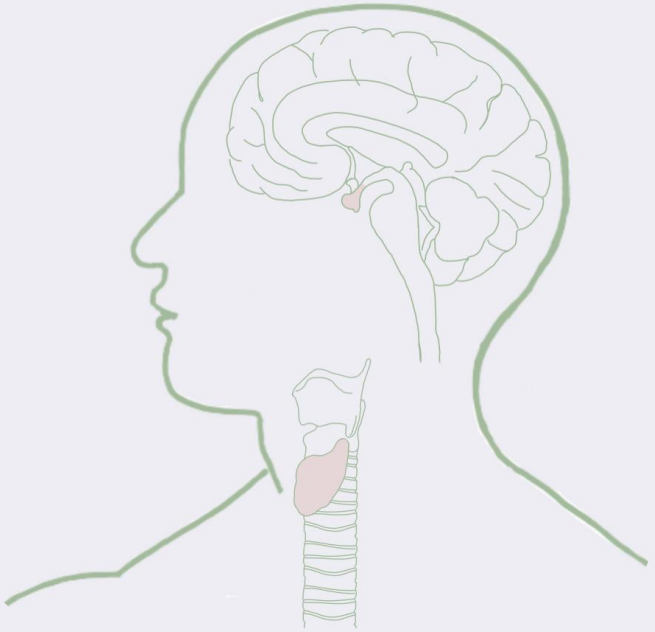

Anatomy & embryology of thyroid & parathyroid glands

Editing File

Color index:

Girls' slides	Boys' slides
Main content	Extra
Important	Drs' notes

MED439
KING SAUD UNIVERSITY

Anatomy Team
MED 439

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Objectives:

- Describe the shape, position, relations and structure of the thyroid gland.
- List the blood supply & lymphatic drainage of the thyroid gland.
- List the nerves endanger with thyroidectomy operation.
- Describe the shape, position, blood supply & lymphatic drainage of the parathyroid glands
- Describe the development of the thyroid & parathyroid glands.
- Describe the most common congenital anomalies of the thyroid gland.

Endocrine System

Click here to check out lecture's related videos playlist

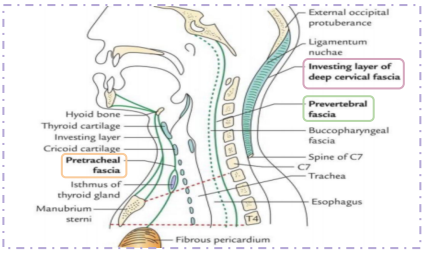
Found in Boys' slides only

- The endocrine system is a network of glands in our body that make the hormones that to help cells talk to each other.
- It is the collection of glands that produce hormones that regulate metabolism, growth and development, tissue function, sexual function, reproduction, sleep, and mood, among other things.
- They are responsible for almost every cell, organ, and function in your body.
- If your endocrine system is not healthy, you might have problems developing during puberty, getting pregnant, or managing stress.
- You also might gain weight easily, have weak bones, or lack energy because too much sugar stays in your blood instead of moving into your cells where it's needed for energy.
- Endocrine glands release the substances they make into your bloodstream.

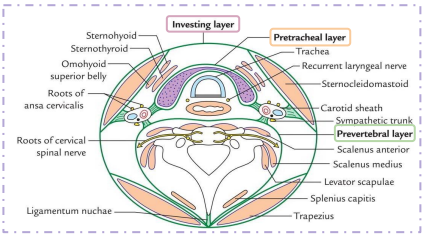
The deep fascia or deep cervical fascia of the neck:

It's divided mainly into 3 layers:

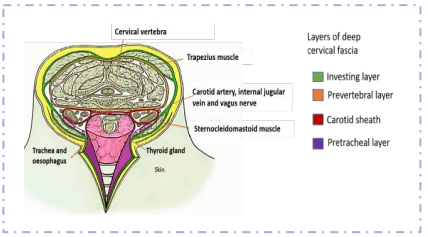
1. **Investing layer**
   Most superficial (external) Surrounds the muscles of the neck anteriorly and the trapezius posteriorly



2. **Pretracheal layer**
   Surrounds the trachea and the thyroid gland



3. **Prevertebral layer**
   Surrounds the prevertebral muscles

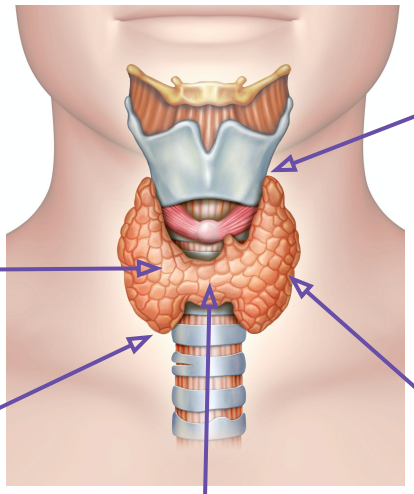


Thyroid gland

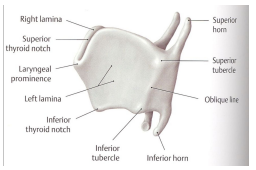
Structure:

- Endocrine, butterfly shaped gland.
  - Largest endocrine gland; Glands of the endocrine system that secrete their products, hormones, directly into the blood rather than through a duct.
  - Found in neck below thyroid cartilage
  - It is surrounded by a facial sheath derived from the pretracheal layer of the deep cervical fascia.
  - **Inside the pretracheal facial capsule,** there is another C.T capsule. So, It's surrounded by **2** membranes. fibrous C.T capsule internally pretracheal deep fascia externally

Lobes:



Apex: reaches up to the **oblique line of thyroid cartilage.**



Right lobe (Pear shaped)

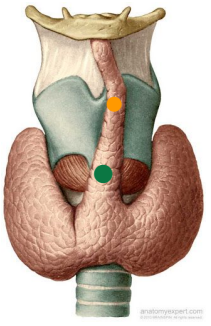
Base: lies at the level of 4th or 5th tracheal rings.

Left lobe (Pear shaped)

The two lobes are connected to each other by a median tissue mass called **narrow isthmus** , which extends across the midline in front of the **2nd, 3rd & 4th tracheal rings.**

Pyramidal lobe:

- A 3rd small ● **pyramidal lobe** is often present which projects from the upper border of the isthmus usually to left of middle line.
- Pyramidal lobe is connected to hyoid bone by a fibrous or muscular band called ● **levator glandulae thyroideae.**
- This pyramidal lobe represents in 50% of people the fibrosed & obliterated thyroglossal duct, it's a remnant of it. thyroid (most people don't have a third pyramidal lobe however it's harmless and non-functioning)
- It's occasionally quite detached or may be divided into two or more parts.



Thyroid gland

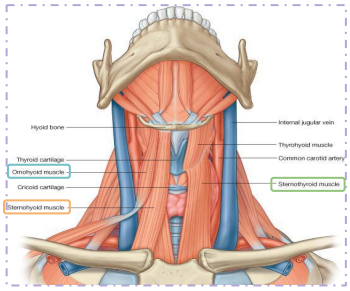
Relations

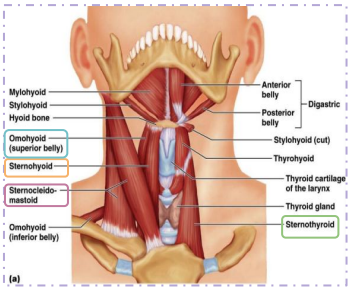
Surfaces

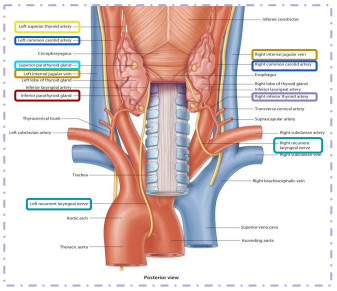
Anterolaterally It all starts with the letter S	Posteriorly	Medially	
		(Above)	(Below)
● **S**ternothyroid. ● **S**ternohyoid. ● **S**uperior belly of omohyoid ● **S**ternomastoid	● Carotid sheath & its contents. (● Vagus nerve, ● common carotid artery and ● internal jugular vein)	○ Larynx ○ Pharynx . ○ Cricothyroid muscle ○ External laryngeal nerve (supplying the cricothyroid muscle)	○ Trachea ○ Esophagus. ● Recurrent laryngeal nerve in between. ○ Cricothyroid muscle ○ External laryngeal nerves

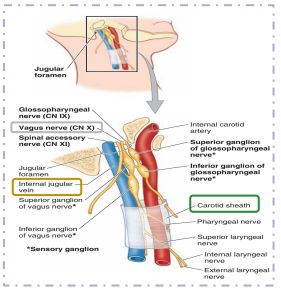
Posterior border is related to

The ● superior & ● inferior Parathyroid glands.	Anastomosis between ● superior & ● inferior thyroid arteries.





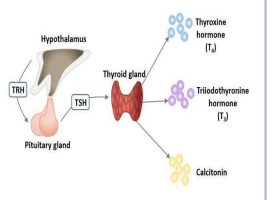




"Found in Boys' slides only"

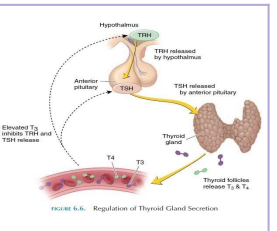
Secretion

- **The gland produces thyroid hormones:**
  -Triiodothyronine(T3)
  - Thyroxine(T4)
- These hormones regulate the growth and rate of function of many other systems in the body



Functions

- Regulating the body metabolism and calcium balance.
- The T4 and T3 hormones stimulate every tissue in the body to produce proteins and increase the amount of oxygen used by cells.
- The calcitonin hormone works together with the parathyroid hormone to regulate calcium levels in the body.



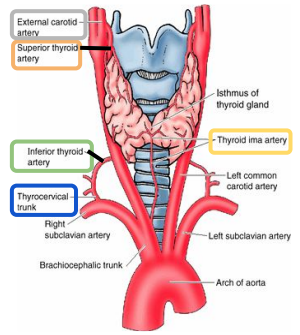
Thyroid gland's supply

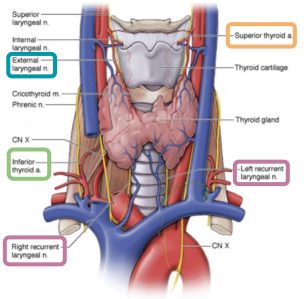
Arterial supply

Superior thyroid and inferior thyroid arteries are the main arterial supply to the thyroid, and there is an anastomosis existing between them

How many arteries supply the thyroid gland? 5 arteries

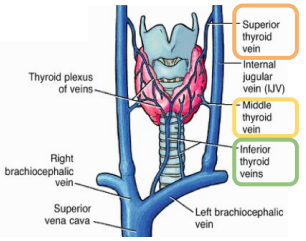
- **1. Superior thyroid artery** (2 arteries) Remember superior always comes with external (external carotid artery and external laryngeal nerve)
  - It is a branch from the ● **external carotid artery**
  - It descends to the upper pole of the lobe, with the ● **external laryngeal nerve** (supplies the cricothyroid)
  - It runs along the upper border of the isthmus to anastomosis with its fellow
- **2. Thyroidea ima artery:** (ima) و ننصدم و نقول اما (Brachiocephalic) تذكروا صدمتنا لما يقولون عندكم بريك
  - If present, it arises from **aortic arch** or from **brachiocephalic artery.**
  - It ascends in front of the trachea to reach the isthmus then to both lobes
- **3. Inferior thyroid artery** (2 arteries)
  - From the ● **thyrocervical trunk** of 1st part of subclavian artery.
  - Then it curves medially behind the carotid sheath.
  - It ascends behind the gland to the level of **cricoid cartilage (at level of C6 vertebra).**
  - Then it reaches the posterior aspect of the gland and descends downwards.
  - The ● **recurrent laryngeal nerve** crosses either in front or behind it.





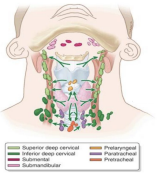
Venous drainage

- Superior thyroid vein → internal jugular vein
- Middle thyroid vein → internal jugular vein
- Inferior thyroid vein → left brachiocephalic vein



Lymphatic

- Deep cervical lymph nodes on the sides of the internal jugular vein.
- Paratracheal lymph nodes.



Innervation

- Sympathetic: Cervical Sympathetic Trunk. (superior, middle, and inferior ganglia)
- Parasympathetic: Branches of Vagus

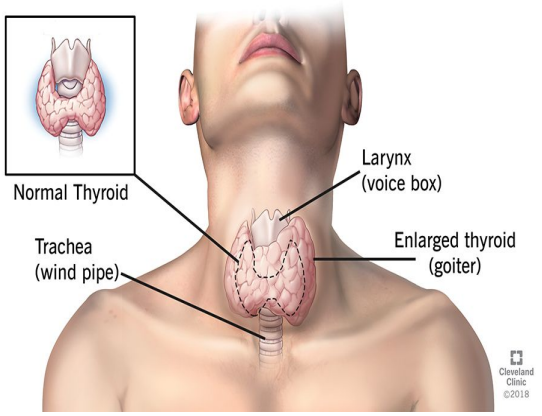
These small nerves enter the gland along with the blood However, these nerves do not control endocrine secretion The release of hormones is regulated by pituitary gland.

Thyroid gland's diseases

Found in Boys' slides only

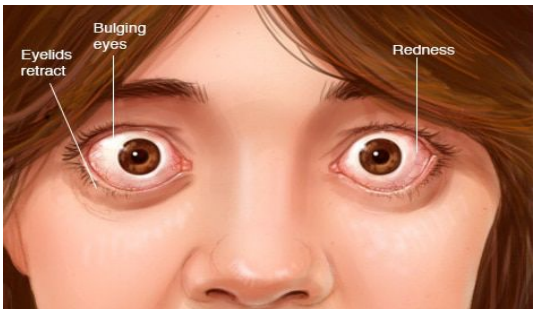
Goiter

- It's a swelling in the thyroid gland which can lead to a swelling of the neck or larynx (voice box).
- It's a term that refers to an enlargement of the thyroid and can be associated with a thyroid gland that is functioning properly or not.
- Worldwide, over 90% cases of goiter are caused by iodine deficiency.



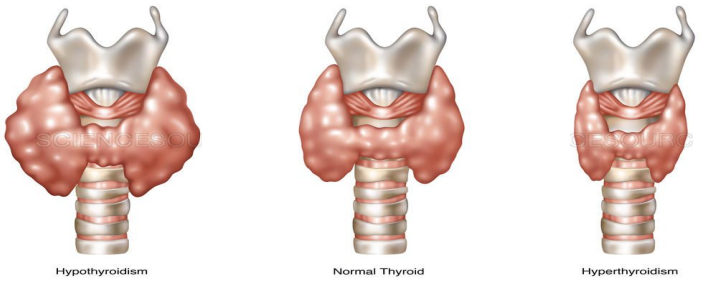
Graves' disease

- It is also called exophthalmic goiter, toxic goiter or thyrotoxicosis.
- It is an autoimmune disorder where hyperplasia of the thyroid parenchyma leads to excess thyroid hormone being produced.
- There is an increase in the metabolic rate of cells resulting in thyrotoxic symptoms such as sweating, weight loss, rapid pulse and warm moist skin.
- Exophthalmos occurs.
- Treatment includes drugs, destruction, or removal of the thyroid gland.



Hyperthyroidism

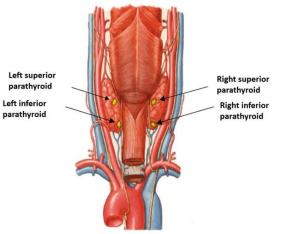
- It generally results from a tumor of the thyroid gland.
- Extreme overproduction of thyroxine results in a high basal metabolic rate, intolerance of heat, rapid heartbeat, weight loss, nervous and agitated behavior, and a general inability to relax.
- Graves' disease is one form of hyperthyroidism.
- In addition to the symptoms of hyperthyroidism described earlier, the thyroid gland enlarges, and the eyes may bulge, or protrude anteriorly.
- Hyperthyroidism may be treated surgically by removal of part of the thyroid (and/or a tumor if present) or chemically with thyroid blocking drugs or radioactive iodine, which destroys some of the thyroid cells.

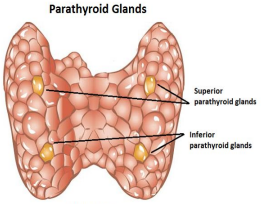


Parathyroid gland

Structure

- 4 small ovoid bodies, about 6 mm long.
- They are found in the neck and produce parathyroid hormone.
- Parathyroid glands control the amount of calcium in the blood and within the bone.
- They lie within the facial capsule of the gland, (between the 2 membranes).located on the rear surface of the thyroid gland.
- Two superior parathyroid has a constant position at the middle of the posterior border of the gland.
- Two inferior parathyroid usually at the level of the inferior pole.
- They lie within the thyroid tissue or sometimes outside the facial capsule . They might even reach the superior mediastinum





Supply

Arterial Supply

- Superior thyroid arteries.
- Inferior thyroid arteries (as it supplies the posterior aspect of the thyroid gland, its branches also supply the nearby parathyroid glands)
- Collateral circulation is delivered by the superior thyroid arteries, thyroid ima artery, laryngeal, tracheal and esophageal arteries.

Venous Drainage

- Superior thyroid vein
- Middle thyroid vein
- Inferior thyroid vein
- The parathyroid veins drain into the thyroid plexus of veins.

Innervation

Same as the thyroid innervation

Sympathetic Trunk Superior & middle cervical sympathetic ganglia(vasomotor).

Lymphatic

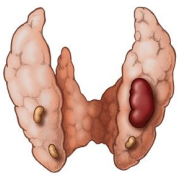
Same as the thyroid lymph

- Deep cervical lymph nodes.
- Paratracheal lymph nodes.

Diseases Found in Boys' slides only

Hyperparathyroidism

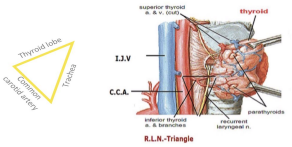
- It occurs when excessive quantities of parathyroid hormone are released.
- This causes excessive amounts of calcium to leave the bones and enter the bloodstream.
- Bones decalcify resulting in osteoporosis, fractures and cysts.
- There is an increased likelihood of renal calculus in these patients due to increased calcium in circulation.
- Hyperparathyroidism is usually due to a tumor in one of the parathyroid glands.
- Treatment involves removal of the tumor.



Clinical notes

- The **External laryngeal nerve** runs close to the **superior thyroid artery** before turning medially to supply the cricothyroid muscle.
- High ligation of the superior thyroid artery during thyroidectomy places this nerve at risk of injury, so it should be ligated within the upper pole of the gland. Its lesion will cause hoarseness of voice.

- The **inferior thyroid artery** is closely associated with the **Recurrent laryngeal nerve**. This nerve can be found in a triangle bounded laterally by the common carotid artery, medially by the trachea, and superiorly by the thyroid lobe.



- NB. Recurrent laryngeal nerve lesion may results in impaired breathing & speech. (An injury to the recurrent laryngeal nerve is much more severe than external laryngeal nerve)
- The relationship of the recurrent laryngeal nerve and the inferior thyroid artery is highly variable in that the nerve can lie deep or superficial to the artery, or between the branches of the artery, and be different on either side of the neck. So, Consideration of this nerve and its branches must be given during thyroidectomy.

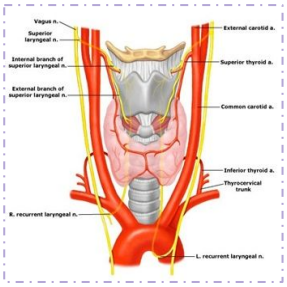
Vagus nerve gives rise to **Superior laryngeal nerve** (which has internal and external branches) and **Recurrent laryngeal nerve.**

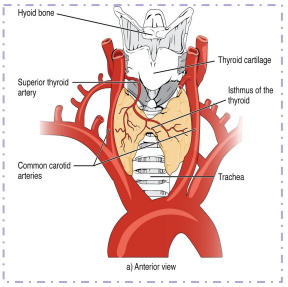
- Superior laryngeal nerve (Internal branch) gives sensory innervation to the area **above** vocal cord.
- Superior laryngeal nerve (External branch) supplies the cricothyroid muscle.
- Recurrent laryngeal nerve supplies all the intrinsic muscles EXCEPT cricothyroid, and has sensory innervation to the area **below vocal cord.** (you can see now why an injury to it would be severe). Also notice that the left and right recurrent laryngeal nerves have different courses.

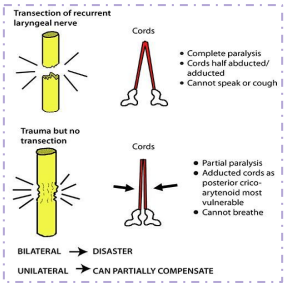
To summarize this slide

Artery: Superior thyroid artery ⇨ **Nerve:** External laryngeal nerve ⇨ **Nerve injury:** Hoarseness of voice

Artery: Inferior thyroid artery ⇨ **Nerve:** Recurrent laryngeal nerve ⇨ **Nerve injury:** Impaired breathing and speech







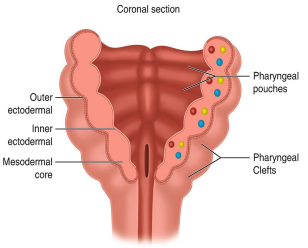
Development of thyroid and parathyroid glands

Pharyngeal apparatus

- The head & neck region develops from the pharyngeal apparatus.
- It is formed of:
  1. Pharyngeal arches
  2. Pharyngeal grooves or clefts (externally).
  3. Pharyngeal pouches (internally).

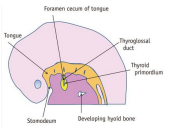
- The mesoderm in the head and neck regions divided into six cubical masses called the 6 pharyngeal or branchial arches. The 5th regresses soon after forming. So only the remaining 5 are left visible.
- Each arch is formed of a **Core** of **mesoderm**.
- Covered externally by **ectoderm**, and the space between 2 arches from outside is called **cleft or groove.**
- Each arch is lined from inside by **endoderm** and the space between the 2 arches from inside is called **pharyngeal pouch**:

  ➔ These are pairs of pouches develop in a craniocaudal sequence between the arches internally.
  ➔ The first pair of pouches lies between the first and second pharyngeal arches.
  ➔ There are four pairs of pharyngeal pouches.
  ➔ The fifth pair of pouches is absent or rudimentary.

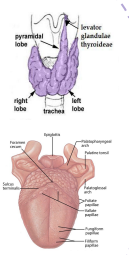


Development of thyroid gland

- As the tongue grows, the developing thyroid gland descends downward in the neck. (the thyroid is pushed down by the developing tongue)
- It descends anterior to the developing **hyoid** bone & laryngeal cartilages through the **thyroglossal duct.**



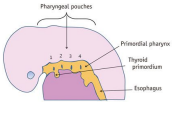
- The upper end of duct persists in the dorsum of the tongue as the **foramen cecum**.
- The distal part of the duct may persists in 50% of people to form the **pyramidal lobe**. (third lobe)
- The pyramidal lobe may be attached to the hyoid bone by fibrous or smooth muscle; the Levator glandulae thyroidae.



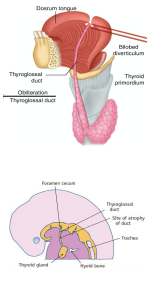
01 **02** **03** **04**

Days are important

- By the **24th day** (4th week) after fertilization, the thyroid gland begins its development.
- It is the **first** endocrine gland to develop.
- It develops from the **endoderm** of the floor of the primitive pharynx .
- It develops from the **(Thyroid primordium).**



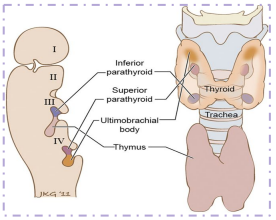
- The thyroid is connected to the developing tongue by a narrow tube, called the **thyroglossal duct**.
- At first the thyroid primordium is hollow, but soon it becomes solid & divided into 2 lobes and an isthmus.
- By **7th week** (50th day) the gland takes its final shape & position, and the thyroglossal duct begins to fibrosis and degenerates. Except in 50% of people



Development of parathyroid gland & Congenital anomalies

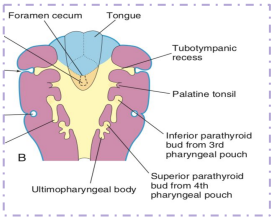
Development of parathyroid glands

Each of the 3rd & 4th pharyngeal pouch develops into dorsal and ventral parts.



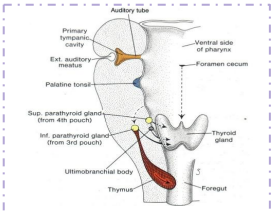
By the **sixth week** Remember Parathyroid develops from the pouch + Third pouch develops into inferior

- The **dorsal** part of the 3rd **pouch** develops into **inferior parathyroid bud.** (so **temporarily** the inferior bud is placed superiorly)
- The **dorsal** part of the 4th **pouch** develops into the **superior parathyroid bud.**



- The **ventral** part of 3rd **pouch** gives the **thymus gland** primordium. Remember **thymus** develops from the **third**
- The **ventral** part of the 4th forms what is called **Ultimopharyngeal body.** (is an embryological structure that gives rise to parafollicular cells of thyroid that secrete calcitonin hormone that lowers the blood calcium level).

The parathyroid gland, thymus and palatine tonsils are developed from the pharyngeal pouch



- As the **thymus primordium** develops, it descends downward to the thorax, behind the sternum in superior mediastinum.
- It draws the inferior parathyroid bud to a lower level than the superior parathyroid.

And now the inferior bud is.....inferior! Thanks to the thymus.

- Both parathyroid glands lie behind the thyroid gland.

Congenital anomalies

1. Congenital hypothyroidism
   Thyroid gland formed but doesn't function well
2. Persistence of thyroglossal duct.
   It doesn't fibrose or degenerate
3. Cervical thyroglossal duct cyst.
4. Ectopic thyroid gland.
5. Accessory thyroid tissue.
   uncomplete margination of thyroid gland, which lead to form other small gland usually in the posterior of the tongue
6. Agenesis of the thyroid gland.
   The gland doesn't develop

Thyroglossal cyst

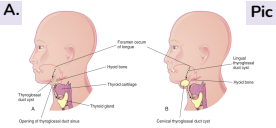
Pic A. Showing the possible locations of thyroglossal duct cysts through the broken line indicating the course of the duct. A thyroglossal duct sinus is illustrated. A sinus happens when the cyst opens externally

Pic B. Illustrating lingual & cervical (common) thyroglossal duct cysts.

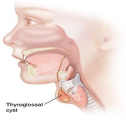
- **Most of thyroglossal duct cysts are located just anterior & inferior to hyoid bone.**

Normally, thyroglossal duct undergo fibrosis and degenerated after the thyroid gland takes its final position. In case of the thyroglossal duct, the duct does not completely close, forming a cyst containing fluid. When the cyst get infected, it may rupture and open to the external environment forming a sinus. -438's team

Pic A.



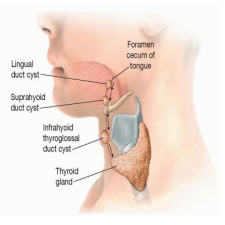
Pic B.

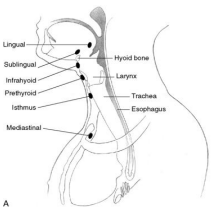


Ectopic thyroid gland

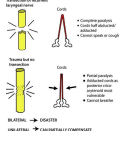
Normally:
-The thyroid glands develops high up close to foramen cecum of the developing tongue.
-Then it descends along the thyroglossal duct to reach its final position by the 7th week.

Ectopic: Descent of the thyroid could be arrested at any point, or extends down (lead to formation of a retrosternal goiter) behind the sternum in the thorax Superior mediastinum .





Anatomy's Summary

	Thyroid Gland			Parathyroid Gland
Note	2 lobes are connected to each other by a narrow isthmus, which overlies the 2nd ,3rd & 4th tracheal rings. **apex** reaches up to the oblique line of thyroid cartilage. Its **base** lies at the level of 4th or 5th tracheal rings.			4 small ovoid bodies lie within the facial capsule of the gland between the 2 membranes
Covering	Inside the pretracheal of the deep cervical fascia. another C.T capsule .it's surrounded by 2 membranes.			They lie within the thyroid tissue or sometimes outside the facial capsule .
Relation	**Antero-laterally**	1. **S**ternothyroid. 2. **S**ternohyoid. 3.**S**ternomastoid. 4.**S**uperior belly of omohyoid.		——
	Posteriorly	1. Carotid sheath & its contents.		
	Medially	**Above**	1. Larynx. 2. Pharynx 3. Cricothyroid muscle 4. External laryngeal nerves	
		Below	1. Trachea. 2. Esophagus. 3. Recurrent laryngeal nerve in between. 4. Cricothyroid muscle 5. External laryngeal nerves	
	Posterior Border	1. the superior & inferior Parathyroid glands. 2. anastomosis between superior & inferior thyroid arteries.		
Arterial	○ **Superior thyroid Artery** from the external carotid It descends to the upper pole of the lobe, with the **external laryngeal nerve.** ○ **Thyroidea ima artery** from aortic arch or from brachiocephalic artery. ○ **Inferior thyroid artery** From the **thyrocervical trunk** of 1st part of subclavian artery. It ascends behind the gland to the level of **cricoid cartilage (at level of C6 vertebra)**			○ Superior thyroid arteries. ○ Inferior thyroid arteries.
Venous	○ Superior thyroid vein → internal jugular vein ○ Middle thyroid vein → internal jugular vein ○ Inferior thyroid vein → left brachiocephalic vein			
Lymphatic	○ Deep Cervical lymph nodes ○ Paratracheal lymph nodes.			
Innervation	○ Sympathetic: Cervical Sympathetic Trunk. ○ Parasympathetic: Branches of Vagus			Sympathetic Trunk : Superior & middle cervical sympathetic ganglia (vasomotor).
Clinical notes	**During thyroidectomy** -External laryngeal nr close to —> **superior thyroid a** —> lesion will cause hoarseness of voice -Recurrent laryngeal nr close to —> **inferior thyroid a** —> lesion results in impaired breathing & speech. 			

Embryology's Summary

Pharyngeal apparatus:	6 cubicle pharyngeal or branchial arches. The core(mesoderm), Inner (endoderm), Outer(ectoderm) The space between 2 arches from outside is called cleft or groove & from inside is called pouch.		
Development of thyroid gland	**24th day after fertilization**	The thyroid gland begins its development (Thyroid primordium)	
	By 7th week (50th day)	The gland takes its final shape & position, and the thyroglossal duct begins to fibrose and degenerate.	
Development of thyroid gland	**By the 6th week :**	dorsal part of the 3rd pouch	inferior parathyroid bud
		dorsal part of the 4th pouch	superior parathyroid bud.
		ventral part of the 3rd pouch	thymus gland primordium
		ventral part of the 4th pouch	Ultimopharyngeal body
Congenital Anomalies of Thyroid gland	**Cervical thyroglossal duct cyst**	Most of thyroglossal duct cysts are located just anterior or inferior to the hyoid bone	
	Ectopic thyroid tissue	Ectopic : Descent of the thyroid could be arrested at any point, or extends down behind the sternum in the thorax.	
	Accessory thyroid tissue	___	
	Agenesis of thyroid gland		
	Persistence of thyroglossal duct		
	Congenital hypothyroidism		
Thyroglossal duct	The upper end of duct persists in the dorsum of the tongue as the foramen cecum. The distal part of the duct may persists in 50% of people to form the pyramidal lobe. It may be attached to the hyoid bone by fibrous or smooth muscle; the **Levator glandulae thyroideae.**		

MCQs

Q1: Which of the following nerves is endanger in ligation of the superior thyroid artery? -Dr's slides

A- External laryngeal
B- Recurrent laryngeal
C- Internal laryngeal
D- Superior laryngeal

Q2: Which of the following structures lies anterior to the thyroid lobe? -Dr's slides

A- Inferior belly of omohyoid
B- Internal jugular vein
C- Vagus nerve
D- Sternohyoid

Q3: Thyroid isthmus overlies ?

A- oblique line of the thyroid cartilage
B- 4th or 5th tracheal ring
C- 2nd, 3rd & 4th rings of the trachea
D- at level of C6 vertebra

Q4: Which pouch gives rise to superior parathyroid bud?

A- Dorsal 3rd
B- Dorsal 4th
C- Ventral 3rd
D- Ventral 4th

Q5: Thyroid gland takes final position by?

A- 5th week
B- 24 days (4th week)
C- 7th week (50th day)
D- 10 days

Q6: The remnant of thyroglossal duct?

A- Pyramidal lobe
B- Left lobe
C- Parathyroid
D- Isthmus

Answers: [Q1:A] [Q2:D] [Q3:C] [Q4:B] [Q5:C] [Q6:A]

SAQs

Q1: Mention 3 medial (above) structure related to the thyroid gland

-Larynx
-pharynx
-Cricothyroid muscle

Q2: How many arteries supply the thyroid gland?

5 arteries: -two Superior thyroid arteries
-two inferior thyroid arteries
-Thyroidea ima artery

Q3: Describe Parathyroid gland innervation

Sympathetic Trunk : Superior & middle cervical sympathetic ganglia (vasomotor).

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