CONNECTIVE TISSUE AND ITS RELEVANCE IN THE BODY

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SUMMARY

In 1907, Dr. Oakley Smith formally founded the medicinal field of naprapathy by launching the Oakley Smith School of Naprapathy, located in Chicago. With this first educational institution, naprapathy gained its foundation as a science and a method of treatment.

The word “naprapathy” comes from the Czechoslovakian word “napravit,” which refers to the traditional Bohemian manual therapies that Oakley Smith studied. Napravit means “to correct” or “to fix.” Smith combined “napra” with “pathos,” the Greek word for suffering, or pain. Put together, naprapathy means “to correct the suffering.”

Smith argued that the cause of pain and dysfunction in our muscles, nervous system, bone structure, and joints (the neuromusculoskeletal system) was due to changes in our connective tissues and tension in our soft tissues.

Rather than simply manipulating joints, such as in chiropractic medicine, Smith’s plan for naprapathic treatment involved soft tissue techniques, neural mobilization, and spinal mobilization and manipulation. Through this course of treatment, Smith was able to achieve long-lasting results in the treatment of pain.

The goal of naprapathic treatment is to enhance the body’s healing ability. To date, it has been proven effective in the management of migraines, sciatica, joint pain, bulging discs, and more. Naprapathy may help with back and neck pain, but it can also be used for sports injuries like tennis elbow or sprains.

Therefore, in this thesis its being explain the importance of the connective tissue, as one of the most important tissues that the body is consisting of it. Naprapathic theory is based on the theory of balance in the soft tissues of the body. Ligamentous tissues are stressed heavily as their imbalance causes muscles and fascia to vacate their jobs of movement and functional hydraulics in the body.

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INTRODUCTION

Connective tissue is one of the many basic types of tissue, along with epithelial tissue, muscle tissue, and nervous tissue. In embryology it develops from the mesoderm. Connective tissue is found in between other tissues everywhere in the body, including the nervous system. The three outer membranes (the meninges) that envelop the brain and spinal cord are composed of dense inert connective tissue. All connective tissue consists of three main components: fibers (elastic and collagen fibers), ground substance and cells. The cells of connective tissue include fibroblasts, adipocytes, macrophages, mast cells and leucocytes.

The term "connective tissue" (in German, Bindegewebe) was introduced in 1830 by Johannes Peter Müller. The tissue was already recognized as a distinct class in the 18th century.

These are a group of tissues in the body that maintain the form of the body and its organs and provide cohesion and internal support. The connective tissues include several types of fibrous tissue that vary only in their density and cellularity, as well as the more specialized and recognizable variants, bone, ligaments, tendons, cartilage, adipose (fat) tissue and even blood. It contains high quantities of water, several types of cells, and a fibrous extracellular matrix. The connective tissue of an organ is usually referred to as the stroma. This tissue type can have very different structures according to the proportions of its components.

EMBRIOLOGICAL FORMATION

Early during embryonic development, the ectoderm and endoderm are separated by the third germinal layer, the mesoderm's. The tissue formed by the cells of this cap is known as mesenchyma (mesos-medium; enchyma-infusion), and from this the connective tissues of the body develop. These include general connective tissue, cartilage, bone, and blood.

The third week of human development is a period of rapid development of the embryonic disc, characterized by the formation of the primitive line and three germinal layers, from which all the tissues and organs of the growing embryo derive.

The process by which the internal cell mass becomes a trilaminar embryonic disc is called gastrulation. This process begins towards the end of the first week, with the formation of the hypoblast, during the second continuous week with the formation of the epiblast is completed during the third week with the formation of the three primary germinative plates: ectoderm, mesoderm and endoderm.

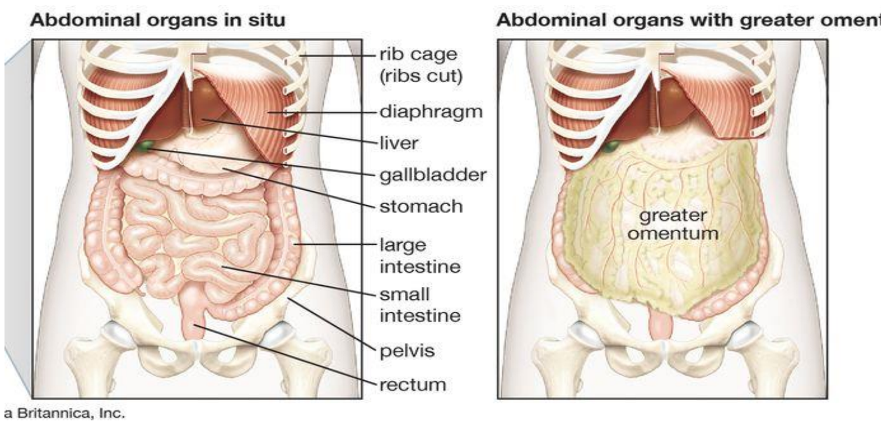
The ectoderm gives rise to the epidermis and nervous system. The endoderm is the layer from which the epithelial coatings of the airways and digestive system derived, including the cells of related organs such as the liver and pancreas. From the mesoderm derived the tunics of the smooth muscle, connective tissue and vessels that irrigate these organs. The mesoderm also originates blood cells and bone marrow, skeleton and striated muscle and reproductive and excretory organs.

Characteristically, the mesenchyma is lax spongy tissue that in initial stages of embryonic life is filling the spaces between the structures that develop from the other germinal layers. It consists of stellate and spindle cells that form a network and an amorphous intercellular substance that contains some dispersed fibers.

MESENCHYMAL CELLS

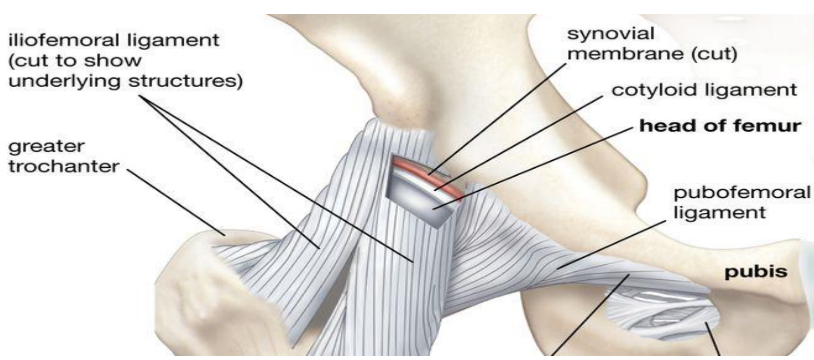
Mesenchymal cells have multiple developmental potentialities. They can differentiate into several different lines to produce many kinds of connective tissue cells. In this way, tissues that have a common origin from the mesenchyma are known as mesenchymal tissues or connective tissues. Connective tissues are different of the epithelium by the presence of abundant intercellular material, or matrix, which is formed by fibers and an amorphous fundamental substance. In any type of connective tissue there are three elements to consider: cells, fibers, and amorphous fundamental substance, bathed in tissue fluid.

In the abdominal cavity, most organs are suspended from the abdominal wall by a membranous band known as the mesentery, which is supported by connective tissue; others are embedded in adipose tissue, a form of connective tissue in which the cells are specialized for the synthesis and storage of energy-rich reserves of fat, or lipid. The entire body is supported from within by a skeleton composed of bone, a type of connective tissue endowed with great resistance to stress owing to its highly ordered laminated structure and to its hardness, which results from deposition of mineral salts in its fibres and amorphous matrix. The individual bones of the skeleton are held firmly together by ligaments, and muscles are attached to bone by tendons, both of which are examples of dense connective tissue in which many fibre bundles are associated in parallel array to provide great tensile strength. At joints, the articular surfaces of the bones are covered with cartilage, a connective tissue with an abundant intercellular substance that gives it a firm consistency well adapted to permitting smooth gliding movements between the apposed surfaces. The synovial membrane, which lines the margins of the joint cavity and lubricates and nourishes the joint surfaces, is also a form of connective tissue.



abdominal organs

The abdominal organs are supported and protected by the bones of the pelvis and ribcage and are covered by the greater omentum, a fold of peritoneum that consists mainly of fat.

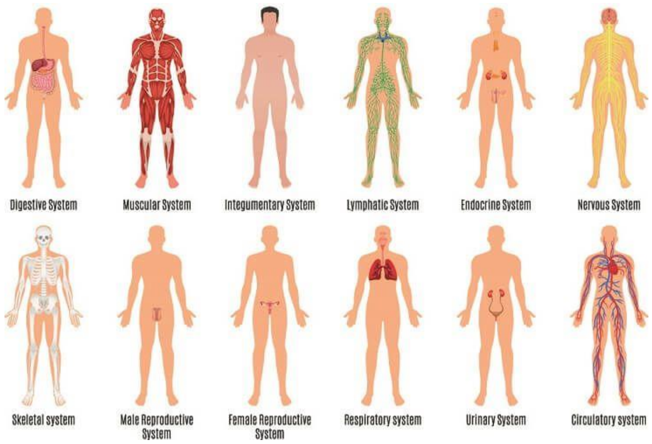


human hip and pelvis

Blood vessels, both large and small, course through connective tissue, which is therefore closely associated with the nourishment of tissues and organs throughout the body. All nutrient materials and waste products exchanged between the organs and the blood must traverse perivascular spaces occupied by connective tissue. One of the important functions of the connective-tissue cells is to maintain conditions in the extracellular spaces that favour this exchange.

CONNECTIVE TISSUE FUNCTION

Connective tissue function is structural, metabolic, and protective. Bone tissue (osseous tissue) is extremely rigid and absorbs energy; cartilage is smooth and lubricated to provide for easy, pain-free movement; our blood brings oxygen and nutrients all over the body and transports waste products to the kidneys and liver. White blood cells within the extracellular matrix help to protect us from antigens and pathogens.



Playing a role in every system

All connective tissue is supportive, either at a cellular level (reticular fibers) or as a support system for larger organs or structures. It stores energy in the form of lipids and transfers forces via tendon attachments. This tissue type is responsible for how smooth our skin looks and is a major contributor to how quickly our body heals. Elastic properties allow expansion and contraction; collagenous properties add strength; gel-like consistencies can be watery or thick. These many different features give it hundreds of different functions.

COMPONENTS OF CONNECTIVE TISSUE

All forms of connective tissue are composed of extracellular fibres, an amorphous matrix called ground substance, and stationary and migrating cells. The proportions of these components vary from one part of the body to another depending on the local structural requirements. In some areas, the connective tissue is loosely organized and highly cellular; in others, its fibrous components predominate; and in still others, the ground substance may be its most conspicuous feature. The anatomical classification of the various types of connective tissue is based largely upon the relative abundance and arrangement of these components.

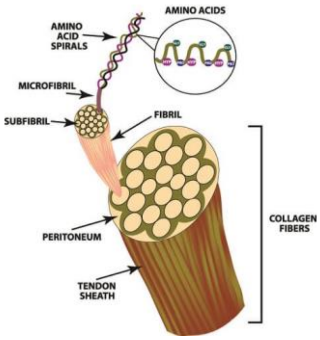
Types of fibers			
Tissue	Purpose	Components	Location
Collagen fibers	Bind bones and other tissues to each other	Alpha polypeptide chains	tendon, ligament, skin, cornea, cartilage, bone, blood vessels, gut, and intervertebral disc.
Elastic fibers	Allow organs like arteries and lungs to recoil	Elastic microfibril and elastin	extracellular matrix
Reticular fibers	Form a scaffolding for other cells	Type III collagen	liver, bone marrow, and lymphatic organs

Extracellular fibres

The fibrous components are of three kinds: collagenous, elastic, and reticular. Most abundant are the fibres composed of the protein collagen. The fibrous components of loose areolar connective tissue, when viewed with the light microscope, appear as colourless strands of varying diameter running in all directions, and, if not under tension, these have a slightly undulant course. At high magnification, the larger strands are seen to be made up of bundles of smaller fibres. The smallest fibres visible with the light microscope can be shown with the electron microscope to be composed of multiple fibrils up to 1000 angstroms (one Å = 1×10^{-7} mm) in diameter. These unit fibrils are cross-striated with transverse bands repeating every 640 Å along their length.

Collagen is of commercial as well as medical interest. Upon chemical analysis, the amino acid composition of collagen is found to be unique in its high proline content and in the fact that one-third of the amino acid residues are glycine. Proline is one of several so-called nonessential amino acids (i.e., animals can synthesize it from glutamic acid and do not require dietary sources) and accounts for about 15 percent of collagen content.

Collagen is the only naturally occurring protein known to contain significant amounts of both hydroxyproline and hydroxylysine. Hydroxyproline constitutes about 14 percent of collagen. It was first isolated in 1902 from gelatin, a breakdown product of collagen. The hydroxylysine component of collagen is believed to play an important role in stabilizing intramolecular and intermolecular cross-links in collagen. This cross-linking capacity appears to be a function of the hydroxyl groups (—OH) present on hydroxylysine. These groups also serve as attachment sites for carbohydrates, particularly certain forms of galactose and glucosylgalactose. The attachment of these carbohydrates occurs via a process known as glycosylation. One collagen fiber is made from many microfibrils. Collagen fibers have only a small level of elasticity but are extremely strong.



Two of the three polypeptide chains constituting the tropocollagen molecule are like collagen in amino acid composition, while the third is distinctly different. In the tissues, the collagen fibrils are believed to be held together by a polysaccharide component. Elastic fibers, when grouped, are yellow. These are also composed of microfibrils contained within a matrix. It is the protein in this matrix that allows for stretch – it is called elastin. An elastic fiber will stretch to around one and a half times its relaxed length. Elastin provides both strength and movement.

Reticular fibers are very fine threads and, unlike elastic fibers but like collagenous fibers, contain collagen (but of a different microfibril protein type to collagenous fibers). Reticular fibers do not need to be very strong or elastic – they support individual cells.

The lace-like network of reticular fibers

All extracellular fibers are contained within a gel-like solution called ground substance. The combination of ground substance and extracellular fibers makes up the extracellular matrix. Add cells to the extracellular matrix and you have connective tissue.

Ground Substance

Ground substance is found in all cavities, keeping the organs hydrated but also a temporary store and mode of transportation for water, salts, and other small molecules.

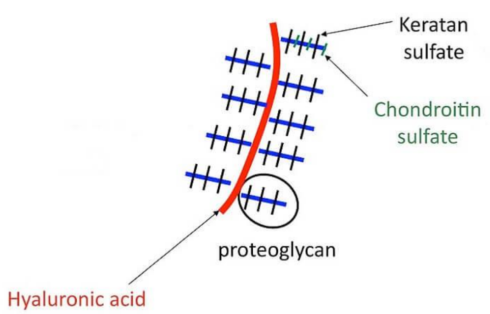
The main ingredient in ground substance – apart from water – is proteoglycans; these provide the gel-like consistency of the ground substance. They are polysaccharide chains with sporadically-linked proteins.

The polysaccharides come from another ground substance ingredient glycosaminoglycans, usually in the form of hyaluronic acid.

You may have seen hyaluronic acid treatments at cosmetic counters. As this acid forms a structural base for connective tissue, it is thought that it can tighten the skin and reduce the signs of aging. Hyaluronic acid easily binds to water molecules but its molecules are very large. Without additional treatments like micro-needling or deep chemical peels, topical hyaluronic acid will not penetrate the epidermis.

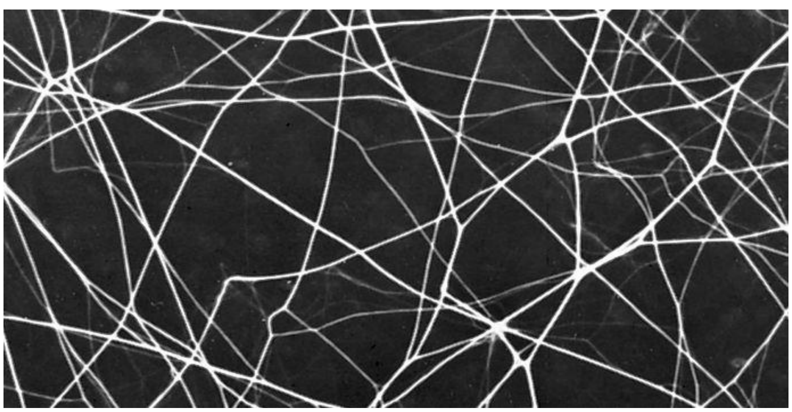
The other four main glycosaminoglycans are chondroitin, dermatan, keratan, and heparan sulfate. These link to the main hyaluronic acid structure.

All glycosaminoglycans bind to water and positively-charged ions; the bound water allows gases, charged ions, and smaller molecules to dissolve and so pass through the extracellular matrix. Because larger molecules cannot get move through the matrix, it also provides a protective barrier against many types of bacteria.



The structure of a glycosaminoglycan

Elastic fibres are composed of the protein elastin and differ from collagenous fibres in dimensions, pattern, and chemical composition. They do not have uniform subunits comparable to the unit fibrils of collagen. They present a variable appearance in electron micrographs; sometimes they appear to have an amorphous core surrounded by minute fibrils, while in other sites they appear to consist exclusively of dense amorphous material. Whether there are in fact two components or whether these are differing forms of the same substance is not yet clear. At the light-microscope level, the fibres vary in diameter and often branch and reunite to form extensive networks in loose connective tissue. When present in high concentration, they impart a yellow colour to the tissue. In elastic ligaments, the fibres are very coarse and are arranged in parallel bundles. In the walls of arteries, elastin is present in the form of sheets or membranes perforated by openings of varying size. Elastic fibres are extremely resistant to hot water, to strong alkali, and even to digestion with the proteolytic enzyme trypsin. They can be digested, however, by a specific enzyme, elastase, present in the pancreas. Upon chemical analysis, elastin, like collagen, is found to be rich in glycine and proline, but it differs in its high content of valine and in the presence of an unusual amino acid, desmosine. As their name implies, elastic fibres are highly distensible and, when broken, recoil like rubber bands. Changes in this property and diminution in their numbers are thought to be, in part, responsible for the loss of elasticity of the skin and of the blood-vessel walls in old age.



areolar connective tissue (Magnified about 390 ×.) Don W. Fawcett, M.D.

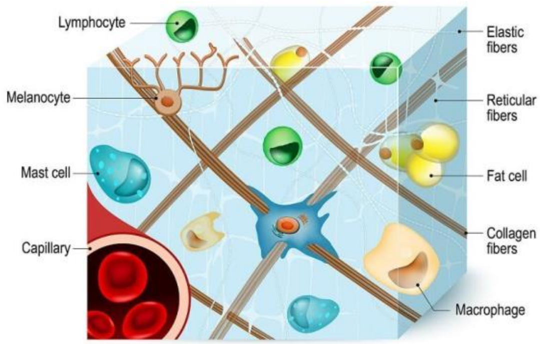
Reticular fibres are distinguished by their tendency to form fine-meshed networks around cells and cell groups and by virtue of their property of staining black, because of adsorption of metallic silver, when they are treated with alkaline solutions of reducible silver salts. They were formerly believed to be composed of a distinct protein, reticulin, but electron microscopy has revealed that reticular fibres are small fascicles of typical collagen fibrils interwoven to form a network. It is now apparent that reticular fibres are simply a form of collagen, and their distinctive staining depends upon the mode of association of the fibrils and possibly upon subtle differences in their relation to the polysaccharide material that binds them together.

Ground substance

The amorphous ground substance of connective tissue is a transparent material with the properties of a viscous solution or a highly hydrated thin gel. Its principal constituents are large carbohydrate molecules or complexes of protein and carbohydrate, called glycosaminoglycans (formerly known as mucopolysaccharides). One of these carbohydrates is hyaluronic acid, composed of glucuronic acid and an amino sugar, N-acetyl glucosamine. Other carbohydrates of the connective tissue are chondroitin-4-sulfate (chondroitin sulfate A) and chondroitin-6-sulfate (chondroitin sulfate C). The sugars of the sulfates are galactosamine and glucuronate. Multiple chains of chondroitin sulfate seem to be bound to protein. These substances in solution are viscous. All substances passing to and from cells must pass through the ground substance. Variations in its composition and viscosity may therefore have an important influence on the exchange of materials between tissue cells and the blood. Its physical consistency also constitutes a barrier to the spread of particulates introduced into the tissues. It is interesting, in this relation, that some bacteria produce an enzyme, hyaluronidase, which breaks up hyaluronic acid into subunits and alters the viscosity of ground substance. The ability of these bacteria to produce this enzyme is probably responsible for their invasiveness in the tissues.

CELLS OF CONNECTIVE TISSUE

The cells of connective tissue include two types that are relatively stationary—fibroblasts and adipose cells—and several types of motile migrating cells—mast cells, macrophages, monocytes, lymphocytes, plasma cells, and eosinophils.



All the cells of connective tissue develop during embryonic life from the mesenchyme, a network of primitive stellate cells that have the potential for differentiating along several different lines depending upon local conditions. In addition to the specialized cell types of adult connective tissue, it is believed that small numbers of mesenchymal cells (stem cells) persist into postnatal life in the walls of small blood vessels and elsewhere and that these retain the capacity to differentiate into fibroblasts, adipose cells, macrophages, or a multitude of other cell types as the need arises.

Stationary cells

The ubiquitous fibroblasts are the principal active cells of connective tissue, occurring as long spindle-shaped cells stretched along bundles of collagen fibrils. Their function is to secrete tropocollagen and constituents of the ground substance and to maintain these extracellular tissue components. When organs are injured, it is believed that cells known as fibrocytes, which reside in the stroma, are stimulated to develop into fibroblasts. The fibroblasts then migrate into the defect and deposit an abundance of new collagen, which forms a fibrous scar.

Adipose cells

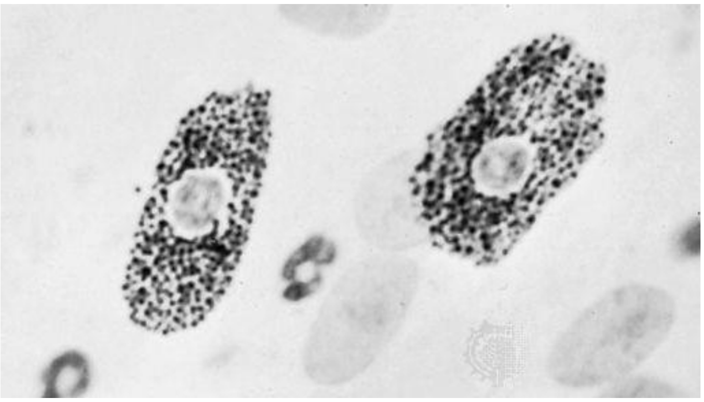
Adipose, or fat, cells are connective-tissue cells that are specialized for the synthesis and storage of reserve nutrients. They receive glucose and fatty acids from the blood and convert them to lipid, which accumulates in the body of the cell as a large oil droplet. This distends the cell and imposes upon it a spherical form. The nucleus is displaced to the periphery, and other metabolically active constituents of the cell are confined to a thin rim of cytoplasm around the large central droplet of lipid.

Adipose cells are completely differentiated and unable to perform mitotic division. Therefore, the new fat cells that can develop at any time in the connective tissue, originate because of the differentiation of more primitive cells. Although these cells, before storing fat, resemble fibroblasts, they are likely to originate directly from undifferentiated mesenchymal cells found in the body. The fat droplets at first small, disappear into the cytoplasm, then increase in size and eventually fuse to form a single large droplet, and the cytoplasm is reduced to a thin layer that surrounds it. The core is compressed and flattened. When fat is used it leaves the cell in the form of soluble components, and the cell is wrinkled.

Adipose cells may occur in small numbers anywhere in connective tissue, but they tend to develop preferentially along the course of small blood vessels. Where they accumulate in such large numbers that they become the predominant cellular element, they constitute the fat or adipose tissue of the body.

Migrating cells

In addition to the relatively fixed cell types described, there are free cells that reside in the interstices of loose connective tissue. These vary in their abundance and are free to migrate through the extracellular spaces. Among these wandering cells are the mast cells; these have a cell body filled with coarse granules that contain two biologically active substances, histamine and heparin. Histamine affects vascular permeability, and heparin, when added to blood, delays or prevents its clotting. Mast cells respond to mechanical or chemical irritation by discharging varying numbers of their granules. Histamine released from them causes fluid to escape from neighbouring capillaries or venules; this results in local swelling, as seen in the welt that appears around an insect bite.



mast cells Metachromatic granules filling the cytoplasm of mast cells. The mast cells' nuclei are centrally located. (Magnified about 750 ×.) Don W. Fawcett, M.D.

Eosinophils

Eosinophils are a type of white blood cell, or leukocyte. Some of these migrate through the walls of capillaries and take up residence in the connective tissues. They have polymorphous nuclei and, in the cell substance outside the nuclei, coarse granules that stain with eosin and other acid dyes. In electron micrographs, the granules contain crystals. The granules have been isolated and shown to contain a variety of hydrolytic enzymes. Eosinophils are normally widespread in connective tissues of the body, but they are especially abundant in persons suffering from allergic diseases. The cells are believed to phagocytose and break down antigen-antibody complexes.

Plasma Cells

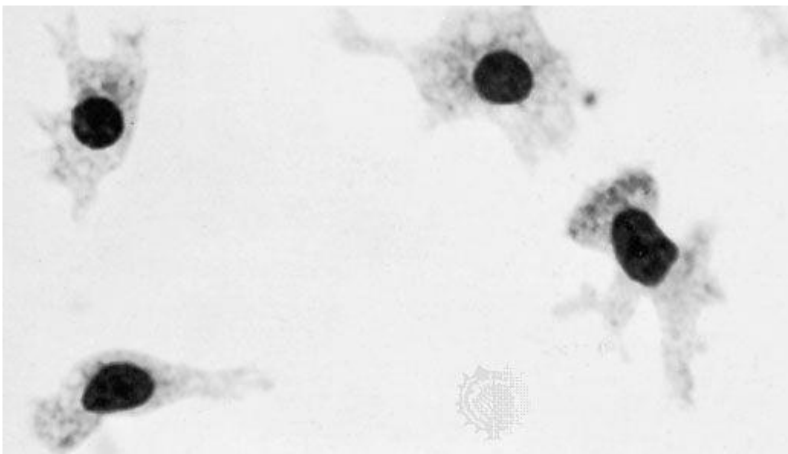
Plasma cells are mature antibody-secreting lymphocytes that are present in limited numbers in loose connective tissues and in larger numbers in lymphoid tissue. Lymphocytes are a type of leukocyte that can recognize foreign proteins and to respond to their presence by proliferating and differentiating into plasma cells. The plasma cells in turn synthesize and release specific immunoglobulins, called antibodies, that combine with and neutralize the foreign proteins. Lymphocytes are among the normal cellular elements of the blood, but they may also leave the blood and migrate in the connective tissues. They constitute an important reserve of relatively undifferentiated cells capable of sustaining an immunological response.

Monocytes

Another of the leukocytes that enter the connective tissues from the blood is the monocyte, a mononuclear cell larger than the lymphocyte and with different potentialities. These migratory cells can divide and, when appropriately stimulated, can transform into highly phagocytic macrophages. The reaction of the blood and connective-tissue cells to injury is called inflammation and is usually accompanied by local heat, swelling, redness, and pain. Under these conditions, the neutrophilic leukocytes (white blood cells called neutrophilic because of their neutral staining characteristics with certain dyes), which are not normally present in connective tissue in significant numbers, may migrate through the capillary walls in astronomical numbers and join the macrophages in the work of ingesting and destroying bacteria. Voraciously phagocytic, the neutrophils have a short life span; having accomplished their mission, they die in great numbers, and this is known as Pus, which may accumulate at sites of acute inflammation, is composed largely of dead and dying neutrophilic leukocytes.

Macrophages

The macrophages, or histiocytes, are derived from circulating monocytes in the bloodstream; they are also important for tissue repair and for defense against bacterial invasion. They have a great capacity for phagocytosis—the process by which cells engulf cellular debris, bacteria, or other foreign matter and break them down by intracellular digestion. Thus, they represent an important force of mobile scavenger cells.

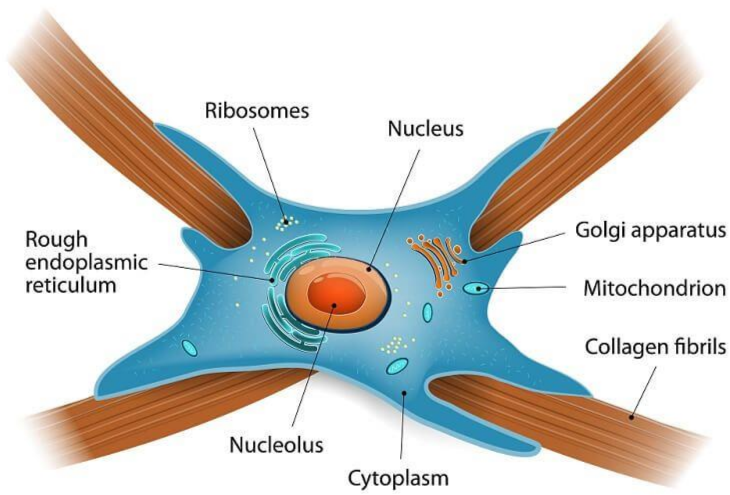


macrophages Four macrophages in cell culture. Their irregular outline is associated with amoeboid migration. (Magnified about 825 ×.) Don W. Fawcett, M.D.

Fibroblasts

Fixed cells are fibrocytes, reticulocytes, and adipocytes. Fibrocytes do not contain as many organelles as most cells; however, this is when the cell is dormant. When the cell is activated by local tissue damage, it becomes a fibroblast.

Fibroblasts have many organelles; they produce reparative proteins and send them to where they are needed. Sometimes, fibroblasts can contract and are then known as myofibroblasts.



An activated fibrocyte becomes a fibroblast

In specialized connective tissue, different fixed cells like osteocytes (bone) and chondrocytes (cartilage) are found in large quantities.

Reticular cells produce reticular fibers but play the role of fibrocytes in areas of tissue that contain reticular fibers.

Adipocytes or fat cells are also fixed within the extracellular matrix. As with all fat cells, they store lipids.

Macrophages look for foreign particles to consume via phagocytosis.

Mast cells release heparin and histamine that bring more blood (and immune cells) to the area when local tissue is under attack.

Lymphocytes are found in smaller numbers; when attacked by recognized pathogens

B cells become plasma cells and release antibodies.

Eosinophils are phagocytes that arrive on the scene to digest any antigens that have been marked by B-cell antibodies.

TYPES OF HUMAN TISSUE

Epithelial tissue covers our external surfaces (our skin) and lines internal organs and cavities. Muscles are also very visible thanks to their large volumes. The average muscle mass for an adult female of around 30 years is almost 30% of her body weight. Our nervous system flows through the entire body and includes the brain, spinal cord, and every single nerve. Connective tissue with a fluid matrix is often considered to be less important; however, it is found in large quantities and is essential.

Compared to the other tissue types, connective tissue has lower populations of cells and an extensive extracellular matrix. But it also has many different features, forms, and uses than expected.

Loose and Dense Irregular Connective Tissue

Non-specialized or general connective tissue, sometimes called connective tissue proper, is subdivided into two groups: loose and dense.

The lamina propria of this fallopian tube is pale pink

Loose regular tissue has a fluid matrix and low proportions of arranged (regular) fibers. The loose form is sometimes called areolar connective tissue and is found:

Connective tissue can be broadly classified into connective tissue proper and special connective tissue. Connective tissue proper consists of loose connective tissue and dense connective tissue(which is further subdivided into dense regular and dense irregular connective tissues.) Loose and dense connective tissue are distinguished by the ratio of ground substance to fibrous tissue. Loose connective tissue has much more ground substance and a relative lack of fibrous tissue, while the reverse is true of dense connective tissue. Dense regular connective tissue, found in structures such as tendons and ligaments, is characterized by collagen fibers arranged in an orderly parallel fashion, giving it tensile strength in one direction. Dense irregular connective tissue provides strength in multiple directions by its dense bundles of fibers arranged in all directions.

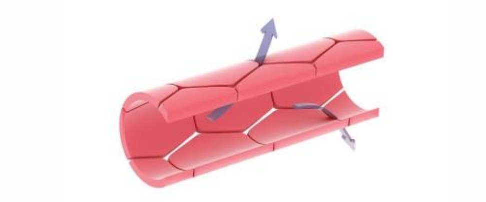
Special connective tissue consists of reticular connective tissue, adipose tissue, cartilage, bone, and blood. Other kinds of connective tissues include fibrous, elastic, and lymphoid connective tissues. Fibroareolar tissue is a mix of fibrous and areolar tissue. Fibromuscular tissue is made up of fibrous tissue and muscular tissue. New vascularised connective tissue that forms in the process of wound healing is termed granulation tissue

Type I collagen is present in many forms of connective tissue and makes up about 25% of the total protein content of the mammalian body.

Bone & cartilage can also be grouped into supportive connective tissue. Blood and lymph are fluid connective tissues.

Characteristics

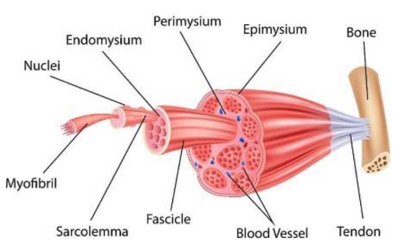
The loose structure means it is easy for nutrients and gases to pass through. Any capillary traveling through areolar tissue can easily release oxygen and nutrients and absorb carbon dioxide and other waste products.



Capillaries are extremely permeable

Dense irregular connective tissue has many fibers, but these are not structured as with regular tissue types. This is what the dermis is made of, as well as the area of the breast just under the nipple.

In the muscles, every muscle fiber bundle is wrapped in a membrane of dense irregular connective tissue called the epimysium; the perimysium is composed of the same tissue (see below). The meninges surrounding the brain are also composed of dense tissue.



Muscle structure

Specialized Connective Tissue

Specialized connective tissue comes in surprising forms. This group includes related tissues that form our tendons, body fat, bones, and cartilage.

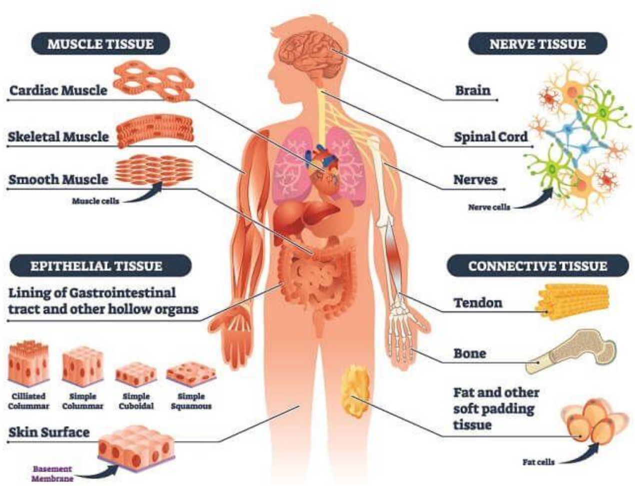
Dense connective tissue is dense because of the high proportion of fibers that run parallel to each other. Dense regular tissue is found in tendons, ligaments, and muscle fascia. In many sources, this type is listed as connective tissue proper; however, it is found in specific locations and can fit into either category.

Bone is a specialized connective tissue type. Instead of an aqueous extracellular matrix, the ground substance is mineralized and hard. High levels of collagen fibers make our bones shock-resistant by absorbing energy. Furthermore, bones are covered by a connective tissue membrane called the periosteum.

Bone is a specialized type of connective tissue

The mesenchyma is the typical, non-specialized connective tissue of the first weeks of embryonic life. Later it disappears when the cells that compose it are differentiated. It is formed by mesenchymal cells, whose branched prolongations appear to be nested, although they do not form a true syncytium, and by a fundamental substance that is a coagulant liquid in the early stages but later contain thin fibrils.

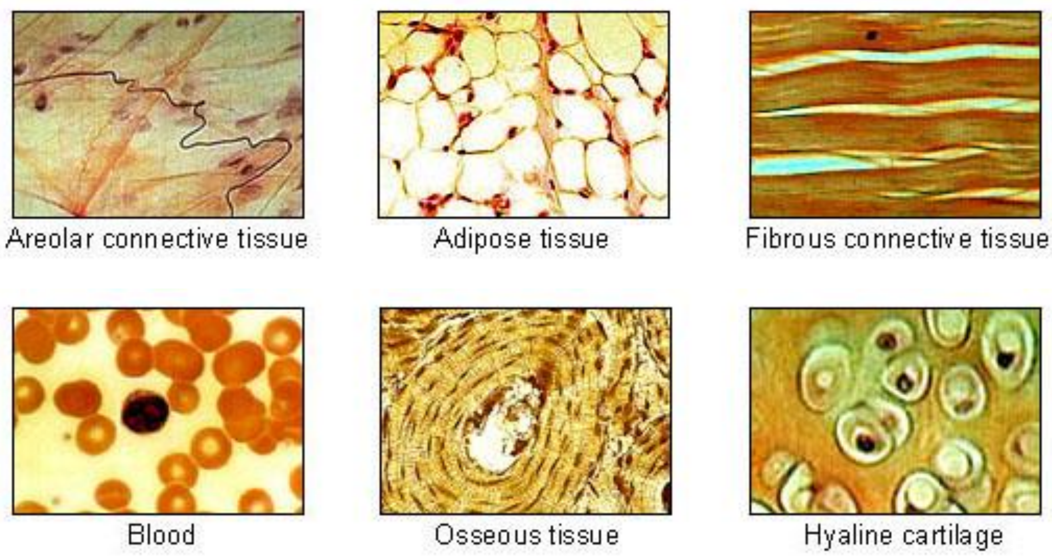
The widely distributed loose areolar connective tissue, which is relatively unspecialized and can therefore be considered prototypic. In the more specialized forms of connective tissues, one component or another may predominate over all the others, depending upon the local structural or metabolic requirements.



Adipose tissue, for example, is a variant of loose areolar tissue in which large numbers of adipose cells make up the bulk of the tissue. Adipose tissue (fat) does not contain fibroblasts, a true matrix, or many fibers. Even so, it is a type of connective tissue.

Type I collagen is present in many forms of connective tissue and makes up about 25% of the total protein content of the mammalian body.

Bone & cartilage can also be grouped into supportive connective tissue. Blood and lymph are fluid connective tissues.



Characteristics

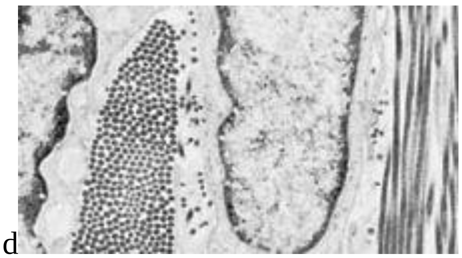
The ground substance is a clear, colorless, and viscous fluid containing glycosaminoglycans and proteoglycans allowing fixation of Collagen fibers in intercellular spaces. Examples of non-fibrous connective tissue include adipose tissue (fat) and blood. Adipose tissue gives "mechanical cushioning" to the body, among other functions. Although there is no dense collagen network in adipose tissue, groups of adipose cells are kept together by collagen fibers and collagen sheets in order to keep fat tissue under compression in place (for example, the sole of the foot). Both the ground substance and proteins (fibers) create the matrix for connective tissue

Connective tissue has a wide variety of functions that depend on the types of cells and the different classes o f fibers involved. Loose and dense irregular connective tissue, formed mainly by fibroblasts and collagen fibers, have an important role in providing a medium for oxygen and nutrients to diffuse from capillaries to cells, and carbon dioxide and waste substances to diffuse from cells back into circulation. They also allow organs to resist stretching and tearing forces. Dense regular connective tissue, which forms organized structures, is a major functional component of tendons, ligaments and aponeuroses, and is also found in highly specialized organs such as the cornea. Elastic fibers, made from elastin and fibrillin, also provide resistance to stretch forces. They are found in the walls of large blood vessels and in certain ligaments, particularly in the ligament flava.

In hematopoietic and lymphatic tissues, reticular fibers made by reticular cells provide the stroma or structural support for the parenchyma, or functional part of the organ.

Mesenchyme is a type of connective tissue found in developing organs of embryos that is capable of differentiation into all types of mature connective tissue. Another type of relatively undifferentiated connective tissue is the mucous connective tissue known as Wharton's jelly, found inside the umbilical cord.

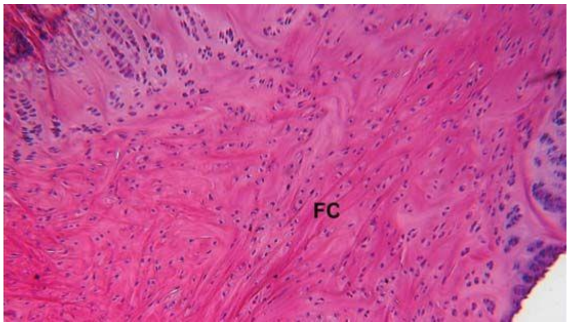
Dense fibrous connective tissue is composed of closely packed bundles of collagen and their associated fibroblasts, but there are relatively few elastic fibres and little ground substance. The term irregular dense fibrous tissue is applied to sites where the collagen bundles are randomly oriented and interwoven, as in the dermis of the skin and the capsules of joints. Regular dense fibrous tissue is the term used to describe tendons, ligaments, and aponeuroses (fibrous sheets that form attachments for muscles), where the collagen fibres are precisely oriented in parallel bundles.

d  connective tissue; fibrocyte (Magnified about 6,625 ×.) Don W. Fawcett, M.D.

The synovial membrane, which lines joint capsules, is composed of loose vascular connective tissue but has cells specialized for secretion of the viscous synovial fluid, which is rich in hyaluronic acid, and for phagocytic functions. This fluid serves as a lubricant and nutrient for the avascular joint surfaces. Similar tissue forms sheaths around tendons where they pass over bony prominences.

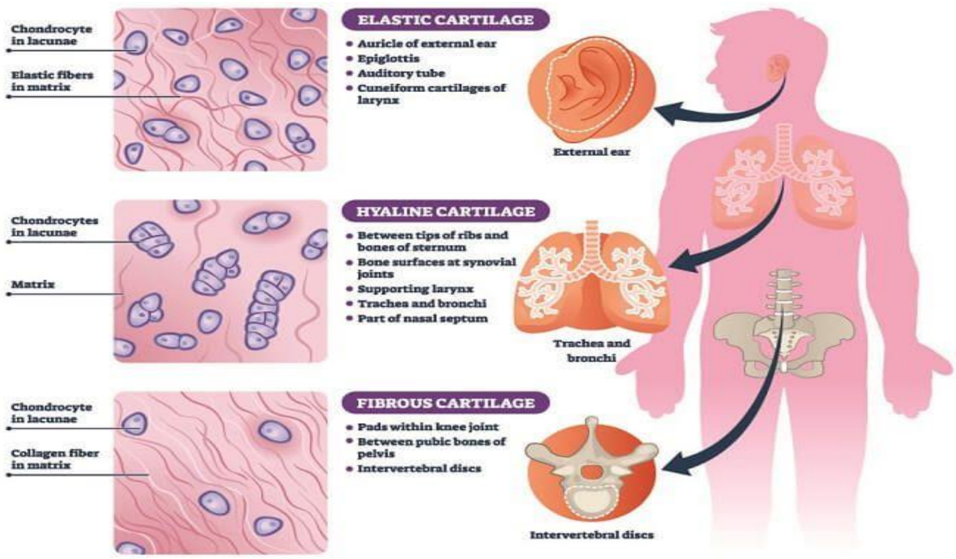
Cartilage

Cartilage is a form of connective tissue in which the ground substance is abundant and of a firmly gelatin consistency that endows this tissue with unusual rigidity and resistance to compression. The cells of cartilage, called chondrocytes, are isolated in small lacunae within the matrix. Although cartilage is avascular, gaseous metabolites and nutrients can diffuse through the aqueous phase of the gel-like matrix to reach the cells. Cartilage is enclosed by the perichondrium, a dense fibrous layer lined by cells that have the capacity to secrete hyaline matrix. Cartilage grows by formation of additional matrix and incorporation of new cells from the inner chondrogenic layer of the perichondrium. In addition, the young chondrocytes retain the capacity to divide even after they become isolated in lacunae within the matrix. The daughter cells of these divisions secrete new matrix between them and move apart in separate lacunae. The capacity of cartilage for both appositional and interstitial growth makes it a favourable material for the skeleton of the rapidly growing embryo. The cartilaginous skeletal elements present in fetal life are subsequently replaced by bone.



cartilage Micrograph showing fibrocartilage (centre), surrounded by areas of hyaline cartilage (upper left and right) that are being converted to bone. Uniformed Services University of the Health Sciences (USUHS) Cartilage is slightly elastic, rigid, thick, and smooth. Cartilage is further classified into elastic-, hyaline-, and fibro-cartilage – names that indicate different proportions of fibers and proteoglycans.

This tissue type contains large amounts of lubricin (glycoprotein) and chondrocytes instead of fibrocytes. Due to the thick extracellular matrix, cells do not have a great range of motion and natural repair mechanisms are extremely slow. Hyaline cartilage, the most widely distributed form, has a pearl-gray semitranslucent matrix containing randomly oriented collagen fibrils but relatively little elastin. It is normally found on surfaces of joints and in the cartilage making up the fetal skeleton. In elastic cartilage, on the other hand, the matrix has a pale-yellow appearance owing to the abundance of elastic fibres embedded in its substance. This variant of cartilage is more flexible than hyaline cartilage and is found principally in the external ear and in the larynx and epiglottis. The third type, called fibrocartilage, has a large proportion of dense collagen bundles oriented parallel. Its cells occupy lacunae that are often arranged in rows between the coarse bundles of collagen. It is found in intervertebral disks, at sites of attachment of tendons to bone, and in the articular disks of certain joints. Any cartilage type may have foci of calcification.



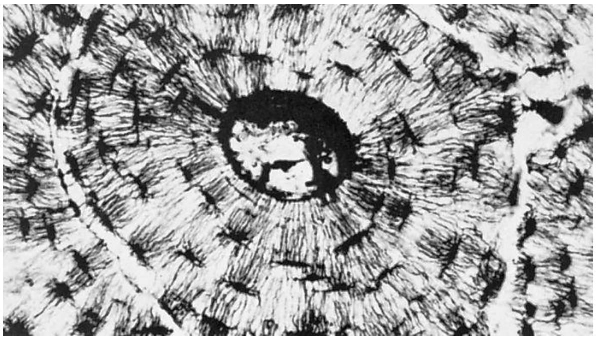
Different types of cartilage

Blood

Blood has a watery matrix (plasma) and soluble proteins (fibrinogen and fibronectin). When activated by the enzyme thrombin, fibrinogen and fibronectin form an insoluble fiber called fibrin; fibrin is an essential component of the blood clotting process. Naturally, blood also contains cells in the form of white blood cells, red blood cells, and platelets.

Bone

Bone consists of cells, fibres, and ground substance, but, in addition, the extracellular components are impregnated with minute crystals of calcium phosphate in the form of the mineral hydroxyapatite. The mineralization of the matrix is responsible for the hardness of bone. It also provides a large reserve of calcium that can be drawn upon to meet unusual needs for this element elsewhere in the body. The structural organization of bone is adapted to give maximal strength for its weight-bearing function with minimum weight. There are bones strong enough to support the weight of an elephant and others light enough to give internal support and leverage to the wings of birds.



osteon; haversian system Photomicrograph of a ground section of bone (Magnified about 125 ×.) Don W. Fawcett, M.D.

FASCIA

Fascia is made up of sheets of connective tissue that is found below the skin. These tissues attach, stabilize, impart strength, maintain vessel patency, separate muscles, and enclose different organs. Traditionally, the word fascia was used primarily by surgeons to describe the dissectible tissue seen in the body encasing other organs, muscles, and bones. Recently, the definition has been broadened to include all collagenous based soft tissues in the body, including cells that create and maintain the extracellular matrix. The new definition also includes certain tendons, ligaments, bursae, endomysium, perimysium, and epimysium.

The fascial system is a continuous connective section through the body, the name of the fascia varies according to the organ that surrounds it

Aponeurosis for the muscles.

Pleura par to the lungs.

Pericardium for the heart.

Peritoneum, mesentery, or omentum for the abdominal viscera.

Meninges for the nervous system.

The fascia has a dual role, leading the vasculonervous system to its destination and serving as an intermediary between the musculoskeletal system and the visceral system.

Very sensitively innervated, the fascia responds to traction giving birth to nociceptive influences; reacts to vascular and biochemical modifications.

Classification System

Fascia can be classified as superficial, deep, visceral, or parietal and further classified according to anatomical location.

*Superficial Fascia

Superficial fascia is found directly under the skin and superficial adipose layers. It can show stratification both grossly and microscopically. Traditionally, it is made up of membranous layers with loosely packed interwoven collagen and elastic fibers.

Superficial fascia is thicker in the trunk than in the limbs and becomes thinner peripherally.

Superficial fascia layers can sometimes include muscle fibers to create all types of structures in the body. A few examples include the platysma muscle in the neck, the external anal sphincter, and the dartos fascia in the scrotum.

A subtype of superficial fascia in the abdomen is Scarpa's fascia.

*Deep Fascia

Deep fascia surrounds bones, muscles, nerves, and blood vessels. It commonly has a more fibrous consistency and rich in hyaluronan as compared to the other subtypes. Deep fascia tends to be highly vascularized and contain well developed lymphatic channels. In some instances, deep fascia can even contain free encapsulated nerve endings, such as Ruffini and Pacinian corpuscles.

There are 2 subtypes of deep fascia:

+Aponeurotic fascia

It forms into sheets of pearly-white fibrous tissue to attach muscles needing a wide area of attachment. Aponeurosis can thin into a tendon and become a point of origin or insertion for other muscles. Some examples of aponeurotic fascia include the fascia of limbs, thoracolumbar fascia, and rectus sheath.

It is the thicker of the 2 subtypes that are normally easily separated from the underlying muscle layer.

It is comprised of 2 to 3 parallel collagen fiber bundles.

+Epimysial fascia

Also known as the epimysium, this is the connective tissue sheath surrounding skeletal muscle and can, in some cases, connect directly to the periosteum of bones.

Some major muscle groups enveloped in epimysium include muscles of the trunk, pectoralis major, trapezius, deltoid, and gluteus maximus.

It is the thinner of the 2 subtypes, on average, and is more tightly connected to the muscle via septa that penetrate the muscle layer.

*Visceral Fascia

Visceral fascia surrounds organs in cavities like the abdomen, lung (pleura), and heart (pericardium).

*Parietal Fascia

Parietal fascia is a general term for tissues that line the wall of a body cavity just outside of the parietal layer of serosa. The most known parietal fascia is found in the pelvis.

In many places in the body, superficial and deep fascial layers are connected by fibrous septa and create a connection network that weaves in between fat lobules that make up the deep adipose tissue layer.

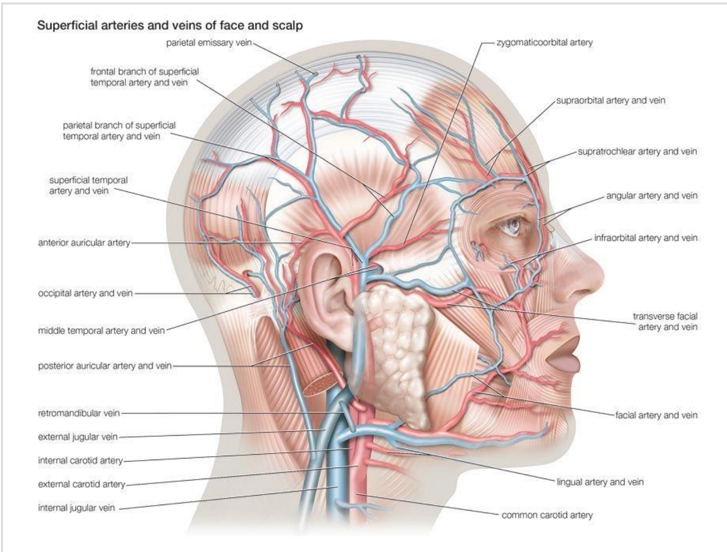
MENINGES

Meninges, singular meninx, three membranous envelopes—pia mater, arachnoid, and dura mater—that surround the brain and spinal cord. Cerebrospinal fluid fills the ventricles of the brain and the space between the pia mater and the arachnoid. The primary function of the meninges and of the cerebrospinal fluid is to protect the central nervous system.

The mesenchyme surrounding the neural period condenses to form a membrane, called the primitive meninge. The outer layer of this membrane thickens to form the dura mater. The inner membrane remains thin and forms the piaarachnoid, composed of the pia mater and the arachnoid, which just constitute the leptomeninges.

Spaces full of liquid appear in the leptomeninges that soon join to form the subarachnoid space. The origin of the pia mater and the arachnoid from a single layer explains in the adult appear many delicate flanges of connective tissue (arachnoid trabeculae) that pass between them.

The pia mater is the meningeal envelope that firmly adheres to the surface of the brain and spinal cord. It is a very thin membrane composed of fibrous tissue covered on its outer surface by a sheet of flat cells thought to be impermeable to fluid. The pia mater is pierced by blood vessels that travel to the brain and spinal cord.



Over the pia mater and separated from it by a space called the subarachnoid space is the arachnoid, a thin, transparent membrane. It is composed of fibrous tissue and, like the pia mater, is covered by flat cells also thought to be impermeable to fluid. The arachnoid does not follow the convolutions of the surface of the brain and so looks like a loosely fitting sac. In the region of the brain, particularly, many fine filaments called arachnoid trabeculae pass from the arachnoid through the subarachnoid space to blend with the tissue of the pia mater. The arachnoid trabeculae are embryologic remnants of the common origin of the arachnoid and pia mater, and they have the frail structure characteristic of these two of the meninges. The pia mater and arachnoid together are called the leptomeninges.

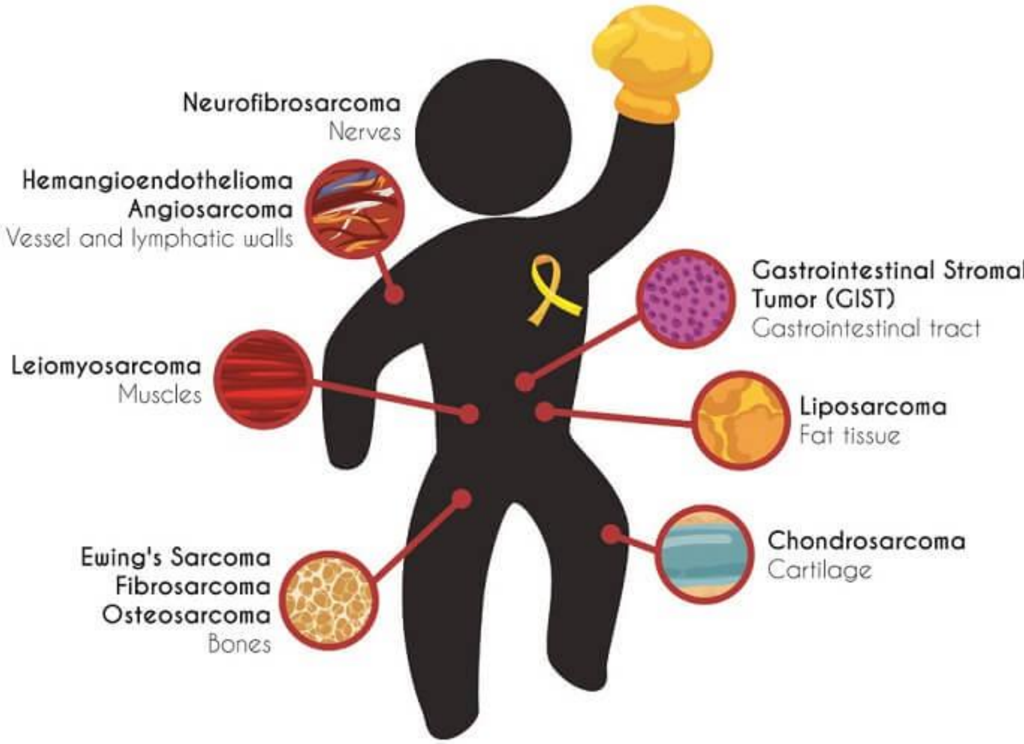
The outermost of the three meninges is the dura mater (or pachymeninx), a strong, thick, and dense membrane. It is composed of dense fibrous tissue, and its inner surface is covered by flattened cells like those present on the surfaces of the pia mater and arachnoid. The dura mater is a sac that envelops the arachnoid and has been modified to serve several functions. The dura mater surrounds and supports the large venous channels (dural sinuses) carrying blood from the brain toward the heart.

The dura mater is partitioned into several septa, which support the brain. One of these, the falx cerebri, is a sickle-shaped partition lying between the two hemispheres of the brain. Another, the tentorium cerebelli, provides a strong, membranous roof over the cerebellum. A third, the falx cerebelli, projects downward from the tentorium cerebelli between the two cerebellar hemispheres. The outer portion of the dura mater over the brain serves as a covering, or periosteum, of the inner surfaces of the skull bones.

Within the vertebral canal the dura mater splits into two sheets separated by the epidural space, which is filled with veins. The outer of these two sheets constitutes the periosteum of the vertebral canal. The inner sheet is separated from the arachnoid by the narrow subdural space, which is filled with fluid. In a few places, the subdural space is absent, and the arachnoid is intimately fused with the dura mater. The most important area of fusion between these two meninges is in the walls of the large venous channels of the dura mater where elongations of the arachnoid, like fingers, penetrate the dura mater and project into the veins. These finger like processes of the arachnoid, called arachnoid villi or arachnoid granulations, are involved in the passage of cerebrospinal fluid from the subarachnoid space to the dural sinuses. Spinal anesthetics are often introduced into the subarachnoid space.

CONNECTIVE TISSUE DISEASE

Connective tissue disease and connective tissue disorders can affect any of the above-mentioned structures. As this tissue is so widespread, the effects of disease can be very different.



Sarcomas begin in the bone

There are more than 200 illnesses ‘connected’ to connective tissue. Some are the result of genetic disorders; some are caused by autoimmune processes. Connective tissue cancer occurs as the result of mutation in any associated cell type; sarcomas and leukemia begin in bone tissue, for example.

Skin lesions that begin in the dermis like dermatofibromas and benign swelling caused by abnormal myofibroblast proliferation (as in cases of infantile myofibromatosis) are known disorders of connective tissue. The scope of this topic is incredibly broad, just like the many functions, types, and locations.

Fibroma of the oral cavity

Similarly, connective tissue disease symptoms and connective tissue disease treatment depends on the affected components of the tissue and/or the tissue ingredients. Most such diseases are treated by a specialist of a certain anatomical or physiological area, or pathology.

The body is held together by tissues that connect all the structures in your body. When you have a connective tissue disease, these connecting structures are negatively affected. Connective tissue diseases include autoimmune diseases like rheumatoid arthritis, scleroderma, and lupus.

Management and Treatment

Connective tissues are made up of two proteins: collagen and elastin. Collagen is a protein found in the tendons, ligaments, skin, cornea, cartilage, bone, and blood vessels. Elastin is a stretchy protein that resembles a rubber band and is the major component of ligaments and skin. When a patient has a connective tissue disease, the collagen and elastin are inflamed. The proteins and the body parts they connect are harmed.

Different types of connective tissue diseases, that may be inherited, caused by environmental factors, or most often, are of unknown cause. Connective tissue diseases include, but are not limited to:

*Rheumatoid Arthritis (RA): Rheumatoid arthritis is one of the most common connective tissue diseases and can be inherited. RA is an autoimmune disease, meaning the immune system attacks its own body. In this systemic disorder, immune cells attack and inflame the membrane around joints. It also can affect the heart, lungs, and eyes. It affects many more women than men (an estimated 71% of cases).

*Scleroderma: An autoimmune condition that causes scar tissue to form in the skin, internal organs (including the GI tract), and small blood vessels. It affects women three times more often than men throughout life, occurring at a rate of 15 times greater for women during childbearing years.

*Granulomatosis with Polyangiitis (GPA, formerly called Wegener's): A form of vasculitis (inflammation of the blood vessels) that affects the nose, lungs, kidneys and other organs.

*Churg-Strauss Syndrome: A type of autoimmune vasculitis that affects cells in the blood vessels of the lungs, gastrointestinal system, skin and nerves.

*Systemic Lupus Erythematosus (SLE): A disease that can cause inflammation of the connective tissue in every organ of the body, from the brain, skin, blood, to the lungs. It's nine times more common in women than in men.

*Microscopic Polyangiitis (MPA): An autoimmune disease that affects cells in blood vessels in organs throughout the body. This is a rare condition.

*Polymyositis/dermatomyositis: A disease characterized by inflammation and degeneration of the muscles. When the condition also affects the skin, it's called dermatomyositis.

*Mixed connective tissue disease (MCTD), also called the Sharp syndrome: A condition that has some, but not all, features of various connective tissue diseases, such as SLE, scleroderma, and polymyositis. MCTD may also have features of Raynaud's syndrome.

*Undifferentiated connective tissue disease(s): Conditions that have characteristics of connective tissue diseases but don't meet the guidelines as defined at a particular time. Some people with these conditions will eventually go on to develop a specific type of connective tissue disease, but most will not. There are many types of connective tissue disorders, such as:

*Connective tissue neoplasms including sarcomas such as hemangiopericytoma and malignant peripheral nerve sheath tumor in nervous tissue.

*Congenital diseases include Marfan syndrome and Ehlers-Danlos Syndrome.

*Myxomatous degeneration a pathological weakening of connective tissue.

*Mixed connective tissue disease a disease of the autoimmune system, also undifferentiated connective tissue disease.

*Systemic lupus erythematosus (SLE) – a major autoimmune disease of connective tissue

*Scurvy, caused by a deficiency of vitamin C which is necessary for the synthesis of collagen.

*Fibromuscular dysplasia is a disease of the blood vessels that leads to an abnormal growth in the arterial wall.

SYMPTOMS AND CAUSES

These conditions can be caused by family genetics and are often known as heritable disorders of connective tissue. Connective tissue diseases can also be caused by things that exist in the environment. Non-inherited causes of autoimmune types of connective tissue disease may include:

Exposure to toxic chemicals, such as those found in air pollution and cigarette smoke.

Exposure to ultraviolet light.

Inadequate nutrition, including lack of vitamins D and C.

Infections.

Because there are so many kinds of connective tissue diseases, symptoms may vary and may affect different parts of the body. Body parts that may be affected include:

Bones.

Joints.

Skin.

Heart and blood vessels.

Lungs. Some of the diseases, like the ones mentioned above, can cause serious pulmonary issues.

Head and face. Some of these diseases can make the face, head, eyes, and ears look different than the faces and heads of other people.

Height. Some diseases cause the people who have them to be very tall or very short.

DIAGNOSIS AND TESTS

The doctor may order various tests depending on what type of connective tissue disorder is suspected. The doctor will first ask for medical history, a family history, and will do a physical examination. Further tests may include:

Imaging tests, such as X-rays and magnetic resonance imaging (MRI) scans.

Tests for markers of inflammation, such as C-reactive protein and Erythrocyte sedimentation rate (ESR).

Tests for antibodies, especially for autoimmune conditions.

Tests for dry eyes or dry mouth.

Blood and urine tests.

Tissue biopsy.

MANAGEMENT AND TREATMENT

Because there are so many different types of connective tissue disorders, the treatments will vary depending on the person and the disease. Treatments might include vitamin supplements, physical therapy, and medications. You will probably have a regular schedule of appointments with the doctor. You might be asked to consult with specialists, depending on what type of connective tissue disorder you have.

PREVENTION

Prevent exposures to toxins and eating healthy foods that meet the vitamin and nutrient needs. However, cannot prevent diseases that are inherited.

OUTLOOK / PROGNOSIS

The outlook for people with connective tissue diseases is different for everyone. The outlook depends on what type of disease the patient have, whether or not to get treatment, and how effective the treatment is. Some types of connective tissue diseases may have relatively minor consequences, and some can be fatal (if they affect the lungs, kidneys or heart.) Some types of these diseases are painful, while others have more mild symptoms.

Patient may be asked to make some lifestyle changes. Also, may be asked to get vaccines for the flu or vaccine for pneumonia (when the connective tissue disease is in remission).

CONCLUSION

After the revised text, you can clearly understand the great importance of connective tissue, as it is an integral part of the the human body, is the biological duct tape holding the whole system together. Connective tissue gives shape to organs, stores/transports minerals and nutrients, provides protection and increases flexibility. These are just some of the roles of this tissue–the role of connective tissue varies depending on the nature of nearby structures

Roles of Connective Tissue in Brief:

Storage, Absorption and Waste Disposal related to Metabolic function (blood, adipocytes/fat, lymphatic tissue)

Transportation of vitamins, minerals, energy, proteins, water, oxygen and other substances (blood)

Protection against harmful contaminants, impact and friction (cartilage, scar tissue)

Immunity and Defense (white blood cells, skin, scar tissue)

Structural Support (tendons, ligaments, bone, cartilage)

Thermal Insulation (adipocytes/fat)

Blood Production (bone marrow, lymphatic tissue)

Metabolic Function

Adipose, or fat, tissue is an example of a connective tissue that facilitates the storage, absorption and disposal of nutrient, vitamins, minerals, and other substances. Fat tissue can be found in a thin layer beneath the skin, surrounding internal organs and interwoven with other structures, such as bone marrow and breast tissue. Human beings develop adipose deposits in specific areas where a supply of energy is needed. Men and women have different areas of their body that require emergency energy, so each gender develops adipose differently. Women tend to store fat around the chest and hips, while men store fat around the abdomen.

Wound Healing

Scars are the visible sign that the connective tissue was working. The skin is the primary defense against infection. When the skin is injured, the body prevents further damage by sending cells to the wound to fight infection and fix the skin. Connective tissues play several roles in the process of wound healing.

Platelets, a structure similar to cells, are carried by the blood to the wound. Platelets build up and form a temporary covering called a scab.

Fibroblasts, the main component of connective tissue, begin collagen production. Collagen seals the skin beneath dried scabs. If a scab falls off too soon or a wound is particularly deep this collagen deposit will be visible as a scar.

White blood cells, also carried by the blood, fight off infection by surrounding and digesting foreign matter, anything that doesn't belong in the body.

Structural Support

Bones, cartilage, tendons, and ligaments provide structural support for the organ systems, enabling the body to stand and move.

Bones are dense organs made from connective tissue in the human body. Bones are important in the human body, as they form the rigid frame that is the skeleton which gives shape to the body, it also gives protection: vertebrae protect the spinal cord; the ribs guard the heart and lungs; the skull shields the brain.

Cartilage is another dense connective tissue, more flexible than bone that serves many purposes. Cartilage fills the gaps between bones and serves as a cushion during movement.

Tendons are tough fibrous tissues, primarily made of collagen, that form connections between bones and muscle. Ligaments, which are like tendons in composition, connect bone to bone. Tendons and ligaments can withstand tension and returning to a stable shape, like a rubber band. These supportive structures not only "tape" tissue together, but they also limit the range of motion preventing from hyperextending.

In this way we can see the importance that beholds the connective tissue in our profession, since is the essence of where our work is being placed, where the techniques of Naprapathy will enhance and improves the health of the patients.

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