

CARTILAGE

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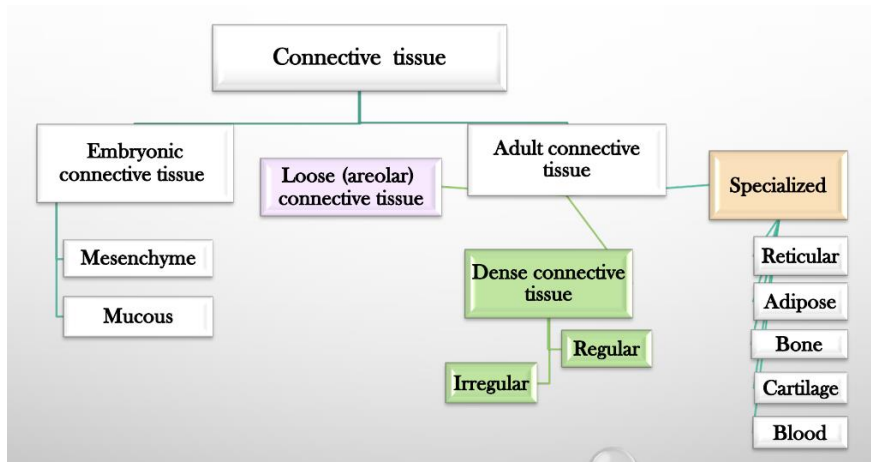


TOPICS OF THE LECTURE

- 1- Introduction
- 2- Perichondrium
- 3- Properties of cartilages
- 4- Types of cartilages
- 5- Cartilage structure
- 6- Matrix & perichondrium
- 7- Osteoarthritis
- 8- Summary



1- INTRODUCTION



- Remember also that the CT (Connective tissue) is formed of: Cells, & ECM which is further divided into (fibers & ground substances)
- Cartilage is a tough and durable CT. (Bone is also tough, but we can distinguish between the two types that the cartilage is compressible while the bone is not compressible)
- Cartilage is rich in ECM
Ground substance: high concentration of gags & proteoglycans
Fibers: Collagen & elastic fibers
- Avascular (There are no blood vessels in the cartilages, nutrients and oxygen are derived to cartilage cells by diffusion, diffusion is enough because cartilage cells – chondrocytes- have low metabolic activity)
- Lack nerves

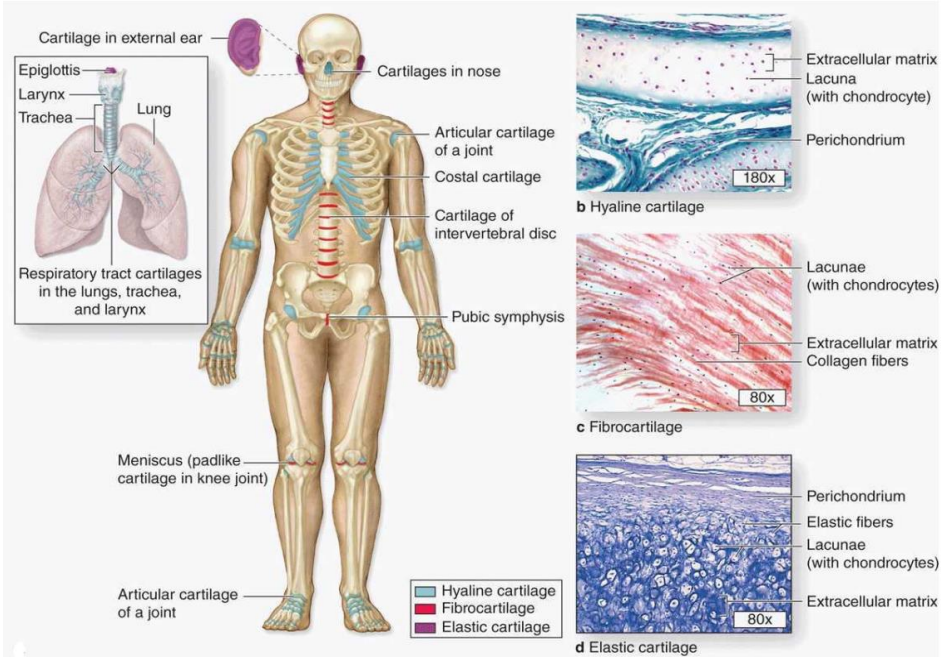
2- PERICHONDRIUM

- Perichondrium: Is a sheath of dense connective tissue that surrounds cartilage (Contains type 1 collagen mainly)
- Forms an interface between the cartilage & the tissue supported by the cartilage
- Contains blood supply and a small neural component (So nutrients reach the cartilage mainly from the perichondrium)
- We have 3 Types of cartilage: Elastic cartilage, Fibrocartilage & Hyaline cartilage (most common)
- Articular cartilage is a special type of hyaline cartilage, it covers the ends of bones in movable joints & it lacks perichondrium (diffusion of oxygen and nutrients from the synovial fluid)
(Note: Fibrocartilages don't have Perichondrium as well)

3- PROPERTIES OF CARTILAGES

- 1) Its semi-rigid consistency (compressibility not elasticity) (rigid up to a limit)
Why it's compressible?
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.
- 2) The physical properties of cartilage depend on electrostatic bonds between type II collagen fibrils, hyaluronan, and the sulfated GAGs on densely packed proteoglycans





4- TYPES OF CARTILAGES

Types of cartilage

1. Hyaline :

→ Found in: At the ends (tips) of the ribs / At the joints (articular cartilage)/ in the walls of larger respiratory passages (nose, larynx, bronchi , trachea)/ epiphyseal plate of cartilage

→ In the embryo, hyaline cartilage forms the temporary skeleton that is gradually replaced by bone

2. Elastic

→ Found in: The external part of the ear & The epiglottis

3. Fibrocartilage:

→ Found between the vertebrae / between hip bones / at the knee

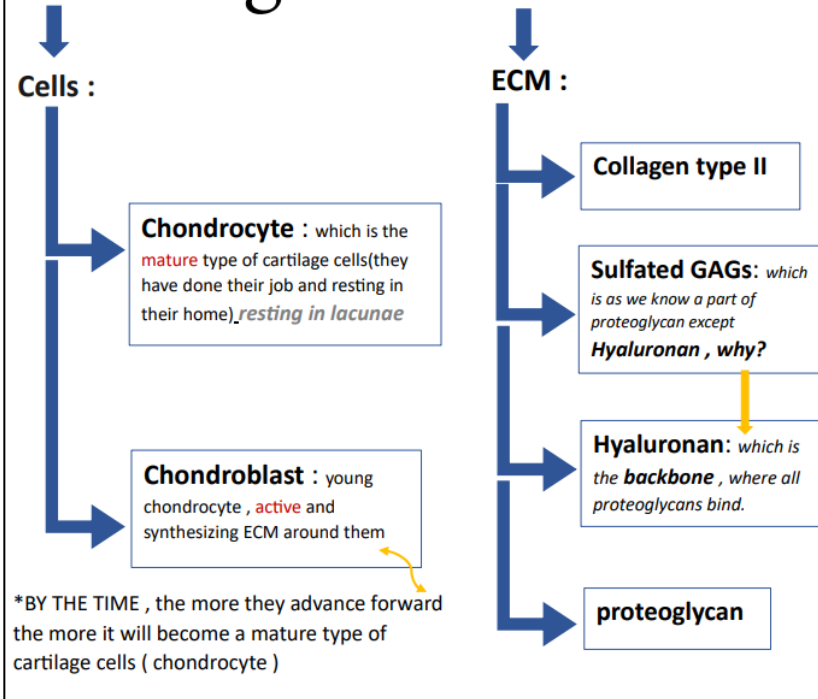
→ Strongest & toughest

→ Made of: **dense** irregular connective tissue with collagen I & **cartilage** with collagen II

→ the size of vertebrae changes from top to bottom (getting bigger) to carry more weight

5- CARTILAGE STRUCTURE

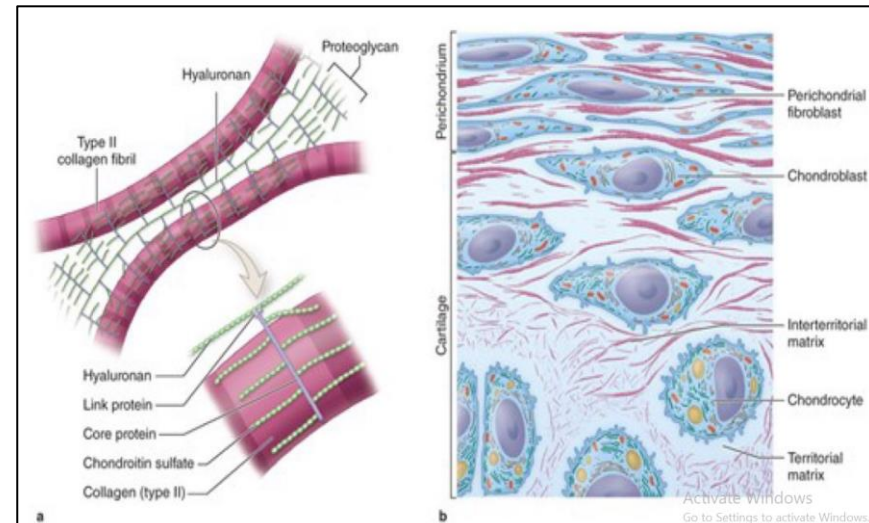
cartilage structure :



Some notes about the cells :

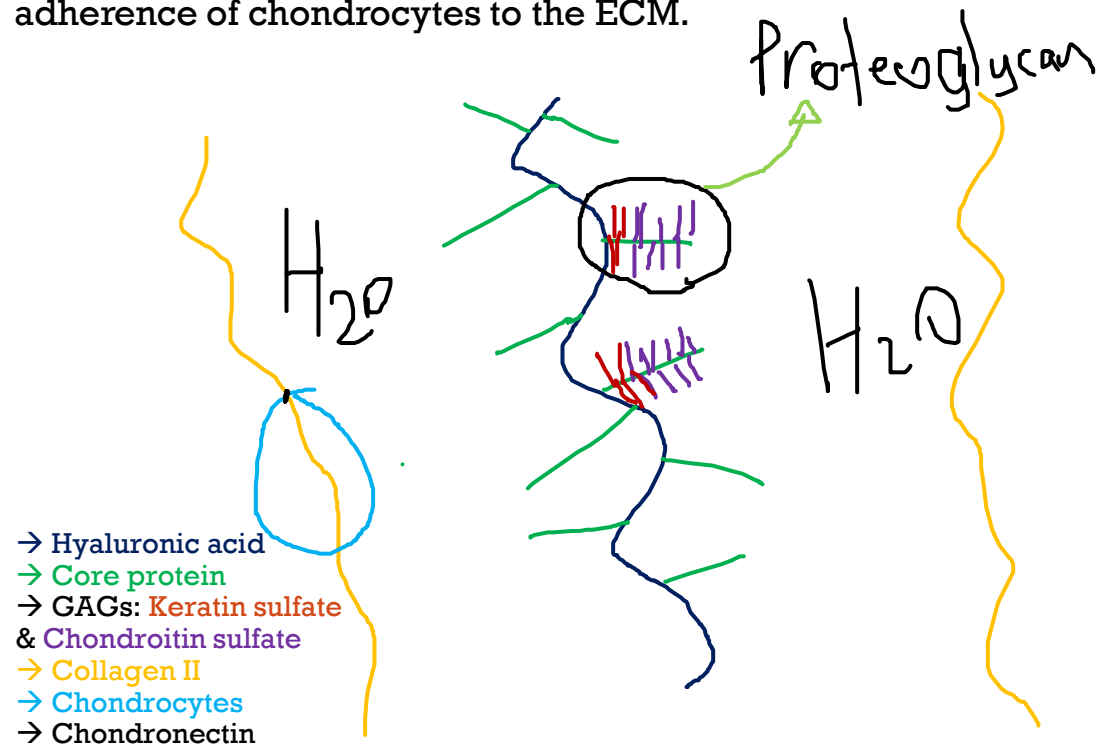
1. consist of only chondrocytes embedded in the ECM
2. chondrocytes synthesize and maintain all ECM
3. located in matrix cavity called **lacuna**

They seem to be Two types BUT you will not see two types, they are actually one type , **One type is a mature form of other type** (one type is young and the other type is a mature type)



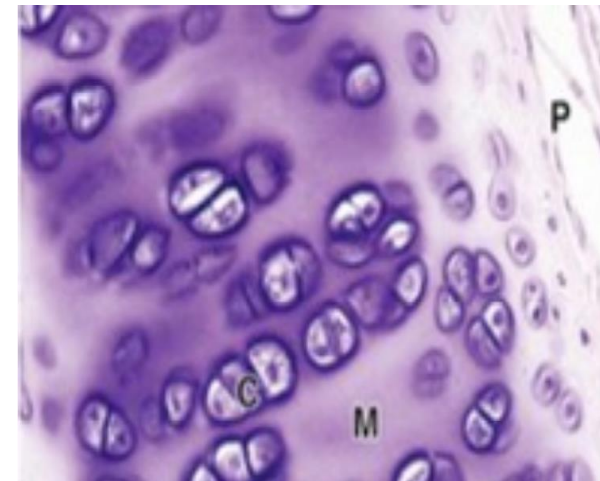
5- HYALINE STRUCTURE

- 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.
- Chondronectin: structural multiadhesive glycoprotein, binds specifically to GAGs, collagen, and integrins, mediating the adherence of chondrocytes to the ECM.



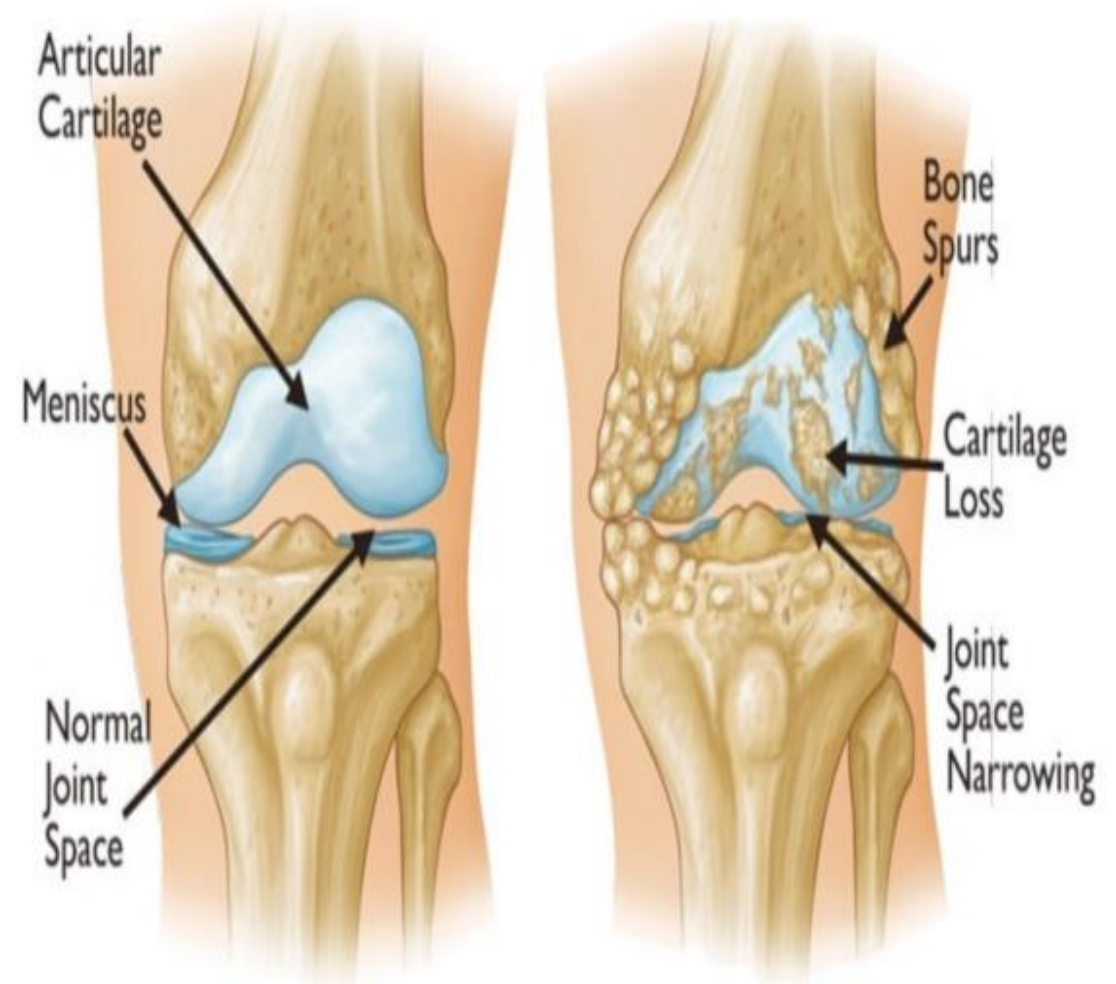
6- MATRIX & PERICHONDRIUM

- Perichondrium has 2 parts:
 - The external one is fibrous and rich with collagen I & fibroblasts
 - The internal surface is more cellular that contains progenitor cells, they will convert into chondroblasts then chondrocytes
- After the cells have released everything around them (the ECM) and become Chondrocytes (mature and retired cells), they are more or less immovable and imprisoned inside their home (within an envelope called the lacunae) with the semi-rigid ECM surrounds them from outside and holds them in their places
- Matrix is two parts:
 - 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



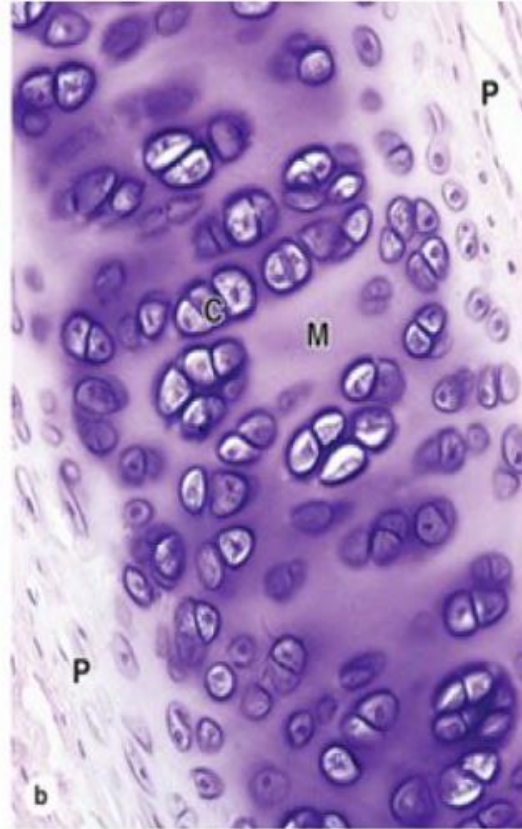
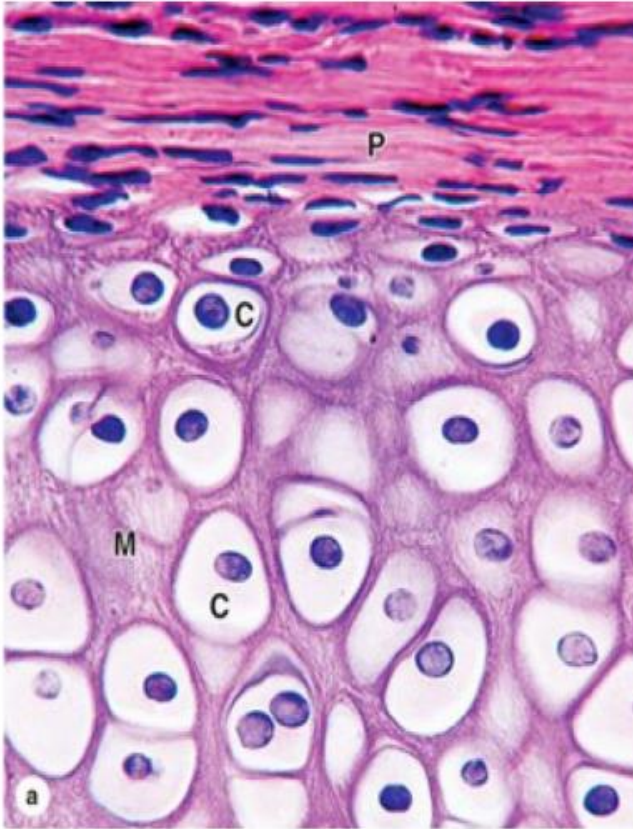
7- OSTEOARTHRITIS

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



8- SUMMARY

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
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