

Histologic-morphologic peculiarities of intact and damaged meniscus
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Гистологические и морфологические особенности неповрежденного и поврежденного мениска

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Abstract: for morphological study by light microscopy, the fragments of menisci (28 in total), excised during surgery, were fixed in 10-12% formalin, on phosphate buffer by Lilly. The paraffin sections were stained with hematoxylin - eosin.

Аннотация: для морфологического исследования световой микроскопии, фрагменты менисков (28 из общего), во время операции, фиксировали в 10-12% формалине, на фосфатный буфер Лилли. Секция парафина окрашивали гематоксилином-эозин.

Keywords: morphology, meniscus, damage.

Ключевые слова: морфология, мениск.

Meniscus is characterized by diversified structure, which can be traced by light and scanning electron microscopies. The stratification of meniscus into vascularized and avascularized zones determines its function, and mainly its regenerative ability in the injuries.

Meniscus is a fibrous-cartilaginous structure, located in the knee joint and protecting it from damage and excessive mechanical stress on the articular surfaces [1, 9, 4, 5, 6].

There are two zones in meniscus, distinguished by the distribution of blood vessels in the tissue. The one, which is vascularized, possesses marked capacity for regeneration and healing of injuries. Avascular zone, on the other hand, does not have reparative potency [7,8,11].

The results of are not always satisfactory even after immobilization and systematic treatment of these injuries. This fact attracts attention of researchers to the problem.

The meniscus is not capable of self-recovery in cases when the rupture size exceeds 1 cm [10]. Even surgical repair of ruptures results in clinical failure in 10-15% [2, 3, 12].

Materials and methods

For morphological study by light microscopy, the fragments of menisci (28 in total), excised during surgery, were fixed in 10-12% formalin, on phosphate buffer by Lilly. The paraffin sections were stained with hematoxylin - eosin.

Studying and photographing of light optical specimens was performed with “AXIOSKOP-40” microscope (Carl Zeiss, Germany) with attached to it digital camera “ProgRess”, further processed by software “CaputerPro 2.6”, installed on PC.

For scanning electron microscopy (SEM), the specimens after fixation were dehydrated for several hours in alcohol, acetone, and then dried by processing through critical point in apparatus HCP-2.

The samples were glued on the aluminum mounts with electrically conductive adhesive. After the vacuum ion sputtering with gold in the “IB-3” (Eiko, Japan), the samples were studied and photographed with “Canon” digital camera, attached to “Hitachi S-405A” SEM, from the screen of the latter. Photomicrographs were processed by computer with Windows XP applications.

Results and discussion

In the vascularized zone of intact part of meniscus, there are a large number of microvessels, surrounded by cellular elements. The meniscal surface is lined by a continuous layer of flat cells. Fibers in vascularized part are not located as tightly as in the adjacent avascularized area.

The arrangement of fibers in this part is perpendicular to surface.

The periphery of meniscus, its avascular part dominated by spindle-shaped cells; the fibers located below are intertwined with each other in a disorderly manner.

The fibers located closer to the surface, are oriented parallel to it. Deeper located collagen fibers are oriented to surface fibers at an angle; cells, mainly spindle-shaped, are evenly distributed among these fibers.

Prevalently round cells grouped in clusters of 3 – 10 cells are located in the central areas of meniscus, which are surrounded by matrix, forming a structure of isogenic groups of typical cartilage. Fibers at these sites are chaotically arranged and interlaced with each other.

The number of round cells increases near the site of damage. The structure of the collagen fibers is characterized by polymorphism and their scarcity at the site.

Damage to meniscus near vascularized areas causes numerous vessels to be congested with blood, and areas of hemorrhages. A large number of round cells with large nuclei and basophilic cytoplasm are located around vessels and on the surface of meniscus. Mitotic figures can be seen at the places quite often. All these, points to the activation of reparative processes in the damaged areas.

Polymorphic collagen fibers, observed to be loose and fragmented, dominate in avascular areas of meniscus, near damage sites. Here, on the surface, located a homogeneous eosinophilic substance, which does not contain cells. Few single round cells are scattered among polymorphic fibers.

On the contrary, the vascularized areas of the meniscus, near sites of damage, along with microvascular congestion and fields of hemorrhages contain numerous cells, which are elongated, spindle-shaped or round. Parts of round cells do not form isogenic groups on the periphery of the meniscus, which are located in groups or individually. At the same time, others round cells, such as chondrocytes, form characteristic groups, surrounded by matrix. As a rule, the periphery of the meniscus is dominated by spindle-shaped cells.

Scanning electron microscopy of menisci in undamaged areas shows that their surface is formed by straight furrows and crests, which are positioned relatively parallel to each other.

Stratified structure of menisci is clearly observed in cleavages. Layers formed by bundles of collagen separated by various sized gaps.

Damaged areas are characterized by tearing off of the meniscus, the expansion of the spaces between the layers on the cleavages and uneven surface.

High magnifications show loosening of surface, due to uneven thickness of collagen fibers and their loose arrangement. Polymorphism and loosening of the fibers, which leads to formation of deep grooves and crests is notable at these sites, and therefore, wide gaps and breaks are common between layers of collagen.

The surfaces of the menisci often reveal individual red blood cells, discocytes as a rule, and fat drops of different sizes, which have a regular spherical shape and smooth surface.

According to the data of literature and our own data, intact areas of the menisci, contain several types of cells, which can be divided into two main groups: first -elongated or fusiform cells, located mainly at the periphery of the menisci and round cells concentrated around central regions.

By the content of microvessels, there are two clearly distinguished zones, which determine their ability to restore after damage. The first zone is characterized by rich vascularization and the other one by scarcity of blood vessels. The presence of cells and microvessels in the corresponding areas of meniscus determines its ability to recover from injuries.

The conducted studies had also shown that damage to the lateral meniscus is accompanied by the inflammatory processes, concluded in microvascular congestion and increase in the number of inflammatory cells.

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