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REHABILITATION STRATEGIES FOR POST-SERVICE EYELASH DAMAGE: THE IMPACT OF INTEGRATED RESTORATION SYSTEMS

Summary. *The article is devoted to the study of rehabilitation strategies for post-service eyelash damage and to determine the impact of integrated restoration systems on the condition of eyelashes, eyelid margin and ocular surface. The purpose of the study is to scientifically substantiate approaches to the correction of damage that occurs after cosmetic procedures with eyelashes and to determine the effectiveness of complex restoration protocols in normalizing the functional and aesthetic state of the ciliary apparatus. In the course of the scientific study, general scientific methods of cognition were used, in particular analysis, synthesis, generalization, systematization, comparison and classification. The results of the study show that post-service eyelash damage is multifactorial and may include allergic-inflammatory reactions, chemical irritation of the ocular surface, mechanical injury to the eyelashes themselves, impaired tear film stability, damage to the conjunctiva and corneal epithelium, infectious complications, as well as follicular changes and disruption of the eyelash growth cycle. It has been studied that such conditions are manifested by itching, redness, swelling, burning, tearing, dryness, photophobia, eyelash loss,*

thinning of the ciliary row and discomfort during blinking. It has been shown that effective rehabilitation should be based on a combination of elimination, anti-inflammatory, hygienic, antibacterial, regenerative, tear-stabilizing and preventive-educational strategies. It was concluded that the elimination of the irritating factor, restoration of eyelid margin hygiene, tear film support, inflammation control and stimulation of the restoration of natural eyelashes create conditions for the gradual normalization of the condition of eyelashes and adjacent structures. The value of the LRCA Method as an integrated restoration system was investigated, which includes an audit of injuries, primary diagnostics, decompression of natural eyelashes, removal of critical load, reconstruction of the ciliary row and safe modeling taking into account the bearing capacity of the own eyelashes. It was shown that such a technique makes it possible to combine aesthetic results with biological restoration, reduce the risk of re-injury and form a protective aesthetic framework. The practical significance of the study lies in the possibility of using the proposed strategies in professional practice for the safe correction of the consequences of post-service damage to the eyelashes.

Key words: *eyelashes, rehabilitation, damage, eyelids, restoration.*

Introduction. Post-service damage to eyelashes is a pressing problem of modern cosmetology and ophthalmology practice, since the procedures of eyelash extension, removal, coloring and modeling can be accompanied not only by aesthetic defects, but also by functional disorders of the eyelid margin and ocular surface. Excessive mechanical stress, contact with glues, removers, dyes or fixing materials can cause loss and weakening of natural eyelashes, irritation of the conjunctiva, inflammatory reactions of the eyelids, disruption of the stability of the tear film and damage to the corneal epithelium. In this regard, the restoration of eyelashes after aggressive or unqualified service exposure requires not only decorative correction, but also a comprehensive rehabilitation approach.

Of particular importance is the development and scientific understanding of integrated recovery systems that combine diagnostics of the degree of damage, elimination of the traumatic factor, support of the follicular apparatus, stabilization of the eyelid margin and prevention of repeated damage. This approach allows us to consider natural eyelashes as a functional element of ocular surface protection, and not only as an object of aesthetic modeling. That is why the study of rehabilitation strategies for post-service eyelash damage is important for the formation of safe practices in the field of lash service and increasing the efficiency of restoring the natural resource of eyelashes.

Literature Review. The issue of rehabilitation strategies for post-service eyelash damage and the impact of integrated recovery systems is not sufficiently comprehensively covered in the scientific literature. Despite this, individual components of this topic are considered by scientists. In particular, the nature of post-service eyelash damage, its clinical manifestations and ophthalmological consequences were studied by the following authors: Y. Amano, Y. Sugimoto, M. Sugita [1], S. Aumond, E. Bitton [2], M. Masud, M. Moshirfar, T. J. Shah and co-authors [7]. These authors studied the anatomical and functional significance of eyelashes, the features of ocular surface damage after cosmetic procedures, as well as the spectrum of side effects associated with eyelash extensions, in particular allergic blepharitis, keratoconjunctivitis, conjunctival irritation and other pathological conditions.

As for the factors of mechanical, chemical, allergic and infectious effects after cosmetic procedures with eyelashes, this issue was studied by several authors. Among them, it is appropriate to highlight F. K. Idu, A. D. Efosa, M. Mutali Jr. [6], who analyzed the prevalence of side effects among eyelash extension users, including itching, redness, pain, and loss of natural eyelashes; M. Moshirfar, M. Masud, T. J. Shah et al. [8], who described a clinical case of chemical conjunctivitis and diffuse lamellar keratitis after improper removal of eyelash extensions; K. Ullrich, N. Saha [9], who investigated a case of bacterial

keratitis associated with semi-permanent eyelash extensions. Taken together, these works indicate that post-service complications can be not only cosmetic, but also clinically significant ophthalmological in nature.

The problem of restoration of eyelashes, eyelid margin and ocular surface after service exposure was considered by Y. Eom, K. S. Na, H. S. Hwang and co-authors [3], C. N. Grupcheva, D. I. Grupchev, N. Usheva, L. O. Grupcheva [4], J. Han, Z. Xie, X. Zhu and co-authors [5], D. Wirta, D. M. Pariser, S. G. Yoelin and co-authors [10]. A separate group of sources is made up of clinical, review and expert publications that allow us to summarize the ophthalmological risks of cosmetic procedures with eyelashes. In particular, the works of M. Masud, M. Moshirfar, T. J. Shah et al. [7], as well as S. Aumond and E. Bitton [2] are important for systematizing knowledge about the structure, functions and pathological changes of eyelashes, while the studies of C. N. Grupcheva et al. [4], J. Han et al. [5], F. K. Idu et al. [6] supplement the analysis with empirical data on dry eye, changes in the ocular surface and the frequency of adverse reactions after eyelash extensions. At the same time, the scientific literature does not sufficiently address the issue of integrated rehabilitation systems that combine diagnostics of post-service damage, reduction of traumatic load, reconstruction of the natural ciliary row and prevention of re-damage.

The scientific novelty of this article lies in the generalization of post-service eyelash damage as a complex condition that encompasses aesthetic, dermatological and ophthalmological manifestations, as well as in substantiating the feasibility of using integrated restoration systems, in particular the LRCA Method, as an applied model for the rehabilitation of natural eyelashes. To achieve the set goal, the methods of analysis, synthesis, systematization, comparison, generalization of scientific sources and a structural-functional approach were used.

Problem Statement. The purpose of the article is to scientifically substantiate rehabilitation strategies for the correction of post-service eyelash

damage and to determine the significance of integrated restoration systems in the normalization of the condition of eyelashes, eyelid margins and ocular surface. To achieve the goal, the following tasks will be performed during the study: to characterize the essence and clinical forms of post-service eyelash damage; to systematize the main factors of mechanical, chemical, allergic and infectious effects after cosmetic procedures; to generalize rehabilitation strategies for the restoration of eyelashes and adjacent structures; to analyze the potential of integrated proprietary techniques, in particular the LRCA Method, in preventing re-damage and maintaining the natural resource of eyelashes;

Methods and Materials. The materials of the study were scientific works devoted to ophthalmological complications after eyelash extensions, anatomical and functional features of the ciliary follicle, the effect of cosmetic procedures on the ocular surface, tear film stability disorders, eyelid margin hygiene, infectious and chemical lesions, as well as methods of eyelash restoration in hypotrichosis. The research used methods of analysis and synthesis to process scientific sources, systematization to group types of post-service damage and rehabilitation strategies, comparison to compare different mechanisms of damage and approaches to restoration, generalization to form conclusions regarding the effectiveness of comprehensive rehabilitation approaches, as well as a structural-functional approach that made it possible to consider eyelashes, eyelid margin and ocular surface as interconnected elements of a single protective system.

Results and Discussions. Post-service eyelash damage is a complex and comprehensive concept. In general, it can be defined as a complex of structural and functional changes that occur after cosmetic manipulations with eyelashes and the adjacent eyelid margin. Such damage is not limited to loss or fragility of eyelashes. It can include inflammatory reactions of the eyelids, irritation of the conjunctiva, disruption of tear film stability, damage to the corneal epithelium and changes in the condition of the eyelashes themselves. As noted by Y. Amano, Y. Sugimoto and M. Sugita, after eyelash extensions, patients may experience

keratoconjunctivitis, allergic blepharitis, conjunctival erosion, reactions to fixing tapes and subconjunctival hemorrhage [1].

Within the framework of this study, post-service eyelash damage can be defined as a set of pathological changes in the eyelashes, eyelid margin and ocular surface that are formed after extension procedures, removal, staining or other cosmetic effects on the eyelashes due to mechanical, chemical, allergic or infectious factors. This definition is important because it allows us to analyze the problem not only as an aesthetic defect, but as a condition that requires gradual recovery. The main types of such injuries are summarized in Table 1.

Table 1

Types of post-service injuries to eyelashes and related structures

Type of injury	Clinical meaning	Typical manifestations
Allergic-inflammatory injury after the use of adhesives or fixing materials [1; 4; 7]	Occurs as a reaction to components of adhesives, fixing tapes, or other materials that come into contact with the eyelids and the root zone of the eyelashes. In the study by Y. Amano, Y. Sugimoto, and M. Sugita, allergic blepharitis was specifically associated with the action of eyelash extension adhesives [1].	Itching, redness of the eyelid margin, swelling, irritation, burning sensation, discomfort during blinking.
Chemical injury to the ocular surface after exposure to adhesive or remover [1; 8; 7]	Develops when adhesive, solvent, or eyelash removal gel comes into contact with the conjunctiva or cornea. M. Moshirfar, M. Masud, T. J. Shah, and co-authors described a case of chemical conjunctivitis and diffuse lamellar keratitis after improper use of a product for removing eyelash extensions [8].	Sharp burning, lacrimation, photophobia, blurred vision, redness, corneal epithelial defects.
Mechanical injury to natural eyelashes [6]	Associated with the excessive weight of artificial eyelashes, frequent removal, tension, or traumatic detachment of the material. F. K. Idu, A. D. Efosa, and M. Mutali Jr. identify pulling out of lashes, that is, the pulling out or loss of natural eyelashes, among the common side effects after the use of eyelash extensions [6].	Loss of eyelashes, weakening of the root zone, uneven growth, thinning of eyelashes, changes in the growth direction of individual eyelashes.
Disruption of tear film stability and dry eye [5]	Occurs due to the effect of artificial eyelashes on blinking, tear evaporation, eyelid margin hygiene, and meibomian gland function. As shown in the study by J. Han, Z. Xie, X. Zhu, and co-authors, a decrease in tear break-up time was observed after	Dryness sensation, foreign body sensation, unstable vision, irritation, redness, discomfort at the end of the day.

	eyelash extension, indicating impaired tear film stability [5].	
Damage to the conjunctiva and corneal epithelium [9]	May result from contact of adhesive, remover, fixing materials, or rigid elements of eyelash extensions with the ocular surface. In the study by K. Ullrich and N. Saha, bacterial keratitis was described in which the bonding agent of an eyelash extension was in contact with the cornea in the ulcer area [9].	Conjunctival erosion, corneal staining, superficial punctate keratitis, pain, photophobia, risk of infectious complication.
Infectious complication after wearing eyelash extensions [9]	Develops under conditions of insufficient eyelid margin hygiene, accumulation of debris near the eyelash roots, mechanical irritation, or microdamage to the ocular surface. K. Ullrich and N. Saha described a case of bacterial keratitis associated with semipermanent eyelash extensions [9].	Pain, marked redness, purulent or mucous discharge, photophobia, deterioration of vision, localized corneal infiltrate.
Follicular injury and disruption of the eyelash growth cycle [2]	Includes changes in the condition of the hair follicle, in particular disruption of the natural growth cycle, weakening of the eyelashes, or their loss. S. Aumond and E. Bitton emphasize that eyelashes are part of the functional system of the eyelid margin, and therefore their integrity is important for ocular surface stability [2].	Hypotrichosis, madarosis, milphosis, reduced density, length, or thickness of eyelashes, slow recovery after removal of artificial materials.

Source: compiled by the author based on sources [1; 2; 4; 5; 6; 7; 8; 9; 10]

As can be seen from Table 1, post-service eyelash damage has various clinical forms. Some of them manifest themselves mainly aesthetically, in particular, thinning or weakening of the eyelashes. Other forms have ophthalmological significance, as they are associated with damage to the ocular surface, eyelid inflammation, tear film instability or infectious risk. All these disorders require correction, but the approach to recovery cannot be the same for all cases. For this purpose, various techniques are used, in particular, eliminating the irritating factor, restoring eyelid margin hygiene, stabilizing the tear film, anti-inflammatory support and methods of stimulating the growth of natural eyelashes.

Strategies for resolving post-service eyelash damage should be formed not according to one universal algorithm, but according to the type of damage. This is important because eyelash loss, allergic blepharitis, chemical corneal irritation,

and tear film disorders have different natures. Accordingly, they require different restorative actions. As shown by Y. Amano, Y. Sugimoto, and M. Sugita, most disorders after eyelash extensions were eliminated after adequate local treatment in the form of drops or ointments [1]. However, in more complex cases, in particular after chemical damage, recovery may be long and require a combination of several methods, as demonstrated in the clinical case of M. Moshirfar, M. Masud, T. J. Shah et al. [8]. The general logic of recovery includes several sequential stages. First, it is necessary to eliminate the factor that caused the damage. This may be glue, remover, excessive weight of artificial eyelashes, dye, or residues of cosmetic materials at the roots of the eyelashes. Next, the condition of the eyelids, natural eyelashes, conjunctiva, cornea, and tear film is assessed. After that, the recovery technique is selected. In mild cases, hygiene of the eyelid margin, temporary refusal of re-extension and maintenance of the tear film are sufficient. In more complex cases, anti-inflammatory, antibacterial or regenerative agents are required. If the main problem is thinning of the eyelashes, the strategy shifts towards supporting the follicle and stimulating growth.

The main strategies for solving problems that arise after service procedures with eyelashes are presented in Table 2.

Table 2

Strategies for solving post-service injuries to the eyelashes and adjacent structures

Strategy	Implementation content	Expected result
Elimination strategy aimed at removing the irritating factor [4]	Involves stopping contact with the material that caused the injury. This may include removing eyelash extensions, avoiding repeated adhesive application, or discontinuing the use of a remover or dye [4].	Reduction of toxic, allergic, or mechanical effects. Conditions are created for the natural recovery of the eyelashes, eyelid margins, and ocular surface.
Anti-inflammatory strategy for blepharitis, irritation, and allergic reactions [1]	Used in cases of redness, itching, swelling, irritation of the eyelid margin, or allergic blepharitis.	Reduction of the inflammatory response, itching, swelling, and redness. Comfort in the eyelid area is restored, and the risk of the process becoming chronic is reduced.

Strategy for restoring eyelid margin hygiene [3]	Involves cleansing the eyelid margin of cosmetic residues, adhesive, meibomian gland secretions, and debris near the eyelash roots.	The bacterial load is reduced, the condition of the eyelid margin improves, and the risk of recurrent irritation and infectious complications decreases.
Strategy for tear film stabilization and dry eye correction [5; 8]	Used when dryness, foreign body sensation, visual instability, or reduced tear break-up time occurs after the procedure.	Improved tear film stability, with reduced dryness, irritation, and superficial corneal staining.
Antibacterial strategy when an infectious complication is suspected [9]	Used in cases of pain, photophobia, discharge, ulceration, or corneal infiltrate.	Prevention of infection progression, preservation of corneal transparency, and reduced risk of visual impairment.
Regenerative strategy for corneal epithelial injury [8]	Appropriate in cases of corneal staining, superficial punctate keratopathy, or epithelial defects.	Gradual epithelial healing, with reduced photophobia, pain, and superficial irritation. In complex cases, the outcome may take a long time to develop.
Strategy for restoring natural eyelashes and supporting the follicle [2; 6; 10]	Used in cases of eyelash loss, milphosis, madarosis, or hypotrichosis.	Gradual improvement in the density, length, and quality of natural eyelashes. Recovery should be monitored, as stimulating agents may cause local adverse reactions.
Preventive and educational strategy for avoiding recurrent injury [6]	Involves informing the client about the risks of repeated eyelash extension, the danger of low-quality adhesives, excessive length or weight of artificial eyelashes, and the importance of eyelid hygiene.	Reduction in the frequency of recurrent injuries. Safer behavior after the procedure is formed, and responsibility increases regarding the choice of materials, technique, and service frequency.

Source: compiled by the author based on sources [2; 4; 5; 6; 8; 9; 10]

A special place among rehabilitation approaches is occupied by author's comprehensive methods that combine diagnostics, restoration and prevention of repeated damage. Such systems include Inna Bahriantseva's author's methodology LRCA Method, which is focused on the rehabilitation of natural eyelashes after aggressive, excessive or unqualified external influence. Its essence lies not only in the aesthetic correction of eyelashes, but in the restoration of their natural resource. This approach is conceptually consistent with the data of S. Aumond and E. Bitton, who consider eyelashes as a functional element of ocular surface protection, and not only as an aesthetic structure [8].

Within the LRCA Method, restoration occurs through several interconnected levels:

- damage audit and primary diagnosis. At this stage, the condition of natural eyelashes after previous procedures is assessed. The degree of mechanical overload, the presence of adhesions, breaks, thinning, signs of cuticle weakening and potential follicular depletion are determined. In fact, the procedure does not begin with modeling a new image, but with an analysis of defects from the previous intervention;
- reconstruction protocol and removal of critical load. The basis of the technique is decompression of natural eyelashes. This means reducing or completely eliminating excess weight that injures the own ciliary row. Then, restorative schemes are applied that allow eyelashes to gradually restore density, growth direction and structural integrity. Such logic corresponds to the clinical observations of C. N. Grupcheva, D. I. Grupchev, N. Usheva and L. O. Grupcheva, where an improvement in the condition of the ocular surface was recorded after removal of eyelash extensions [6];
- safe modeling as a prevention of repeated damage. At the final stage, parameters for further work with eyelashes are selected. This concerns the length, curvature, diameter, weight and density of the artificial material. The choice is not made according to the principle of fashionable form, but taking into account the bearing capacity of the natural eyelash. This approach reduces the risk of traction damage, excessive tension and repeated eyelash loss;
- forming a protective aesthetic framework. In practical terms, the technique is aimed at ensuring that the aesthetic result does not contradict biological restoration. Artificial material, if used, should not destroy the natural row, but create safe conditions for it. This is where the difference between the rehabilitation model and the standard decorative procedure is manifested.

Thus, the LRCA Method can be considered as an example of an integrated author's system in which work with eyelashes moves from a regular service to a

controlled recovery process. Its practical value lies in the combination of expert diagnostics, reduction of traumatic load, reconstruction of the natural ciliary row and prevention of repeated damage. It is these techniques that can be used as an example of the applied implementation of rehabilitation strategies in the field of post-service eyelash restoration.

Conclusions. The study found that post-service eyelash damage should be considered not only as an aesthetic defect, but as a complex of structural and functional changes involving natural eyelashes, eyelid margin, conjunctiva, corneal epithelium and tear film. The main clinical forms of such damage are mechanical loss or weakening of eyelashes, allergic-inflammatory reactions, chemical irritation of the ocular surface, tear film instability, follicular depletion and infectious complications.

Systematization of factors of post-service damage showed that the leading role is played by mechanical overload of natural eyelashes, contact with glues, removers, dyes and fixing materials, insufficient hygiene of the eyelid margin, as well as repeated or unqualified performance of cosmetic procedures. Accordingly, rehabilitation strategies should be approached in a differentiated manner: from eliminating the irritating factor, restoring eyelid hygiene and stabilizing the tear film to anti-inflammatory, antibacterial, regenerative support and stimulating the growth of natural eyelashes.

Integrated restoration systems, in particular the LRCA Method, have an applied value as a comprehensive approach to the rehabilitation of natural eyelashes after aggressive or unqualified service exposure. Their effectiveness lies in the combination of primary diagnostics, reducing traumatic load, reconstruction of the ciliary row, safe modeling and prevention of re-injury, which allows us to consider eyelash restoration as a guided rehabilitation process, and not just as a decorative procedure.

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