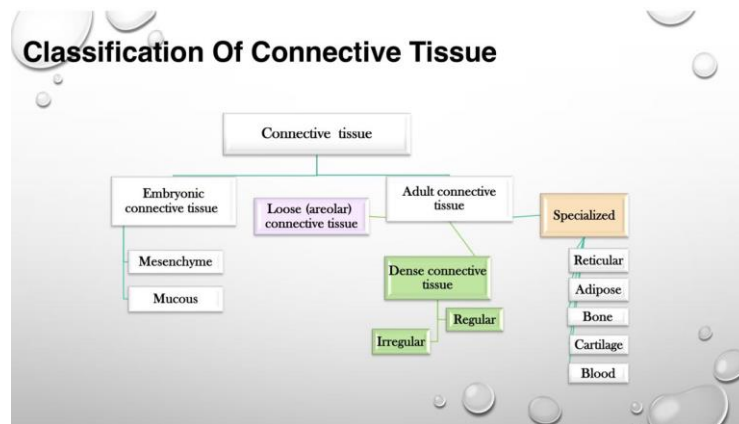


# Cartilage

## B-Elastic cartilage:

As you remember that connective tissue classified into many types as the following:



-the figure from Dr.Ghada slides

This type of tissue contains:

1- collagen type(2)

2- rich with elastic fibers, so it is more flexible than hyaline.

So, elastic can be bent and it will go back to its normal structure, but we can't bend it so severely, but just to know that it is more flexible than hyaline.

**Information from slides:**

1- it is similar to hyaline cartilage except that it contains an abundant network of elastic fibers in addition to mesh work of collagen type II fibrilles.

2- the abundant elastic fibers provide greater flexibility to this type of cartilage.

3- Found on the:

a- auricle of the ear, so we can bend them and for example sleep without breaking or pain.

b- the walls of the external auditory canals (القناة السمعية)

c- the auditory (eustachian) tubes (قناة استاكيوس التي توصل الأذن الوسطى بالبلعوم) (للمساواة الضغط داخل الأذن و خارجها).

d- the epiglottis (اللسان المزمار): to prevent food from passing through the passage airway, so it bends backward and close the larynx.

e- the upper respiratory tract.

4- includes a perichondrium.

Why should we have elastic cartilage?

Because it is **strong, can hold its shape, bendable, don't calcified with age.**

**What is calcification?** (Calcium ions deposition in tissues)

It makes the tissue harder and occurs in **hyaline cartilage but doesn't happen in elastic and fibro cartilage.** Because elastic structure has to remain elastic throughout life, but in case of hyaline we may have calcification.

But why in Hyaline?

osteogeneses happen in two ways:

**1- (intramembranous ossification) :** mesenchyme → bone cells (osteoblast) → bone tissue.

**2- endochondral ossification:** mesenchyme → chondroblast (hyaline cartilage) → then will replace this hyaline by bone.

Bones which are formed by this way are: long bones (humerus, radius, ulna, phalanges and metacarpals).

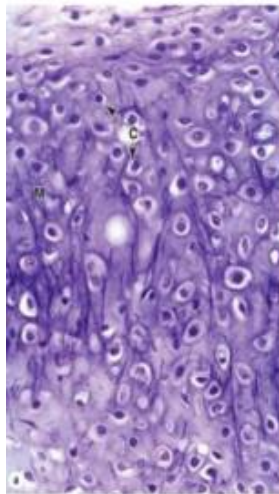
Now generally the skeleton of the embryo is hyaline and then calcification will happen then transformation of hyaline to bone (it continues also after born to the age 18).

When aging in elderly: what happen in endochondral (التعظم الغضروفي) ossification similar to it what happens in calcification on hyaline cartilage.

**From slides :**

1- 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 the costal cartilage adjacent to ribs.

2- 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.



	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

### C-Fibro cartilage: (The most special one)

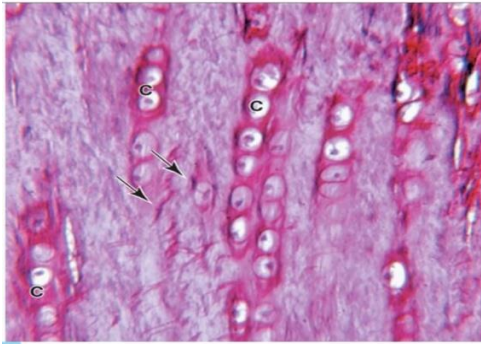
The chondrogenesis of it is a bit more special because two cells of different origin form this tissue; here mesenchyme give two types of tissues which combined together to give the fibro cartilage: dense irregular and cartilage tissue.

Fibro: The fibrous tissue (dense irregular connective tissue) contains fibroblast And collagen type (1), which gives strength for this cartilage.

و انا رايج اشوف اللي راكمته لبعده الميد



## Fibrocartilage



Fibrocartilage	
Main features of the extracellular matrix	Type II collagen and large areas of dense connective tissue with type I collagen
Major cells	Chondrocytes, fibroblasts
Typical arrangement of chondrocytes	Isolated or in isogenous groups arranged axially
Presence of perichondrium	No
Main locations or examples	Intervertebral discs, pubic symphysis, meniscus, and certain other joints; insertions of tendons
Main functions	Provides cushioning, tensile strength, and resistance to tearing and compression

**Pictures will be discussed another time Insha'Allah in lab online lecture.**

In pic:

C : chondrocytes

Which are oriented beside each other (isogenous groups).

Around them: matrix of chondrocytes.

In fibrocartilage chondrocytes are single or grouped in rows but in hyaline or in elastic and hyaline usually occur as rounded globular structure (مدورين حولين بعض في النسيج)

In between dense irregular tissue we can find fibroblast (by the shape of the nuclei: elongated thin nuclei) (عليهم سهم بالصورة اللي فوق)

Immunohistochemistry can help to differentiate between fibroblasts and progenitor cells.

انتبهو للجدوال عشان ما يصير فينا مثل المبد :

**Comparing between 3 types of cartilage:**

**Strength: Fibro > Hyaline > elastic**

**Elasticity: Elastic > Hyaline > Fibro.**

**There are 2 tissues that lack perichondrium (articular cartilage and fibrocartilage)**

**As a result, they lack chondroblasts and their regenerative power is compromised.**

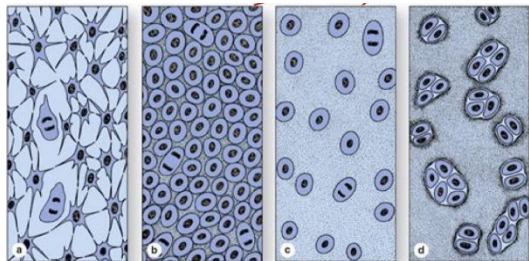
If any damage occurs in these tissues fibroblasts will replace the damage so they will increase in volume and organelles and proliferate to form a tissue -scar tissue- with different physical properties because its avascular .... Low metabolic activity ...low ability to proliferate.

### Information from slides:

- 1- A composite of hyaline cartilage and dense connective tissue.
- 2- It is found in intervertebral discs, in attachments of certain ligaments, and in the pubic symphysis – serves as very tough, yet cushioning support tissue for bone.
- 3- Chondrocytes occur singly and often in aligned isogenous aggregates.
- 4- Areas with chondrocytes and hyaline matrix are separated by other regions with fibroblasts and dense bundles of type 1 collagen, which give extra tensile strength.
- 5- relative scarcity of proteoglycans; matrix more acidophilic.
- 6- There is NO distinct surrounding perichondrium.
- 7-Intervertebral discs of the spinal column are composed primarily of fibrocartilage.

### Cartilage Formation, Growth & Repair:

-Chondrogenesis: How cartilage formed in embryo.



-Mesenchyme (branched with star shape) is the precursor for all types of cartilage. (a)

- Mitosis and initial cell differentiation to form chondroblasts (increase in number and become spherical -rounded and go under proliferation. (b)

-Chondroblasts produces various matrix components. (c)

- Multiplication of chondroblasts gives rise to isogenous cells, around them tough, not strong and thick gelatinous; so, cells can't go anywhere but in this matrix there is some elasticity that allows compression. (c)

Also, there are some undifferentiated cells for future growth.

-Multiplication (تضاعف) of chondroblasts gives rise to isogenous cells. But not all cells must be multiplied (تنتين او وحدة وممكن كلهم ممكن); so, you can see either even or odd number of chondrocytes within the same isogenous group. (d)

الشرح حسب السلايدات :

(a) Mesenchyme is the precursor for all types of cartilage.

(b) Mitosis and initial cell differentiation produces a tissue with condensations of rounded cells called chondroblasts.

(c) Chondroblasts are then separated from one another again by their production of the various matrix components, which collectively swell with water and form the extensive ECM.

(d) Multiplication of chondroblasts within the matrix gives rise to isogenous cell aggregates surrounded by a condensation of territorial matrix.

-In mature cartilage, this interstitial mitotic activity ceases and all chondrocytes typically become more widely separated by their production of matrix.

**NOW after embryo is born:**

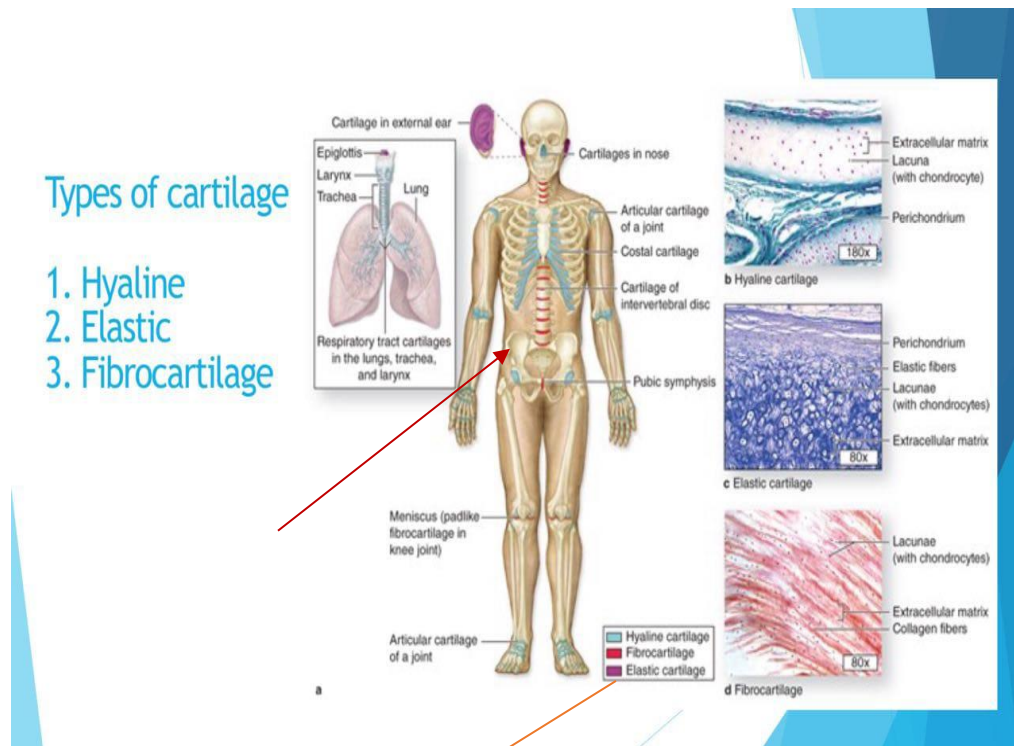
-Once formed, the cartilage tissue enlarges both by:

- Interstitial growth: proliferation of preexisting chondrocytes (After chondrogenesis)
- Appositional growth: chondroblast differentiation from progenitor cells in the perichondrium. (After birth)
- In both cases, the synthesis of matrix contributes greatly to the growth of the cartilage.
  - ❖ Appositional growth of cartilage is more important during postnatal development.
  - ❖ Interstitial growth in cartilaginous regions (epiphyseal plates) within long bones is important in increasing the length of these structures.
  - ❖ Articular cartilage -no perichondrium- worn away tissue replaced from within.



- Damaged cartilage undergoes slow and often incomplete repair.
- Cells in the perichondrium invade the injured area and produce new cartilage.
- In damaged areas the perichondrium produces a scar of dense connective tissue instead of forming new cartilage; because of that the new tissue is not strong enough.
- The poor capacity of cartilage for repair or regenerations due in part to its avascularity and low metabolic rate; the repair needs cell division and cell division as factories need resources but the diffusion here through thick gelatinous matrix of cartilage which is some hard, and so diffusion in cartilage lower than it is in regular connective tissue when compare with epithelial tissue.
- Even with perichondrium also the regeneration is not very good but still better than without.

هيك الحمد لله بنكون خلصنا بس ضايل نحكي وين موجود كل نسيج بصورة الهيكل الاتية: من السلايدات..



كل لون بالرسمه يمثل نوع معين من الغضاريف

## **Fibro cartilage : (red)**

1- intervertebral disc جزء منه مش كله

2- pubis symphysis: when the two hip bones meet the pubic bone make a joint – strong cartilaginous joint.

3-meniscus: structure of fibrocartilage that adds to the stability of the knee joint and participates in the resistance of weight when transmitted through the knee.

The size of intervertebral disc (fibrocartilage) increases as we go down. the cervical is the smallest because it carries a small weight (head and neck) but the biggest is sacral because here the weight is bigger which pass through the sacroiliac joint (between ilium which is part of hip bone and L5)

(عليه سهم احمر طويل بالصورة فوق) and in intervertebral disc we have fibro cartilage because it is the strongest, so for e.g. hyaline is not the best.

## **Elastic: (Purple)**

WE MENTIONED THEM IN ELASTIC .

## **Hyaline: (Blue)**

-the biggest member in cartilage (اكثر لون بشوفه)

1- Costal cartilage: attach to the tips of the ribs and articulate with sternum.

2- nose

3- articular surfaces: (covered with hyaline cartilage) two ends of the bones which participate in the formation of joints.

**THE END OF SHEET #10**