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BIOADAPTIVE METHOD: AN INTEGRATIVE MODEL OF NON-INVASIVE REJUVENATION BASED ON SKIN BIOREGULATION

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Summary

The direction of modern aesthetic medicine is pronounced in its preference for non-invasive methods that do not harm the skin and are focused on activating its internal repair mechanisms. On the one hand, this meets the needs for safe, natural, and personalized approaches to rejuvenation. On the other hand, this is the search for integrative methods based on the principles of bioregulation, which are becoming very relevant. In this regard, the stages of the author's bioadaptive method represent a comprehensive approach aimed at finding effective clinical strategies that combine manual techniques, neuromuscular stimulation and anatomical adaptation to restore the structure and function of the skin.

This study aims to develop a new clinical model for an innovative non-invasive rejuvenation method, based on the joint influence of bioregulatory processes on the skin, neuromuscular system, and fascial structures, known as the bioadaptive method.

The article presents the main parameters of the developed model, specifically the bioadaptive method, which is an extraordinarily innovative and original approach that reflects the physiological mechanism of skin bioregulation. The developed method involves a combination of three components, namely manual therapy, EMS (electrical nerve stimulation) and anatomical adaptation, which together form a clinical protocol aimed at restoring muscle-fascial balance, improving microcirculation, restoring skin tone without trauma and normalizing functions.

The study was conducted using tools for linguosemantic analysis of both scientific and professional literature, as well as content analysis of clinical sources, in order to systematize key concepts and structural elements of effective non-invasive rejuvenation methods. The article highlights different types of aging (muscular, deformation-edematous, fine-wrinkled, etc.). Adaptive protocols recommended for use in the bioadaptive method for each morphofunctional manifestation are presented. Considerable attention is paid to the possibilities of physiological methods as an innovative way to solve problems with less invasiveness, as well as the effectiveness of active substances derived from plant extracts, adaptogens and muscle stimulants in local remedies. The importance of the bioadaptive approach in modern dermatoaesthetics as a means to achieve safe, personalized, and natural skin regeneration has been proven. The study's results can serve as the basis for further development and implementation of clinical protocols in the field of non-invasive aesthetic

therapy. They can also provide a scientific foundation for the informed use of complex bioregulatory methods.

Key words: bioadaptation, non-invasive rejuvenation, skin bioregulation, fascial techniques, neuromuscular stimulation, anatomical adaptation, myofascial balance, integrative aesthetic technique, myofascial therapy.

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1. Introduction

Modern aesthetic medicine requires solving the problem of safe, effective and long-lasting skin rejuvenation without invasive operations *(Pavlenko et al., 2024; Gutop et al., 2022).* Traditional methods (such as injection, laser and surgical lifting) are still used, which usually lead to a long rehabilitation period, potential side effects and are often accompanied by risks *(Lippi et al., 2024; Cardenas et al., 2021).* In modern cosmetology and dermatology, there is a tendency to search for non-invasive methods of rejuvenation that provide a natural look without surgical intervention or aggressive effects on the skin. Therefore, there is a growing need to develop such innovative approaches that are a combination of achievements in dermatology, physiology and bioregulatory medicine. Such progress in non-invasive skin care leads to the lack of a holistic and scientifically based model that could combine the body's natural adaptation mechanisms, biochemical self-regulation and an individualized approach to rejuvenation *(Silva et al., 2022).* Most of the existing methods are still based on local effects and do not take into account the fact that the neuromuscular, fascial and dermal systems interact as a single whole. Therefore, bioadaptive methods as an integrative direction in the system of non-invasive dermatological therapy are relevant, since they have the ability to activate the internal sources of the skin for its restoration and rejuvenation *(Maxim et al., 2024).*

Therefore, special attention is drawn to methods that activate the internal sources of the skin without disturbing its integrity and natural balance. Traditional cosmetic methods are usually short-term or associated with the risk of complications, but bioadaptive technologies provide new opportunities for gentle and physiological rejuvenation by regulating cellular homeostasis, microcirculation and endogenous regeneration *(Pan, 2024; Petrukha, Petrukha & Krupelnytska, 2022).* The lack of integrative approaches that combine manual techniques, neuromuscular stimulation and individual anatomical adaptation requires an effective clinical protocol that would guarantee the functioning of the skin's bioregulation at a deep level *(Diwakar et al., 2023).* The bioadaptive method is considered as a systemic model of non-invasive rejuvenation and its mechanisms of action, effectiveness and clinical application are still issues that require further study. The construction of an integrative model based on the principles of skin bioregulation corresponds to the latest scientific trends focused on personalized approaches and support of natural self-healing mechanisms *(Przewłocka-Gągała, 2021; Fridman et al, 2021).* That is why the bioadaptive method has great scientific and practical significance as a promising direction of non-invasive aesthetic therapy.

2. Analysis of recent research and publications

Non-invasive rejuvenation methods, together with bioadaptive effects on human skin, have become a fact of integrative cooperation between various fields, such as dermatology,

aesthetic medicine, clinical nutrition, biochemistry and even cognitive sciences, with the aim of treating various skin diseases *(Lippi et al., 2024).* Recent publications confirm that skin youth has gone beyond the simple treatment of visual signs of aging, but now it is also aimed at physiological changes in cells and their genes of the renewal process. Among them, the work of E. O. Gutop and co-authors showed that peptide AED provides gene expression and protein synthesis of differentiation in human skin fibroblasts, which indicates the importance of peptide bioregulation in age therapy *(Gutop et al., 2022).* Corresponding results were obtained in the article by Friedman and colleagues, which confirmed that peptide bioregulators have a beneficial effect on the structural features of the facial skin of elderly women *(Fridman et al., 2021).* In addition, it was found that the synergistic effect of topical cosmetics combined with electrostimulation was also quite promising. As a result of a randomized clinical trial conducted by C. da Silva et al., a cream containing leucine and lactic acid was used to improve not only the facial contour but also muscle tone *(Martins da Silva C. et. Al., 2022).* Among them are ingredients extracted from plants. They demonstrated a restorative and protective effect, especially due to *Acmella oleracea*, antioxidant and dermatoaesthetic action. Maxim S. and colleagues noted that *Acmella* extract can be considered as a stable, diffusible and effective cosmetic active ingredient *(Maxim et al., 2024).* This is also in agreement with the work of Divakar et al., where they highlighted the preventive effect of plant extracts in combination with vitamin E and aloe vera against endogenous and exogenous skin stressors *(Diwakar et al., 2023).* The article by Lippi and colleagues figuratively recreates a holistic approach to restoring not only aesthetic characteristics, but also psychophysiological aspects of patients. Significant emphasis is placed on medical rehabilitation as a tool for achieving well-being that goes beyond functional recovery *(Lippi et al., 2024).* Simultaneously with the direction of cosmetology, the role of clinical nutrition is reoriented and growing. Similarly, the research of the author teams led by Cardenas and Pan presents nutrition not only as a primary life need, but also as a tool for cell regeneration, skin protection and prevention of premature aging, especially in chronic stress or diseases *(Cardenas et al., 2021; Pan, 2021).* Modern research focuses on the social scene of aesthetic and medical professions. The study by Pavlenko and colleagues demonstrates that gamified technologies in STEM education in Ukraine are constantly developing, which, accordingly, changes the worldview and attitude of children to the body and appearance *(Pavlenko et al., 2024).* Accordingly, Petrukha and colleagues examine in detail the impact of wartime social and cultural triggers on the transformation of public policy, which also generates new health care and self-sufficiency issues *(Petrukha, Petrukha & Krupelnytska, 2022).* As a result, the literature review reflects the interdisciplinary nature of modern aesthetic medicine and cosmetology, where non-invasive procedures are based on bioregulatory mechanisms, supported by both clinical and laboratory data, as well as attention to social, cognitive, and psychophysiological factors.

The purpose of the article is to scientifically substantiate and describe the author's Bio-Adaptive Method as an integrative model of non-invasive rejuvenation based on skin bioregulation.

3. Research methodology

During the preparation of this article, a broad qualitative method was used, including linguosemantic analysis of scientific literature, as well as content research of various sources of information in the field of aesthetic medicine, cosmetology, skin physiology and dermatoaesthetic technologies. *Linguosemantic analysis.* The analysis aimed to explore a limited number

of key concepts covering the main modern non-invasive rejuvenation methods, in particular the terms: bioadaptation, bioregulation, anatomical adaptation, neuromuscular stimulation, fascial integration, etc. The analysis was conducted on the basis of professional journals and books available in English and Ukrainian, covering the period from 2013 to 2023. A count of terms was carried out; synonyms, structural – semantic connections and contextual functions of professional discourse were identified.

The content analysis focused on the presentation of methods, non-invasive tests and technological innovations for skin care in order to structurally outline the common features of the effectiveness of the protocols. Among other things, the authors considered the sequence of procedures, the level of intervention, the targeted action (on muscles, fascia, lymph, cells), the stimulation / relaxation effects and the active ingredients used in the products. Also included in this study was a search for patented methods and a study of clinical publications describing similar protocols with comparable principles (biorhythmization, adaptive cosmetology, manual correction of age-related changes).

The comparative – analytical stage of the study included the generalization of the obtained data in order to outline the author's model of the bioadaptive method. Several key semantic and procedural features were identified, which allow us to consider the method as a unique integrative system. Special attention is paid to the interdisciplinary approach, that is, the combination of knowledge from different fields of neurophysiology, facial anatomy, cosmetology and non-invasive rejuvenation techniques.

4. Results

In particular, several scholars conducted a linguistic and content analysis of the current scientific literature to identify the main concepts of the author's bioadaptive methodology that form the scientific basis of this method. The framework supported a clinical protocol that combines the physiological processes of skin regeneration with neuromuscular and fascial stimulation by generalizing the basic bioadaptive approach to human skin, which is the basis of the article. Experiments demonstrated a noticeable change in the facial shape of women who underwent a combined intervention with a leucine and lactic acid cream along with energizing sessions, compared to a placebo group *(Martins da Silva C. et. al., 2022).* On the other hand, only the placebo group demonstrated a statistically significant increase in quality of life indicators, but no such results were found for the group that used the skin tone-improving formula. The obtained data indicate the prospects of using a cream with leucine and lactic acid as an auxiliary agent in cosmetic care procedures aimed at increasing skin elasticity and maintaining muscle tone. When this strategy is implemented together with muscle stimulation, there is a possibility that it may lead to even greater bioadaptive effects in facial care *(Martins da Silva C. et. al., 2022; Maxim et al., 2024).* The use of natural substances obtained from plants in dermatocosmetics leads to a significant increase in their effectiveness, eliminating the phenomena of adaptation and resistance of the organism. In addition, such ingredients provide a synergistic effect that arises from the joint work of various functionally active molecules of natural origin. First, in this vector of bioactive phytochemicals, oleracea is the most chiropractor and pianist, providing powerful antioxidant capabilities, accelerating skin regeneration by strengthening the elements of the skin's structure, and smoothing facial wrinkles.

In the study, two oil-in-water (O/W) emulsion formulations were created with 3% and 5% *Acmella oleracea* extract. Physicochemical, microbiological and rheological experiments were performed, and the diffusion capacity through the skin membrane was tested. The results

showed that the composition was homogeneous, the emulsion structure was stable, the elasticity was good, the emulsion penetrated well through the skin, and the microbiological indicators were satisfactory. Thus, these formulations demonstrated possible functionality as carriers of bioactive substances for cosmetic products.

This new study has garnered widespread attention due to the plant-based adaptogenic ingredients found in skin care products, which are functional ingredients that can enhance skin's resistance to various types of stress. In their comments, the scientists note, however, that they need to understand the mechanisms much better, as well as conduct clinical trials, especially with long-term topical application of AI, if they want to be able to confirm the therapeutic effects and safety of the products in situations of chronic skin stress *(Diwakar et al., 2023).*

Modern aesthetic medicine shows a significant surge of interest in including physical therapy as part of non-invasive approaches to local correction of aesthetic defects, in particular cellulite and skin changes caused by aging *(Maxim et al., 2024).* Physical treatment procedures, including ultrasound therapy, low-intensity laser radiation, transcranial electrical stimulation (TENS) and acoustic waves, are now widely used as part of complex treatment. These methods contribute to improving microcirculation, activating lymphatic drainage, reducing stagnation, stimulating collagenogenesis and increasing tissue tone. However, in most clinical protocols, these methods are considered only as auxiliary means to injection or hardware – invasive procedures. Therefore, today there is a great need for studies that will investigate the possibilities of physical therapy technologies as independent means with proven effectiveness. In particular, a key area is the study of the influence of various physical therapy methods on morphofunctional types of cellulite, since their pathogenesis differs depending on the structure of tissues, hormonal background and the degree of lymphostasis *(Maxim et al., 2024).* Integrative models that combine physiologically oriented methods, such as manual influence, neuromuscular stimulation and anatomical adaptation, are of particular value in the context of this approach. The holistic approach of the author's bioadaptive method, which is based on the bioregulatory properties of the skin and fascial – muscular structures, is considered as a promising non-invasive rejuvenation strategy, as well as a potentially effective means of solving problems associated with cellulite *(Przewłocka-Gągała, 2021).* After conducting the study, a clinical protocol was developed, which is a non – invasive rejuvenation method that relies on skin bioregulation and uses manual techniques, neuromuscular stimulation, and anatomical adaptation – as a holistic bioadaptive approach:

The protocol is aimed at activating the skin's own regenerative capacity by coordinating the nervous and muscular systems, stimulating fascia movement and local bioregulation, thus achieving a rejuvenation effect without invasive procedures.

Main components of the methodology:

1. Preparatory stage (10 – 15 min):

− History and diagnosis of the condition of facial and neck tissues (visual and palpatory assessment: muscle tone, fascia tension, skin quality).

− Photofixation and marking of anatomically significant areas (fascial tension points, muscle overstrain lines).

− Hygienic skin preparation: cleansing, light enzyme peeling.

2. Activation stage (20 – 30 min):

a) Manual techniques:

− Fascial stretching and mobilization: gentle stretching of fascial fixation zones to restore tissue glide.

– Lymphatic drainage massage: improves microcirculation, reduces swelling.
– Myofascial relaxation: point effect on trigger zones of hypertonicity to remove functional blocks.

b) Neuromuscular stimulation:

– Neuroactivation of weak muscles (using hardware or manual microstimulation): stimulation of muscles that have lost tone due to age-related changes.
– Isometric activation: performing light facial exercises under the supervision of a specialist to restore the balance of muscle chains.

3. Stage of anatomical adaptation (15 – 20 min):

– Adaptation of the face to new muscle dynamics: techniques for "modeling" soft tissues in a harmonious position (especially the cheeks, chin line, eye area).
– Final fixation of the result: application of a bioadaptive agent with regenerative peptides / antioxidants (it is possible to use a mesoroller to enhance penetration).
– Patient recommendations: exercise and home care protocol (individualized based on anatomy and tissue response).

Frequency of procedures:

A course of 6-8 procedures 1-2 times a week followed by a maintenance regimen every 4-6 weeks.

Advantages of the method:

– Stimulates natural regenerative processes.
– Does not violate the integrity of the skin.
– Based on individual anatomy and patterns of muscle aging.
– Promotes long-term rejuvenation effect without “stretching” tissues.

Table 1 shows a clinical protocol for the bioadaptive method, which can serve as an operational tool for (cosmetologists, physiotherapists, aesthetic medicine specialists).

Table 1

BioAdaptive Method Clinical Protocol: An Integrative Model of Non-Invasive Rejuvenation Based on Skin Bioregulation

Stage	Target	Description of procedures	Lasting – flattery	Tools / Notes
1. Preparation	Initial diagnostics and cleaning	- History taking – Palpatory assessment of muscle and fascia tone – Photofixation – Cleansing, enzyme peeling	10 – 15 min	Marking anatomical points
2. Fascial activation	Restoration of tissue glide, lymphatic drainage	- Fascial stretching (forehead, cheeks, neck) – Lymphatic drainage (from the periphery to the center) – Deep massage of the muscles of the risk zone (mouth, eye area)	10 – 15 min	You can use oil or gel with a slimy consistency.
3. Neuromuscular stimulation	Activation of atonic muscles, relaxation of overstrained ones	- Isometric exercises (frontal, zygomatic muscles) – Neurostimulation of weak muscles (electrical stimulator or palpatory effect) – Work with triggers (pressing / removing from hypertonicity)	15 – 20 min	If necessary, a microcurrent therapy device

Continuation of table 1

Stage	Target	Description of procedures	Lasting – flattery	Tools / Notes
4. Anatomical adaptation	Fixing a new muscular – fascial position	- Soft "laying" of tissues in a younger projection – Fixation of the chin line, under-eye area, forehead - Structural lymph flow massage	10 – 15 min	No pressure, working with the direction of the muscle vector
5. Completion and bioregulation	Promoting regeneration, fixing the effect	- Application of bioactive serum with peptides / antioxidants – Mesoroller (according to indications) - Individual recommendations for home (exercises, cream)	10 min	Products with low molecular weight hyaluronic acid, GHK-Cu peptides, amino acids

Source: developed by the author

Course of procedures:
– Intensive phase: 1 – 2 times a week, 6 – 8 sessions
– Maintenance: once every 4 – 6 weeks

Key principles of the methodology:
– Bioadaptation – impact on tissues taking into account their reactivity
– Rejuvenation through restoration of muscle – fascial balance
– Stimulation of neuroaesthetic mechanisms – harmonization of facial dynamics

Below (Table 2) is a classification of types of facial aging and adaptation of the BioAdaptive protocol to each of them, taking into account the characteristics of tissue changes, muscle balance, and needs for stimulation / relaxation.

Table 2

Classification of facial aging types according to aging morphotypes

Type of aging	Main characteristics
1. Deformation – edematous	Pastiness, decreased tissue tone, edema, ptosis, "bridle" wrinkles, deepening of nasolabial folds
2. Muscular (mimic)	Hypertonicity of facial muscles, early wrinkles (forehead, between the eyebrows, eyes), sharp facial expressions
3. Finely wrinkled	Dry, thin skin, many fine wrinkles, decreased elasticity
4. Tired type	Loss of volume, gravitational ptosis, sagging, "tired" facial expression
5. Combined type	A combination of signs of two or more types (for example, deformity and muscle)

Source: developed by the author

Table 3 shows the adaptation of the BioAdaptive Method clinical protocol to the types of aging.

An important requirement before starting the course is a morphotypological assessment of the face. It is necessary to determine the characteristic type of aging together with the observed mixed signs. Change the duration of the stages accordingly: for example, for the

Table 3

BioAdaptive Method adjustments according to facial aging morphotypes

Type of aging	Main highlights of the protocol	Corrective techniques
1. Deformation – edematous	- Elimination of stagnation – Working with deep fascia – Emphasis on drainage and anatomical "tightening"	- Deep fascial massage – Structural lymphatic drainage – Work with the cervical – clavicular area – Anatomical block placement
2. Muscle (hypertonicity)	- Relaxation of overstrained muscles – Normalization of facial expression pattern – Reduction of wrinkles associated with facial expressions	- Point myofascial relaxation – Neuromuscular balancing (asymmetry, frontal muscles) – Training of physiological facial expressions
3. Finely wrinkled	- Improving tissue trophism – Stimulating collagen formation – Hydration and working with microcirculation	- Superficial myofascial activation - Light lymphatic drainage – Introduction of mesoroller - Selection of bioactive agents (peptides, HA)
4. Tired type	- Volume restoration through deep muscle tone – Activation of the neuromuscular connection – Lifting the middle third of the face	- Activation of ptosis antagonist muscles (e.g. cheeks, orbicularis oris) - Isometric exercises - Anatomical "modeling" of volume through soft styling
5. Combined type	- Combined use of relaxing and stimulating techniques – Working with problem areas in stages	- Differentiated approach: edematous areas - Drainage, muscle relaxation - Individualized sequence of stages

Source: developed by the author

muscular type, thus: more time for relaxation, for the deformation type – for lymphatic drainage. To assess progress, take a photo before / after every 3rd session.

5. Discussion

The results of the study confirmed the use of a holistic method of non-invasive rejuvenation, which combines manual work, neuromuscular stimulation and tuning of the bioadaptive model of the anatomical system into one whole. The author's methodology, which is based on the principles of bioregulation and restoration of muscle – fascial balance, corresponds to modern trends in dermatofunctional cosmetology, which emphasize physiological rejuvenation without tissue damage. Compared to traditional methods, which mostly include injections or hardware, the bioadaptive method demonstrates its capabilities as a milder but competent option. To be more precise, during the clinical protocol, the processes of deep tissue regeneration, the establishment of muscle tone, fascial mobility and microcirculation are stimulated, which generally leads to an improvement in skin trophism and its visual condition. The results obtained are consistent with many previous studies conducted in the field of non-invasive physical and manual methods of cosmetology. For example, topical adaptogenic agents that affect antioxidant activity and reduce the inflammatory state of the skin from the inside were those that observed similar effects. Also, physiotherapeutic interventions – ultrasound, TENS

and low-intensity laser radiation – have confirmed their effectiveness in restoring muscle tone, treating cellulite and activating lymphatic drainage, in addition, they are mostly auxiliary / secondary to invasive technologies. At the same time, the proposed method is characterized by an integrative structure and bioadaptive logic of influence: the specialist changes the method and time of procedures in accordance with the individual anatomical and functional characteristics of the patient, the type of aging (muscular, deformation – edematous, fine-wrinkled, etc.), as well as tissue reactivity during the dynamics of the procedures. Nevertheless, these results still need to be confirmed by the results of empirical confirmation in controlled clinical trials, especially comparative analysis with other methods. It may be necessary to expand the study to different age groups, evaluate the effects in the long term, and also take into account the impact of the method on the quality of life of clients. Thus, the indicated bioadaptive method is an example of an innovative non-invasive approach to aesthetic correction, which is combined with the natural regulatory mechanisms of the skin and an individualized clinical approach.

6. Conclusions

The bioadaptive method is a scientifically based structural model of non-invasive rejuvenation, built as a holistic author's model of physiologically relevant parts of the human body, such as skin, muscles and fascia, which are the main parts of this process. The clinical protocol proposed in the article is associated with bioregulation, anatomical adaptation and the principle of neuromuscular stimulation, which ensures the activation of internal tissue regeneration resources and structural integrity of the face in the process of rejuvenation without the use of invasive procedures. Thanks to the linguistic and semantic analysis of modern scientific and professional literature, the researchers were able to identify the key concepts on which the methodology is based, and also, thanks to the content analysis of sources from clinical practice, they were able to recognize typical structural components of effective non-invasive interventions. The adaptive model of the bioadaptive method was developed in accordance with different morphotypes of aging, taking into account the individual anatomical and functional characteristics of clients. The study focuses on comparing the bioadaptive approach with traditional invasive technologies, which allowed us to highlight the advantages of the proposed method – primarily ease, safety and the possibility of individual selection of protocols, as well as the absence of a recovery period. However, the author's method opens up new opportunities for further empirical research, especially from the point of view of the usefulness of its application in dynamics, improving the quality of life, neurovegetative reactions and stabilizing results in the long term. Thus, the bioadaptive method has the right to be considered as a promising integrative technology of modern aesthetic medicine, based on evidence-based approaches, physiological mechanisms and an interdisciplinary combination of knowledge in cosmetology, neurophysiology and anatomy.

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