

ISSN 2509-4327 (print)
ISSN 2510-4780 (online)

Inter
GING



Deutscher Wissenschaftsherold German Science Herald

№ 6/2017

Die Zeitschrift „Deutscher Wissenschaftsherold“ ist eine Veröffentlichung mit dem Ziel ein breites Spektrum der Wissenschaft allgemeinverständlich darzustellen. Die Redaktionsleitung versteht sich als Vermittler zwischen Wissenschaftlern und Lesern. Durch die populärwissenschaftliche Bearbeitung wird es möglich unseren Lesern neue wissenschaftliche Leistungen am besten und vollständigsten zu vermitteln. Es werden Untersuchungen, Analysen, Vorlesungen, kurze Berichte und aktuelle Fragen der modernen Wissenschaft veröffentlicht.

Impressum

Deutscher Wissenschaftsherold – German Science Herald

Wissenschaftliche Zeitschrift

Herausgeber:

InterGING

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Auflage: № 6/2017 (Dezember) – 20

Redaktionsschluss Dezember, 2017

Erscheint alle 2 Monate

Editorial office: InterGING

Sonnenbrink 20

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Tel.: + 49 51519191533

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Deutscher Wissenschaftsherold – German Science

Herald is an international, German/English language,

peer-reviewed, twice a month published journal.

№ 6/2017

Passed in press in December 2017

Druck: WIRMachenDRUCK GmbH

Mühlbachstr. 7

71522 Backnang

Deutschland

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INDEXING: Google Scholar, WorldCat, Index Copernicus, InfoBase Index, Journal Index, Citefactor, International Scientific Indexing, JIFACTOR, Scientific Indexing Services, International Institute of Organized Research.



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INTERNATIONAL
Scientific Indexing



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<http://miar.ub.edu/issn/2509-4327>

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NON-SURGICAL TACTICS OF LIGATURE CORRECTION OF FACIAL SOFT TISSUE AGE CHANGES AND SUBSTANTIATION OF THEIR USE IN COSMETIC DERMATOLOGY ON THE BASIS OF PATHOMORPHOLOGICAL INVESTIGATIONS CONDUCTED

Abstract. *To determine reasonability of ligature correction use by means of introduction of resorptive and permanent grafts on the basis of investigating pathomorphological changes in the skin. The study was conducted on 30 mature albino male rats of “Wistar” line with the body weight of 100-130 grams. Experimental animals were divided into 2 groups depending on the type of threads grafted. Rats of all the groups (14, 30 and 90 day) were divided into 3 subgroups 10 animals each. All the 10 rats in every subgroup were implanted with suture material of the same type. Threads produced by Aptos, namely, Excellence Visage (EV) and Light Lift Thread (LLT) were used for the study. Examination of morphological changes in the peri-implant area determined that collagen is formed in all the groups of experimental rats at different chronological stages with different term of biological degradation and in different amounts. Dependence between the type of grafting thread (structure) and stimulation of collagenosis has been determined. The experiment demonstrated that collagen is formed in the peri-implant areas in both groups of experimental animals at different chronological stage with different term of biological degradation and in different amounts. At the expense of the structure of threads (springs, thread with incisions) and polylactic acid available collagenosis was found to be stimulated considerably. The information provided by the producer concerning the time of disintegration in 365 days correspond to the real facts, since on the 90th day of the experiment resorptive thread was not disintegrated completely; it confirms reasonability of use of these cosmetic threads in esthetic dermatology with the purpose of a long lifting correction of the skin. Polylactic acid available in the content of threads is not an indicator factor of collagenosis efficacy. The structure of the ligature itself must be of greater effect.*

Key words: *collagen, collagenogenesis, permanent graft, resorptive graft, ligature correction.*

Introduction. In recent years the esthetic issues have gained more topicality. Today beauty industry has a number of methods and means of correction and rejuvenation of the face and body, and lifting in particular [9, 10].

The procedure is directed to stimulation of formation of additional collagen in the skin ensuring improvement of turgor and elasticity at the expense of strengthening the frame.

Collagen (Greek kolla — glue + genos — genus) is one of the extracellular, closely related proteins that are the main component of the connective tissue and provides its strength and elasticity. It is fibrillar protein of glycoprotein structure consisting of macromolecules possessing a unique three-spiral structure. It constitutes approximately $\frac{1}{3}$ of all the proteins of the mammalian organisms and 70% of protein mass in the skin. Collagen in the human body fulfills an

important “regulatory role” of the connective tissue functioning (qualitative content of the tissue structure, ensuring flexibility and elasticity of the tissue, prevention of its dehydration, providing moistening of deeper skin layers and inhibition of its aging, improvement of the hair and nails condition) [6, 8].

In the body collagen is synthesized from protocollagen in fibroblasts and chondrocytes, is contained in the connective tissue, fills intercellular space and together with proteoglycans participates in the intercellular interaction, influences upon the mobility of cells, morphogenesis of the organs and tissues during development of the organism [6-8].

The number of transverse connections in a collagen molecule increases in the body with age, resulting in the reduction of its resistance and elasticity, decrease of strength in the cartilages

and ligaments, increase of bone fragility. The structure of collagen fibers depends on the type of tissue and its “specialization”. The most widespread types of collagen are: 1) the main component of the skin, tendons, ligaments and bones; 2) over 50% of protein in the cartilage tissue; 3) restorative component of the walls of the blood vessel and intestines; 4) restorative component of the basal epithelial plate in the filters of the blood capillaries and nephron glomeruli [3, 6].

Fibrillar collagen in the skin of an adult (1, 3 and 5 types) is the biggest collagen fraction: the 1st type collagen constitutes approximately 80-90% and the 3rd type collagen constitutes 8-12% [7].

The use of threads in esthetic medicine is based on their ability to stimulate collagenogenesis, which is stated by producers, although this information does not have any grounds, since none of the studies could confirm this hypothesis [2-5].

Therefore, we have decided to check collagen formation with the use of one of the most aggressive methods of cosmetic dermatology – resorptive grafting threads.

Objective: to determine reasonability of ligature correction use by means of introduction of resorptive and permanent grafts on the basis of investigating pathomorphological changes in the skin.

Materials and methods. The study was conducted on 30 mature albino male rats of “Wistar” line with the body weight of 100-130 grams. Experimental animals were divided into 2 groups depending on the type of threads grafted.

Rats of all the groups (14, 30 and 90 day) were divided into 3 subgroups 10 animals each. All the 10 rats in every subgroup were implanted with suture material of the same type. Threads produced by Aptos were used: Excellence Visage (EV – thread with folds, 30 % caprolactone + 70% polylactic acid, time of biological degradation \geq 365 days) and Light Lift Thread (LLT- thread with incisions welded with needles, both contain 50 % of caprolactone + 50 % of polylactic acid, time of biological degradation \geq 365 days).

All the animals were kept under conditions of vivarium. The animals were taken out from the experiment by means of overdosage of ether narcosis (exposition for 5-7 minutes) on the 14th,

30th and 90th day of the experiment. The fragments of the skin with subcutaneous adipose tissue from the back were used for morphological examination [1]. Paraffin blocks were made from every fragment, histological staining was made according to the common method and Mallory’s histochemical staining.

Results. The cosmetic thread Excellence Visage was used in the first group of experimental animals. On the 14th day since the beginning of the experiment lymphoplasmocytic infiltration was detected in all the ten experimental specimens.

In all the necrotic materials of the skin angiogenesis of the similar intensity was found. The areas of angiomatosis were located more distally from the places of implantation. The number of fibroblasts in the peri-implant areas was high, and they form a “sleeve” of the connective tissue around implants.

At the 2nd stage of the study – on the 30th day – intensity of infiltration in the peri-implant areas decreased. Degree of angiogenesis remained on the previous level and was characterized by the capillaries, single arterioles and venules available. The number of fibroblasts around the areas of implantation remained on the level of the first stage of the experiment.

On the 90th day since the beginning of the experiment any infiltration in the areas around implants was practically absent. Intensity of angiogenesis was similar to that of the previous stages, although the vessels were in the form of arterioles and venules with the tendency to decrease. All the 10 experimental animals on the 90th day demonstrated decreased number of fibroblasts as compared to the previous stages (Fig. 1).

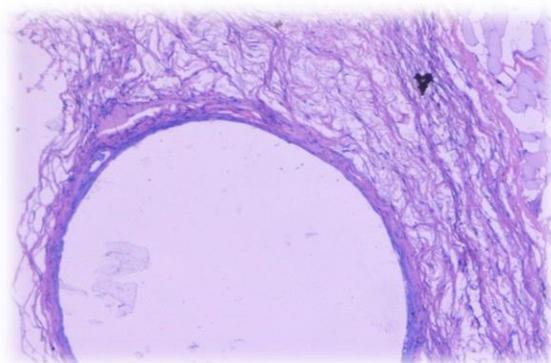


Fig. 1. Morphological picture of the skin tissue sample in the place of implantation of the cosmetic thread Excellence Visage on the 90th day of the experiment. Stained with hematoxylin-eosin. X100

Mallory's histochemical stain showed a low degree of collagen formation in the areas around cosmetic implants; degree of anastomosing also remained rather low; the bundles of collagen fibers remained rather thin and in considerably less as compared to the 30th day (Fig. 2).

The analysis of the results of pathohistological examination determined that intensity of inflammatory infiltration was progressively decreasing in EV implants, and on the 90th day it was not practically determined. However, in case of EV use focal aggregations of eosinophils were present, which can be indicative of a weak allergic reaction in the skin in response to the graft.

The cosmetic suture material Light Lift Thread was used in the second group of the experimental animals. The following morphological manifestation on the skin was found on the 14th day of the experiment after the use of the cosmetic thread Light Lift Thread (they were mostly of the same type in all the ten experimental animals): perifocal peri-implant tissue infiltration mostly by lymphocytes, single plasmocytes, and macrophages. Single aggregations of eosinophils were found.

A "sleeve" is formed around the implantation openings consisting of fibroblasts and fibers of the connective tissue (collagen and elastic); the fibers are mainly directed circularly to the place of opening location; fibroblasts are numerous but located out of order. Aggregations of vessels of a capillary type are present there as well. On the 30th day of the experiment any inflammatory infiltrations were absent. Proliferation of the angiomatous component in the place of alteration was not found. However, it should be noted that bundles of the connective tissue fibers were stratified into more differentiated structures, the number of fibroblasts decreased a little.

90 days later: any inflammatory tissue response in the places of implantation was absent. In certain experimental animals single arteries and small veins with perivascular inconsiderable sclerosis were formed. The number of fibroblasts in comparison with previous stages of the study decreased to the absolute minimum, although it became possible to verify that fibroblasts form bundles. The number of fibroblasts located out of order remains rather low (Fig.3). Mallory's histochemical stain of samples determined a

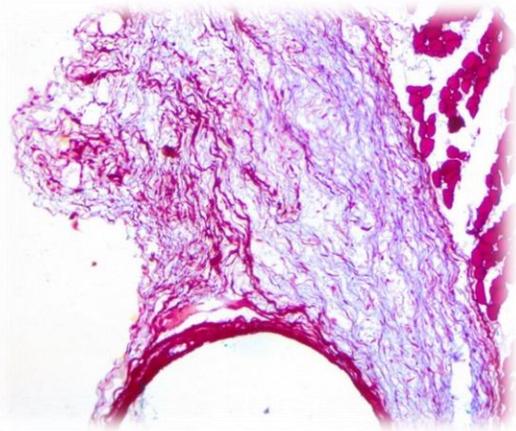


Fig. 2. Collagenogenesis in the peri-implant area (Excellence Visage, 90th day); Mallory's histochemical stain, X100

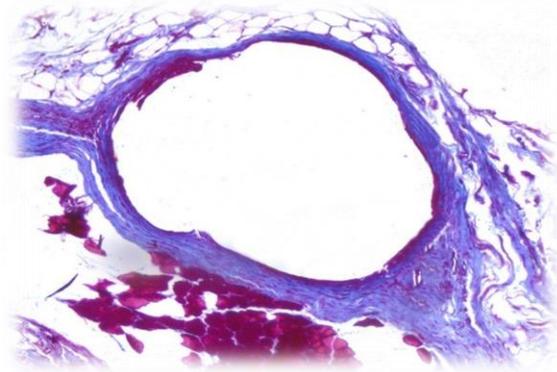


Fig.3. Morphological picture of the necrotic skin tissue sample in the place of implantation of the cosmetic thread Light Lift Thread on the 90th day of the experiment. Stained with hematoxylin-eosin. X100

considerable number of coarse collagen bundles which closely anastomose between themselves, the number of anastomoses is higher in comparison with the previous samples. Direction of collagen fibers in the implantation area was similar. It should be noted that intensity of collagenogenesis remained rather high during all the three stages of the study, and its number did not reduce (Fig.4).

The analysis of the results of pathohistological examination determined, that intensity of inflammatory infiltration in LLT grafts was decreasing progressively, and on the 90th day it was not found practically. However, in case of LLS use focal lymphoplasmocytic infiltrations remained in certain experimental animals on the 90th day since the beginning of the experiment. Degree of angiomatosis was not widely variable and was presented by rather inconsiderable number of small arteries and veins on the 90th day of the experiment. In the group of experimental

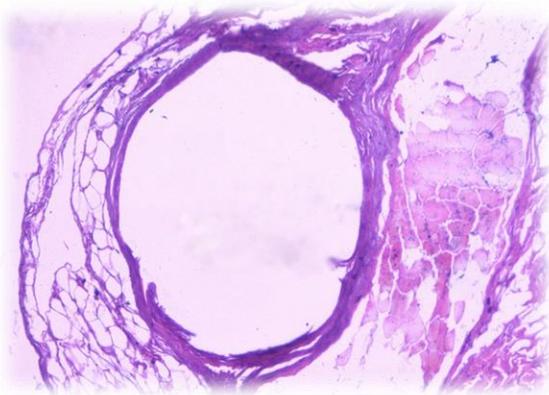


Fig.4. collagenogenesis in the peri-implant area (Light Lift Thread, 90th day); Mallory's histochemical stain, X100

animals where the cosmetic thread Light Lift Thread was used the number of vessels was

considerably less in comparison with another group, although more pronounced collagenogenesis was found.

Examination of resorptive grafts in the skin of the experimental animals determined, that on the 90th day of the experiment none of the threads did not deteriorate completely.

Discussion. On the basis of the above results it was found that collagenogenesis is influenced not only by polylactic acid present in the threads (low collagen formation in EV group; and intensive collagenogenesis with the use of LLT), but mostly by the structure and relief of the cosmetic thread (Table 1). Conducted preliminary statistical estimation of reliability of interrelations between experimental groups is presented in Table 2.

Table 1.

Summary results of morphological changes in the skin of peri-implant areas at different chronological stages

	Infiltration		Infiltrate content		Angiomatosis		Degree of collagenosis	
	LLT	EV	LLT	EV	LLT	EV	LLT	EV
14 th day	F++	D++	L+++ E+ Mp+	L++ E+ Mp++	C+	C+	CCB++ TCB++	CCB+++ TCB+
30 th day	-	F+	-	L++ E+	C+	C+	CCB+ TCB ++	CCB++ TCB+
90 th day	-	-	-	E+	C+	AV+	CCB+ RCB+++	CCB+ TCB+

Notes: D – diffuse; F – focal; L – lymphocytes; E – eosinophils; Mp – macrophages; ISGT – initial signs of the granulation tissue; C – capillaries; AV – arterioles and venules; CCB – cellularity of collagen bundles; TCB – thin collagen bundles; RCB – rough collagen bundles.

Table 2.

Statistically reliable interrelations between the experimental groups

Thread term \ Comparison of differences in groups	Degree of collagen formation	Formed collagen bundles	Degree of anastomosing
LLT 14 day			
LLT 30 day	P _{EV} <0,05;		
LLT 90 day	P _{EV} <0,05;		P _{EV} <0,05;
EV 14 day			
EV 30 day	P _{LLT} <0,05;		
EV 90 day	P _{LLT} <0,05;		

Notes: the table presents only statistically reliable parameters. In all other groups 0,1>p>0,05

Conclusions.

1. The experiment demonstrated that collagen is formed in the peri-implant areas in both groups of experimental animals at different chronological stage with different term of biological degradation

and in different amounts.

2. At the expense of the structure of threads (springs, thread with incisions) and polylactic acid available collagenosis was found to be stimulated considerably.

3. The information provided by the producer concerning the time of disintegration in 365 days correspond to the real facts, since on the 90th day of the experiment resorptive thread was not disintegrated completely; it confirms reasonability of use of these cosmetic threads in esthetic dermatology with the purpose of a long lifting correction of the skin.

4. Polylactic acid available in the content of threads is not an indicator factor of collagenosis efficacy. The structure of the ligature itself must be of greater effect.

Prospects of further scientific studies.

Examination of necrotic skin samples at later chronological stages (180, 365 and 540 days) is planned to be further conducted with additional use of immunohistochemical methods of investigation to determine the type of collagen formed.

The spectrum of examined threads including three more kinds different by their structure and chemical content should be extended.

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