

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
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Endocrine Anatomy, Histology & Embryology | MID 4

Parathyroid Glands



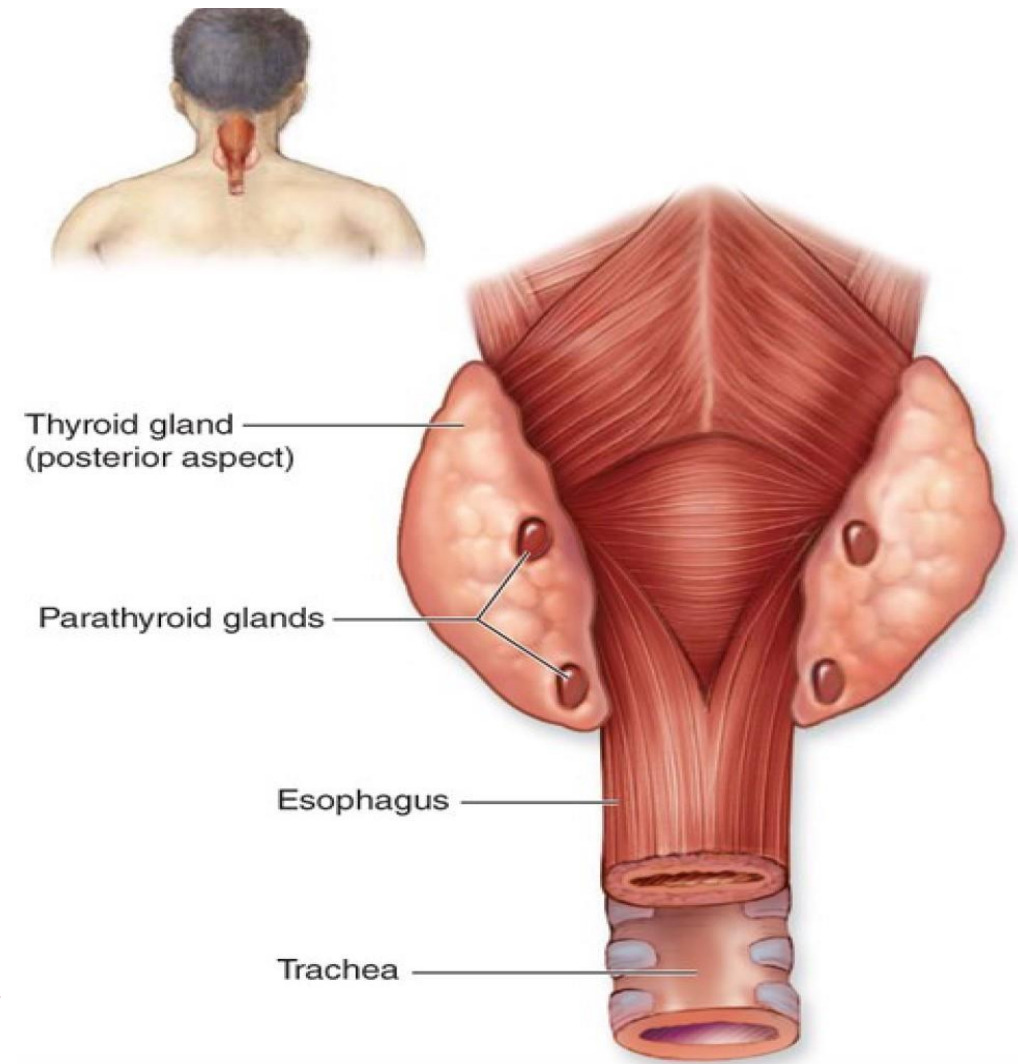
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Parathyroid glands

The parathyroid glands are located on the **posterior surface (posterior border) of the thyroid gland lobes**. There are **four glands in total**: two superior and two inferior parathyroid glands. They are usually **embedded within the capsule of the thyroid gland**.

Being embedded within the thyroid gland has both advantages and disadvantages. Although this location offers some protection, the main clinical significance is that any pathology involving the thyroid gland, particularly **thyroid cancer**, may also affect the parathyroid glands. During **thyroidectomy**, especially when thyroid cancer has spread throughout the thyroid tissue, it may not be possible to preserve all of the parathyroid glands. This is because leaving behind even a small amount of cancerous tissue increases the risk of recurrence (**cancer cells divide continuously and can rapidly proliferate if not completely removed**). As a result, removal of the thyroid gland may also require removal of one or more parathyroid glands. In such cases, the patient will require **hormone replacement therapy** to compensate for the loss of thyroid function, as well as **calcium and/or parathyroid hormone-related supplementation** to replace the function of the parathyroid glands.

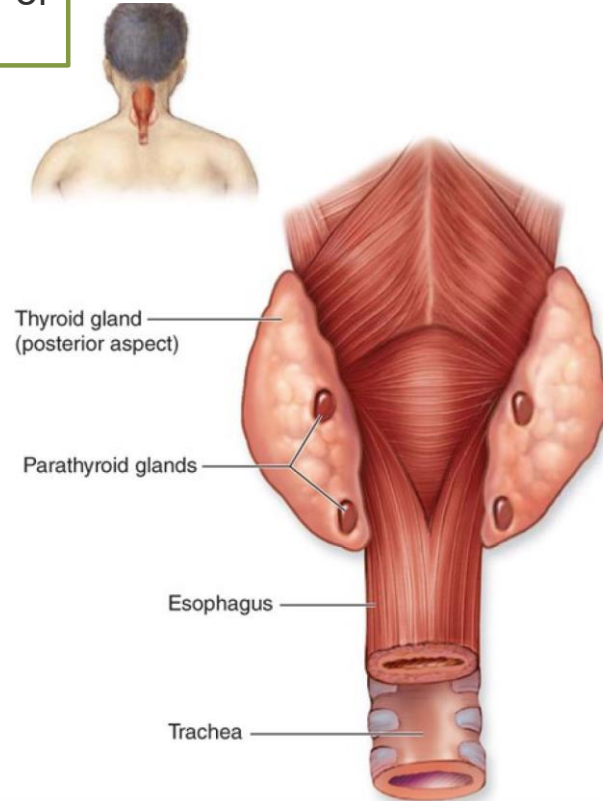
However, if the surgeon can achieve a **safe surgical margin** around a parathyroid gland (**a margin confirmed to be free of cancer cells**), that gland can be preserved. In many cases, at least one parathyroid gland can be spared, particularly if it is sufficiently distant from the affected area.



Anatomy/ Characteristics

- Four small ovoid masses—3 × 6 mm—total weight 0.4 g.
- Located on the back of the thyroid gland, usually embedded in the gland's capsule.
- Closely related to the posterior border of the thyroid gland.

Blood supp./Venous D./ Lymph D.: same as thyroid, They do not have an independent vascular or lymphatic system.



A characteristic histological feature of the parathyroid glands is the **progressive increase in adipose tissue** with **increasing age**---many secretory cells are replaced with adipocytes (>50%) of the gland in older people.

Despite this increase in fat, the gland still contains functional **parenchymal cells**, mainly chief (principal) cells, which continue to produce parathyroid hormone (PTH).

- The two superior parathyroid glands are the more constant in position (**meaning they usually remain in the same location during development**)---lie at the level of the middle of the posterior border of the thyroid gland
- Contained within a thin capsule from which septa extend into the gland (**septa**) dividing it into small compartments and carrying blood vessels into the parenchyma.
- The two inferior parathyroid glands usually lie close to the inferior poles of the thyroid gland

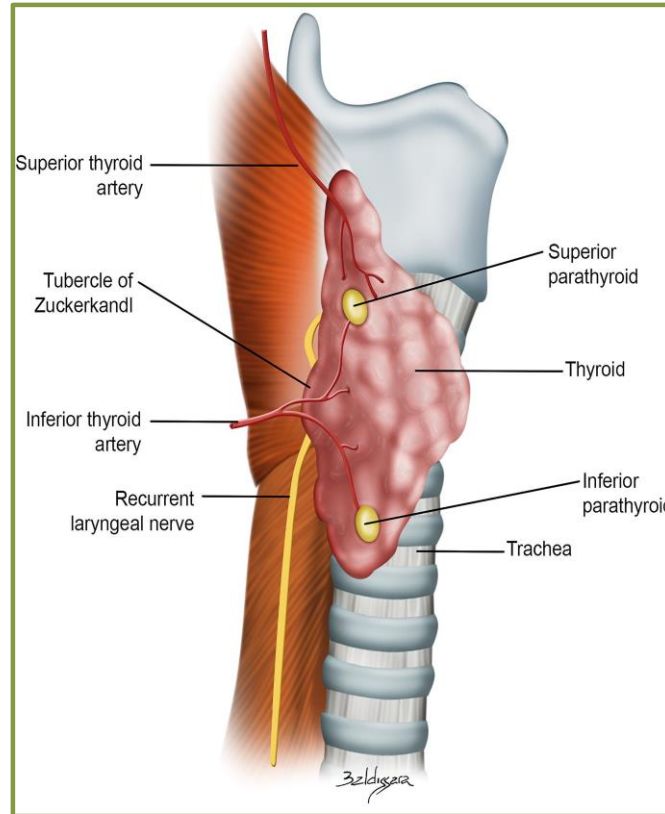
In contrast, the **inferior parathyroid glands** have a more variable position because they migrate during embryological development with the thymus. As a result, they may be found lower in the neck or, in some cases, within the **superior mediastinum (thorax)**.

Anatomy/ Embryology

Superior parathyroid glands

Derived from the fourth pharyngeal pouch, **in close association with the ultimobranchial body, which develops from the region between the fourth and fifth pharyngeal pouches..**

Located near the posterolateral aspect of the superior pole of the thyroid, 1cm superior to the junction of the recurrent laryngeal nerve (RLN) **which lies medial to the thyroid gland**, and the inferior thyroid artery.



Inferior parathyroid glands

Derived from the **third** pharyngeal pouch.

Located near the inferior poles of the thyroid glands, within 1-2 cm of the insertion of the inferior thyroid artery into the inferior pole of the thyroid.

Location is much more variable than the superiors: it can be intra-thyroidal or within the thymus or other mediastinal structures, and can even be found along the aortic arch (16%).

Embryology

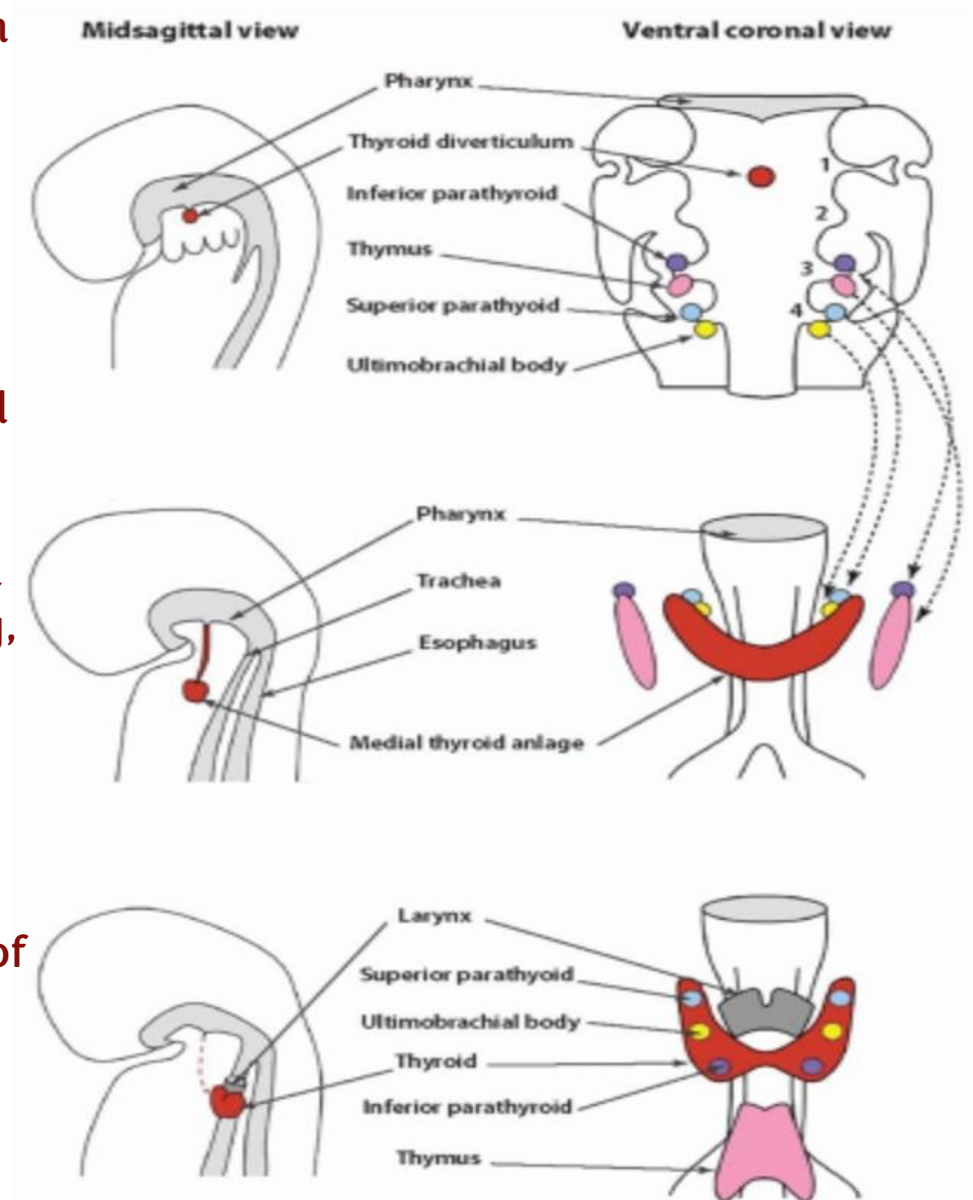
The **inferior parathyroid glands** originate from a higher anatomical position relative to their counterpart—specifically from the **third pharyngeal pouch**—which aligns with the intuitive logic of their developmental pathway. Within this region, specialized primordial tissue undergoes distinct glandular differentiation before being systematically delivered to its ultimate anatomical destination.

In contrast, The thyroid primordium develops in the midline at the foramen cecum, in the floor of the primitive pharynx. The thyroid descends to its final position anterior to the upper trachea (approximately opposite C5–T1).

Following the descent of the thyroid proper, it is closely succeeded by the migration of the **ultimobranchial bodies**, which fuse with the lateral thyroid lobes to contribute the calcitonin-producing parafollicular cells. Structurally, the complete parathyroid apparatus is comprised of four distinct glands:

- **Two superior parathyroid glands** derived from the fourth pharyngeal pouches.
- **Two inferior parathyroid glands** derived from the third pharyngeal pouches.

This entire parathyroid complex differentiates following the primary phase of thyroid morphogenesis, with active tissue migration and glandular establishment occurring precisely around the **fifth and sixth weeks of gestation**, concurrent with the development of the ultimobranchial bodies.



Structure

The histological appearance of the parathyroid gland in the lecture slides may differ slightly from the specimens observed in the laboratory. This is because the histological sections used for teaching may originate from different species, including **humans, monkeys, and pigs**. Despite these differences, the overall histological organization remains the same

Chief cells (basophilic cells):

- Manage the secretion of parathyroid hormone (PTH).
- Prominent Golgi apparatus and a developed endoplasmic reticulum (synthesis and secretion of the hormone)
- Smaller than the oxyphil cells, they are more abundant.

Oxyphil cells (eosinophilic cells):

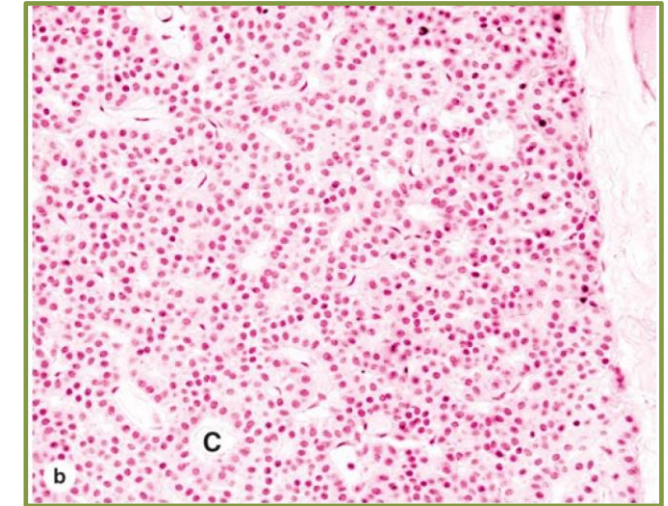
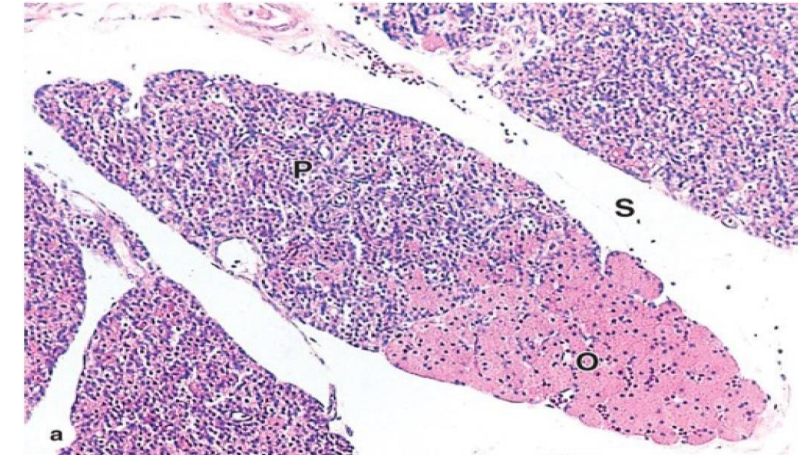
The purpose of these cells is not entirely understood.

Larger than the chief cells and seem to increase in number with age.

The younger individuals have a predominance of chief cells, whereas the number of oxyphil cells increases with age.

Therefore, the greater the number of oxyphil cells seen in a section, the older the individual is likely to be.

With aging, there is also a **progressive increase in adipose tissue** within the parathyroid gland. In elderly individuals, adipocytes may occupy **more than 50% of the gland**, while functional parenchymal cells remain scattered between the fat cells.



- (a) A small lobe of parathyroid gland, septa (S),
(b) (b) Higher magnification shows that principal cells have round central nuclei and pale-staining cytoplasm

Surgical Considerations

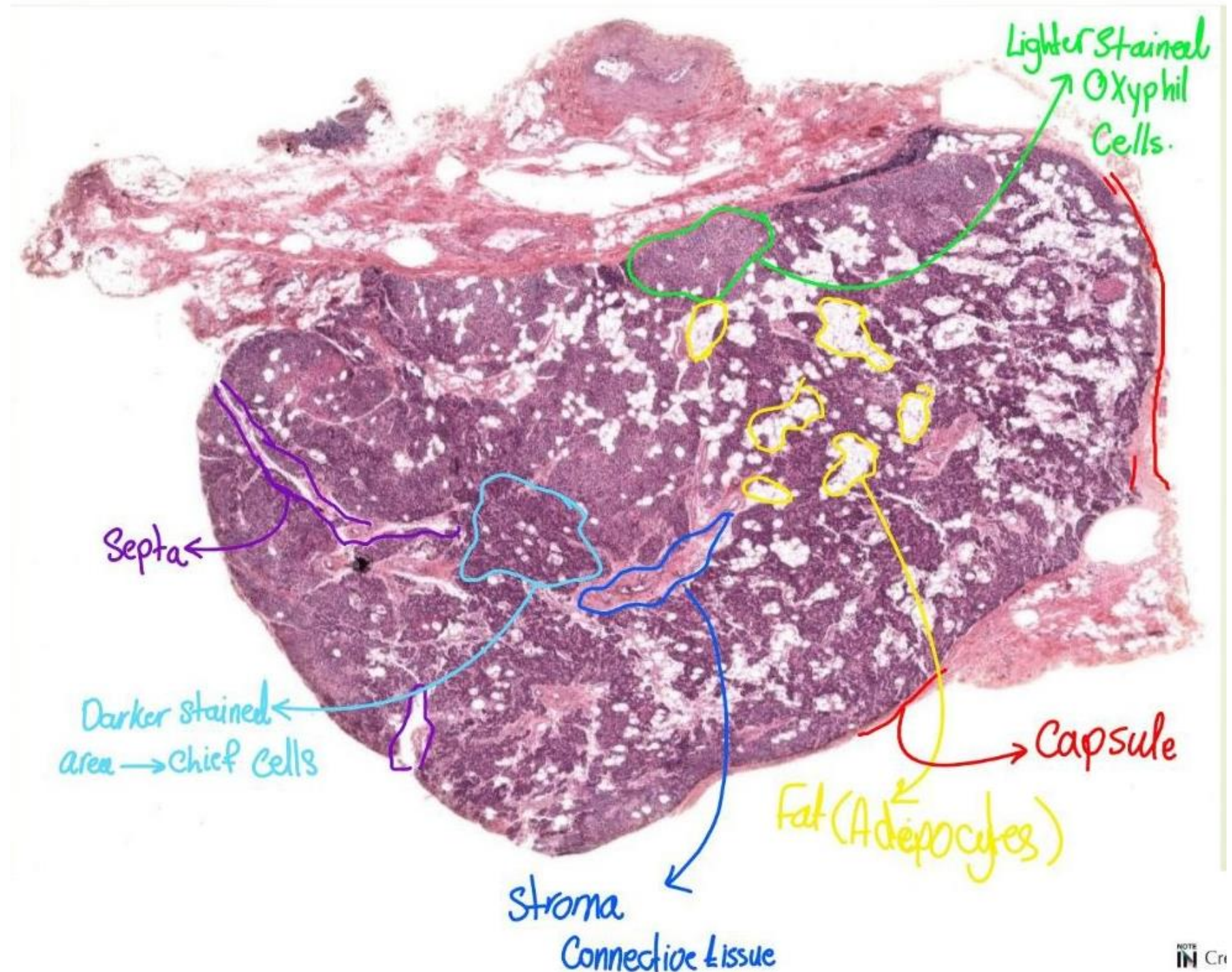
- Have inconsistent locations between individuals and these locations can vary widely.
- Damage to the glands can occur during neck surgery, especially thyroidectomy.
- Preservation of as many parathyroid glands as possible.
- A single parathyroid gland should be sufficient!!!!
- Lifelong calcium and vitamin D supplementation may be required, when?

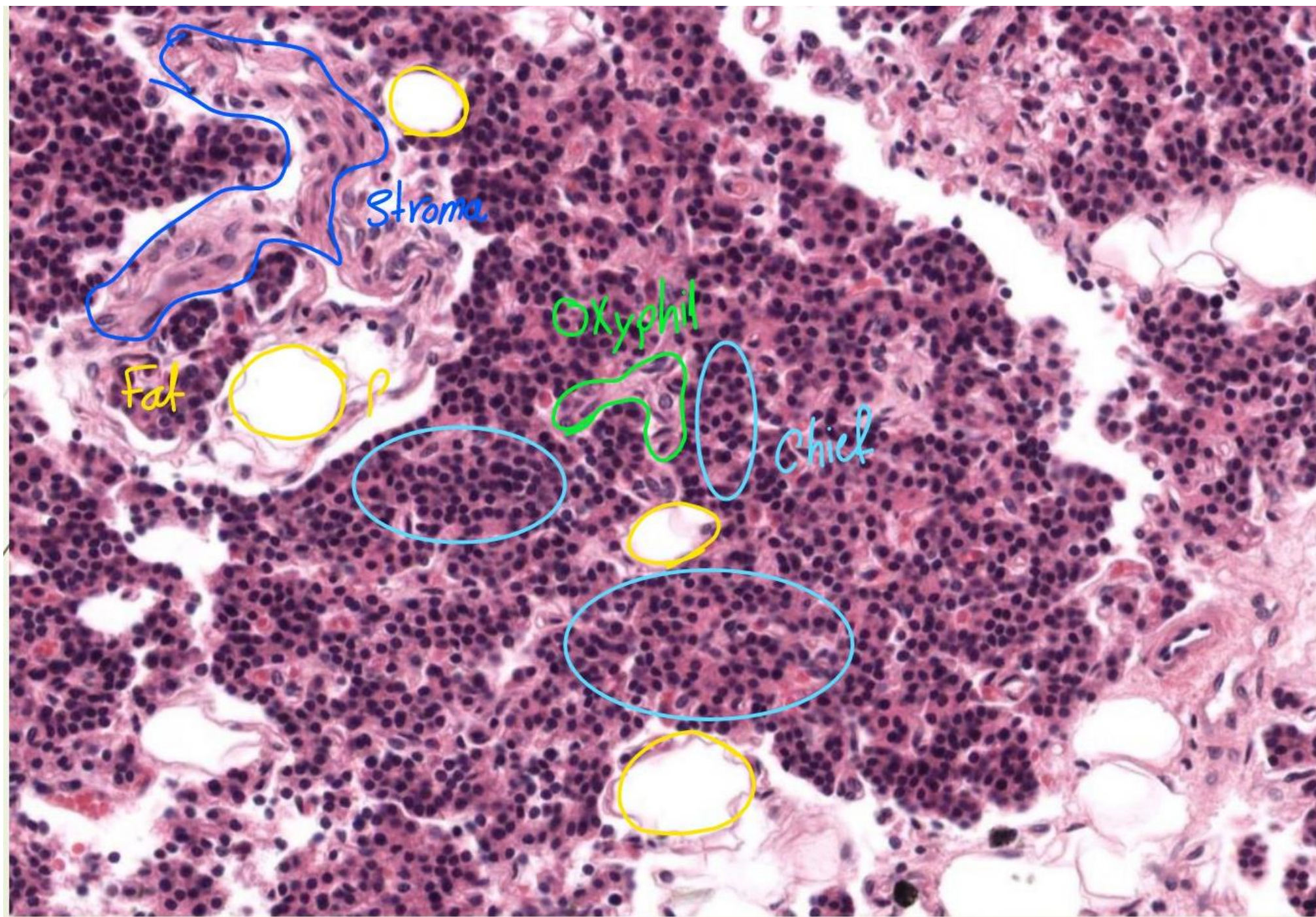
When all four parathyroid glands must be removed or their blood supply is compromised during surgery, the patient will develop hypoparathyroidism and thus lifelong supplementation with calcium and active vitamin D (and, in selected cases, PTH replacement therapy) is required to maintain normal serum calcium levels..

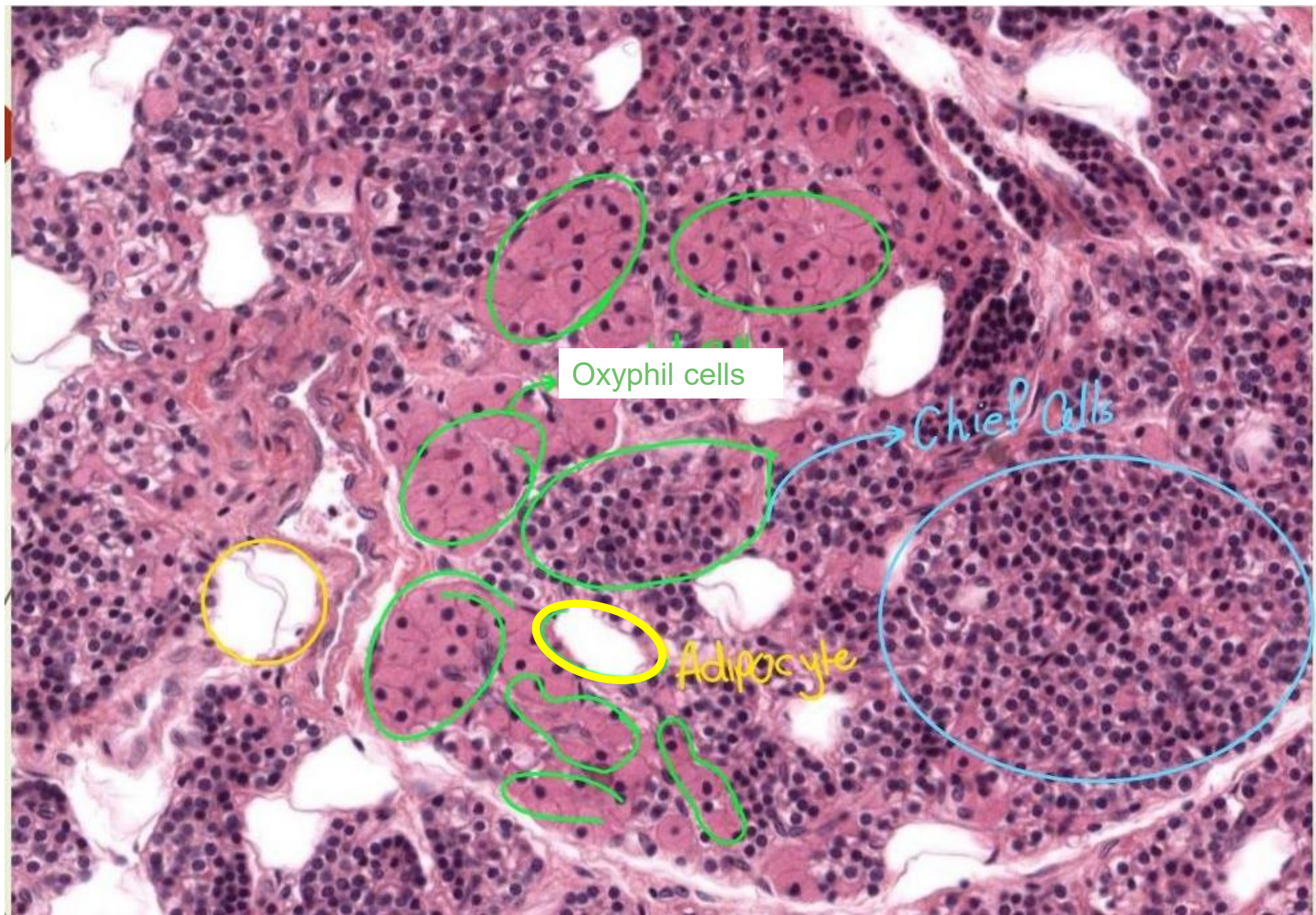
- Removal of both pairs of the parathyroid gland is extremely uncommon.

Low magnification (H&E stain)

- **Adipose (fat) tissue** is normally present within the gland. The presence of fat is a characteristic feature of the **adult parathyroid gland** and helps distinguish it from younger glands, which contain little or no adipose tissue.
- The gland **does not appear homogeneous**. Instead, it is divided into **lobules**, giving it a slightly irregular appearance.
- The entire gland is surrounded by a **thin connective tissue capsule**.
- From this capsule, **connective tissue septa (trabeculae)** extend into the gland, forming the **supporting stroma**.
- These septa **carry blood vessels, nerves, and lymphatic vessels** into the gland, providing structural support and supplying the parenchyma.







رسالة من الفريق العلمي:

نَعِيبُ زَمَانَنَا وَالْعَيْبُ فِينَا

وَمَا لَزِمَانِنَا عَيْبٌ سِوَانَا

وَنَهْجُو ذَا الزَّمَانِ بِغَيْرِ ذَنْبٍ

وَلَوْ نَطَقَ الزَّمَانُ لَنَا هَجَانَا

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Versions	Slide # and Place of Error	Before Correction	After Correction
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V1 → V2			