II- Connective Tissue

This is the most abundant of the four types of body tissue. It provides connection and support functions. These tissues exhibit great polymorphism but share common characteristics. Regardless of their anatomical location, they comprise the following three basic components:

- Cells
- Fibers
- A ground substance.

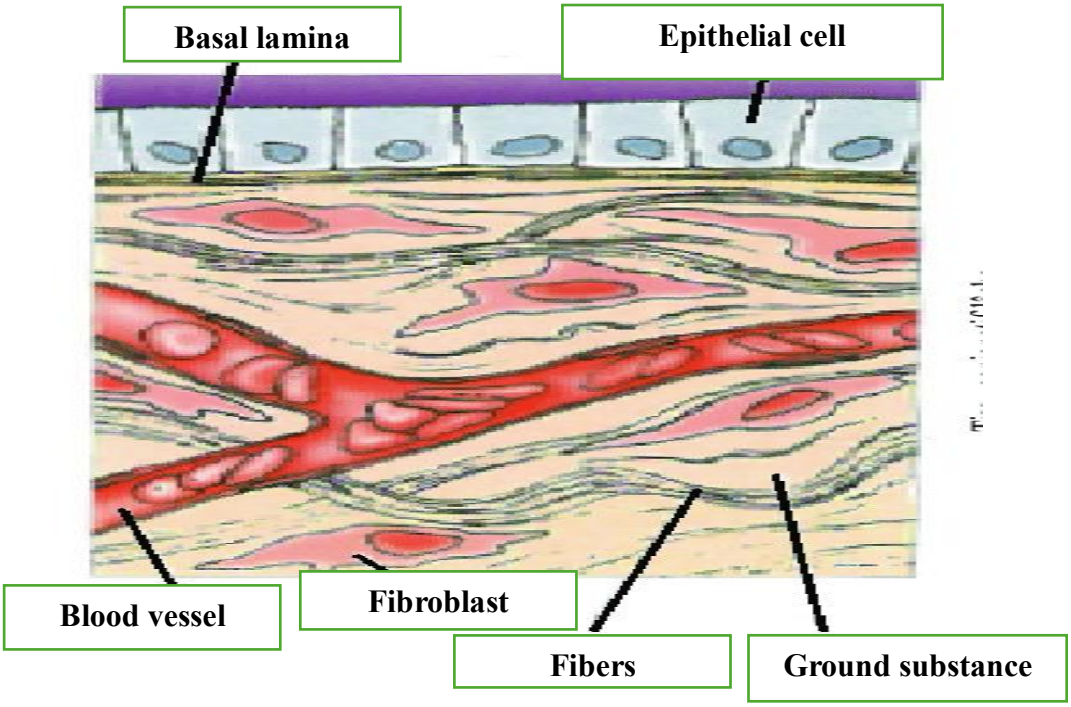

Figure : Components of connective tissue

II-1- Connective Tissue Cells

Connective tissue contains:

- Fixed cells with little or no mobility (fibroblasts and adipocytes).
- Mobile cells, also called free cells (cells of blood origin: macrophages, lymphocytes, etc.).

II-1-1- Fibroblasts

These are the main cells of connective tissue. They are young, very active cells, spindle-shaped or stellate, 20 to 30 µm long. The cytoplasm is rich in organelles: rough endoplasmic reticulum (RER), free ribosomes, and a well-developed Golgi apparatus, indicating intense synthesis of protein precursors, fibers, and ground substance.

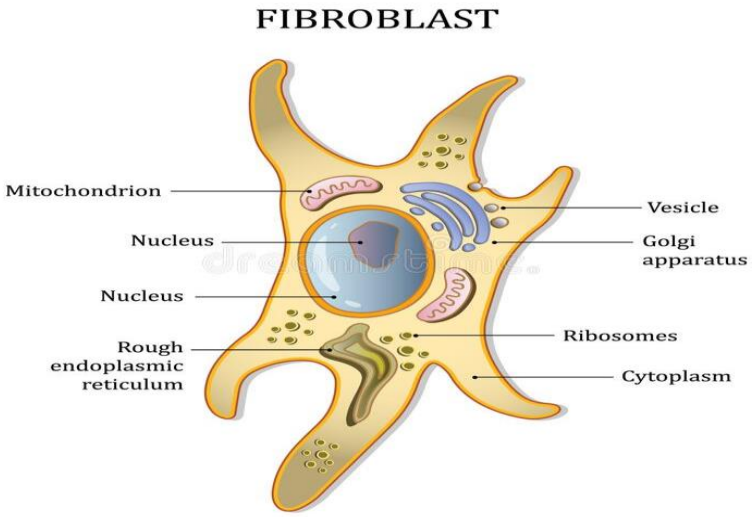

Figure : Fibroblast

II-1-2- Adipocytes

An adipocyte is a large cell (120 µm in diameter). Most adipocytes are grouped in adipose tissue. They are specialized cells for storing lipids.

There are two categories of adipocytes: white fat adipocytes (a large lipid vacuole that occupies almost all of the cytoplasm), the only type present in adult humans, and brown fat adipocytes (very small size and multiple lipid vacuoles).

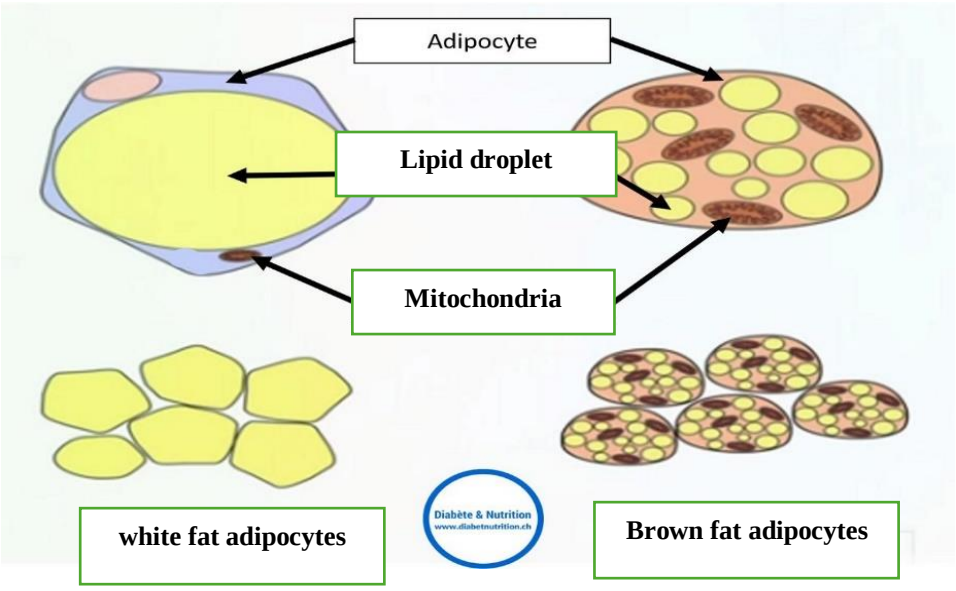

Figure : Adipocytes

II-1-3- Macrophages

These are polymorphic cells that originate in the bone marrow and circulate in the blood as monocytes, performing their function of defending the body in connective tissues.

They are large cells with cytoplasmic extensions (pseudopodia). Their cytoplasm is rich in organelles that synthesize the body's defenses against foreign agents.

They can act through: phagocytosis, secretion of toxic substances, and triggering immune responses.

II-2- Fibers

II-2-1- Collagen Fibers

These are the thickest of the connective tissue fibers. Collagen fibers are extensible but not elastic. They give connective tissue its resistance to mechanical forces and its strength. Collagen is an insoluble fibrous protein synthesized by several cell types: fibroblasts of the dermis, chondrocytes of cartilage, endothelial cells and smooth muscle cells of vascular walls, keratinocytes of the cornea, and osteoblasts of bones.

II-2-1- Elastic Fibers

Elastic fibers are characterized, as their name suggests, by their elasticity. They are strong and extensible, returning to their original length after stretching.

Elastin is the main constituent of elastic fibers. They are abundant in cutaneous connective tissue and the walls of arteries.

II-3-1- Reticulin Fibers

These are newly formed collagen fibrils that acquire a glucose-lipid layer which prevents their transformation into collagen fibers. They are located in embryonic connective tissue and in certain organs (liver, endocrine glands).

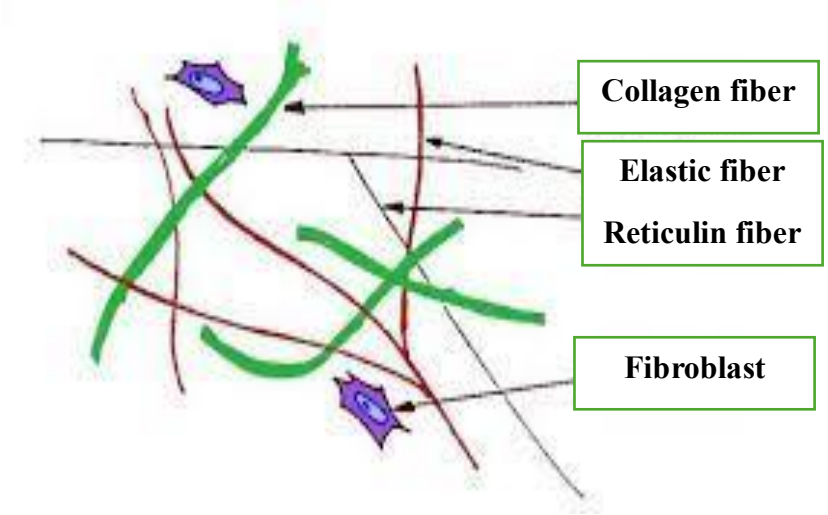

Figure : Different types of fibers

II-3- Ground Substance

This is a homogeneous substance occupying the spaces between the fibers and cells. The cells of connective tissue are bathed in a very water-rich environment containing small dissolved molecules (mineral salts, sugars, polypeptides, etc.) and large protein macromolecules.

II-2- Function of Connective Tissues

Depending on its location and subtype, connective tissue performs three main functions:

1- a support and cohesion function, linked to its high fiber content.

2- a nutritive and exchange function, linked to its high extracellular matrix and blood vessels.

3- a defense function, linked to the presence of transient immune cells.

II-3- Classification of Connective Tissues

Connective tissues are classified according to morphological criteria, based on the relative proportions of their components.

II-3-1- Embryonic Connective Tissue

a- Mesenchyme

Present in the embryo, it gives rise to all other connective tissues. The cells are irregular, the ground substance is semi-liquid, and the fibers are reticulated.

b- Mucous Connective Tissue (Mucoid)

Found in the umbilical cord. It is very poor in cells and very rich in ground substance. The cells are stellate. The ground substance is hydrated and gelatinous. The fibers are collagen fibers, very fine and dispersed.

II-3-2- Adult Connective Tissue

II-3-2-1 Loose Connective Tissue

Widely distributed throughout the body, it plays a supporting and defensive role. Some loose connective tissues are highly specialized; therefore, we distinguish:

a- Random tissues

Located beneath the epithelium, they surround glands and vessels. They play a mechanical role in providing support, nutrition through the vessels they carry, and defense of the body through the cells they contain.

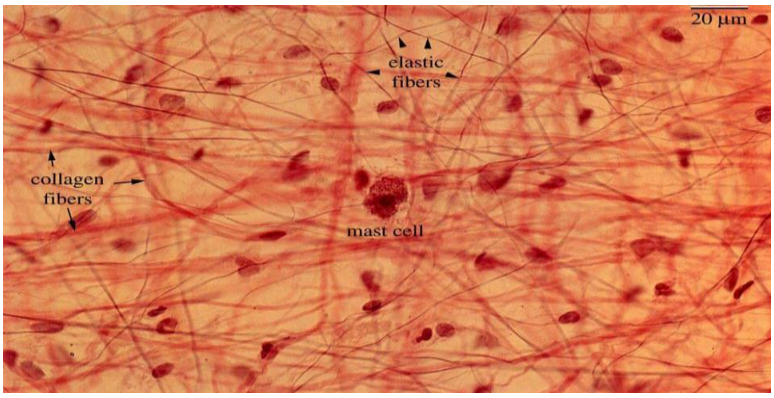

Figure : Aleatory connective tissu

b- Adipose tissue

This is a loose connective tissue with a predominantly cellular composition. Most connective tissues contain cells adapted for fat storage; these cells are called adipocytes. There are two main types of adipose tissue:

*** White adipose tissue**

This is distributed throughout the body, particularly in the deeper layers of the skin. In addition to being an important energy reserve, white adipose tissue acts as thermal insulation under the skin and cushions against mechanical shock in areas such as the kidneys.

*** Brown adipose tissue**

This highly specialized type of adipose tissue is found in mammals, especially newborns, where it plays an important role in regulating body temperature. Only small amounts of brown adipose tissue are found in adults.

c- Reticular tissues

This tissue is very rich in type III collagen fibers called reticulin. It forms the stroma of the spleen, bone marrow, and liver.

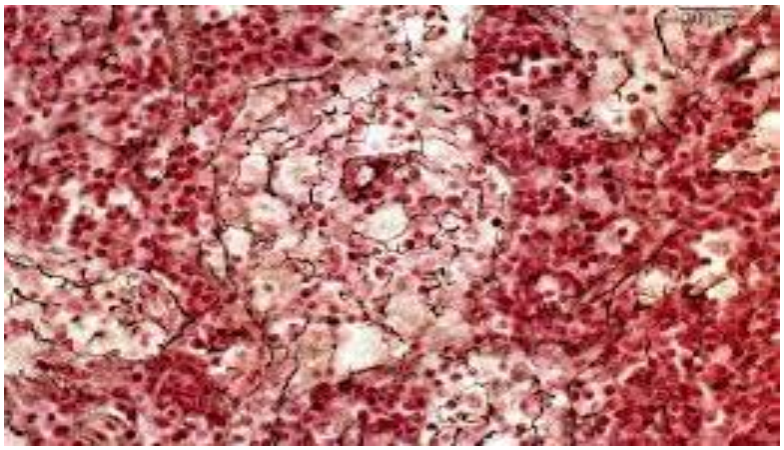

Figure : Reticular tissue

II-3-2-2- Dense Connective Tissue

These are tissues in which fibers predominate. The cells are few in number, consisting almost exclusively of fibroblasts whose synthetic activity is slowed.

a- Oriented Dense (Fibrous) Connective Tissue

This is a tissue in which collagen fibers predominate. The parallel collagen fibers follow unidirectional paths. Ligaments, which provide several types of connections, including bone-to-bone connections, are an example. Tendons, which are cords attached to parts of the skeleton, providing a point of attachment for muscles, are also an example.

Figure: Oriented Dense (Fibrous) Connective Tissue

b- Dense (fibrous) non-oriented connective tissue

It is composed of numerous dense collagen fibers without a precise orientation. It forms the membranes of organs, whose attractive forces are multidirectional.

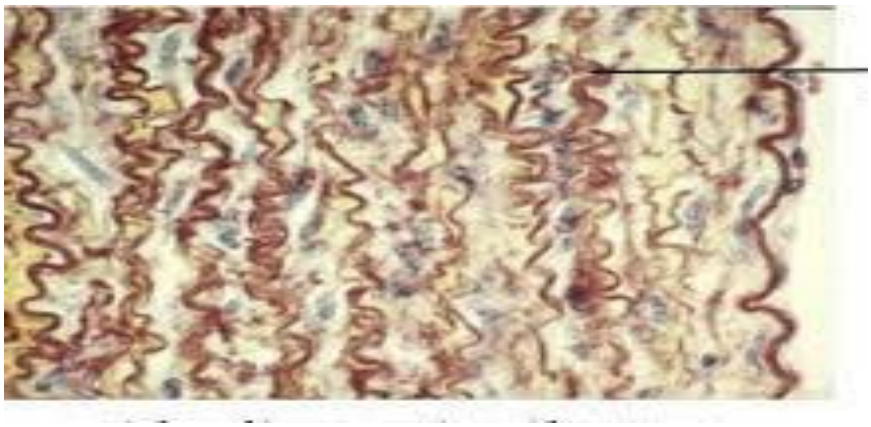

Figure : Dense (fibrous) non-oriented connective tissue