Connective Tissue

Classification of Connective Tissue

Connective tissue develops from mesenchyme, an embryonic type of tissue. Embryonic connective tissue is present in the umbilical cord and in the pulp of the developing teeth.With the exceptions of blood and lymph, **connective tissue** consists of **cells** and **extracellular material** called **matrix.**
The extracelluar matrix consists of connective **tissue fluid, ground substance** within which are embedded the different protein **fibers** (collagen, reticular, and elastic).
The connective tissue binds, anchors, and supports various cells, tissues, and organs of the body. The connective tissue is classified as either loose connective tissue or dense connective tissue, depending on the amount, type, arrangement, and abundance of cells, fibers, and ground substance.

TYPES OF CONNECTIVE TISSUE

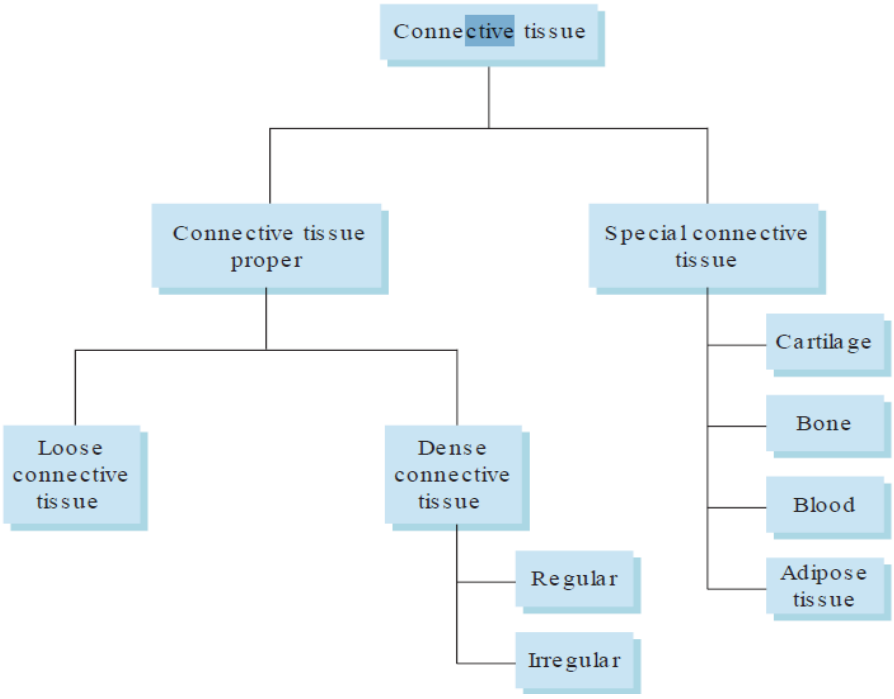
Connective tissue is classified based on the composition of its cellular and extracellular components and their arrangement.
● Connective tissue is broadly classified into two groups (a) Connective tissue proper (b) Special connective tissue.

●Connective tissue proper includes those connective tissues in which fibrous component is predominant.

Connective tissue proper includes loose (areolar) connective tissue and dense (regular and irregular) connective tissue.

● Special connective tissue is designed or specific functions and hence is present at specific locations. It includes adipose tissue, cartilage, bone and blood.

● In general, the term connective tissue refers to connective tissue proper, while special connective tissues are referred to by their specific names (e.g. bone).



Classification o connective tissue

LOOSE CONNECTIVE TISSUE

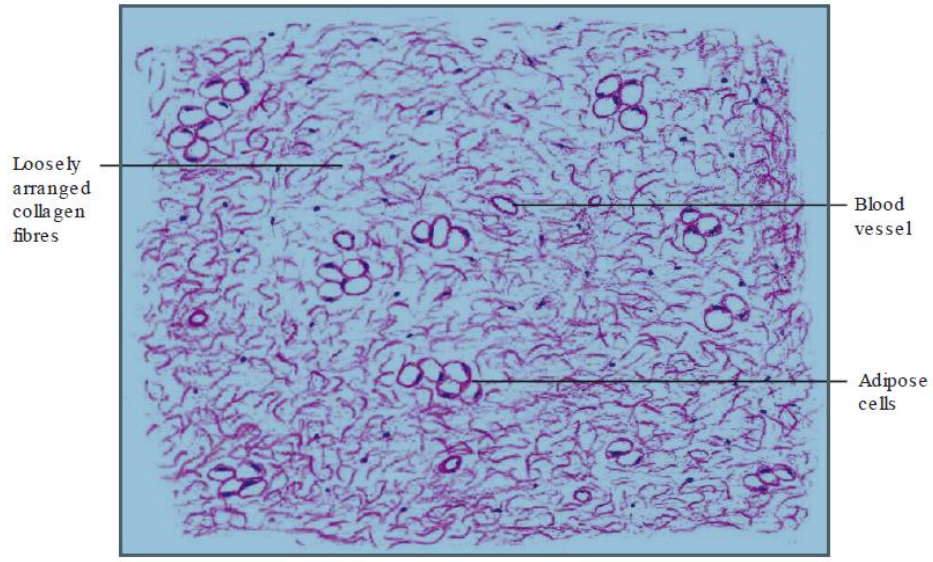
● It is also called loose areolar tissue.

● It consists of loosely arranged collagen fibers and abundant ground substance. Elongated nuclei of fibroblasts can be seen. Other cells of connective tissue are also present.

● It gets distorted easily; hence, it allows the tissue to move freely.

● It also supports the overlying epithelium. It is a vascular tissue; metabolites and oxygen di use through it to the epithelium (which is avascular).

● Example: Lamina propria and submucosa of various tracts (respiratory, gastrointestinal, urinary, etc.) and hypodermis.



Loose connective tissue in low magnif cation (H&Epencil drawing).

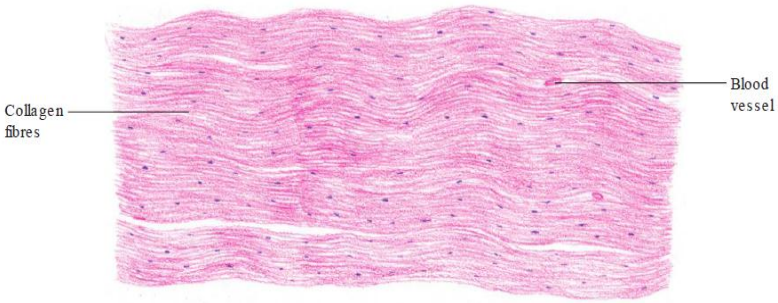
DENSE CONNECTIVE TISSUE

● It provides tensile strength to the tissue. It also offers protection to the underlying tissue.
● It has more fibres and less ground substance and cells.
● Based on the orientation of the fibres, it is o two types—dense regular and dense irregular connective tissues.

Dense Regular Connective Tissue

● Connective tissue is arranged in a definite pattern
Collagen fibers are aligned uniformly. This uniform alignment helps in transferring mechanical force.
● Example: tendons and ligaments.

Figuer shows Dense rregular Connective Tissue .



.13 Longitudinal section of tendon in low magnif cation showing dense regular connective tissue. Note the regular arrangement of collagen f bre bundles (H&Epencil drawing).

Dense irregular Connective Tissue .

- Collagen fibres are arranged irregularly.
- This tissue provides resistance to mechanical stress from all directions.
- Example: Reticular layer of the dermis

Cells of the Connective Tissue

The two most common cell types in the connective tissue are the active **fibroblasts** and the inactive or resting fibroblasts, the **fibrocytes.** Fusiform-shaped fibroblasts synthesize all of the connective tissue fibers and the extracellular ground substance.

Adipose (fat) cells, which may occur singly or in groups, are seen frequently in the connective tissue; these cells store fat.When adipose cells predominate, the connective tissue is called an **adipose tissue.**

Macrophages or **histiocytes** are phagocytic cells and are most numerous in loose connective tissue. They are difficult to distinguish from fibroblasts, unless they are performing phagocytic activity and contain ingested material in their cytoplasm.

Mast cells, usually closely associated with blood vessels, are widely distributed in the connective tissue of the skin and in the digestive and respiratory organs. Mast cells are spherical cells filled with fine, regular dark-staining and basophilic granules.

Plasma cells arise from the lymphocytes that migrate into the connective tissue. These cells are found in great abundance in loose connective tissue and lymphatic tissue of the respiratory and digestive tracts.

Leukocytes, or white blood cells, neutrophils, and eosinophils, migrate into the connective tissue from the blood vessels. Their main function is to defend the organism against bacterial invasion or foreign matter.

Fibroblasts and adipose cells are permanent or resident connective tissue cells.

Neutrophils, eosinophils, plasma cells, mast cells, and macrophages migrate from the blood vessels and take residence in the connective tissue of different regions of the body.

Fibers of the Connective Tissue

There are three types of connective tissue fibers: **collagen, elastic,** and **reticular.** The amount and arrangement of these fibers depend on the function of the tissues or organs in which they are found. Fibroblasts synthesize all of the collagen, elastic, and reticular fibers.

Type of Collagen Fibers
Collagen fibers are tough, thick, fibrous proteins that do not branch. They are the most abundant fibers and are found in almost all connective tissue of all organs. The most frequently recognized fibers in histologic slides are the following:

• **Type I** collagen fibers. These are found in the dermis of skin, tendons, ligaments, and bone. They are very strong and offer great resistance to tensil stresses.

• **Type II** collagen fibers. These are present in hyaline cartilage and elastic cartilage. The fibers provide resistance to pressure.

• **Type III** collagen fibers. These are the thin, branching reticular fibers that form the delicate supporting meshwork in such organs as the lymph nodes, spleen, and bone marrow.

• **Type IV** collagen fibers. These are present in the basal lamina of the basement membrane, to which the basal regions of the cells attach.

Reticular Fibers

Reticular fibers, consist maily of type III collagen, are thin and form a delicate netlike framework in the liver, lymph nodes, spleen, hemopoietic organs, and other locations where blood and lymph are filtered. Reticular fibers also support capillaries, nerves, and muscle cells. These fibers become visible only when the tissue or organ is stained with silver stain.

Elastic Fibers

Elastic fibers are thin, small, branching fibers that allow stretch. They have less tensile strength than collagen fibers, and are composed of microfibrils and the protein **elastin.** When stretched, elastic fibers return to their original size (recoil) without deformation. Elastic fibers are found in abundance in the lungs, bladder, and skin. In the walls of the aorta and pulmonary trunk, the presence of elastic fibers allows for stretching and recoiling of these vessels during powerful blood ejections from the heart ventricles. In the walls of the large vessels, the smooth muscle cells synthesize the elastic fibers.

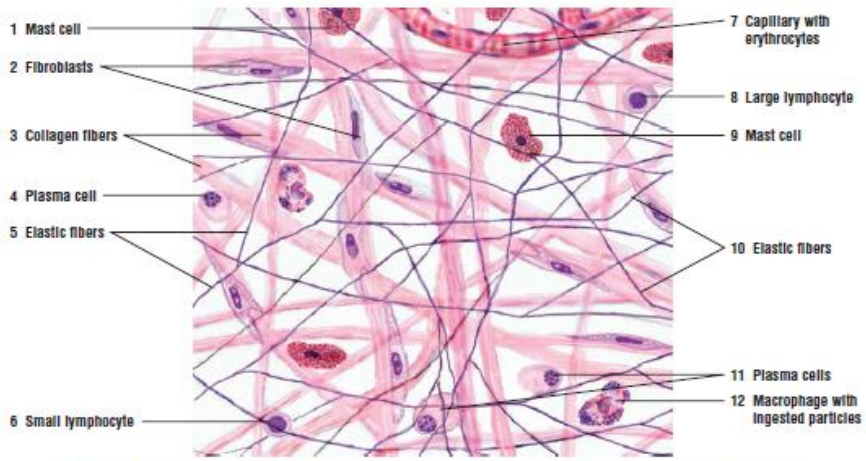


FIGURE 3.1 ■ Loose connective tissue (spread). Stained for cells and fibers. High magnification.

Individual Cells of Connective Tissue

The main cells of connective tissue are the fibroblasts and fibrocytes. The fibroblast (1) is an elongated cell with cytoplasmic projections, an ovoid nucleus with sparse chromatin, and one or two nucleoli.

The fibrocyte (6) is a more mature, smaller spindle-shaped cell without cytoplasmic projections; the nucleus is similar but smaller than that in the fibroblast.

The plasma cell (2) exhibits a smaller, eccentrically placed nucleus with condensed, coarse chromatin clumps distributed peripherally in a characteristic radial (cartwheel) pattern and one central mass. A prominent, clear area in the cytoplasm is adjacent to the nucleus.

The large adipose cell (3) exhibits a narrow rim of cytoplasm and a flattened, eccentrically nucleus. In histologic sections, the large fat globules of adipose cells have been dissolved by different chemicals, leaving a large, highly characteristic empty space.

The large lymphocyte (4) and small lymphocyte (10) are spherical cells that differ primarily in the greater amount of cytoplasm that is present in the large lymphocyte (4). The densestaining nuclei of all lymphocytes have condensed chromatin but no nucleoli.

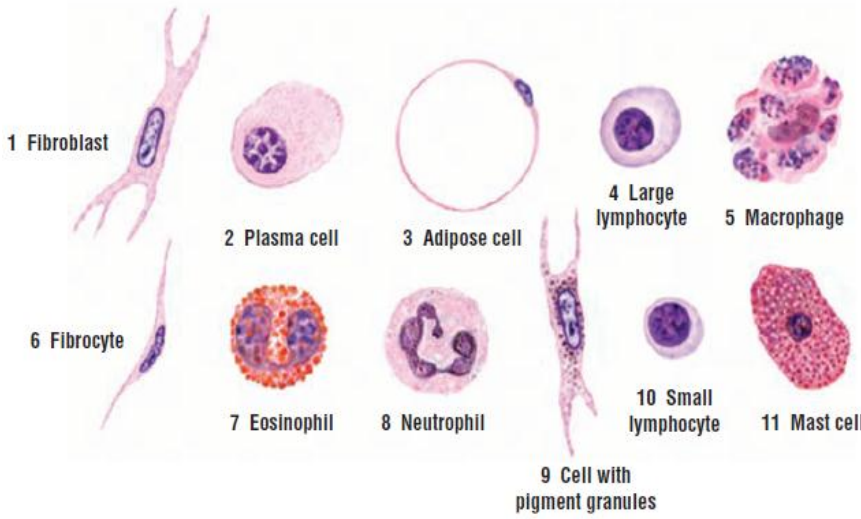
The free macrophage (5) usually appears round with irregular cell outlines, but exhibits a variable appearance. In the illustration, the macrophage exhibits a small nucleus rich in chromatin and cytoplasm filled with dense, ingested particles.

Eosinophil (7) is a large blood cell with a bilobed nucleus and large, eosinophilic cytoplasmic granules that fill the cytoplasm.

Neutrophil (8) is also a large blood cell, characterized by a multilobed nucleus and a lack of stained granules in the cytoplasm.

Cells with pigment granules (9) may be seen in the connective tissue. Also, the basal epithelial cells of the skin contain brown-staining pigment or melanin granules.

Mast cell (11) is usually ovoid, with a small, centrally placed nucleus. The cytoplasm is normally filled with fine, closely packed, and dense-staining granules



.2 ■ Cells of the connective tissue. Stain: hematoxylin and eosin. High magnification or oil
1.