ANATOMY & DEVELOPMENT OF THYROID & PARATHYROID GLANDS

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By

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Intended Learning Outcomes (ILOs)

1. Describe anatomy of thyroid gland (features, relation & blood supply).
2. Describe anatomy of parathyroid glands (features, relation & blood supply).
3. Describe development of thyroid and parathyroid glands.
4. Summarize congenital anomalies of thyroid and parathyroid glands.

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Agenda

1. Anatomy of thyroid gland (features, relation & blood supply).
2. Anatomy of parathyroid glands (features, relation & blood supply).
3. Development of thyroid and parathyroid glands.
4. Congenital anomalies of thyroid and parathyroid glands.

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Anatomy of Thyroid Gland

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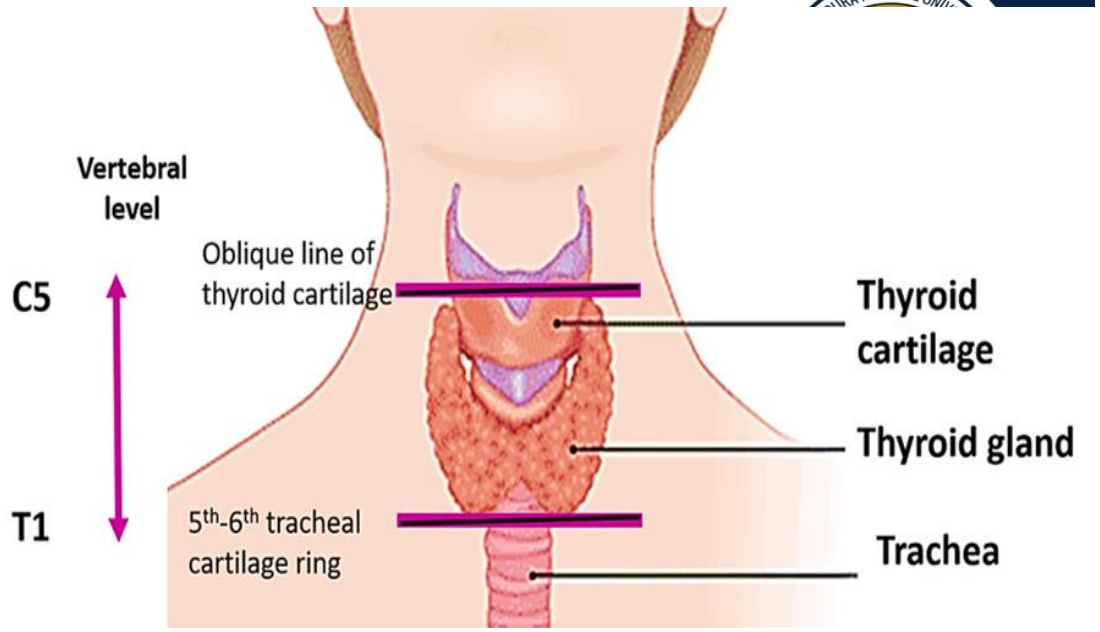
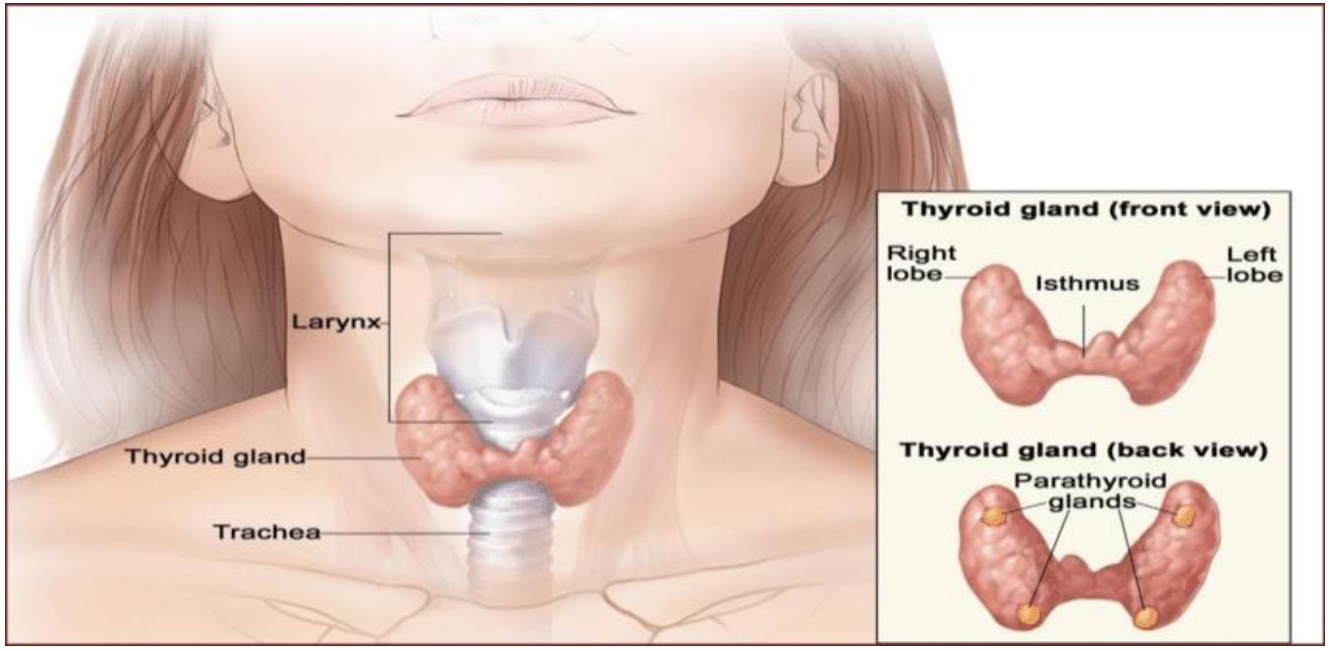
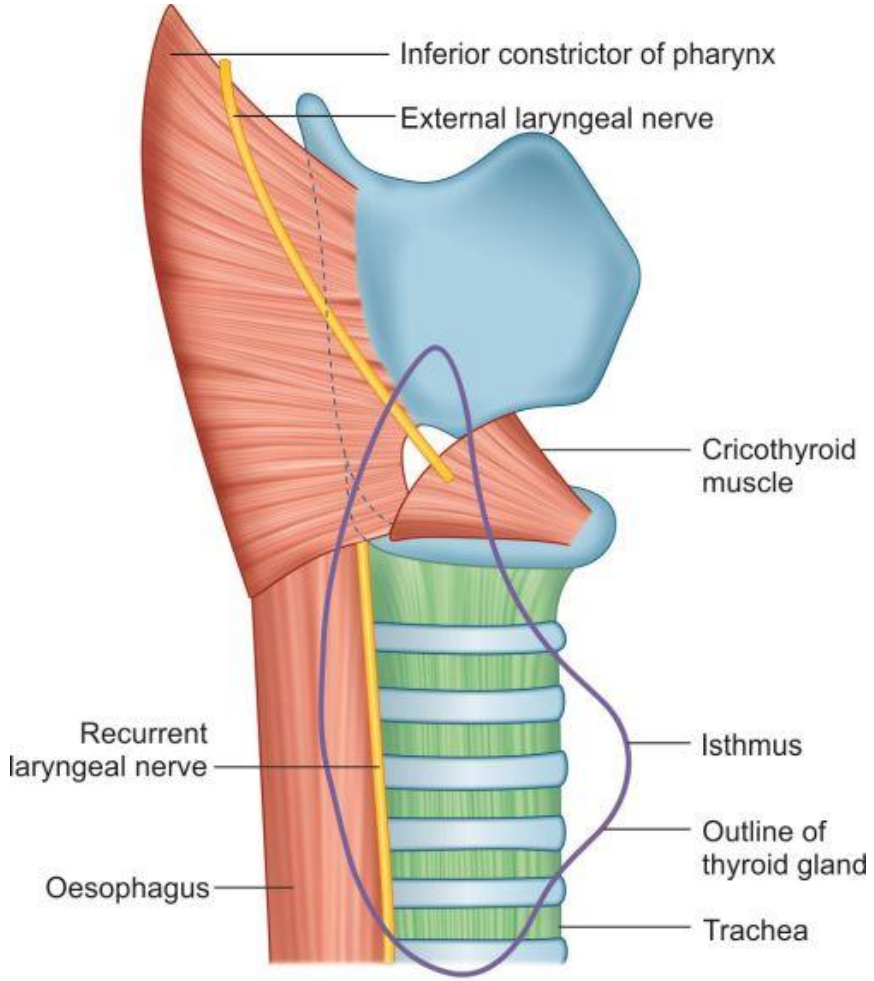
Extent

- in the lower part of front of neck
- extending from middle of thyroid cartilage to 5th tracheal ring
- opposite 5^{th}, 6^{th}, 7^{th} cervical vertebrae & 1st thoracic vertebra (behind)

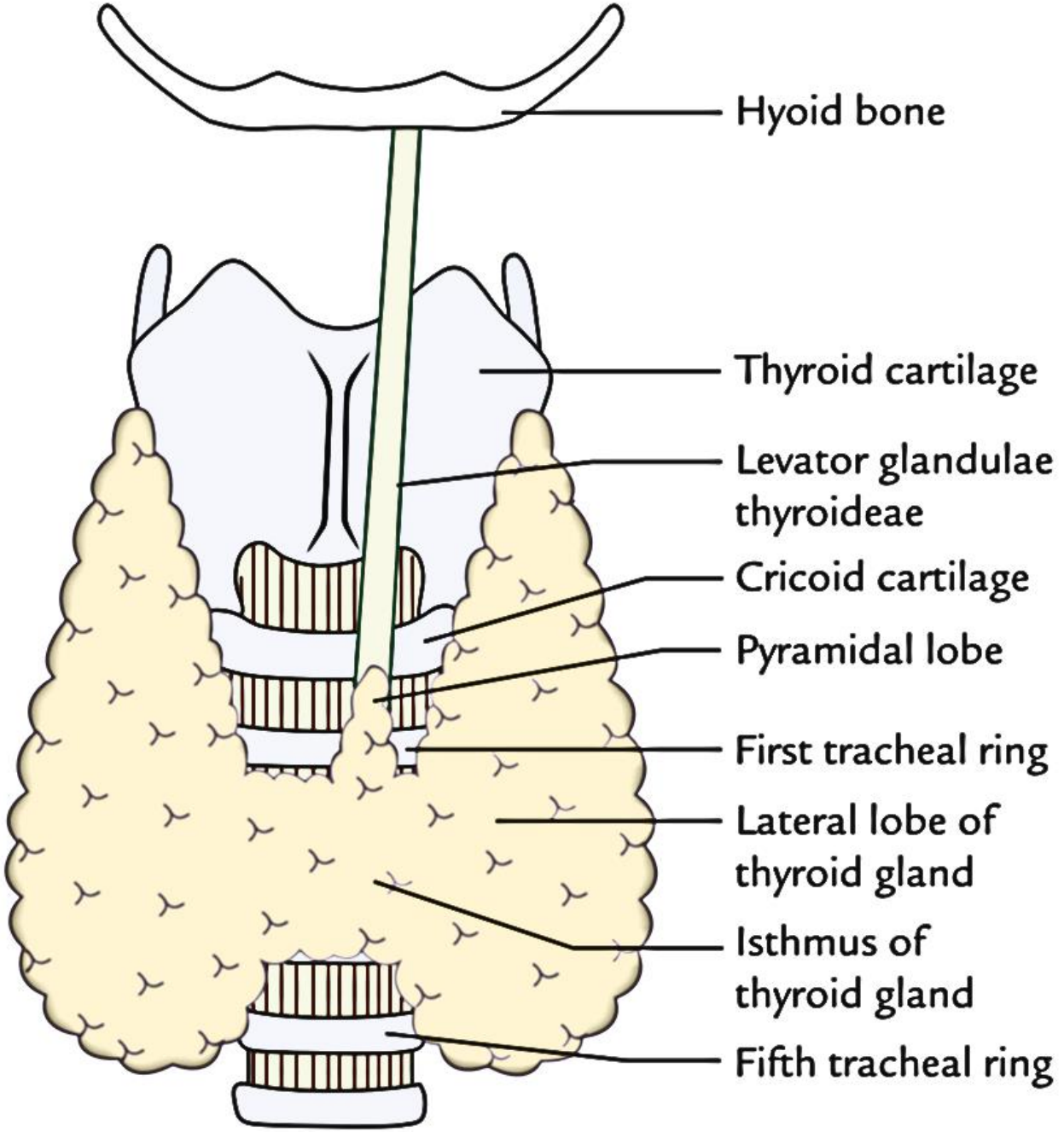


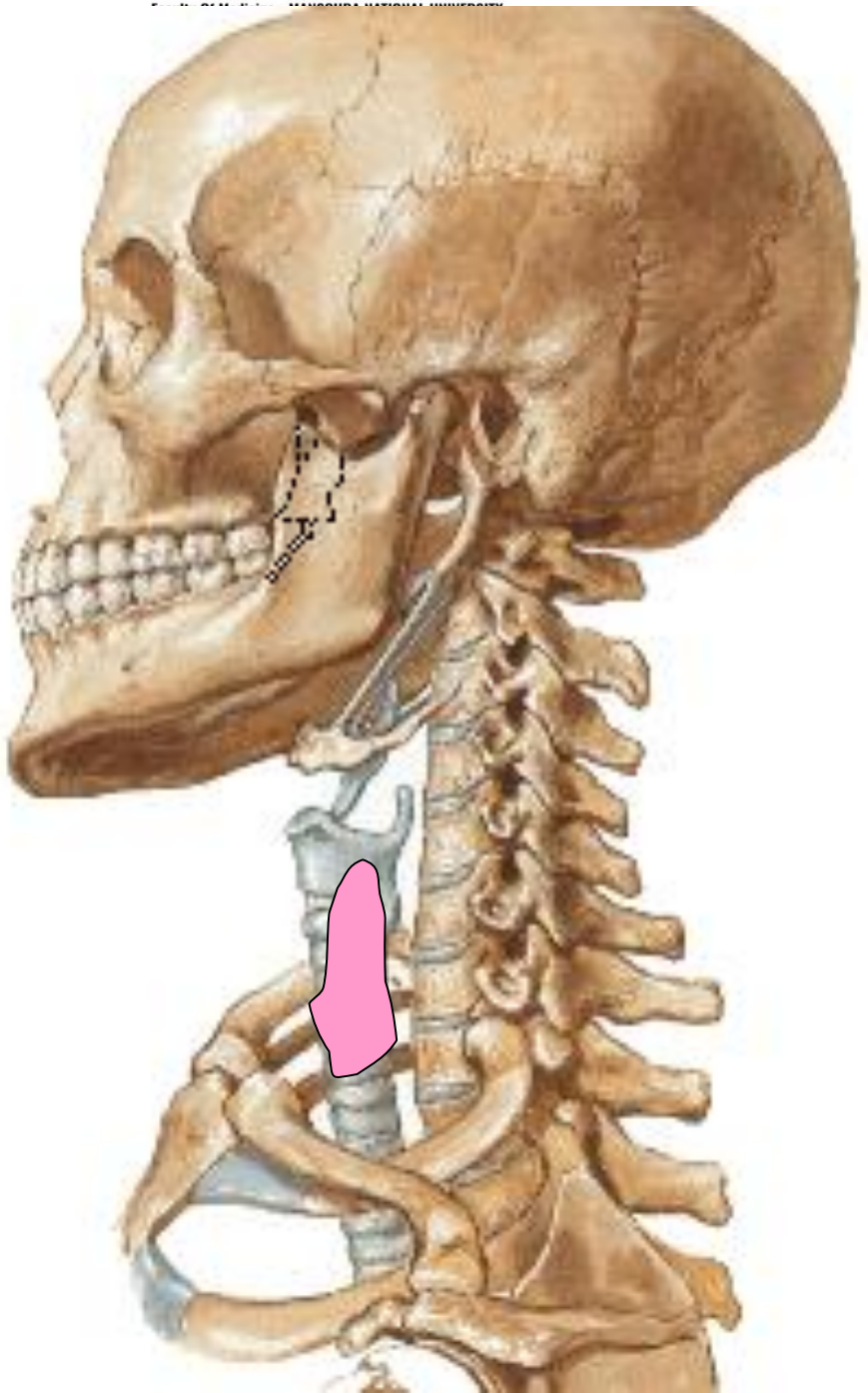




Vertebral levels

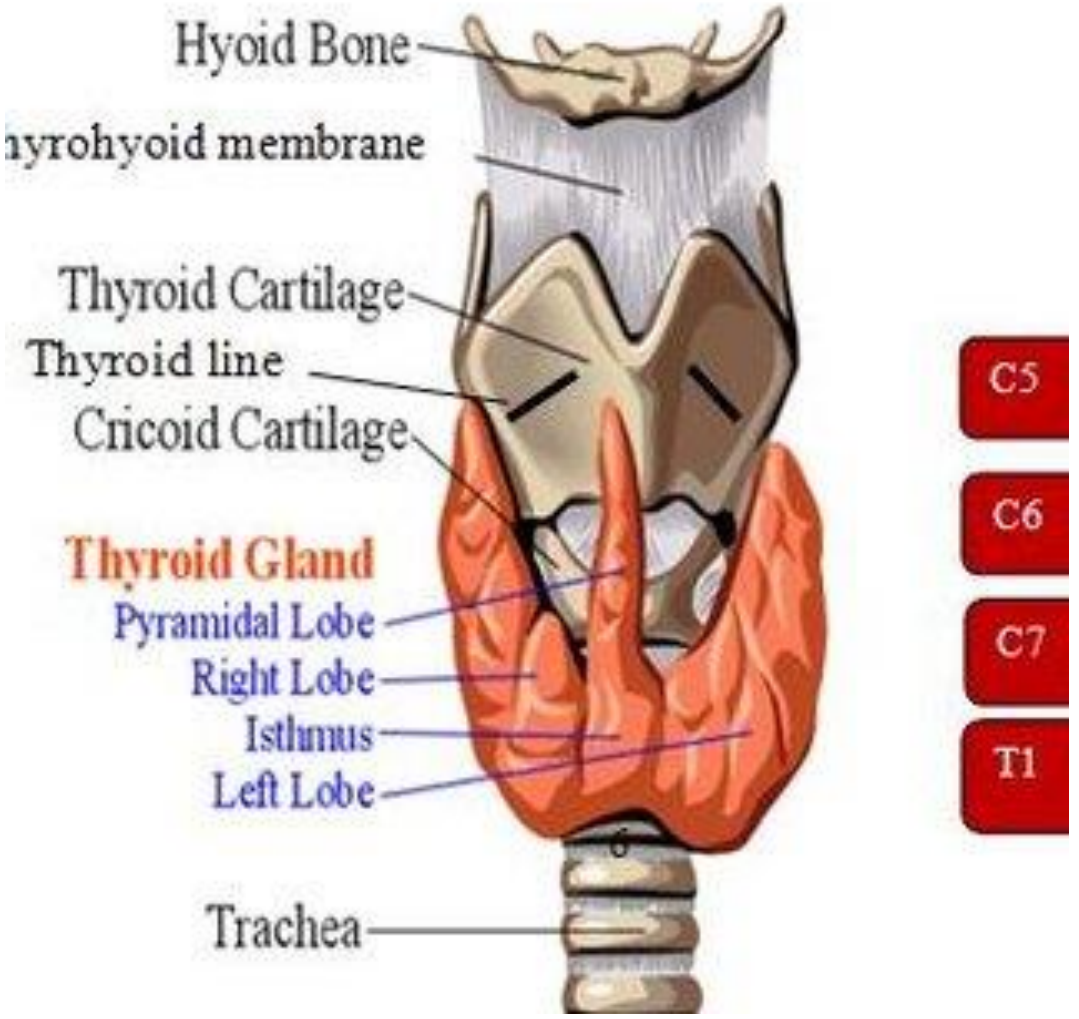
- C5
- C6
- C7
- T1





Shape

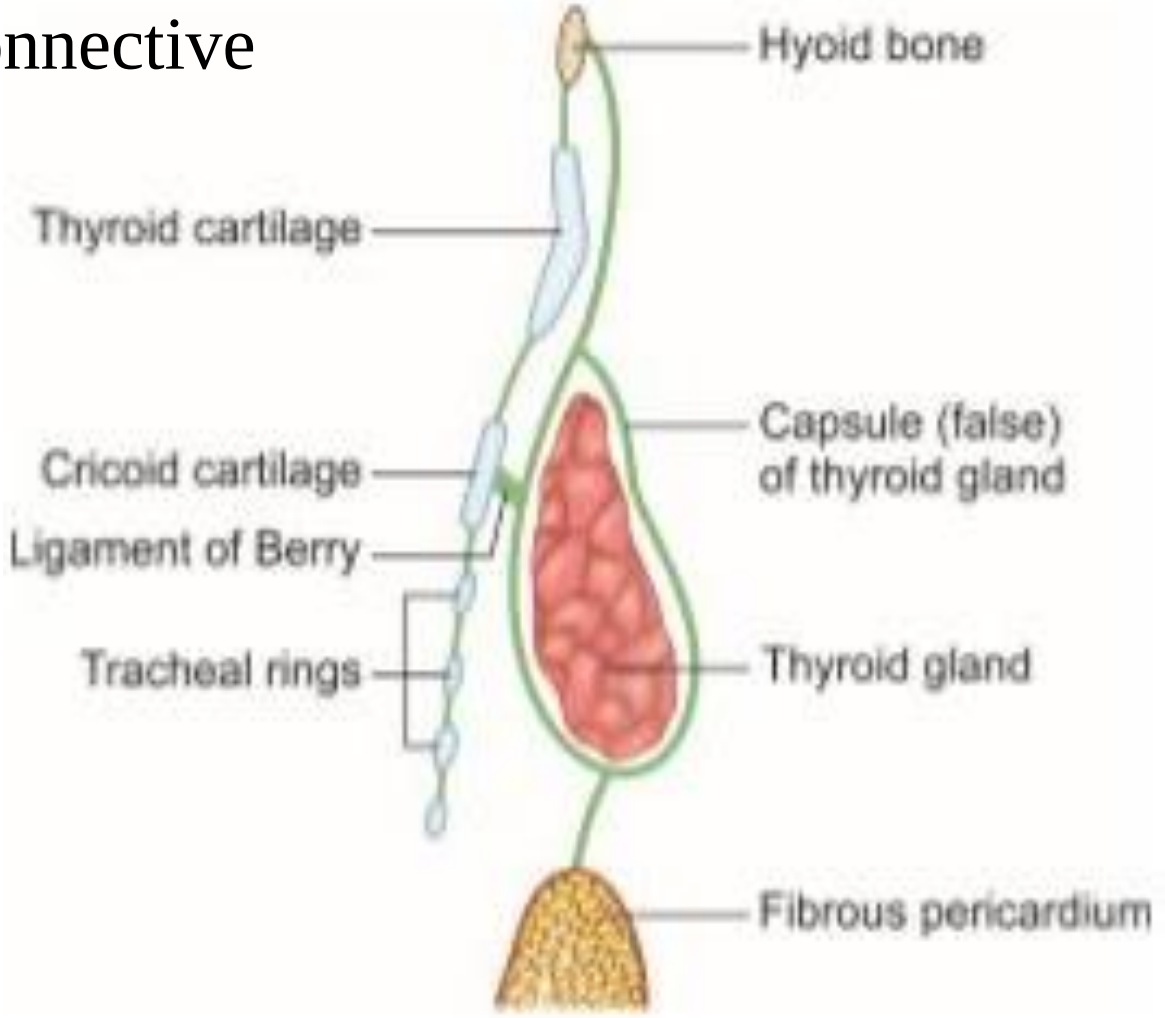
- Butterfly in shape.
- Formed of
  1. Right & left lobes.
  2. Isthmus connecting the 2 lobes.
  3. Pyramidal lobe

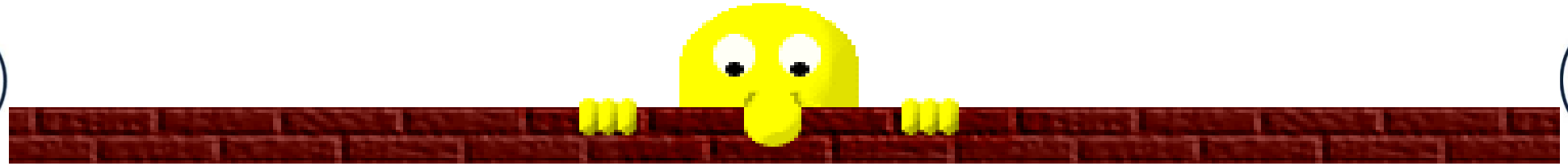


Capsules

A.True capsule: condensation of connective tissue of the gland.

B.False capsule: a sheath of **pretracheal fascia**, which fixes the gland to hyoid bone, thyroid & cricoid cartilage. (the gland moves up and down with swallowing)





Surfaces & Relations

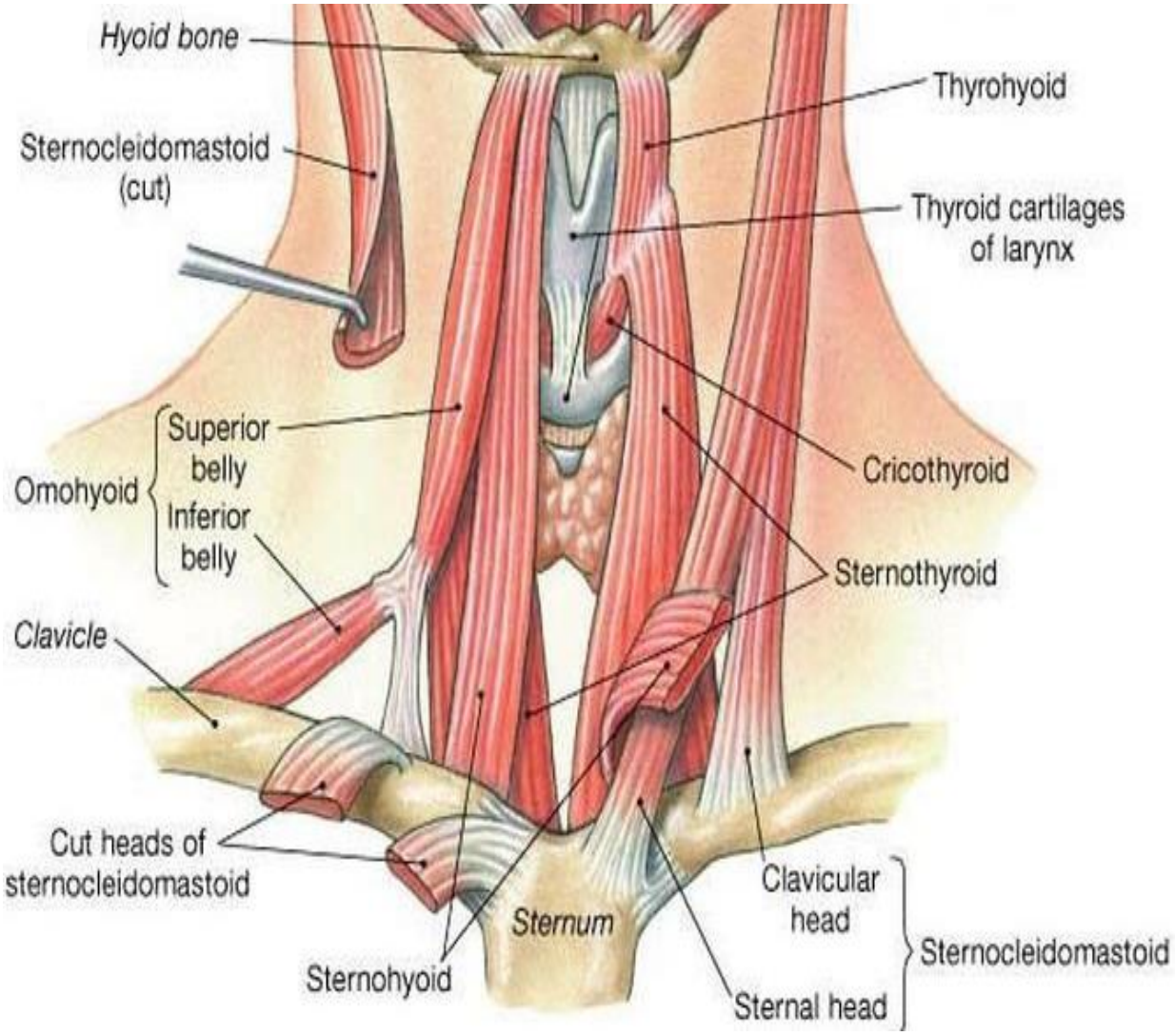
Lateral surface

Superficial (lateral) surface, is full & rounded & is Covered by:

i. Superior belly of omohyoid, at its upper part.

ii. Sternomastoid, at its lower part.

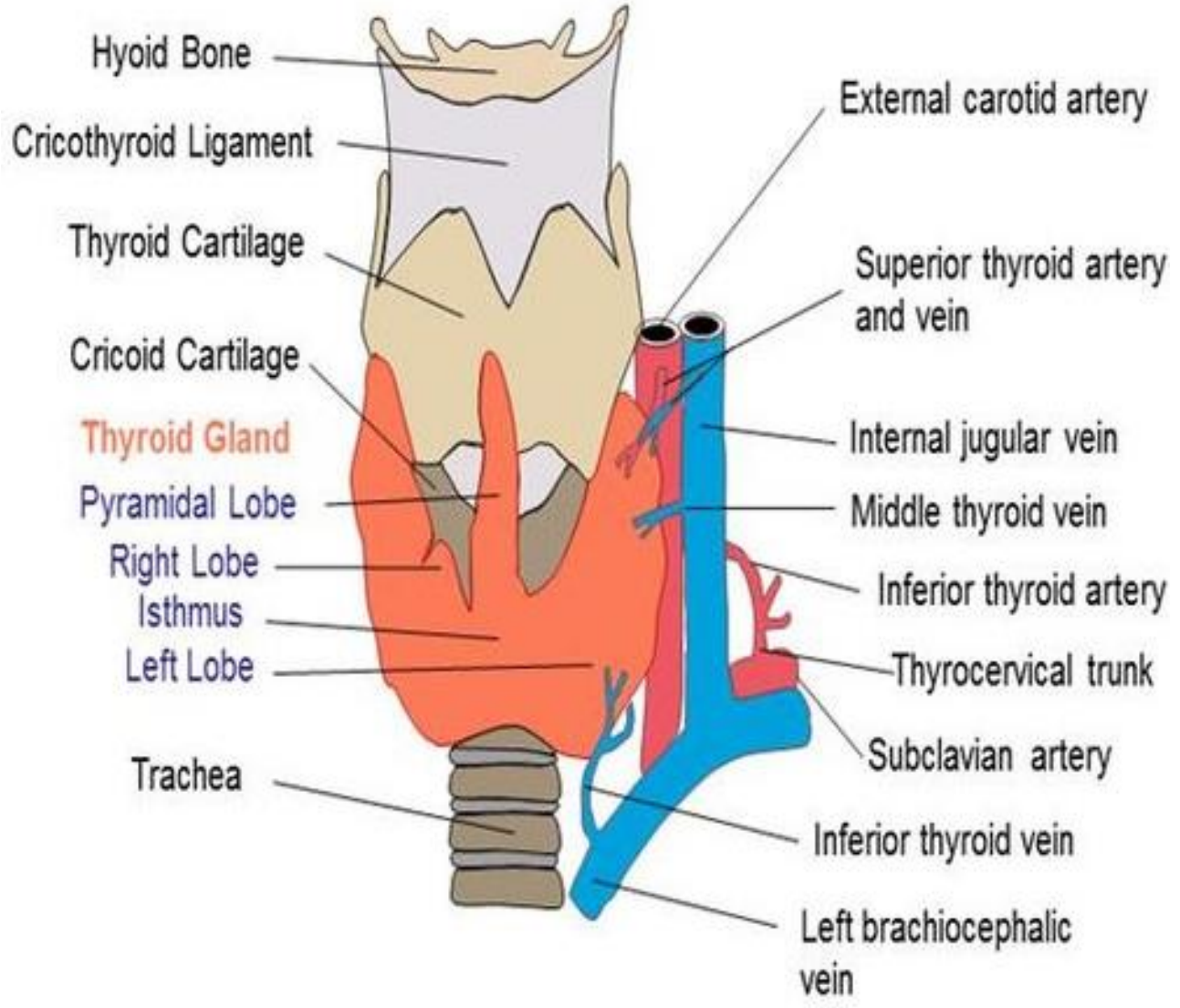
iii. Sternohyoid & sternothyroid, at middle



Posterior surface

Carotid sheath:

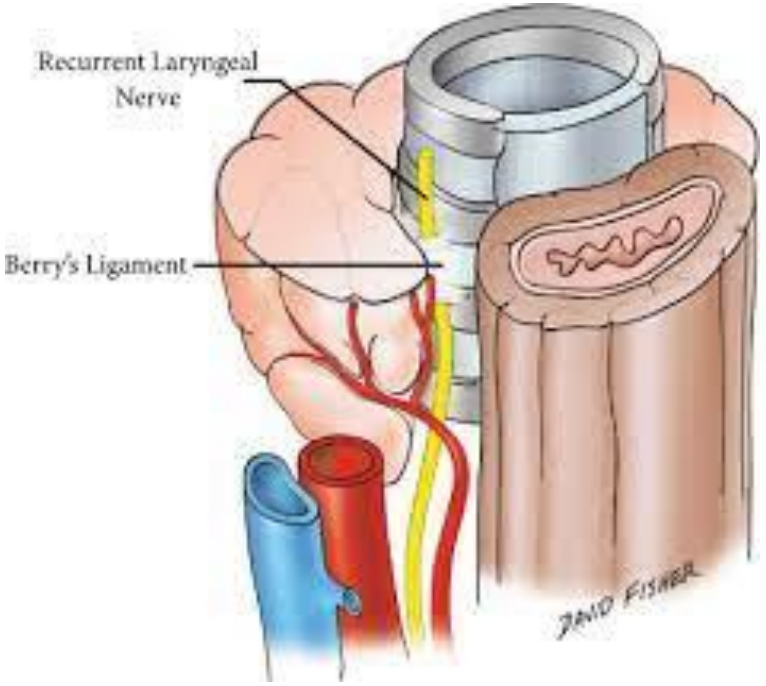
A. Common carotid artery
B. Internal jugular vein
C. Vagus in between

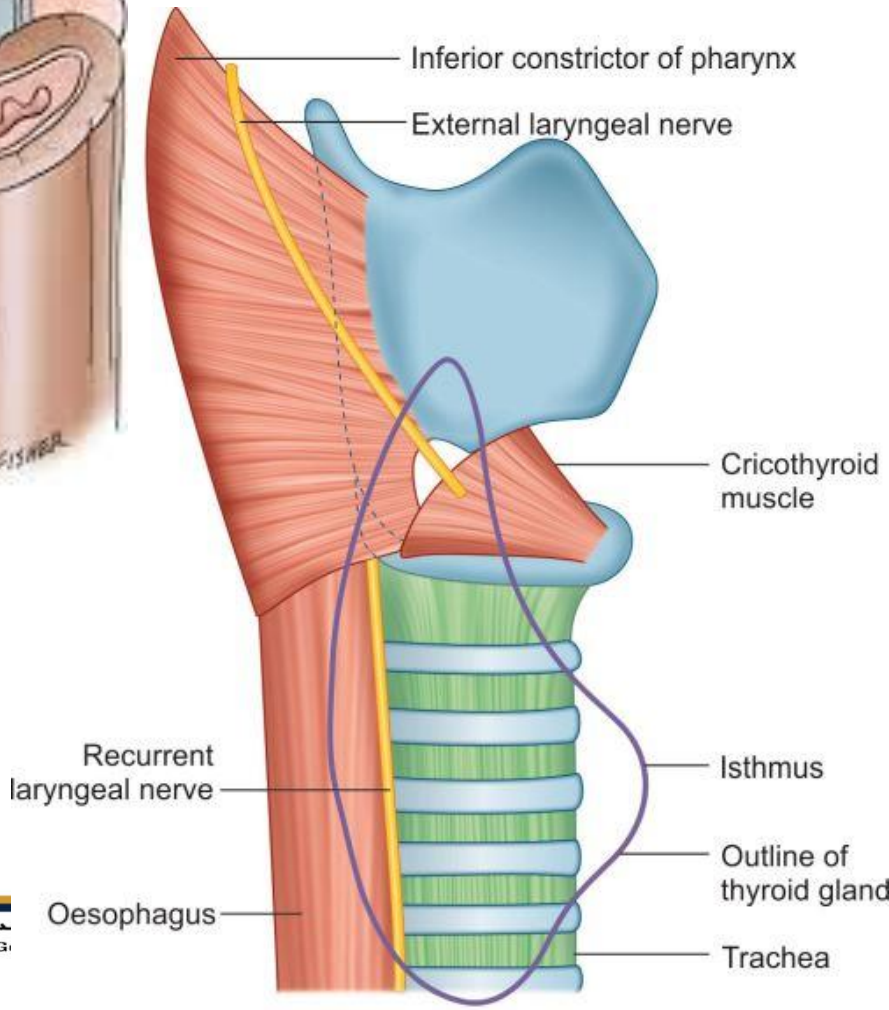


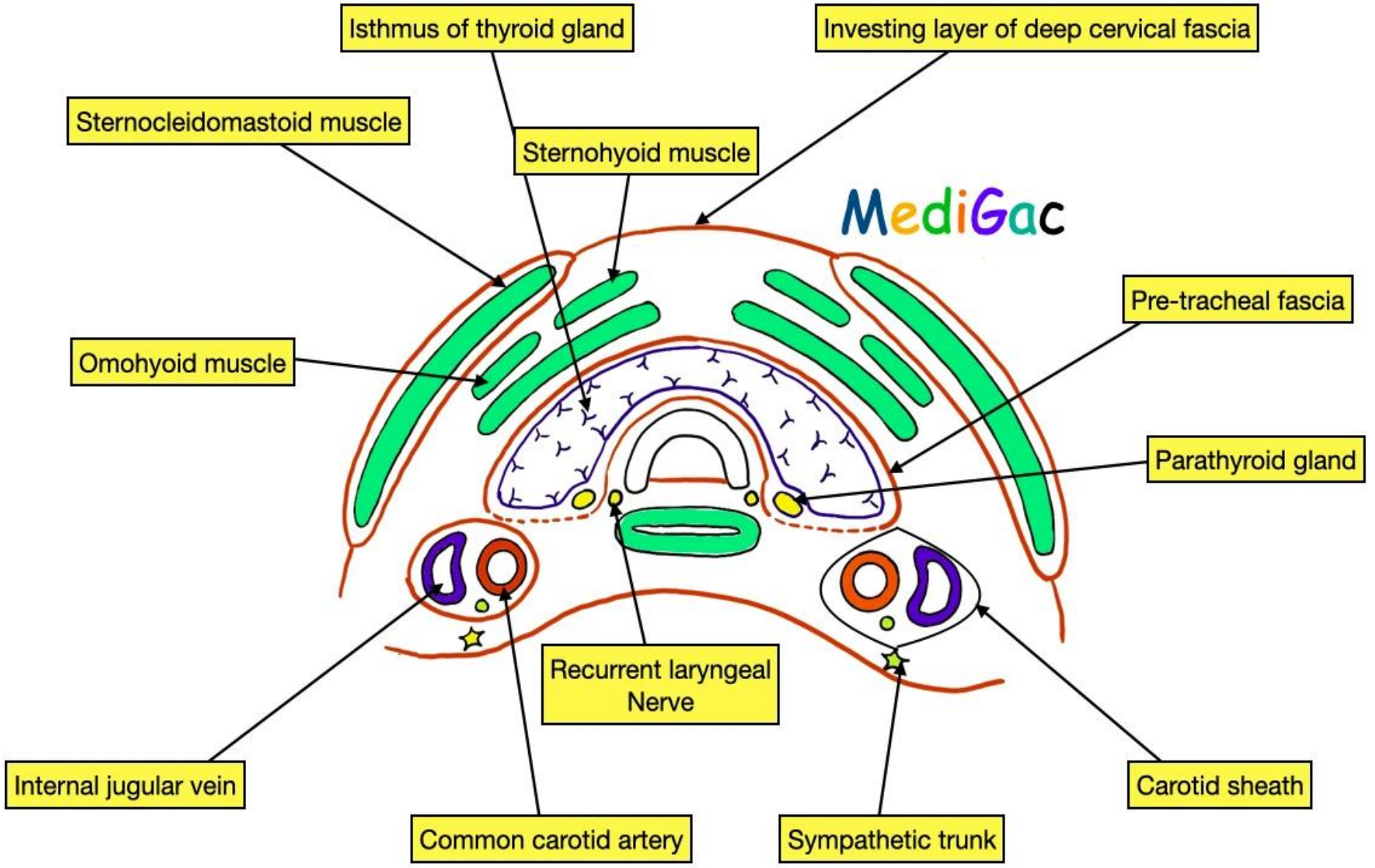
Medial surface

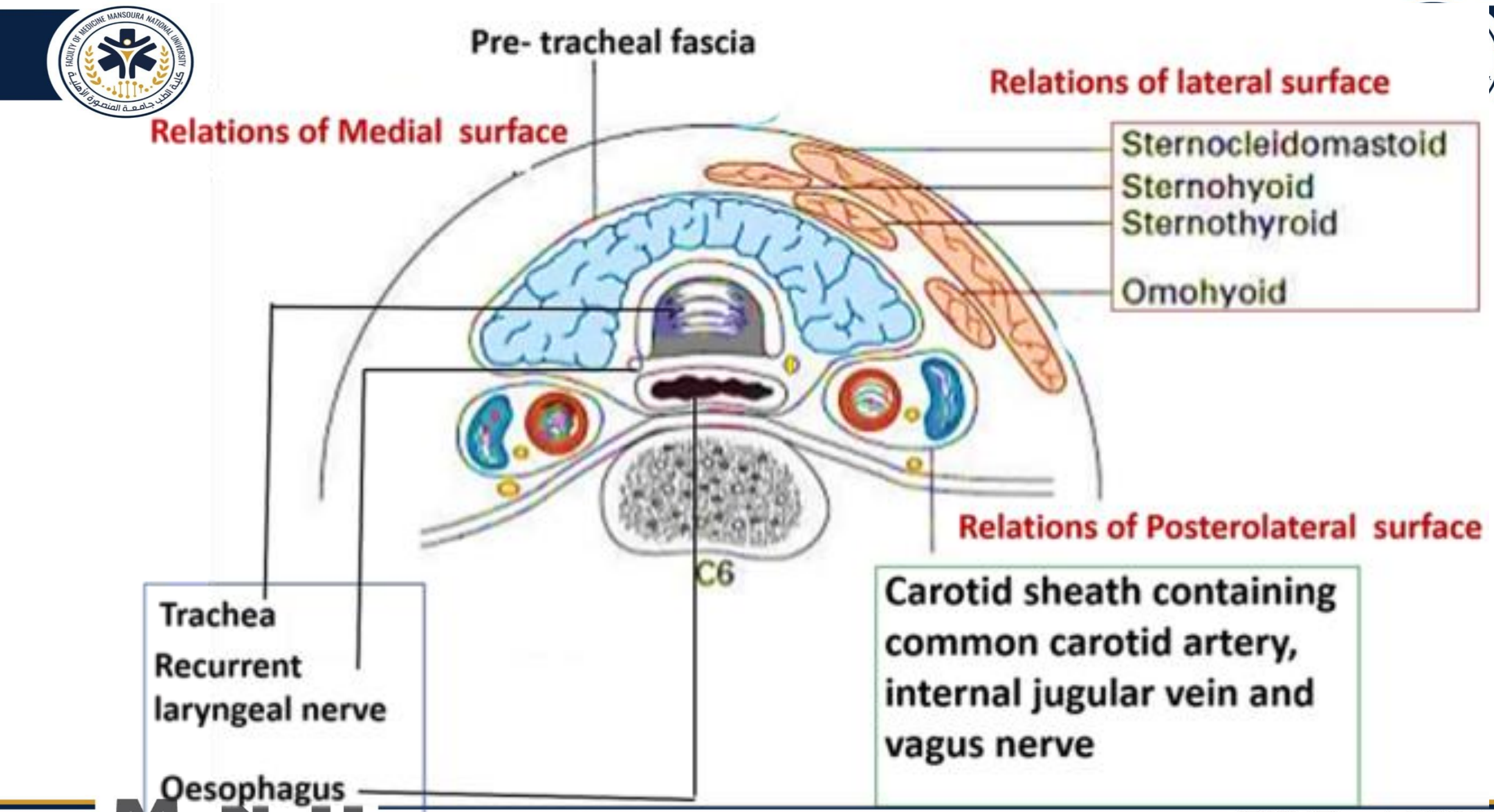
1. **Upper part:**
   - A. **Larynx**
   - B. **Pharynx**
   - C. **External laryngeal nerve**

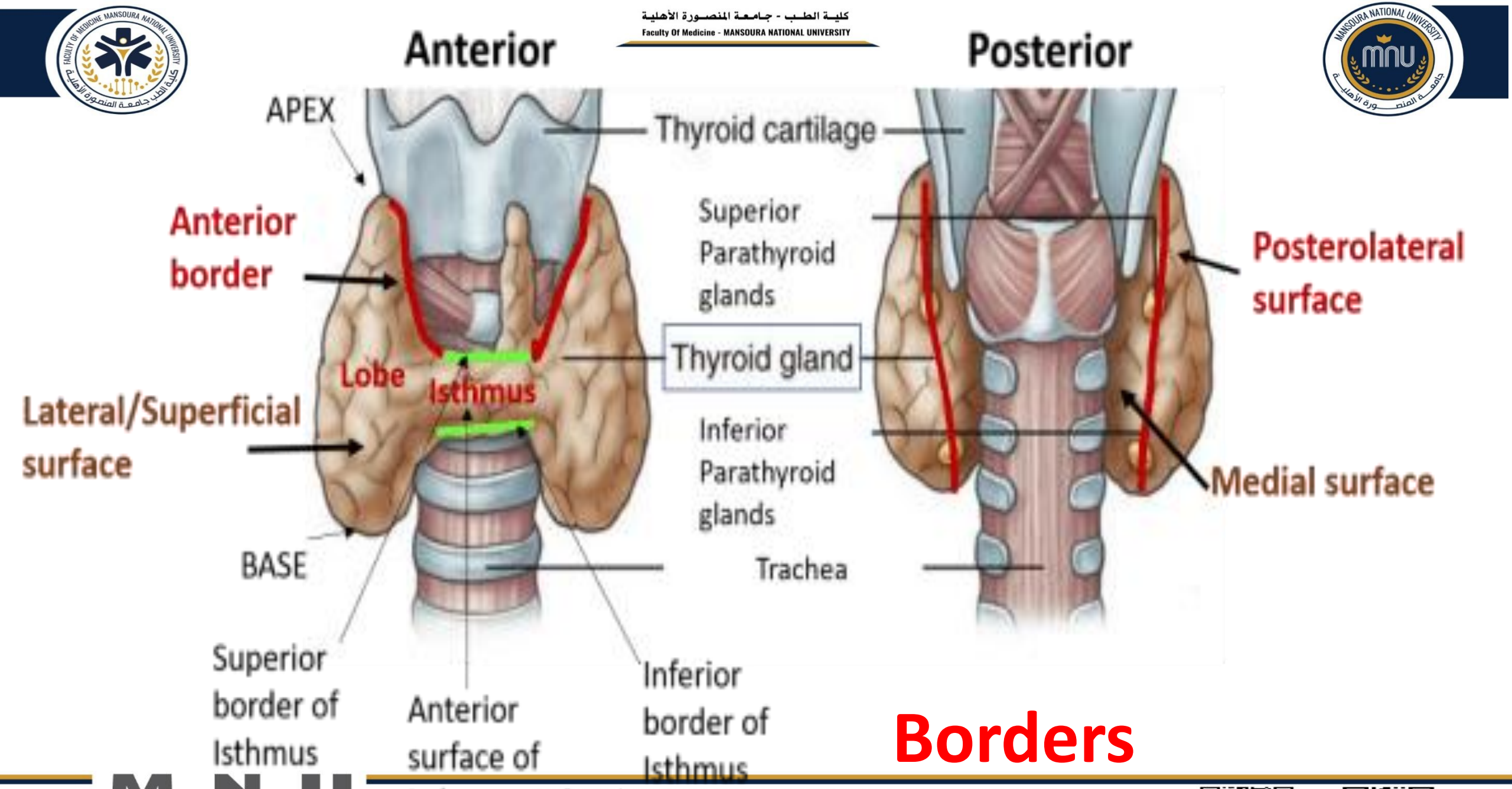
   in between
2. **Lower part:**
   - A. **Trachea**
   - B. **Esophagus**
   - C. **Recurrent laryngeal n. in between**






Isthmus of thyroid gland
Investing layer of deep cervical fascia
Sternocleidomastoid muscle
Sternohyoid muscle
MediGac
Pre-tracheal fascia
Omohyoid muscle
Parathyroid gland
Recurrent laryngeal Nerve
Internal jugular vein
Common carotid artery
Sympathetic trunk
Carotid sheath


Pre- tracheal fascia
Relations of Medial surface
Relations of lateral surface
Sternocleidomastoid
Sternohyoid
Sternothyroid
Omohyoid
Relations of Posterolateral surface
C6
Trachea
Recurrent laryngeal nerve
Oesophagus
Carotid sheath containing common carotid artery, internal jugular vein and vagus nerve


Anterior
Posterior
APEX
Thyroid cartilage
Anterior border
Superior Parathyroid glands
Posterolateral surface
Thyroid gland
Lobe
Isthmus
Lateral/Superficial surface
Inferior Parathyroid glands
Medial surface
BASE
Trachea
Superior border of Isthmus
Anterior surface of Isthmus
Inferior border of Isthmus

Borders

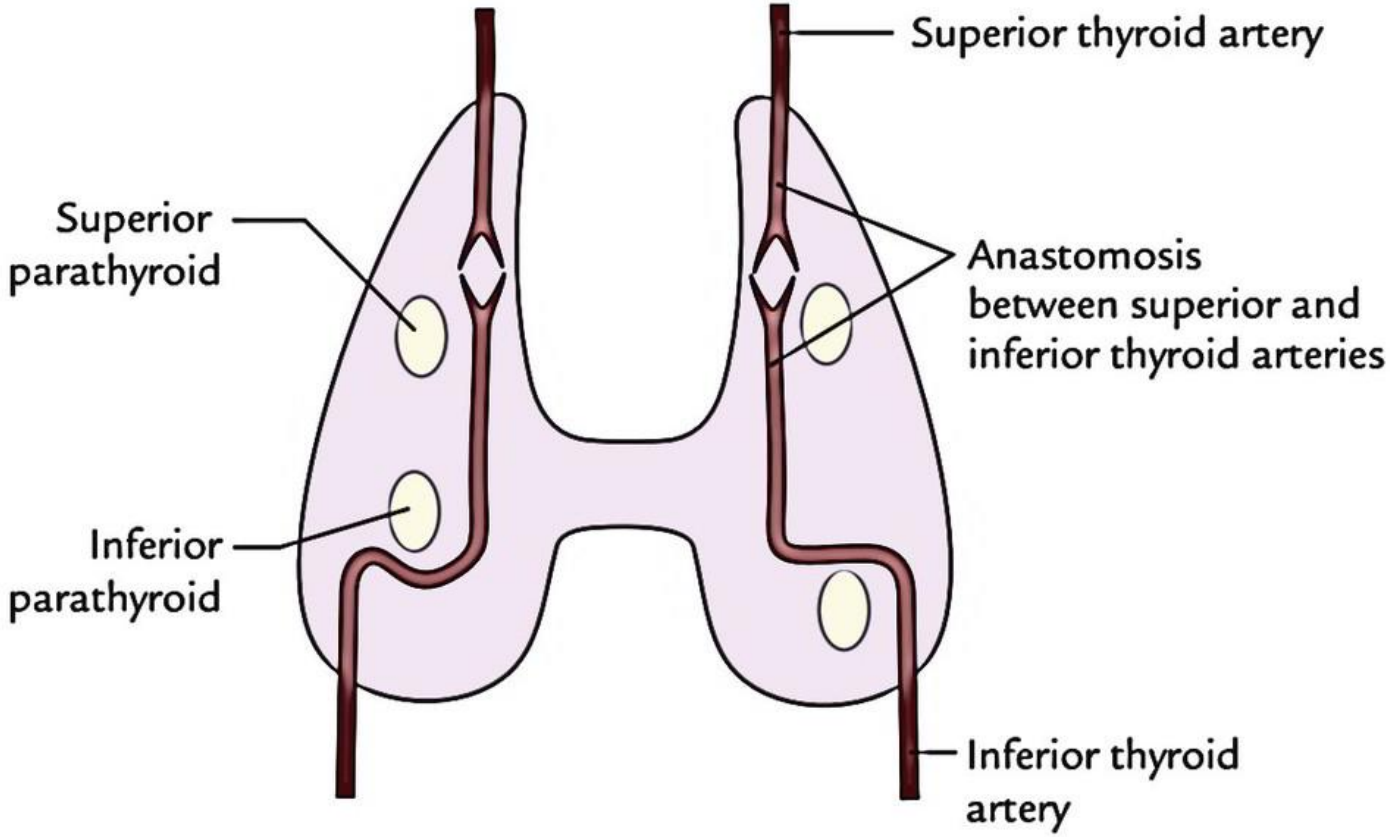
Borders

Anterior border:

Related to anterior branch of superior thyroid artery.

Posterior border:

Related to parathyroid glands, inferior thyroid artery & anastomosis between superior & inferior thyroid arteries



Isthmus of thyroid gland

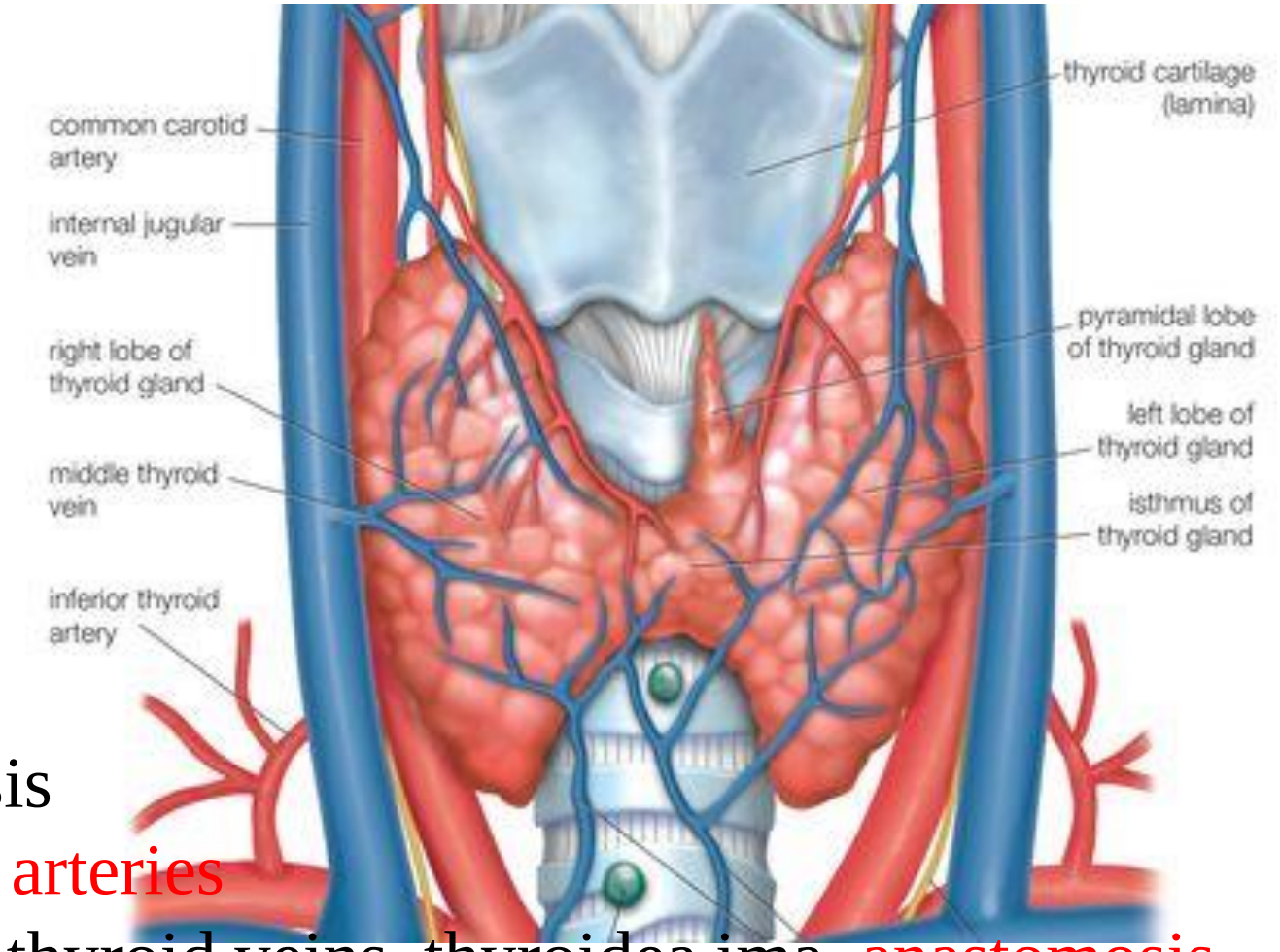
It connects the two lobes.

- **Surfaces:**

A. Anterior surface: is covered by:

- Sternohyoid
- Anterior jugular veins.
- Sternothyroid

B. Posterior surface: related to **2nd, 3rd & 4th tracheal rings**



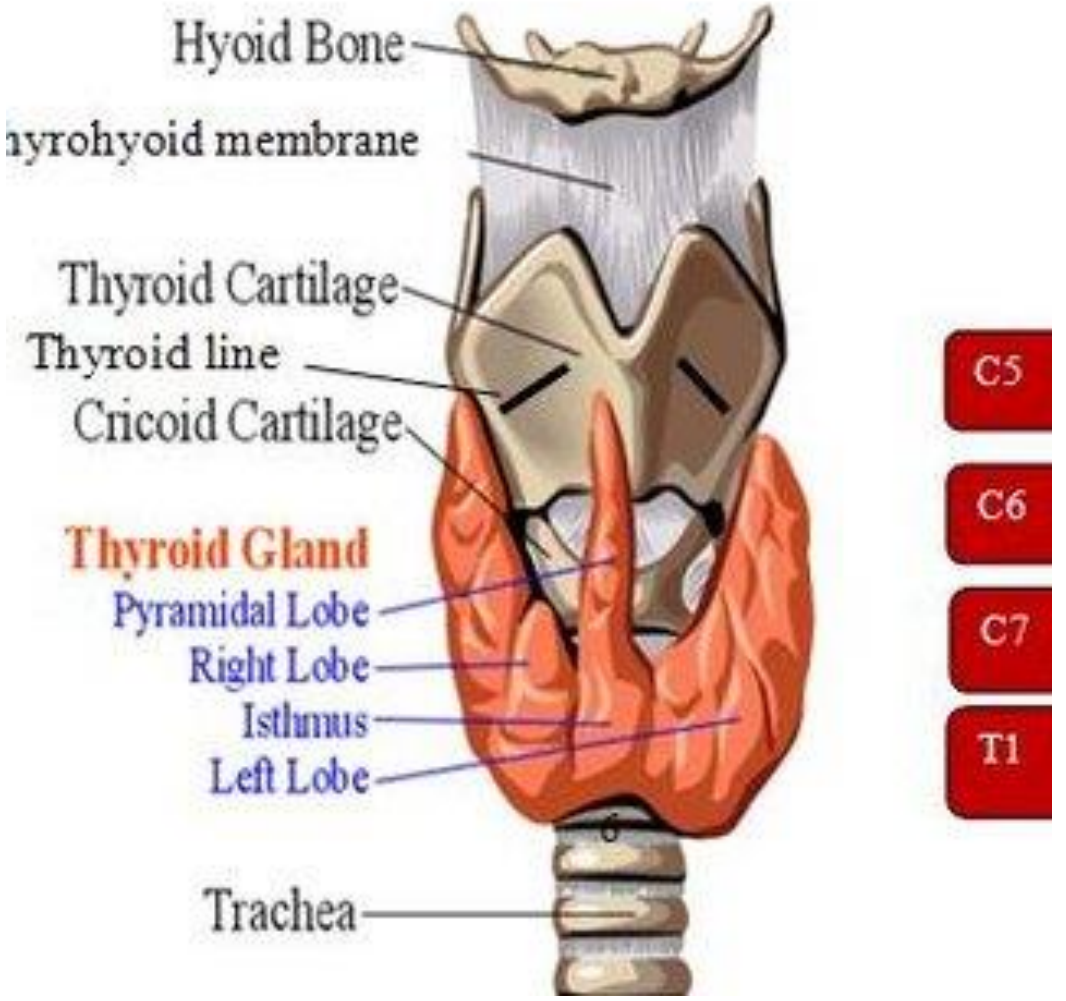
- **Borders:**

A. Upper border: shows anastomosis between the two superior thyroid arteries

B. Lower border: related to inferior thyroid veins, thyroidea ima, anastomosis between inferior thyroid arteries

Relations of the pyramidal lobe

- It is a small conical process that extends from the upper border of the isthmus.
- It connected to the hyoid bone by a fibromuscular band, the levator glandulae thyroidae.



Blood supply of thyroid gland

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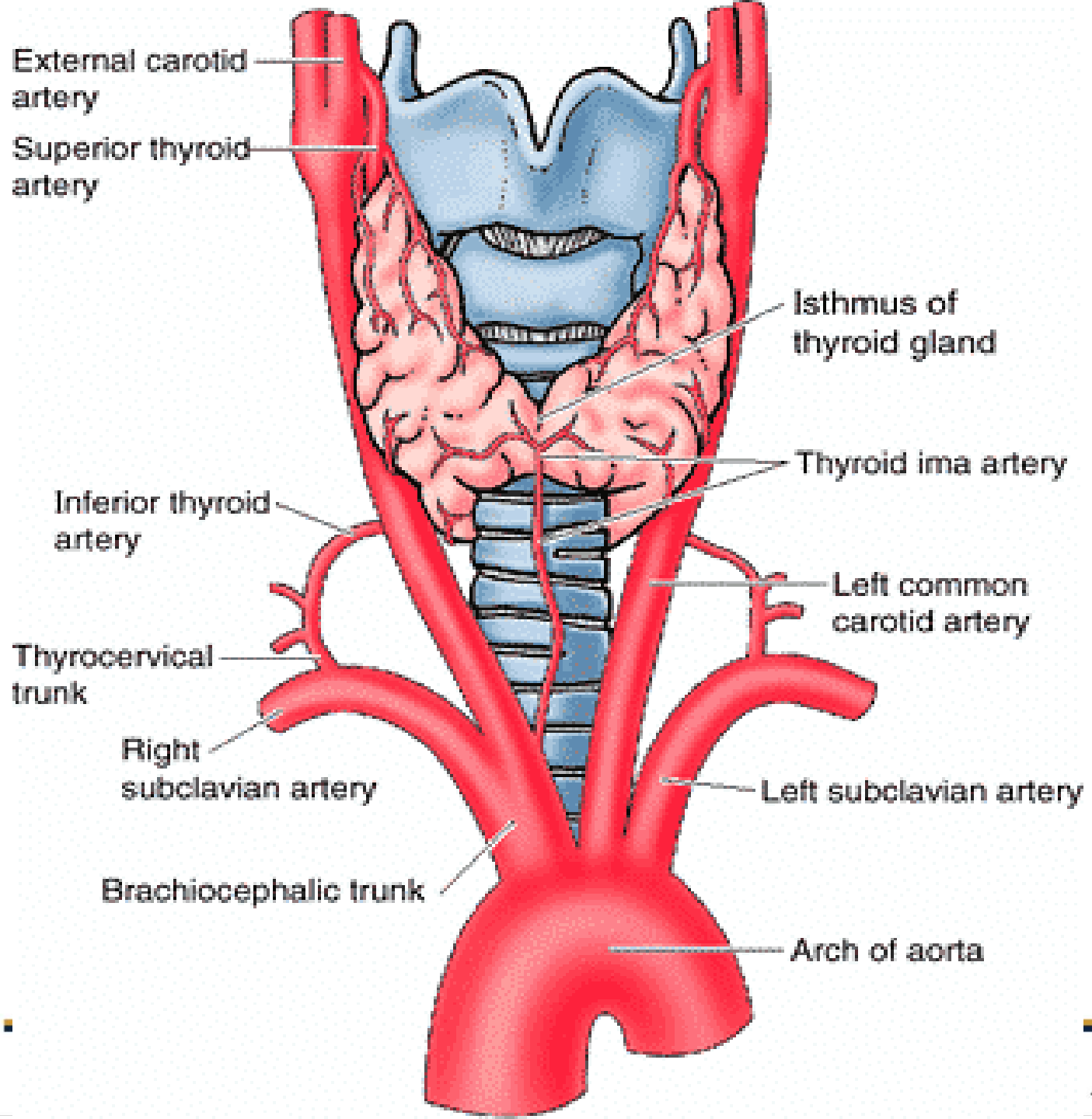

External carotid artery
Superior thyroid artery
Isthmus of thyroid gland
Thyroid ima artery
Inferior thyroid artery
Left common carotid artery
Thyrocervical trunk
Right subclavian artery
Left subclavian artery
Brachiocephalic trunk
Arch of aorta

1. Superior thyroid artery

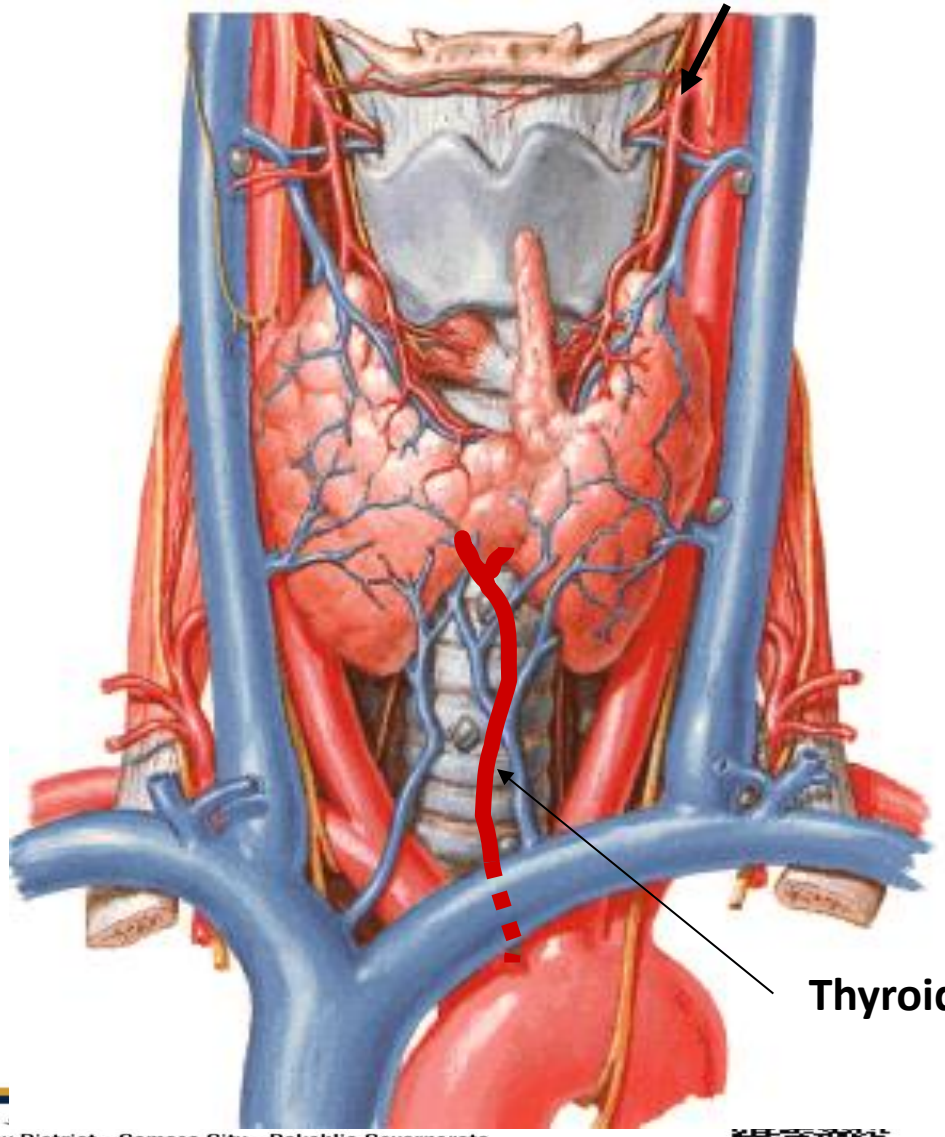
Origin: external carotid artery.

Course: accompanied with external laryngeal nerve

Termination: it ends in the apex by dividing into:

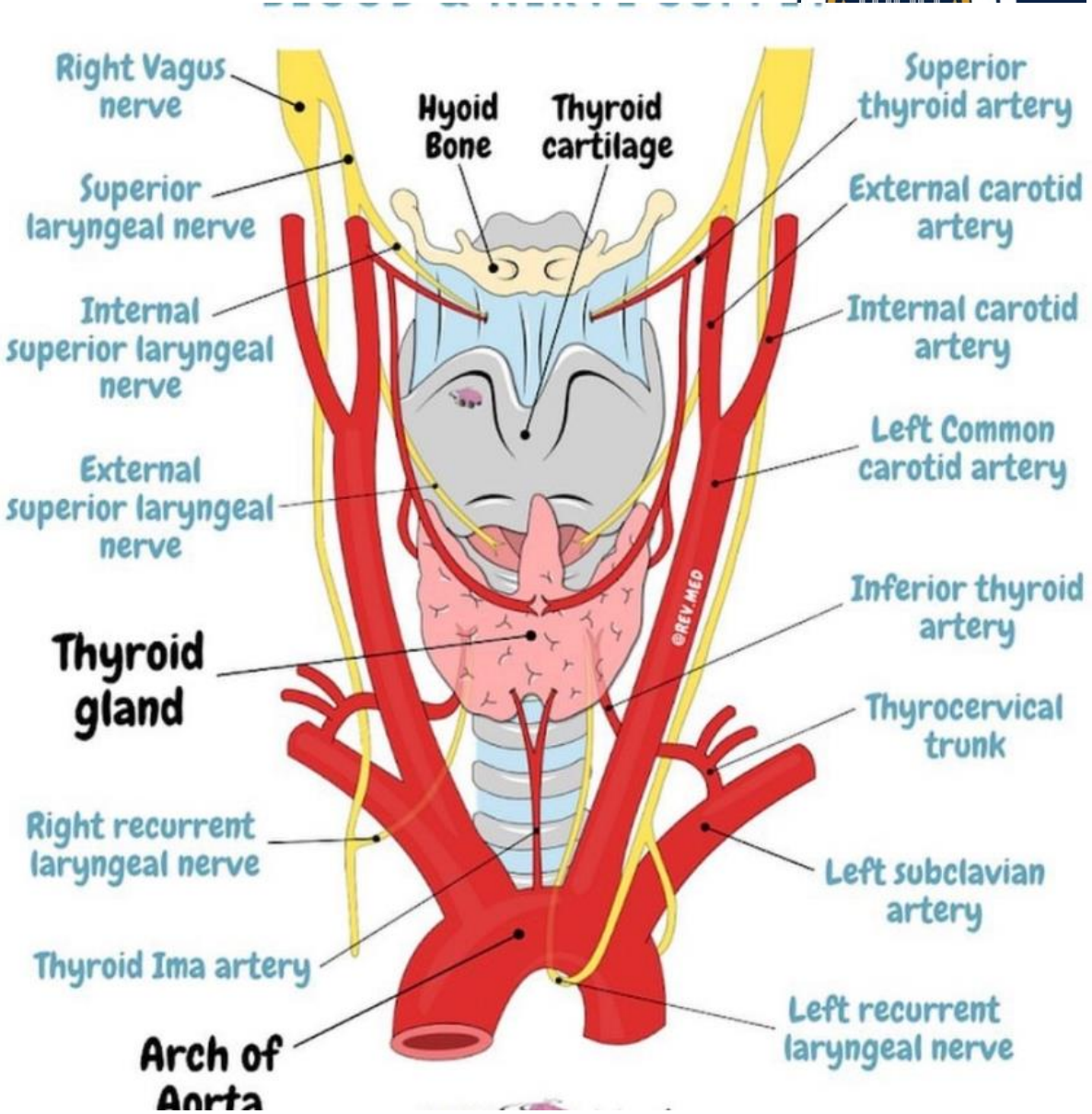
Anterior branch that anastomoses with its fellow of the opposite side.

Posterior branch that anastomoses with inferior thyroid artery.



Branches of thyroid artery:

1. Glandular branches: to the apex & upper 1/3 of the thyroid lobe and upper 1/2 of the isthmus.
2. Superior laryngeal artery: pierces the thyrohyoid membrane.
3. Infrahyoid artery.
4. Artery to sternomastoid muscle.
5. Artery to cricothyroid muscle.



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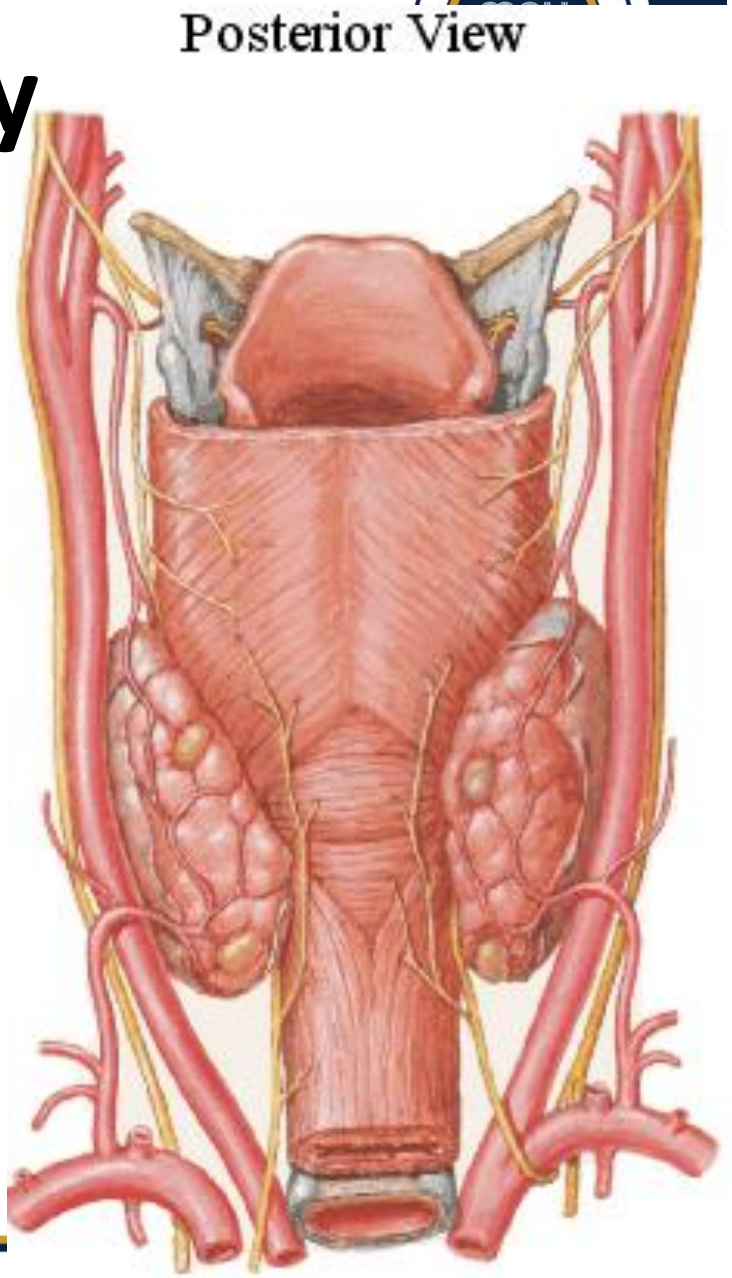
2. Inferior thyroid artery

Origin: thyrocervical trunk from 1st part of subclavian artery.

Course: accompanied with recurrent laryngeal nerve is related to it close to the gland.

Branches:

1. Glandular branches: to the base & lower 2/3 of the thyroid lobe and lower 1/2 of the isthmus.
2. Parathyroid glands
3. Inferior laryngeal artery.
4. Tracheal and esophageal branches.
5. Ascending cervical artery: anterior to scalenus anterior.



3. Thyroid ima artery:

- It may be present.
- **Origin:** it arises either from the arch of aorta or from the brachiocephalic artery.
- Ascends in front of the trachea to supply the isthmus.
- It is a potential source of bleeding when performing procedures in the midline of the neck inferior to the isthmus.

NB: Accessory thyroid arteries: From the esophageal and tracheal branches.

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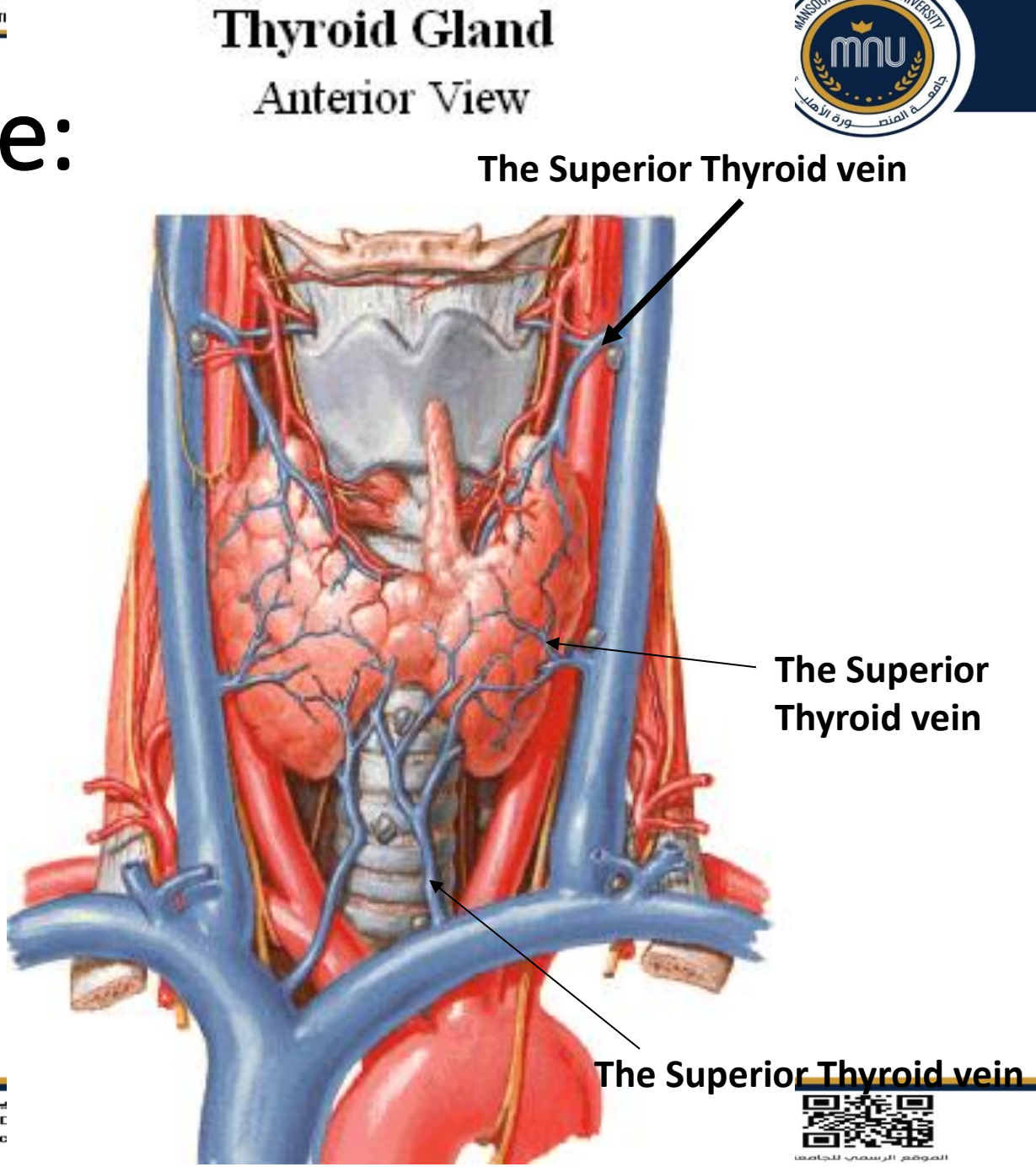
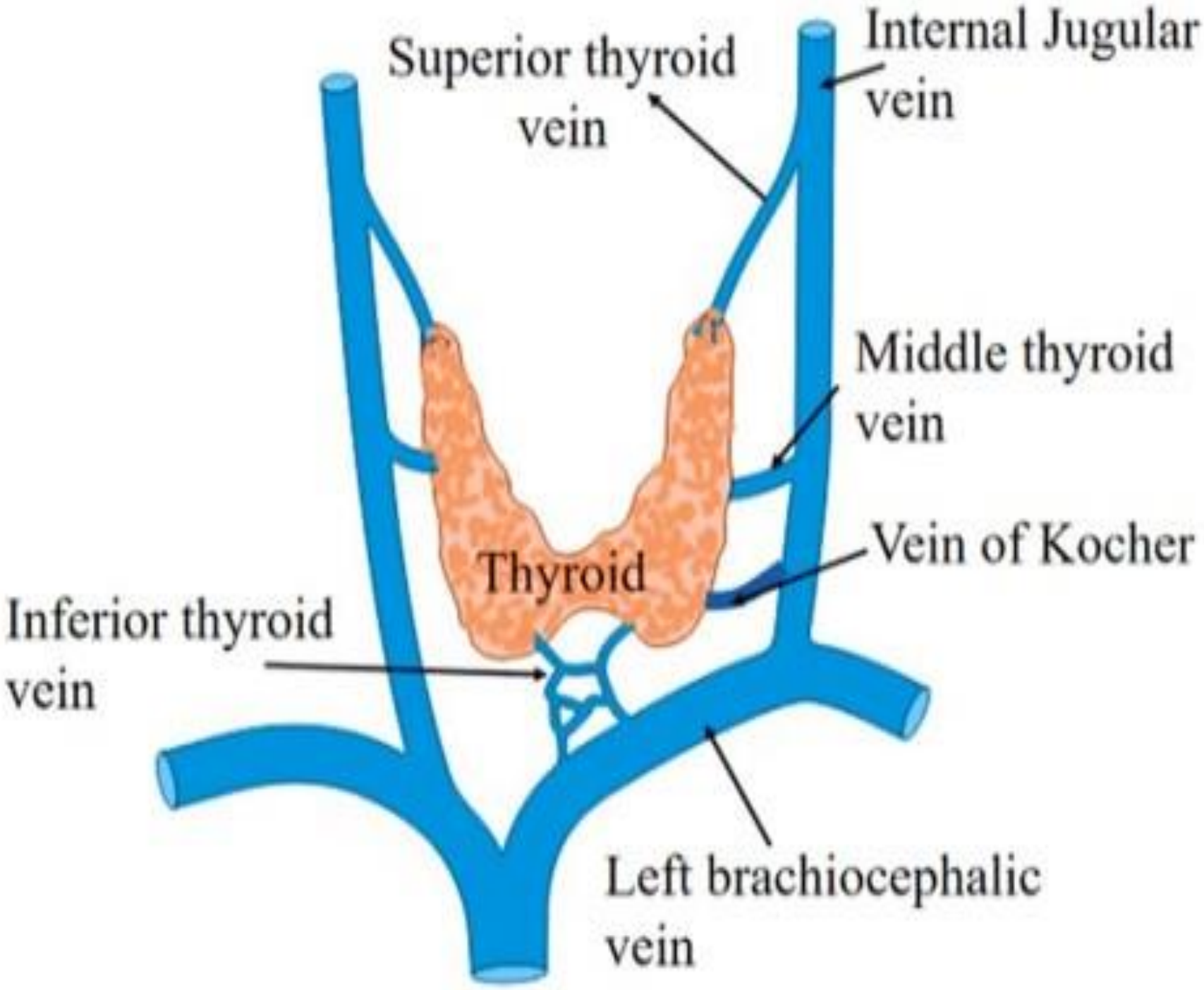
Venous Drainage:

1. **Superior thyroid vein:** it ends in internal jugular vein.
2. **Middle thyroid vein:** it ends also in internal jugular vein.
3. **Inferior thyroid vein:** it ends in brachiocephalic vein.




Superior thyroid vein
Internal Jugular vein
Middle thyroid vein
Vein of Kocher
Thyroid
Inferior thyroid vein
Left brachiocephalic vein

Lymphatic drainage of thyroid gland

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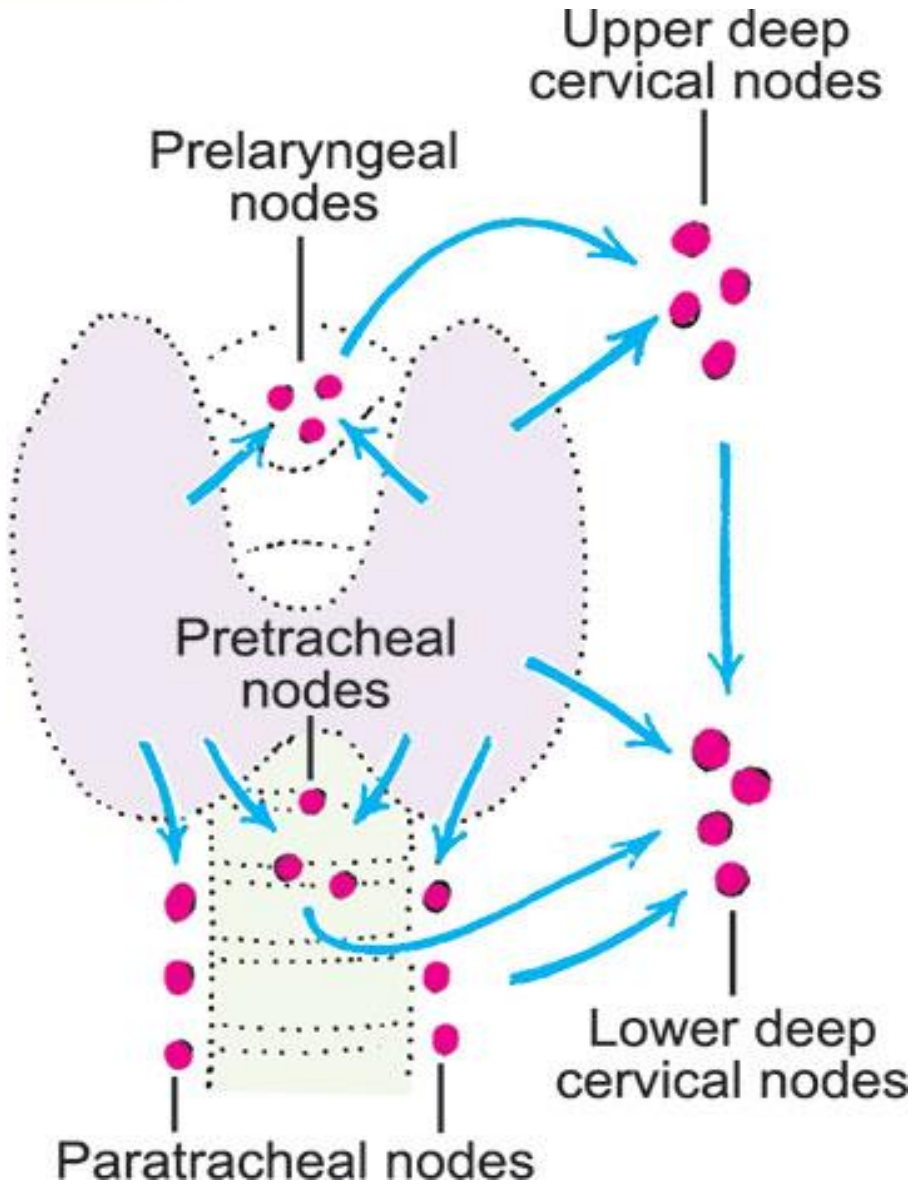
- **Upper parts:** upper and deep cervical lymph nodes.
- **Lower parts:** lower deep cervical lymph nodes.
- **Isthmus:** pretracheal lymph nodes.



Applied anatomy for thyroid gland

Injury of laryngeal nerves during thyroidectomy may cause hoarseness of voice

1) **Try to avoid injury of external laryngeal n** while ligating superior thyroid artery by ligating it near to the gland (as it lies away from the nerve at that position).

2) **Try to avoid injury of recurrent laryngeal n** while ligating inferior thyroid artery by ligating it away from the gland (as it lies away from the nerve at that position).

Clinical applied of thyroid gland

Case study

- 54 years old patient suffering from palpation, alertness and irritability. Lab examination and U/S was performed indicating **goiter**. **Thyroidectomy** was done but the patient suffered from post-operative hoarseness of voice.

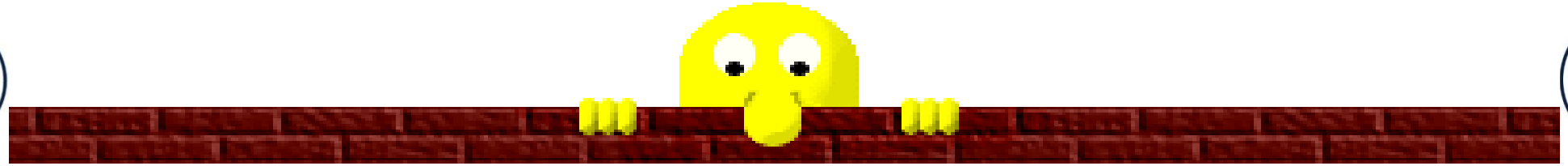
Explain?!!!

NB:

1. Unilateral or partial injury of recurrent laryngeal nerve may result in transient hoarseness of voice.

2. Bilateral nerve injury of recurrent laryngeal nerve may present with severe respiratory distress and stridor requiring immediate airway management and potential tracheostomy.

Massive Thyroid Enlargement



Parathyroid glands

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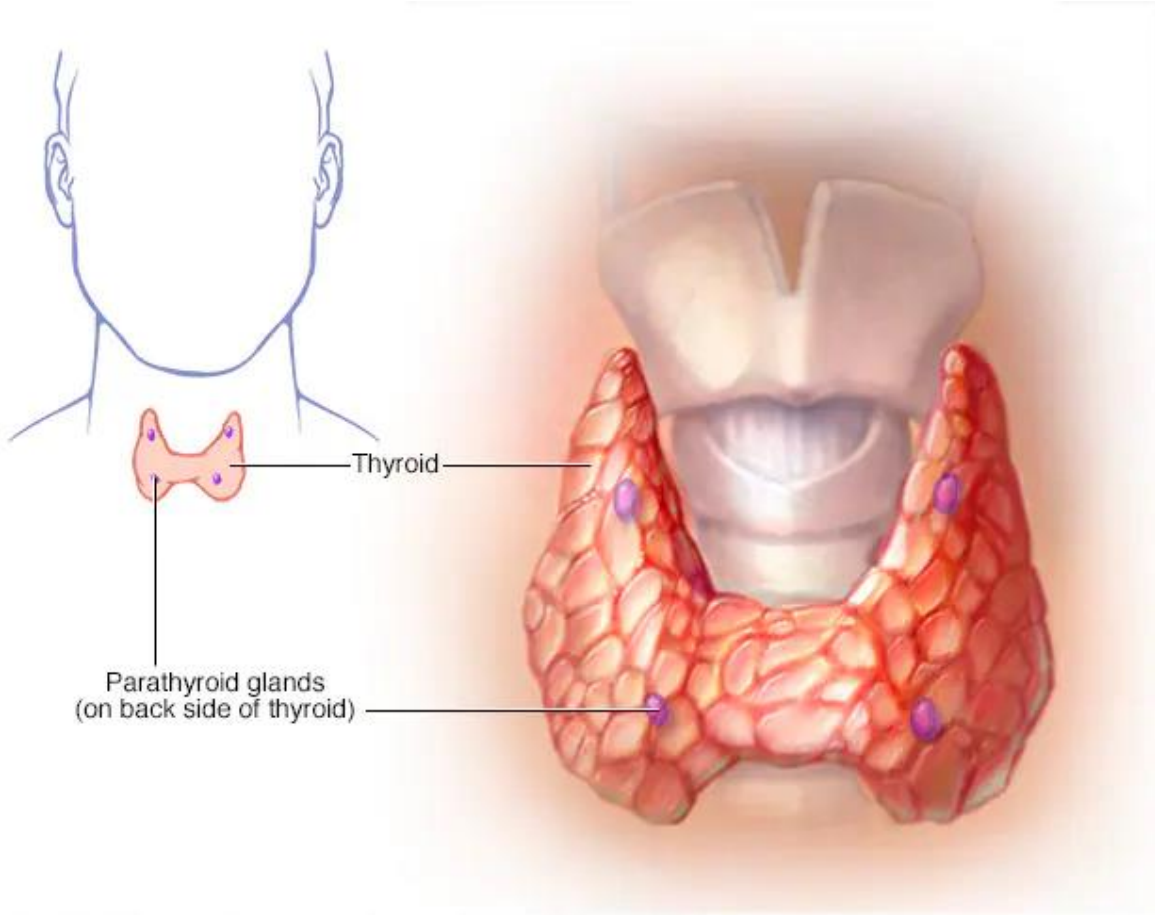
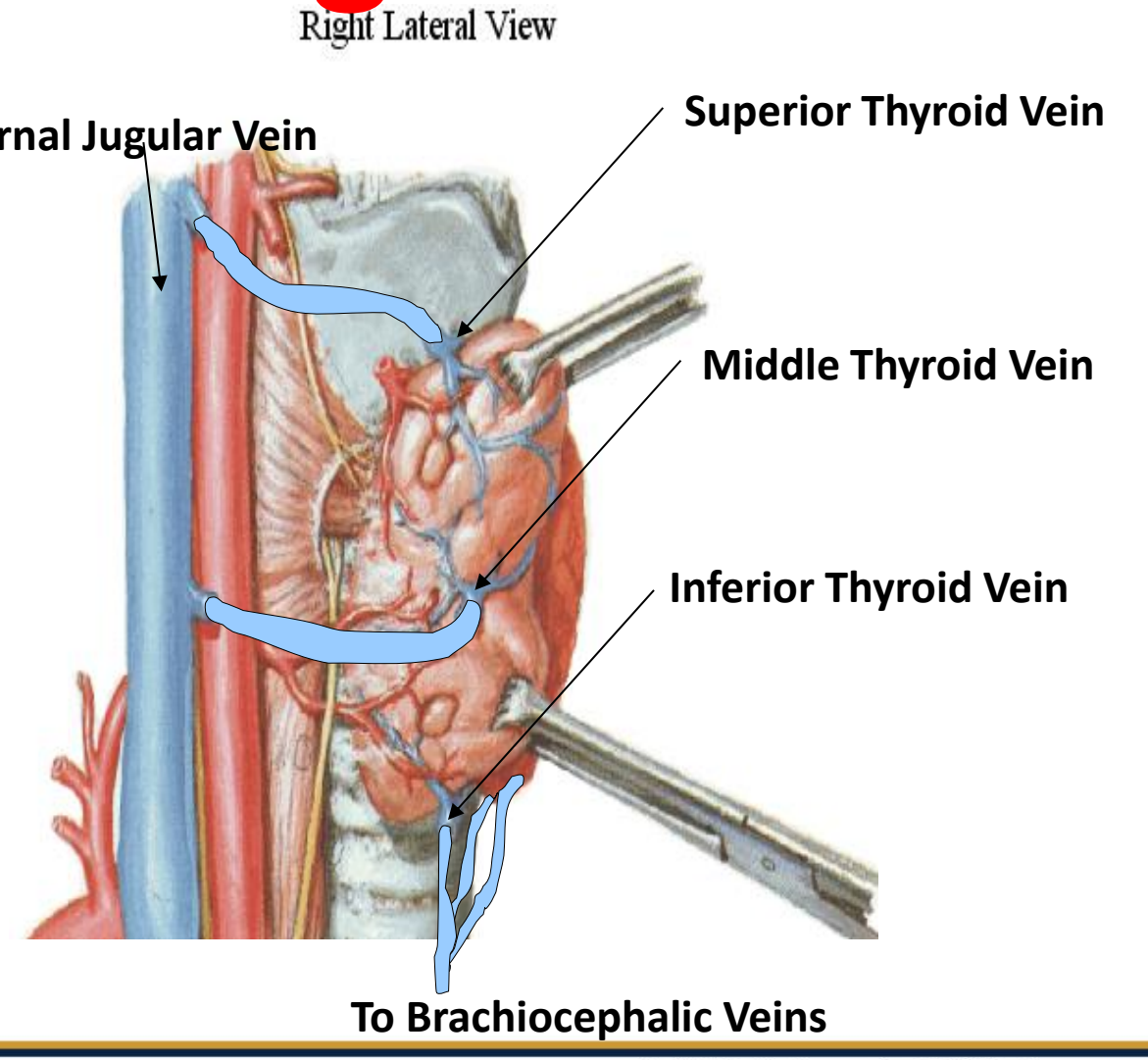
Site of parathyroid glands

The **two superior parathyroid glands** are the more constant in position and lie at the level of the middle of the posterior border of the thyroid gland, usually at the level of the inferior border of the cricoid cartilage.

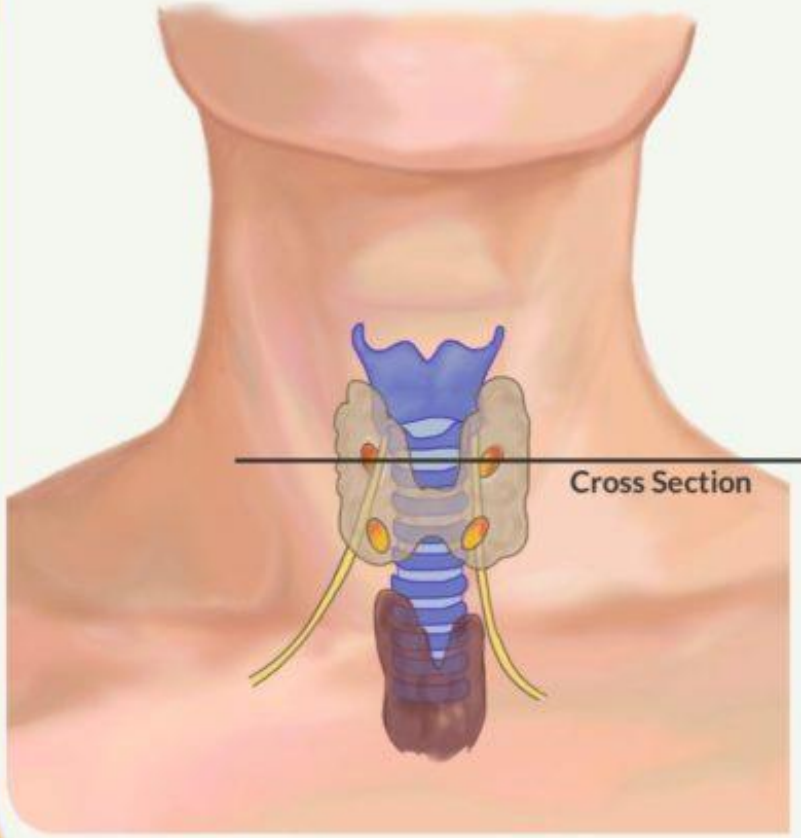


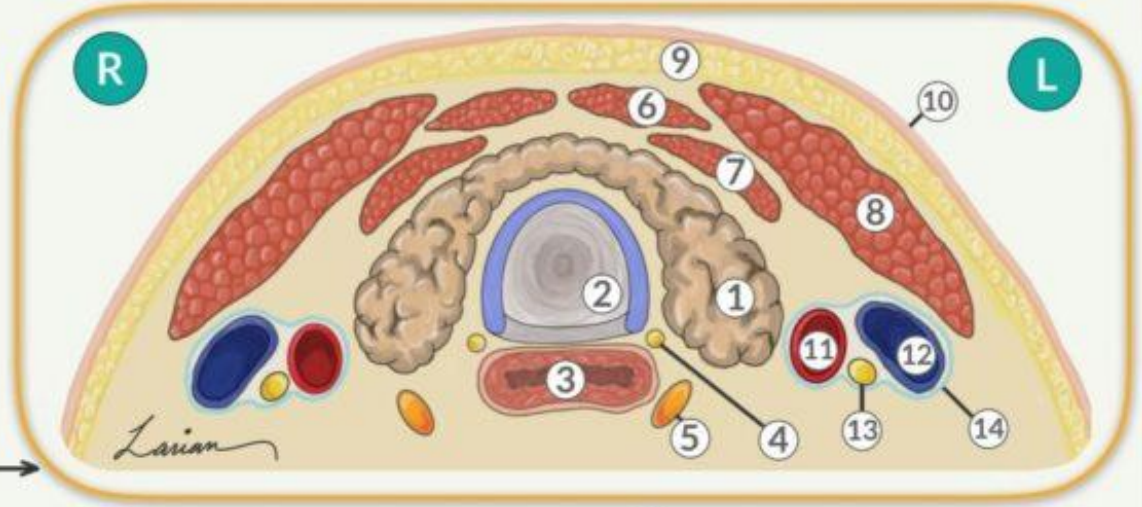
Site of parathyroid glands

- The **two inferior parathyroid glands** usually lie close to the inferior poles of the thyroid gland.
- They may lie within the fascial sheath, embedded in the thyroid substance, or outside the fascial sheath.
- They may be found some distance caudal to the thyroid gland, in **association with the inferior thyroid veins,** or they may in the superior mediastinum in the thorax.



Relative Location of Superior Parathyroids & RLN

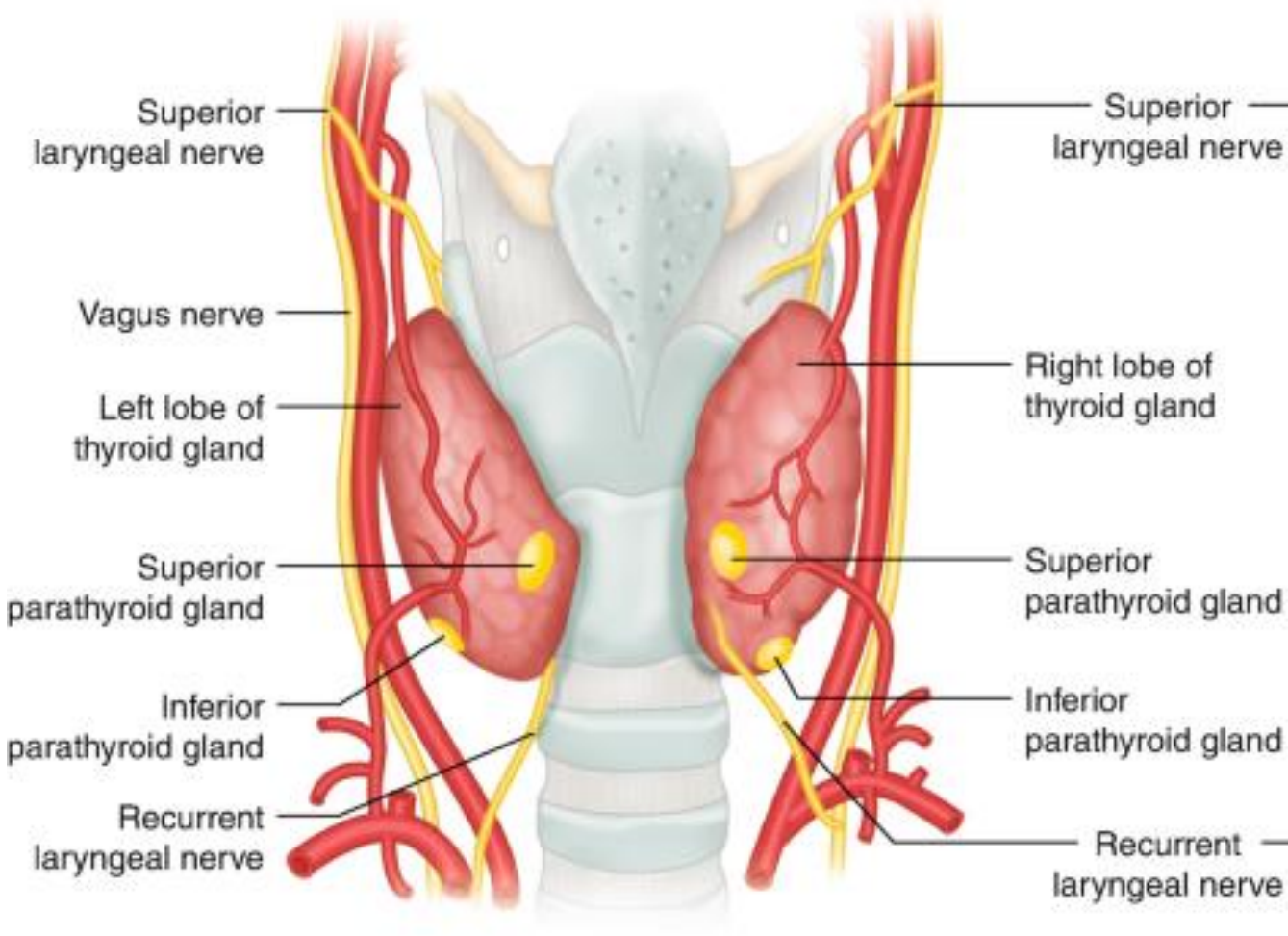




1. Thyroid
2. Trachea (Breathing Tube)
3. Esophagus (Swallowing Tube)
4. Recurrent Laryngeal Nerve (RLN)
5. Parathyroid
6. Sternohyoid Muscle
7. Sternothyroid Muscle
8. Sternocleidomastoid Muscle
9. Fat Layer Under Skin
10. Skin
11. Carotid Artery
12. Jugular Vein
13. Vagus Nerve
14. Carotid Sheath (Contains 11-13)

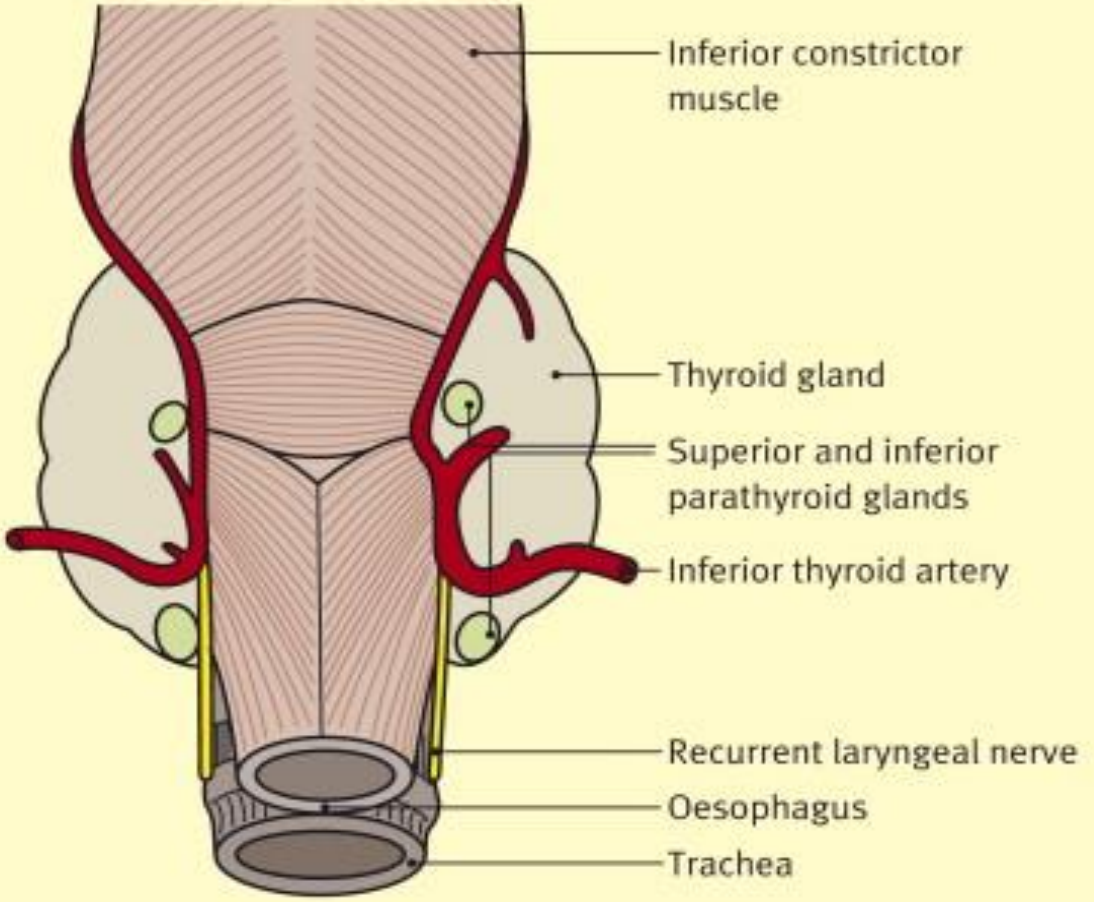
Features of parathyroid Glands

- The parathyroid glands are **ovoid bodies** measuring about **6 mm** in their greatest diameter.
- They are four in number and are closely related to the posterior border of the thyroid gland, lying within its fascial capsule.



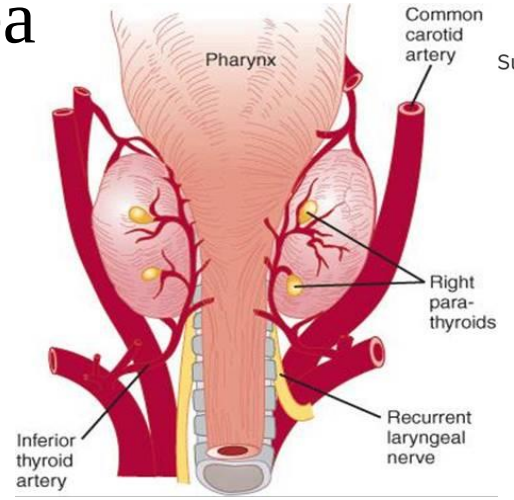
Posterior

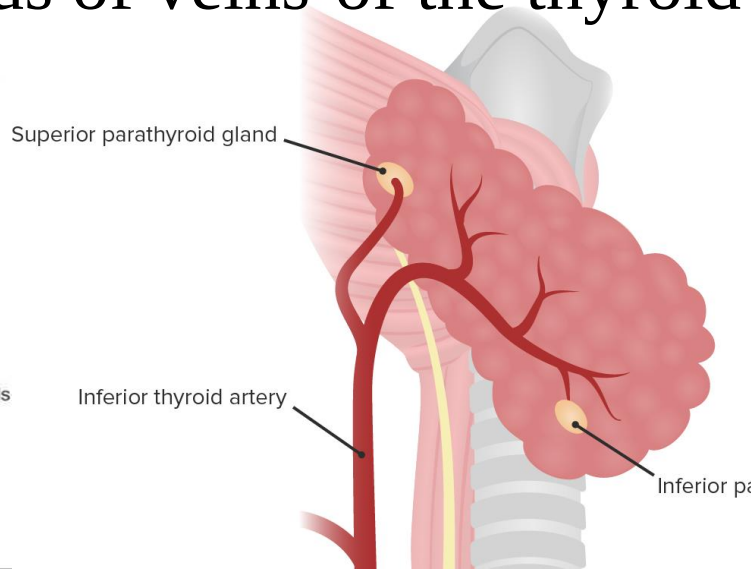
Posterior aspect of the thyroid gland

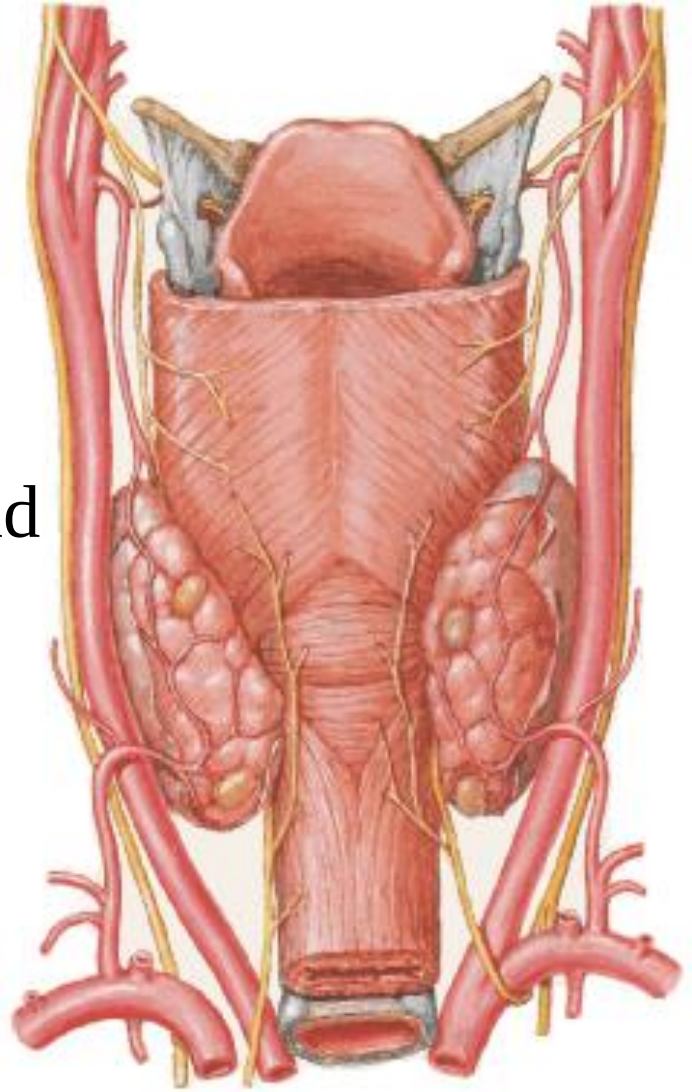


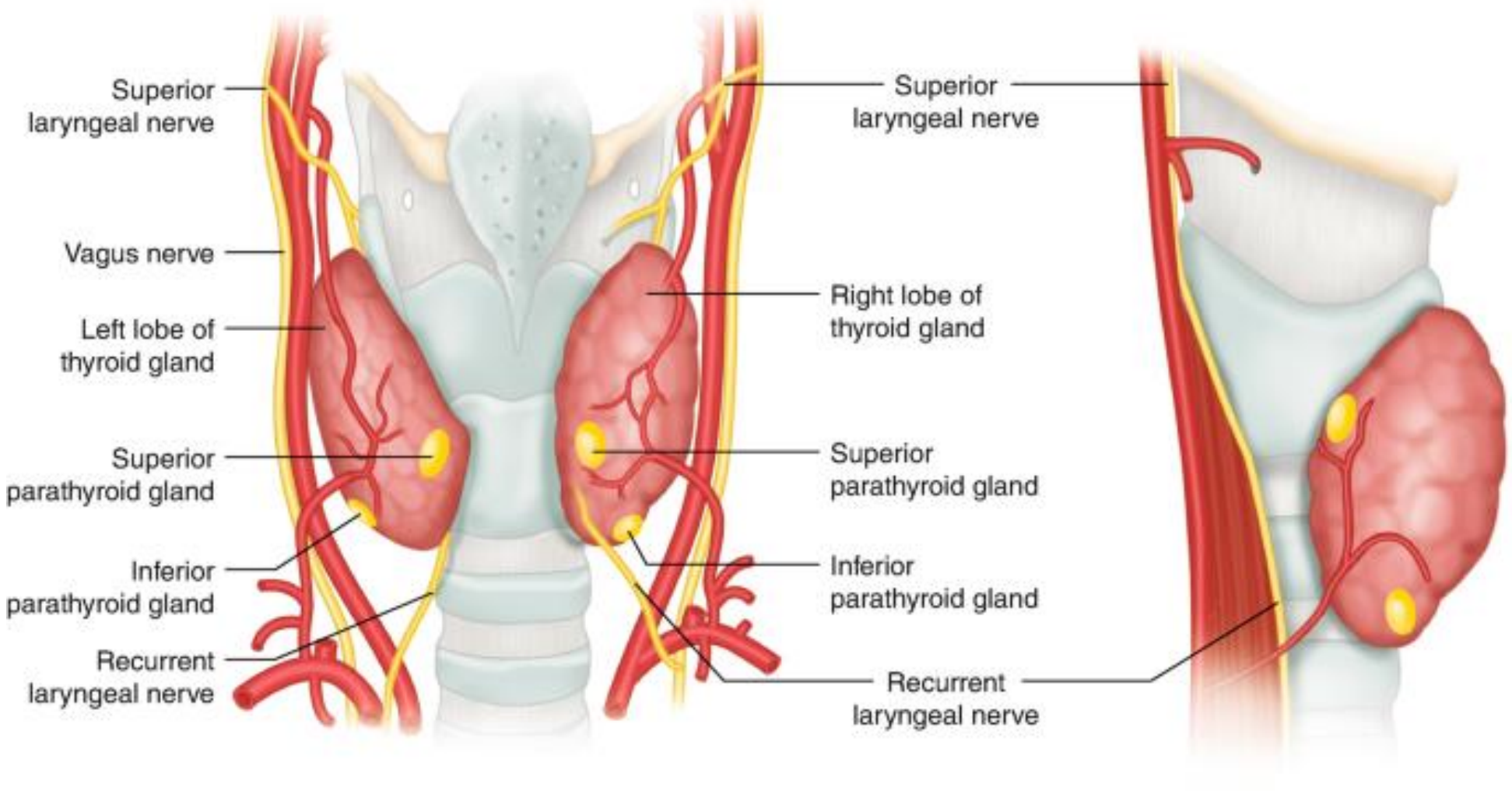
Blood Supply

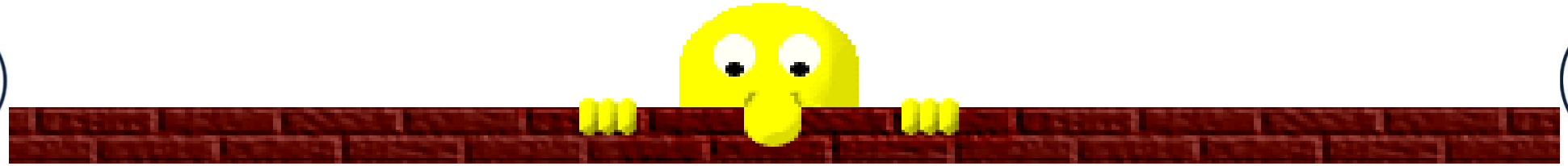
- **The arterial supply** to the parathyroid glands is from superior and inferior thyroid arteries **mainly inferior thyroid arteries.**
- **The venous drainage** is into the parathyroid veins drain into the thyroid plexus of veins of the thyroid gland and trachea








Superior laryngeal nerve
Vagus nerve
Left lobe of thyroid gland
Superior parathyroid gland
Inferior parathyroid gland
Recurrent laryngeal nerve
Superior laryngeal nerve
Right lobe of thyroid gland
Superior parathyroid gland
Inferior parathyroid gland
Recurrent laryngeal nerve



Development of thyroid gland

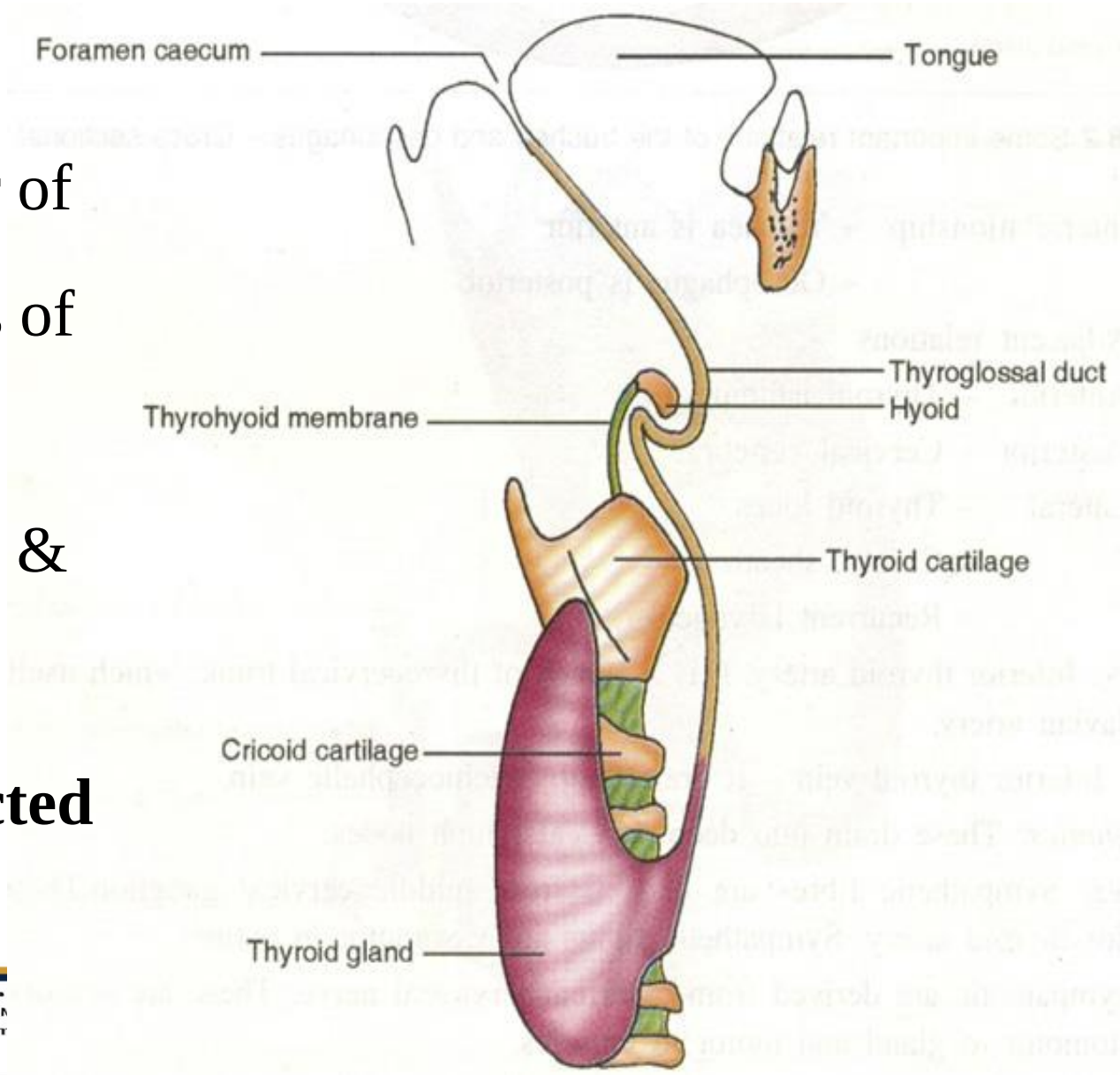
Time of development: 4th week

Steps:

1) Median **bilobed diverticulum** in floor of primitive pharynx between the processes of tongue

2) It **descends** ventral to pharynx, hyoid & thyroid cartilage

3) During its migration, it is still **connected** to tongue with thyroglossal duct



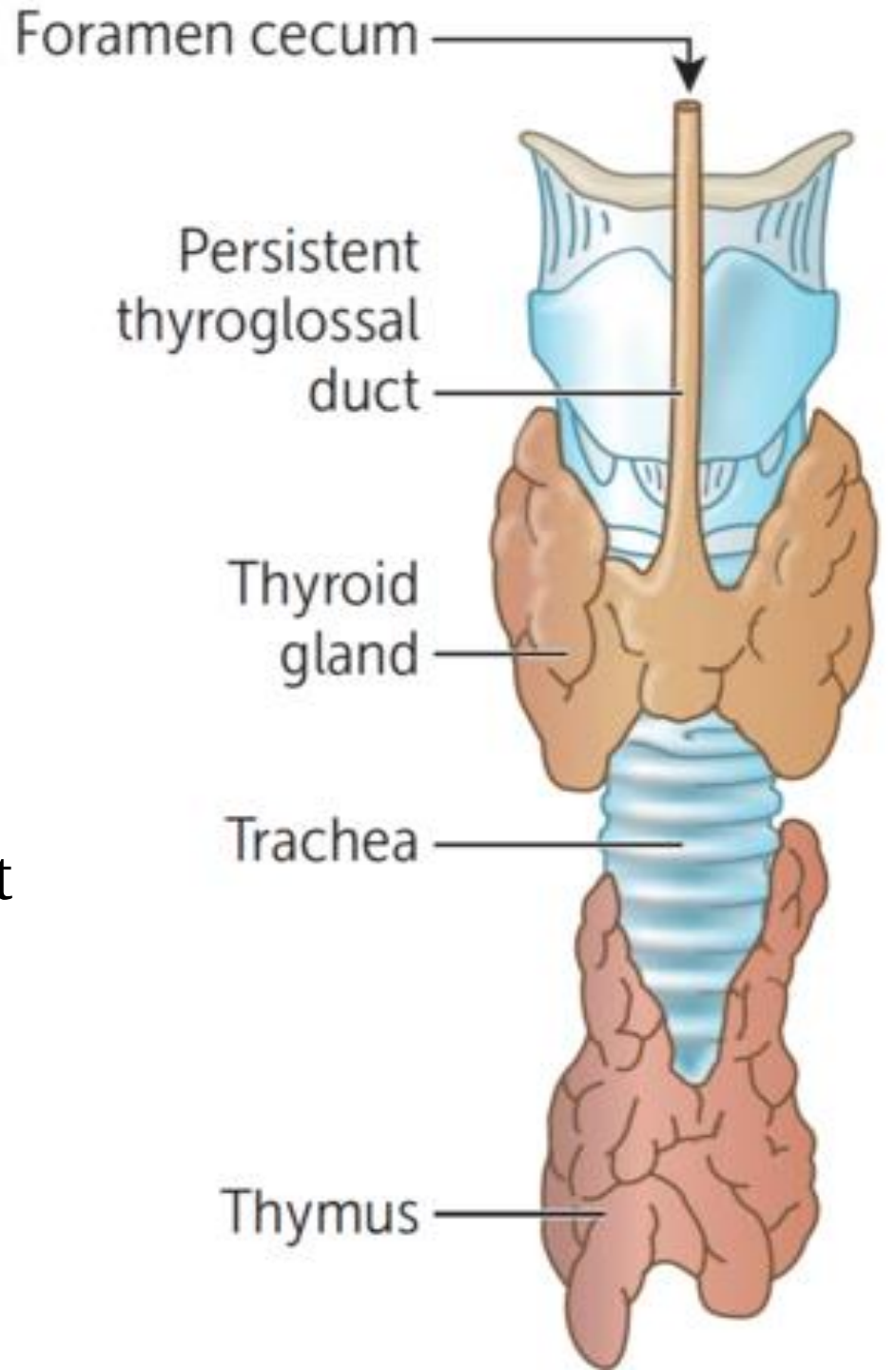
4) It reaches its **final position** in front of trachea **in 7th week**

5) It that time, it is formed of 2 lobes with a narrow isthmus

6) **Thyroglossal duct:** disappears except

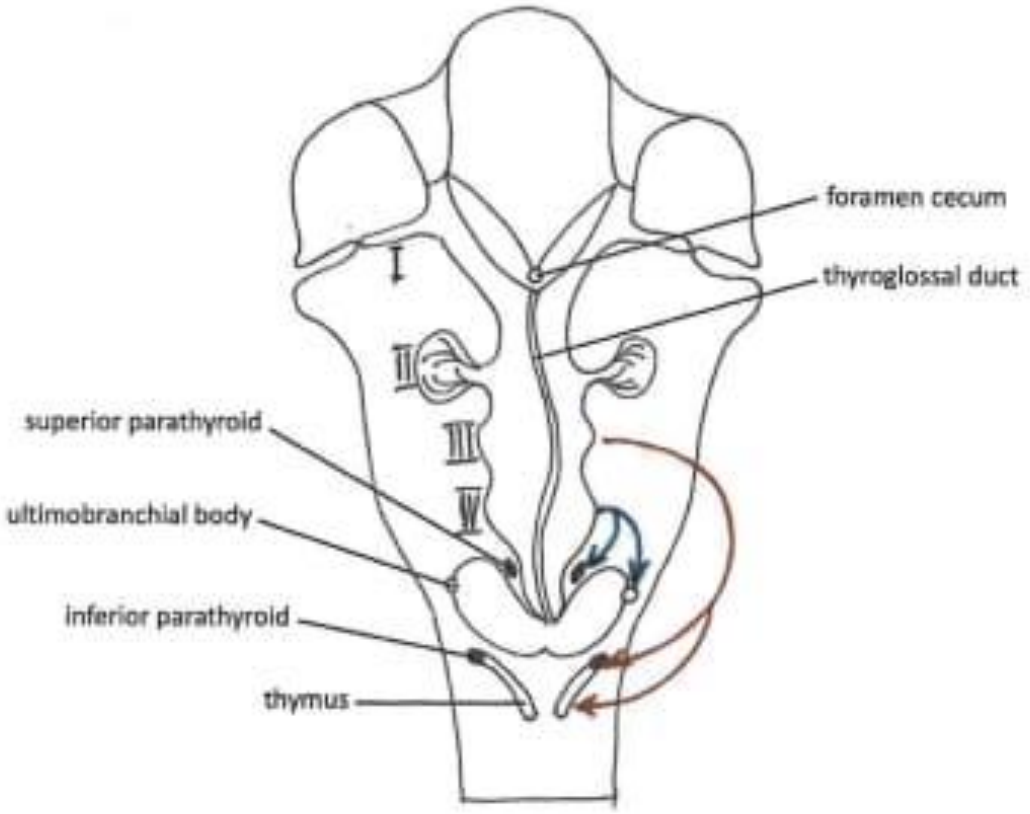
a) Foramen cecum of tongue at its proximal part

b) Pyramidal lobe & levator glandulae thyroidae at its distal part

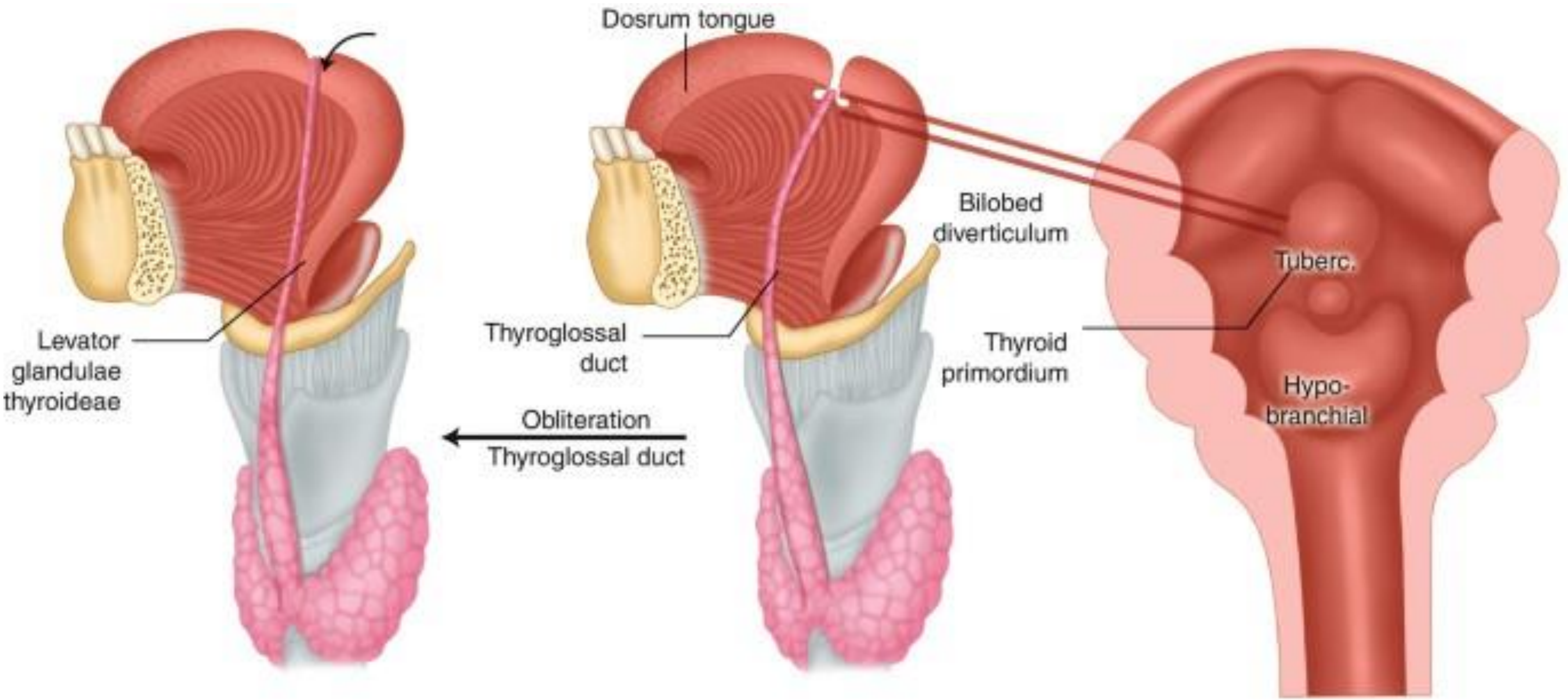


7) gland becomes functioning at 12th week with **colloid- filled follicles**

8) Parafollicular cells, (C cells) secreting calcitonin, derived from ultimobranchial body at 5th pouch.



NB: ultimobranchial body is an out pocketing of the fourth pharyngeal pouch that fuses with the thyroid diverticulum, giving rise to calcitonin-producing C-cells


Dosrum tongue
Bilobed diverticulum
Tuberc.
Thyroid primordium
Hypo-branchial
Levator glandulae thyroideae
Thyroglossal duct
Obliteration
Thyroglossal duct

Anomalies of thyroid

1) Aplasia or hypoplasia

2) Aberrant thyroid gland: found along path of thyroid descent

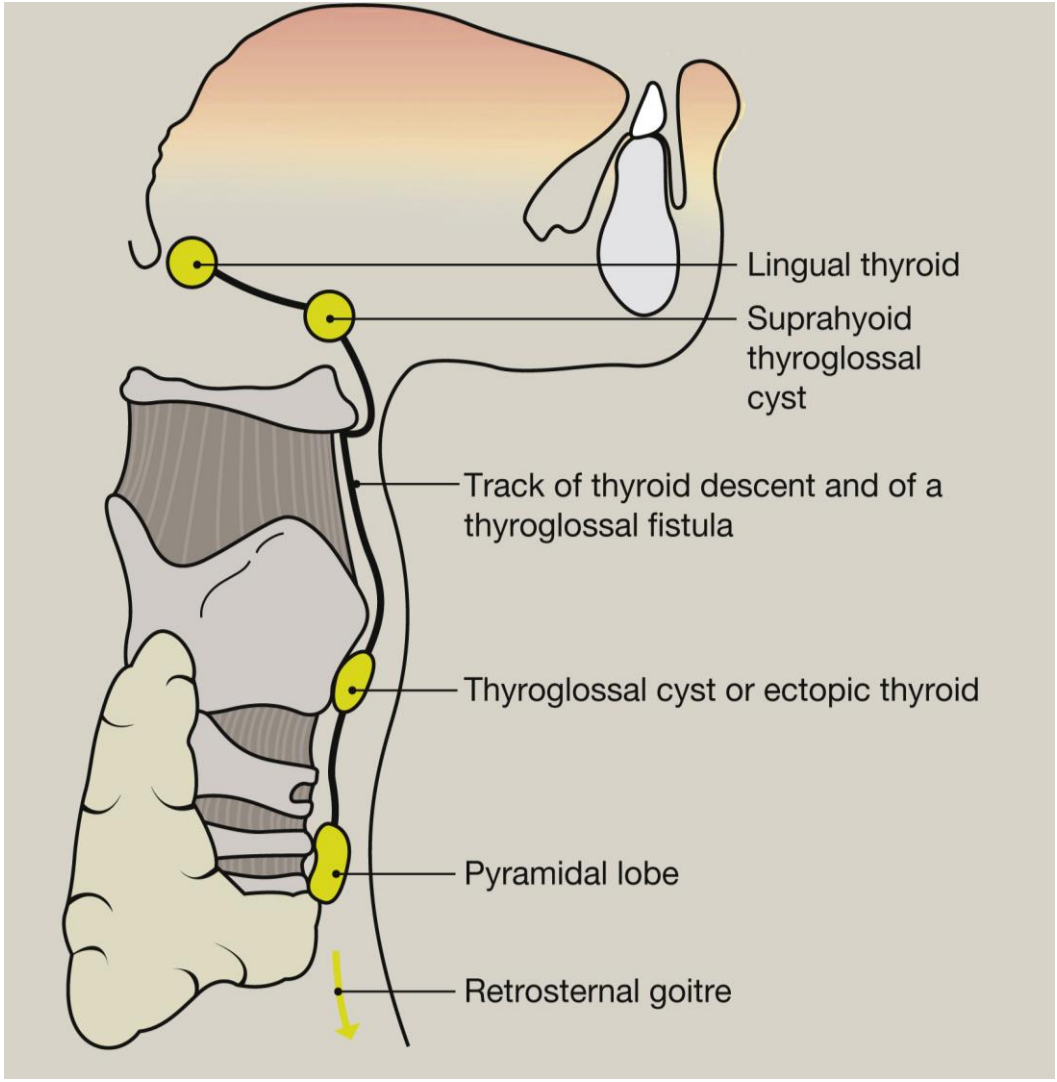
a) Lingual thyroid: found at base of tongue due to failure of descent

b) Retrosternal thyroid: due to excessive descent

3) Anomalies of thyroglossal duct:

a) Thyroglossal cyst: found along path of thyroid descent at midline

b) Thyroglossal fistula: opening at midline of neck



Anomalies of the thyroid gland

Agenesis

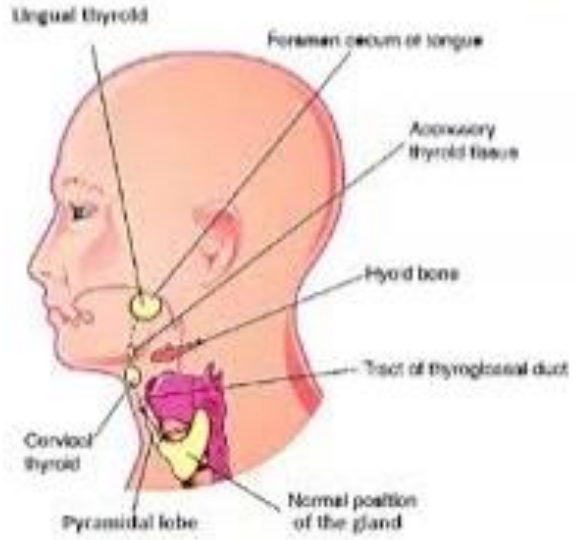
- It means congenital absence of thyroid gland, causing congenital cretinism.

Aberrant thyroid

- It means ectopic thyroid tissue along the course of the thyro-glossal duct (lingual, supra-hyoid, retro-hyoid, or infra-hyoid thyroid).

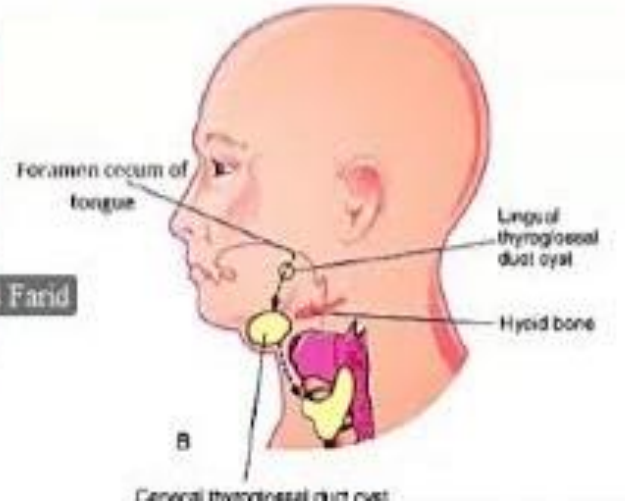
Thyro-glossal cyst

- It is located close to the middle line, and moves with deglutition (compare with branchial cyst).



Aberrant thyroid

Thyro-glossal cyst



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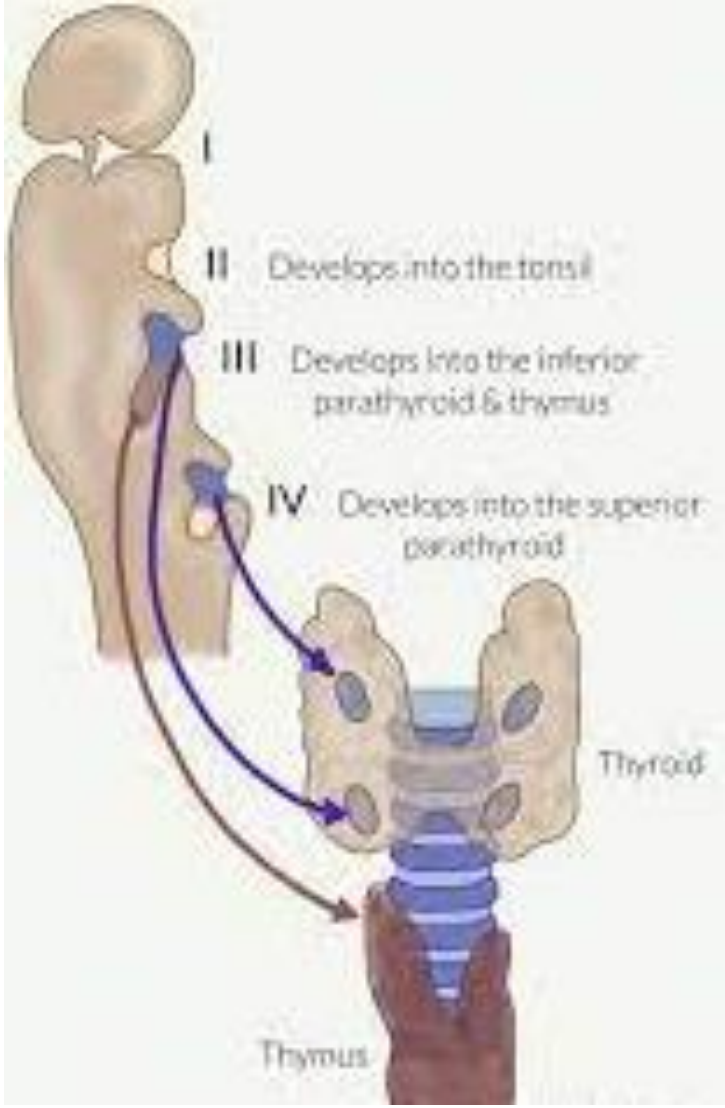
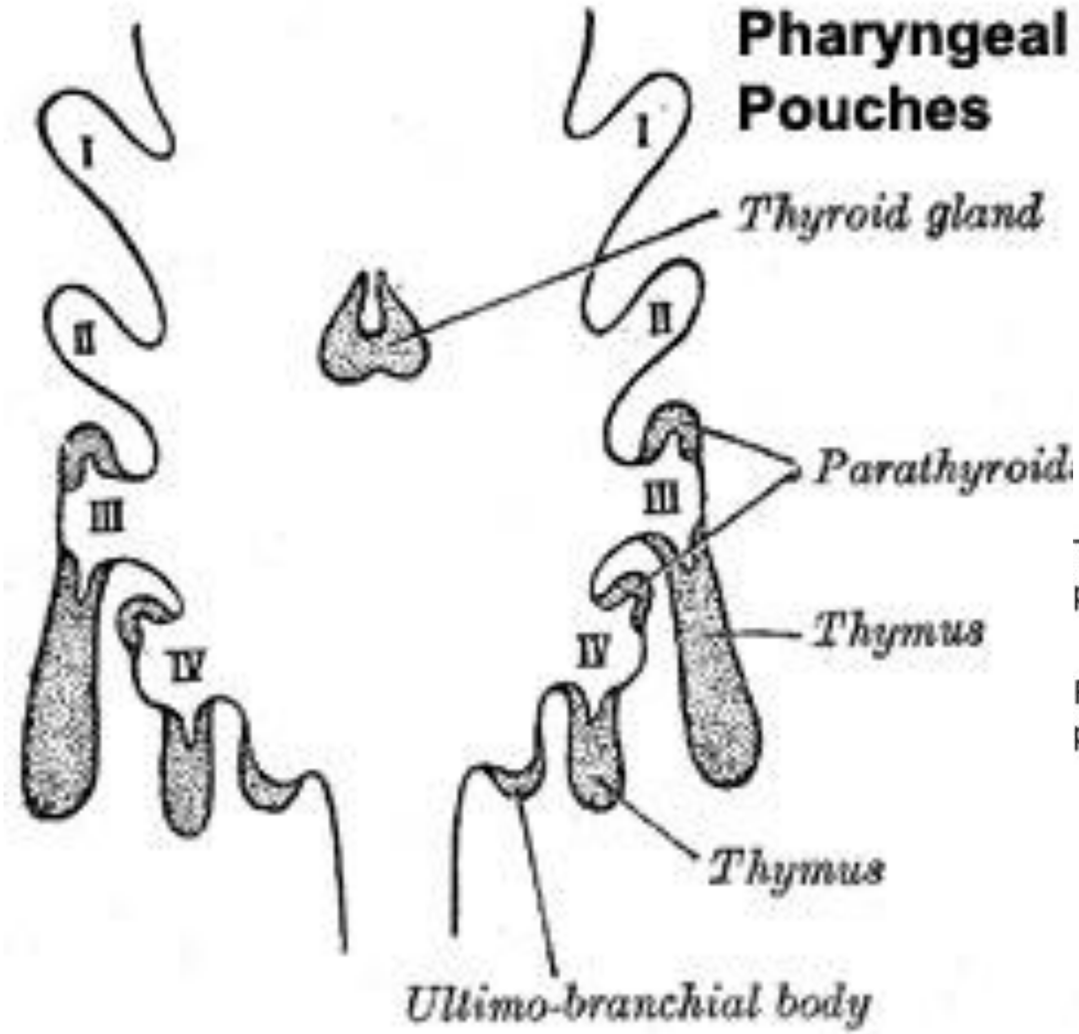
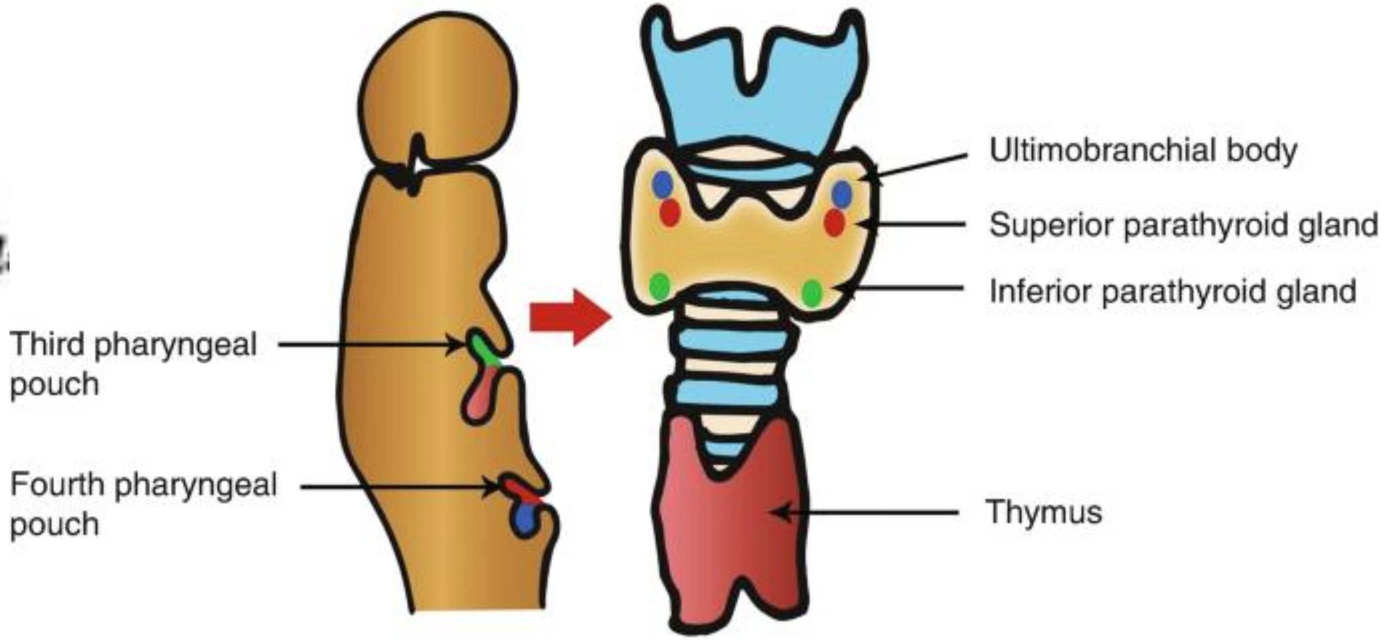
Development of Parathyroid glands

Development of parathyroid glands

- Embryologically, the parathyroid glands derive from the endoderm of the third and fourth pharyngeal pouches.
- The third pharyngeal pouch gives rise to the inferior parathyroid glands.
- the fourth pharyngeal pouch gives rise to the superior parathyroids.




Pharyngeal Pouches
I
II
III
IV
Thyroid gland
Parathyroid
Thymus
Thymus
Ultimo-branchial body


Third pharyngeal pouch
Fourth pharyngeal pouch
Ultimobranchial body
Superior parathyroid gland
Inferior parathyroid gland
Thymus

Quiz 1

1- Superior thyroid artery arises from which artery

A- Internal carotid

B- External carotid

C- Subclavian

D- Vertebral

ANSWER: B

Quiz 2

2- Thyroid gland reaches its final position in front of trachea in which week

A- 4^{th}

B- 5^{th}

C- 6^{th}

D- 7^{th}

ANSWER: D

References for further readings

- Oxford Handbook of Clinical Medicine (3rd edition).
- Gray's anatomy for students
- Longman`s medical embryology 10th edition , T.W.Sadler
- Chen CJ (2001) Suprasellar and infrasellar craniopharyngioma with a persistent craniopharyngeal canal: Case report and review of the literature. Neuroradiology 43:760–762
- Chong BW, Newton TH (1993) Hypothalamic and pituitary pathology. Radiol Clin North Am 31:1147–1183


الحمد لله
Thank You
Thank You