

Human Histology

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Histology of Connective Tissue

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**1. Atlas of Histology with Functional Correlations
by Vector .P. Eroschenko**

**2. Textbook of Human Histology with Colour Atlas and Practical
Guide. K. Pushpalatha**

3. Human Histology /Stevens & Lowes

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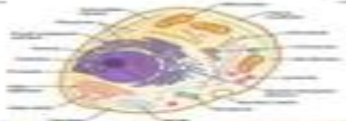
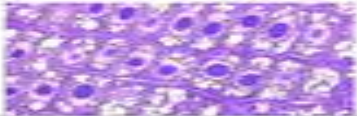



FUNCTIONS OF CONNECTIVE TISSUE

COMPONENTS OF CONNECTIVE TISSUE

TYPES OF CONNECTIVE TISSUE

Cells to Tissues

- As human body develops from single to multicellular, cells specialize.
- Body is interdependent system, malfunction of one group of cells is catastrophic.
- Cells specialize into types of tissues, then interspersed into organs.

Cell	Basic structural and functional unit of a living organism	 
Tissue	Group of cells with similar structures, working together to perform a shared function	 
Organ	Structure made up of a group of tissues, working together to perform specific functions	 

INTRODUCTION

Most widespread and abundant type of tissue in the human body.

Major constituent is extracellular matrix, composed of fibres, ground substance & tissue fluid.

Embedded within the extracellular matrix are the connective tissue cells.

Structurally, connective tissue can be divided into 3 classes: cells, fibres & ground substance.

CLASSIFICATION

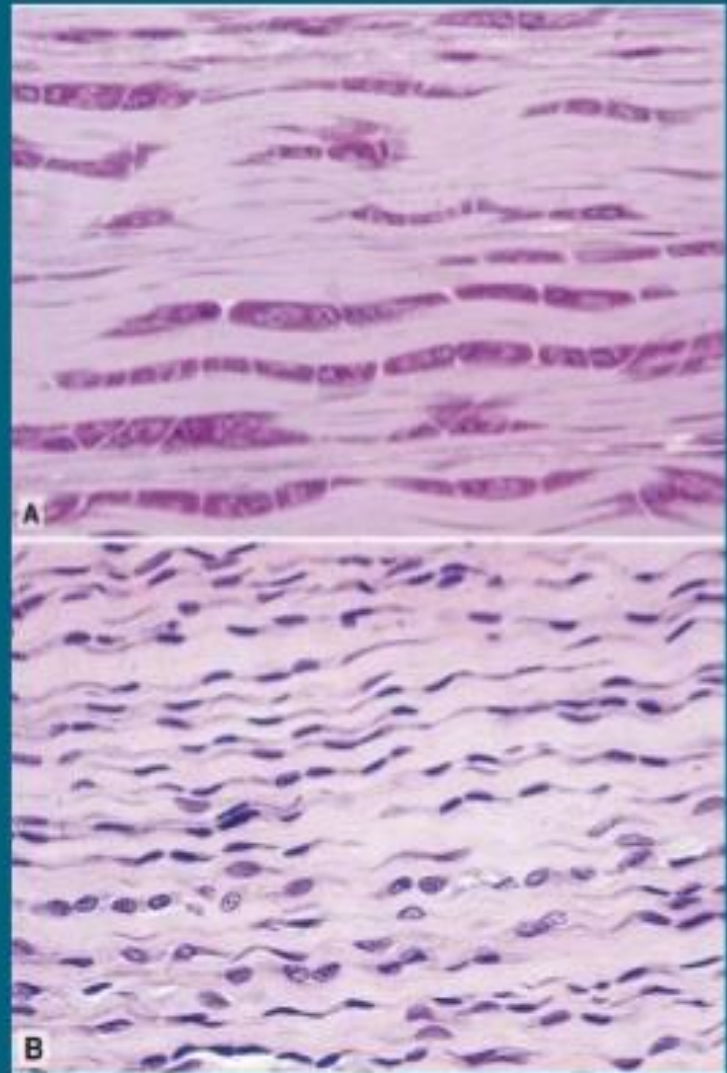
Classification is based on the composition and organization of cellular and extracellular components and on special functions.

Classification

- I. Connective Tissue Proper
 - Loose connective Tissue
 - Dense connective tissue – regular & irregular
- II. Connective Tissue with special properties
 - Adipose CT
 - Elastic CT
 - Hematopoietic CT (lymphatic and myeloid)
 - Mucous CT
- III. Supporting Connective Tissue
 - Cartilage
 - Bone

Composition of Connective Tissues

- Connective tissue cells
- Connective tissue fibers
- Intercellular or Ground substance
- Blood vessels – except in Mucous CT and in cartilage



FUNCTIONS OF CONNECTIVE TISSUE

- SUPPORT- To epithelium e.g.: lamina propria.
- STRENGTH- Provides tensile strength to mechanical stress e.g.: dermis of skin , ligament.
- STORAGE- Fat cells store fat while ground substance store water , ions and inorganic materials.
- TRANSPORT- Water, ions and inorganic materials are transported from blood to various tissues of body through connective tissue matrix.
- PACKING- They fill spaces e.g.: loose connective tissue and adipose tissue.
- REPAIR- Helps in wound healing
- DEFENSE- Cells helps in defense action e.g.: plasma cells, macrophages, lymphocytes, monocytes, eosinophils.

Connective Tissue cells

Fixed or permanent

- Are native to the tissue in which they are found:
 1. undifferentiated mesenchymal cells
 2. fibroblasts
 3. macrophages
 4. fat cells

Wandering cells

- Are immigrant cells usually from blood or bone marrow. Some retain their original characteristics and may take up permanent residence there:
 1. mast cells
 2. plasma cells
 3. pigment cells
 4. blood leukocytes

Undifferentiated Mesenchymal cells

- Precursor of most cells indigenous to CT including fibroblasts and adipose cells
- **Adventitial cells** remain undifferentiated in adult CT and constitute a reserve population of stem cells
- **Perivascular cells**, often located along the walls of blood vessels
- Are difficult to distinguish from active fibroblasts – recognition come not with the microscope but from numerous observations of their responses to certain stimuli
- **Pluripotential cells**, capable of differentiation either into the usual cell types or into other cell types such as smooth muscle cells

Types of connective tissue

1. Mesenchymal CT:

Dominant connective tissue of young embryo.

With development it differentiates into smooth muscles, vascular and lymphatic channels and all of the CT types like cementum, dentin and pulp of teeth.

2. Mucus CT:

Intermediate stage between the mesenchyme and differentiated/adult tissue.

Found in the umbilical cord where it is known as **wharton's jelly**

Classification of CN-tissue

- Classification into various types depending on the following four criteria.

(1)Relative proportion of the various fibers presents

(2) Compactness & arrangement of these fibers

(3)Nature of the matrix

(4)types of cells present

Above mention criteria CN-tissue are the following two groups

(A)Embroyonal CN-tissue

(B)Adult CN-tissue

EMBRYONAL CN-TISSUE

- Developmentally, the CN-tissue are derived from mesoderm which is one of the three primary embryonic layers.
- The immature CN-tissue of the embryo derived from the mesoderm is known as **mesenchyme**. It is composed of roughly star-shaped cells which lie in an abundant, relatively homogenous intercellular substance.
- As the development proceeds, the mesenchyme gradually assumes characteristics of Adult CN-tissue.

Ectoderm. ... Ectoderm is one of the three primary germ layers in the very early embryo. The other two layers are the mesoderm (middle layer) and endoderm (most proximal layer), with the ectoderm as the most exterior (or distal) layer. It emerges and originates from the outer layer of germ cells.

The first changes appears of fibers in the intercellular substance which thus becomes more viscous .

The embryonic CN-tissue of this stages is known as **mucous tissue**. Widely distributed in the body of fetus. The umbilical cord also contain a considerable amount of mucous tissue .

ADULT CN-TISSUE

- Divide into main three varieties
 1. CN-tissue proper
 2. Cartilage
 3. Bone
- 1. CN-tissue proper discuss earlier as loose & dense CN-tissue

Characteristics of connective tissue

- More matrix than cells
- Derived from mesoderm in embryo – mesenchyme and mucous connective tissue
- Vascular
- Can replicate (healing and repair)
- Is not present on free surfaces or body cavities
- innervated

Components of connective tissue

- Connective tissues differ widely but still made up of three fundamental components
 - Cells
 - Protein fibers
 - Ground substance
- Protein fibers and ground substance are collectively called as extracellular matrix.
- The composition and structure of extracellular matrix determine function and characteristic of connective tissue

Fibroblasts:

- ❑ large, flat cells with branching processes present in all the general connective tissues
- ❑ usually are the most numerous.
- ❑ Fibroblasts migrate through the connective tissues, secreting the fibers and certain components of the ground substance of the extracellular matrix.

Macrophages

- ❑ develop from monocytes
- ❑ have an irregular shape with short branching projections and are capable of engulfing bacteria and cellular debris by phagocytosis.
- ❑ *Fixed macrophages* reside in a particular tissue; examples include alveolar macrophages in the lungs or splenic macrophages in the spleen.
- ❑ *Wandering macrophages* have the ability to move throughout the tissue and gather at sites of infection or inflammation to carry on phagocytosis.

Plasma cells

- small cells that develop from B lymphocyte.
- Plasma cells secrete antibodies, proteins that attack or neutralize foreign substances in the body.
- Although they are found in many places in the body, most plasma cells reside in connective tissues, especially in the gastrointestinal and respiratory tracts.
- They are also abundant in the salivary glands, lymph nodes, spleen, and red bone marrow.

Mast cells

- abundant alongside the blood vessels that supply connective tissue.
- produce histamine, which dilates small blood vessels as part of the inflammatory response.

Cells specific to a particular type of connective tissue:

- Adipocytes** - store triglycerides. Insulate and cushion
- Osteocytes (osteoblasts)** - bone
- Chondrocytes (chondroblasts)** - Cartilage
- leukocytes and erythrocytes** - blood

CELL TYPE	LOCATION	FUNCTION
Monocyte	Blood	Precursor of macrophages
Macrophage	Connective tissue, lymphoid organs, lungs	Production of cytokines, chemotactic factors, & several other molecules that mediate inflammation, antigen presentation
Kupffer Cell	Liver	Production of cytokines, chemotactic factors, & several other molecules that mediate inflammation, antigen presentation

Microglia Cell	Nerve tissue of CNS	Production of cytokines, chemotactic factors, & several other molecules that mediate inflammation, antigen presentation
Langerhans Cell	Skin	Antigen Presentation
Osteoclast	Bone	Bone Resorption
Multinuclear Giant Cell	Connective Tissue	Digestion of foreign bodies

Extracellular Matrix of connective tissue

GROUND SUBSTANCE

- component of a connective tissue between the cells and fibers.
- The ground substance may be viscous (as in blood), semisolid (as in cartilage), or solid (as in bone).
- supports cells, binds them together, stores water, and provides a medium for exchange of substances between the blood and cells.
- plays an active role in how tissues develop, migrate, proliferate, and change shape.

- It primarily consists of protein and carbohydrate molecules and variable amounts of water.
- The protein and carbohydrates are mainly present in form of proteoglycans and glycoproteins.
 - ❑ Proteoglycan = Protein core + glycosaminoglycan
 - ❑ Glycoprotein = Protein + oligosaccharide
- Also present in the ground substance are adhesion proteins , which are responsible for linking components of the ground substance to one another and to the surfaces of cells. E.g. fibronectin which bind collagen fiber and ground substance together

Protein fibers

Three types of protein fibers

1: Collagen fibers

- made up of collagen.
- Collagen fibers are tough and only slightly elastic.
- They often occur in bundles with the fibers parallel to one another, which gives great tensile strength.
- Make different association in different tissues., as in cartilage molecular arrangement allows it to draw more water as compared to bone.
- Collagen is found in most connective tissues, esp. bone, tendons, and ligaments.

2: Elastic fibers

- are composed of a protein called elastin and glycoprotein framework called fibrillin.
- They are very stretchy and branch and join to form a network.
- Can stretch upto 150 times its relaxed size
- They provide strength to tissues, but allows the tissue to be flexible and stretchy. They are found in skin, blood vessels, and lungs

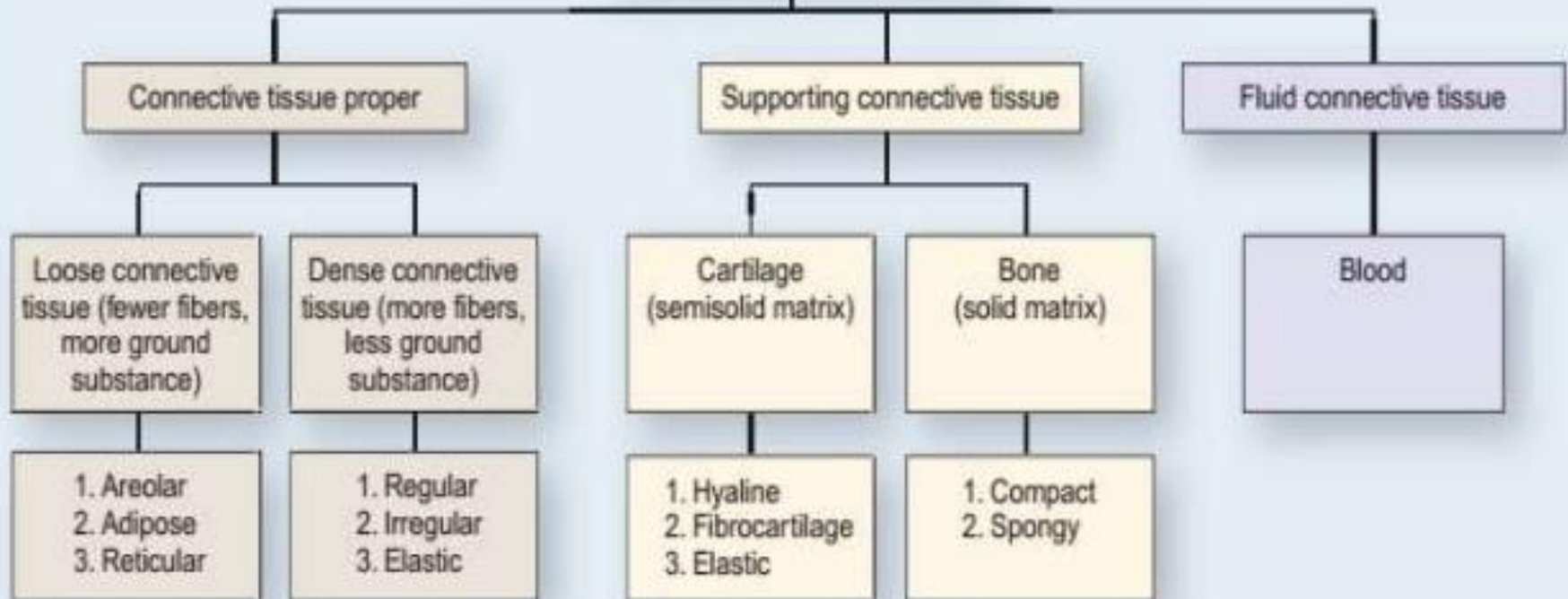
3: Reticular fibers.

- Made up of collagen but are thinner as compared to collagen fibers and are arranged in branching network (not in parallel rows as are collagen fibers) .
- They form a spongelike framework , stroma, for such organs as the spleen and lymph nodes
- Also present in blood vessels, nervous tissue, muscles and adipose tissue where it provide support

Classification of connective tissue

Connective Tissue Classification

Common origin (mesenchyme)



TYPES OF DENSE CONNECTIVE TISSUE

Dense irregular ct

- Fibres make up bulk of the tissue and arranged in bundles oriented in various directions
- Cell population is sparse and typically of single type mainly fibroblasts
- Ground substance is also less
- E.g submucosa in intestinal tract

Dense regular ct

- It is characterized by orderly and densely packed arrays of fibres.
- Cells are densely packed.
- Decrease no. of cells, ground substance, densities of blood and lymphatic vessels.
- It is main functional component of tendons. Ligaments and aponeurosis

- **Loose Connective Tissue**

- **Mainly fibroblasts**
- **Fluid to gel-like matrix**
- **Collagenous fibers**
- **Elastic fibers**
- **Bind skin to structures**
- **Beneath most epithelia**
- **Blood vessels nourish nearby epithelial cells**
- **Between muscles**

Thank You and Good Luck

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