Supporting connective tissue

- Cartilage and bone are modified CT in which ground substance is hardened to provide support for soft tissue
- Cartilage and bone form the skeleton of the body

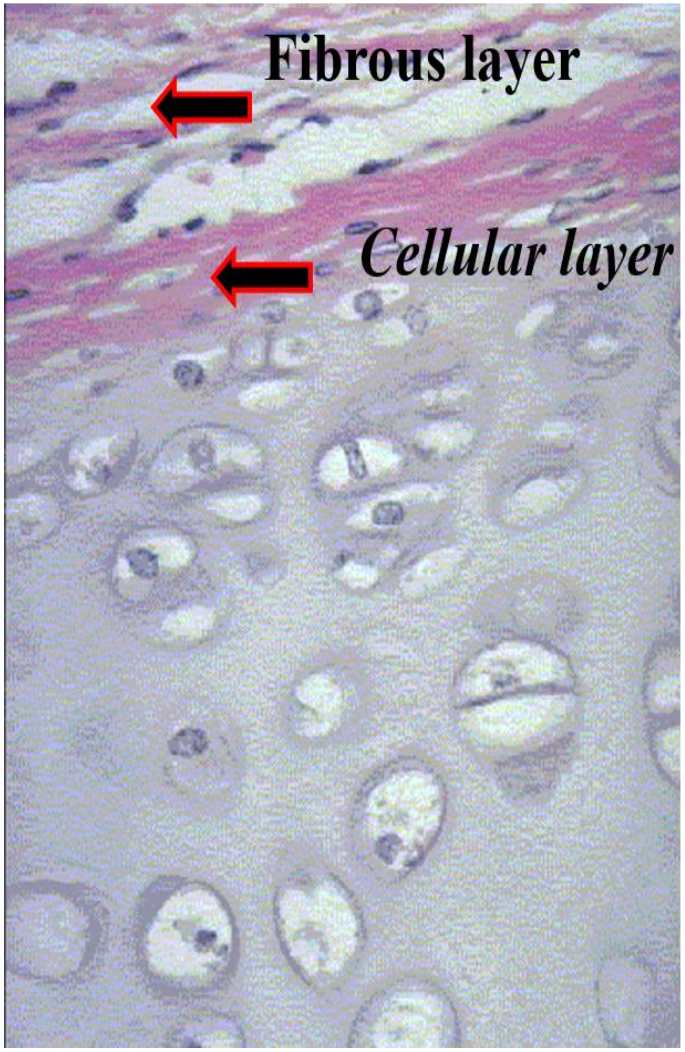
CARTILAGE

Characteristic features of cartilage

- Modified connective tissue with firm ground substance & flexible
- Avascular (nutrients diffuse through matrix from surrounding CT or from synovial fluid in joint cavities)
- Cartilage is usually covered by perichondrium which is rich in blood vessels
- Cartilage has No lymphatic or nerves
- Cartilage cells are isolated in lacunae (small cavities in the ground substance)

PERICHONDRIUM

- ❑ Ensheaths the cartilage
- ❑ Present in **most** of the hyaline & elastic cartilage , **absent** in fibrocartilage
- ❑ Fibro-cellular membrane that consists of two layers :
- ➢ Outer fibrous layer houses the blood vessels that nourish chondrocytes
- ➢ Inner vascular & cellular layer (chondrogenic layer) this layer contains chondroblasts which are capable of forming new cartilage



Function :

1. It is responsible for nourishment of chondrocytes
2. It is responsible for appositional growth

Structure of cartilage

Extracellular matrix

1. Ground substance

2. Fibers :

Cartilage cells

- Chondroblasts
- Chondrocytes

Extracellular MATRIX

Ground substance

It is responsible for firmness & flexibility of cartilage

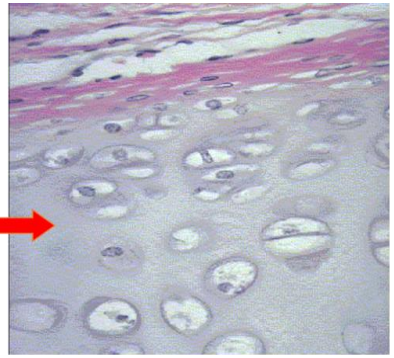
❖Produced by cartilage cells

❖ Basophilic

- ➢Water **60-80 %**
- ➢Adhesive glycoprotein e.g. **chondronectin**
- ➢Glycosaminoglycans (chondroitin sulfates & keratan sulfate) bound to hyaluronic acid
- ➢Proteoglycans & glycoprotein

Fibers

- Collagen type II
- Collagen type I
- Elastic fibers

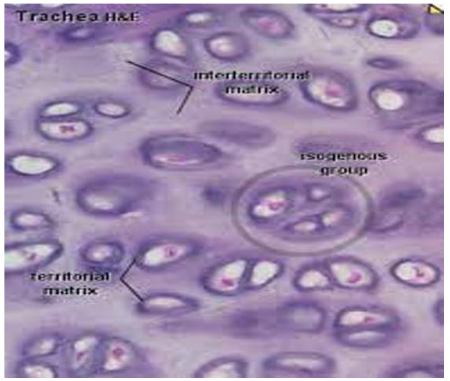


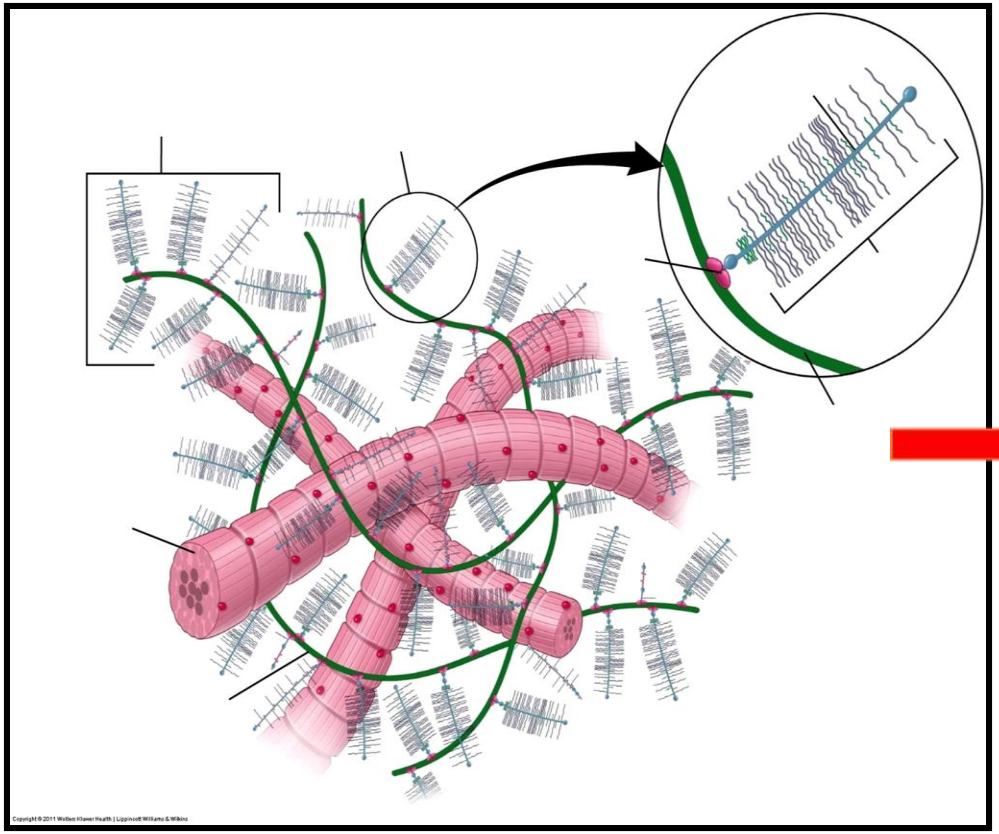
Territorial matrix

surrounds lacuna (space in which chondrocyte present)

➢Interterritorial matrix

Between the lacunae

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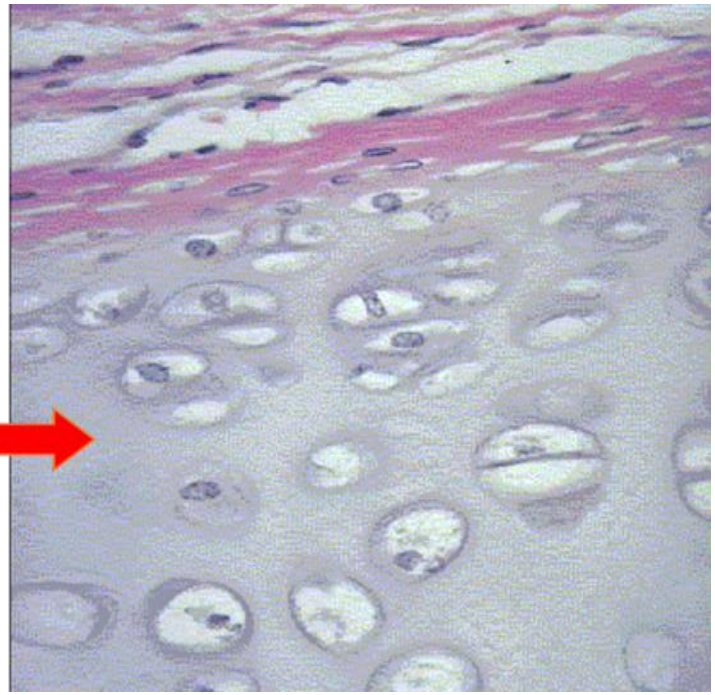
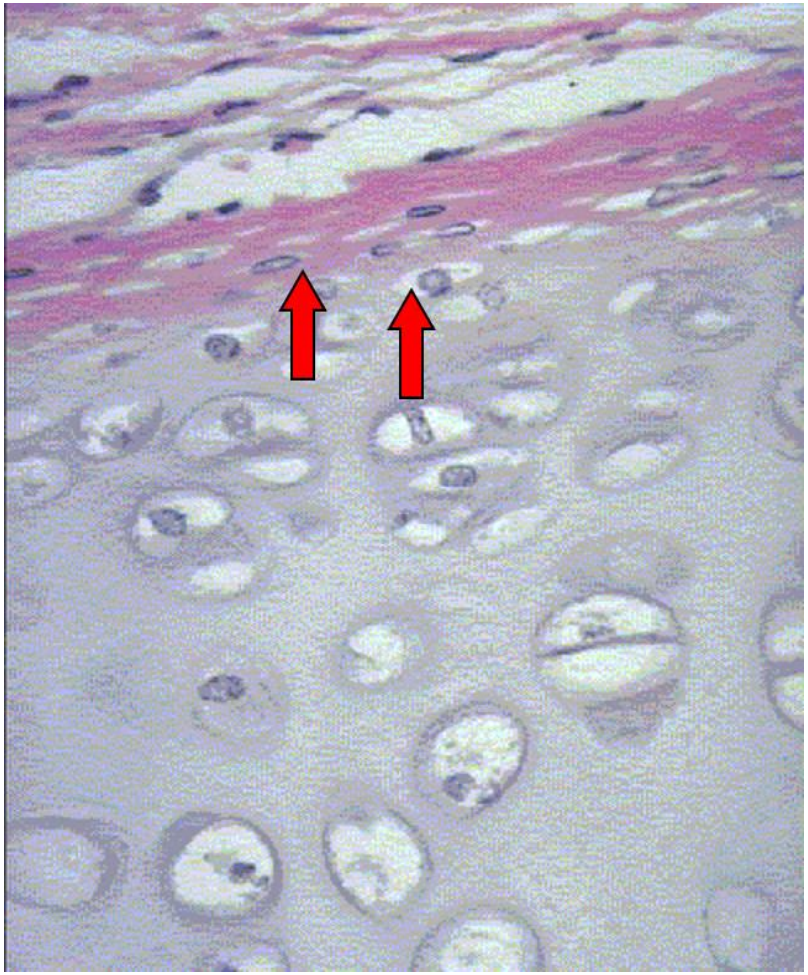


Cells of cartilage
1. CHONDROBLAST

- Differentiate from perichondrium
- Progenitor of chondrocytes
- Lines border between perichondrium and matrix
- Synthetically active, produce ground substance and fibers
- Synthesize type II collagen, proteoglycans and chondronectin.
- When reside in a space called the **lacuna** → chondrocytes

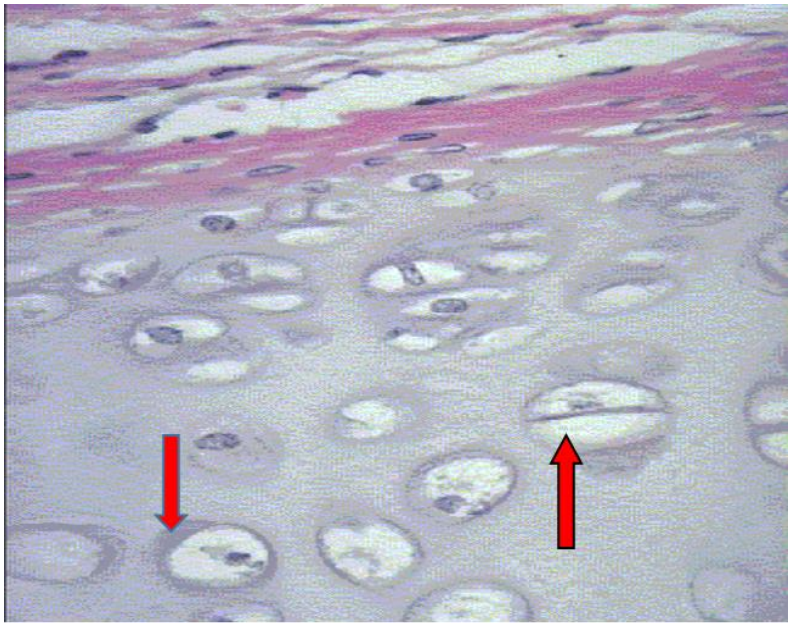


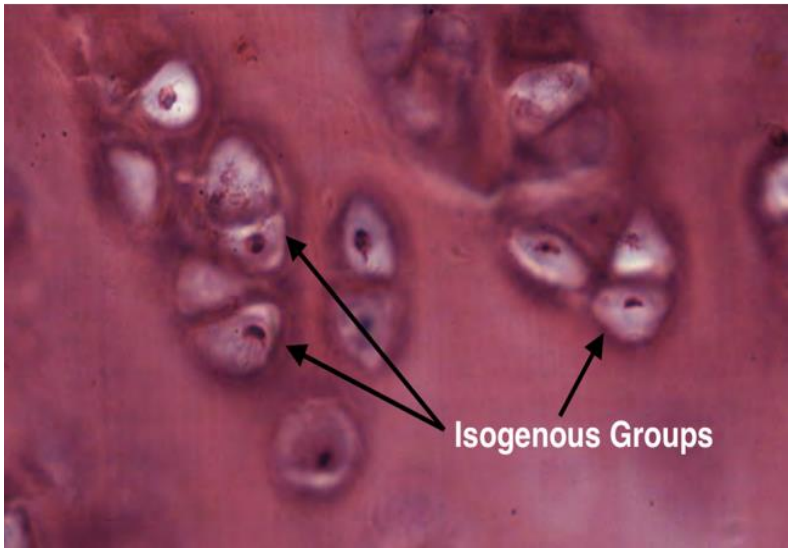
2. CHONDROCYTE

- Mature cartilage cell
- Reside in a space called the **lacuna**
- Form isogenous cell group

called (Cell nest)

- Maintain the extracellular matrix





TYPES OF CARTILAGE

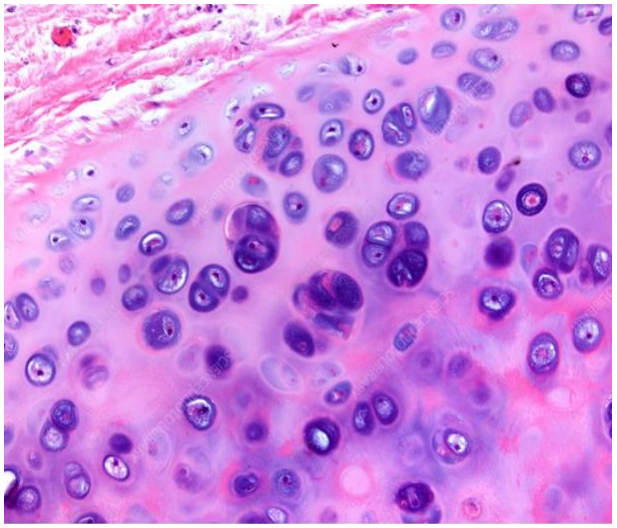
- **Hyaline cartilage**
- **Elastic cartilage**
- **White fibrocartilage**

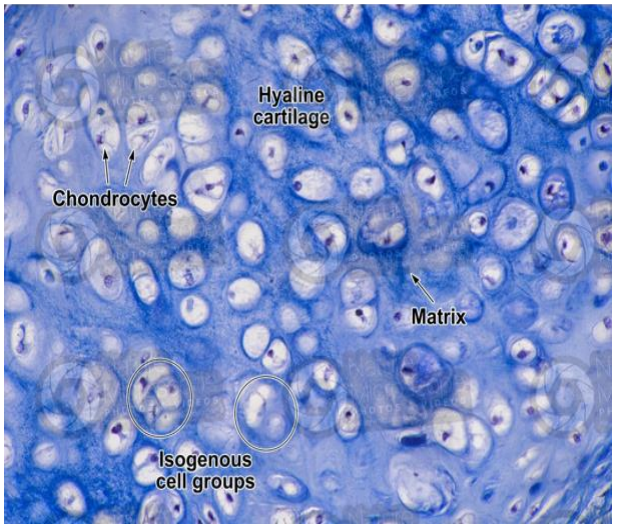
HYALINE CARTILAGE

- **Sites:** Tracheal rings, nasal septum, larynx, costal cartilage & articular surfaces of joints
- **Perichondrium :** may or may not present
- **Cartilage cells:** Present singly or in groups of 2 -8 cells inside lacunae

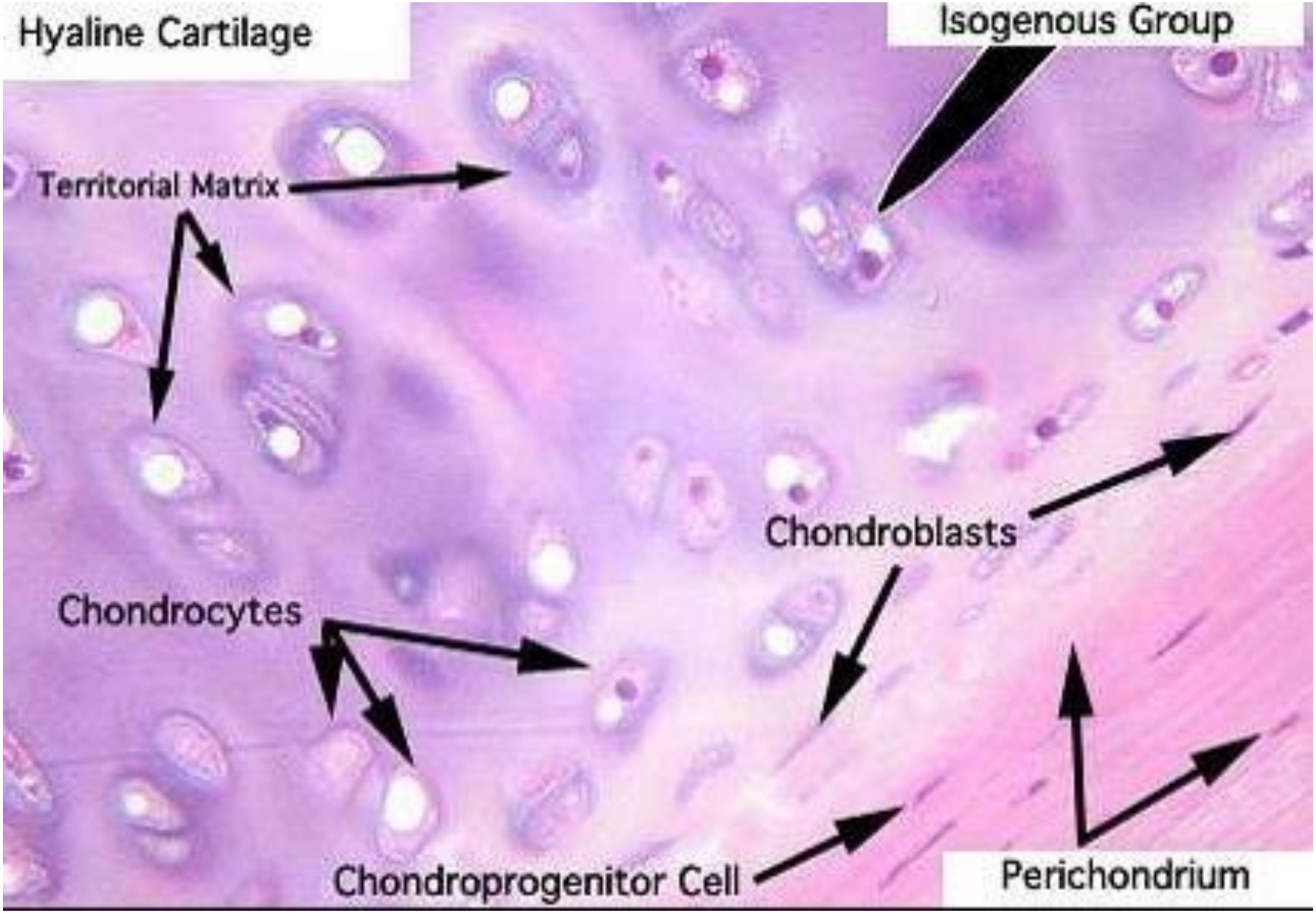
Called cell nest

- **Cartilage fibers:** Collagen type II
- **Ground substance:** Homogenous, clearly Pale basophilic with glassy appearance





- **Functions:** supportive
- bone formation in fetal skeleton
- epiphyseal bone growth
- provide smooth articulation for joints

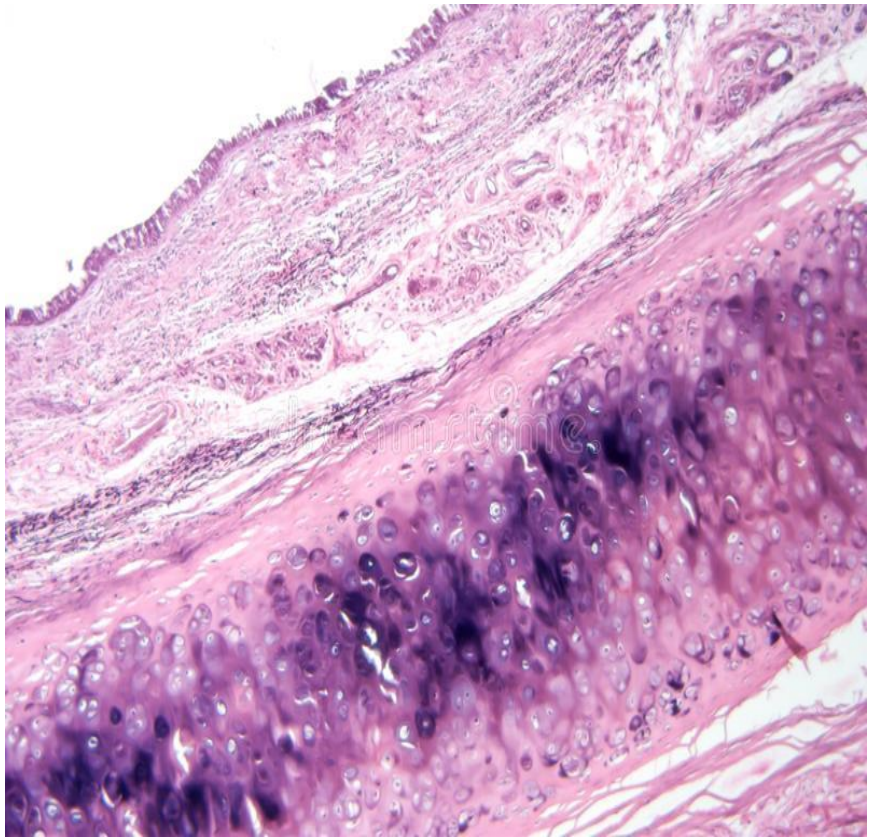

Hyaline Cartilage
Isogenous Group
Territorial Matrix
Chondroblasts
Chondrocytes
Chondroprogenitor Cell
Perichondrium

ELASTIC CARTILAGE

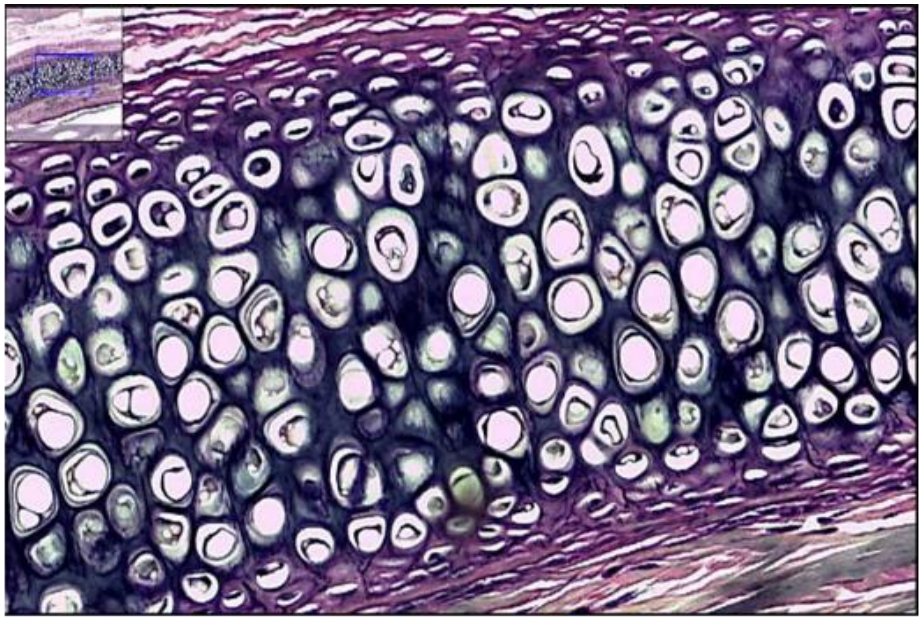
- **Sites:** Auricle, ext. auditory meatus, auditory tube, epiglottis
- **Perichondrium :** always present
- **Cartilage cells:** small , more numerous, packed more closely

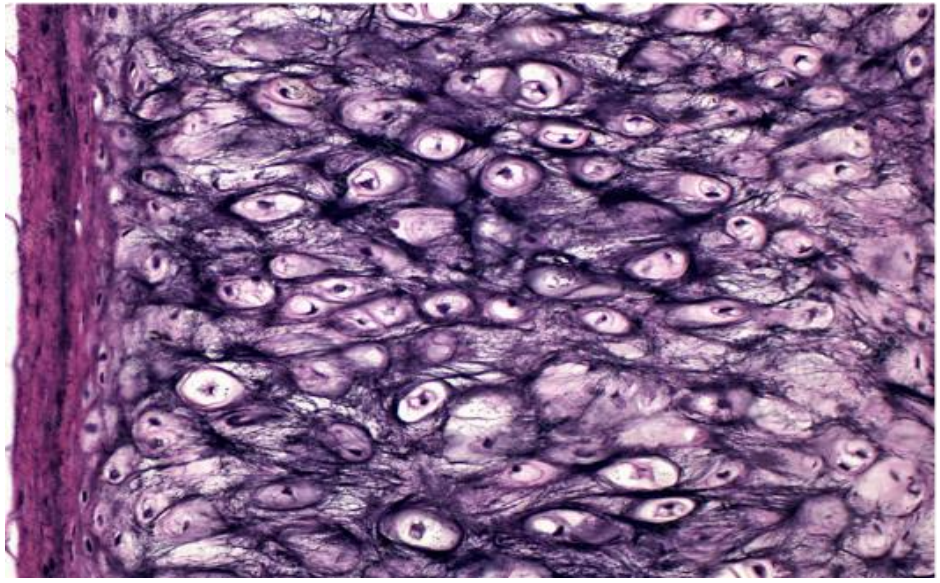
in groups of 1-3 cells inside lacunae

- **Cartilage fibers :** elastic fibers, collagen type II
- **Ground substance:** Rich in elastic fibers **(little)**
- Elastic fibers stain with orcein& VVG
- **Functions:** supportive with resilience

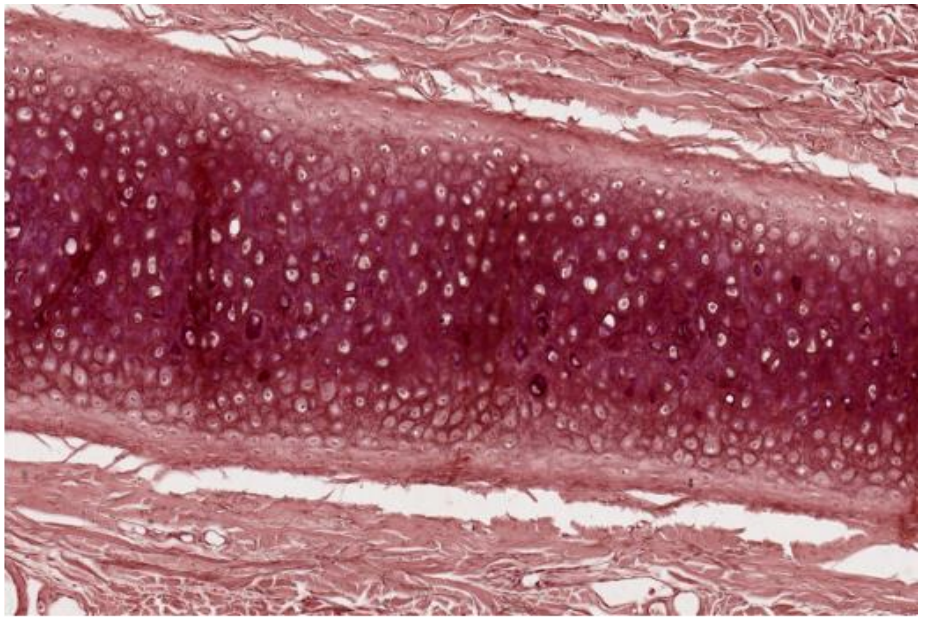


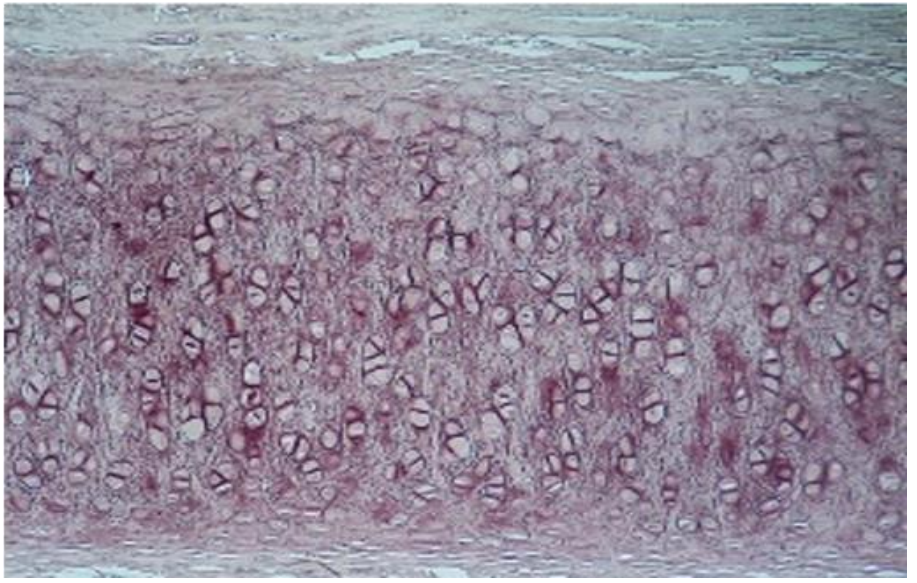
VVG stain





Orcein stain





White FIBROCARTILAGE

- **Sites:** intervertebral discs, pubic symphysis, sternoclavicular joint, articular disc of Tempromandibular joint.
- **Perichondrium :** Never covered
- **Cartilage cells:** fewer, smaller, scattered singly or in rows

1-2 cells inside lacunae

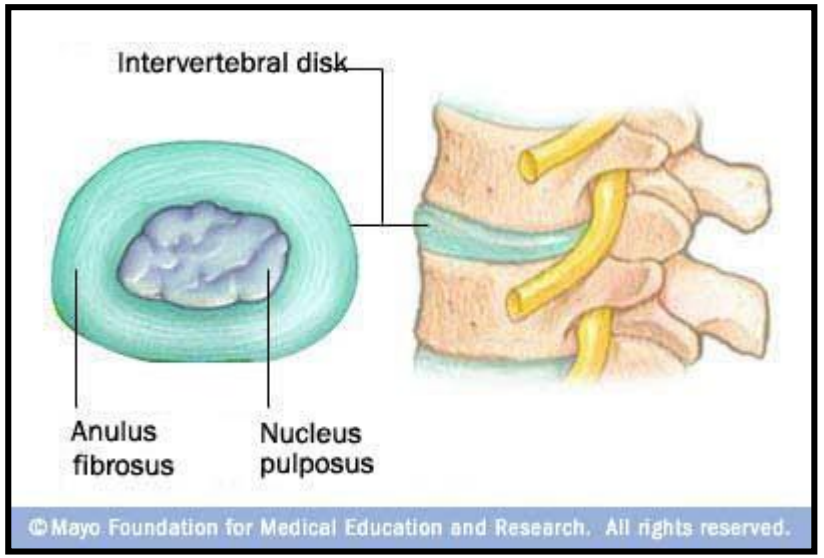
- **Cartilage fibers: mainly** collagen type I & few II
- **Ground substance: little**
- **Functions:** supportive with tensile strength

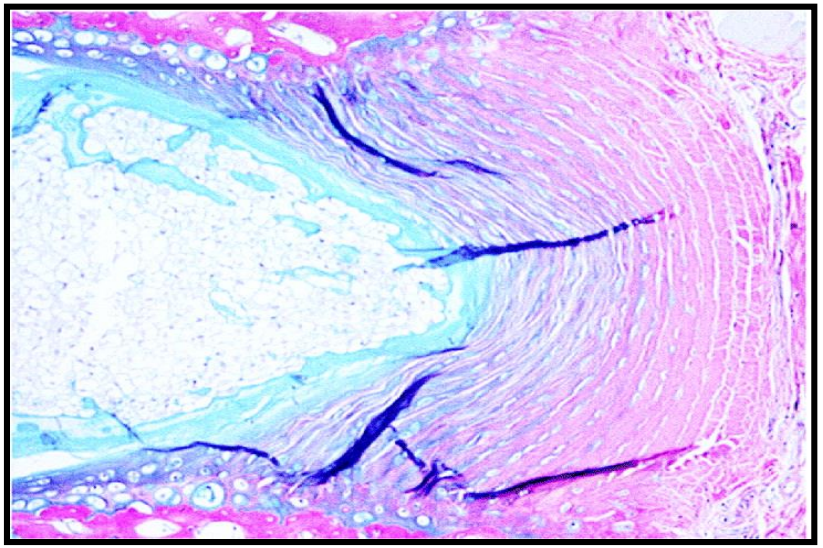
Intervertebral disks

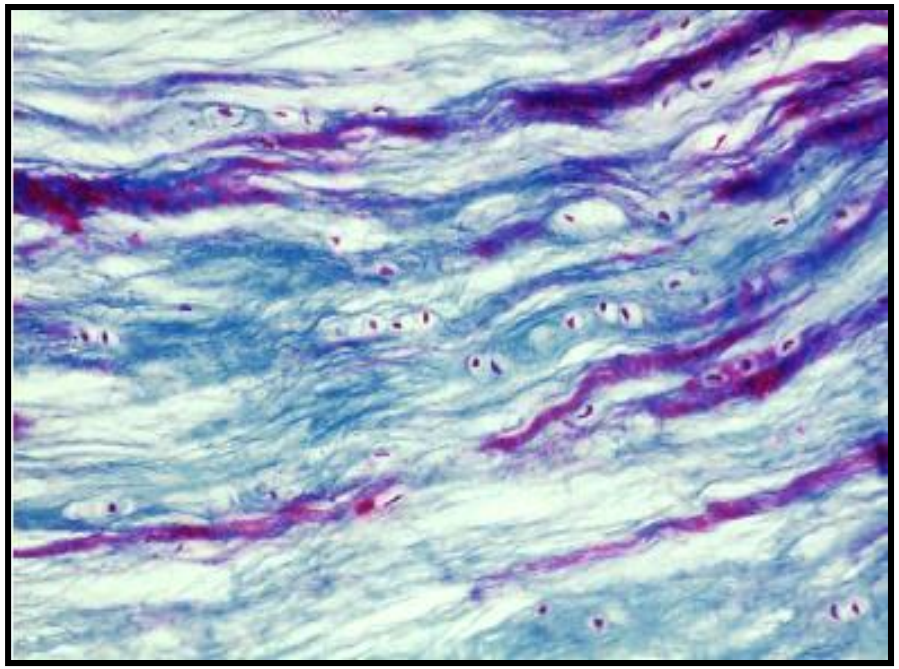
consist of fibrocartilage plates between the vertebrae and act as mechanical shock absorbers. In sections they are seen to be formed of two components:

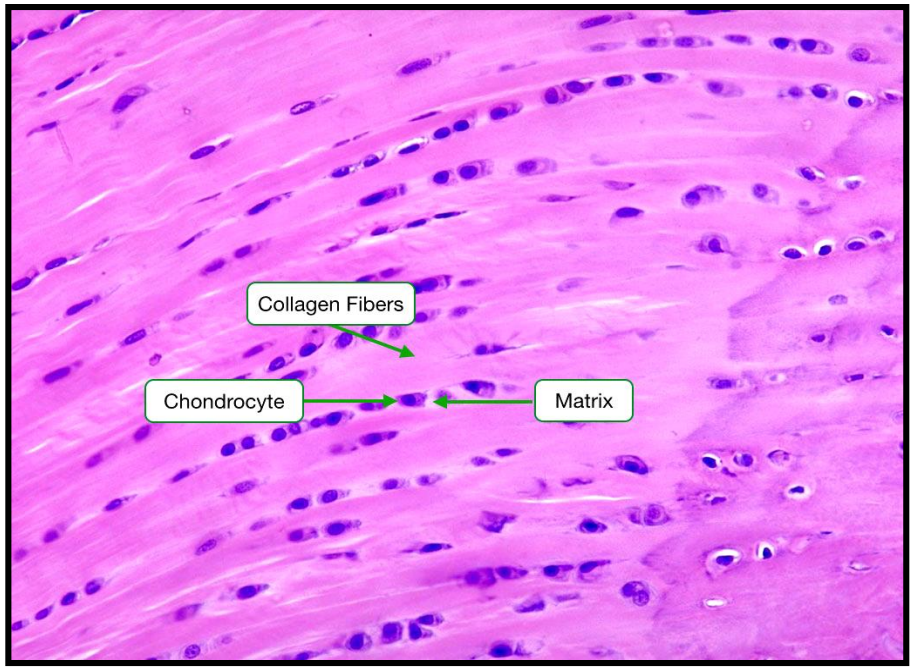
annulus fibrosus, which is the outer region consisting of orderly concentric arrangements of cells and matrix dominated by **type I collagen**

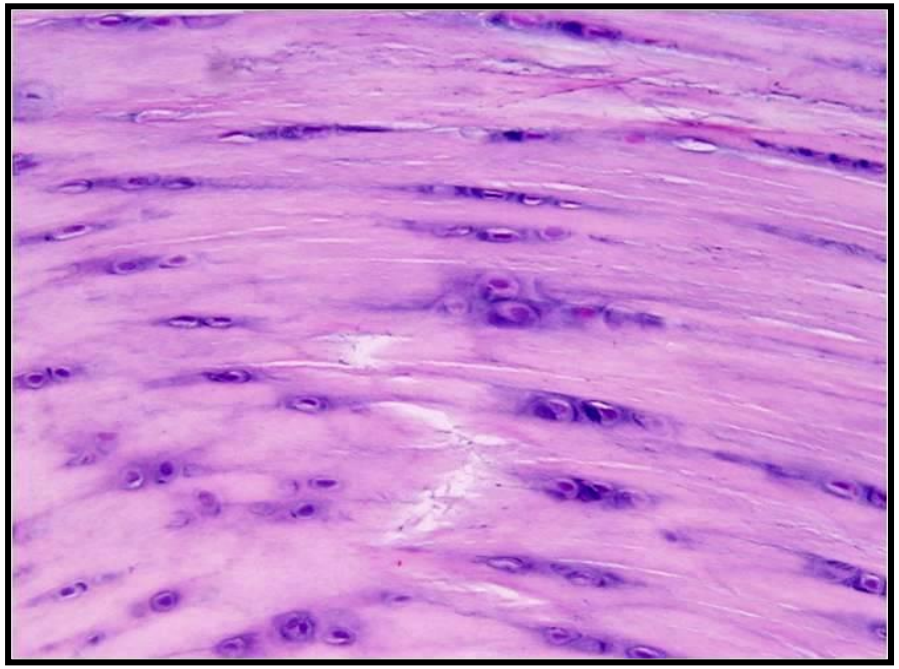
nucleus pulposus (large vacuolated cells, that are vestiges of the embryonic notochord.

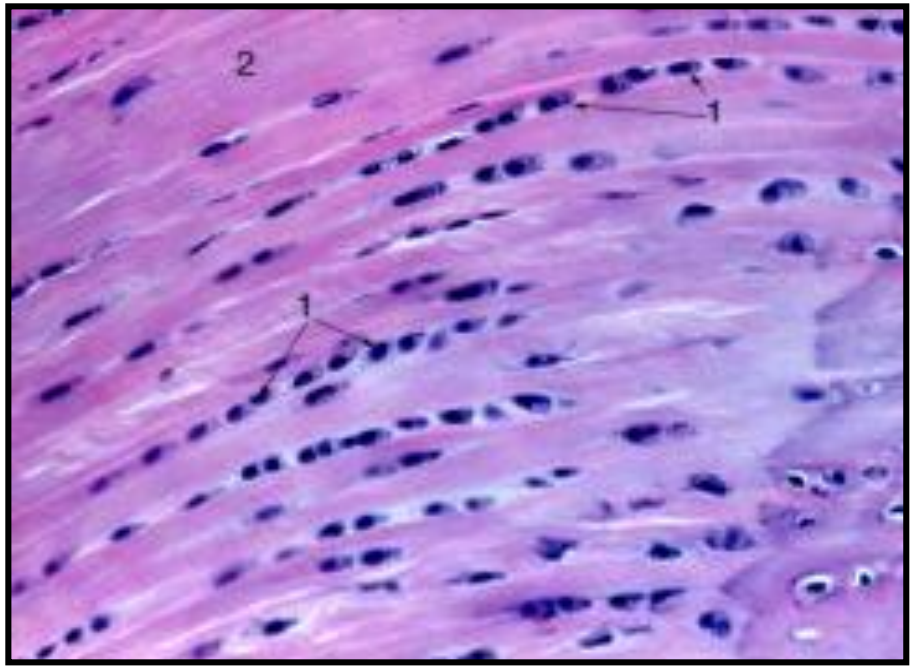







Collagen Fibers
Chondrocyte
Matrix




2
1
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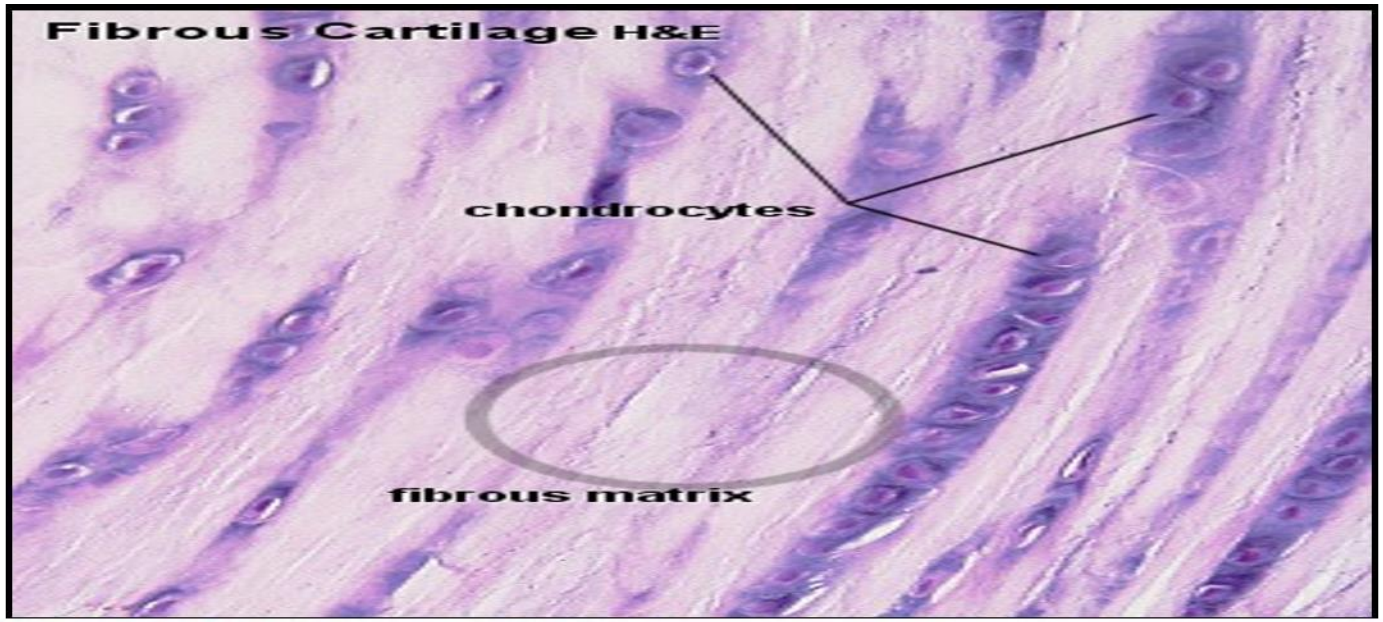
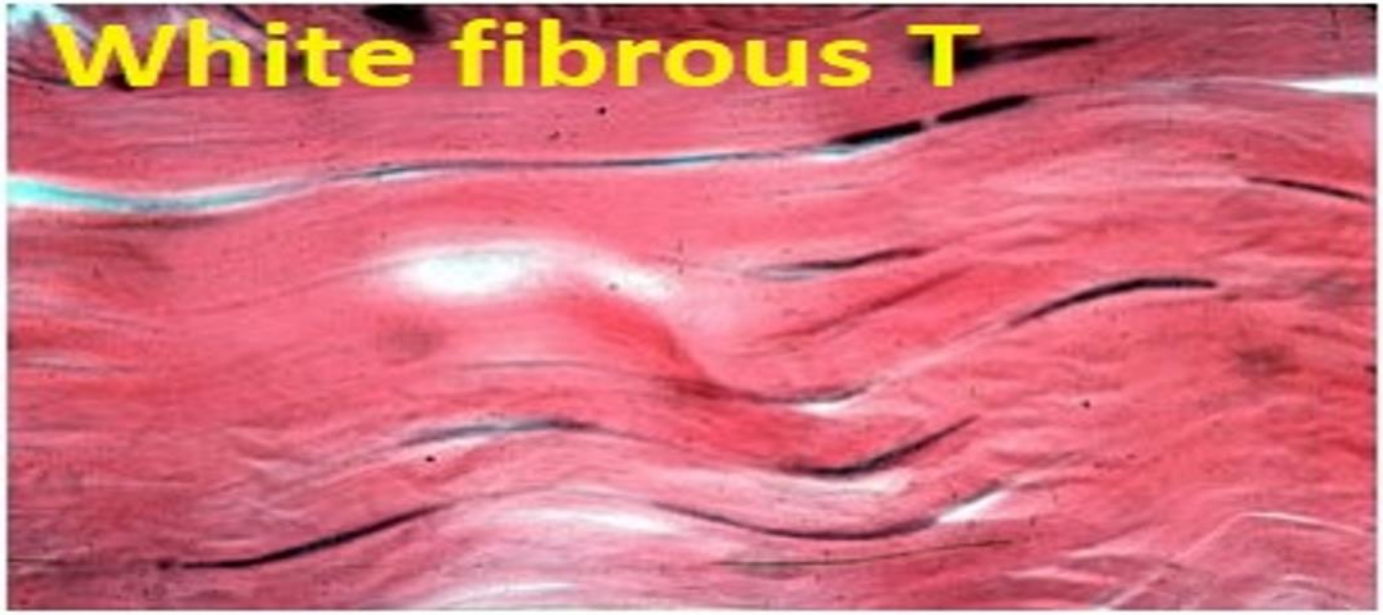
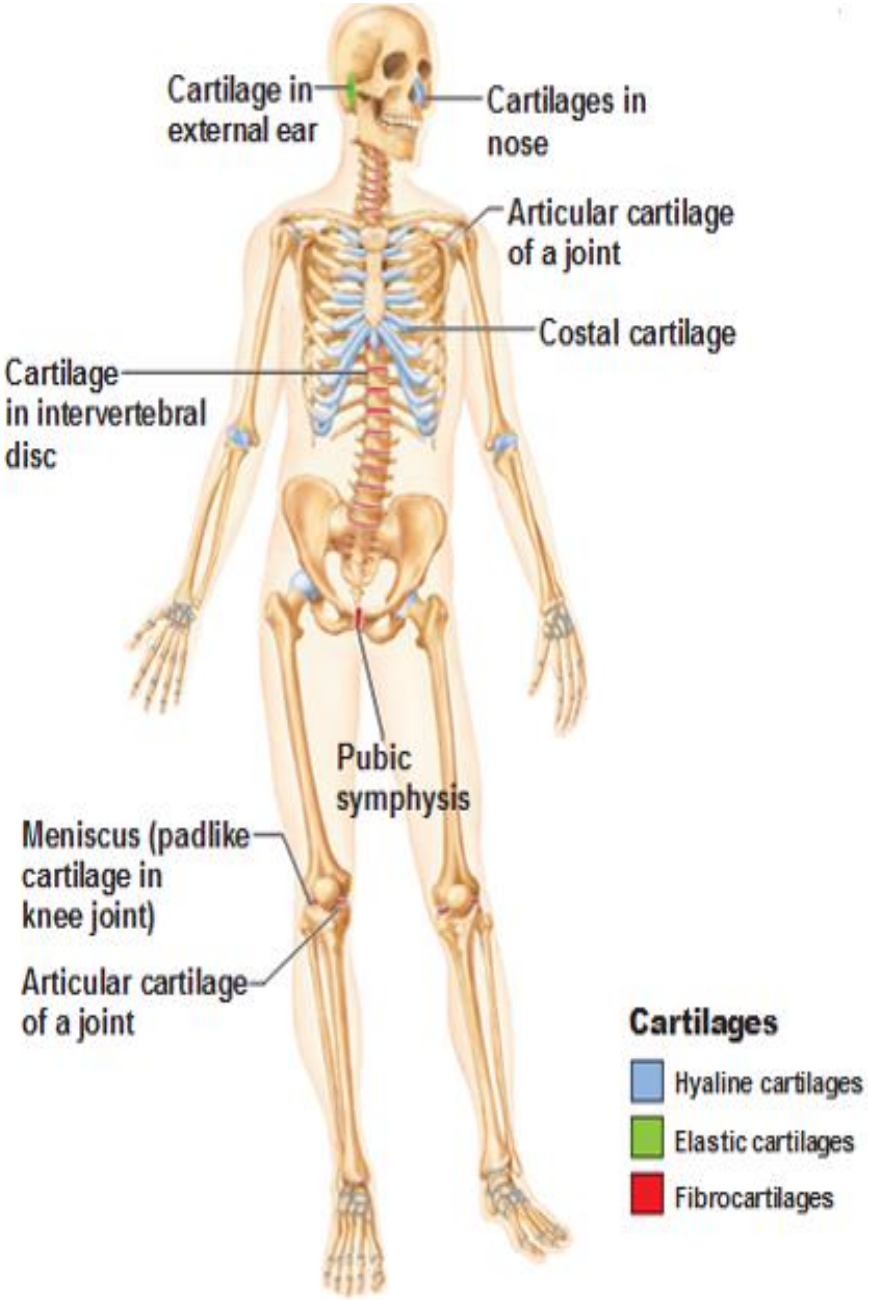
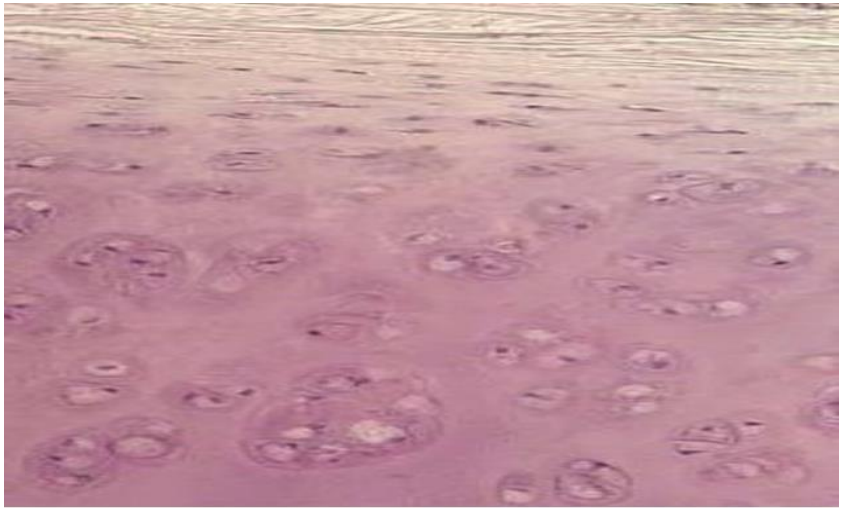
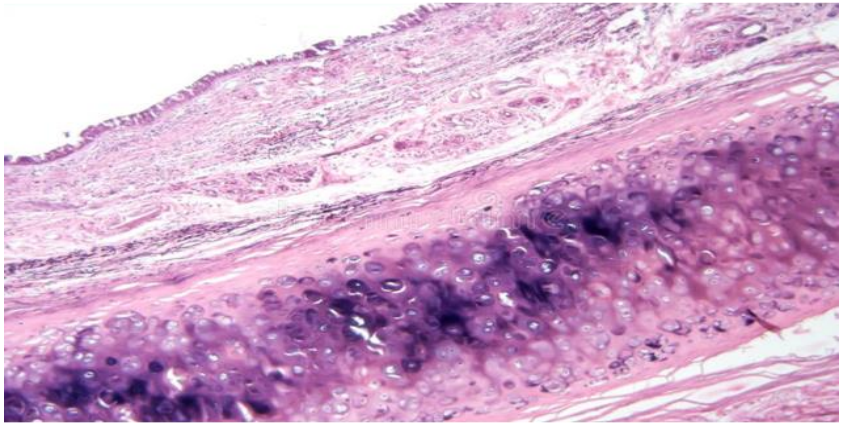
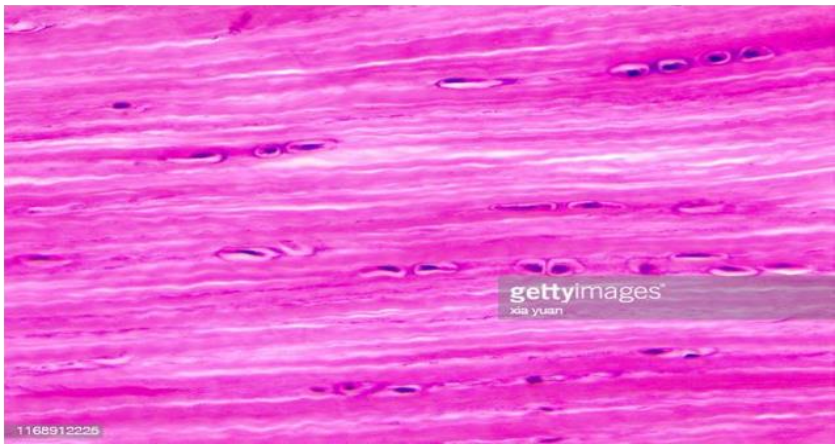

Fibrous Cartilage H&E
chondrocytes
fibrous matrix


White fibrous T


Cartilage in external ear
Cartilages in nose
Articular cartilage of a joint
Costal cartilage
Cartilage in intervertebral disc
Pubic symphysis
Meniscus (padlike cartilage in knee joint)
Articular cartilage of a joint
Cartilages
Hyaline cartilages
Elastic cartilages
Fibrocartilages



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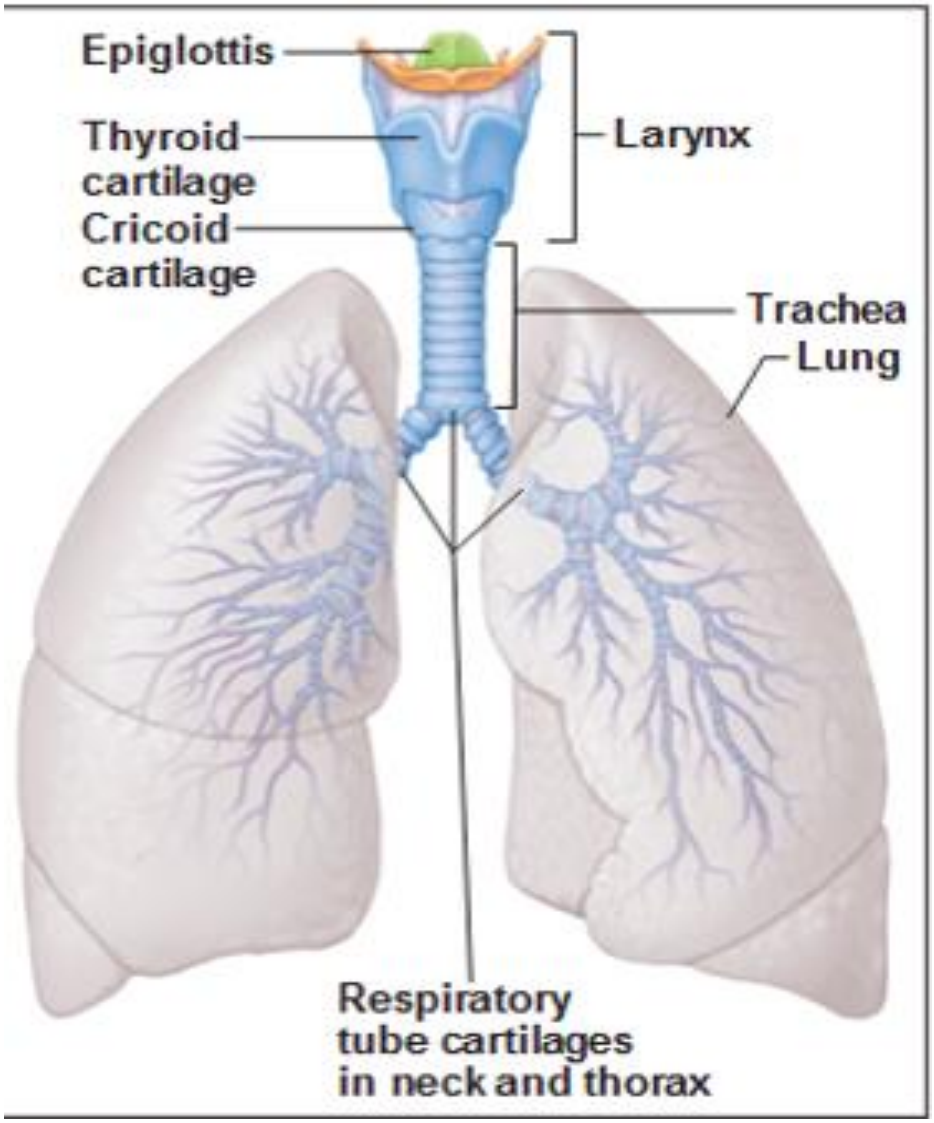
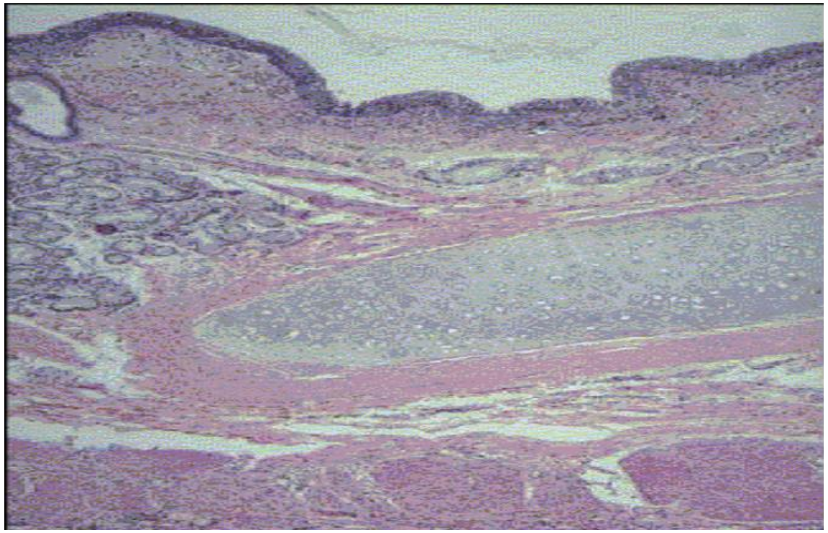

Epiglottis
Thyroid cartilage
Cricoid cartilage
Larynx
Trachea
Lung
Respiratory tube cartilages in neck and thorax



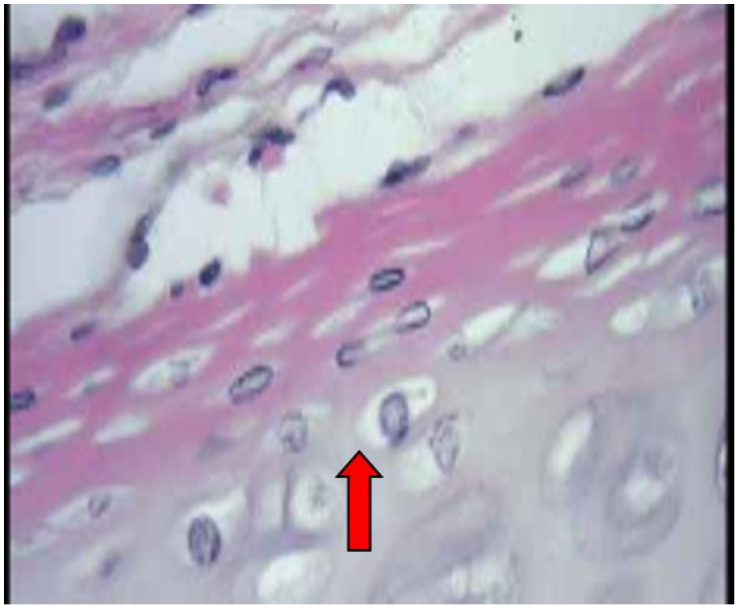
CARTILAGE GROWTH

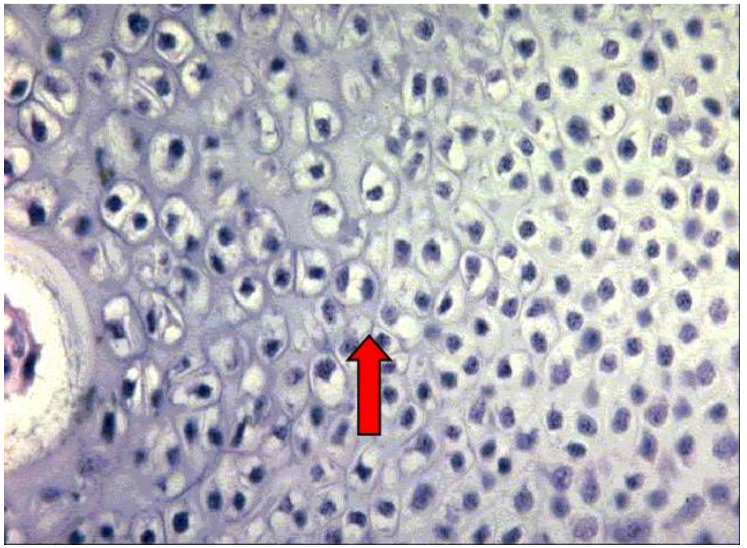
- **Appositional**

  Addition of new cartilage over the surface of existing cartilage.

- **Interstitial**

  Newly formed cartilage grows by multiplication of cells throughout its substance.





	Hyaline	Elastic	White fibrocartilage
Perichondrium	Covered with perichondrium except inside joint cavity	Always covered with perichondrium	Never covered with perichondrium
Nutrition	From perichondrium Inside joint cavity from synovial fluid	From perichondrium	From synovial fluid
Extracellular matrix	• Bluish grey color in fresh state • Pale basophilic with glassy appearance • No apparent fibers because they have the same refractive index as the ground substances • Collagen type II	Yellowish color in fresh state Large number of elastic fibers & collagen II Stained by orcein & VVG	White in fresh state Bundle of collagen I + collagen II
Characters	Smooth & firm	Very flexible can bear mechanical stress	Great strength with flexibility and rigidity
Chondrocytes	▪ Widely scattered ▪ Cell nest 1-8 / lacunae	Numerous 1-3 / lacunae	Few in row between collagen bundles 1-2 / lacunae
Sites	1. Skeleton of embryo 2. Epiphyseal plate in growing bone 3. Costal cartilage 4. Nose , larynx , trachea 5. Articular surface of joint	1. Ear pinna 2. External auditory canal n 3. Epiglottis	1. Intervertebral disc 2. Symphysis pubis 3. Temporomandibular joint