BONE & CARTILAGE

Objectives For both Bone & Cartilage sessions

1. Describe the microscopic appearance of the different histological types of cartilage.

2. Identify the cell types found in bone and describe the microscopic organisation of cortical and trabecular bone.

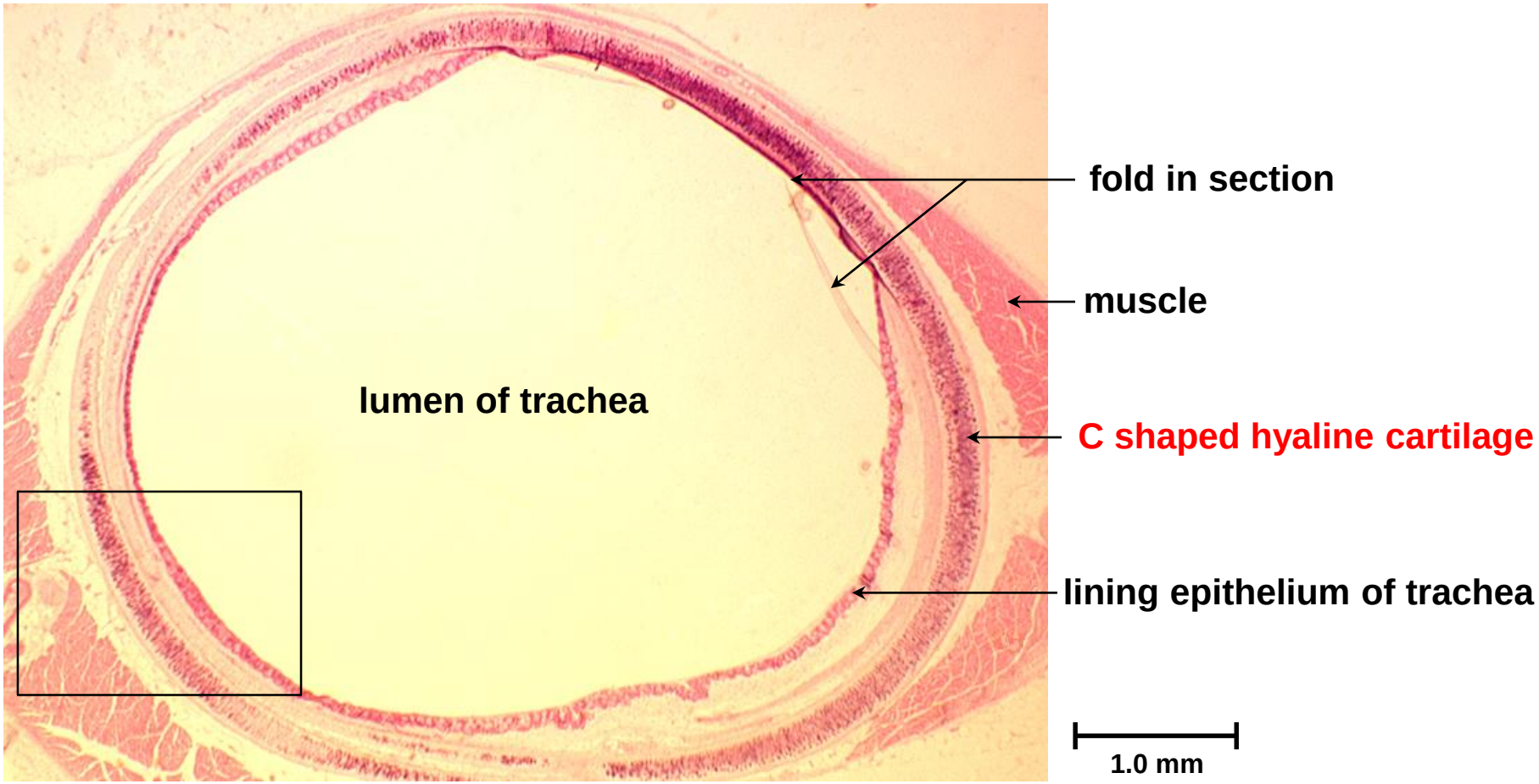
3. Consolidate the information on bone development gained in lectures by observing the microscopic appearance of developing bones.

Trachea Hyaline cartilage

At low magnification determine whether the section is transverse or longitudinal?

Answer : transverse section of trachea.

Identify the position of the hyaline cartilage.



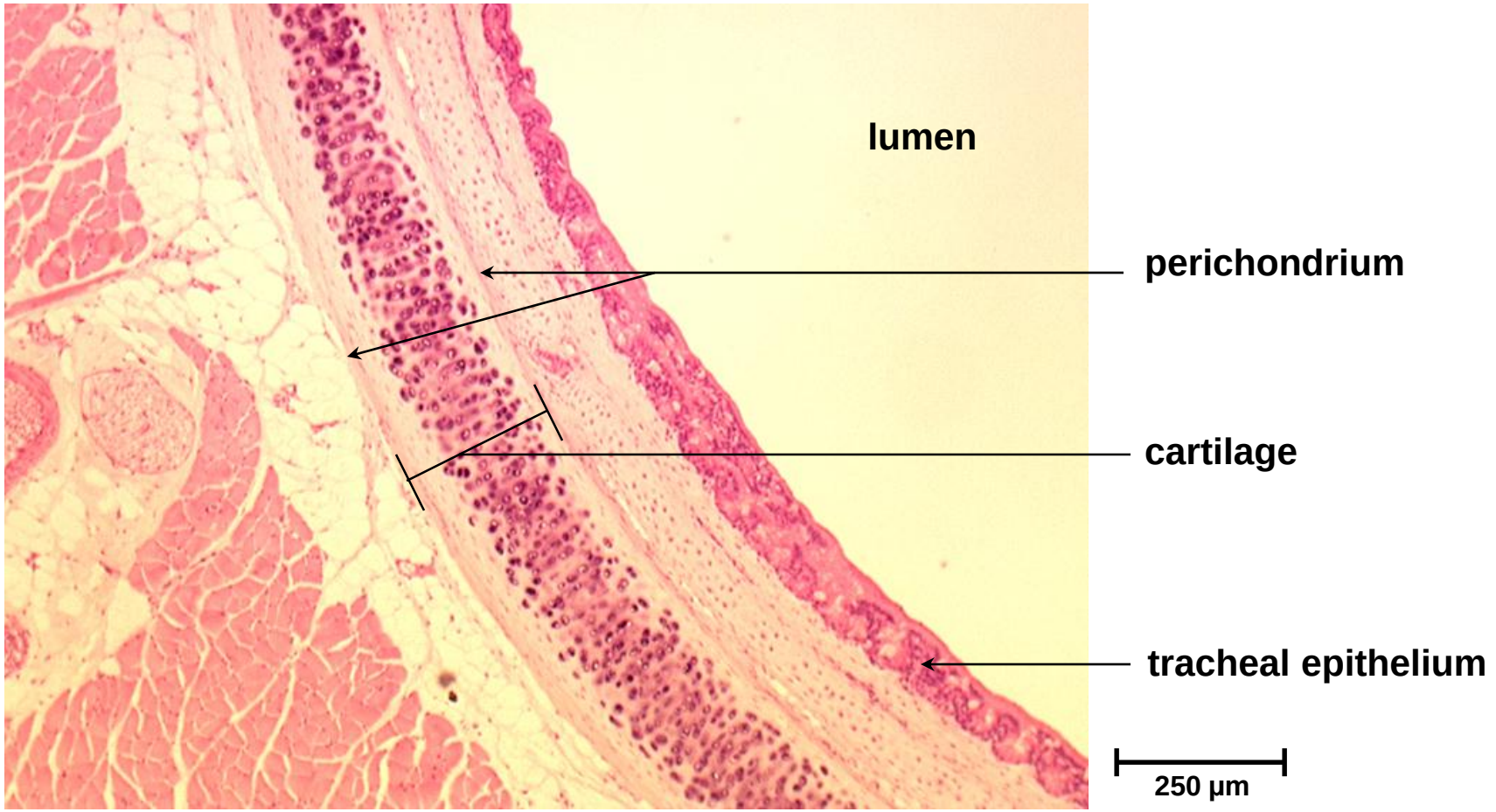
Trachea Hyaline cartilage

What is the function of the hyaline cartilage of the trachea?

It maintains the shape of the trachea.

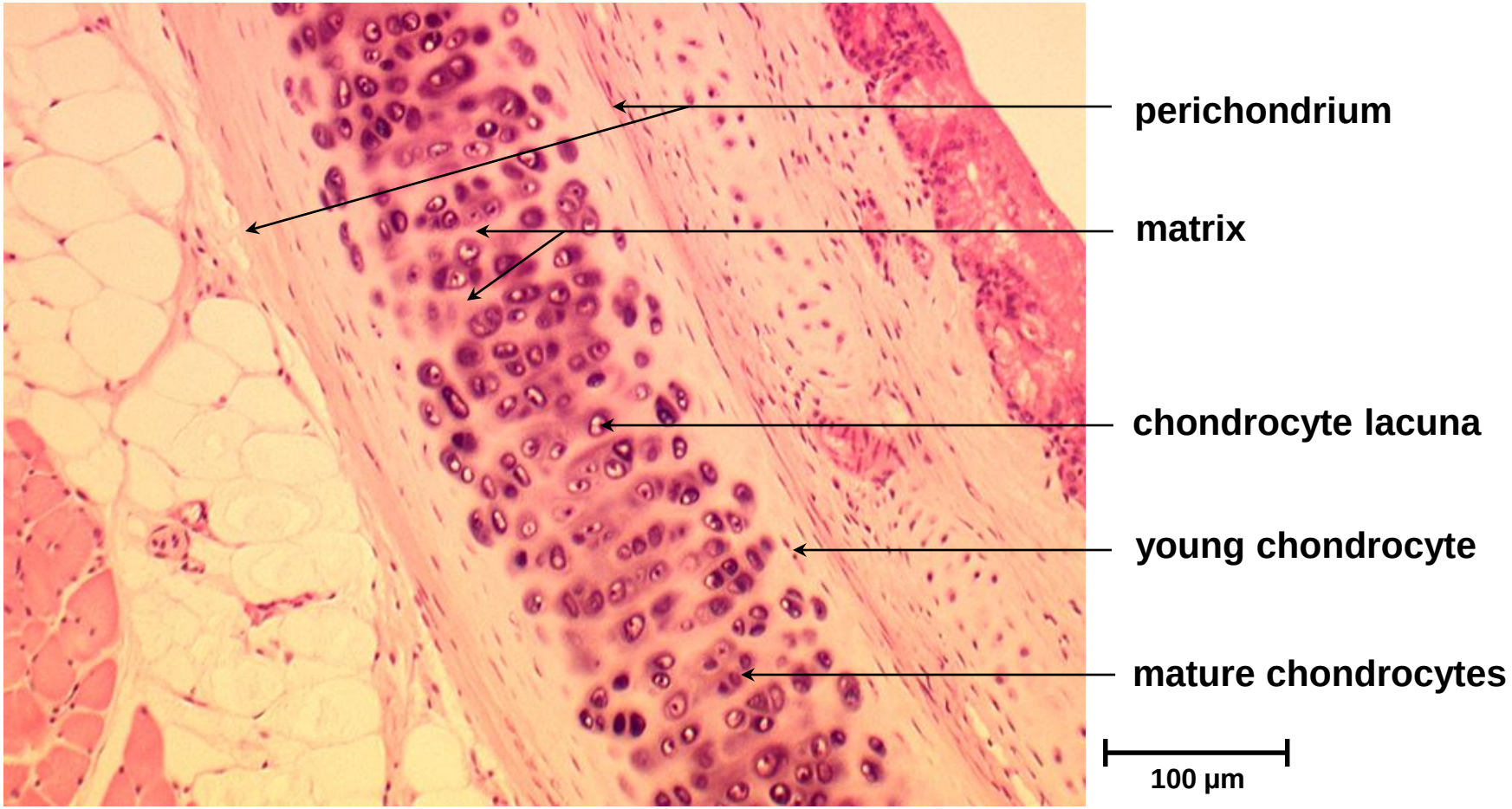
It resists compression; but allows movement due to the C shaped rings.

It provides a resilient support to the trachea.



Trachea Hyaline cartilage

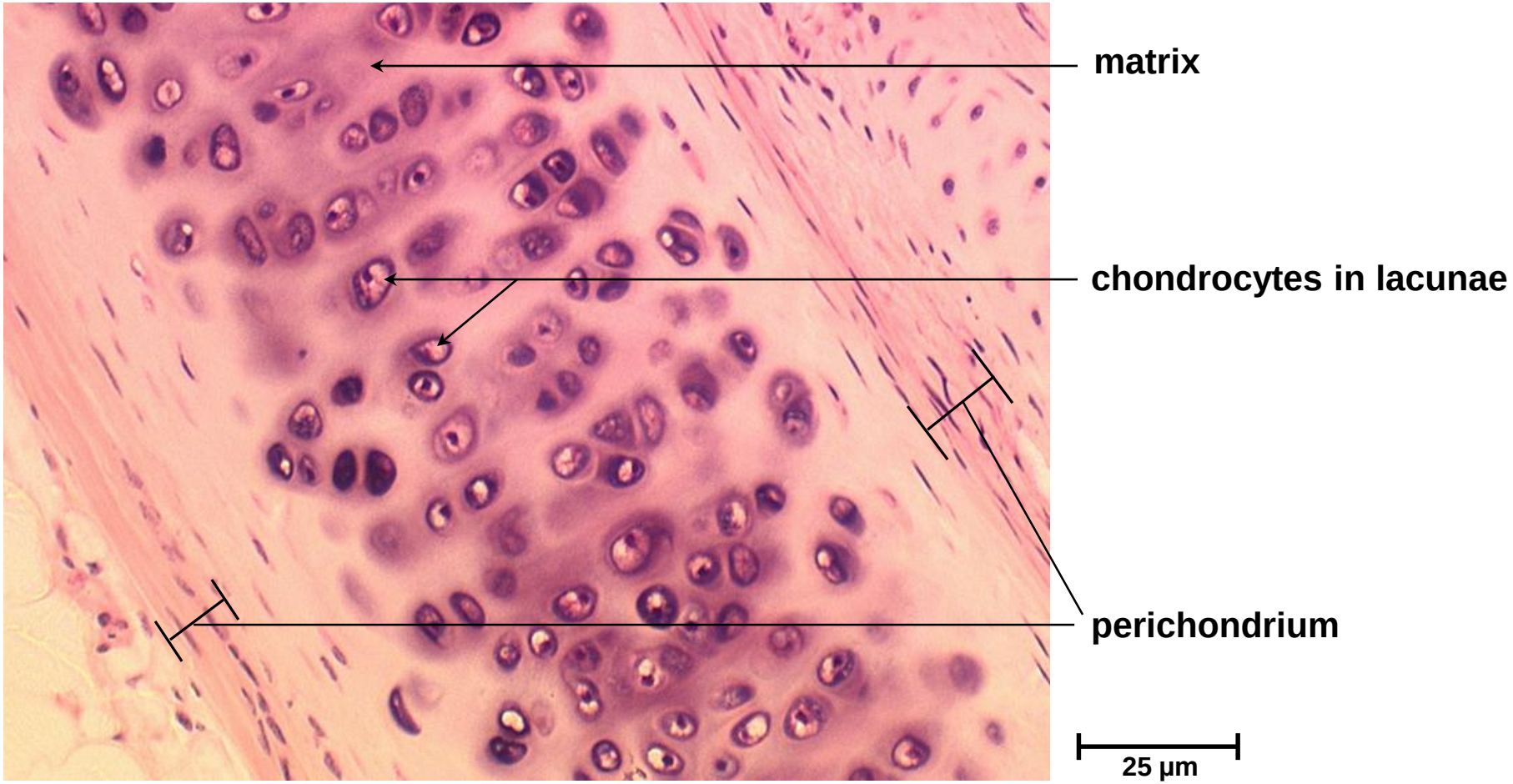
Identify : perichondrium.
young and mature chondrocytes.
chondrocyte lacunae and matrix.



Trachea Hyaline cartilage

Higher magnification area from previous slide.

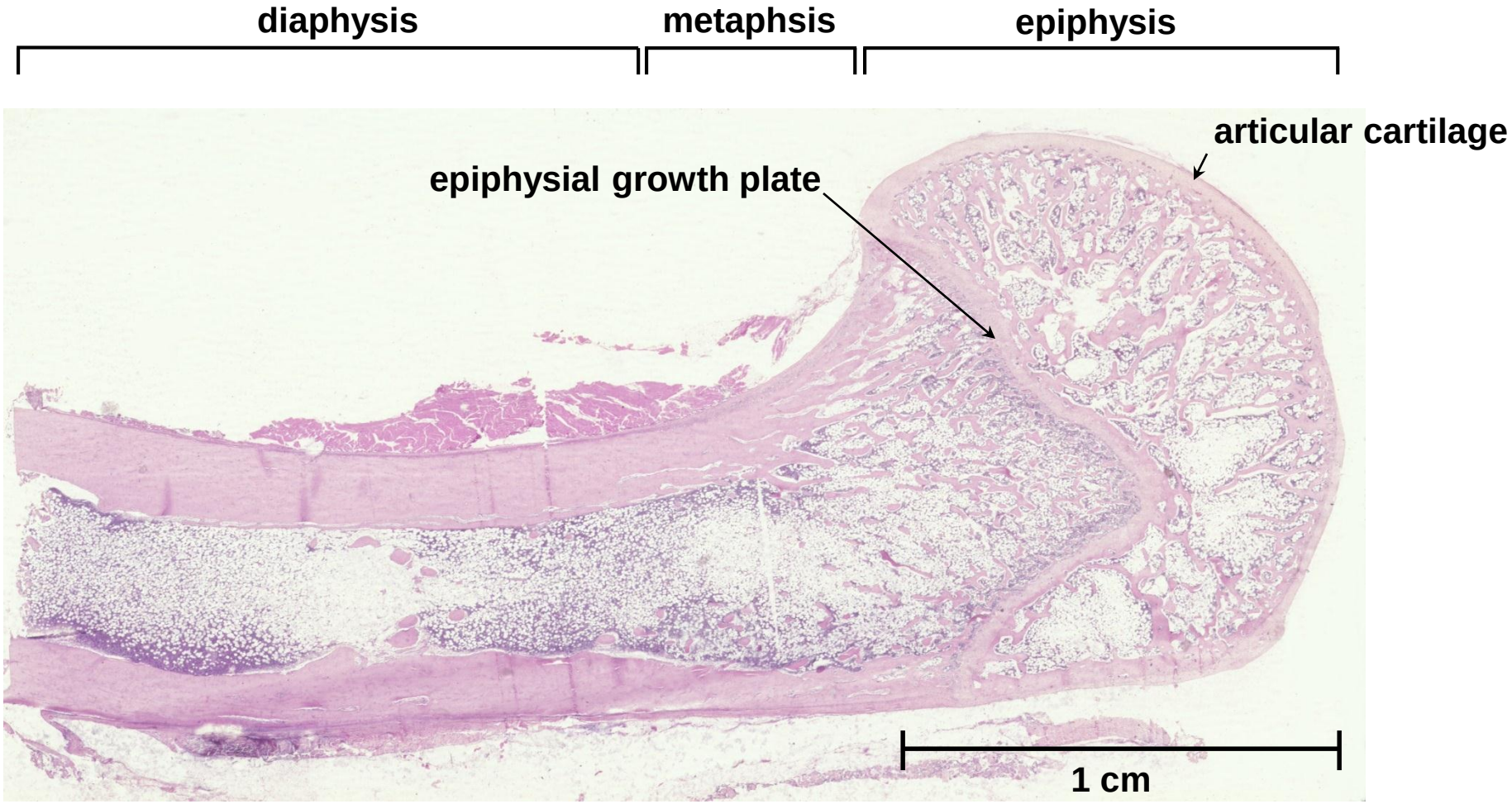
Perichondrium covers both surfaces and is composed of an outer fibrous layer of connective tissue and an inner layer of chondrogenic cells.



Articular cartilage Hyaline cartilage

Whole section. Again determine whether the section is transverse or longitudinal?

Answer : Longitudinal section of bone.

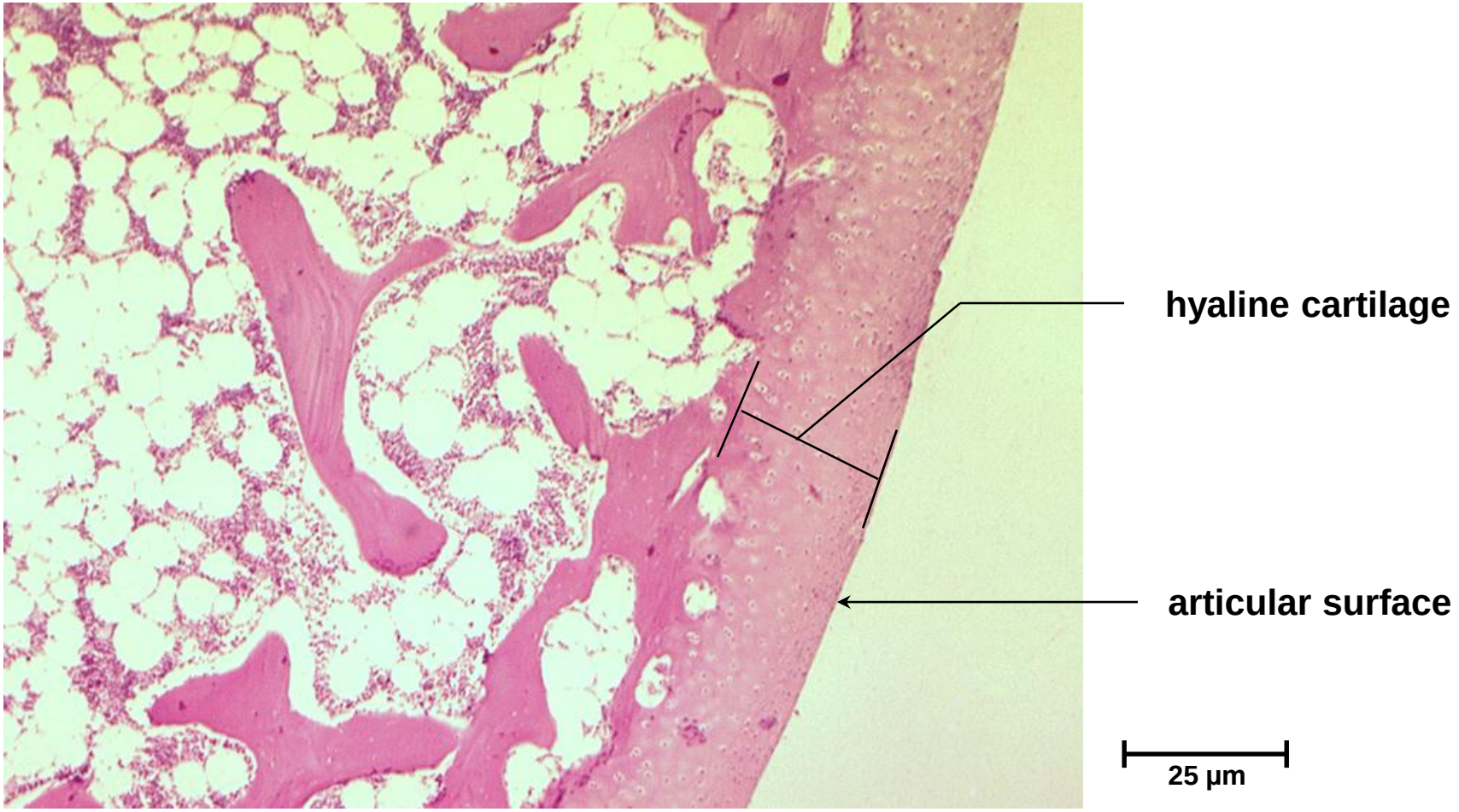


Articular cartilage Hyaline cartilage

What is the function of the hyaline cartilage of the articular surface?

Friction reduction; provides a smooth sliding surface for joint movement.

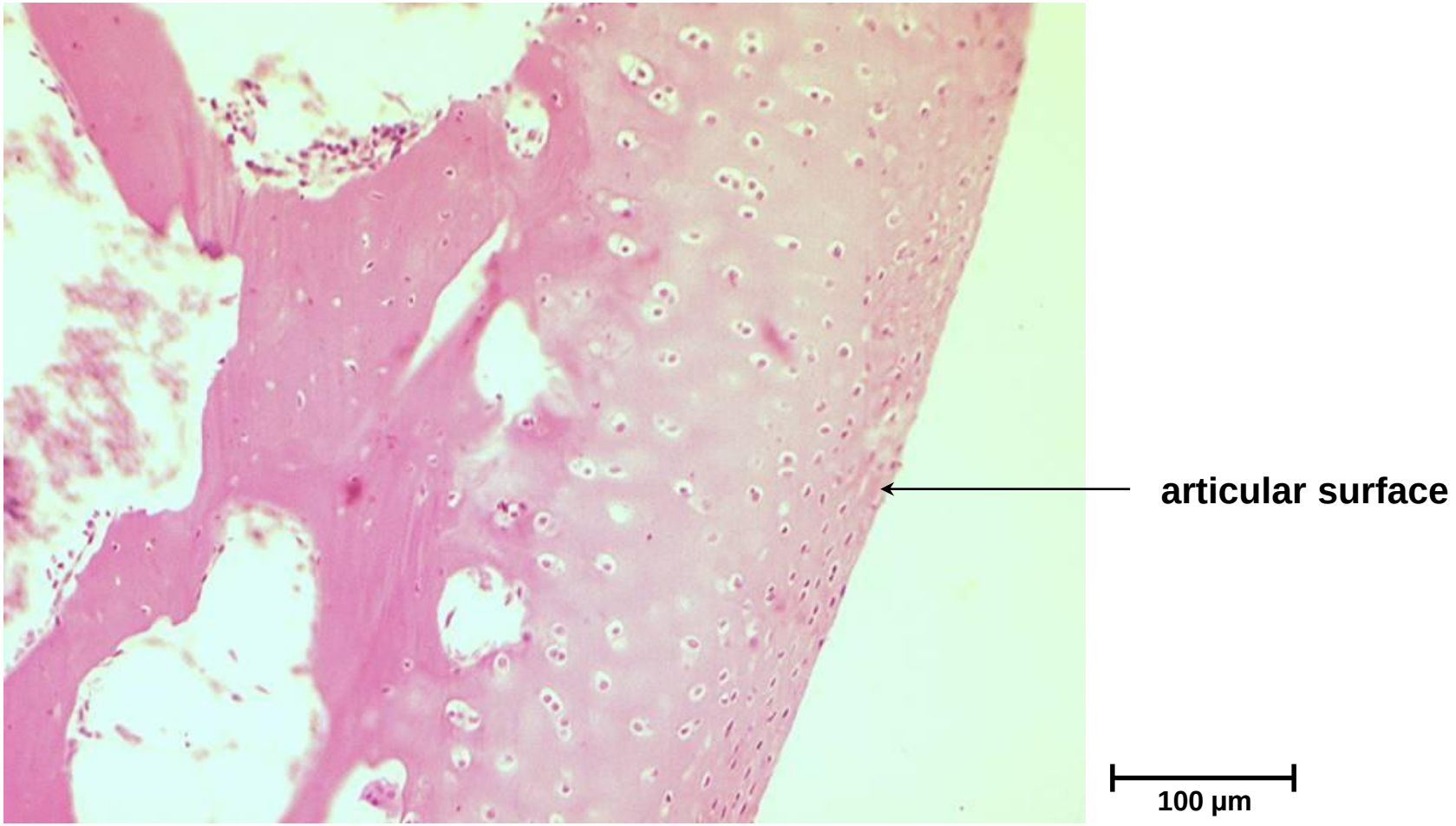
Again provides a resilient support and resists compression.



Articular cartilage Hyaline cartilage

Enlarged area from previous slide.

Chondrocytes now visible.

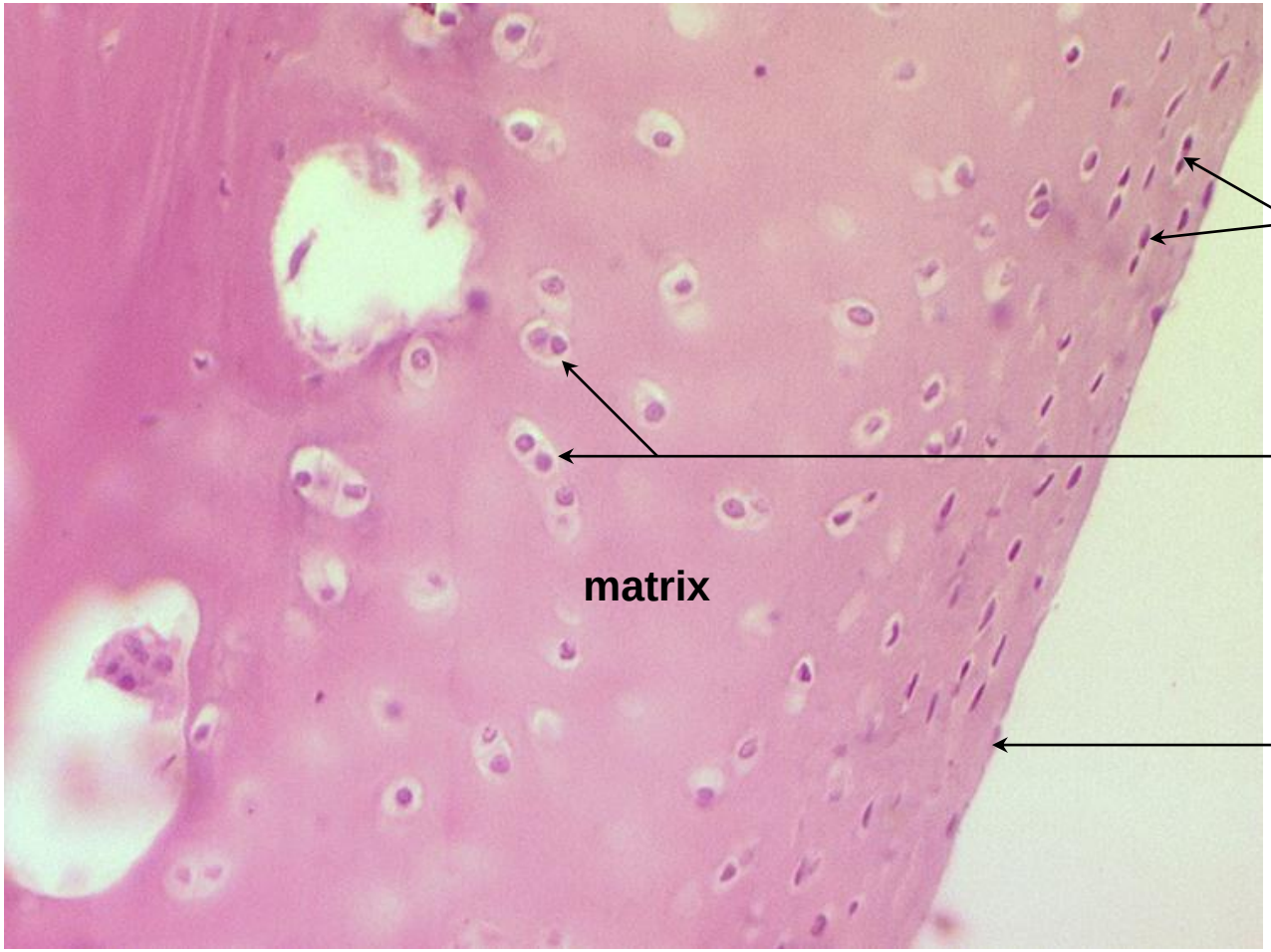


Articular cartilage Hyaline cartilage

Is a perichondrium present in articular hyaline cartilage?

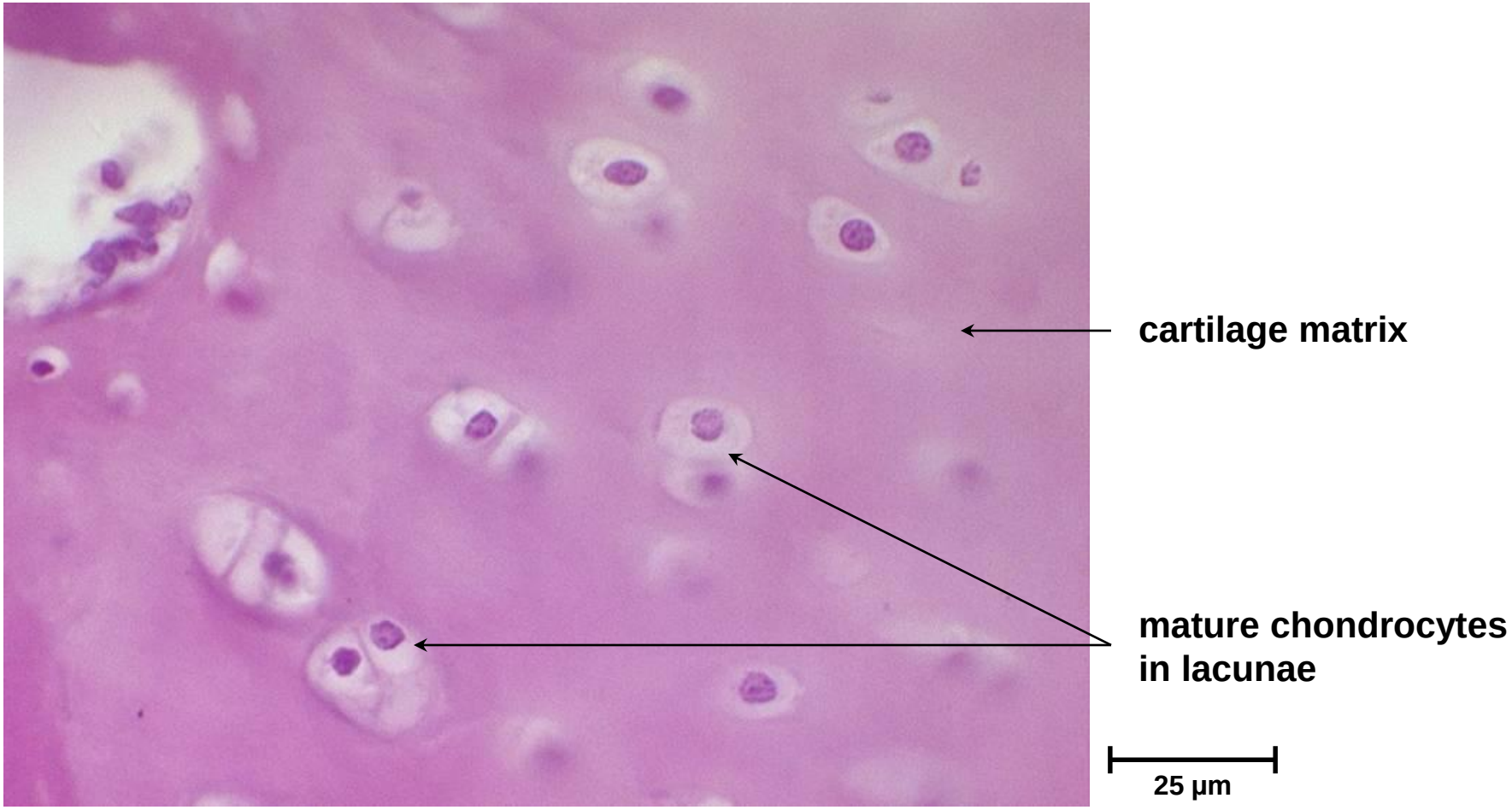
No.

Note the flattened appearance of chondrocytes at and close to the articulating surface.



Articular cartilage Hyaline cartilage

Perichondrium covers all hyaline cartilage except that forming articular surfaces in joints.



Articular cartilage Hyaline cartilage

1. **What cells are responsible for the synthesis of the cartilage matrix?**
   Chondrocytes.

2. **Name the predominant components of the extracellular matrix of hyaline cartilage?**
   Thin fibrils of collagen type II.
   Amorphous ground substance : Proteoglycans.
   Chondronectin.
   Water.
   Hyaluronic acid.

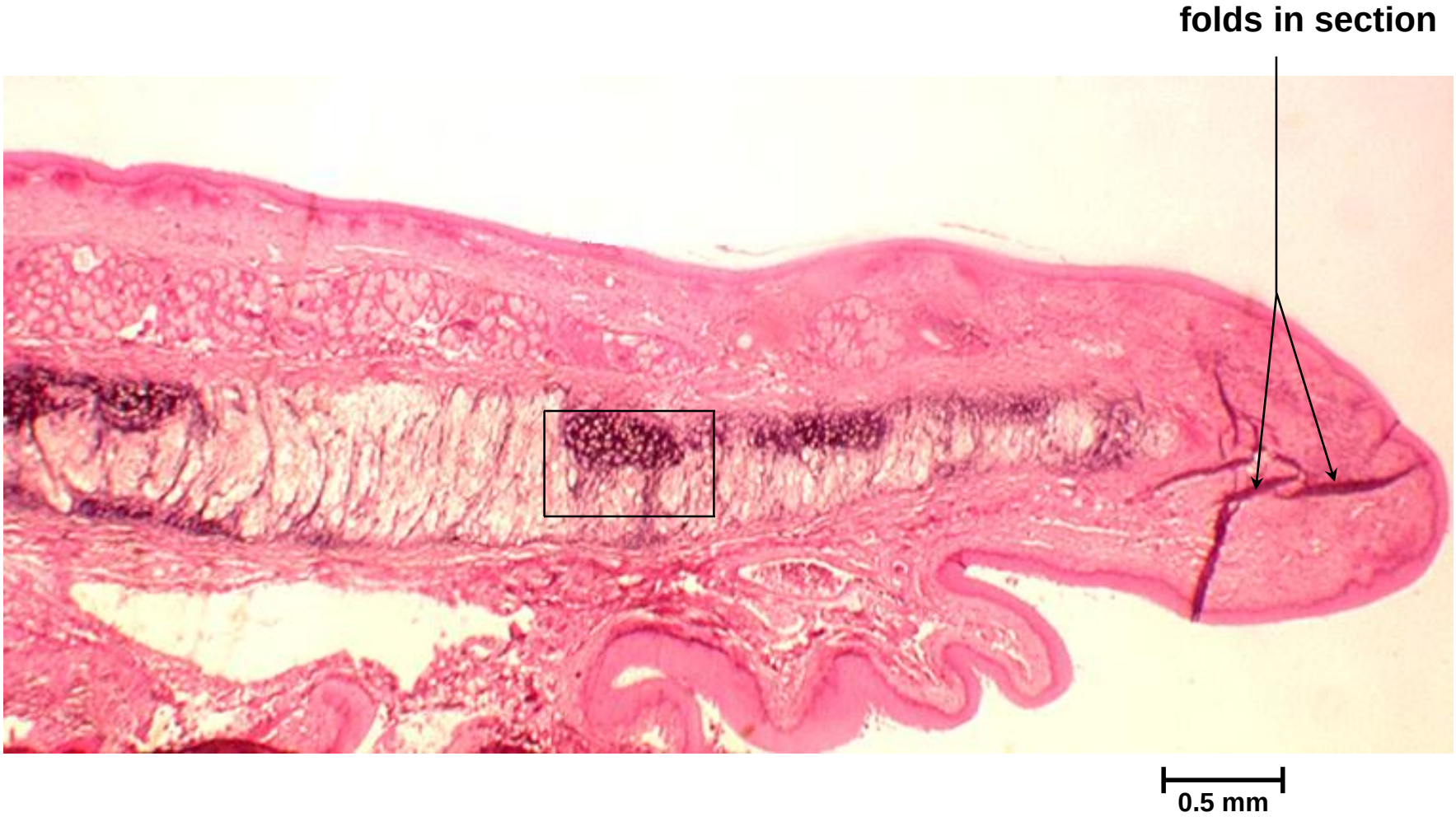
3. **What sub-cellular organelles would you expect to find in cells actively involved in the synthesis of this matrix?**
   Abundant rough endoplasmic reticulum (RER) and well developed golgi.

4. **Does cartilage contain blood vessels?**
   No.

Epiglottis Elastic cartilage

Low magnification view of the epiglottis.

Elastic fibres are stained black in this preparation.



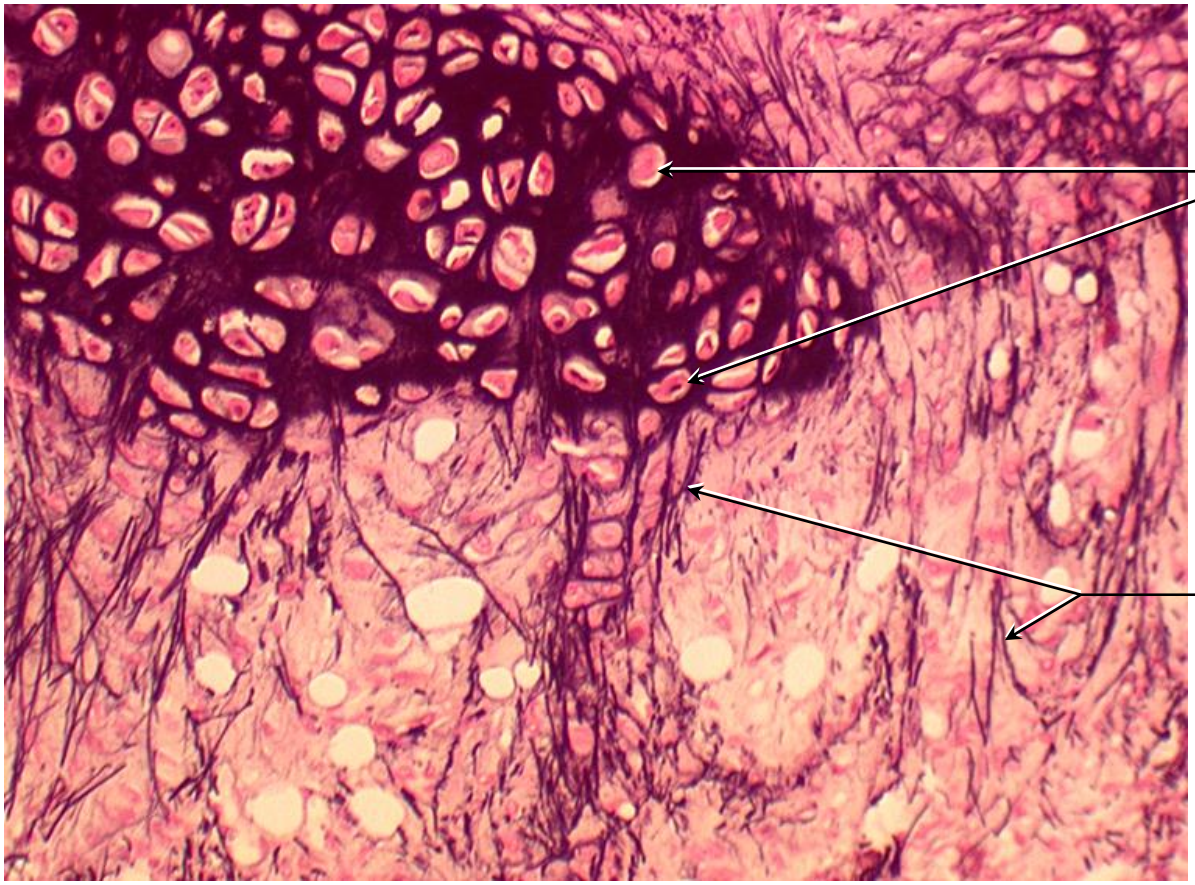
Epiglottis Elastic cartilage

Do the elastic fibres have a regular or irregular arrangement?

Mainly irregular : a dense network of branching fibres around the chondrocytes, less dense towards the perichondrium.

How can you relate this to the function of the epiglottis?

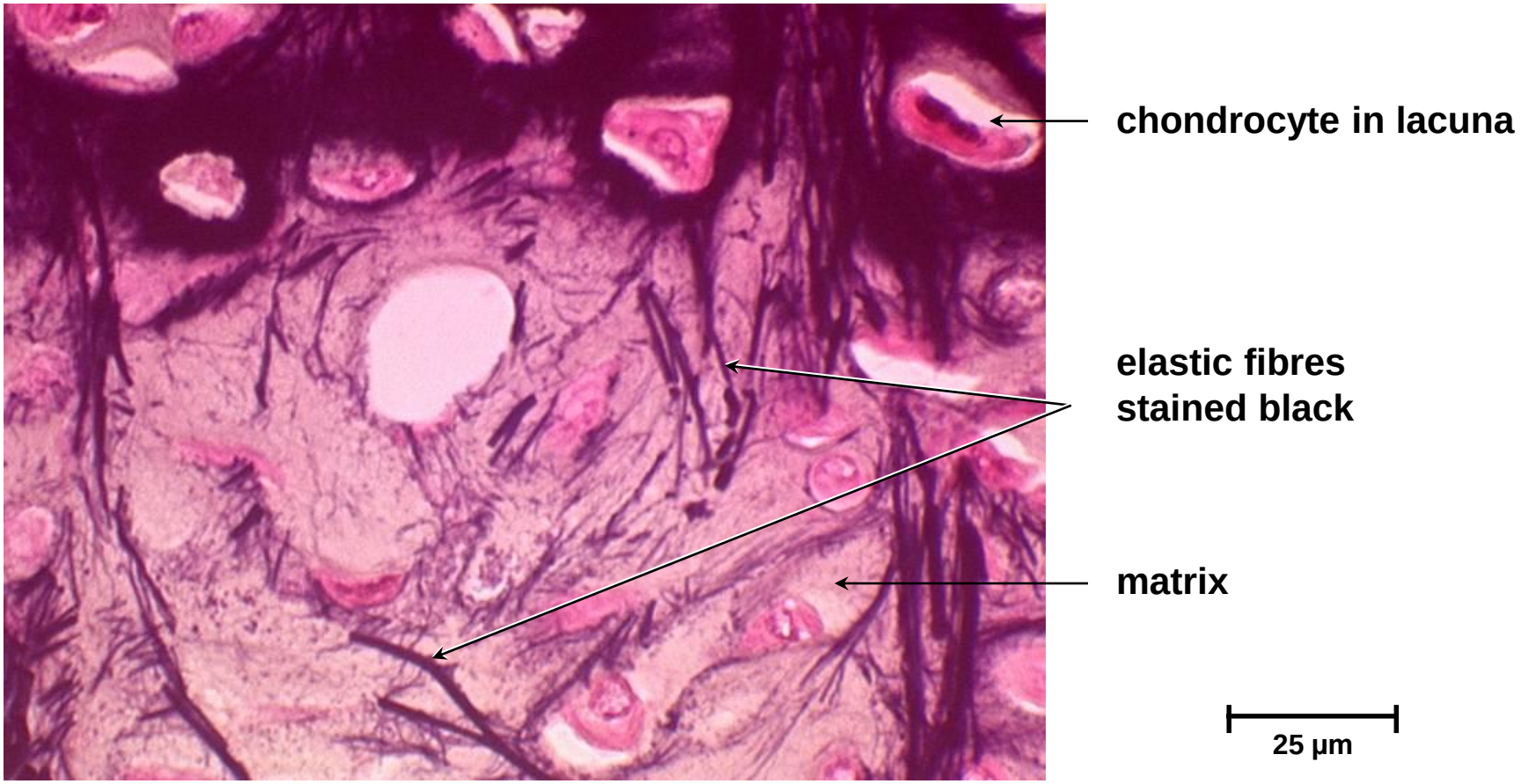
The epiglottis can return to its normal shape after distortion.



Epiglottis Elastic cartilage

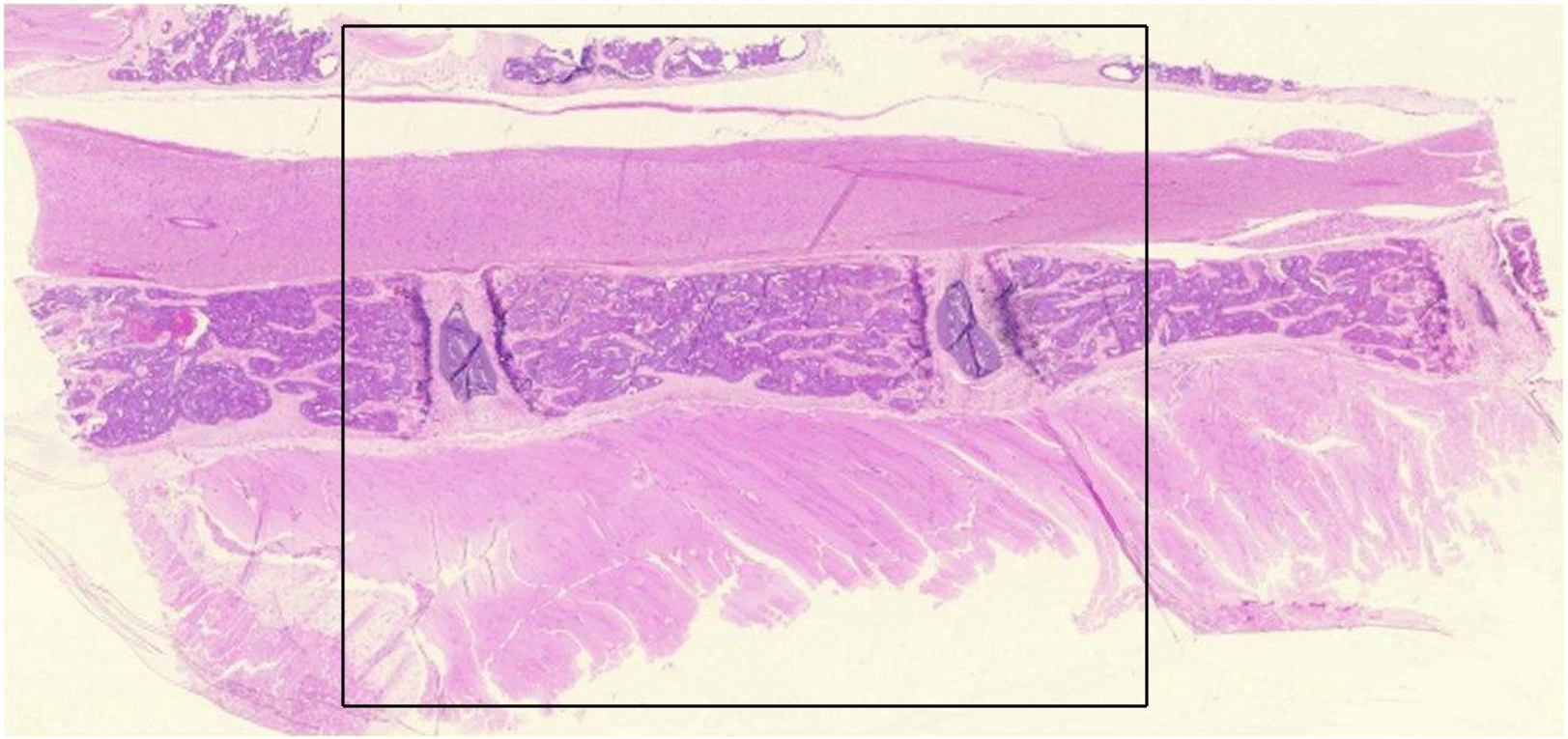
Elastic cartilage is found in areas which need to resist mechanical deformation.

As well as the epiglottis it can be found in the larynx, external auditory canals and auditory tubes.



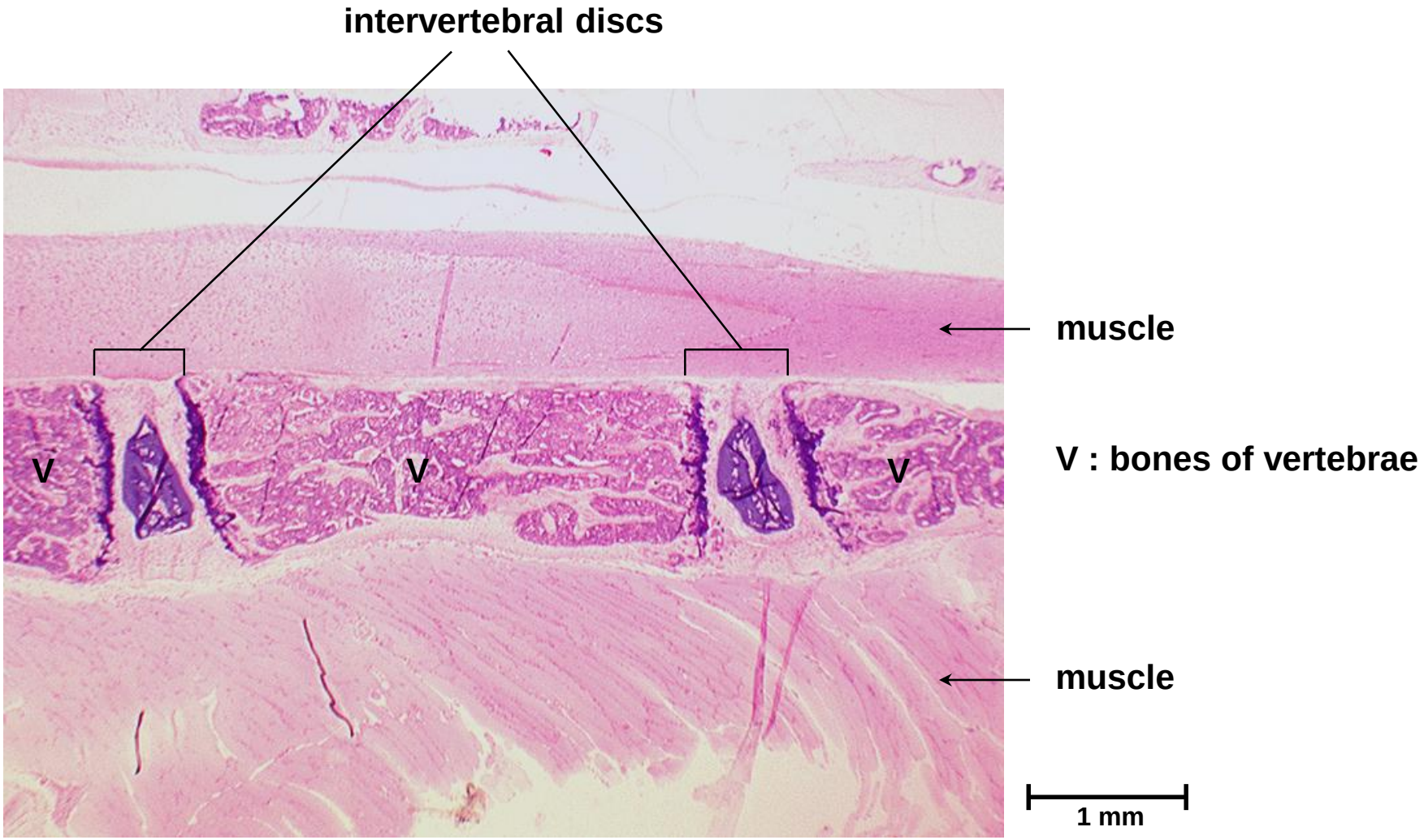
Intervertebral disc Fibrocartilage

Whole section



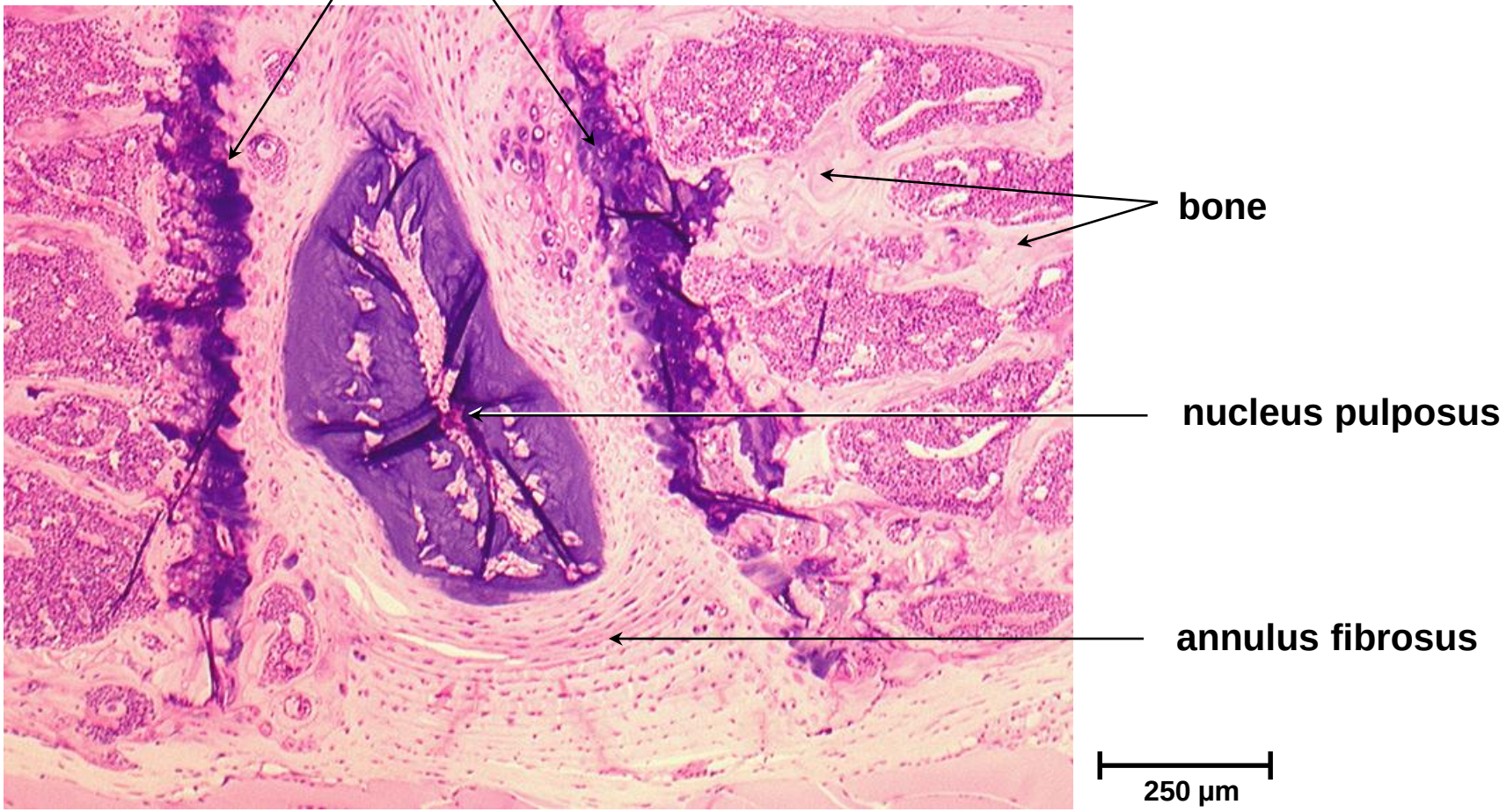
Intervertebral disc Fibrocartilage

Selected area x1 objective



Intervertebral disc Fibrocartilage

Selected area x4 objective

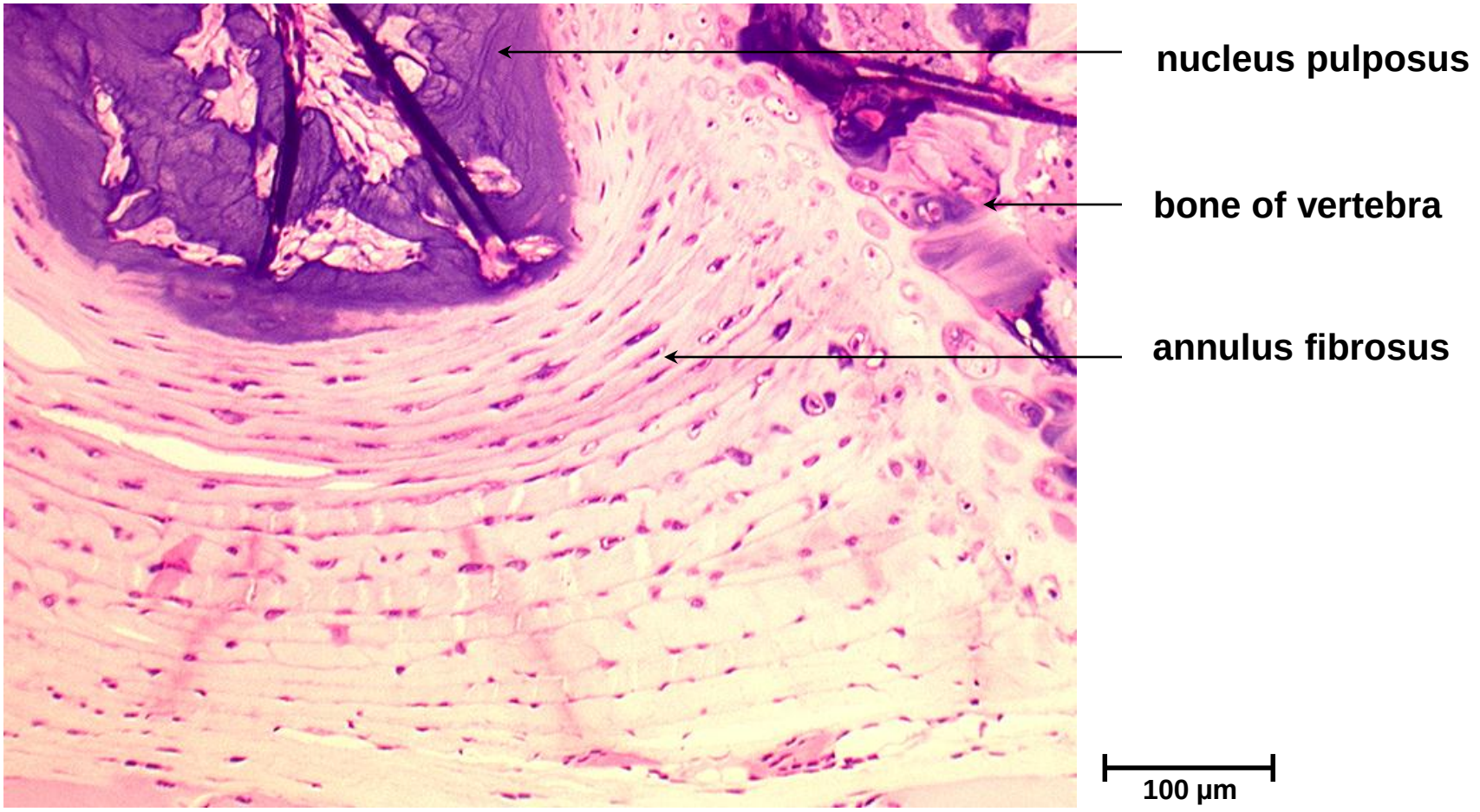


Intervertebral disc Fibrocartilage

Observe the predominant concentric collagen fibre layers in the annulus.

Explain what you understand the term ‘slipped disc’ to mean.

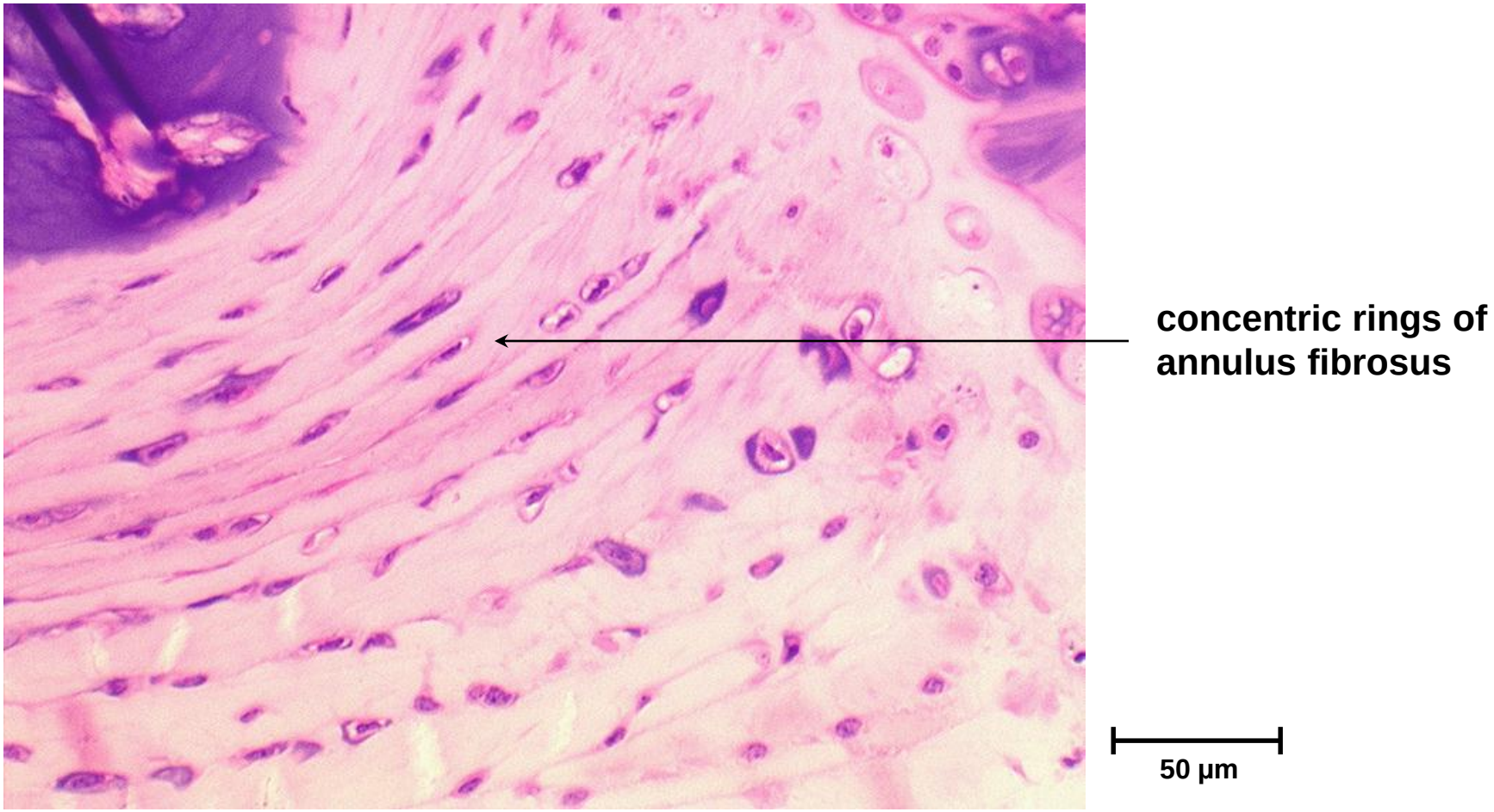
Displacement of the nucleus pulposus.



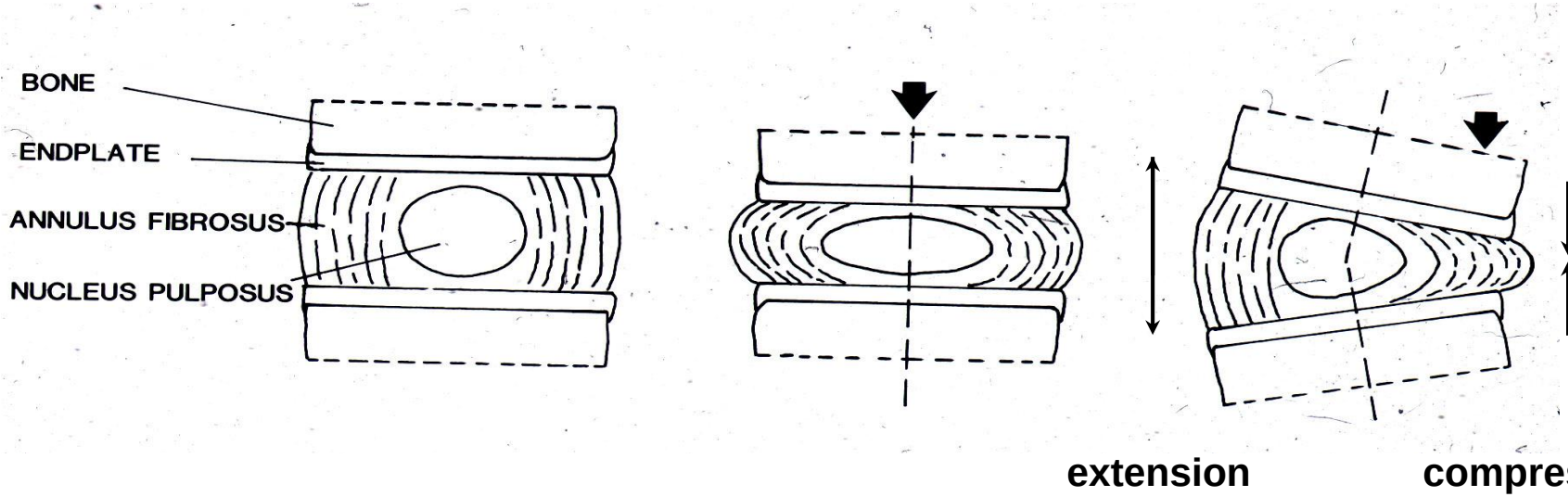
Intervertebral disc Fibrocartilage

What collagen type predominates in the Annulus Fibrosus?

Collagen type I fibres.



This series of diagrams shows the disc and changes induced by Axial Compression and Bending.
Which sites on the RHS diagram are experiencing extension or tension?



extension **compression**

Skull Cancellous (spongy or trabecular) bone

Whole section.

Consider how a section through a bath sponge might appear!

Skull Cancellous (spongy or trabecular) bone

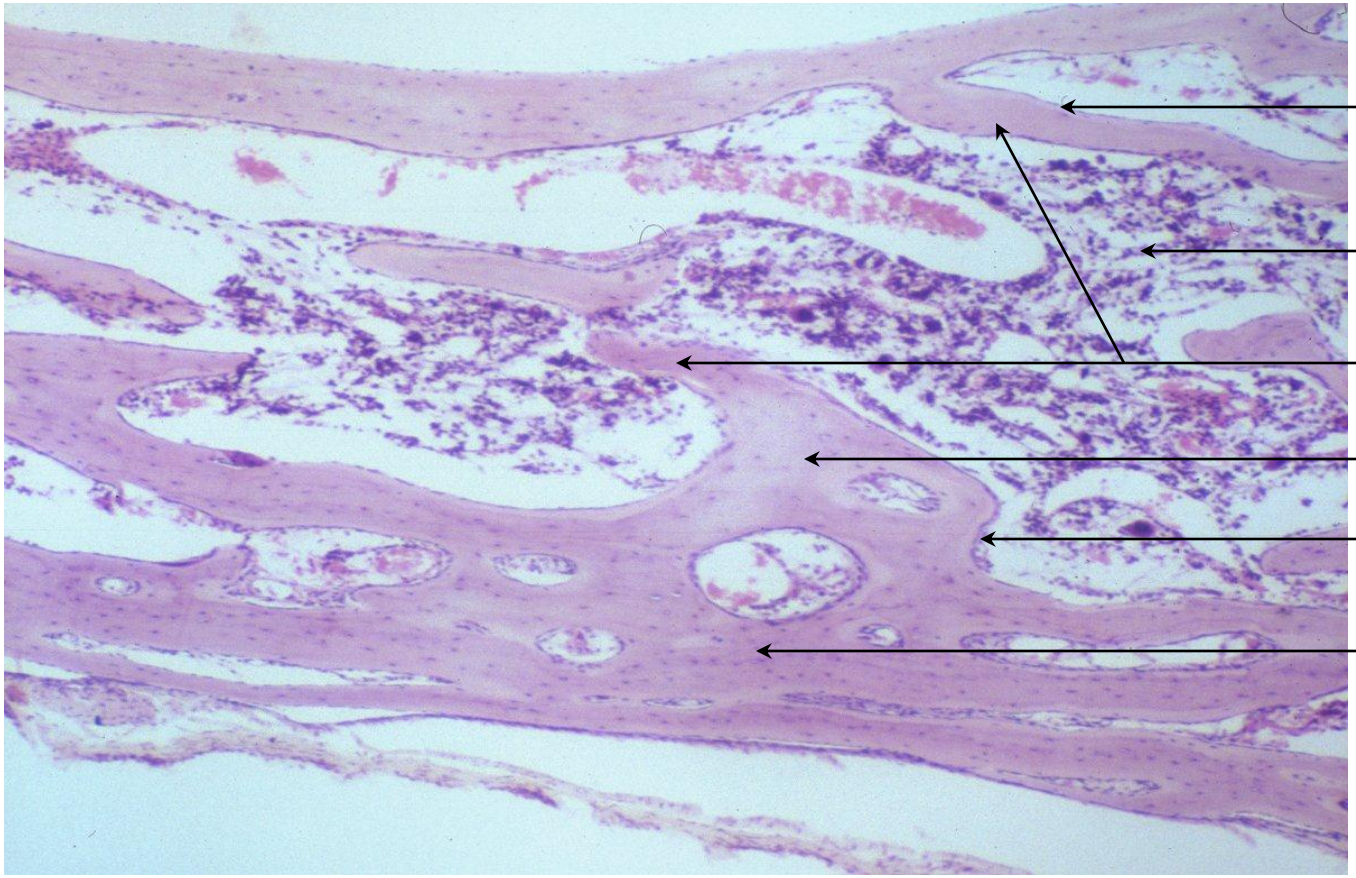
Selected area. Identify : Bone marrow between trabeculae.

Bone matrix.

Osteocytes within the bone matrix.

Osteoblasts on forming surfaces.

Lining cells : line vascular canals and marrow spaces.



Skull Cancellous (spongy or trabecular) bone

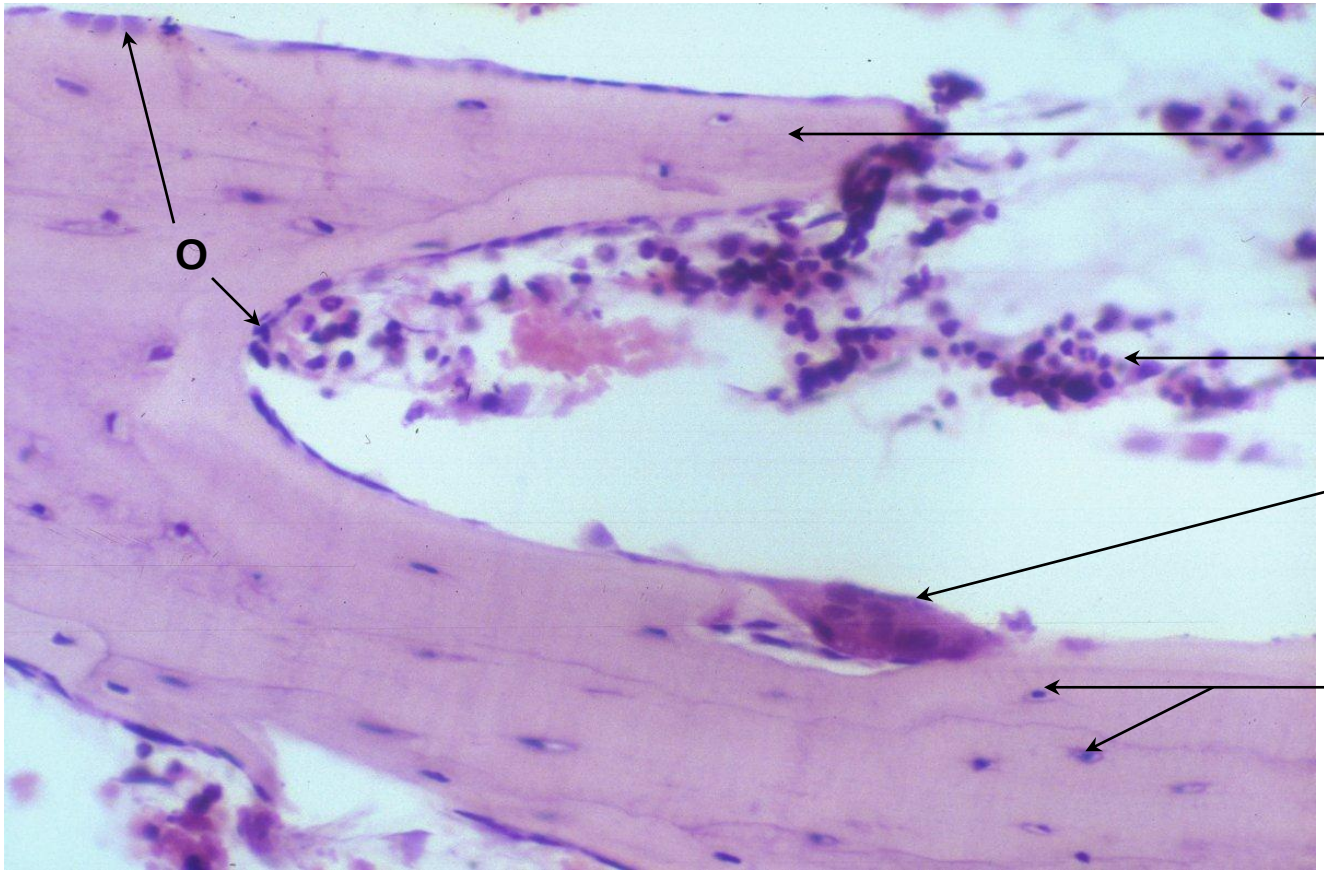
Identify osteoclasts if present.

Which of these cells is responsible for forming bone?

Osteoblasts synthesize the organic matrix. Secretory surface faces the bone.

Which of these cells is responsible for removing bone?

Osteoclasts.



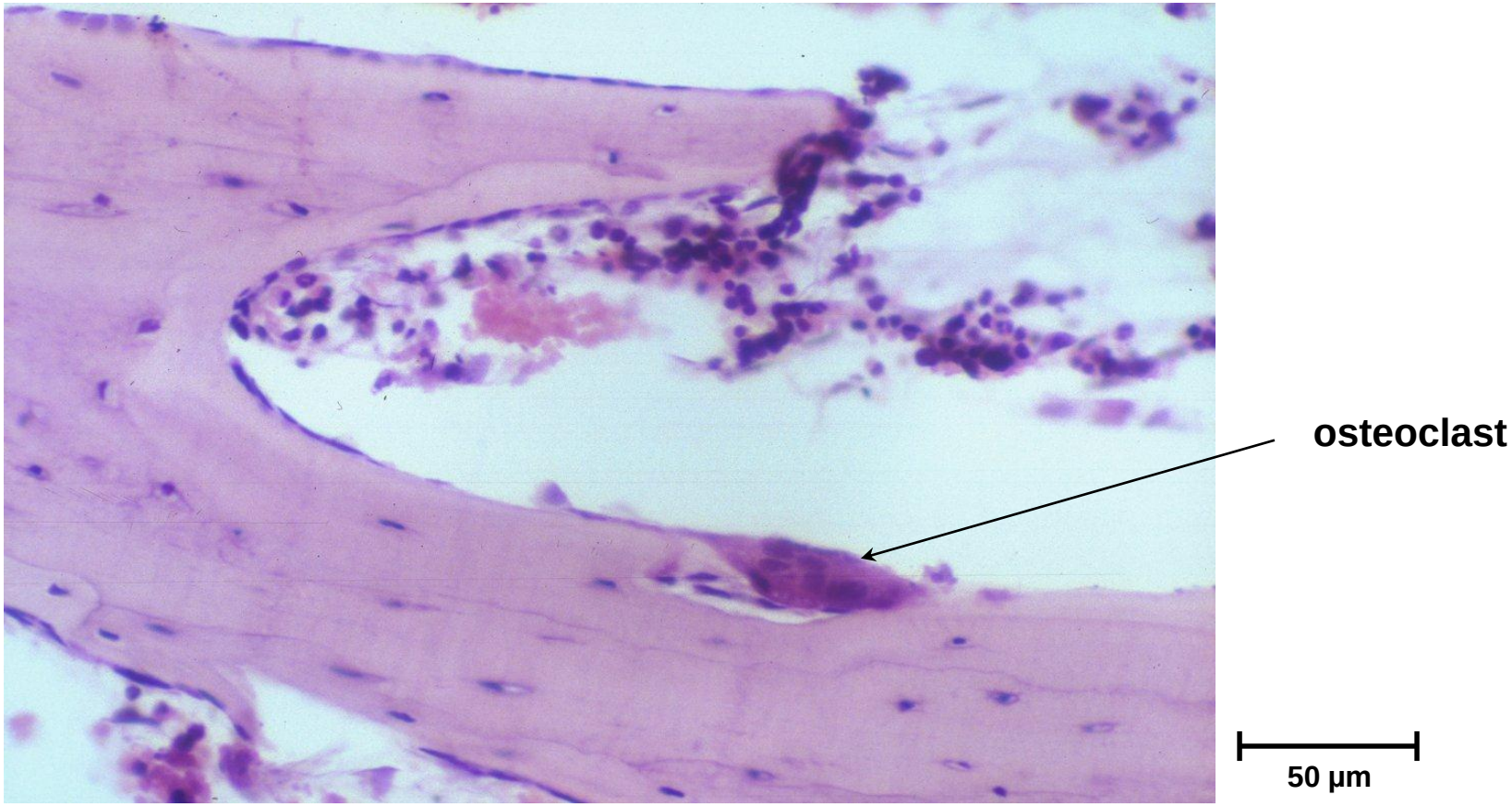
Skull Cancellous (spongy or trabecular) bone

Active osteoclasts contain many lysosomes and facing the bone have a folded surface termed a ‘ruffled border’.

From which cells are osteoclasts derived and describe one characteristic feature of mature osteoclasts?

They are derived from the fusion of monocytes.

They are multinuclear.

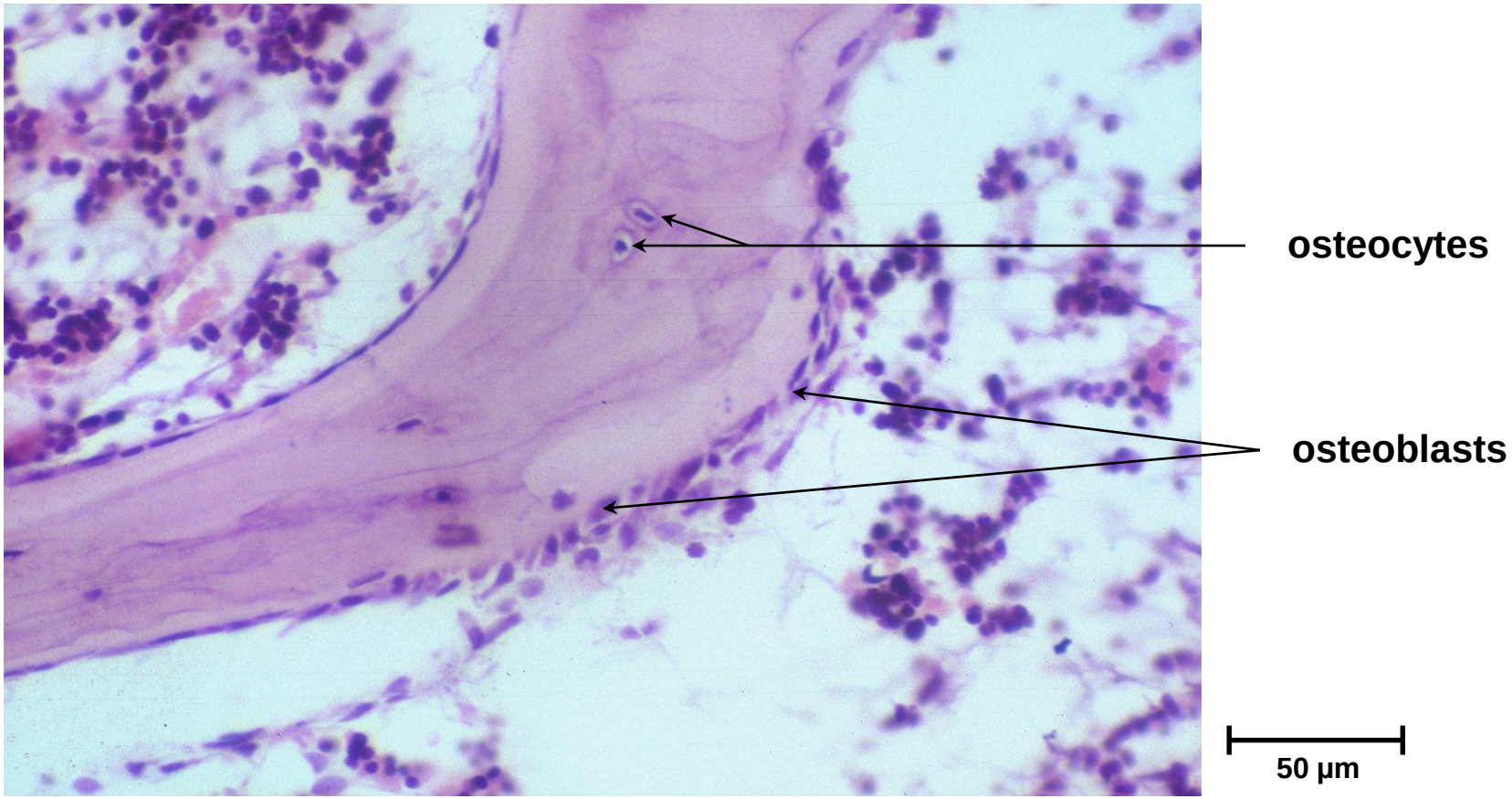


Skull Cancellous (spongy or trabecular) bone

Why is the cytoplasm of the osteoblast basophilic?

Because of the well developed rough endoplasmic reticulum (RER).

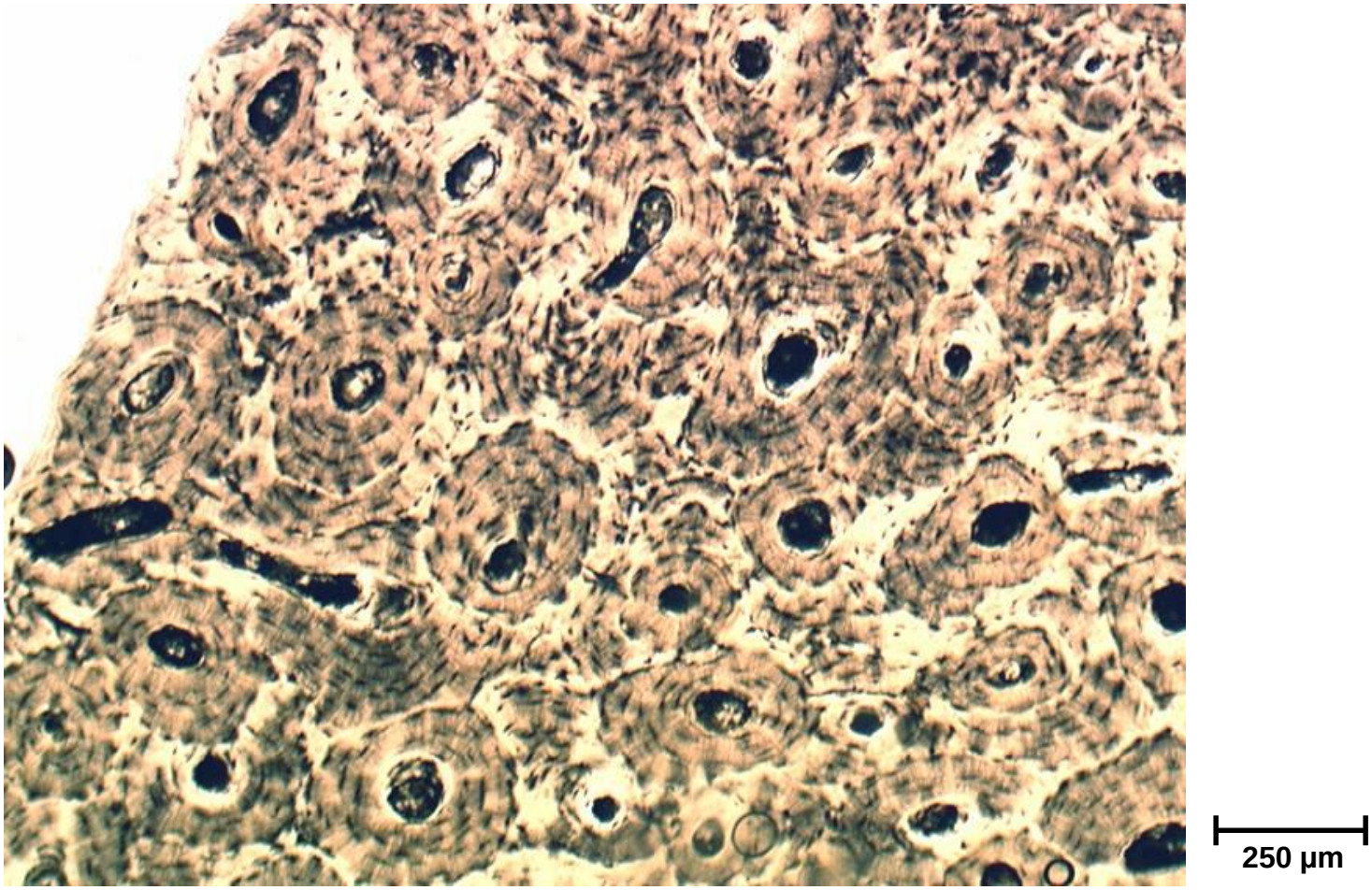
Characteristic of cells specialised in the secretion of proteins.



Compact bone ground section

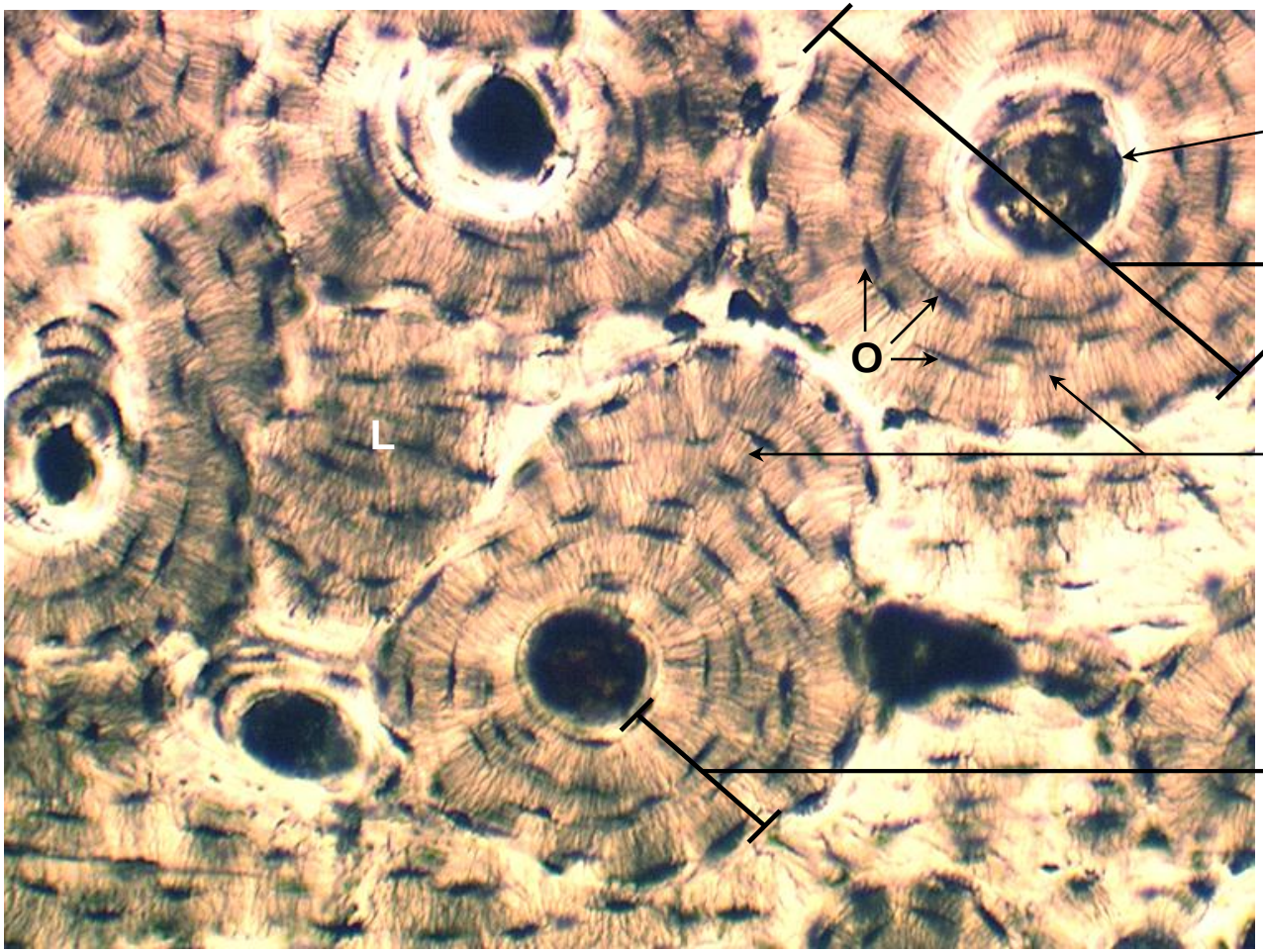
This is a transverse section through a piece of compact bone: ‘bony’ mineral alone is preserved.

The spaces between this mineral appear black.



Compact bone ground section

Identify: Canaliculi, Haversian canal, Interstitial lamellae, Osteon, Osteocyte, Concentric lamellae, Osteocyte lacuna



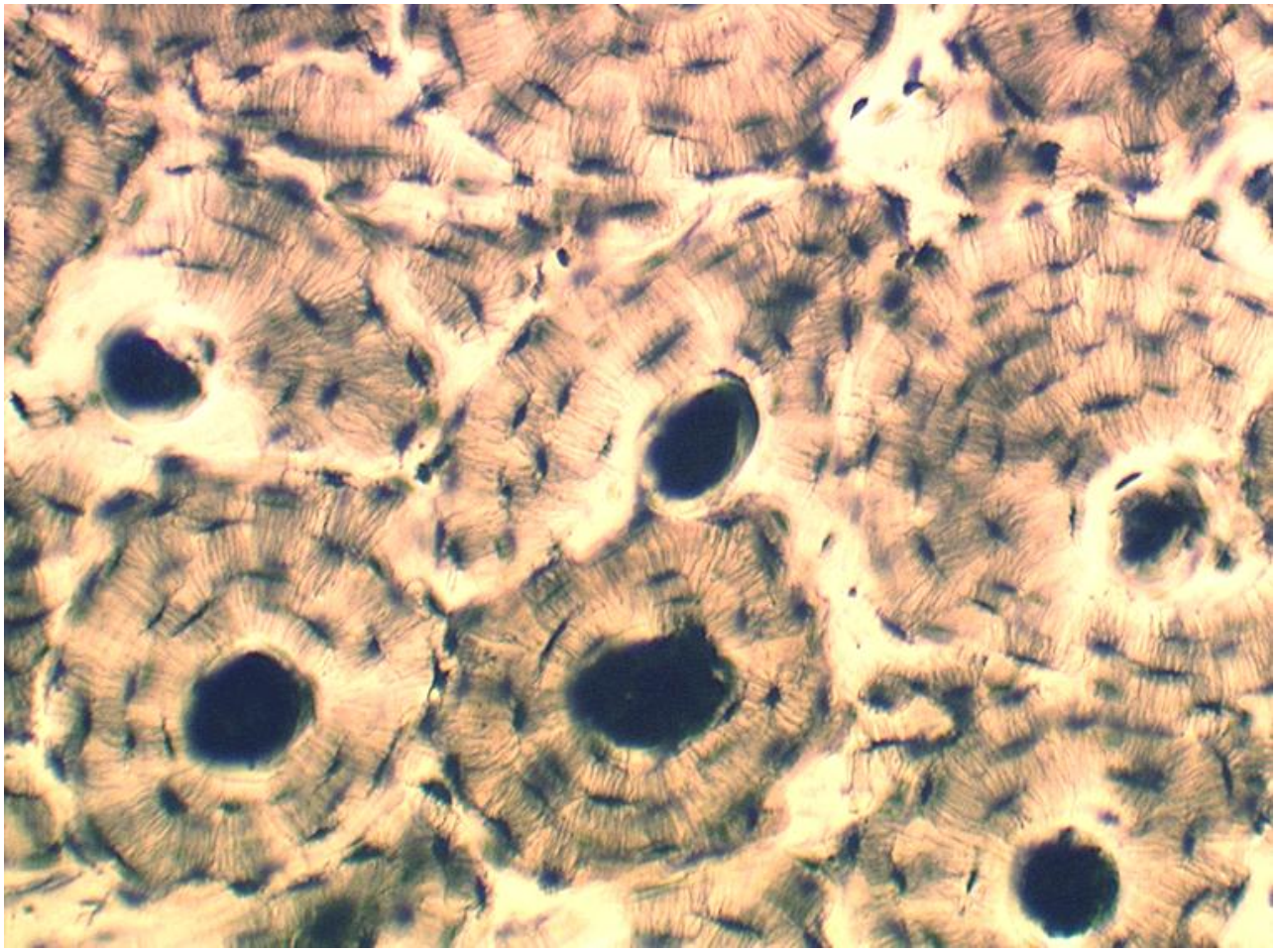
Compact bone ground section

How are canaliculi formed?

They contain the cytoplasmic processes of the osteocytes, connected by gap junctions.

What is the predominant cell type in this section?

The osteocyte.



Osteon

Osteocytes in lacunae forming concentric lamellae surrounding central Haversian canal. Radiating canaliculae between the osteocytes.

100 µm

Compact bone ground section

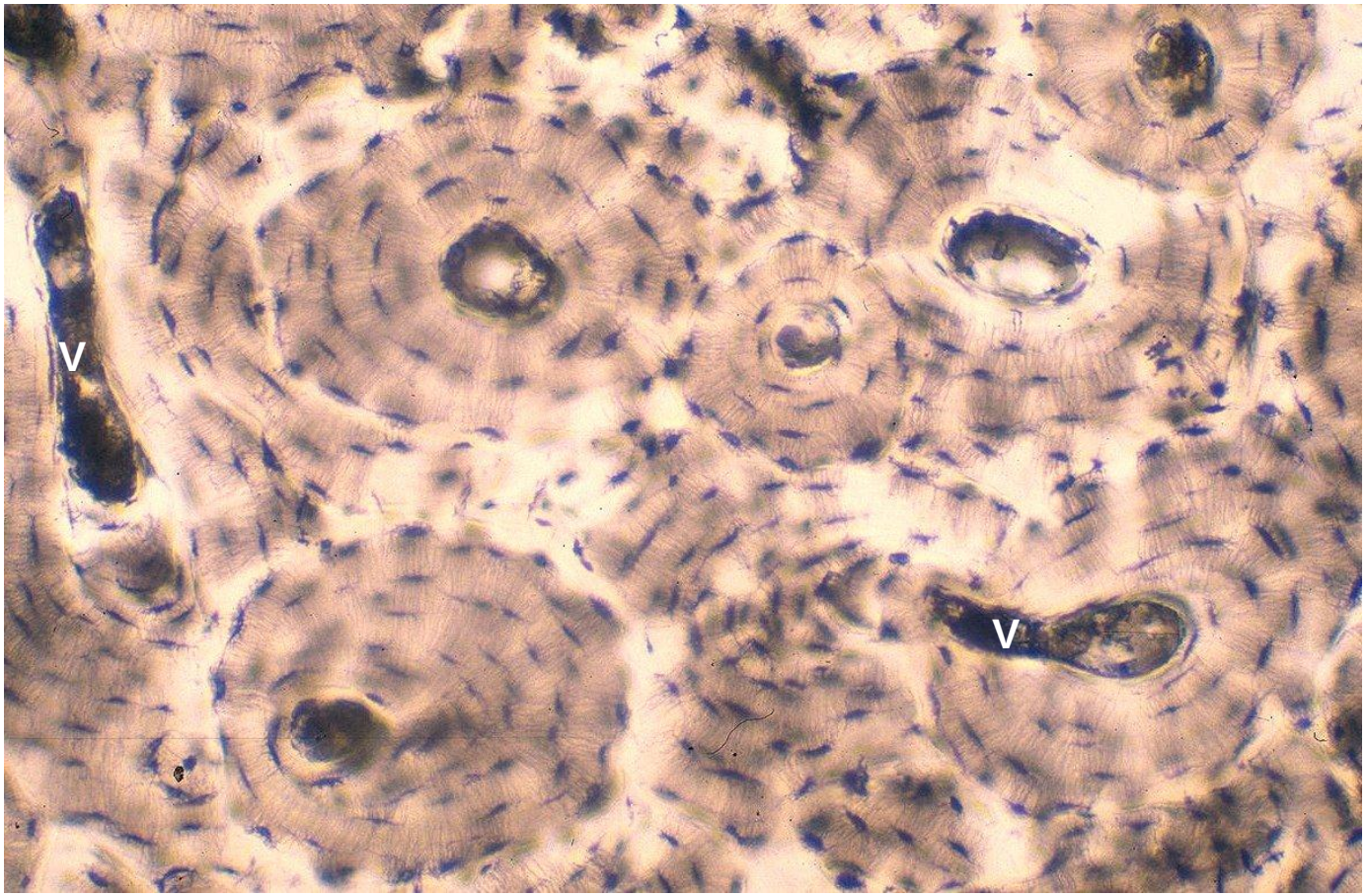
What does the arrangement of osteones suggest regarding Haversian remodelling?

Presence of many interstitial lamellae (remnants of osteons remodelled)

Suggests extensive 'remodelling'. Mostly secondary osteons.

What are Volkmann's canals?

Transverse links between Haversian canals.

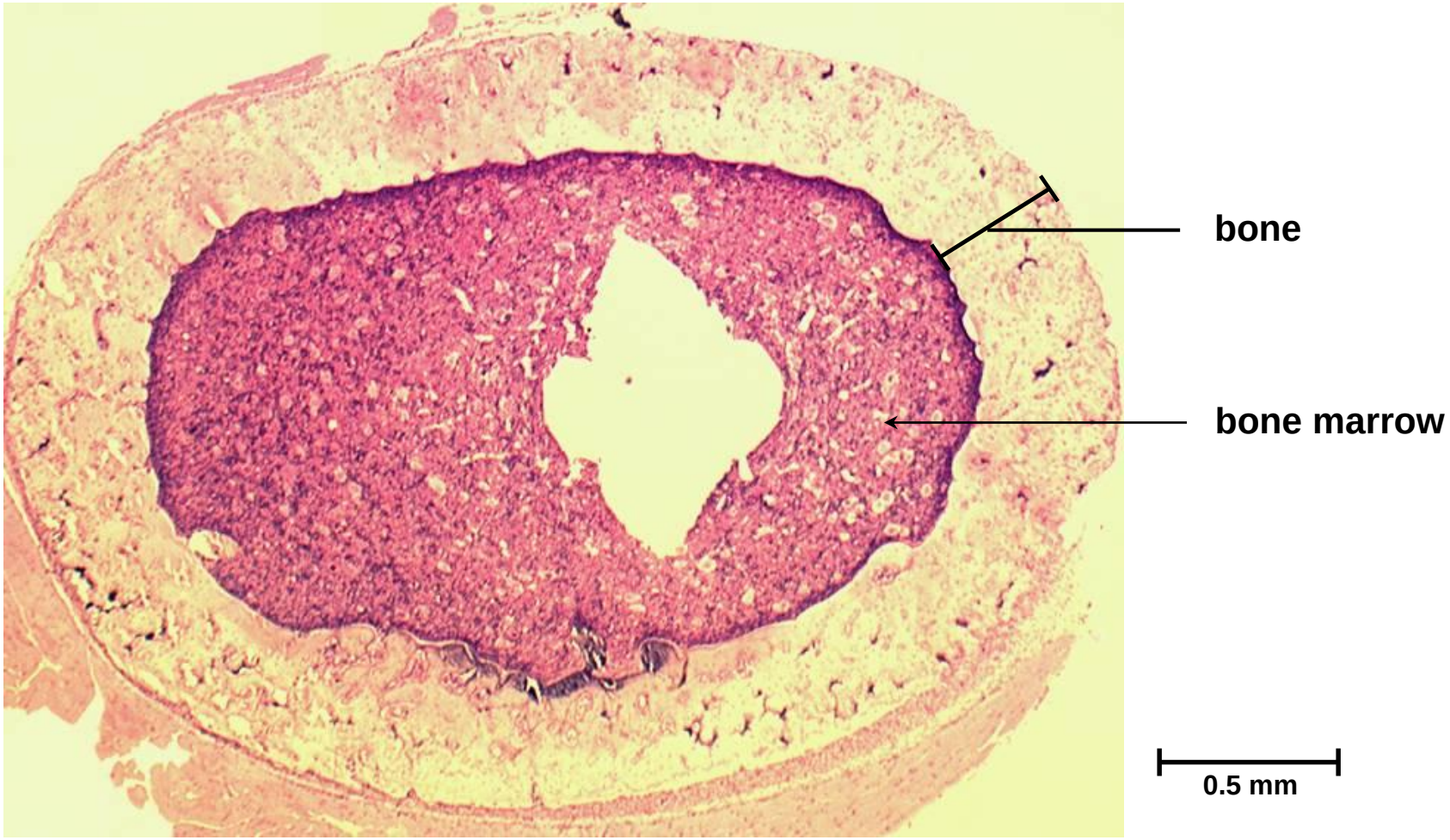


V : Volkmann's canals

100 µm

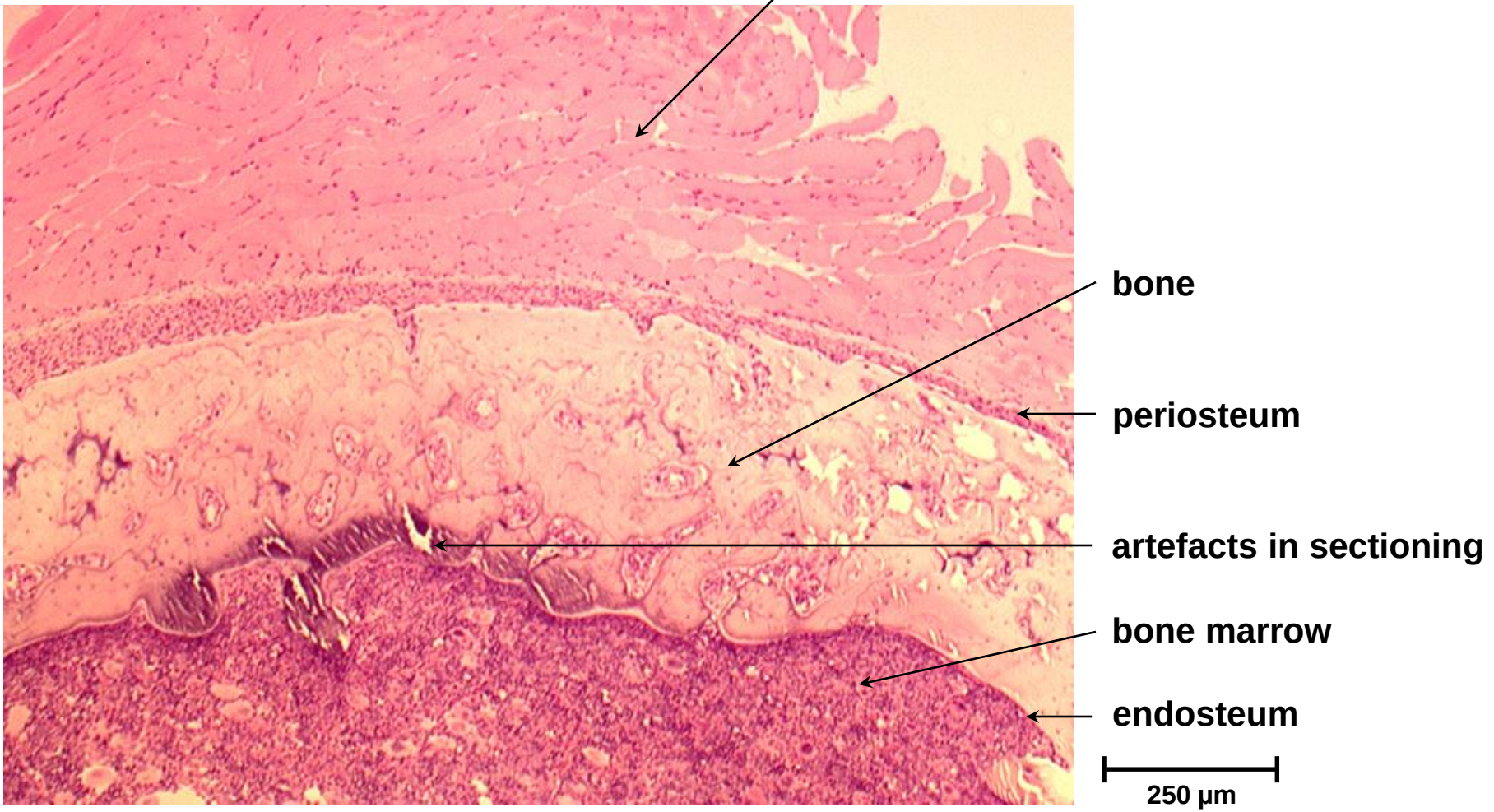
Femur decalcified bone

The hard calcium salts in bone produce poor and torn sections by routine techniques. Chelating agents such as Ethylene diamine tetracetic acid (EDTA) binds with calcium and can be used as a decalcifying agent producing minimal artefacts.



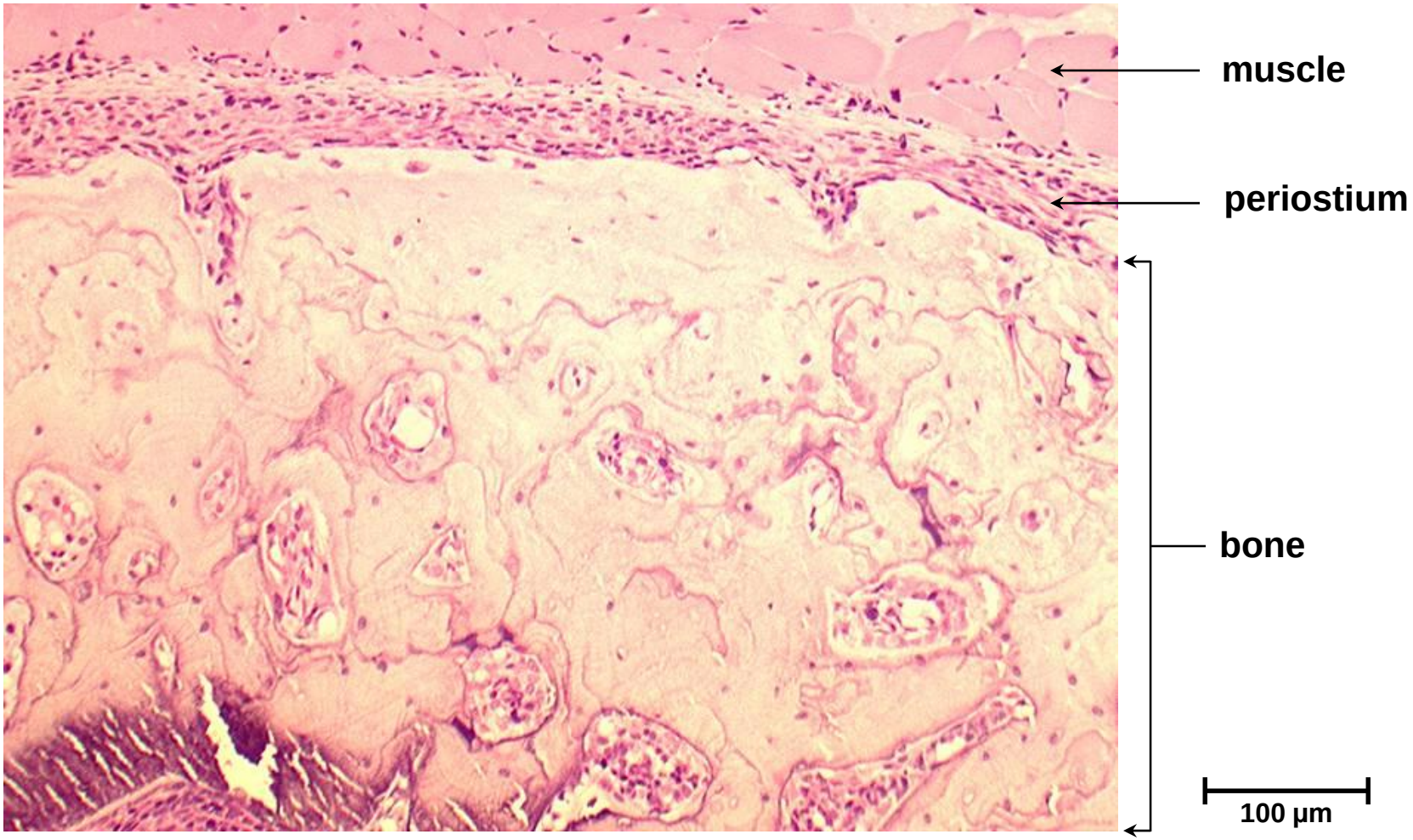
Femur decalcified bone

With x4 objective.



Femur decalcified bone

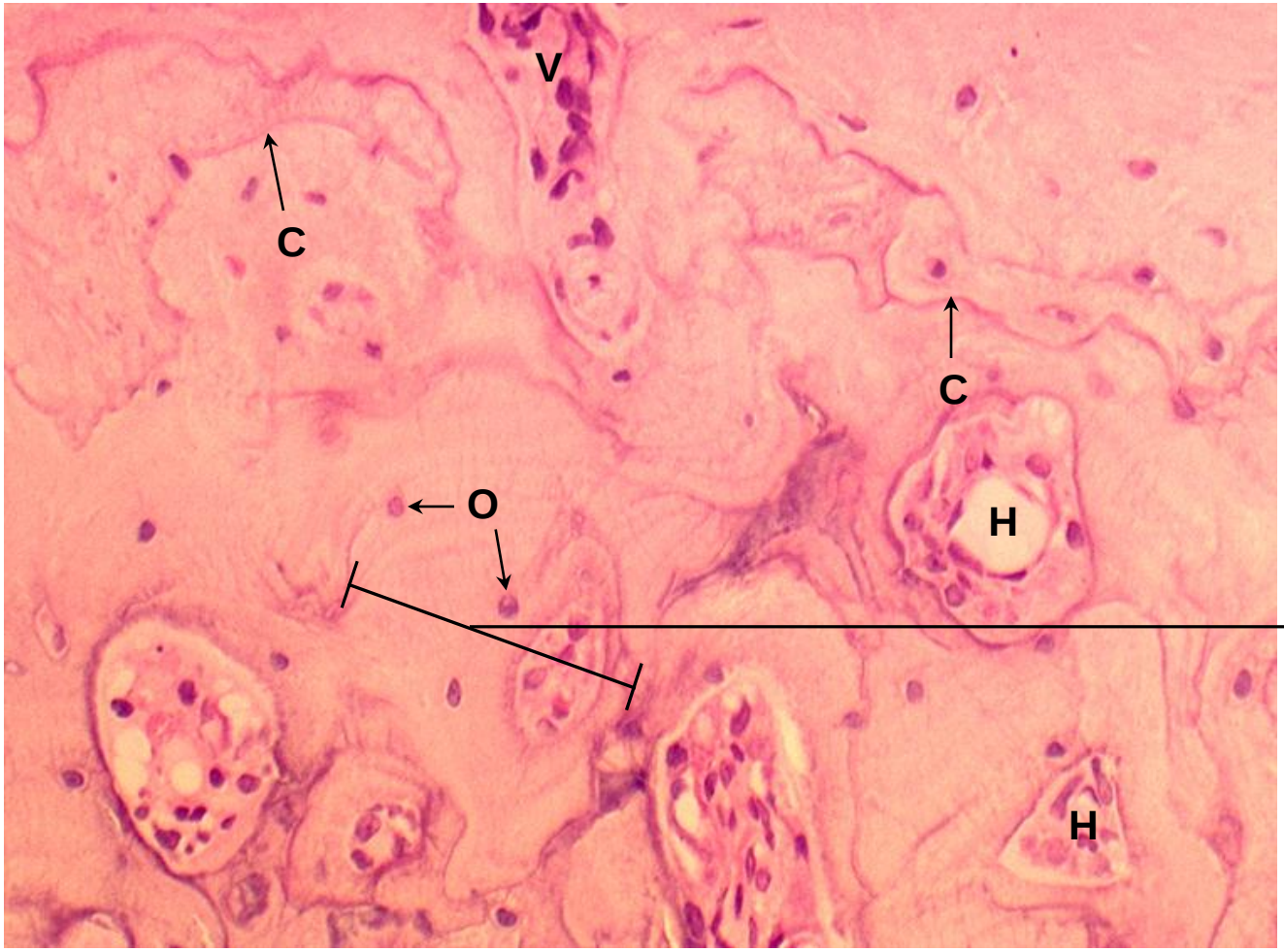
With x10 objective.



Femur decalcified bone

Margins of osteons termed cement lines visible.

With x20 objective.



H : Haversian canals

V : Volkmann's canal

O : osteocytes

C : cement lines