

Morphological Changes of the Ankle Tissue on the Surface of the Knee Joint in Deformable Gonarthrosis

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Abstract: Deforming gonarthrosis is a chronic degenerative disease in which the cartilaginous tissue of the knee joint is destroyed. Morphological changes include dehydration and loss of proteoglycans, which leads to a decrease in the elasticity of the cartilage and deterioration of its shock-absorbing properties. Destruction of the collagen network and the formation of microcracks on the cartilage surface contribute to its further wear. The number and activity of chondrocytes decreases, which complicates tissue regeneration. In the late stages of the disease, calcification and ossification of the cartilage may occur. These processes lead to a decrease in joint mobility, pain, and a significant deterioration in the quality of life of patients.

Keywords: cartilage tissue, fibrous foci, synovial fluid, apoptosis.

Introduction

The knee joint is one of the largest and most important joints in the human body, providing support and movement of the lower limbs. Articular cartilage covering the surfaces of the bones in the knee plays a key role in ensuring smooth sliding of the bones during movement and distributing mechanical loads. However, in degenerative changes, such as deforming gonarthrosis (osteoarthritis of the knee joint), the cartilage tissue undergoes significant changes that lead to destruction and loss of functionality. Gonarthrosis is a chronic disease characterized by progressive degeneration of articular cartilage, which ultimately leads to significant clinical symptoms such as pain, stiffness and impaired mobility.

The structure of the cartilaginous tissue of the knee joint

The cartilage of the knee joint consists of cells (chondrocytes) and an extracellular matrix that includes collagen fibers, proteoglycans, glycosaminoglycans and water. Under normal conditions, this structure provides cartilage with high resistance to compression and the ability to withstand significant mechanical loads. The main components of cartilage:

- Chondrocytes are specialized cells that produce and maintain the extracellular matrix.
- Collagen is the main structural protein that provides strength and stability to cartilage.
- Proteoglycans and glycosaminoglycans are biomolecules that bind water, creating a gel-like structure that gives cartilage its elasticity and the ability to absorb stress.

Morphological changes in cartilage tissue in deforming gonarthrosis

With the development of deforming gonarthrosis, complex changes are observed in both the cellular structure of the cartilage tissue and its extracellular matrix. These changes occur at the molecular and tissue levels, which leads to gradual degradation of the cartilage and its functional capabilities.

Dehydration and loss of proteoglycans

One of the first changes in gonarthrosis is the loss of water and a decrease in the concentration of proteoglycans in the cartilage tissue. Proteoglycans, which bind water molecules, provide hydration of the matrix and its shock-absorbing properties. As gonarthrosis develops, enzymes that destroy proteoglycans, such as metalloproteinases and aggrecanases, are activated, which leads to a decrease in the content of glycosaminoglycans in the cartilage. As a result, the cartilage loses its elasticity and the ability to evenly distribute the load.

Destruction of the collagen network

Collagen fibers, mainly type II, form the basis of cartilage and ensure its structural integrity. In the process of gonarthrosis, the collagen network is destroyed by various proteolytic enzymes. These enzymes destroy collagen fibers, which leads to a loss of stability of the cartilage tissue. Deformation and ruptures in collagen fibers contribute to further degradation of cartilage, making it more vulnerable to mechanical damage.

Superficial microcracks and erosions

In later stages of gonarthrosis, the cartilage loses its smoothness, and microcracks and erosions begin to form on its surface. These injuries disrupt the integrity of the cartilage surface, which leads to further mechanical wear. Microcracks deepen into the thickness of the cartilage, creating foci of weakening that accelerate the process of tissue destruction under stress on the joint.

Decrease in the number and functional activity of chondrocytes

Chondrocytes, which are the main cells of cartilage, are responsible for maintaining and renewing the extracellular matrix. In gonarthrosis, both a decrease in their number and a decrease in their metabolic activity are observed. Chondrocytes undergo apoptosis (programmed cell death), and their ability to regenerate tissue is significantly reduced. This process leads to further deterioration of the cartilage, since matrix renewal becomes impossible.

Changes in synovial fluid

Synovial fluid, which provides lubrication of the articular surfaces, also undergoes changes in gonarthrosis. Normally, it contains high concentrations of hyaluronic acid and other components that help maintain normal viscosity and elasticity. However, in gonarthrosis, the composition of the synovial fluid changes: the concentration of hyaluronic acid decreases, which worsens its lubricating properties. This leads to increased friction between the articular surfaces and further destruction of the cartilage.

Calcification and ossification of cartilage

In the late stages of gonarthrosis, calcification and ossification (ossification) of the cartilage tissue can be observed. Under normal conditions, cartilage does not contain vessels and does not calcify. However, with degeneration and inflammation, characteristic of gonarthrosis, calcium salts begin to be deposited in the cartilage, which leads to its hardening. In some cases, the cartilage can be partially replaced by bone tissue, which significantly worsens the mobility of the joint and aggravates the clinical manifestations of the disease.

Changes in the underlying subchondral bone

Although the main focus in gonarthrosis is on changes in the cartilaginous tissue, the subchondral (underlying the cartilage) bone also undergoes significant morphological changes. As the disease progresses, microcysts, fibrous foci, and compactions may form in the subchondral bone. These changes disrupt the normal distribution of the load in the joint and may contribute to increased degenerative processes in the cartilage.

Clinical consequences of morphological changes in cartilage

Morphological changes in cartilaginous tissue in deforming gonarthrosis have pronounced clinical manifestations. Progressive loss of cartilage leads to the fact that the articular surfaces of the bones begin to directly contact each other, causing pain, inflammation, and dysfunction of the joint. Pain in gonarthrosis occurs both at rest and during movement, which significantly reduces the quality of life of patients. Limited mobility and stiffness in the joint lead to disruption of daily activities, including walking, lifting weights and even simple movements.

Conclusion

Deforming gonarthrosis is a complex disease in which significant morphological changes occur in the cartilaginous tissue of the knee joint. These changes include the destruction of the collagen network, loss of proteoglycans, death of chondrocytes and calcification of cartilage. Degeneration of cartilaginous tissue is accompanied by changes in the synovial fluid and subchondral bone, which ultimately leads to dysfunction of the knee joint and pronounced clinical symptoms. Therapy for gonarthrosis should be aimed at slowing down degenerative processes, improving cartilage regeneration and reducing pain

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