Histology

Special connective tissue

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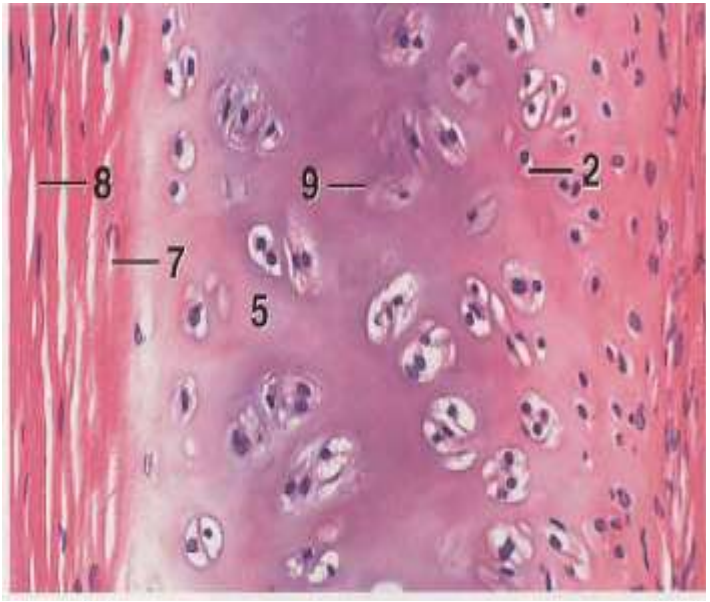
Cartilage:

- *The cartilage possesses cells called chondrocytes which occupy small cavities called lacunae in the extra cellular matrix.*
- *The substance of cartilage neither vascularized, nor supplied with nerves or lymphatic vessels. The cells nourishment from blood vessels of surrounded connective tissues by diffusion through the matrix .*
- *The collagen and elastic fibers embedded in the matrix .*
- *There are three type of cartilages depended on the fibers which present in the matrix .*

Hyaline cartilage

It is most common cartilage of the body, located in the nose, larynx, tracheal ring, bronchi and in the articular surface of movable joints of the body.

This type of cartilage is surrounded by perichondrium which consist of fibroblast and collagen fibers in the outer surface, in the inner surface there are chondroblast which have the ability to produce a new layer of new cartilage .



Histogenesis and growth of cartilage:

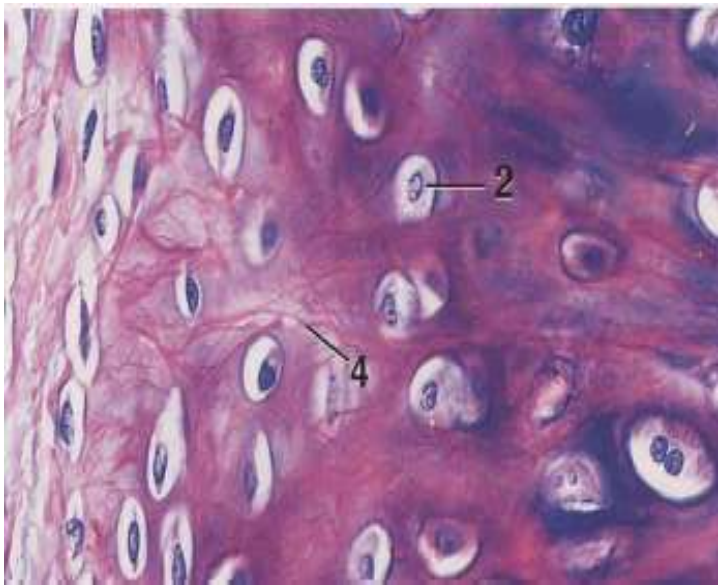
- *The un differentiated mesenchymal cells are responsible for hyaline cartilage formation which are aggregation as a dense masses cells which called chondrification centers , these cells differentiate into chondroblasts after losing the cytoplasmic processes become rounded , then turning chondrocytes which have the ability to produce the ground substance and in the same time still capable of cell division to forming a lacuna .*

Types of cartilage growth:

- *There are two types of cartilage growth:*
- *1 – Interstitial growth:*
- *It is occurring only in the early stage also the cartilage grows in the center by chondrocytes division and increase in the ground substance.*
- *2 – Appositional growth:*
- *In this way the cartilage also grows by adding to its periphery a new cartilage from chondroblast.*

Elastic cartilage :

The elastic cartilage greatly resembles hyaline cartilage except that it is matrix and perichondrium possess elastic fibers, therefore, known as a yellow cartilage. This type of cartilage found in the pinna of ear, epiglottis.



Fibro cartilage

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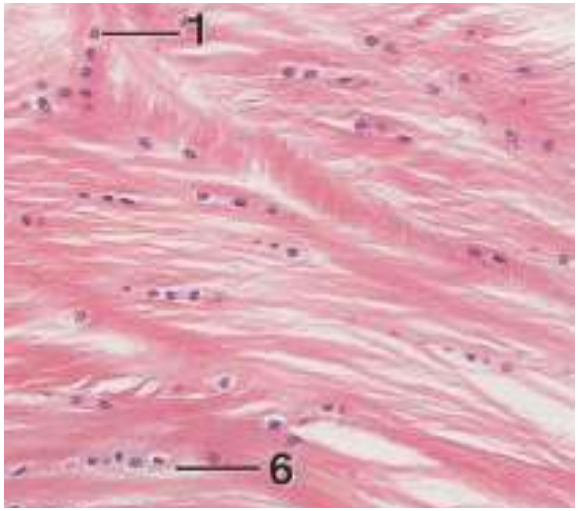
Is present in the intervertebral discs and in the pubic symphysis, it is associated with hyaline cartilage and with dense connective tissue unlike the other two types of cartilage:

1 –fibro cartilage does not possess a perichondrium therefore the growth occur by differentiation of fibroblast in the dense connective tissue which found aside to the chondrocytes.



2 – The ground substance is very few because of there are a large amount of collagenous bundle and chondrocytes.

3 –The cells are small in the lacuna

and appear as a short strip .

Bone :

- *The bone is a specialized connective tissue consists of cells, fibers and ground substance.*
- *Whose extra cellular matrix is calcified, the bone is nourishment by blood vessels.*
- *The bone characterized by has only appositional growth and have haversian system.*

Bone functions :

- *1 – The bone tissue form a skeleton of body for support and protection of the soft organs of the body including brain , spinal cord , heart , lungs .*
- *2 – Supporting structure for muscles.*
- *3 –Consider as a source for several minerals of the body (store about 99% of the body's calcium).*
- *4 – The bone contains the marrow cavity which houses the bone marrow (a hemopoietic organ).*

Types of bones:

- *The gross observation of bone shows two types of bones:*
- *1 – Compact bone (cortical bone) : It's a hard mass of bone substance. The bone is covered on its external surface, except at synovial articulations, with* ***periosteum*** *which consist of an outer layer of dense fibrenous connective tissue and an inner cellular osteogenic cells, also the central cavity of bone is lined by endosteum.*
- *2 – Spongy bone (cancellous bone) (trabecular bone):*
- *Consist of irregular interconnecting bars , the trabeculae , forming three dimensional net work of lined spaces filled with bone marrow .*

Cells of the bone

- ***1 - Osteoprogenitor cells*** *:*
- *The cells are located in the inner cellular layer of the periosteum and in the endosteum, these cells derived from the mesenchymal cells. they have ability to differentiated to the osteoblast.*
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2 – Osteoblast :

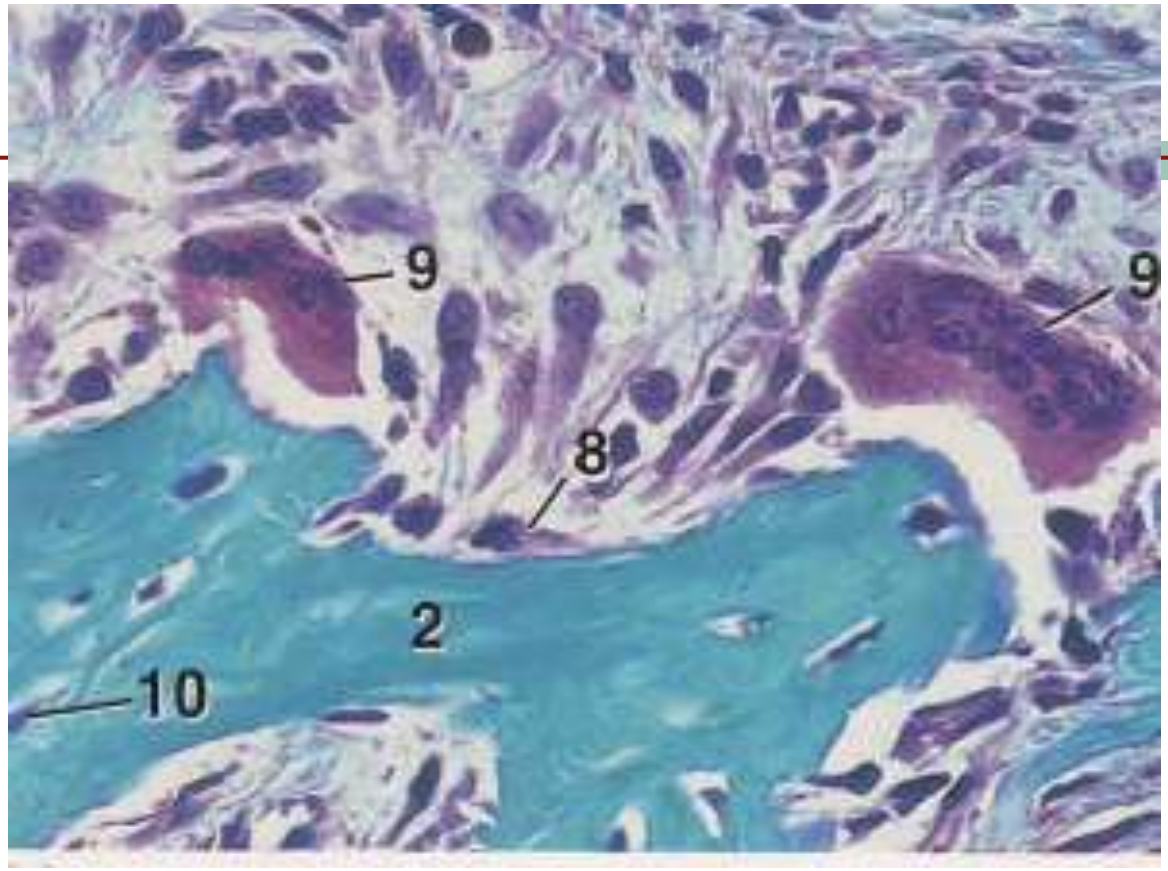
- *Derived from osteoprogenitor cells, are responsible for the synthesis of organic components of the bone matrix including collagen and ground substance. Its located on the surface of the bone.*

3 – Osteocytes

- *Are mature bone cells, derived from osteoblasts. They are housed in the lacunae within the calcified bone matrix.*

4 – osteoclasts

- *They are large multinucleated cells, derived from the fusion of many blood cells (monocytes).*
- *They are occupies shallow depressions called **Howship ،s** lacunae on the surface of the bone.*
- *play an important role of bone resorption, these mechanism controlled by two hormones ,parathyroid and calcitonin.*



1. Bone marrow
2. Bone matrix
3. Calcified cartilage
4. Epiphyseal disc (plate)
5. Hyaline cartilage
6. Immature bone
7. Mature bone
8. Osteoblast
9. Osteoclast
10. Osteocyte
11. Osteoid
12. Spongy bone, diaphysis
13. Spongy bone, epiphysis

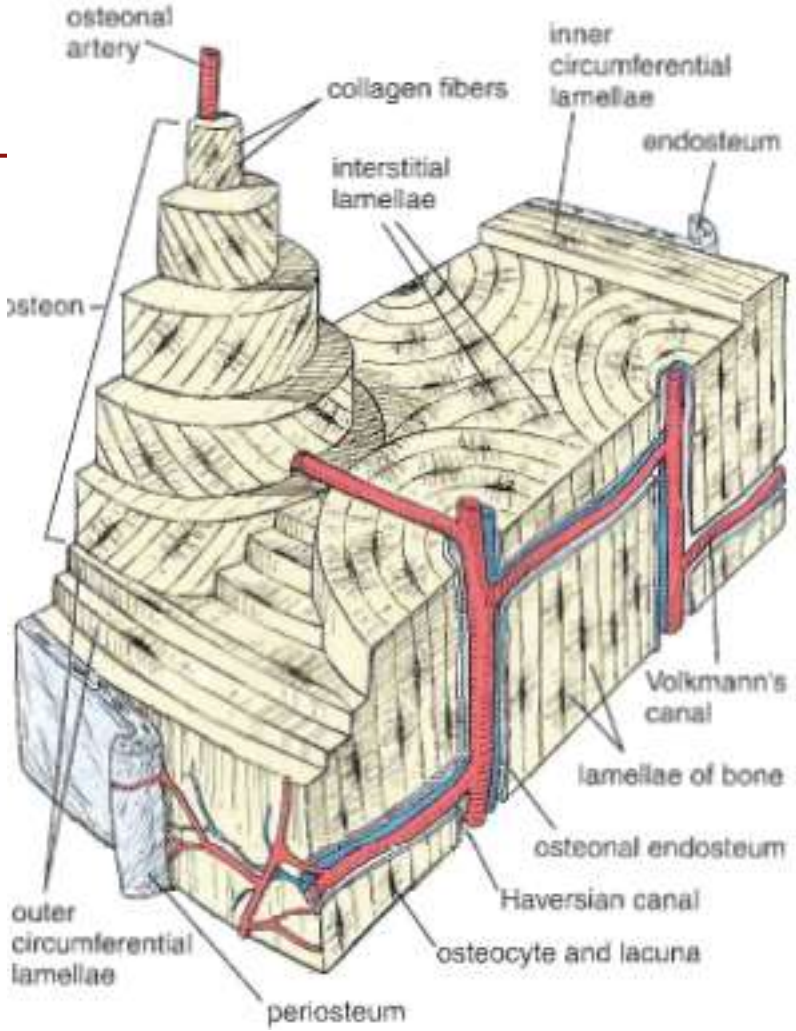
Bone Matrix :

- *The bone matrix is consisting of collagen fibers embedded in the hard ground substance. The hardness of ground substance due to inorganic components which form 65% while organic components form 35 % , often the inorganic material is formed from crystal of calcium phosphate .*
- *The bone matrix is precipitate as a lamellae and the fibers in each lamella are parallel*

Bone structure:

The structural unit of the compact bone is a haversian system (Osteons) , each system is composed of cylinders of lamellae , concentrically arranged around a vascular space known as the haversian canal .each lamella consist of oval small osteocyte which located in the lacuna and from the lacuna extend a small canaliculi which occupies by a cytoplasmic process of osteocyte and by which the communication occur among osteocytes and between osteocytes and haversian canal . Haversian canal of the adjacent Osteons are connected to each other by transversal canal called ***Volkmann,s canals*** *.*

The interstitial space between Osteons is filled by bone lamellae called interstitial lamellae , the outer circumferential lamellae are just deep to the periosteum and attached to the periosteum by sharpies fibers , the inner circumferential lamellae just deep to the endosteum



Histogenesis and growth of bone:

- *The bone formation during embryonic development (fetal period) occur by two types, intramembranous and endochondreal.*
- *The growth of bone occurs only by Appositional growth and because of the hard ground substance the interstitial growth not occurs.*

Intra membranous bone formation

- *Most flat bone (scapula, frontal, ramus, clavical bones formed by intra membranous formation .*
- *The undifferentiated mesenchymal cells differentiate into osteoblasts that secrete bone matrix forming network of specules and trabiculae , this region of initial osteogenesis is known as the **primary ossification center** .Calcification occur and the osteoblasts trapped in their matrix become osteocytes .*
- *The mesenchymal cells provide a supply of undifferentiated osteoprogenitor cells which form osteoblasts.*
- *As the sponge – like network of trabeculae is established, the vascular connective tissue in there interstitial transformed into bone marrow and forming spongy bone and when added additional bone lamellae the spongy bone transferred to the compact bone.*

Endochondreal bone formation:

- *Most of long and short bones of body developed by endochonderial bone formation. The hyaline cartilage model is formed at first then the cells in the center of cartilage are hypertrophy and mature then the matrix among the cells become little after that the chondrocytes begin release the alkaline phosphatase which play role in digestion the cartilage matrix after that, the capillaries in the perichondrium invaded the matrix then the matrix calcified and the chondrocytes will die in the same time the undifferentiated mesenchymal cells in perichondrium differentiated to Osteoblast , then this cells begin to produce bone matrix . The perichondrium become periosteum , the osteoclasts remove mineralized osseous matrix in the center and gradually the center of bone is empty to occupies by marrow .*