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Morphology of Tissues During Intraoperative Stretching in The Plastic of Scar Deformities of The Lips

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Annotation: Post-burn scarring of the lips often causes functional disorders. Intraoperative balloon stretching of tissues as a method of reconstructive surgery is widely used in surgical rehabilitation of this category of patients. However, structural changes in tissues during balloon stretching have not been sufficiently studied. Using light-optical and electron microscopy, samples of various areas of intact lip skin subjected to stretching during surgery in order to obtain a skin resource for plastic surgery were studied. It has been shown that stretching does not lead to significant violations of the skin structure.
Keywords: burns, consequences of burns, scar, reconstructive surgery, skin structure, functional morphology.

The Relevance Of The Problem. The changes in the epidermis appear to be temporary, and microscopically the skin returns to normal within a year or two after stretching. Moreover, the physical location of collagen fibers changes, and elastic fibers fragment. When stretching, an increase in pigmentation may occur, associated with temporary stimulation of melanin production. Hair follicles become less frequent due to an increase in surface area, but the true number of follicles remains the same. In addition, the thickness of the basal layer increases and a greater number of myofibroblasts are found than in non-stretched skin. The stretching process also affects the associated structures of subcutaneous tissues. Adipose tissue does not tolerate stretching very well and becomes significantly thinner, losing up to 50% of its original thickness [1]. Fat cells flatten, lose fatty inclusions and can be replaced by fibrous tissue. However, this loss of fat can be made up to some extent after stretching. Vascular changes in this case can be dramatic. Chronic tissue stretching is a strong stimulus for vascular proliferation [3, 6]. This is one of the great advantages of stretching, since this process usually leads to improved blood supply to the stretched flap, which can be especially useful in cases where the vascular network is disrupted. Then stretching can give not only an increase in surface area, but also an improvement in blood supply and greater resistance of the stretched tissue to infection [2, 7, 8]. During stretching, there is a proliferation of capillaries and, of course, venules and arterioles, as well as elongation of vascular structures [4, 5].

In turn, morphological changes in soft tissues during balloon stretching also play an important role in the anatomical and functional results of plastic surgery. It is known that significant biological and morphological changes occur in tissues undergoing preliminary prolonged stretching Zhu X. [361], then changes in the histological picture during rapid intraoperative tissue stretching remain unexplored. A morphological examination of the intraoperatively stretched skin area would allow us to assess the adequacy of the developed scheme.

The purpose of the study. Morphological substantiation of the possibility of using rapid intraoperative balloon stretching of tissues in the plastic of scarring defects of the facial skin.

To solve the problem, the following tasks are set:

1. To determine the effect of intraoperative stretching on the overall architectonics of the skin (light microscopy).
2. To study the effect of stretching on intercellular contacts (electron microscopy).
3. To investigate changes in the microrelief of the skin, the state of the fiber skeleton of the dermis during skin stretching (scanning electron microscopy).

Materials and methods of research. To assess the effect of balloon intraoperative stretching of the facial skin in the lip area, light-optical methods of morphological examination, as well as scanning and transmission electron microscopy were used.

For light microscopy, samples from various areas of the skin of the lips and face (27 samples in total) subjected to stretching, obtained during surgery, were fixed in a 10-12% solution of neutral formalin. After appropriate

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processing, the samples were poured into paraffin and sections 5-7 microns thick were prepared. The general morphological picture was studied on sections stained with hematoxylin and eosin.

The results and their discussion. There are 4 distinct layers in the epidermis of the lip skin: the basal layer, the layer of spiny cells, the layer of granular cells, and the stratum corneum. The shiny layer is practically undetectable (Fig. 1).

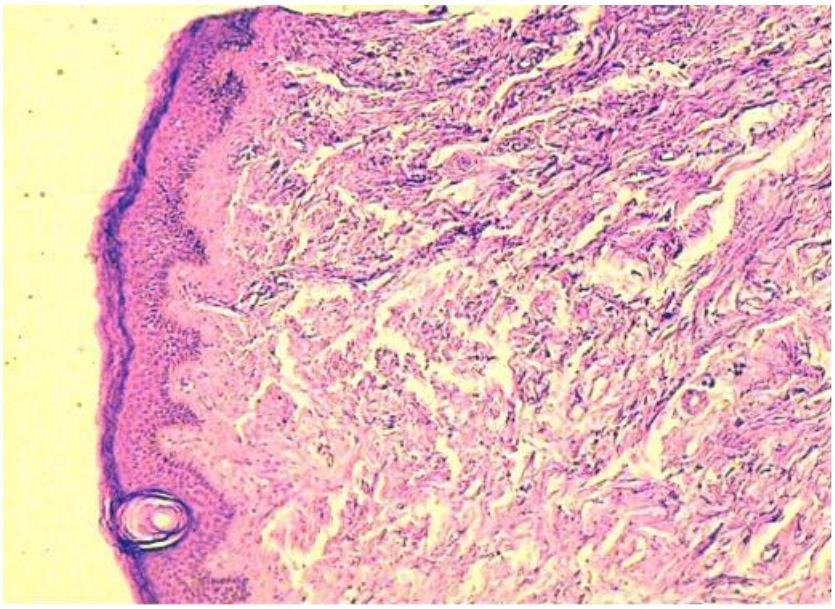

Fig. 1. The skin of the lip area. Control. Hair rods, several rows of cells of the thorny layer, the papillary layer of the dermis and its fibers are pronounced. Mr. 10x10.

The granular layer of the facial skin is slightly keratinized skin. It is represented by 1-2 layers of cells with characteristic keratogyalin granules. The shiny layer in the skin, as noted above, is not detected. The stratum corneum is formed by cells subjected to complete keratinization. They do not define kernels.

The stratum corneum is thinner in the lip area. Hair follicles are found here and hair rods are determined in the thickness of the epidermis.

The stratum corneum is also well developed in the facial area (Fig. 2). The main difference between this area and other areas (upper and delicate lips) is the developed fatty layer in the hypodermis.

SEM studies have shown that the surface of the epidermis is a characteristic microrelief with numerous furrows and ridges, the larger furrows and ridges of the microrelief are determined by the underlying layers of the dermis.

In the lip area, hair rods often protrude above the surface of the epidermis. Numerous horny scales are located in the mouths of the hair bags (Fig. 2). They are evenly distributed over the entire surface of the skin and, at high magnifications, look like fallen leaves.

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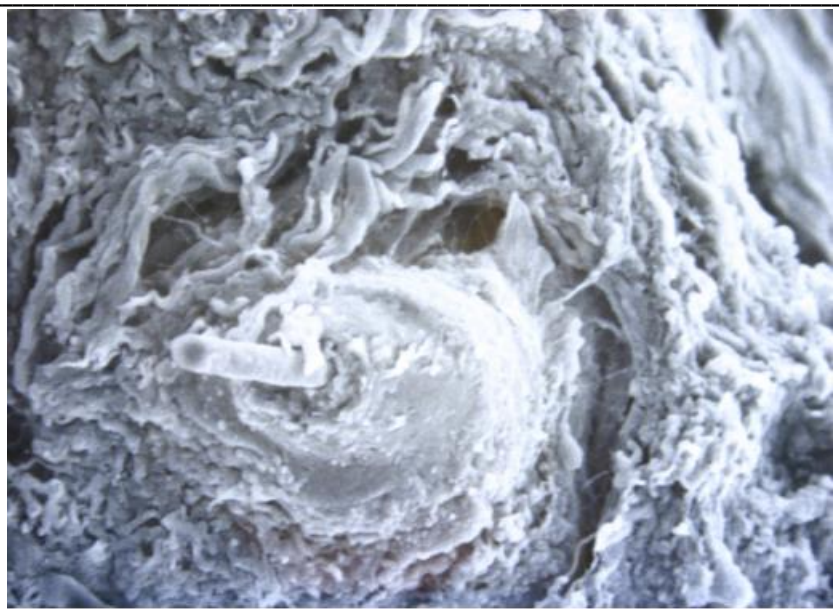

Fig. 2 The mouth of the hair bag. Control numerous horny scales. SAM x 1000.

In the dermis, fibers of various thicknesses, intertwining with each other, form a characteristic network. Connective tissue cells are located among the intertwining fibers. In the facial area, with SAM, significant accumulations of fat cells are detected in the dermis, located in groups and singly. TEM studies have shown that the cells of the basal layer attach to the basement membrane separating the epidermis from the dermis with the help of so-called semi-osmoses.

The cells of the spiny layer are connected to each other by numerous desmosomes located at the ends of the processes of these cells (Fig. 5.8). The cells contain oval nuclei with 1-2 nucleoli. In the basal parts there are numerous tonofilaments reaching the basement membrane.

In the dermis, strands of fibers are located under the basement membrane, in which individual strands are grouped into bundles. In the papillary layer there are microvessels formed by a single layer of endothelium and connective tissue cells – fibroblasts, lymphocytes, mast cells and others.

Stretching of soft tissues leads to smoothing of the papillary layer of the dermis. It is characteristic that the number of rows of cells of the thorny layer becomes the same throughout. Their number is reduced to 4-5. At the same time, there is no violation of the integrity of the epidermal part of the skin, as in the area of the lips, face (Fig. 3).

In the forehead area, blood filling of blood vessels and areas of hemorrhage in the fatty layer of the hypodermis are more pronounced during stretching. The phenomena of acantholysis of the thorny layer were also not revealed. The integrity of the dermis is not violated either. In particular, there were no tears of its fibers or violation of the integrity of blood vessels. There are no hemorrhages in the dermis.

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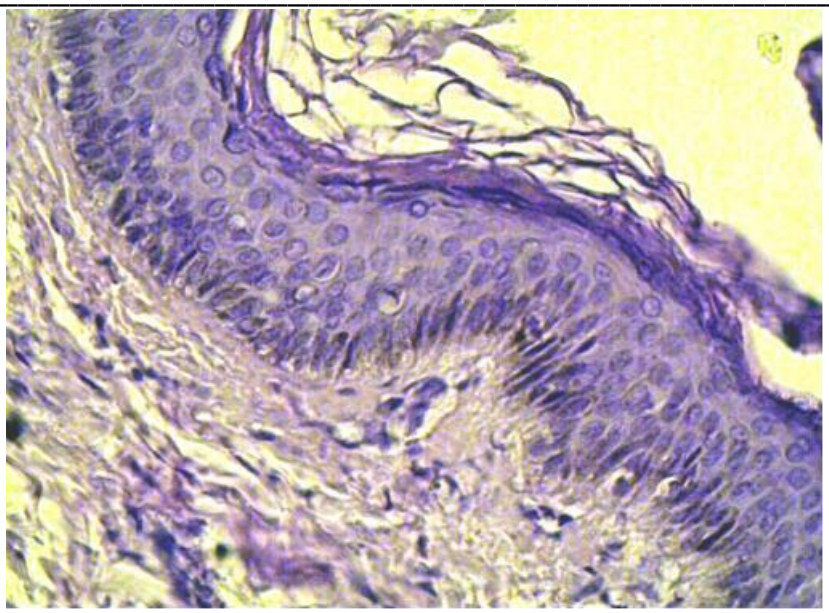

Fig. 3. Lip skin. Stretching. Smoothing of the papillary layer of the dermis, reducing the number of rows of cells of the thorny layer. G-E 10x40.

Areas of hemorrhage are found only in the hypodermis, among the layers of adipose tissue cells. At the same time, there were no violations of the integrity of the walls of blood vessels. The integrity of the fibers is preserved in deeper areas of the dermis, on the border with the hypodermis, where the fibers are thicker and rougher.

Studies of the ultrastructure of the skin using scanning electron microscopy have shown that the microrelief of the skin surface is not disturbed. It is represented by a characteristic surface pattern with depressions, furrows and ridges. The fibers of the dermis also retain their inherent structure in the form of intertwining filamentous complexes of various sizes and shapes.

Moreover, the fibers of chic are more chaotically intertwined with each other, as a rule, thicker than the fibers of the facial dermis. Connective tissue cells, mainly lymphocytes, are also found among the fibers of the dermis.

Fig. 4. Preservation of the integrity of the dermis fibers and the microrelief of the skin surface of the lip area after intraoperative stretching. SAM x 400.

In the deeper layers of the dermis, the fibers are looser after stretching the skin, but the integrity of the mesh structure of the fiber base is not violated (Fig. 5).

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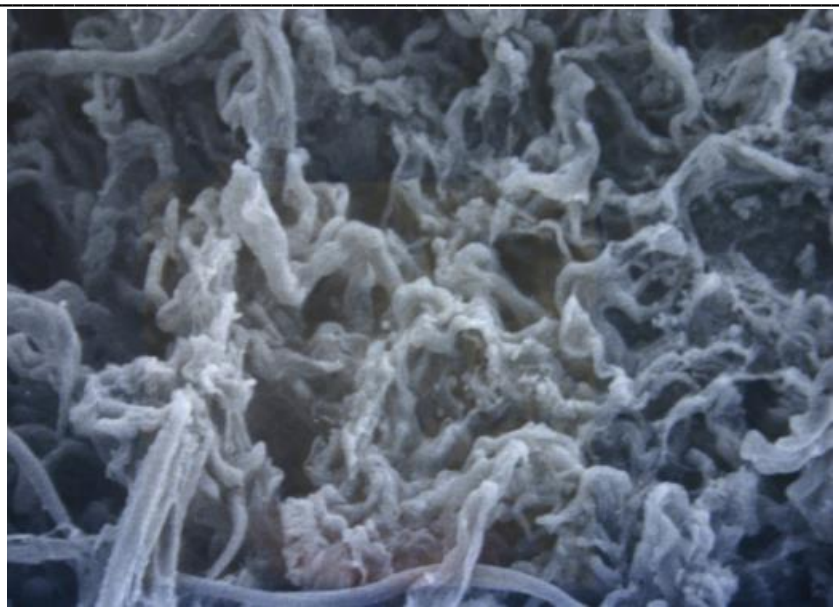

Fig. 5. The dermis. Stretching. Interlacing loosely arranged fibers. SAM x 1000.

In the cells of the granular layer there are few medium-sized granules of keratogyalin. The stratum corneum is loosened somewhat (fig. 6).

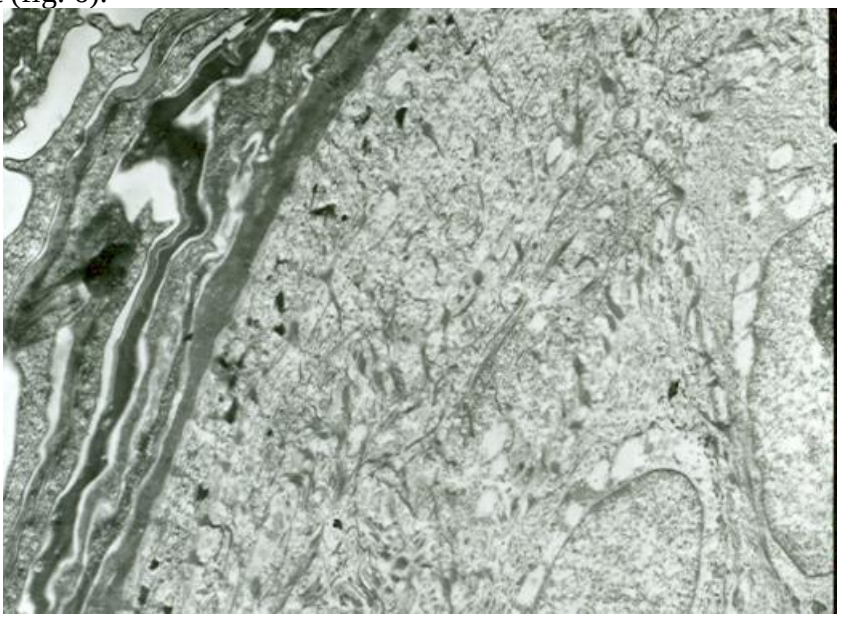

Fig. 6. Spiny (W), granular (H), horny (R) layers of the epidermis. Stretching. Preservation of cellular connections of the epidermis, loosening of the stratum corneum. TAM. X 7500.

Results. Studies conducted using TEM have shown that intraoperative balloon stretching of the skin does not lead to a violation of the integrity of the basement membrane and contacts of epithelial cells of the basal layer with it. Intercellular contacts of cells of both the basal and thorny layers are not disrupted. Moreover, in the basal layer, the connection of cells with each other is carried out mainly due to interdigitations - interlacing processes of neighboring cells. In the thorny layer, the integrity of the rows of keratinocytes is ensured by numerous desmosomes located at the contacting ends of the processes of neighboring cells. Balloon stretching does not lead to disruption of contacts in the form of interdigitation of plasma membranes of neighboring cells of the basal layer and rupture of desmosomes at the ends of the processes of neighboring cells of the thorny layer.

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Conclusion. Thus, intraoperative stretching of soft tissues according to the scheme developed in the clinic does not cause pathological changes in the general architectonics of the skin, does not violate the microrelief of the surface and the mesh structure of the fiber base of the skin.

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