Connective tissue notes pdf

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Author: Jana Vasković MD • Reviewer: Nicola McLaren MSc Last reviewed: August 02, 2022 Reading time: 12 minutes Connective tissue is the tissue that connects or separates, and supports all the other types of tissues in the body. Like all tissue types, it consists of cells surrounded by a compartment of fluid called the extracellular matrix (ECM). However connective tissue differs from other types in that its cells are loosely, rather than tightly, packed within the ECM. Based on the cells present and the ECM structure, we differ two types of connective tissue: Connective tissue proper; further divided into loose and dense connective tissues Specialised connective tissue; reticular, blood, bone, cartilage and adipose tissues We know that there are way cooler histology topics than connective tissue, like muscle tissue or neural tissue. But as the connective tissue is the glue that holds all other tissues together, it has the important function of ensuring that our body systems work in harmony. This page will explain what is connective tissue and present you with an overview of its types. Key facts Dense connective tissue Cells: fibroblasts Fibers: collagen fibers heavily packed in the ECM either in parallel order (dense regular), or randomly interlaced (dense irregular) Loose connective tissue Cells: fibroblasts Fibers: collagen fibers loosely scattered in the ECM Reticular connective tissue Cells: reticular cells Fibers: reticular fibers organized in delicate networks Cartilage Cells: chondrocytes ECM: collagen II (hyaline cartilage), elastic fibers (elastic cartilage), collagen I (fibrocartilage) Bone Cells: osteoblasts, osteocytes, osteoclasts ECM: calcified lamellae Blood Cells: erythrocytes, leukocytes, platelets ECM: blood plasma Adipose tissue Cells: white and brown adipocytes ECM: no ECM Embryonic connective tissue Mesenchyme: mesenchymal cells in reticular fibers rich ECM Mucoid tissue: mesenchymal cells in collagen rich ECM The three components of connective tissue are cells, ground substance and fibers. Ground substance and fibers make up the extracellular matrix (ECM). The primary cell of connective tissue is the fibroblast. Its function is to produce and maintain the ECM of connective tissue. Besides fibroblasts, several other cell types are present. These are the cells of the immune system (macrophages, lymphocytes and mast cells) and adipocytes. Specialised connective tissue contains specialised cells, for example cartilage contains chondrocytes and bone contains osteocytes. Ground substance is a viscous gel made of water, proteoglycans, glycoproteins and glycosaminoglycans. These make the ground substance viscous and bind high amounts of water which allows hydration, diffusion of nutrients and nourishing of the tissue. Feeling confused? Find out how to learn histology easier with our histology slide quizzes. There are three types of protein fibers; collagen, elastic and reticular. Collagen fibers and reticular fibers both belong to the collagen family, of which there are over 20 different types. Collagen fibers are predominantly made of collagen type I. These are the most abundant protein fiber type, providing varying degrees of strength and rigidity to tissues. Reticular fibers consist of collagen type III, they are thin delicate fibers that form meshlike networks in organs such as the spleen, kidneys and lymph nodes. Elastic fibers are made from the protein elastin, giving stretching and bending properties to tissues. They are mostly found within the walls of large blood vessels, elastic cartilages, yellow ligaments, lungs and skin. Variations in the cell and protein fiber combinations and arrangements result in the different types of connective tissue. Connective tissue proper is found throughout the entire body. There are two subtypes of connective tissue proper; loose and regular. They differ in the structural layout of their extracellular matrix. Loose connective tissue is also called the areolar connective tissue. It has almost equal amounts of cells, fibers and ground substance. Chief cells are the fibroblasts. However, immune system cells are also present. Collagen fibers are the principal fibers of the ECM. They are sparsely distributed within the ECM, which is why this tissue type is called ‘loose’. Besides the collagen fibers, moderate amounts of reticular and elastic fibers are present as well. Loose connective tissue is the most widely distributed type of connective tissue, found in the lining of the body's inner surfaces. The cell to fiber combination makes loose connective tissue flexible but not very resistant to mechanical stress. This allows the tissue to play an important role in binding other tissue types together, for example joining tissues into organs, holding organs in place and attaching epithelial tissue to other tissue types. The presence of immune system cells adds an immuno-protective connective tissue function. Examples of loose connective tissue include; the lamina propria of the alimentary and respiratory tracts, mucous membranes of reproductive and urinary tracts, glands, mesentery and dermis of the skin. Learn the structure and function of loose connective tissue here: Loose connective tissue Explore study unit ... or you're feeling ready for a test already? Try out our quiz: Dense connective tissue has fewer cells than loose. Instead, its ECM is densely packed with collagen fibers. Based on the arrangement of the fibers, there are two subtypes of dense connective tissue; dense regular and dense irregular. Dense regular connective tissue has the collagen fibers aligned parallel to each other. This arrangement provides the tissue with high unidirectional resistance to stress. The best dense regular connective tissue examples are the tendons and ligaments. Dense irregular connective tissue has collagen fibers randomly interwoven, forming a three-dimensional network resistant to distension in all directions. It is usually located in the capsules and walls of the organs, the dermis of the skin and glands. Dense connective tissue starter pack is waiting for you here: Reticular connective tissue is produced by modified fibroblasts called reticular cells. These produce reticular fibers arranged in an interlaced network (reticulum), similar to dense irregular connective tissue. The difference between them is that the reticular fibers are thinner, compose a more delicate mesh, with reticular cells remaining bonded to the fibers. Reticular tissue supports the stroma of body organs, especially lymphoid. Reticular meshes filter lymph and provide a microenvironment for the passage and attachment of white blood cells. Thus, it is present in red bone marrow, lymph nodes and the spleen. Master this histology topic with our video tutorial and quiz. Cartilage is the avascular connective tissue that connects bones at joints and comprises walls of upper respiratory airways and external ear. It is surrounded by perichondrium, a layer of dense connective tissue. The perichondrium is rich in blood vessels and supplies the cartilage. Chief cells in cartilage are chondrocytes, lodged into cavities within the ECM called lacunae. The ECM is vast, rich in water bound to glycosaminoglycans. This ECM structure makes cartilage flexible in various degrees but resilient to mechanical stress. There are three types of cartilage; Hyaline cartilage - most represented type. Rich in collagen II molecules, it is found on the articular surface of joints (as articular cartilage), in the walls of the upper respiratory airways and medial ends of the ribs. Elastic cartilage - has many elastic fibers. It is found in the walls of the external ear, epiglottis and cuneiform cartilage in the larynx. Fibrocartilage - has many collagen I molecules. It comprises articular discs, such as the intervertebral discs, pubic symphysis and knee menisci. Learn more about cartilage histology here. Fibrocartilage Explore study unit Hyaline cartilage Explore study unit Bone is the tissue that comprises the body skeleton. Like all connective tissues, bone is composed of cells within an extracellular matrix of fibers (predominantly collagen type 1) and ground substance. The extracellular bone matrix is mineralized and arranged in circular layers called lamellae. These lamellae circumvent around a central canal (Haversian canal) which serve for the passage of neurovasculature that supplies the bone and house the cells. Bone ECM is produced and maintained by several cells; osteoblasts, osteocytes and osteoclasts. Osteoblasts are cells that actively produce the bone matrix. When dormant, they are called osteocytes. Osteoclasts do the opposite; they absorb the bone matrix. Synchronized function of these cells is necessary for the recovery of broken bones (bone remodeling) and for the general well being of the skeletal system. The specialised cell and ECM nature of bone allows it to serve as a storage site for calcium and phosphate, alongside its weight bearing and protection functions. Learn more about bone histology here. Bone tissue Explore study unit Bone tissue formation Explore study unit Blood is the specialized connective tissue within the circulatory system that transports blood cells and dissolved substances throughout the body via blood vessels. As all connective tissue, it has cellular and extracellular components. The extracellular matrix of the blood is called blood plasma. It consists of water and solutes (proteins, electrolytes, nutrients, gases, hormones and waste products). The blood cells, also called the formed elements, carried by plasma are the erythrocytes (red blood cells), leukocytes (white blood cells) and thrombocytes (platelets). These cells are produced in the bone marrow in the process of hematopoiesis. Adipose tissue is the energy-storing connective tissue. It consists of adipocytes, cells filled with lipids (fats). This tissue has a small amount of ECM made of only a few collagen fibers that keep the cells together. Depending on how the lipids are distributed within the cell; there are white and brown adipose tissues. In brown adipose tissue each cell contains multiple fat drops, surrounding the centrally positioned nucleus. This type is usually found in babies where instead of energy-storing it serves for thermogenesis (heat production). In white adipose tissue the lipid is collected into a single large droplet, which presses the organelles against the cell membrane. White adipose tissue is predominant found in adults. It stores energy, cushions and protects organs, and acts as an endocrine organ by secreting hormones. White adipose tissue distributes into visceral and parietal fats. Visceral fats surround and support the body organs, such as eyeballs (periorbital fat) and kidneys (perinephric fat). Parietal fats are aggregations embedded in the connective tissue proper of the skin, typically in the abdominal, back and thigh regions. Embryonic connective tissue is found in the early embryos and umbilical cord. Chief cells are mesenchymal cells. It is divided into mesenchyme (in embryos) and mucoid connective tissue (umbilical cord). Mesenchyme originates from mesoderm, one of the three germinative layers in embryos. It matures into other types of connective tissues, muscles, vessels, mesothelium and the urogenital system. Its mesenchymal cells are dispersed within ECM filled mainly with reticular fibers. Mucoid connective tissue is found in the umbilical cord. Its mesenchymal cells are loosely distributed within a collagen rich ECM called Wharton’s jelly. All content published on Kenhub is reviewed by medical and anatomy experts. The information we provide is grounded on academic literature and peer-reviewed research. Kenhub does not provide medical advice. You can learn more about our content creation and review standards by reading our content quality guidelines. References: Ross, H. M, Pawlina, W. (2011). Histology (6th ed.). Philadelphia, PA: Lippincott Williams & Wilkins. Mescher, A. L. (2013). Junquiera’s Basic Histology (13th ed.). New York, NY: McGraw-Hill Education. Overview and types of connective tissue: want to learn more about it? Our engaging videos, interactive quizzes, in-depth articles and HD atlas are here to get you top results faster. What do you prefer to learn with? “I would honestly say that Kenhub cut my study time in half.” – Read more. Kim Bengochea, Regis University, Denver