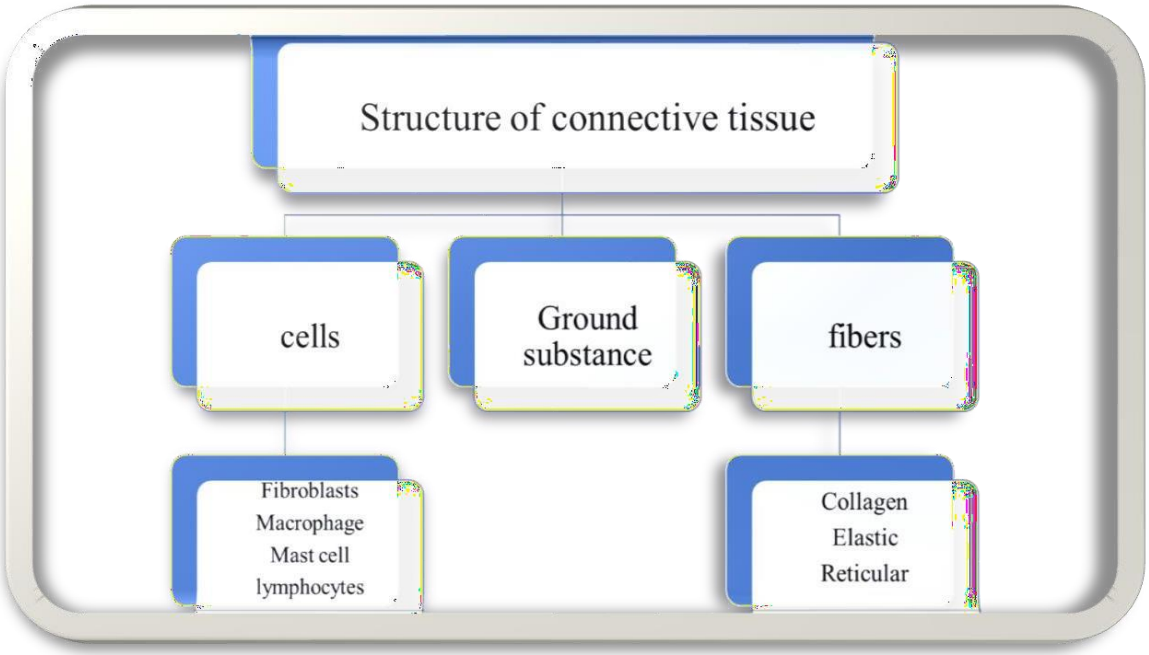
Connective tissue

The different types of connective tissues are responsible for providing and maintaining form in the body. Structurally, connective tissue is formed by three classes of components: **cells**, **fibers,** and **ground substance**. Unlike the other tissues (epithelium, muscle, and nerve), which are formed mainly by cells, the major constituent of connective tissue is the extracellular matrix. Extracellular matrix consist of different combinations of protein fibers (**collagen, reticular,** and **elastic**) and **ground substance.**

Functions

1) Binding, support, and packaging.
2) Protection, defense, and repair.
3) Insulation.
4) Transportation.



The cells

A variety of cells with different origins and functions are present in connective tissue. Fibroblasts originate locally from undifferentiated mesenchymal cells and spend all their life in connective tissue; other cells such as mast cells, macrophages, and plasma cells originate from hematopoietic stem cells in bone marrow, circulate in the blood, and then move into connective tissue where they remain and execute their functions White blood cells (leukocytes) are transient cells of most connective tissues; they also originate in the bone marrow and move to the connective tissue where they reside for a few days, then usually die by apoptosis.

Fibroblasts

Synthesize and maintain fibers and ground substance. Major resident cell in connective tissue proper. Active and inactive fibroblasts

❖ Active fibroblast

Large, euchromatic, oval nucleus. Cytoplasm not usually visible but contains abundant rough endoplasmic reticulum and Golgi. Elongated, spindle-shaped cells, High synthetic activity

❖ Inactive fibroblast

Small, heterochromatic, flattened nucleus Reduced cytoplasm and organelles ,Low synthetic activity.

Macrophages

Derived from blood monocytes; monocytes enter connective tissue from the bloodstream and rapidly transform into macrophages that function in phagocytosis, antigen processing, and cytokine secretion.

Mast cell

Mediate immediate hypersensitivity reaction and anaphylaxis by releasing immune modulators from cytoplasmic granules, in response to antigen binding with cell surface antibodies

Lymphocytes (T and B lymphocytes)

Small spherical cells with sparse cytoplasm and a round heterochromatic nucleus, often with a small indentation.

B cells enter connective tissue where they transform into plasma cells and secrete antibodies.

T cells are primarily located in lymphatic tissues and organs; however, T cells can be present in connective tissue proper under certain circumstances (e.g., organ transplantation).

The ground substance

Is the amorphous substance that fills the space between the cells and contains the fibers. It is composed of interstitial fluid, cell adhesion proteins, and proteoglycans. Cell adhesion proteins allow the connective tissue cells to attach themselves to matrix elements.

The fibers

In all connective tissues except blood, the cells secrete fibers made up of structural proteins called collagen or elastin.

Three main types of fibers are secreted by fibroblasts

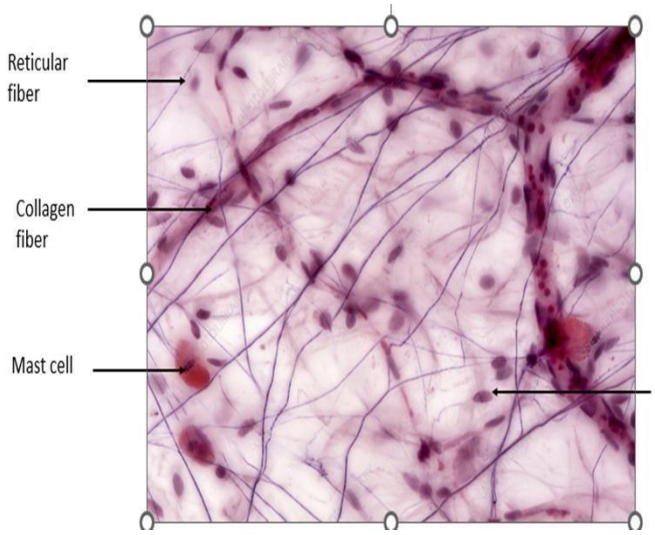
1) Collagen fibers (white fibers) : contain collagen (most abundant protein in the body). Tensile strength - resistance to stretching ,they are strong but only in one direction.
2) Elastic fibers (yellow fibers) contain elastin they are stretchy in all directions, and help tissues return to their previous shapes after extension. Elasticity - can be stretched, yet still, return to its original length
3) Reticular fibers - contain collagen very fine collagen fibers that form a net-like structure, which wraps around organs (such as the liver and spleen)and protects their integrity Support - network of thin fibers.

Classification of connective tissue

Loose connective tissue

Areolar tissue

Highly cellular, numerous cell types present. Fewer and smaller caliber collagen fibers compared with dense. Abundant ground substance, allows for diffusion of nutrients and wastes. Highly vascularized, provides padding between and around organs and tissues.

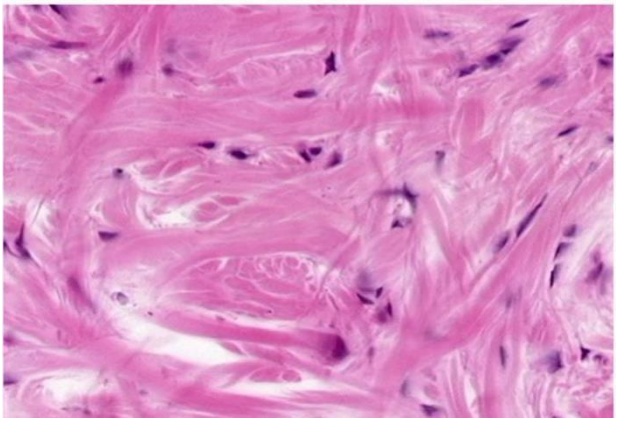


Dense connective tissue

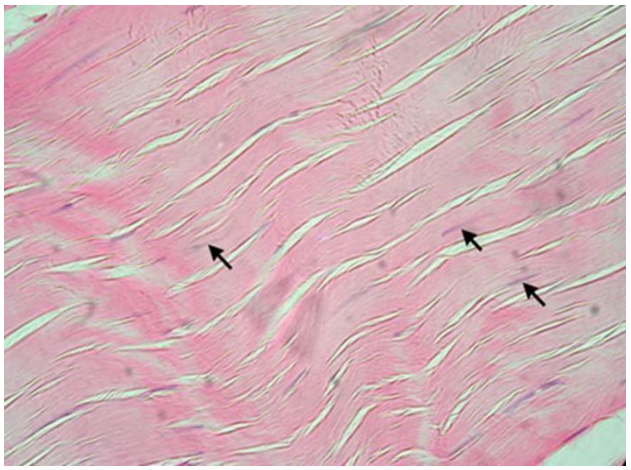
Fewer cells, mostly fibroblasts. Highly fibrous with larger caliber collagen fibers, provides strength. Minimal ground substance, Poorly vascularized.

Types:

- Dense, irregular connective tissue: Fiber bundles arranged in an interlacing pattern; forms the capsule of organs and the dermis of the skin.



- Dense regular connective tissue: Parallel arrangement of fiber bundles; restricted to tendons and ligament .



- Dense elastic connective tissue:It consists of freely branching elastic fibers. Fibroblast are present in space between fibers. It is yellowish in color. It's present in tissue , walls of elastic arteries , trachea and bronchial tubes. It allows stretching of various organs.

Specialized connective tissue

Cartilage

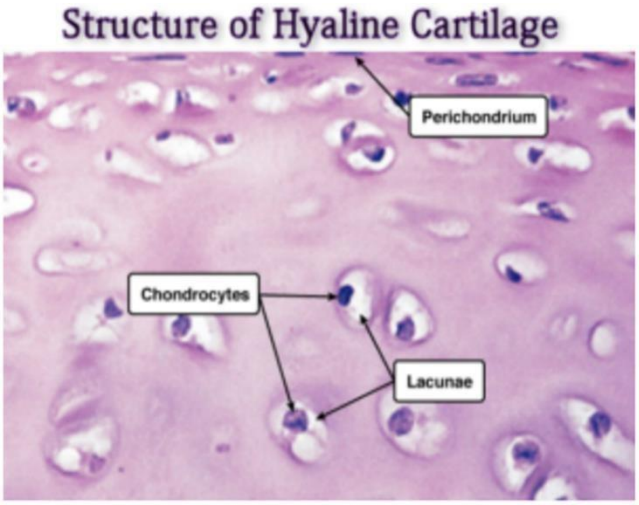
Composition is similar to that of all connective tissues (The cells of mature cartilage called as chondrocytes, and Extracellular matrix consisting

of fibers, ground substance). Cartilage is avascular and possesses no lymph vessels or nerves.

Types of cartilage:

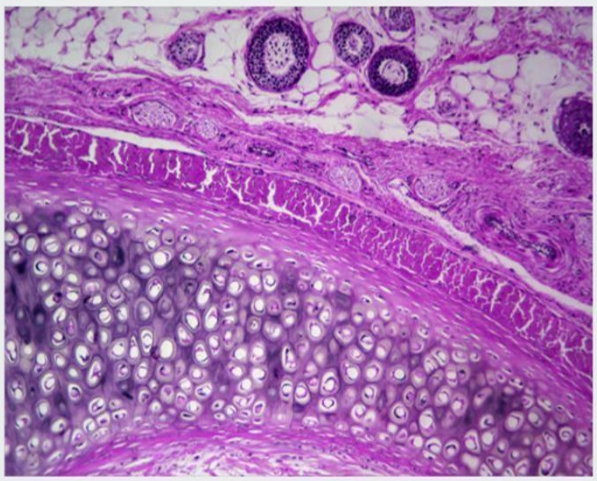
Hyaline cartilage

It's bluish white in color. It consists of fine collagen fibers and many chondrocytes. It's present at the end of long bones, anterior ends of ribs. It provides small surface for movement at joints, flexibility and support.



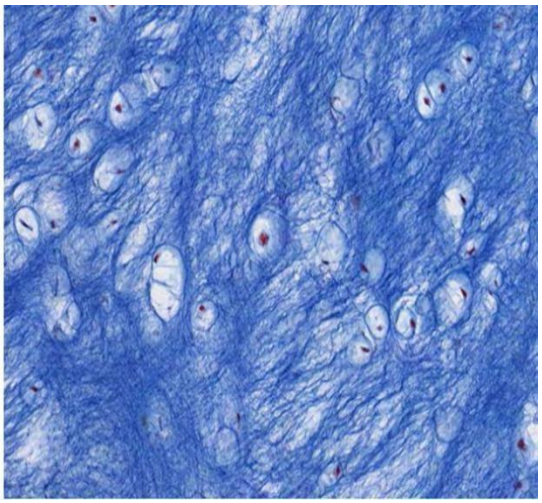
Elastic cartilage

Has a visible network of interlacing elastic fibers in addition to collagen type II fibers. Possesses fewer isogenous groups than does hyaline cartilage. It's pinna of ear, epiglottis, smaller laryngeal cartilages (i.e., present where flexibility and support are necessary)



Elastic cartilage of the epiglottis

Fibro cartilage



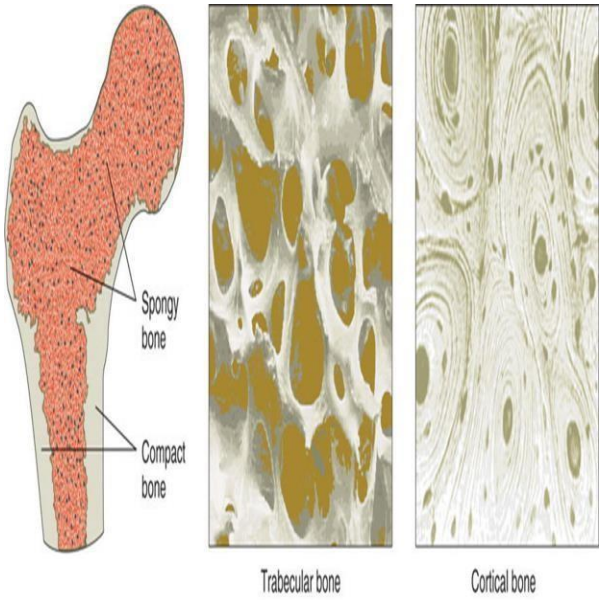
intervertebral discs, in attachments of certain ligaments). It is characterized by alternating rows of fibroblast-derived chondrocytes surrounded by scant matrix and thick parallel bundles of type I collagen fibers. Fibrocartilage is located in areas where support and tensile strength are required

Bone

Is a hard, inflexible tissue that is specialized to resist compression. There are two types of bone: compact bone (cortical bone) and spongy bone (trabecular).

Compact bone: Appears as a solid mass to the naked eye, covering the exterior of bones and forming the shaft of long bones.

Spongy or trabecular bone: Gross appearance is like a sponge, with a labyrinth of bony spicules and intervening spaces that are filled with loose connective tissue or red marrow and at least one blood vessel Spongy bone is located in the interior of bones



Discussion //

Is there a relationship between connective tissue histological changes and the accuracy of histopathological diagnosis of periodontal disease ?