Specialized Connective Tissues

1-Cartilage **2- Bone** **3-Blood**

1- **Cartilage** Is a special form of c.t. in which the extracellular matrix has a firm consistency. The main function of cartilage is to support soft tissues. Being smooth surfaced and resilient, it provides a shock-absorbing and sliding area for joints.

Cartilage is also essential for the development and growth of long bones both before and after birth. Cartilage consists of cells (chondrocytes) and an extensive extracellular matrix composed of fibers and ground substance.

Chondrocytes synthesize and secrete the extracellular matrix. The cells themselves are located in matrix cavities called lacunae. Collagen, hyaluronic acid, proteoglycans, and small amounts of several glycoproteins are the principal macromolecules present in all types of cartilage matrix.

As a consequence of different function requirement, three forms of cartilage have evolved, each exhibiting variations in matrix composition, hyaline cartilage, elastic cartilage, and fibrocartilage.

In all three types cartilage is avascular and is nourished by diffusion of nutrients from capillaries in adjacent c.t. (perichondrium) or by means of synovial fluid from joint cavities. In some instances, blood vessels traverse a cartilage to nourish other tissues, but these vessels do not supply nutrients to the cartilage. Cartilages have no lymphatic vessels or nerves.

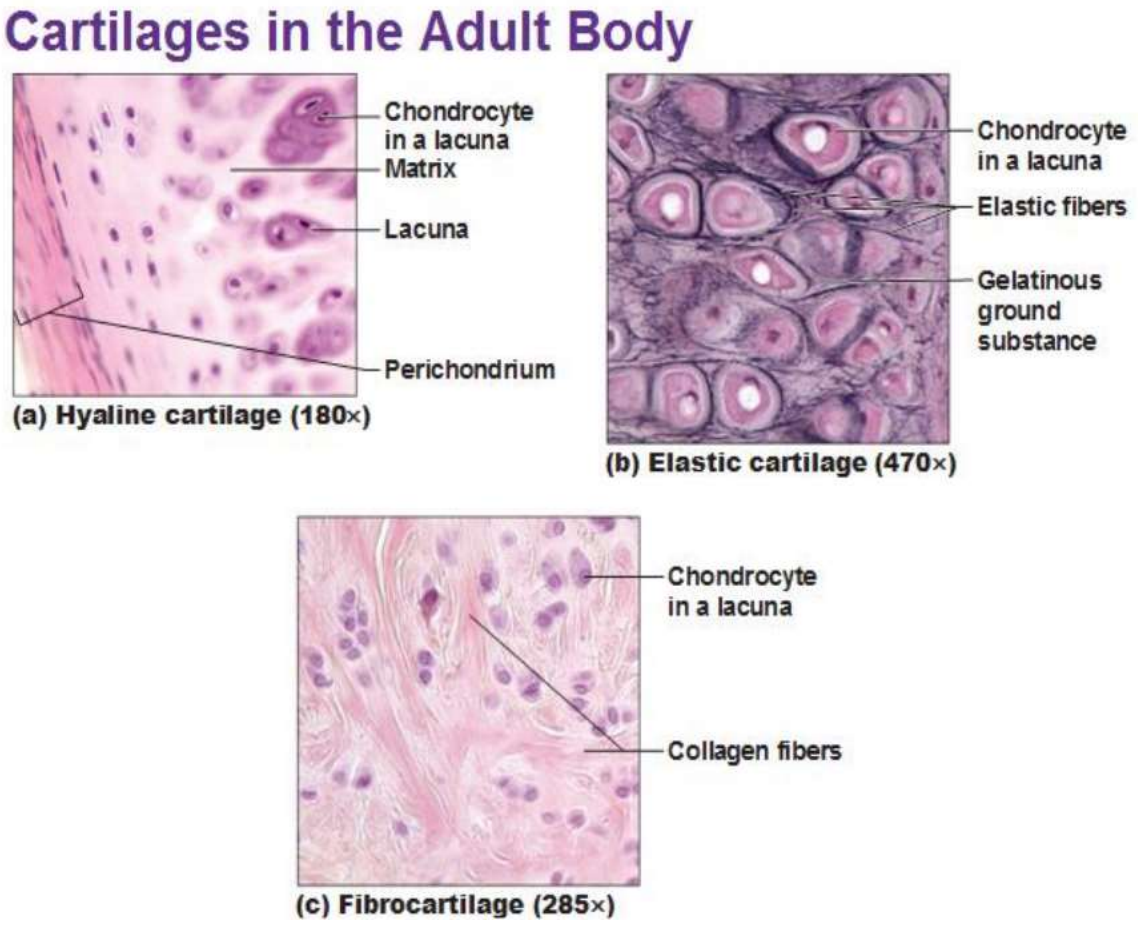

Figure 1: Three types of cartilage.

The perichondrium: is a capsule-like sheath of dense c.t. that surrounds cartilage in most places forming an interface between the cartilage and the tissue, the cartilage serves to support.

The perichondrium harbors the vascular supply for the avascular cartilage. Articular cartilage which covers the surface of the bones of movable joints is devoid of perichondrium and is sustained by the diffusion of oxygen and nutrients from the synovial fluid.

• **Hyaline cartilage:** is the most common and best-studied of the three types. Fresh hyaline cartilage is bluish-white and translucent. In the embryo, it serves as a temporary skeleton until it is replaced gradually by bone. Between the diaphysis and the epiphysis of growing long bones the epiphyseal plate, composed of hyaline cartilage, is responsible for the longitudinal growth of bone. In adults, hyaline cartilage is present mainly in the walls of the respiratory passages (nose, through bronchi), on the ventral ends of the ribs, and on bone surfaces within joints (articular cartilages).

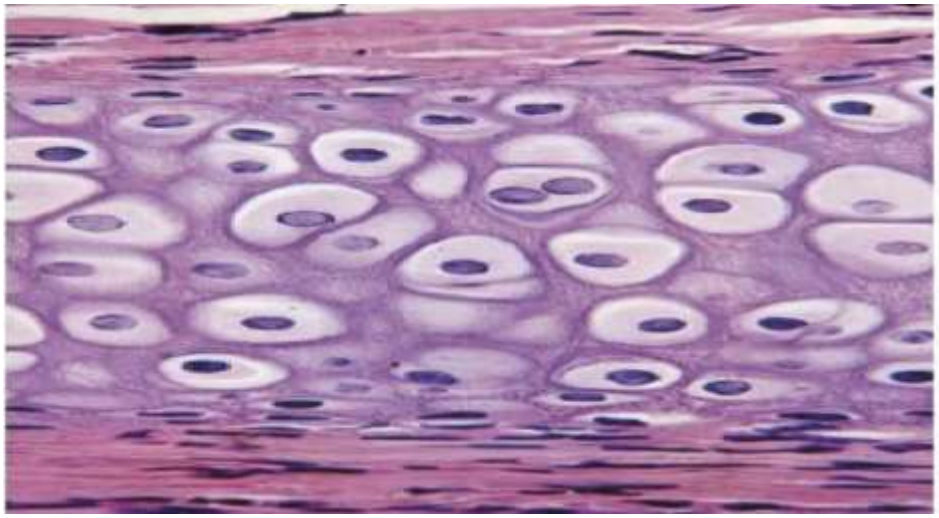

Figure 2: Hyaline cartilage

• Matrix: forty percent (40%) of the dry weight of hyaline cartilage consists of collagen embedded in an amorphous intercellular substance.

In routine histologic preparations, the collagen is indiscernible from the amorphous substance for two reasons:

1- Collagen is in the form of fibrils, which have submicroscopic dimensions.
2- These fibrils have a refractive index very near to that of the amorphous intracellular substance which surrounds them.
3- The relative proportions of collagen, hyaluronic acid, and the sulfated proteoglycans and the disposition of the collagen fibrils in the matrix vary with anatomic site and age.

The high content of solvation water acts as an elastic shock absorption that function as a biomechanical spring of great importance, especially in articular cartilage. Within the cartilage matrix, immediately surrounding each chondrocyte, is a zone of glycosaminoglycan-rich, collagen-poor matrix. This peripheral zone, called the capsule, histochemically exhibits intense basophilia.

- **Chondrocytes:** at the periphery of hyaline cartilage, the chondrocytes have an elliptic shape, with the long axis parallel to the surface. Further in, they are round and may appear in groups of up to 8 cells originating from mitotic divisions of a single chondrocyte, the proliferating chondrocytes are accumulated in rows. Cartilage cells and the matrix shrink during histologic preparation, causing the irregular shape of the chondrocytes and their retraction from the capsule.

- Perichondrium: except in articular cartilage of joints, all hyaline cartilage is covered by a layer of dense c.t., the perichondrium which is essential for the growth and maintenance of cartilage. It is rich in collagen fibers and contains cells that resemble fibroblasts. These extend from the periphery of the perichondrium but are more numerous closer to the cartilage.

• Nutrition: in general cartilage is devoid of vessels, lymphatics, and nerves.

The fluid of the matrix permits nutrients, dissolved gases, and waste products to diffuse readily between the small b.v. of the perichondrium and the more deeply placed chondrocytes.

• Retrogressive changes: with old age, cartilage loses its translucency and becomes less cellular, and the matrix shows less basophilia owing to a loss of proteoglycans and an increase in non-collagenous proteins. The most important retrogressive change within cartilage is calcification.

• Regeneration: the ability to regenerate an area of cartilage that has been lost or damaged is low. A fracture of mature cartilage may be repaired by dense c.t. maybe later replaced by bone.

• **Elastic cartilage**: Occurs in locations where support with flexibility is required as in the external ear, auditory tube, and epiglottis. In fresh condition, it is yellow in color. The matrix contains extensive networks of elastic fibers. The cartilage is surrounded by a perichondrium elastic cartilage and is less likely to undergo retrogressive changes.

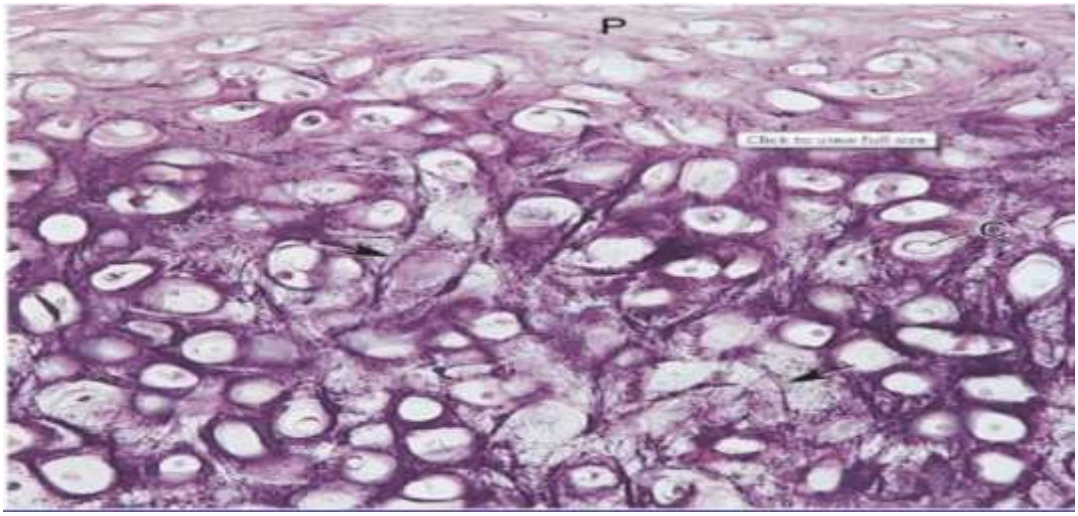

Figure3: Elastic cartilage

Fibrocartilage: Occurs where tough support or tensile strength is required, e.g. intervertebral discs, in the symphysis pubis, and where some tendons and ligaments are attached to the bone. It never occurs alone but merges gradually into neighboring hyaline cartilage or with dense fibrous tissue. It is composed of dense collagenous c.t. between bundles of which there are small regions of hyaline cartilaginous matrix containing lacunae with enclosed cells. This cartilage is devoid of perichondrium.

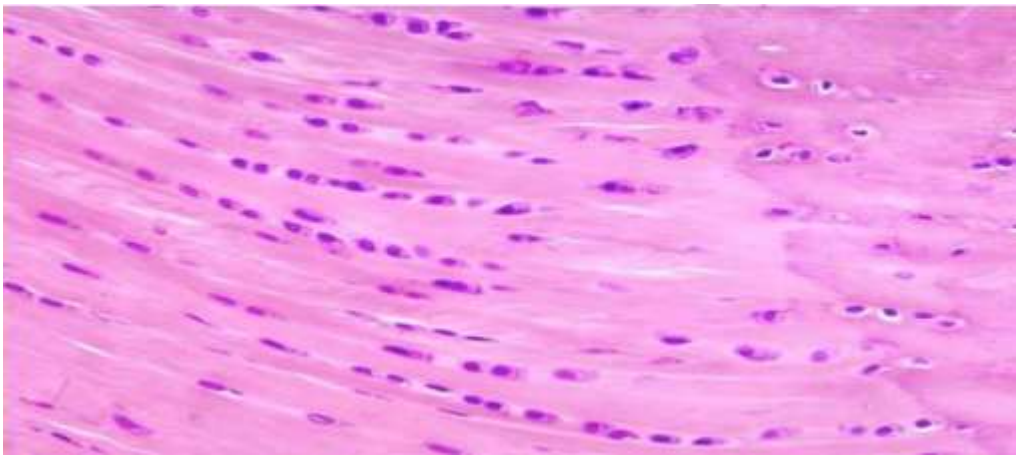

Figure 4: Fibrocartilage.