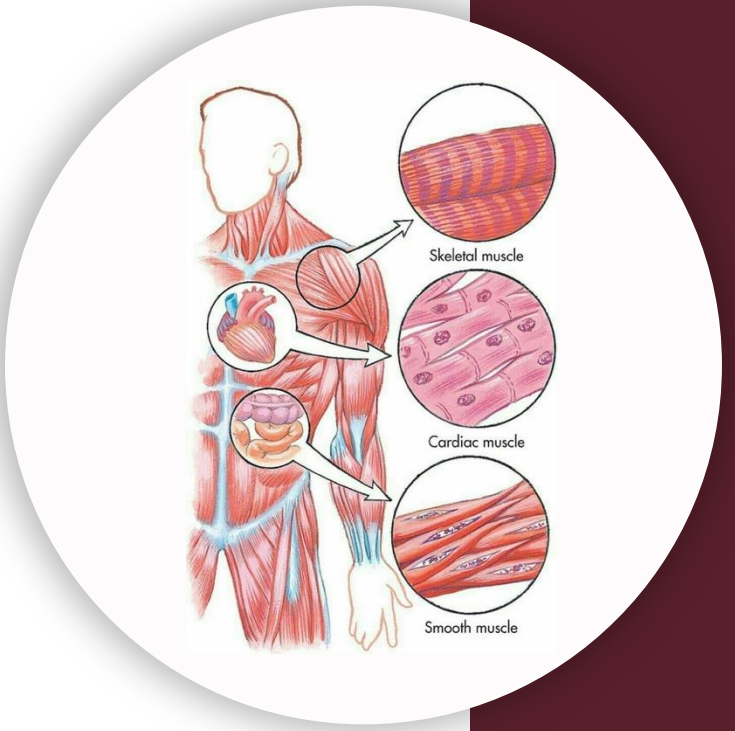
بسم الله الرحمن الرحيم

Histology – Final 1

Cartilage Pt.1



Written by : Mayar Khader
Jannat Nasri

Reviewed by : Tala Alali
Jannat Nasri

Cartilage

· it's a specialized type of connective tissue which produce a three types of cartrilage adapted to local bio-mechanical needs .
· its cells derived from mesoderm
· ▶ **Cartilage is a tough and durable CT**(long lasting)(the difference between the bone the cartilage is flexibility) (the cartilage is the second toughest CT after the bones)

- **Rich extracellular matrix (ECM) with high concentrations of GAGs and proteoglycans** (GAGs remind you with hydration because it able to bind with many water molecules which make cartilage more gelatinous than bones)
- **Contains collagen and elastic fibers.** (all types of cartilaginous tissues contain collagen 2 but there is a type have abundant amounts of collagen type 1(the strongest fiber) which gives the tissue more resistance to the tensile forces)

- **Avascular** (low metabolic activity). Which means there isn't any blood vessels reach it and it receives nutrients by diffusion from perichondrium , chondrocytes exhibit low metabolic activity

(generally it has poor regeneration power although where are extremely poor regenerative cells and others slightly higher regenerative ~depending on adult or child cells

- **Lacks nerves** (doesn't have any nerves)

Perichondrium

- It is a sheath of dense connective tissue that surrounds cartilages(**not all types**)
- Forms an interface between the cartilage and the tissues that is supported by the cartilage.(think like it isolate the cartilage from the outside)
- Contains blood supply and a small neural component.

Use it has 2 layers; an outer(rich with fibers) and inner cellular layer and it has progenitor cells .
(STM cells give rise to progenitor cells and progenitor cells give rise to the fully differentiate cells)

- **Articular cartilage** (it is a hyaline type cartilage that covers the ends of bones in movable joints to enhance the movement and make it much easier)

lacks perichondrium soo it is sustained by diffusion of oxygen and nutrients from synovial fluid

Features

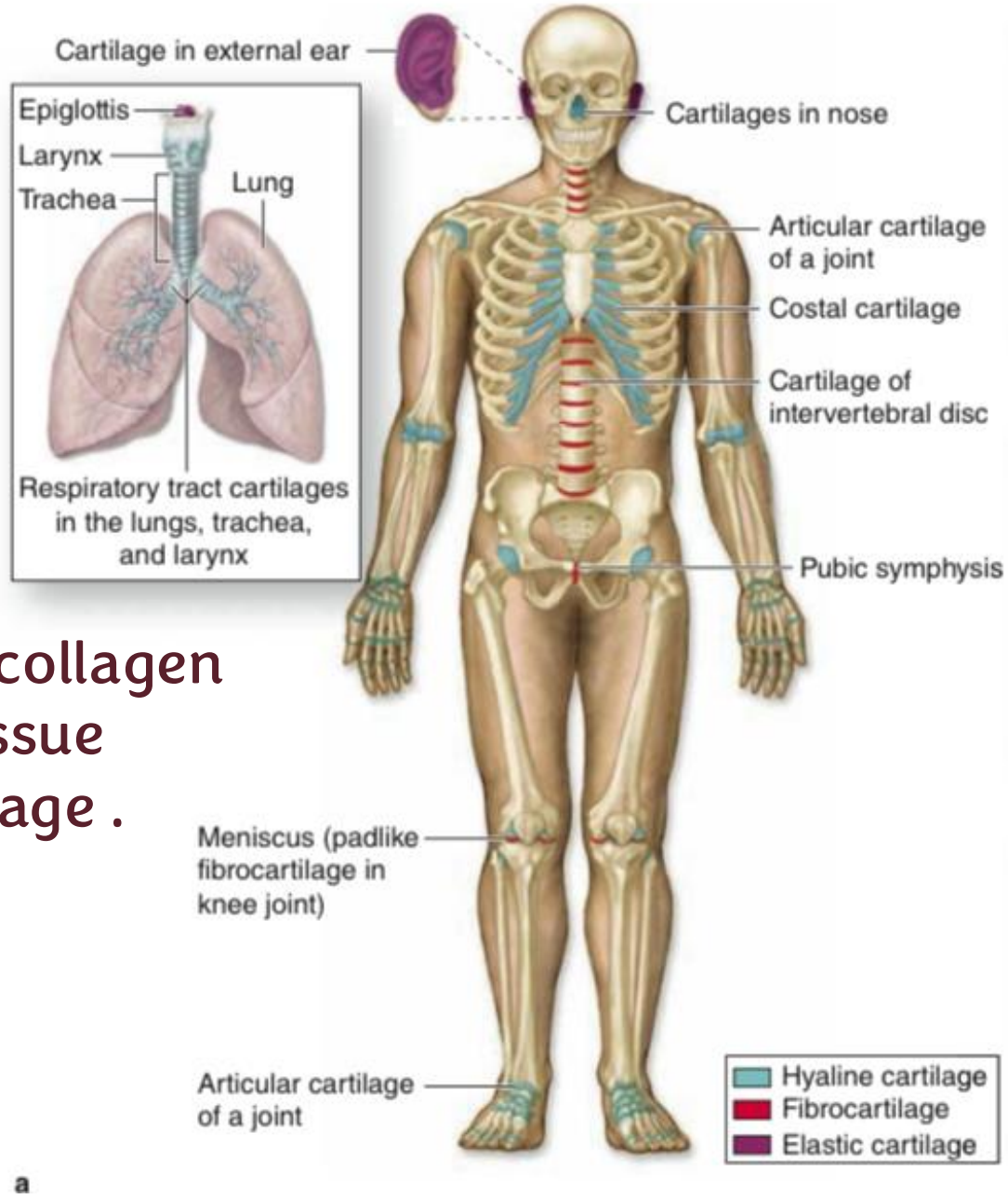
- *Its semi-rigid consistency is attributable to water bound to the negatively charged hyaluronan and GAG chains extending from proteoglycan core proteins, which in turn are enclosed within a dense meshwork of thin type II collagen fibrils*---**shock absorber**.

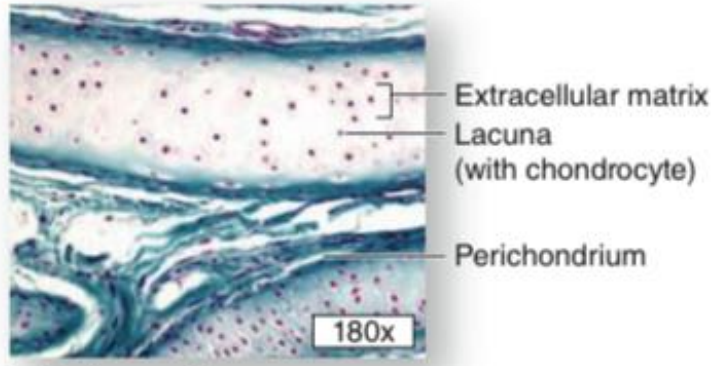
- *The physical properties of cartilage depend on electrostatic bonds between type II collagen fibrils, hyaluronan, and the sulfated GAGs on densely packed proteoglycans*

Types of cartilage

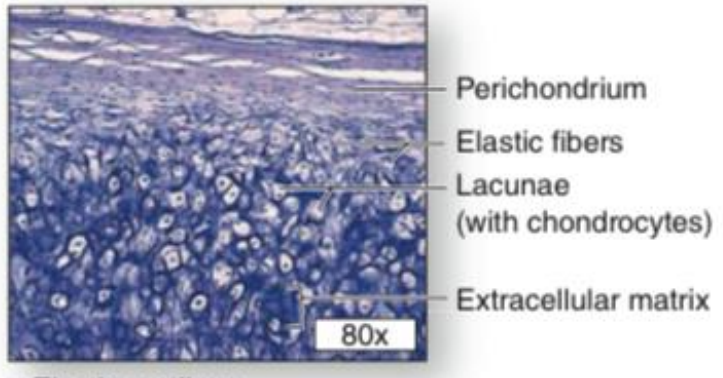
1. Hyaline
2. Elastic
3. Fibrocartilage

it's dense irregular(collagen type I) connective tissue combined with cartilage .

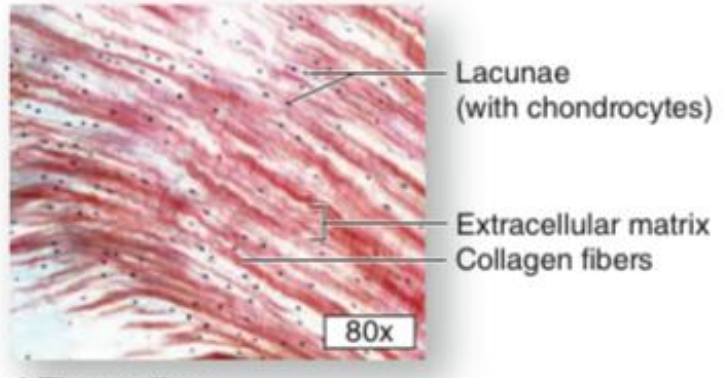




b Hyaline cartilage



c Elastic cartilage



d Fibrocartilage

Structure

- **Cells**

- Consists of only chondrocytes embedded in the ECM
- Chondrocytes synthesize and maintain all ECM
- Located in matrix cavities called lacunae.

ECM

- Type II Collagen Fibrils
- Hyaluronan
- Sulfated GAGs
- Proteoglycans

The perichondrium consists largely of collagen type I fibers and fibroblasts. Among these fibroblasts in the inner layer of the perichondrium are progenitor cells for chondroblasts that divide and differentiate into chondrocytes.

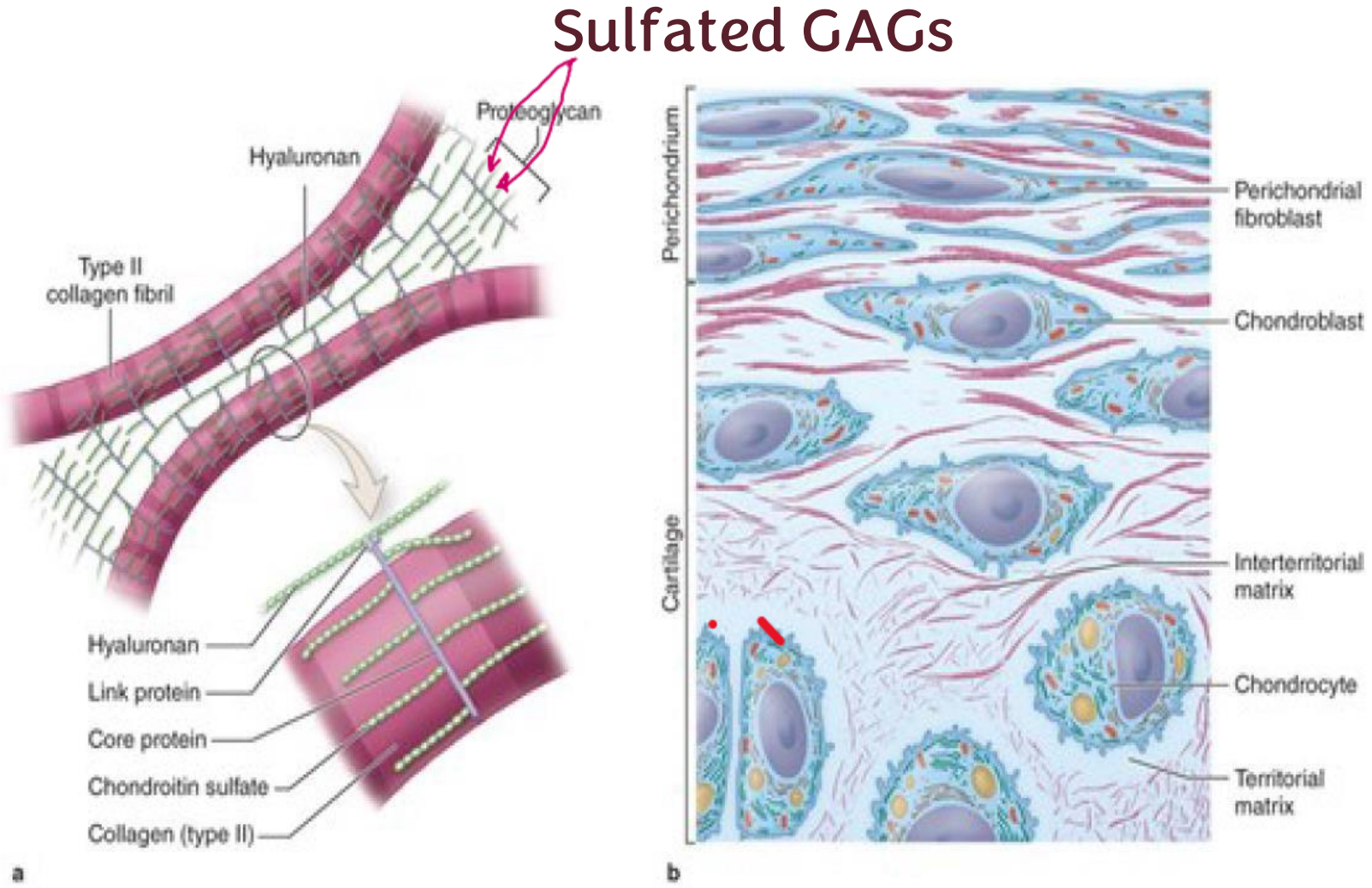
ECM

Type II Collagen

Hyaluronan

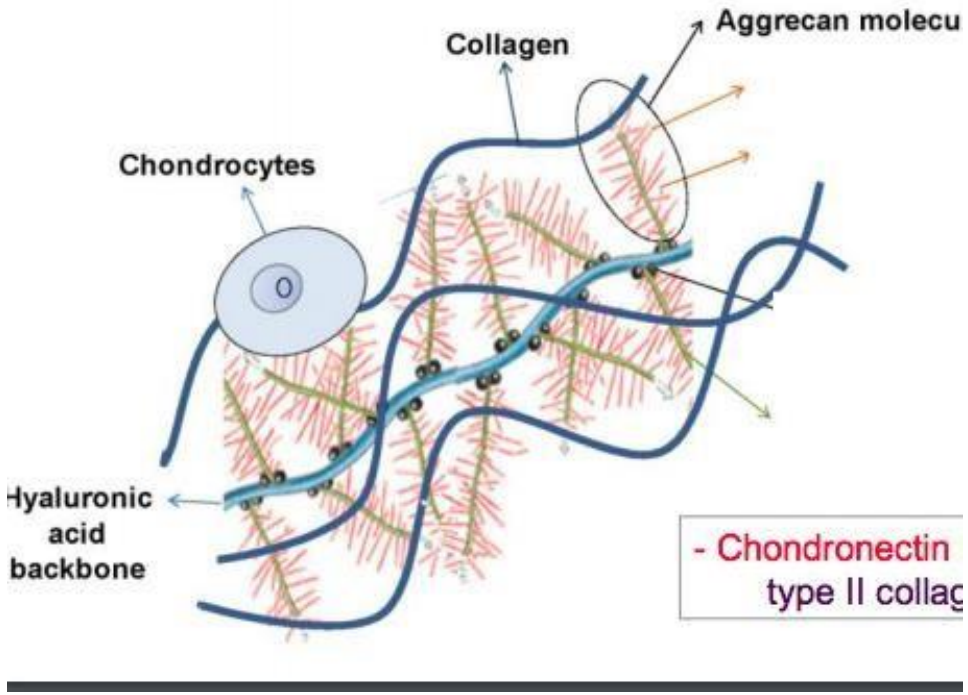
Sulfated GAGs

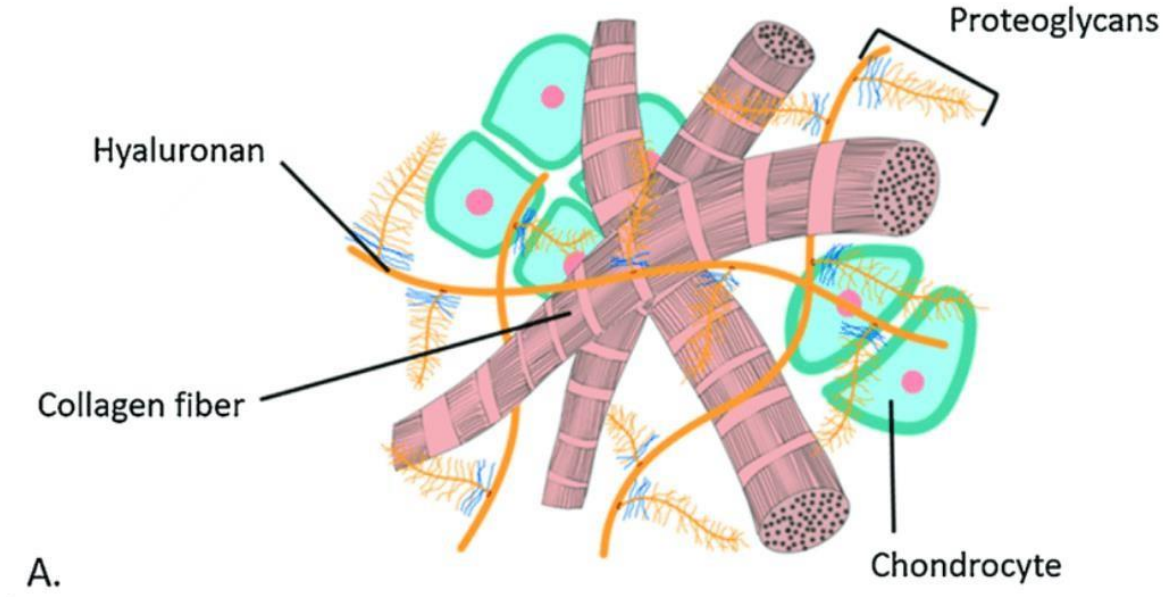
Proteoglycans

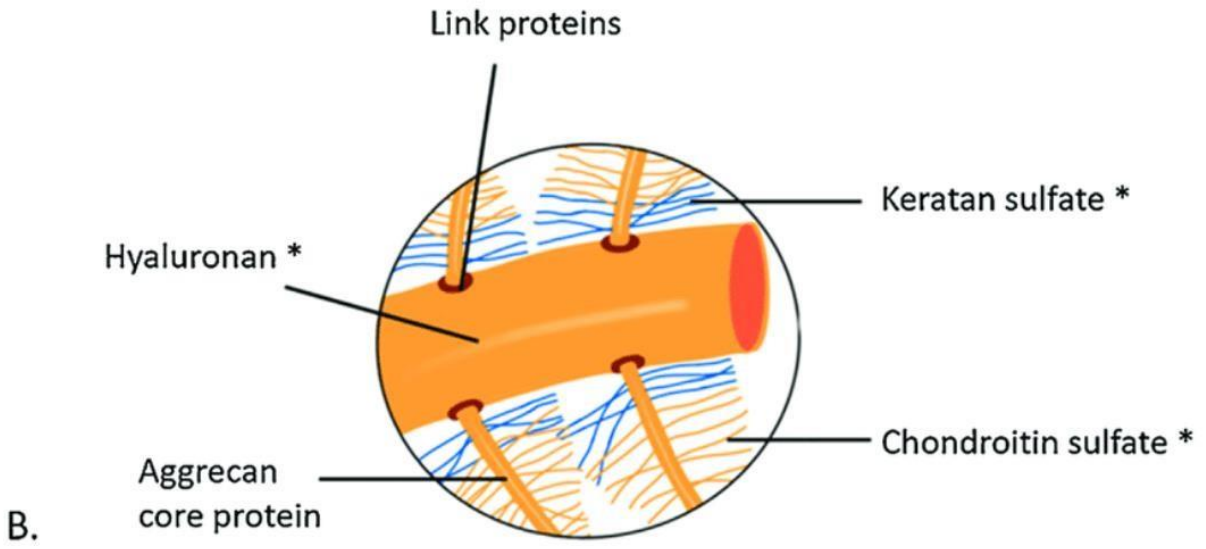


Chondrocytes are connected to the ECM through glycoproteins on their surfaces, thus enabling them to maintain the integrity of the ECM.

Hyaline Cartilage







Hyaline Cartilage

- Most common of the three types.
- Is homogeneous and semitransparent in the fresh state.
- Located in the articular surfaces of movable joints, in the walls of larger respiratory passages (nose, larynx, trachea, bronchi), in the ventral ends of ribs, where they articulate with the sternum, and in the epiphyseal plates of long bones.
- In embryoS, hyaline cartilage forms the temporary skeleton that is gradually replaced by bone.

Supports airways

Hyaline Cartilage / Structure

- Collagen is embedded in a firm, hydrated gel of proteoglycans and structural glycoproteins.
- Proteoglycans --matrix basophilic and the collagen fibrils are barely discernible.
- Most of the collagen is type II (small amounts of minor collagens are present).
- **Aggrecan** (150 GAGs--chondroitin sulfate and keratan sulfate) is the most abundant proteoglycan of hyaline c.
- Water bound to GAGs in the constitutes to 60%-80% of the weight. Gelatinous
- **Chondronectin:** structural multiadhesive glycoprotein, binds specifically to GAGs, collagen, and integrins, mediating the adherence of chondrocytes to the ECM.

A large glycoprotein

Matrix

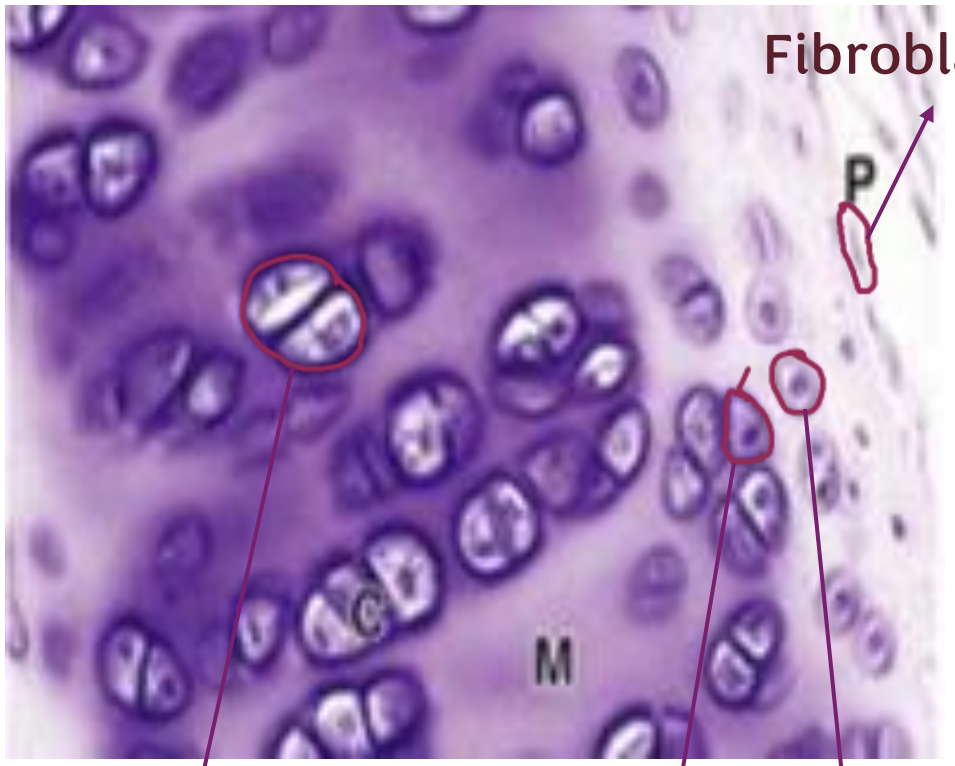
Classified according to the location and composition

Surrounds lacuna, stained draker

- **Territorial matrix**: immediately surrounding each chondrocyte, the ECM is relatively richer in gags than collagen, causing these areas of to stain more basophilic. Contains mostly proteoglycans and sparse collagen
- **Interterritorial matrix**: more distant from lacunae, richer in collagen and may be less basophilic.

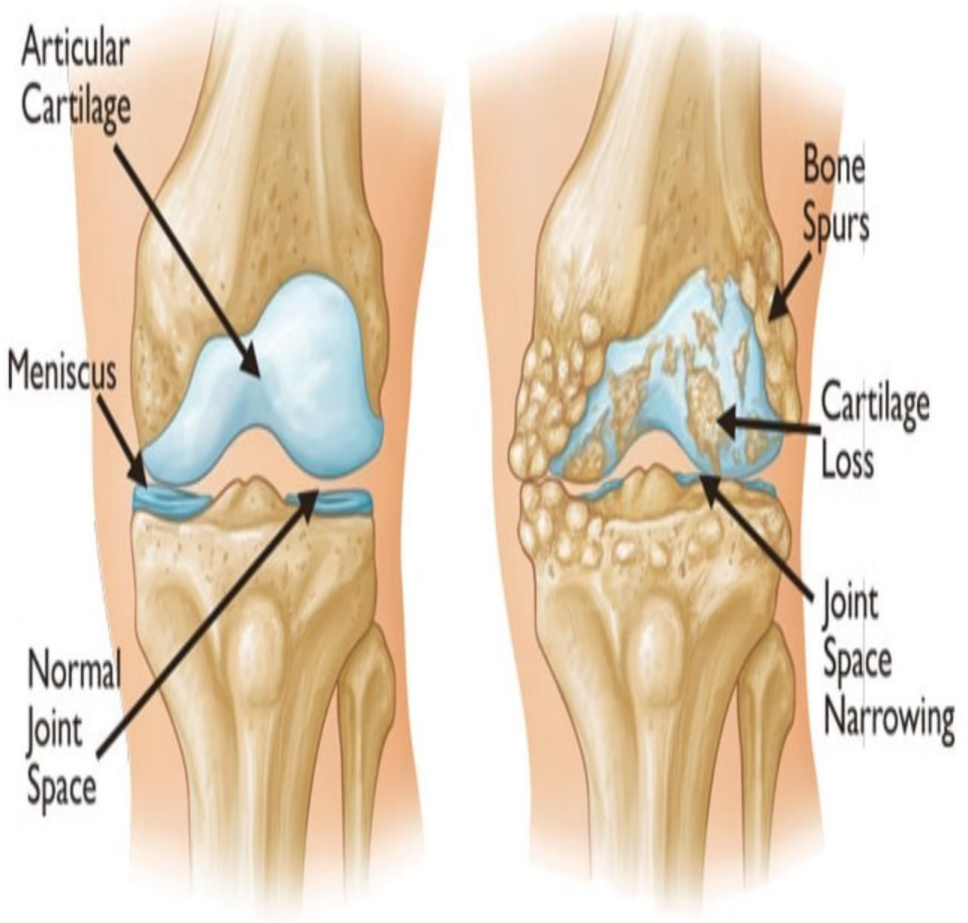
Between lacunas, stained lighter

H&E bright field microscope



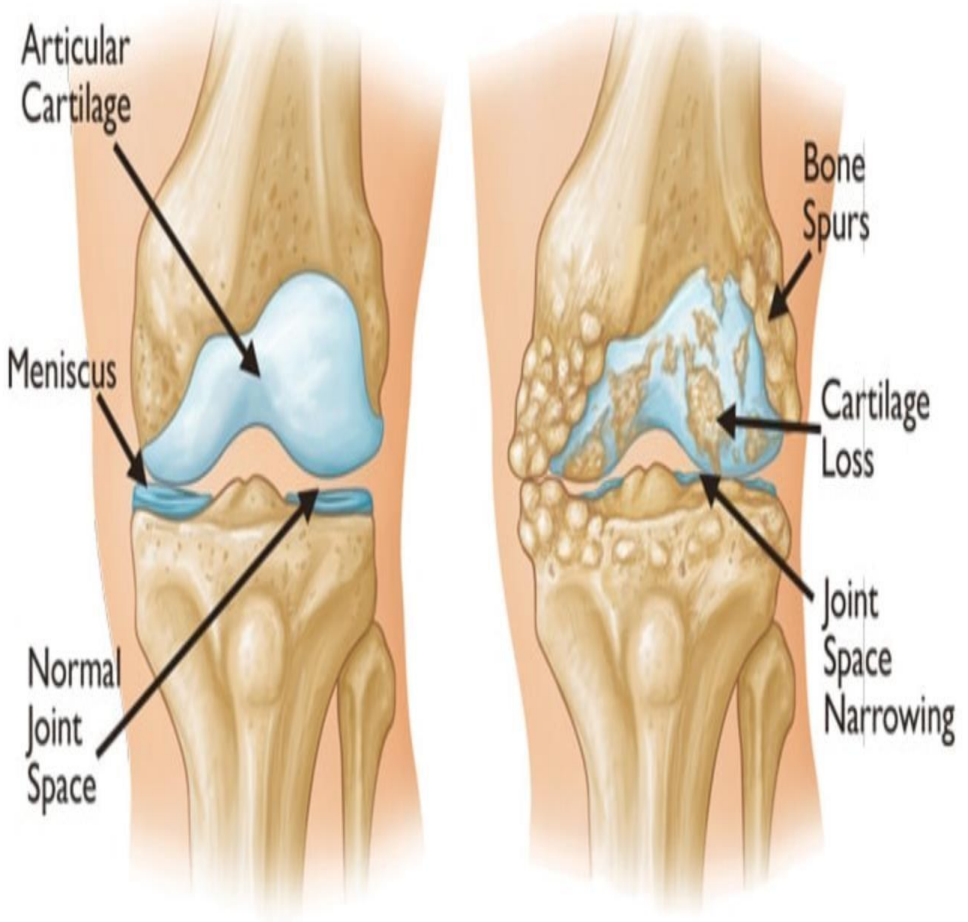
Osteoarthritis (Clinical application)

- A chronic condition that commonly occurs during aging.
- Involves the gradual loss or changed physical **Becomes less hydrated** properties of the articular cartilages.
- Weight-bearing Joints (knees, hips) or heavily used (wrist, fingers) are most prone to cartilage degeneration.



Osteoarthritis (Clinical application)

Osteoarthritis is a chronic joint condition that usually happens with aging(A sign of aging). It involves the gradual breakdown of articular cartilage, which normally cushions the ends of bones. As the cartilage wears away, bones may rub against each other, causing pain, stiffness, swelling, and reduced movement. Over time, joint space becomes narrower, and bone spurs may develop, making the condition worse.

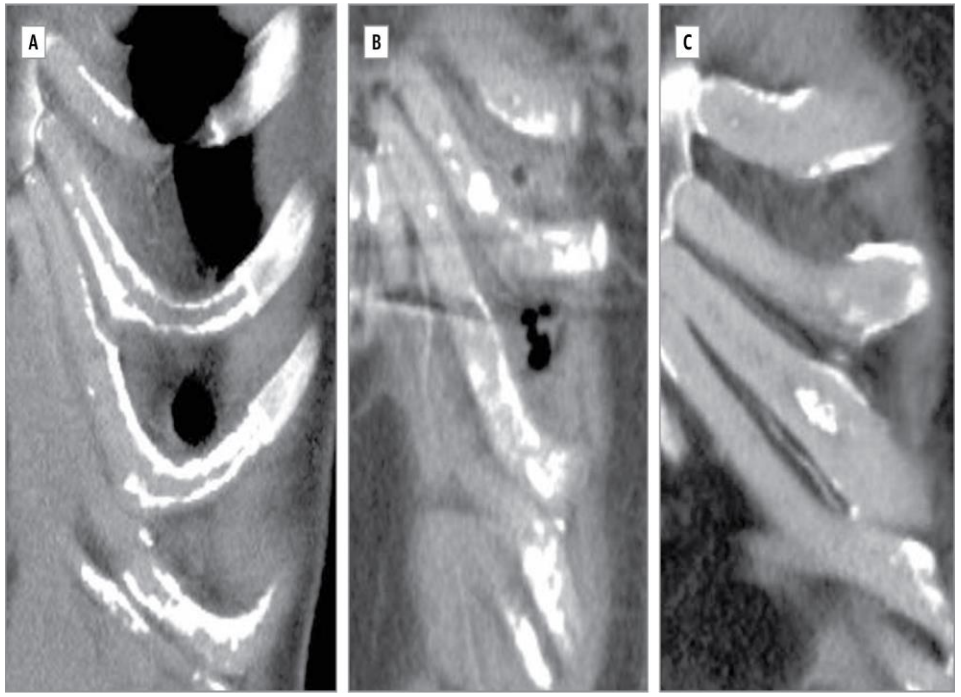


Calcification

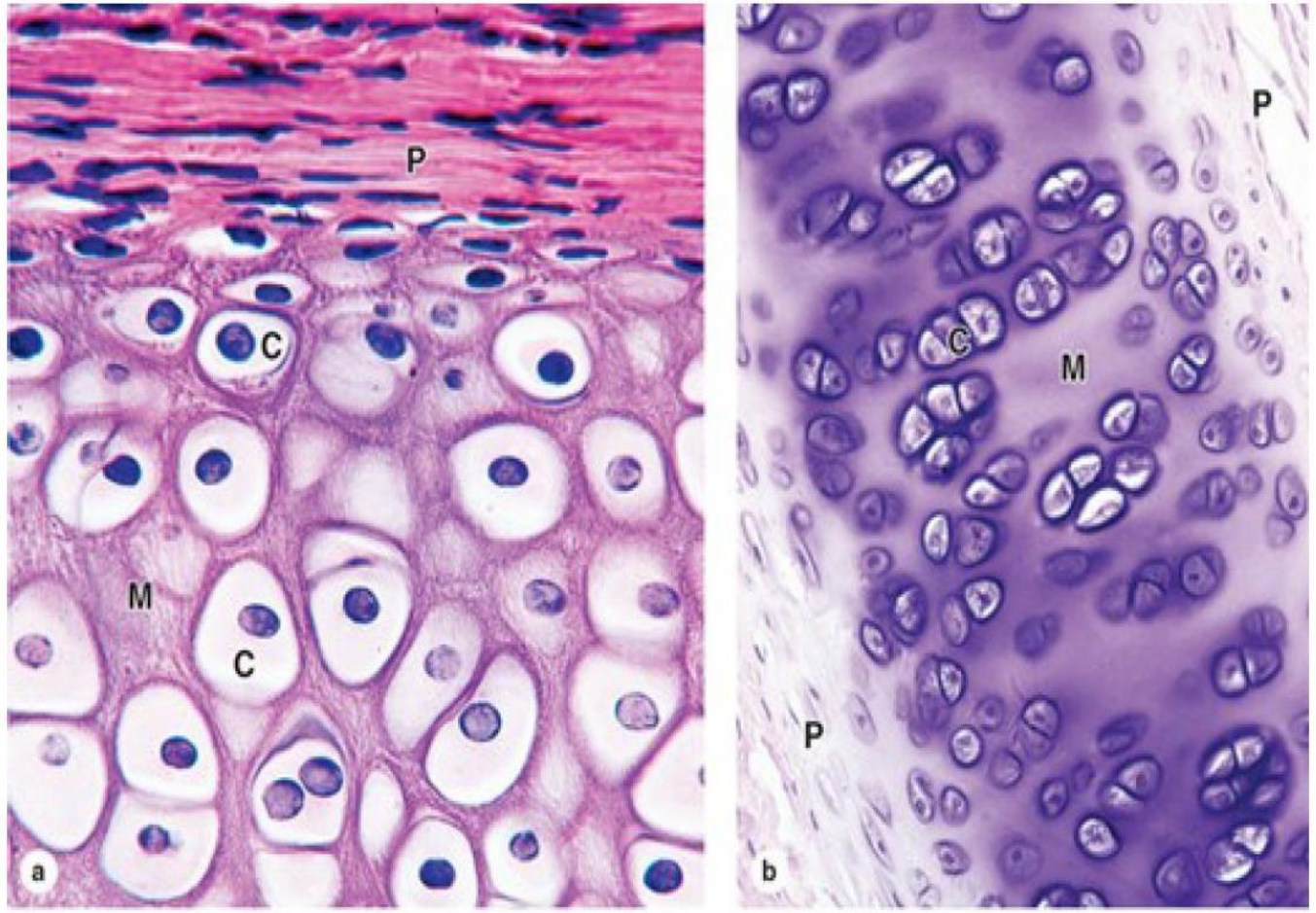
- In contrast to other forms of cartilage and most other tissues, hyaline cartilage is susceptible to partial or isolated regions of **calcification** during aging, especially in the costal cartilage adjacent to the ribs.
- Calcification of the hyaline matrix, accompanied by degenerative changes in the chondrocytes, is a common part of the aging process and in many respects resembles endochondral ossification by which bone is formed

Calcification

Calcification of hyaline cartilage is the abnormal deposition of calcium salts within the cartilage, usually seen with aging or certain conditions. This makes the cartilage stiffer and less flexible. On X-ray images, calcified areas appear as white or bright spots because calcium absorbs more X-rays than soft tissue. It is commonly seen in places like the costal cartilages and usually indicates age-related changes rather than disease.



Hyaline cartilage



	Hyaline Cartilage
Main features of the extracellular matrix	Homogeneous, with type II collagen and aggrecan
Major cells	Chondrocytes, chondroblasts
Typical arrangement of chondrocytes	Isolated or in small isogenous groups Usually even number of cells
Presence of perichondrium	Yes (except at epiphyses and articular cartilage)
Main locations or examples	Many components of upper respiratory tract; articular ends and epiphyseal plates of long bones; fetal skeleton
Main functions	Provides smooth, low-friction surfaces in joints; structural support for respiratory tract

Articular cartilage doesn't have perichondrium = It cannot regenerate

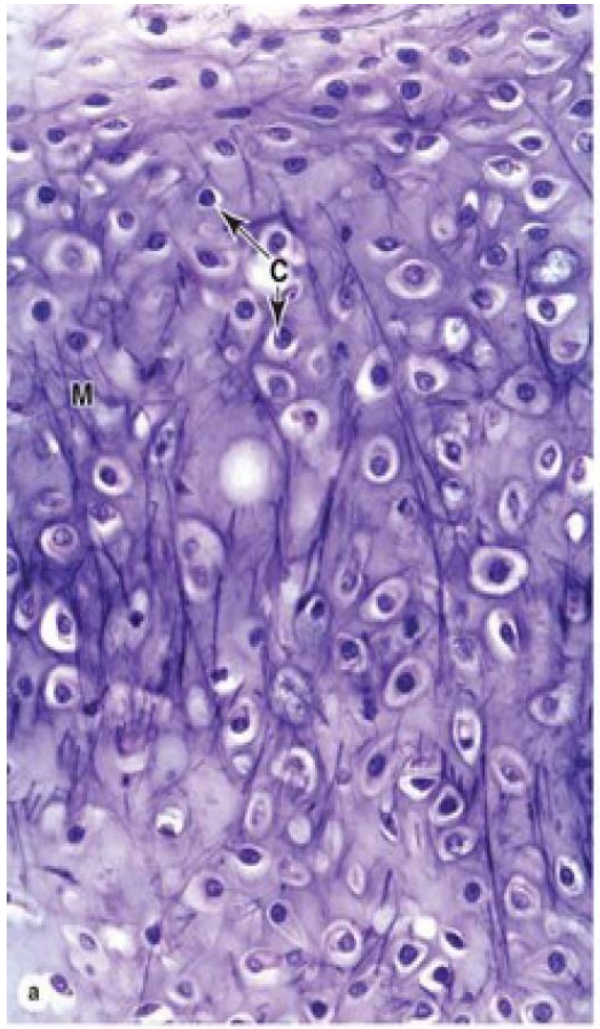
Elastic Cartilage

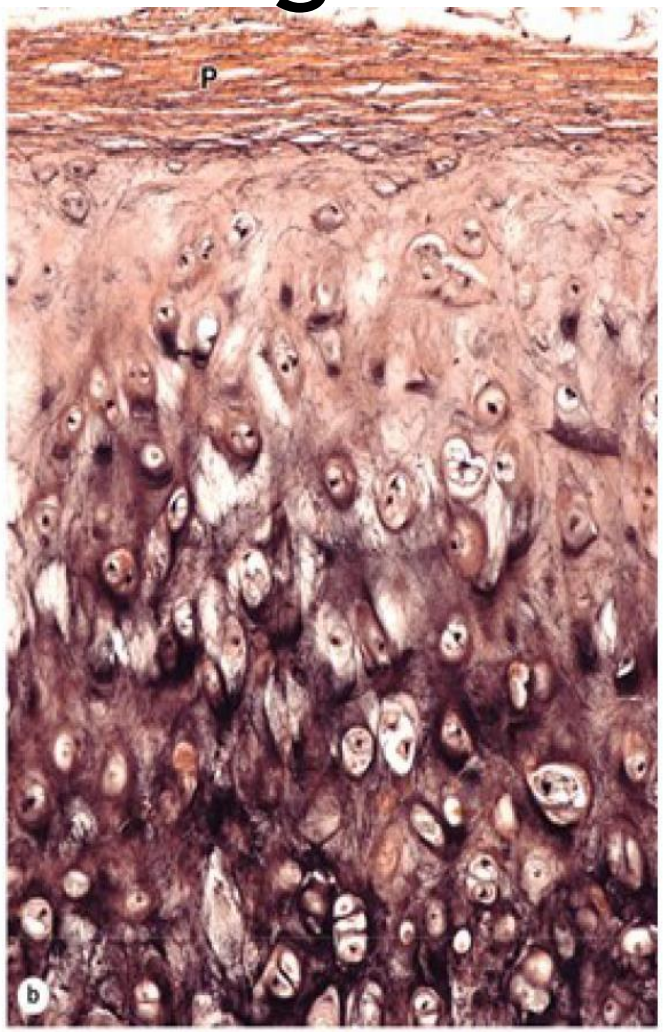
Elastic cartilage can be distinguished by different stains such as aldehyde fuchsin.

- Similar to hyaline cartilage except that it contains an abundant network of elastic fibers in addition to a meshwork of collagen type II fibrils.
- The abundant elastic fibers provide greater flexibility to this type of cartilage.
- More flexible than hyaline cartilage,
- Found in the auricle of the ear, the walls of the external auditory canals, the auditory (eustachian) tubes, the epiglottis, and the upper respiratory tract.
- Includes a perichondrium.

Because of its repetitive movement it should be elastic

Elastic Cartilage





	Elastic Cartilage
Main features of the extracellular matrix	Type II collagen, aggrecan, and darker elastic fibers
Major cells	Chondrocytes, chondroblasts
Typical arrangement of chondrocytes	Usually in small isogenous groups
Presence of perichondrium	Yes
Main locations or examples	External ear, external acoustic meatus, auditory tube; epiglottis and certain other laryngeal cartilages
Main functions	Provides flexible shape and support of soft tissues

For any feedback, scan the code or click on it.

Corrections from previous versions:

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

رسالة من الفريق العلمي:

ثبت عن رسول الله –صلّى الله عليه وسلّم- أنه قال: " من صام رمضان، ثم أتبعه ستًا من شوال؛ كان كصيام الدهر".

هم ست أيام واحنا طالعين من رمضان يعني ان شاء الله الصيام سهل علينا فاستغلوهم وصوموهم قبل ما نبلش ميد ويطول النهار أكتر .

تذكير: لا تنسوا دائما بعد ما تخلصوا دراسة تحكوا "اللهم إنّي استودعتك ما تعلمت وما حفظت فردّه إليّ عند حاجتي إليه يارب العالمين " اللهم آمين