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Evaluation of the function of connective tissue fibers in the human body

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Abstract
Connective tissue is one of the tissues that maintain the shape and skeleton of the body and cause the cohesion and support of the internal structures of the body. One of the components of this tissue are fibers, which play an important role in the structure of the body and have different types, which are: Collagen fibers, Reticular fibers and Elastic fibers. Each of these fibers performs a specific function in the body.
Among these fibers, collagen is made by fibroblast cells and makes up the body's most protein. These fibers often form the basic structure of the body's connective tissue, including bone, cartilage, ligament, peritoneum, skin, etc., and have different types. These fibers are very strong and resistant to natural shear and shock forces and are an important component of all connective tissue as well as the basement membranes of epithelial tissue and the outer layers of muscle and nerve cells. Based on the molecular composition, morphological features, dispersion, and their function are distinguished from each other. There is a family of 28 types of collagen in Animal Vertebra, of which types 1, 2, 3 and 4 are the main types and play a greater role in the body.
Reticular fibers are very thin, branched fibers that form fine networks. These fibers connect the connective tissue to the adjacent tissue. The origin of these fibers is fibroblasts and they have a net-like shape. In terms of characteristics, they are considered as raw collagen fibers. Reticular fibers surround the arteries, sinuses, and muscle cells. This network is located under the epithelial cells and forms the basement membrane. These fibers also create subtle networks, strengthen cell clusters, and provide functional units for cells. In addition, these fibers can be found in the uterus and the muscular layer of the intestines.
Elastic fibers are fibers that are easily stretched and return to their original position if released. The main task of these fibers is to provide elasticity in the body organs, and this task is especially evident in the skin and arteries.

Keywords: Fiber, tissue, collagen, elastic, reticular

Introduction
Connective tissue fibers are one of the most important topics in biology, especially histology; because these fibers are the most common type of proteins in the body and exist in different parts of the body and cause strength, elasticity, repair and renewal and the connection of different parts of the body to each other and strengthen the cells by creating delicate networks.
Due to the importance of this research, it can be a good reference for students, professors and enthusiasts of biology, especially in the fields of histology and anatomy, and on the other hand, by obtaining information about connective tissue fibers and its function in the body, realize the importance of this structure. And we will be diligent in maintaining it and its health.

Research purpose
1. Recognition and introduction of connective tissue;
2. Introduction of fibers and its types;
3. Function of connective tissue fibers in the body;
4. Causes of disturbances in the fibers;

Research methods
In this research, the results of the work done by other researchers have been used. Therefore, this research is a library-based research using qualitative method.

Evaluation of the function of connective tissue fibers in the human body
Almost every organ in the body has a network of connective tissue that covers and supports

it. Generally, connective tissue contains a small number of cells which are located in an intercellular substance, which contains microscopic fibers of yarn-like scattering in a matrix. The matrix is a thin, gel-like substance made from polysaccharides, which are secreted by these cells. The nature and function of any type of connective tissue is determined by the structure and properties of the interstitial material (Solomon, Berg and Martin, 2012, p. 773) [13] and (Peter H., 2004, p. 1009) [11].

The connective tissue forms a large part of the body structure and, unlike the epithelial tissue, has more extracellular fluid. In terms of embryonic origin, most of the connective tissue originates from the mesoderm, in the order that it arises from the Multi-potential Mesenchyme mesoderm, followed by various forms of connective tissue such as bone, cartilage, tendon, ligament, peritoneum (Fascia), organ capsules, blood, blood cells, and lymphatic cells develops from it. The main functions of this tissue are citation, defense, material transfer, storage and repair of tissues. This tissue also forms soft plates to separate and insulate the tissue and organs from each other (Siddiqui, 2013 p. 45) [12] and (Nasimi, 2012 p. 74) [10].

This tissue has three important parts, which are: cells, fibers and stem material (Matrix) (Dezfulian and Shariatzadeh, 2007, p. 164) [5]. Because the purpose of this article is the subject of connective tissue fibers, so we will pay more attention to this case:

Introduction of fibers and its types

Fibers are protein compounds, all of which are made in fibroblasts. The mentioned fibers are divided into the following three groups in terms of physical, chemical and functional characteristics:

1. Collagen Fibers
2. Reticular Fibers
3. Elastic Fibers

The first two types of fibers are made from a protein called collagen and the third type is made from a protein called elastin. All three of these fibers are produced by fibroblasts. Fibroblasts are cells with a stellar cytoplasm and a pale elliptical nucleus that have one or two large nuclei. Fibroblasts secrete substances that make up the matrix and also produce collagen with white fibers and elastin with yellow fibers (Hojjatullah, 2007, p. 115) [1].

Types of collagen fibers

Collagen is the body's most abundant protein and is a major constituent of bone, muscle, cartilage, tendons and skin. It is also found in other parts of the body, including the arteries, cornea, teeth, and skin. This protein is like a glue that puts different parts and tissues of the body together in one piece. So far (28) types of this protein are known.

Collagens form a family of proteins that have been selected during evolution because of their ability to form different types of fibers, layers, and extracellular networks, all of which are very powerful and durable against natural shear forces. Collagen is an important component of all connective tissue as well as the basement membranes of epithelial tissue and the outer layers of muscle and nerve cells. Collagen is the most abundant protein in the human body, accounting for 30% of the body's dry weight. Collagen, which is the main product of fibroblasts, is also produced by different types of other cells (Mescher, 2016, p. 159) [8].

Collagens are the most basic fibers in connective tissue, and the majority of collagen is digested through metalloproteinase action such as serine proteinases collagenase (Amiri, 2014, p. 64) [2].

Based on the molecular composition, their morphological features, dispersion, function and pathology are distinguished from each other. There is a family of 28 types of collagen in vertebral animals, of which types 1, 2, 3 and 4 are the main types and play a greater role in the body. Similarly, the most important types of collagen can be divided into the following groups based on the structure resulting from the interaction of their subunits: (Wikipedia, 2021) [14].

Fibrillar constituent collagens

Most collagen types I, II, and III have protein subunits that accumulate to form large fibrils that can be seen under electron or light microscope. This type of protein makes up 90% of the body's collagen and is made of very dense fibers. And are widely distributed throughout the body, these fibers often fill the connective tissue tightly. Collagen type I is found in the skin, bones, tendons, fibrous cartilage of connective tissue and teeth and is highly resistant to traction.

Other collagens that are included in the fibrillar type are:

1. Fibrils with loose fibril accumulations have double refractive properties in cartilage and vitreous and are resistant to pressure.
2. Thin silver-friendly thin fibers with weak double refraction properties in the skin, muscles, blood vessels, often with the first type, which has the task of structural protection in dilated organs.
3. This type is often formed with type (l) fibers and is found in embryonic tissue, skin, bone, placenta and visual tissue and is involved in the function of type (l) collagen.
4. This type of molecule is 300 nm and has small fibers, its main location is in the cartilage and is involved in the function of type II collagen.

The second type, network and layer making collagens

Collagen type IV has subunits that are made by epithelial cells and are the main building proteins of the outer layers and all layers of the epithelial base. This type (IV) is responsible for supporting epithelial cells and filtration in all basal and outer layers.

Collagen type-X is a hexagonal network that is detected by immunocytochemistry. This type of collagen in hypertrophic cartilage is involved in the formation of intra-cartilage bone and its main function is to increase the compression of the matrix.

Linking collagens

They are short collagens that bind fibrillar collagens to each other and to other components. They include the following types:

- VII binding collagen, which is the main location of epithelial bases and connects the basal layers to the lower reticular layers.
- Type-XI binding collagen, the main site of which is cartilage and vitreous, and binds to various proteoglycans with type II collagen.
- XII This type of connective collagen is located in the

placenta, skin, and tendons and interacts with type I collagen.
- XIV This type of connective collagen is located in the placenta and bone and binds to type I collagen fibrils, and together with types V and XII, enhances the production of fibers (Mescher, 2016, p. 159) [8].

The chemical composition of collagen

The collagen molecule is 300 nm long and 1.4 nm in diameter, consisting of three alpha (α3) polypeptide chains and about 1100 amino acids. In the collagen polypeptide chain, two components are located between the amino acid glycol. Proline and Hydroxy Proline also make up a quarter of the collagen amino acids. Lysine and Hydroxy Lysine are also present in its structure, and sugars such as glucose and galactose are attached to the hydroxyl agent of these amino acids by coulomb bonds.

There are three polypeptide chains in collagen in the form of alpha (α) helix. Therefore, its molecules are tangled in the form of a twisted spring. So far, about 12 types of collagen have been identified. Which are divided according to the type of alpha chain and the location of the tissue in which they are located.

Collagen is converted to gelatin by heat. Gelatin is not a complete protein because it lacks the essential amino acid tryptophan (Mihan, Farzami, Dosti *et al*. 2011, p. 103) [15].

Function

In nature, collagen is found exclusively in animals, especially in the meat and connective tissue of mammals. Therefore, they have the following functions in the body:
- Collagen, as we know it, is a part of the connective tissue that helps to strengthen, repair and constantly renew the skin cells. Collagen is very important for the elasticity of the skin.
- A tendon is a long, cylindrical structure that connects muscle to bone, is white and non-extensible, and is made up of collagen strands parallel to each other that point in one direction and are so close together that they are almost compressed. They appear to be homogeneous, with fibroblasts located in the space between the strands and being the only cell seen in the tendon. These cells are so pressurized by collagen fibers that their cytoplasm is invisible and only their dark, small, dense nucleus is visible. Collagen fibers form the bundles, and each bundle is wrapped in a sheath of regular tissue, and the bundles come together to form the tenders.
- Ligament: The structure of most ligaments is similar to a chord and is made of collagen fibers, in other words, they are another type of collagen that connects two bones and thus binds the joints together.
- Fascia: has the same composition of the tender, with the difference that these are smoother and thinner and its strands have traveled in different directions (Anwar, 2005, p. 120) [3, 4].
- Bones are a special form of connective tissue with collagen fibers. Among which Ca and salts, especially Hydroxyapatites, are displaced, and about 70% of the bones are composed of calcium and phosphate salts and about 30% of the organic matrix, and 90 to 95% of the matrix consists of collagen fibers and the rest of it is the cell uniformity environment. The same collagen fibers give the bones tensile strength. Similarly, the first step in bone formation is the separation of collagen fibers by osteoblasts. These collagen structures are uncalcified and are called osteoid tissues, which have cartilage-like structures. After the formation of osteoid, calcium salts begin to deposit on the surface of Collagen Fiber, which is called Calcification, and it takes a week for bone formation.
- Collagen fibers make teeth resistant to traction. Collagen fibers fix teeth in place with Cementum. Excessive stretching of the teeth causes the Cementum layer to become thicker and stronger, which increases in thickness and strength with age (Froutan, 2014. pp. 115-123) [7].

Reticular fiber

They are very thin and branched strands that form fine networks. These strands connect the connective tissue to the adjacent tissue. Reticular fibers contain collagen and glycoprotein. The reticular fibers are very thin, 0.5 to 0.3 microns in diameter, and often form the parenchyma or core in different organs for tissue support. These strands are usually visible with silver staining (Solomon, Berg and Martin, 2012, p. 885) [13] and (Moradloo, 2010, p. 86) [16].

The origin of these fibers is fibroblasts and it has a wavy shape. From the point of view of descriptions, they are considered as raw collagen fibers. This fiber is the first fiber of connective tissue that appears during evolution, in this regard, it is received in large quantities in infants and fetuses (Anwar, 2016, p. 124) [3, 4].

The reticular fibers extend along the collagen fibers; Therefore, it is thought that one type of fiber may be converted to another. The similarity in the composition and structure of the molecule and the morphological characteristics of the retinal and collagen fibers, as well as the alternation of light and dark areas observed in microscopic studies, confirms this theory. But the material that surrounds these two types of fibers and the thickness of these two types of fibers are different, which results in two types of fibers with different properties. In staining, these two fibers are different from each other. Collagen fibers are red in normal staining but reticular fibers are not stained in normal staining and take on black color with silver staining (Anwar 2005, pp. 115-123) [3, 4].

Function

In reticular tissue, a large number of type III collagen fibers form a thin network that supports a variety of cell types. This collagen is also called reticulum and is produced by mutated fibroblasts, often called reticular cells; These cells remain attached to the fibers and partially cover them. The loose state of reticular glycosylated fibers provides a framework with specialized feed environments for hematopoietic tissue cells and some lymphoid organs (bone marrow, lymph nodes, and spleen). The depleted location of the resulting cells forms a network for the passage of leukocytes and lymph (Mescher, 2016, p. 178) [8].

Reticular fibers are abundantly woven into the embryonic and neonatal stages. But over time, one part of the fibers takes on the properties of collagen and the other part remains reticular. When the wounds heal, the retinal fibers are first made and gradually gain thickness and provide collagen fibers.

Reticular fibers surround the arteries, sinuses, and muscle cells. This network is located under the epithelial cells and

forms the basement membrane. These fibers also create subtle networks, strengthen cell clusters, and provide functional units for cells. In addition, these fibers can be found in the uterus and the muscular layer of the intestines (Anwar 2005, p. 123) [3, 4] and (Hojjatullah, 2007, p. 118) [1].

Elastic fiber

This fiber is also called the yellow fiber, which has the following properties and functions:

As the name implies, these are fibers that are easily stretched and if released, they return to their original state. The main task of these fibers is to provide elasticity in the body organs and this special task can be clearly observed in the skin and arteries**.**

Elastic fibers are long, narrow fibers or flat fibers that appear yellow in the groin. These fibers can be identified under a normal microscope and have no transverse lines. The maximum pressure they can withstand is a maximum of 20 to 30 kg / cm2. Due to this force, the fiber length increases by one and a half times. Elastic fibers are divided into branches, in the arteries the end of these fibers is reconnected and create a window-like shape (Anwar, 2005 p. 117) [3, 4] and (Hojjatullah, 2007, p. 86) [1].

Function

These fibers give the tissue elasticity and give it the ability to return to its original state. This tissue is especially seen in the hollow organs, which are responsible for returning to the original state, such as the arteries. Because these strings have extremely elastic properties, they are observed and perform their duties in the following areas**.**

1. Arterial walls
2. Audio rope
3. Trachia and bronchi
4. Air sacs of the lungs (Hojjatullah, 2007, p. 119) [1].

Chemical building

It is a water-soluble fibrous protein found in the yellow elastic fibers of connective tissue, cartilage, and tendons, and its precursor is Tropoelastin, which has a molecular weight of 70,000 Da. It also contains the amino acids proline and hydroxyproline, but lacks the amino acids lysine and hydroxy lysine. Alstein are hydrolyzed by pancreatic elastase enzyme (Mihan, Farzami, Dosti *et al*. 2011, p. 103) [15].

Disorders

Age and nutrition affect collagen metabolism, and a number of diseases specifically irritate collagen. In some diseases, they have recently been able to identify the stage where collagen formation is defective and track its cause.

It has long been known that scurvy, which occurs due to a decrease in vitamin C or ascorbic acid, is insufficient due to the lack of collagen fibers. It has now been observed that the addition of vitamin C to the culture medium of fibroblasts obtained from animals with scurvy intensifies the conversion of proline to hydroxyproline in collagen. This observation shows that the disruption of collagen production in patients with vitamin C deficiency is due to a decrease in hydroxyproline.

There is a rare inherited disease in humans called Ehlers Danlos in which short limbs, increased joint movements, tendency to dislocate joints and high ability of the skin to stretch can be seen (Dezfulian and Shariatzadeh, 2007, p. 179) [5].

Keloid Formation: As it turns out, body wounds are repaired by connective tissue, especially the production of collagen fibers, but in a number of people, especially black people, a hypertrophic scar called a keloid forms during wound healing.

Marfan's Syndrome: A genetic defect on chromosome 15 in which Fibrillin, which is a structural component of elastic fibers, is not made, resulting in rupture or rupture of the Aorta's artery (Siddiqui, 2013, p. 53) [12].

The elastic fiber, as its name implies, has an elastic property and helps to restore the natural shape of the tissue after stretching, so these fibers will also lose performance as they age or are exposed to the sun (Faradars Weblog, 2021) [6].

Conclusion

Connective tissues are among the tissues that maintain the shape and skeleton of the body and cause the cohesion and support of the internal structures of the body. One of the components of this tissue are fibers.

Fibers are one of the most important components of connective tissue and play an essential role in body structure. There are three types of fibers: collagen fibers, reticular fibers and elastic fibers. Each of these fibers has a specific function in the body.

These fibers are present in different parts of the body and cause elasticity, strength and connection of different parts of the body to each other and strengthen cells by creating fine networks. Collagen also helps to strengthen, repair and constantly renew skin cells and is very important for the elasticity of the skin.

Some factors and a number of diseases cause dysfunction of collagen and other fibers. For example: age, nutrition, inherited diseases and vitamin C deficiency.

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