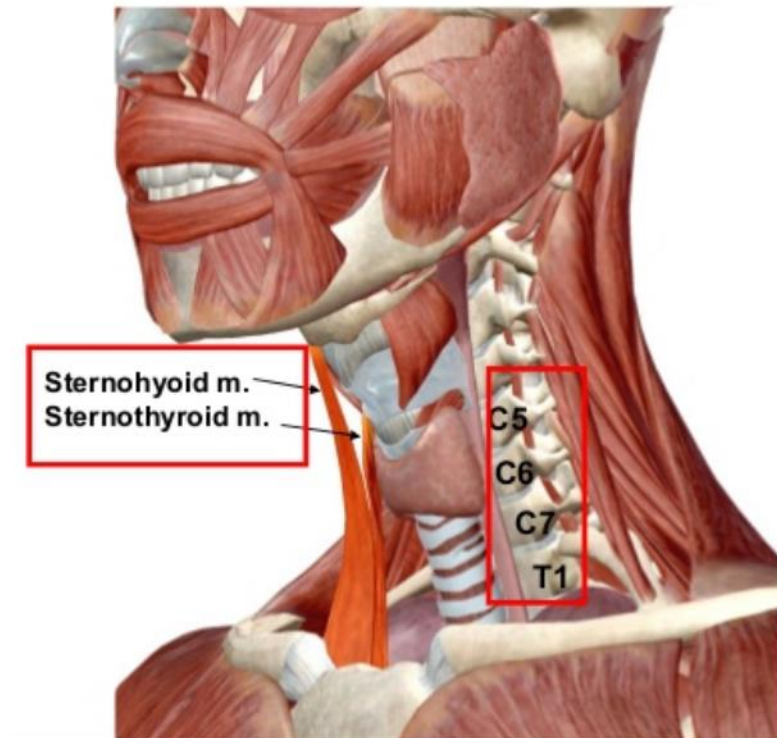
- Normal thyroid gland weighs about 15-25 g in adults.
- “Butterfly” in shape.
- Two lobes:
  - Consists of right and left lobes
  - Anterolateral to the larynx and trachea
- Thin isthmus unites the lobes over the trachea.



# Anatomy of thyroid.....

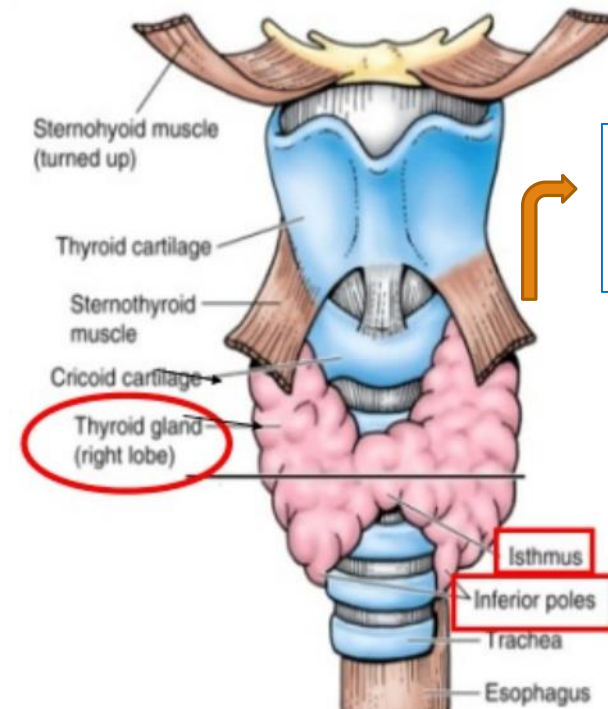
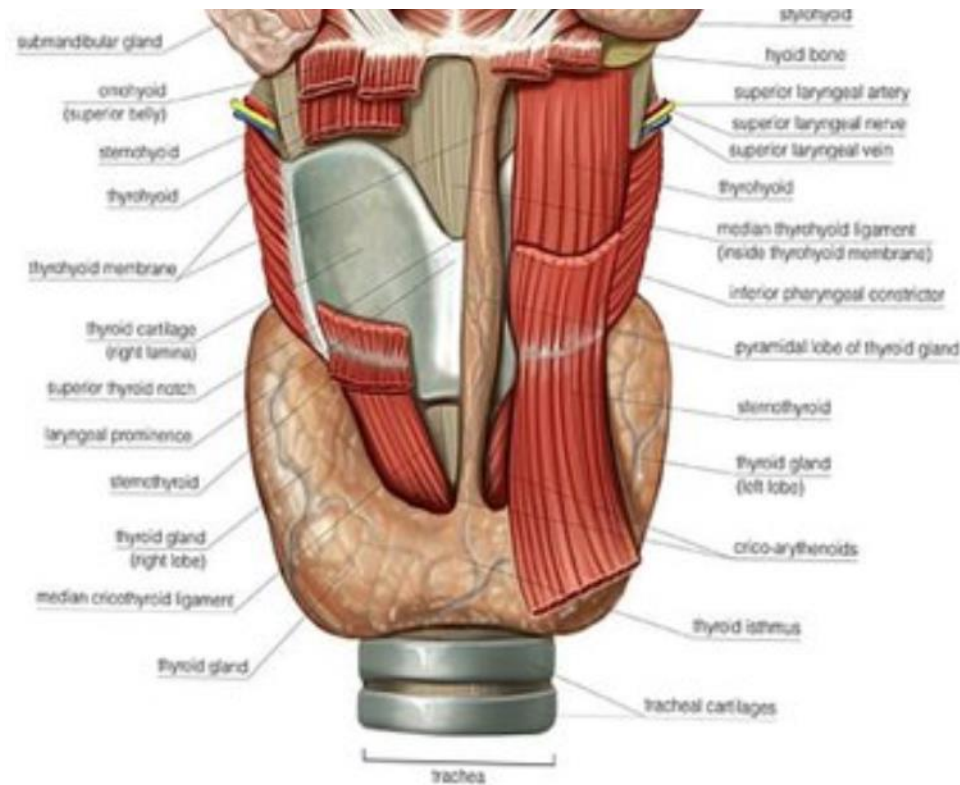
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- Anteriorly in the neck at the level of the **C5 -T1** vertebrae.
- Deep to the sternothyroid and sternohyoid muscles
- Superior pole-
  - Lateral to inferior constrictor muscle and cricothyroid muscle.
  - At the level of 1<sup>st</sup> tracheal ring.
- Inferior pole-
  - Extends up to the level of 5th or 6th tracheal rings





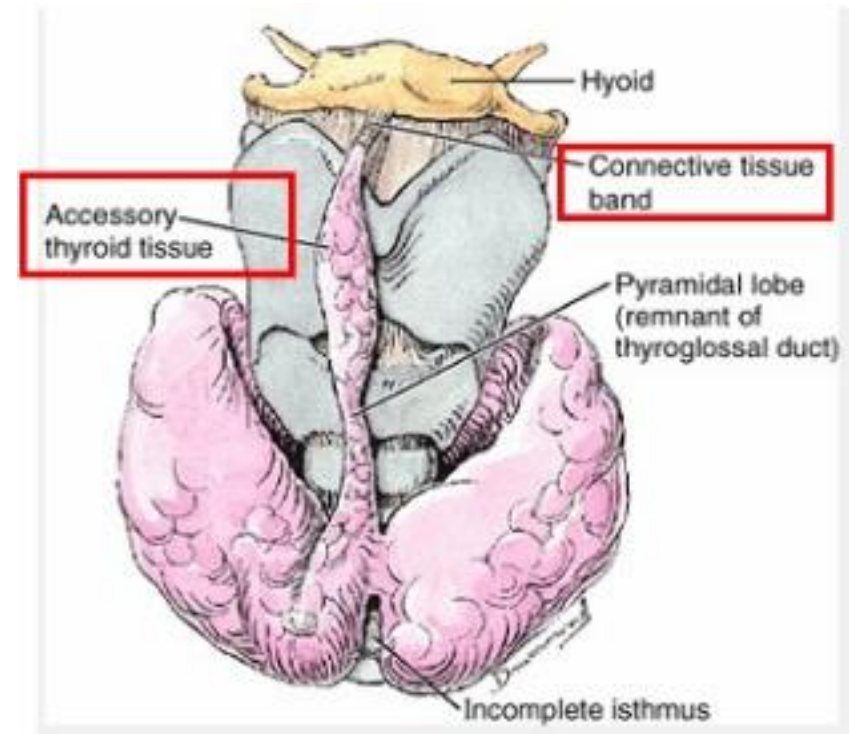
# Anatomy of thyroid.....



Surgical importance:  
Thyroid swelling never  
moves upward

# Anatomy of thyroid.....

- Pyramidal lobe:
  - ~50% of thyroid glands.
  - Extends superiorly from the isthmus.
- “*Levator glandulae thyroideae*”:
  - Fibrous tissue connecting pyramidal lobe with hyoid bone.
- Accessory thyroid tissue
  - A band of connective tissue, often containing accessory thyroid tissue, may continue from the apex of the pyramidal lobe.
  - Surgical importance.



# Anatomy of thyroid.....

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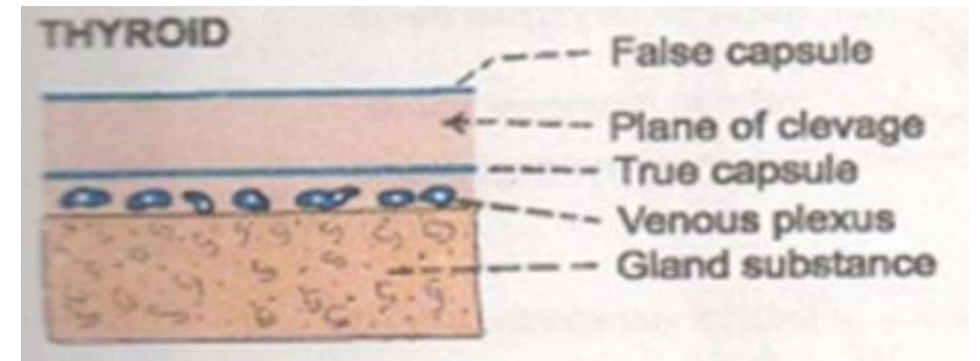
## ■ Thyroid Gland Capsule:

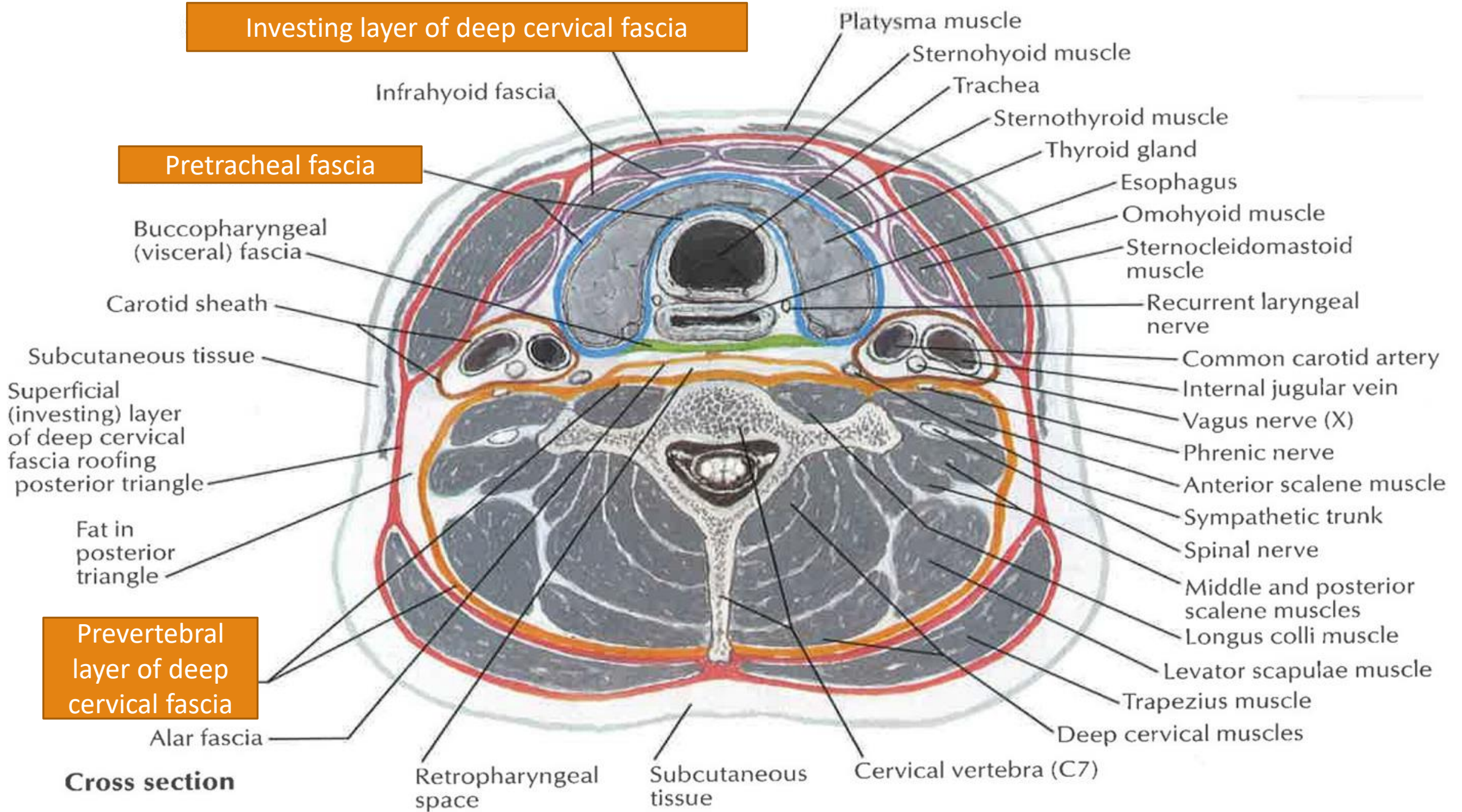
### ➤ True capsule:

- A thin fibrous capsule, which sends septa deeply into the gland.
- Divides the thyroid tissue into microscopic lobules.

### ➤ False/ Surgical capsule:

- External to the true capsule.
- A loose sheath formed by the visceral portion of the pre-tracheal layer of deep cervical fascia.





Investing layer of deep cervical fascia

Pretracheal fascia

Prevertebral layer of deep cervical fascia

Cross section

Platysma muscle

Sternohyoid muscle

Trachea

Sternothyroid muscle

Thyroid gland

Esophagus

Omohyoid muscle

Sternocleidomastoid muscle

Recurrent laryngeal nerve

Common carotid artery

Internal jugular vein

Vagus nerve (X)

Phrenic nerve

Anterior scalene muscle

Sympathetic trunk

Spinal nerve

Middle and posterior scalene muscles

Longus colli muscle

Levator scapulae muscle

Trapezius muscle

Deep cervical muscles

Infrahyoid fascia

Buccopharyngeal (visceral) fascia

Carotid sheath

Subcutaneous tissue

Superficial (investing) layer of deep cervical fascia roofing posterior triangle

Fat in posterior triangle

Retropharyngeal space

Subcutaneous tissue

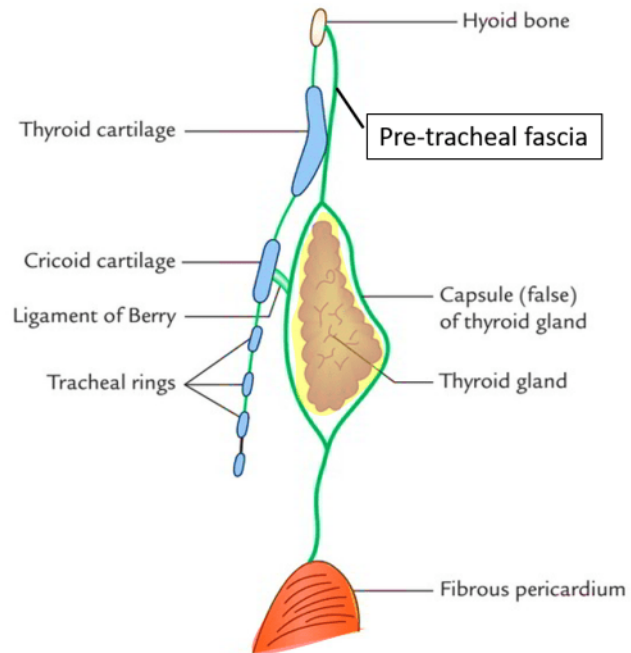
Cervical vertebra (C7)

Alar fascia

# Anatomy of thyroid.....

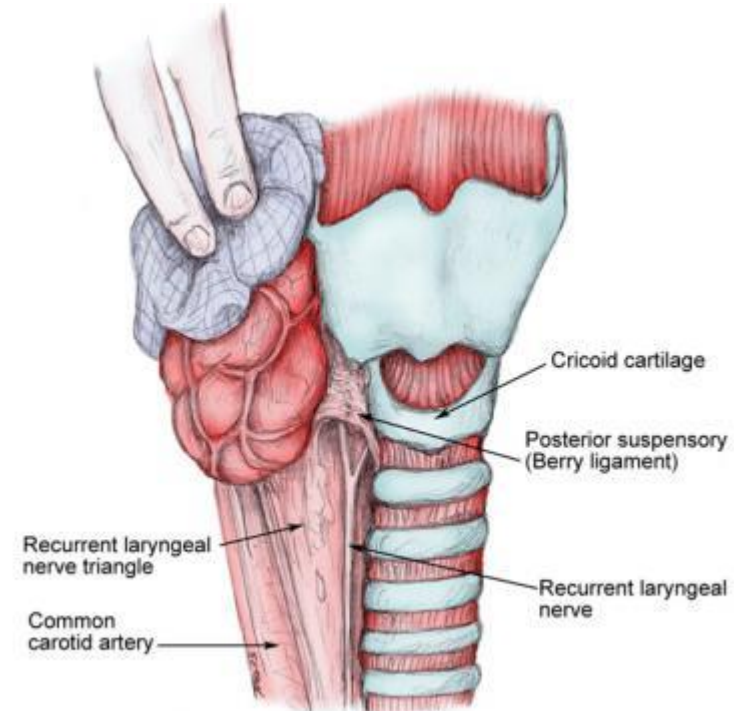
## ■ Ligament of berry:

- Formed from thickened pre-tracheal fascia
- On the inner surface of the gland
- Connect gland to cricoid cartilage



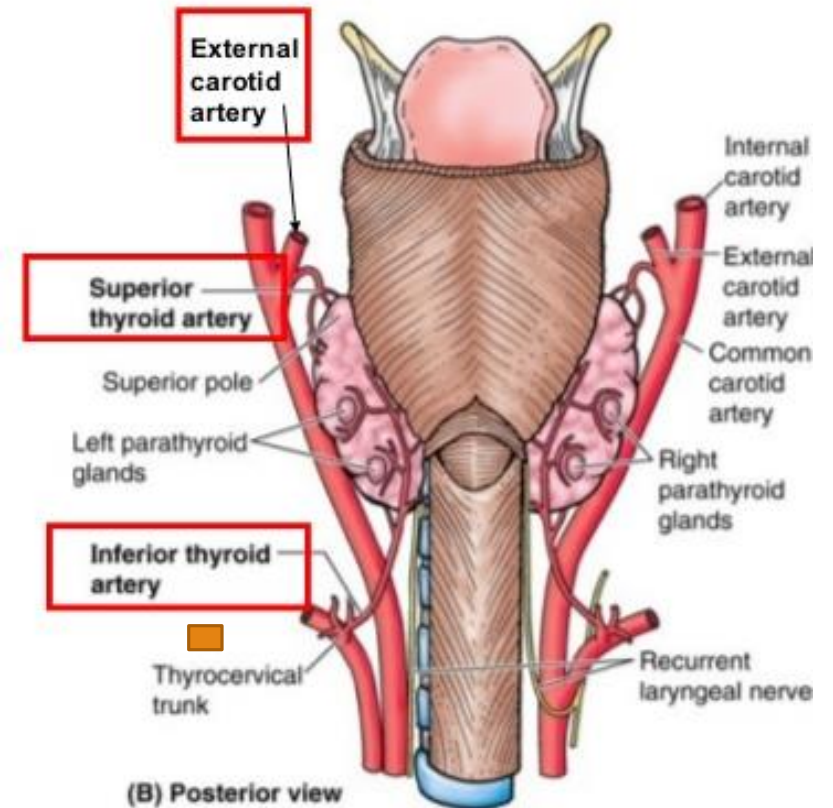
## ■ Surgical importance:

- RLN often passes through this ligament.
- Also contains the terminal branches of inferior thyroid artery.



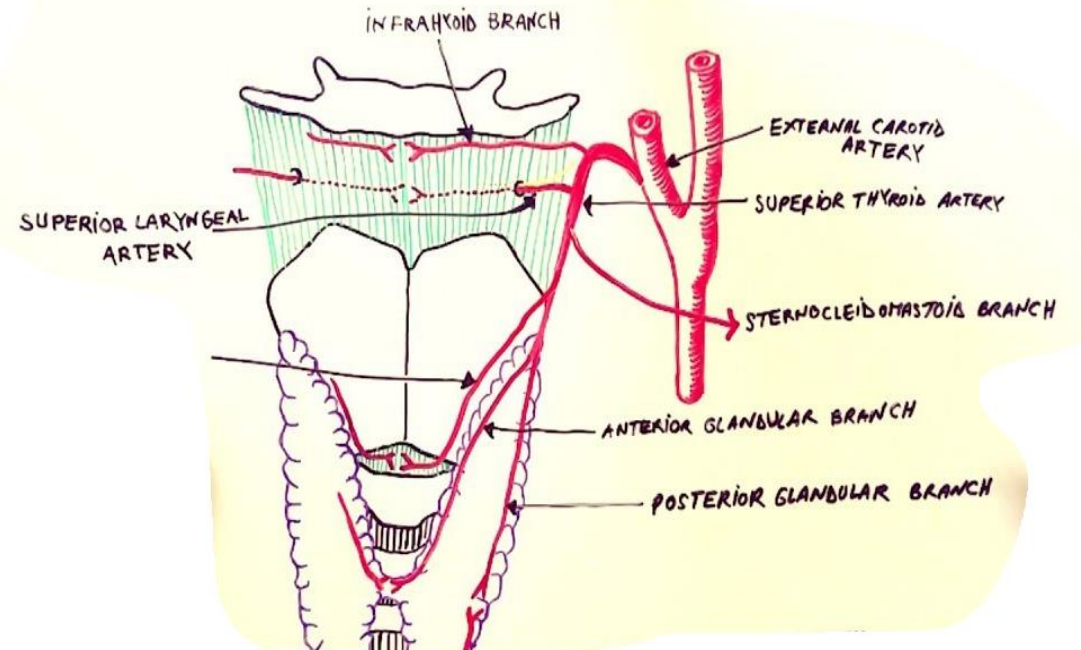
# Anatomy of thyroid.....

- Arteries of the Thyroid Gland:
  - Highly vascular.
  - Supplied by:
    - Superior thyroid arteries.
    - Inferior thyroid artery.
  - Vessels lie between the fibrous capsule and loose fascial sheath.



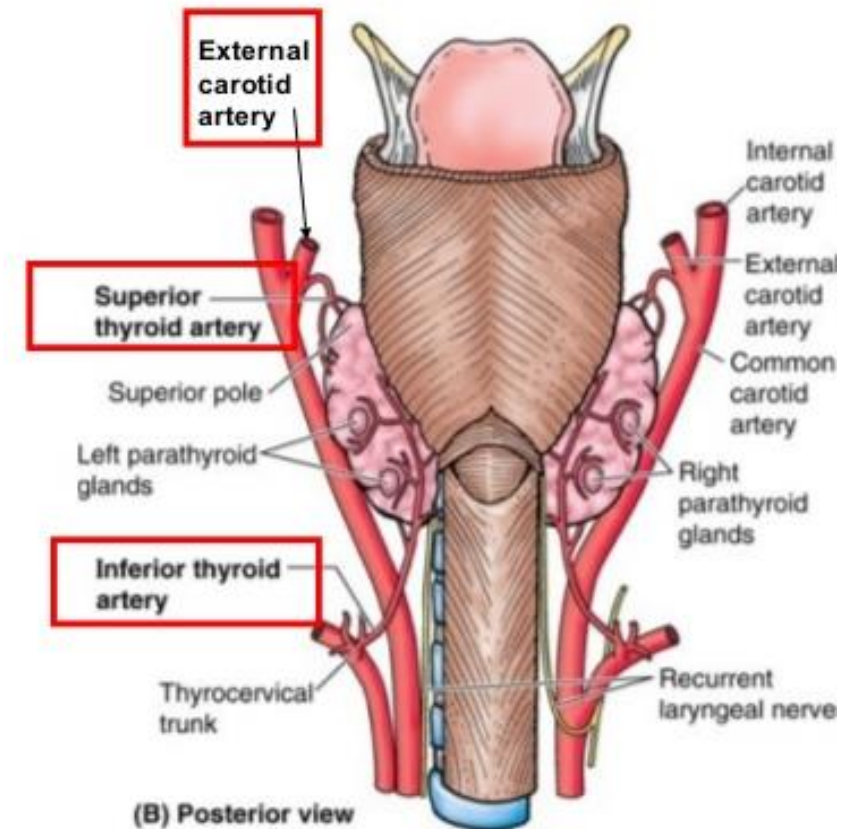
# Anatomy of thyroid.....

- Superior thyroid artery (STA):
  - Descend to the superior poles of the gland.
  - Pierce the pre-tracheal layer of deep cervical fascia.
  - Divide into anterior and posterior branches.



# Anatomy of thyroid.....

- Inferior thyroid arteries (ITA):
  - Branches of the thyrocervical trunks.
  - Run supero-medially posterior to the carotid sheaths to reach the posterior aspect of the gland.
  - Supply postero-inferior aspect with inferior poles of the gland.
- Right and left STA and ITA arteries form anastomoses within the gland.

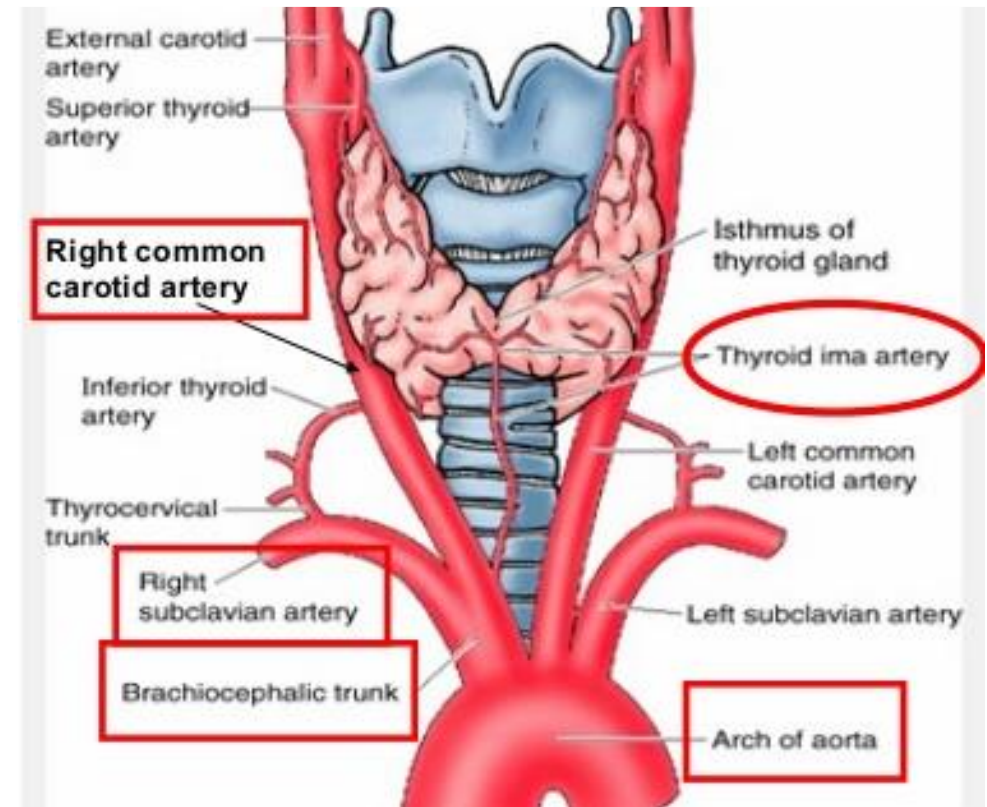




# Anatomy of thyroid.....

## ■ Thyroid Ima Artery:

- Approx. 10% of people have small unpaired thyroid ima artery
- Possible sources of Ima artery:
  - Branch of brachiocephalic trunk
  - Arch of the aorta
  - Right common carotid/subclavian/internal thoracic arteries
- Ascends on the anterior surface of the trachea and continues to the thyroid isthmus.
- Presence of this artery must be considered before tracheotomy (as a potential source of bleeding!)

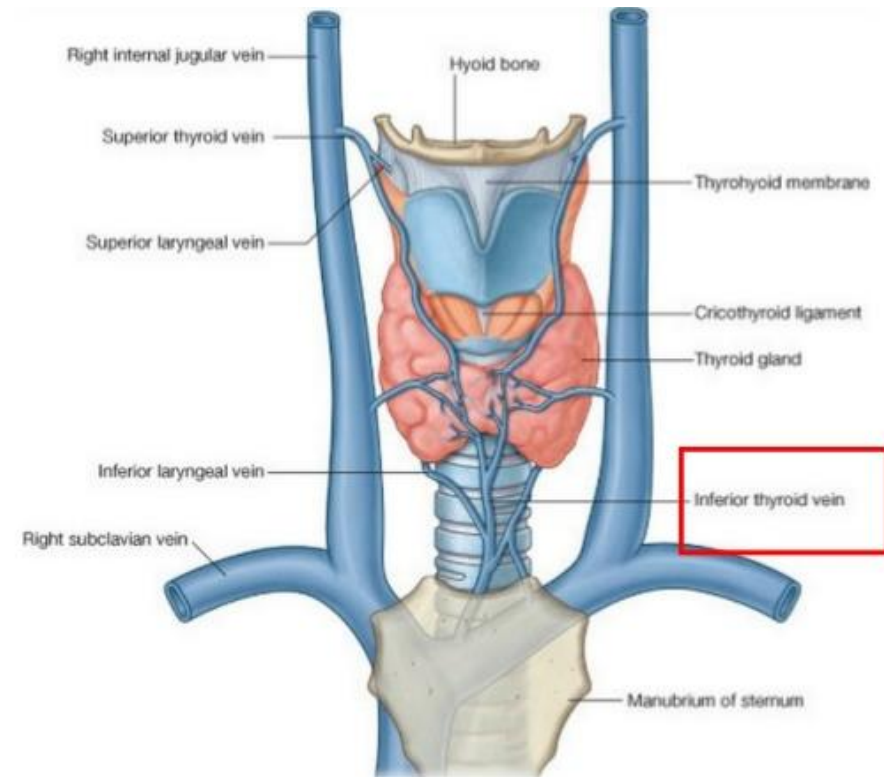


# Anatomy of thyroid.....

## ■ Veins of the Thyroid Gland:

➤ Form thyroid plexus of veins on the anterior surface of the thyroid gland- Three pairs of thyroid veins (superior, middle, inferior)

1. Superior thyroid veins- accompany the STA.
2. Middle thyroid veins- do not accompany but run essentially parallel courses with the ITA.
3. Inferior thyroid veins- accompany the thyroid ima artery (if artery is present)



# Anatomy of thyroid.....

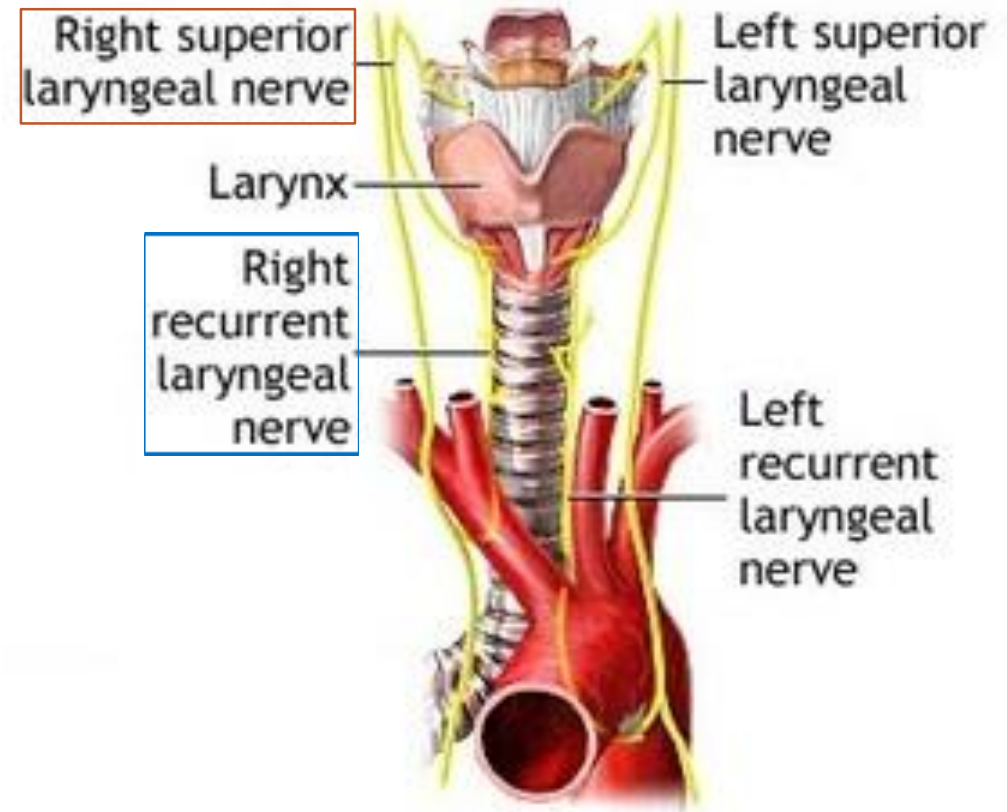
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- Important nerves:

- Superior Laryngeal Nerve (SLN)

- Two branches- internal and external

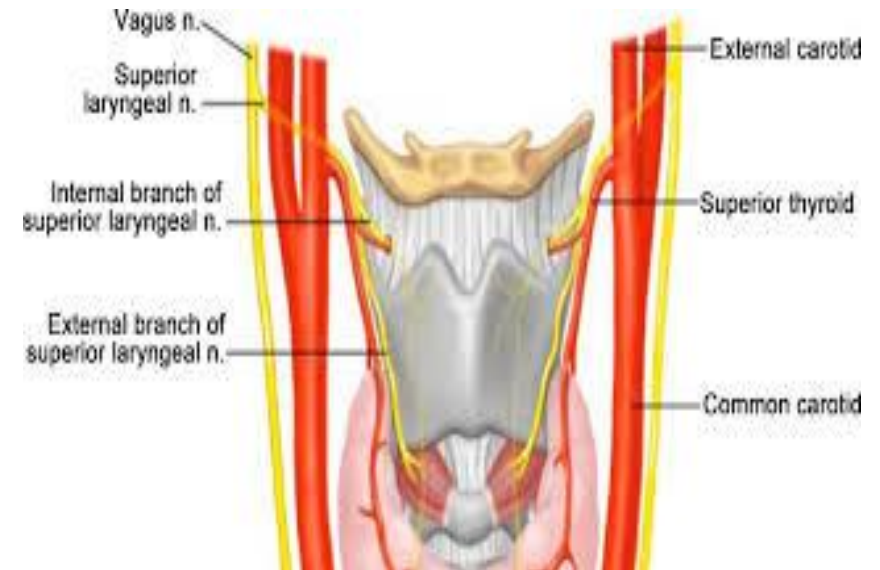
- Recurrent Laryngeal Nerve (RLN)



# Anatomy of thyroid.....

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- Superior laryngeal nerve:
  - Originates at the inferior ganglion of vagus nerve.
  - Average length of SLN is about 1.5 to 2 cm.
  - Courses:
    - Posterior and medial to the internal carotid artery.
    - Descends antero-inferiorly to reach the larynx.
  - At the level of Greater Cornu of hyoid bone it divides:
    - Large- Internal laryngeal branch.
    - Smaller- External laryngeal branch.

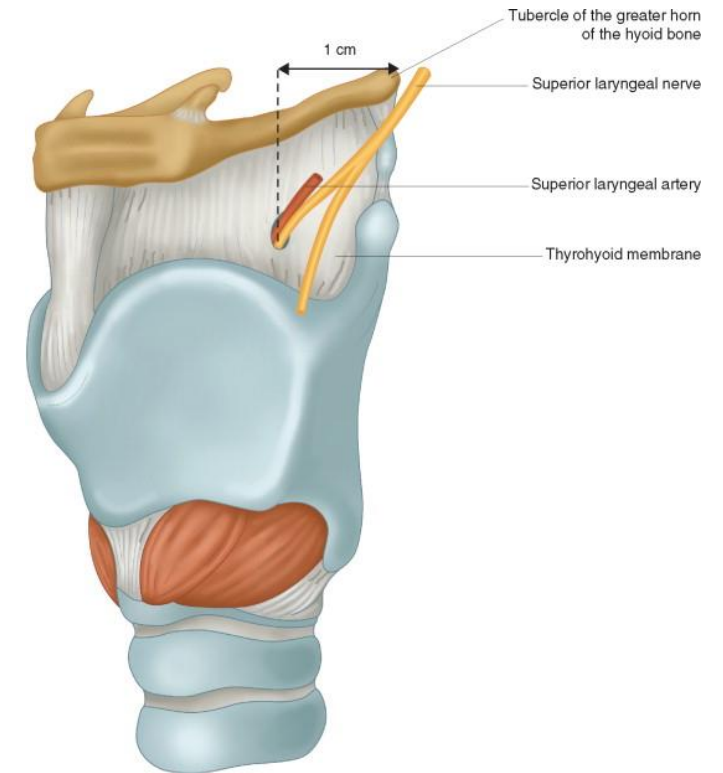


# Anatomy of thyroid.....

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## ■ Internal Laryngeal Nerve:

- Passes between thyrohyoid muscle and the thyrohyoid membrane.
- Pierces the thyrohyoid membrane along with superior laryngeal artery and vein.
- After entering into the larynx this nerve divides into three branches i.e. superior, middle and inferior.
- Supply sensation to:
  - Interior of larynx.
  - Supraglottis and pyriform sinus.



# Anatomy of thyroid.....

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- Internal Laryngeal Nerve:

- Superior division divides into 2-3 branches supplying sensations to

- Lingual surface of epiglottis, lateral aspect of glosso-epiglottic fold.

- Middle division innervates

- Aryepiglottic fold, vocal folds, vestibular folds and the posterior aspect of arytenoid.

- Inferior division

- The largest of the branches of superior laryngeal nerve.

- It lies along the medial aspect of pyriform fossa.

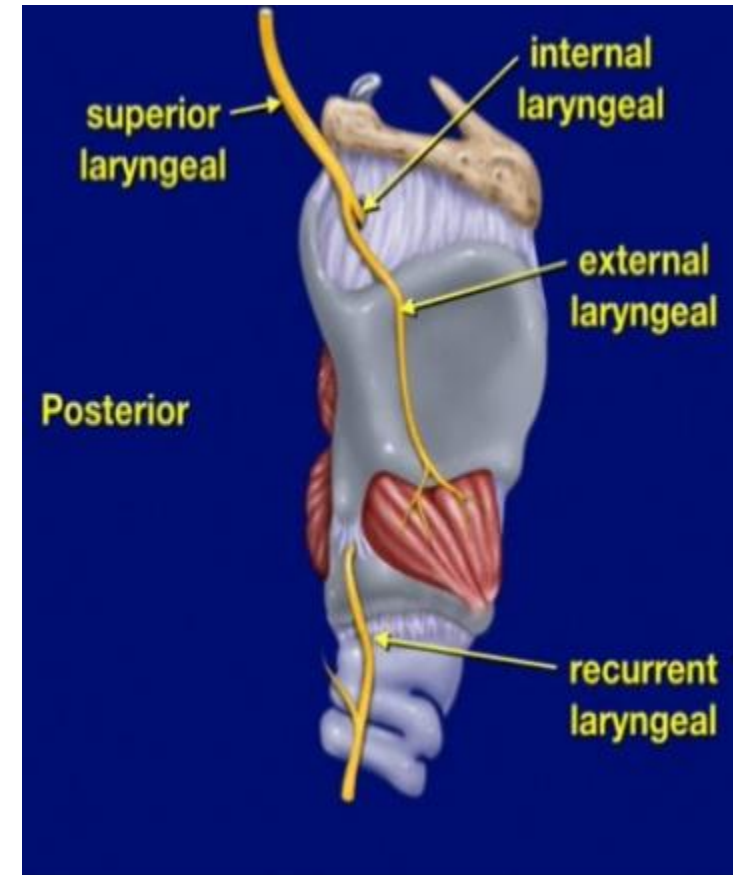


# Anatomy of thyroid.....

- External laryngeal nerve

- Course:

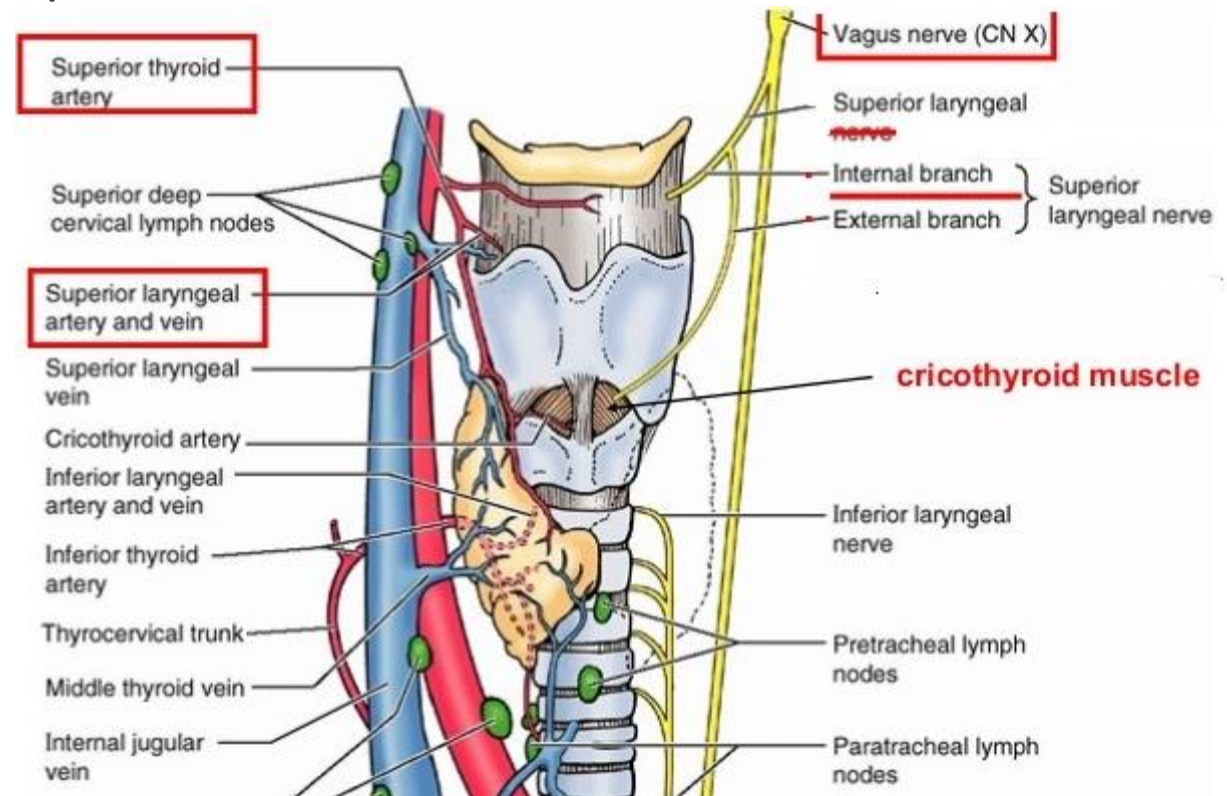
- At the level of superior horn of thyroid cartilage turns medially.
    - And runs posterior and parallel to the oblique line.
    - Lies deep to the STA.
    - Relationship with the superior pole of thyroid gland is highly variable.



# Anatomy of thyroid.....

- Anatomical Relationships between STA and External Branch of SLN:

- Closely related to external laryngeal nerve at its origin.
- Nerve moves away from the artery as artery approaches the upper pole of the gland.





# Anatomy of thyroid.....

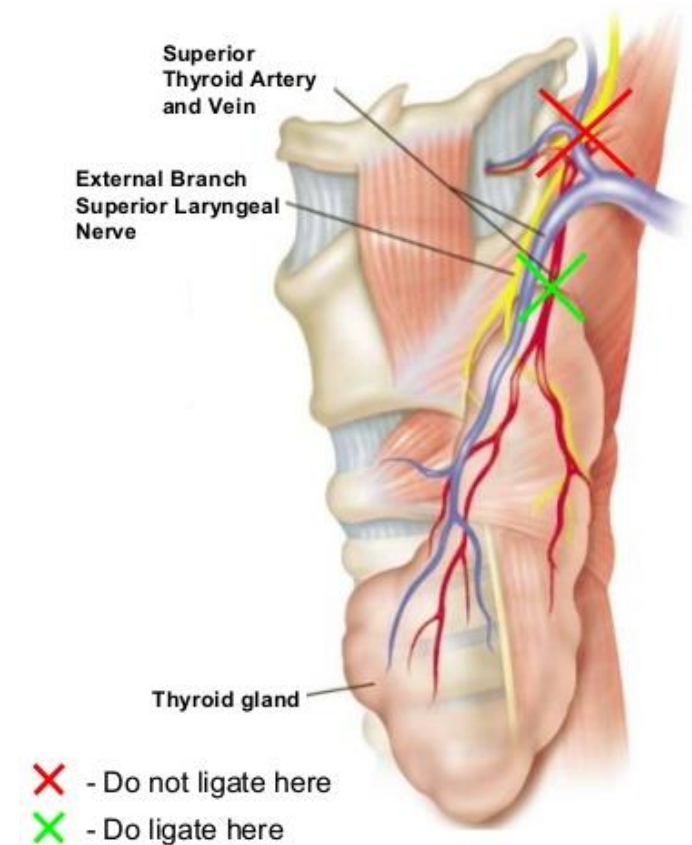
- In order to avoid injury of External Laryngeal Nerve:

- STA need to be ligated just near the superior pole.

- Complication:

- Superior laryngeal nerve injury:

- Paralysis of the cricothyroid muscle.
- Changes in the pitch of the voice.
- Inability to make explosive sounds.
- Bilateral injury presents as a tiring and hoarse voice.

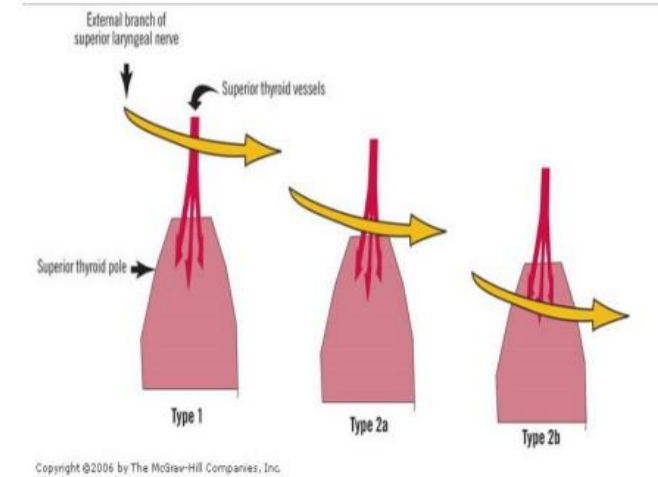


# Anatomy of thyroid.....

## ■ Relationship of the EB-SLN and STA:

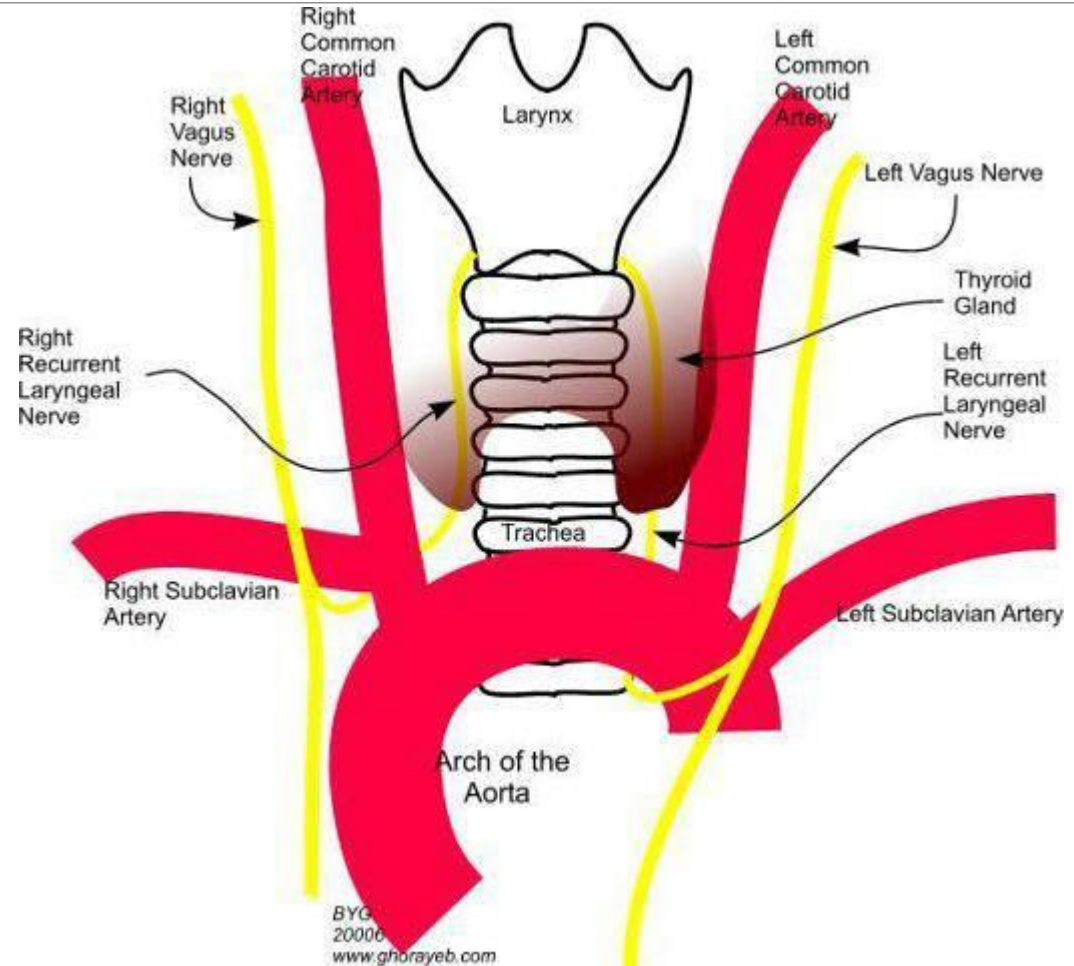
➤ Originally described by Cernea And Colleagues.

- Type 1 anatomy- nerve crosses the artery  $\geq 1$  cm above the superior aspect of the thyroid lobe.
- Type 2 anatomy-
  - 2a- nerve crosses the artery  $<1$  cm above the thyroid pole
  - 2b- nerve crosses the artery  $<1$  cm below the thyroid pole



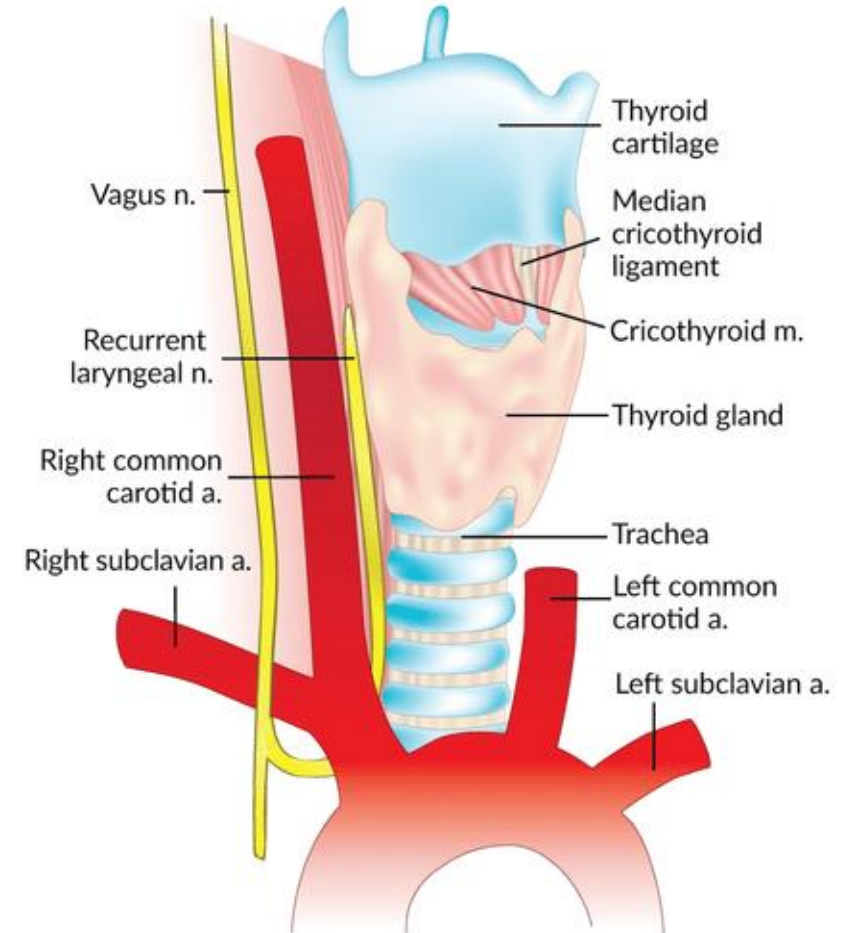
# Anatomy of thyroid.....

- RLN- Always asymmetric.



# Anatomy of thyroid.....

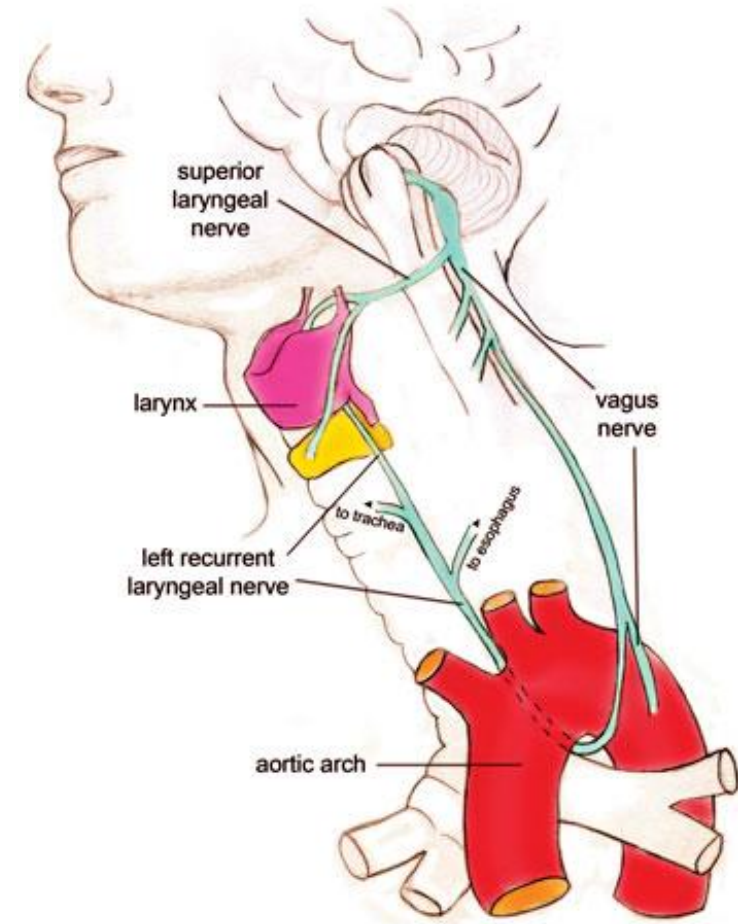
- Right recurrent laryngeal nerve:
  - Arises from vagus in the chest.
  - Reaches neck by crossing anterior to right subclavian artery.
  - Loops around Right subclavian artery to reach the trachea-oesophageal groove.
  - Ascends posterior to thyroid gland.
  - Enters the larynx behind the cricothyroid articulation and inferior cornua of thyroid.



# Anatomy of thyroid.....

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- Left recurrent laryngeal nerve:
  - Arises from vagus in the chest.
  - Crosses the arch of aorta to reach the neck.
  - Ascends posterior to gland to reach the trachea-oesophageal groove.



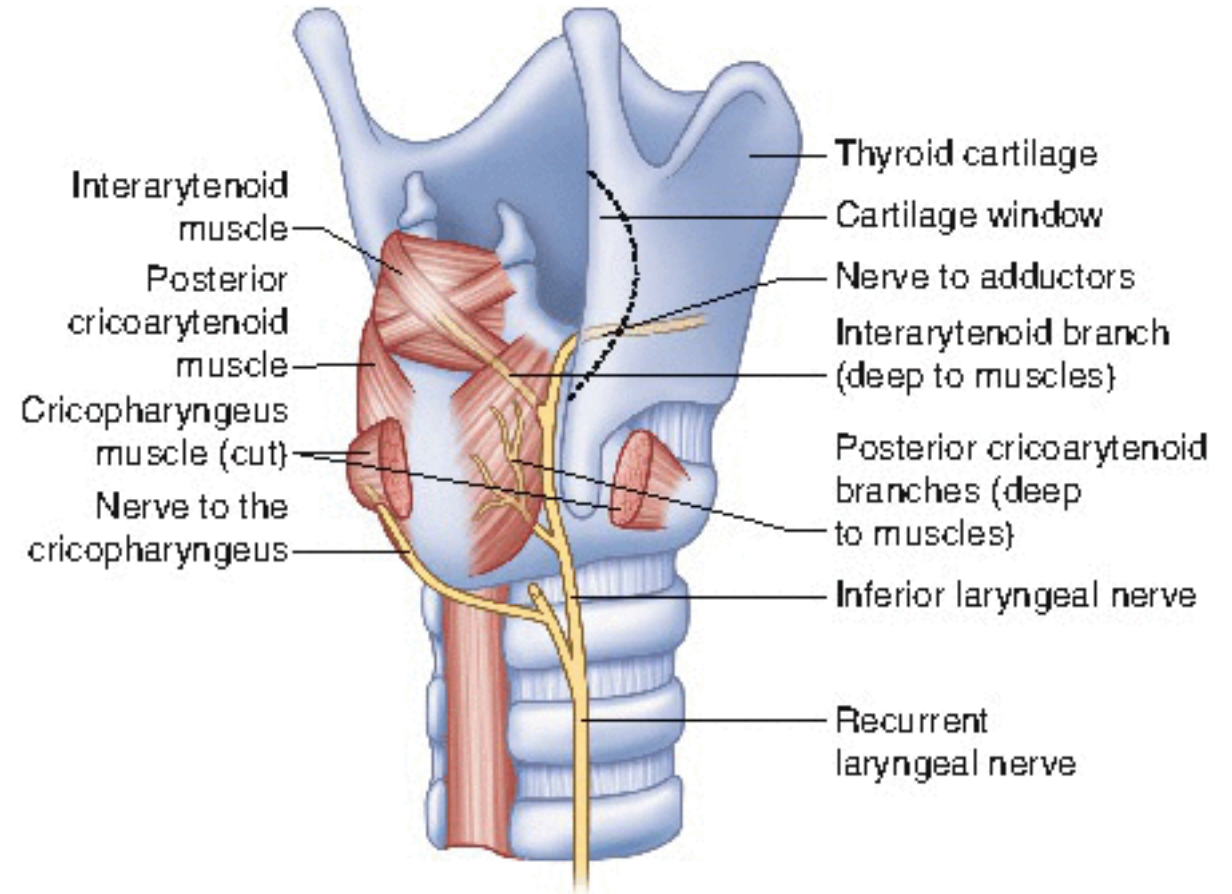
# Anatomy of thyroid.....

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- Major difference in course between Right and Left RLN:
  - Loops around- subclavian and aortic arch respectively
  - In lower part- left RLN is more closely related to the trachea than right side.
  - In middle part of the course- RLN is found within the trachea-oesophageal groove commonly.
  - At the lower pole of thyroid gland- right nerve is slightly more anterior than the left.

# Anatomy of thyroid.....

- Motor supply of RLN:



# Anatomy of thyroid.....

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- Relationship of RLN to the ITA



1) Nerve in tracheoesophageal groove R: 64% L: 77%



2) Nerve lateral to trachea R: 28% L: 17%



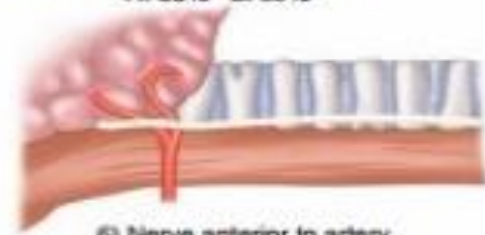
3) Nerve far anterior R: 8% L: 6%



4) Nerve between branches of inferior thyroid artery R: 7% L: 67%



5) Nerve posterior to artery R: 53% L: 69%



6) Nerve anterior to artery R: 37% L: 24%



# Anatomy of thyroid.....

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- Intraoperative localization of nerves:

- EB-SLN:

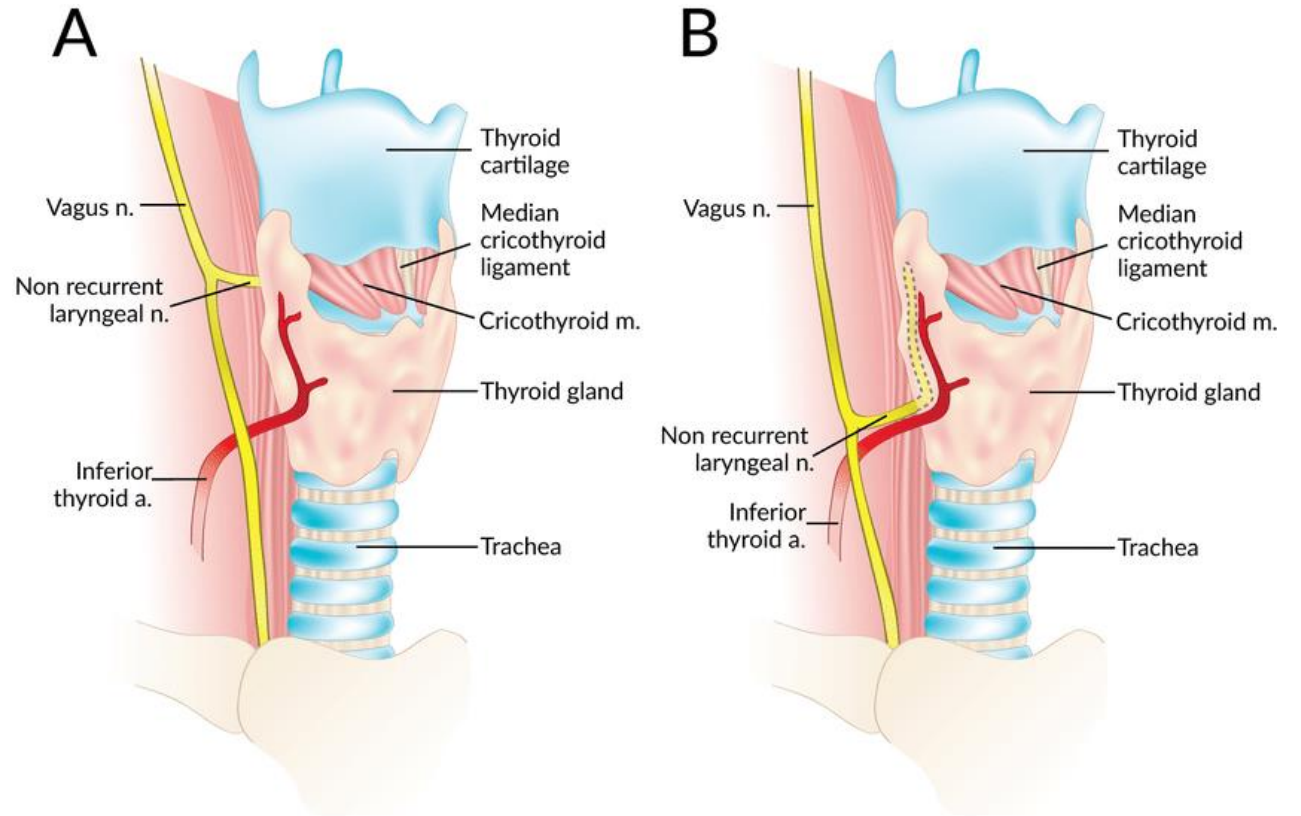
- Joll's Triangle
    - Space of Reeve

- RLN:

- Boehar's Triangle
    - Simon Triangle

# Anatomy of thyroid.....

- Non-recurrent laryngeal nerve:
  - An anomaly of the RLN.
  - Origin is cervical.
  - Direct course from the vagus nerve to the larynx without looping around.



# Anatomy of thyroid.....

- Types of NRLN:

- Type 1- arises directly from the vagus and travels with the Superior Thyroid Pedicle vessels.

- Type 2A- travels transversely, parallel and superficial to the trunk of the Inferior Thyroid Artery .

- Type 2B- travels in a transverse path parallel, but deep to or between the branches of the Inferior Thyroid Artery.

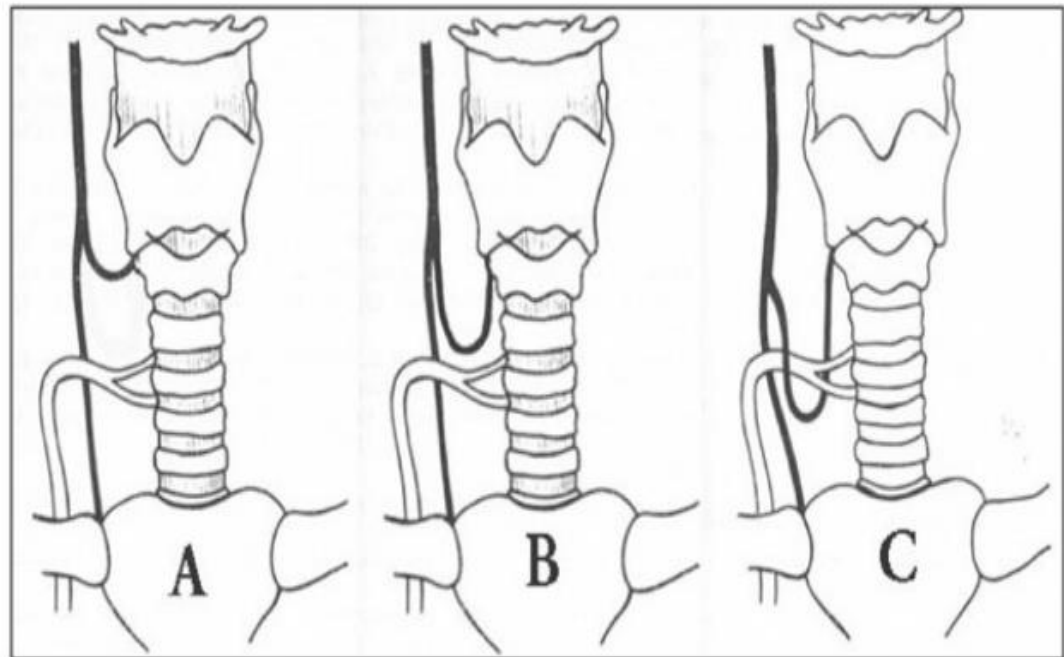


Fig. 1 - Schematic presentation of the three types of NRLN. A: Type 1. B: Type 2A. C: Type 2B.

# Anatomy of thyroid.....

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## ■ Surgical importance of RLN:

### ➤ Unilateral RLN injury-

- Paralysis of I/L intrinsic muscles of larynx i.e. loss of abduction
- Unopposed action of cricothyroid muscle i.e. adduction
- Paramedian position of I/L vocal cord
- Voice will be breathy but compensation occurs i.e. near to normal
- Airway will be patent but can be compromised during exertion



# Anatomy of thyroid.....

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- Surgical importance of RLN:

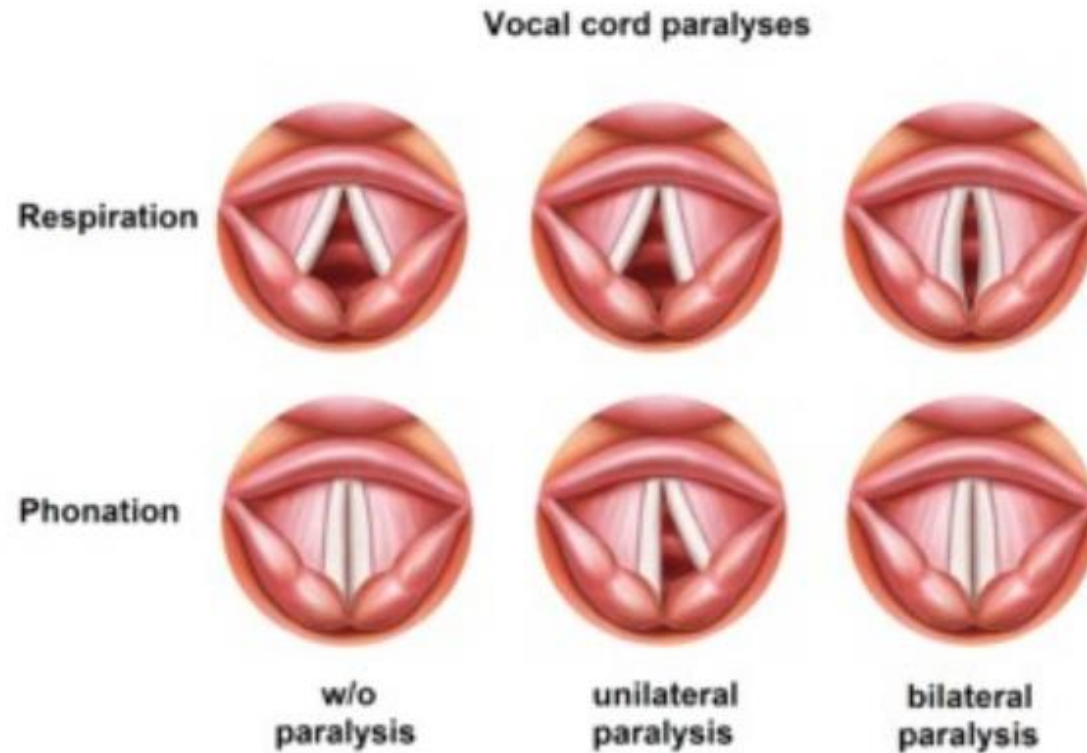
- Bilateral RLN injury-

- Paralysis of B/L intrinsic muscles of larynx i.e. loss of abduction.
- Unopposed action of cricothyroid muscle i.e. adduction.
- Paramedian or median position of vocal card.
- Stridor during breathing because compromised airway.



# Anatomy of thyroid.....

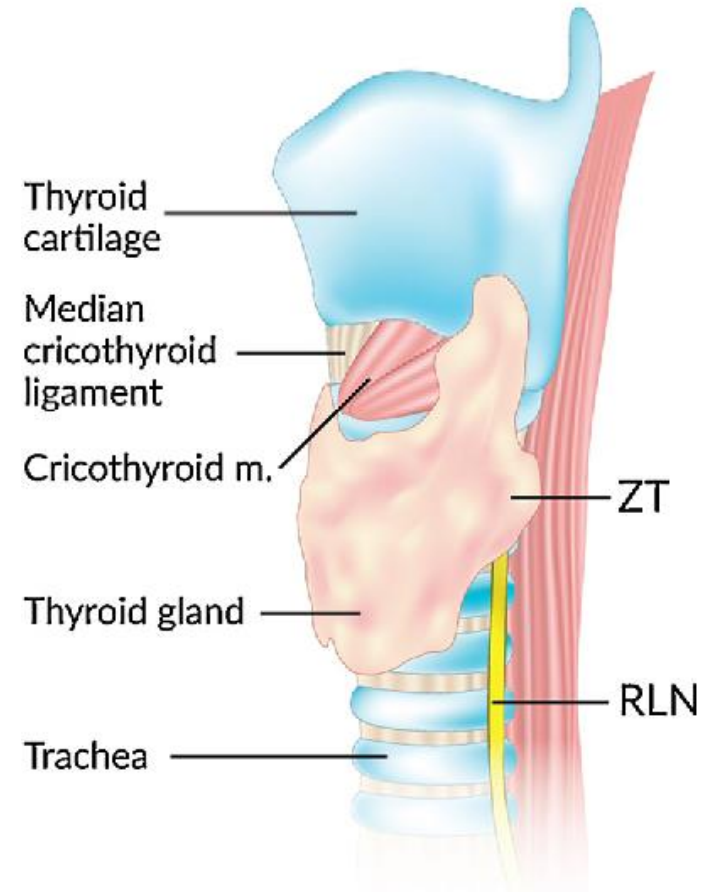
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# Anatomy of thyroid.....

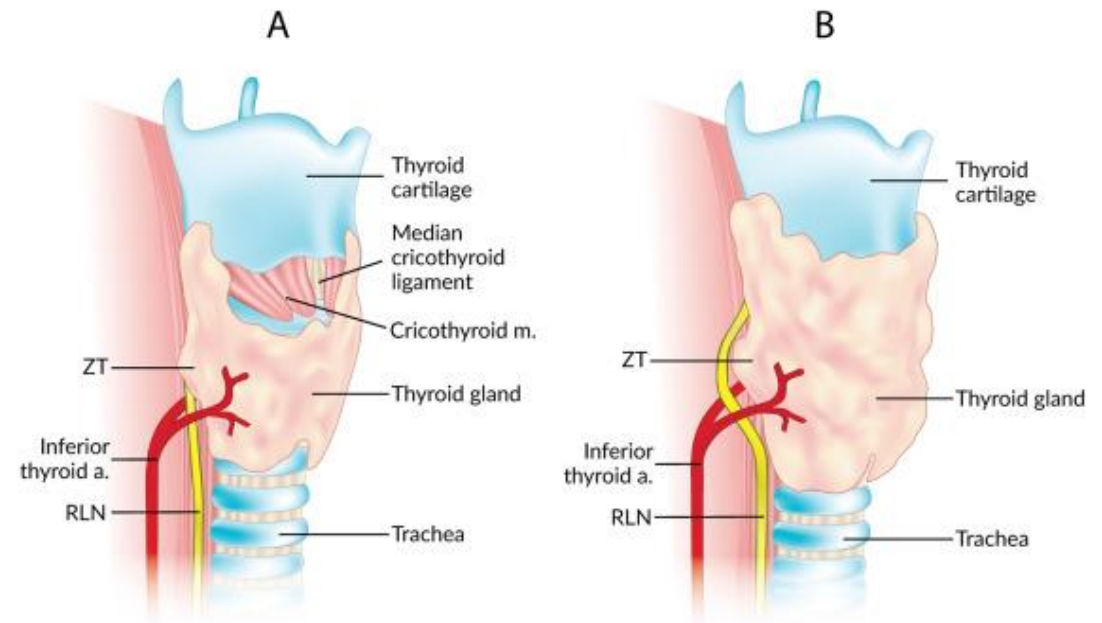
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- Zuckerkandl's tubercle (ZT)
  - Posterior extension of the lateral lobes.
  - Composing of thyroid tissue only.



# Anatomy of thyroid.....

- Surgical importance of ZT:
  - Dissection and excision of ZT for total thyroidectomy.
  - Close relationship between ZT and recurrent laryngeal nerve (RLN).
  - Needs careful, fine, and very close dissection around the nerve.
  - Safe identification of the nerve and resection of the tubercle.





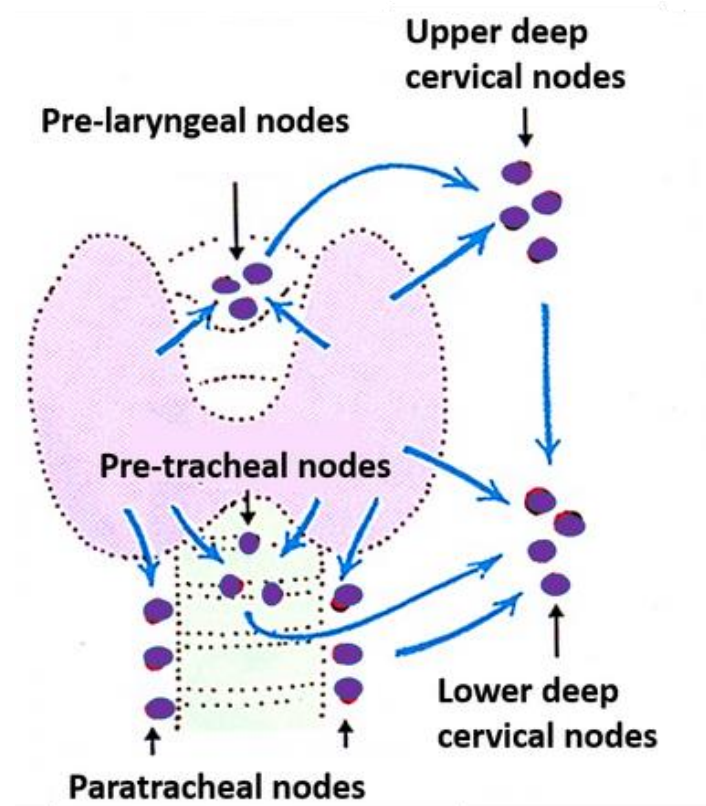
# Anatomy of thyroid.....

## ■ Lymphatic Drainage of the Thyroid Gland

### ➤ Thyroid lymphatic vessels communicates with:

- 1st level: Pre-laryngeal, Pre-tracheal, and Para-tracheal lymph nodes
- 2nd level:
  - Superior deep cervical nodes (from the prelaryngeal nodes)
  - and Inferior deep cervical nodes (from the pretracheal and paratracheal nodes).
- Some lymphatic vessels may drain into the brachiocephalic lymphatic nodes.

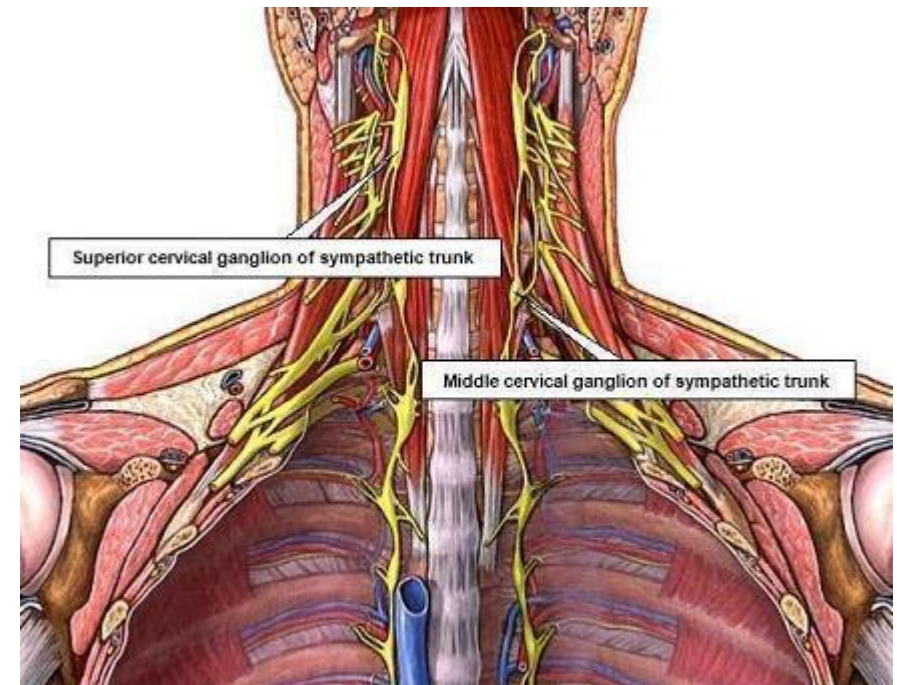
❖ Presence of metastases in lymphatic nodes of neck can be first sign of thyroid carcinoma!!!



# Anatomy of thyroid.....

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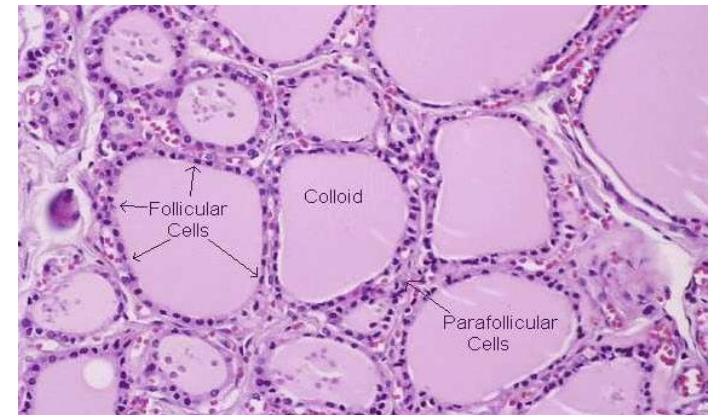
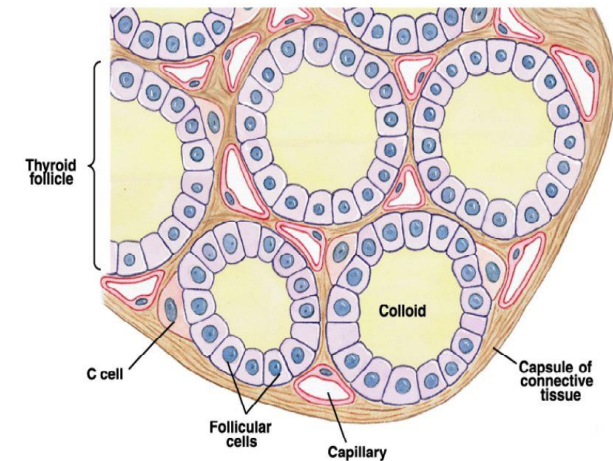
- Innervation of Thyroid Gland:
  - Derived from- (Superior, Middle, and Inferior) Cervical Sympathetic Ganglia
  - Nerves reach the thyroid through-
    - Cardiac periarterial plexus
    - Superior and inferior thyroid plexus
  - Only vasomotor fibers- constriction of blood vessels
  - No secretomotor supply
- ❖ Endocrine secretion from the thyroid gland is hormonally regulated by the pituitary gland through TSH!



# Histology of thyroid

- Each lobule of contains:
  - 20 to 40 follicles.
  - Composed of follicle cells and colloid.
  - Colloid fills the follicle cavities
- Follicle cells produce thyroglobulin.
- Between follicles are Para-follicular cells, which produce Calcitonin.

Section of thyroid gland



**THANKS**

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