

EXPERIMENTAL DETERMINATION OF THE EXTENSIBILITY OF THE ANTERIOR ABDOMINAL WALL TISSUES AT DIFFERENT TIMES OF PREGNANCY USING VARIOUS APPROACHES TO HERNIOPLASTY

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ABSTRACT

This article presents the results of hernioplasty for ventral hernias in women of fertile age, an experimental study of the strength characteristics of fixation by various methods (the adhesion force of the mesh implant with the tissue). These studies clearly demonstrated the presence of differences in the load on the tissues of the anterior abdominal wall in different areas during pregnancy, which confirmed our idea of the need for research to justify a differentiated approach to choosing a repair method in the presence of hernias, depending on its localization.

KEYWORDS: *Women Of Fertile Age, Abdominal Hernias, Hernioplasty, Implant, Rat.*

INTRODUCTION

The introduction of artificial materials in herniology has led to studies of the effect of allomaterials on body tissues, which are carried out at the intersection of morphology and surgery [1,3,5,8, 9,11,14,15].

One of the pioneers in studying the effect on the repair processes in the alloplasty zone was Tsukanov A.V. (2010), who published the results of a study on fibroblast activity after anterior abdominal wall plasty with various allografts. Scientists have proven that the use of embryonic fibroblasts can accelerate the formation of connective tissue around the mesh material [2].

Katunina T.P. (2012) demonstrated in her work that the introduction of a culture of allogeneic embryonic fibroblasts into the area of alloplasty leads to a decrease in the intensity of inflammatory processes and stimulates the maturation of granulation tissue [3].

A large study conducted on laboratory mice, which included the results of a ten-year study of the morphological features of the tissues of the anterior abdominal wall after the introduction of embryonic fibroblasts, was carried out by Ivanov I.S. [7].

The observation was carried out in individuals in which polypropylene, polytetrafluoroethylene and polyvinylidene fluoride allografts were implanted into the anterior abdominal cavity, and on the seventh and tenth days, embryonic fibroblasts were introduced into the operation area. In the experiment, it was proved that the first introduction of the culture led to a decrease in the

inflammatory response and an increase in the production of fibroblasts, and the second injection led to greater stimulation of fibroblasts [6].

These studies have not found wide recognition and application in view of the high cost and technological complexity of manufacturing cultures of embryonic fibroblasts. It should be noted that the above drugs are not included in the international standards for the treatment of patients with hernias, therefore, the implementation of the results of these works is limited in countries with compulsory health insurance.

A number of works devoted to the morphological study of the area of implantation of polypropylene implants have shown the presence of defects in the fixation of the latter in the tissues of the anterior abdominal wall [2, 5,7,12,13].

Thus, the use of allomaterials is currently a routine practice, but the search for the "ideal" endoprosthesis continues. The interaction of allomaterial with body tissues, its anti-adhesiveness, resistance to microflora are important issues of modern herniology and require constant new developments and research.

Considering the above, **the purpose of this study** was to improve the results of surgical treatment of women of childbearing age with hernias of the anterior abdominal wall by substantiating a differentiated approach to the choice of allohernioplasty method.

Material and research methods

To determine the strength of the tissues of the anterior abdominal wall at different stages of pregnancy, as well as when using various allomaterials, we conducted experimental studies. The essence of the experiment was to conduct research on tissue rupture. Taking into account the fact of different extensibility of tissues in different parts of the anterior abdominal wall during pregnancy, we studied the initial morphological characteristics of the tissues of the anterior abdominal wall and the nature of the changes during its maximum stretching.

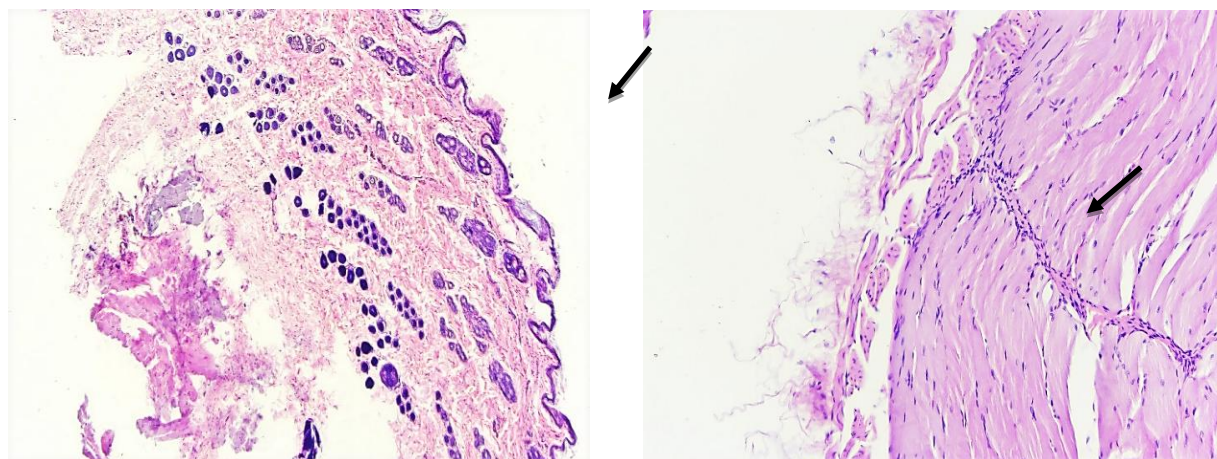
For this purpose, one rabbit was withdrawn from the experiment and tissues were taken without stretching from various parts of the anterior abdominal wall, followed by a morphological study:

1. Tissues of the anterior abdominal wall in the midline.
2. Tissues of the anterior abdominal wall in the lateral region of the abdomen.
3. Tissues of the anterior abdominal wall in the region of the xiphoid process.
4. Tissues of the anterior abdominal wall in the inguinal region.

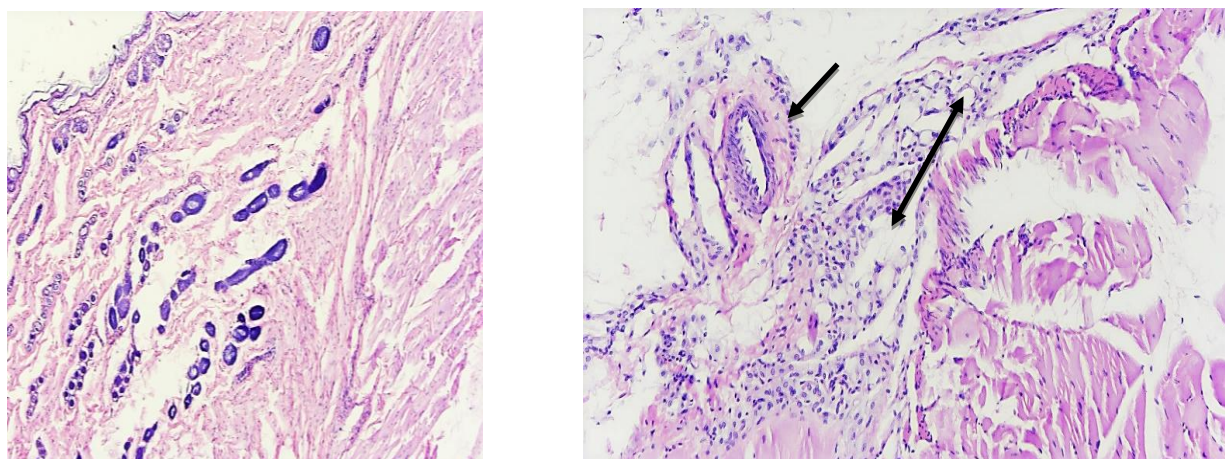
In the morphological study of the tissues of the anterior abdominal wall in the area of the midline, it was noted that the skin tissues were with the preservation of all structural elements. Epithelium with signs of keratinization (indicated by an arrow in the figure), multiple elements of hair follicles in the reticular and papillary dermis. The hypodermis is sparse with a transition to muscle tissue. On the histological section, the transverse and oblique muscles with a dense fibrous-collagen fascia (arrow) between them. The presence of multiple fibroblasts along the fascia line is noted (fig. 1).

The study of the morphological structure of the tissues of the anterior abdominal wall in the lateral region of the abdomen showed that the skin tissues with the preservation of the mucosa,

under it the hair follicles without signs of change. Transverse abdominal wall muscle surrounded by serosa and adipose tissue (double arrow). Blood vessels without features (arrow), (fig. 2).

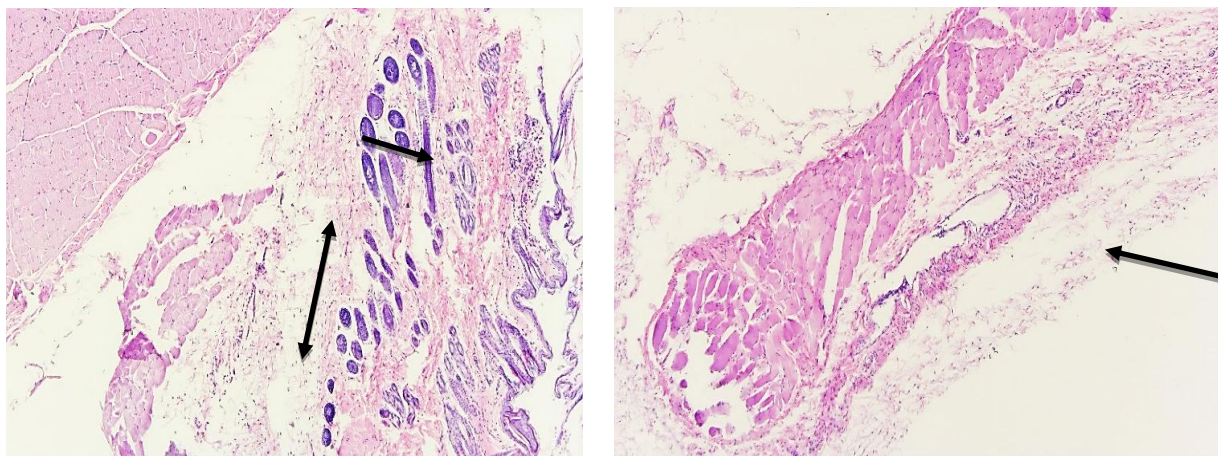


Rice. 1. Tissues of the anterior abdominal wall in the area of the midline without stretching. Hematoxylin-eosin staining. SW. 10x10.



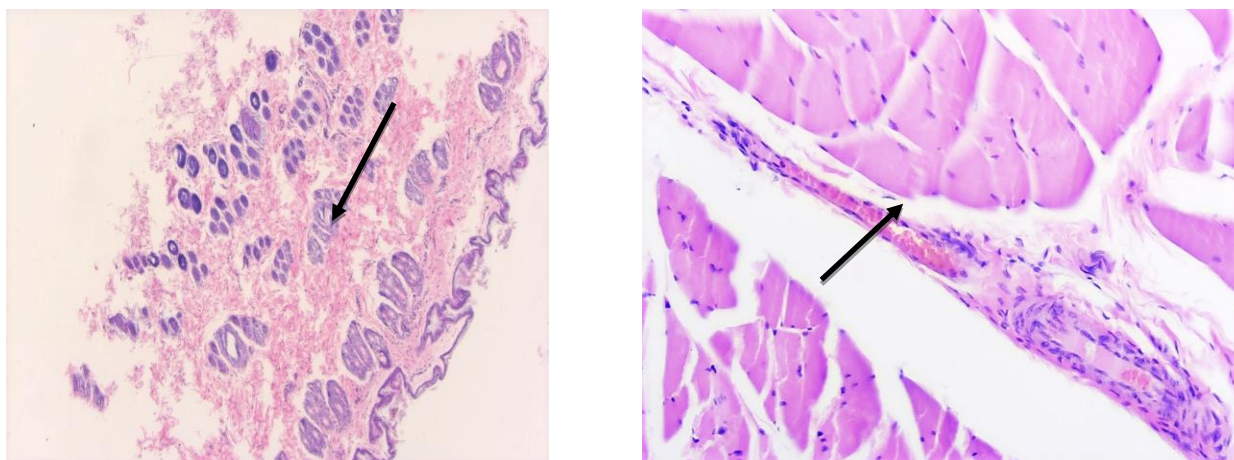
Rice. 2. Tissues of the anterior abdominal wall in the lateral region of the abdomen without stretching. Hematoxylin-eosin staining. SW. 20x10.

In the morphological study of the tissues of the anterior abdominal wall in the area of the xiphoid process without stretching, it was noted that the skin tissues with multiple hair matrix follicles (arrow). Superficial adipose fascia (double arrow) and external oblique muscle without pathological changes. Loose-fibrous connective tissue, which makes up the structure of the aponeurosis, smoothly passes into fibrous-collagen (arrow) and then into muscle tissue (fig. 3.).



Rice. 3. Tissues of the anterior abdominal wall in the area of the xiphoid process without stretching. Hematoxylin-eosin staining. SW. 20x10.

The study of the morphological structure of the tissues of the anterior abdominal wall in the inguinal region of the abdomen showed that skin tissues with many hair follicles (arrow). Collagen connective tissue structure with fibrocytes. Around the aponeurosis, fibro-adipose tissue is noted. In the structure of the aponeurosis between the oblique muscles of the anterior abdominal wall there are blood-filled vessels (arrow), (fig. 4.).



Rice. 4. Tissues of the anterior abdominal wall in the inguinal region without stretching. Hematoxylin-eosin staining. SW. 20x10.

Studies have shown that the existing tissues of the anterior abdominal wall (skin (own dermis and epidermis), subcutaneous fat layer (hypoderm), aponeurosis (consisting of connective tissue), muscle and serous layer (peritoneum)) without stretching have a normal structure. It should be noted that in experimental animals, in contrast to humans, a pronounced hairline, and, accordingly, in the structure of the skin, there is a greater number of hair matrix follicles.

To assess the nature of changes in the tissues of the anterior abdominal wall and the possibility of assessing changes in the strength of tissues during autoplasty and alloplasty with various

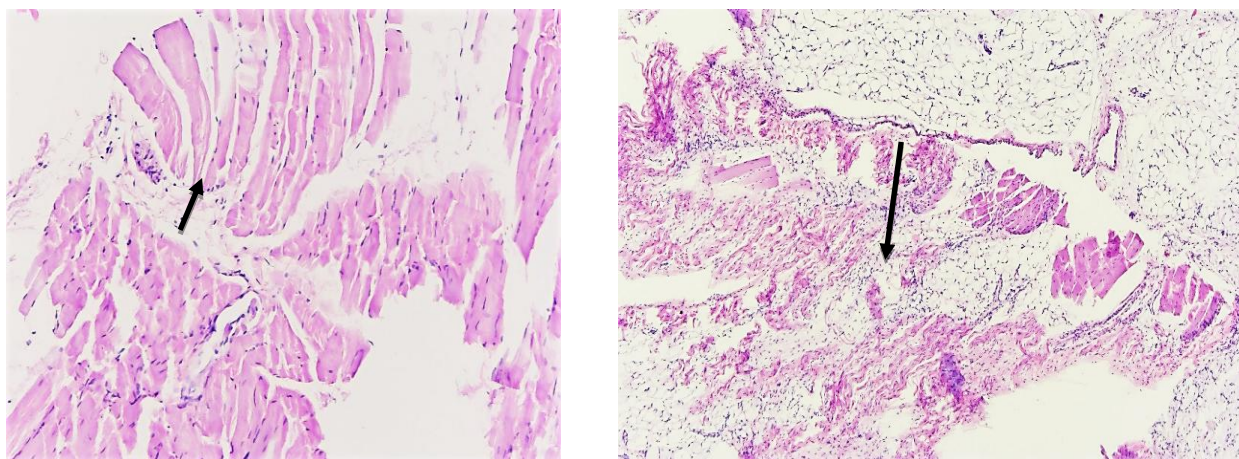
materials, which is fundamentally important in progressive pregnancy, we conducted morphological studies of tissues of various parts of the anterior abdominal wall of experimental animals at their maximum stretch.

To do this, the developed model of "pregnancy" was reproduced in the experimental animal with an increase in the abdomen to its maximum period, and after 20 days tissue sampling was performed and a morphological study of tissues was performed. The specified period of material sampling was chosen empirically. As in the experimental rabbit without stretching, in this case, the material was taken from four sites:

1. Tissues of the anterior abdominal wall in the midline after stretching.
2. Tissues of the anterior abdominal wall in the lateral region of the abdomen after stretching.
3. Tissues of the anterior abdominal wall in the region of the xiphoid process after stretching.
4. Tissues of the anterior abdominal wall in the inguinal region after stretching.

When analyzing morphological studies, special attention was paid to the study of structural changes in the aponeurosis and muscles, in view of the fact that these layers are involved in the process of autoplasty and alloplasty of the hernia ring.

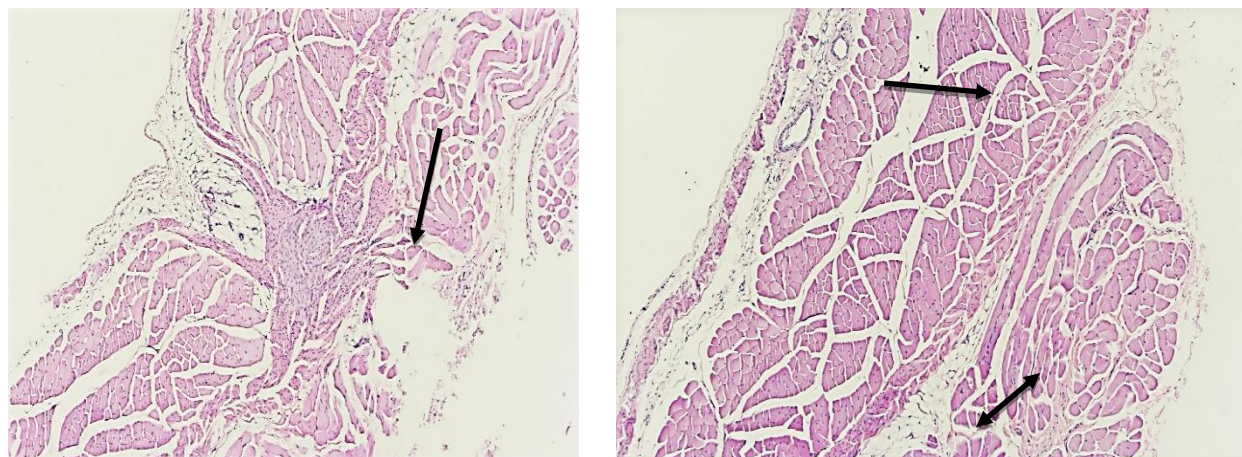
Morphological studies of the tissues of the anterior abdominal wall along the midline of the abdomen after stretching showed that between the two oblique muscles there are signs of hypertrophy with hyperplasia of adipocytes and fibrocytes (arrow). Aponeurosis zone with signs of pronounced loosening (arrow) and hyperplasia of fat cells - adipocytes with an admixture of fibrocytes (fig. 5.).



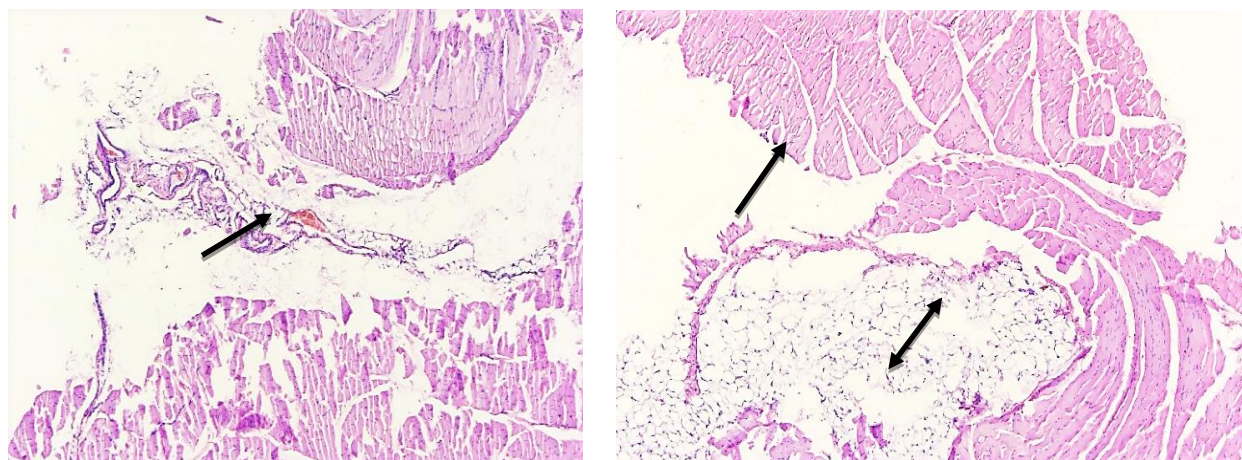
Rice. 5. Tissues of the anterior abdominal wall along the midline of the abdomen after stretching. GE coloring. SW. 10x10.

Histological examination of the tissues of the anterior abdominal wall in the area of the xiphoid process after stretching showed signs of proliferative activity and moderate hyperplasia of the aponeurosis (arrow). There is an increase in the number of fibrocytes. Oblique and longitudinal muscles with interstitial edema (arrow), hypertrophy of the fat layer is noted (double arrow), (fig. 6.).

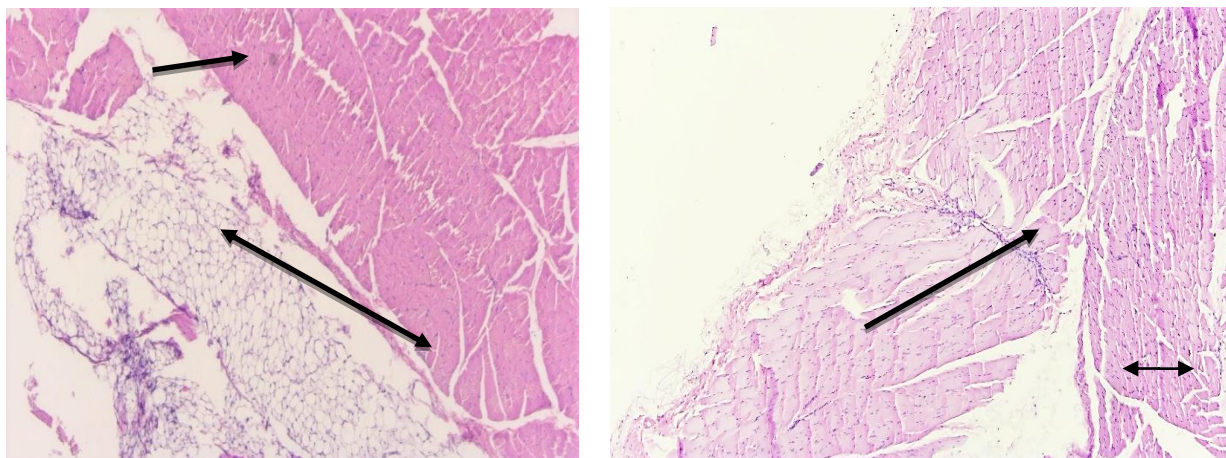
Morphological studies of the tissues of the anterior abdominal wall along the lateral areas of the abdomen after stretching showed that the aponeurosis is moderately thinned, dystrophic (arrow), with an increase in the number of vessels and is surrounded by a hyperplastic layer of adipose tissue. Extraperitoneal adipose tissue with signs of hyperplasia (double arrow). Intermuscular spaces are enlarged and with signs of edema, both between the longitudinal (arrow) and oblique, and in the oblique muscle itself (fig. 7.).



Rice. 6. Tissues of the anterior abdominal wall in the region of the xiphoid process after stretching. GE coloring. SW. 10x10.



Rice. 7. Tissues of the anterior abdominal wall in the lateral region of the abdomen after stretching. GE coloring. SW. 10x10.



Rice. 8. Tissues of the anterior abdominal wall in the inguinal region after stretching. GE coloring. SW. 10x10.

Histological examination of the tissues of the anterior abdominal wall in the groin after stretching showed that the aponeurosis was slightly thinned, but the structure was preserved (double arrow), surrounded by muscle tissue with signs of interstitial edema (arrow) and dystrophy. Muscular fascia (arrow) unchanged. There is an expansion of the gap between the longitudinal and oblique muscles (double arrow) (fig. 8.).

The conducted morphological studies have shown that during pregnancy the “load” on different parts of the anterior abdominal wall is carried out unevenly. The more the tissues lengthen, the more pronounced are the structural changes in the tissues of the anterior abdominal wall. The most pronounced changes were noted in the tissues of the midline of the abdomen, which was expressed in a pronounced loosening of the aponeurosis, muscle hypertrophy and hyperplasia of fibrocytes. Less pronounced changes were noted on the side of the xiphoid process, then on the tissues of the lateral wall of the abdomen. The smallest changes in the tissues of the anterior abdominal wall during "pregnancy" were noted in the inguinal region.

Currently, the range of alloprostheses used in clinical practice is wide. There are lightweight and ultra-light materials, non-absorbable, semi-absorbable and absorbable meshes. The effectiveness of various alloprostheses is debatable because the clinical results obtained in terms of the recurrence rate are variable: a number of researchers demonstrate a decrease in the number of early and late postoperative complications without an increase in the recurrence rate, while other surgeons do not find significant differences in the use of different meshes when analyzing long-term results. Evidence is provided that indicates the need for careful use of lightweight materials due to the relatively high recurrence rate. To date, no agreement has been reached on this issue. The problem is that after allohernioplasty, significant morphological changes are observed, the strength characteristics of tissues in the area of mesh implantation change. Considering this fact, as well as to achieve the set goals, we conducted experimental studies to determine the strength of the tissues of the anterior abdominal wall at different stages of pregnancy using various methods of hernia repair. This series consists of four parts.

The first part is an experiment on tissue extensibility in rabbits without alloplasty. 10 rabbits were used in the experiment. All experimental animals were reproduced the model of "pregnancy" according to our model. According to the developed criteria for gestational age, all

rabbits were implanted in the abdomen with a balloon and expanded the circumference of the abdomen to a period corresponding to 20 weeks. In the following days, the abdominal circumference of the rabbits was adjusted to the required diameter, according to the gestational age. At 20, 25, 30, 35 and 40 weeks of "pregnancy" two rabbits were taken out of the experiment. In the indicated terms, from the four sections of the anterior abdominal wall - the region of the median line; under the xiphoid process; in the lateral region of the abdomen; in the inguinal region of the abdomen - two pieces of tissue with dimensions of 2.5x3.0 cm were taken and the strength of the tissues for extensibility was determined.

Thus, the studies on the extensibility of tissues in various areas confirmed our assumption, which arose on the basis of the morphological studies. The tissues of the anterior abdominal wall in the area of the midline were subjected to the greatest extensibility during "pregnancy". From the initial level, the extensibility in terms of 40 weeks was 132.2%. In the region of the xiphoid process, the extensibility of tissues in these periods was 120.9%, while the tissues of the lateral wall of the abdomen were stretched by 113.8%. Relative to the baseline, tissue strength along the midline and under the xiphoid process was statistically significantly different from tissue strength by the end of "pregnancy". The least extensibility was in the inguinal region and amounted to 108.8%. These studies clearly demonstrated the presence of differences in the load on the tissues of the anterior abdominal wall in different areas during pregnancy, which confirmed our idea of the need for research to justify a differentiated approach to choosing a repair method in the presence of hernias, depending on its localization.

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