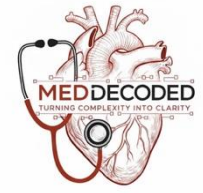


بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



HISTOLOGY

MID | Lecture 12

CT Lab

﴿ وَلَقَدْ خَلَقْنَا الْإِنْسَانَ وَنَعَلَهُمَّ آتُوسُوسٍ بِهِ ۚ نَفْسُهُ وَنَحْنُ أَقْرَبُ إِلَيْهِ مِنْ حَبْلِ الْوَرِيدِ ﴾

Reviewed by :

Yamen Aljarrah

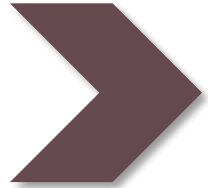
Yaman Khalil



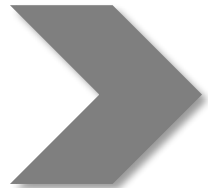
Color coding used in the modified:



Black: the original slides



Maroon: the doctor's explanation/words



Gray: additional information and explanation



Red: important information

fibroblasts : (active)
bigger cells
More processes
bigger cytoplasm
Large euchromatic nucleus

fibrocytes : (dormant)
smaller cells
almost no processes
small amount of organelles
Condensed "small" heterochromatic nucleus

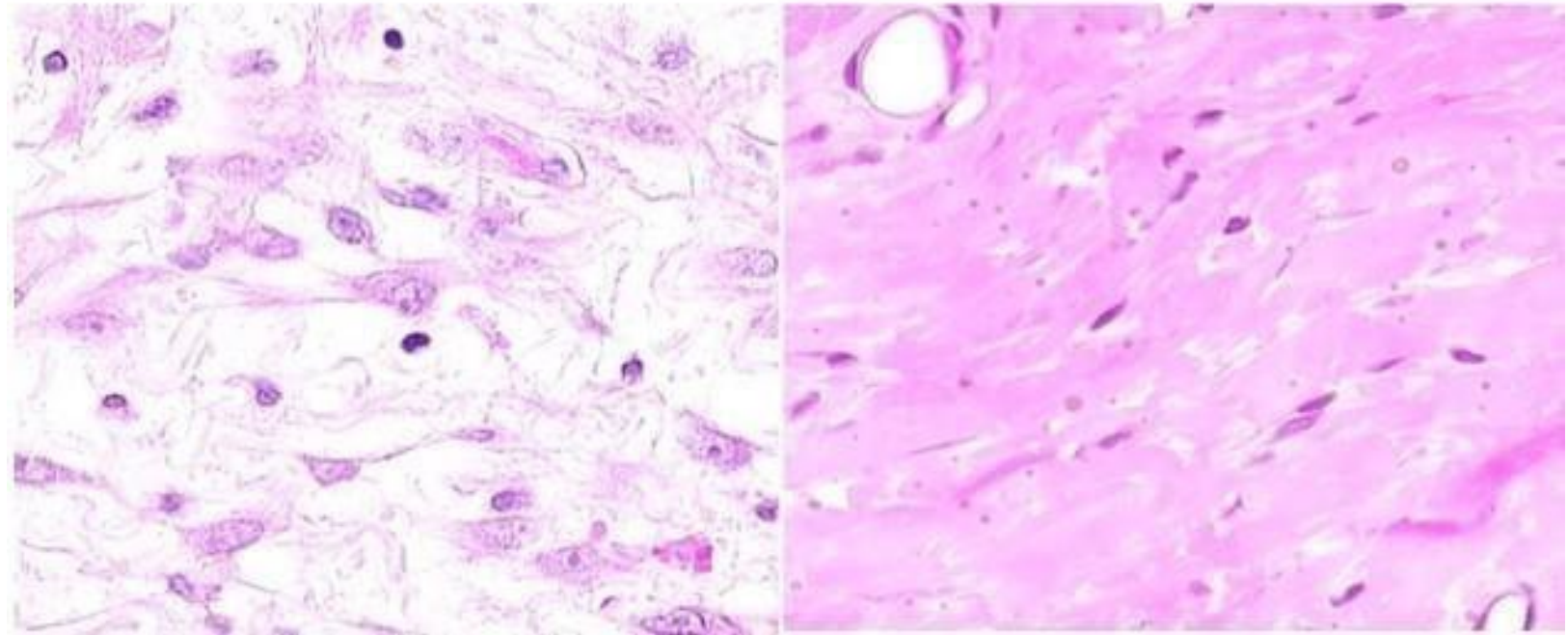
The Fibroblast is the most important one of the resident cells in the connective tissue. It's responsible of synthesis and secretion of different elements of connective tissue



<http://www.servier.com/Powerpoint-image-bank>

stains : H&E microscope : bright field

Usually we see fibroblasts in loose CT
In the dense CT we see fibrocytes

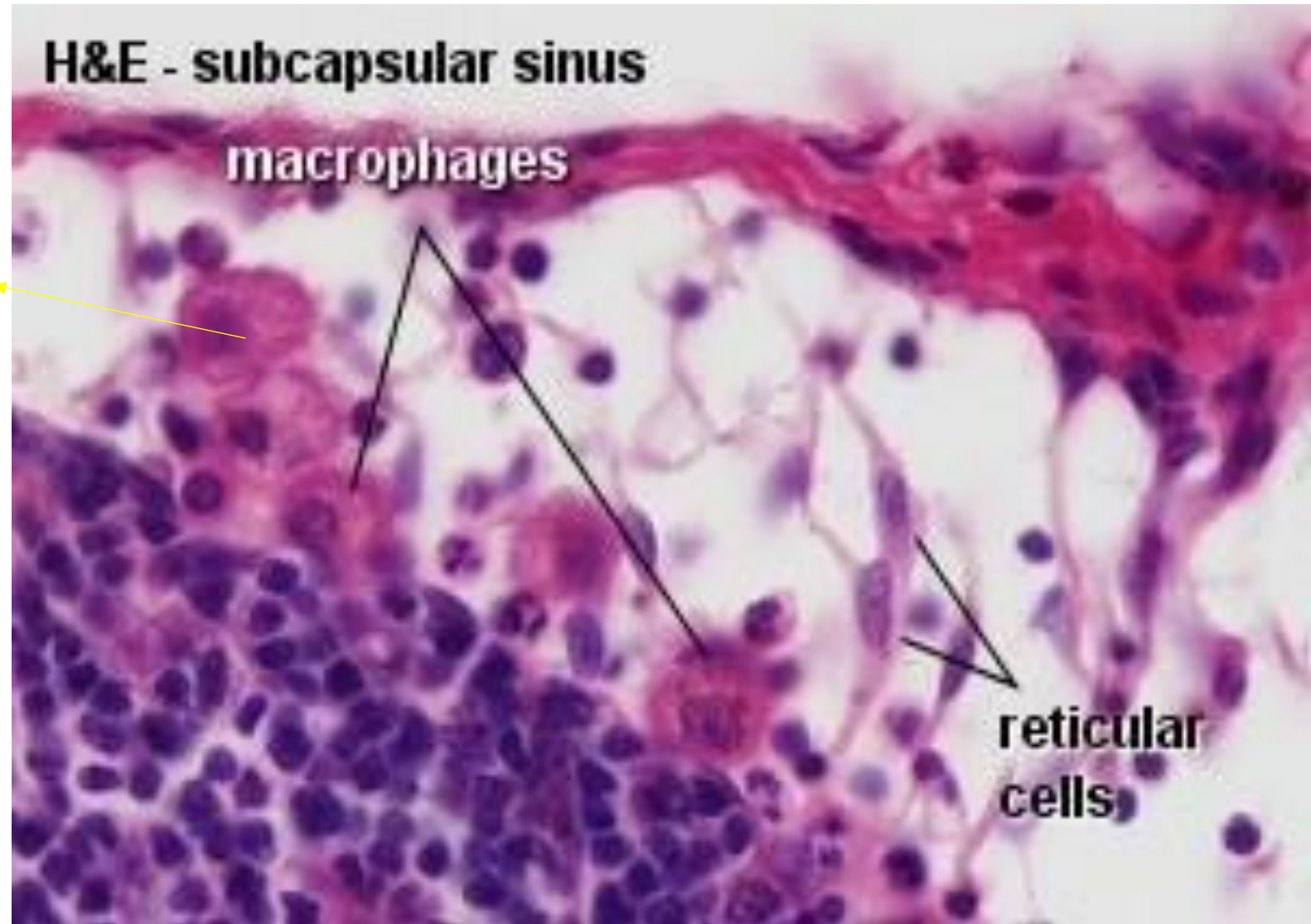


Macrophage

Derived from monocytes, has immune function like phagocytosis, antigen presentation, cytokine release
Except the OSTEOCLASTS (doesn't have immune related functions)

Macrophages are large and active cells (30um diameter)

They appear large
Have large nucleus
Good amount of cytoplasm and organelles (especially lysosomes)

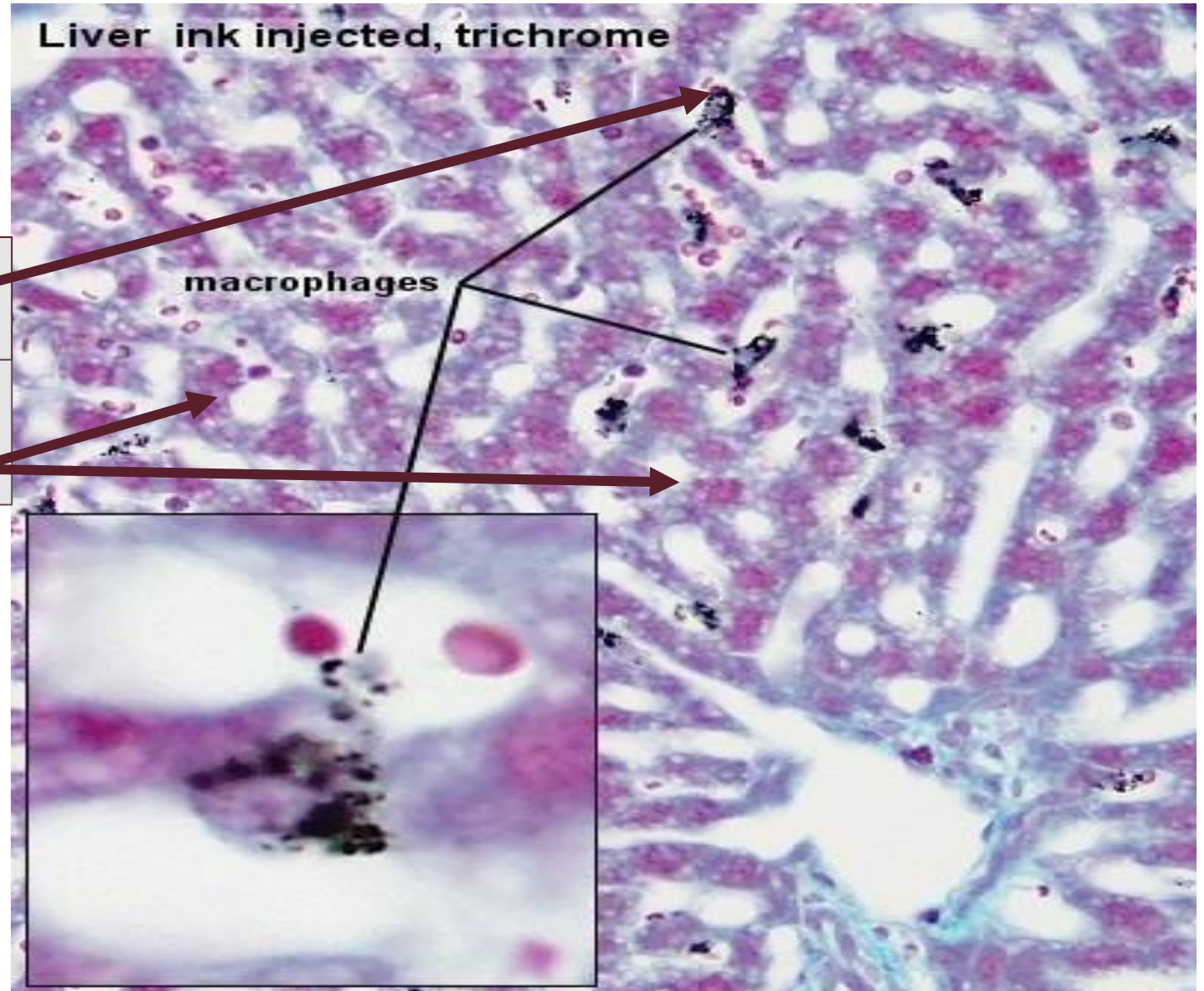


Macrophage

this section was taken from the liver :
macrophages are called Kupffer cells

The darkly stained cells are
Macrophages.

Hepatocytes appear large with a
prominent , large and purple
nucleus

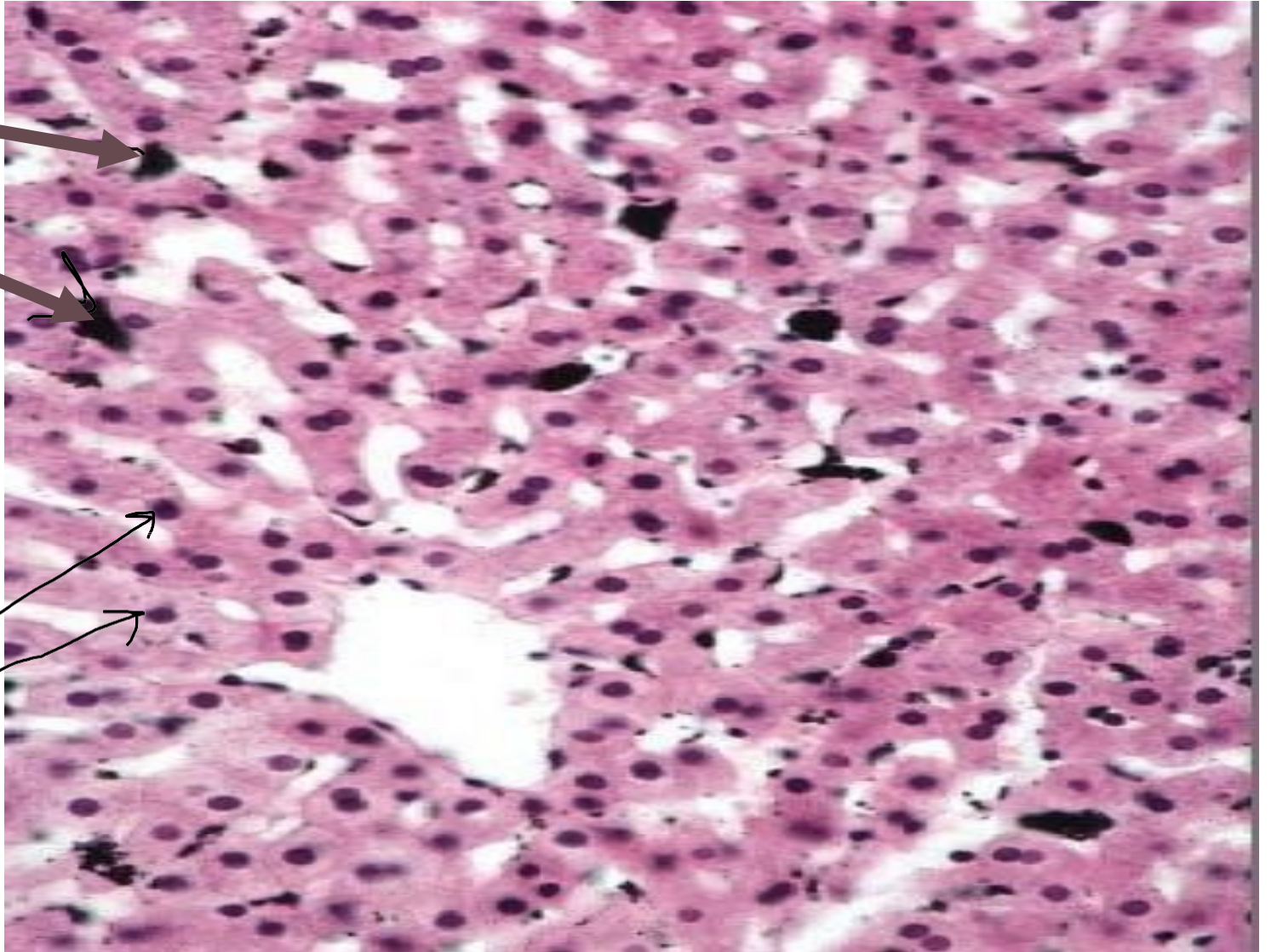


Macrophage

this section was taken from the liver: kupffer cells || H&E stain

The darkly stained
Cytoplasm are
Macrophages

Hepatocytes

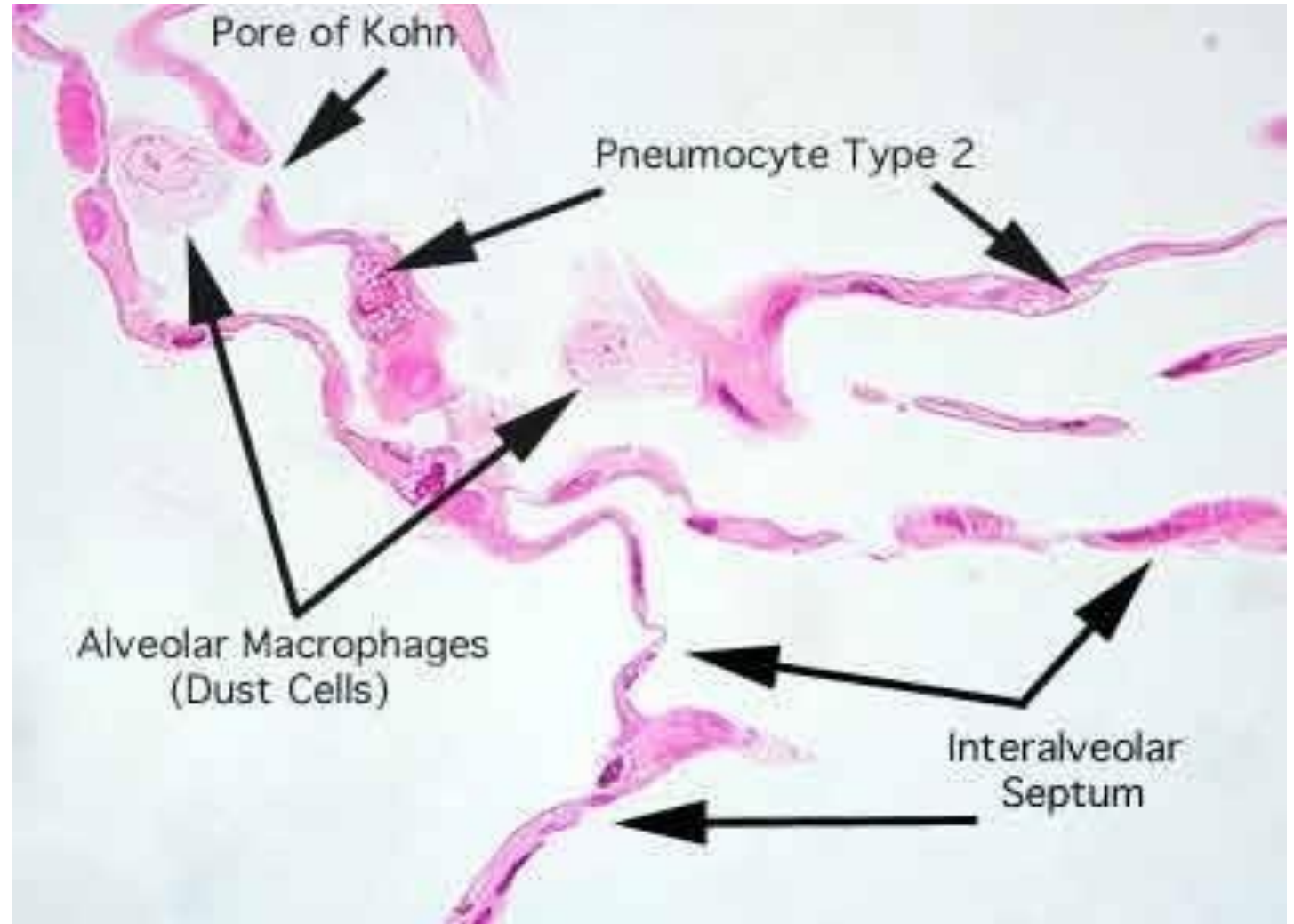


Hepatocytes appear large
with a prominent , large
and purple nucleus

Macrophage

Monocytes that have resided in the lungs to purify the interior the tissue of pathogens and intruders and engulf them.

Alveolar macrophages are called : Dust cells

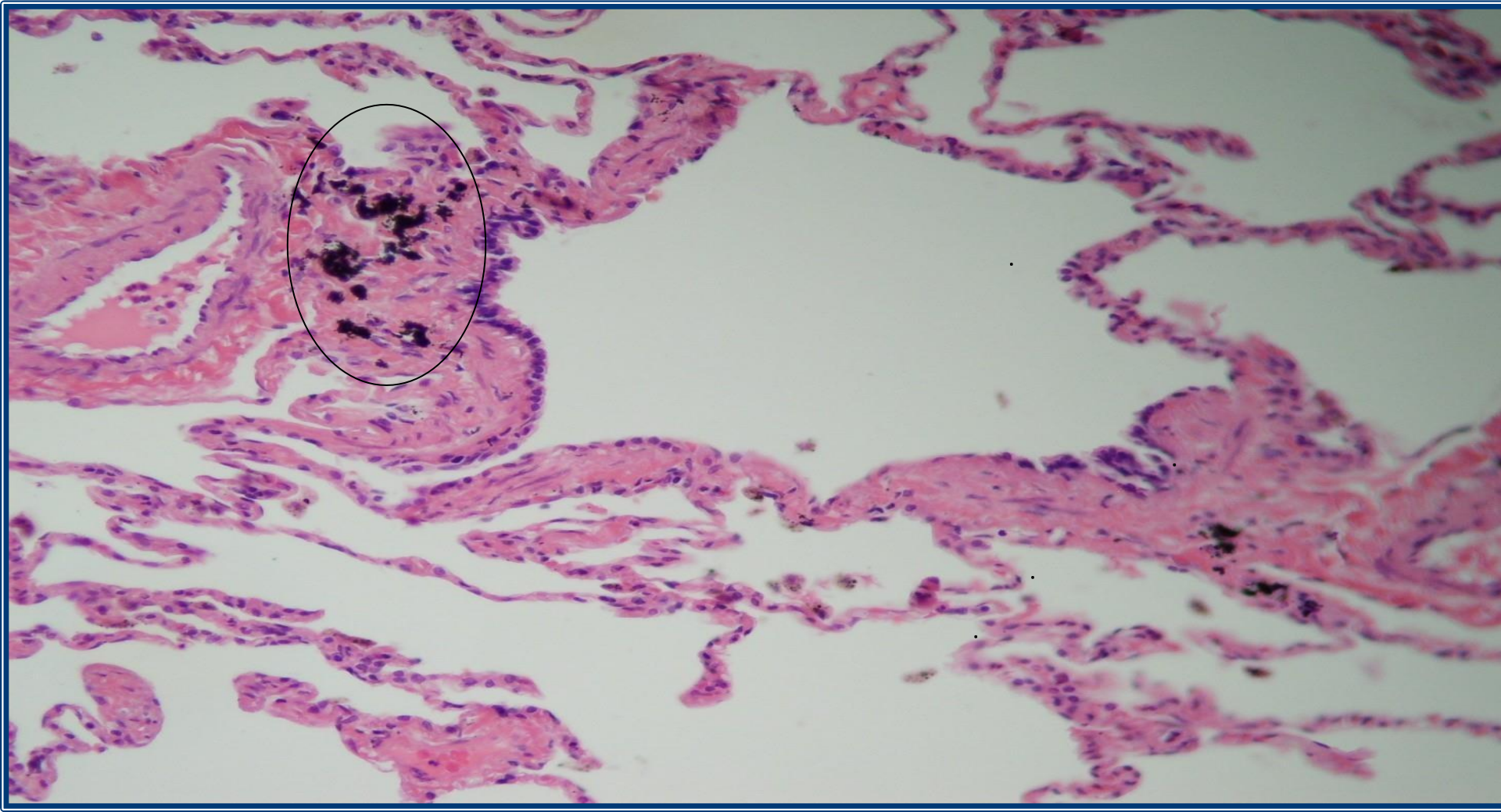


H&E || high magnification

Lung tissue

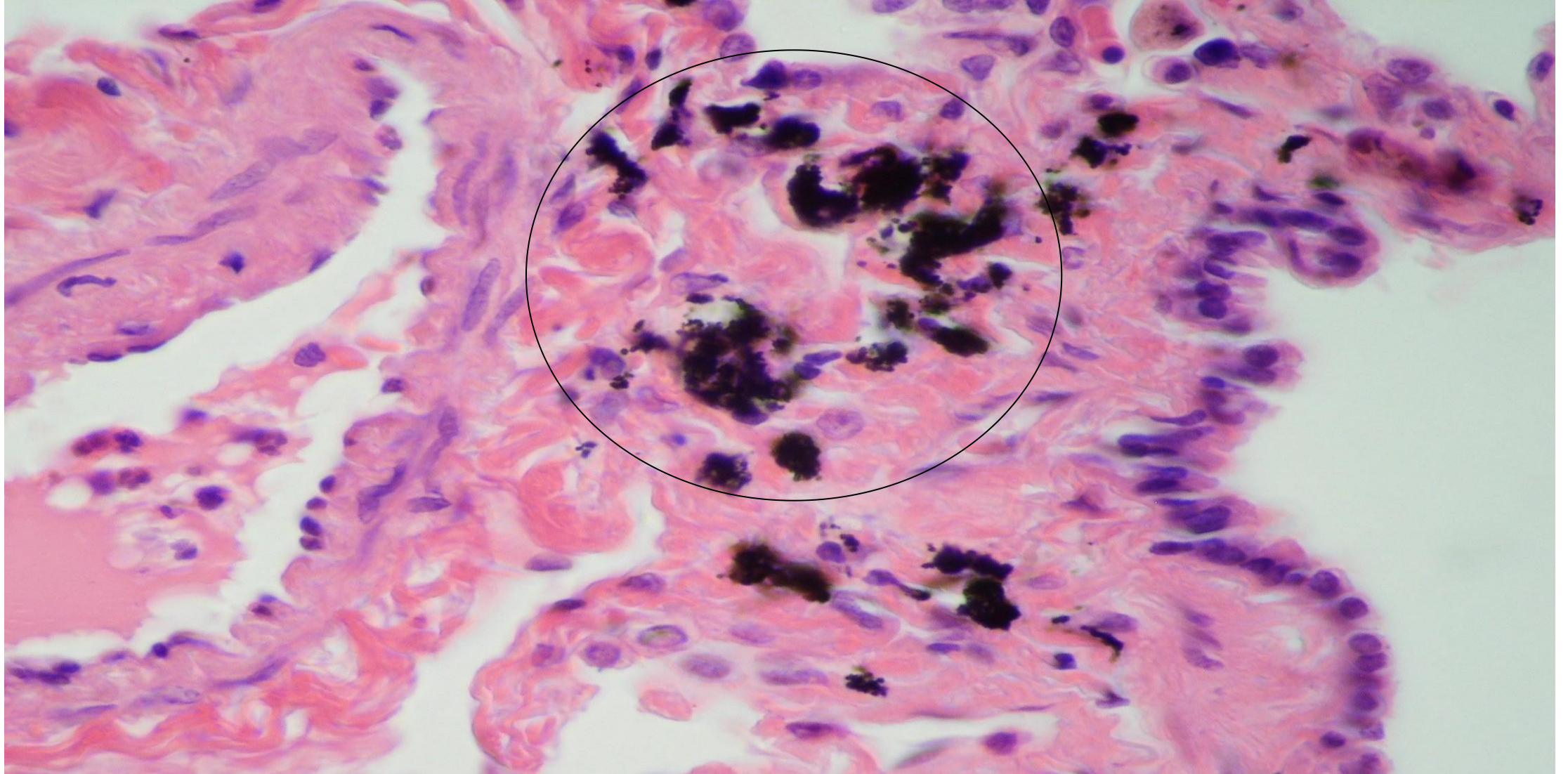
Extra :This is more likely a tissue from Old person , because the macrophages are loaded with cell debris .
or may be it is for a person who live in a polluted area or possibly a smoker.
In fact : dust cells are called this name because they appear like they accumulate dust in their vacuoles .

H&E stain || low magnification || acquired by bright field microscope



The macrophages are those in blackish color
They turn black because they engulf the particles in air we inhale , these particles will accumulate inside in vacuoles because dust cells can't degrade it.

Alveolar **macrophage=dust cell**
Same image as last slide, with higher magnification



Extra: how to tell the difference between dust cells and kupffer cells on higher magnification :

The Liver (Kupffer Cells):

- The Background : It looks like a solid wall of big, pink, blocky cells (hepatocytes).
- The Empty Space : The only white spaces are tiny, narrow little cracks running between the hypatocytes.
- The Macrophage : The Kupffer cell is squished flat against the hypatocytes inside that narrow little crack. It looks like it is clinging to the pink hepatocytes. It doesn't have much room to move.

2. The Lungs (Dust Cells):

- The Background : It looks like thin pink strings or spiderwebs.
- The Empty Space : There are huge, wide-open white areas (the air sacs/alveoli). Even on high magnification, the white space usually takes up a lot of the picture.
- The Macrophage : The dust cell is a large, round cell that is often floating completely free in the middle of the white empty space, or just resting lightly on the thin pink web.

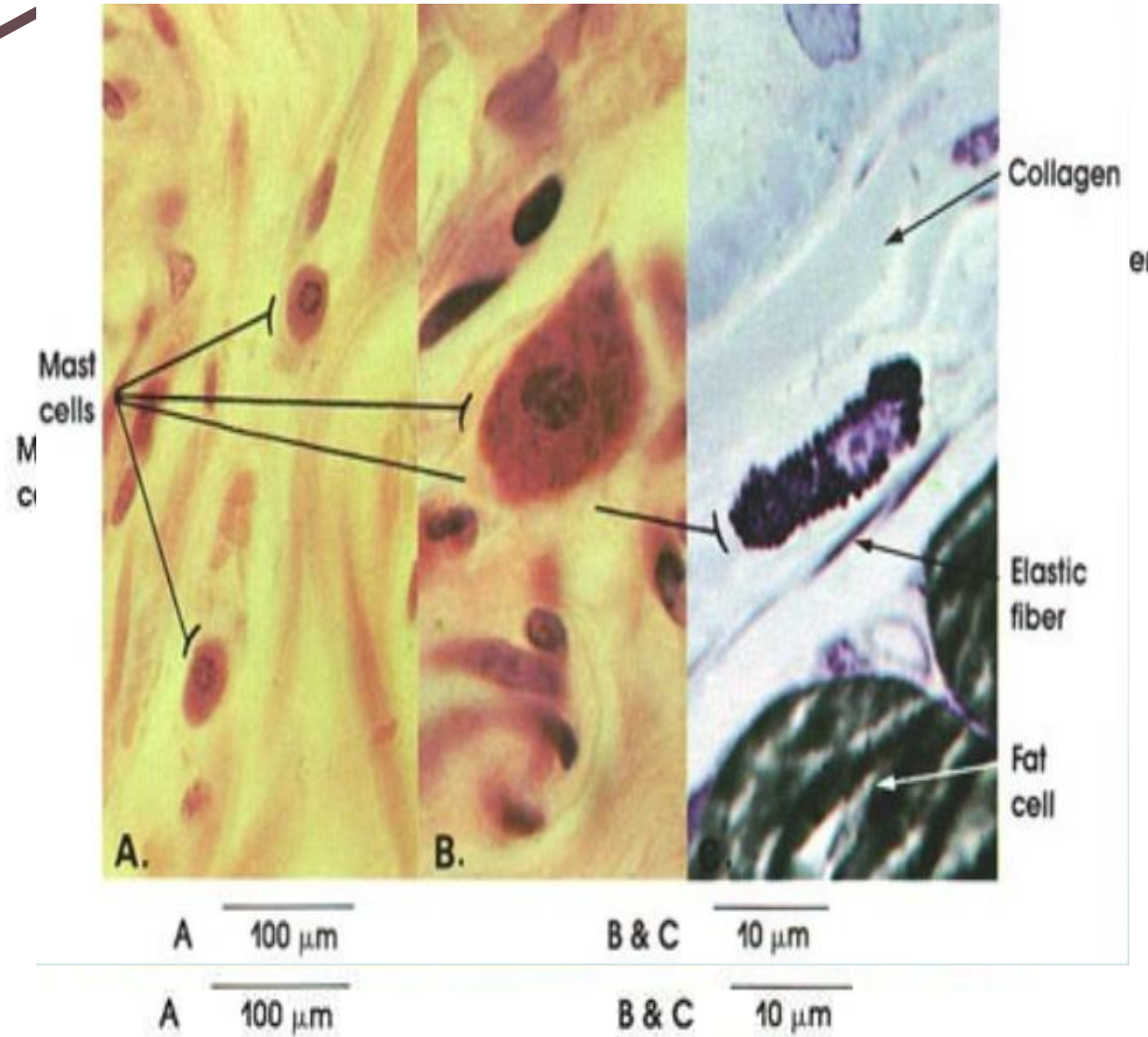
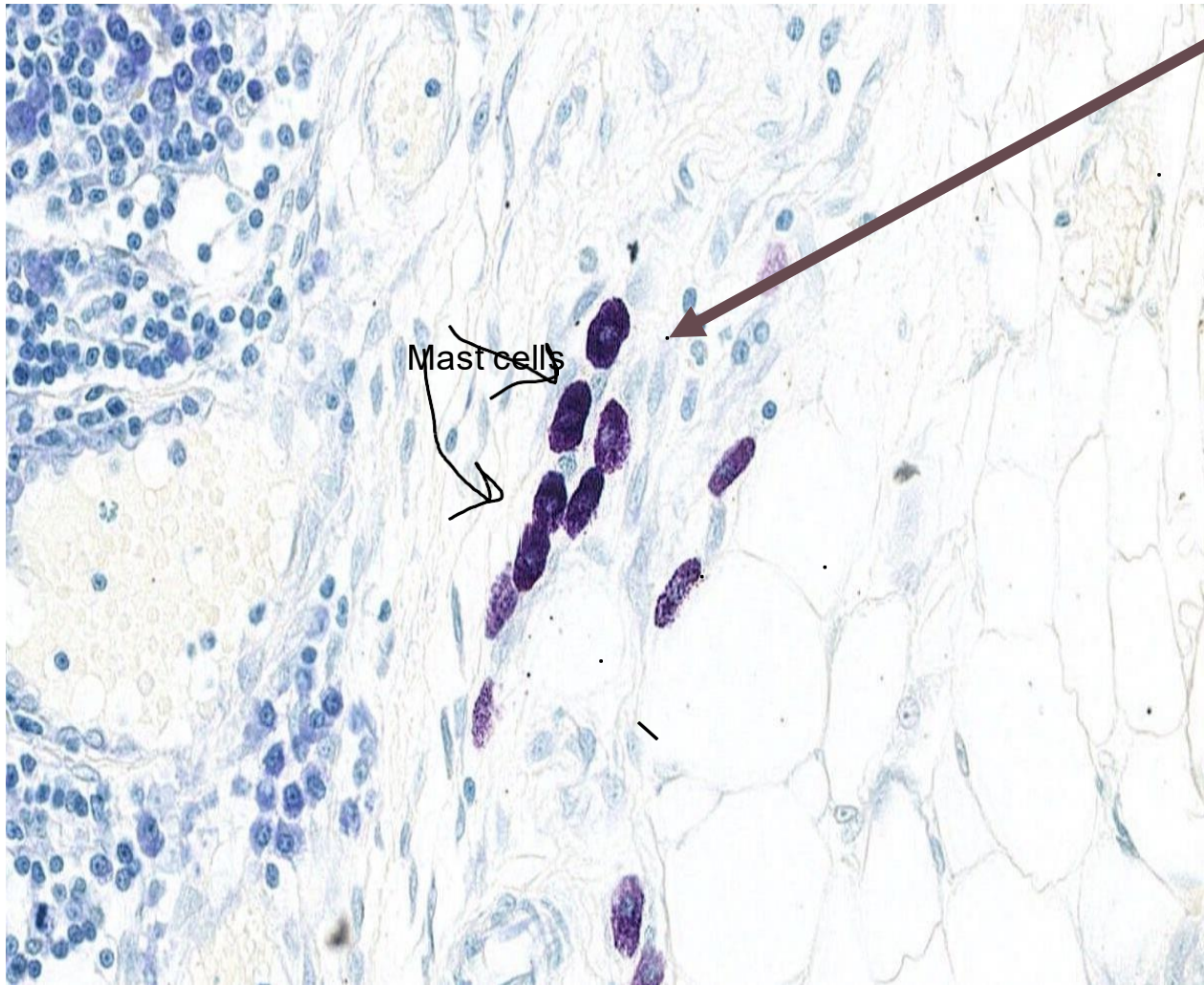
More clarification:

If you see a black-stuffed cell floating freely in a big white pool, it is a lung dust cell. If it is crammed into a tiny white crack between giant pink blocks, it is a liver Kupffer cell.

Mast cells

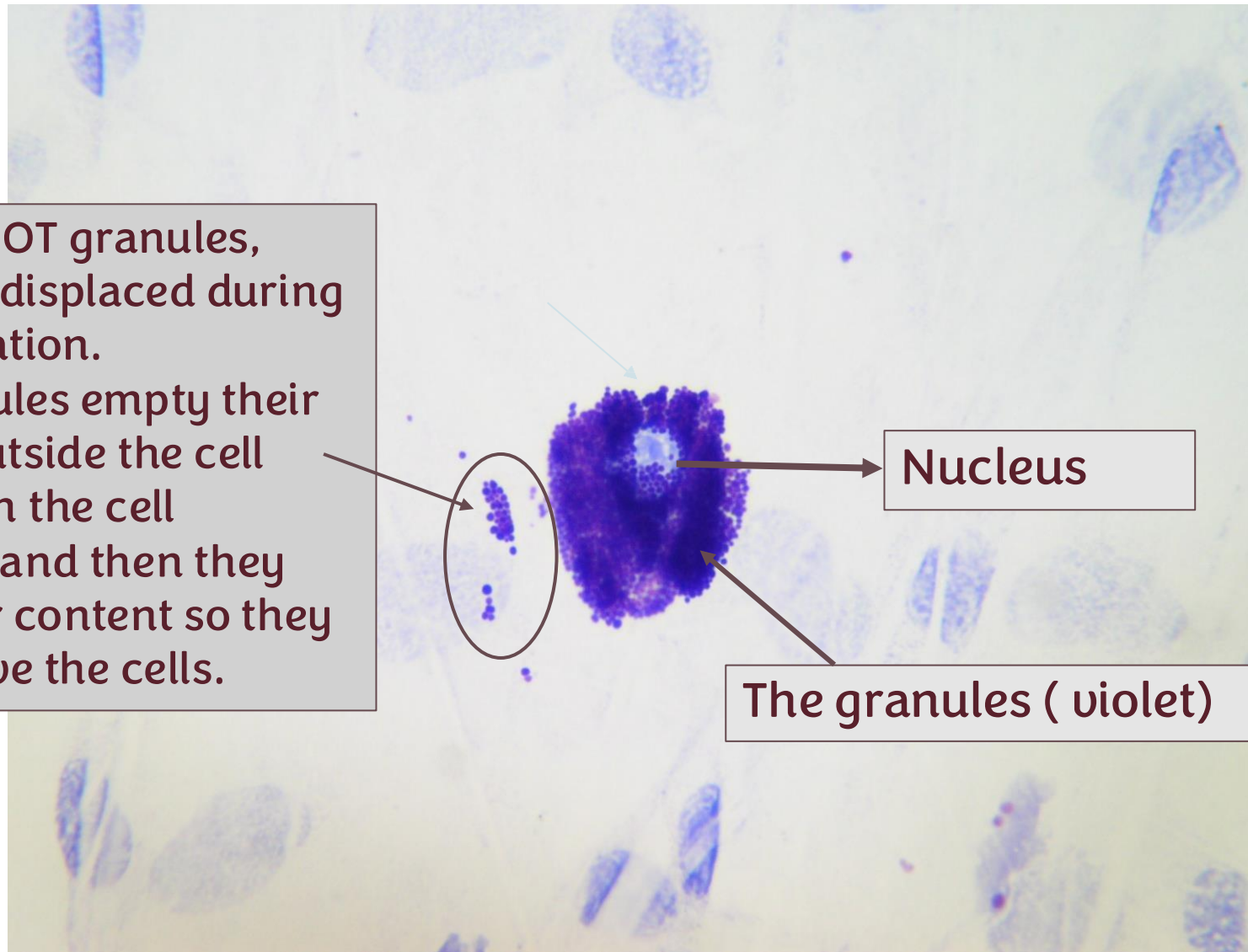
cells that have a lot of granules that contain bioactive molecules that would be released when encountering foreign substances.

Toluidine blue stain, a special stain
It shows the granules in the mast cell in a violet color.
Because it has a lot of granules, they obscure the nucleus so you barely can recognize it in low magnification.



Mast cell (toluidine blue stain) granules

- These are NOT granules, these were displaced during cell preparation.
- when granules empty their contents outside the cell, they fuse in the cell membrane and then they empty their content so they do NOT leave the cells.

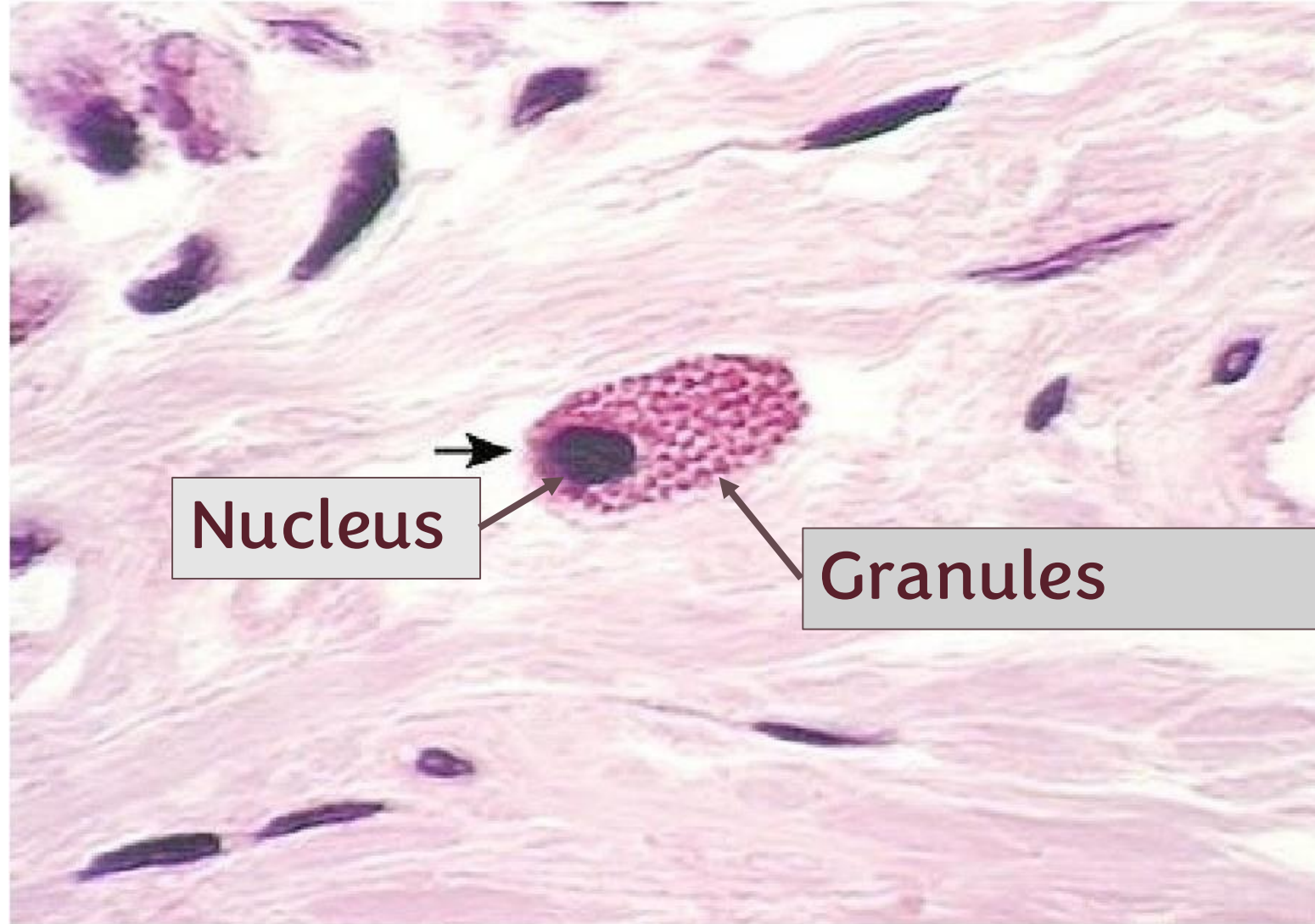


Nucleus

The granules (violet)

Mast cells

You can tell the difference between mast cells and macrophages by the granules!



Plasma cells

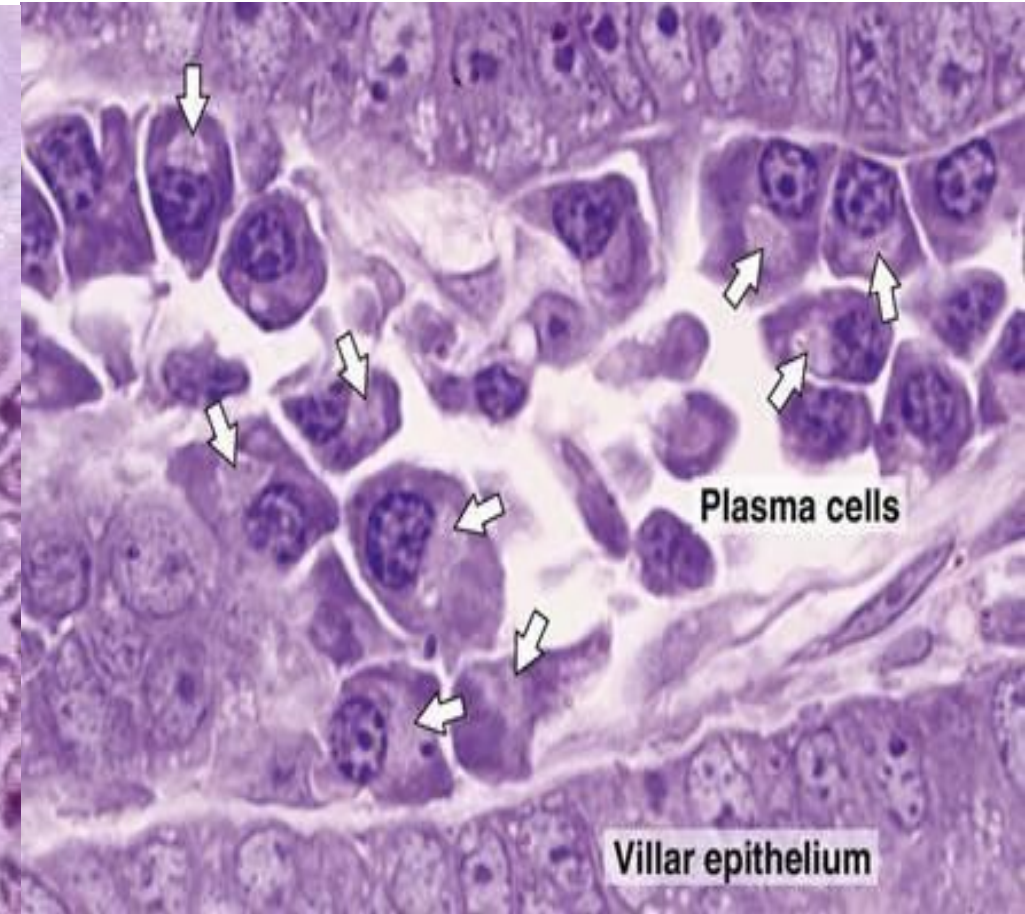
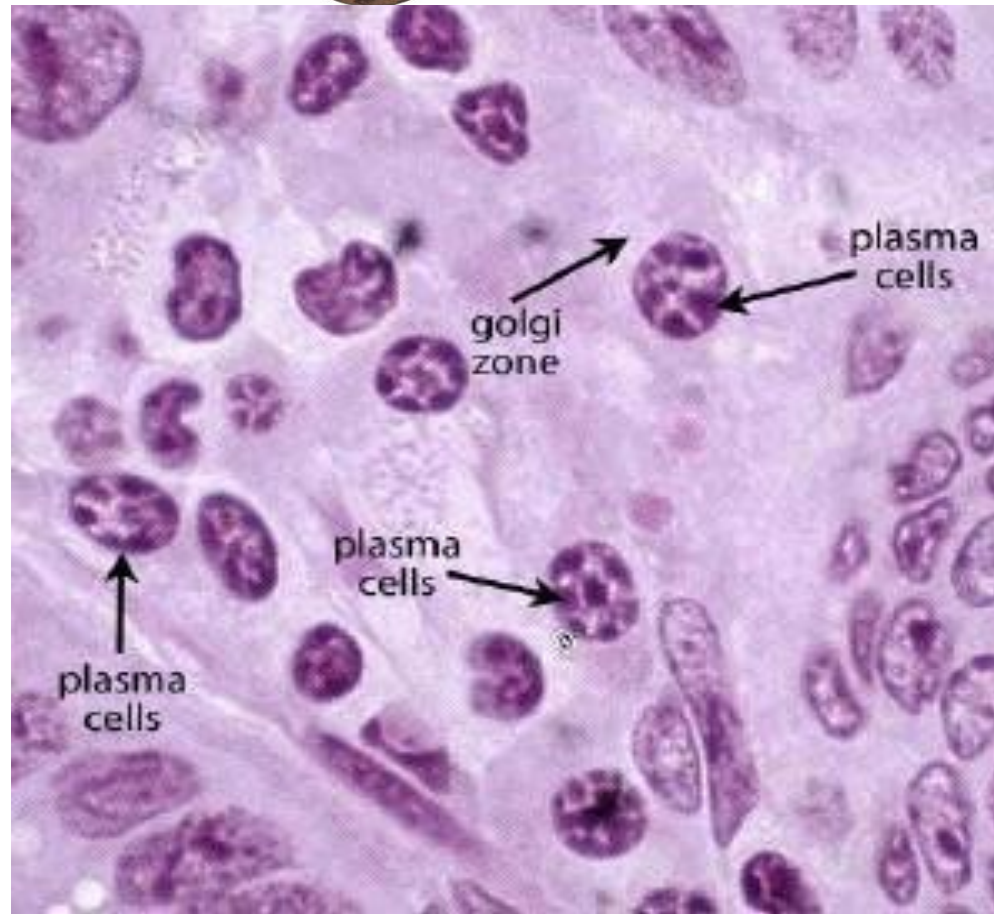
white blood cells specialized in antibodies secretion and synthesis and they are important for accelerating the immune response. they are B- lymphocyte derived.

plasma cells are larger than B-lymphocytes. rich with organelles, big amount of cytoplasm. synthesize immunoglobulin (antibodies).

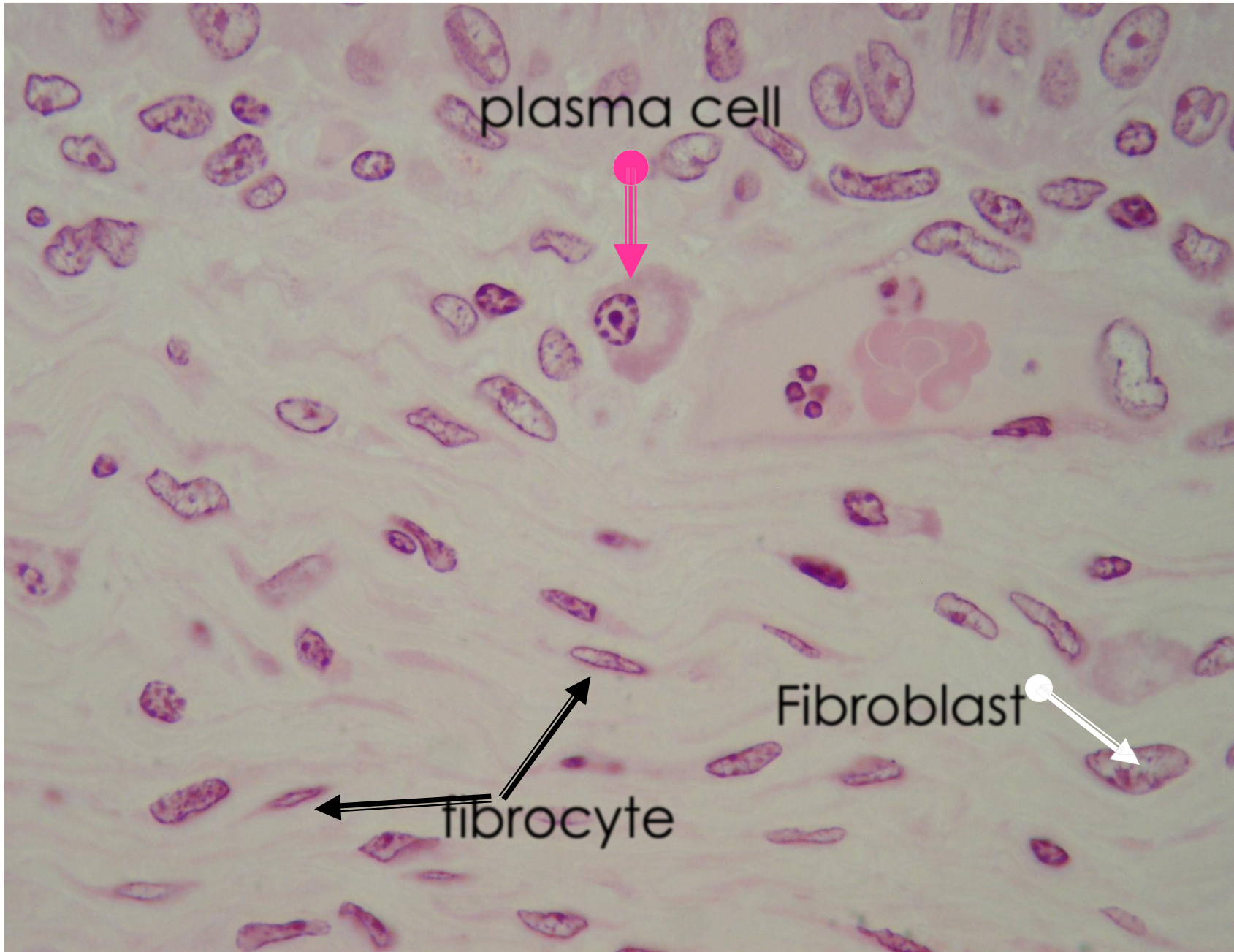
What's special about plasma cells is how the genetic material is organized in the nucleus . It is organized in a way called the cart-wheel appearance where it is Ranged into clumps at the periphery and in the center.

We recognize plasma cells by their genetic material shape.

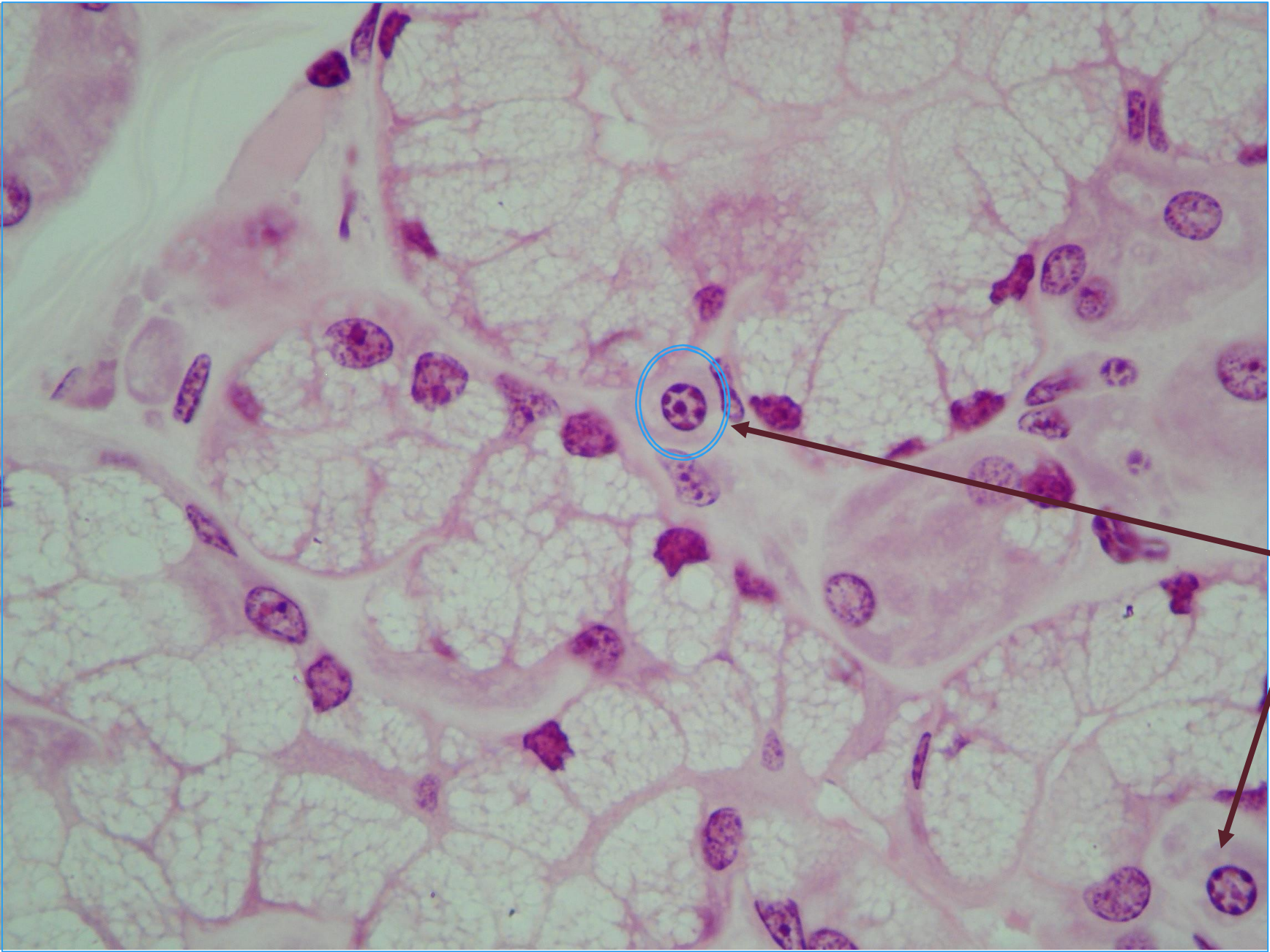
Wheel cart shape .



This is a loose connective tissue.



We might see fibrocytes and fibroblasts in the same tissue. It depends on the tissue type and we might have more fibroblasts than fibrocytes or the opposite.



This tissue is taken from a gland a mucus secreting gland to be specific.

Plasma cells

Collagen and elastin

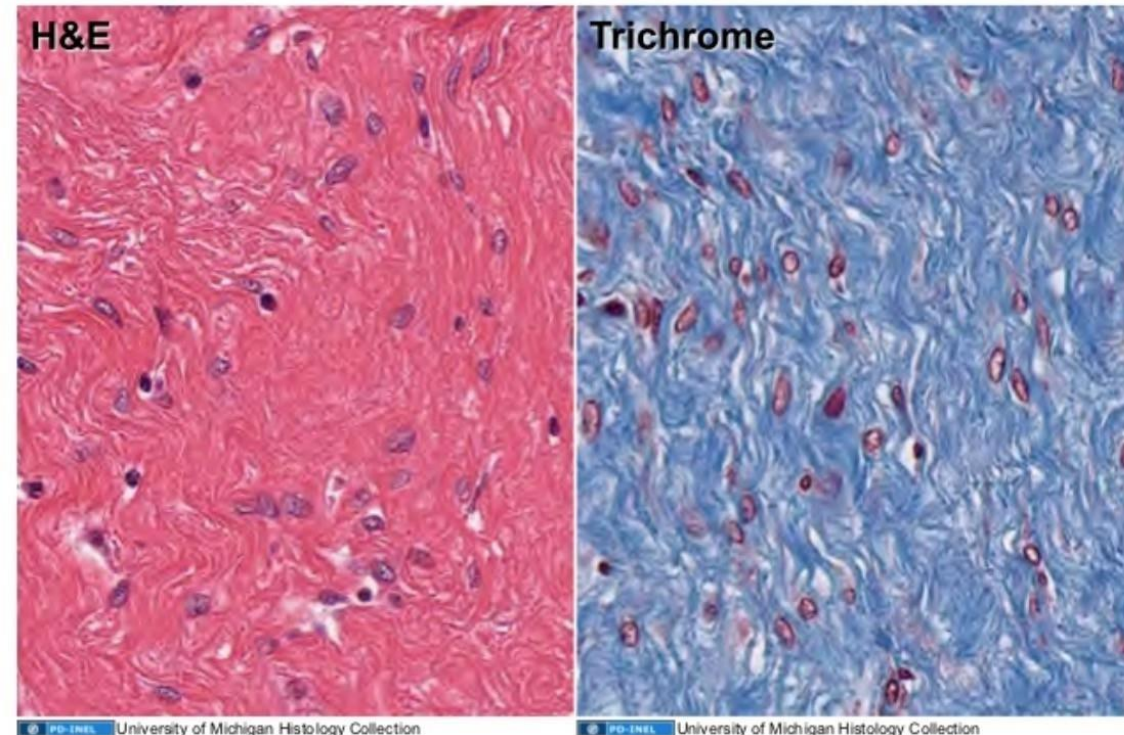
The best way to visualize fibers :

1. Collagen: eosin stain
2. Elastin and reticular : special stains to distinguish them

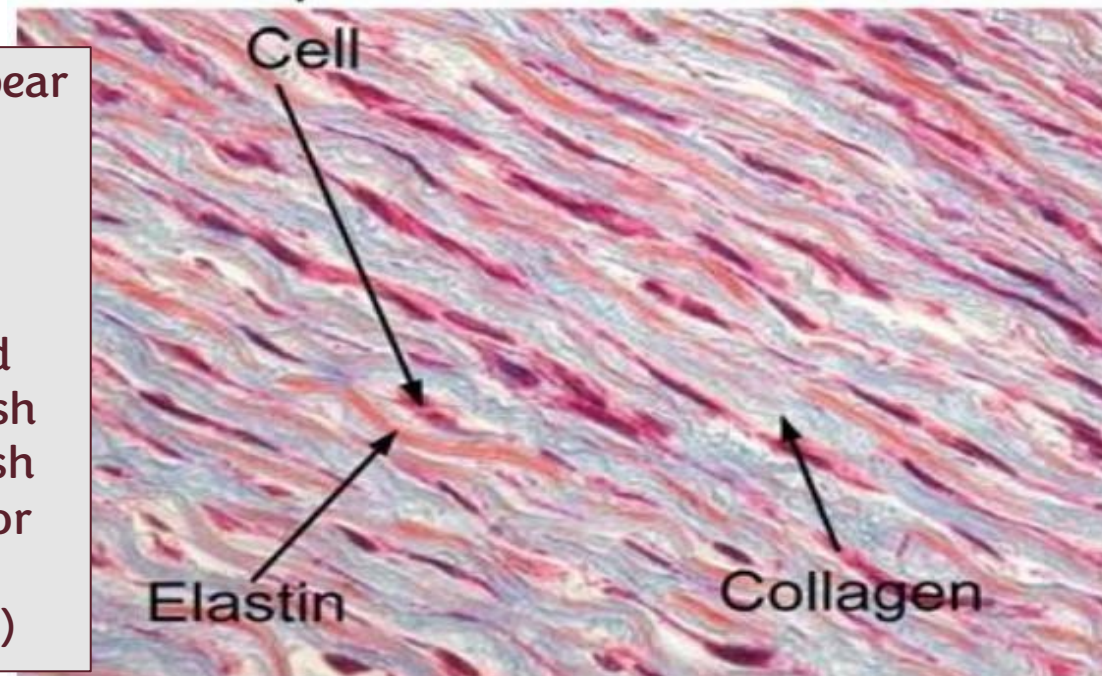
Dense CT, we see lots of fibers (mainly collagen) but it's hard to distinguish between fibers here unless we have a special stain.



Mason's trichrome



Elastin appear orangish , collagen usually appears bluish , and dark reddish and purplish color are for the nuclei (fibrocytes)



Collagen appears in pink Collagen appears in blue

Collagen and elastin

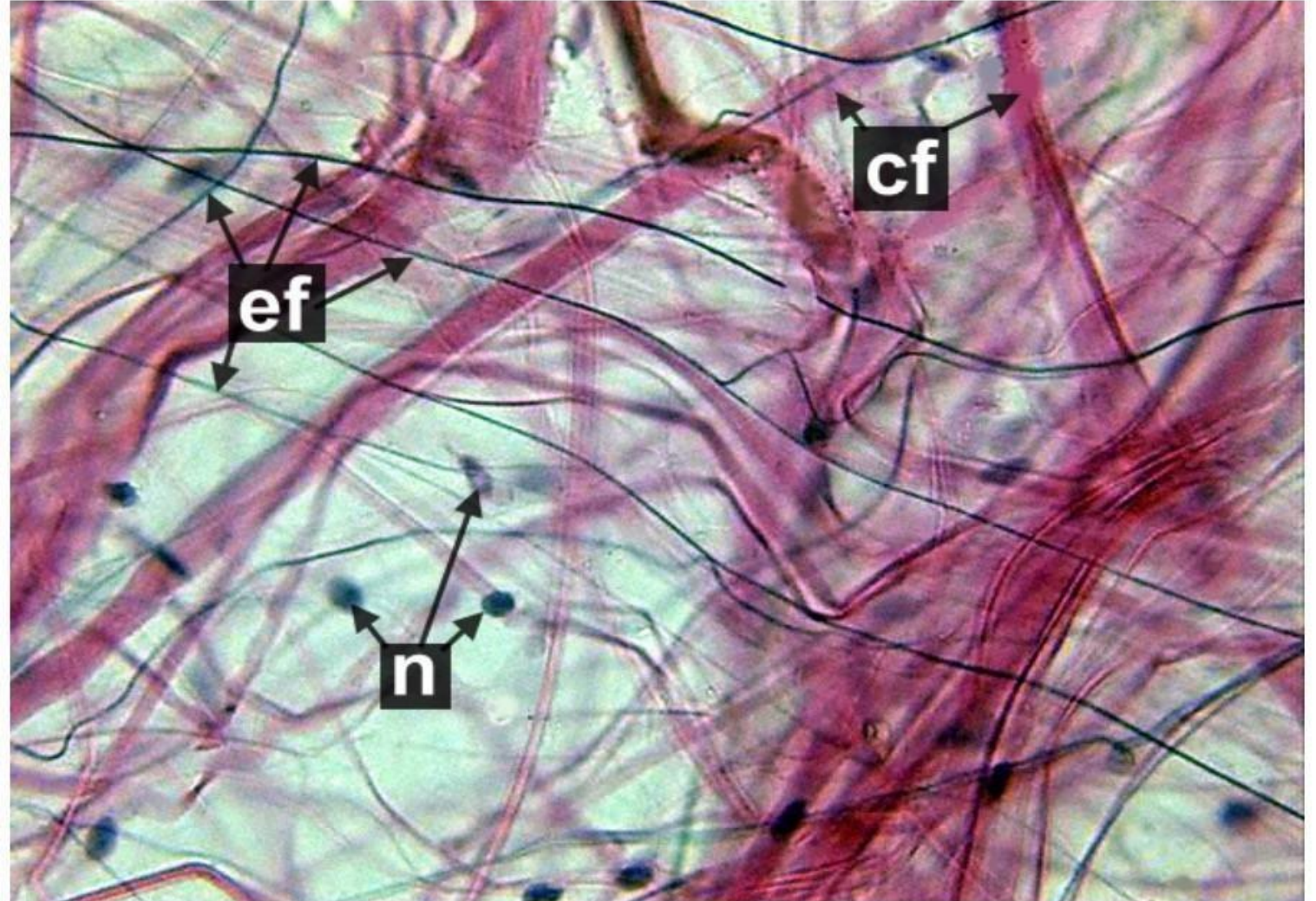
This is a loose Connective tissue

EF: elastic fibers

CF: collagen fibers

N: nuclei of the connective tissue

white gaps : they are not empty, they are filled with ground substance.

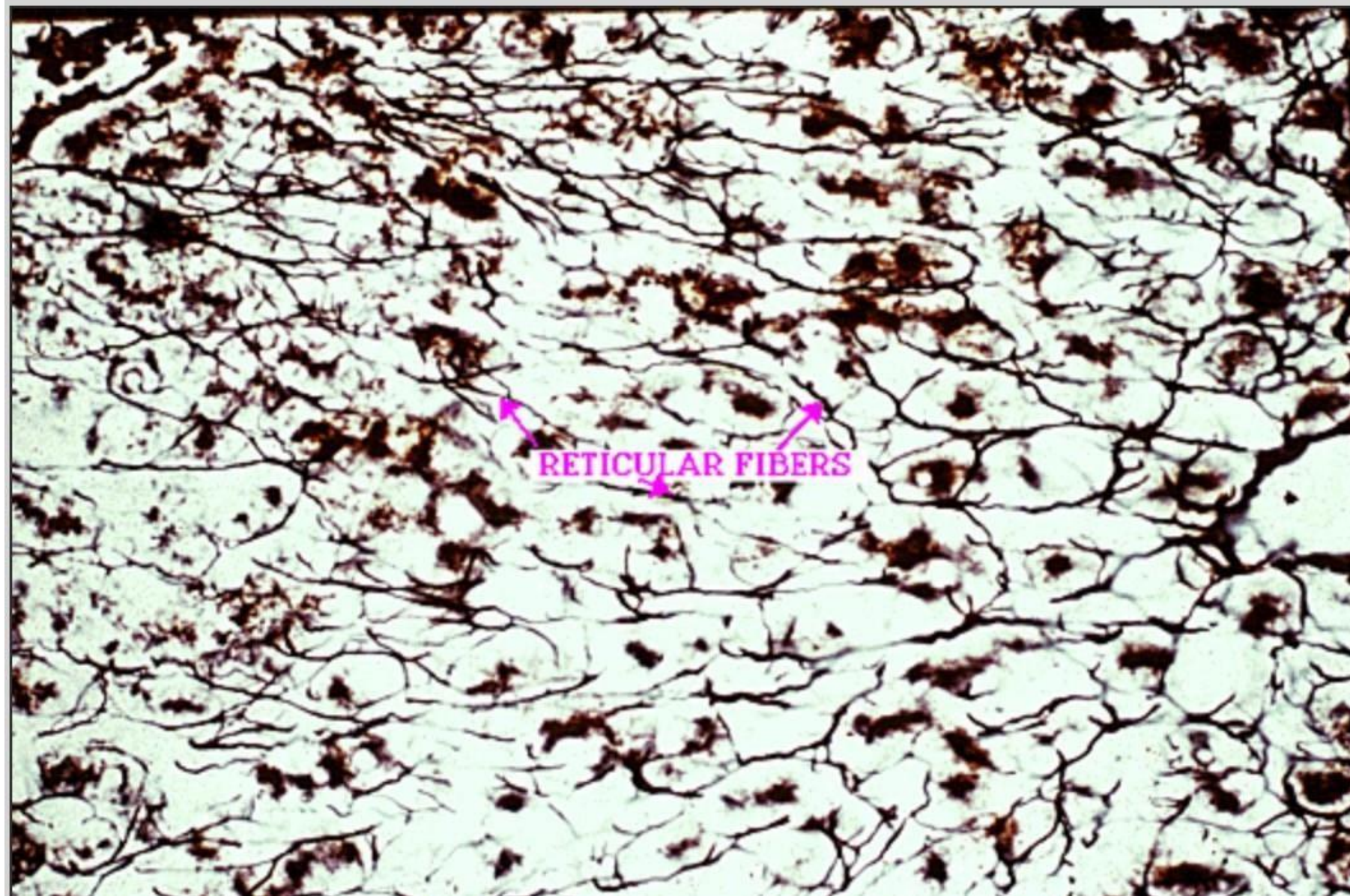


Reticular fibers

Collagen type III mainly

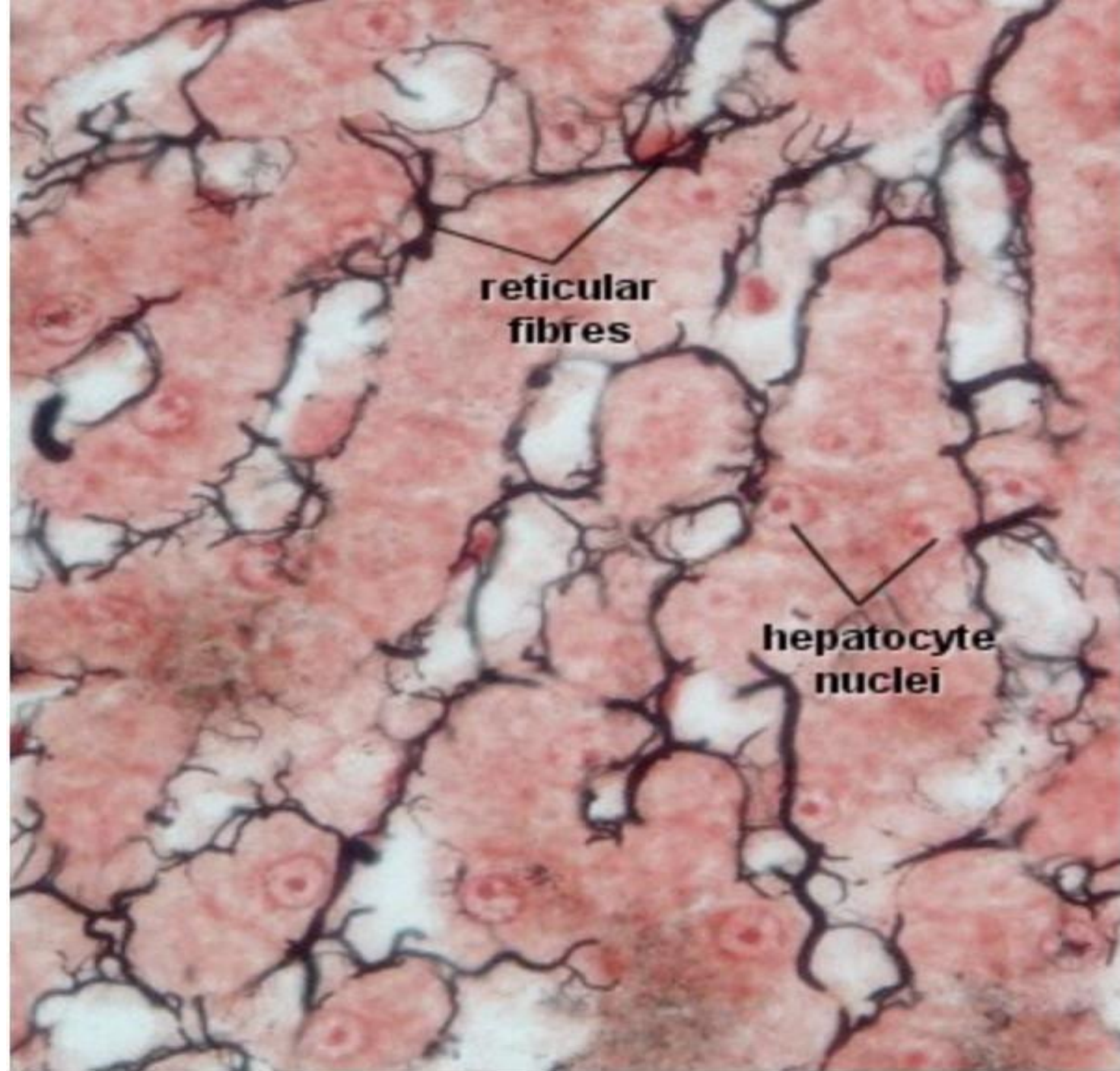
stained with silver salts ,another way to stain it is by using PAS(periodic acid Schiff) staining due to their high content of sugars.

Reticular fibers: form a delicate supporting network unlike collagen I and II which form bundles , or elastic where it forms wavy structures or lamellae which could be seen in the aorta



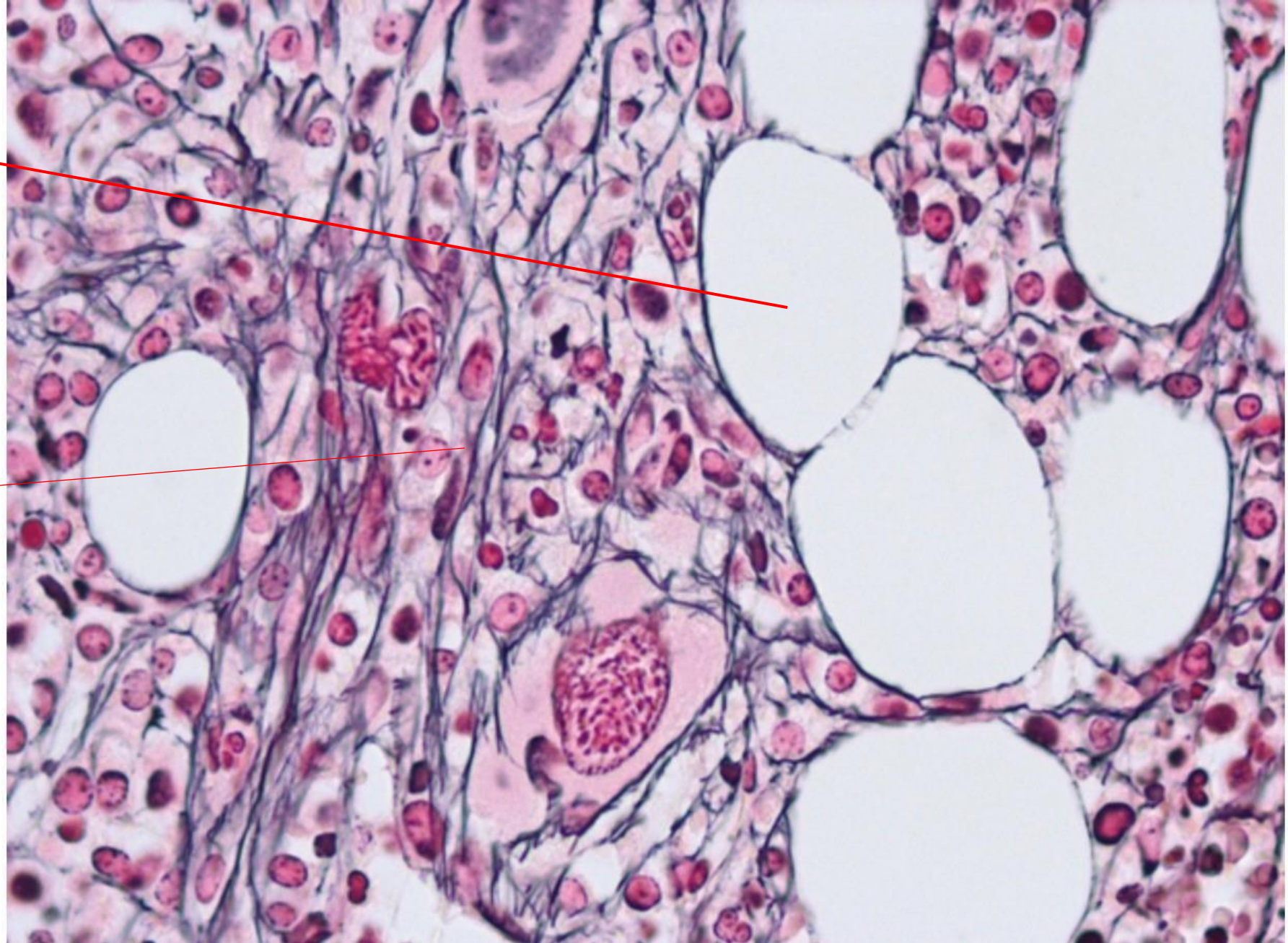
A section from the liver

Reticular fibers surround and support the hepatocytes. (hepatocytes are liver cells).



fat cell (adipocyte)

reticular fibers (the black lines
which create networks)



Connective tissue types

Mesenchyme

Embryonic CT, derived from mesoderm

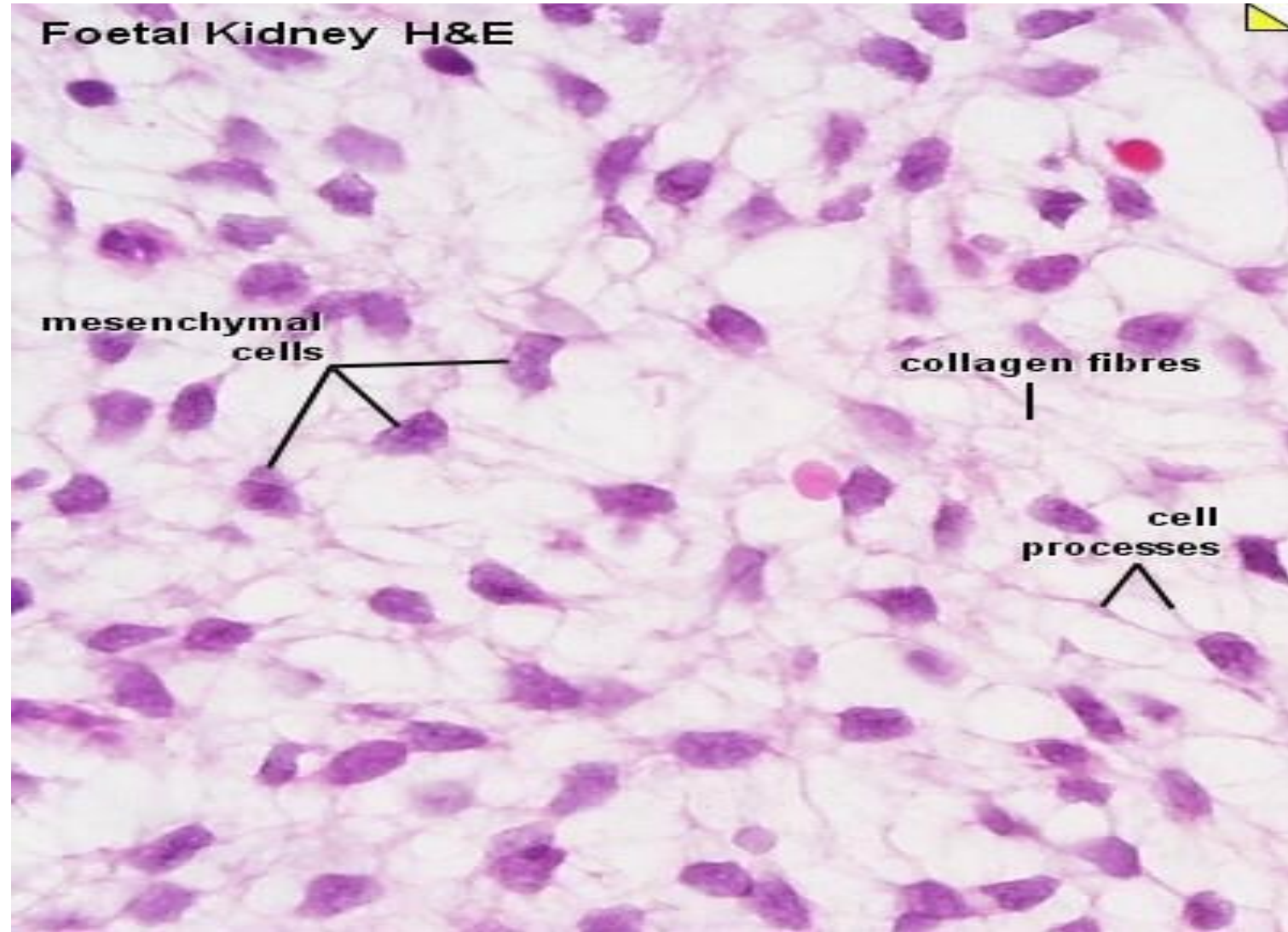
how to recognize mesenchymal CT:

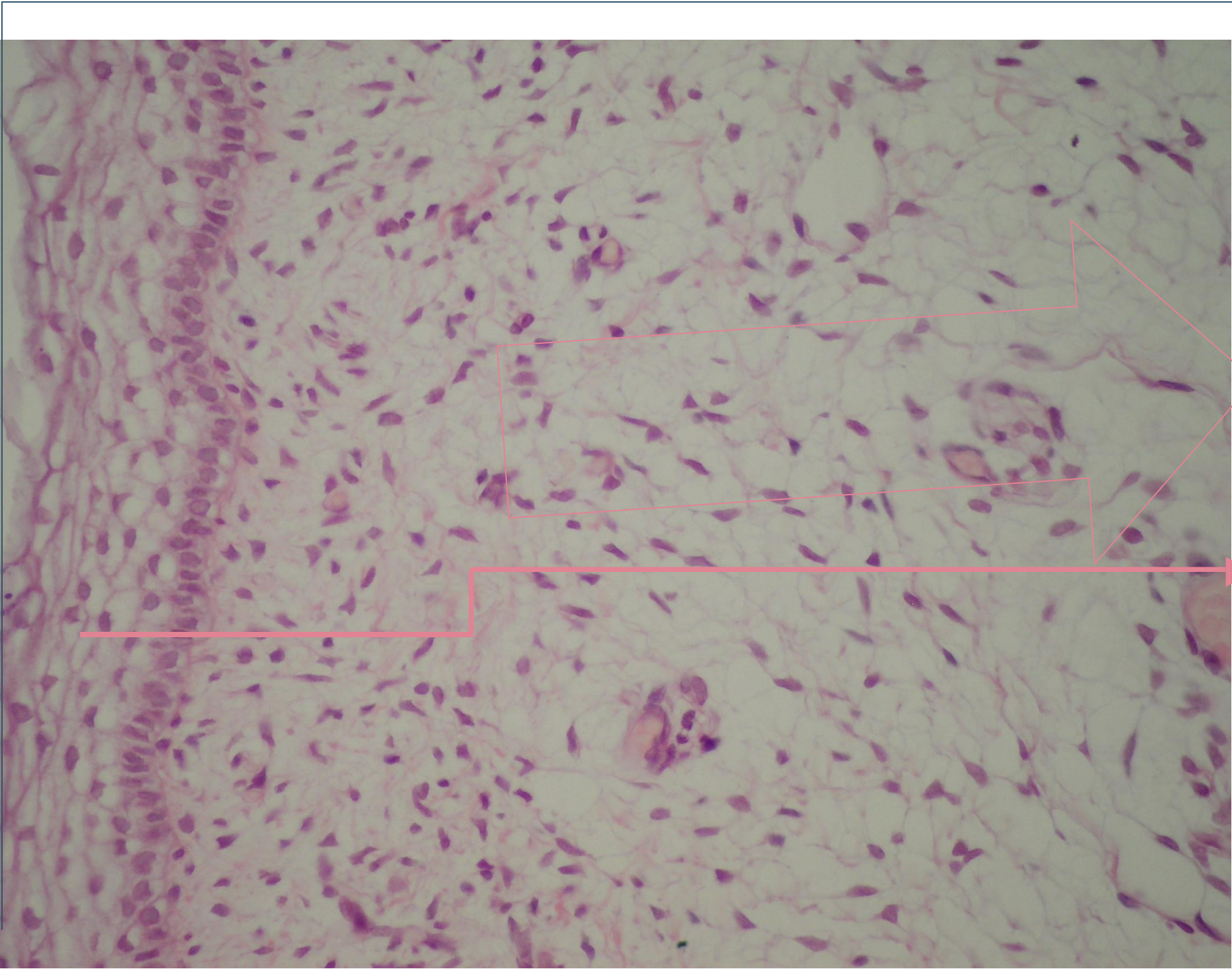
1. Evenly distributed mesenchymal stem cells, where they have collagen fibers in between
- 2, they have a good amount of ground substance .

How do Mesenchymal stem cells look like:

Euchromatic nucleus and good amount of ground substance around it.

This section was taken from the fetal kidney





Mesenchymal Connective tissue

This section is taken from the skin (epidermis and dermis), we know by noticing:

*mesenchymal CT that will form the future dermis

* stratified squamous non keratinized, we look at the Apical layer and it's flat and there's multiple rows of cells below it, and it is non keratanized (epithelial tissue)

Mucoid connective tissue

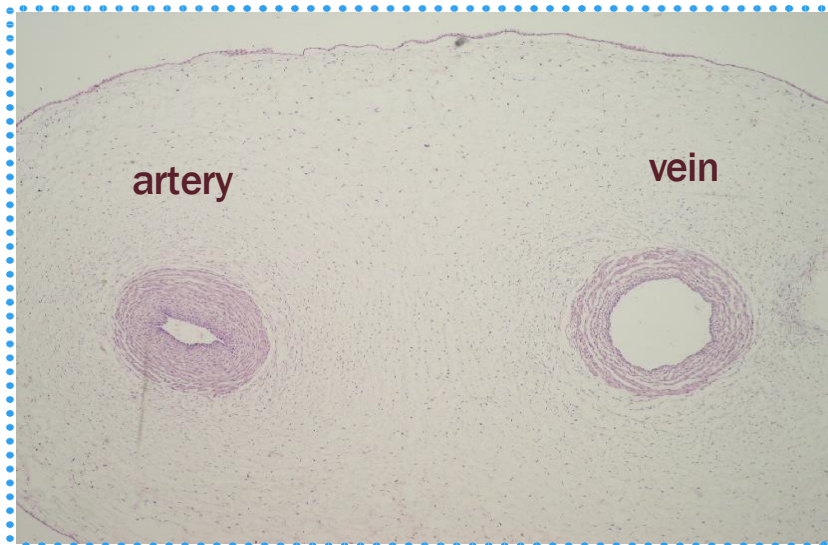
This section was taken from the umbilical cord (the main site we can find mucoid CT in) .

mucoid (mucous) :

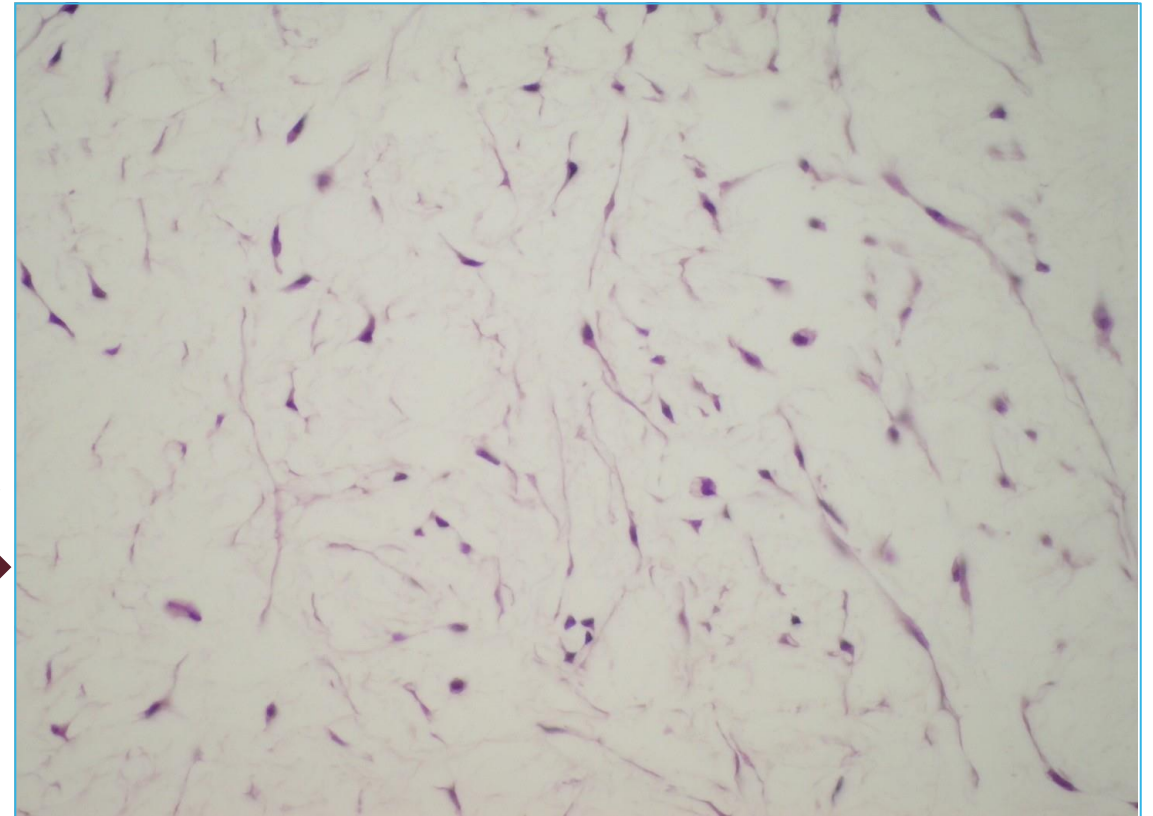
ground substance: a lot of ground substances precisely **hyaluronic acid** to protect the internal vessels

Cells: mainly fibroblasts + some mesenchymal stem cells .

Fibers: **small** amount of collagen fibers



magnify
➔

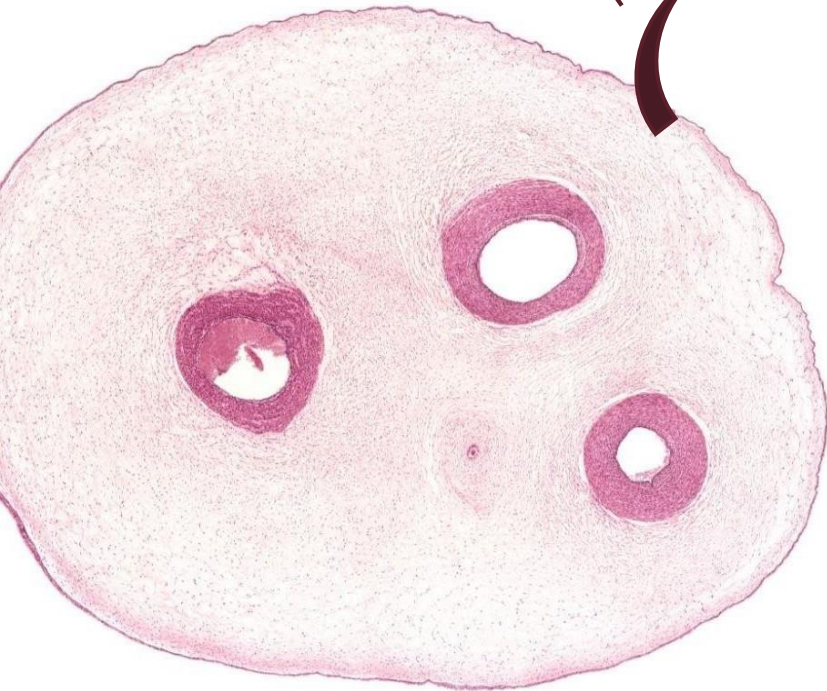


☉☉☉ Although it has a smaller amount of mesenchymal cells than that found in mesenchymal CT it is useful in extracting mesenchymal stem cells , which is used to treat a variety of diseases

Mucoid CT

2 umbilical arteries
1 umbilical vein

Magnify



The walls of the arteries are thicker
vein with thinner wall

Most of them
is fibroblasts

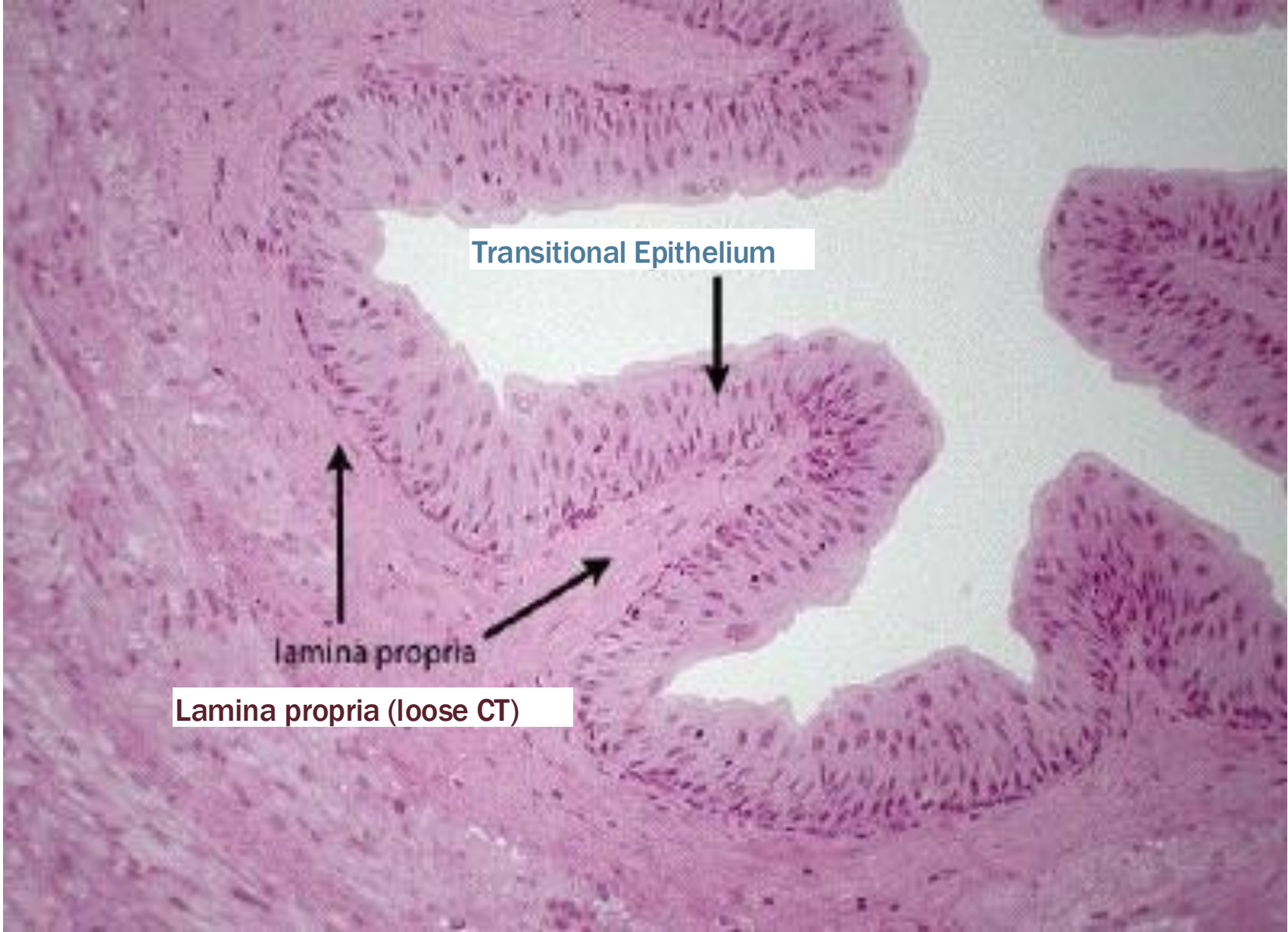


Connective tissue (CT) proper- Loose CT

More cells and ground substance
Less fibers
Contains several types of cells mostly fibroblasts
Contains all 3 types of fibers

Usually, the CT under the Epithelium is loose CT



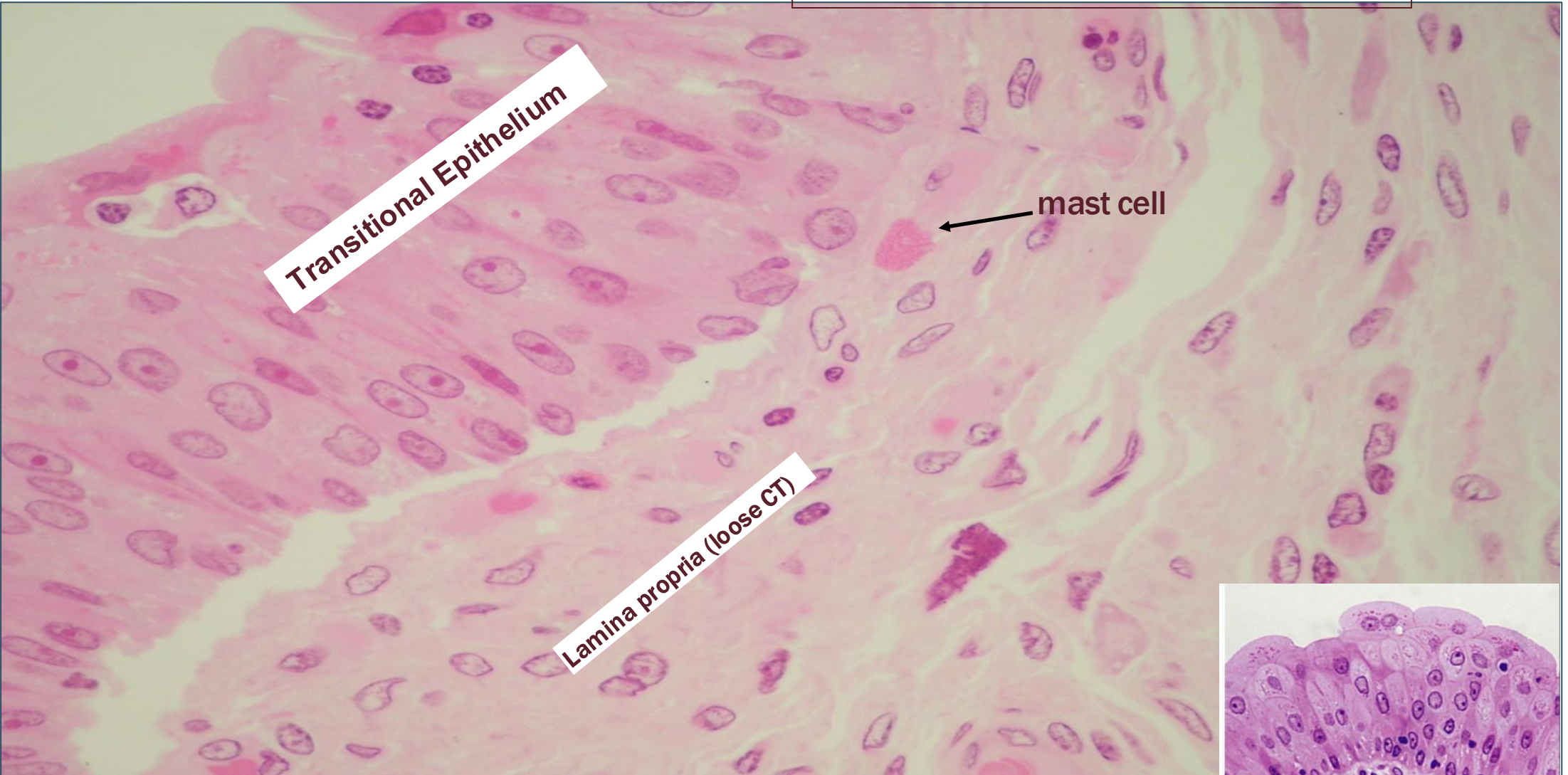


Transitional Epithelium

lamina propria

Lamina propria (loose CT)

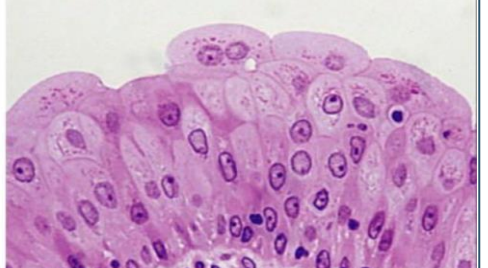
Loose CT is mostly composed of fibroblasts but also there are another types (mast cells here)



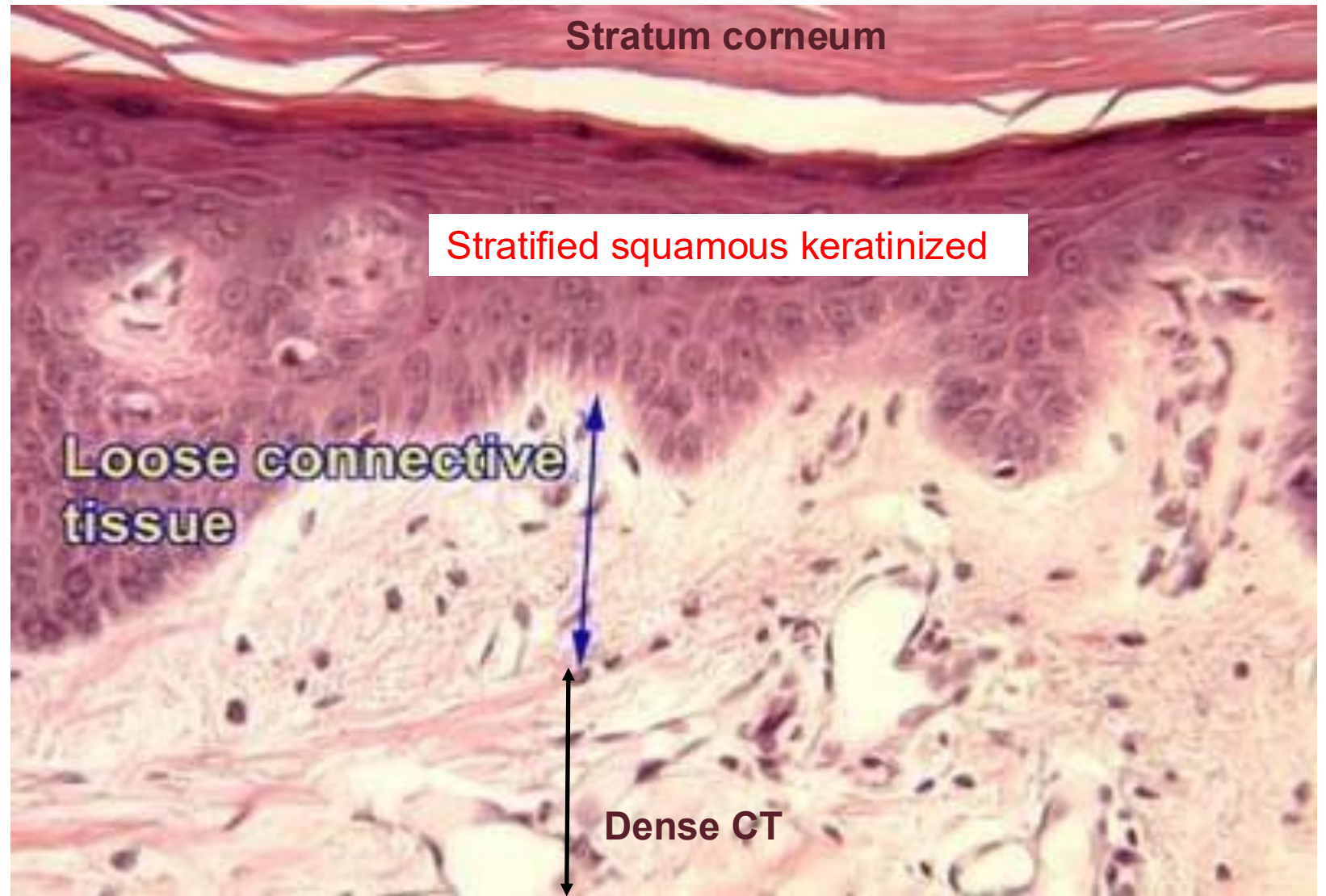
Transitional Epithelium

Lamina propria (loose CT)

mast cell



This section is taken from the skin



Stratum corneum

Stratified squamous keratinized

Loose connective tissue

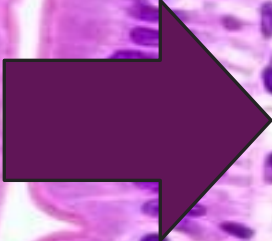
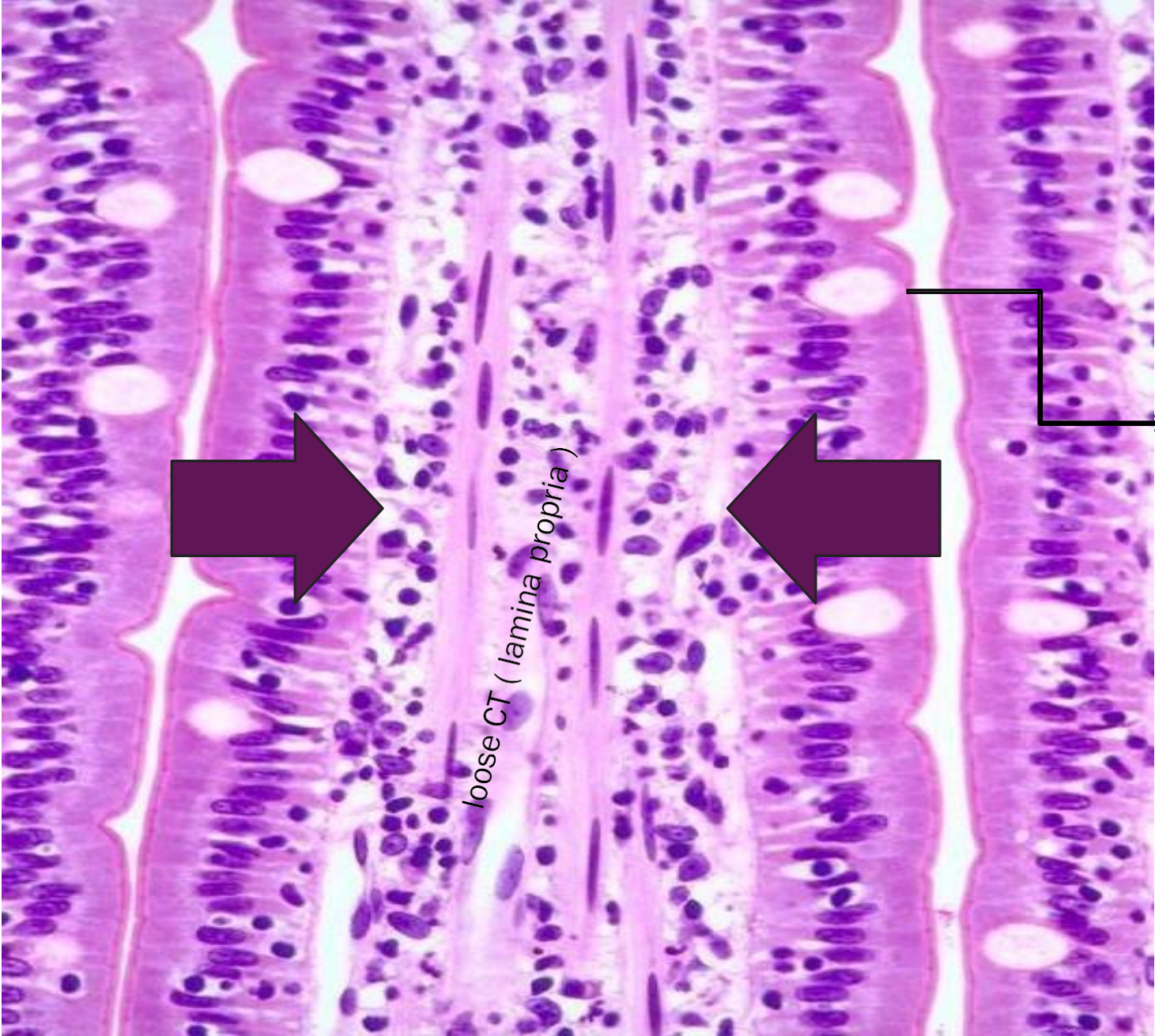
Dense CT

Dermis (2layers):

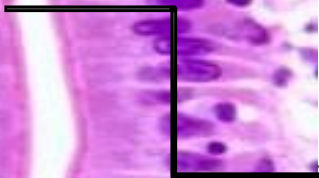
1-Loose CT (adjacent to the epidermis)

2-Dense CT

This section was taken from GIT



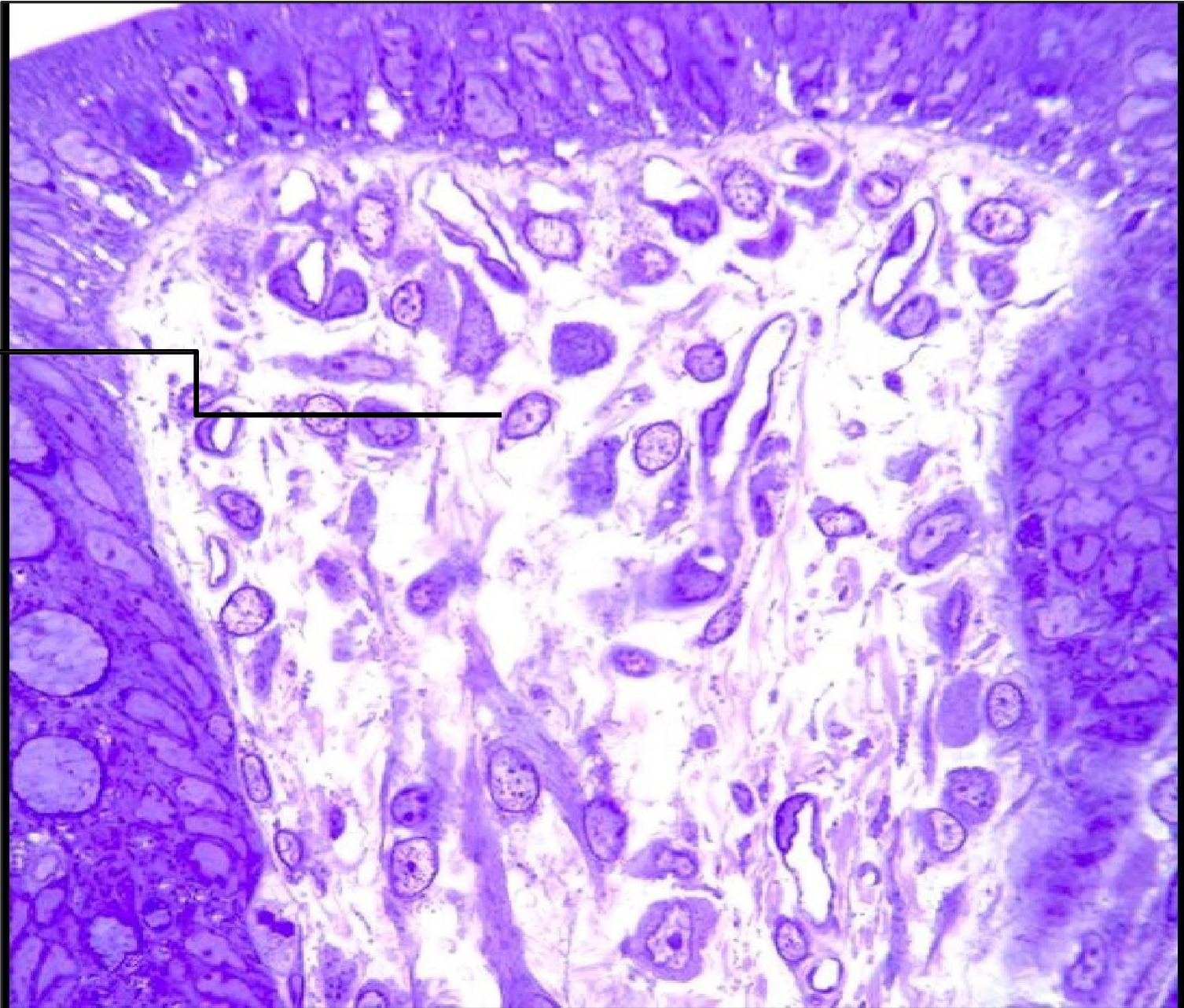
loose CT (lamina propria)



simple columnar epithelium with goblet cells & microvilli

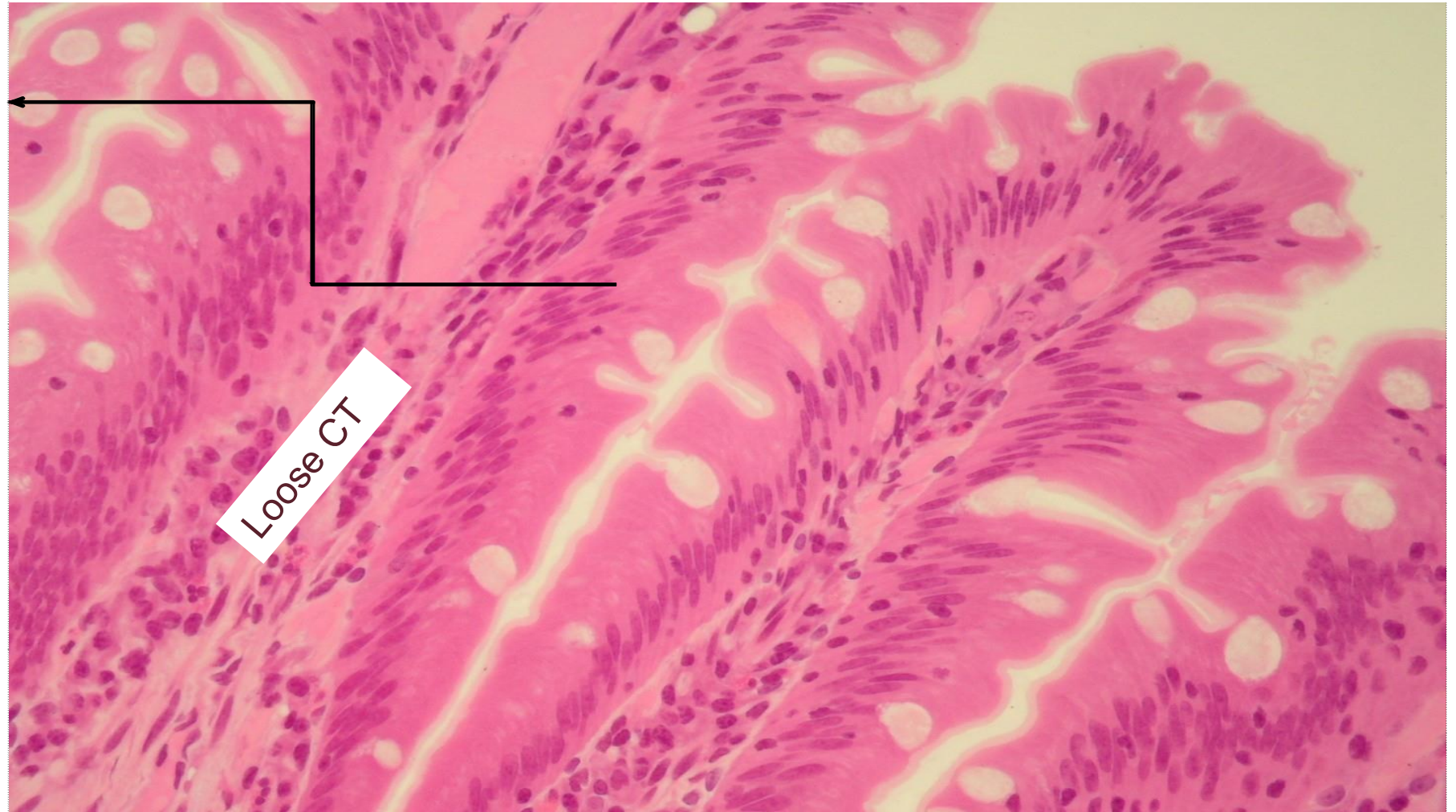
This section was taken from GIT

loose CT

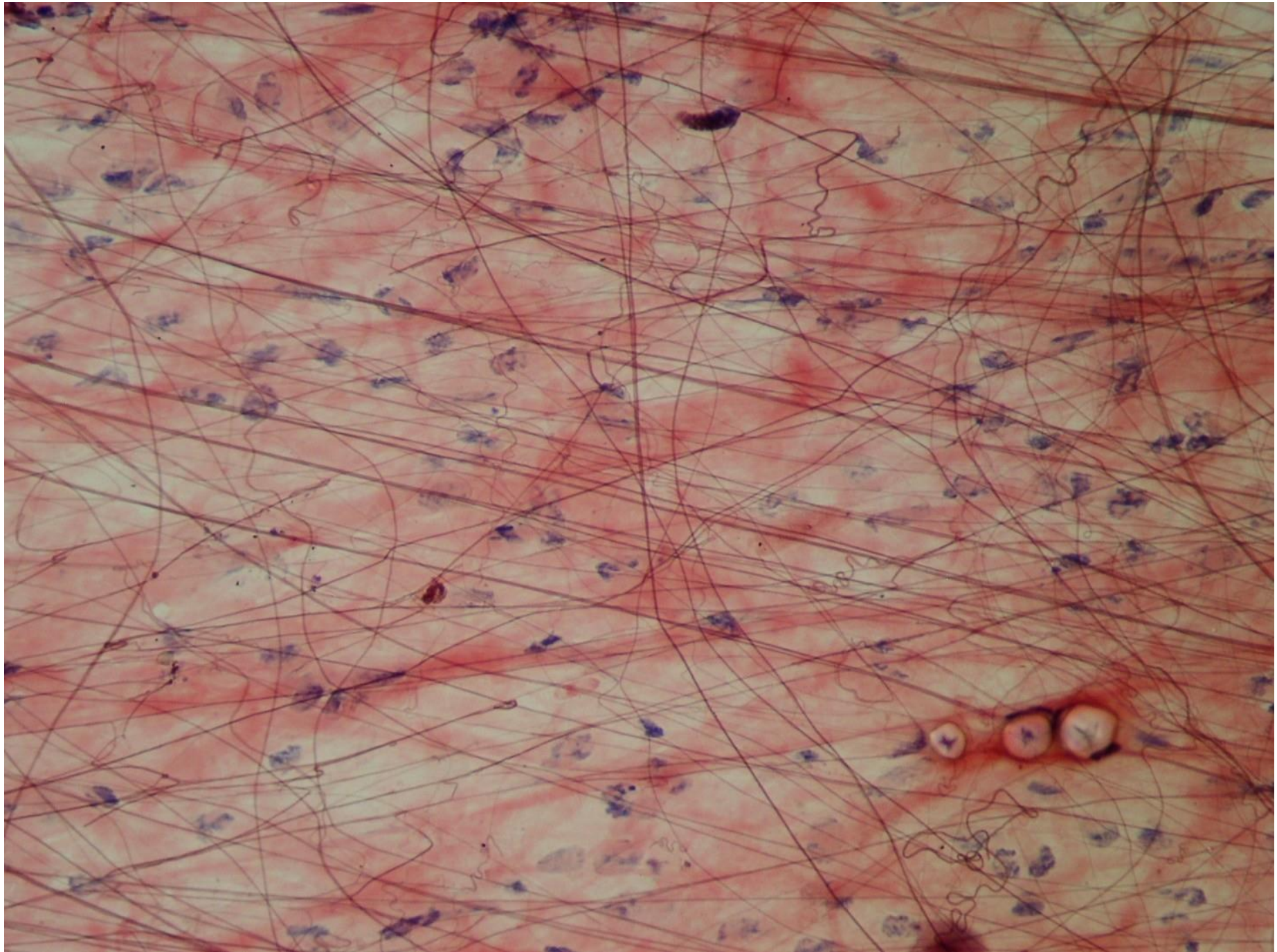


This section was taken from GIT

simple columnar with microvilli



Loose CT



Connective tissue (CT) proper- Regular dense CT



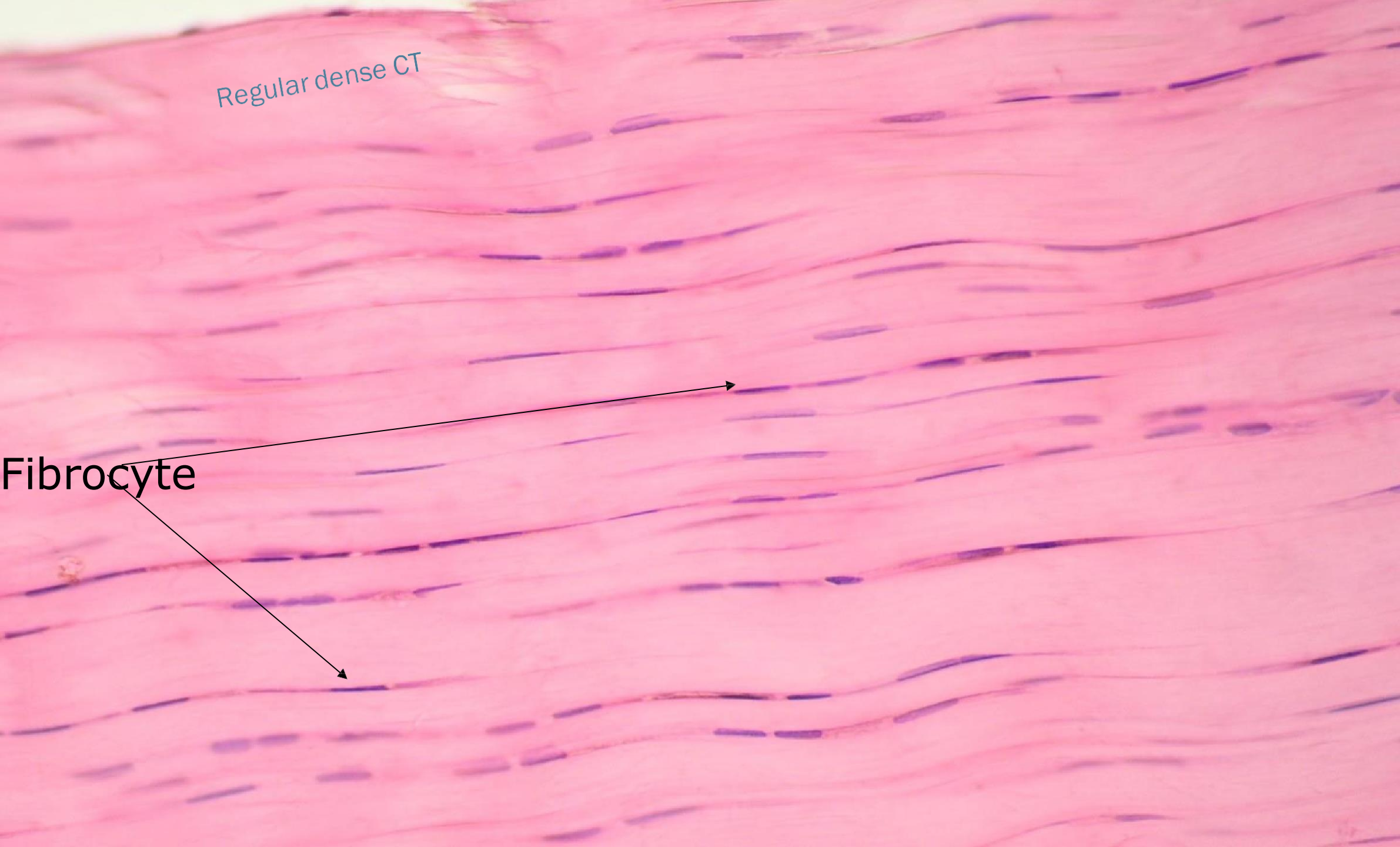
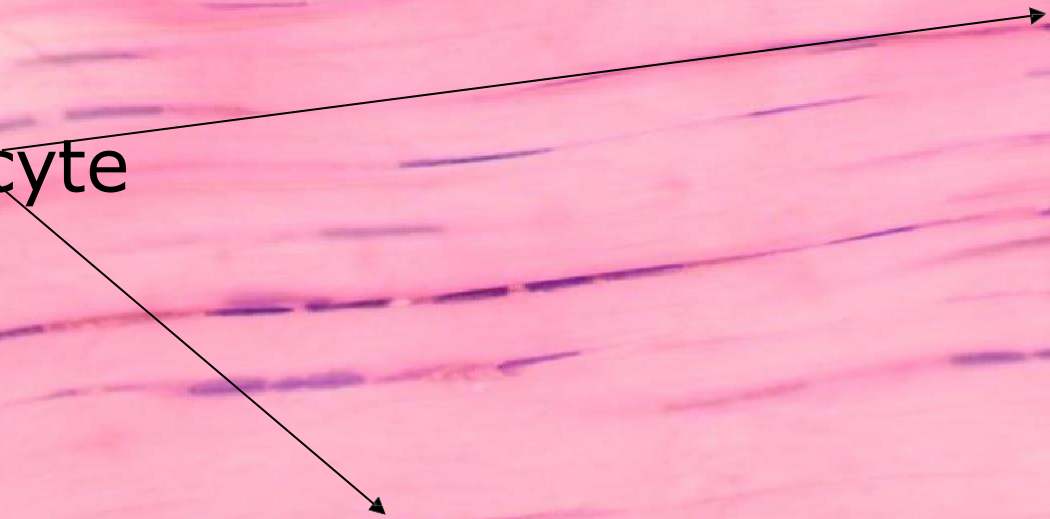
Stratified squamous
non-keratinized

Dense regular CT that supports
cornea is called stroma

Cells here are
fibrocytes not
fibroblasts
(In the corneal
stroma)

Regular dense CT

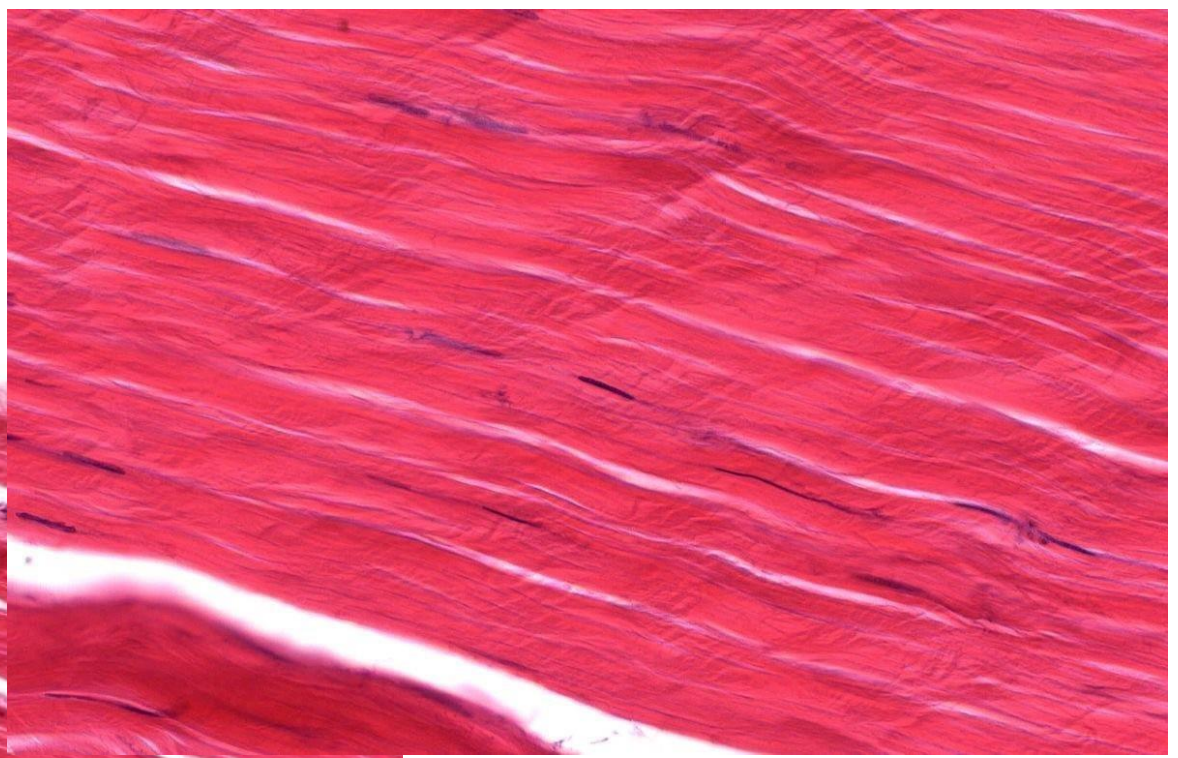
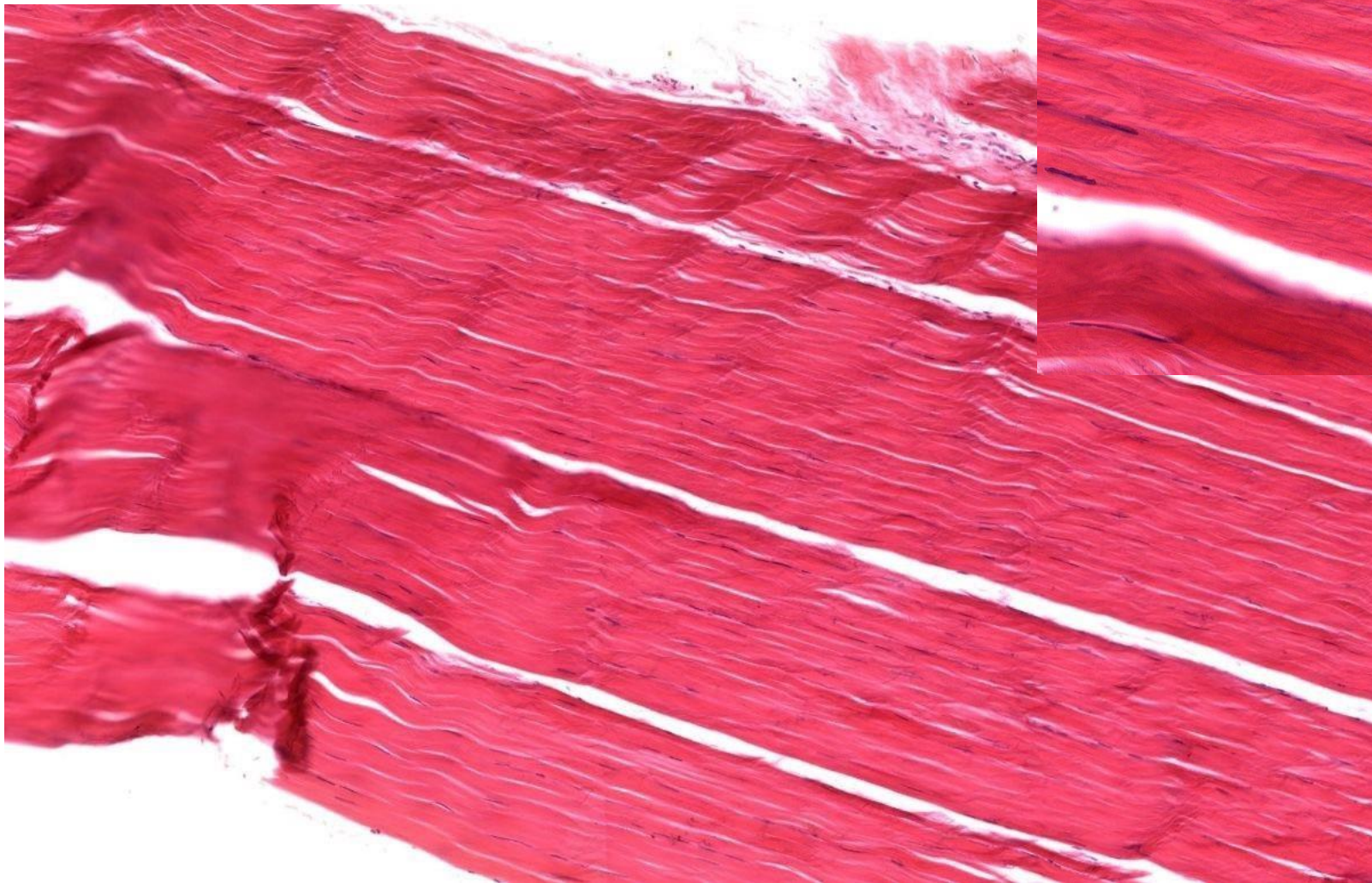
Fibrocyte



Identify?
Cells?

Regular dense CT

Mainly fibrocytes



H & E stain

Connective tissue (CT) proper- Irregular dense CT

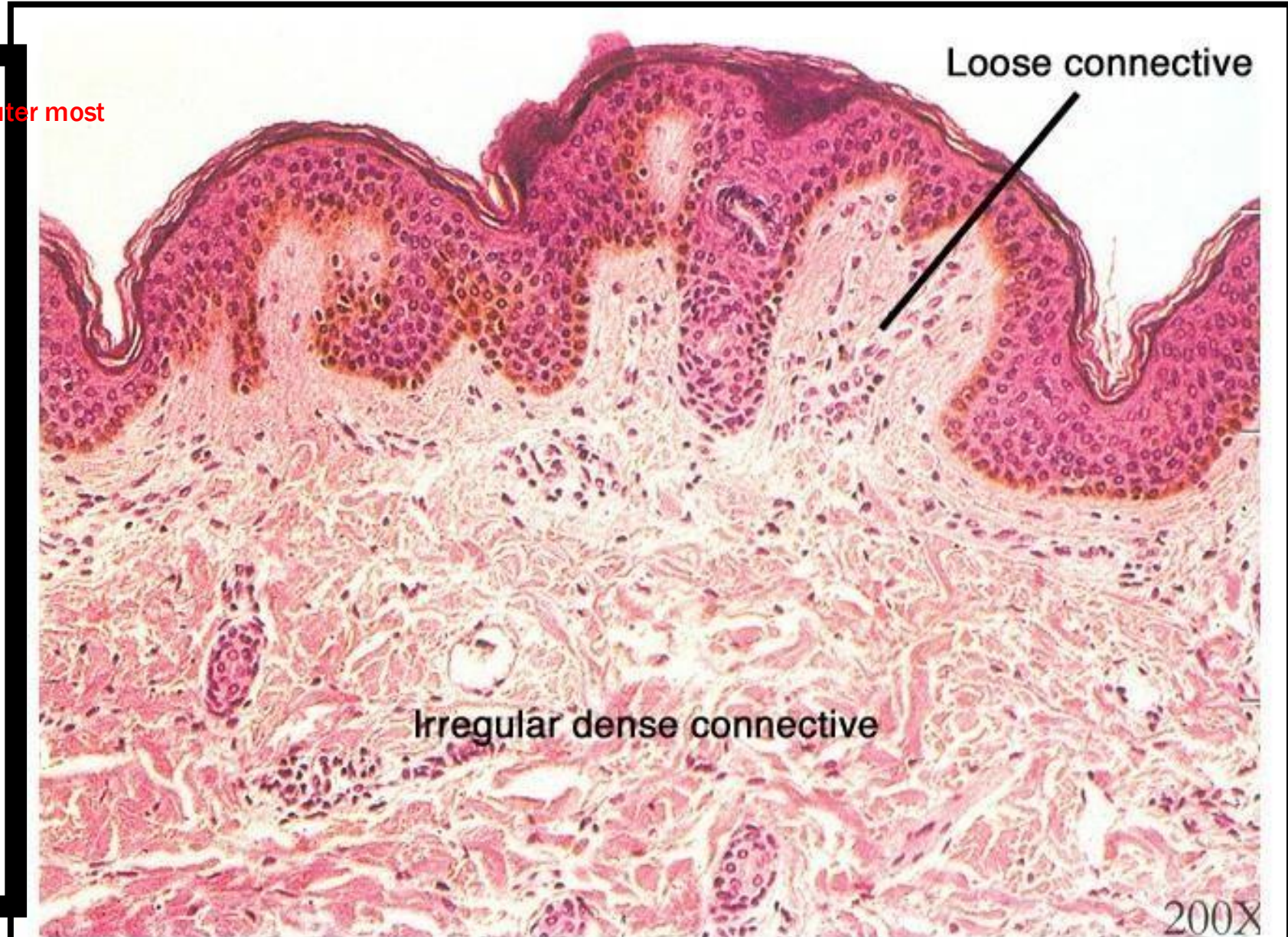
Extra information

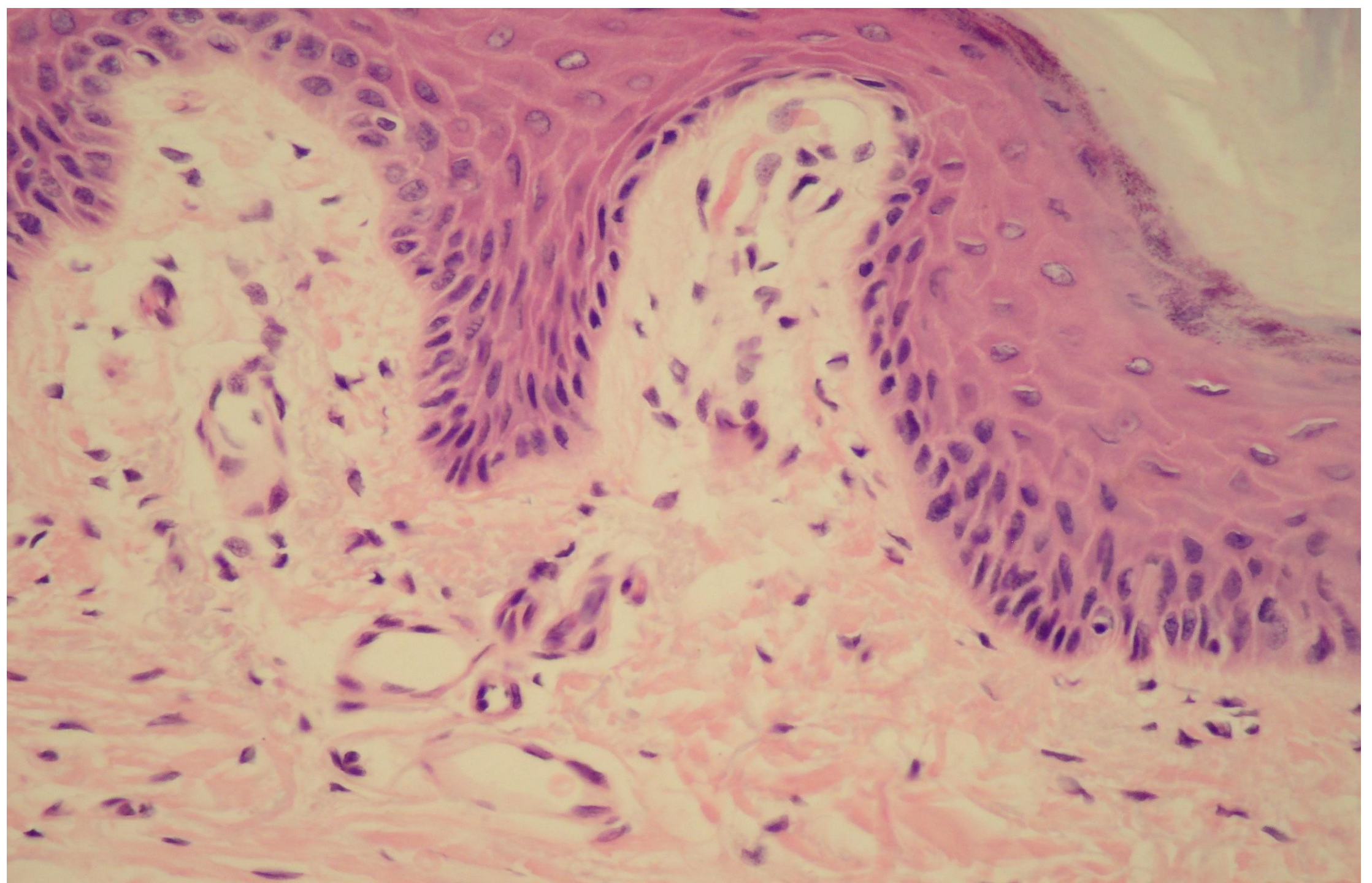
epidermis	Stratum corneum
	Stratum lucidum
	Granular layer
	Spinous layer
	Basale layer
dermis	Papillary (loose CT)
	Reticular layer (dense CT)
Subcutaneous layer	

Outer most

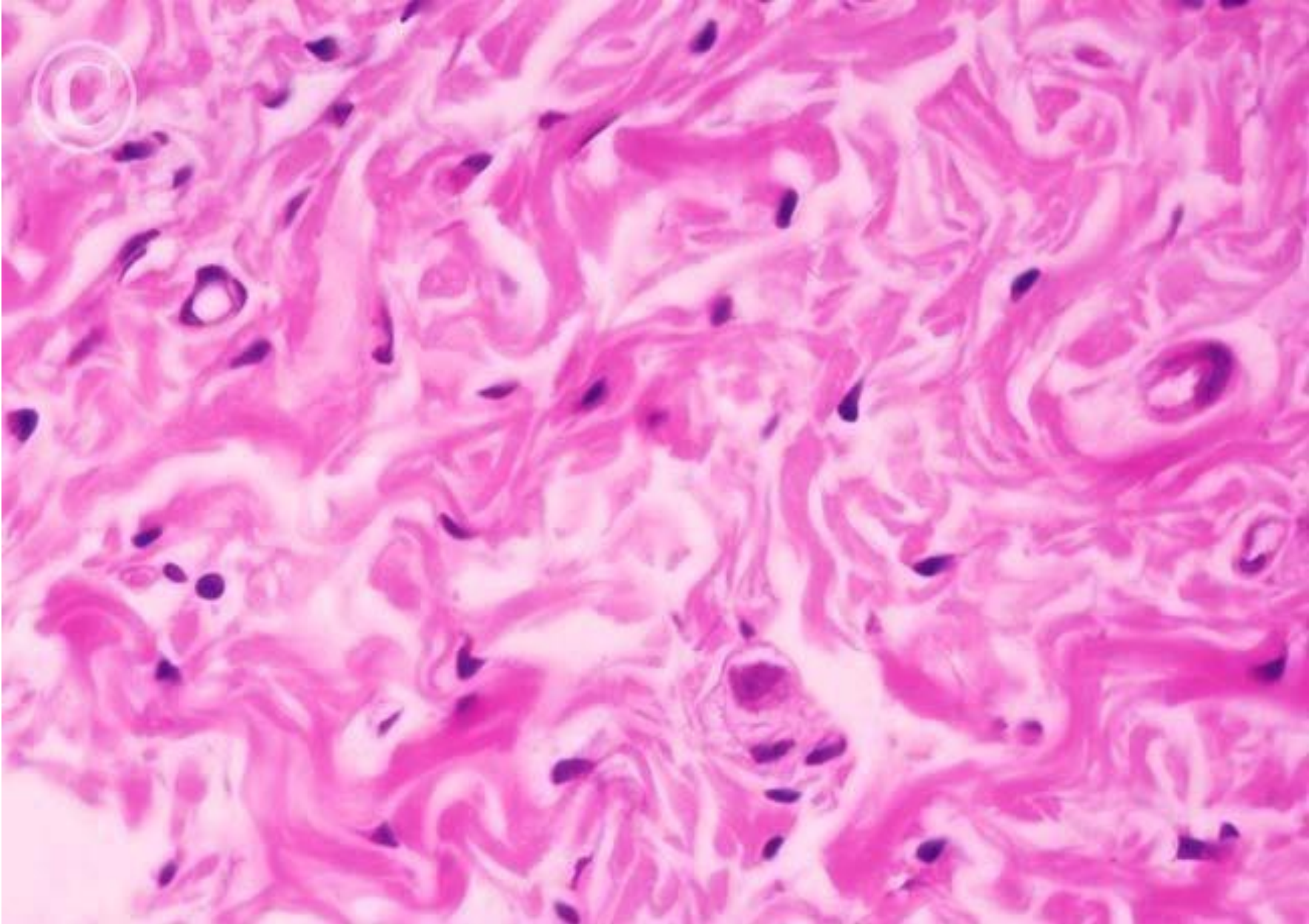
Inner most

This section was taken from the skin

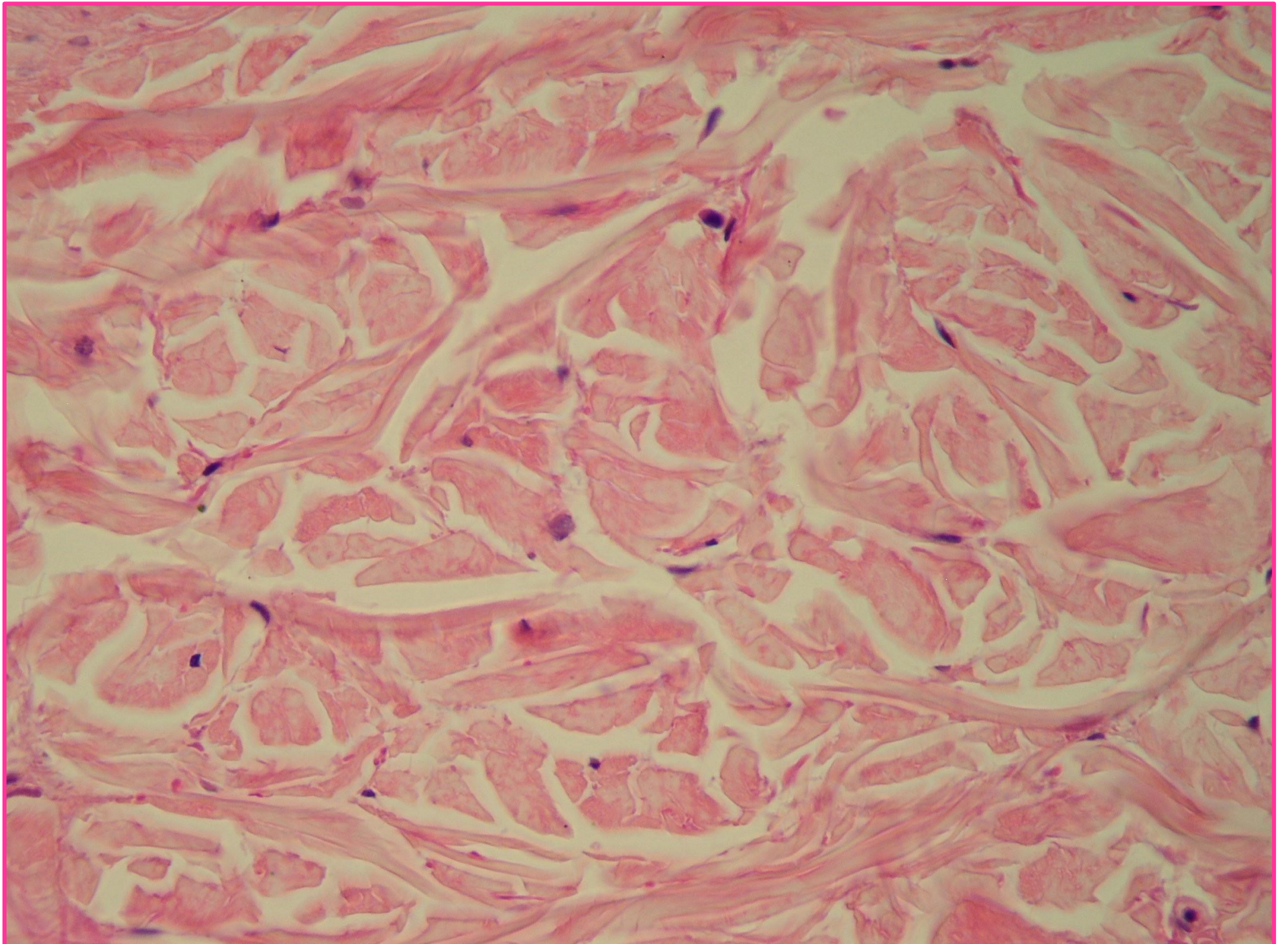




Dense irregular CT



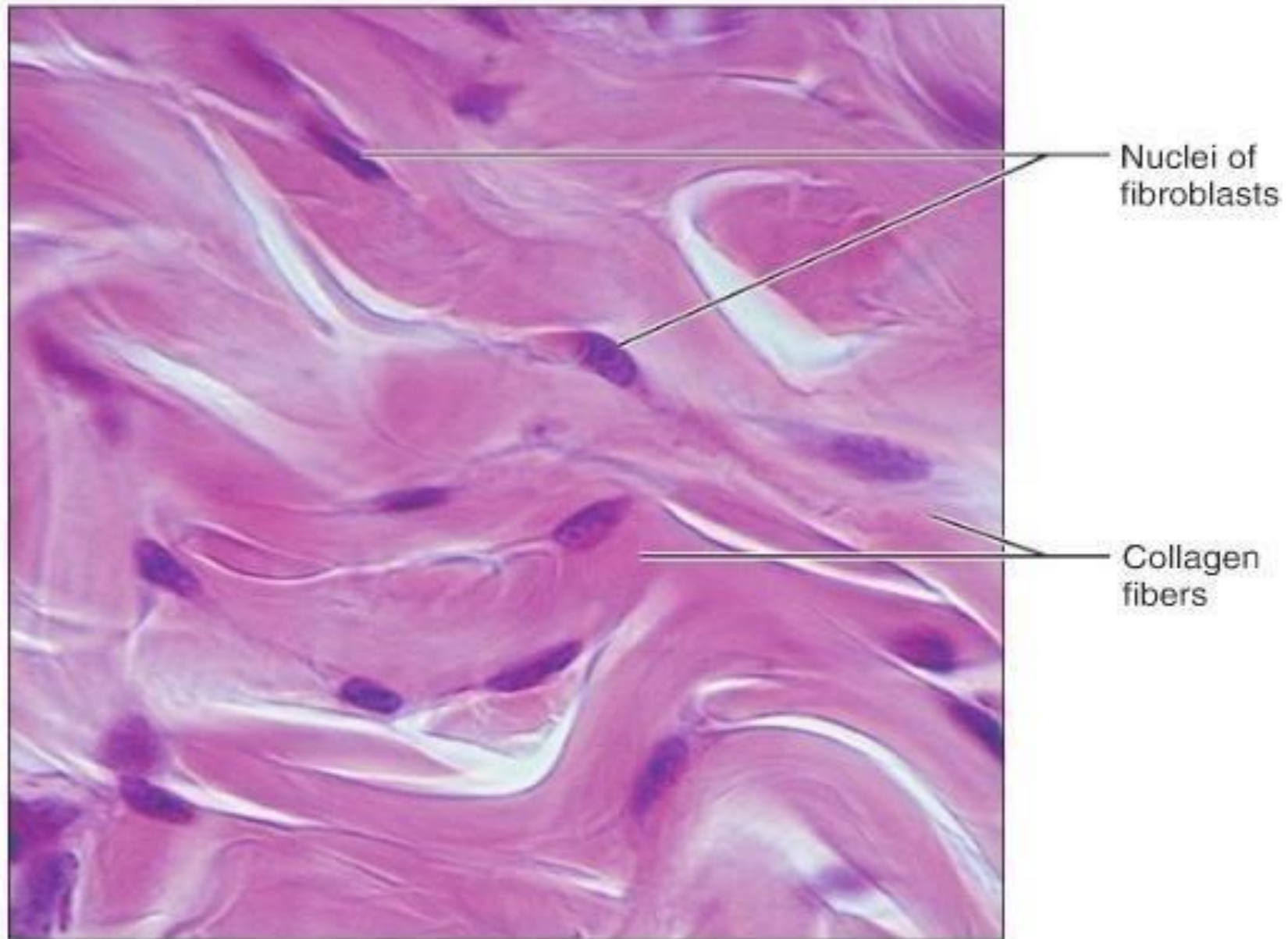
**Dense
irregular CT**



We can notice the difference between loose and dense by eosinophilia, dense CT stains more darkly since it has more fibers.

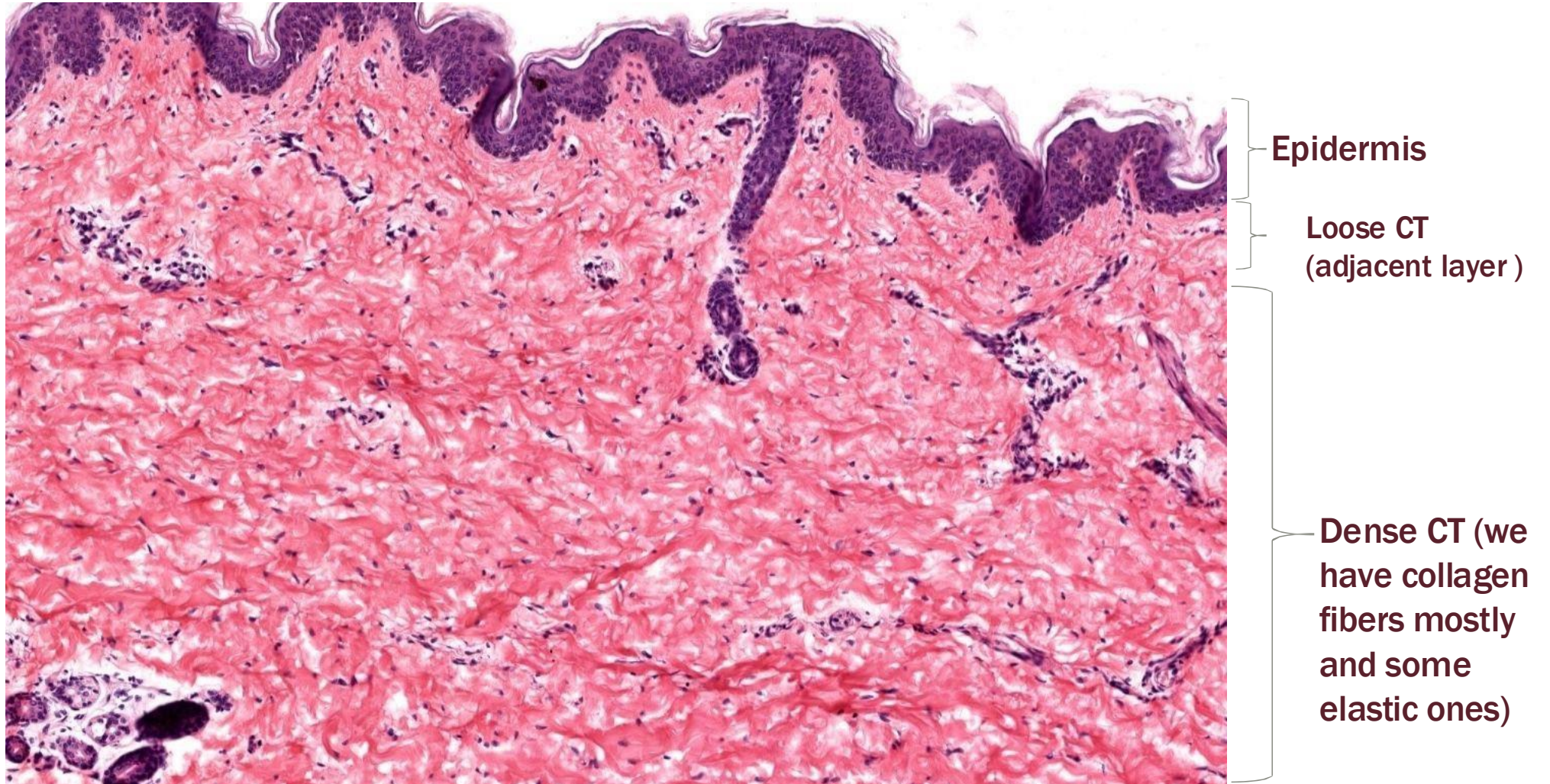


Dense irregular CT



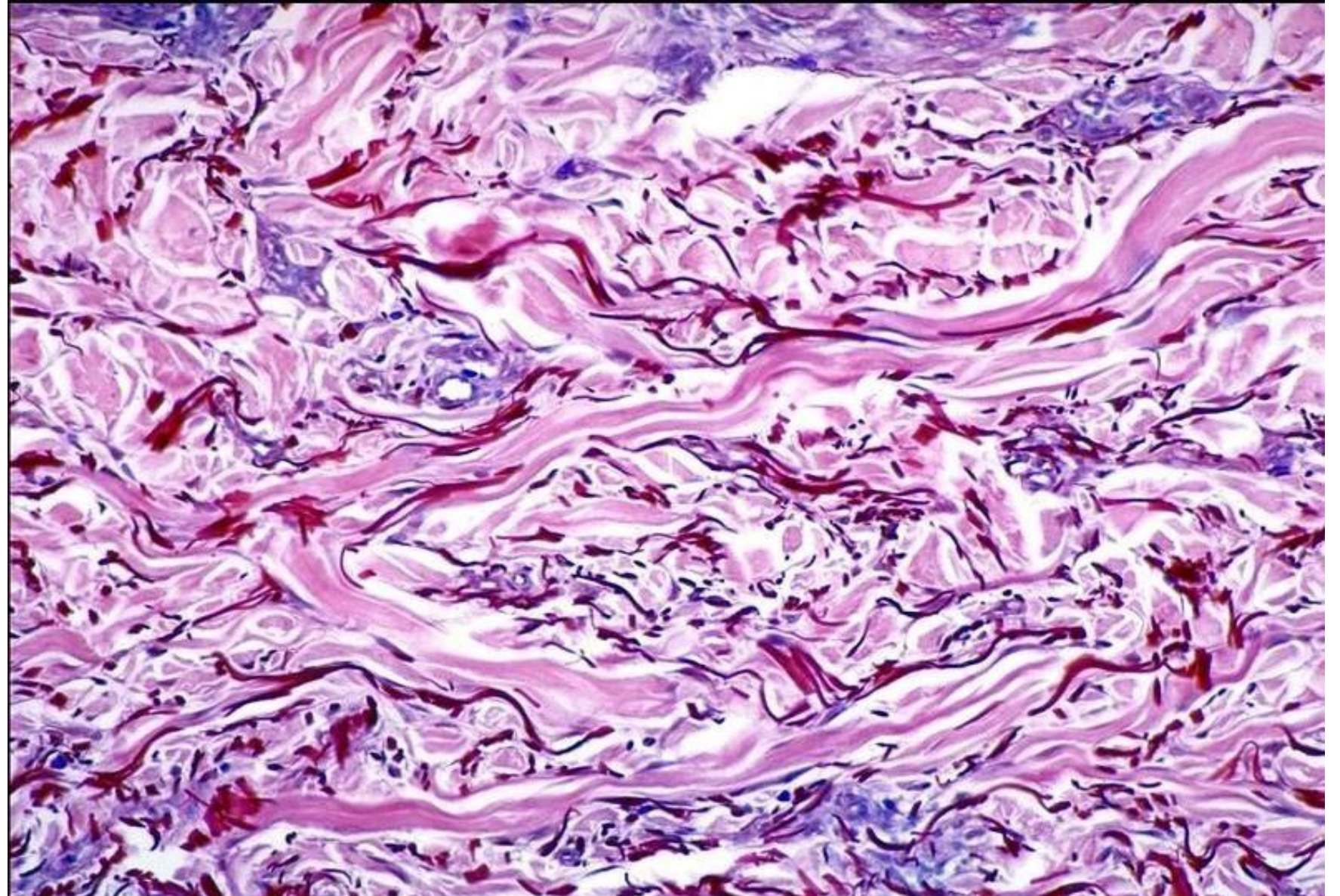
Identify?

It is obvious that this section was taken from the skin



Aldehyde fusion/elastic

Dense irregular
wavy elastic fibers
appear
dark (reddish)
due to aldehyde
fusion
staining

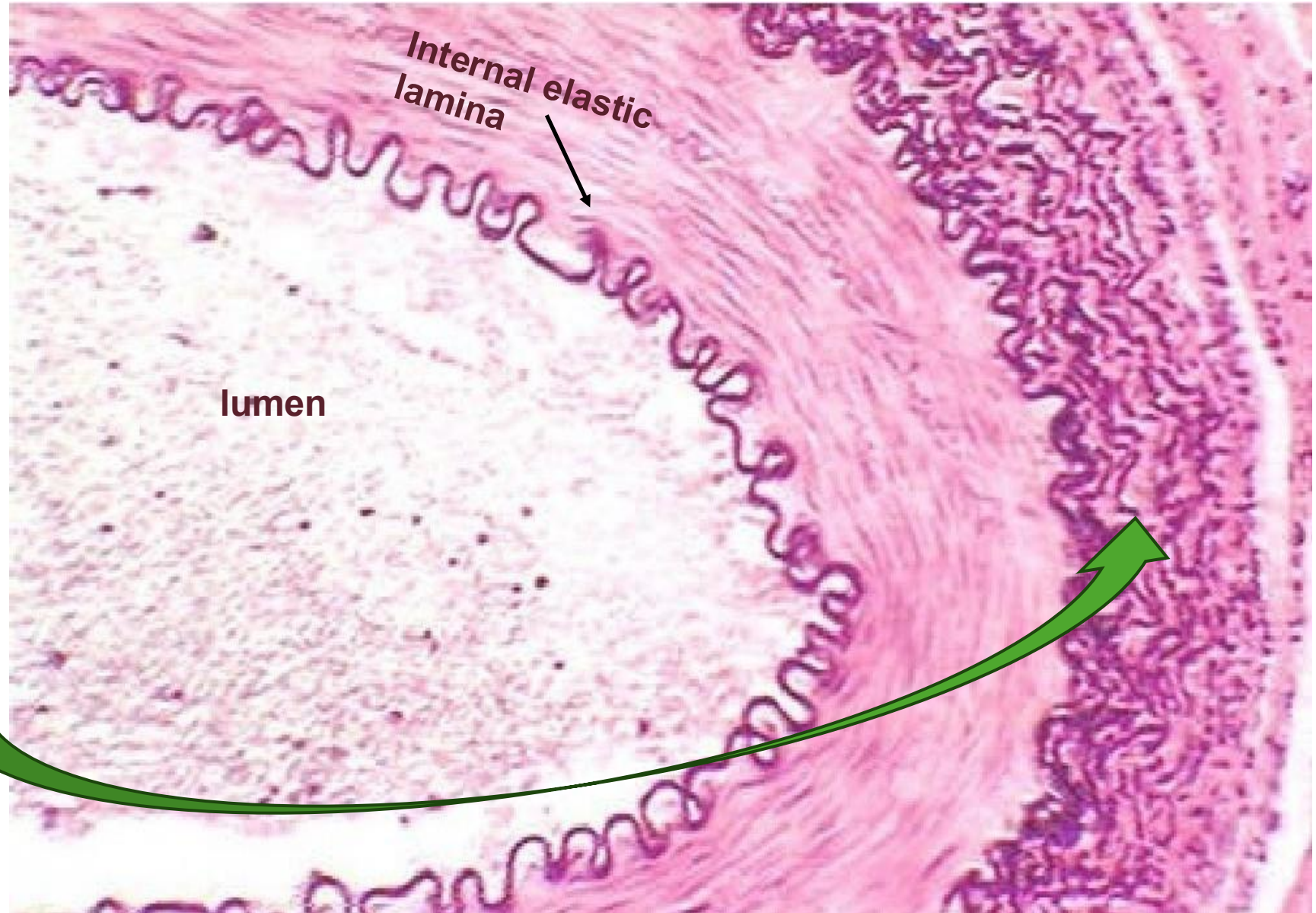


Elastic fibers

This section is for a blood vessel

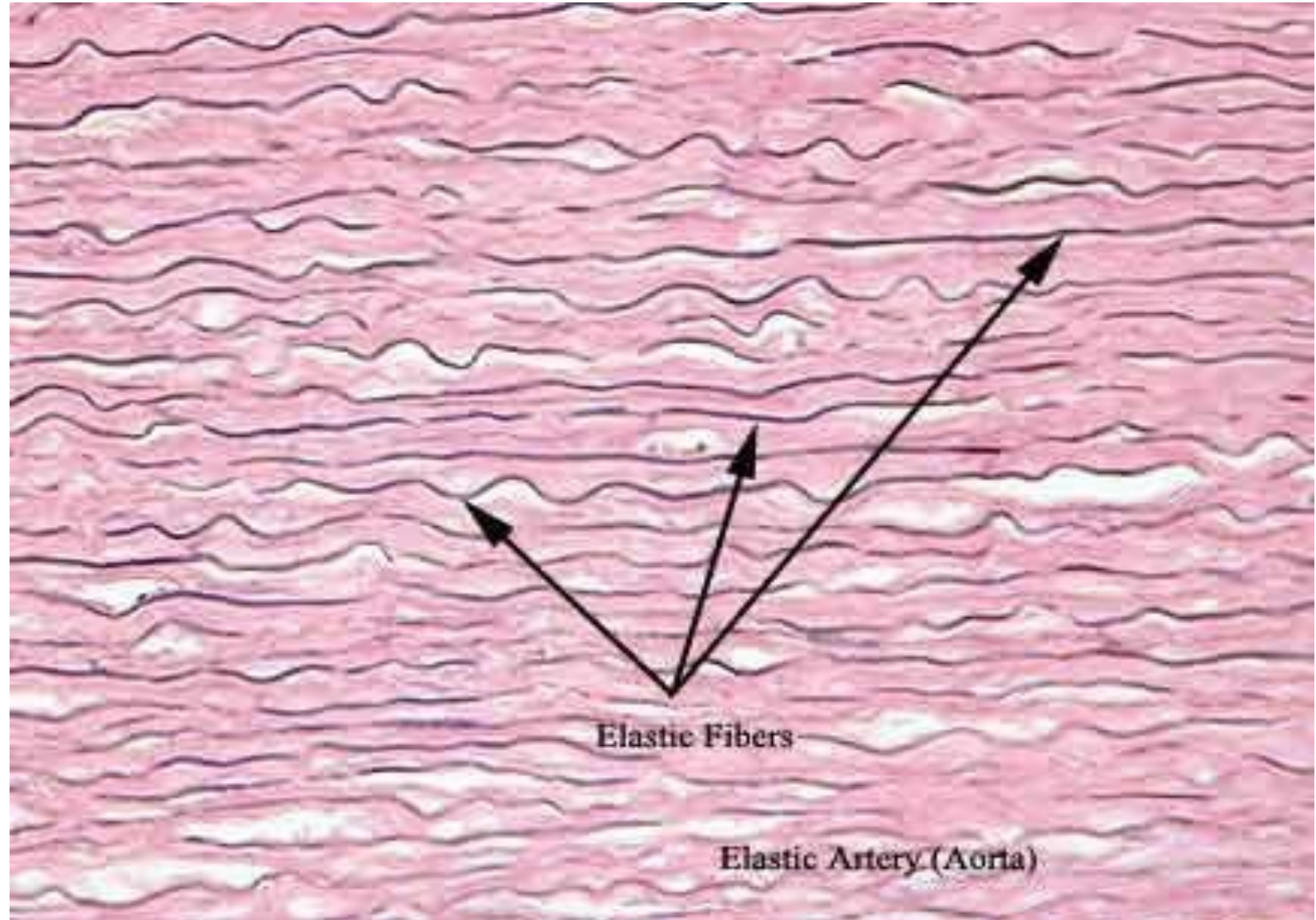
elastic fibers are found usually where we have stretching. ex :blood vessels (aorta mainly) , dermis, lung tissue

This is how elastic fibers look when they are concentrated into lamellae (wavy lines interspersed by collagen fibers and sometimes smooth muscles)



**This is a special stain
for elastic fibers
where it appear
blackish**

**collagen fibers & smooth
muscles
(Interspersed with elastic
fibers)
appear pinkish.**



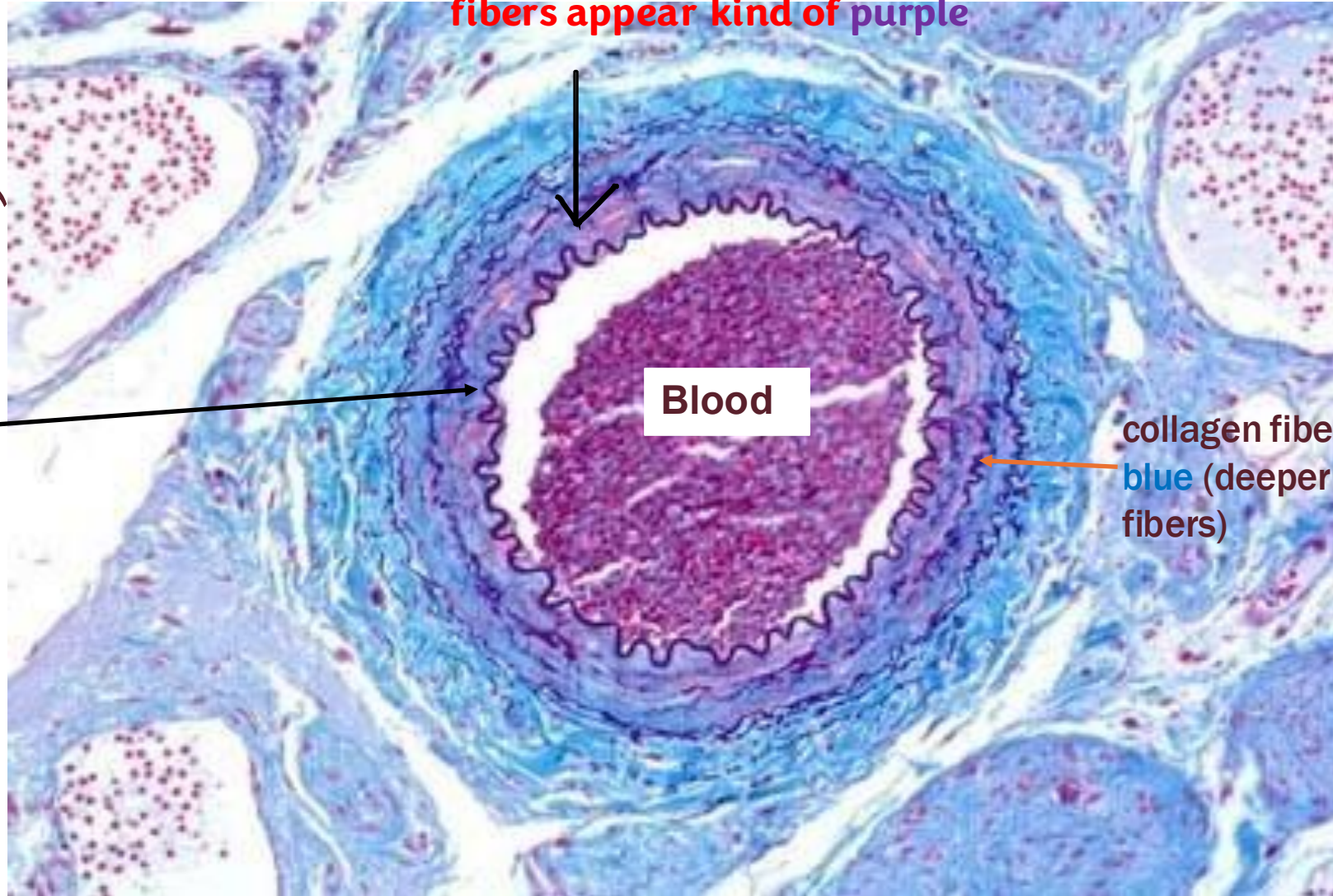
Identify the stain?

This section was taken from a blood vessel

Trichrome staining

wavy structures are elastic fibers appear kind of purple

Endothelium (simple squamous)
(lining of the blood vessel)



Blood

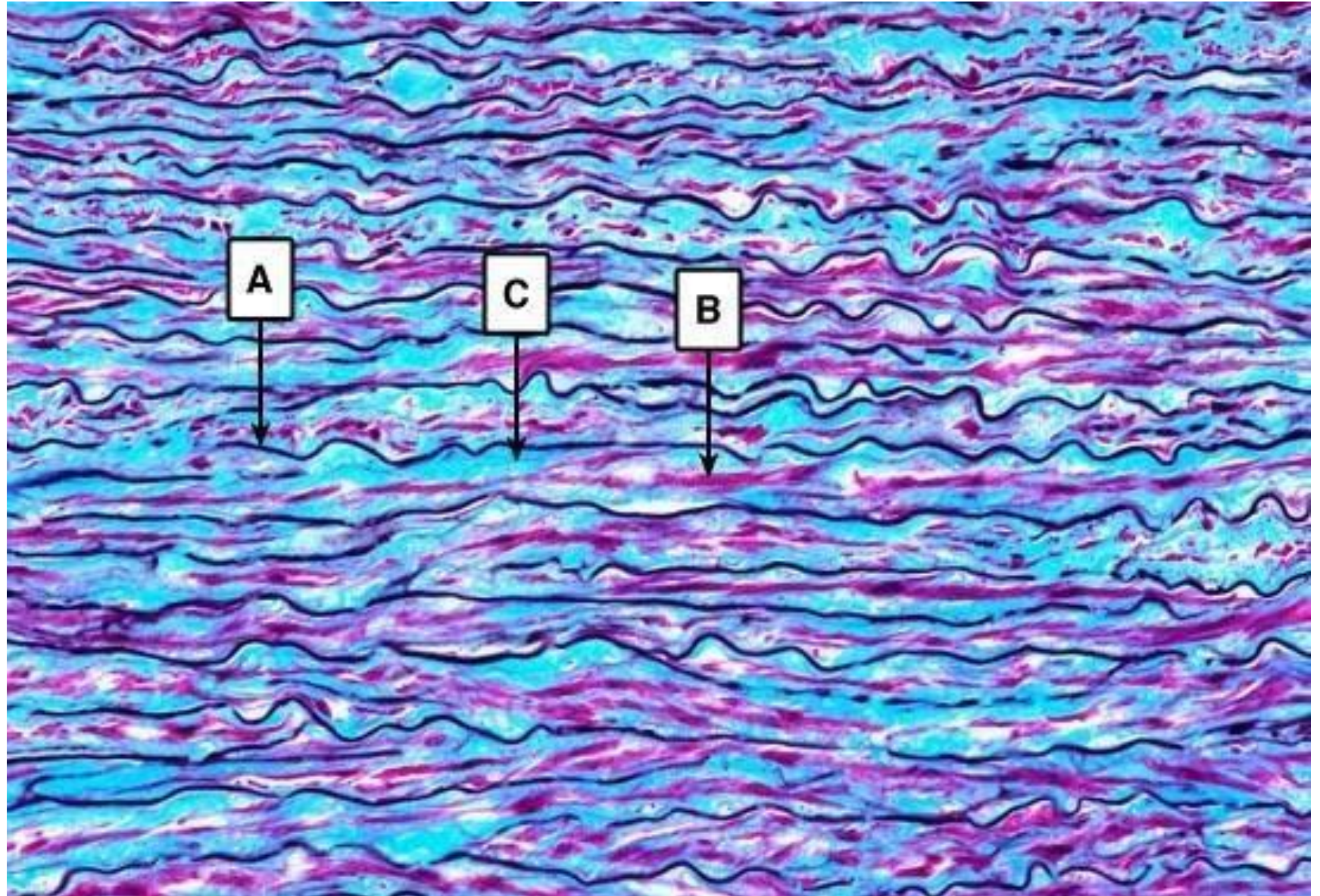
collagen fibers stains blue (deeper than the elastic fibers)

section through blood vessel

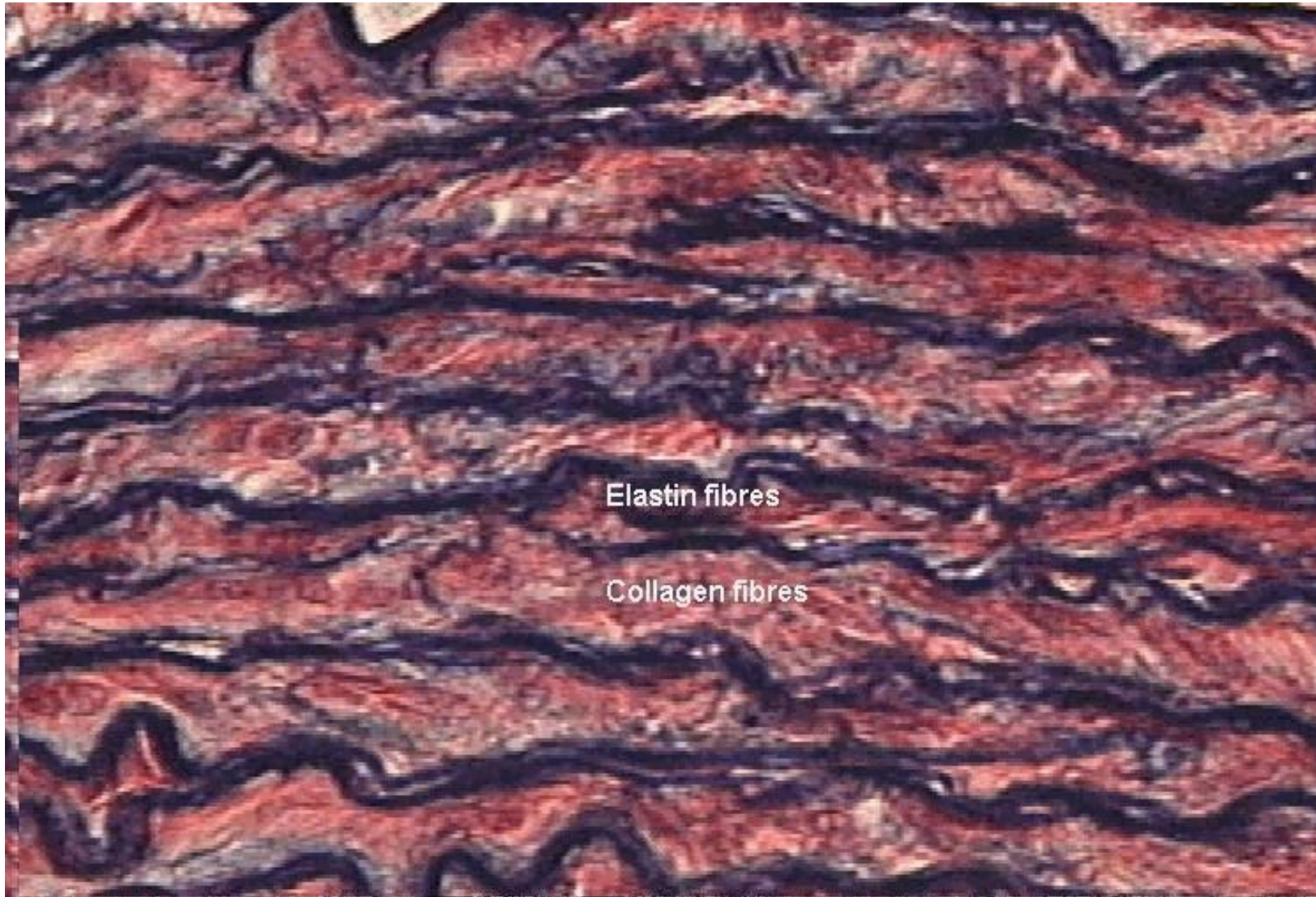
A: elastic fibers

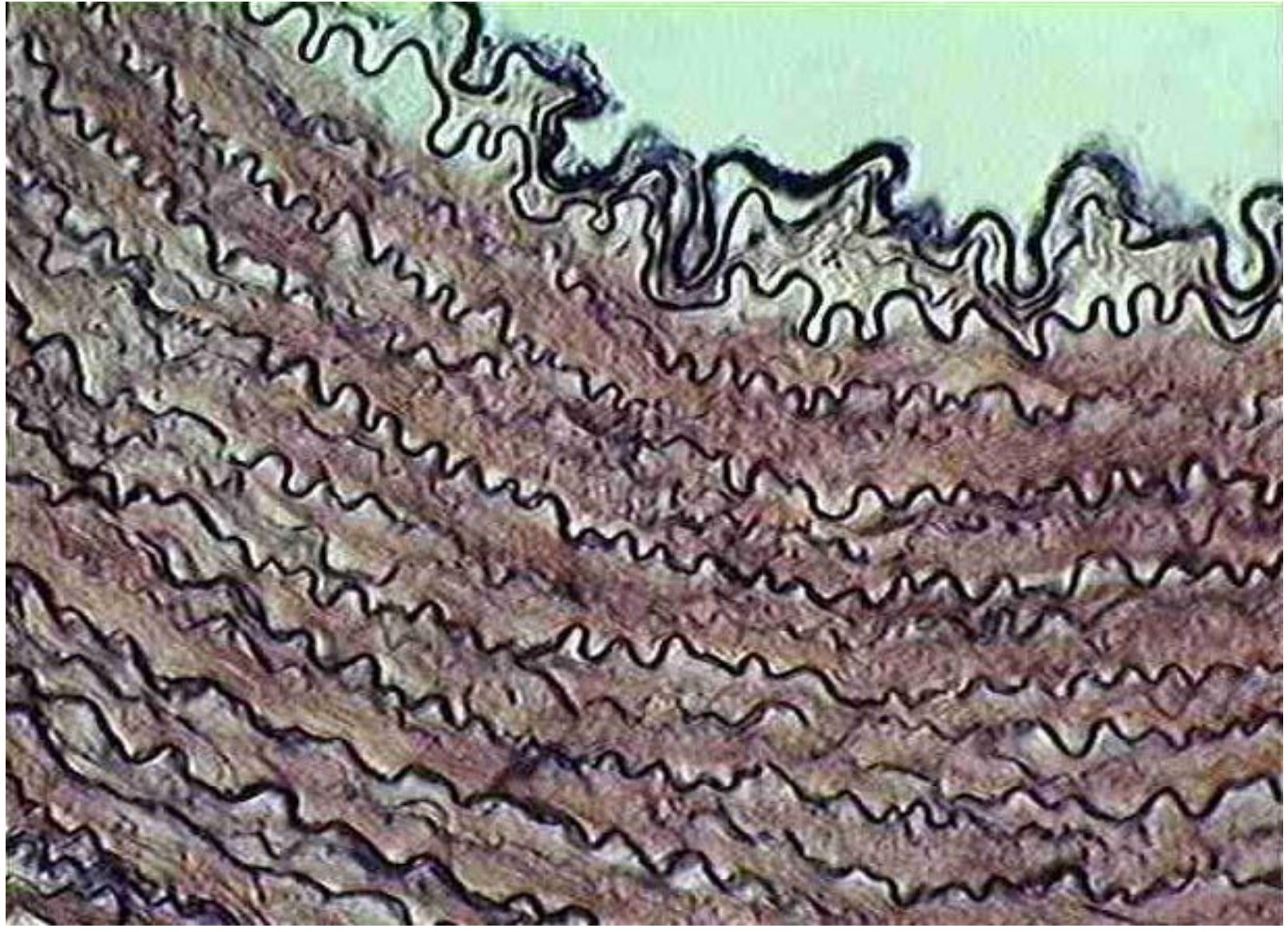
B: smooth muscle
fibers (pink)

C: collagen (blue)

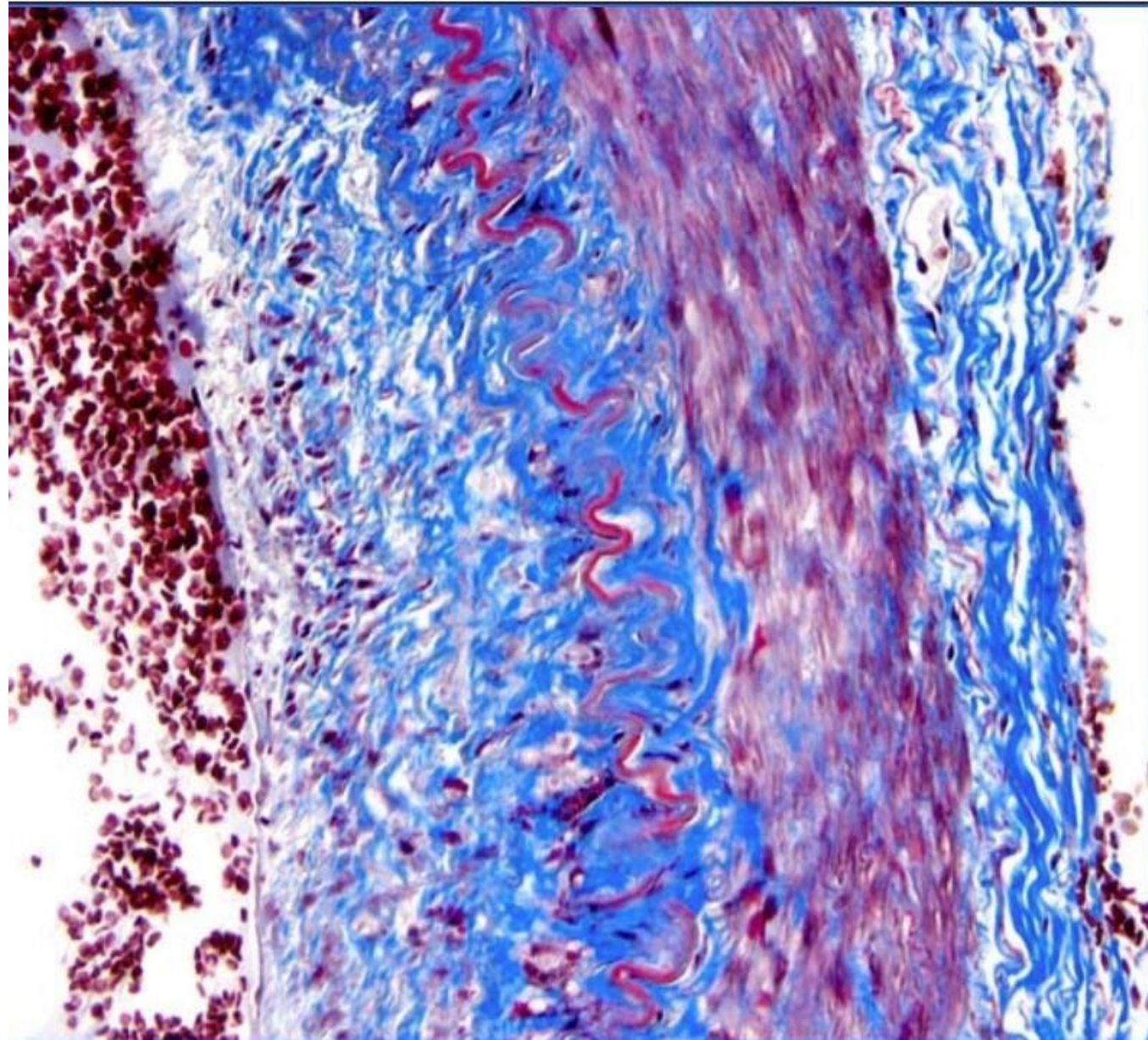


lots of elastic fibers
concentrated together, this is called elastic lamellae
interspersed by many collagen fibers

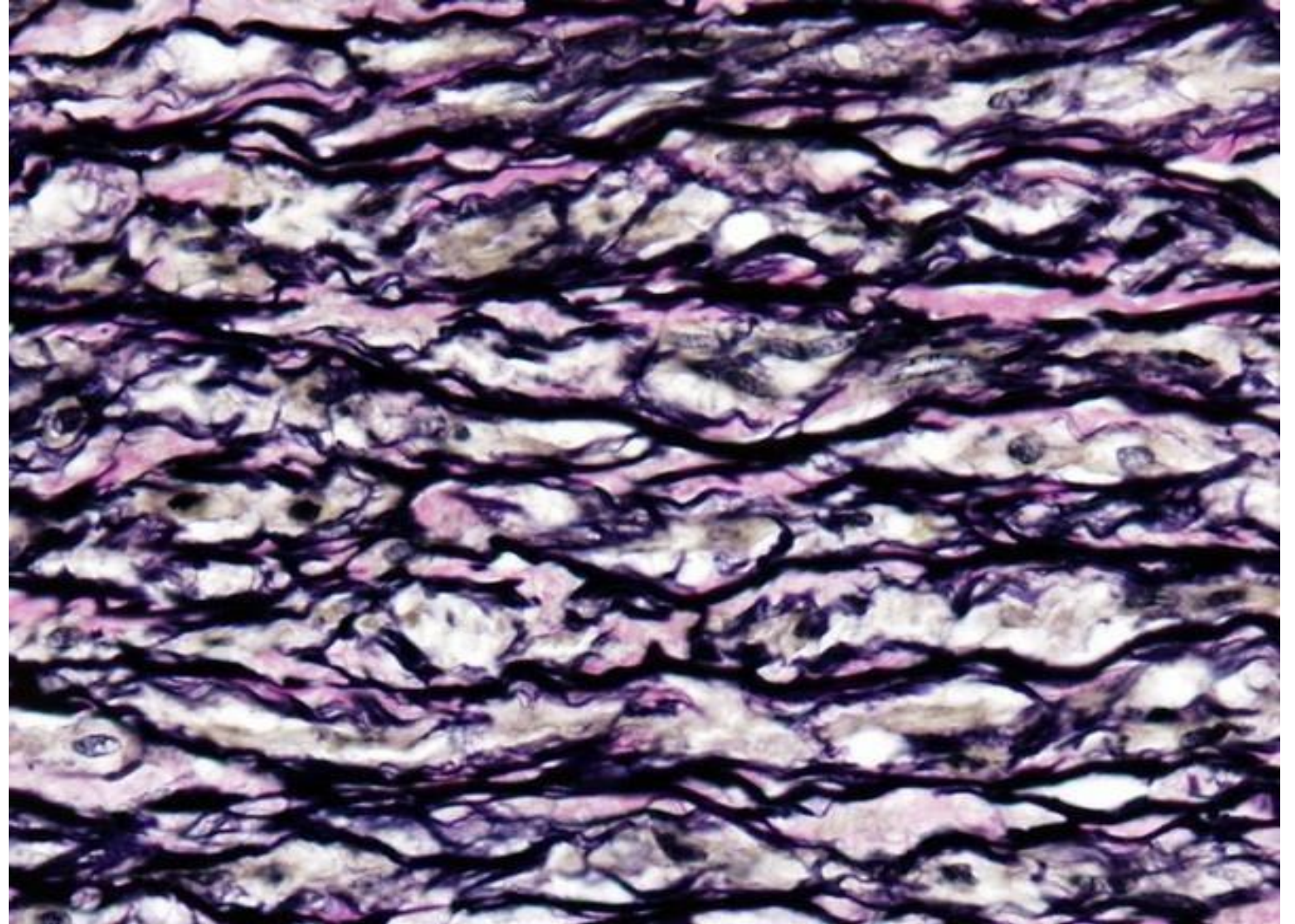




Gomori's one step Trichrome stain

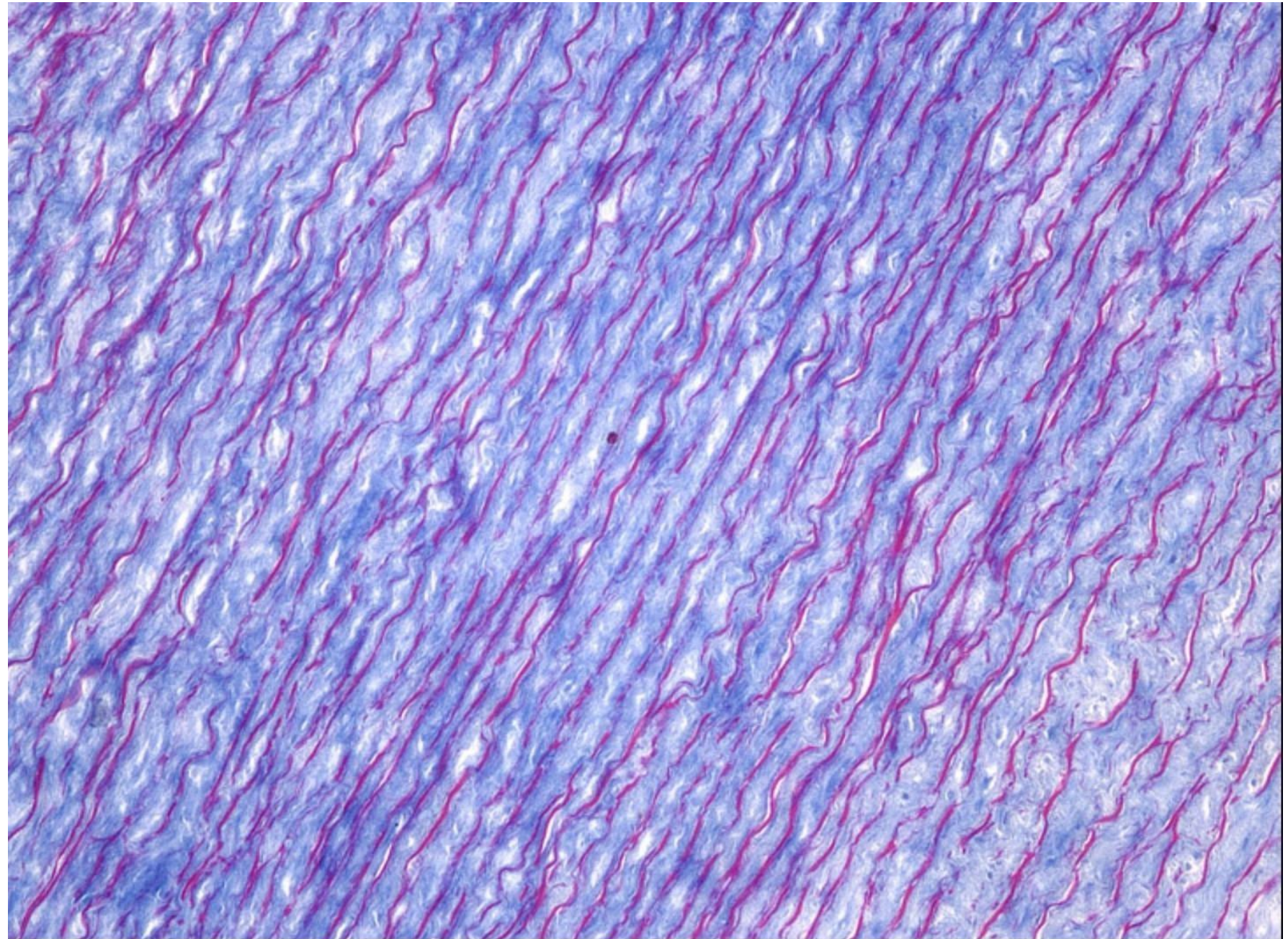


Verhoeff-van Gieson



**pinkish - reddish :
elastic fibers**

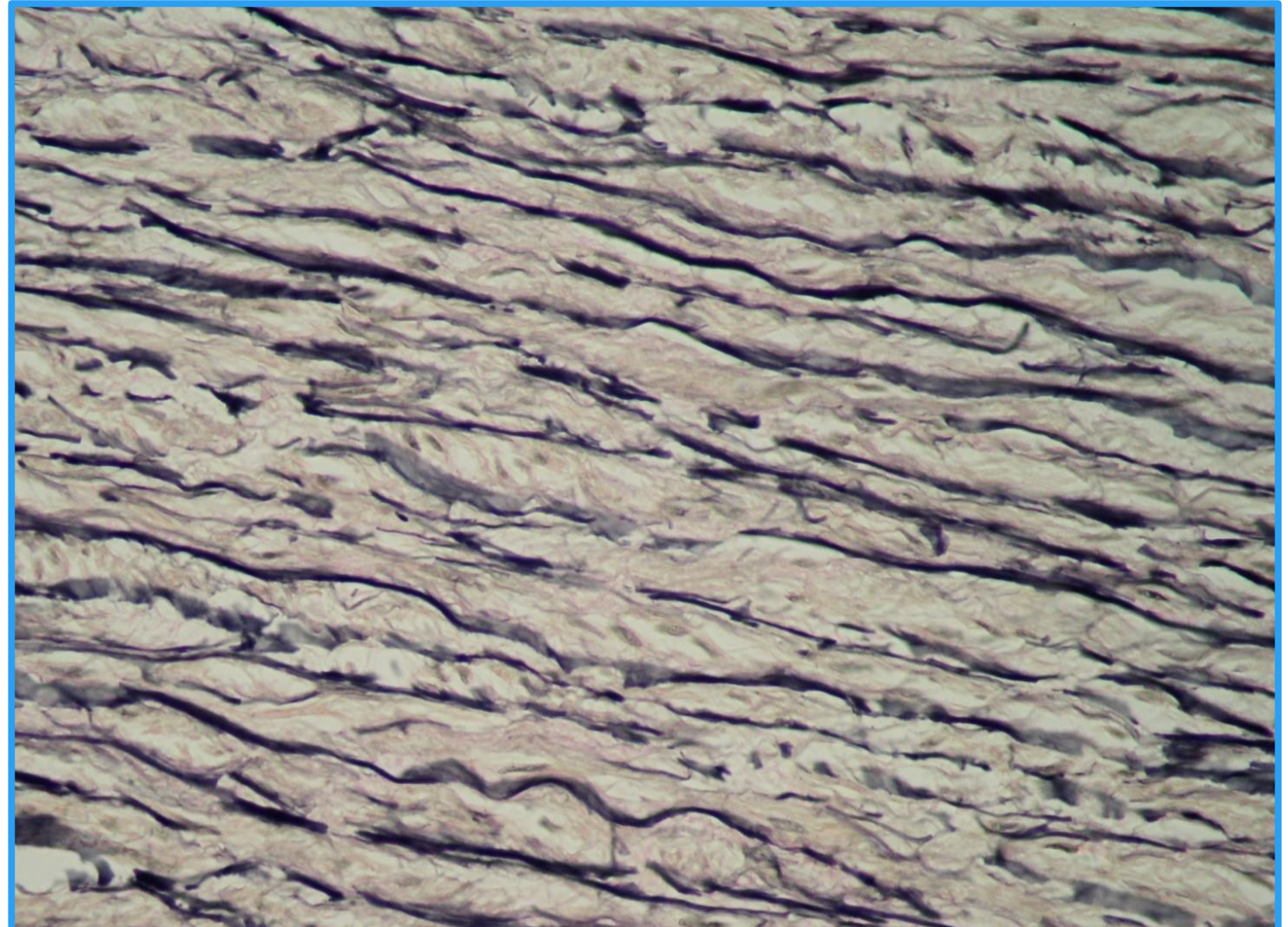
**bluish- collagen
fibers**



Elastic fibers-Orscein

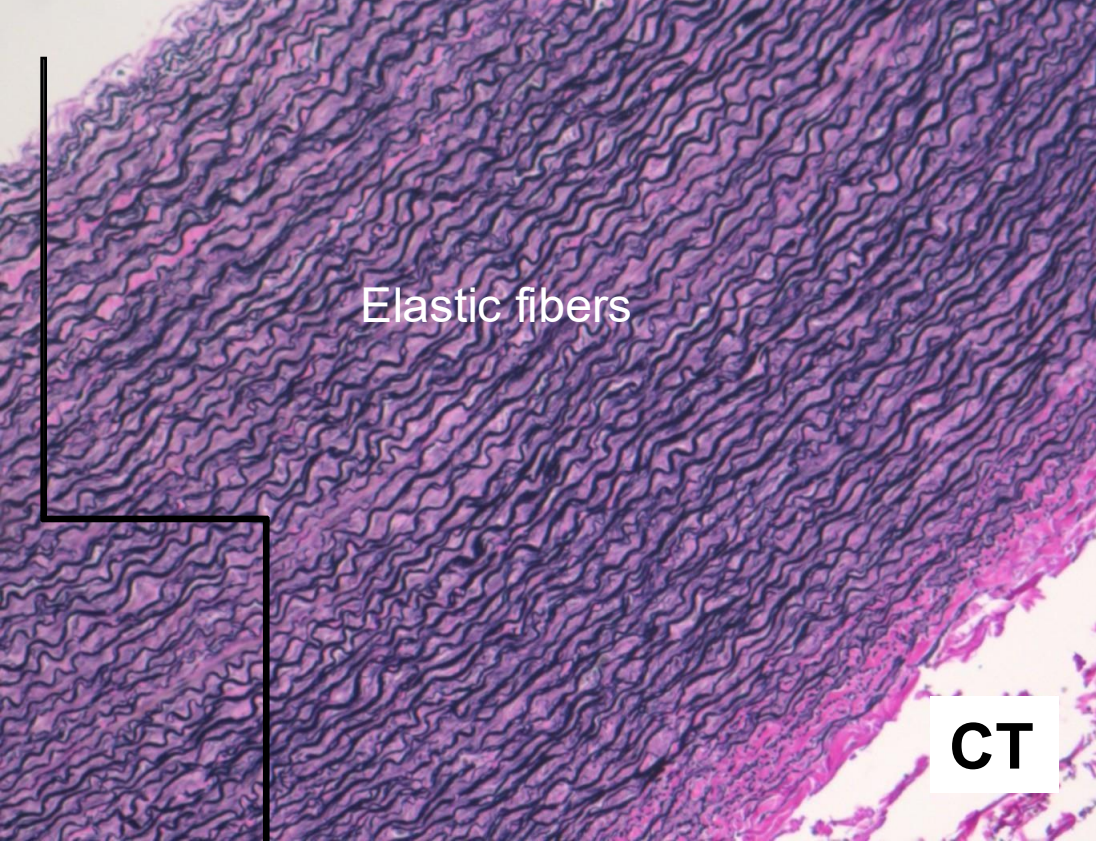
Using this stain elastic fibers appear blackish wavy structures .

Whenever you see waviness, you are looking at elastic fibers



Elastic- VERHOEFF VAN GIESON

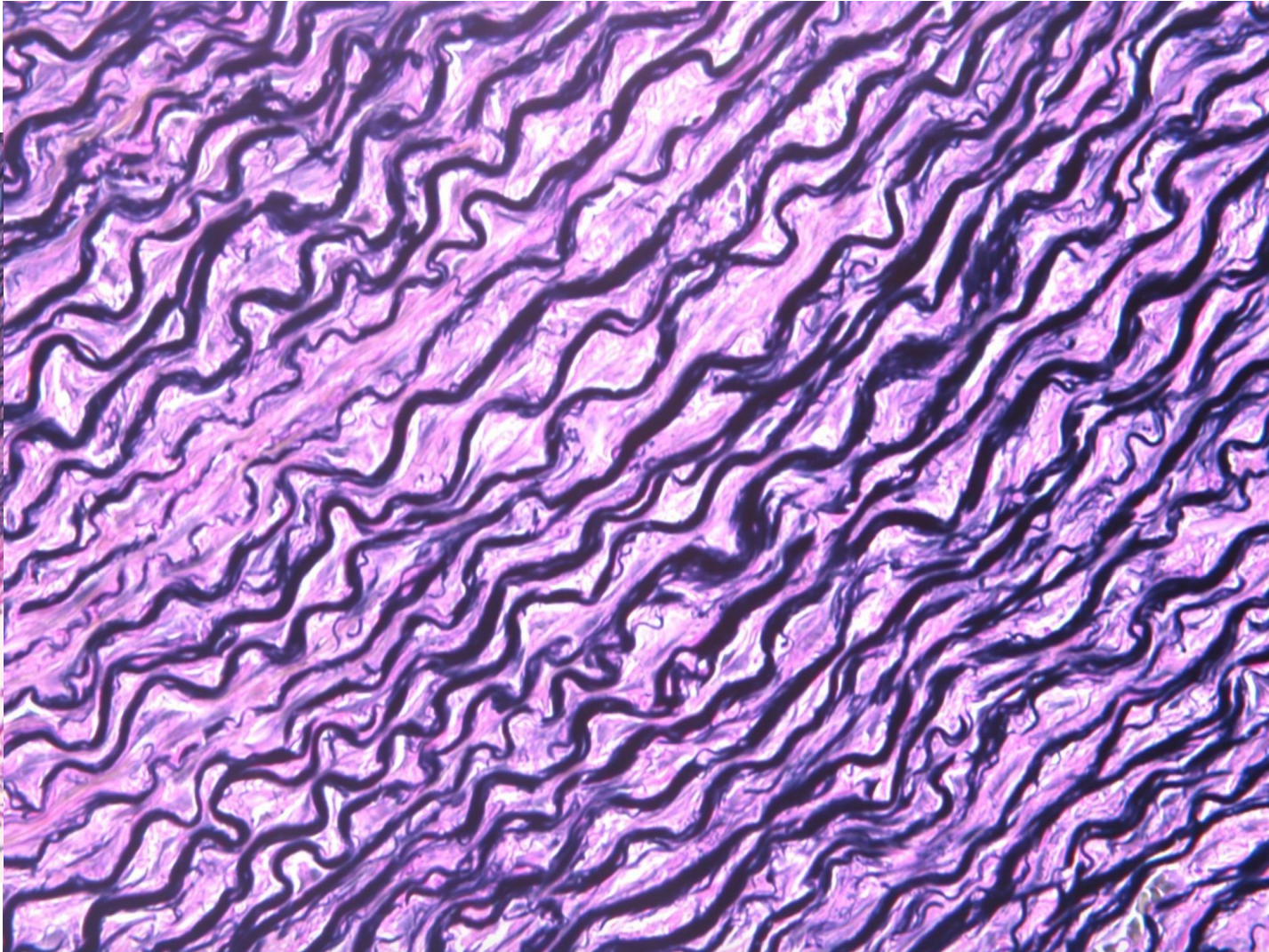
This section is through the Aorta



Elastic fibers

CT

Endothelium of the Aorta



Elastic fibers are interspersed by collagen fibers and smooth muscles

Reticular fibers -liver

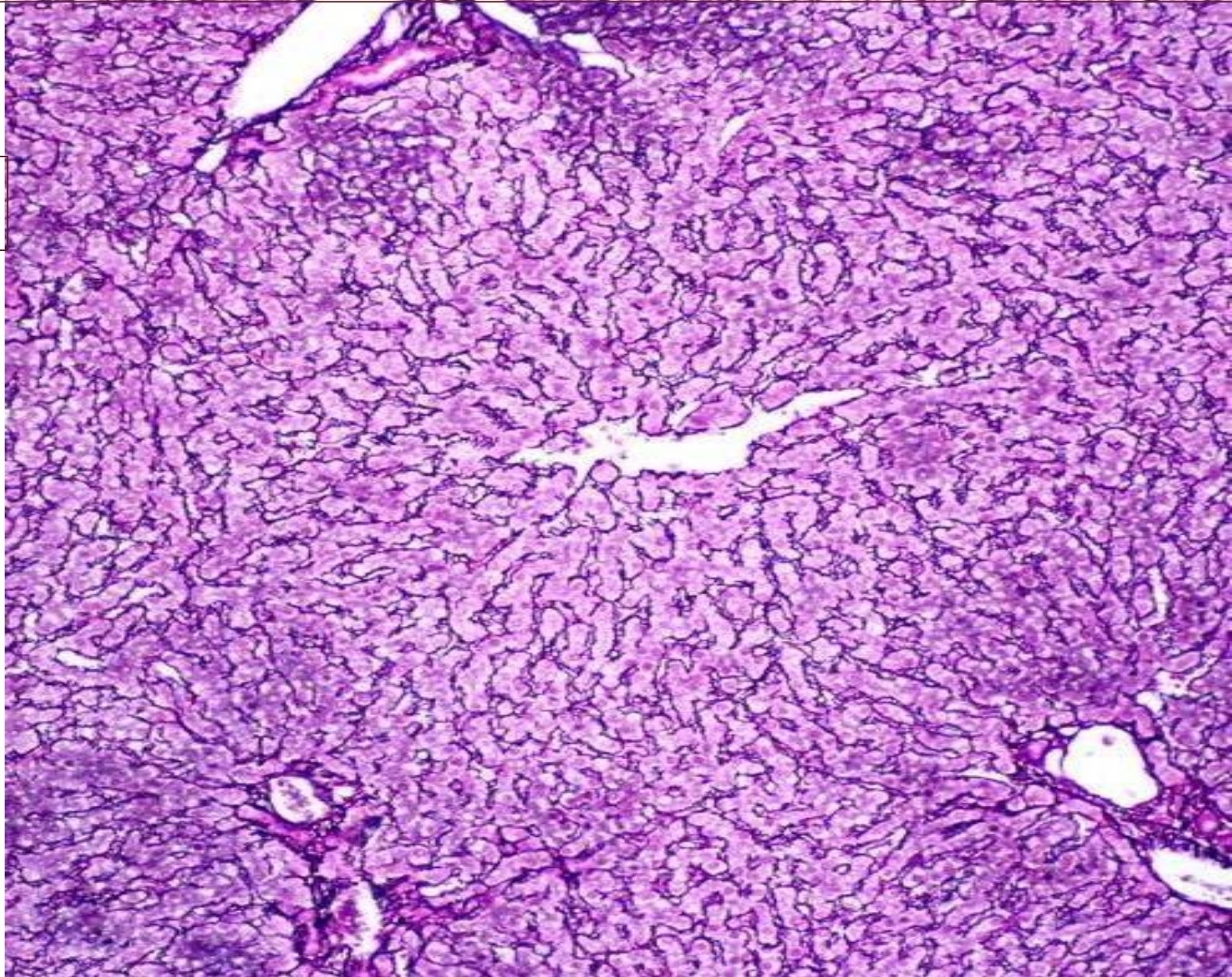
staining used : silver salt staining (without eosin)



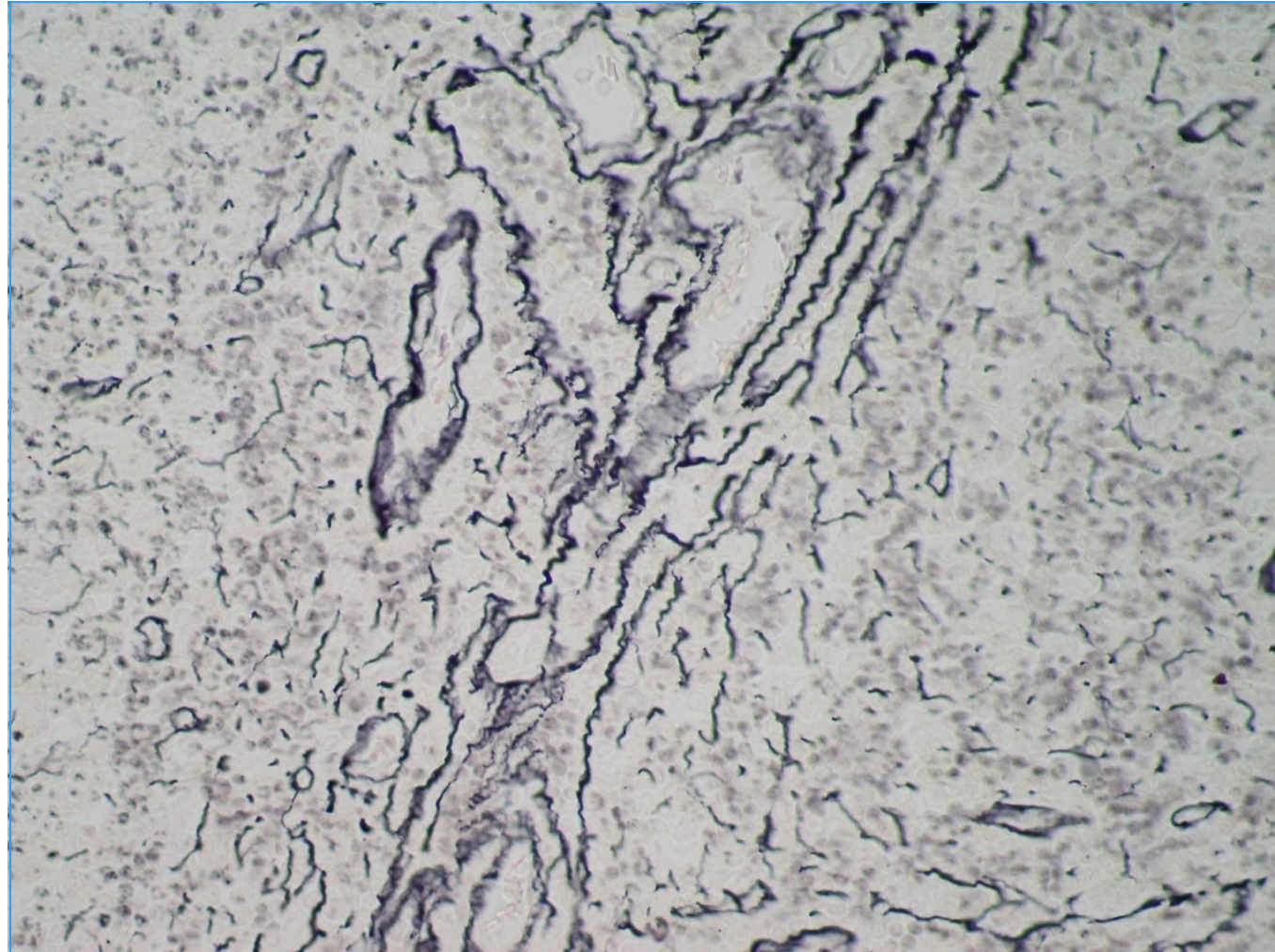
Both this and the next slide are liver but there, eosin is used additionally

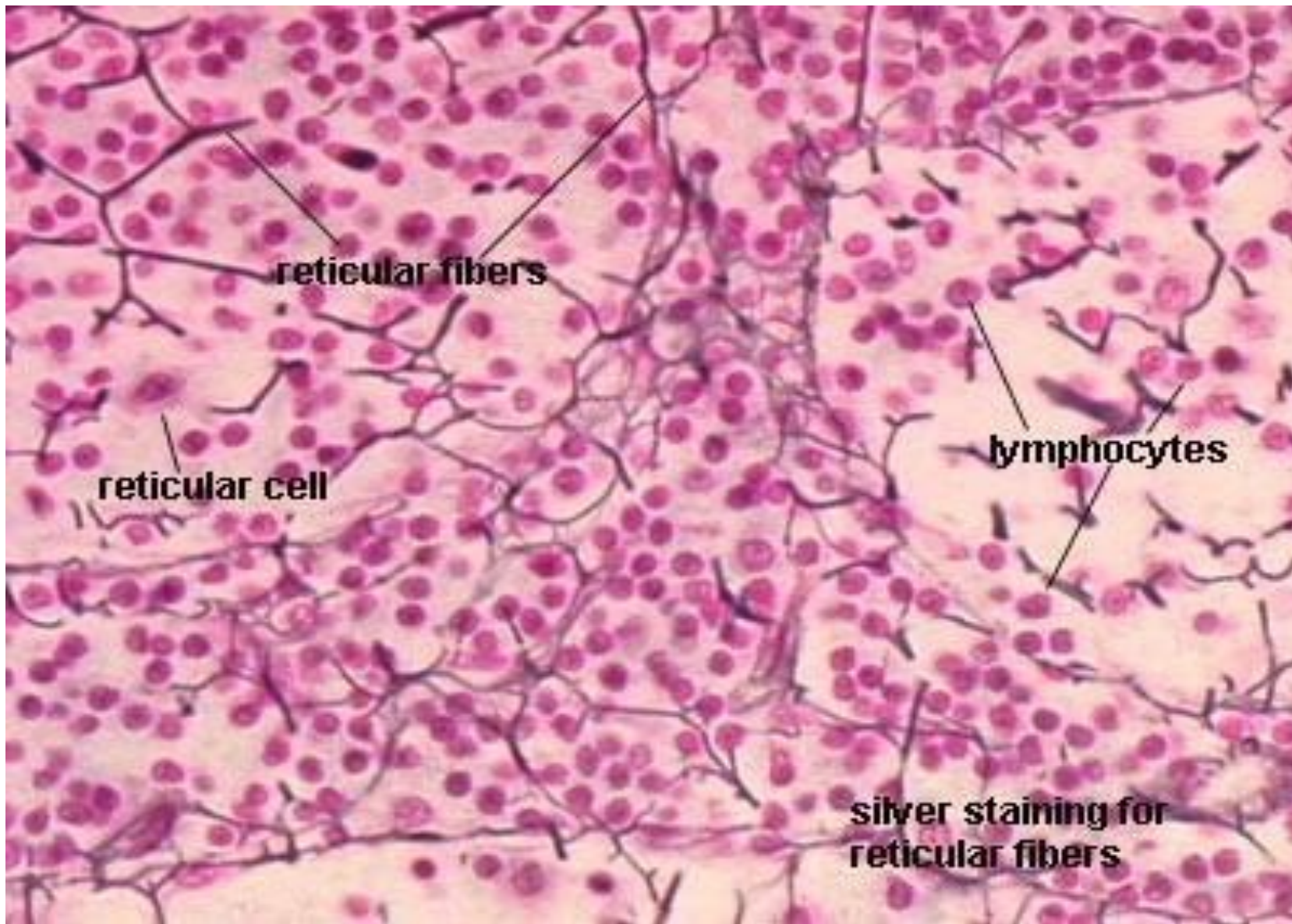
Reticular fibers in the liver , they form a network that surround and protect delicate cells in the liver (hepatocytes)

**Staining used here is
eosin& silver salts**



reticular





This section is taken from a lymphoid organ

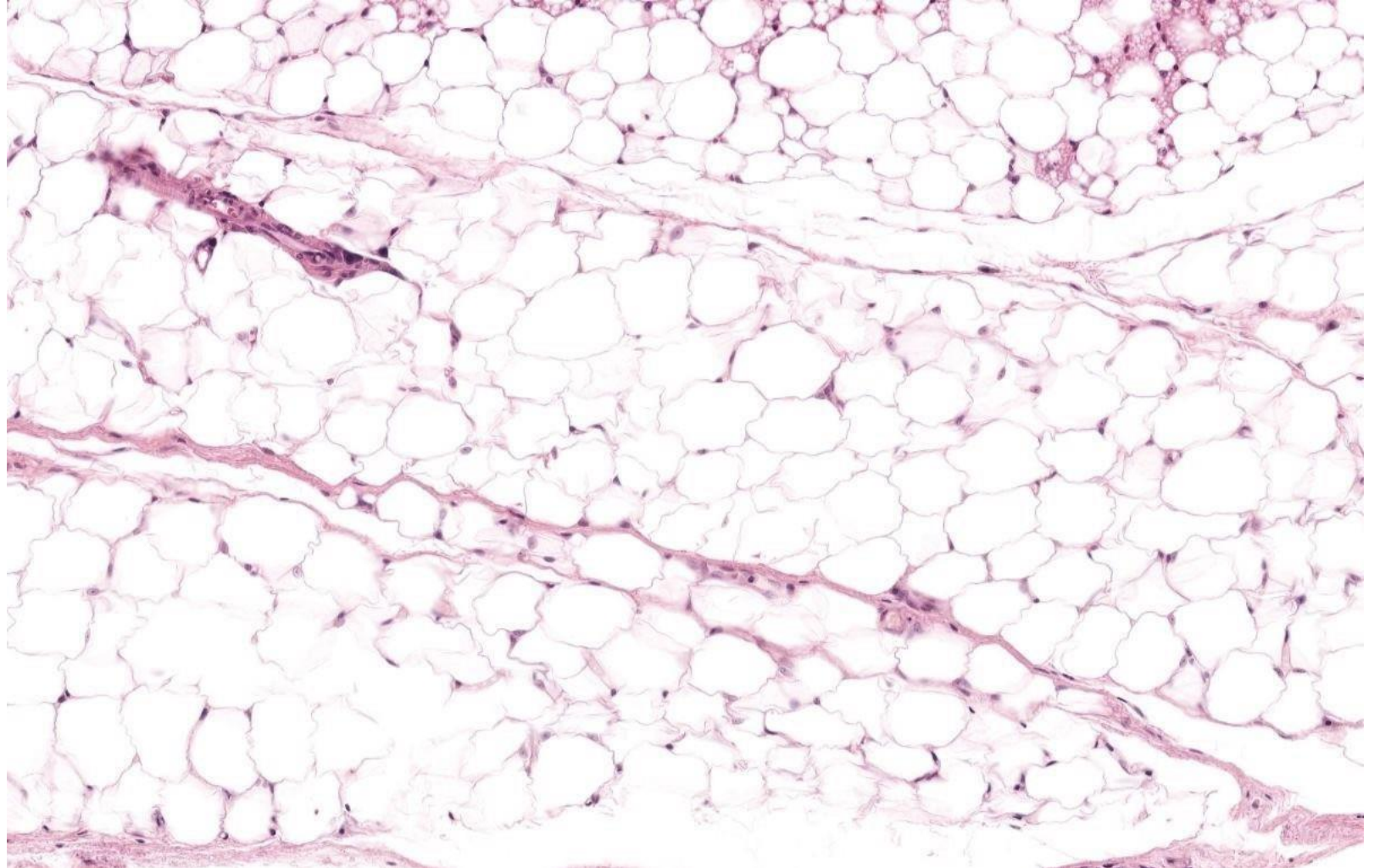
Reticular fibers surrounding & protecting delicate lymphocytes

White adipose CT

Adipose CT: loose CT that is very rich with adipocytes

We know it is white
type because of :

- 1 signet ring appearance
- 2 unilocular (has one fat vacuole)

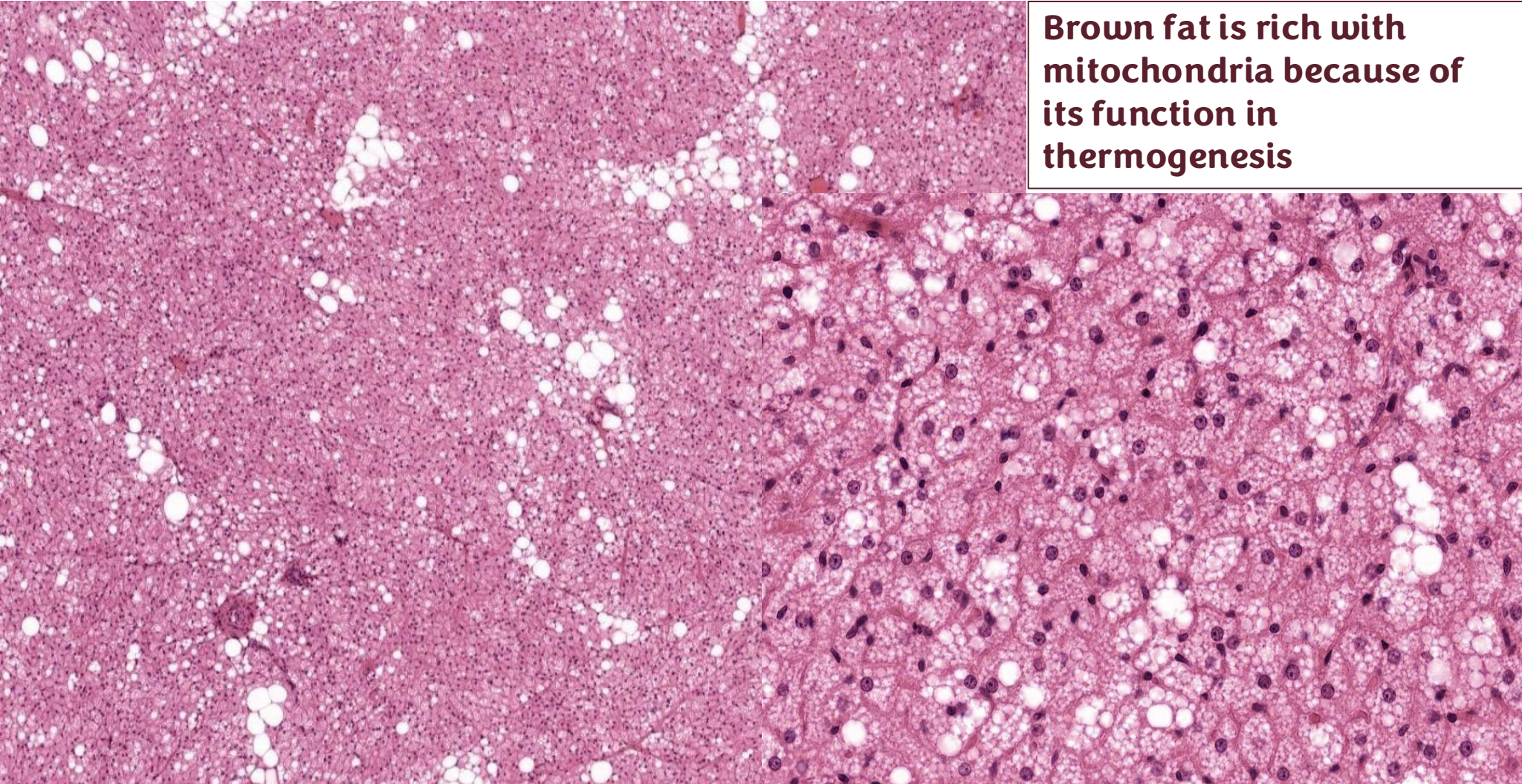


Brown adipose CT

We know it is brown type because of :

1-multilocular (has many small fat vacuoles)

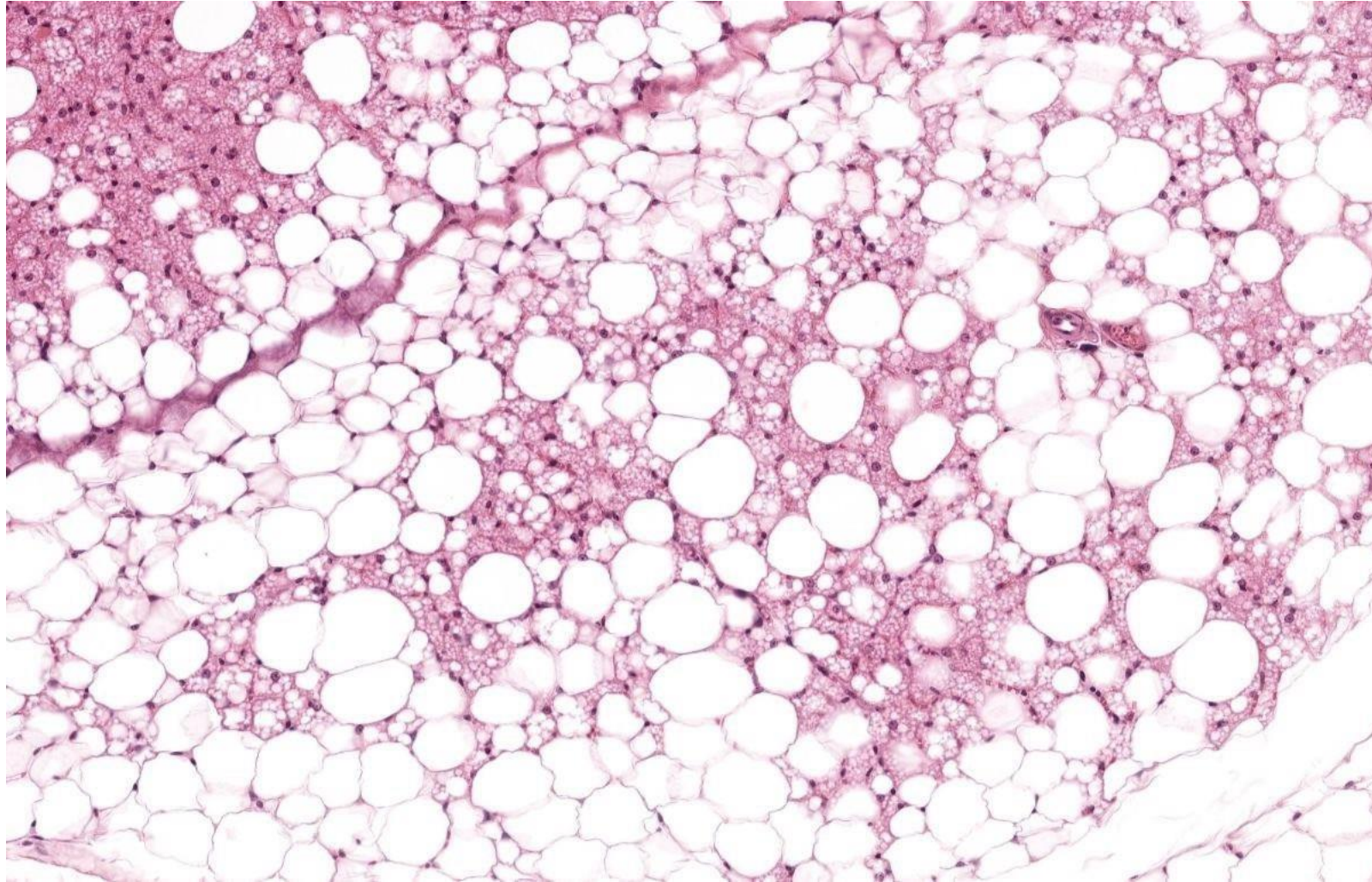
2-centrally located nucleus



Brown fat is rich with mitochondria because of its function in thermogenesis

well vascularized because to create heat it needs good blood supply (to have glucose)

White and brown adipose CT



Test yourself

<https://forms.gle/4BdTQghzQRKaBr388>



For any feedback, scan the code or click on i



Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			

Additional Resources:

Reference Used:

Dr. Ghada slides and recorded lecture
of CT lab

رسالة من الفريق العلمي:

قال الإمام الشافعي رحمه الله :

بقدر الكد تكتسب المعالي
ومن طلب العلا سهر الليالي