

Tkáně lidského těla

**soubory buněk a mezibuněčné hmoty
s podobnou morfológickou a funkční
charakteristikou**

Tkáň epitelová

Tkáň pojivová

Tkáň nervová

Tkáň svalová

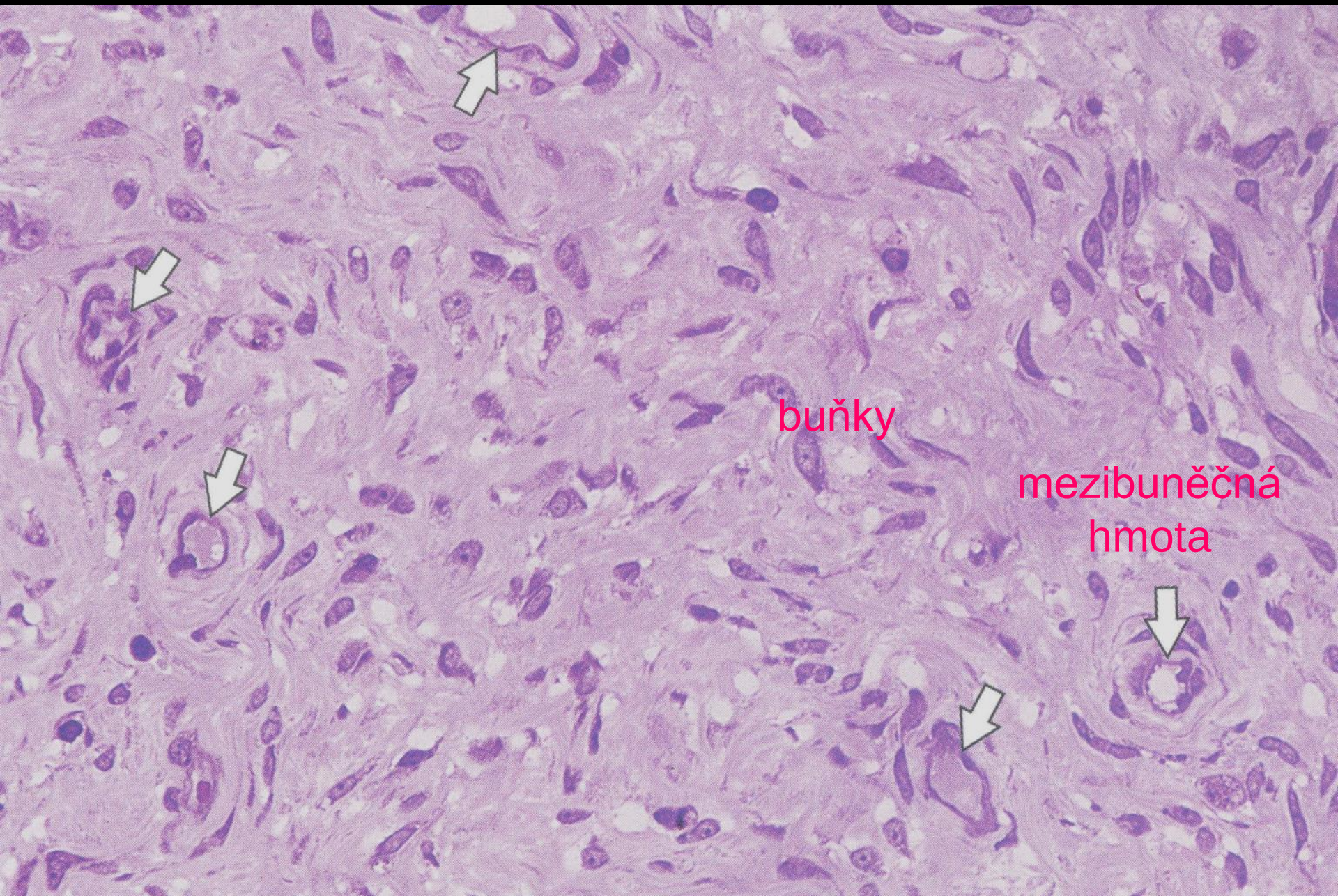
Tkáň pojivová

buňky zalité v mezibuněčné hmotě,
která je produktem těchto buněk
a svým objemem nad nimi převažuje

vazivo

chrupavka

kost



buňky

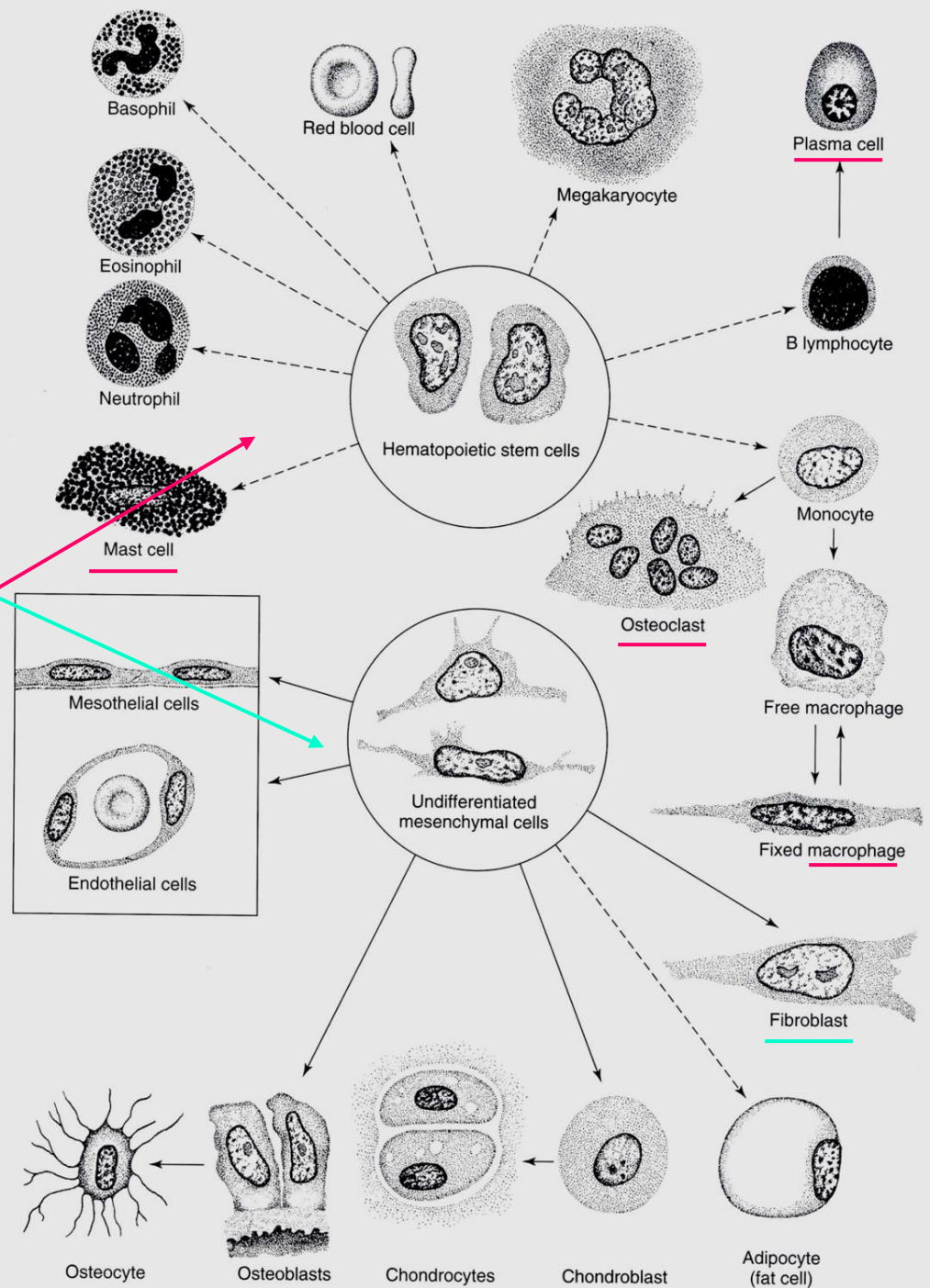
mezibuněčná
hmota

šipky = drobné cévy

Buňky pojivové tkáně

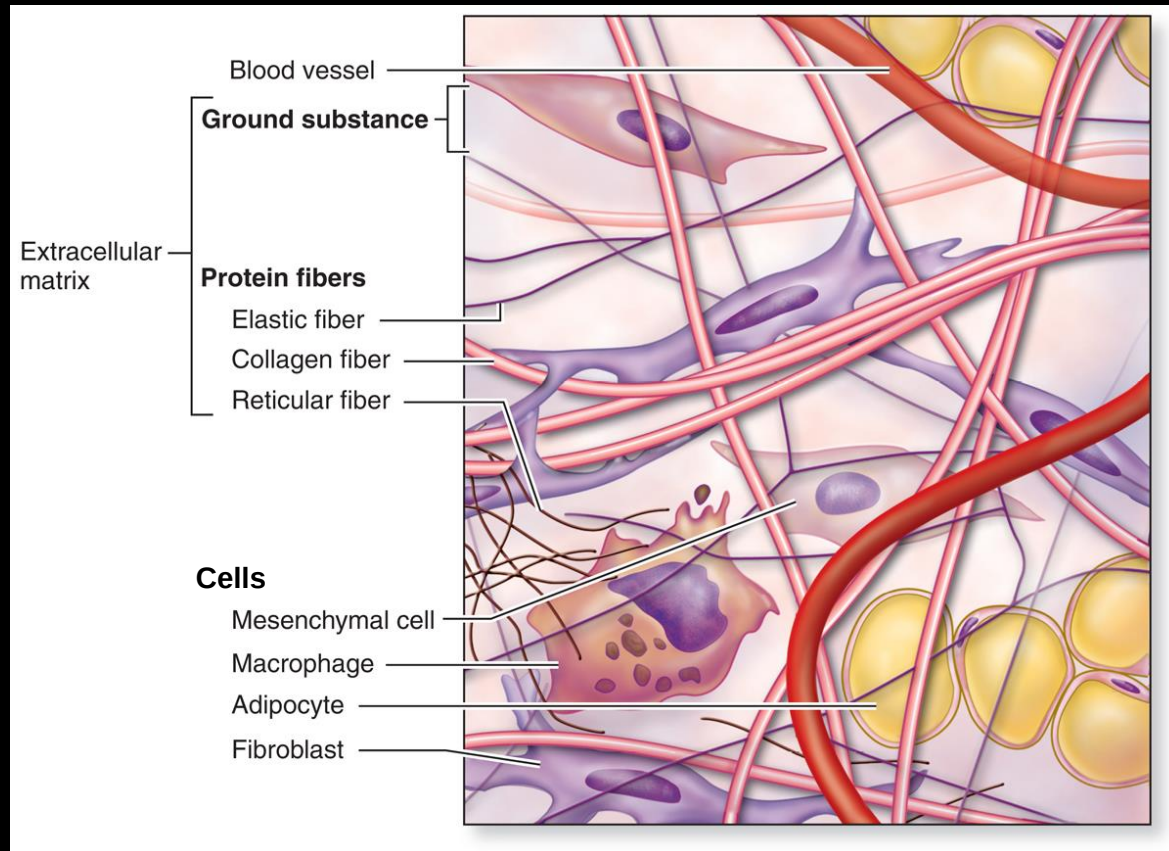
a/ fixní, residentní
– vznikají v dané
tkáni, produkují
mezibuněčnou
hmotu

b/ volné, bloudivé
– z kostní dřeně,
v pojivové tkáni tráví
pouze část svého
životního cyklu



Mezibuněčná hmota (extracelulární matrix, ECM) pojivové tkáně

- vláknitá složka (vlákna, fibrily)
- amorfní složka (základní hmota)



Tkáň pojivová

fixní buňky



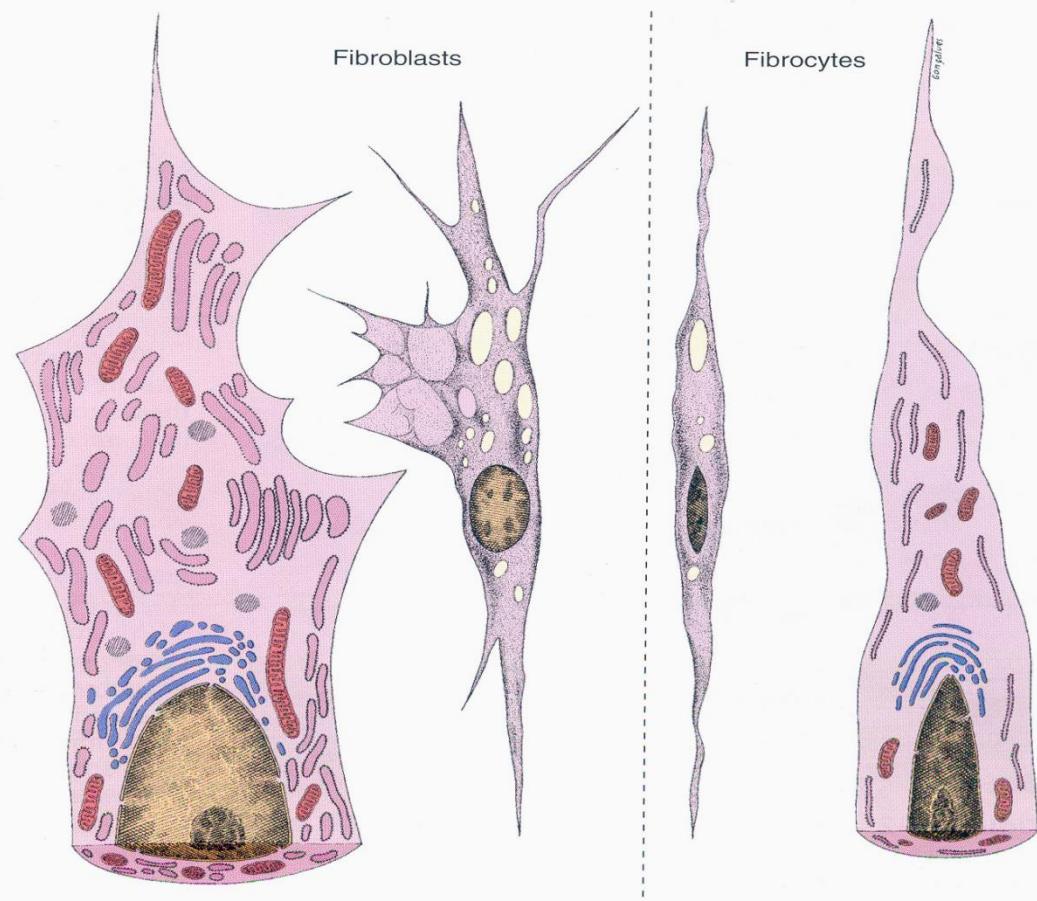
a mesenchymové buňky



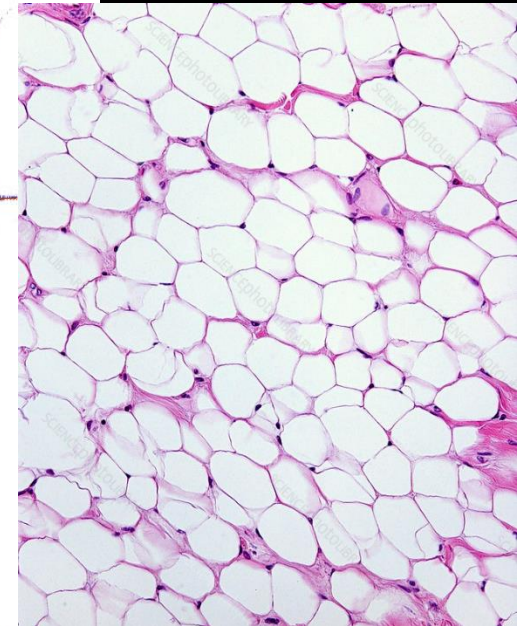
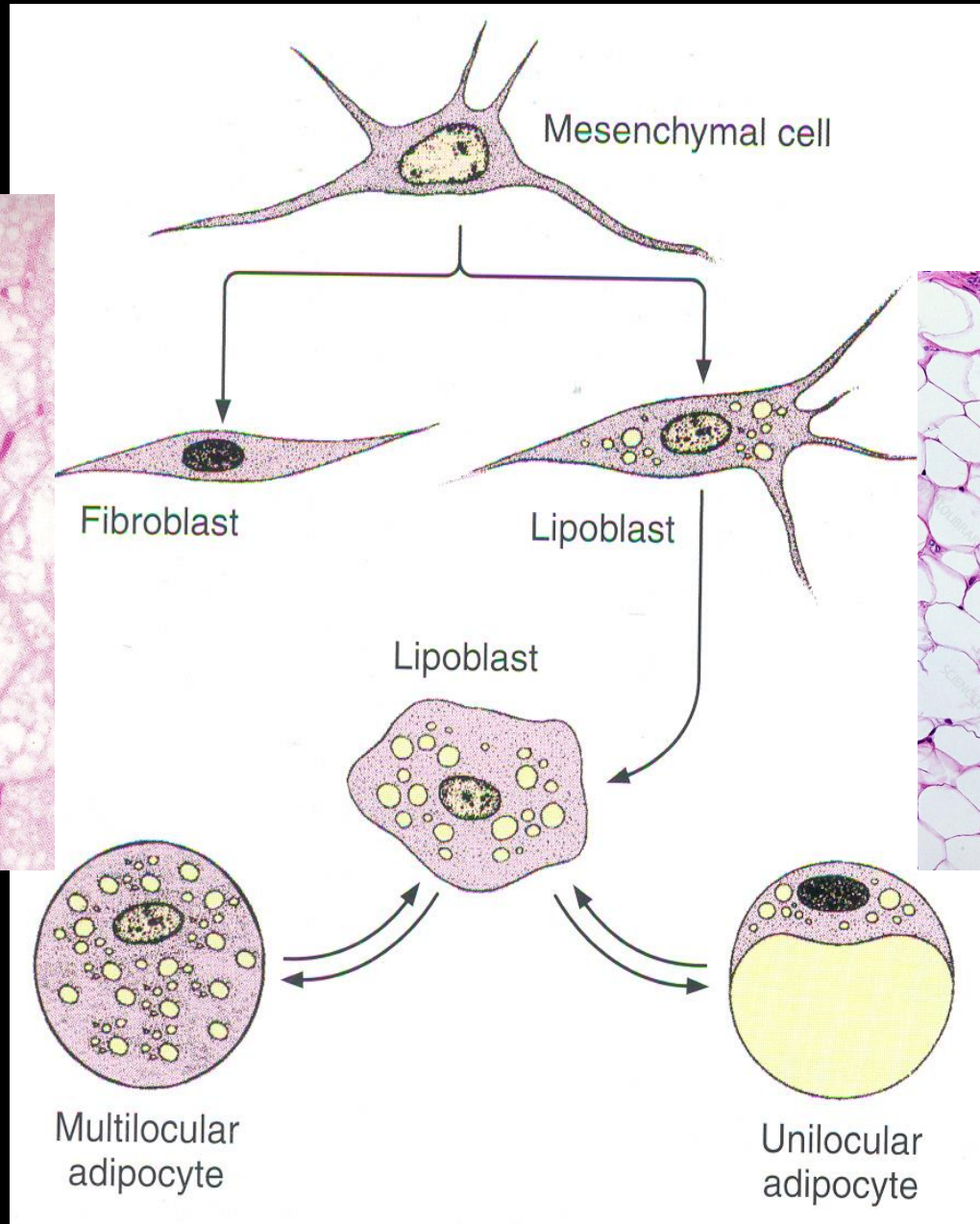
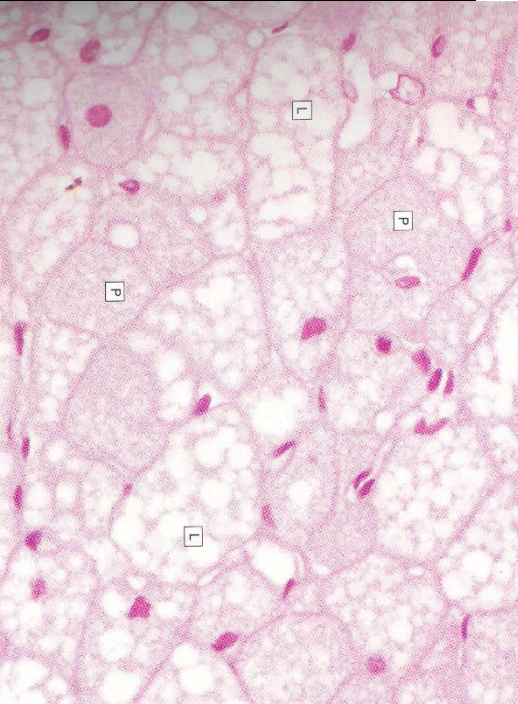
b fibroblasty

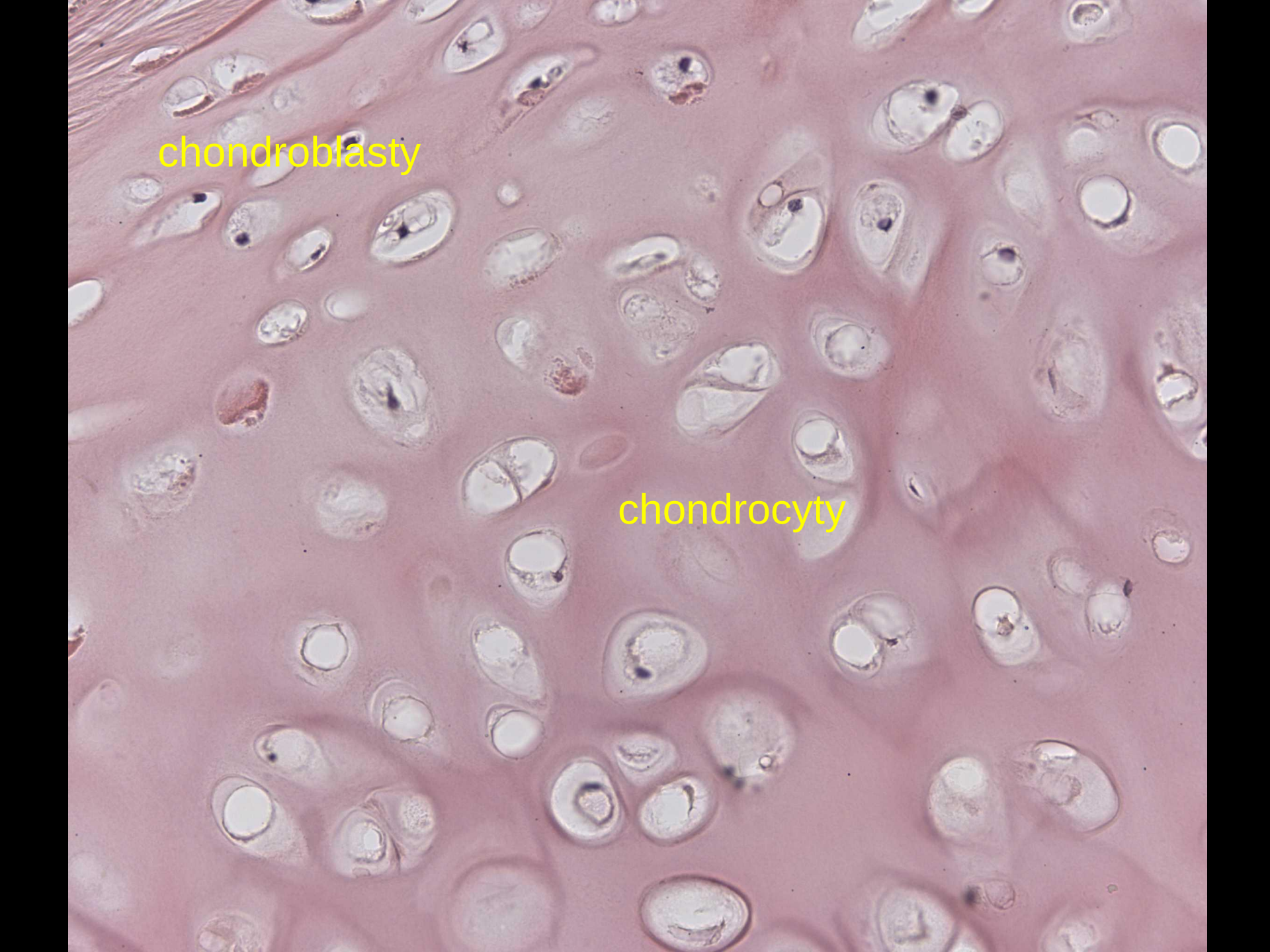


c fibrocyty



adipocyty





A histological micrograph of cartilage tissue. The image shows numerous cells embedded in a pink-stained extracellular matrix. The cells are of two types: chondroblasts, which are larger and more rounded, and chondrocytes, which are smaller and more elongated. The chondroblasts are located in the upper left quadrant, and the chondrocytes are located in the lower right quadrant. The labels 'chondroblasty' and 'chondrocyty' are written in yellow text over the respective cell groups.

chondroblasty

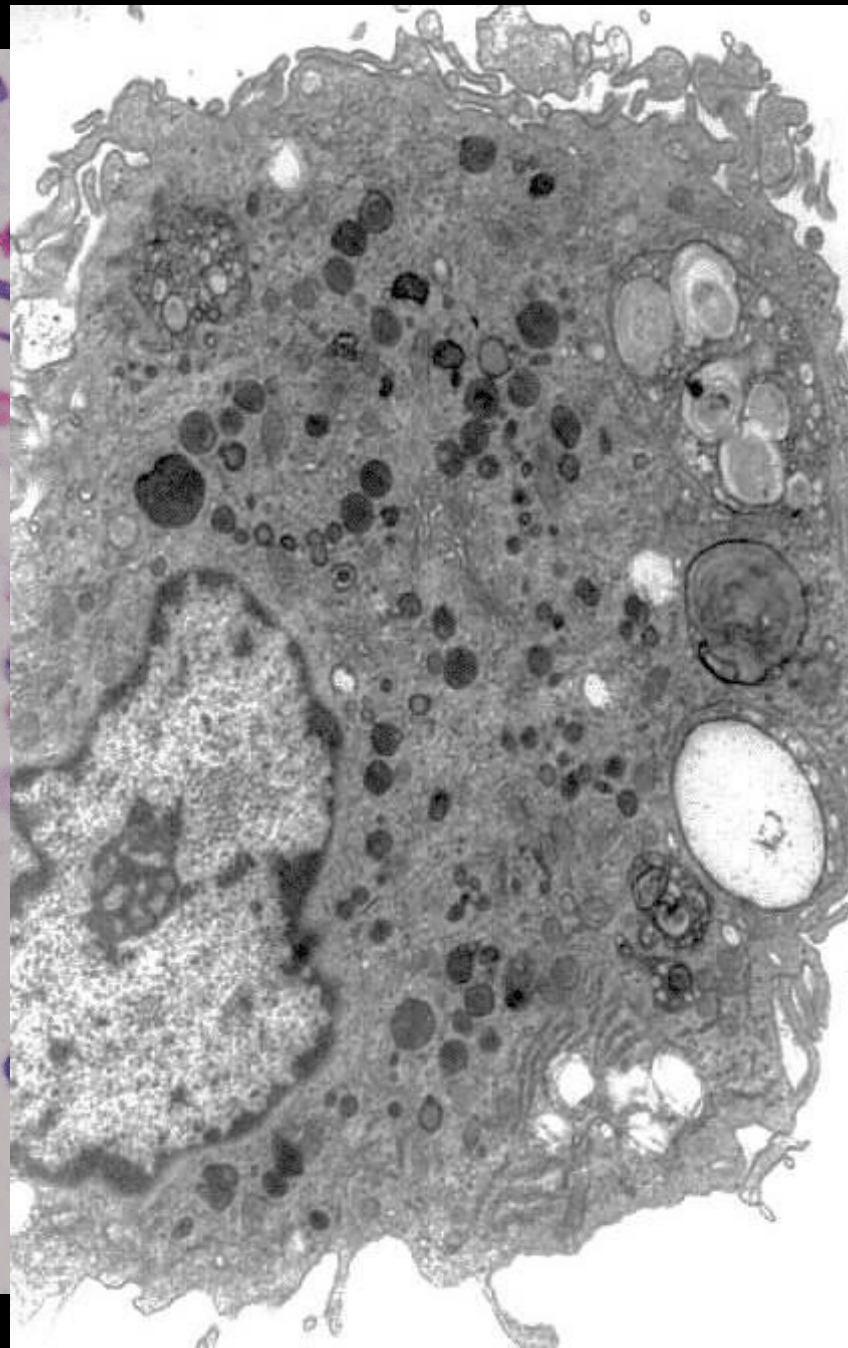
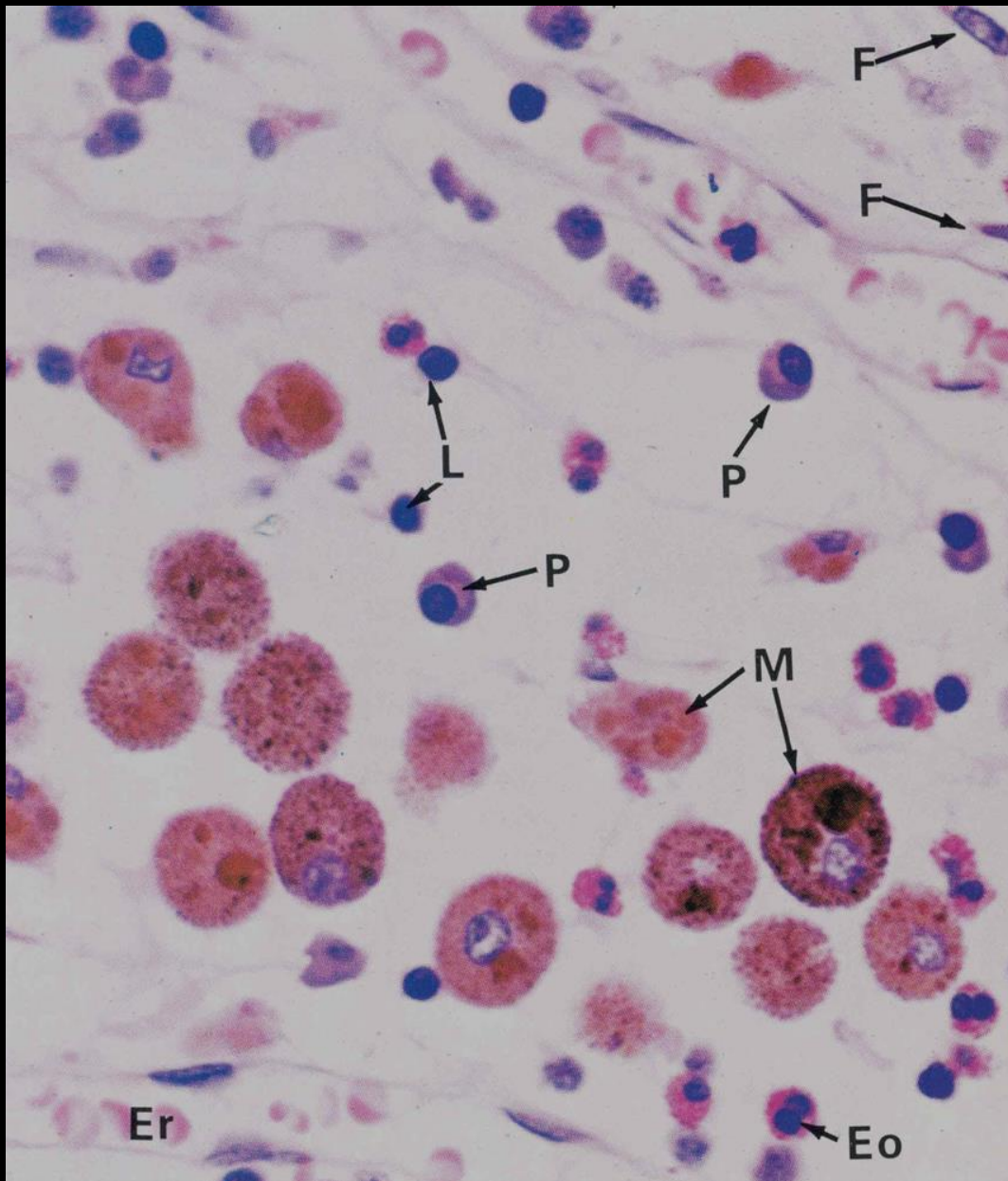
chondrocyty



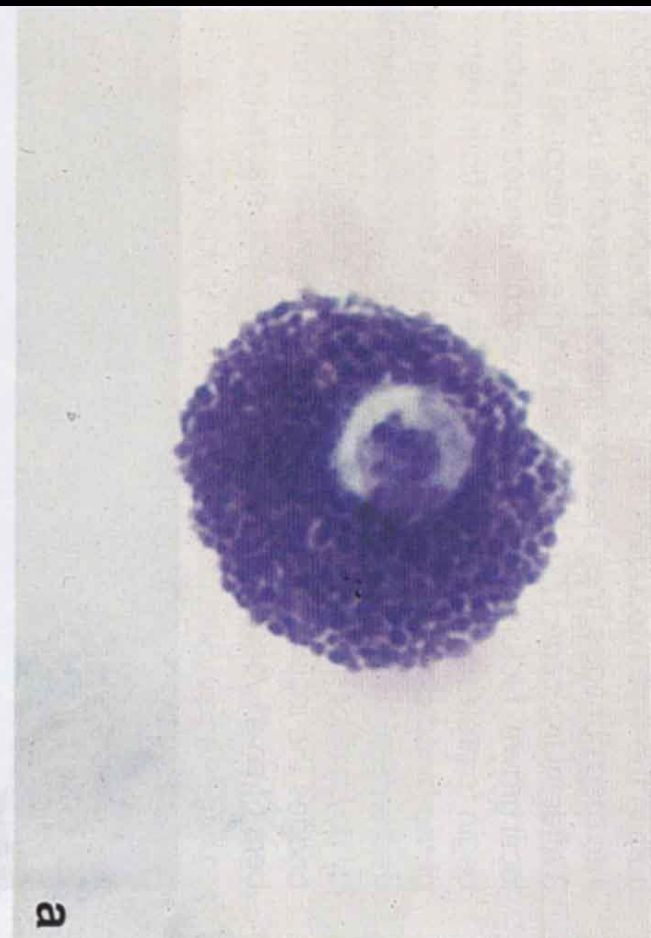
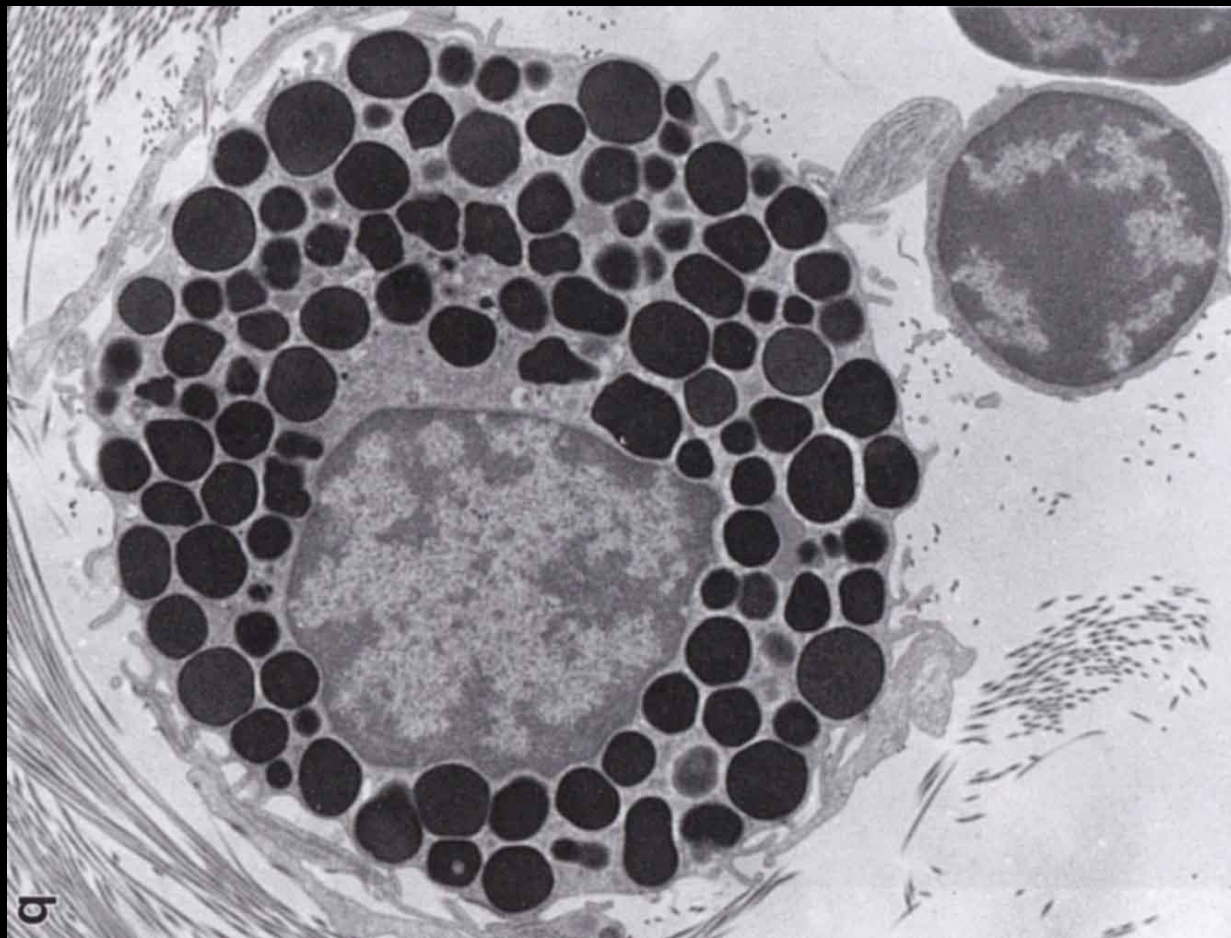
Tkáň pojivová

bloudivé buňky

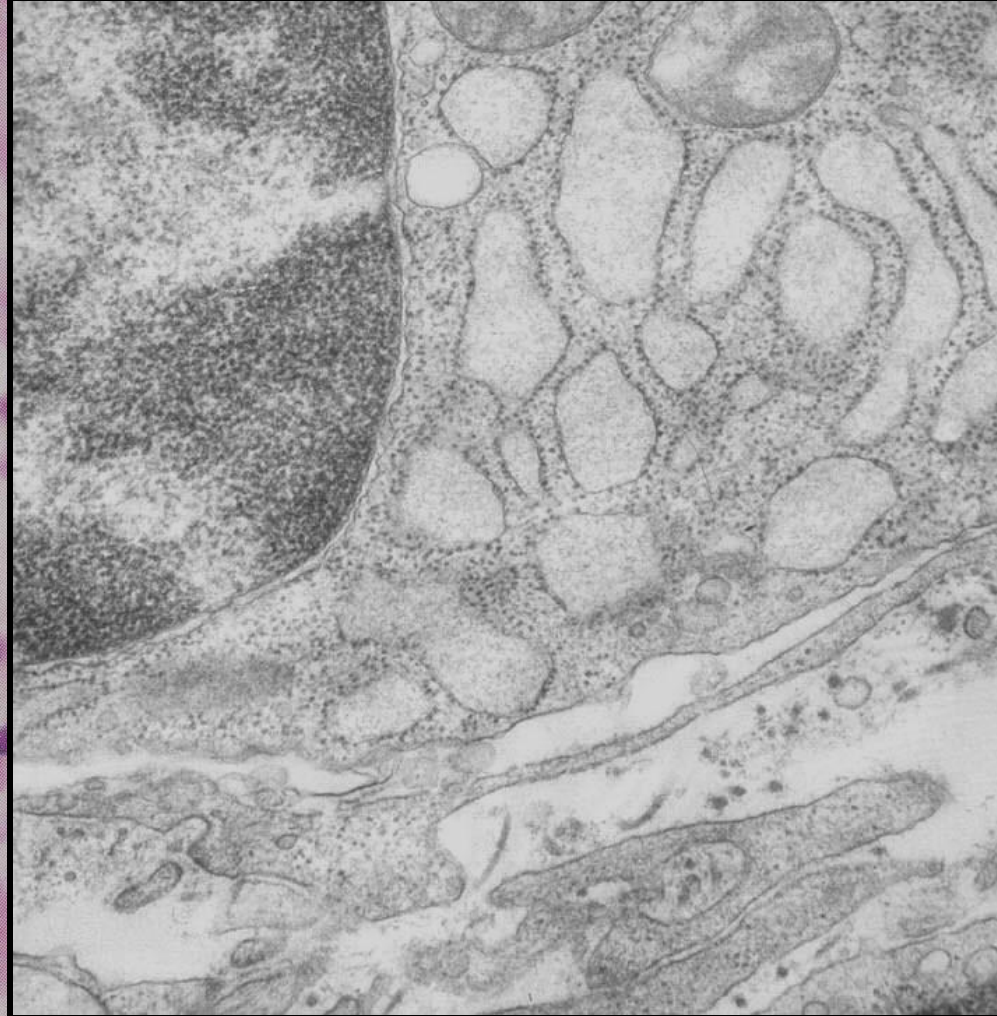
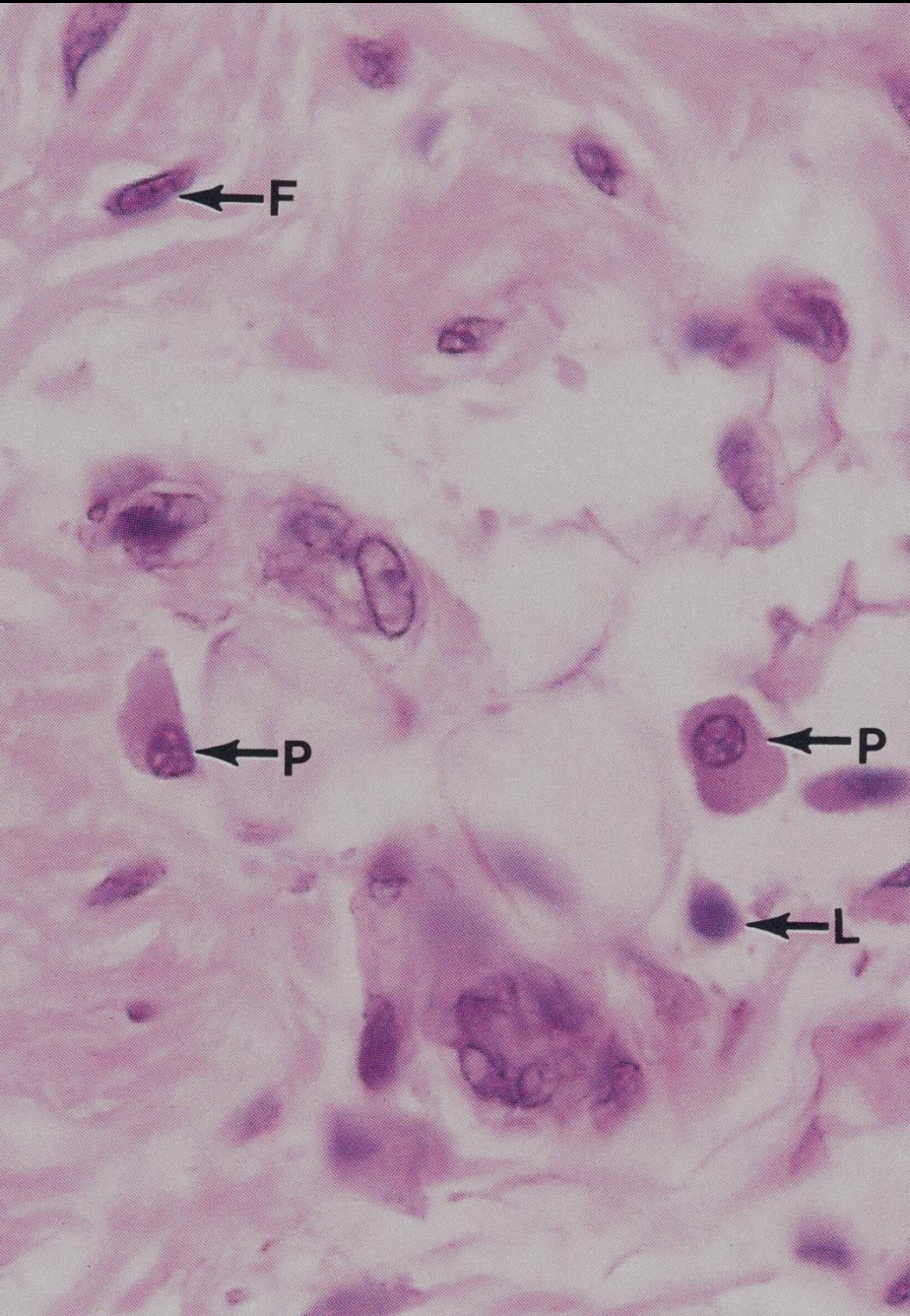
makrofág



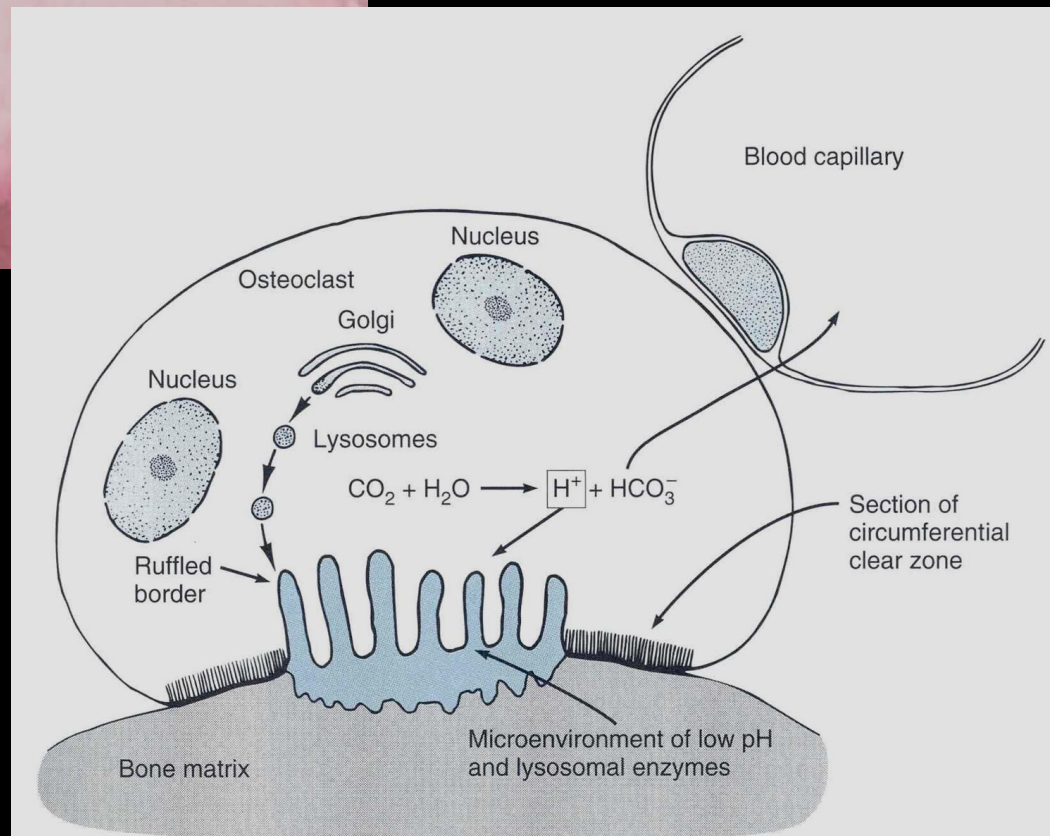
žírné buňky



plasmatické buňky



osteoklast



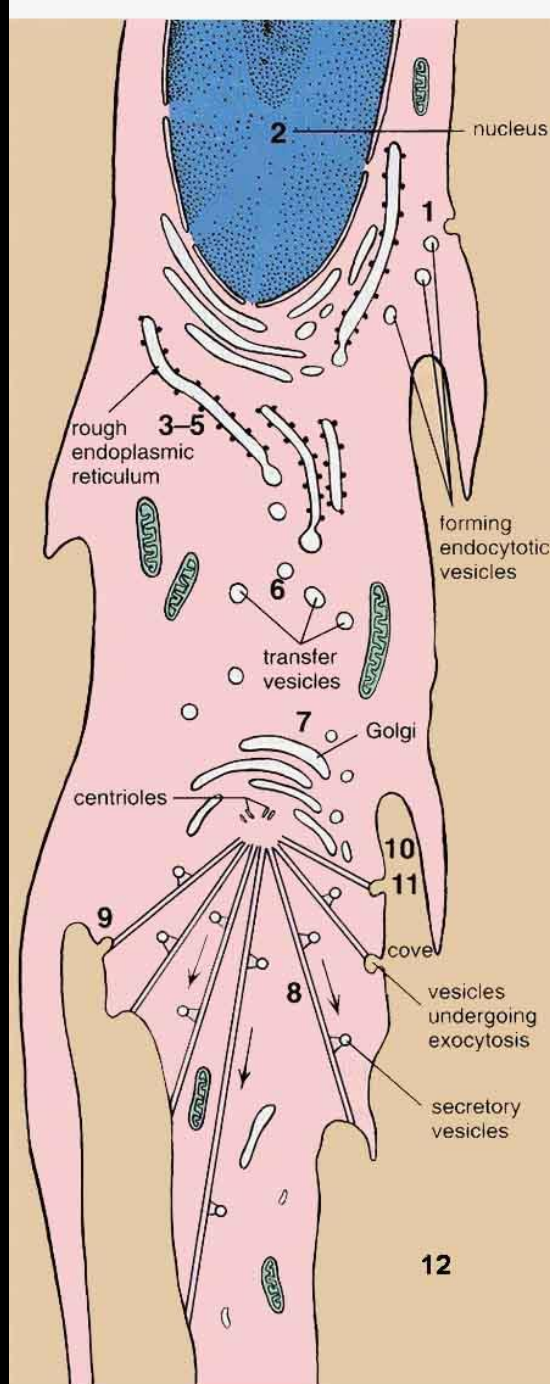
Tkáň pojivová

mezibuněčná hmota

Mezibuněčná hmota pojivové tkáně

- vláknitá složka
 - kolagen (různé typy, jen některé tvoří vlákna)
 - elastin a fibrilin (elastická vlákna)
- amorfnní složka
 - glykosaminoglykany (GAG, lineární polysacharidy)
 - proteoglykany (GAG navázané na proteinovém nosiči)
 - strukturální glykoproteiny (proteiny s navázanými sacharidovými řetězci)

Syntéza a sekrece kolagenu



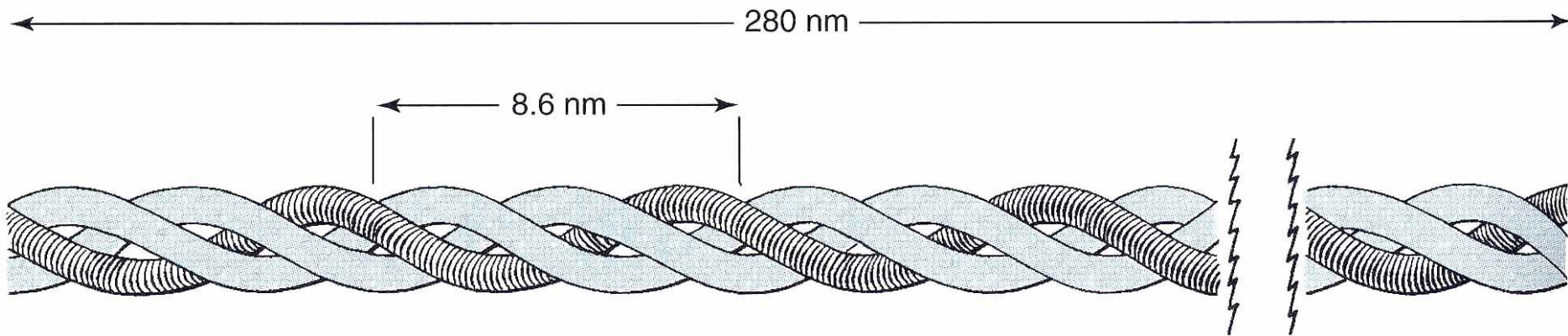
INTRACELLULAR EVENTS

- 1 Uptake of amino acids (proline, lysine, etc.) by endocytosis
- 2 Formation of mRNA
- 3 Synthesis of α chains with registration peptides by ribosomes
- 4 Hydroxylation of proline and lysine residues (vitamin C required) and cleavage of signal sequence of rER
- 5 Glycosylation of specific hydroxyllysyl residues in rER
- 6 Formation of procollagen triple helix molecules in rER and movement into transfer vesicle
- 7 Packaging of procollagen by Golgi into secretory vesicles
- 8 Movement of vesicles to plasma membrane, assisted by microfilaments and microtubules
- 9 Exocytosis of procollagen

EXTRACELLULAR EVENTS

- 10 Cleavage of registered, nonhelical ends of procollagen to form tropocollagen molecule
- 11 Polymerization of tropocollagen molecule into protofibril (in coves initially)
- 12 Parallel aggregation of protofibrils into fibrils

(Tropo)kolagen



tloušťka 1,5 nm

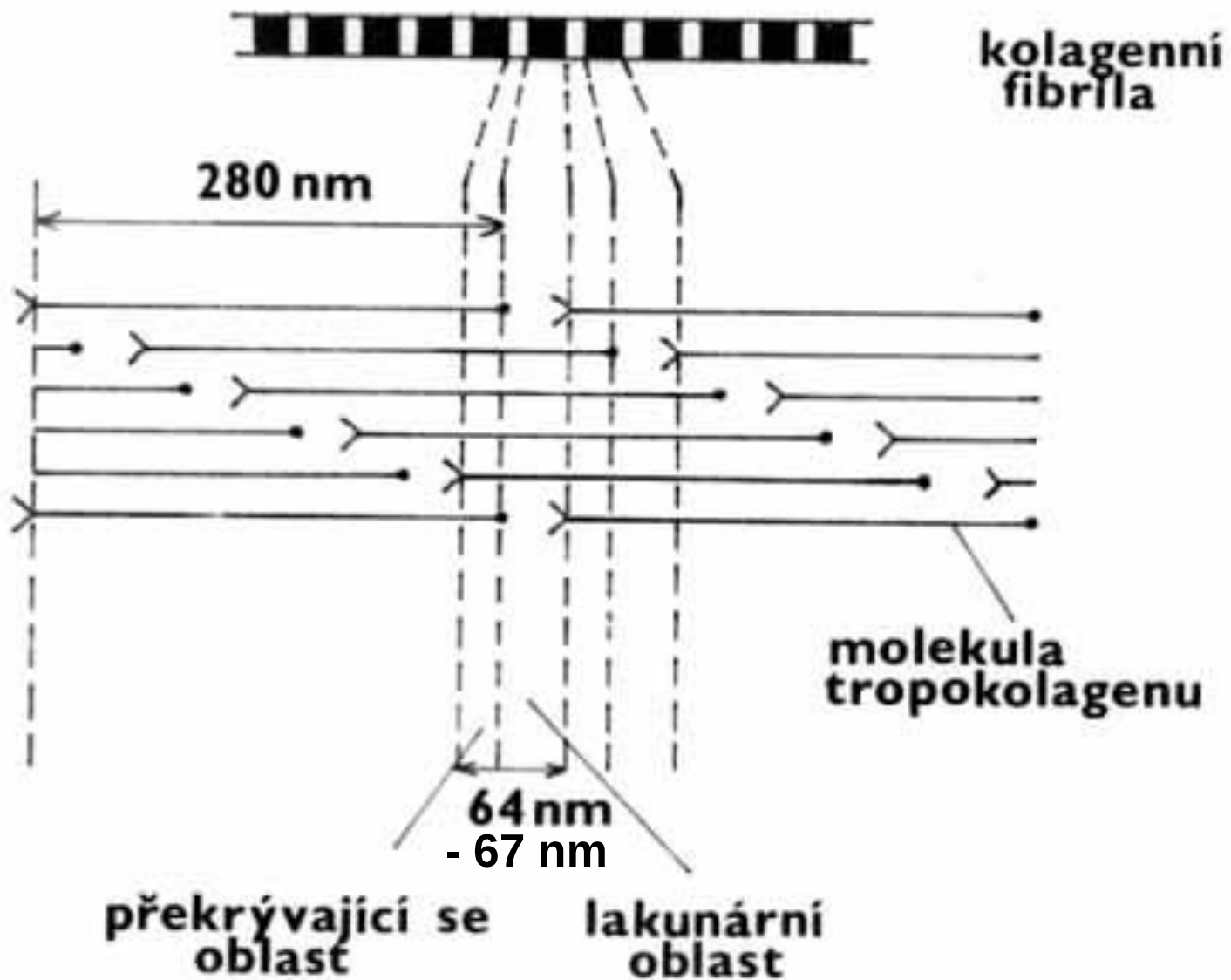
délka 280 – 300 nm

trojitá šroubovice

heterotrimerické molekuly ($2 \alpha_1 + 1 \alpha_2$ nebo $\alpha_1 + \alpha_2 + \alpha_3$)

homotrimerické molekuly (3 stejné α řetězce)

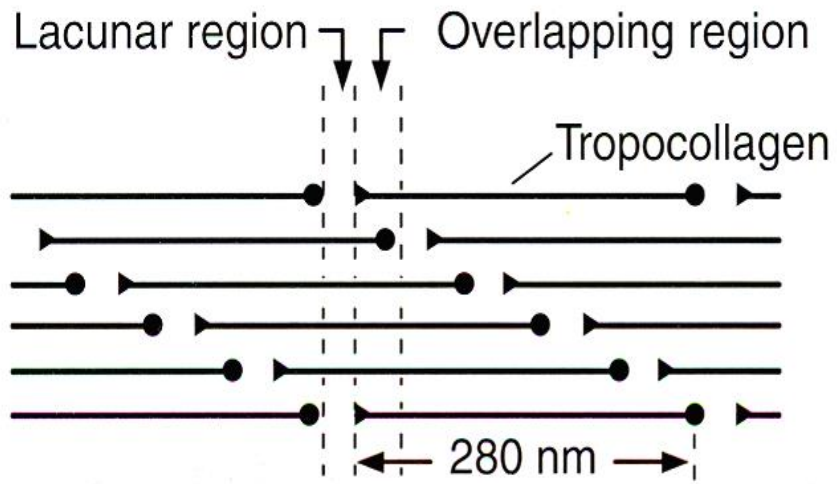
STAVBA KOLAGENNÍ FIBRILY



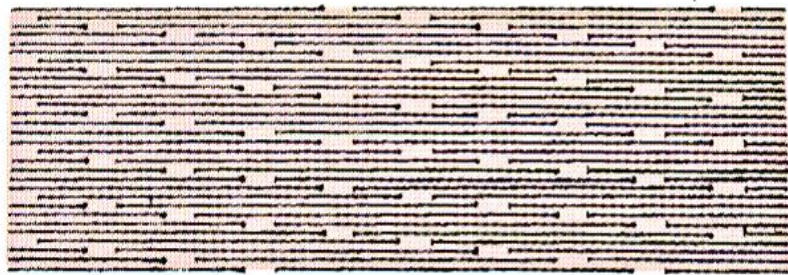
This is a black and white electron micrograph showing several parallel collagen fibrils. The fibrils exhibit a characteristic periodic banding pattern, with alternating light and dark horizontal bands. The background is a granular, light gray texture. The text 'kolagenní fibrily' is overlaid in red on the right side of the image.

kolagenní fibrily

1



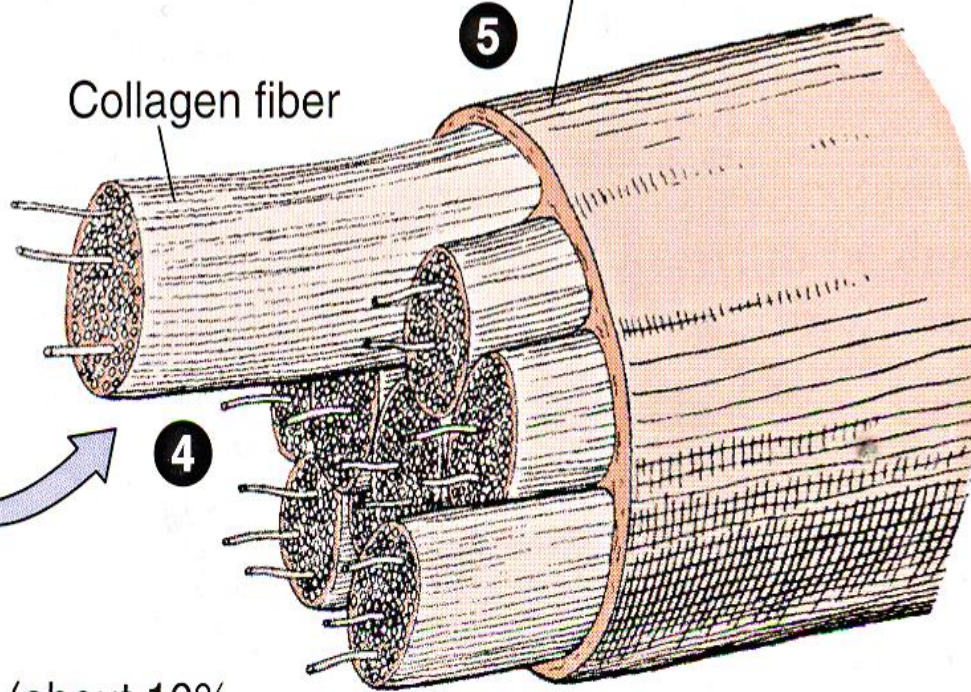
2



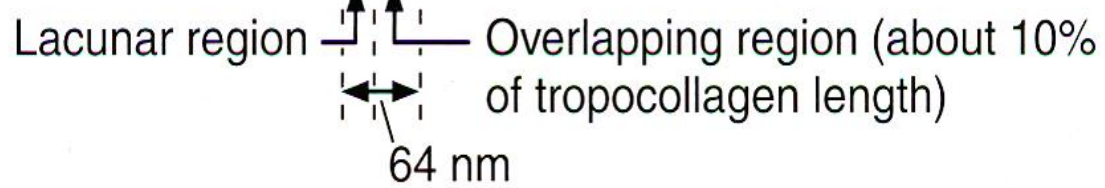
3

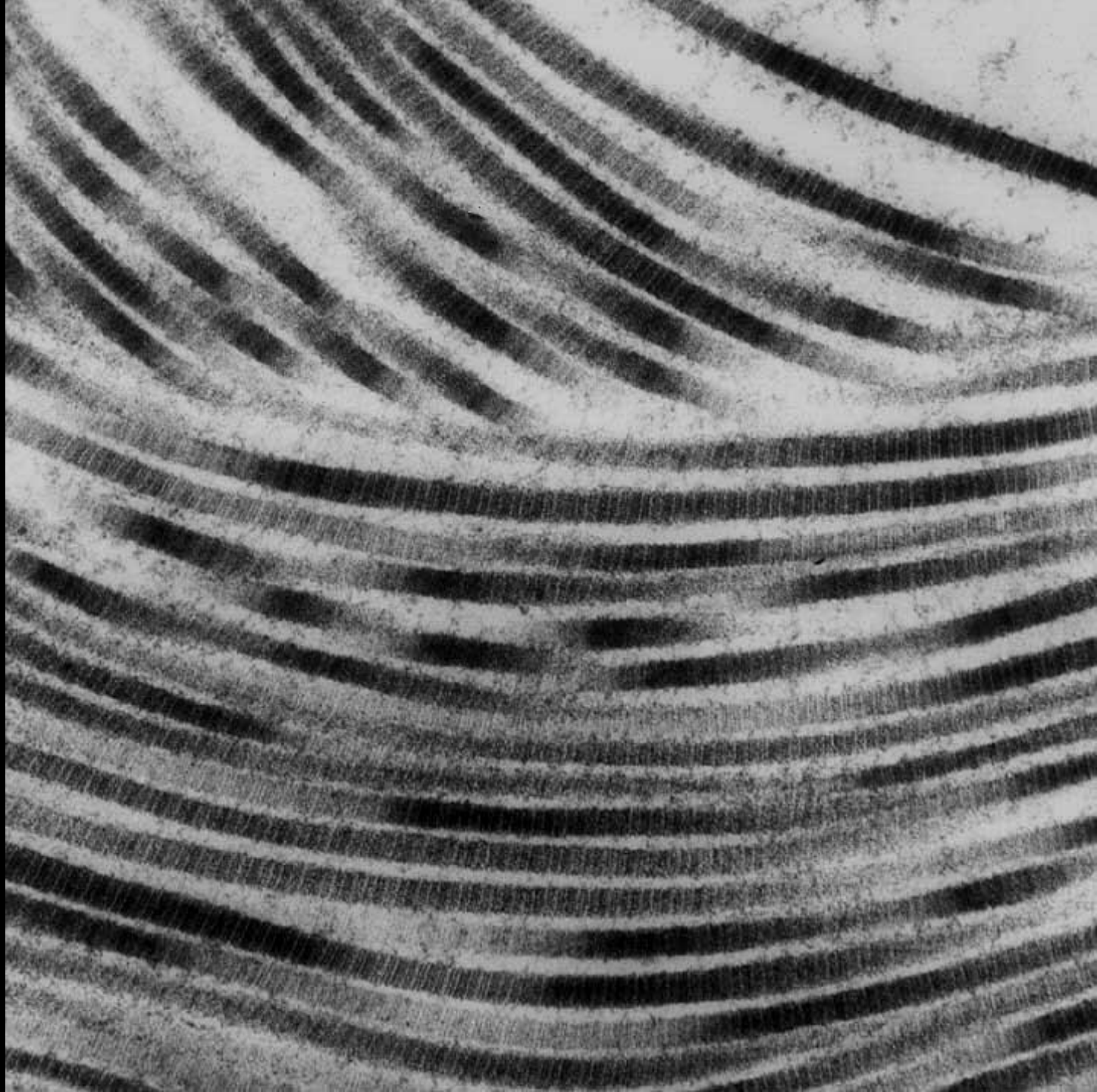


4



5





KOLAGEN

1. kolageny tvořící fibrily

- a) typ I, II, III, V (kolagen typu V tvoří kofibrily s kolagenem typu I a III)
- b) typ IX, XII, XIV (tvoří fibrily připojené ke kolagenu typu I)
- c) typ VI (zevní lamina svalové tkáně, chrupavka)
- d) typ VII (tvoří kotvící fibrily)

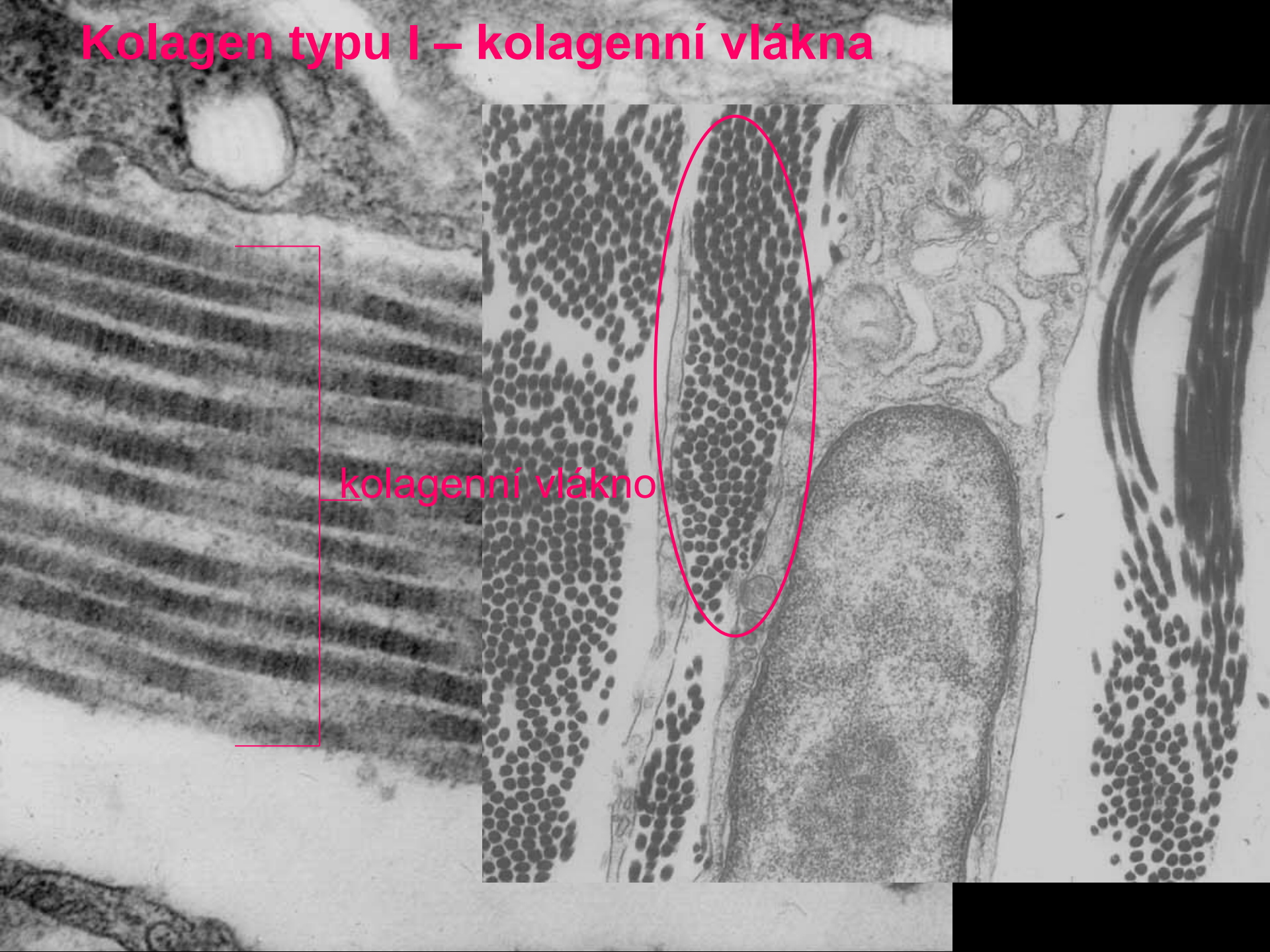
2. kolageny, které netvoří fibrily

- a) typ IV (tvoří síťovitou strukturu)

Důležité typy kolagenu

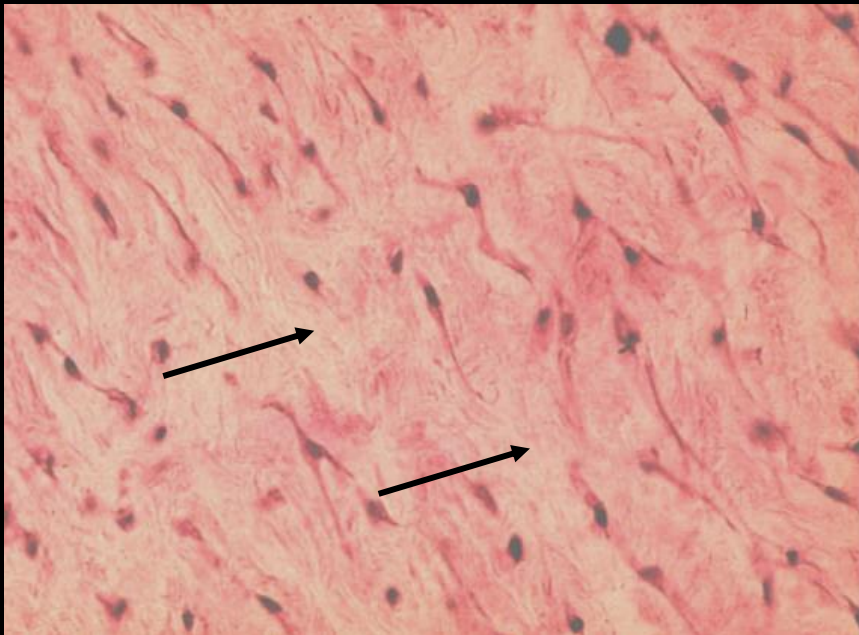
Typ	výskyt	fibrily	vlákna
I	kolagenní vlákna (vazivo, vazivová chrupavka, kost)	Ø 75 nm	Ø 2 – 20 µm
II	chrupavka	Ø 20 nm	netvoří
III	retikulární vlákna (vazivo)	Ø 45 nm	Ø 0,1 – 2 µm
IV	basální a zevní lamina	netvoří	netvoří

Kolagen typu I – kolagenní vlákna

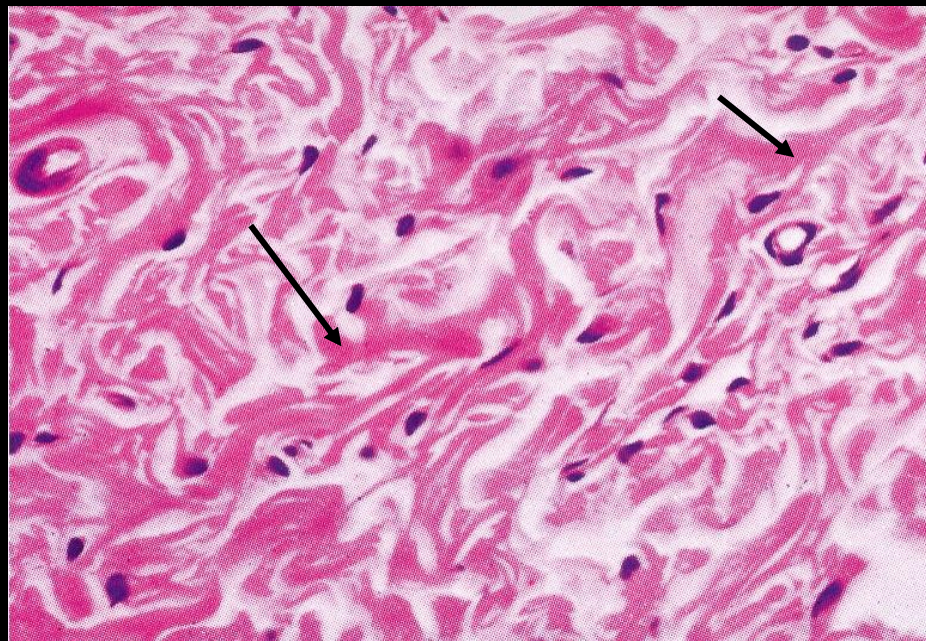


kolagenní vlákno

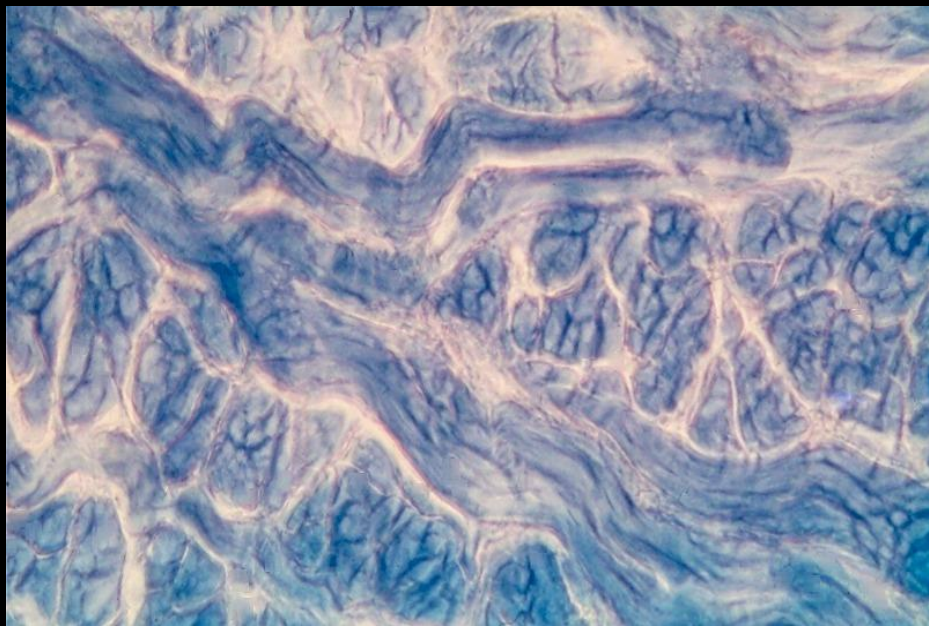
tenká kolagenní vlákna (HE)



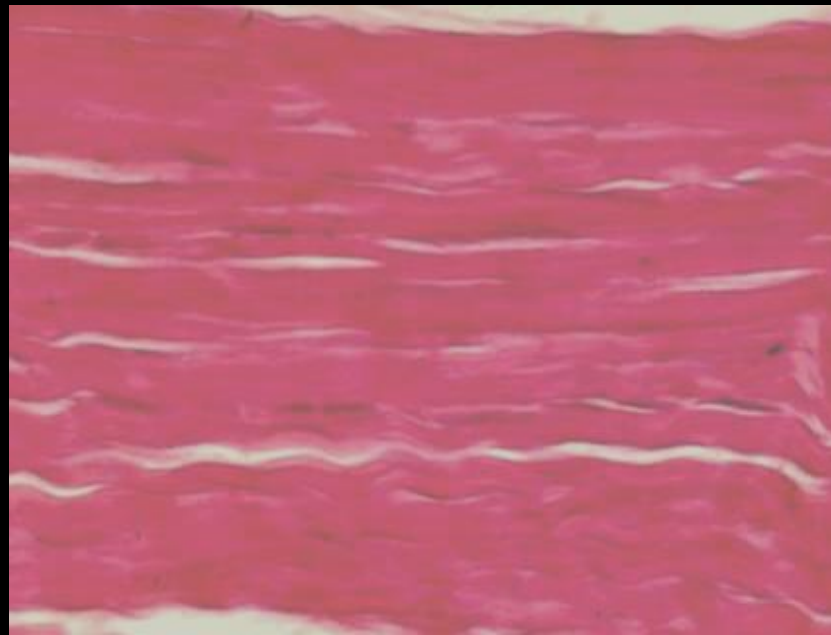
tlustá kolagenní vlákna (HE)



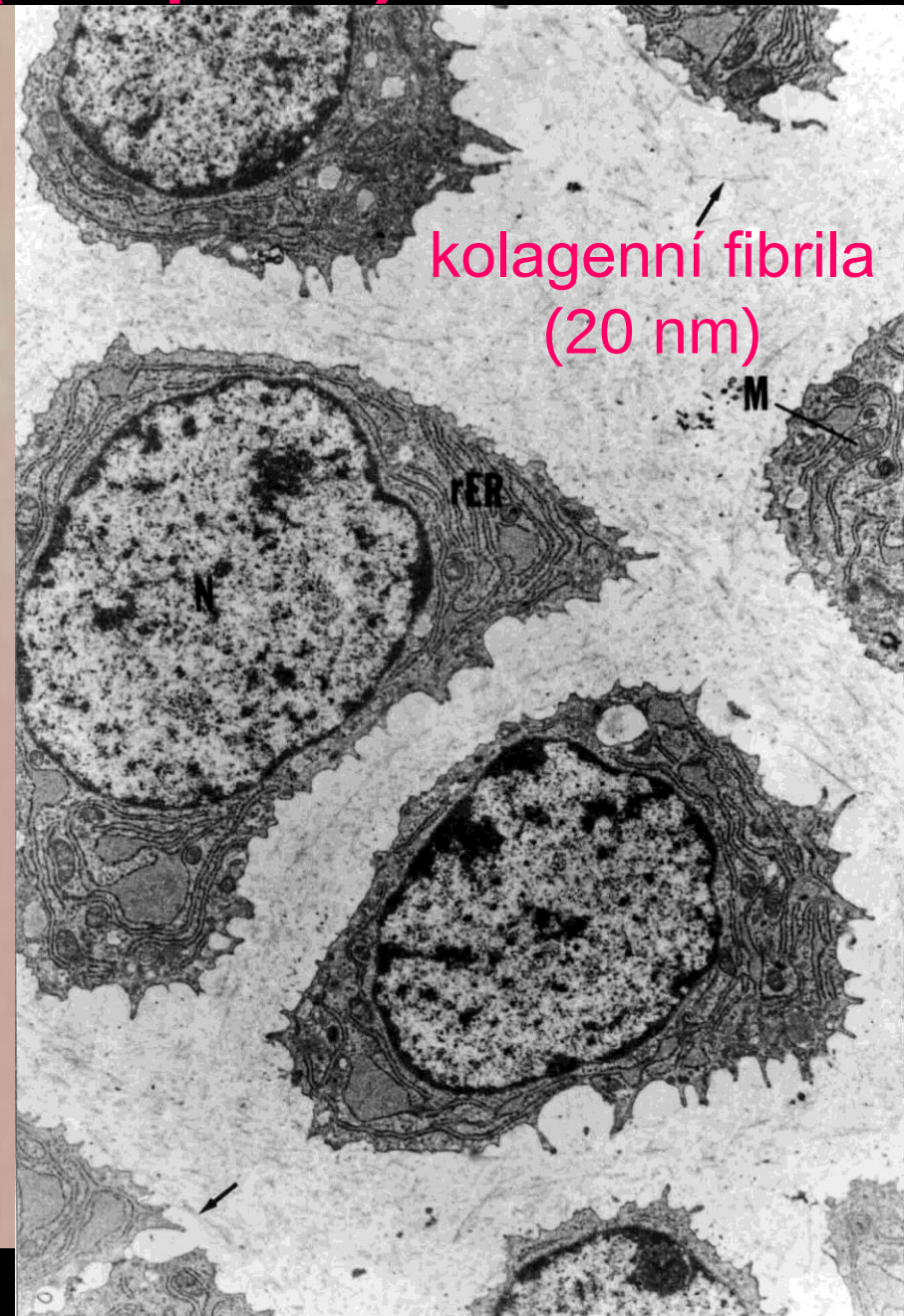
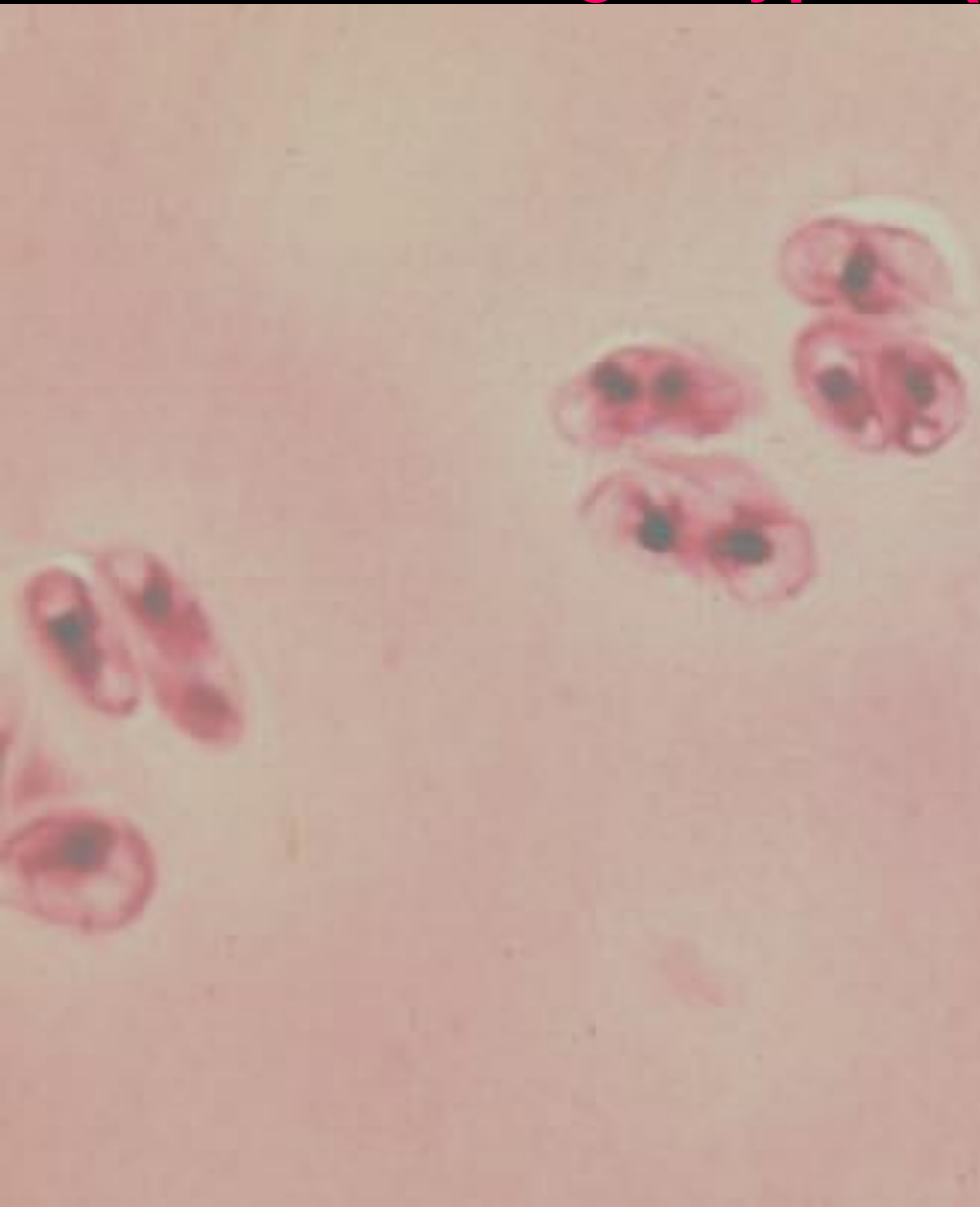
kolagenní vlákna (modrý trichrom)



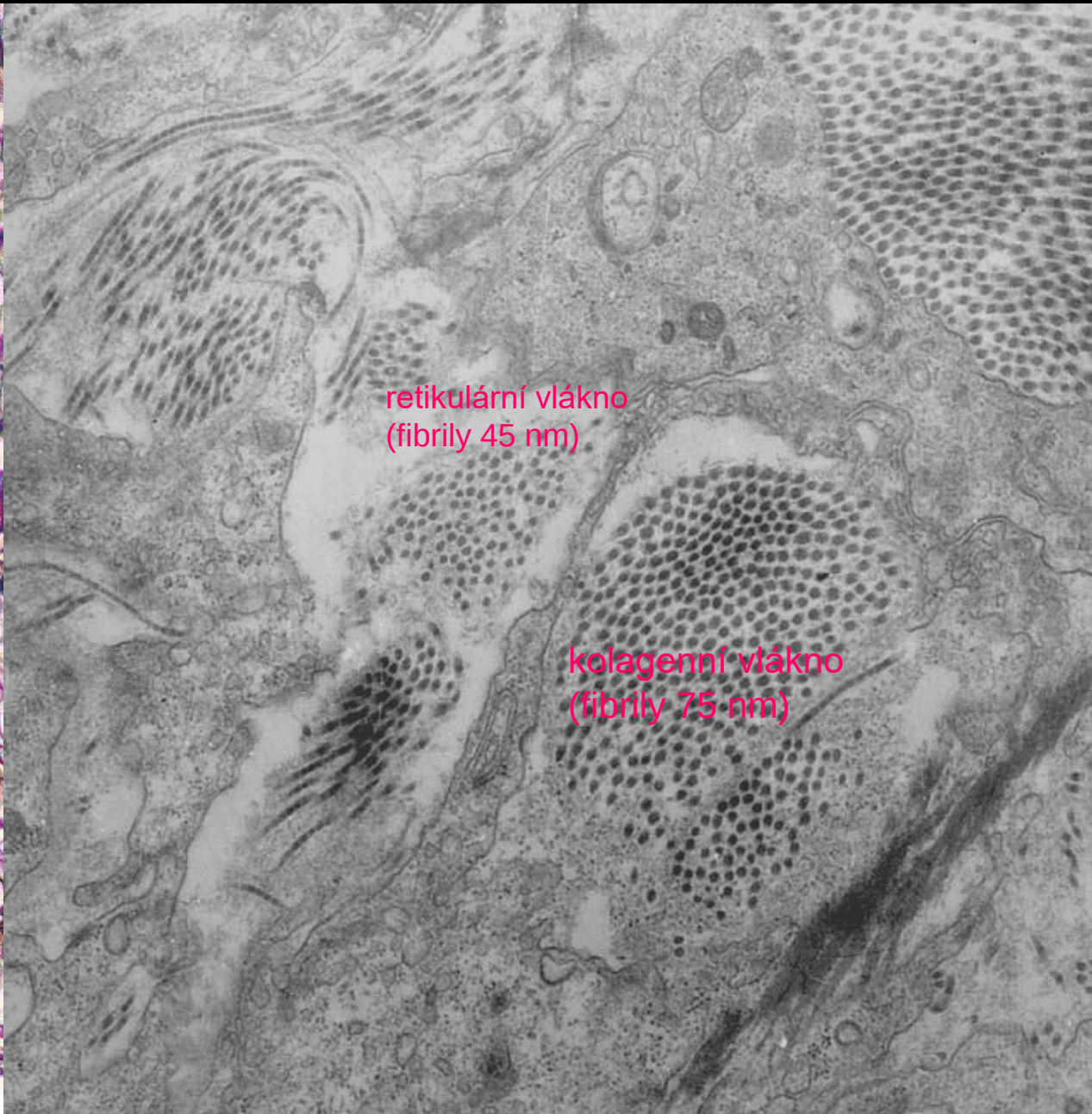
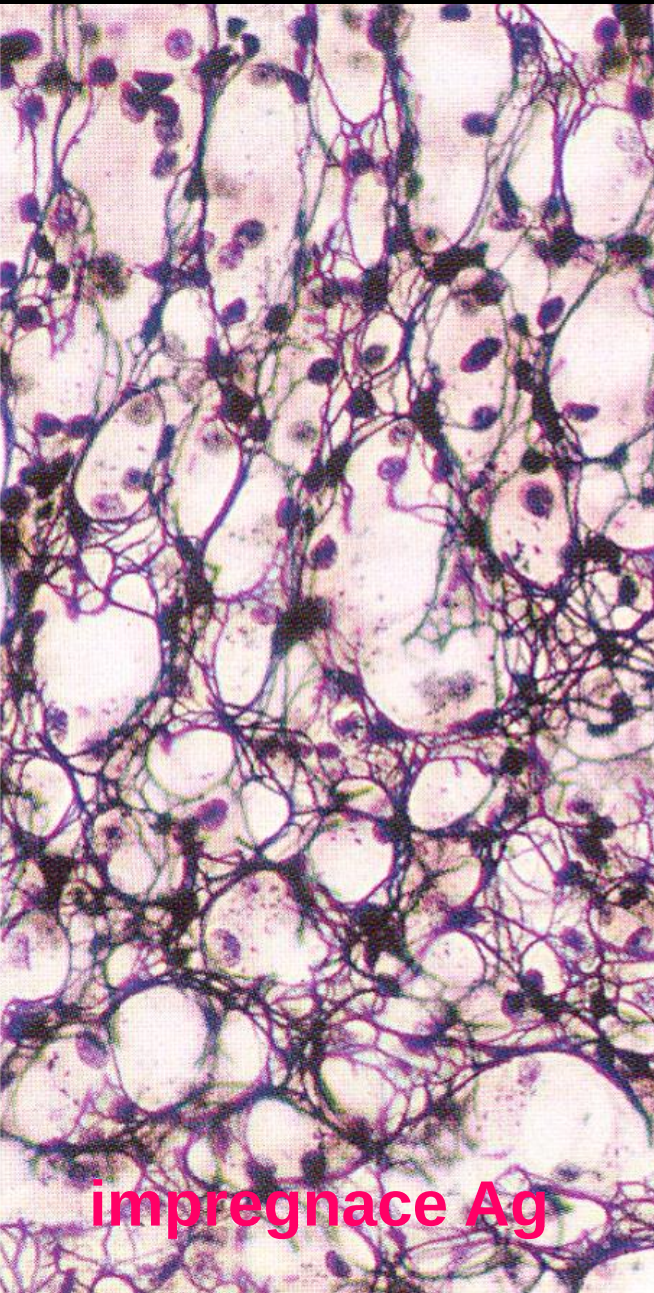
svazek kolagenních vláken (HE)



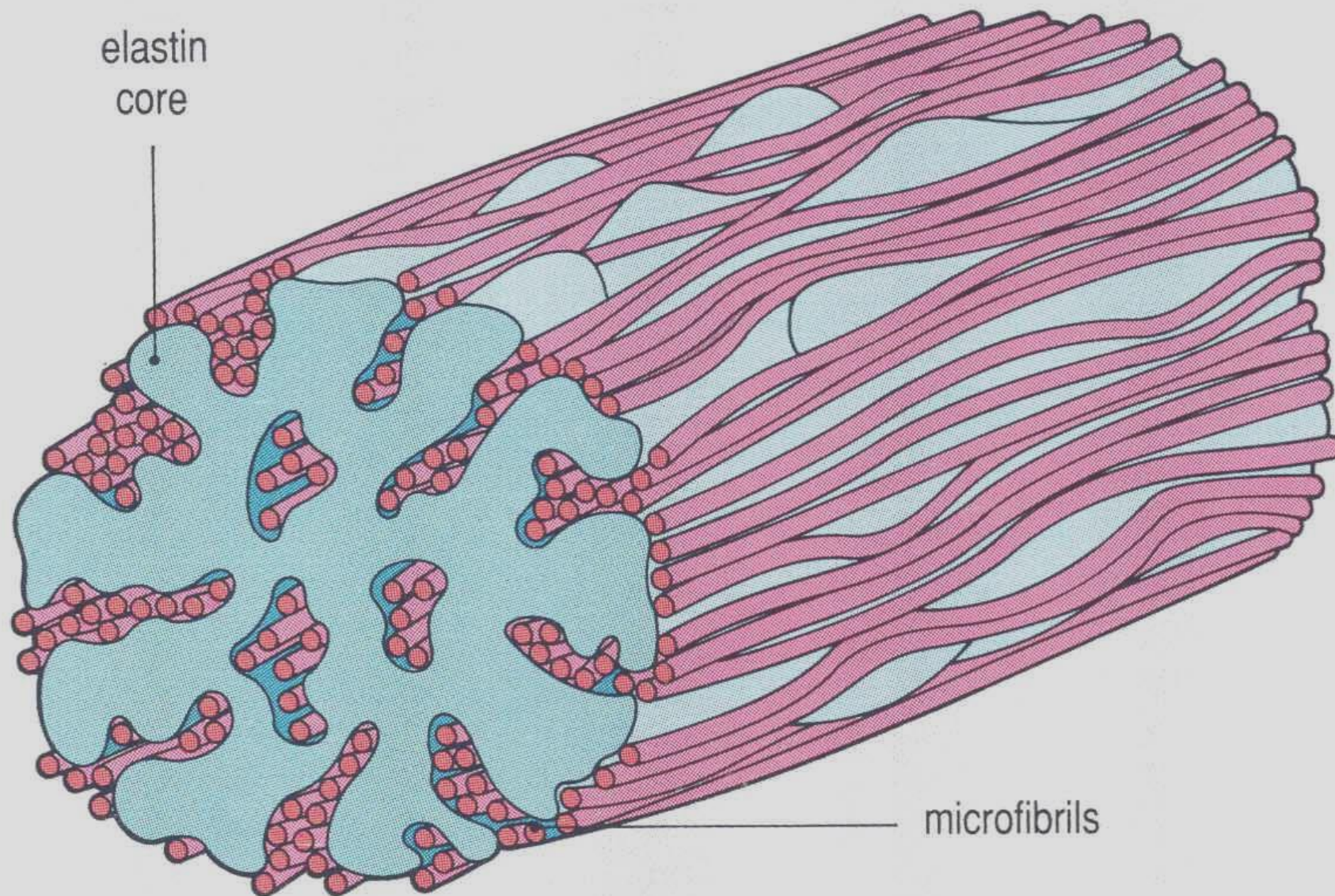
Kolagen typu II (chrupavka)



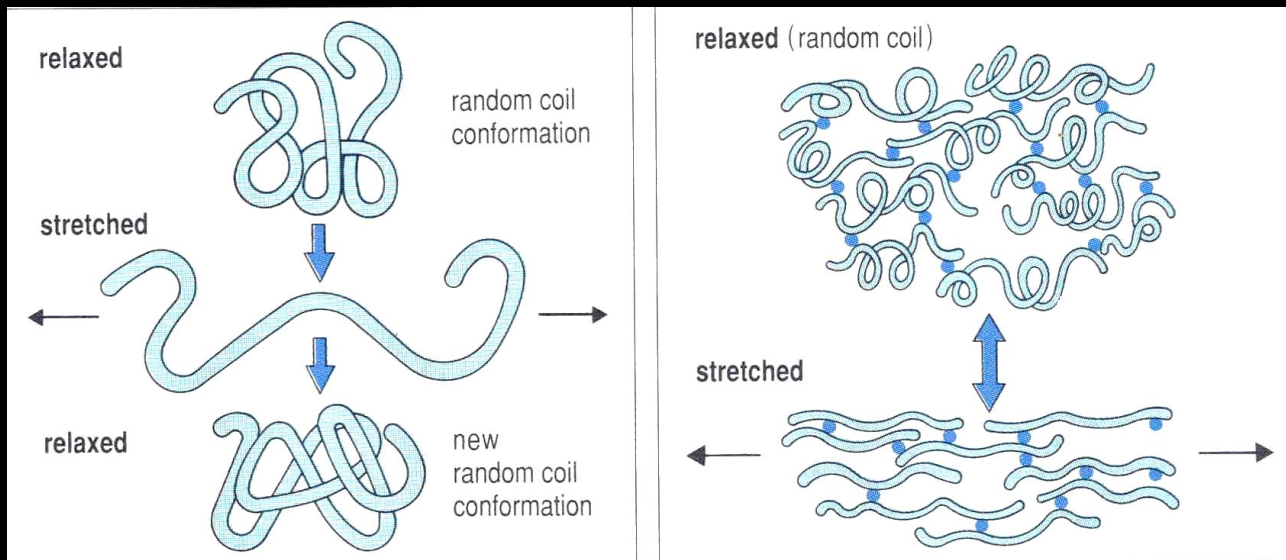
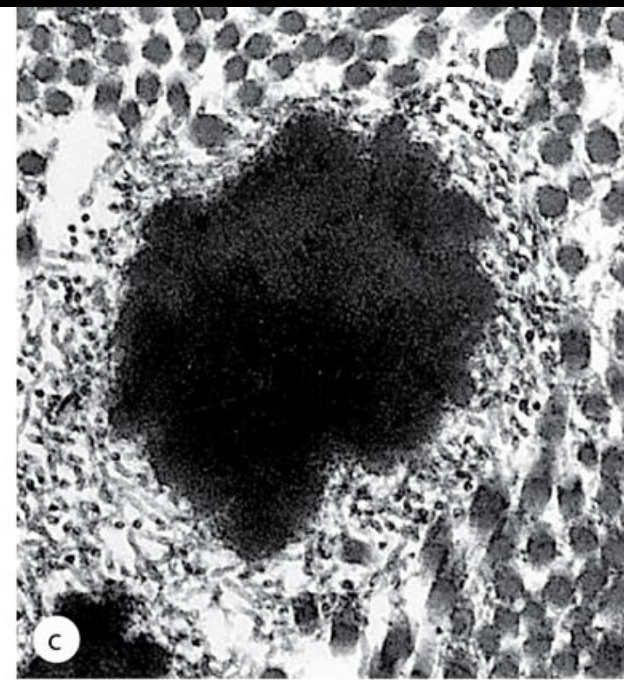
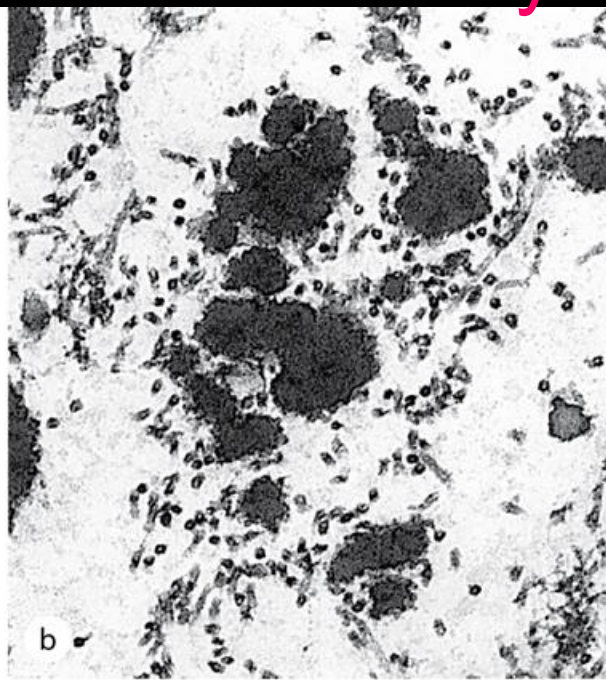
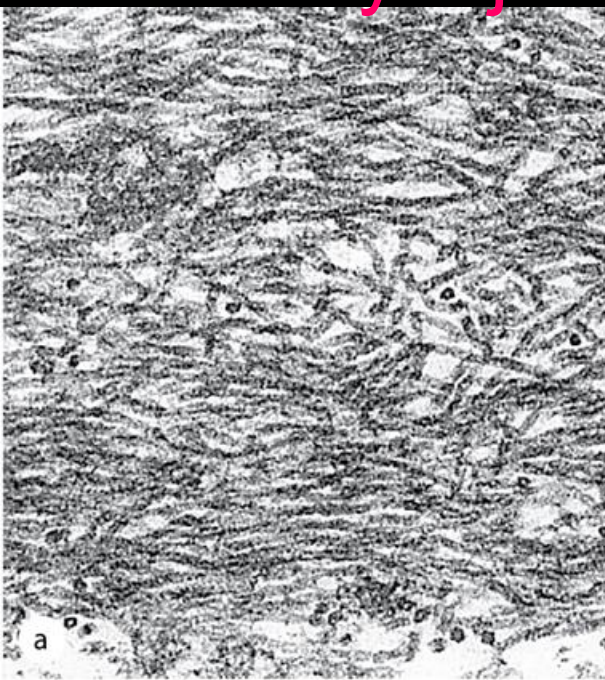
Kolagen typu III – retikulární vlákna

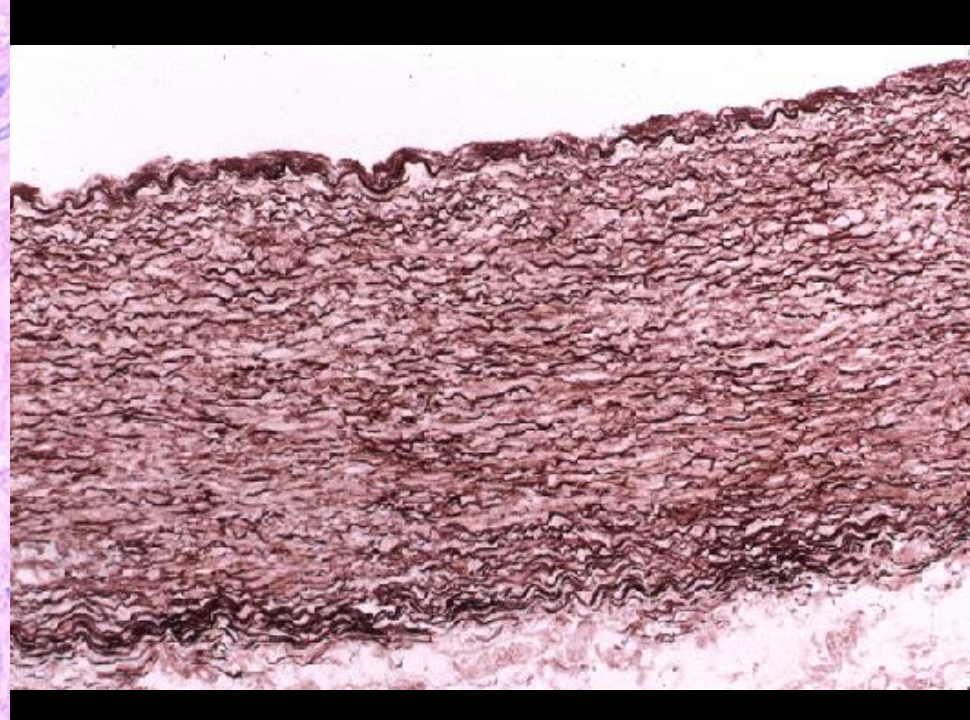
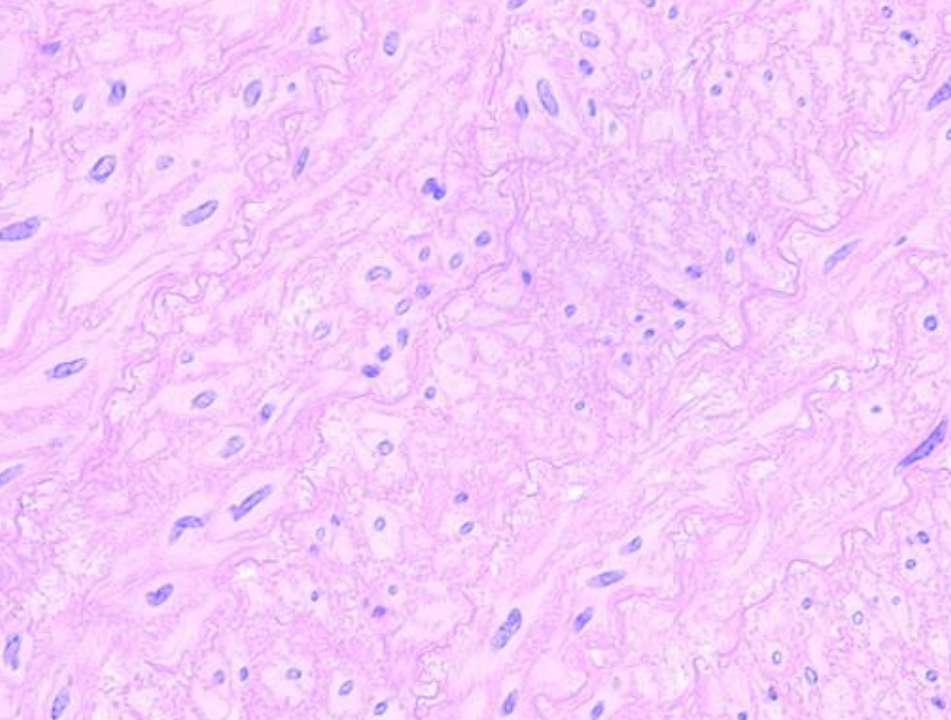
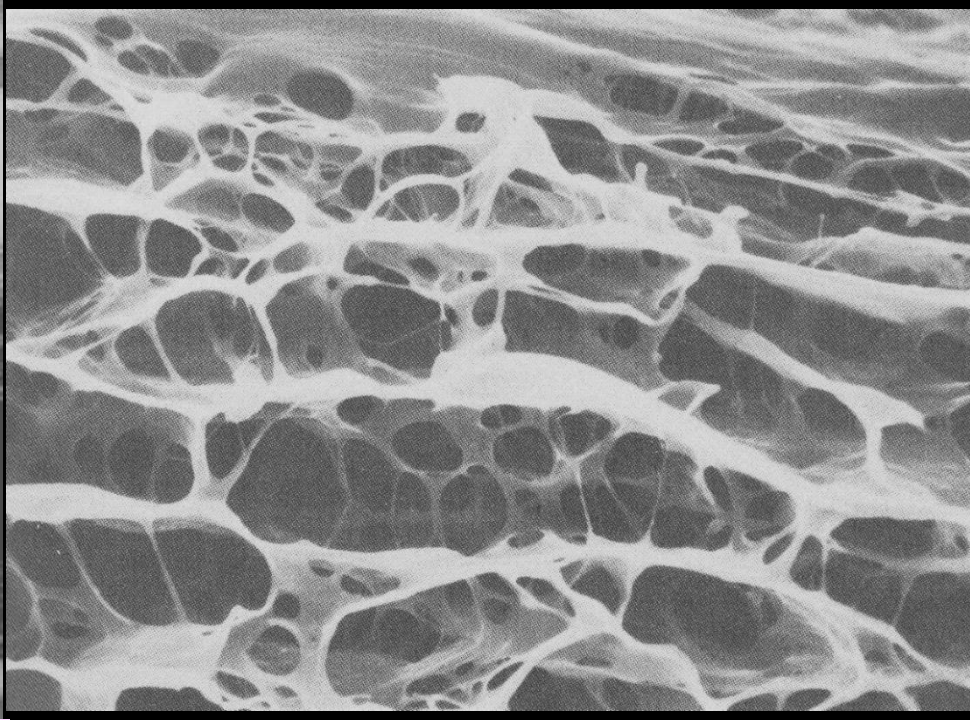
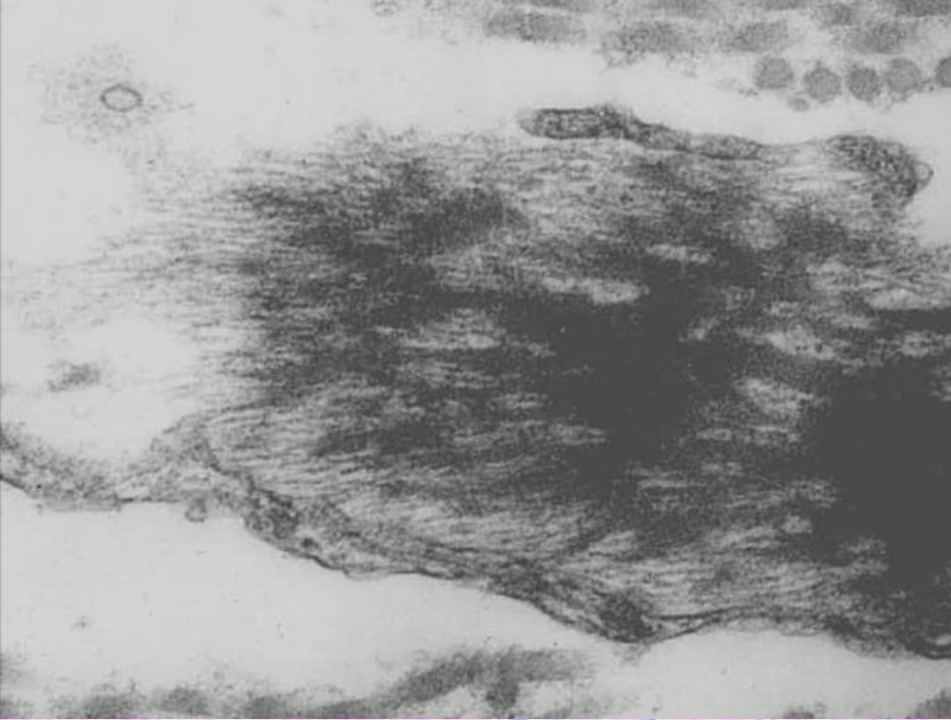


Elastické vlákno



vývoj a funkce elastických vláken





GLYKOSAMINOGLYKANY

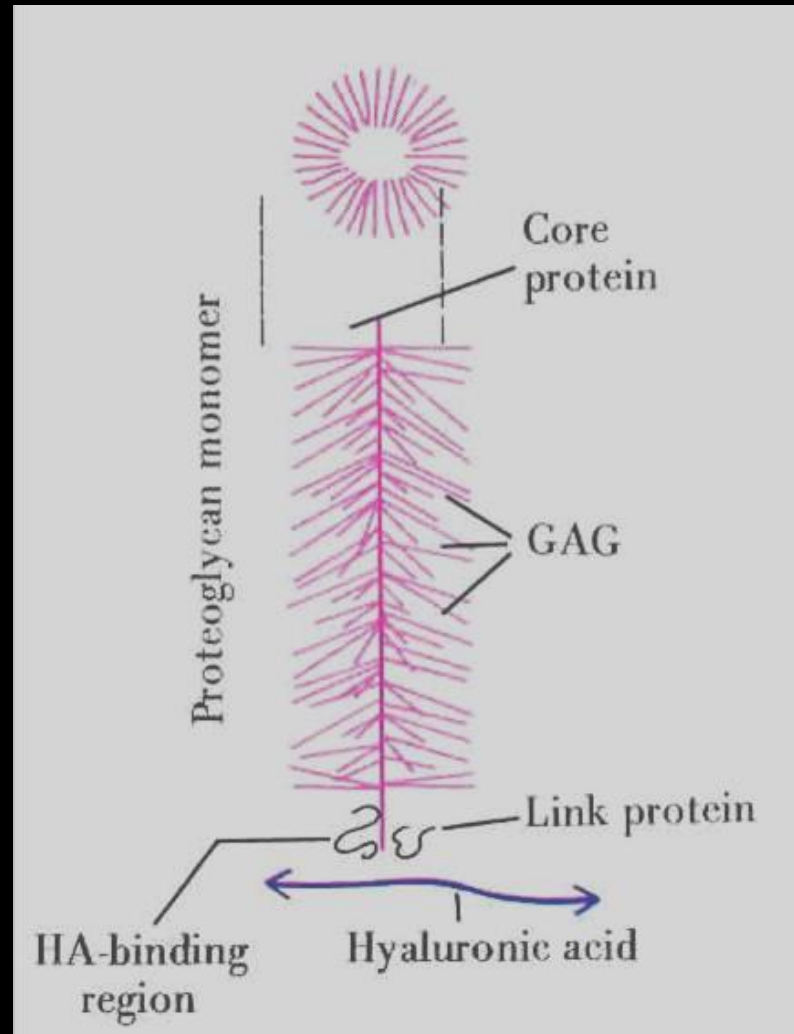
glykosaminoglykan	výskyt	stupeň interakce	typ kolagenu
hyaluronová kyselina	pupečník, synoviální tekutina, humor vitreus, chrupavka	—	—
chondroitin sulfát	chrupavka, kost, cornea, kůže, aorta (media)	+ + +	II.
dermatan sulfát	kůže, šlacha, aorta (adventicia)	+	I.
heparan sulfát	aorta, plíce, játra, bazální lamina	+ +	III., IV.
keratan sulfát	cornea, chrupavka, nucleus pulposus, annulus fibrosus	—	—

uronová kyselina + N-acetylovaný cukr

proteoglykany

GAGy + osový protein

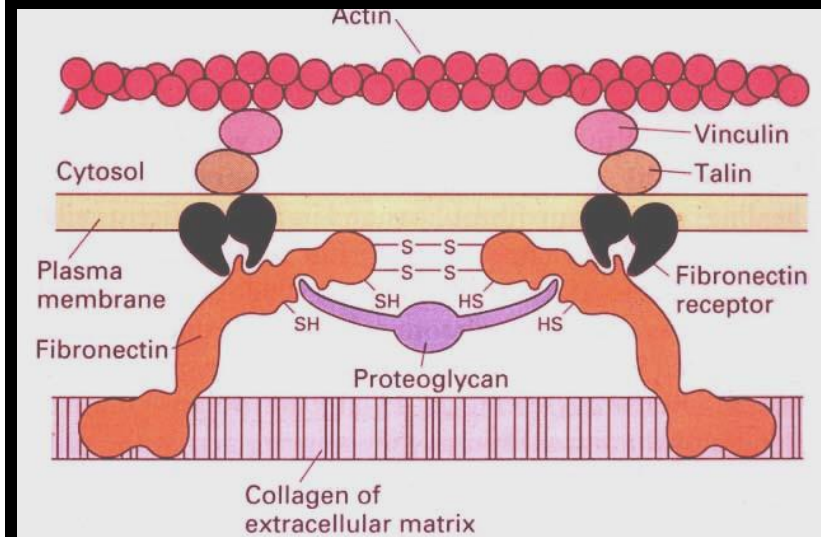
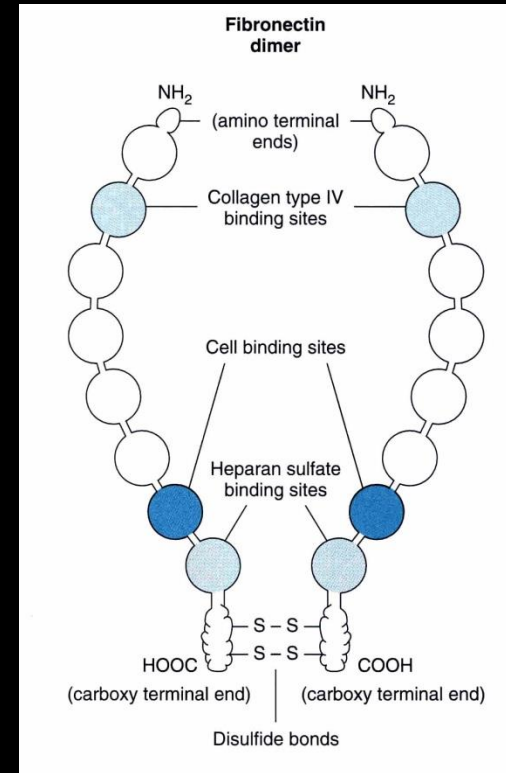
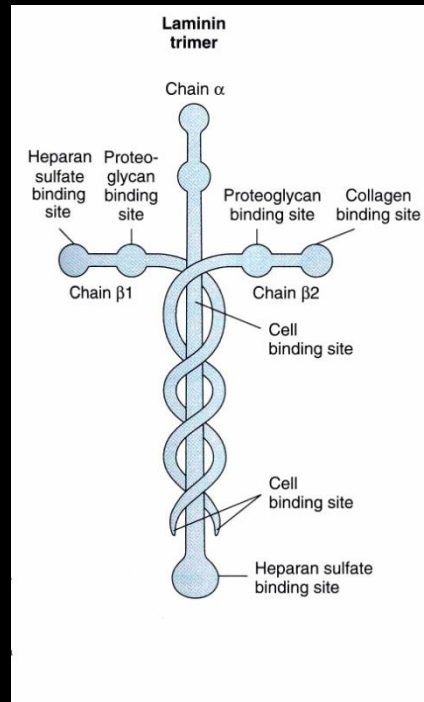
agregan
biglykan
perlekan
versikan
lumikan
atd.



strukturální glykoproteiny

glykosylované proteiny

fibronektin
chondronektin
osteonektin
osteopontin
fibrilin
vitronektin
tenasciny
laminin



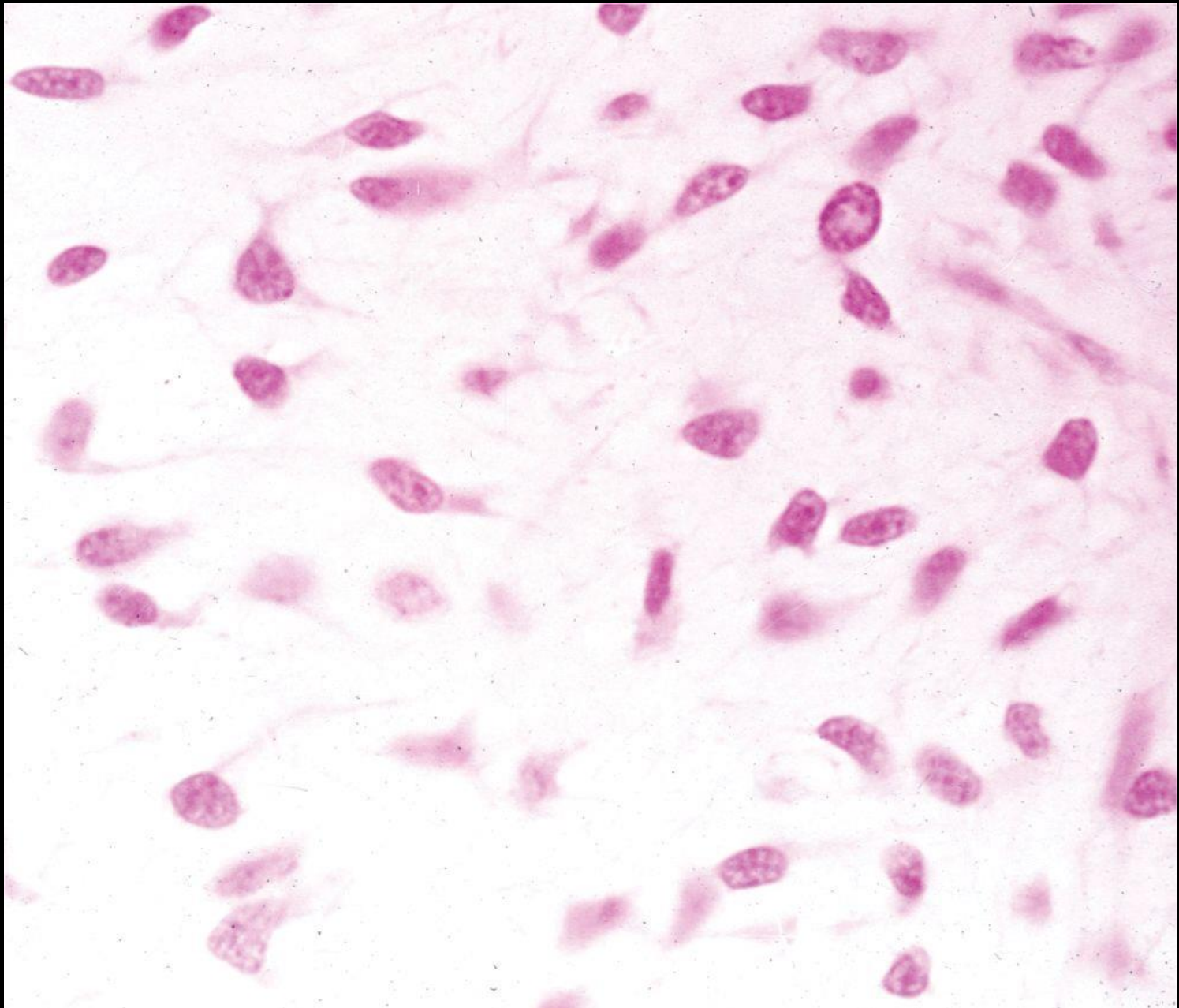
Tkáň vazivová a její typy

- **fixní buňky**
fibroblasty, fibrocyty, myofibroblasty,
retikulární buňky, adipocyty
- **bloudivé buňky**
makrofágy, žírné buňky, plasmatické buňky,
leukocyty
- **vláknitá složka mezibuněčné hmoty**
všechny 3 typy vláken
- **amorfní složka mezibuněčné hmoty**
gelová konsistence, kyselina hyaluronová,
dermatansulfát, fibronectin

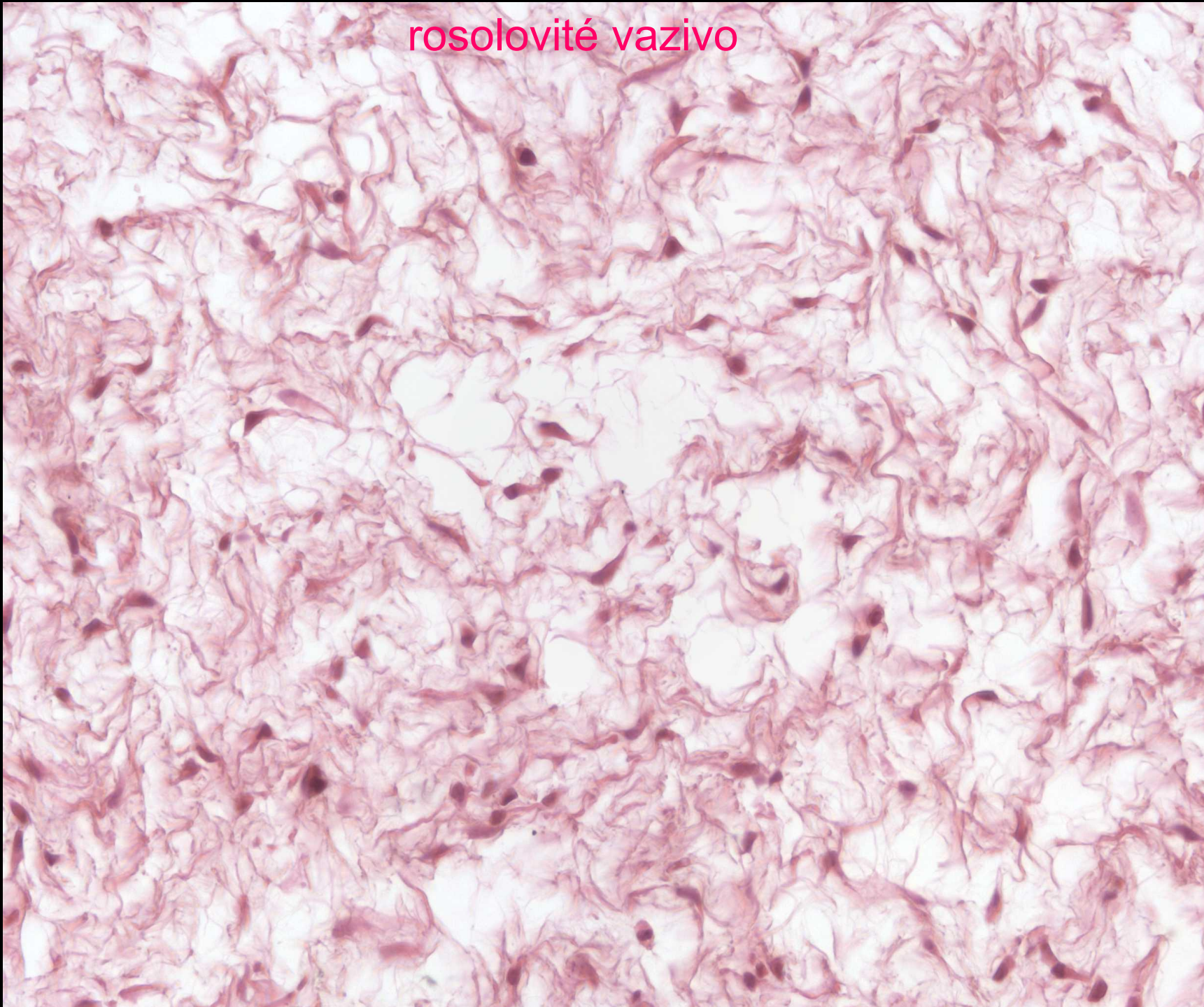
Typy vaziva

- **mesenchymové** – embryonální tkáň, mesenchymové buňky, málo mezibuněčné hmoty
- **rosolovité** – pupečník (Whartonův rosol), zubní dřeň, fibroblasty, kyselina hyaluronová, retikulární vlákna
- **kolagenní** – nejběžnější, všechny složky
 - **řídke** – tenká vlákna, více buněk (fibroblasty, mnoho volných b)
 - **husté** – uspořádané (šlachy, vazy) a **neuspořádané** (orgánová pouzdra, škára), tlustá vlákna (kol.), méně buněk (fibrocyty)
- **retikulární** – lymfatické orgány, kostní dřeň, retikulární buňky, retikulární vlákna
- **elastické** – žluté vazy páteře, fibrocyty, elastická vlákna
- **tukové** – **bílé** (univakuolární adipocyty) a **hnědé** (multivakuolární adipocyty), málo mezibuněčné hmoty (retikulární vlákna)

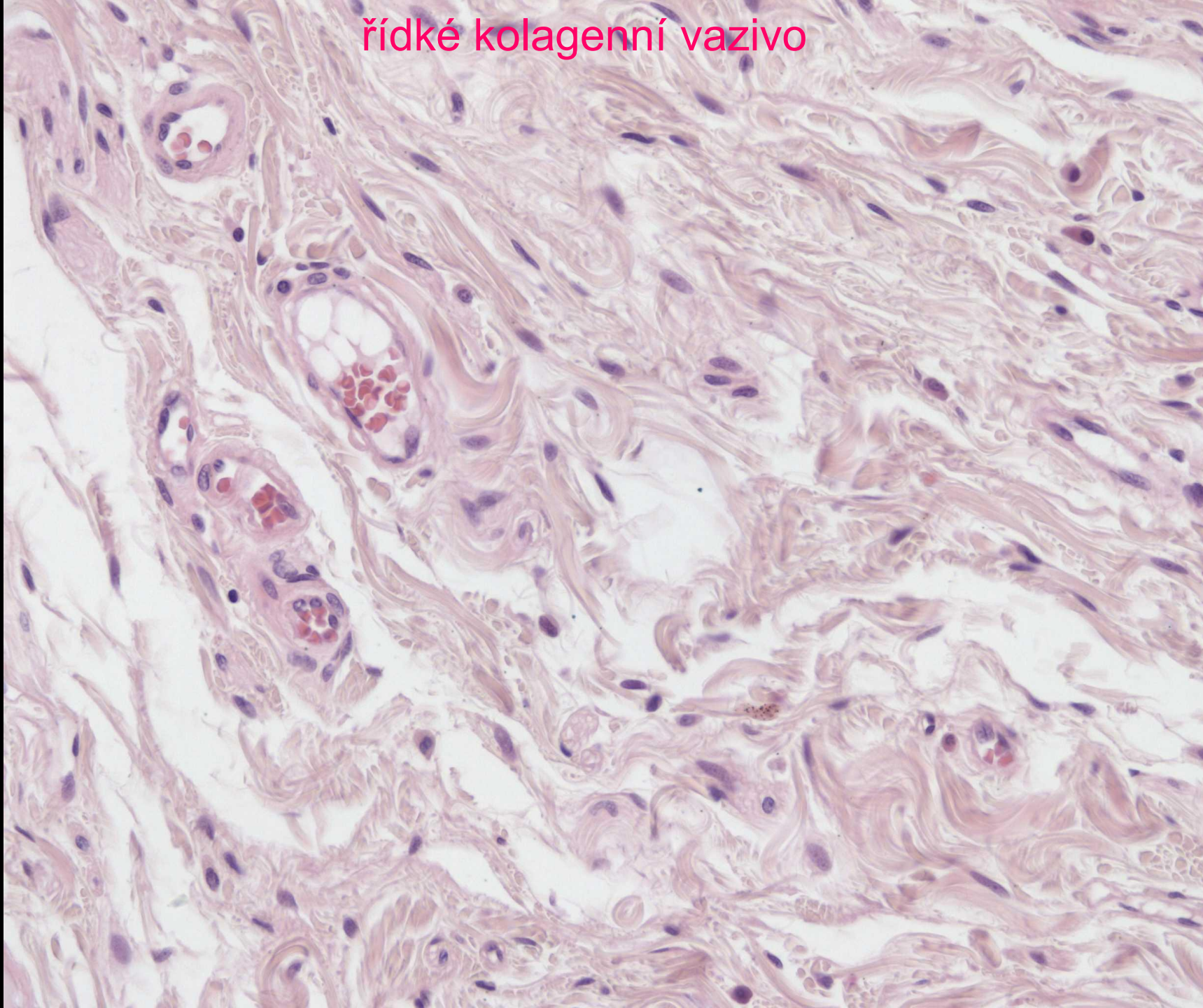
mesenchymové vazivo



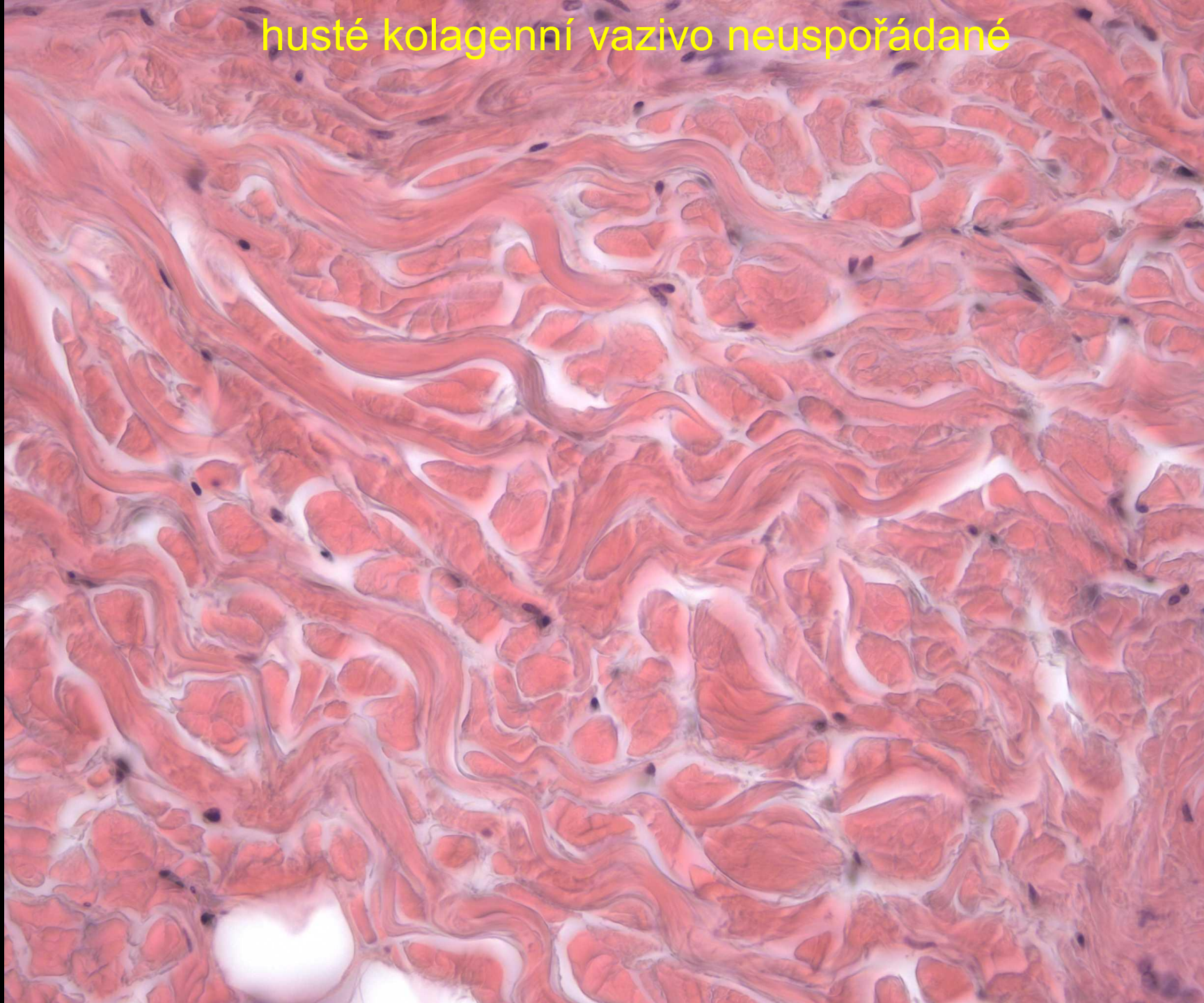
rosolovitě vazivo



řidké kolagenní vazivo



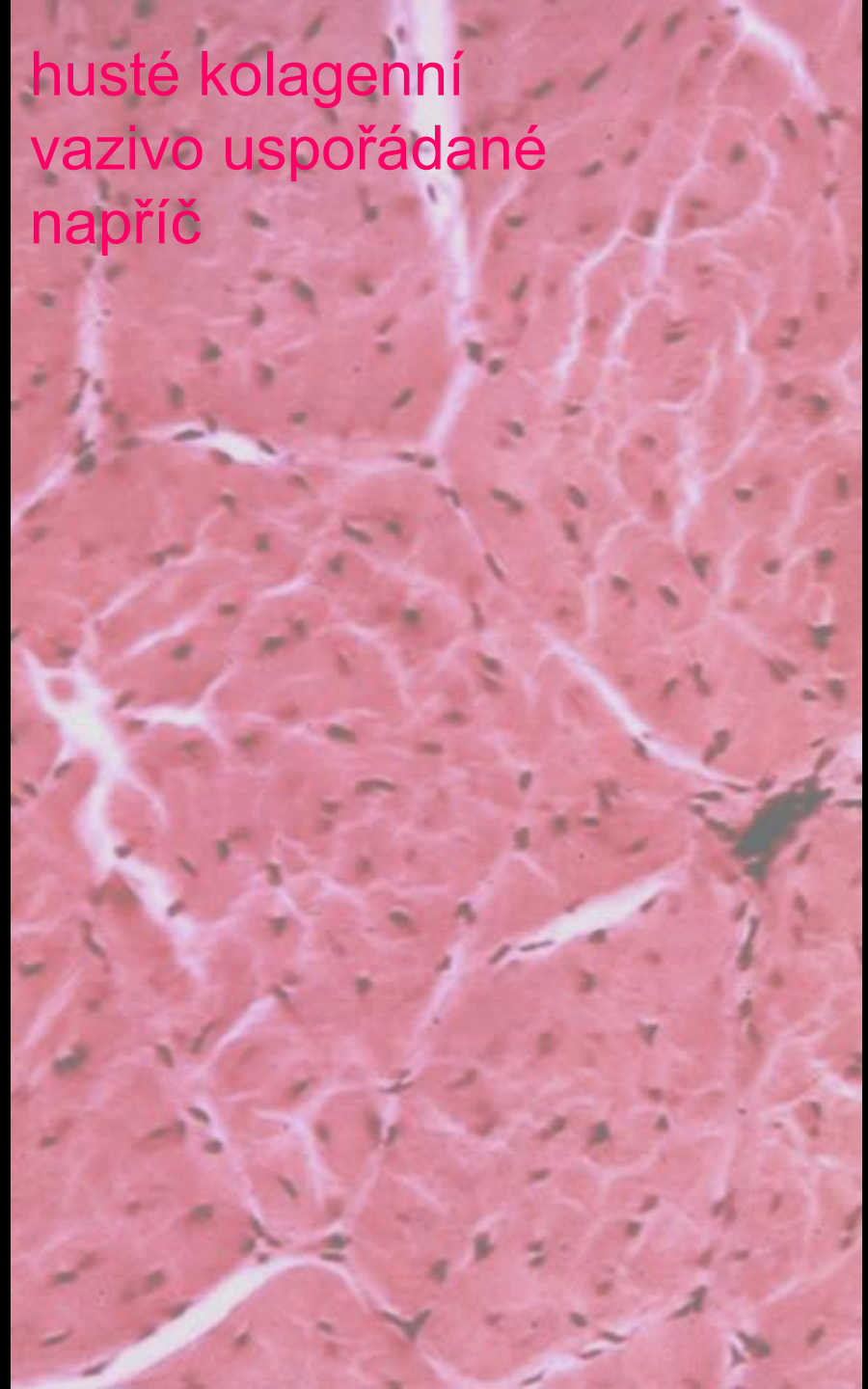
husté kolagenní vazivo neuspořádané



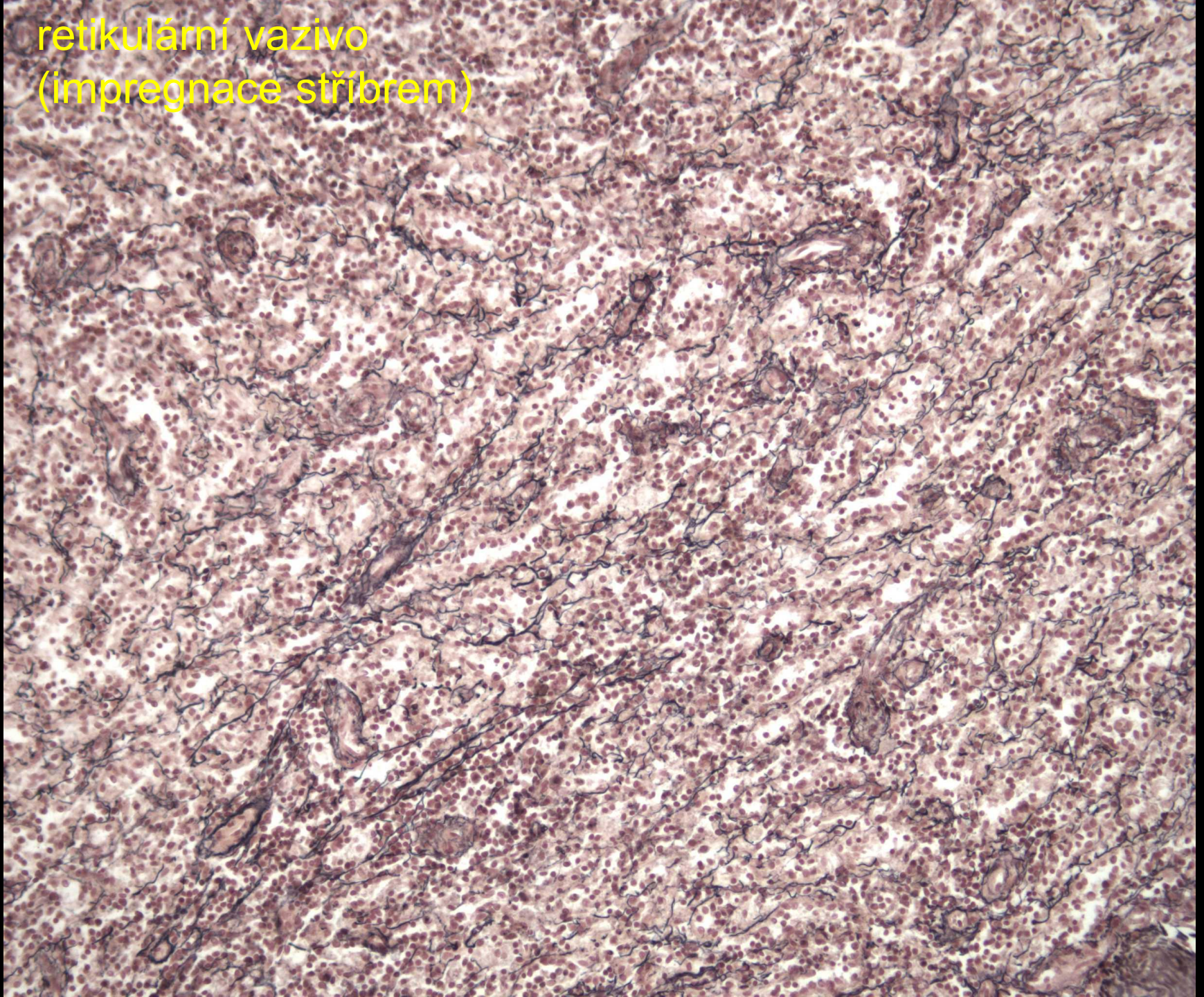
husté kolagenní
vazivo uspořádané
podél



husté kolagenní
vazivo uspořádané
napříč



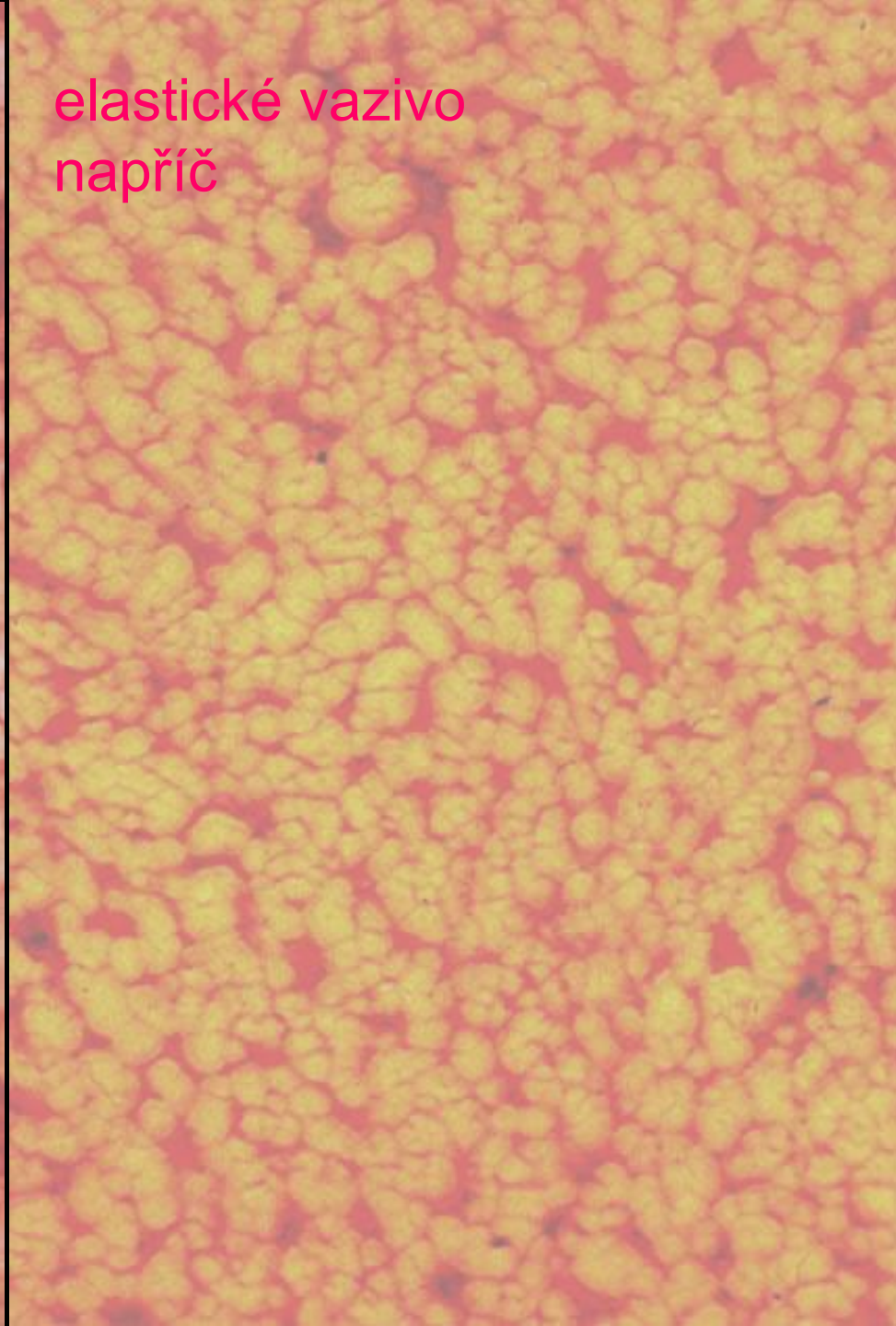
retikulární vazivo
(impregnace stříbrem)



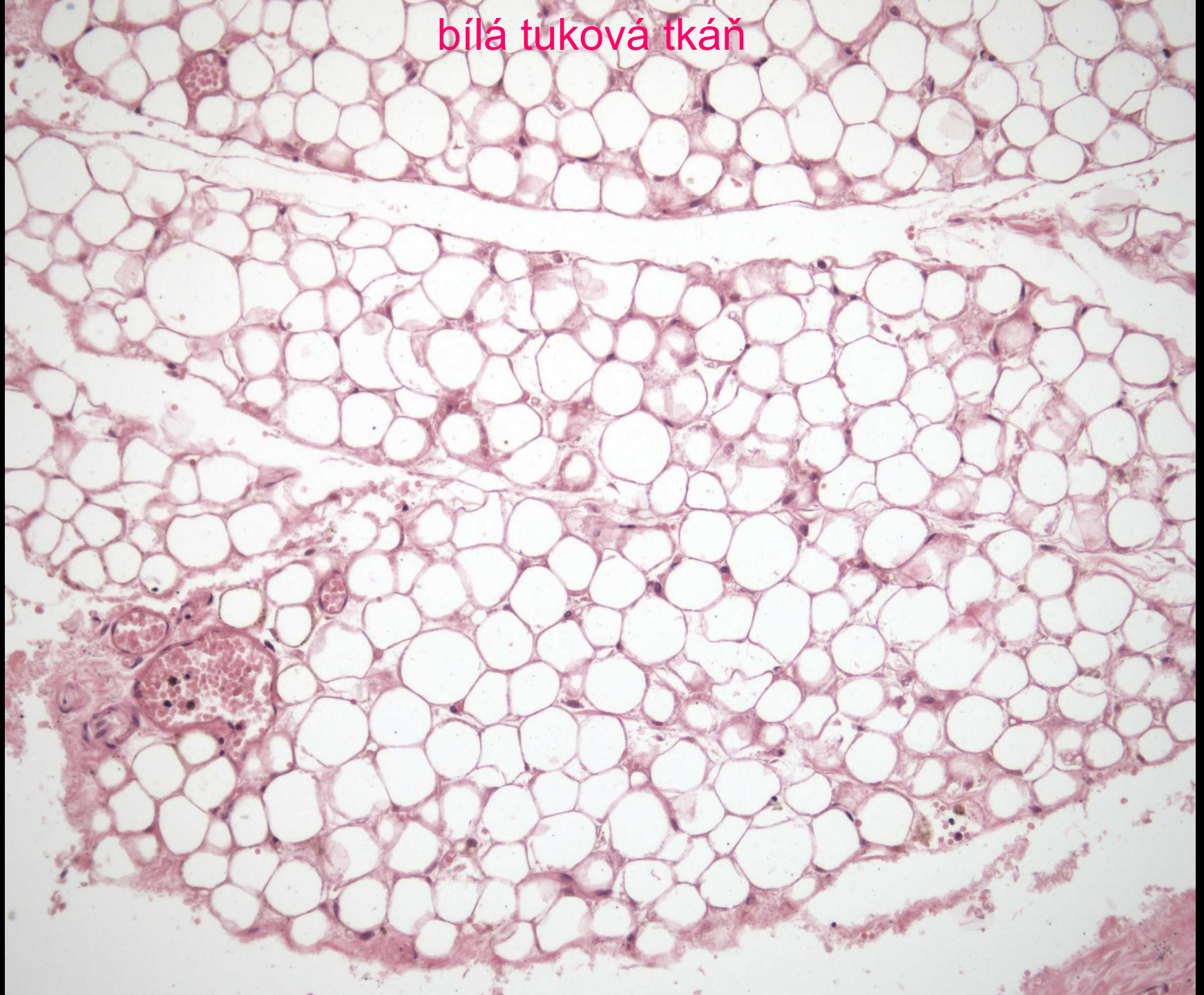
elastické vazivo
podél



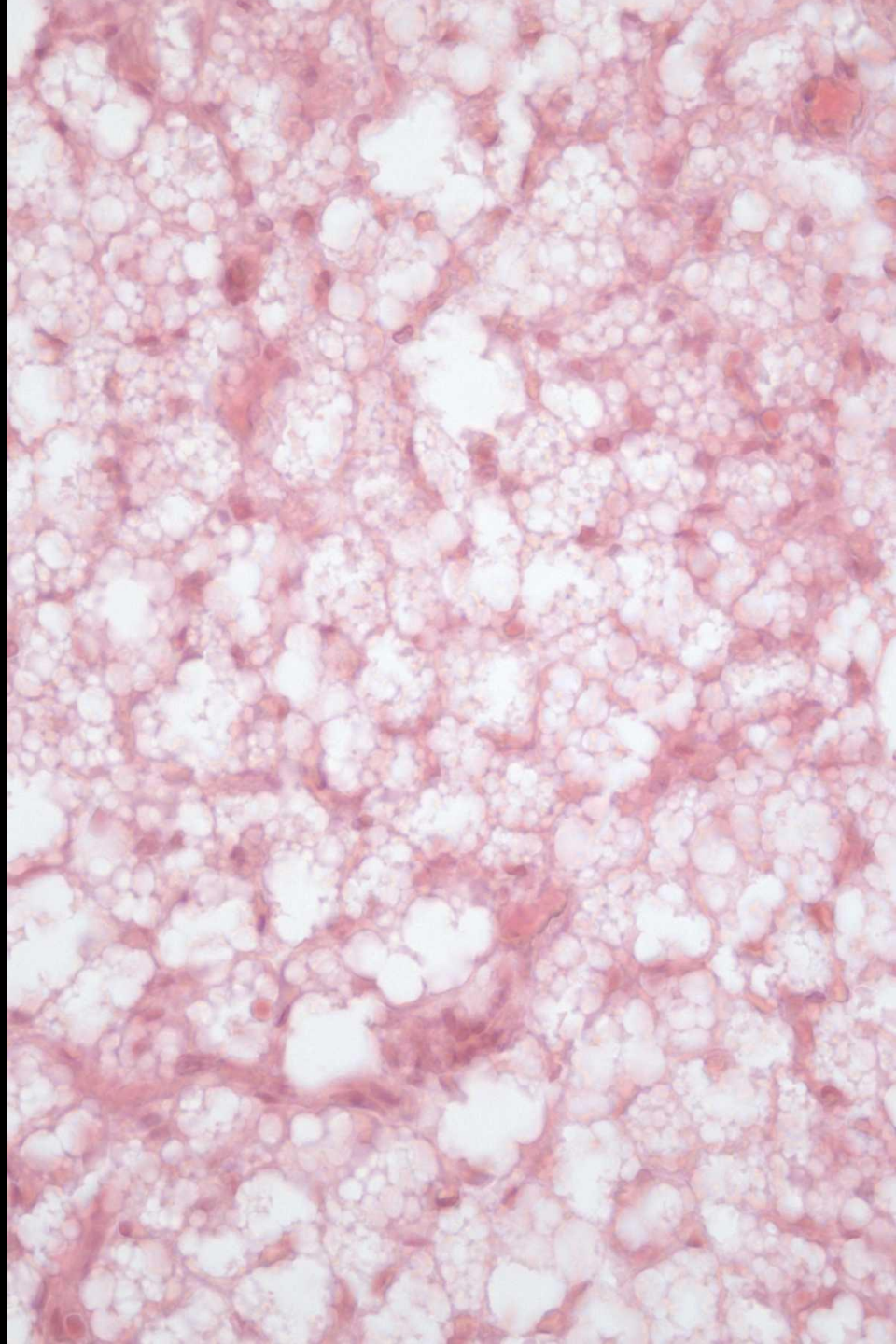
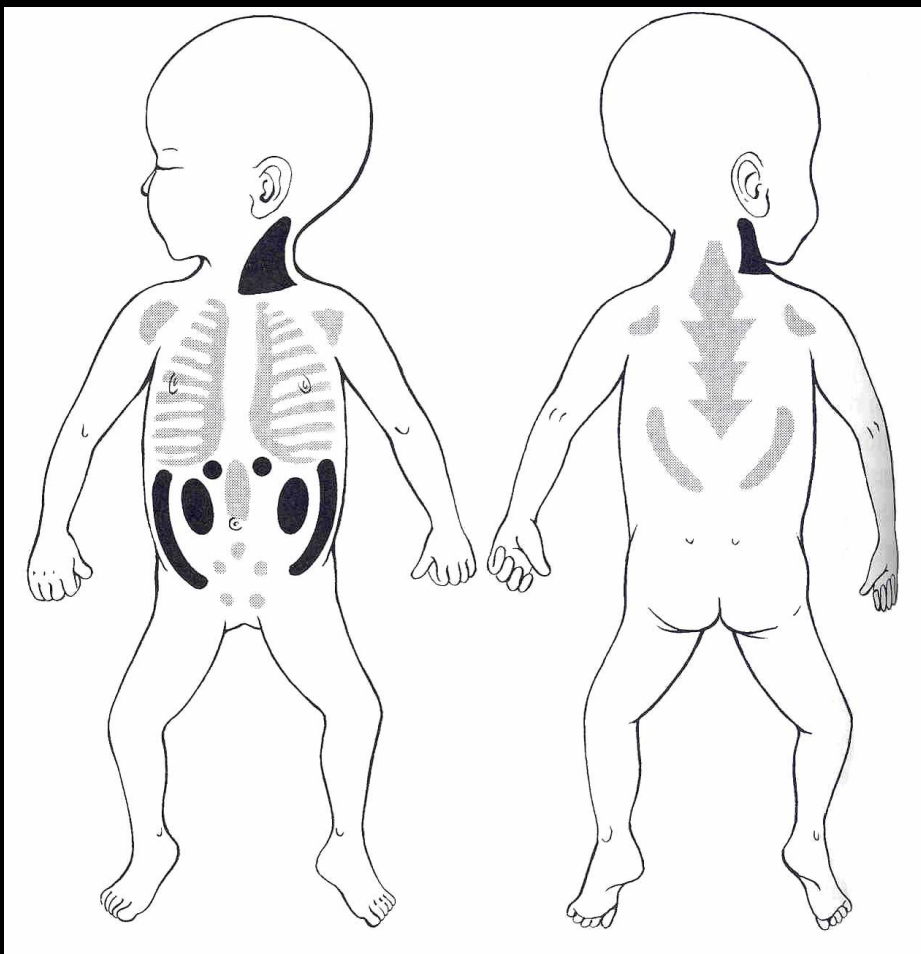
elastické vazivo
napříč



bílá tuková tkáň

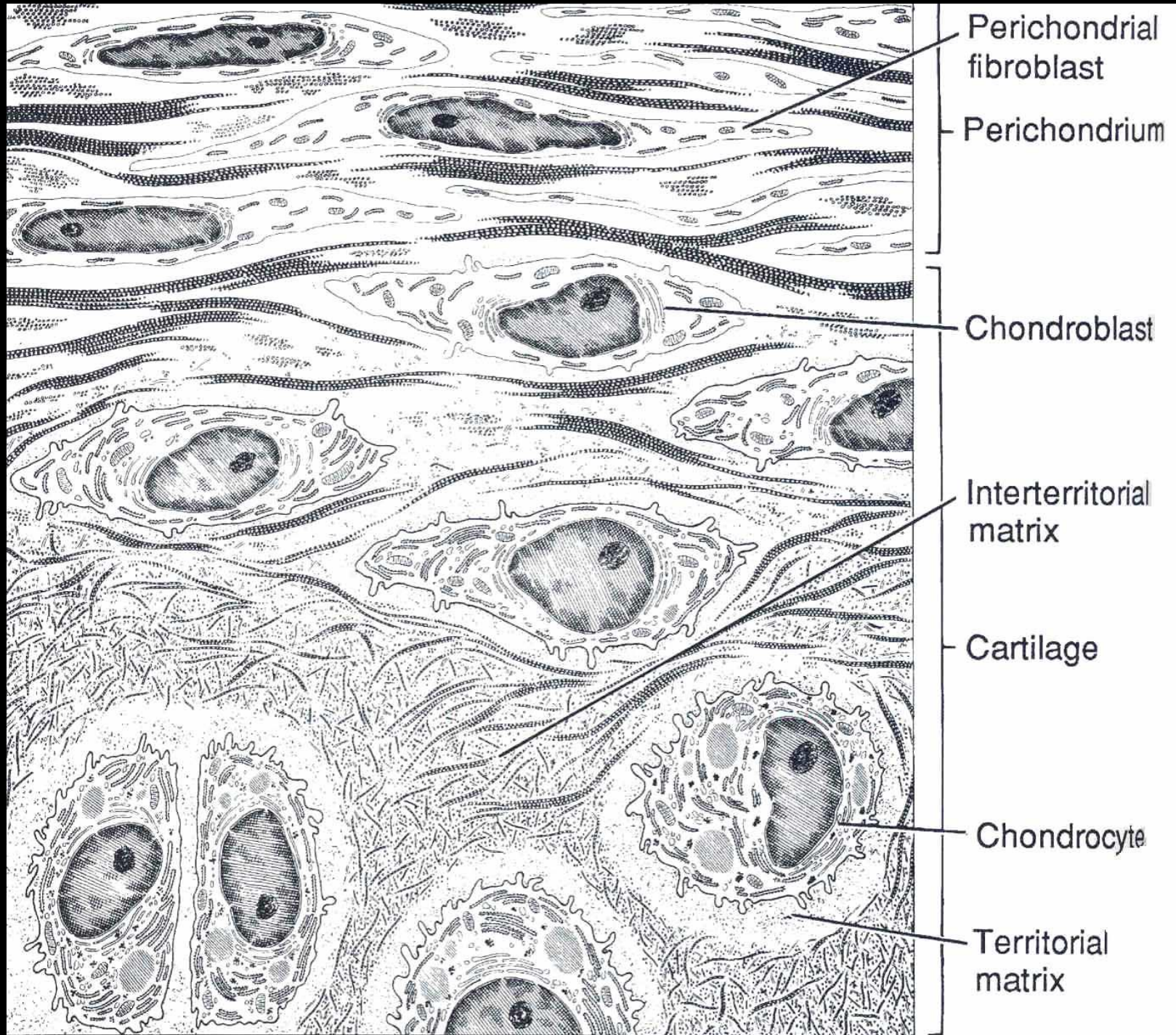


hnědá tuková tkáň

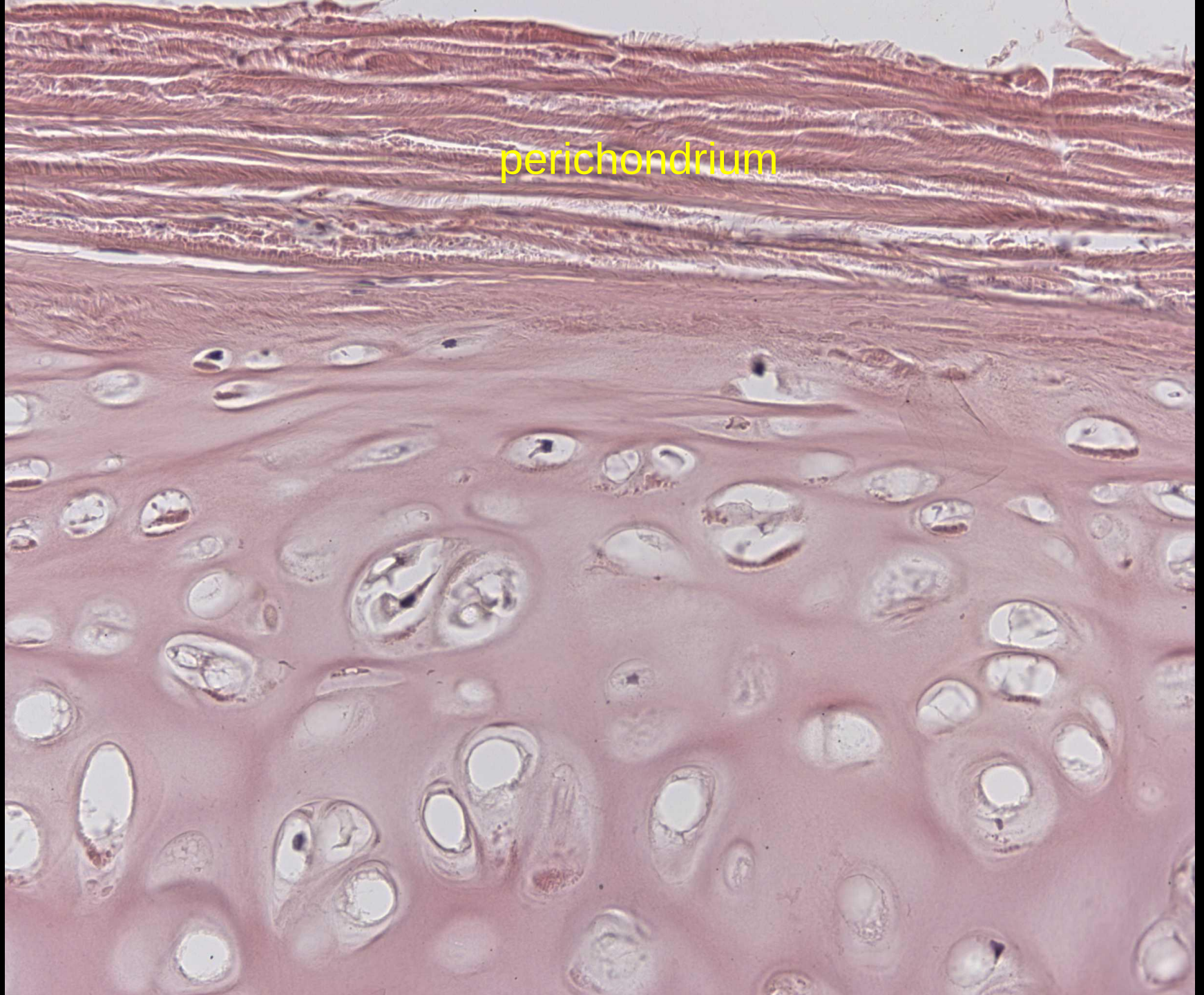


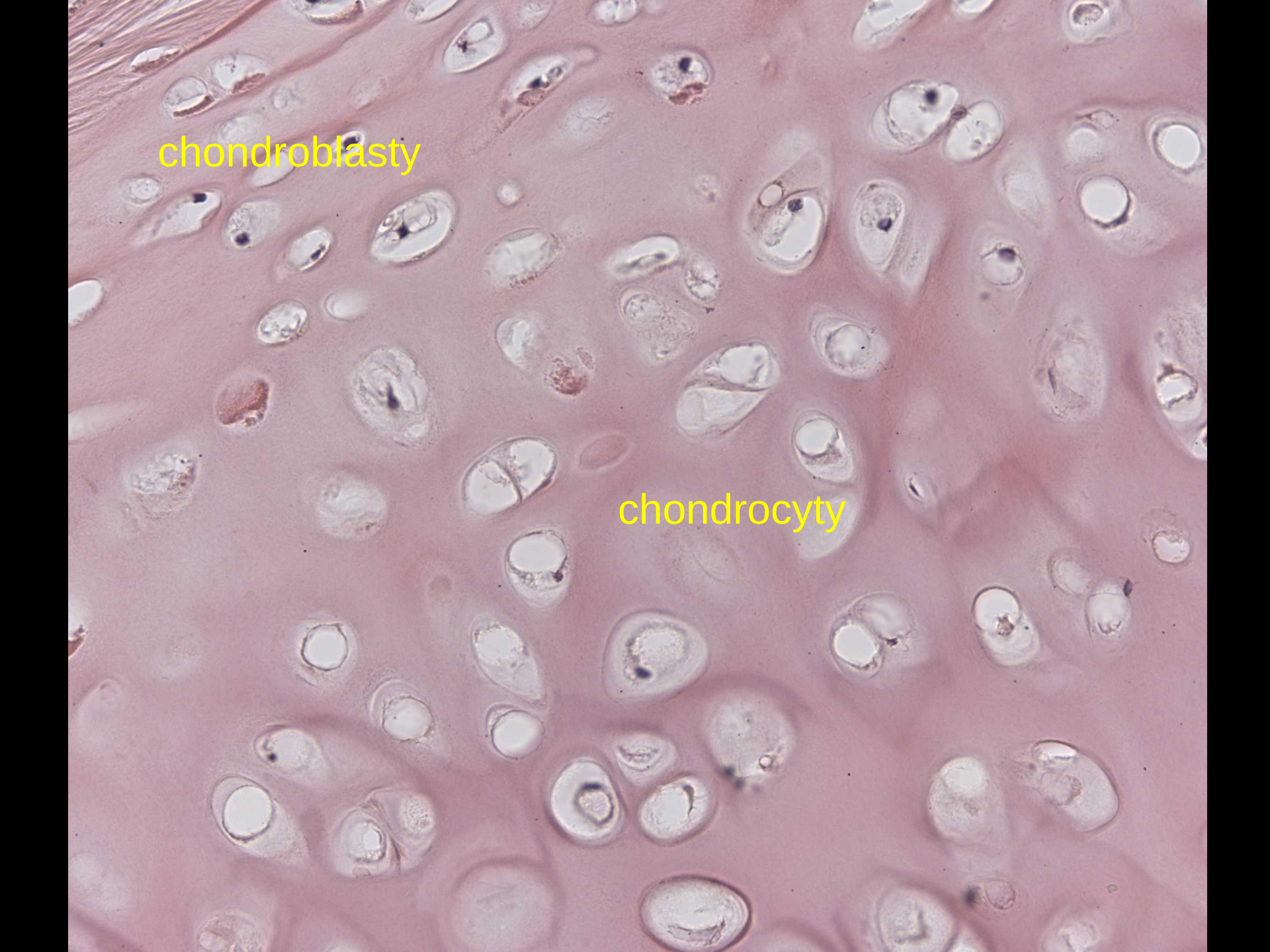
Chrupavka – obecná stavba

- **fixní buňky**
chondroblasty, chondrocyty
- **bloudivé buňky**
chondroklasty
- **vláknitá složka mezibuněčné hmoty**
vždy kolagen typu II
elastická chrupavka ještě elastická vlákna
vazivová chrupavka ještě kolagenní vlákna
- **amorfní složka mezibuněčné hmoty**
pevná a pružná konsistence
agregáty složené z kyseliny hyaluronové
a proteoglykanů s obsahem chondroitinsulfátu
a keratansulfátu, chondronektin



perichondrium



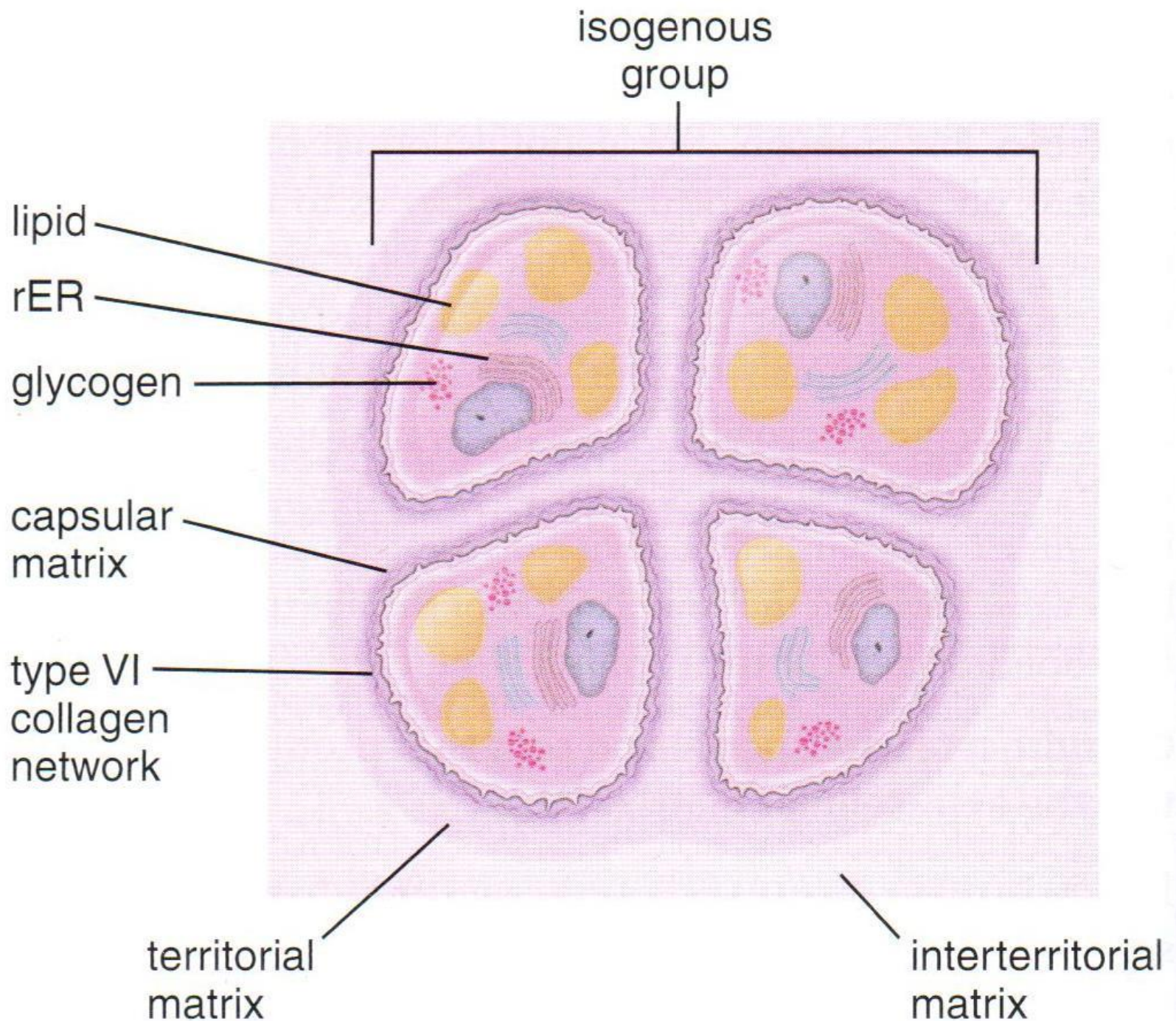
A histological micrograph of cartilage tissue. The image shows numerous cells embedded in a pink-stained extracellular matrix. Some cells are small and dark, while others are larger and more rounded. The labels 'chondroblasty' and 'chondrocyty' are overlaid in yellow text.

chondroblasty

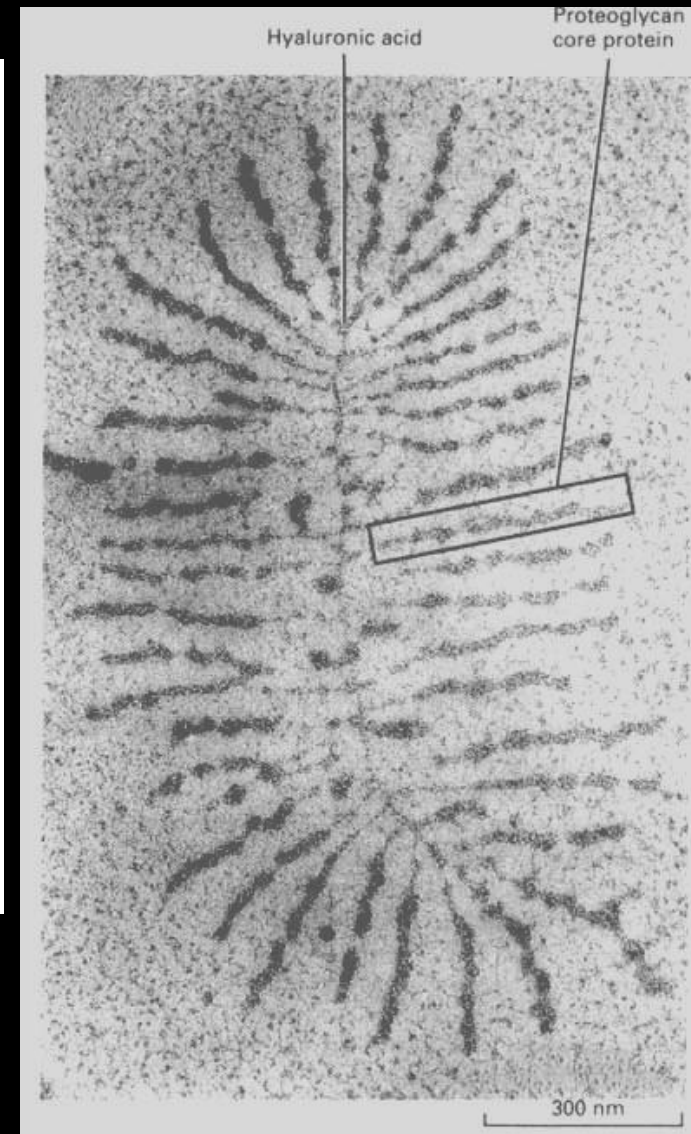
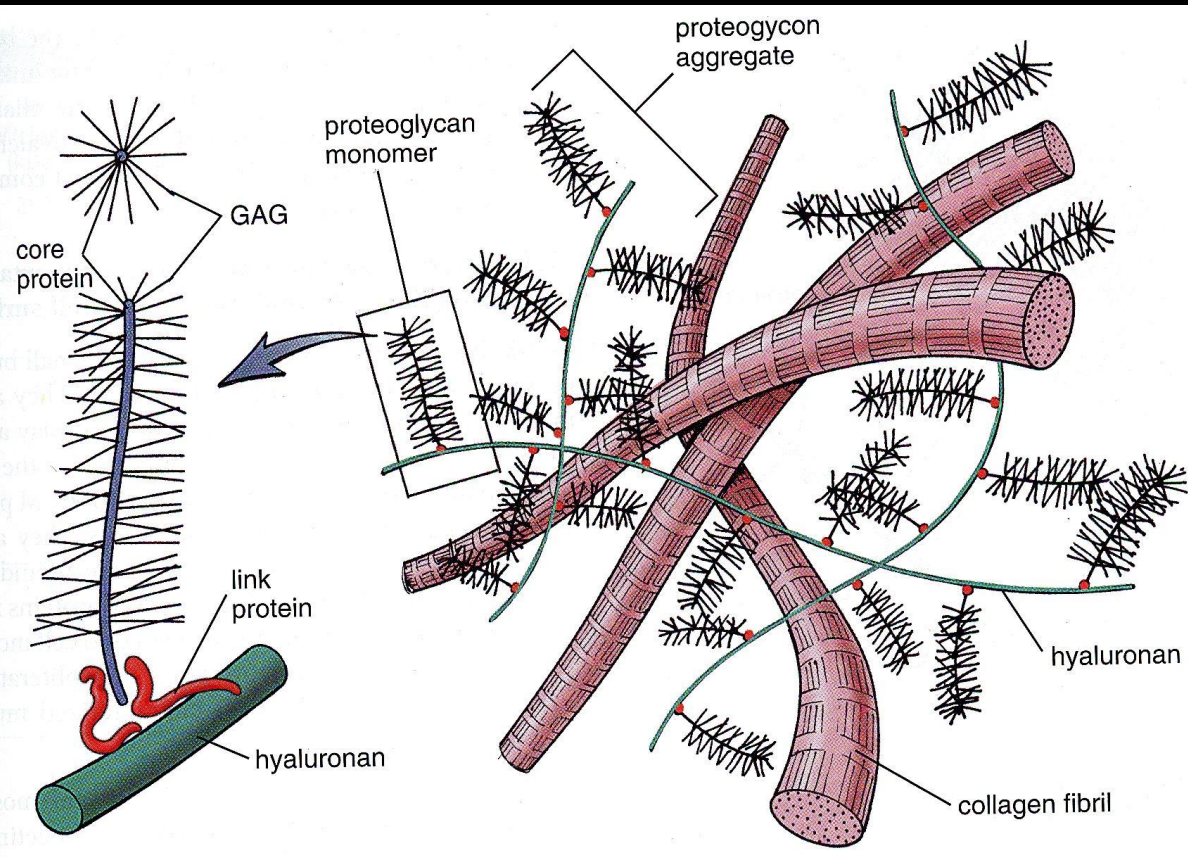
chondrocyty

izogenetické skupiny



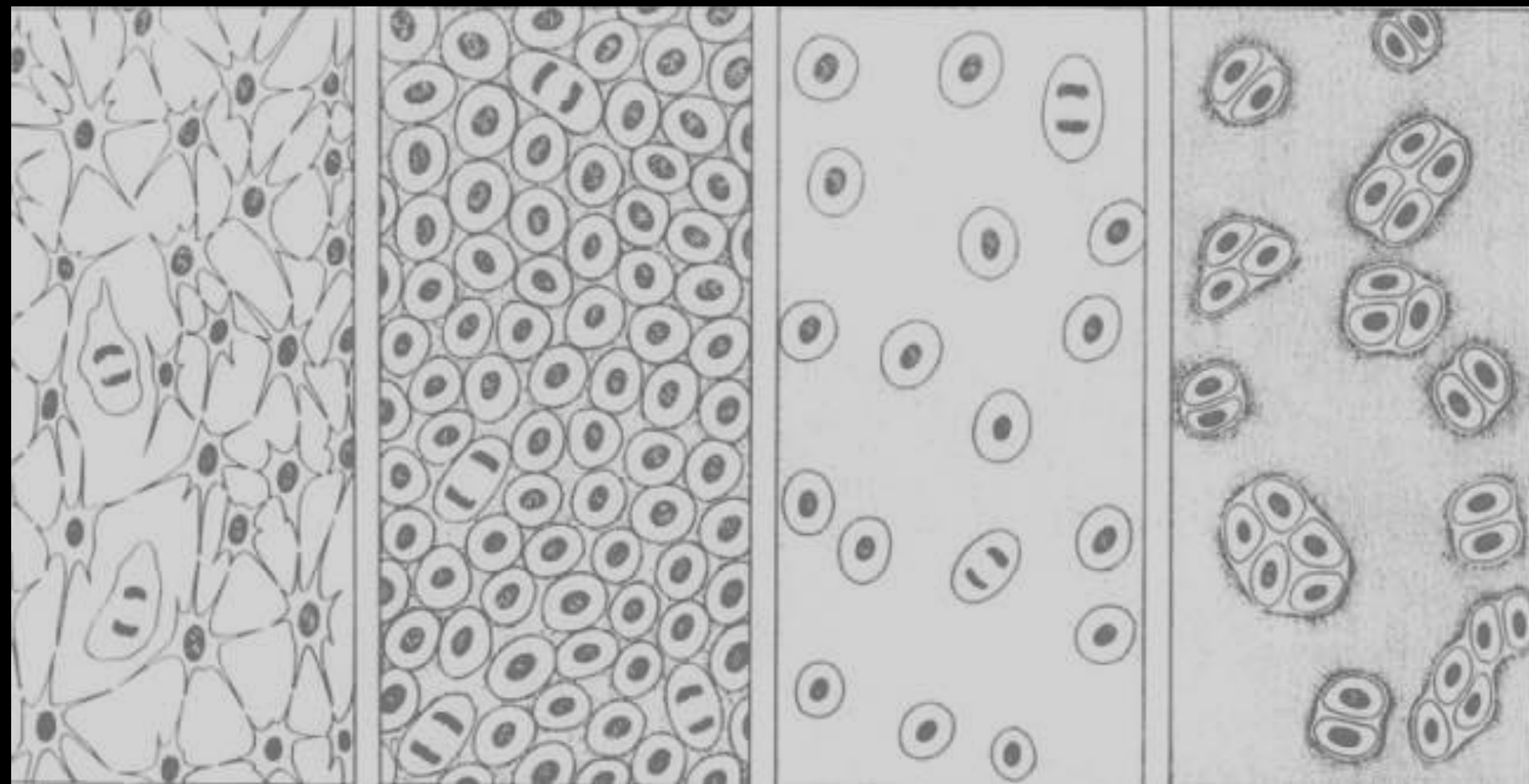


Proteoglykany chrupavky



agrekan

Diferenciace chrupavky z mesenchymu



Růst chrupavky

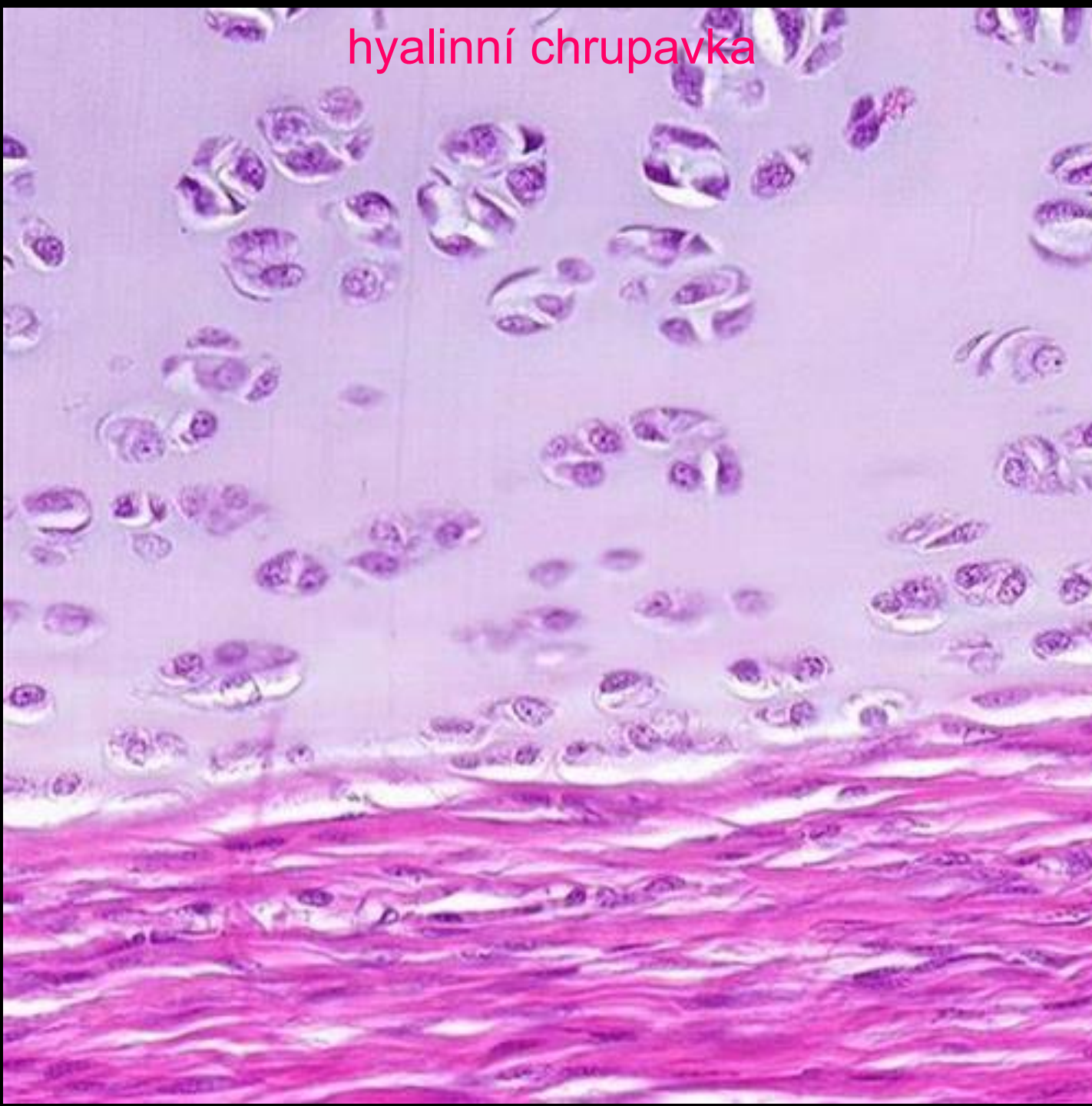
apozice

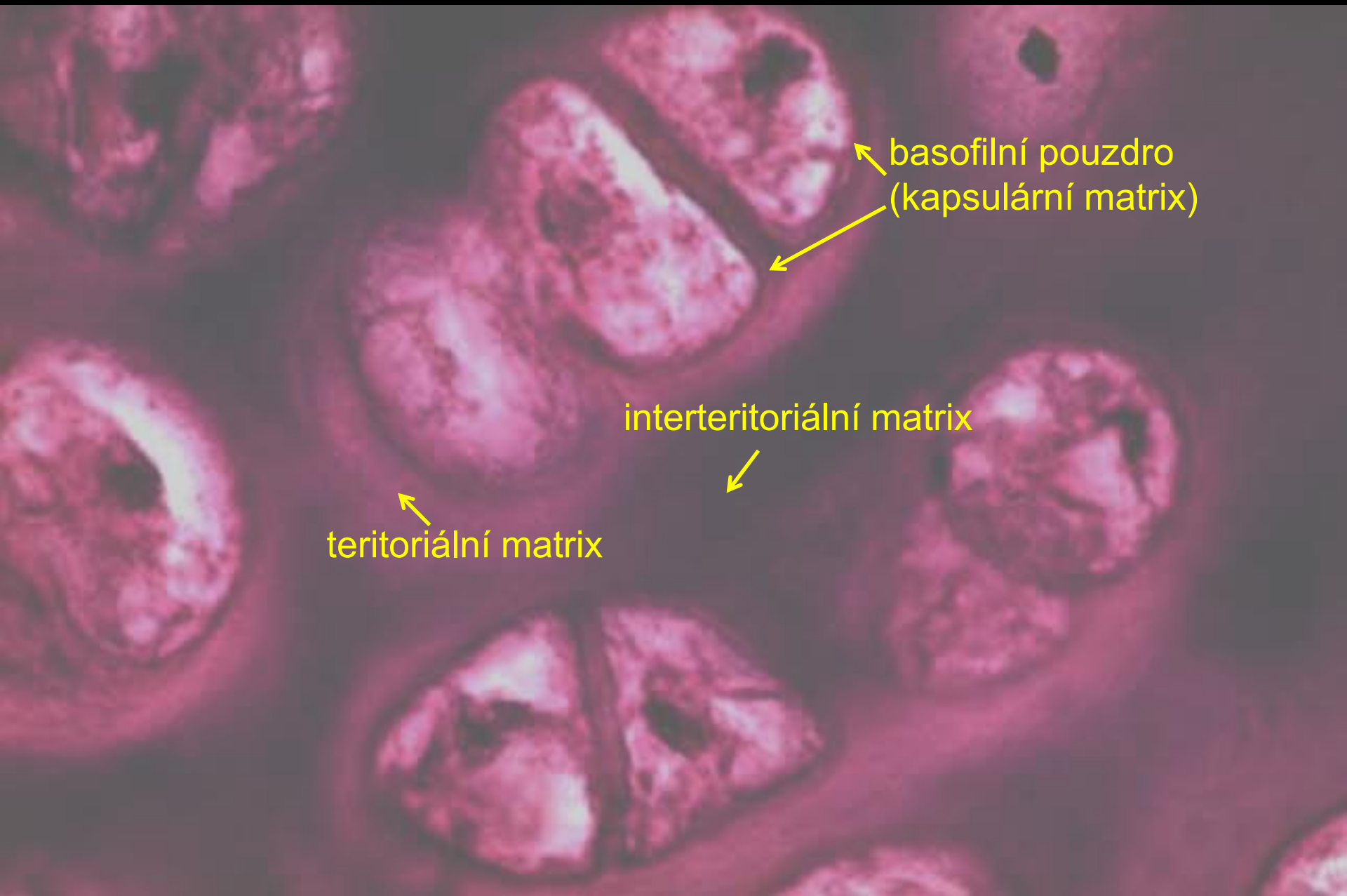
intersticiální růst



Typy chrupavky

hyalinní chrupavka



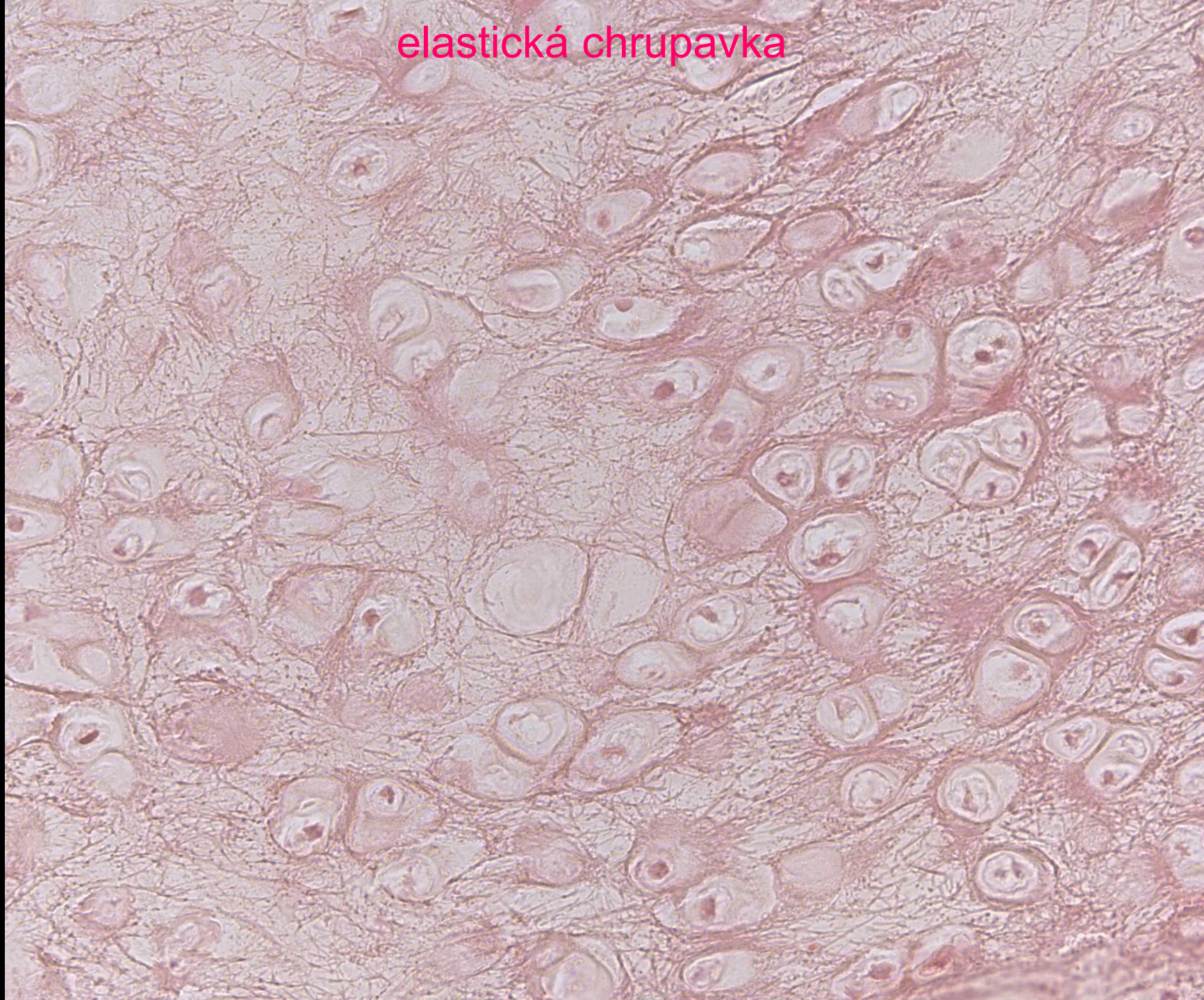


basofilní pouzdro
(kapsulární matrix)

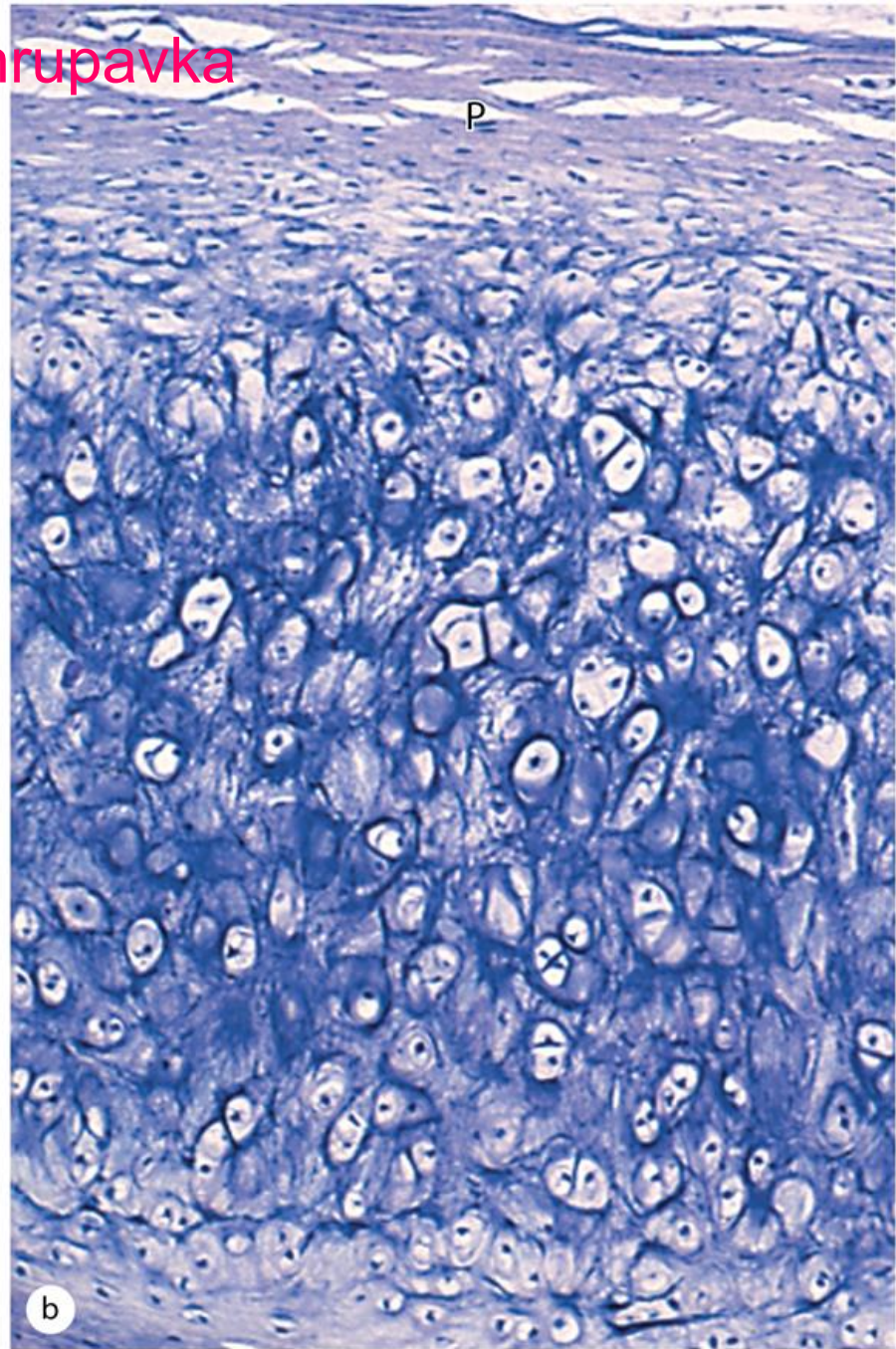
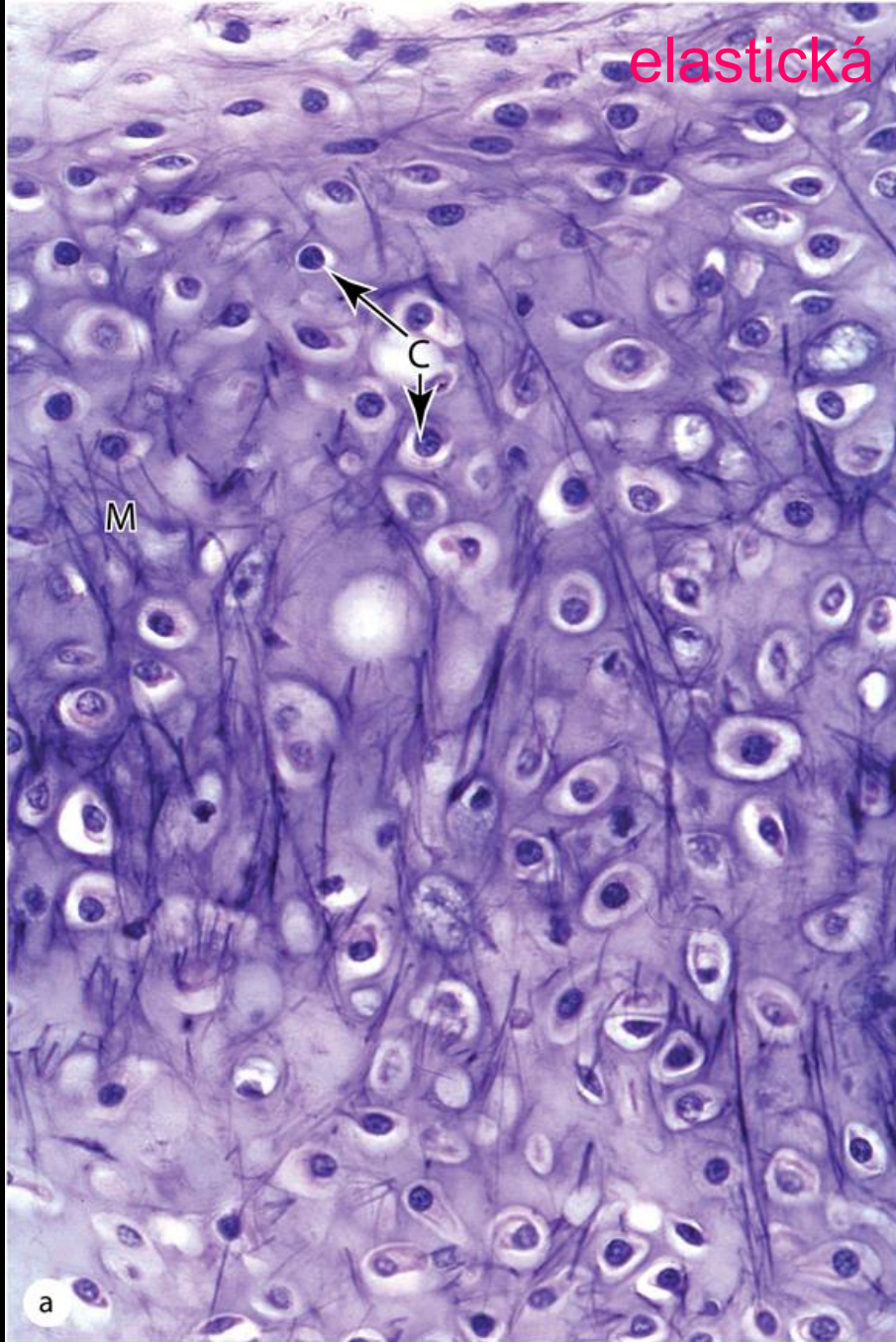
interteritoriální matrix

teritoriální matrix

elastická chrupavka



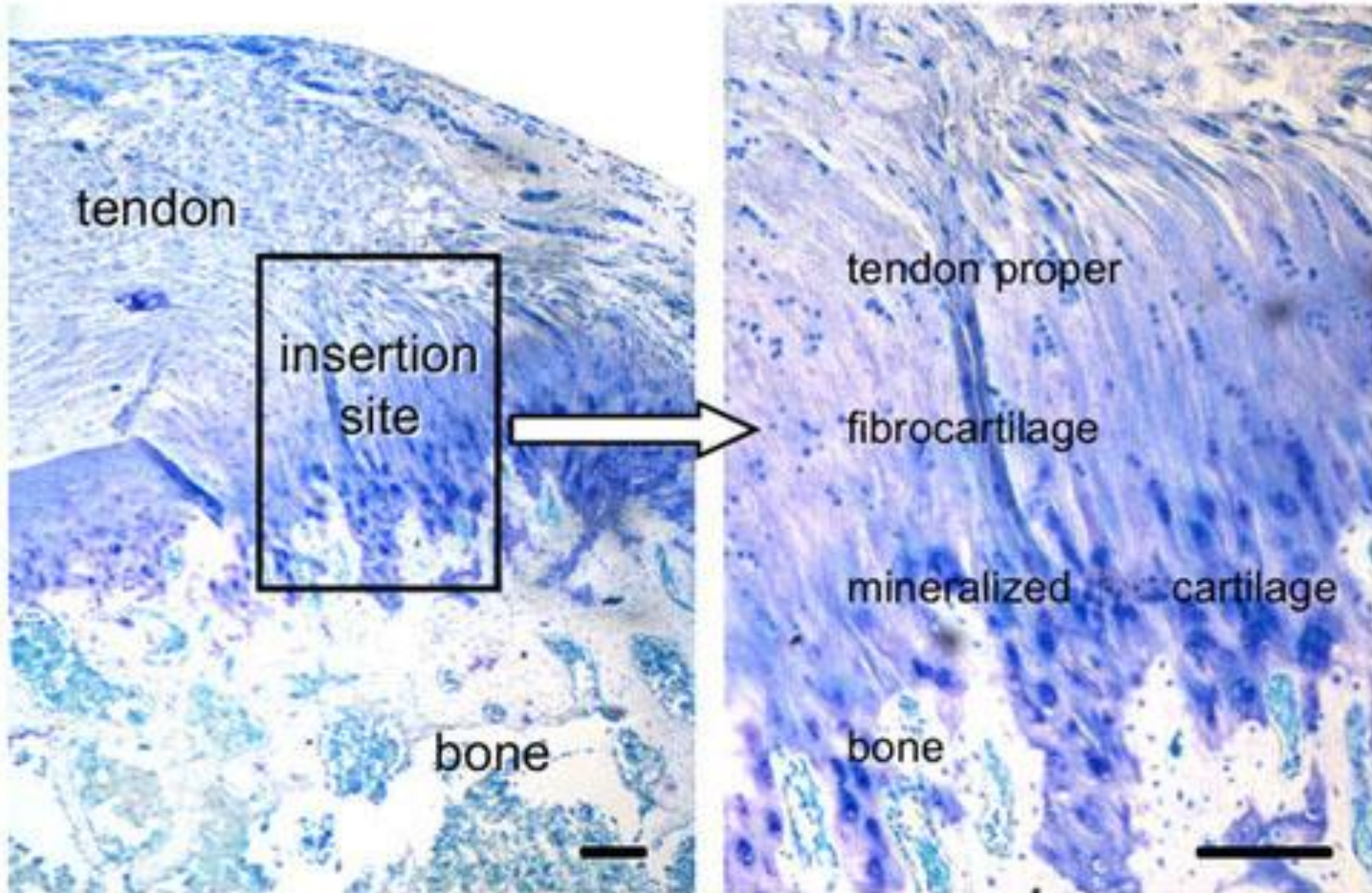
elastická chrupavka



vazivová chrupavka

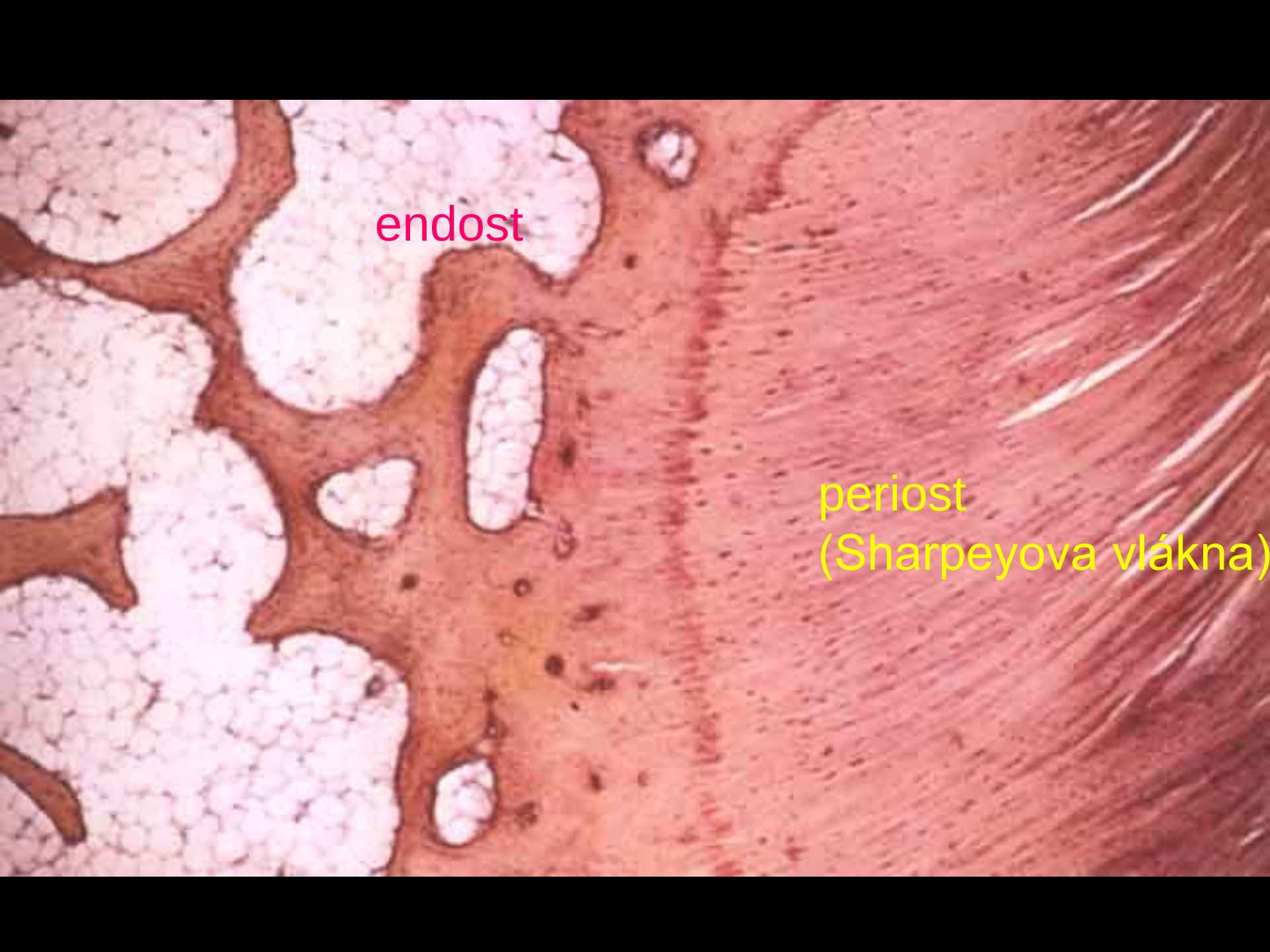


Vazivově chrupavčitá enthesis (spojení šlachy a povrchu kosti)



Kostní tkáň – obecná stavba

- **fixní buňky**
osteoblasty, osteocyty
- **bloudivé buňky**
osteoklasty
- **vláknitá složka mezibuněčné hmoty**
kolagenní vlákna
- **amorfní složka mezibuněčné hmoty**
tvrdá a pevná konsistence, proteoglykany
s obsahem chondroitinsulfátu a keratansulfátu,
osteonektin, glykoproteiny vážící Ca (sialoprotein,
osteokalcin)
- **mineralizace** mezibuněčné hmoty
krystaly hydroxyapatitu $\text{Ca}_{10}(\text{PO}_4)_6\text{OH}_2$



endost

This histological micrograph shows a cross-section of bone tissue. On the left, the endosteal region is visible, characterized by a thin layer of bone lining the marrow cavity. The marrow itself is a pale, granular substance. The central part of the image shows the dense, reddish-brown bone matrix with several osteons. On the right, the periosteum is visible, a multi-layered structure that encloses the bone. It contains Sharpey's fibers, which are collagen fibers that anchor the bone to the surrounding soft tissue. The overall structure is highly organized and shows the typical architecture of compact bone.

periost
(Sharpeyova vlákna)

Osteoclast

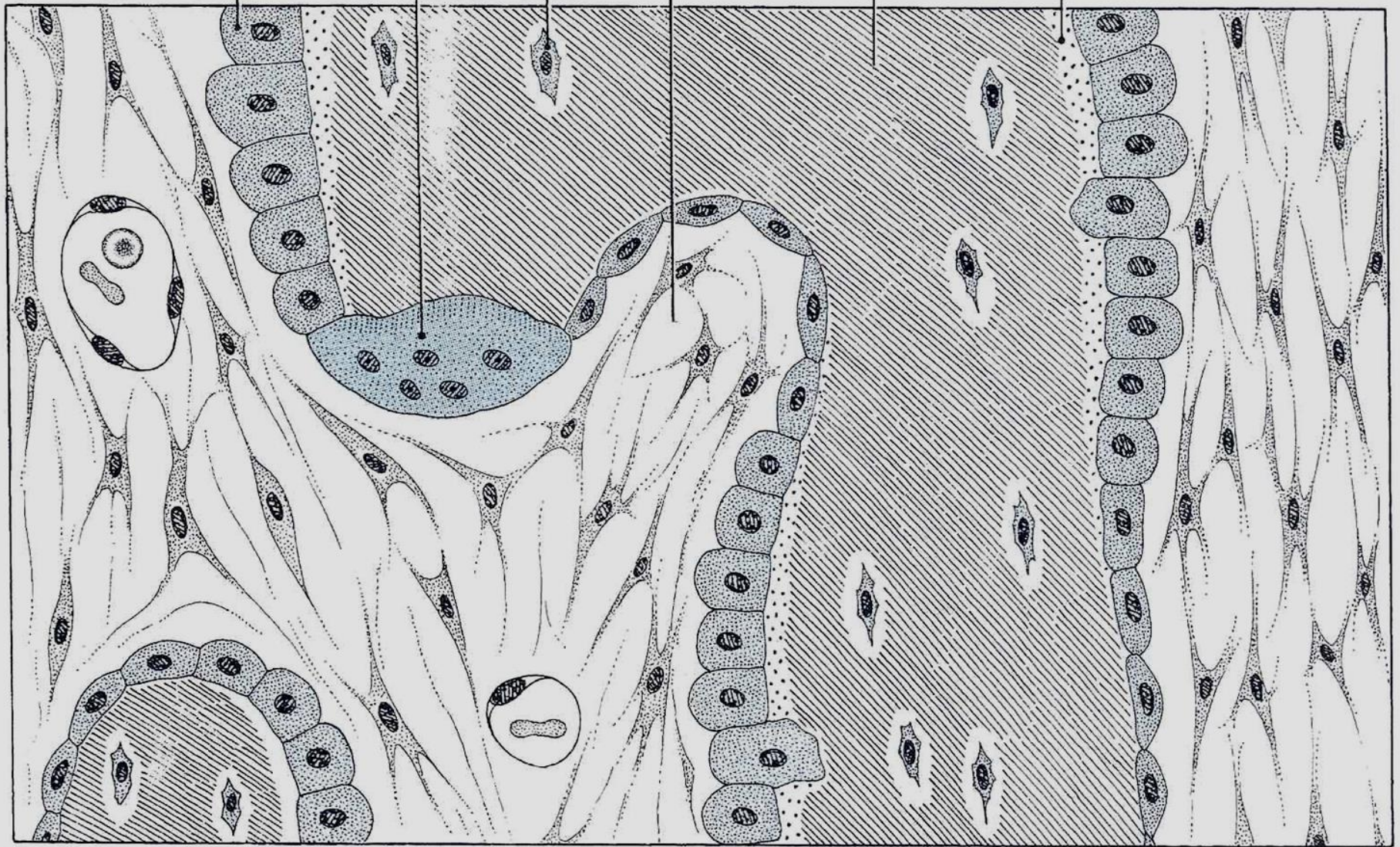
Mesenchyme

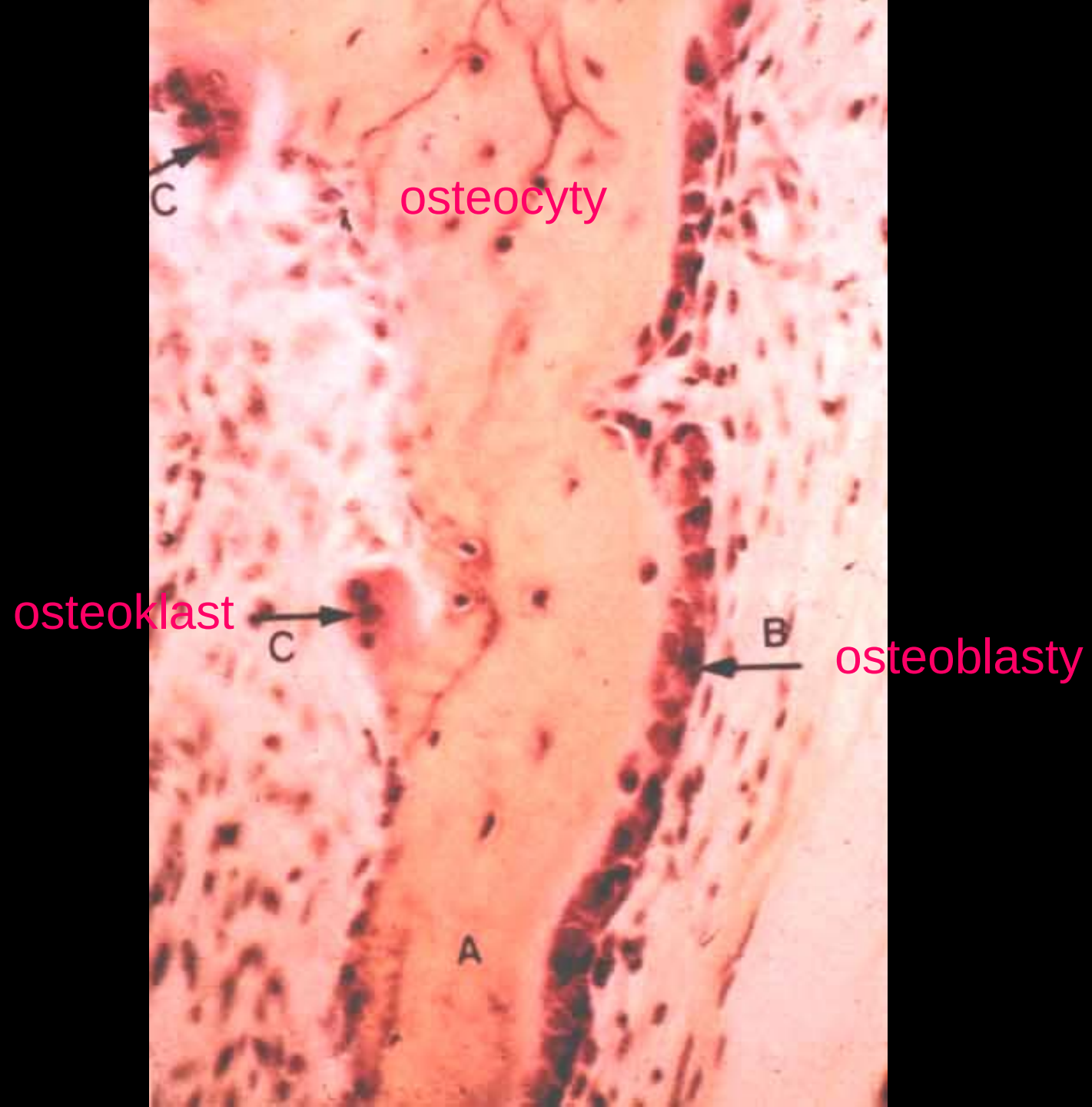
Newly formed matrix (osteoid)

Osteoblast

Osteocyte

Bone matrix





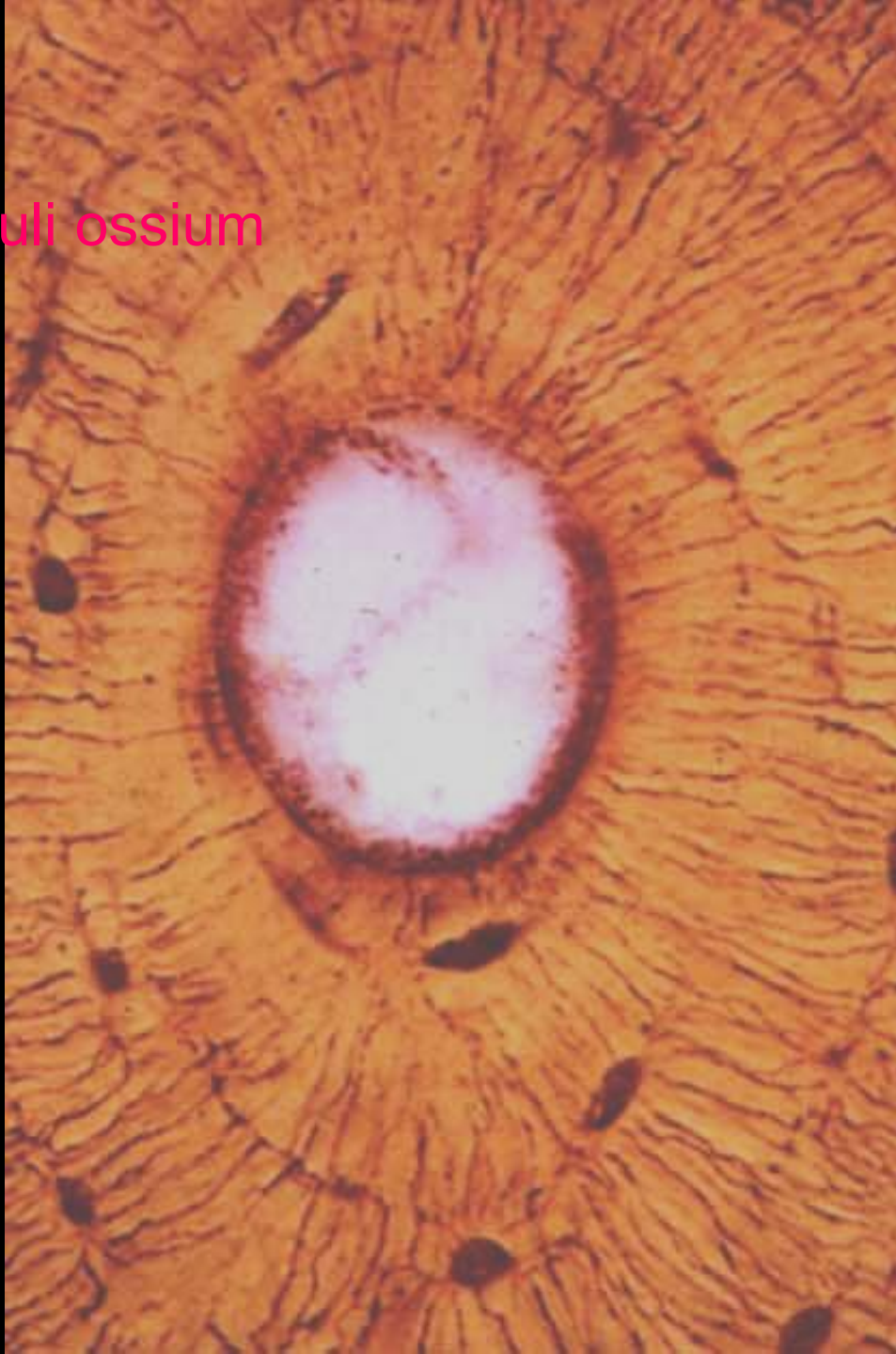


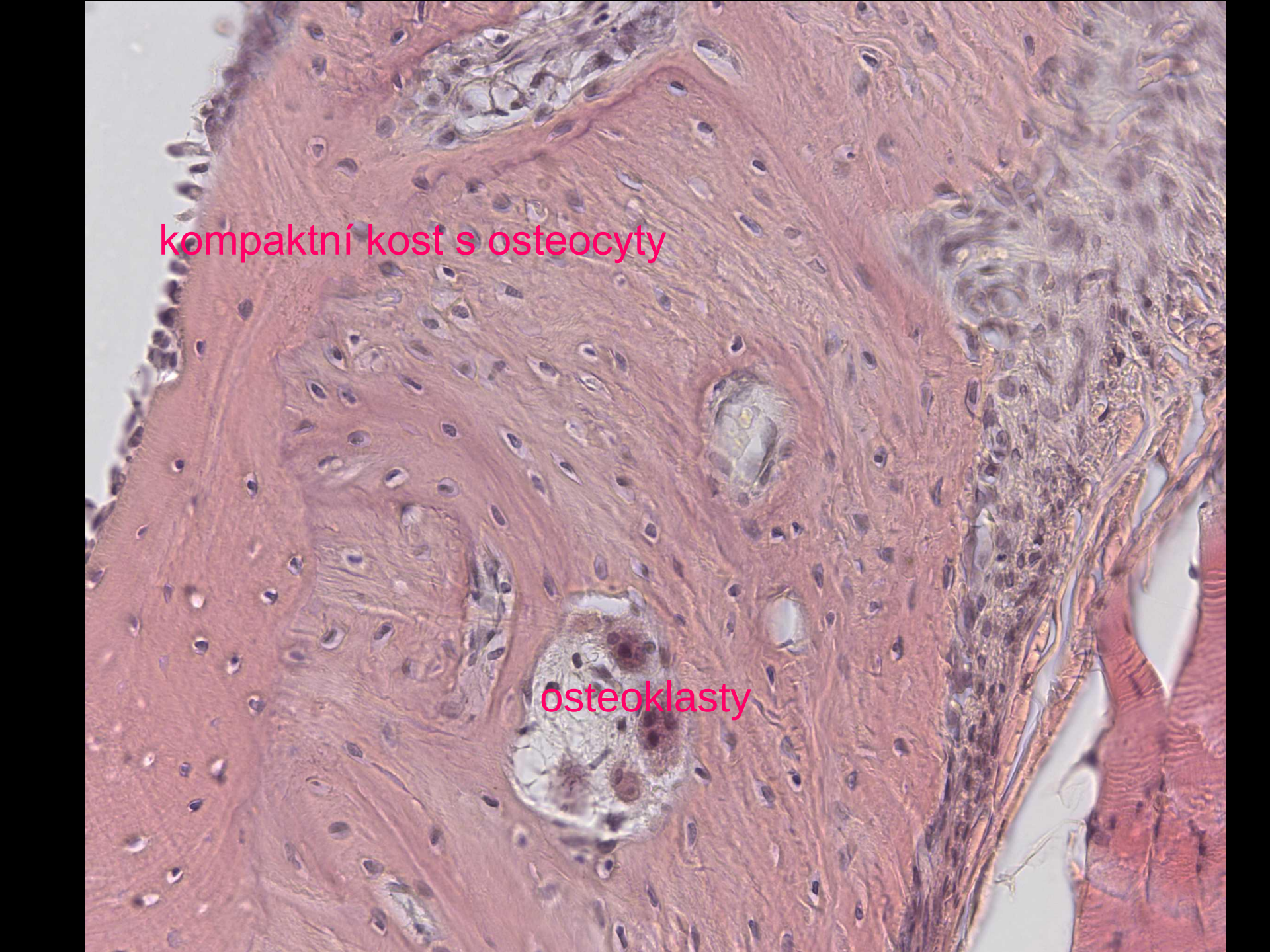
osteoblasty

Haversův kanál

osteocyty

výbrus kosti
viditelné canaliculi ossium





kompaktní kost s osteocyty

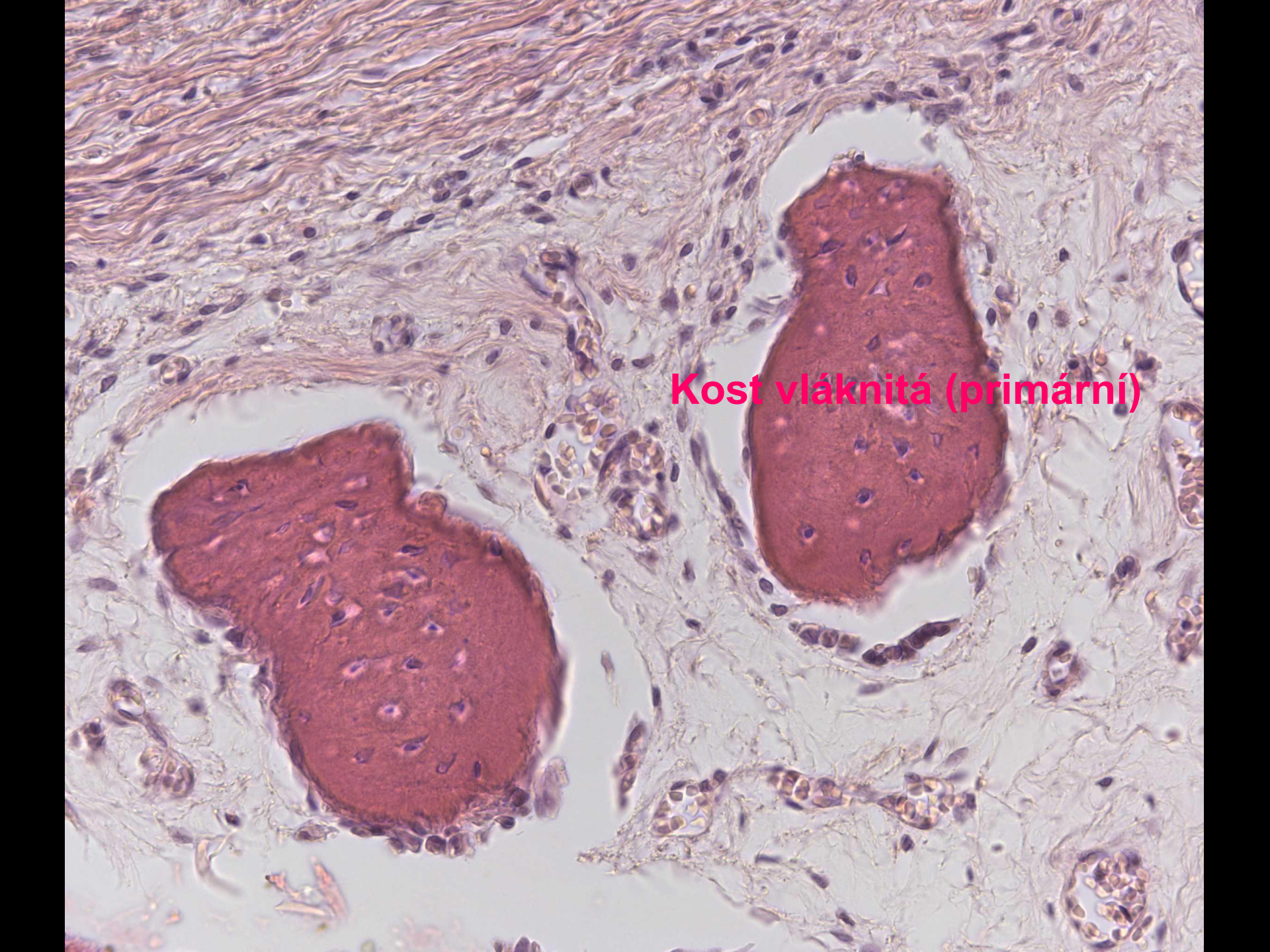
This histological image shows a section of compact bone tissue. The tissue is characterized by a dense arrangement of osteons, which are the basic structural units of bone. Each osteon consists of concentric layers of bone tissue (lamellae) surrounding a central canal. The osteons are separated by narrow spaces called interstitial spaces. The bone matrix is stained pink, and the nuclei of osteocytes are stained purple. Two large, multinucleated cells, identified as osteoclasts, are visible in the lower central part of the image. They are characterized by their large size and multiple dark nuclei. The overall structure is highly organized and shows the typical architecture of compact bone.

osteoklasty

Typy kostní tkáně

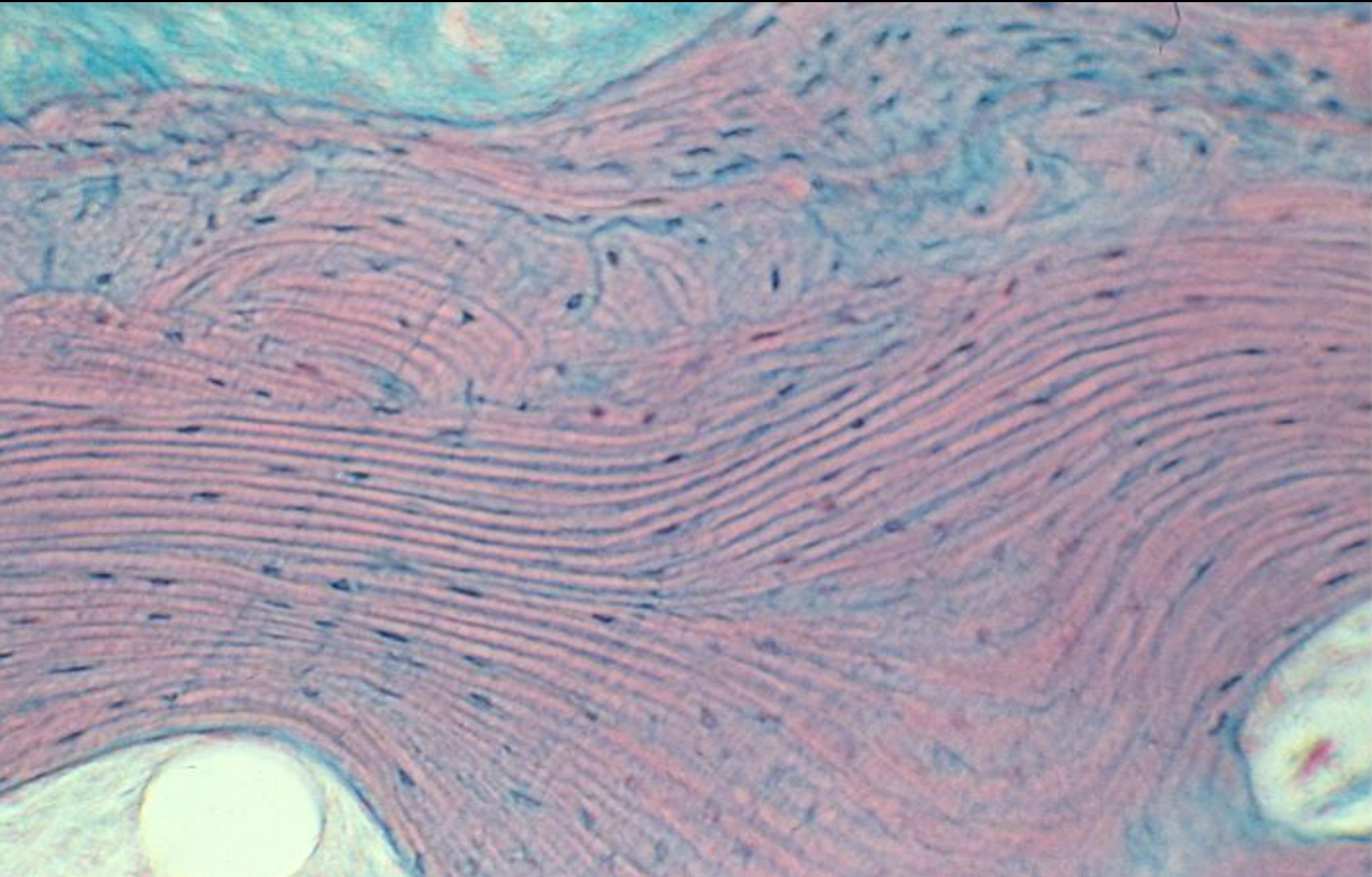
Typy kostní tkáně

- **vláknitá (primární)** – dočasná kost při vývoji a hojení kostní tkáně, nepravidelné uspořádání, méně mineralizovaná
- **lamelární (sekundární)** – tvořena lamelami z pravidelně uspořádaných kolagenních vláken zalitých v mineralizované matrix, osteocyty především mezi lamelami v tmelové substanci
 - **kompaktní** – kompletní i vmezežené osteony (Haversovy systémy), plášťové lamely
 - **spongiózní (houbovitá)** – anastomózující kostní trámce tvořené paralelně uspořádanými lamelami nebo osteony

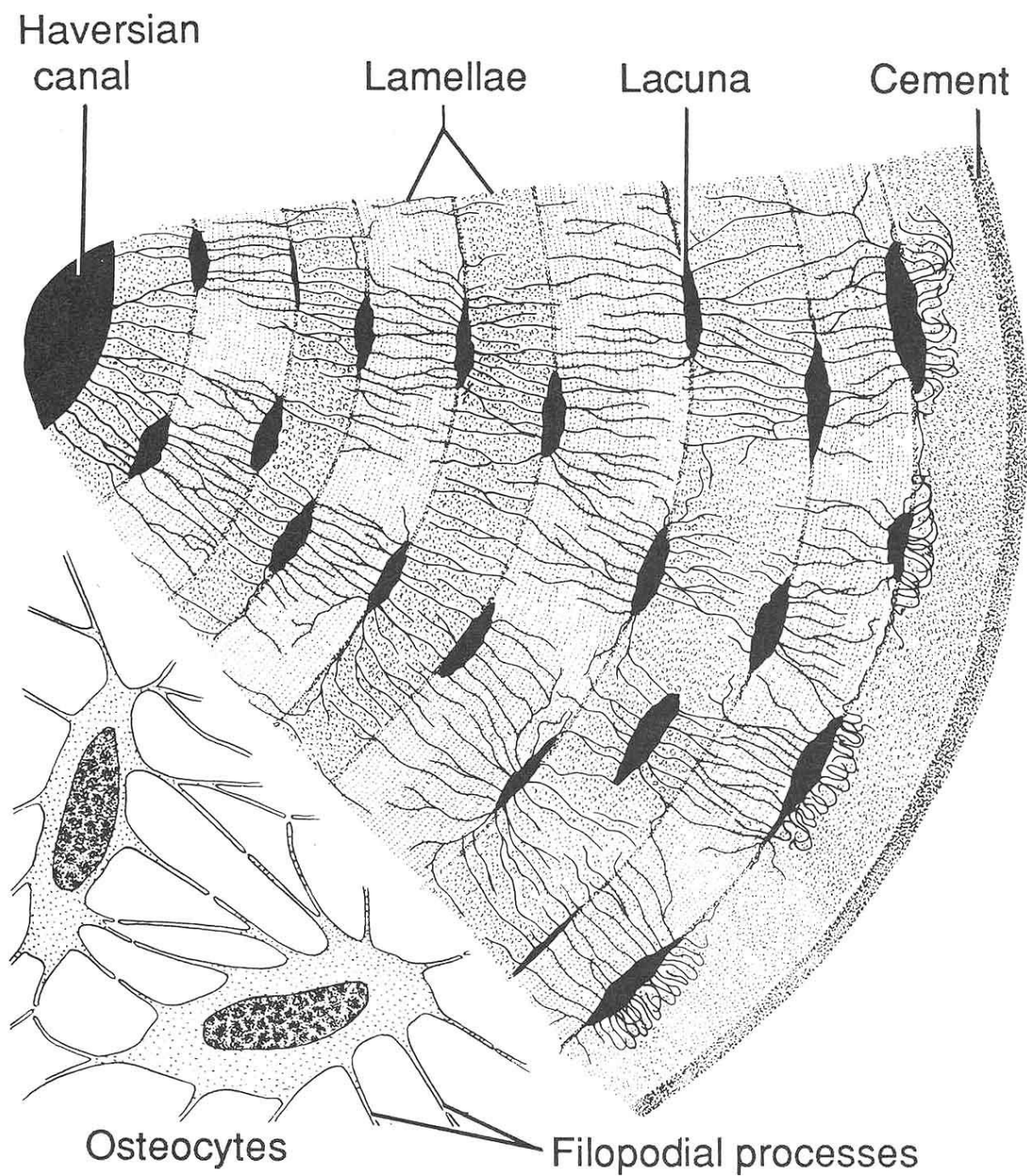


Kost vláknitá (primární)

Lamelární kost (sekundární)



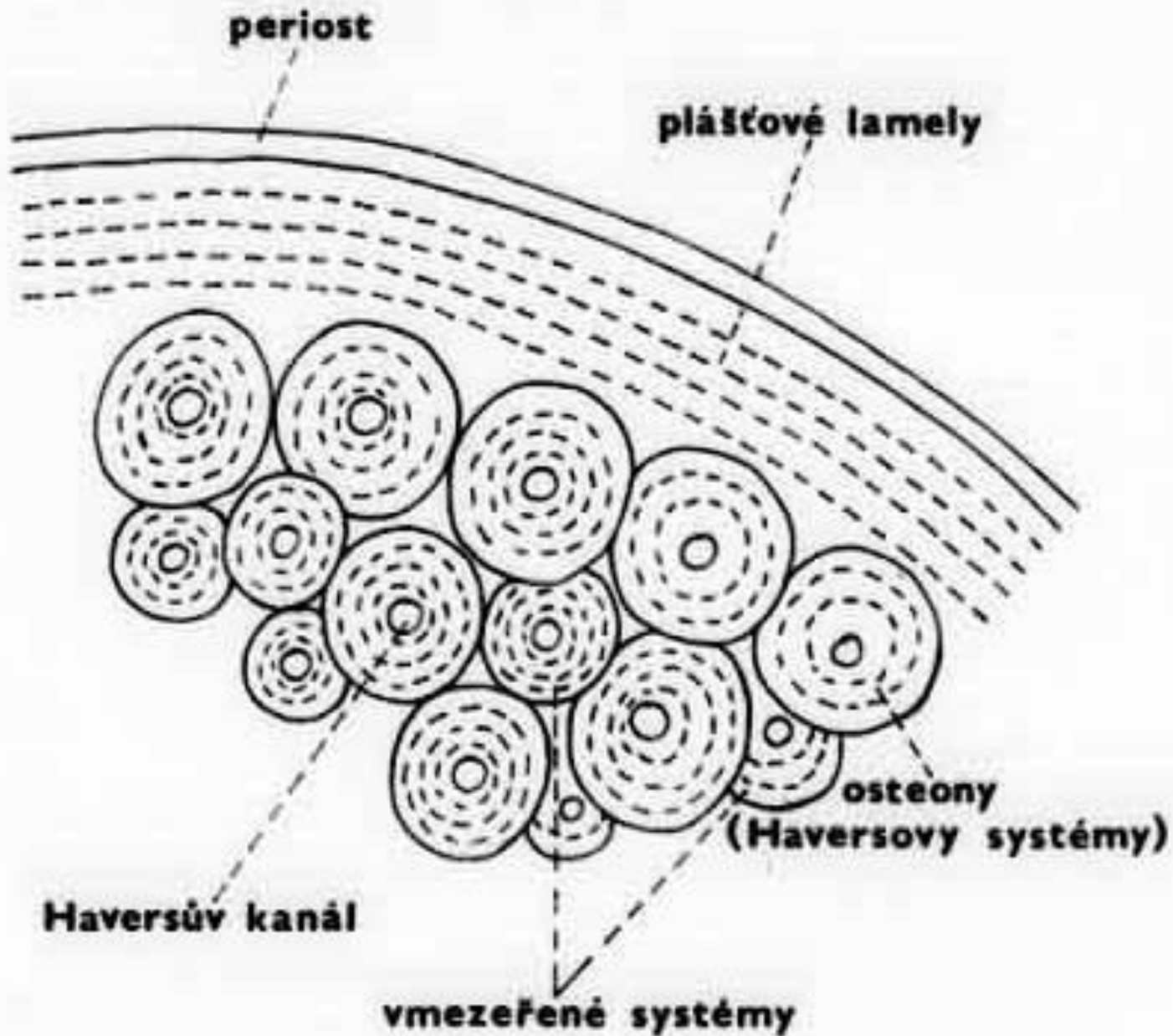
Kost lamelární (sekundární)

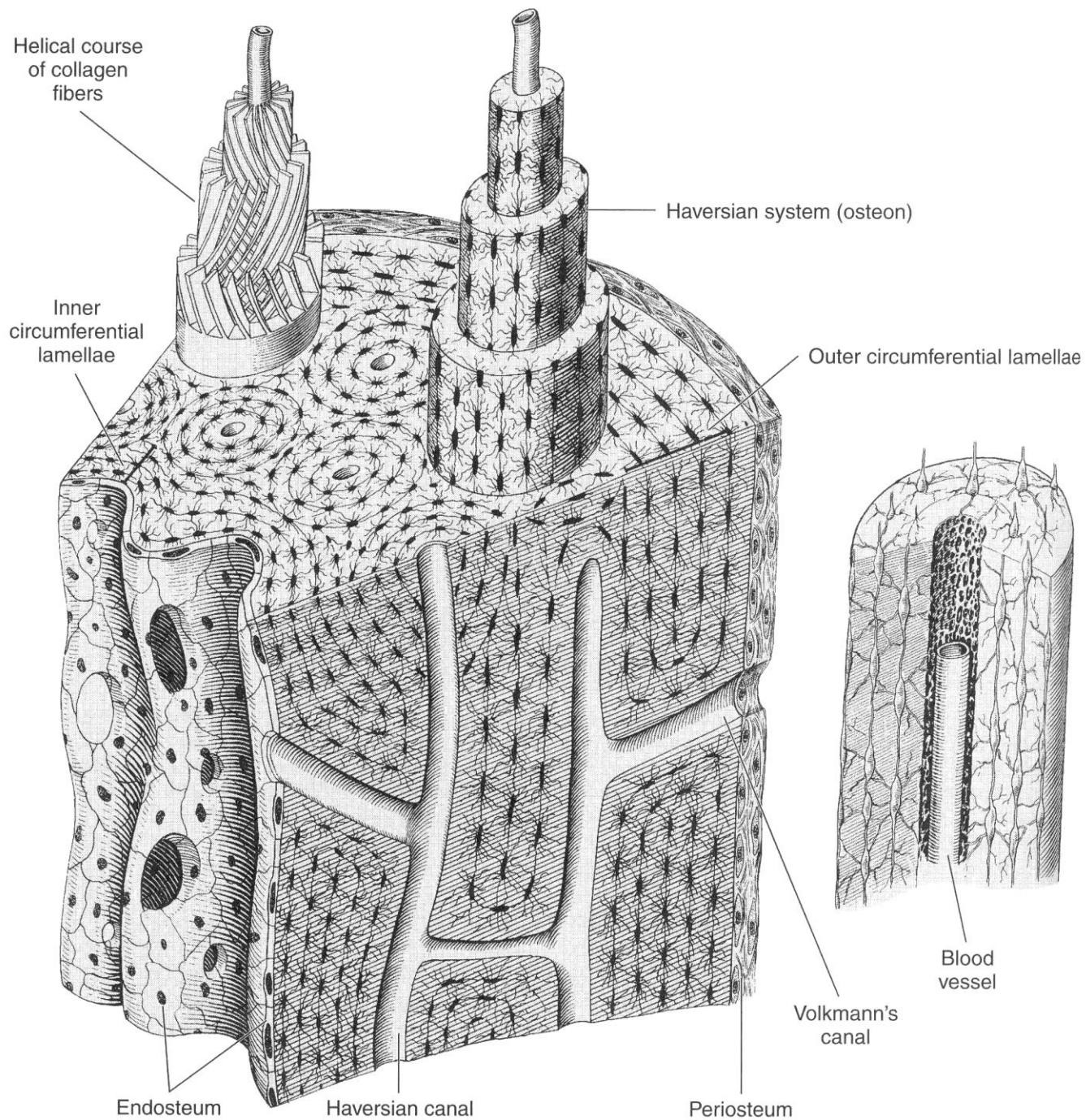


Haversův systém (osteon)



Kompaktní kost, kompakta





plášťové
lamely





osteon
(Haversův
systém)

This histological micrograph displays compact bone tissue. The image is characterized by numerous concentric, wavy lines representing lamellae. These lamellae are organized into circular or oval structures known as osteons. Each osteon contains a central Haversian canal, which appears as a clear, circular space. The overall color of the tissue is a deep pinkish-red, typical of bone stained with hematoxylin and eosin (H&E). The text 'osteon (Haversův systém)' is overlaid in red, identifying one of these structural units.



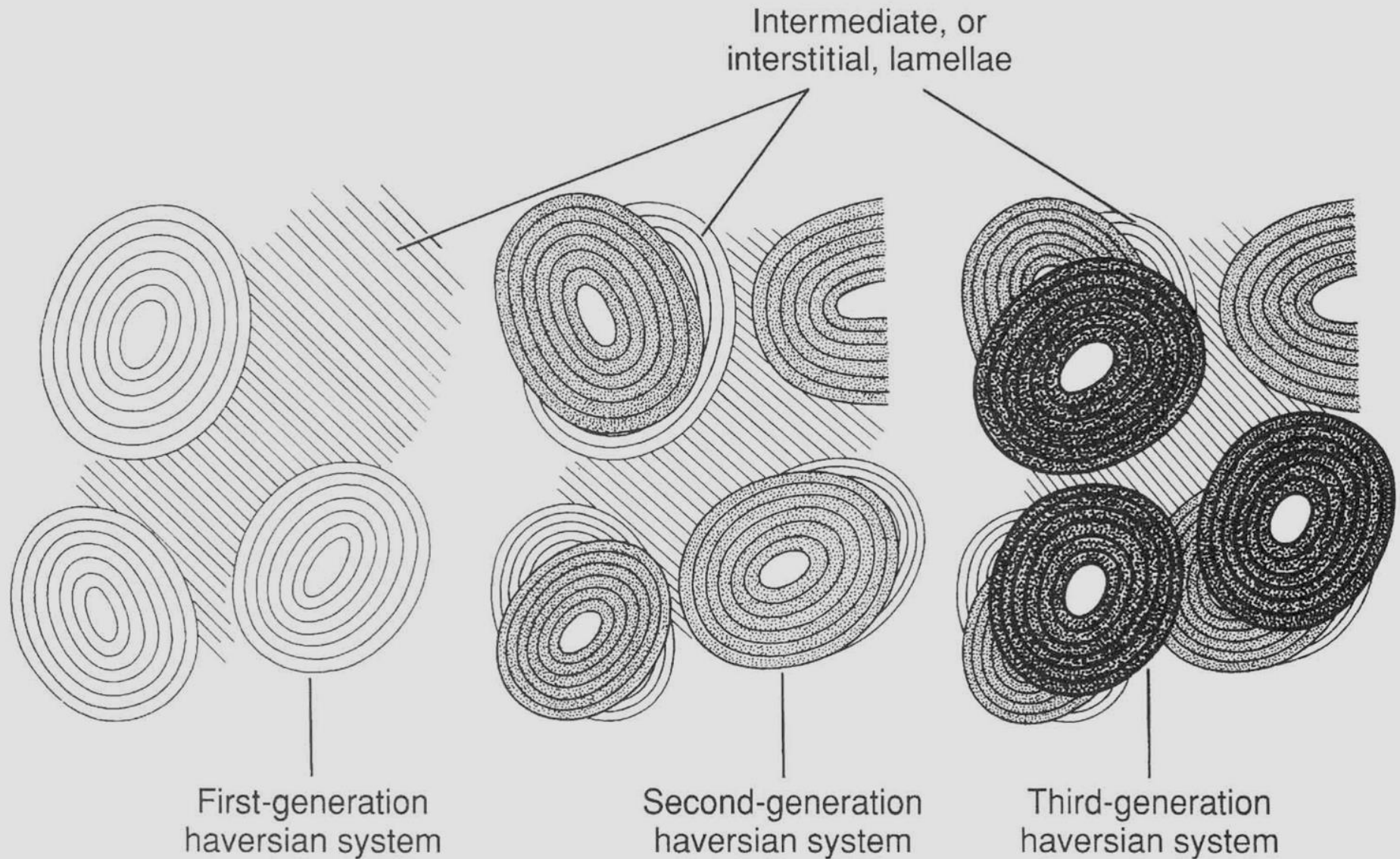
Haversův kanál

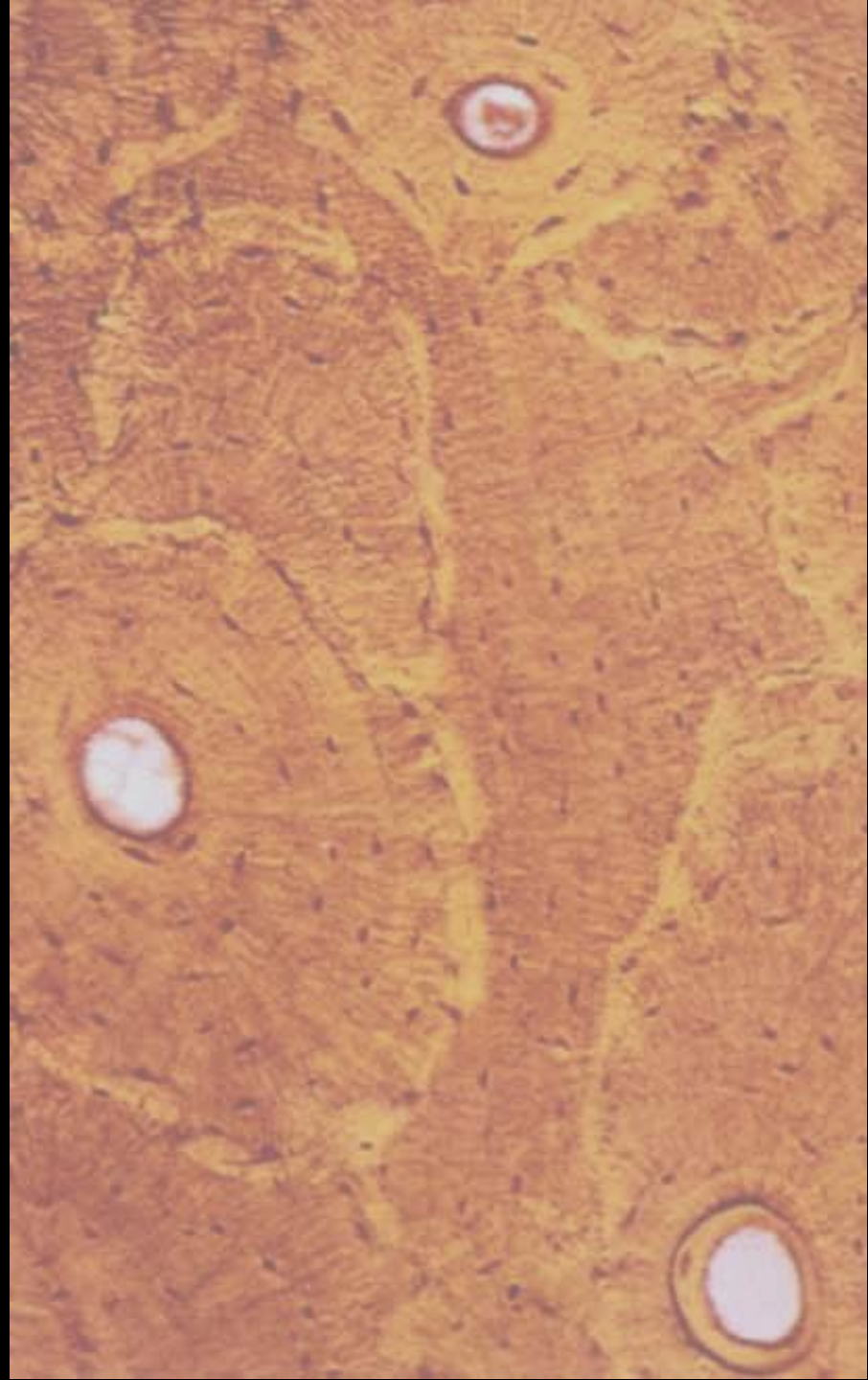
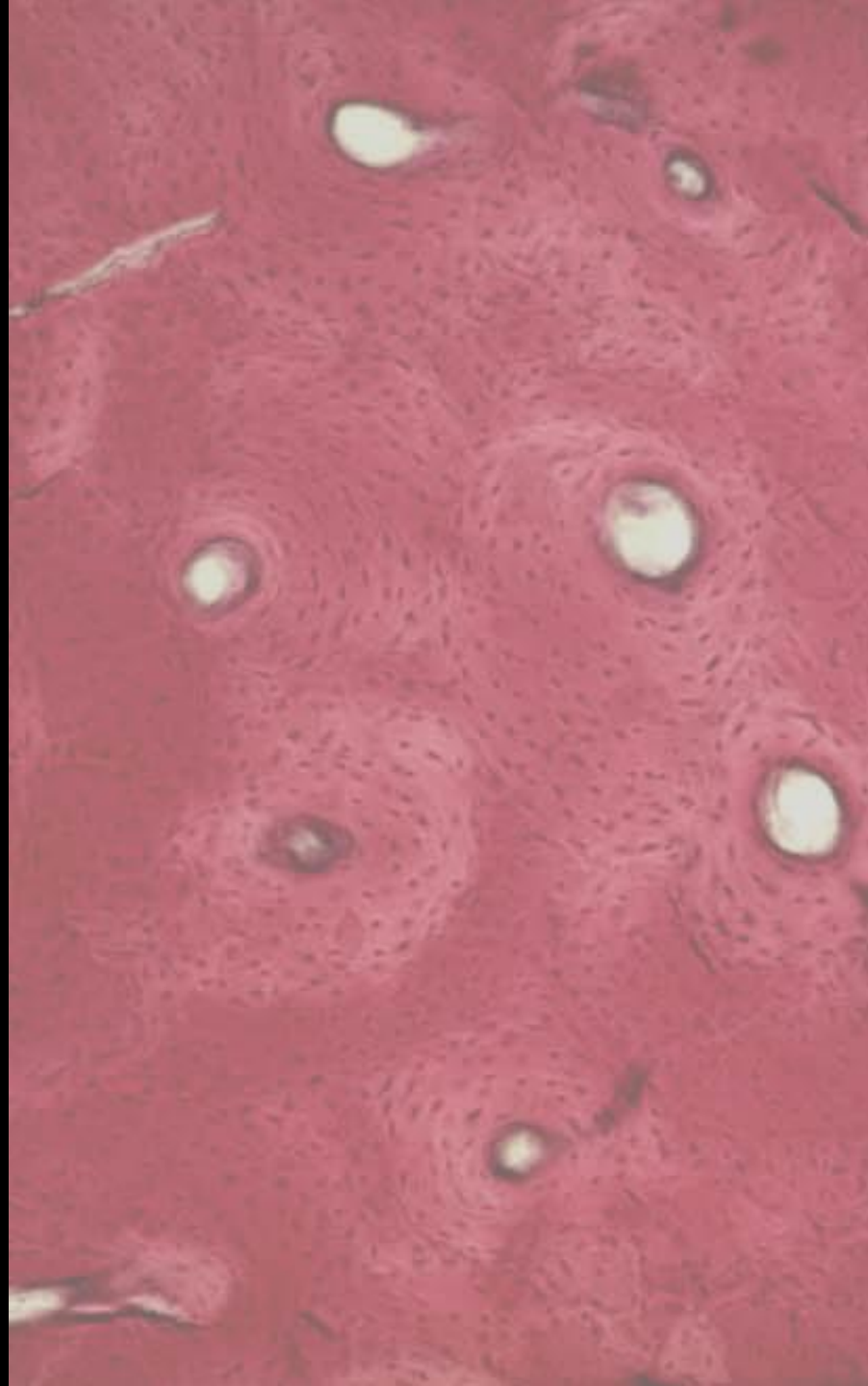
This is a histological micrograph of bone tissue, likely stained with hematoxylin and eosin (H&E). The image shows several Haversian canals, which are large, irregularly shaped, and empty spaces. These canals are surrounded by concentric layers of bone tissue, known as lamellae. The lamellae are visible as fine, parallel lines radiating from the canals. Between the Haversian canals, there are smaller, more numerous spaces called Volkmann canals, which connect the Haversian canals and allow for the passage of blood vessels and nerves. The overall structure is highly organized and shows the characteristic architecture of compact bone.

Volkmannův kanál

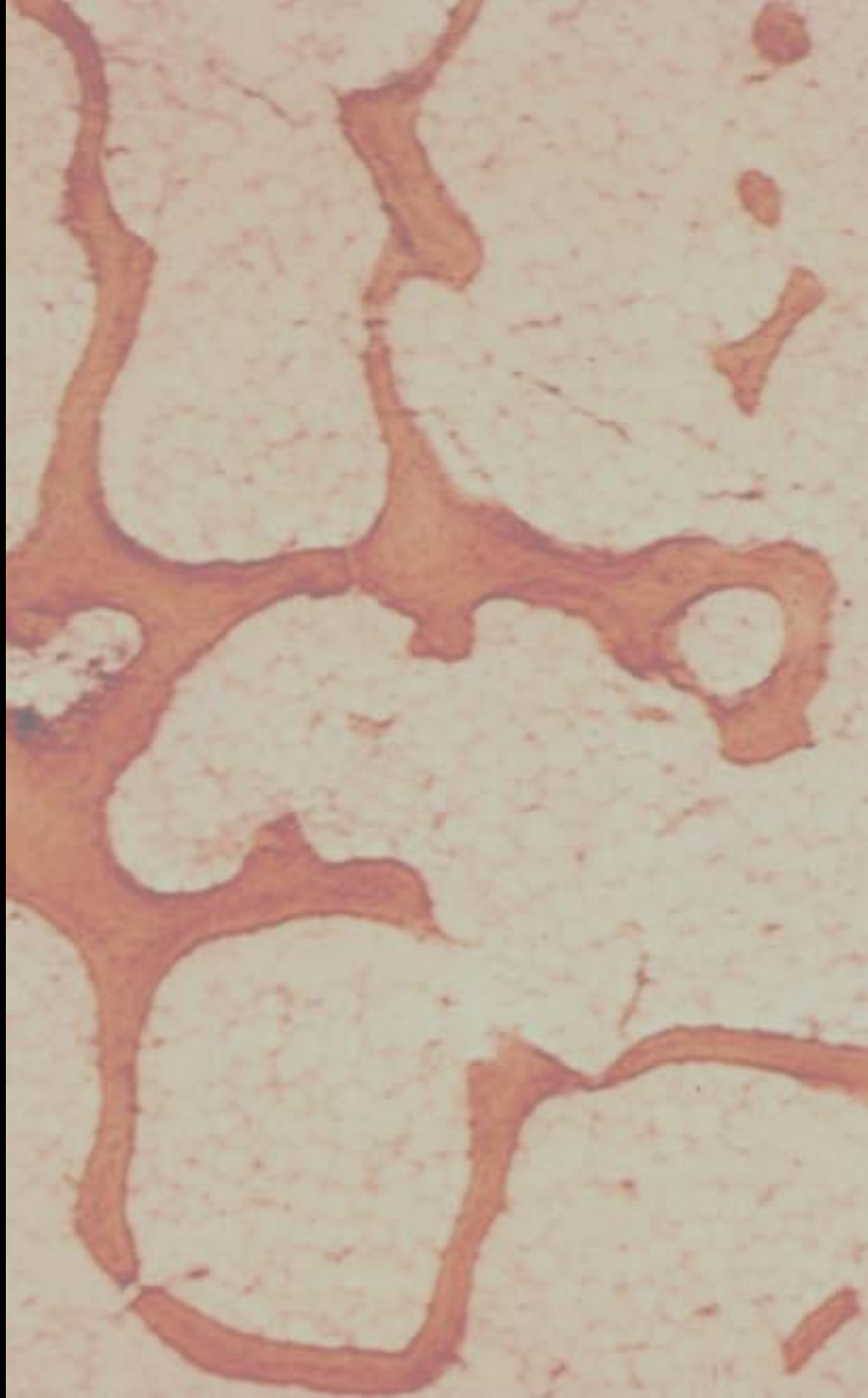
Haversův kanál

Vmezeřené (intersticiální) lamely

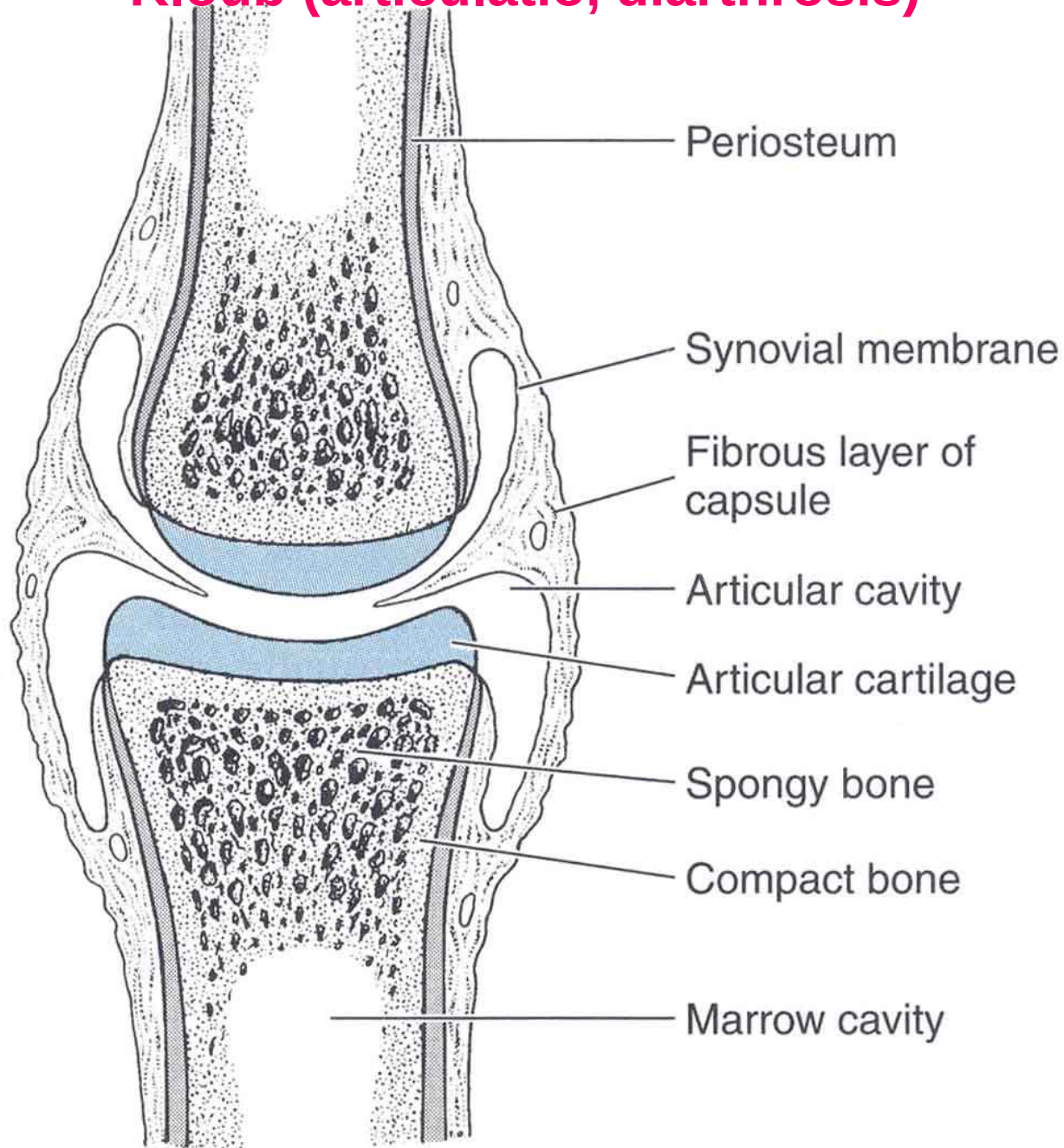




**Spongy
(cancellous)
bone**



Kloub (articulatio, diarthrosis)



kloubní chrupavka

Joint cavity

Lining cells

Connective tissue

Blood capillaries

histologická stavba synoviální membrány

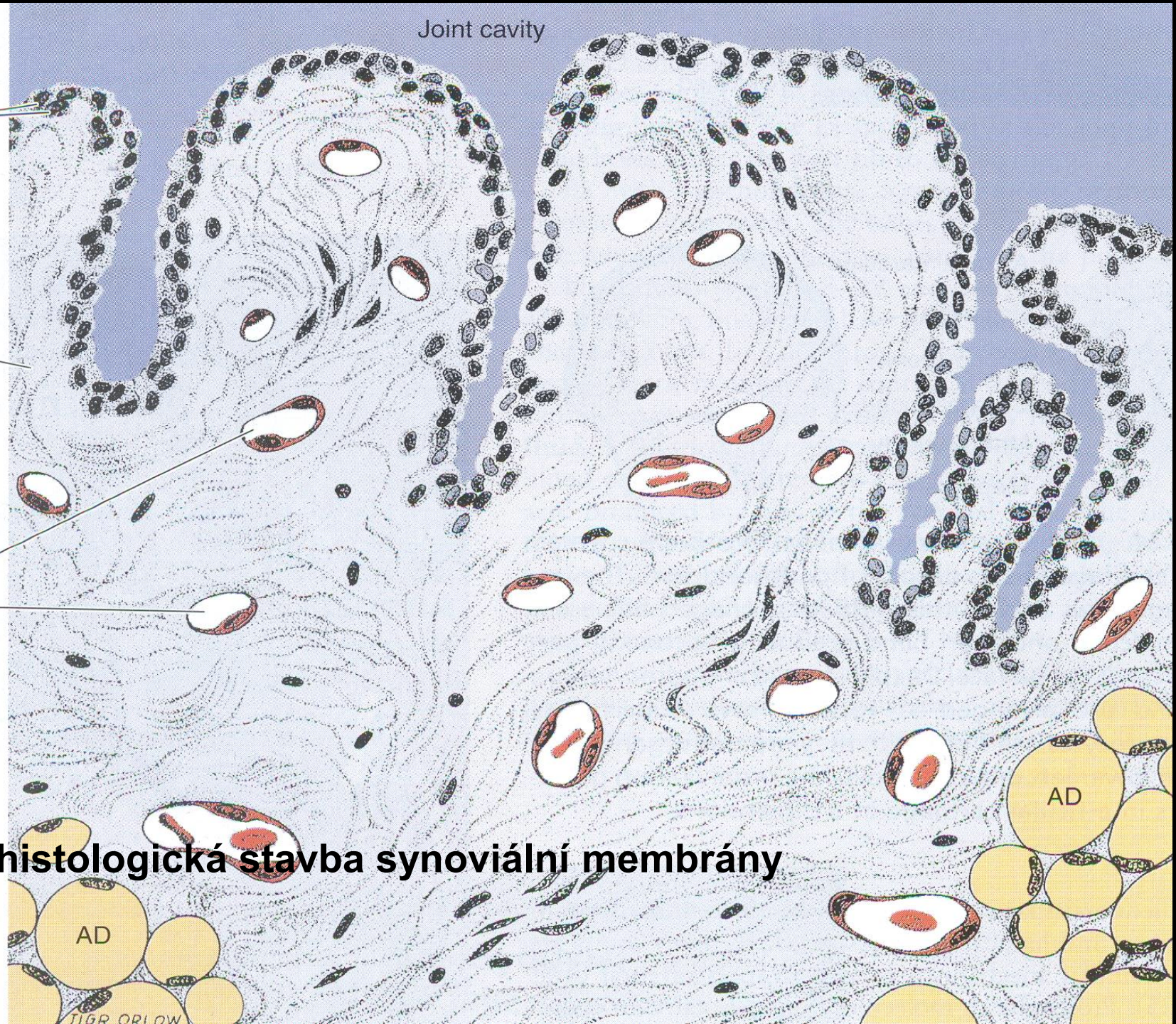


Schéma ultrastruktury synoviální membrány

Macrophagelike cell

Ground substance

Fibroblastlike cell

Fenestrated blood capillary

Collagen fibrils

Fibroblast

