

MUSCLE TISSUE

Objectives

Students should be able to:

- 1. Specify and interpret light microscopic sections of stained muscle (eg. Muscle type, structure, fibre type, metabolic profile).**
- 2. Identify structural features, similarities and differences between various types of muscle fibres.**

Striated skeletal muscle

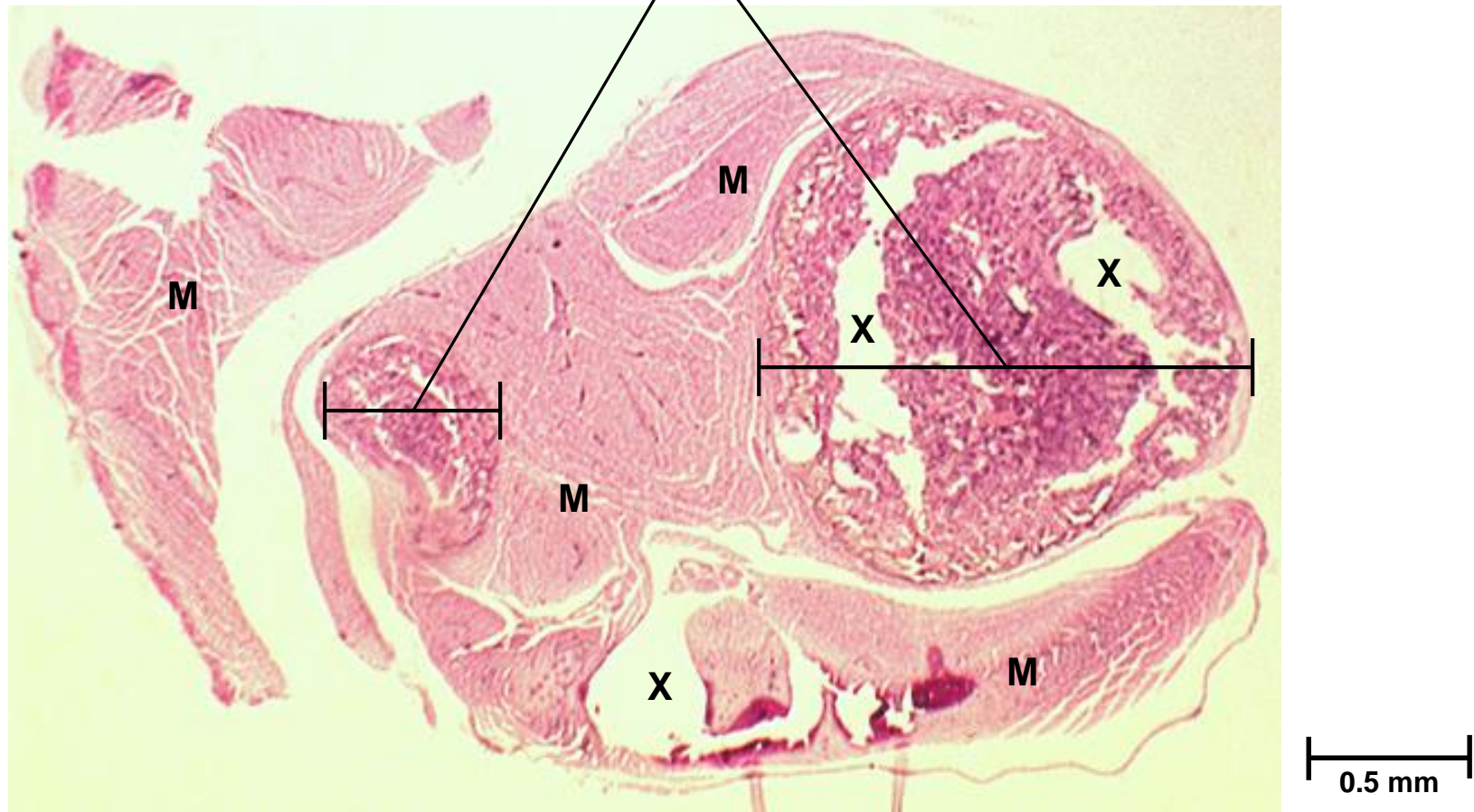
Examining this section under low magnification.

Distinguish between the muscle groups and the limb bone in the centre of the section.
H&E stain.

M : muscles

limb bones

X : areas of damage on section



Striated skeletal muscle

Indicate : bundles of muscle fibres.

epimysium.

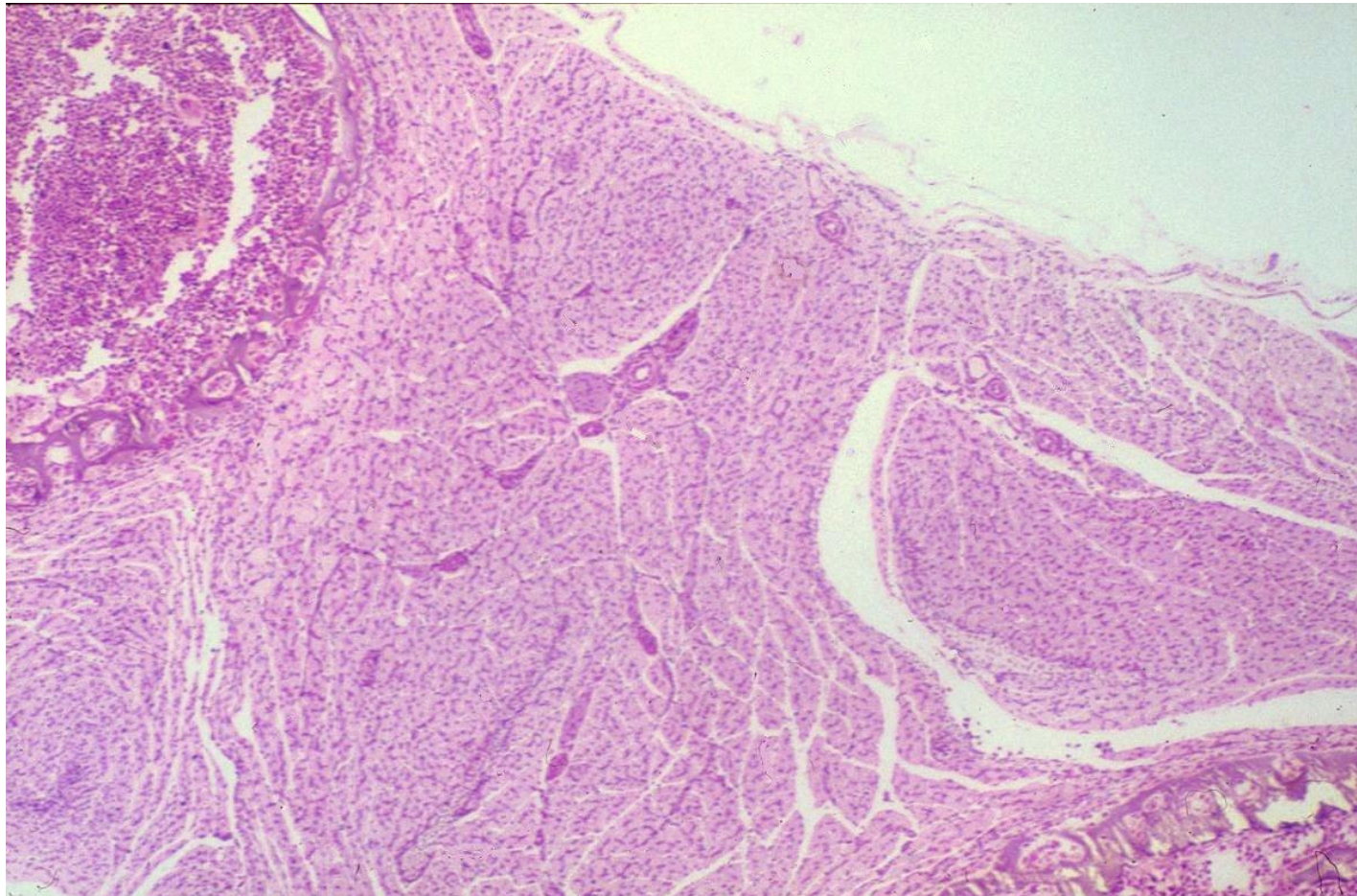
Connective tissue surrounding whole muscle.

perimysium.

Connective tissue surrounding bundles of muscle cells.

endomysium.

Connective tissue surrounding individual muscle cells.



250 μ m

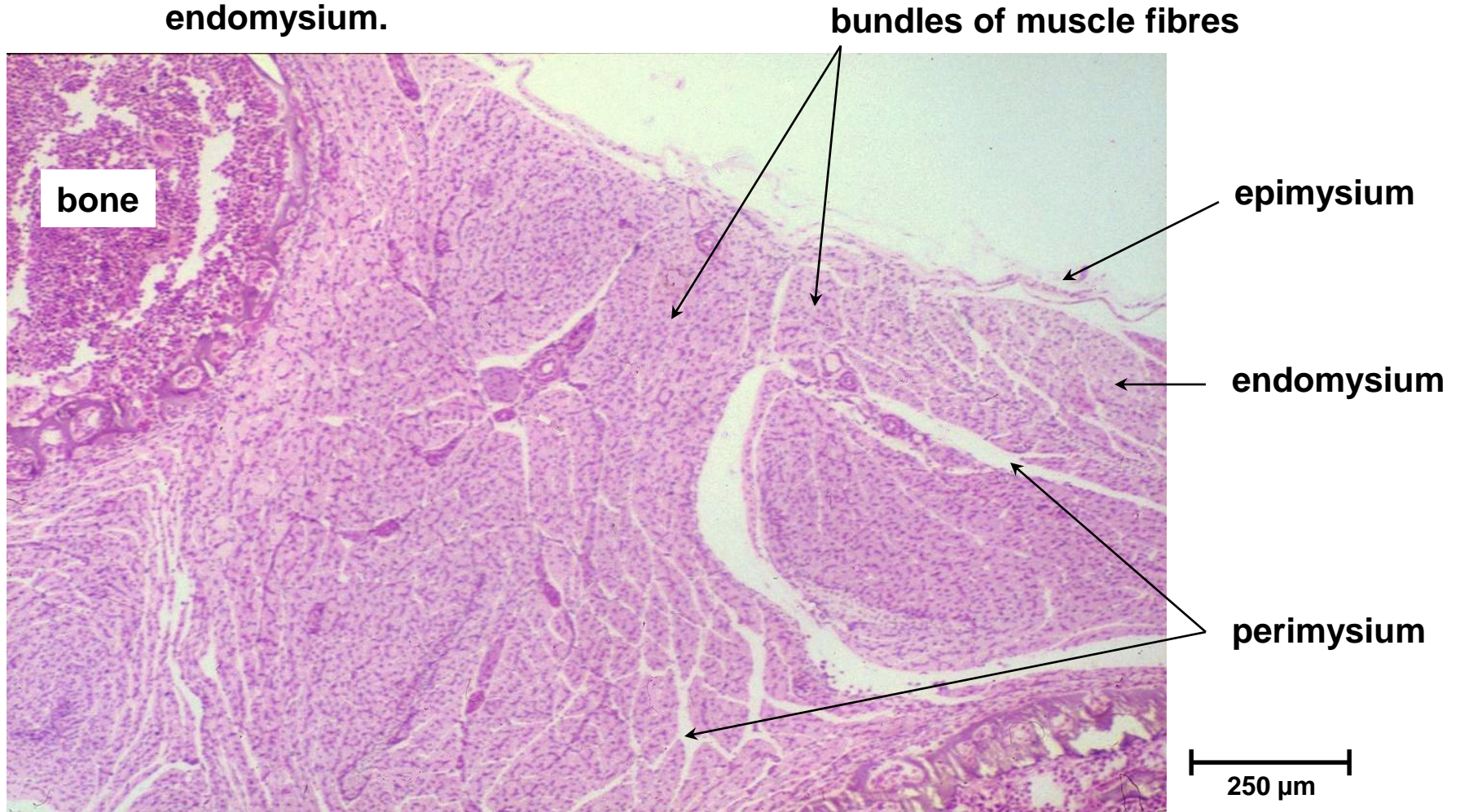
Striated skeletal muscle

Indicate : bundles of muscle fibres.

epimysium.

perimysium.

endomysium.



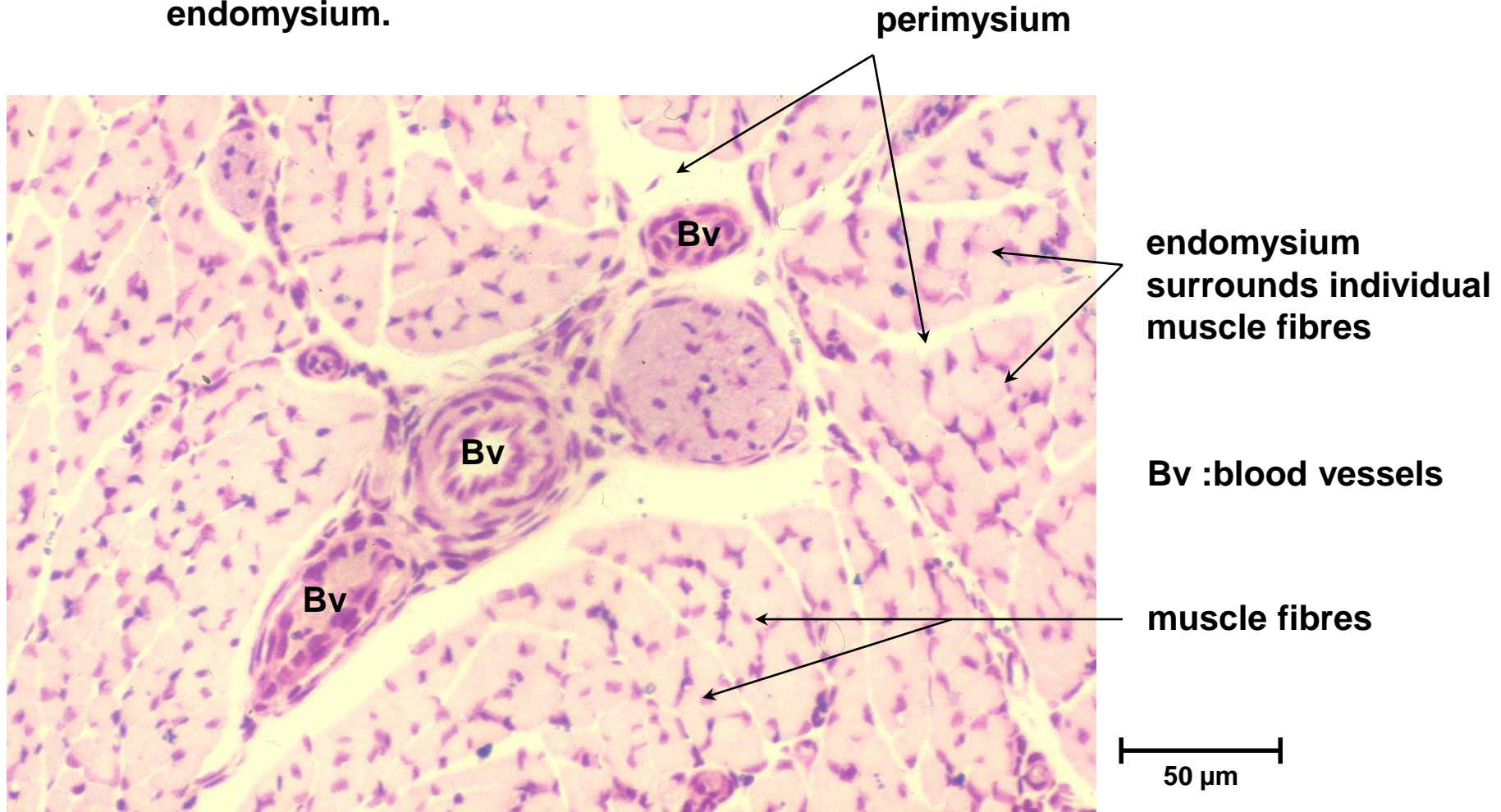
Striated skeletal muscle

Indicate : bundles of muscle fibres.

epimysium. Not visible on this section.

perimysium.

endomysium.

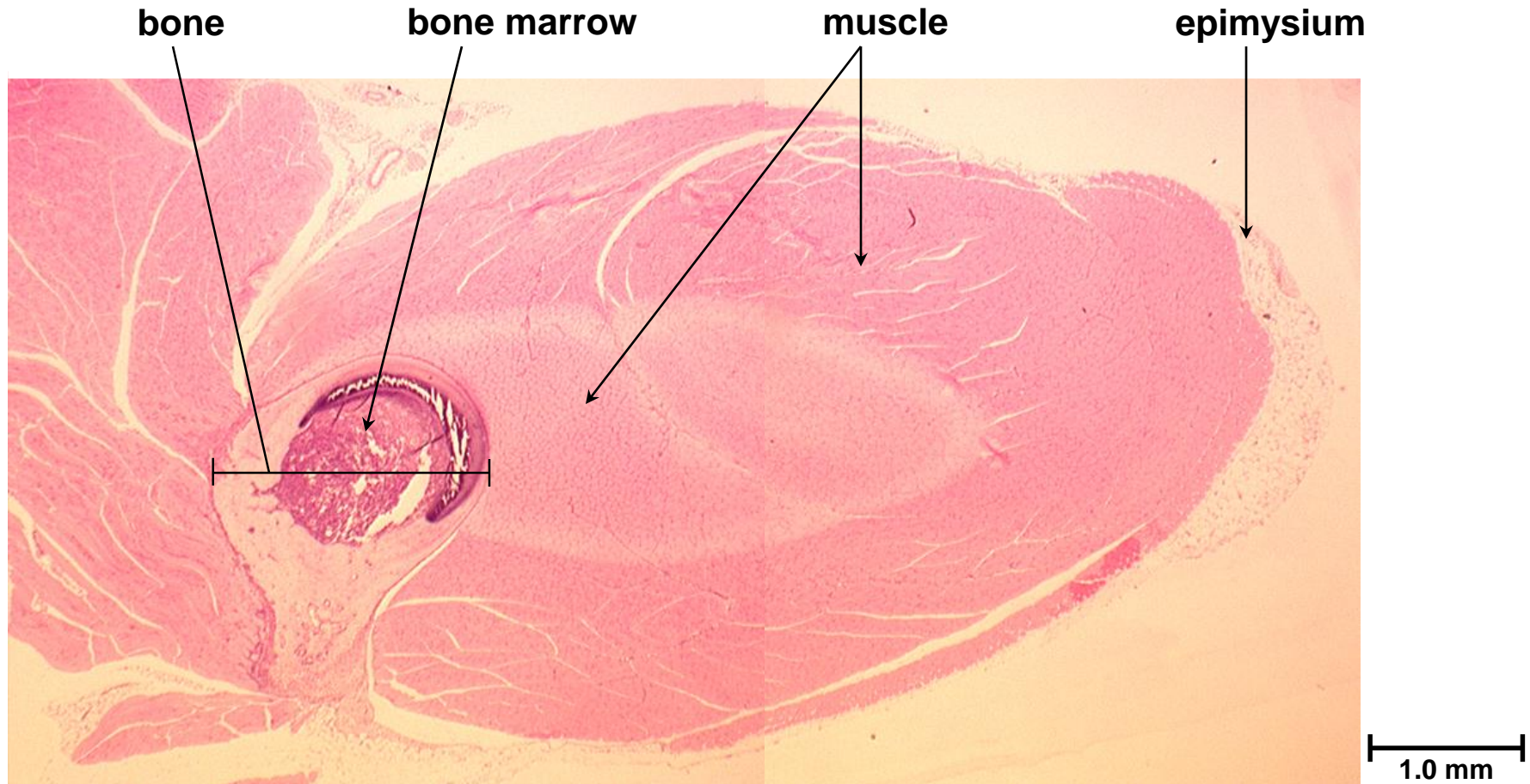


Striated skeletal muscle

This section is viewed at low magnification.

Distinguish between the muscle groups and the limb bone in the centre of the section.

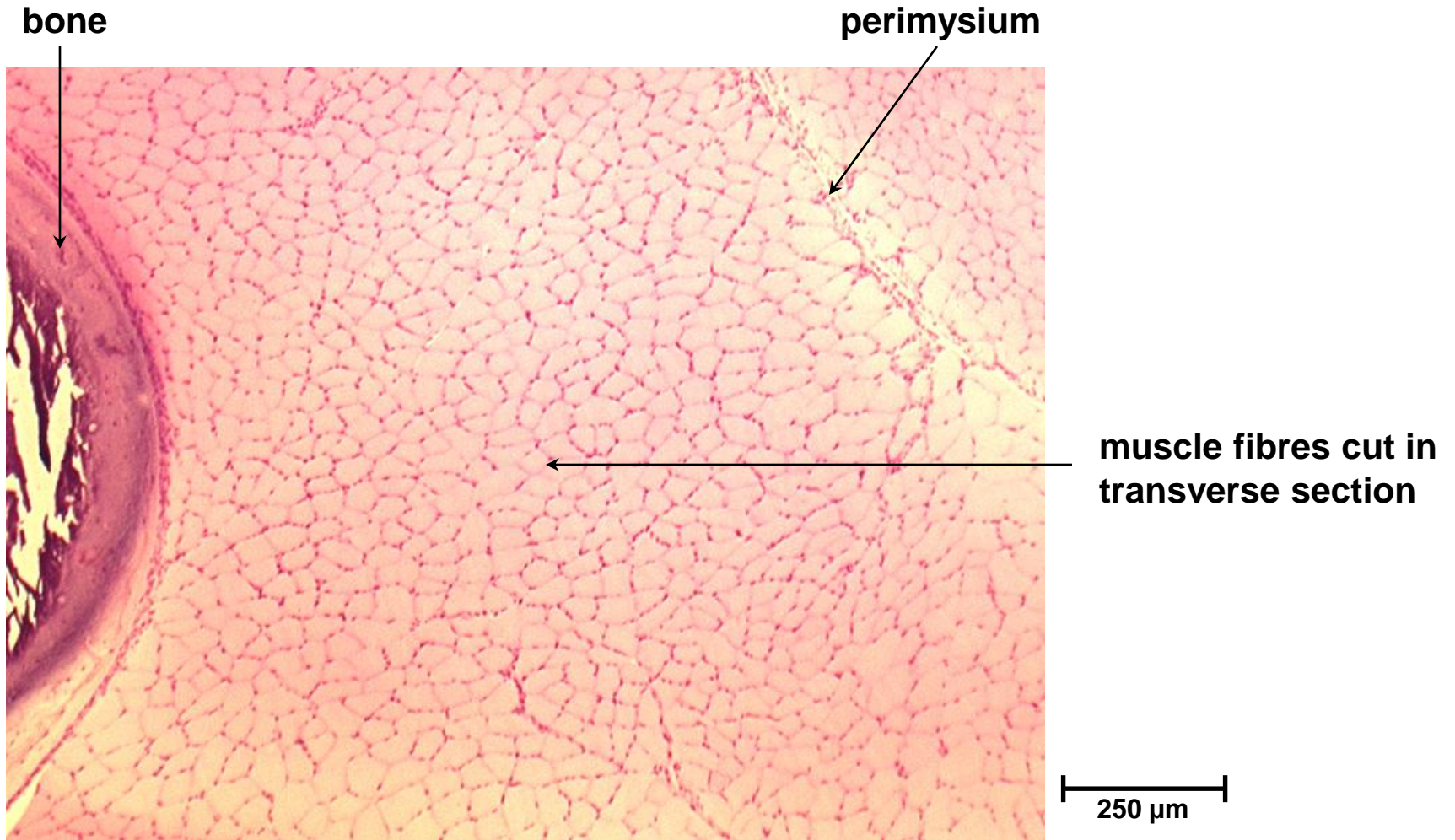
H&E stain.



Striated skeletal muscle

This section is viewed at high magnification.

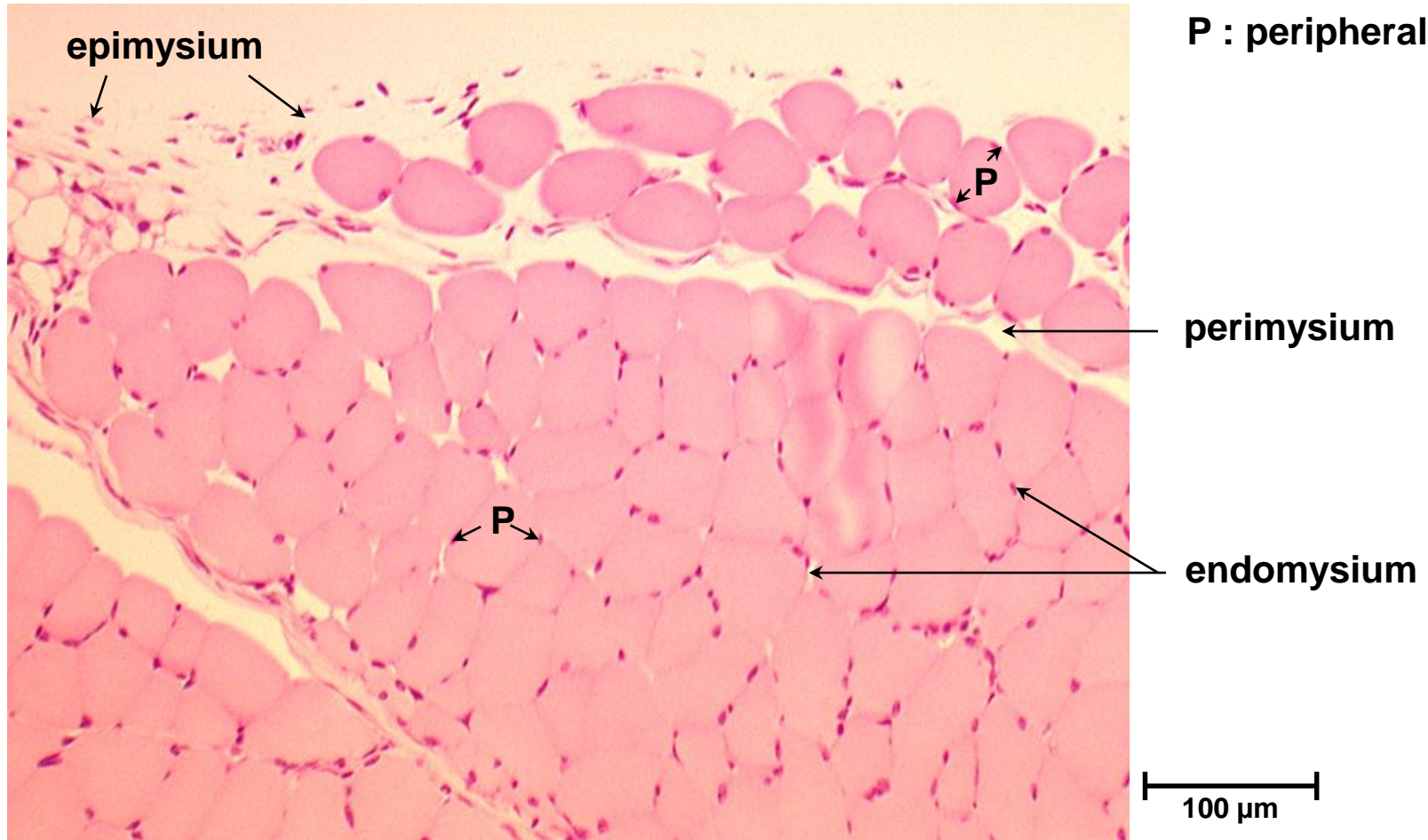
Find muscle fibres seen in a) transverse section.



Striated skeletal muscle

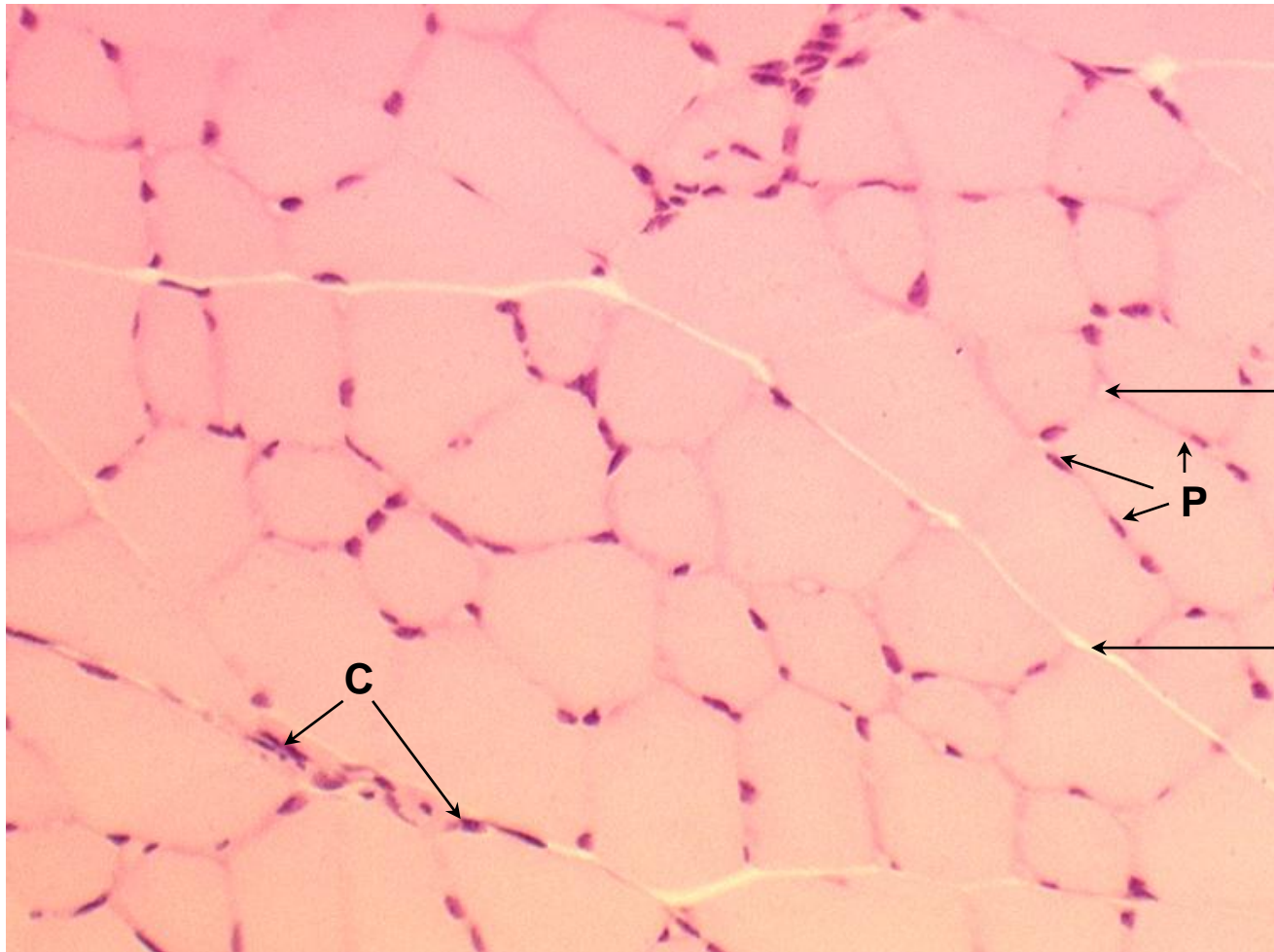
Transverse fibres in the outer regions of the muscle.

Note peripherally located nuclei and areas of epimysium perimysium and endomysium.



Striated skeletal muscle

Again identify the multinucleated muscle cells with peripherally located nuclei.
Some endothelial cell nuclei of capillaries can be seen between the fibres.



P : peripheral nuclei

C : capillaries

endomysium

perimysium

50 μ m

Striated skeletal muscle

High magnification, (using oil immersion lens) of an area cut in longitudinal section.
(H & E stain).

Peripheral nucleus visible, also cross striations.



Cross striations

← A bands



■ I band



← Z lines

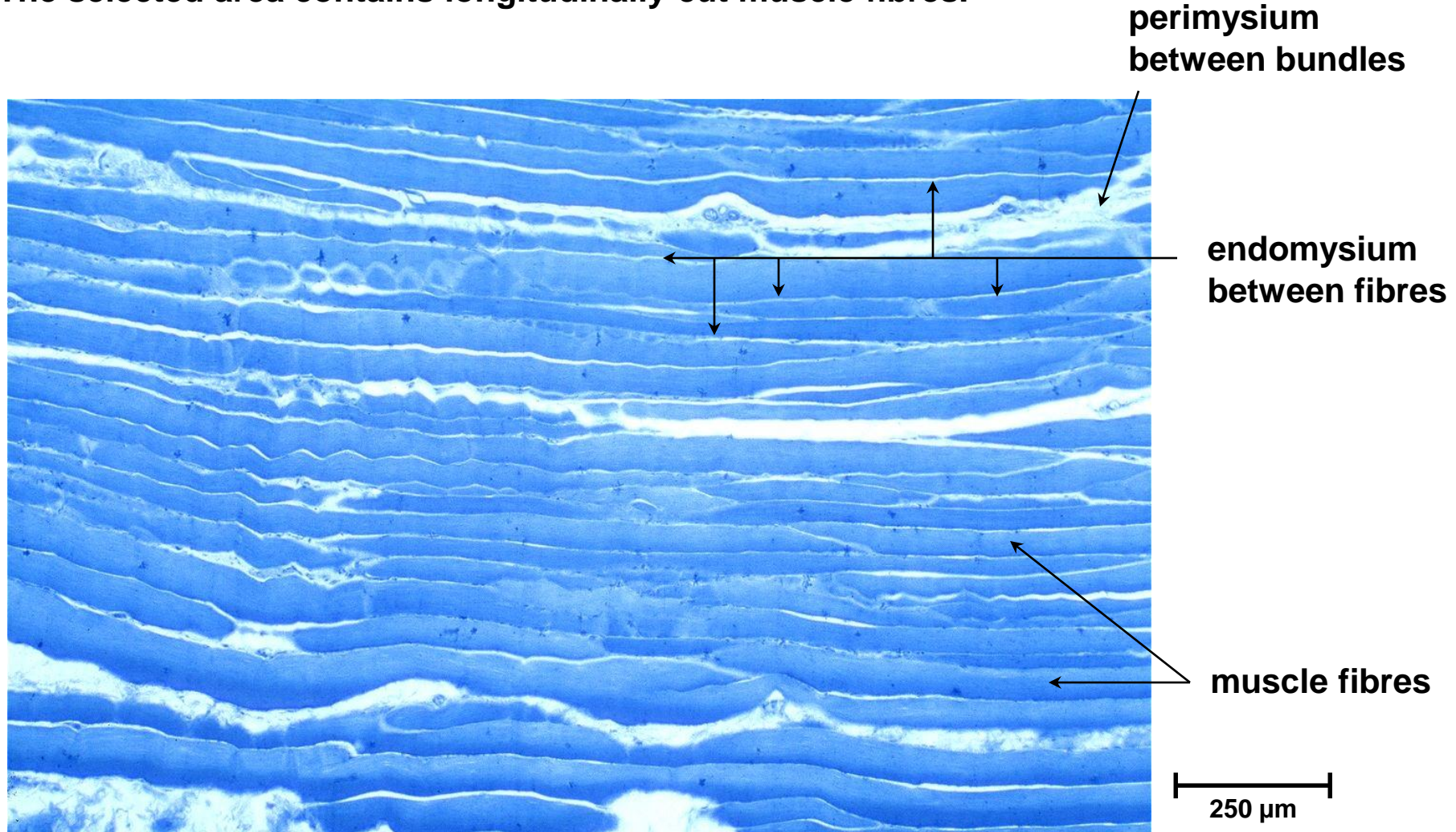


N : muscle cell nuclei

10 μ m

Striated skeletal muscle

This section has been stained with Heidenhain's Haematoxylin.
The selected area contains longitudinally cut muscle fibres.

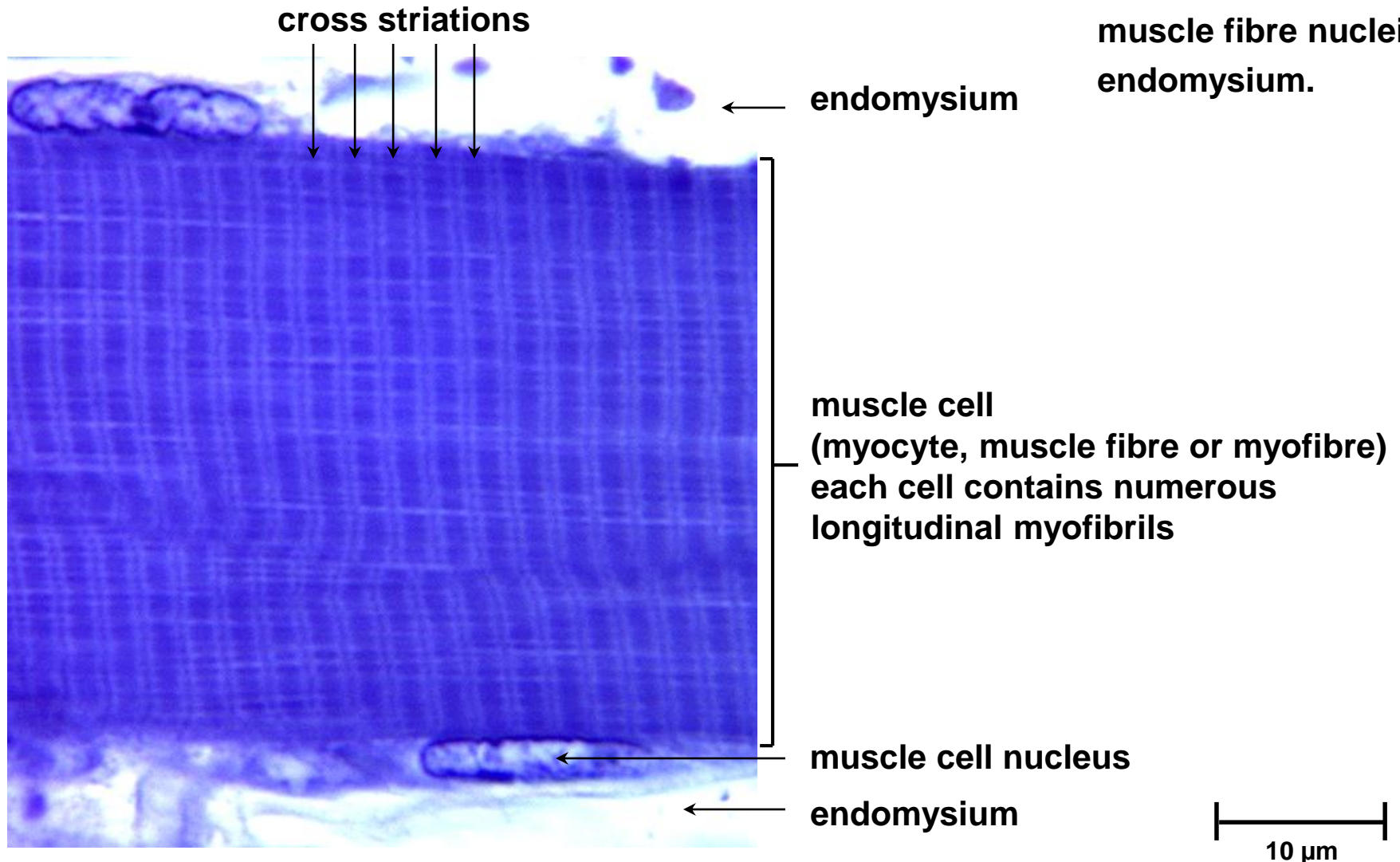


Striated skeletal muscle

Examining this area under high magnification.

Identify : myofibrils.

cross-striations.
muscle fibre nuclei.
endomysium.



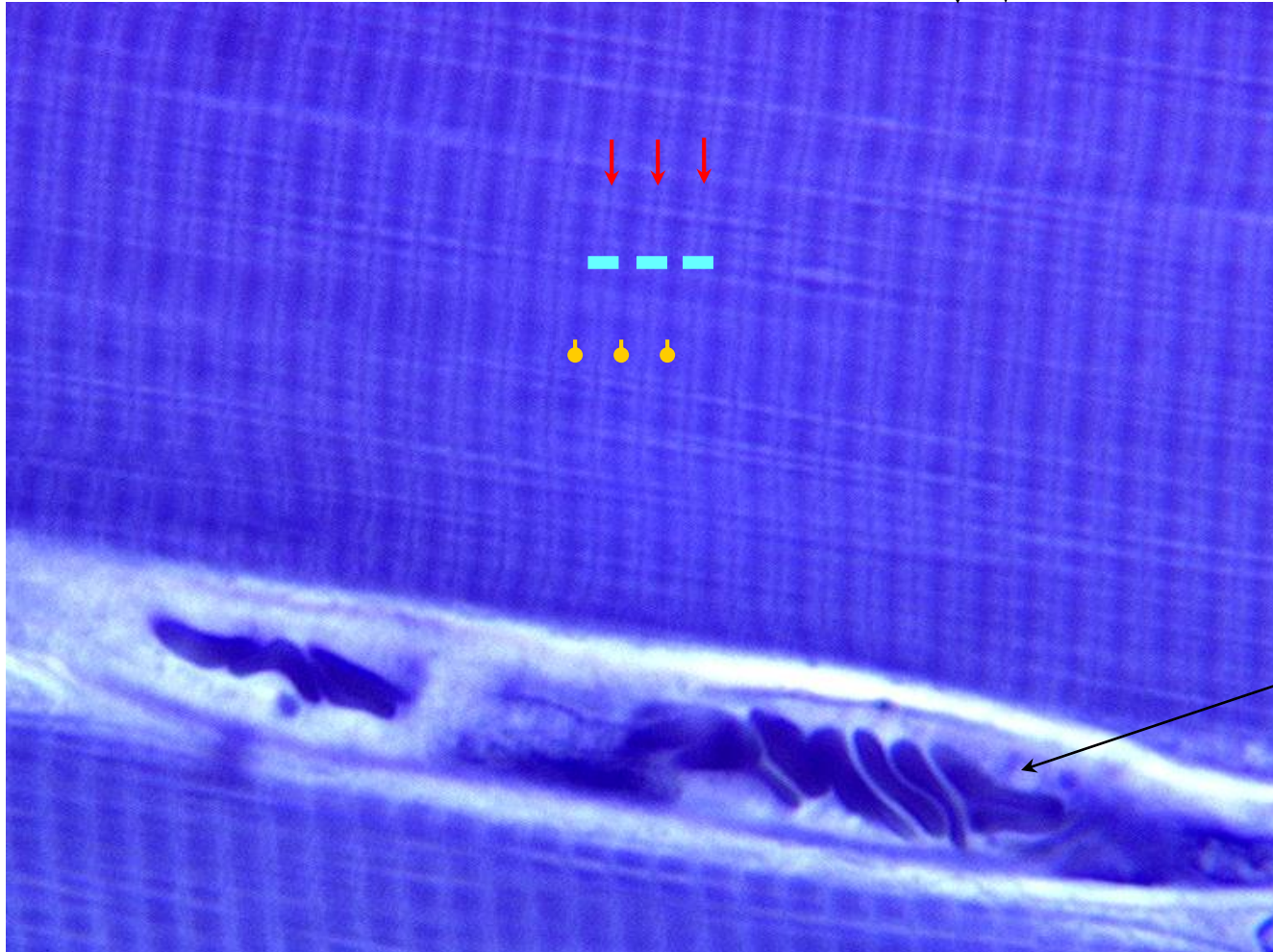
Striated skeletal muscle

Identify : A-bands. ●

I- bands. —

Z-lines ↓

sarcomere



capillary in the endomysium

10 μm

Striated skeletal muscle

What is the major protein found in the A- band?

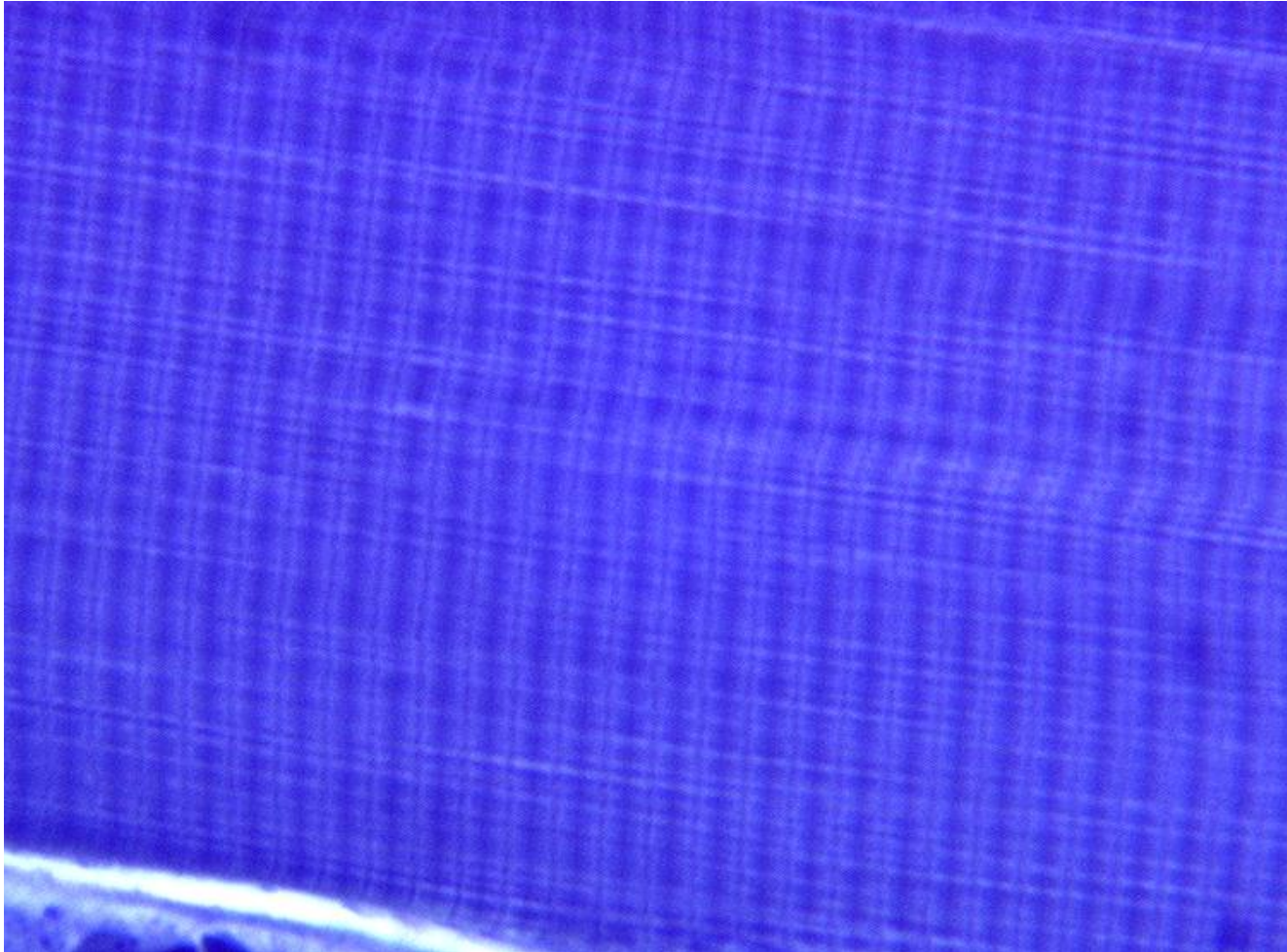
myosin.

What is the major protein found in the I –band?

actin.

What is the major protein found in the Z – line?

α -actinin.



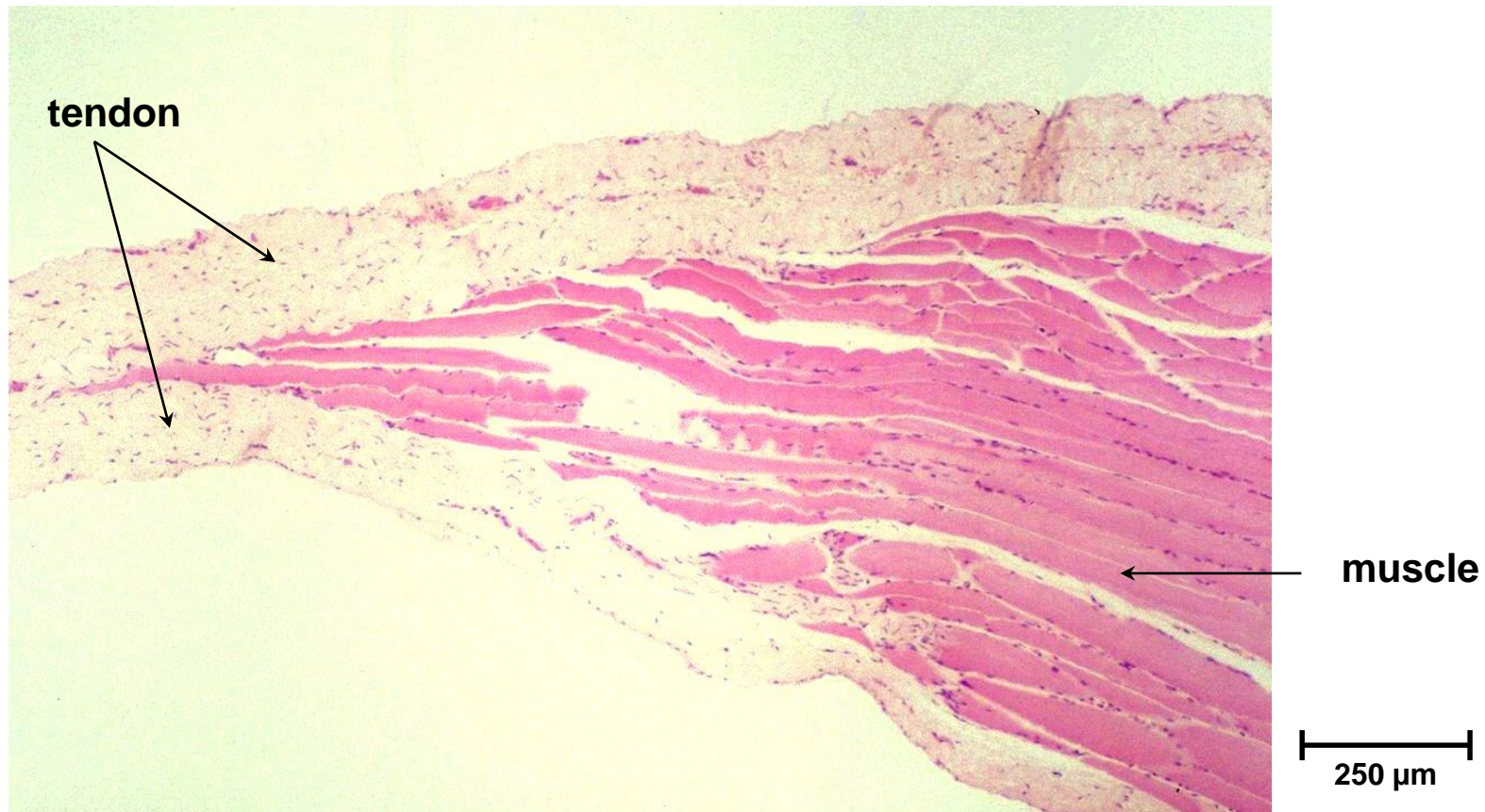
10 μ m

Striated skeletal muscle

Myotendon junction (diaphragm)

Section as seen under low magnification.

Note the tapering muscle and the continuity of the connective tissue sheath with the tendon.



Striated skeletal muscle

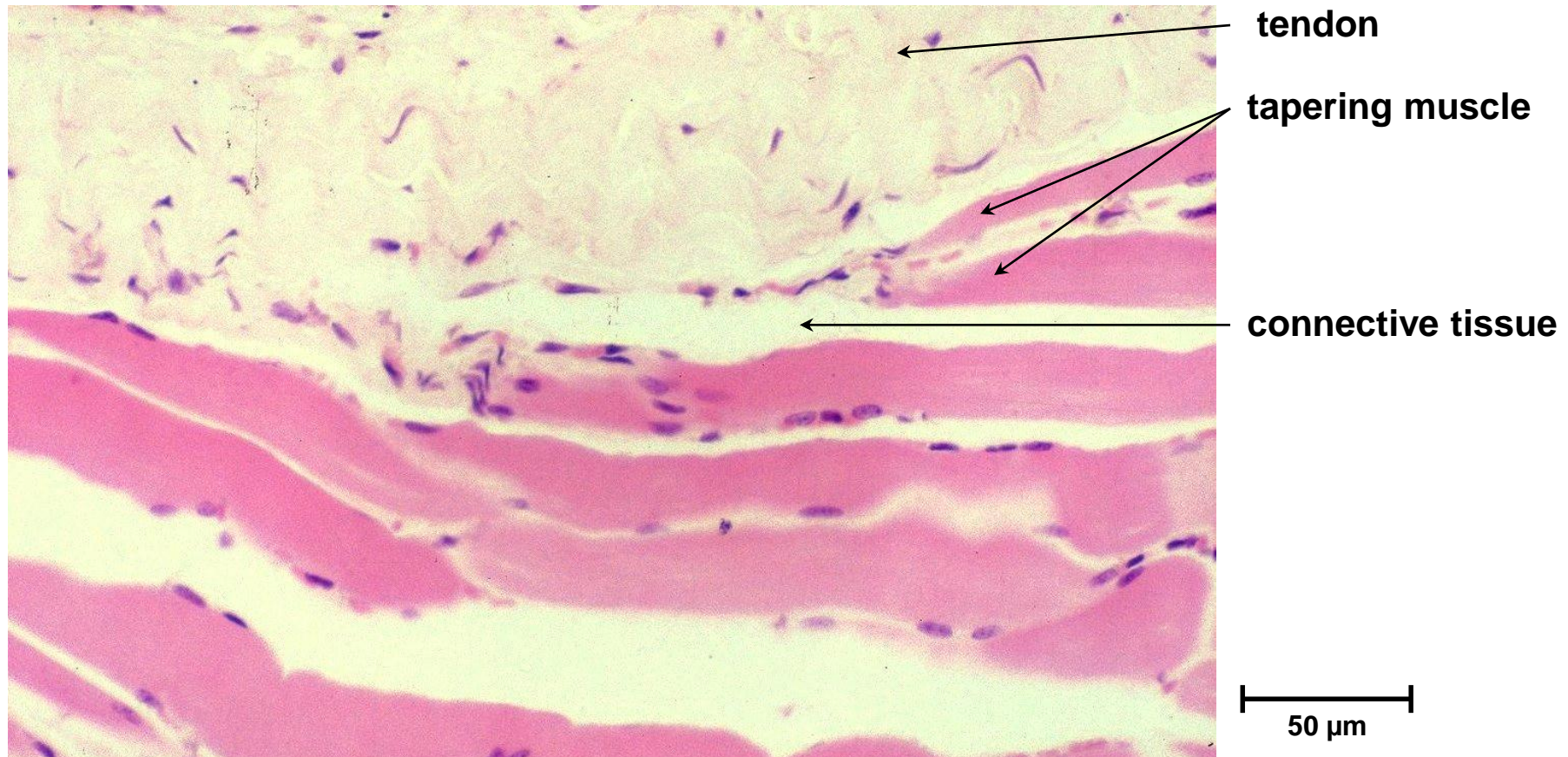
Myotendon junction (diaphragm)

What is the major protein found in the tendon matrix?

Collagen fibres. Collagen type I.

What cells produce this matrix?

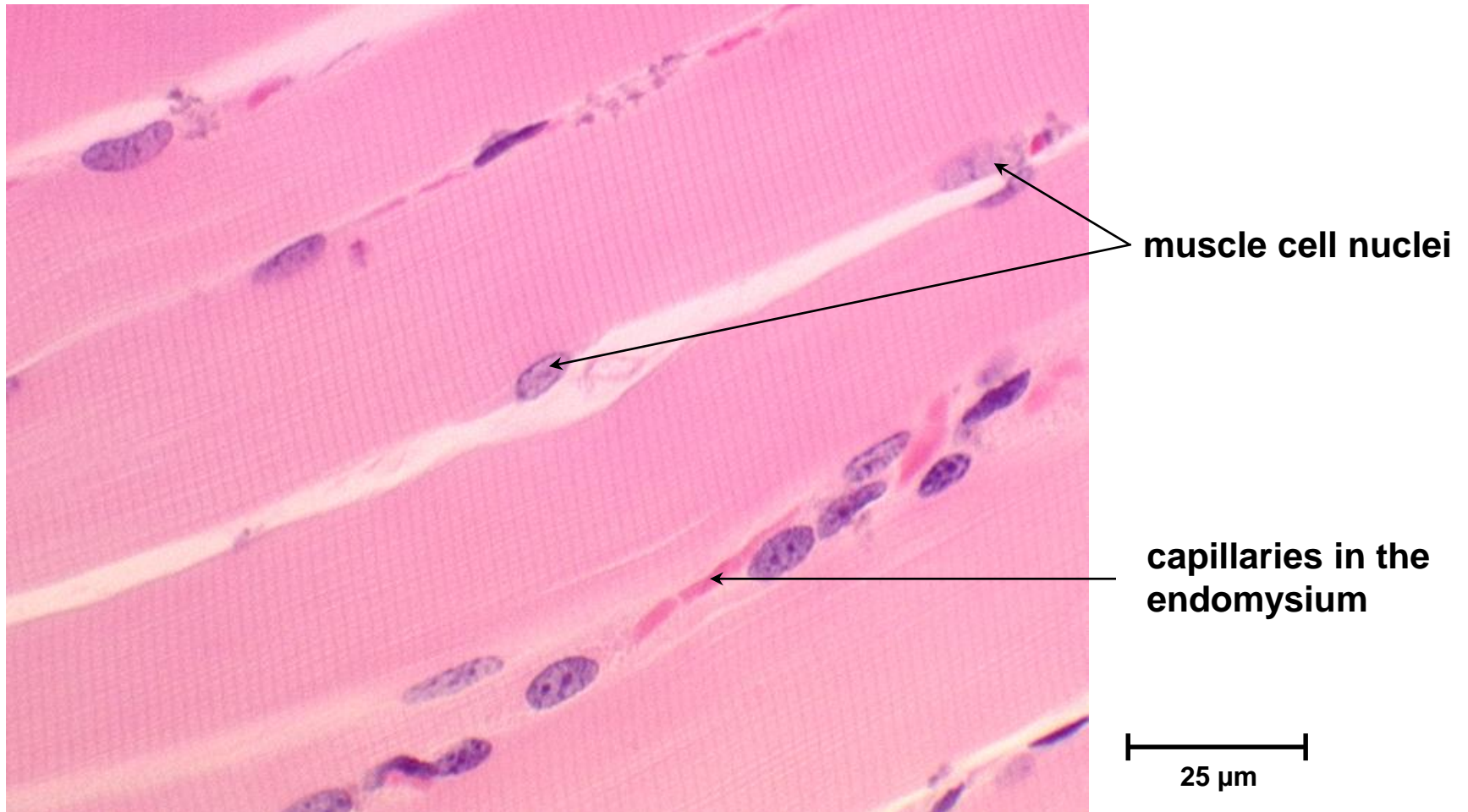
Fibroblasts.



Striated skeletal muscle

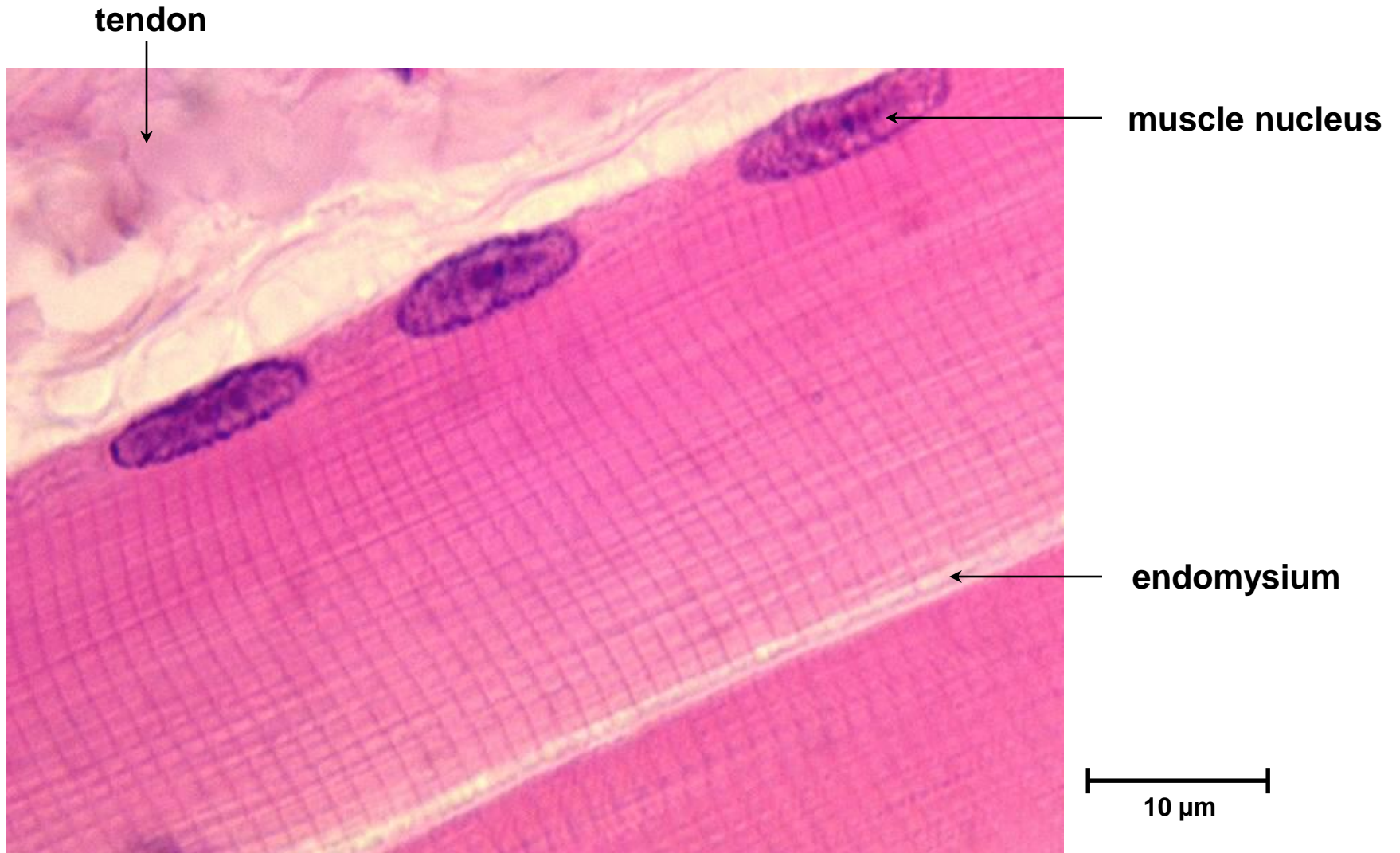
Myotendon junction (diaphragm)

Longitudinally cut muscle fibres close to the myotendon junction.



Striated skeletal muscle

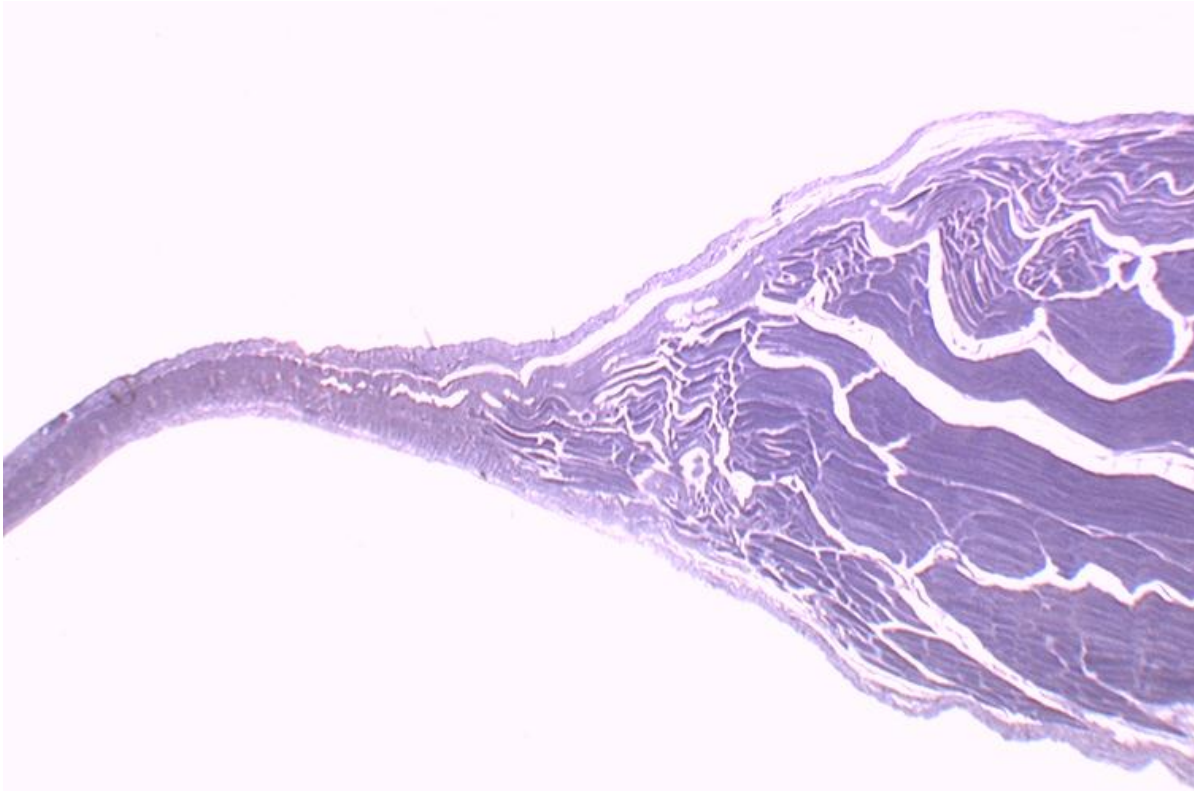
Myotendon junction (diaphragm)



Striated skeletal muscle

Myotendon junction (diaphragm)

This section has been stained blue-black to emphasise the cross-striations of the muscle fibres and the wavy bundles of collagen fibres within the tendon.

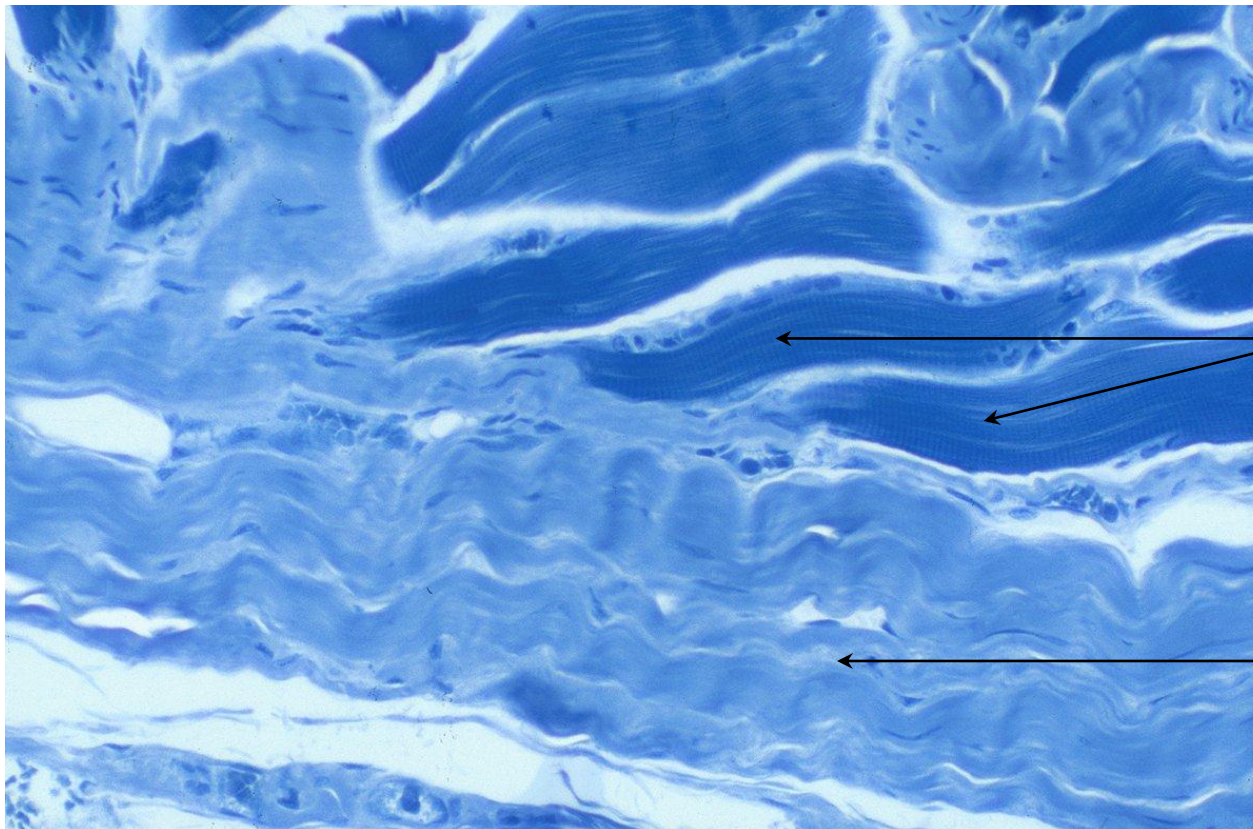


1.0 mm

Striated skeletal muscle

Myotendon junction (diaphragm)

The stain used is Heidenhain's haematoxylin.



tapering muscle fibres

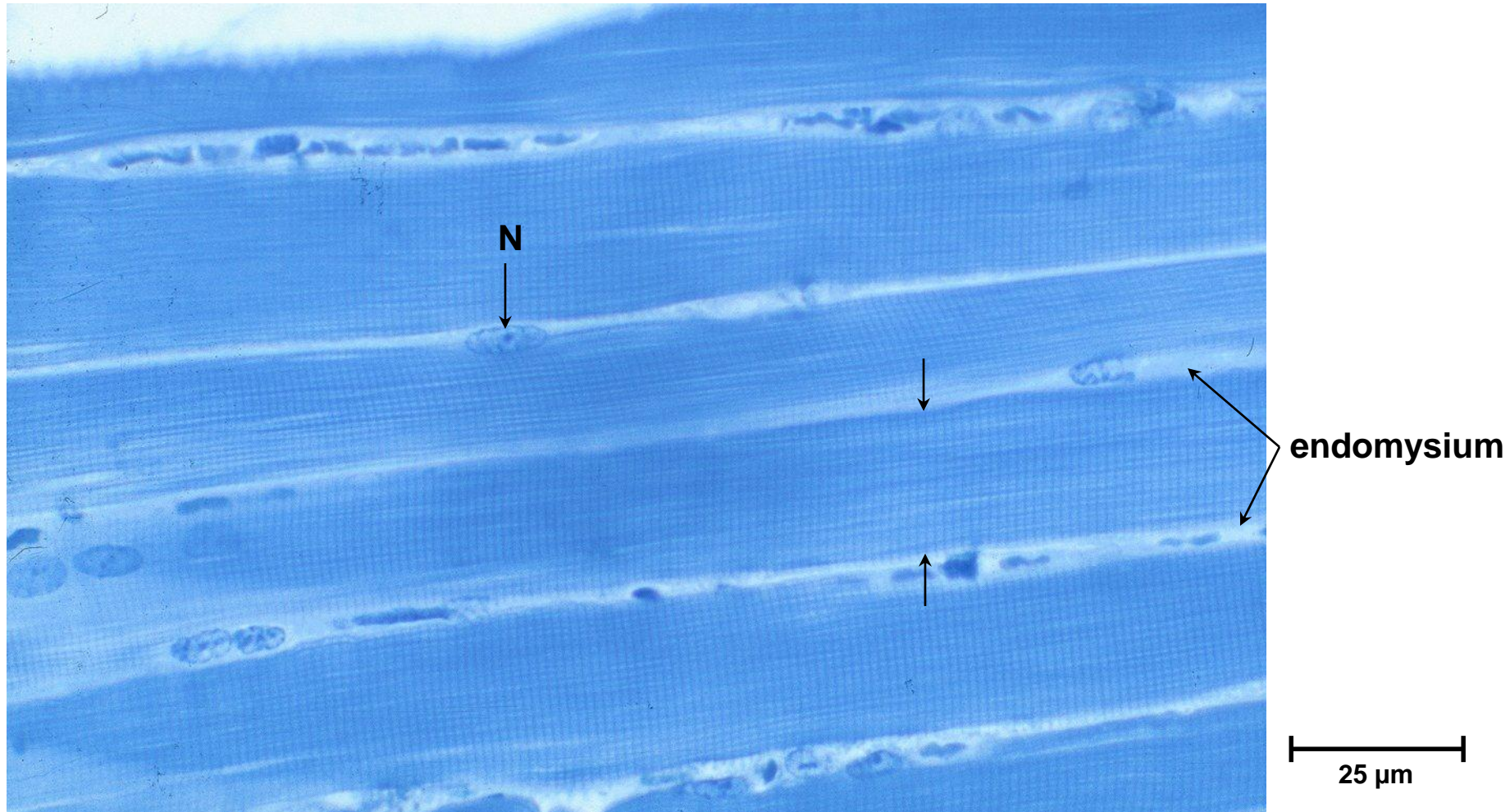
wavy collagen of tendon

50 μ m

Striated skeletal muscle

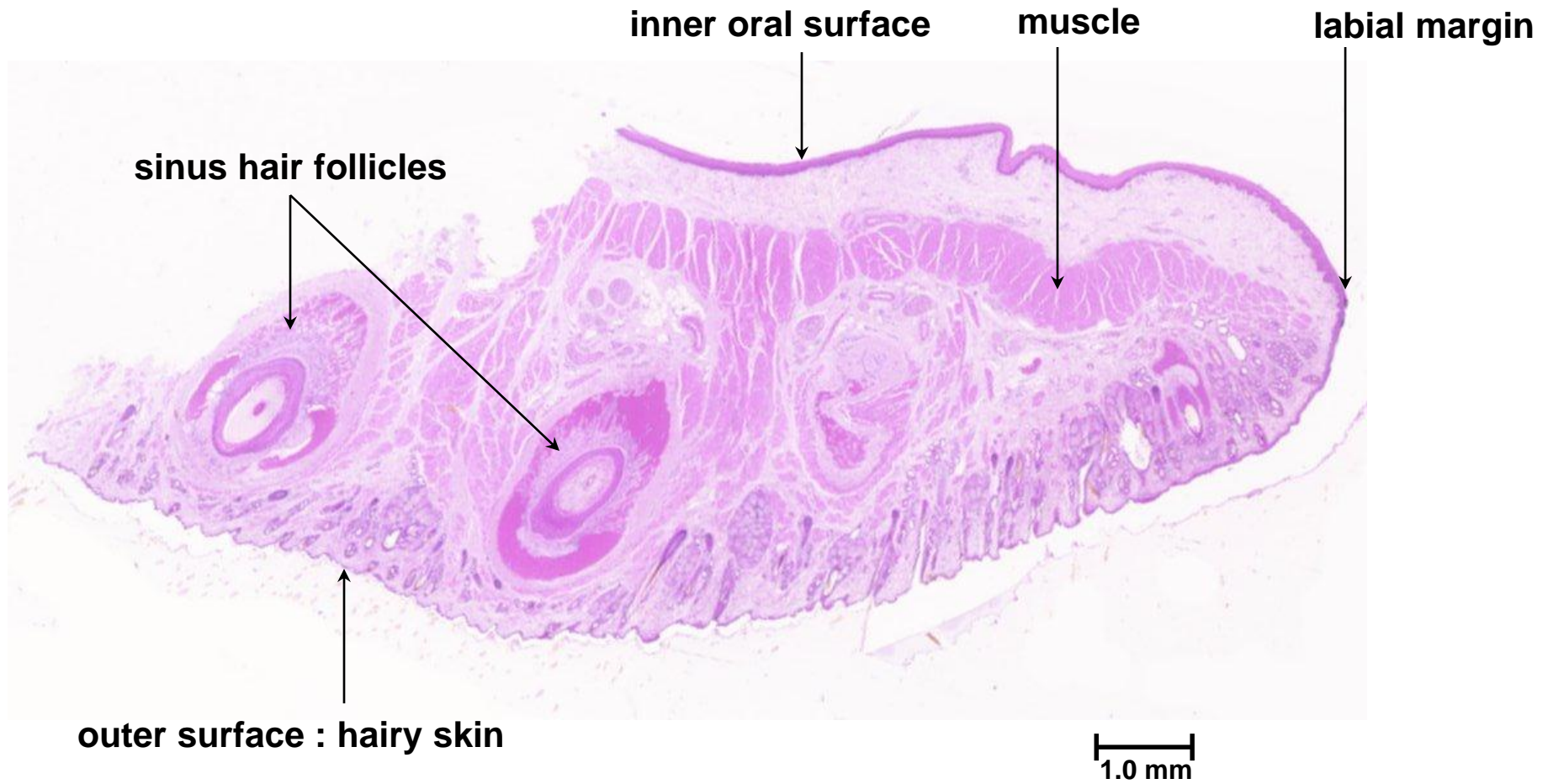
Myotendon junction (diaphragm)

Cross striations arrowed, N : muscle cell nucleus.



Lip (H&E stain)

Identify striated muscle fibres in this section.

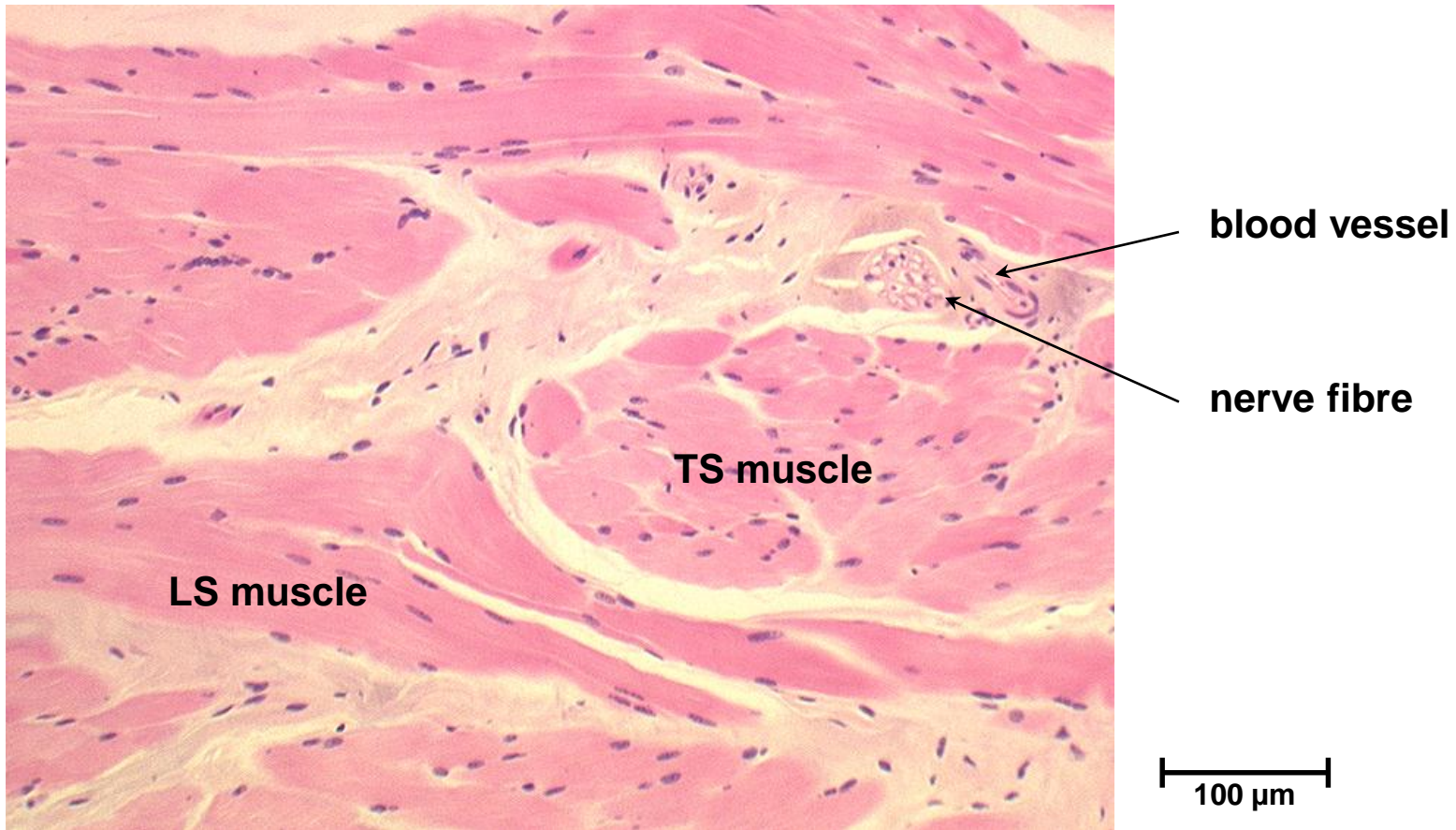


Lip

What feature(s) is/are most helpful in aiding your identification?

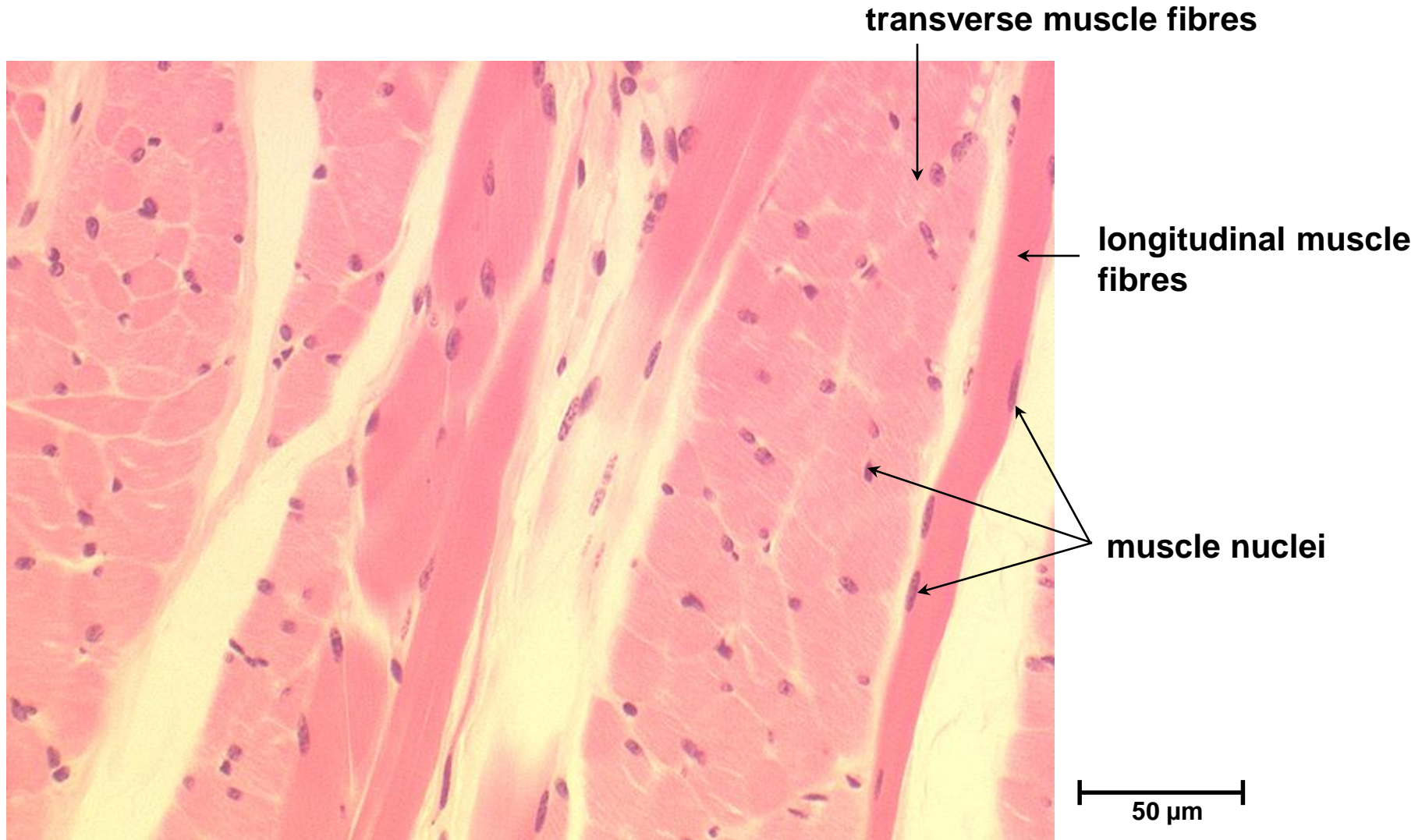
Peripheral nuclei.

Cross striations (when visible in good high magnification longitudinal sections).



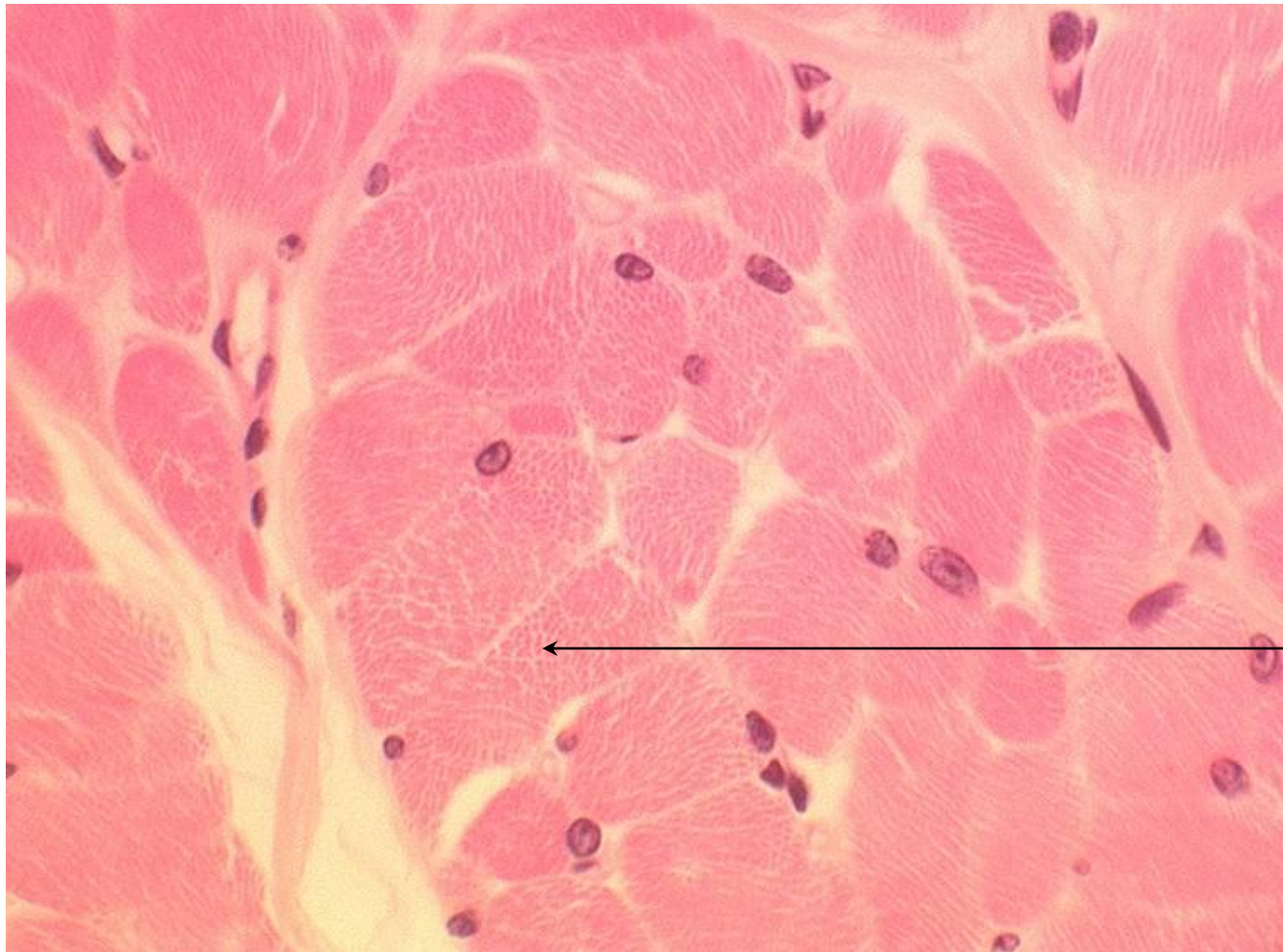
Lip

Identify striated muscle fibres in this section.



Lip

Transverse section from striated muscle of lip showing myofibrils.



myofibrils visible in
TS section of fibre

25 μ m

Tongue H&E stain

Transverse section whole of slide shown.



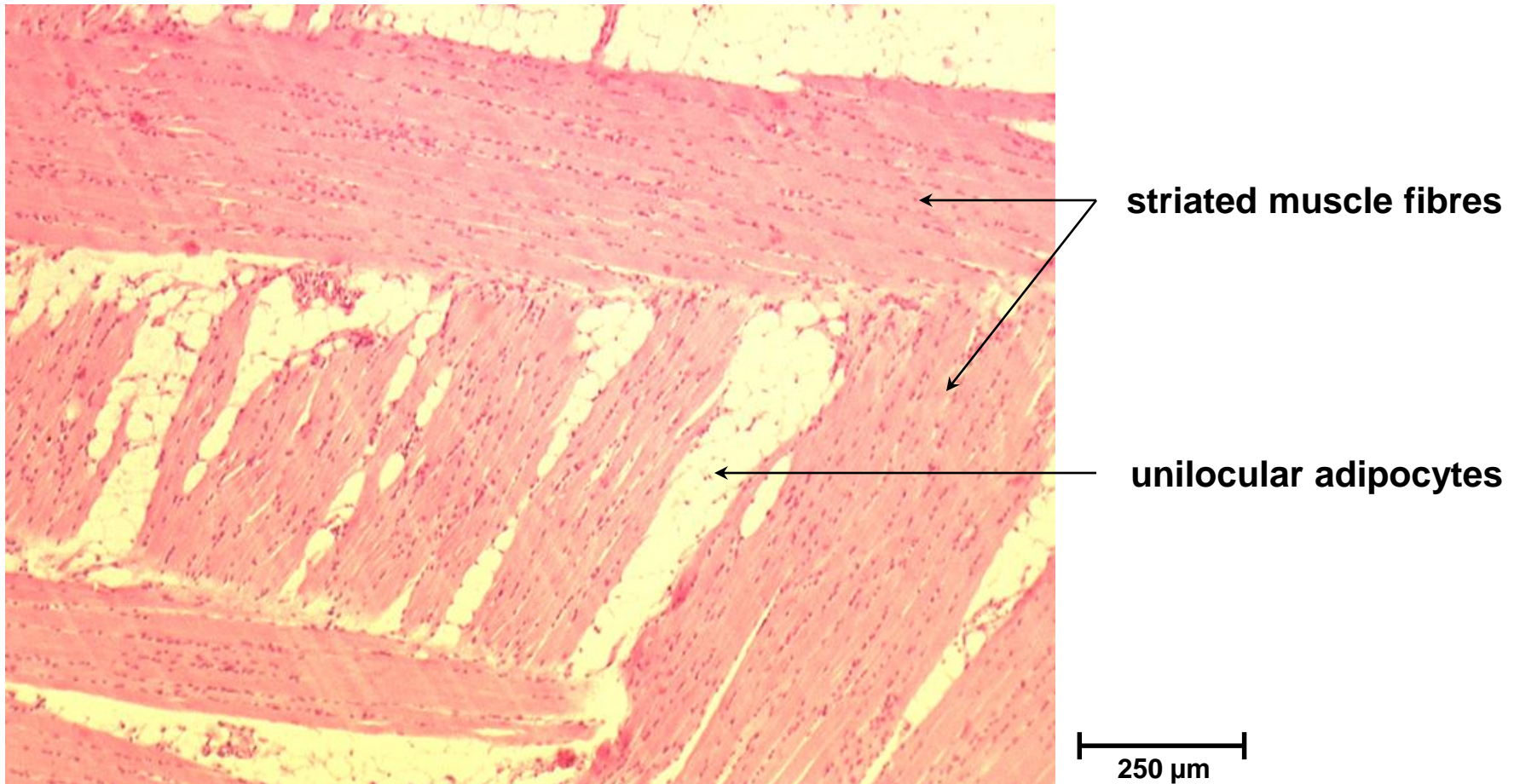
2.0 mm

Tongue

Identify striated muscle fibres in this section.

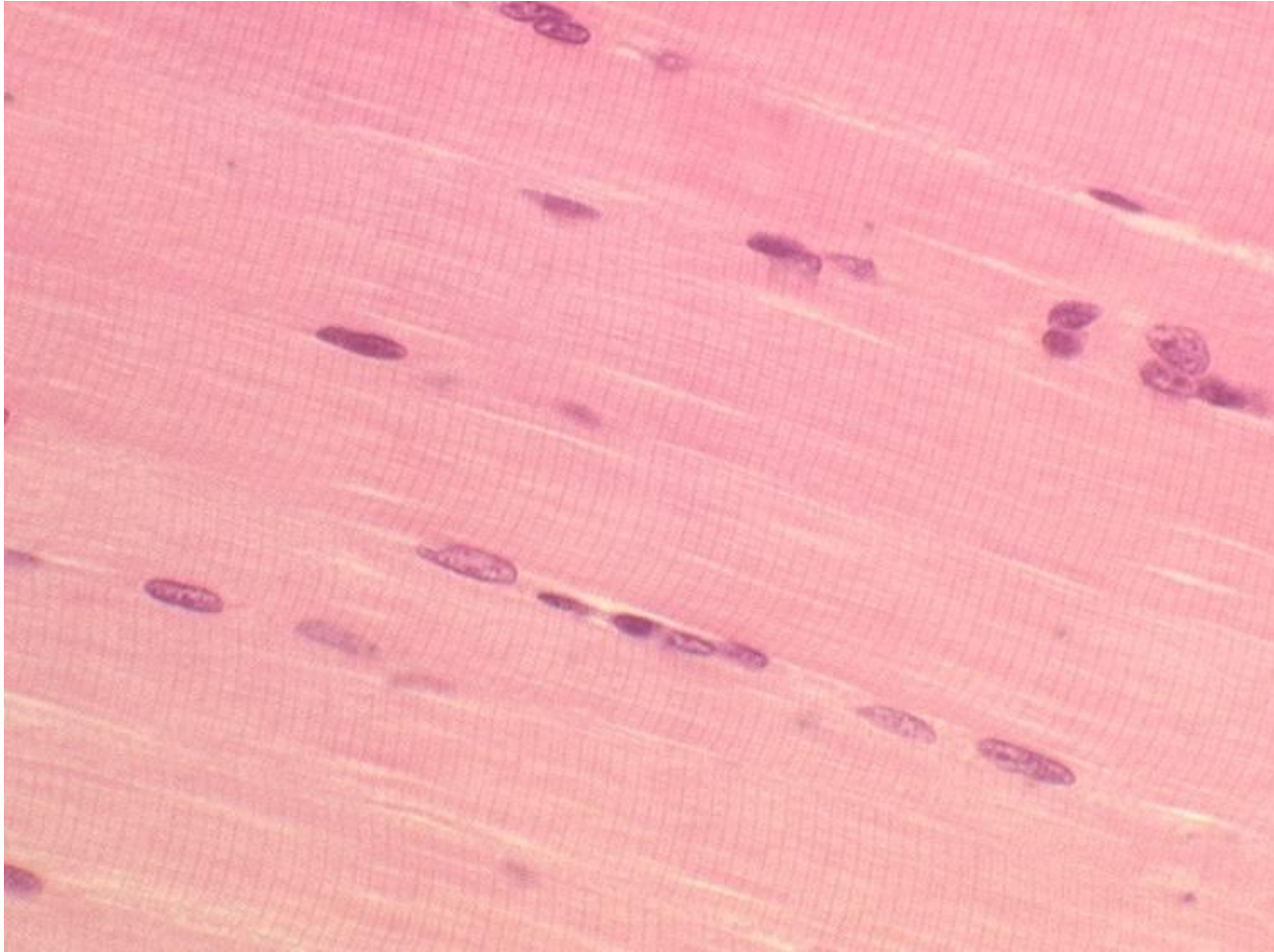
How would you describe the orientation of the various fibre bundles?

Fibre bundles running in many directions, often orthogonal (right angles) to each other.



Tongue

Cross striations and peripheral nuclei visible in this higher magnification view of the tongue.



25 μ m

Oesophagus

Does this muscle layer extend throughout the length of this organ in the dog?

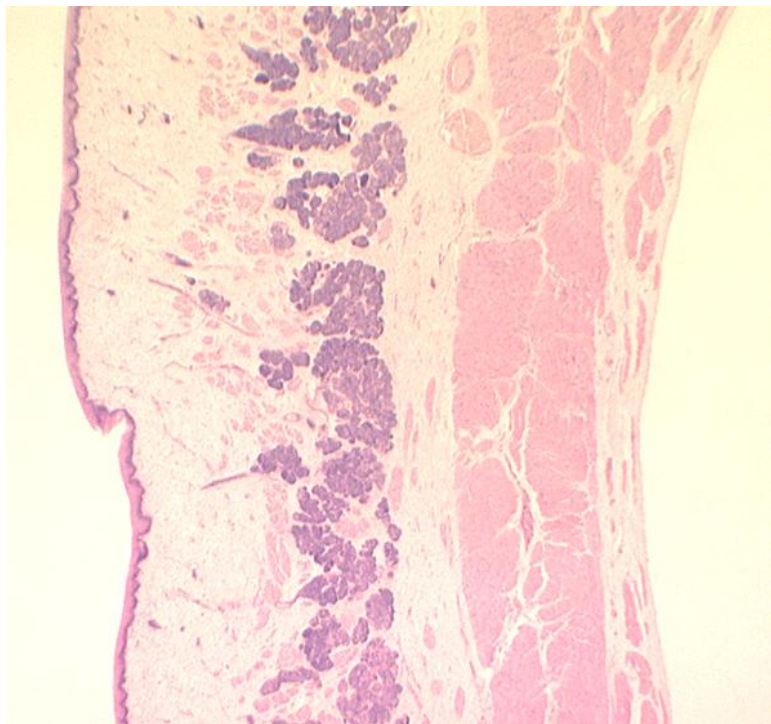
Yes : In dogs and ruminants it extends for the entire length.

How about in the cat?

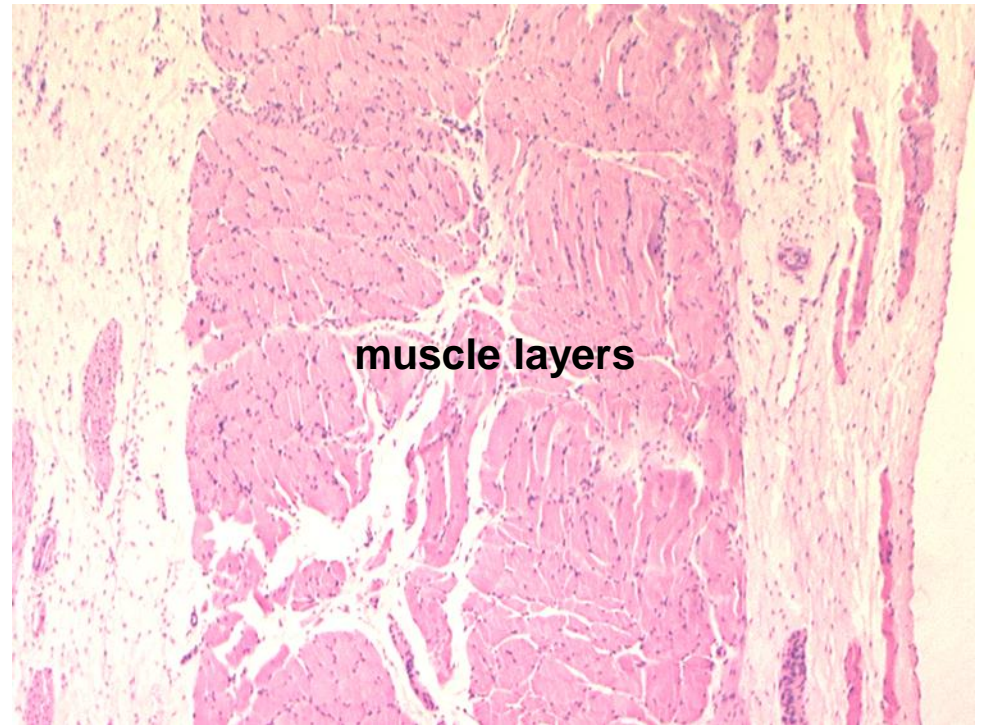
No : In the cat striated muscle is found in the cranial four fifths.

(In horses and pigs it extends for the cranial two thirds).

(In humans it extends for the cranial one third).



1.0 mm

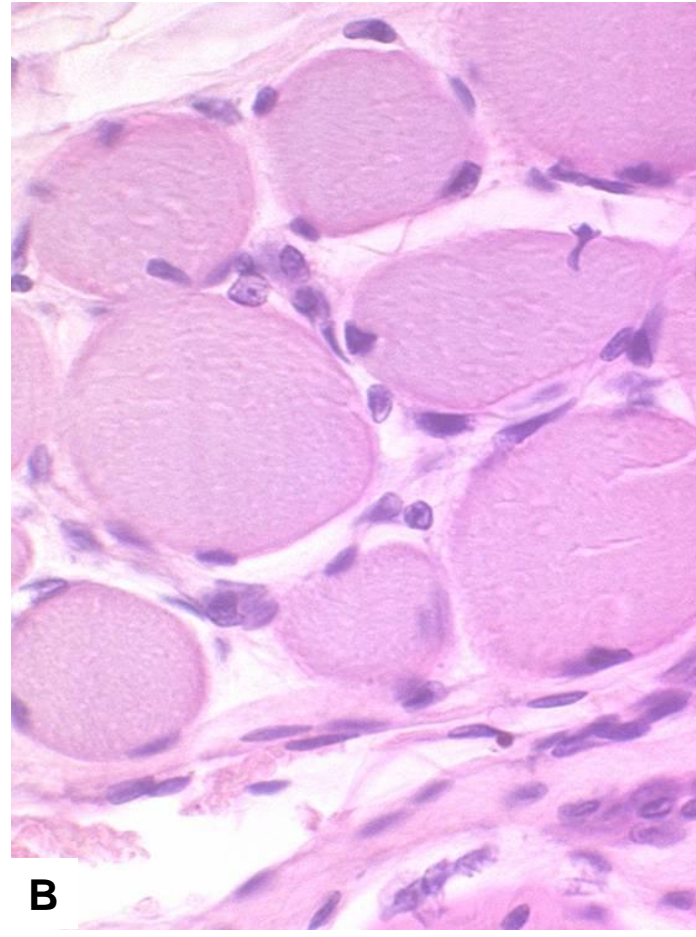
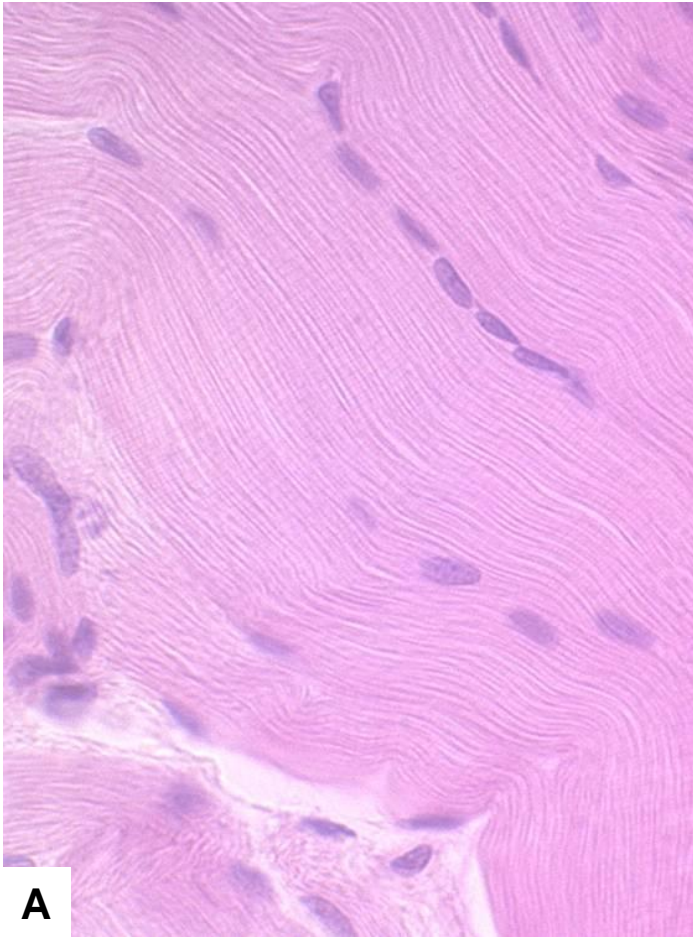


muscle layers

250 μm

Oesophagus

The striated muscle in the oesophagus is found in the tunica muscularis.
It forms an outer longitudinal layer : Picture A.
and an inner circular layer : Picture B.



25 μ m

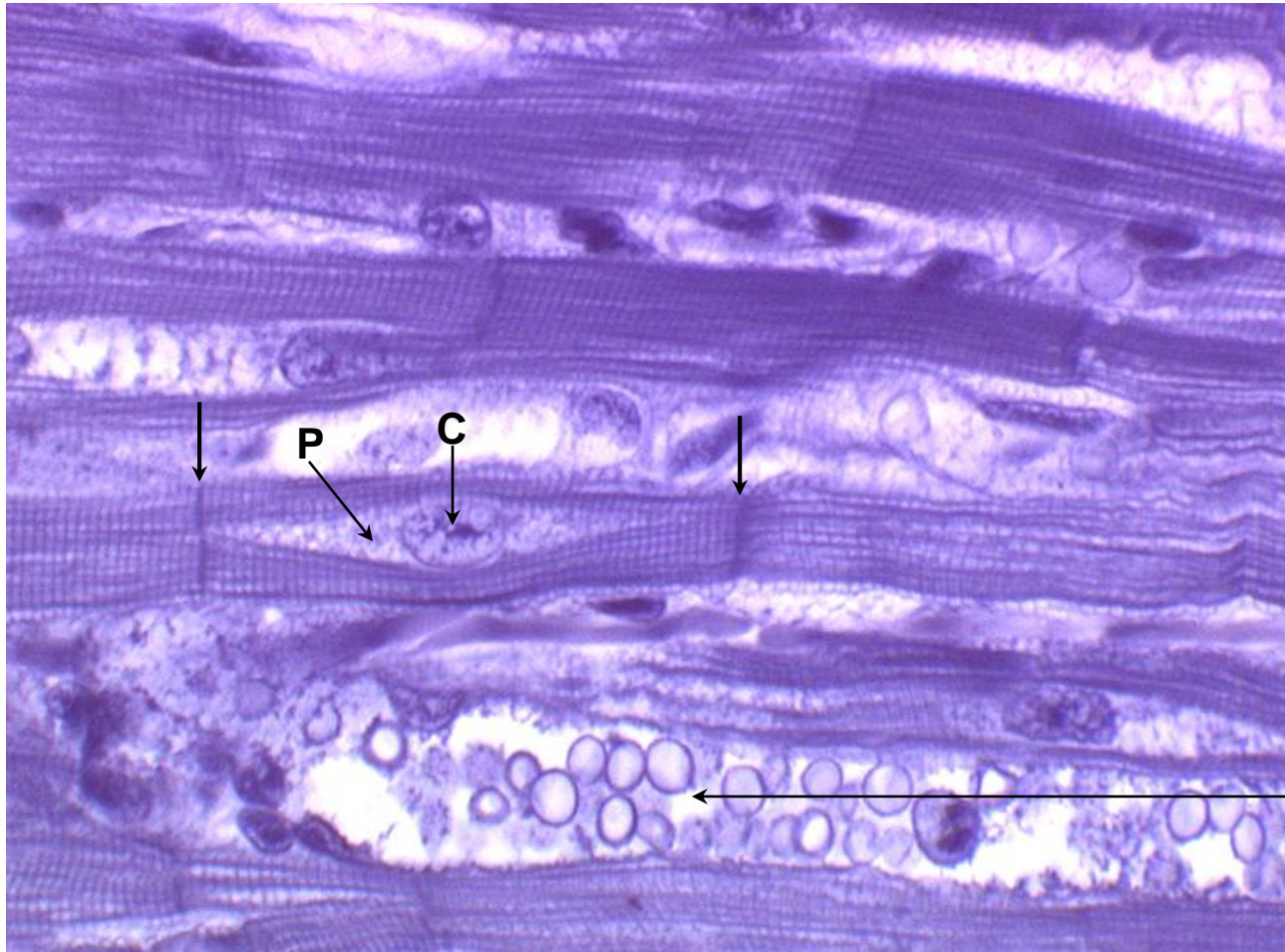
Striated cardiac muscle

In longitudinal section identify key features characteristic of cardiac muscle.

Intercalated discs.

Central nuclei.

Peri-nuclear cytoplasm free of striations.



intercalated discs
arrowed

C : central nucleus

P : perinuclear space

capillary

25 μ m

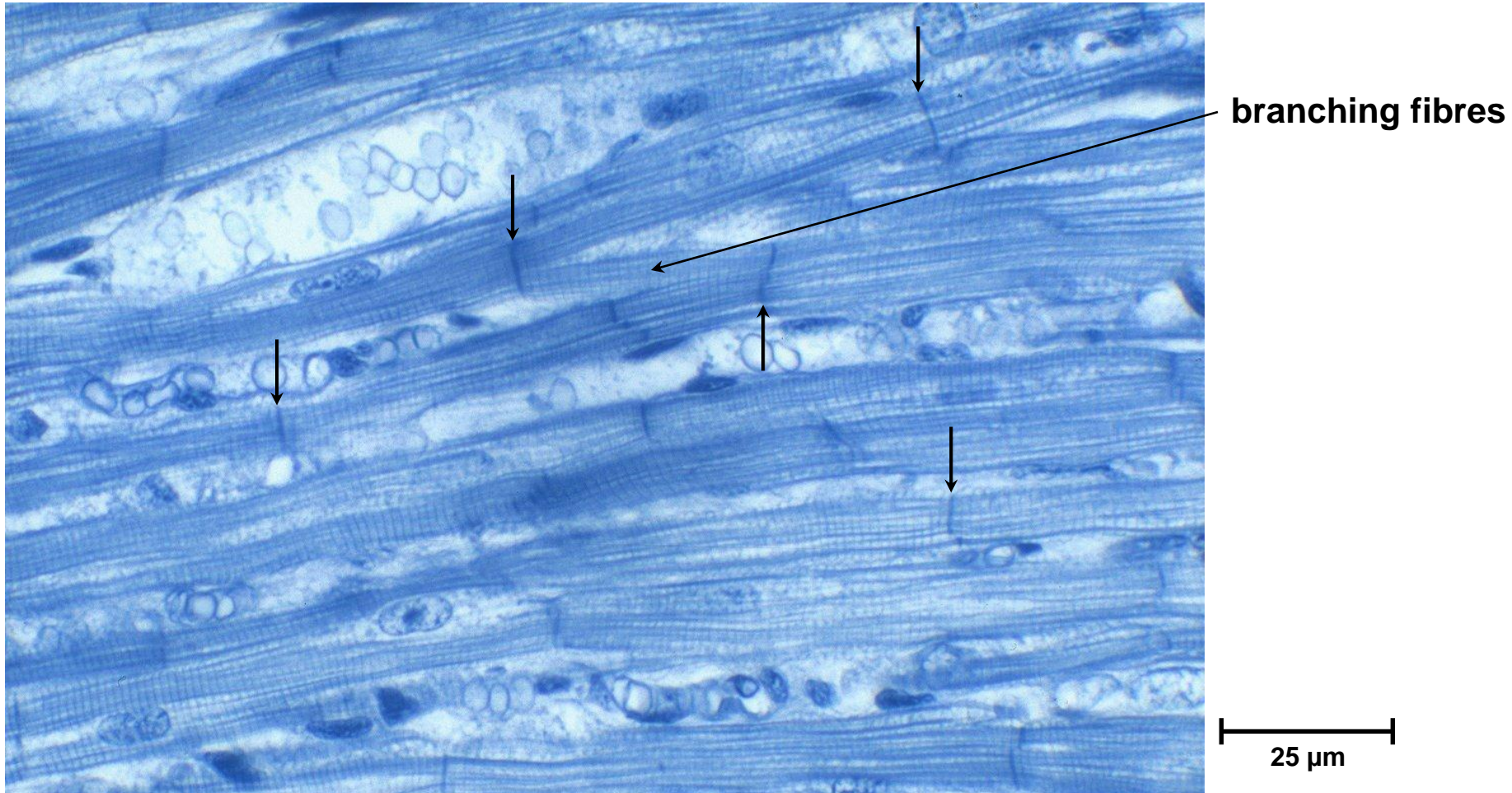
Striated cardiac muscle

In longitudinal section identify key features characteristic of cardiac muscle.

Intercalated discs.

Branching fibres.

intercalated discs arrowed



Striated cardiac muscle

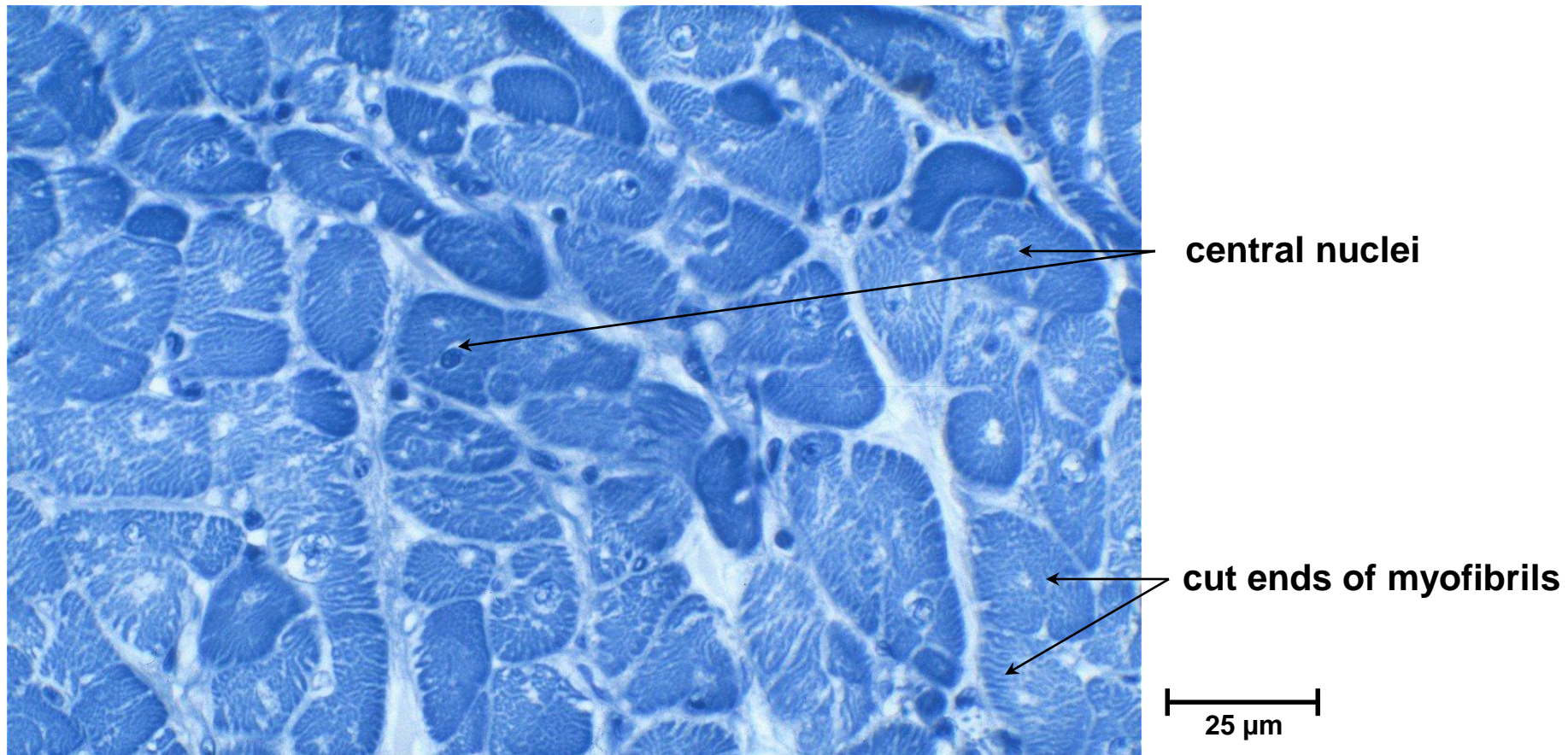
Locate muscle fibres cut transversely.

Identify their nuclei.

Identify cut ends of myofibrils.

Cardiac muscle fibres are unicellular - True or False?

False : rows of cells joined by intercalated discs, fibres branch.

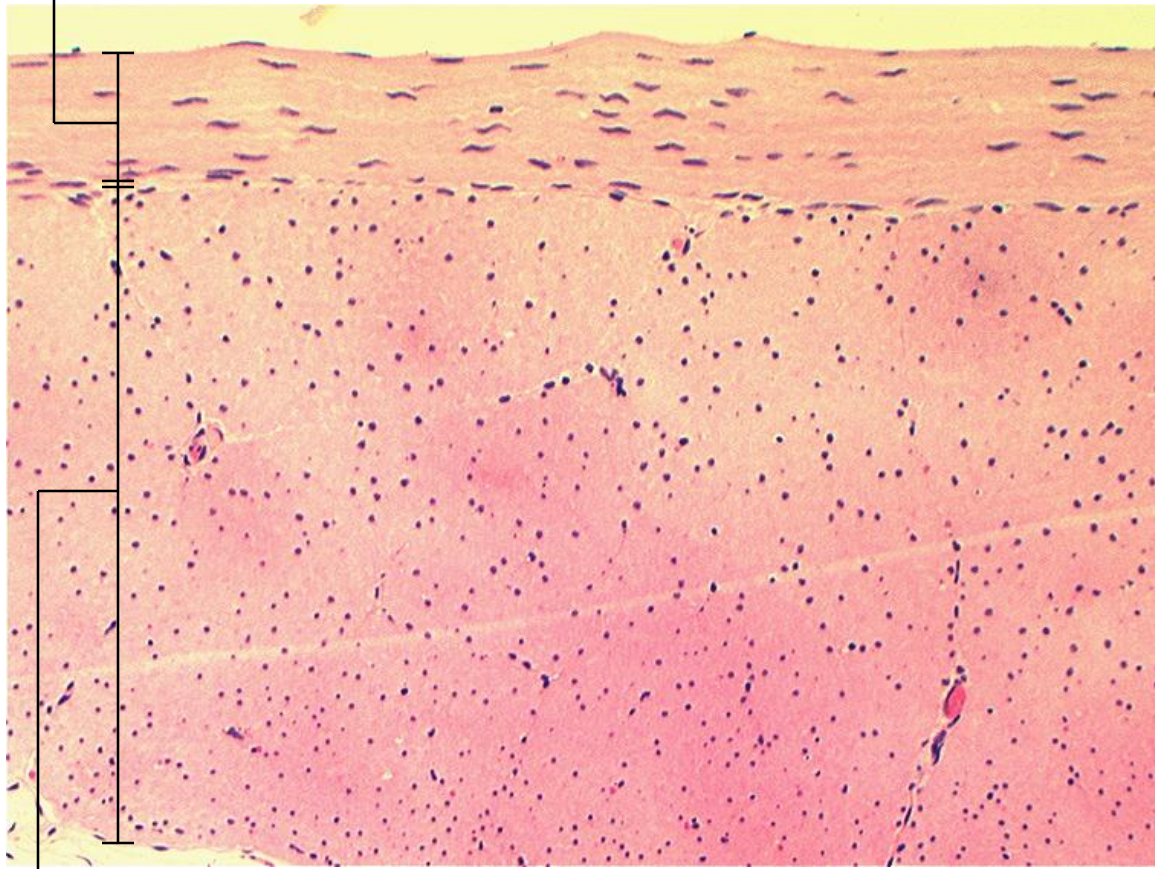


Smooth muscle duodenum

Longitudinal section through the duodenal wall.

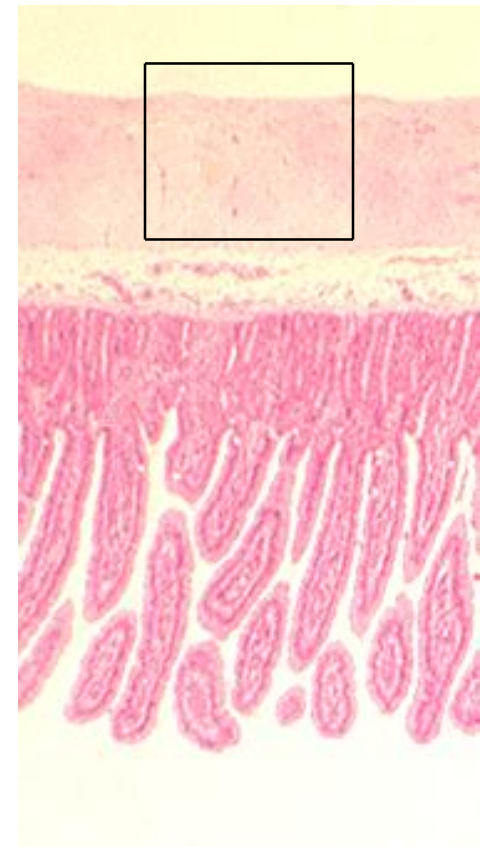
Identify smooth muscle cells, seen in transverse and longitudinal section, from the outer wall of the duodenum.

outer longitudinal muscle layer



inner circular muscle layer
seen in transverse section

100 μ m



1.0 mm

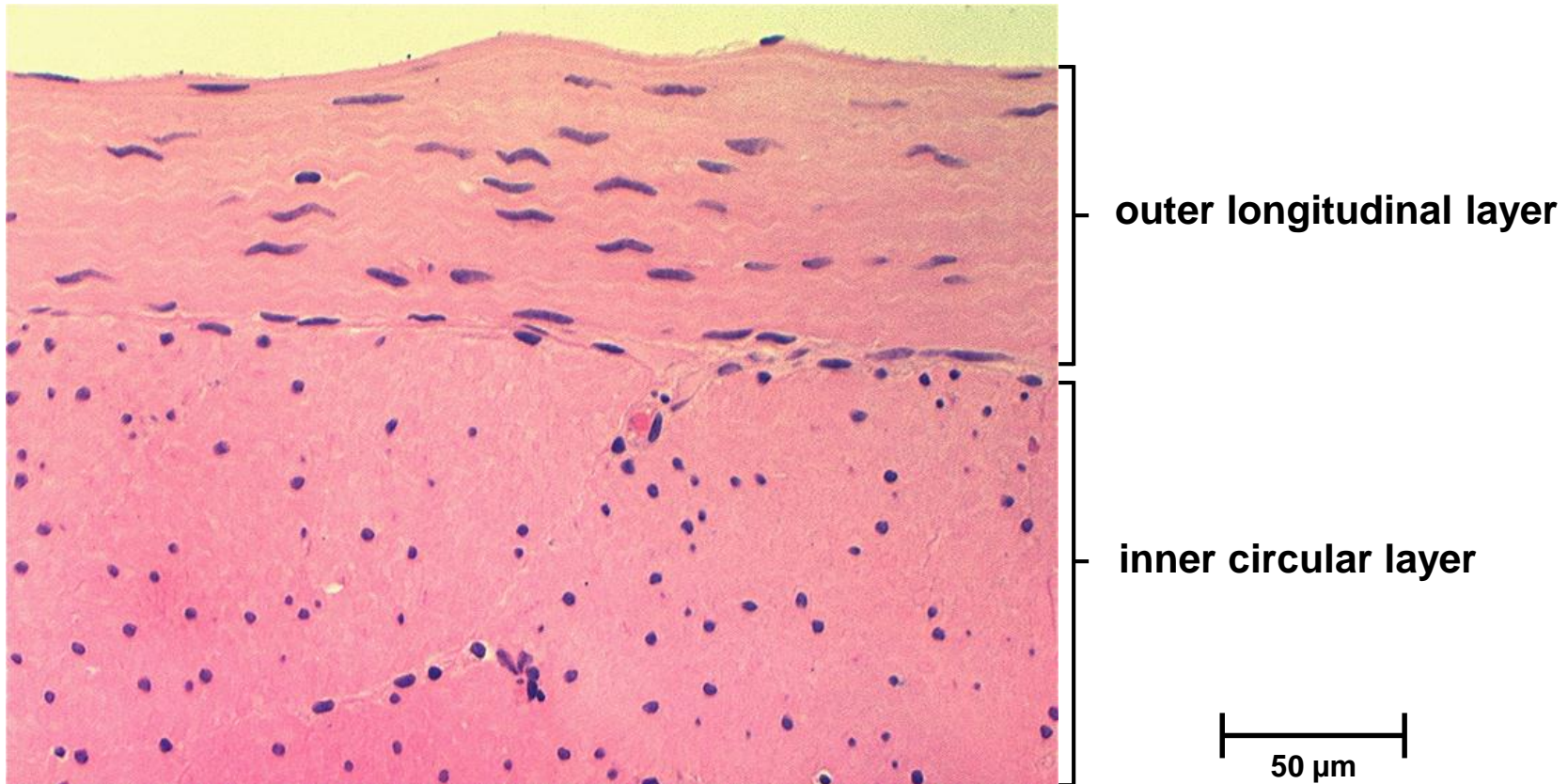
Smooth muscle duodenum

With respect to this organ, can you define the two smooth muscle layers?

Inner circular and outer longitudinal layers of the tunica muscularis.

What is the functional significance of the arrangement of the muscle cells in these structures?

The two layers enable propulsive movements (peristalsis) to occur in the digestive tract.

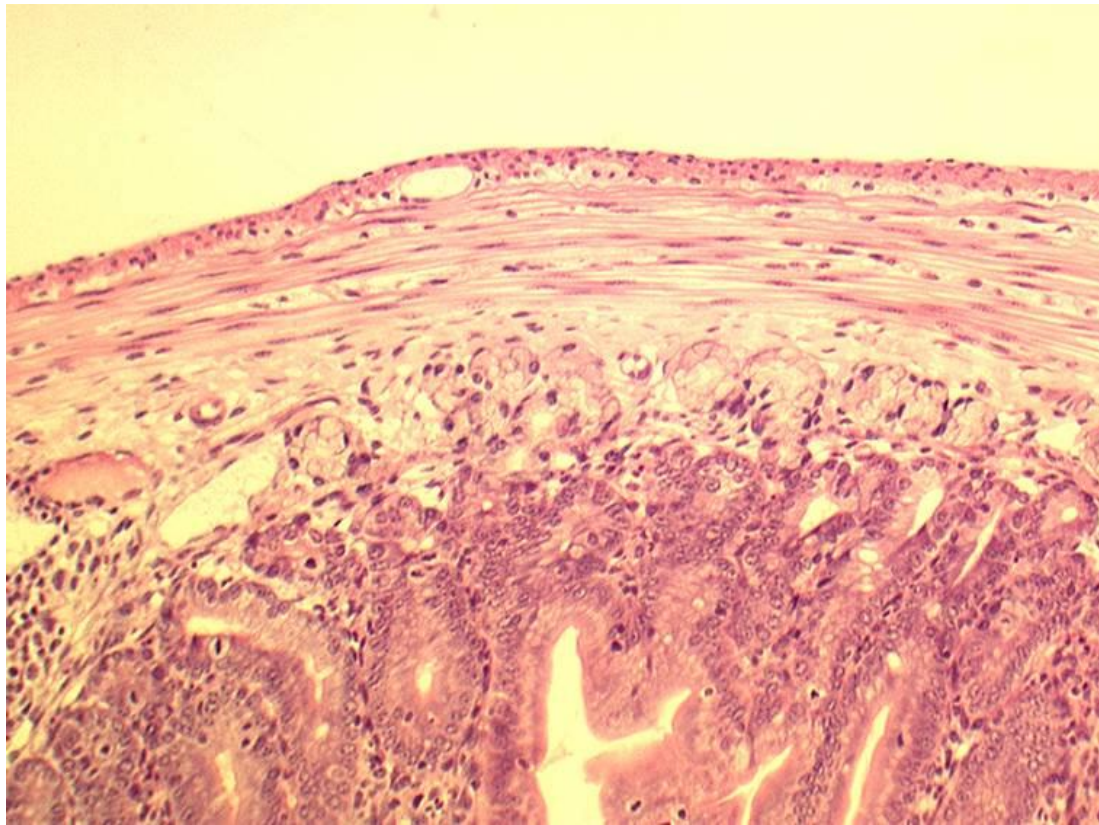


Smooth muscle duodenum

This section shows the duodenum cut in transverse section.

Note : The previous slide 45 was duodenum, but cut in longitudinal section.

Think of how this will affect the microscopic appearance of the muscle layers in these sections.



100 μ m

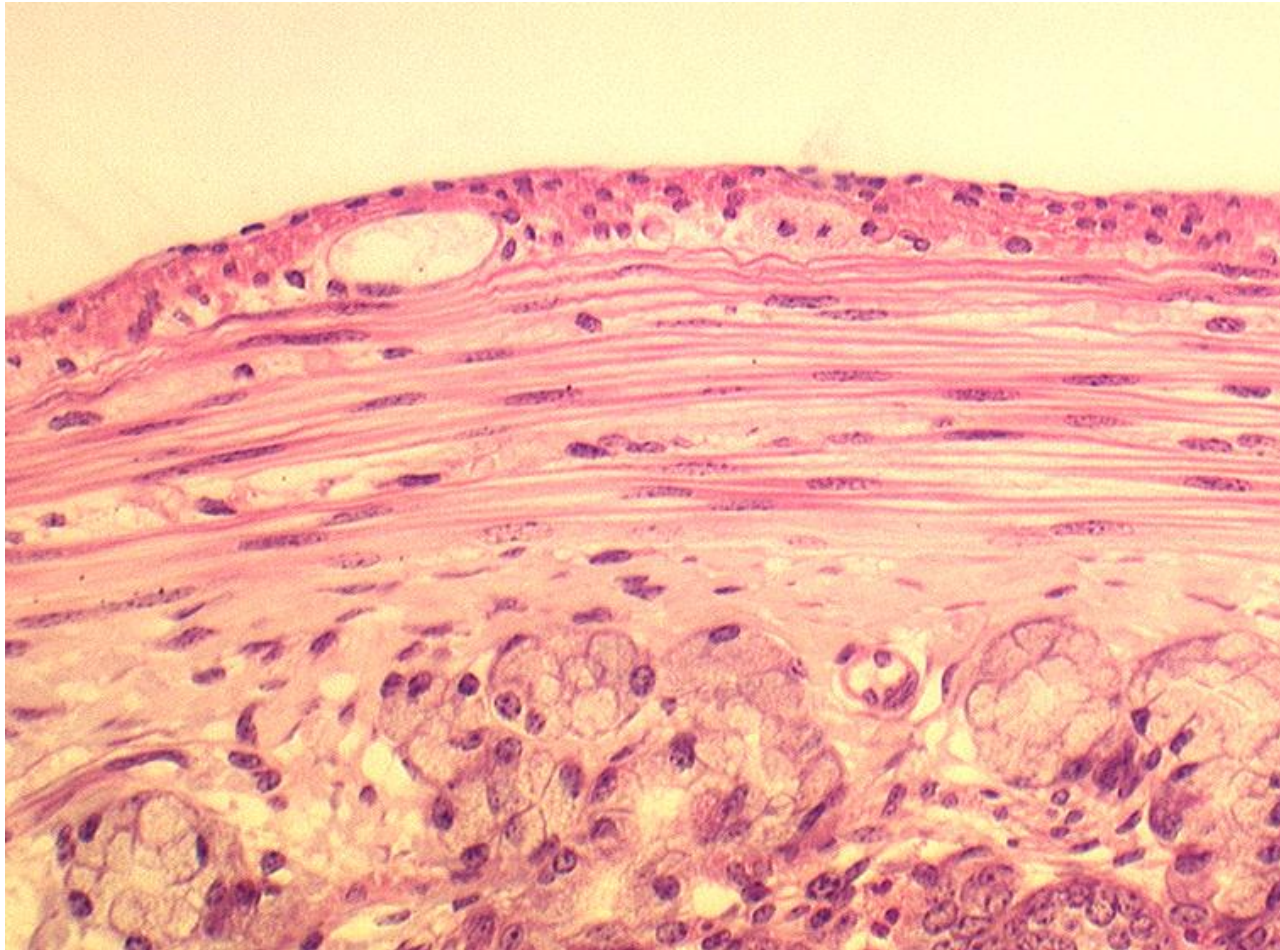


1.0 mm

Smooth muscle duodenum

This section shows the duodenum cut in transverse section.

Identify smooth muscle cells seen in transverse and longitudinal section.



transversely sectioned
smooth muscle cells of
the outer longitudinal
layer.

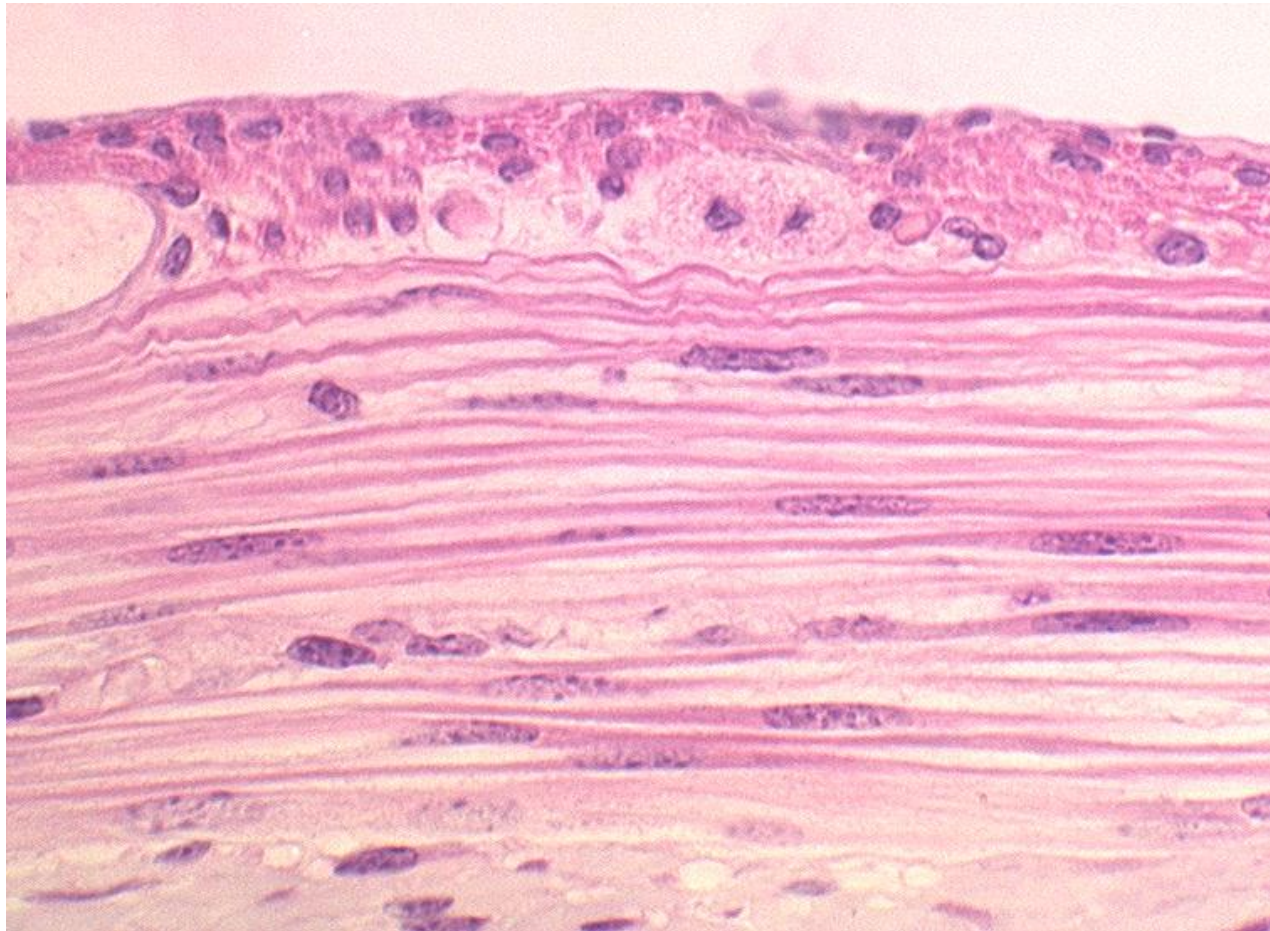
longitudinally sectioned
smooth muscle cells of
the inner circular layer.

50 μ m

Smooth muscle duodenum

Smooth muscle fibres are unicellular- True or False?

True.



outer longitudinal layer
seen here in TS section.

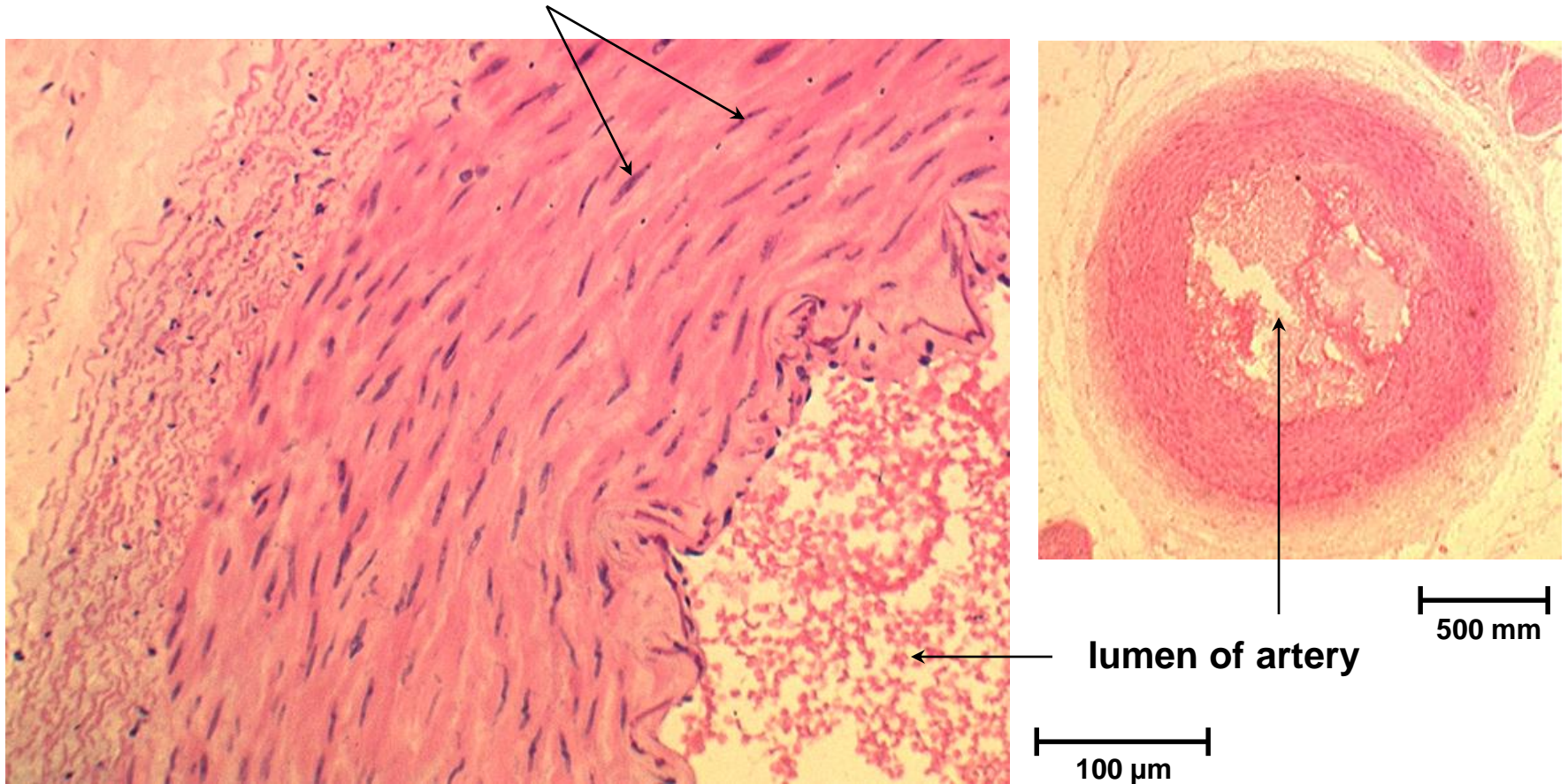
inner circular layer
seen here in LS section.

25 μ m

Arteries

Identify smooth muscle cell nuclei in the wall of this artery.

elongated nuclei of smooth muscle cells

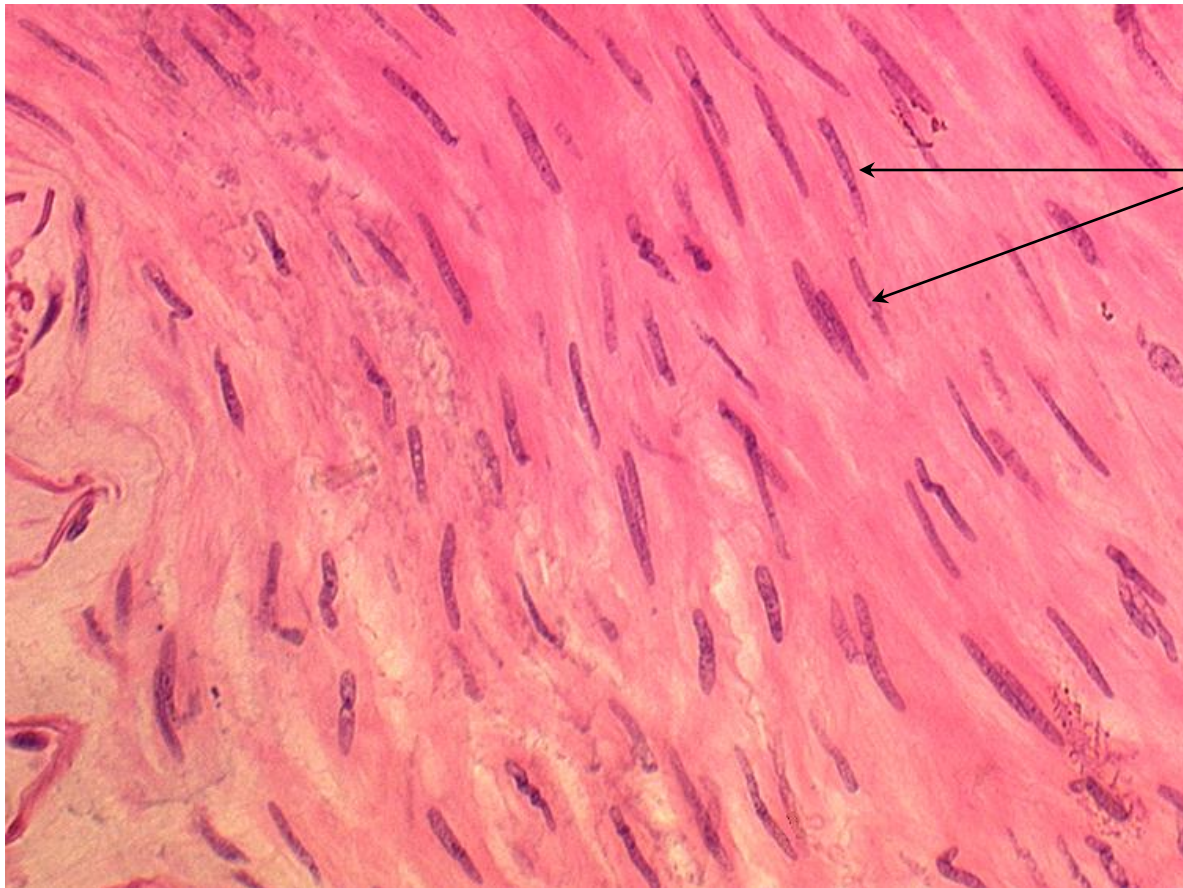


Arteries

What is the functional significance of the arrangement of muscle cells in this structure?

The smooth muscle is in a near-circular tight helical arrangement.

Muscular arteries control blood flow to various organs.



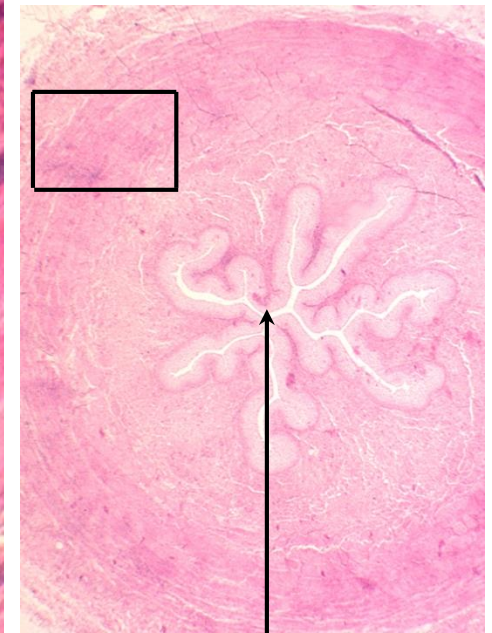
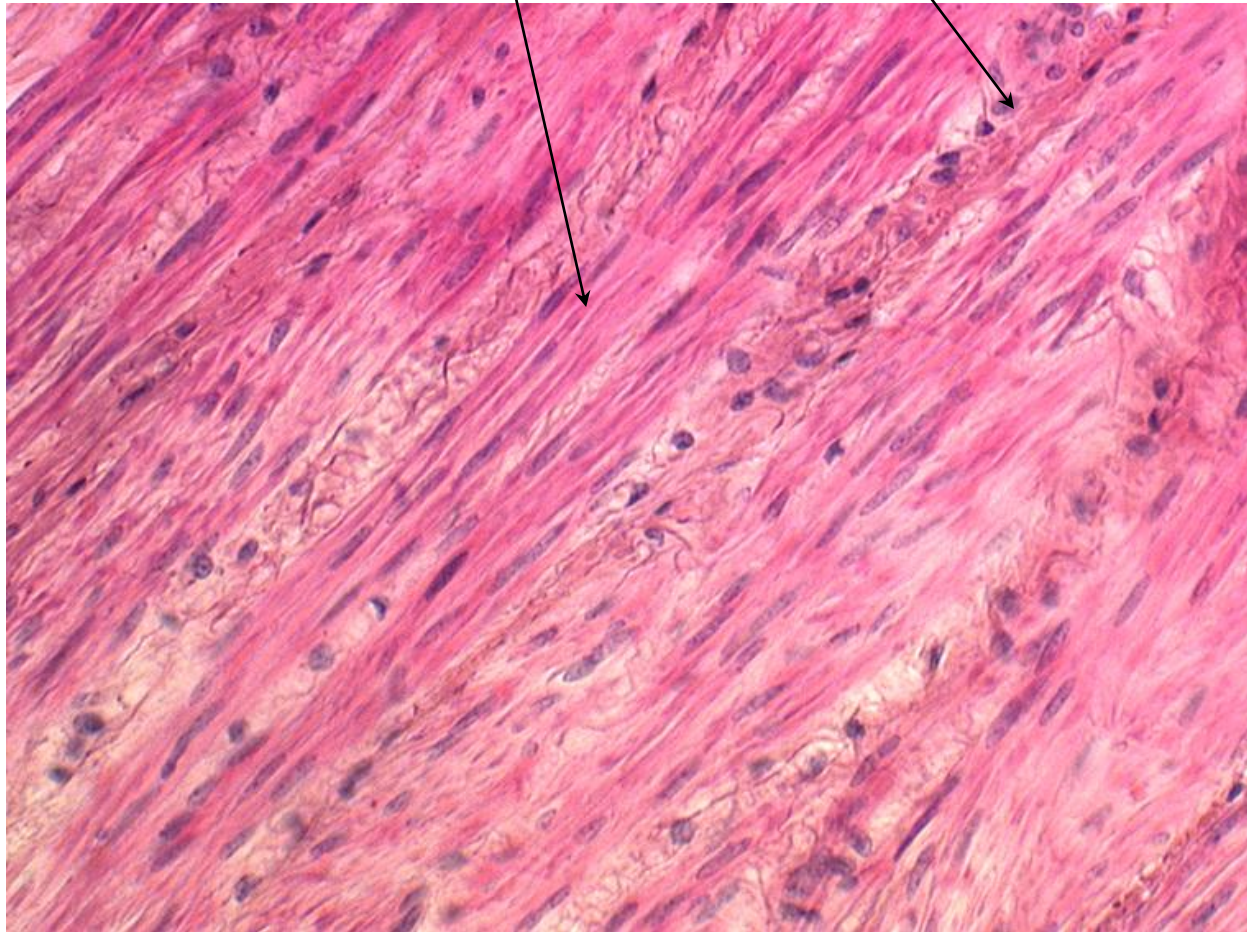
smooth muscle cell nuclei
in the tunica media

50 μm

Ureter TS section

Identify smooth muscle nuclei in the wall of this organ.

longitudinal smooth muscle transverse smooth muscle



lumen

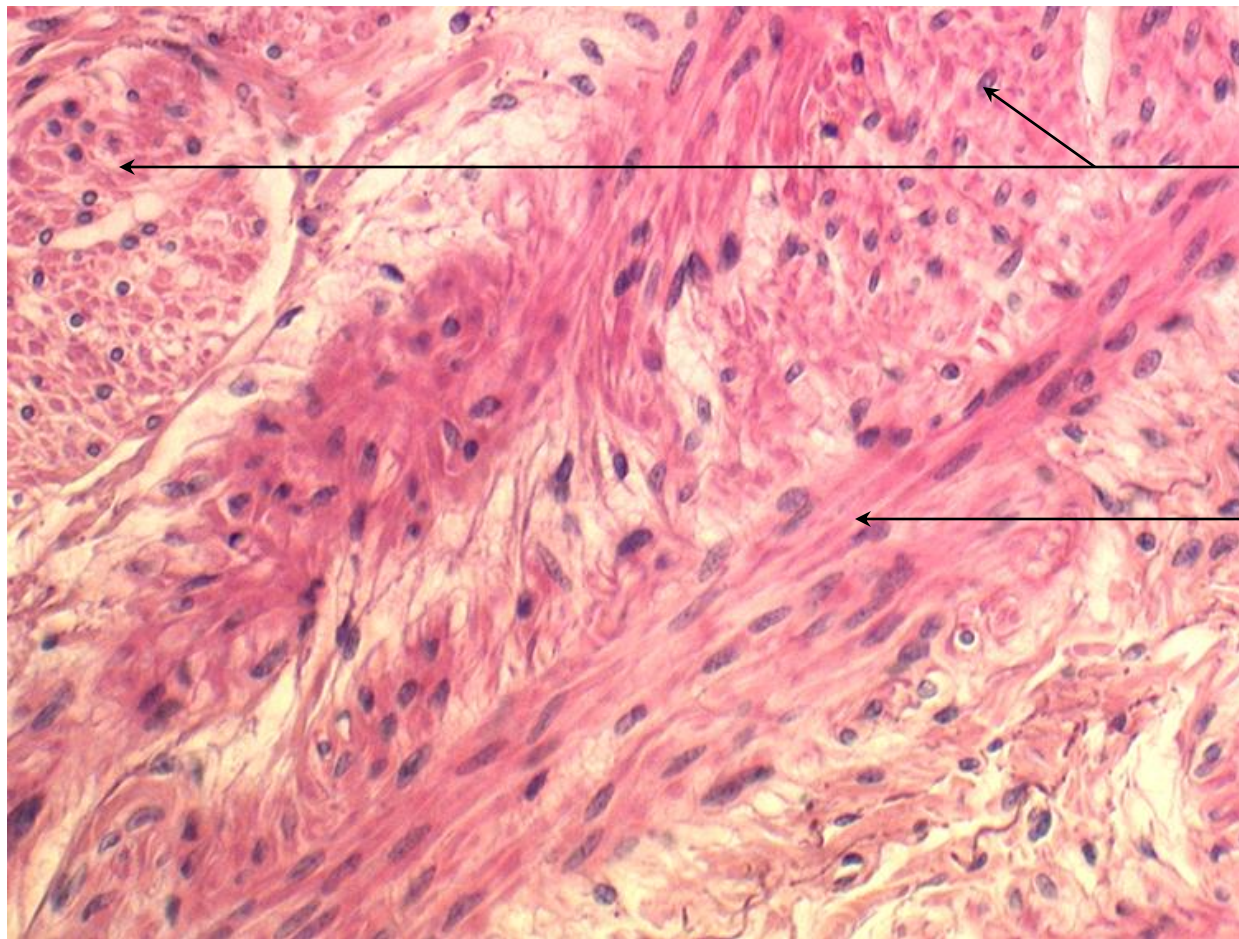
1.0 mm

50 μm

Ureter

What is the functional significance of the arrangement of muscle cells in this structure?

Inner longitudinal and outer circular layers ensure that the star shaped lumen is maintained and cannot be completely closed, thereby ensuring voluntary urination.



inner longitudinal layer
(seen in TS section).

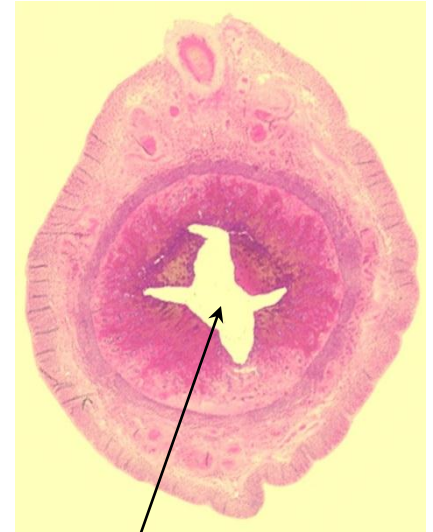
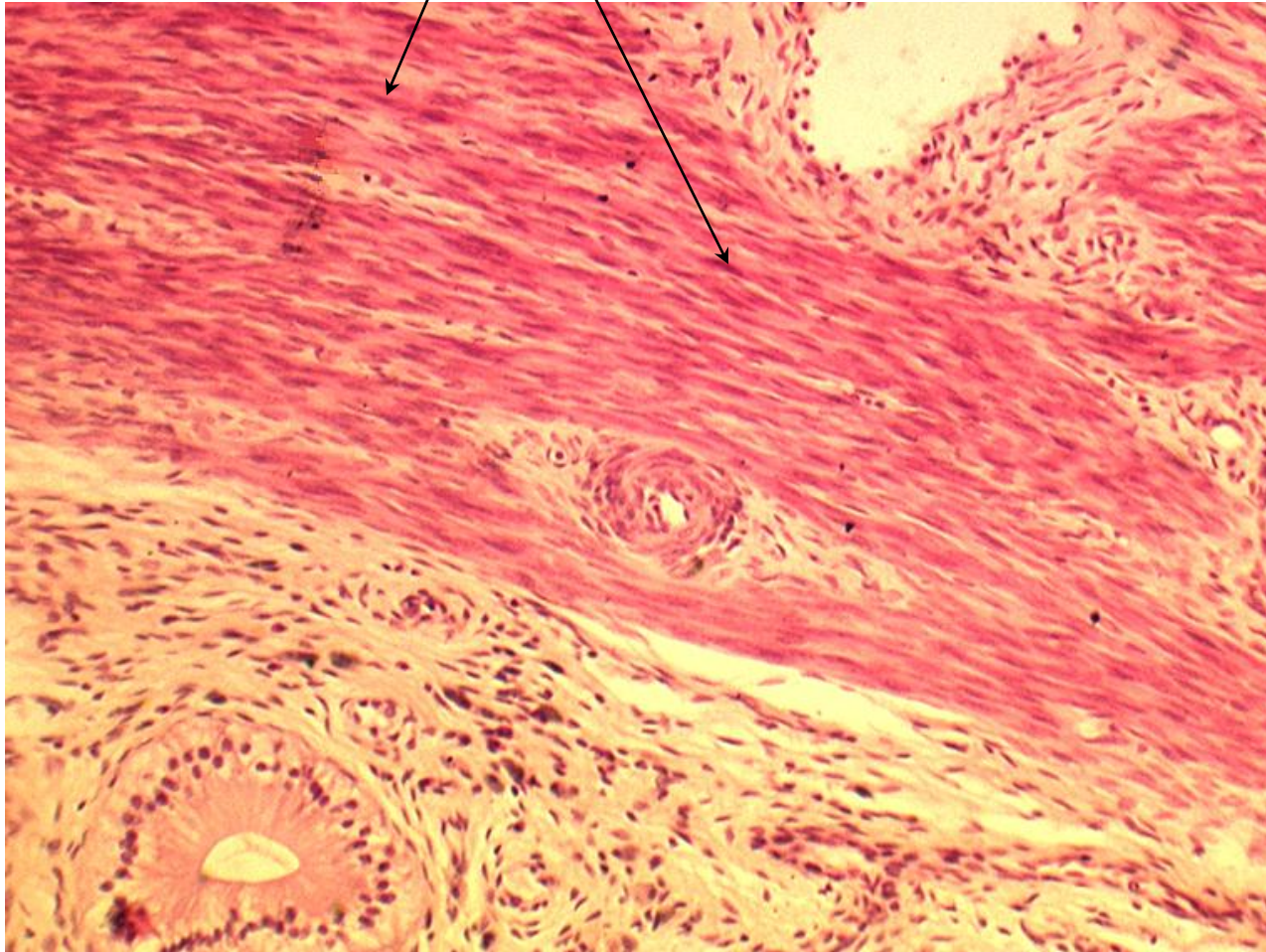
outer circular layer
seen in LS section

50 μm

Uterus

Identify smooth muscle nuclei in the wall of this organ.

smooth muscle nuclei



lumen

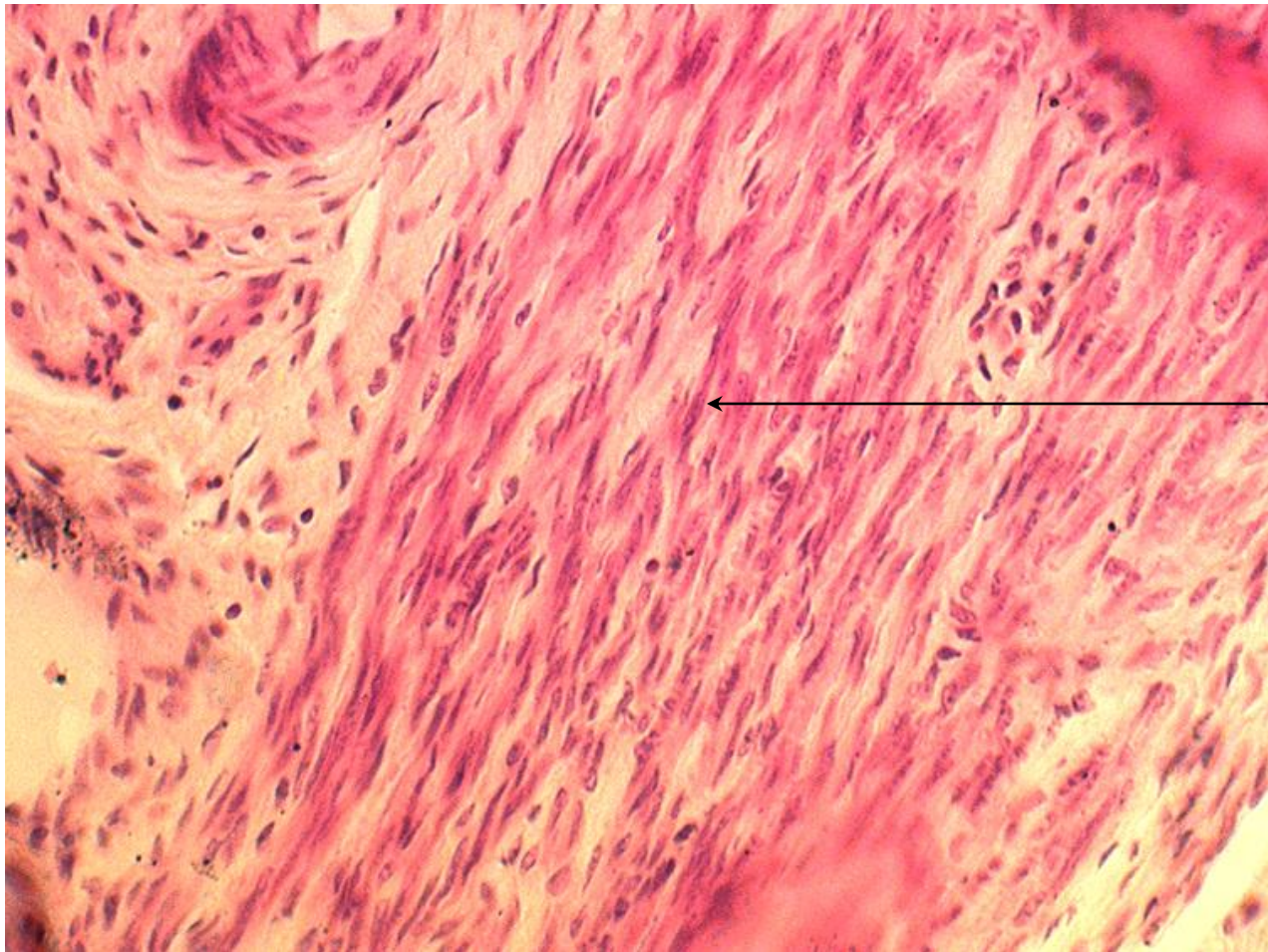
1.00 mm

100 μ m

Uterus

What is the functional significance of the arrangement of muscle cells in this structure?

The two smooth muscle layers of the uterus define the myometrium. A circular inner layer and a longitudinal outer layer are present, although these are often somewhat ill-defined. The muscle layers increase in size during pregnancy.



← muscle cells

50 μ m